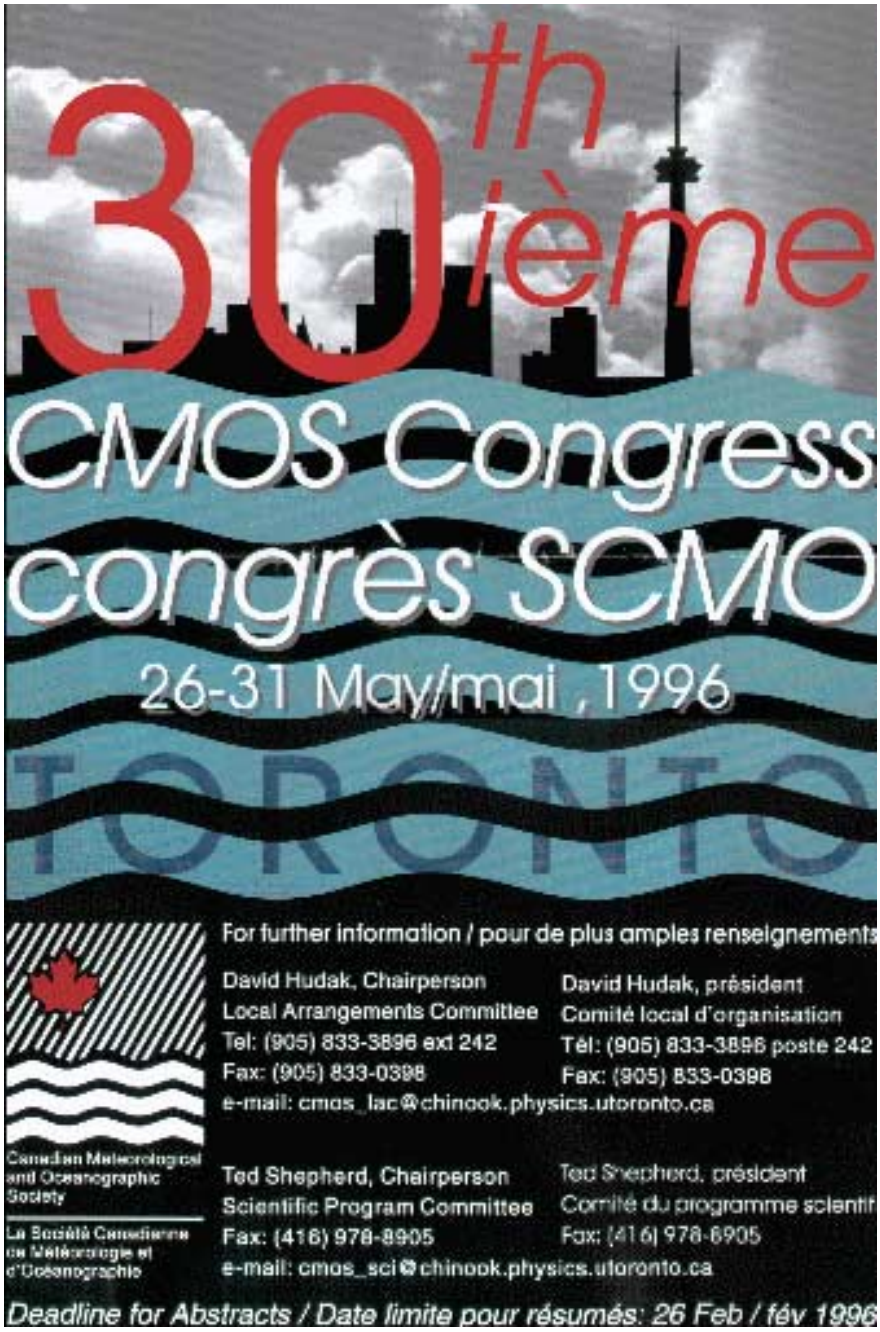

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Large Scale Sea-Ice Characteristics During the Northern Hemisphere Polar Night as Revealed Through Animation of SSM/I 85.5GHz Imagery

Agnew, Tom A.,

Climate and Atmospheric Research Directorate, Environment Canada Downsview, Ontario, Canada, M3H 5T4

Le, Hao

Same as above

Speaker: Agnew, Tom A.,

Time: Monday 14:45

Abstract

This paper summarizes results of quantitative estimation of sea ice motion over the Arctic Basin from SSM/I 85.5 GHz average daily imagery. The motion is estimated between image pairs separated by 4 day intervals over a three week period using a correlation technique developed by the Canadian Ice Branch of AES. Quantitative estimates of sea ice motion are compared to estimates from the International Arctic Buoy Data. The SSM/I daily average data were obtained on CD-ROM from the National Snow and Ice Data Center (NSIDC, 1994). Seven years of data (September 1987 to June, 1994) were transferred onto hard disk and noise removal techniques were applied to improve image quality. Special animation software, developed for a personal computer, was then used to display the data and select periods of extreme sea ice/ atmosphere interaction for further study. Results are presented for the month of January, 1994, when the Arctic ice pack was in rapid motion in the Canada Basin. Surface pressure maps for period show that this was caused by a very intense anticyclone circulation over the Canada Basin/Beaufort Sea. The 4-day motion vectors compare well with Arctic buoy motions during the month and show considerably more detail than is possible from sparse buoy coverage over the Basin. In a second example during mid-December, 1993, 85.5 GHz SSM/I animation revealed an almost Basin wide shift in the ice pack between the Canadian Arctic Islands and the Siberian side of the Arctic Basin. The main cause was a very strong southwesterly gradient over the Beaufort and Chukchi Sea caused by an intense cyclone over Alaska combined with a High pressure over the North Pole region. This shift in the ice pack towards Siberia exposed a large area of ocean off Banks and Prince Patrick Islands as wind stresses forced the ice pack offshore. The large areas of exposed open water quickly re-froze but remained visible in the SSMI 85.5 GHz imagery as high brightness temperatures for the rest of the winter. The main conclusion is that 85.5 GHz imagery reveals important information on the sea ice environment. The imagery is most useful during the Arctic winter (and to some extent the fall and spring) when atmospheric

moisture is minimal. Animation of the imagery reveals important dynamic behavior of the sea ice pack over weekly to monthly time scales. Surface features are sufficiently resolved to use feature tracking techniques to estimate broadscale ice motion over the Arctic Basin.

Notes

video

Meteorological Data and Products Exchange: The International Situation (invited)

Allard, Hubert

Director-General, CMC, Atmospheric Environment Service, Dorval, QU

Speaker: Allard, Hubert

Time: Monday 10:35

Abstract

Meteorological data and products have been exchanged in real time between countries for more than a century in a rather free and unrestricted manner. Relatively speaking, it is only recently (a few decades ago at most) that commercialization of meteorological services really started. During the same period, governments began to apply fiscal restraint and looked for new ways of financing what used to be totally provided out of the tax base. The competition for revenues has certainly led to a very difficult situation as far as the international exchange of data and products. The presentation will review the current status of this question, its most recent developments and the current Canadian position with respect to the issue.

Notes

How does the El Niño generated coastal Kelvin wave propagate past the Mendocino escarpment?

Allen, S.E.

Oceanography, Dept. of Earth and Ocean Sciences, University of British Columbia, Vancouver, B.C., V6T 1Z4

Hsieh, William W.

Same as 1

Speaker: Allen, S.E.

Time: Wednesday 13:15

Abstract

A nonlinear, two-layer, f-plane, shallow-water model is used to determine the amplitude loss of a low frequency Kelvin wave as it propagates over an escarpment. This model is applicable to both the El Niño generated, warm coastal current propagating poleward along the west coast of North America, and the bottom water flowing equatorward along a western boundary. As the El Niño generated coastal Kelvin wave passes the Mendocino Escarpment off northern California, its amplitude loss is estimated to be less than 1%. In contrast, much larger amplitude losses are found when bottom water encounters escarpments. The amplitude loss is predicted to be much larger when the Kelvin wave travels over a depth increase than over a depth decrease (as in the case of the Mendocino escarpment).

Notes

Mechanisms for lateral exchange with oceanic convection sites.

Alverson, K.

Department of Physics, University of Toronto, Toronto, Ontario, M5S 1A7

Speaker: Alverson, K.

Time: Monday 11:55

Abstract

The lateral removal of deep water from a region of deep open-ocean convection is investigated using a three-dimensional, primitive-equation model. Previous studies of oceanic convection cool locally, in a disk-shaped region, thereby parameterizing the oceanic processes which actually determine the horizontal scale and location of convective chimneys. The current study employs uniform surface buoyancy forcing, while mean flow over idealized, Gaussian-shaped, bottom topography explicitly preconditions the location and horizontal scale of the convective chimney. For this particular preconditioning mechanism, it is shown that baroclinic instability of the convective chimney is suppressed. Essentially, the advective timescale, L/U, where L is the radius of the chimney and U is the magnitude of the mean flow, is significantly shorter than the time scale associated with baroclinic eddy growth, $1/kc_i$, where k is the wavenumber of the fastest growing mode and c_i is the imaginary part of the phase speed of a waveform disturbance. Thus, the principle means of lateral exchange between the convection site and the deep ocean is by the imposed mean flow. The depth of penetration of the convective chimney itself, as well as the rate at which convection is able to ventilate the major ocean basins, are both critically dependent on the specific process by which lateral fluxes are accomplished. At the very least, this study

suggests that the process is dependent on mean flow in the vicinity of the convective region. Thus, results from simplified models should be used with caution when attempting to parameterize the rate of formation of deep water as a function of surface forcing.

Notes

oral

Laboratory Studies of Bromide Oxidation in Aerosol Particles

Anastasio, Cort

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M2R 2W6

Mozurkewich, Michael

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M2R 2W6

Speaker: Anastasio, Cort

Time: Tuesday 17:00

Abstract

Field observations and modelling studies indicate that photoactive halogen species (e.g. HOBr/Br2) and the resulting halogen radicals (e.g. Br) may play important oxidative roles in the marine troposphere. These species appear to be formed from heterogeneous reactions, but the mechanisms for their formation are still highly uncertain. We have studied the oxidation of bromide in NaBr particles using a flow system consisting of: a nebulizer to generate the NaBr aerosol, inputs of ozone and water vapor, a 5-liter reaction flask, and a downstream collection system consisting of an annular denuder for gaseous Br species and a filter for particulate Br. The reaction flask also contains a UV lamp in a quartz sleeve to photolyze ozone and produce gas-phase HO2 and OH. In the presence of 1 ppm ozone and no UV light there is appreciable oxidation of particulate Br. The amount of Br oxidized under these conditions is much greater than that expected based on the reported liquid-phase rate constant for ozone and bromide. Greater rates of bromide oxidation are seen with 1 ppm ozone in the presence of UV light. The results from these experiments and others will be presented and the atmospheric significance of these results will be discussed.

Notes

poster

Flow Distortion and Wind Measurements From Ships

Anderson, R.J.

Ocean Circulation Section, Bedford Institute of Oceanography, DFO, P.O. Box 1006, Dartmouth, N.S. B2Y 4A2.

Smith, S.D.

Same as 1.

Dobson, F.W.

Same as 1.

Speaker: Anderson, R.J.

Time: Thursday 08:45

Abstract

Marine wind, pressure and temperature data measured a few meters above the sea surface from buoy- mounted instruments or up to a few tens of meters from sensors mounted on ships or platforms of various sizes and shapes are routinely reported to observing networks. Observations made from surface vessels are used in a great many applications, both in prediction and in climatology. Ship's anemometers are usually placed above the bridge deck at a location which can be readily serviced, but this is also where the wind field can be greatly distorted by the ship's superstructure; changes of 20-50% are not uncommon, depending on shape, size and orientation of the ship relative to the wind direction. K nowledge of the ship's speed and of the vertical temperature profile are also required in order to adjust the wind speed a standard reference height of 10m. Wind and temperature measurements from a number of experiments on two research vessels of different size and shape are evaluated. Corrections for flow distortion, based on wind tunnel studies with model ships and on numerical flow simulation, are applied to the measured wind speeds. We are using the data to determine the wind stress ove r the open ocean by the inertial-dissipation method from observed spectra of wind velocity fluctuations. Our data are from bow masts designed to place anemometers away from most of the flow distortion of the ship. Even so, our results for similar wind and wave conditions from experiments on different vessels compare well only when corrections for flow distortion have been applied to the wind; without corrections we had significant differences from one ship to the other. There is an opportunity to improve the accuracy of routinely observed wind data by applying similar methods to correct for flow distortion and to adjust to a standard height.

Notes

Is the formation of ozone in the Lower Fraser Valley NOx or VOC limited?

Anlauf, K.G.

Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

Bottenheim, J.W.

Same as 1.

Li, S.-M.

Same as 1.

Wiebe, H.A.

Same as 1.

Speaker: Anlauf, K.G.

Time: Tuesday 15:10

Abstract

Air quality control agencies have struggled since the 1960s with the question whether reduction of high levels of ozone in ambient air should require a strategy of VOC or NOx emission reductions. While traditionally VOC emission controls have been promoted this has undergone changes in the last decade. While more advanced modelling tools have discredited much of the earlier approaches on which VOC emission control was based, this has not necessarily invalidated its conclusions. The main deficiency in almost all modelling exercises has remained: the large uncertainty in the input data base. Recently a alternate strategy was proposed to determine whether ozone production is likely to be VOC or NOx limited in a region, based on measurements of ambient air quality parameters such as a variety of oxides of nitrogen, formaldehyde, and hydrogen peroxide. From the PACIFIC93 study in the Lower Fraser Valley many of these parameters that are not routinely measured are available. In this presentation the problems of determining the best strategy for ozone reduction will be reviewed, and the field data will be used to gather insight into the question whether ozone production in the area is VOC or NOx limited (or both).

Notes

Temperature climatology of the middle atmosphere derived from Purple Crow Lidar measurements

Argall, P. S.

Department of Physics, The University of Western Ontario, London, Ontario, Canada N6A 3K7

Sica, R. J.

Same as 1.

Speaker: Argall, P. S.

Time: Thursday 11:35

Abstract

The Purple Crow Lidar uses a 600 mJ/pulse, 20 Hz frequency-doubled Nd:YAG transmitter and a dedicated 2.65 m diameter liquid mercury mirror as the receiver. For this work 85 nights of measurements in the summer and fall of 1994 and 1995 were used for a climatological study of the temperature profiles. The year to year average and variability of the measured temperature profiles will be discussed, though on the whole the monthly averages between the two years are consistent. The temperature profiles will also be compared to empirical models and other measurements. The comparisons show that the averages offer good agreement with the CIRA 86 model between 30 and 50 km. Between 50 and 85 km the averaged measurements are cooler than the model by as much as 20 K. In the lower thermosphere the measured averages are 10 to 20 K warmer than the model. The latter result is consistent with recent measurements from both ground-based and space-based instruments.

Notes

Production of ozone in rural Southern Ontario: Results from the study of nitrogen species in SONTOS.

Hastie, D.R.

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3.

Shepson, P.B.

Department of Chemistry, Purdue University, West Lafayette, Indiana 47907-1393.

Arias, C.

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McConnell, John C.

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Plummer, D.A.

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Roussell, P.

Ontario Hydro Technologies, Research Division, 800 Kipling Ave., Toronto, Ontario M8Z 5S4.

Melo, O.T.

Same as 5.

Speaker: Arias, C.

Time: Tuesday 16:40

Abstract

A large database of summertime concentration and meteorological parameters relevant to rural oxidant production has been assembled for the Hastings SONTOS site. We have examined ozone and nitrogen oxide data to investigate the processes controlling ozone production in rural Ontario. On average, only 40% of the nitrogen oxide reaching Hastings is still in the emitted form of NO or NO_{2}. The remaining 60% having been oxidised to HNO_{3}, PAN or other NO_{x}-carrying species. Each of these oxidised molecules contributes 11-12 ozone molecules to the air mass. In general, high ozone concentrations were associated with high nitrogen oxide concentrations, rather than with extended air mass processing. Late afternoon cases of high ozone concentrations were examined. These were also associated with high nitrogen oxide concentrations but appeared to have lower processing, suggesting these air masses could continue to produce ozone even further downwind of Hastings.

Notes

An active climate diagnostic of a forest fire event using the LCM.

Arif, Abderrazak

C2GCR et Département des sciences de la terre, Université du Québec à Montréal, Case postale 8888, succ.Centre Ville, Montréal, QC H3C 3P8

Blanchet, Jean-Pierre

C2GCR et Département des sciences de la terre, Université du Québec à Montréal, Case postale 8888, succ.Centre Ville, Montréal, QC H3C 3P8

Speaker: Arif, Abderrazak

Time: Monday 11:35

Abstract

Forests cover about 30 % of the world's land areas whose 10 % are Canadian forests (45 % of total Canadian land are forests) and forest fires damage each year to several tens of millions of forested hectares over the world (F.A.O., 1991). Under the current global warming trend, this important resource is stressed by increasing forest fires events. Global Climate Models, based on physical principles, can calculate realistic climate scenarios. The 1D version of the CCC/GCM, the Local Climate Model (LCM), is used as a active diagnostic scheme to investigate the aspects of physical climatology likely to affect forest fire incidence. The forest fire indexes are calculated together all GCM variables on a real fire event to investigate at seasonal time scales the process involved in the generation of extreme conditions.

Notes

Precipitation features observed by the Doppler radar at Tuktoyaktuk, NWT, Canada, during the BASE period

Asuma, Yoshio

Division of Earth and Planetary Sciences, Graduate School of Science, Hokkaido University, Sapporo, 060, Japan

Kikuchi, K.

Same as 1.

Uyeda, H.

Same as 1.

Iwata, S.

Same as 1.

Shimamura, T.

Same as 1.

Kimura, R.

University of Tokyo

Tsuboki, K.

Same as 6

Stewart, R.E.

Atmospheric Environment Service

Hudak, D.R.

Atmospheric Environment Service

Hudson, E.T.

Atmospheric Environment Service

G.W.K. Moore

University of Toronto

Speaker: Asuma, Yoshio

Time: Monday 14:25

Abstract

BASE (Beaufort and Arctic Storms Experiment) project had been carried out over the southern Beaufort Sea and Mackenzie Delta in Northewest Territories (N.W.T.), Canada, during the fall of 1994. As a part of BASE, the dual polarization Doppler radar observations were conducted at Tuktoyaktuk, N.W.T., Canada. 13 IOPs (intensive Operation Periods) were recorded during the BASE period. These IOPs were decided by the disturbances over the BASE area. Most of these disturbances were classified as 'Pacific Origin' storm and 'Storm Track' by the synoptic situations. 'Pacific Origin' storm means that the storms are originated over the Pacific Ocean and 'Storm Track' means that they are originated in the Arctic Area and move over the observation site. The 'Pacific Origin' storm was characterized by the weak radar reflectivity and two layered structure with the strong vertical wind shear at the boundary at Tuktoyaktuk. Southerly wind and weak continuous precipitation were observed in the upper layer. And the precipitation behavior in the lower layer was strongly characterized by the wind direction. That is, at the first time, the wind was easterly, the dry air intruded from the inland and the precipitation was evaporated. And them, the wind changed northerly, the wet air intruded from the Beaufort Sea and the precipitation was enhanced in the lower layer. On the other

hand, the 'Storm Track' was characterized by the mono-layered structure and the strong wind. We can recognized the precipitations associated with warm and cold front by the radar observation.

Notes

Predicting the Moisture Content of Canadian Wheat Export Cargoes using Climatology of the Growing region in the Prairie Provinces

Babb, J.C.

Grain Research Laboratory, Canadian Grain Commission 1404-303 Main Street, Winnipeg, Manitoba, R3C 3G8

Speaker: Babb, J.C.

Time: Monday 11:55

Abstract

The moisture content of wheat (Triticum aestivum) is an important determinant of its quality in terms of storability, processing properties and economic value. To satisfy the specifications of certain markets for Canadian wheat, it is useful to be able to antispate the moisture content of wheat exports. In this study, multiple regression methodology is applied to data for the crop years 1971-72 through 1995-96 to develop an effective climate-based model for early prediction of the average outgoing moisture content of Pacific export cargoes of various grades of Canada Western Spring wheat. The model relates monthly precipitation and temperature data for the wheat growing region of the prairie provinces to monthly and quarterly averages of moisture measurements on wheat export cargoes. Cross validation is used to assess predictive performance of the model.

Notes

Regional scale simulations of mountain waves over the Rockies

Balaji, V.

Department of Earth and Atmospheric Science, York University, North York, Ontario, Canada M3J 1P3

Klaassen, G.P.

Department of Earth and Atmospheric Science, York University, North York, Ontario, Canada M3J 1P3

Laprise, René

Université du Québec à Montréal, Montréal, Canada

Speaker: Balaji, V.

Time: Monday 16:35

Abstract

The understanding of the general circulation of the middle atmosphere has been made considerably more complex by the fact that the drag exerted by upward-propagating tropospheric gravity waves is a significant component of the global budget of momentum. The gravity waves have many sources (orography, convection) and are poorly understood. As these are generally below the resolution of general circulation models, their effects are usually represented through parameterization schemes based on simplified configurations. The effects of time-varying and horizontally inhomogeneous flow are generally not considered. We present here a comparison between parameterized momentum transfer in the middle atmosphere and the results of simulations in a non-linear compressible model resolving a significant portion of the gravity wave spectrum over the troposphere and stratosphere. The studies are carried out in the Canadian Regional Climate Model (RCM) which is nested (one-way) within the Canadian Middle Atmosphere Model (MAM). The nesting provides these simulations with a background flow varying in time and space. We study the dependence on the resolution of the orography, and the behaviour of the waves in the stratosphere. Departures from theory are discussed, and implications for the parameterization of gravity wave drag considered.

Notes

Orographic effects upon sub-freezing surface precipitation during winter storms near St. John's, Newfoundland

Banfield, Colin E.

Dept. Of Geography, Memorial University of Newfoundland, St. John's, Newfoundland, A1B 3X9

Hudak, D.R.

AES, King City, Ontario, L7B 1A3

Thomson, Alan

Dept. Of Physics, University of Toronto, Toronto, Ontario, M5S 1A7

Speaker: Banfield, Colin E.

Time: Monday 16:15

Abstract

Spatial and temporal patterns of precipitation during winter storms over eastern Newfoundland are examined with a view to assessing their orographic component. On the Avalon Peninsula the relief is relatively subdued (200-300 m) compared with most temperate coastal areas exhibiting orographic precipitation effects. However, this study demonstrates a degree of orographic modulation over precipitation intensity during portions of cyclonic storm events occurring in the vicinity of St. John's during the CASP-II field experiment in the winter, 1992. Attention is focussed upon the pre-warm frontal precipitation periods associated with three such storms, when onshore easterly flows of near-saturated air produced several hours of snow, freezing rain and/or ice pellets within the near surface layer of below freezing temperatures. Precipitation was measured by Belfort weighing gauges, equipped with Nipher shield, located at the upwind coast and on higher ground slightly inland. Gauge site comparisons reveal an approximate doubling of intensity and accumulated amount as elevation increases by 200 m within a horizontal downwind distance of 15-20 km. The spatial distribution of the precipitation across the study-area is further examined using volume scan data from the University of Toronto X-band Doppler radar. Radar derived precipitation amounts support gauge results. Radar cross-sections were constructed in combination with a detailed representation of surface topography. The patterns demonstrate that local orographic enhancement can develop during this particular type of sub-freezing precipitation episode, subject to a favorable relationship between the direction of the near-surface wind and the orientation of the local hill ridges. The quantitative treatment of the role of orography is shown to be important for the development of mesoscale forecasting techniques and for improved understanding of local hydrology.

Notes

Trace metals in air and cloud water over the Atlantic Ocean south of Nova Scotia

Banic, C.M.

Cloud Physics Research Division, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

Wong, H.K.T.

National Water Research Institute, Burlington, Ontario

Speaker: Banic, C.M.

Time: Thursday 16:45

Abstract

During August and September, 1993 measurements of trace metals were made in aerosol and cloud water collected as part of the North Atlantic Regional Experiment (NARE). Aerosol was sampled at a coastal site near Yarmouth, Nova Scotia. Aerosol and cloud water aloft were sampled on 24 and 6 flights, respectively, with the National Research Council of Canada Twin Otter aircraft. The samples were analyzed for As, Ba, Cd, Mn, Ni, Pb, Se and Zn. Concentrations in aerosol at the surface and aloft will be compared. An estimate will be made of the transport of these species to the North Atlantic atmosphere.

Notes

Revisiting the issue of Absorption of Solar Radiation by 3-D Clouds

Barker, H.W.

Cloud Physics Research Division, AES Downsview Ontario, M3H 5T4

Li, Z.

Canada Centre for Remote Sensing, Ottawa, Ontario

Speaker: Barker, H.W.

Time: Tuesday 10:05

Abstract

It has been suspected for some time that clouds absorb more solar radiation than that predicted by conventional models. Over the past two years, much ado has been made about this issue. Most notable, Cess et al. (1995) and Ramanathan et al. (1995) maintained that on a global basis, clouds absorb far more solar radiation than was thought previously. Their claims led to the idea that single-scattering albedo of cloud particles was too high (Kiehl et al. 1995) but this hypothesis cannot be justified. Li et al. (1995) showed that anomalous absorption is largely limited to warm climates and may be related to aerosols or towering convective clouds. While their experiments with 3-D clouds sometimes yielded slightly enhanced absorptances relative to their plane-parallel, homogeneous counterparts, the magnitude of the enhancements were nowhere near that demanded by Cess et al. (1995). Since then, two unpublished studies have documented enhanced absorption by 3-D clouds, and now Cess et al. (1996) acknowledge this to be the likely cause of enhanced absorption. The main point of this presentation is to elaborate on Li et al.'s (1995) results pertaining to absorption of solar radiation by both 3-D clouds and their plane-parallel, homogeneous counterparts. It is shown that when near-planar clouds exist above 3-D clouds (as is often the case), the disparity between 3-D clouds and plane-parallel clouds is much attenuted. This limits seriously the ability of the 3-D hypothesis to account for much enhanced absorption. References Cess, R.D. et al., 1995: Science, 267, 496-499. Cess, R.D. et al., 1996: Submitted to J. Geo. Res. Kiehl,

J.T., et al., 1995: J. Climate, 8, 2200-2212. Li, Z. et al., 1995: Nature, 376, 486-490. Ramanathan et al., 1995: Science, 267, 499-503.

Notes

Space-based observations of the middle atmosphere - what we have now and what we need for the future

Barnett, J.J.

Atmospheric, Oceanic and Planetary Physics, Oxford University Dept. of Physics, Clarendon Laboratory, Oxford OX1 3PU, U.K.

Speaker: Barnett, J.J.

Time: Monday 13:15

Abstract

Satellite measurements of the middle atmosphere have reached a mature state with the information flowing from the NASA Upper Atmosphere Research Satellite and other spacecraft. We have for the first time a comprehensive view of many of the processes that are taking place in the middle atmosphere, particularly in the stratosphere. A number of these measurements will be described in detail. Where do we go from here? A variety of problems remain, notably the need for higher spatial resolution, for measurements of interactions with the troposphere, and for much more reliable measurements of long term trends. The peak of chlorine levels predicted to occur early next decade will produce unique atmospheric behaviour that may ever-more be used for model validation and which we need to capture. The paper will go on to describe what we can expect in the future from the NASA EOS missions, particularly EOS-Chem, the ESA and Japanese programmes and from new types of measurement such as radio-occultation.

Notes

A Comparison of Three Methods for Estimating Evapotranspiration in the SLURP Hydrologic Model

Barr, Alan G.

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G.W. Kite

National Hydrology Research Centre, Saskatoon, SK

R.J. Granger

National Hydrology Research Centre, Saskatoon, SK

C.D. Smith

Department of Geography, U. Saskatchewan, Saskatoon, SK

Speaker: Barr, Alan G.

Time: Wednesday 11:15

Abstract

The SLURP hydrologic model simulates the water balance of Canadian mesoscale watersheds. The watershed is subdivided into aggregated simulation areas (ASAs), which are in turn subdivided by land cover. For each ASA and land cover, the model calculates a daily water balance which includes terms for evapotranspiration and runoff. Runoff is converted to streamflow and routed between ASAs. This study assesses the sensitivity of model performance to changes in the evapotranspiration method, using five years of data (1986 to 1990) from the Kootenay Basin of eastern B.C. The evapotranspiration methods include: Morton's complimentary relationship; the Granger modification of Morton's method; and the Spittlehouse-Black energy-limited vs. soil-water-limited method. The evapotranspiration methods are evaluated by the simulated seasonal and interannual variability in evapotranspiration, and their ability to simulate the measured annual hydrograph.

Notes

Slides

Arctic tropospheric chemistry and climate

Barrie, L.A.

Atmospheric Environment Service, 4905 Dufferin St., Downsview, ON, M3H 5T4.

Speaker: Barrie, L.A.

Time: Monday 08:45

Abstract

The arctic troposphere plays an important role in the physical and chemical climate of the northern hemisphere. Surrounded by industrialized continents and northern oceans, it is a unique chemical reactor influenced by sources both anthropogenic(greenhouse gases, sulphur oxides, black carbon, heavy metals, persistent organic contaminants) and natural(sea salt, soil dust, marine biogenic products). It is underlain by the biologically

active Arctic Ocean from which it is separated by a crack-ridden ice membrane 2 to 6 m thick. Ocean-atmosphere exchange, atmospheric circulation and a very seasonal light regime influence the composition of the reactor. From 21 Sept. to 21 Dec. to 21 March, light conditions change from 24 hour daylight to several months of continuous darkness and then back to continuous daylight. During this time, average air temperatures are between -25 and -50 C, absolute humidity is very low and the lower troposphere is stabily stratified. In this environment, tropospheric chemistry takes on a different character from that further south. Since photochemistry is absent for extended periods of time, many reactive substances that photolyze or react with photolysis products have much longer lifetimes in winter than in summer and therefore tend to peak in concentration in the dark. As sunlight strikes the enriched mixture of gases and aerosols at polar sunrise, a number of chemical changes take place. Perhaps the most sensational is the destruction of lower tropospheric ozone accompanied by production of aerosol bromine and iodine. These halogen compounds are likely of marine origin although their production may involve anthropogenic substances. Another is the production of sulphuric acid aerosol particles from the oxidation of anthropogenic sulphur dioxide contributing to the phenomenon of Arctic Haze. These particles not only are involved in ozone depletion and visibility reduction but also alter the atmospheric energy balance by scattering solar and terrestrial radiation. In contrast to southern regions, light absorptive black carbon aerosols can completely counteract the lose of energy by scattering resulting in a warming influence in spring. Aerosols may also reduce tropospheric water vapour content thereby increasing infrared radiative cooling. Relatively low precipitation and dry deposition in winter results in aerosol lifetimes of several weeks in contrast to summer lifetimes of days. Lower tropospheric transport from mid-latitudes into the Arctic is also very seasonal being greatest in winter/spring. As a result of both these processes, winter/spring aerosol concentrations are 10 to 20 times higher than those in summer. The Arctic is also a receptor of semi-volatile organochlorine pesticides and herbicides that are cold-trapped as they advect into the north from further south. In this review, the nature and chemistry of Arctic haze, ozone depletion, aerosol-climate forcing and toxic chemicals in the northern polar region is reviewed.

Notes

Self-similarity of decaying 2-d turbulence

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Warn, T.

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Speaker: Warn, T.

Time: Wednesday 11:15

Abstract

High resolution numerical studies have shown that decaying, homogeneous two-dimensional turbulence tends to organize into a collection of coherent vortices on a background `sea of vorticity', which subsequently tend to increase in scale through a complex sequence of mergers while nearly preserving their amplitudes. The spectral evolution is also slow compared to the prediction of a similarity theory of Batchelor, due to the suppression of nonlinearities within the vortex cores. By contrast, the one-point vorticity density, which Batchelor's hypothesis predicts to be of the form $p_\omega\sim t~f(\omega t)$ as $t\to\infty$, where f is universal, obeys similarity except in the tails. Specifically, similarity applies over a range $|\omega|< \omega_m$, where ω_m is a measure of amplitude of the most intense vortices and is conserved or decays weakly in the limit of large Reynolds numbers. f is also found to be hyperbolic, i.e. $f(x)\sim c/|x|^{1+q_c}$ as $|x|\to\infty$, with $q_c\approx 0.4$, which induces a phase transition % $$\langle\omega^q\rangle\sim \cases{ c_q ~ t^{-q}, &{\rm when}~~$-1<qq_c$,}$$ % between the self-similar sea and the coherent vortices. Here c_q and c are universal. Moments of order $q

Nonlinear Geostrophic Adjustment and Inverse Cascades in Geophysical Fluid Turbulence

Bartello, P.

RPN/AES, 2121 voie de Service nord, Dorval (Québec) H9P 1J3

Speaker: Bartello, P.

Time: Wednesday 09:45

Abstract

Rotating stratified nonhydrostatic turbulence is investigated numerically and analytically, in order to examine both the mechanism of nonlinear geostrophic adjustment and the proposed mesoscale inverse cascade of rotational energy from convective scales (Gage 1979; Lilly 1983). Following Warn's (1986) study of the shallow-water equations, the analysis is guided by energy and potential enstrophy conservation as well as resonant interaction theory, with a view to determining the cascade properties of rotational modes (i. e. those contributing to the potential vorticity) and wave modes at low Rossby and Froude numbers. As $Ro ~{\rm and}~Fr \rightarrow 0$ rotational modes are only weakly coupled to wave modes when initial conditions are random. A catalytic interaction involving two waves and a rotational mode, leaving the rotational mode unchanged, transfers wave energy downscale to the dissipation, thereby providing the mechanism for nonlinear geostrophic adjustment. Since the remaining large-scale energy is dominated by rotational modes, an active upscale cascade takes place (Charney 1971), implying that rotational structures are robust to the dissipation. At larger Ro, transfer from rotational

to wave modes is important at any Fr and rotational structures are not robust to the dissipation.

Performance of the Canadian Land Surface Scheme at a deciduous forest and a mixed forest, Chalk River, Ontario.

Bartlett, Paul A.

Geography Department, Queen's University, Kingston, Ontario, K7L 3N6

McCaughey, J. Harry

Geography Department, Queen's University, Kingston, Ontario, K7L 3N6

Speaker: Bartlett, Paul A.

Time: Monday 17:15

Abstract

The performance of the Canadian Land Surface Scheme (CLASS) is evaluated at two neighbouring forests located near Chalk River, Ontario, an aspen- birch stand and a mixed stand of maple, spruce, balsam fir, and pine. The experimental data represent periods from late spring to early autumn, and were collected during one to three month field campaigns in 1987, 1989, 1990 and 1991. Relationships between environmental conditions and the ability of CLASS to simulate sensible, latent, and soil heat fluxes are examined. CLASS is shown to be particularly sensitive to mean volumetric soil moisture through its effect on estimated values of soil water suction, which are used in modelling canopy resistance. It is argued that the non-linear relationship between soil moisture and evaporation, combined with the assumption of a homogeneous surface, can result in a bias towards underestimation of the latent heat flux when soil moisture heterogeneity is high and the mean volumetric soil moisture is low.

Notes

Poster Diana Verseghy (AES) has mentioned a session for those working with the CLASS model. We believe this to be Session 12.

New developments in the Canadian MAM project.

Beagley, S.R.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3, Canada.

de Grandpré, J.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3, Canada.

Koshyk, J.N.

Department of Physics, University of Toronto, Toronto, Ont., M5S 1A7.,Canada.

McFarlane, N.

CCCMA, AES, University of Victoria, P.O. Box 1700 MS 3339, Victoria, BC V8W 2Y2 , Canada.

Shepherd, T.G.

Department of Physics, University of Toronto, Toronto, Ont., M5S 1A7.,Canada.

Speaker: Beagley, S.R.

Time: Thursday 15:25

Abstract

The original MAM model has been developing over the years and is now growing with the addition of important new physical process modules. These include work on the stratospheric/mesospheric radiation code, parameterization of gravity wave drag, semi-lagrangian water and tracer transport and gas phase stratospheric chemistry. All have been implemented and are being tested in the MAM model. Results will be shown of the latest MAM 3 year simulation together with some of the new test results to show the progress of the model.

Notes

Simulations of Lee Cyclogenesis during BASE using the MC2

Bensimon, Dov Richard

Same as 2

Yau, M.K.

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal Quebec, H3A 2K6

Zhang, Da-Lin

Same as 2

Speaker: Yau, M.K.

Time: Thursday 14:35

Abstract

The lee sides of major mountain ranges are observed to be favourable regions for cyclogenesis. In this project, we attempt to gain a better understanding of the influence of mountains on the formation and development of lee cyclones by examining two cases of lee cyclogenesis which occurred during BASE (Beaufort and Arctic Storms Experiment) using the Mesoscale Compressible Community model (MC2). In one case, a relatively strong parent cyclone occurring over the Gulf of Alaska gives rise to a weaker lee cyclone, whereas in the other case, a relatively weak parent cyclone occurring over the Eastern Pacific Ocean spawns a strong lee cyclone. We have obtained successful simulations of the two lee cyclogenesis events. Results indicate that the MC2 is sensitive to: 1) the model initial conditions, 2) the size of the domain used and 3) the position of the lateral boundaries. In one simulation, a "picket-fence" experiment, the western lateral boundary is aligned with the west coast of North America, which produces a more realistic simulation than the other performed on a larger domain whose upstream information is from over the Pacific Ocean. Detailed results on 1) sensitivity tests in which the topography is removed or altered, 2) the mechanisms of the formation and the structures of the two lee cyclones, 3) the distribution of precipitation and its relation to topography will be presented at the time of the conference.

Notes

none

Laboratory Measurements of Phase Transitions in Model Atmospheric Aerosols

Bertram, A.K.

Department of Chemistry, University of Waterloo, Waterloo ON N2L 3G1

Patterson, D.D.

Same as 1.

Sloan, J.J.

Same as 1.

Speaker: Bertram, A.K.

Time: Tuesday 17:00

Abstract

We have developed an apparatus capable of generating and characterizing a range of model atmospheric aerosols including types I and II PSCs, binary (H2SO4/H2O) and ternary (H2SO4/HNO3/H2O) model stratospheric aerosols and model sea-salt aerosols in size ranges from about 0.1 micron to 5 micron. The apparatus consists of a temperature controlled flowtube capable of operating at conditions from ambient sea-level to those of the winter polar stratosphere. Characterization is done using FTIR extinction spectroscopy, which gives us the ability to determine both the composition and the size distribution of the aerosol. (Size distributions are determined by comparison with Mie scattering calculations.) In recent experiments, we have determined the freezing points of binary H2SO4/H2O aerosols over a range of compositions. We find that there is a size-related freezing point depression of 35 - 40 K. Furthermore, we find that freezing of this aerosol begins with the formation of an ice crystallite inside the aerosol droplet. As the temperature is decreased, the crystallite increases in size and the supernatant acid becomes more concentrated. Presently, we are exploring the effect of organic vapours on the properties (phase and water uptake) of model sea-salt aerosols. In this case, we determine the relative humidity in the air surrounding the suspended aerosol from the water vapour absorption spectrum, and the composition, phase and size distribution of the aerosol from the IR extinction spectrum. We shall report results from both of these projects.

Notes

Entrainment-layer budget estimates of boundary-layer top entrainment above boreal forest.

Barr, Alan G.

National Hydrology Research Centre, 11 Innovation Blvd., Saskatoon, SK, S7N 3H5

Betts, Alan K.

Atmospheric Research, R.R. #3, Box 3125, Pittsford, VT, 05763

Speaker: Barr, Alan G.

Time: Wednesday 16:25

Abstract

Day-time, surface fluxes of sensible and latent heat fuel the growth and development of the mixed atmospheric boundary layer (BL) over land. As the mixed BL deepens, it entrains or mixes downward warmer, drier air from above. The balance between the surface fluxes and entrainment determines the rates of BL deepening, warming and moistening (or drying). In turn, the resultant BL temperature and humidity structures

control the evolution of coupled cloud layers at BL top and influence whether the clouds deepen and precipitate. This study uses radiosonde data collected during the 1994 field phase of the Boreal Ecosystem-Atmosphere Experiment (BOREAS). One of the objectives of BOREAS was to quantify the interaction between the boreal forest and the atmospheric BL. The diurnal BL cycle is difficult to simulate in large scale models, because the surface forcings are not easily estimated at regional scales, and because our understanding of BL-top entrainment is limited. The common parameterizations of entrainment have not been adequately evaluated for different land surface types and wind shears. Radiosonde-based budgets of heat and moisture provide a framework for evaluating surface and entrainment fluxes at the regional scale, and for assessing their joint influence on BL development. This presentation summarizes an entrainment-layer budget analysis of 1994 BOREAS radiosondes. We computed a mean entrainment parameter (AR = Hvi/Hvs) of 0.21 above boreal forest. The dependence of entrainment on buoyant and shear forcings agreed with accepted formulations.

Notes

Slides

Effects of degradation of wavelength registration on NO$_2$ and O$_3$ retrievals for an {\it OSIRIS} type spectroradiometer in a polar twilight orbit

Bhattacharya, Yajnavalkya

Centre for Research in Earth and Space Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P4

Strong, Kimberley

Centre for Atmospheric Chemistry and Dept. of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

McConnell, John C.

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario M3J 1P3

McDade, Ian C.

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario M3J 1P3

Speaker: Bhattacharya, Yajnavalkya

Time: Monday 15:05

Abstract

Retrievals of NO$_2$ and other atmospheric trace constituents (eg, O$_3$,OClO) amounts from solar UV-visible spectra in the stratosphere depends on the detector resolution, the stability of the wavelength registration, and the sampling ratio (in case of array detectors with discrete sampling) and how sampling convolves with slit function. Degradation of the wavelength registration may occur during a campaign due to temperature effects on grating, backlash etc. Hence, it is necessary to determine any possible wavelength changes in the in the instrument that may be interpretated as a translation and or stretching of the registration from the original calibration. Thus a means must be found to recalibrate the wavelength registration. One possibility is to use the spectral features that one is attempting to measure. Another is by using distinctive features in the solar spectrum. We have used a forward model to generate spectra at various altitudes. This represents atmospheric `truth', to which we can add noise. Then we stretch and or translate these spectra and use retrieval routines to invert the NO$_2$ and O$_3$ concentrations from successively degraded spectra. The retrieval routines use similar CCD sampling ratio (2.4 Angstrom per pixel) and slit function proposed for the OSIRIS instrument on board the ODIN satellite to be flown in 1997. This information may be used to estimate the magnitude of errors in retrieved species from uncorrected spectra and determine necessary instrument resolution and sampling for a given tolerance in accuracy of retrieved parameters. We will present results showing the effects of translation and stretching on the retrieved amounts.

Notes

The Effect of a Dissipative Layer on the Momentum Flux Associated to Simulated Mountain Waves

Laprise, René

Département des Sciences de la Terre, Université du Québec à Montréal, C.P. 8888, Succ. Centre-ville, Montréal, PQ, Canada, H3C-3P8

Biner, Sébastien

Same as 1.

Speaker: Biner, Sébastien

Time: Monday 16:15

Abstract

Mountain waves (MW) exert an important influence on the atomspheric flow on a wide range of altitudes and scales. Since this phenomenon is too fine to be resolved by most numerical weather prediction and all climate models, it has to be parametrized.

Neverthless, the actual parametrization is quite unsatisfactory; this partially due to a lack of knowledge of different aspects of the phenomena. In this study we are interested in the field of MW in the presence of a dissipative layer, such layer being a component of most MW parametrization schemes. We start by using linear theory to describe the field of MW in the presence of an idealized dissipative mechanism. We then find the constructive/destructive condition on the momentum flux at the ground as a function of the height of the base of the dissipative layer. Validation of these analytic results is finally done with the Mesoscale Compressible Community (MC2) model, a non-hydrostatic nonlinear model. We present results for different heights of the dissipative layer and different values of the dissipative coefficient.

Notes

Variability of the thermohaline circulation in coupled zonally averaged ocean-atmosphere model.

Bjornsson, Halldor

Dept. of Atmospheric and Oceanic Sciences and the Center for Climate and Global Change Research, McGill University, 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6

Mysak, Lawrence

Same as 1.

Schmidt, Gavin

Same as 1.

Speaker: Bjornsson, Halldor

Time: Tuesday 16:00

Abstract

Evidence from sediment cores that characterize the last glacial indicate that large amounts of ice were periodically discharged into the North Atlantic. A coupled zonally averaged atmosphere-ocean model is used to examine the response of the thermohaline circulation to these events. We also examine whether there are internal oscillations (free as opposed to forced) in the model that could explain some of the century-to-millennial time scalevariability seen in the paleoclimatic archives. By solving the time independent model equations, exact steady states can be found. Linearizing about these states yields information about their stability, and the resulting eigenmodes can help explain how small perturbations around the steady state propagate between the ocean basins in the model.

Notes

Two-dimensional interactive climate and photochemical model for studies of climate change

Blanchette, Christian

Atmospheric Environment Service, 4905 Dufferin St., Downsview, Ontario, M3H 5T4

Chan, D.

Same as 1

Higuchi, K.

Same as 1

Speaker: Blanchette, Christian

Time: Thursday 13:55

Abstract

We are constructing a two-dimensional climate-transport model with fully interactive tropospheric and stratospheric chemistries along with a land-biota carbon cycle model. The model is based on the AES 2D climate model (Chan et al . 1995) and on the AES land-biota carbon cycle model (Chan et al., 1996). It also includes improved radiation-heating-cooling module (Barker and Li, 1995) and derived its chemistry from York University's 1-D photochemical model (Blanchette and McConnell, 1992). We will present preliminary results of our sensitivity studies. Attention will be given to the potential feedbacks between the chemistry and the physical climate.

Notes

Coupled atmosphere-ocean general circulation climate modelling (Invited)

G.J. Boer

Canadian Centre for Climate Modelling and Analysis, Atmospheric Environment Service, University of Victoria, Victoria, B.C.

Flato, G.

as above

Lee, W.

as above

McFarlane, N.

as above

Reader, M.C.

as above

Ramsden, D.

as above

Weaver, Andrew J.

as above

Speaker: G.J. Boer

Time: Wednesday 13:15

Abstract

The development of a fully three-dimensional coupled atmosphere-ocean-ice general circulation climate model represents a new enterprise for CCCma. The group has developed several "generations" of GCMs beginning with GCM-1, a purely atmospheric GCM, the precursor of GCM-2, a coupled model combining a sophisticated atmosphere with a simple mixed layer ocean (used for equilibrium climate studies) and thence to the current coupled model development involving a fully three-dimensional ocean and atmosphere. By combining the results of current ocean, ice, land surface, troposphere and middle atmosphere modelling initiatives, the goal is a unified model extending "from the bottom of the ocean to the top of the atmosphere". As an intermediate step to this goal, the atmospheric component of GCM-2 is coupled to a comparatively high resolution version of the MOM three-dimensional ocean model. A first version of this coupled model is being used for investigating "spin-up" questions, developing coupling techniques, and performing initial climate variability and climate change simulations. The early results of this first effort are reviewed. The current climate simulation is put in context by comparison with other coupled modelling efforts as studied for the IPCC. Preliminary results of a control and of a transient climate change simulation (involving the effects of greenhouse gases and aerosols), both beginning at 1850, are discussed. Finally, current difficulties and future developments are briefly mentioned.

Notes

Summertime climatology of ozone with a column version of a regional circulation model

Bouchet, Véronique S.,

Dépt. des Sciences de la Terre, Université du Québec à Montréal, Montréal, Québec, H3C 3P8

Torlaschi, Enrico,

Same as speaker.

Laprise, René

Same as speaker.

McConnell, John C.

Centre of Research in Earth and Space Science and Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3

Speaker: Bouchet, Véronique S.,

Time: Wednesday 10:05

Abstract

Photochemical pollution in the Windsor-Quebec Corridor is a topic of concern as it is the region of Canada where ozone excursions above the maximum acceptable level (82 ppb) occur with the highest frequency. Simulations of ozone formation are performed with a one-dimensional time dependent photochemical and dynamical model. A one-dimensional version of the Canadian Regional Circulation Model (RCM), which uses the subgrid-scale parameterization of the Canadian General Circulation Model (CGCM), controls the physical and dynamical processes. Photochemical processes are treated within the model with an updated version of the chemical mechanism of the Acid Deposition and Oxidant Model (ADOM). The column version represents a tool that is straightforward to use to create the interface between the physical and chemical modules and readily allows for testing of various parameterizations of chemistry and dynamics. Results of simulations of the evolution of ozone in the Saint-Lawrence Valley over a whole summertime period will be presented. Our analysis for this presentation will focus on the days with high ozone levels. This work represents a preliminary step towards the climatology of the production of ozone occuring using the full three dimensional version of the RCM.

Notes

Effects of 1 year and 10 year flood events in Doubtful Sound: high resolution numerical simulations

Bowman, Malcolm J.

Marine Sciences Research Center, State University of New York, Stony Brook, NY, 11794, USA

Dietrich, David E.

Center for Air Sea Technology, Mississippi State University, Stennis Space Center, MS 39529, USA

Mladenov, Philip

Department of Marine Science, Otago University, Dunedin, New Zealand

Speaker: Bowman, Malcolm J.

Time: Tuesday 09:45

Abstract

Doubtful Sound is a branching fjord, about 40 km in length, located in southwest New Zealand. In addition to high annual rainfall, New Zealand's largest hydroelectric power station discharges up to 465 m^3/s into the head of the fjord, representing 2.5 times the mean rainfall over the watershed. High resolution, three dimensional numerical simulations (minimum vertical resolution 43 cm, horizontal resolution 200 m) were performed using the DieCast model. The intent was to investigate the gravitational circulation and the properties of the jet current, originating in the sea-level tailrace tunnel, as it propagates to the sea. The jet is sandwiched, just below the surface, between the slightly warmer, direct runoff water, and the saline ocean water below. The model realistically represents the two layered estuarine circulation observed in the Sound and the structure of the jet. The jet maintains its integrity throughout the fjord as it propagates downstream, while significantly increasing in transport as it entrains seawater from below. Results are presented of the circulation and mixing induced by one year and ten year flash flood events.

Notes

Commercialization and Client Services in AES (solicited)

Nancy Bresolin

Director, Commercial Services, Atmospheric Environment Service, Terrasses de la Chaudi{\`}ere, Hull, QU

Speaker: Nancy Bresolin

Time: Monday 11:05

Abstract

The Government of Canada has initiated a program of generating revenue through commercialization and the provision of services. This is a significant departure from previous paradigms for government. The Atmospheric Environment Service of Canada (and other government departments) has been transitioning to this concept for the past several years. The decision to go this route has been soul wrenching and strikes at the heart of the role of government. A brief history of the events and decisions leading to the shift in culture, the actions that have occurred, the major issues, the impact within and outside the government and the future of commercial and client services within the AES will be described.

Notes

Hydrocarbon observations around North America

Brickell, P.C.

Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario M3H 5T4

Bottenheim, J.W.

Same as 1.

Speaker: Brickell, P.C.

Time: Tuesday 11:35

Abstract

Measurements of C2-C6 hydrocarbons were made throughout the Arctic Ocean Section expedition cruise track. Samples were taken from July to October 1994 spanning 7 to 90 degrees North while circumnavigating North America and Greenland on board the USCGC Polar Sea. The data from the Arctic portion the voyage will be compared with those from other Arctic land and aircraft studies. Phenomena observed at the very high lattidutes (>85N) will be discussed. Patterns observed during the circumnavigation of the North American continent will be presented.

Notes

Diverse Uses of NEONS, Publicaly Released Software Used for Meteorological and Environmental Related Applications Worldwide

Briggs, Ann,

Empress Software Inc., 6401 Golden Triangle Drive, Greenbelt, MD, 20770

Speaker: Briggs, Ann,

Time: Monday 12:05

Abstract

The Naval Environmental Operational Nowcasting System (NEONS) is a software application development tool widely used by meteorologists and oceanographers around the world. Developed by the U.S. Navy between 1989-92, NEONS has since been adopted for use by other agencies and government institutions. There are currently more than 20 NEONS sites worldwide. This widespread use of relatively new software can be explained, in part, by the versatility of NEONS, which harness database technology for storage and retrieval of complex environmental data. In addition, the software's broad availability -- via licensing from the U.S. government -- has made it accessible to weather-related groups in both business and industry. This is a lucid Abstract of no more than 250 words....

Notes

Empirical normal modes and predictability of atmospheric model error propagation

Brunet, Gilbert

RPN/SEA, Dorval, Québec, Canada

Gauthier, Pierre

RPN/SEA, Dorval, Québec, Canada

Speaker: Brunet, Gilbert

Time: Wednesday 15:25

Abstract

During the last decade, there has been an increasing concern, in the field of atmospheric diagnostics and predictability, to make use of optimal statistical basis for flow decomposition when processing large datasets. Despite the statistical nature of these bases and their lack of interpretability, they turned out to be extremely efficient for compressing the dynamical information along a very limited number of degrees of freedom, and for providing compact vectors to be used as predictors for statistical prediction models. A new theory of empirical normal modes (ENMs) for the atmosphere is presented. ENMs are basis functions that both have the statistical properties of empirical orthogonal functions (EOFs) and the dynamical properties of normal modes.

We propose a general formulation for calculating normal modes from a generalized hermitian problem. The leading ENMs generally have a more monochromatic behavior, which give them an intrinsically more predictable character. The monochromatic behavior has been shown robust in the diagnostic of gravity waves in regional model simulations (MC2), of Rossby waves using potential vorticity map constructed from NMC analyses and in other numerical simulations. We show that the ENM coefficients, when used as predictors in a statistical linear model provide a better predictions of the behavior of the atmosphere than EOF coefficients. We will present preliminary results showing the usefulness of this approach as a diagnostic and predictive tool for model error propagation in the Canadian SEF global model.

Notes

CART-Neural Network regression models for broadband UV at the ground in the presence of clouds and other weather elements

Burrows, William R.,

Numerical Prediction Research Division, Meteorological Research Branch, Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Speaker: Burrows, William R.,

Time: Wednesday 10:25

Abstract

Models were built for prediction and diagnosis of broadband ultraviolet radiation. UV-B observations at Downsview for 1989-1993 were matched with meteorological predictors from Pearson airport. Data were stratified into 3 sets partitioned by solar zenith angle 70 degrees and time 1000- 1400 LST. Linear regression and CART nonlinear regression models were generated to fit normalized UV-B irradiance. CART regressions were superior by 5-10% error for zenith angle less than 70 degrees, and by much more for greater zenith angles. For zenith less than 70 degrees CART built a model with 31% cross-validated relative error using only three predictors: total opacity, liquid precipitation, and snow cover. This error was reduced only 1% by adding more predictors. For zenith greater than 70 degrees, CART produced a model with 15% relative error using three predictors: total opacity, zenith angle and clear sky UV. Models to be applied elsewhere should avoid compounding errors from predictor estimates. CART produced models with three predictors: total opacity, zenith angle, and clear-sky UV flux, having 34-35% error. The 3 models were tested in near-real time at 11 Brewer sites May to December 1995 using CMCs 18-hr ozone forecast, and both observed and 18-hr forecast opacity. Substantial decreases in error were seen by modifying the clear-sky forecast. A predictor not included was smoke from forest fires. Occurrences during the test period showed clear-sky UV-B is reduced 20-30% by smoke aloft many hundreds of km from the fires, and 40-50% nearer to the fires.

Notes

oral or poster presentation is OK

Factors affecting surface ozone concentrations in eastern Canada

Burrows, William R.,

Numerical Prediction Research Division, Meteorological Research Branch, Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Benjamin, Mario

Environnement Canada, Quebec Region, Ville Saint- Laurent, Quebec, H4M 2N6

Speaker: Burrows, William R.,

Time: Wednesday 11:35

Abstract

Ground-level ozone observations for May-September 1980-1990 were matched with meteorological and other predictors at 6 NAPS sites in eastern Canada. Long-range transport was included from 925 mb back-trajectories. Latitude, longitude, temperature, precipitation, and NO2 emission at trajectory locations each hour were obtained from the nearest observation site within 300 km, smoothed by distance from the trajectory. NO2 emissions were from grid-point annual averages in the 1985 inventory. NO2 was assumed to be injected into the air as it moved along a trajectory, and scenarios for loading were computed by summation along the trajectory positions. Local emission at t0 was added to the total. Both un-weighted and weighted scenarios were tried. Weighting was by exponential time decay multiplied by a precipitation weight, several of which were tried. Results are still being studied. O3 levels greater than 100 ppb occur with much less emission loading at sites far removed from large NO2 sources than for sites within or close to NO2 source regions. Separation of effects of meteorology and emissions on surface ozone was done by CART non-linear regression. A result seen at all inland stations is maximum temperature must reach about 25 deg C for higher levels of O3 to occur. Dewpoints higher than 18-20 degrees are related to reduced O3 concentrations. Certain aspects of trajectory information are important, and vary among sites: emission loading at certain times; minimum emission value at any hour; temperature, dewpoint, and NO2 emission 18-30 hours back; and total hours of precipitation.

Notes

oral or poster presentation is OK

Some new ways of fitting environmental data by non-linear regression

Burrows, William R.,

Numerical Prediction Research Division, Meteorological Research Branch, Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Jessup, Ralph G.,

Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Speaker: Burrows, William R.,

Time: Wednesday 16:45

Abstract

Most environmental problems exhibit a highly non-linear structure that is difficult to deal with in linear statistical models. Linear regression is no longer the only tool available to attempt to relate a predictand to predictors. In the last few years several new statistical methods for fitting data have emerged. One of these is CART, a non-parametric tree-based classification and regression algorithm that has been used successfully for a number of environmental analysis and prediction problems, such as mesoscale snowsqualls, adjusting clear-sky UV forecasts for clouds and aerosols, ground-level ozone, and ice-cover in the Great Lakes. By a variance-minimizing algorithm, CART fits a predictand by cross-validating the tree structure as it grows and properly stopping growth at the noise level allowed by the predictors. In many cases the CART solution is acceptable in spite of being piecewise continuous. However, when a continuous answer is desired CART can be used as a pre-processor for adaptive neural network and Sugeno fuzzy inference systems. Important advantages of CART are that it shows which predictors can be eliminated when many are available, and the stopping error-level for training. A smooth solution can be obtained with a neural network designed from information provided by the CART partition functions, path structure, and terminal node values, and trained with the constraint that error not exceed that of the CART solution. For the Sugeno fuzzy inference system CART shows the approximate number of clusters to find in the clustering process. Examples of applying these techniques will be shown.

Notes

oral or poster presentation is OK

The Late Cretaceous: Simulation with a Coupled Atmosphere-Ocean GCM

Bush, Andrew B.G.

Program in Atmospheric and Oceanic Sciences, Princeton University, P.O. Box CN710, Sayre Hall, Princeton, New Jersey, 08544-0710

Philander, S. George H.

Same as 1.

Speaker: Bush, Andrew B.G.

Time: Tuesday 16:20

Abstract

Results are presented for the atmospheric climate and the wind-driven ocean circulation of the late Cretaceous (~ 65 My b.p.) as simulated by a global climate model that is fully coupled to a primitive equation global ocean model. Interactive coupling between the two models ensures a realistic atmospheric response to oceanic SST and surface current velocities, as well as a realisitic oceanic response to surface wind stress, heat flux, freshwater flux, and shortwave radiation. Seasonal variation of solar insolation is imposed, clouds are a predicted quantity, land-sea distribution is specified according to paleomagnetic reconstructions, and the atmospheric mixing ratio of CO_2 is increased by a factor of four. The responses of the global atmosphere and the global ocean to the increased levels of CO_2 and to the Cretaceous geography are explored and contrasted with those of the present climate. In particular, we examine the magnitude of the seasonal cycle in high latitudes, which regulates temperature variations and hence plays a first order role in the polar extent of Cretaceous flora and fauna. We also demonstrate the existence of a robust westward flowing circumglobal current (the Tethys Circumglobal Current or TCC) whose existence, though supported by paleobiogeographical reconstructions, has come into question following previous numerical simulations which have failed to capture it. The cross-sectional area, the core current speed, and the mass transport of the TCC all vary with position. Despite local surface current reversals in the Tethys seaway during the south Eurasian monsoon months, the TCC remains a robust feature of the simulation.

Notes

video

The use of an automated forecasting tool (SCRIBE) in a working environment

Cantin, Andre,

BSME de Quebec, 1141, Route de l'Eglise , 7e etage, Sainte-Foy (Quebec) H4M 2N7

Babin, G.

BSME de Montreal 100, boul. Alexis-Nihon, 3e etage, Saint-Laurent (Quebec) H4M 2N7

Speaker: Cantin, Andre,

Time: Thursday 14:15

Abstract

The Weather Environmental and Services Offices of The Quebec Region of the Atmospheric Environment Services have been using SCRIBE, an automated forecasting tool , for the last two years. This presentation will focus on the different products that are done with this automation device and how these products are linked and made in an operational environment. The presentation will show up the advantages and disadvantages of the toolk and make mention of new development in the near future.

Notes

A Theory of Cyclone Track and Development: Moist Potential Vorticity Perspective

Cao, Zuohao

Department of Physics, University of Toronto, 60 St. George Street Toronto, Ontario Canada, M5S 1A7

Moore, G.W.K.

Same as above

Speaker: Cao, Zuohao

Time: Thursday 11:35

Abstract

The physical mechanism of cyclone track and development is investigated from moist potential vorticity (MPV) point of view. Based on a new development equation, the surface cyclone can deepen through mid-level negative vertical MPV flux. Diagnostics using ECMWF analyzed fields during the period of the Canadian Atlantic Storms Program Phase II (CASP II) shows that there is an unique mesoscale dipole structure of positive and negative vertical MPV flux associated with extratropical cyclones. It is found that the surface cyclone center follows the motion of the mesoscale dipole, and that the position of negative vertical MPV flux indicates the location of next 6-hour maximum surface cyclone deepening. The processes that mid-level negative vertical MPV flux enhances the surface cyclone deepening are also examined. The mid-level negative MPV flux influences the track and development of extratropical cyclones through two physical processes. In the first process, mid-level negative vertical MPV flux ahead of the surface

low enhances the surface cyclone deepening through moist air convergence at a strong baroclinic zone in an updraught. In the second process, the deepened surface cyclone leads to latent heat release to generate new negative vertical MPV flux in the vicinity of condensation. The new formed negative vertical MPV flux ahead of the surface low continues to deepen the surface low through the first process, and more condensation takes place afterwards. This positive feedback loop makes the mid-level negative vertical MPV flux as an excellent indicator of surface cyclone track and development.

Notes

oral presentation preferred

Rapid Thermohaline Transition in the Arctic Ocean

Carmack, Eddy

Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C. Canada, V8L 4B2

Speaker: Carmack, Eddy

Time: Monday 16:35

Abstract

CTD and geochemical tracer data from the Canada/U.S. 1994 Arctic Ocean Section (Arctic-94) show the general circulation of the Arctic Ocean to be dominated by narrow (order 100 km) topographically-steered velocity cores following shelf margins and submarine ridges. Large, basin-scale changes in thermohaline structure have occurred in recent years in response to perturbations in the inputs of waters entering from the Atlantic and Pacific, suggesting a strong link with the global climate system. These thermohaline transitions are manifest across the full width of individual Arctic basins (order 1000 km) by thin (order 40 m) double-diffusively driven intrusions.

Notes

Réponse de l'atmosphère à un forçage diabatique prescrit à l'échelle synoptique.

Caya, Alain

Département des Sciences de la Terre, Université du Québec à Montréal, B.P. 8888, Succ. "Centre-ville", Montréal, Qc, Canada, H3C 3P8

Laprise, René

Same as 1.

Zwack, Peter

Same as 1.

Speaker: Caya, Alain

Time: Thursday 09:05

Abstract

Le vent à l'échelle synoptique est largement balancé dans l'atmosphère. La question qui a conduit à ce travail est pourquoi il en est ainsi. Pour pouvoir répondre à une telle question, il faut d'abord savoir comment l'atmosphère atteint cet état. On cherchera à déterminer le temps requis pour que l'ajustement se fasse à l'échelle synoptique. Nous utilisons le modèle de mésoéchelle compressible communautaire (MC2) pour effectuer la simulation. Ce modèle est non-hydrostatique, pleinement compressible et utilise un schéma temporel semi-implicite et semi-lagrangien pour intégrer les équations d'Euler. L'état de base est une atmosphère au repos, isotherme et en rotation uniforme. On emploiera un forçage diabatique prescrit constant dans le temps pour stimuler le système. On observe comment les champs évoluent lors du processus d'ajustement qui dure quelques heures. On observe également la propagation d'ondes acoustiques et de gravité qui transportent de l'énergie hors de la zone perturbée. L'état balancé résultant s'accorde bien avec la théorie balancée.

Notes

Absorption of solar radiation by clouds: Interpretations of satellite, surface and aircraft measurements

Cess, Robert D.

State University of New York at Stony Brook Stony Brook, NY 11794-5000

Speaker: Cess, Robert D.

Time: Tuesday 08:45

Abstract

To investigate the absorption of shortwave radiation by clouds, we have collocated satellite and surface measurements of shortwave radiation at several locations. Considerable attention has been directed towards understanding and minimizing sampling errors caused by the satellite measurements being instantaneous and over a grid that is much larger than the field of view of an upward facing surface pyranometer. The collocated data indicate that clouds absorb considerably more shortwave radiation than is predicted by theoretical models. On a global average, it could amount to about 15 to 20

W m^-2 excess cloudy-sky absorption. This is consistent with the finding, from both satellite and aircraft measurements, that observed clouds are darker than model clouds. In the limit of thick clouds, observed top-of-the-atmosphere albedos do not exceed a value of 0.7, whereas in models the maximum albedo can be 0.8. Furthermore, the solar-zenith-angle dependence of the observed cloud absorption is quite different from that of a plane-parallel cloud model, irrespective of how much absorption one puts into the model. A speculative suggestion is that the excess cloud absorption is caused by cloud morphology rather than by cloud microphysics.

Notes

Gravity wave diagnosis using Generalized Empirical Normal Modes

Charron, Martin

Department of Atmospheric and Oceanic Sciences, McGill University, 805 rue Sherbrooke ouest, Montréal, Québec, H3A 2K6

Brunet, Gilbert

Recherche en Prévision Numérique, Environnement Canada, 2121 route Trans-canadienne, Dorval, Québec, H9P 1J3

Speaker: Charron, Martin

Time: Monday 15:55

Abstract

In the middle atmosphere, one of the major eddy forcings on the zonal mean flow is the drag force exerted by gravity waves. It is therefore crucial that gravity wave drag forces be well parameterized, in order for numerical models to adequately simulate the dynamics of the middle atmosphere. This drag is due to wave transience and breaking which causes Eliassen-Palm flux divergences, turbulence, and dissipation. In order to better understand gravity wave transience, a statistical method based on Empirical Orthogonal Functions (EOFs) and using wave-activities to construct a modified covariance matrix is presented. This method is capable of identifying and diagnosing wave transience, and has proven to be useful in the study of planetary wave propagation. It turns out that when a system is linear, unforced, and non-dissipative, the EOFs are simply the normal modes of the dynamical system. The analytical framework related to gravity wave diagnosis will be presented. Gravity wave diagnoses which use the aforementioned method will be performed on the output of a high resolution regional model.

Notes

If possible, I would like to give my talk on May 27th or 28th.

The Effects of Heterogeneous Reactions on Stratospheric Ozone Balance.

Chartrand, Darryl J.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P4

McConnell, John C.

Same as above.

Speaker: Chartrand, Darryl J.

Time: Thursday 09:25

Abstract

Heterogeneous reactions in and on stratospheric sulfate aerosols and polar stratospheric clouds are important in the photochemical balance of the stratosphere. We have used a box photochemical model of the stratosphere with a detailed chemistry package which includes a heterogeneous reaction module to evaluate the effect of these reactions of inorganic halides. We will discuss the details of the parametrizations involved and present the results from a one year simulation in the 100-50 mbar level at a number of latitudes. Results will show the effect that these reactions have on Odd Oxygen, NO$_x$, ClO$_x$, and BrO$_x$ concentrations and comparisons will be made with strictly gas phase simulations.

Notes

Hydroxyl radical chemistry of non-methane hydrocarbons in the atmosphere of Long Point, Ontario (1994-1995)

Chen, Shu-Ping

Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3

Speaker: Chen, Shu-Ping

Time: Tuesday 10:05

Abstract

Atmospheric non-methane hydrocarbon (NMHC) concentrations have been monitored recently at Long Point Provincial Park using gas chromatography with flame ionization

detection. The NMHC concentrations demonstrated typical characteristics of a location near to pollution sources. A new and simple method to examine the importance of hydroxyl radical oxidation of the NMHCs at Long Point has been developed. This method could be also used to distinguish background NMHCs and transported NMHCs, and to determine local concentration ratios of NMHCs. The results will be discussed.

Notes

Tidal velocities from Lagrangian drifters: Comparison to a numerical model

Cherniawsky, J.Y.

same as 1.

Crawford, W.R.

Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C. V8L 4B2

Foreman, M.G.G.

Same as 1.

Woodward, M.J.

Same as 1.

Speaker: Cherniawsky, J.Y.

Time: Wednesday 14:35

Abstract

Loran-C surface drifters were deployed at various locations north of Vancouver Island and all around Queen Charlotte Islands during spring and summer of 1990-92 and 1994-95. Approximately 200 drifter tracks were recorded during this time, varying in duration between 2 days and 3 weeks. Drifter positions were reported every 30 minutes with a typical relative error of about 50 m. Velocity power spectra (computed for tracks longer than about 3 days using overlaping data segments) show a strongest peak in a semidiurnal band. Rotary spectra show strong semidiurnal clockwise and weaker anticlockwise motion, with evidence of clockwise inertial oscillations in some of the tracks. Barotropic tidal velocities were also computed along each drifter track using four semidiurnal and four diurnal tidal harmonics from a three-dimensional finite element model of the north coast of British Columbia. Power and rotary spectra from these velocities were compared to those from drifter velocities. Rotary spectra show good agreement in phase and amplitude of the semidiurnal band for anticlockwise motion in most of the tracks and for clockwise motion during spring. On the other hand, model clockwise velocities are

usually lower and often out of phase with those from surface drifters over deeper areas of the continental shelf during summer. This additional clockwise motion is most likely due to propagating semidiurnal internal tides that are generated along topographic slopes in areas of significant vertical density stratification.

Notes

Variability south and east of the Grand Banks of Newfoundland over the last four decades.

Clarke, R. Allyn,

Ocean Sciences Division, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, NS B2Y 4A2

Yashayaev, Igor M.,

Same as 1.

Speaker: Clarke, R. Allyn,

Time: Thursday 08:45

Abstract

A number of authors have compared recent occupations of Atlantic sections with the IGY sections of 1957 and have described the warming and cooling of different parts of the water column. In course of intercalibrating three recent Canadian WOCE cruises in the Newfoundland Basin of the NW Atlantic, we searched back through all the past Canadian and US cruises in this region. The precision and accuracy of modern state of the art CTD/rosette measurements of temperature and salinity are an order of magnitude better than the water bottle measurements of the late 1950's. In spite of these changes in technology, the records reveal the profound cooling and freshening of all the intermediate and deep waters formed in the North Atlantic throughout the 1980's.

Notes

Lightning sign, location, and evolution showing severe weather in the Great Lakes area

Clodman, Stephen

Forecast Research Division (ARMF), Atmospheric Environment Service, North York, Ontario, M3H 5T4

Speaker: Clodman, Stephen

Time: Tuesday 17:00

Abstract

Lightning (cloud-to-ground) location data from Ontario stations were compared in detail to King City, Ontario, radar data for selected storms. It is already known that storms with high positive flash counts give severe weather - for example, the Plainfield, Illinois, tornado of 28 August 1990. We show that moderate positive flash counts are probably also related to severe high-topped storms - for example, the southern Ontario tornadoes the same day. For this day, the storm systems had the positive flashes in the middle, and the negative flashes mostly in and behind the developing area to the rear of the system. A probable horizontal separation of positive and negative charge is suggested. This contrasts with the system of 15 June 1991 in which the positive flashes were colocated with the negative flashes, and contrasts with cases having fewer positive flashes. We can infer that these cases differ in dynamic pattern. Time evolution of the lightning flash patterns is also important. The time of maximum positive flash rate is usually close to a surge in high altitude storm development, and is often along with or soon before any severe weather. Also, very rapid local changes in the negative flash rate usually closely precede tornadoes and/or strong nearby shears. In particular, the most severe Ontario tornado on 28 August 1990 (F3 strength) occurred just after flashes increased sharply behind a rapidly advancing (30 m/s) line. Thus strong helicity and/or shear may relate to lightning generation. It is concluded that detailed lightning data analysis is important for storm forecasting.

Notes

Oral presentation is preferred, but poster presentation would be accepted. If there is a session either on convective storms or on atmospheric electricity, this paper would be suitable.

Evaluating ISCCP cloud optical depths using surface solar irradiance measurements

Curtis, T.J.

Dept. of Geography, McMaster University, Hamilton Ontario, L8S 4K1

Barker, H.W.

Cloud Physics Research Division, AES, Downsview

Leontieva, E.

Geophysical Institute, U. of Alaska

Stamnes, K.

Geophysical Institute, U. of Alaska

Speaker: Curtis, T.J.

Time: Tuesday 11:35

Abstract

Recent studies have attempted to infer cloud optical depths ($\tau $) from surface pyranometer measurements (Leontieva and Stamnes, 1994; Leontieva et al., 1994). These studies were concerned primarily with the statistical description of $\tau $ for specific locations. While such an approach is geographically limited, use of surface measurements, that often began long before satellite monitoring, can yield long time series of $\tau $. In addition, unlike reflected radiation fields used by satellite techniques, transmitted radiation is relatively insensitive to specifications of cloud droplet effective radii thereby limiting the number of influencing variables. This study utilizes a similar approach to infer $\tau $ but for a more spatially and temporally extensive database. Hourly-integrated broadband solar irradiances, reports of sky conditions, and a plane-parallel homogeneous radiative transfer model are used to solve for $\tau $ during overcast conditions at 21 stations across Canada. These records often extend for more than 20 years. Seasonal and annual statistics for applicable stations during snow-free periods are presented. In addition, surface-based estimates of $\tau $ are compared to similar data fields from concurrent periods of the ISCCP-C1 data archive. Thus, in using two very different, but near simultaneously measured radiation fields, this study attempts to provide a validation for ISSCP values of $\tau $. References Leontieva, E. and K. Stamnes, 1994: Journal of Climate, 7, 566-578. Leontieva, E., K. Stamnes, and J.A. Olseth, 1994: Theoretical and Applied Climatology, 50, 73-82.

Notes

An Operational System for Emergency Response to Large Scale Release of Pollutants in the Atmosphere

D'Amours, Réal

Canadian Meteorological Centre, 2121 Voie de service Nord, Dorval, Qc, H9P 1J3

Jean, Michel

Same as 1.

Servranckx, René

Same as 1.

Trudel, Serge

Same as 1.

Bourgouin, Pierre

Same as 1.

Speaker: D'Amours, Réal

Time: Tuesday 17:00

Abstract

The X-window interactive model launching procedures will be demonstrated on a workstation, along with the various applications for displaying and analysing the results. Several animations of real cases responses will be displayed on the workstation and on a micro-computer.

Notes

This paper is presented in two parts - oral and poster The oral presentation is in the Air Quality session

An Operational System for Emergency Response to Large Scale Release of Pollutants in the Atmosphere

D'Amours, Réal

Canadian Meteorological Centre, 2121 Voie de service Nord, Dorval, Qc, H9P 1J3

Jean, Michel

Same as 1.

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Trudel, Serge

Same as 1.

Bourgouin, Pierre

Same as 1.

Speaker: D'Amours, Réal

Time: Wednesday 13:35

Abstract

A large scale atmospheric transport and diffusion model - the CANadian Emergency Response Model (CANERM), is part of the operational numerical weather prediction system of the Canadian Meteorological Centre (CMC). The model execution can be initiated by the duty meteorologist at any time, and results are available to users shortly thereafter. The model can be executed for releases occuring anywhere in the world. CANERM is an Eulerian model in which the advection diffusion equation is solved. Diffusion is modelled according to the gradient theory. The model takes into account turbulent mixing; wet and dry scavenging are simulated. CANERM executes on the CMC NEC supercomputer. X-Window based applications, which run on the front end computers and workstations, guide the duty meterologist in entering the parameters required by the model and appropriate for the release scenario. Similar applications are used to examine model results and to produce outputs that can be tailored to the specific situation and user needs (e.g monochrome charts, cross-sections, vertical profiles, coloured-charts, time series, animations). The system has been used to respond to various national and international nuclear emergency exercises. The system has also been used to provide real time guidance on the motion of volcanic ash plumes resulting from several eruptions: Mount Spurr (Alaska), in the summer of 1992, the Rabaul caldeira (Papua New-Guinea) in september 1994, Mount Klyuchevskoi (Kamchatka), october 1994, for which verifying statellite imagery is available. This presentation describes the model and the associated system in operation at CMC. Examples of the real cases results, along with the verifying satellite imagery, are shown.

Notes

This paper is presented in two parts - oral and poster

An analysis of cyclone growth rates and sea-surface temperature anomalies in the Kuroshio and Gulf Stream Currents

Danielson, R.,

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A 2K6

Gyakum, J. R.

Same as 2.

Speaker: Danielson, R.,

Time: Tuesday 14:50

Abstract

An comprehensive analysis of 64 surface cyclones propagating over the Gulf Stream and Kuroshio Currents is performed using a new concept, growth rate, in lieu of the traditional central pressure fall criterion. This new criterion, based upon the semi-geostrophic form of the vorticity equation, provides the basis for an improved dynamical understanding of surface cyclogenesis. We find that typical rapid cyclogenesis, as defined by central pressure fall, is preceded by the most rapid growth, in upstream regions of weaker stratification and warmer tropospheric air. Observational evidence of the underlying oceanic state during the passage of the cyclones and their possible related effects are also presented. A modified Cressman objective analysis is applied to the Comprehensive Ocean- Atmosphere Data Set (COADS) of ship observations in the regions of cyclogenesis to obtain fields of sea-surface temperature (SST) and the SST anomaly from the long-term climatological mean. We find that the downstream warm SST anomaly is a characteristic of rapidly-growing systems. Sensible and latent heat fluxes, computed using the bulk aerodynamic method, reveal the preferential presence of downstream fluxes in these extreme systems. Dynamical implications of these SST anomalies and fluxes will be discussed.

Notes

Support for Atmospheric Science within the Canadian Space Agency (invited)

David J.W. Kendall

Space Science Program, CSA, P.O. Box 7275, Vanier Postal Stn., Ottawa, K1L 8E3

Speaker: David J.W. Kendall

Time: Monday 14:25

Abstract

The Canadian Space Agency has been actively supporting atmospheric science since its inception in 1989. The two branches most heavily involved in such activities are the space science program and the space technology branch. This support ranges from the troposphere to the upper reaches of the atmosphere with much activity concentrated in the middle atmosphere (stratosphere and mesosphere). Major projects that will be covered include WINDII, Odin and MOPITT. The talk will also discuss the scientific rationale behind the CSA program as well as future initiatives that are presently being developed.

Notes

Validation of global NWP analyses and forecasts using DMSP SSM/I retrievals

Deblonde, G.,

Atmospheric Environment Service, Data Assimilation and Satellite Meteorology Division, 2121 Trans-Canada Highway, Dorval, P.Q. Canada, H9P 1J3

Yu, W.,

Atmospheric Environment Service, Data Assimilation and Satellite Meteorology Division, 2121 Trans-Canada Highway, Dorval, P.Q. Canada, H9P 1J3

Dastoor, A.P.,

Atmospheric Environment Service, Modelling and Integration Research Division, 2121 Trans-Canada Highway, Dorval, P.Q. Canada, H9P 1J3

Garand, L.,

Atmospheric Environment Service, Data Assimilation and Satellite Meteorology Division, 2121 Trans-Canada Highway, Dorval, P.Q. Canada, H9P 1J3

Speaker: Deblonde, G.,

Time: Monday 16:55

Abstract

Retrievals of environmental parameters (Column integrated water vapor--IWV, near-surface oceanic wind speed--SWS, cloud liquid water path --LWP and surface rain rates--SRR) obtained from special sensor microwave/imager (SSM/I) brightness temperatures for October 1993 were used to validate the Canadian Meteorological Center analysis/forecast system and an improved version of the forecast model that included a prognostic equation for cloud water. Over the global oceans, the agreement between analyzed IWV, forecasted IWV and SSM/I retrievals was quite good. In the GOES-7 window however, large biases in the analyzed IWV were found to be due to the assimilation of Humsat (GOES-7) retrieved water vapor profiles. Considerable differences were found between analyzed/forecasted SWS and SSM/I retrieved SWS and in particular in the tropics. Forecasted cloud fraction from the improved model was compared with that observed using the Humsat retrieval system; over the open oceans, modeled cloud fraction was overestimated by 8% suggesting that cloud formation was too active. By comparing SSM/I LWP retrievals with those forecasted, it was possible to identify mispositioning of cloud systems that were also associated with large biases in the humidity analysis. It was also shown that the choice of function to obtain the liquid phase component of the modeled cloud water largely affected the magnitude of the monthly mean LWP. The differences in patterns between precipitation short-range forecasts (accumulated over a month) obtained with the operational and improved forecast models

were considerably smaller than the differences between each of these forecasted fields and SSM/I retrievals or long-term climatologies.

Notes

Extreme value statistics for maximum soil frost penetration in the northeastern United States using air temperature and snow cover data

DeGaetano, Arthur T.

Northeast Regional Climate Center, Cornell University, Ithaca, NY, USA, 14853

McKay, Megan

Same as 1.

Wilks, Daniel S.

Same as 1.

Speaker: DeGaetano, Arthur T.

Time: Thursday 15:25

Abstract

A physically-based model for estimating frost penetration is used to develop a climatology of soil frost penetration extremes. Since the model is based on meteorological variables which are observed at U.S. Cooperative Network stations, frost depth statistics can be derived for approximately 500 sites within the northeastern United States. The theoretical basis for the frost penetration model is that the process is driven primarily by thermal diffusion. At the lower boundary an approximately constant temperature and negligible heat flux are assumed. The upper boundary condition is given by the observed average daily air temperature. Layers of variable depth in the snow/soil system are then defined by frozen and unfrozen zones, the boundaries of which are at 0 degrees C. Imbalances between the resulting vertical heat fluxes are made up through either freezing or thawing a sufficient depth of soil. Using model simulations, a suite of candidate extreme value distributions are screened for use in representing annual frost penetration extremes. This screening is based on a bootstrapping procedure in which data from stations with relatively long climatological records are used to construct a series of model estimates. Random samples of 30 are then repeatedly withdrawn from these records and used to fit each candidate distribution. Extropolations to the exceedence probabilies of the largest points in the parent data series are made and used to evaluate the bias and precision of each distribution. Based on this analysis the Gumbel distribution was chosen as providing the best representation of the soil freezing extremes.

Notes

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

Zwack, Peter

Department of Earth Sciences, Universite of Quebec at Montreal, P.O. Box 8888, Station A, Montreal, Quebec H3C 3P8

Olivier Hamelin

Ecole Nationale de la Meteorologie, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Santurette, Patrick

SCEM, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experiemental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies amoung the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the cause of a region of upward motion or pressure falls provided the forecaster with enought confidence to follow the model guidence. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes

Gas phase chemistry in the Canadian Middle Atmosphere Model

de Grandpré, J.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Sandilands, J.W.

Same as 1.

Beagley, S.R.

Same as 1.

McConnell, John C.

Same as 1.

Speaker: de Grandpré, J.

Time: Thursday 09:05

Abstract

An important objective of middle atmosphere global climate modelling is to be able to predict the response of the middle atmosphere to natural or anthropogenic perturbations. Thus the inclusion of a comprehensive chemical modelling package to solve gas phase and heterogeneous chemistry in these models is an important goal. We are developing such a code for the Canadian Middle Atmosphere Model. The current gas phase chemical module is run on-line and involves 44 species including nitrogen, chlorine, bromine and hydrocarbon families. The chemistry is currently processed throughout the entire middle atmosphere and calculated every dynamical time step (15 minutes). Transport of species is currently treated with a spectral scheme which will be shortly replaced by a semi-lagrangian advection scheme. A full diurnal cycle is simulated with photolysis rates provided by a look up table. The algorithm is a mass conserving fully implicit backward difference scheme and currently uses less than 10\% of the GCM run time. Results from a several months integration will be presented including some comparison with measurements.

Notes

The chemistry module in the Canadian Middle Atmosphere Model

de Grandpré, J.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Sandilands, J.W.

Same as 1.

Beagley, S.R.

Same as 1.

McConnell, John C.

Same as 1.

Speaker: de Grandpré, J.

Time: Tuesday 17:00

Abstract

A gas phase chemistry module has been implemented in the Canadian Middle Atmosphere Model with the ultimate goal of solving middle atmosphere ozone photochemistry. In its first version, the module includes nitrogen, chlorine, bromine and hydrocarbon families to represent the evolution of the key species in a wide range of time scales. Among the 44 species included, sixteen are considered as long lived species and are therefore transported individually. These species and families are: ${\rm O}_{\rm x}$, ${\rm NO}_{\rm x}$, $\rm ClO_{\rm x}$, $\rm BrO_{\rm x}$, $\rm HNO_3$, $\rm HNO_4$, ${\rm N}_2O$, $\rm HCl$, $\rm Cl_2O_2$, $\rm HBr $, $\rm H_2O_2$, $\rm H_2O$, ${\rm CH}_4$, $\rm CO$ and 2 passive tracers. Among the shorter lived species, some are transported via the family method: $\rm O_3$, $\rm O$, $\rm O^1D$, $\rm NO$, $\rm NO_2$, $\rm NO_3$, $\rm N_2O_5$, $\rm Cl$, $\rm ClO$, $\rm HOCl$, $\rm OClO$, $\rm ClONO_2$, $\rm Br$, $\rm BrO$, $\rm HOBr$, $\rm BrONO_2$, $\rm BrCl$ and others are solely considered as chemically active: $\rm H$, $\rm OH$, $\rm HO_2$, $\rm CH_2O$, $\rm CH_3O_2$ and $\rm CH_3OOH$. The surface emission of a few species is specified as well as the distribution of some other fields such as H$_2$, CO$_2$, CFC-11 and CFC-12. Heterogeneous reactions on aerosols are currently not included but the current chemical solver is sufficiently robust to handle parameterized heterogeneous chemistry. The description of the method and results from a several month long integration will be presented.

Notes

poster

Non-quasigeostrophic barotropic instability in a bounded vertical domain

De la Cruz-Heredia, M.

Atmospheric Physics Dept., University of Toronto 60 St. George Street, Toronto, Ontario, Canada, M5S 1A7

Moore, G.W.K.

Same as above.

Speaker: De la Cruz-Heredia, M.

Time: Tuesday 15:10

Abstract

We study a linear, primitive equation (PE) barotropic problem in which the basic flow is confined between two horizontal boundaries and thus provides us with a more realistic representation of actual situations which arise in the atmosphere. Under quasigeostrophic (QG) theory the dynamics of the perturbations can be described by defining an equivalent wavenumber in terms of the zonal and vertical wavenumbers and solving a "purely barotropic" eigenvalue problem where the vertical domain is effectively unbounded. Starting from a primitive equation model, however, leads to a much more complex dependence on the vertical structure, and the above simplification is no longer possible. Upon solving the eigensystem that results we find that, in addition to the growing "QG mode" obtained in the first case, a new instability arises. This "PE mode" attains its maximum growth rate at a vertical wavelength which approximately coincides with the scale height of the basic flow (in our case the height of the tropopause). Resonance between a Kelvin and a Rossby wave within the flow may be the cause for the appearance of this second mode. We will also discuss the applicability of this model to the generation of tropical cyclone pairs.

Notes

poster

On the atmospheric interannual fluctuations (Invited)

Derome, Jacques

Dept. of Atmospheric and Oceanic Sciences, and Centre for Climate and Global Change Research, McGill University, Montreal

Speaker: Derome, Jacques

Time: Wednesday 15:25

Abstract

Interannual fluctuations in the atmospheric mean-seasonal states can be generated by an interaction with the lower boundary, by some external forcing such as a volcanic eruption, or simply by the atmosphere's own internal dynamics. This presentation will review the main characteristics of the year-to-year fluctuations in the mean seasonal states and discuss the role of the atmospheric internal dynamics in generating or maintaining them. In particular, the role of the transient eddies, or "weather noise" will be discussed, with reference to the question of the predictability of the mean-seasonal states.

Notes

On the impact of blowing snow sublimation in the Mackenzie River Basin water budget.

Déry, S. J.

Dept. of Earth and Atmospheric Science, York University, 4700 Keele St., North York, ON, M3J 1P3

Taylor, Peter A.

same as 1.

Speaker: Déry, S. J.

Time: Tuesday 11:15

Abstract

Blowing snow is commonly known as a hazardous meteorological process in Canada. Blowing snow may also be a significant hydrological process in the water cycle due to the redistribution of snow and the sublimation of airborne snow while in transport. The process of snow sublimation by the wind may also act as a significant source of moisture and a sink of sensible heat in the MAGS (Mackenzie GEWEX Study) area and should be included in northern atmospheric boundary-layer models. We will discuss one such model which is a spectral adaptation of the Prairie Blowing Snow Model (PBSM) that determines the thermo- dynamic effects of blowing snow sublimation to the near-surface air. Results show that air temperature decreases can reach 1oC. Saturation of air, however, accompanies this temperature change and occurs quite rapidly near the surface thus significantly reducing sublimation rates at long fetches. This would indicate that the overall impact of blowing snow sublimation in the Mackenzie River Basin water budget may be less than previously anticipated. Horizontal transport and redistribution of snow by wind remain, however, significant processes.

Notes

Combining Persistence and Climatology for Very Short Term Forecasts

Norman R. Donaldson

Cloud Phyics Research Div, A.E.S., 14780 Jane St, King City, Ontario, L7B 1A3

Speaker: Norman R. Donaldson

Time: Thursday 11:35

Abstract

To score forecasts, their performance is usually measured against a "naive" forecast such as persistence or climatology. In order to make a reasonable assessment the naive forecast should be the best one available. Murphy (1992) and other works back to at least 1958 discuss optimal combinations of persistence and climate forecasts. They indicate when persistence should be preferred over climate. Unfortunately those works used persistence in a manner that differs from the usage in very short term forecasts. In nowcasting the predictor and predictand are taken from different populations and the present work has reformulated the problem to reflect nowcasting applications. The reformulated persistence theory indicates an improved mixture of persistence with climatological trends. The effectiveness of persistence and climatology forecasts is illustrated using a 36-year record of hourly surface data from Toronto's Pearson International Airport (YYZ). For temperature the modified persistence outperforms climatology out to 24 hours, in contrast to 4-5 hours for ordinary persistence.

Notes

On the form of wave dissipation in a wind-driven wave field

Donelan, Mark A.

National Water Research Institute, Canada Centre for Inland Waters, Burlington, Ontario, L7R 4A6

Kenney, Barney C.

National Hydrology Research Institute, Saskatoon, Saskatchewan, S7N 3H5

Speaker: Donelan, Mark A.

Time: Monday 14:25

Abstract

Waves receive energy from the wind, carry some of it away as they grow and propagate and leave behind a good deal of it in the form of turbulence and increased currents. More than 95~\% of the energy delivered to waves by wind is lost locally. The residual accounts for the growth of wave energy with time or fetch. While the form and magnitude of the input from the wind to a given wave spectrum are now quite well known, the character of the dissipation of energy due to whitecapping is poorly understood. In this paper we make use of the approximate local balance of energy in and out of the wave field to estimate the form and rate of dissipation of waves due to whitecapping. The data are drawn from wave and wind measurements on six towers in Quill Lake, Saskatchewan during a five month period. Dissipation is shown to be highly nonlinear in the degree of saturation of the spectrum.

Notes

Lidar Measurements of Stratospheric Aerosol and Ozone in the Canadian Arctic during the 1994/95 and 1995/96 Winters

Donovan, D.P.

ISTS/York U. Dept. of Physics and Astronomy, North York, ON, M3J 3K1

Bird, J.C.

Same as 1.

Carswell, A.I.

Same as 1.

Duck, T.J.

Same as 1.

Pal, S.R.

Same as 1.

Whiteway, J.A.

Same as 1.

Speaker: Donovan, D.P.

Time: Thursday 11:55

Abstract

This paper reports on lidar derived measurements of stratospheric ozone and aerosol made during the 1994/95 and 1995/96 winters. These observations were conducted at Eureka (80^{o}N,86.42^{o}W) in the Canadian arctic. The measurements were carried out at a facility operated by the Canadian Atmospheric Environment Service (AES). The AES/ISTS lidar at Eureka is primarily designed for the measurement of ozone profiles, however, profiles of aerosol backscatter and extinction as well as temperature can also be deduced. The Eureka measurement site is particularly interesting since its position relative to the stratospheric polar vortex can be quite variable. For the 1995/96 and 1994/95 winters, examples of correlated ozone, aerosol and potential vorticity behavior are presented and discussed. In particular, the use of aerosol and ozone as pseudo-tracers reveal some details of the complicated vertical structure of the vortex edge. In addition, the correlation between observed ozone mixing ratio and aerosol as well as potential vorticity indicate that substantial decreases of intra-vortex ozone, likely chemical in nature, occurred during both the 1994/95 and 1995/96 seasons.

Notes

Simulation and validation of GCM's surface energy budget using SIMMS and BOREAS results.

Dorais, Michel

C^{2}GCR and Département des sciences de la terre,=20 Université du Québec à Montréal (UQAM), C.P.=20 8888, Succ. "Centre-ville", Montréal (Québec), H3C 3P8

Blanchet, Jean-Pierre

same as 1

Speaker: Dorais, Michel

Time: Wednesday 11:35

Abstract

Field experiments like SIMMS and BOREAS have been conducted with the specific intent of improving General Circulation Models (GCM). These expeditions provided data which are not normally measured at meteorological stations. High quality measured variables such as radiation and other surface fluxes are excellent quantities for validation of climate models. Using only the standard radiosonde observations (temperature, wind, moisture), surface pressure and precipitation, the GCM's physics can retrieve all other variables carried by the model. This is the basis of the 1D version of the GCM, the Local Climate Model (LCM). By comparing LCM to observed surface fluxes and other fields, the models physics can be validated. Alternatively, once the physics is validated, the LCM can be used to bridge gaps in data or to reconstruct climatology of, say, surface fluxes at any sites where precipitation is measured. This new approach is referred to as an

“active diagnostic method” (ADM) since all physical variables are interactive and balanced during the evaluation at 20 min. time steps. Effectively the LCM is used to replay the observed climate at particular sites. Thus, field expeditions give us the opportunity of testing a new method of physical climatology which actively combines a numerical model and existing meteorological data.

Notes

Monthly mean upper layer fields during the ice-free season in the Gulf of St.Lawrence

Doyon, P.

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Ingram, R.G.,

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A-2K6

Speaker: Doyon, P.

Time: Wednesday 15:25

Abstract

In the context of atmosphere-ocean-biosphere interactions, a general knowledge of the Gulf of St.Lawrence (GSL) surface layer average state is desirable. Using basic statistical analyses and a historical hydrographic dataset covering the last 75 years, monthly mean vertical fields of temperature (T) and salinity (S) were produced throughout the GSL. Objective fields of sea surface salinity (SSS) and temperature (SST) were computed, and the latter compared with monthly mean distributions of satellite-derived SST. These multichannel SST (MCSST) consisted of remotely sensed composites for 8 recent years, and were derived from the Advanced Very High Resolution Radiometer (AVHRR) carried aboard the NOAA-series polar orbiting satellites. Despite poor coverage for certain regions and/or months in the archived database, the SST maps compared well with other known climatologies as well as with the MCSST. Both reproduced several known physical surface characteristics i.e.: colder upwelling waters, temperature gradients, spatio-temporal evolution of T and S minima, etc. Monthly means of mixed-layer depth (MLD) and upper-layer heat content were also obtained for 15 subregions of the GSL. To estimate the relative importance of various physical forcing influencing the MLD, simple diagnostic and prognostic calculations were performed. Finally, using these oceanic averages in combination with proper atmospheric data and satellite cloud cover, the surface heat budget was computed over the entire Gulf from May to November. A modified 1D heat diffusion model enabled us to assess key factors controlling the monthly evolution of the GSL upper-layer thermal structure.

Notes

Interannual variability of the Gulf of St.Lawrence upper layer fields during the ice-free months

Doyon, P.

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Ingram, R.G.,

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A-2K6

Speaker: Doyon, P.

Time: Monday 17:15

Abstract

Atmosphere-ocean interactions are critical in determining our local climate and in affecting primary biological productivity. Consequently, the surface waters influence the rate at which various exchanges of heat, mass and momentum take place through the air-sea interface. First, monthly anomalies of air temperature (Ta) and wind mixing energy (Ew) were produced to assess the role played by the atmospheric forcing in inducing year-to-year variations of the Gulf of St.Lawrence (GSL) surface waters. Anomalies of mixed-layer depth (MLD) and sea-surface temperature (SST) were correlated with those of Ew and Ta, respectively. Although MLD time series were too poorly sampled to yield unaliased statistics, significant correlations were obtained between anomalies of SST and Ta at a lag of one month. In general, observations show the surface variability to be essentially interannual, which is further confirmed by EOF analysis. Spatial variations are also investigated using remotely sensed monthly SST for 8 recent years. Although the monthly climatological picture is easily explained, it is difficult to assess quantitatively which environmental factors determine the year-to-year fluctuations of the upper-layer physical state. Too many parameters interact in a complicated and integrated fashion throughout a wide spectrum of scales to be easily “picked-up” by simple statistical analyses. Moreover, aliasing and incompleteness of several datasets complicate the analysis. It is therefore necessary to study all aforementioned variables via numerical models, and work in this direction is currently underway linking mixed-layer physics, dynamics, stratification and biological productivity.

Notes

poster (I'll prepare a talk in case there is no poster session, or if the session is too empty!)

Upper-layer stability and nutrient flux in the Gulf of St.Lawrence during the 1992-94 JGOFS cruises

Doyon, P.

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Ingram, R.G.,

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Prestidge, M.C.,

Plymouth Marine Laboratory, Prospect Place, West Hoe, Plymouth, PL1-3DH, UK

Wesson, J.,

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A-2K6

Speaker: Doyon, P.

Time: Tuesday 11:15

Abstract

Analysis of all CTD, ADCP and turbulence profile data collected in the Gulf of St.Lawrence cruises indicates that the observed near-surface thermohaline structure is in close agreement with the corresponding monthly climatology. From late-fall to mid-spring, salinity variations control upper-layer stability. The large surface buoyancy input associated with the ice melt and the increased runoff from the St.Lawrence river and the Baie des Chaleurs leads to the formation of a stable upper layer in the Northwest part of the Gulf in April-May. Consequently, a spring bloom occurs in this region before the remaining study area. Comparison of turbulence profiles to static stability characteristics shows the possibility of using the CTD data and observed winds during the previous 4 days to evaluate mixing regimes at most stations. When microstructure dissipation data were not available, vertical diffusivities were calculated using the winds and a constant-stress layer approximation, and nutrient flux into the euphotic zone estimated. Finally, in-situ biological measurements are compared with satellite-derived pigment concentrations, and preliminary results from a mixed-layer-phytoplankton model are discussed. (Contribution to the programme of GIROQ: Groupe Interuniversitaire de Recherches Oceanographiques du Quebec)

Notes

The air-sea momentum flux in conditions of wind-sea and swell.

Drennan, William M.

National Water Research Institute, Canada Centre for Inland Waters, Burlington, Ontario, L7R 4A6

Donelan, Mark A.

Same as 1.

Katsaros, Kristina B.

Institut Français de recherche et exploitation de la mer, Plouzané, France

Speaker: Drennan, William M.

Time: Thursday 09:05

Abstract

During the Surface Wave Dynamics Experiment (SWADE), direct measurements of momentum, heat and water vapour fluxes were obtained from a mast on the foredeck of a SWATH (small water-plane area, twin hull) ship in deep water off the states of Delaware and Virginia. Directional wave spectra were obtained simultaneously from a 6- or 3-wire wave-staff array mounted at the bow of the ship. One hundred and twenty-six 17 minute runs of flux and wave data obtained with the ship steaming slowly into the wind are examined for the effects of the relative direction of the wind sea and background swell on the momentum transfer. The adequacy of the inertial dissipation method, which depends on the high frequency turbulent fluctuations for evaluating the wind stress, is also examined for any effects of swell. The results show that the presence of counter- and cross-swells can result in drag coefficients that are much larger than the value for pure wind sea. The eddy correlation and inertial dissipation methods for measuring wind stress are found to diverge during the complex sea conditions. We interpret the latter observations as an indication that the inertial dissipation method may be unsuitable for use in a marine boundary layer disturbed by swell.

Notes

The Measurements Of Pollution In The Troposphere (MOPITT) Instrument: A Progress Report

James R. Drummond

Dept. of Physics, University of Toronto, 60 St. George Street, Toronto, Ontario, M5S 1A7

Bailak, G.

Same as 1

Mand, G.

Same as 1.

Yu, Zhen Z.

Same as 1.

Speaker: James R. Drummond

Time: Monday 15:55

Abstract

The Measurements Of Pollution In the Troposphere instrument will measure carbon monoxide and methane in the atmosphere on a global basis. It will be launched as part of NASA's EOS-AM1 payload in mid-1998 and will make measurements for a period of five years. The instrument is being built in Canada and is financed by the Canadian Space Agency. MOPITT is one of the first space instruments to make measurements of tropospheric composition which is a new and challenging area of space measurement. The instrument uses cooled detectors and correlation cells to achieve a high discrimination between the infrared emission from the gases being measured and the large surface radiance. The Engineering Model of the MOPITT instrument has been built and tested. The science team has been working on the retrieval algorithms for the instrument and the final delivery of the flight instrument and the processing algorithms will occur between now and launch. This talk will briefly describe the instrument and will discuss what we have learned about the strengths and weaknesses of the measurement technique as a result of our activities so far.

Notes

A modeling study of Mei-Yu front and the associated potential vorticity

Du, Jun

Departmet of physics, University of Toronto, Toronto, Ontario, M5S 1A7

Cho, Han-Ru

Same as 1.

Speaker: Du, Jun

Time: Thursday 15:25

Abstract

Mei-Yu is a climatic phenomenon over most part of east Asia during the late spring and early summer seasons. Precipitations during the Mei-Yu season are usually produced by convective clouds organized into eastward moving mesoscale systems. Previous studies indicate that although northeastern sector of a Mei-Yu front resembles a typical cold front, southwestern part of the front shows a nearly barotropic structure with a weak horizontal temperature gradient but a strong horizontal wind shear in the low levels. The results of our stability analysis suggest that mesoscale disturbances along Mei-Yu fronts are organized by the instability of low-level PV anomaly along the Mei-Yu front. High spatial and temporal resolution fields generated by a mesoscale prediction model are used to study an observational case of PV generation along a Mei-Yu front. Both numerical simulations and trajectory tracing showed that the PV anomaly associated with the Mei-Yu front was caused entirely by latent heat release. These findings reveal that diabatic heating takes an important role in Mei-Yu frontogenesis and maintenance of the frontal circulation.

Notes

Permafrost-Climate dataset in the discontinuous permafrost zone.

Eley, F.J.

AES - CPEOD, Environment Canada, 11 Innovation Blvd. Saskatoon, Sask., S7N 3H5

Speaker: Eley, F.J.

Time: Thursday 14:35

Abstract

A series of 16 weather stations were operated for 5 to 10 years in the discontinuous permafrost zone. Temperatures above and below ground, snow depth, humidity, wind and radiation were monitored continuously. The data-set is being used to study the linkages between air temperature, snow cover, wind, humidity and solar radiation to ground temperatures on various time scales down to the one-hour observation interval. Over the past 30 years, there was a general warming in western areas and cooling in the Baffin Island region, so both types of change are represented. The presentation will discuss regional differences and processes that are clearly defined in preliminary analysis.

Notes

Could be a poster, but aural preferred.

Measurements of the Surface Forcing Radiation of Global Warming from Greenhouse Gases

Evans, W.F.J.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Puckrin, E.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Speaker: Evans, W.F.J.

Time: Tuesday 15:10

Abstract

Global warming is driven by increases in the greenhouse effect of the atmosphere. Atmospheric spectra of greenhouse radiation from the atmosphere have been measured at ground level from Peterborough at a resolution of 0.25 wavenumbers. This long wave radiation consists of thermal emission from natural gases such as CO2 and H2O as well as from many trace gases such as CH4, CFC11, CFC12, CFC22 and HNO3. The forcing radiative fluxes from CFC11, CFC12 and CH4 have been quantitatively measured. A summary of the fluxes we have measured is presented. A flux imbalance of about 3 W/m2 has been created by anthropogenic emissions of greenhouse gases of which we have measured 0.85 W/m2. The implications for global warming potentials are discussed since there is strong water interference on the fluxes from some bands. We would like to compare these measurements with the radiation fluxes predicted by the Canadian GCM.

Notes

Near-Infrared Spectral Measurements Indicate Liquid Water Absorption May Contribute to the Anomalous Absorption Cloud Effect

Evans, W.F.J.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Puckrin, E.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Speaker: Evans, W.F.J.

Time: Tuesday 10:25

Abstract

Spectral measurements of the near infrared solar flux using an FTIR spectrometer have yielded important information concerning the anomalous cloud absorption effect. A comparison of the spectra of solar fluxes for clear and cloudy sky conditions on several days including September, 1995 at a northern mid-latitude location demonstrates that more than 100 W/m2 of the solar radiation from 1 - 4 um can be absorbed preferentially by cumulus clouds. It has been assumed previously in climate models that clouds mainly scatter solar radiation while absorbing about 4% of the extraterrestrial insolation; our measurements indicate that this absorption may reach over 12% in cumulus clouds. A comparison with the transmission spectra of liquid water suggests that the anomalous absorption may be attributed primarily to the presence of liquid water droplets inside the cloud. The absorption of the NIR solar radiation by the cloud may be dominated by the absorption due to liquid water rather than by water vapour as in the clear atmosphere. There was no evidence of the presence of any other significant gaseous absorbers in the spectra which could cause anomalous solar flux absorption.

Notes

Deglacial Meltwater Episodes: A Simulation of the Younger Dryas

Fanning, Augustus F.

School of Earth and Ocean Sciences, University of Victoria, Victoria, B.C., V8W 2Y2

Weaver, Andrew J.

School of Earth and Ocean Sciences, University of Victoria, Victoria, B.C., V8W 2Y2

Speaker: Fanning, Augustus F.

Time: Tuesday 16:40

Abstract

The transition between the last glaciation and the present Holocene was interrupted by an abrupt return to glacial climate, an event known as the Younger Dryas (hereafter the YD). While the cause of the YD is still an open question, the coincidence of meltwater (to the northern North Atlantic- from the Laurentide Ice Sheet) suggests an oceanographic mechanism resulting from meltwater influences on the production of North Atlantic deepwater. At the same time, however, there was a corresponding increase of runoff to the Arctic ocean, as well as local runoff to the northern North Atlantic from the Fennoscandian ice sheet. In an effort to investigate the climatic impacts of deglacial meltwater events, a series of experiments are carried out utilizing an energy-moisture balance atmosphere model coupled to a realistic geometry global ocean general circulation model. The influence of the timing as well as positioning of deglacial

meltwater pulses is investigated, and implications on the production of North Atlantic deepwater; poleward heat transport; and local as well as global climate are discussed.

Notes

Sea Surface Temperature Distribution Over Queen Charlotte Sound During The Summer Months Of 1990 To 1994

Faucher, M.

Dept. of Earth & Ocean Sciences, University of British Columbia, 6270 University Blvd., Vancouver, B.C., V;6T 1Z4

LeBlond, P.H.

Dept. of Earth & Ocean Sciences, University of British Columbia, 6270 University Blvd., Vancouver, B.C., V;6T 1Z4

Speaker: Faucher, M.

Time: Wednesday 14:15

Abstract

Short-term variations of sea surface temperatures (SST) over Queen Charlotte Sound, British Columbia, have been poorly understood, mainly due to the lack of data, and therefore hardly predictable. A potentially important consequence of SST variations is the choice of salmon homeward migratory route, which has a significant impact on the commercial fishery. Up to the present time, predictions of fish migration routes have been made by using SST data at Kains Island, one of the lighthouse stations at the northern end of Vancouver Island. Since the early nineties, AES buoy stations have provided a new set of hourly SST in offshore waters, which may be a better representation of the fish marine environment. This paper presents results from SST time series analysis, including visual inspection, statistical and spectral analysis, and links SST to wind data. For a larger scale point of view, comparisons are made with weather synoptic maps, as well as with AVHRR satellite imagery.

Notes

Incorporation of a time-filtering approach into intermittent data-assimilation

Fillion, Luc,

Meteorological Research Branch, Environment Canada, Dorval, Quebec

Ritchie, Harold

Recherche en Prevision Numerique, Environment Canada, Dorval, Quebec

Leduc, Anne-Marie

Canadian Meteorological Center, Environment Canada, Dorval, Quebec

Speaker: Ritchie, Harold

Time: Wednesday 16:05

Abstract

Most intermittent atmospheric data assimilation systems consist of three components: an analysis step, a nonlinear normal mode initialization procedure, and a short forecast (typically 6 hours) to provide the background field for the next analysis. All the information about the history of the evolving model state up to the analysis time is contained in the background field valid at the analysis time. The resulting time picture of this sequentially estimated model "trajectory" is a succession of 6h model forecasts approximating the true atmospheric evolution, with discontinuous jumps at the analysis times when the assimilation procedure corrects the background field. One way to further ensure a dynamical consistency in the analysis step at a given time may be to perform a time-filtering procedure on a time sequence of model states valid before and after the analysis time. The "before" branch of the time series may be supplied by the model evolution during the 6h forecast in the standard intermittent data assimilation procedure that has just been described. The "after" branch is the model evolution during a 6h forecast made from a preliminary analysis. The resulting filtered state (valid at the current analysis time of the intermittent data assimilation cycle) may be used by the analysis step as a prior-estimate in replacement of the usual background field. A digital time-filter may be used efficiently to perform the filtering, thus avoiding the need to keep in memory all the predictive fields of the time series. Such a procedure was examined in different contexts including a simulated statistical interpolation procedures for a global spectral shallow-water model and a three-level quasi-geostrophic model. Various time-spans and frequency-cutoffs of the filter were examined in order to isolate the impact of the procedure on the spatial and temporal scales of the resulting analyses and forecasts. Based on the positive impacts observed, an extension of the time-filtering procedure to the full- fledged operational data assimilation system in use at the Canadian Meteorological Center was examined. Results indicate that a positive impact on the accuracy of the forecasts can be obtained, especially at the medium-range, without reducing the accuracy of short-term forecasts.

Notes

On the Problem of Variational Assimilation of Precipitation Data Using Moist-Convective Parameterization Schemes

Fillion, Luc,

Meteorological Research Branch, Environment Canada, Dorval, Quebec

Errico, Ronald

National Center for Atmospheric Research, Boulder, Colorado

Speaker: Fillion, Luc,

Time: Wednesday 13:55

Abstract

The availability of precipitation data derived from satellite observation systems represents an important source of information for atmospheric data assimilation. The improvement of precipitation system location and intensity in NWP initial conditions can improve not only short-term precipitation forecasts, but may play a potentially crucial role in the initial stage of baroclinic development through accurate specification of diabatic forcing in the model. The incorporation of convective parameterization schemes directly into the analysis procedure thus represents a challenging aspect considering its non-smooth behavior in time and space. Since the majority of moist-convective parameterization schemes operate on vertical profiles of temperature and humidity, a careful and extensive study on the use of these schemes can be made in a one-dimensional variational data assimilation framework (1DVAR). In this study, the role of error statistics of the prior-estimate and precipitation data in the resulting 1DVAR analysis and the occurence of pathological convective regimes were examined in detail. In order to assure some generality of the results, two types of moist-convective parameterization schemes were used: the NCAR Kuo scheme and the "Relaxed Arakawa-Schubert" (RAS) scheme. Extensive Monte Carlo simulations were also performed to explore the a-posteriori probability distribution of the analyzed state.

Notes

The Hydraulics of Strong Outflow Winds in Howe Sound, British Columbia

Finnigan, T.D.

Centre for Water Research, University of Western Australia, Nedlands, Western Australia 6009, Australia.

Allen, S.E.

Oceanography, Dept. of Earth and Ocean Sciences, University of British Columbia, Vancouver, British Columbia, V6T 1Z4

Lawrence, G.A.

Dept. of Civil Engineering, University of British Columbia, Vancouver, British Columbia, V6T 1Z4

Steyn, D.G.

Dept. of Geography, University of British Columbia, Vancouver, British Columbia, V6T 1Z4

Speaker: Allen, S.E.

Time: Thursday 09:45

Abstract

Strong, cold, outflow winds which flow through the fjords of British Columbia are common winter phenomena. Driven by both buoyancy and a synoptic pressure gradient between the interior and the ocean, the winds commonly reach 20 m/s with gusts to 30 to 40 m/s. A severe event in Howe Sound in December 1992 was documented using microbarographs. The results clearly show hydraulic jumps in the swift flowing, thin, cold air layer. A three-dimensional physical model of Howe Sound has been constructed in the laboratory (geometrically and kinematically similar to the full scale flow). The model shows qualitative agreement to the measurements but clearly illustrates very strong cross-stream variations in the flow. The highly two-dimensional flow shown in the model, and the hydraulic features which do not behave in the traditionally one-dimensional manner will be discussed.

Notes

Biomass Burning and Tropical Deep Convection

Folkins, Ian A.,

Depts. of Oceanography and Physics, Halifax, Nova Scotia, B3H 4J1

Speaker: Folkins, Ian A.,

Time: Wednesday 15:25

Abstract

Tropical deep convection can increase the impact of biomass burning effluents by injecting them into the upper troposphere, where residence times of most chemical species are much longer than in the lower troposphere. This talk will focus on observations from a descent through a biomass burning plume taken in October of 1994 during the ASHOE/MAESA campaign. During one of the flights from this campaign, the ER-2 encountered a layer of enhanced CO, NO$_y$, and O$_3$ near 100 mb (15 km)

while descending into Fiji. Observed enhancements of carbon dioxide and carbon monoxide within the plume were consistent with those anticipated from biomass burning. Back trajectories and satellite pictures support the notion that the plume originated from a tropical storm east of New Guinea. Space shuttle images indicate that a low-level haze due to drought induced biomass burning covered much of Indonesia during this time. It is argued that tropical deep convection, followed by southward high level outflow and advection by the subtropical jet, may have the capacity to disperse the products of biomass burning on a global scale.

Notes

A new version of the 15 μm CO$_2$ band cooling parameterization for the Canadian MAM

Fomichev, V.I.

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Turner, D.S.

Meteorological Research Branch, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

Blanchet, Jean-Pierre

Same as 1.

Speaker: Fomichev, V.I.

Time: Thursday 14:15

Abstract

A new matrix parameterization of the 15 μm CO$_2$ band radiative cooling in the middle and upper atmosphere is proposed. This scheme calculates the radiative cooling for both, LTE (local thermodynamic equilibrium) and non-LTE conditions. Unlike the current MAM scheme which was designed for a fixed CO$_2$ profile, the new code is applicable over a wide range of CO$_2$ concentrations (150-720 ppmv). This makes it possible to investigate climate change. The new scheme has been compared against theoretical radiative transfer calculations for various atmospheric states of temperature, carbon dioxide and, in the non-LTE layer, atomic oxygen concentrations. Differences of only a few percent were observed throughout most of the domain, which is substantially better than the currently used scheme.

Notes

Neural Network Simulation in Energy and Gas Exchange Studies over Agricultural and Forest Systems

Abareshi, Behzad

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Schuepp, P.H.

Same as 1.

Desjardins, Raymond L.

Center for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa, K1A 0C6

MacPherson, Ian J.

Institute for Aerospace Research, National Research Council of Canada, Ottawa, K1A 0R6

Speaker: Abareshi, Behzad

Time: Monday 11:15

Abstract

The potential of satellite-based remote sensing as observation platforms in global climatology can only be fully realized if exchange processes of energy or trace gases between the atmosphere and the terrestrial biosphere can be deduced from radiometric observation of surface characteristics. This is not easy since the link between the many physical and biological processes that govern the energy, moisture or greenhouse gas balance at the earth's surfaces, and the radiative properties that can be assessed by remote sensing are neither simple nor well understood. We are exploring the use of neural network simulation as a tool to deduce such links, based on empirical data sets obtained from near-surface observation of surface characteristics and fluxes, from tower-based and airborne observation platforms. A study on data obtained in the First ISLSCP (International Satellite Land Surface Climatology Project) Field Experiment (FIFE), over grassland in Kansas in 1987 and 1989, showed that a neural net with one hidden layer, using excess of radiometric surface temperature over air temperature (DT), wind (u), net radiation, time of day, and the composite variable uDT, and trained on data obtained at a single observation station within the FIFE domain during the summer of 1989, was capable of successful prediction of the diurnal evolution of sensible heat at other stations and during the 1987 campaign, as long as physiological properties of the vegetation and soil moisture did not vary significantly. We are currently exploring extension of such

techniques to agricultural and forest systems, using airborne observations of flux and surface characteristics (the latter from satellite-simulating sensors), in an attempt to define to what extent satellite based remote sensing might be used to estimate large-scale energy and trace gas balances. The status of current enquiry and progress will be discussed.

Notes

Oral Presentation; Overhead Projector

Simulation of a radiatively active tracer using RCM: the Kuwait oilfire case.

Fontecilla, Juan Sebastian

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Blanchet, Jean-Pierre

same as 1

Speaker: Fontecilla, Juan Sebastian

Time: Wednesday 09:45

Abstract

Elemental carbon or soot is a strongly absorbing aerosol at visible wavelengths. Transporting soot particles as an active tracer has strong implications on the regional heat budget and atmospheric circulation. The Canadian Regional Climate Model (RCM) under development at UQAM is used to simulate smoke emission and transport from a well-documented case: the Kuwait oilfire of 1990. This remarkable event has persisted for many months and has been the subject of considerable measurements and modelling. An aerosol microphysics scheme as been implemented into RCM, allowing coagulation to alter the size spectrum. Dry and wet depositions are considered. The objective of the study is to evaluate the coupling between active aerosol and the regional climate response to forcing.

Notes

Wavelet Zonal Spectral Analysis of Observed Geopotential and Winds: Blocking Patterns and Local Kinetic Energy and Enstrophy Transfer between Scales

Fournier, Aimé

Dept. of Physics, Yale University, New Haven, USA, 06520-8109

Speaker: Fournier, Aimé

Time: Thursday 10:05

Abstract

Zonal Fourier analysis of fields such as geopotential and wind has long been a useful technique for resolving phenomena on different scales, and quantifying exchanges between scales, `scale' being identified with latitude cosine over wavenumber. Examples are the filtering of blocking patterns, illustrating persistent low wavenumbers of geopotential, or the kinetic energy (KE) transfer between mean zonal current and eddies. Different-wavenumber eddies act as sources and sinks. Fourier analysis is limited by loss of localization information. The localized coherent structures and strong gradients in observed fields are not well described by truncated Fourier series. Wavelet analysis (WA) contains both scale and position information, and is better suited to address these difficulties. We apply WA to empirical distributions of geopotential obtained by the National Meteorological Center. The efficiency of wavelet representation of blocking patterns is evaluated by their description by few coefficients. The latitude phase change of ridges is associated with meridional momentum transports, and is characterized in a wavelet domain. Wavelet KE and enstrophy transfer functions are computed, which describe the interconversion among components on different scales of eddies located near particular longitudes in a sequence of resolutions, and the mean zonal current. The Fourier spectra of orthonormal projections (inverse WA of components at all the longitude values in a particular resolution) onto different subspaces is studied. This study addresses the question of the relative merits of WA to atmospheric science.

Notes

Recent Experience With the Profiling ALACE Float Technology

Freeland, Howard J.

Inst. of Ocean Sciences, Sidney, B.C. V8L 4B2, Canada

Speaker: Freeland, Howard J.

Time: Thursday 10:05

Abstract

ALACE (Autonomous Lagrangian Current Explorer) floats have been deployed in large numbers during WOCE. A recent innovation is the addition of a CTD to the profiling device so that during its ascent it acquires a profile of temperature and salinity. The data are transmitted to land via the Système Argos. This talk will outline experience deploying and extracting data from the profiling ALACE (or, Palace) float. The economics of the deployment of Palace floats in large numbers will be discussed, and the general

preformance outlined. Finally, there are several new types of float being developed as successors to the Palace, these will be described, and the implications for large monitoring programs, like GOOS and GCOS will be discussed.

Notes

none

A radiation scheme suitable for use in climate study and remote sensing

Fu, Qiang

Dept. of Oceanography, Dalhousie University, Halifax, Nova Scotia B3H 4J1

Speaker: Fu, Qiang

Time: Tuesday 14:50

Abstract

A Radiation parameterization has been developed for numerical models and remote sensing. The parameterization scheme integrates in a coherent manner the delta-four-stream approximation for radiative transfer, the correlated k-distribution method for nongray gaseous absorption, and the scattering and absorption properties of aerosols and hydrometeors. The hydrometeors are categorized into five types: cloud droplets, ice crystals, raindrops, snow, and graupel. In this scheme, the IR and solar radiation has been treated in a self-consistent fashion. The radiation parameterization has been well verified by the most recent radiation measurements such as the ARM UAV flux profile observations and ICRCCM observations of vertically downwelling radiances at the surface. In particular, this parameterization scheme has been tested against observations obtained during the FIRE-IFO. The model results for the first time successfully explain the observed relationship between solar albedo and IR emissivity of cirrus clouds. This is because the hexagonal structure and ice crystal size distribution have been considered in the present parameterization. We have incorporated the radiation scheme into cloud ensemble models to study cloud-radiation interactions in different cloud systems: tropical deep convection and subtropical marine boundary cloud system. This scheme has been also applied to remote sensing in CERES/ARM/GEWEX Experiment to study surface and atmospheric radiative budget. The applications of the radiation parameterization scheme to climate models will be also presented.

Notes

ENSO simulation and prediction

Fyfe, John C.

Canadian Centre for Climate Modelling and Analysis Atmospheric Environment Service, University of Victoria P.O. Box 1700 MS 3339 Victoria, B.C., CANADA V8W 2Y2

Mo, Ruping

Department of Atmospheric & Oceanic Sciences McGill University 805 Sherbrooke St. W. Montreal, Qc, Canada H3A 2K6

Derome, Jacques

Department of Atmospheric & Oceanic Sciences McGill University 805 Sherbrooke St. W. Montreal, Qc, Canada H3A 2K6

Speaker: Fyfe, John C.

Time: Monday 16:55

Abstract

Using a historical dataset of global (hence interpolated) sea-ice extent and sea-surface temperature (1948-1994) we empirically derive (using a principal oscillation pattern analysis) the dominant mode of interannual sst variability. The global empirical mode has all the hallmarks of the oceanic component of the El Nino-Southern Oscillation (period of 3.5 years and well known inter-basin correlations). We exploit the global empirical mode in two ways: 1) to force an AGCM in order to systematically assess the atmospheric response to ENSO (i.e. multiple runs with varying initial conditions) and 2) to perform sst predictions (where we demonstrate very considerable skill).

Notes

video

Upper-boundary effects in a contour dynamics model of the polar stratospheric vortex

Fyfe, John C.

Canadian Centre for Climate Modelling and Analysis Atmospheric Environment Service, University of Victoria P.O. Box 1700 MS 3339 Victoria, B.C., CANADA V8W 2Y2

Wang, Xiaohong

Same as speaker.

Speaker: Fyfe, John C.

Time: Thursday 16:05

Abstract

We compare ultra-high resolution numerical simulations of a topographically forced polar stratospheric vortex using: 1) a rigid upper-boundary condition and 2) a vertical sponge (preventing spurious reflection of upward propagating waves). In 1) both local (to the forcing) and remote breaking is evidenced for moderate forcing while only local breaking is observed for sufficiently strong forcing In 2) remote breaking is absent and local breaking, which occurs for sufficiently strong forcing, has quite a different character to that seen in 1). Compressibility effects are also discussed.

Notes

Development of a cloud scheme for a climatic model with the Local Climate Model.

Gagnon, Normand

C^{2}GCR et département des Sciences de la Terre, Université du Québec à Montréal, Montréal,Québec, C.P. 8888, Succ. "Centre-Ville", H3C 3P8

Blanchet, Jean-Pierre

Same as 1.

Speaker: Gagnon, Normand

Time: Wednesday 13:55

Abstract

Clouds have strong effects on climate. The description of the cloud macroscopic and optical properties are essential for climate simulations. These properties depend greatly on cloud cover, water content, precipitation and their spatial variance. A new cloud scheme based on parameterized sub-grid scale turbulence for distribution of water content is presented. The scheme assumes a close link between vertical velocity and cloud variance. A transect of vertical velocity at subgrid-scale is defined to calculate cloud cover properties. In its present version, this transect is estimate from a parameterized gravity wave and atmospheric turbulence spectrum depending on the static stability. The cloud physics is calculate at subgrid scale assuming adiabatic displacement of air parcels in function of the assumed vertical velocity transect. Water content, cloud coverage, precipitation and latent heat release are computed for the maximum parcel's displacement within each layers. The scheme has been developed and tested in the 1D Local Climate Model (LCM). This model has the same physics package as the CCC/GCM second generation (GCMii). Because LCM's "dynamics" is calculate as a residual, the cloud water content is prognostic but not advected in space. Results obtain with LCM driven by radiosonde observations are presented and compared with observed clouds.

Notes

Numerical study of the separation of the Brazil Current and variability in the South Atlantic Ocean

Gan, Jianping

The Center for Climate and Global Change Research and Department of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke St. W, Montreal, Quebec, H3A 2K6

Mysak, Lawrence

Same as 1.

Straub, David

Same as 1.

Speaker: Gan, Jianping

Time: Thursday 09:25

Abstract

The Princeton Ocean Model (POM) which resolves the coastal regions, has been used for the study of the circulation in the South Atlantic Ocean. The model is eddy-resolving, and contains lateral boundary fluxes, surface wind driven and buoyancy forcing as well as open boundary conditions . Experiments demonstrate that in a purely barotropic model, topographic effects near the coastal regions are unrealistically exaggerated. The runs using the Levitus' climatological temperatures and salinities as input for the density field give a quite reasonable circulation pattern in the South Atlantic Ocean, with the Brazil Current separating near 40^{o}S. Sensitivity runs for the different prescribed lateral boundary fluxes show that the location of the Brazil/Malvinas Confluence is sensitive to the strength and distribution of the Antarctic Circumpolar Current (ACC) at the Drake Passage, but not to the distribution of ACC at the eastern end of the domain. A seasonal variability study reveals that the subtropical gyre is weak and shifts northward, with a more northerly separation point of the Brazil Current during winter than summer. The effects from the seasonal variations of the ACC at the Drake Passage, the surface buoyancy flux and wind stress are discussed in detail.

Notes

Validation of modeled clouds and radiation in the Arctic using AVHRR data

Garand, L.

AES, 2121 Trans-Canada Highway, Dorval, P.Q., H9P1J3

Nadon, S.

AES, 2121 Trans-Canada Highway, Dorval, P.Q., H9P1J3

Speaker: Garand, L.

Time: Tuesday 09:45

Abstract

MC2 model runs of clouds and radiation are verified with AVHRR data on the 15 km grid used during the six weeks of BASE (Sept. 1 to Oct. 15, 1994). A new cloud detection algorithm was designed for nighttime use. Infrared AVHRR data at 2.5 km resolution are used with MC2 analyses of temperature profiles and ground forecast temperatures as ancillary information for cloud thresholding. Monthly results for a monthly period at 00 and 12 UTC are shown for outgoing infrared radiation, cloud cover and cloud height for MC2 analyses and forecasts. Links with monthly precipitation may be attempted by the time of the conference.

Notes

Implementation of a 3D variational analysis at the Canadian Meteorological Center

Gauthier, Pierre

Meteorological Research Branch, Environment Canada, Dorval, Quebec

Luc Fillion

Meteorological Research Branch, Environment Canada, Dorval, Québec

Charette, Cécilien

Meteorological Research Branch, Environment Canada, Dorval, Québec

Koclas, Pierre

Canadian Meteorological Centre, Environment Canada, Dorval, Québec

Speaker: Gauthier, Pierre

Time: Wednesday 13:15

Abstract

A 3D variational statistical interpolation analysis is currently being implemented at the Canadian Meteorological Centre for the global analysis/forecast cycle using the Spectral Finite Element model. This analysis follows the general principles described in Parrish and Derber (1992) and Courtier et al. (1993). The background error statistics are specified in terms of forecast error variances that vary in physical space while the error correlations are assumed to be homogeneous and isotropic but non separable. Defining the geostrophic balance with respect to the linear balance relationship $(\Phi_B= {\cal L}\zeta)$, the departure from geostrophy $(\Phi' = \Phi - {\cal L}\zeta)$ is used as an analysis variable in combination with the vorticity ζ and the divergence D. By modulating its variance in physical space, it is possible to go from total geostrophy when $\sigma^2_{\Phi'} = 0$ to a complete univariate treatment of the geopotential when $\sigma^2_{\Phi'} = \sigma^2_{\Phi}$ which occurs at the equator. The incremental approach of Courtier et al. (1994) is being used by computing the observation residuals at the full resolution of the model (T199L21) while the increments are computed at a lower horizontal resolution. On top of the observations used operationally, new types of observations are being added such as SSM/I precipitable water content and TOVS radiances. New estimates of the background error correlations have been computed and their impact will be assessed in the analysis. At the time of the conference, the variational analysis is expected to be experimented in a parallel run with a view of being implemented in September 1996.

Notes

The AWOS Performance Evaluation Project

Giguére, A.

Environment Canada, ARMF, 4905 Dufferin Street, Downsview, ON, M3H 5T4

Wilson, Laurence J.

Environment Canada, ARMF, 4905 Dufferin Street, Downsview, ON, M3H 5T4

McNair, S.

Environment Canada, AWPM, 4905 Dufferin Street, Downsview, ON, M3H 5T4

Speaker: Giguére, A.

Time: Thursday 09:05

Abstract

The AWOS Performance Evaluation (APE) project was initiated in the late summer of 1995 to address specific performance problems in the automated observing system AWOS. Although the main goal is to assess the latest version of AWOS and to prove that

earlier serious problems have been rectified, the experiment has been designed to provide a valuable dataset for assessment of systematic differences between AWOS and manual observations of surface weather elements, which should be of help to forecasters in using a mixture of data from the two sources. Seven sites have been identified for the evaluation, Moncton, St. Johns, Dorval, Yorkton, Inuvik, Saskatoon, and Terrace. They have been chosen to represent a variety of climatological conditions across Canada, and each has been equipped with the latest version of AWOS and an observer. At most sites, the observer will monitor the AWOS output and provide comments on performance, while carrying out a complete 'manned' observing program following MANOBS standards", while at two sites ("blind sites"), the AWOS and the observer will operate a totally independent observing program. A mix of subjective and objective evaluation criteria will be used to determine whether or not AWOS meets aviation users' requirements. Data collection started in September, 1995 and will continue until June 1996, or until enough data has been collected to provide statistically stable analysis results. The presentation will contain a discussion of the data that is being collected, along with the design and specific goals of the data analysis. Opportunities for additional studies will also be highlighted. It is expected that some preliminary analysis results will be shown as well.

Notes

Enclosure-based measurements of biogenic hydrocarbon fluxes from black spruce trees

Gillespie, T.J.

Dept. of Land Resource Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1

Fulton, D.A.

Same as 1.

Wang, D.

Conservation and Protection, Environment Canada.

Fuentes, J.

University of Virginia

Speaker: Fulton, D.A.

Time: Monday 10:55

Abstract

Emissions of biogenic volatile organic compounds (VOCs) are known to be an important factor in the formation of tropospheric ozone. Efforts are presently underway to incorporate the effects of VOC emissions into models used to predict ozone formation. A source of uncertainty in these models is the estimation of VOC emissions rates from data of temperature and light levels. Experiments conducted on young black spruce trees, which are an important component of the boreal forest, revealed a strong correlation between temperature and VOC emissions, with a lesser dependence on light levels. The observed relationship between VOC emissions, temperature, and light levels corresponds to the empirical functions suggested by Guenther et al. (1991). These results suggest that increasing temperatures in areas of black spruce trees may result in increasing potential for tropospheric ozone production, but this would only be realized if higher concentrations of nitrogen oxides were also present.

Notes

poster preferred, but would give oral presentation if more papers required for and Ag. and Forest Met. session.

Linear polarization schemes for meteorological radar

Gingras, Yves

Département des sciences de la terre, Université du Québec à Montréal, Case postale 8888, succ.Centre Ville, Montréal, QC H3C 3P8

Torlaschi, Enrico

Same as 1

Zawadzki, Isztar

Dept. of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke West, Montreal, QC, Canada, H3A 2K6

Speaker: Gingras, Yves

Time: Wednesday 09:45

Abstract

Polarization diversity is to be implemented at McGill Radar Observatory. The MRO operates at two frequencies: S-band (3 GHz) and X-band (10 GHz). The S-band, and possibly the X-band, will be polarized. The most appropriate polarization scheme has to be determined in order to obtain reliable and accurate measurements. Our purpose is to give guidance on the frequency and polarization scheme to be used. At microwave frequencies, radar observables result not only from back- scattering, but also from

propagation through precipitation. To assess the combined effects of backscattering and propagation, we performed numerical simulations of polarization diversity radar at X-band and S-band. Model storms were used to calculate reflectivity, differential reflectivity, differential phase shift,... Scattering amplitudes were obtained from non-Rayleigh scattering theory for Marshall-Palmer drop-size distribution and equilibrium drop-shape relationship. Other practical aspects of the radar such as resolution, limit of detectability, mismatch between receivers and noise due to the statistical nature of the meteorological signal are also included. The following polarization schemes are considered: 1) Horizontal and vertical polarized radiation is alternately transmitted, and the copolar and crosspolar components are received. 2) Switched transmission between +45 deg and -45 deg with respect to the horizontal is used and the horizontal and vertical components of the received signal are measured. 3) Same as in 2 except that the copolar and crosspolar components are received. Comparisons of the polarization schemes and frequencies are discussed, based on the results of the numerical simulations and practical considerations.

Notes

Simulation of Arctic haze formation and evolution with the Canadian Regional Climate Model: A tool for the Arctic climate change assessment in winter.

Girard, éric

Center for Climate and Global Change Research (C2GCR) and Dept. of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke Street West, Montréal, Québec, H3A 2K6

Blanchet, Jean-Pierre

Center for Climate and Global Change Research (C2GCR) and Dept. of Earth Sciences, Université du Québec à Montréal, P.O. box 8888, succ."Centre Ville", Montréal, Québec, H3C 3P8

Speaker: Girard, éric

Time: Monday 10:55

Abstract

In the current global warming trend (IPCC, 1995), the Arctic climate did not experience yet the predicted warming by GCMs (IPCC, 1990). On the contrary, the high Arctic ocean has experienced significant surface cooling during winters over the last 40 years (Kahl et al., 1993). Some improvements in the understanding of physical processes involved in Arctic are necessary in order to make better prediction concerning climate change. This research investigate a new physical process as a possible factor for inconsistencies between observations and model predictions. Blanchet and Girard (1994)

hypothesised that anthropogenic acid aerosols (Arctic haze) alters the regional climate by enhancing the dehydration cycle and the surface IR cooling due to a weakening of the water vapour greenhouse effect. Simulations with detailed microphysics model have shown that aerosols enriched by sulphuric acid produce fewer but larger ice crystals. Furthermore, it has been shown also with a radiative column model that increasing the dehydration rate of the air mass leads to a strengthening of the surface inversion. This result is in agreement with winter observations of the last 40 years over the Arctic Ocean. In order to assess the role of these anthropogenic aerosols on Arctic climate, the Canadian Regional Climate Model is used with parameterized aerosol microphysics. With prognostic aerosol size spectra it becomes possible to simulate coagulation and water uptake in climate models. A parameterization of these two processes will be presented. We will discuss how acidification changes the aerosol spectrum by altering coagulation rate. Finally, some simulations of Arctic haze with the CRCM will be presented.

Notes

A mixed-phase cloud scheme. Part I: Parameterization and mesoscale evaluation

Glazer, Anna

Atmospheric Environment Service, Cloud Physics Research Division, 2121 Trans Canada Highway, Dorval, Quebec, H9P 1J3

Tremblay, Andre

Same as 1.

Speaker: Glazer, Anna

Time: Wednesday 14:15

Abstract

Mixed-phase clouds influence several atmospheric phenomena, but their treatment is still oversimplified, if not incorrect in many NWP models and GCMs. To address this issue, a new mixed-phase cloud scheme is formulated. The scheme considers only one prognostic variable (the total water content) partitioned diagnostically into solid and liquid phases at subfreezing temperatures. Since the scheme is derived from complex microphysics parameterization currently used in cloud resolving models, it preserves the basic microphysical processes characterizing natural mixed-phase clouds and does not include any adjustable (nonphysical) parameter. The proposed parameterization of mixed-phase clouds was implemented into the canadian Mesoscale Compressible Community (MC2) model, and numerical experiments were performed for several winter storms (as documented in CASP II). The simulations have shown that mixed-phase clouds generated with the scheme are confined to localized regions and are strongly correlated with the

intensity of the vertical lifting. The amount of supercooled liquid water was substantially less than the amount obtained from other schemes using temperature as the only indicator for the appearance of mixed-phase clouds. The above results will be presented along with a comparison with the actual operational cloud scheme of Sundqvist. Differences and similarities between obtained results and various meteorological observations will be outlined.

Notes

Sea salt aerosols in the northern hemispheric troposphere: an application of the Northern Aerosol Regional Climate Model (NARCM)

Gong, S.L.

Atmospheric Environment Service, 4905 Dufferin Street Downsview, Ontario M3H 5T4 Canada

Barrie, L.A.

Same as 1.

Blanchet, Jean-Pierre

Earth Sciences Department University of Quebec at Montreal (UQAM) P.O. Box 8888, Stn "Downtown" 515 Ste-Catherine St Montreal, QC, Canada H3C 3P8

Spacek, Lubos

Same as 3.

Speaker: Gong, S.L.

Time: Tuesday 11:55

Abstract

A Northern Aerosol Regional Climate Model [NARCM] has been developed by incorporating the processes of aerosol generation, diffusive transport, transformation and removal as a function of particle .size into a 3-D version of Canadian regional climate model [RCM] with a resolution of 1 =D7 1 . Centered at the North Pole, NARCM is used to simulate sea-salt aerosol spatial and= temporal distributions in the northern hemisphere [~30 degree North]. = After testing a one-dimensional column model with observed sea salt number distributions at ocean baseline observatories, a comparison is made between= observations at non-marine baseline observatories and model predictions for= sea-salt total mass concentration. Since the sea-salt generation term is relatively well quantified, the comparison is a test of the parameterization= of removal and transport in NARCM.

Size-segregated aerosol concentration in= NARCM is treated as a prognostic variable. When fully implemented, sea salt= aerosols in NARCM will join sulphates, black carbon and soil dust aerosols= as active constituents in the climate simulation.

Notes

Meso/regional Scale Oxidant Modelling : A Canadian Southern Atlantic Region Study

Wanmin Gong

Atmospheric Environment Service, Downsview, Ontario, Canada

Xiude Lin

Ontario Hydro Technologies, Toronto, Ontario, Canada

Sylvain Menard

3185 10th Avenue, Ville Ile Perrot, Quebec,Canada

Speaker: Wanmin Gong

Time: Wednesday 09:45

Abstract

It is well known that the tropospheric ozone is a secondary pollutant formed photo-chemically from its precursors, namely nitrogen oxides (NOx) and volatile organic compounds (VOC), as well as CO. The fact that the distribution of the ground-level ozone (the main concern of smog problem) depends on the emission of the precursors, atmospheric transport processes and atmospheric chemical processes (non-linear) makes comprehensive modelling as an essential tool for establishing "source/receptor" relations and for testing various NOx/VOC control strategies. As one of the three ozone non-attainment regions in Canada, the Canadian Southern Atlantic Region (SAR) is recognised as a region where the oxidant problem is strongly influenced by long range transport. In this paper, we will present a modelling study of the oxidants in eastern Canada especially the SAR using a modelling system that combines a Canadian mesoscale community model, the MC2 model, (as meteorological driver) and ADOM (an Acid Deposition and Oxidant Model). The new MC2/ADOM modelling system has a self-nesting ability to allow higher resolution modelling focused on the area of interest. The present study primarily comprises a simulation of photo-oxidants during the EMEFS-1 intensive period focused on the SAR and a series of sensitivity tests designed to examine the governing factors for the oxidant problem in the region. In particular, the influence of emissions in different regions in northeastern US and in eastern Canada as well as the influence of meteorology/mesoscale flow in the surface layer ozone will be discussed.

Notes

An Interactive Aviation Weather Database

Gosselin, Denis

Development Branch, Canadian Metorological Centre, Dorval, H9P 1J3

Verret, Richard

Same as 1.

Speaker: Gosselin, Denis

Time: Thursday 09:45

Abstract

Despite all technological and scientific progresses made in analyzing and forecasting atmospheric conditions, the content and format of aviation weather information have not significantly evolved from the traditional alphanumerical bulletins that are still in use nowadays. However, computerization have brought forth new perspectives for producing and disseminating aviation weather information. The capacity of numerical atmospheric models to ingest an ever-increasing amount of data from various sources and to produce high-quality gridded forecasts in relatively short periods of time has prompted initiatives on the automated production of a new generation of aviation weather products. Other related initiatives include the development of user-friendly interactive systems to generate those products in graphic formats allowing a quick and intuitive understanding of actual and forecast aviation weather conditions. The aviation weather database described here is the core component of a future aviation weather display system to be used as a self-briefing tool. Development work has so far resulted in the creation of a database of aviation-impact variables that can be interactively queried at the Canadian Meteorological Centre in using locally developed utility softwares. The driving model for the database is the operational Regional model. Variables are computed on the high resolution portion of the model's grid which covers all of Canada, adjacent waters and a significant portion of United States. Space and time characteristics of variables are similar to, or derived from, those of the model's actual operational outputs: 35 km horizontal resolution, 41 flight levels (from main sea level up to 40 000 feet) integrated from the 28 sigma levels of the model, and a 3-hour time resolution from zero to 48 hours. Most variables, including icing and turbulence, are calculated in using algorithms that are adapted versions of pre-existing operational ones. The remaining variables were already available as standard outputs from the model. The database is updated twice daily in real-time. Current observation data will also be incorporated in the database. Utility programs have so far been developed for the treatment of METARs. Future programs will be developed for TAFs and other alphanumerical data as well as for satellite imagery, radar data, and others. Current development work is focusing on data management

systems and improving the performance of the icing and turbulence algorithms. Future areas of development include telecommunications, product generation, and graphical user interface. The presentation will focus on the database structure and on examples of its current content.

Notes

Veronis Effect in a World Ocean Circulation Model

Gough, W. A.

Environmental Science, Scarborough College, University of Toronto, 1265 Military Trail, Scarborough, Ont. M1C 1A4

Speaker: Gough, W. A.

Time: Thursday 16:25

Abstract

The Veronis effect has been clearly identified in ocean general circulation models in a single basin configuration in previous work. It was found that spurious interior downwelling that characterizes this effect was mitigated by the reduction of the horizontal diffusivity. In a series of experiments the impact of reducing the horizontal diffusivity for an ocean general circulation model in a world ocean configuration is examined. With lower diffusivities there is substantial reduction in the number of downwelling points, particularly in the Indian and Pacific Oceans. There is a marginal reduction in the Atlantic Ocean. Other Veronis effect diagnostics are presented.

Notes

Sea level rise in Hudson and James Bays

Gough, W. A.

Environmental Science, Scarborough College, University of Toronto, 1265 Military Trail, Scarborough, Ont. M1C 1A4

Hyndman, D.

Same as above

Speaker: Gough, W. A.

Time: Tuesday 11:55

Abstract

Sea level rise as a result of climate change is examined in the James Bay and Hudson Bay region. An ocean general circulation model is used to assess sea level rise rates due to thermal expansion of sea water. These values are compared to sea level fall rates resulting from localized isostatic rebound. It was found that thermal expansion mitigated the effect of the isostatic rebound by as much as 50%. Reduction rates varied with proposed warming scenario.

Notes

Dynamical structure of the Almeria-Oran front, Western Mediterranean Sea, during the Spring of 1991.

Gratton, Y.

INRS-Océanologie, Rimouski, Québec, G5L 3A1

Prieur, L.

Laboratoire de physique et de chimie marines, 06230 Villefranche-sur-mer, France

Ingram, R.G.

Dept. Atmospheric Sciences, McGill University, Montreal, Quebec, H3A 2K6

Lafleur, C.

Same as 1.

Speaker: Gratton, Y.

Time: Tuesday 10:05

Abstract

The inflow of Atlantic surface waters in the Alboran Sea through Gibraltar Strait forms a geostrophic jet along the Algerian coast known as the Atlantic Current or the East-Algerian Current. A permanent front between the lighter Atlantic jet waters and the denser Mediterranean waters is found between Almeria (Spain) and Oran (Algeria). Two gyres are associated with the meanders of this coastal jet. We present CTD and ADCP observations, from a three week (83 stations) in the Eastern Alboran Sea in the Spring of 1991, describing the structure of the Eastern Alboran Gyre, or Atlantic Anticyclonic Gyre, and of the East-Algerian Current. Their dynamical features are also discussed.

Notes

Rossby adjustment under a fresh water pulse

Gratton, Y.

INRS-Océanologie, Rimouski, Québec, G5L 3A1

Vézina, A.F.

Institut Maurice Lamontagne, P\^{e}ches et Océans Canada, C.P. 1000, Mont-Joli, Québec, G5H 3Z4

Savenkoff, C.

Same as 2.

Lafleur, C.

Same as 1.

Speaker: Gratton, Y.

Time: Wednesday 15:45

Abstract

As part of a multidisciplinary program to study physical-biological interactions regulating carbon flows in the lower St. Lawrence estuary, three cruises were conducted in June-July 1990 during a neap-spring tidal cycle. A coherent structure was observed to develop during the passage of a freshwater pulse through the study area. Observations before, during and after the passage of the pulse are presented. A simple Rossby adjustment model is used to show how the surface layer adjusts to the passage of the pulse.

Notes

The proposed Canadian Unified Model

Gravel, S.

Recherche en Prévision Numérique, Atmospheric Environment Service, Dorval, Québec, H9P 1J3

C\^oté, J.

Same as 1.

Roch, M.

Same as 1.

Staniforth, A.

Same as 1.

Patoine, A.

Centre Météorologique Canadien, Atmospheric Environment Service, Dorval, Québec, H9P 1J3

Methot, A.

same as 5.

Speaker: Gravel, S.

Time: Tuesday 16:00

Abstract

The present operational needs of the Canadian Meteorological Centre are met by the combined use of two dynamical models: the Finite-Element Regional Model for high-resolution short-term forecasts, and the Spectral Finite-Element Model for global medium-range forecasts. A unified model has been developped to meet all actual and foreseeable operational requirements for Canada. This versatility is achieved by means of a global finite-element discretization allowing variable horizontal resolution in a very natural way. A striking feature of the new model is therefore its meshing which can be configured to offer high resolution over an area of interest or uniform resolution everywhere. Other innovative features are a two-time-level semi-implicit semi-Lagrangian discretization, and the use of a pressure-type hybrid vertical coordinate. Preliminary results of the evaluation of this model will be presented. The results are obtained from various case studies performed in both regional and global mode configuration, as well as daily forecasts performed since January using a regional mesh.

Notes

The development and testing of a harmonic finite element ocean model.

Greenberg, David A.

Department of Fisheries and Oceans, Bedford Institute of Oceanography, P.O. Box 1006 Dartmouth N.S., B2Y-4A2

Werner, Francisco E.

Marine Sciences Program, CB {\#}3300, University of North Carolina, Chapel Hill,NC, 27599-3300, USA

Lynch, Daniel R.

Thayer School of Engineering, Dartmouth College, Hanover N.H., 03755 U.S.A.

Speaker: Greenberg, David A.

Time: Thursday 15:45

Abstract

A linear harmonic finite element model using spherical-polar coordinates has been developed from a Cartesian version. The model can be forced by boundary elevation or current, surface stress and a fixed density field. Boundary conditions include specified elevation, specified current and geostrophic. Illustrative solutions have been computed for Stommel's Gulf Stream computation and Apel's picture of a full ocean basin driven by wind stress. The power of the scheme is shown with preliminary computations of the density driven circulation of the North Atlantic and the evolution of shelf waves moving down the Northwest Atlantic Coast.

Notes

Look-up tables for use in photochemical models: Comparison of the 2-stream and the Matrix Operator Doubling and Adding method in calculating J values.

Griffioen, Erik

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P4

McConnell, John C.

Same as 1.

Speaker: Griffioen, Erik

Time: Thursday 09:45

Abstract

An important quantity used in 3-D photochemical models of the atmosphere is the photodissociation rate, often called the J-value. The J-value represents the angularly averaged mean radiance integrated over wavelength. Thus it is dependent on the atomic or molecular characterics such as cross-section and quantum efficiency as well as the angular characteristics of the radiation field. The latter depends on solar flux, surface

albedo, and the concentrations of atmospheric scatterers and absorbers. For example, the presence of clouds and aerosols can have a major effect on the radiation field and thus on the J values. A detailed evaluation of the J-value is thus potentially computationally intensive, especially when it must be done for the 50-100,000 points typical of 3-D chemical models. Thus an efficient yet accurate means must be explored to reduce the computations. This can be done by exploring simple scattering models or by interpolation of more complex models. In this talk we explore both of these possibilities. A comparison of the simple 2-stream method and more complicated, but accurate 1-D matrix operator (doubling and adding) method to determine J values for specific species such as O(^{1}D) NO$_2$ and NO$_3$ has been made. Both clear sky and cloudy conditions are considered. Correction for the solar beam passing through a spherical atmosphere has been made, but with 1-D plane-parallel scattering. This simple correction has been shown by Anderson et al. (1979) and Anderson (1983) to extend the range of validity to solar zenith angles up to 90 degrees. Next, the possibility of using look-up tables representing a range of atmospheric conditions and heights (from the troposphere to the thermosphere) will discussed.

Notes

Heat storage in the fabric of North American cities

Grimmond, C.S.B.

Dept. of Geography, Indiana University, Bloomington, IN 47401 USA

Oke, T.R.

Dept. of Geography, University of British Columbia, Vancouver, B.C. V6T 1Z2

Speaker: Oke, T.R.

Time: Wednesday 16:05

Abstract

The uptake and release of heat by the fabric (buildings, trees, ground, etc.) of cities is expected to be a large component of their energy balance. The change of storage at sites in seven cities has been evaluated (Chicago, Los Angeles, Mexico City, Miami, Sacramento, Tucson, Vancouver). In all cases the heat storage change is determined as the residual of the energy balance after direct measurement of the net radiation by net pyrradiometer and sensible and latent heat fluxes by eddy correlation. The heat storage change is found to account for 29% to 60% of the daytime net radiation input with a distinct phase lag between the two fluxes. The storage is greatest at downtown and light industrial sites. A simple parameterization of heat storage change is tested and found to work well. Results show the urban boundary layer is extremely well coupled to the surface.

Notes

none

Cloud Microphysical Influence on GCM Radiative Chracteristics: Indirect Effects of Aerosols and Parameterized Equations

Gultepe, I.

Atmospheric Environment Service, Cloud Physics Research Division, Downsview, ONT. M3H-5T4

Isaac, George A.

Same as speaker.

Speaker: Gultepe, I.

Time: Tuesday 11:55

Abstract

The purpose of this study is to test parameterized equations using a radiation column component of the National Center for Atmospheric Research (NCAR) Community Climate Model (CCM2). Parameterized equations obtained from observations collected during Canadian field projects and from earlier studies are used. The basic microphysical parameters used as input in the radiation column model are effective radius r_{eff} and total number concentration of aerosols (N$_{a}$). For this study, a stratiform cloud with 1 km thickness in the vertical with its base at 800 mb over North America is considered. Earlier studies indicated that radiative forcing of clouds is a strong function of cloud microphysical parameters such as r$_{eff}$, droplet number concentration (N$_{d}$), and liquid water content (LWC). The geographical distribution of these parameters depends on environmental conditions, including processes related to temperature, available moisture, and vertical air velocity. The parameterized relationships of N$_{d}$ versus N$_{a}$, and constant value of r_{eff} are used to obtain LWC, LWP, optical thickness, heating and cloud forcing rates of SW and IR radiation, respectively. The results showed that SW radiative forcing and IR heating in the cloud is strong function of N_{a} and r_{eff}. A change of N$_{a}$ from 1500 cm^{-3} to 300 cm^{-3} within the cloud resulted in approximately a 50$\%$ change in the net cloud radiative forcing. Differences in the parameterized equations, depending on N$_{a}$, are found to be responsible for about a 10-40 W m^{-2} change in net cloud forcing value. In conclusion, for general circulation models, a better representation of droplet-aerosol characteristics as a function of temperature, moisture, and cloud type are needed.

Notes

For oral presentation

The response of the surface layer of Lake Ontario to Hurricane Opal

Hamblin, P.F.

Aquatic Ecosystems Restoration Branch, National Water Research Institute, 867 Lakeshore Rd., Burlington, Ontario L7R 4A6

Schertzer, W.M.

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He, C

Same as 1.

Speaker: Hamblin, P.F.

Time: Tuesday 11:35

Abstract

The circulation and mixing of the upper 10m of Lake Ontario is poorly known as hazards to moored instrumentation from ship traffic has prevented conventional unattended observation. Knowledge of the surface currents is important from a practical viewpoint to spill cleanup and search and rescue operations and scientifically for the estimation of resupply of nutrients to the photic zone from the hypolimnion. We report on time series of winds, air temperatures, temperature and current profiles from an inverted acoustic doppler profiler and fixed point moorings at an open lake location in Lake Ontario(depth 221m) spanning the passage of Hurricane Opal, one of the most severe storms in recent history in the area. Northeast winds started at the be- ginning of October, 5 1995 reaching a peak of nearly 18m/s 24hr later and then slowly subsiding in the subsequent 12hr. During the storm, currents continued as inertial or Poincare waves but at higher level reaching a maximum of 50cm/s seven hours after the peak wind speed with little intensification near the surface. Currents following the peak exhibited pronounced vertical shear with a jet developing at the thermocline 30hr after peak winds. A train of large amplitude(10m) internal waves disturbed the thermal structure following the hurricane and persisting for several days similarly to the case of Typhoon 9313 on Lake Biwa, Japan.

Notes

video or VGA projector of animated data sequences

Modeling the three-dimensional mean circulation over the Scotian Shelf

Han, G.

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Hannah, C.G.

Oceadyne Environmental Consultants, 373 Ridgevale Drive, Bedford, N.S., B4A 3M2

Smith, P.C.

Same as 1.

Loder, J.W.

Same as 1.

Speaker: Han, G.

Time: Wednesday 16:05

Abstract

The seasonal mean circulation over the Scotian Shelf is studied numerically by computing mean and tidal current fields for winter, spring and summer using a three-dimensional nonlinear diagnostic model. The mean current fields are forced by seasonal-mean baroclinic pressure gradients, tidal rectification, uniform wind stresses, and associated barotropic pressure gradients. The historical hydrographic database is used to determine the climatological mean baroclinic forcing. Flows across the upstream open boundaries are estimated from the density fields to give no normal geostrophic bottom flow, and are specified as either along-boundary elevation gradients or depth-integrated normal velocities. The numerical solutions for nominal bimonthly periods (January-February, April-May, and July-August) reveal the dominant southwestward nearshore and shelf-break flows of relatively cool and fresh shelf water from the Gulf of St. Lawrence and Newfoundland Shelf, with speeds up to about 20 cm/s, and pronounced topographic-scale influences of submarine banks, basins and cross-shelf channels on the circulation, such as anticyclonic (cyclonic) gyres over banks (basins). Baroclinicity is the dominant forcing throughout the domain, but tidal rectification is comparable in the vicinity of Browns Bank. The solutions are in approximate agreement with observed currents and transports over the Scotian Shelf, although there are local discrepancies. The seasonal intensification of the southwestward flows is reproduced by the model, with the transport increasing from 0.3 Sv in summer to 0.9 Sv in winter for the inner Halifax section.

Notes

Implementation and Application of the Variable Grid Urban Airshed Modeling System (UAM-V) to the Lower Fraser Valley for Tropospheric Osone Assessment and Planning

Haney, J.L.

Systems Applications International,101 Lucas Valley Road, San Rafael, CA 94903

Lolk, N.K.

same as 1

Douglas, S.G.

same as 1

Thomson, R.B.

Environment Canada, 1200 West 73rd Avenue, Suite 700, Vancouver, B.C., Canada, V6P 6H9

Pottier, J.

same as 4

Speaker: Haney, J.L.

Time: Tuesday 14:50

Abstract

During the last decade, the Greater Vancouver metropolitan area, located in the Lower Fraser Valley (LFV) of British Columbia, experienced the largest growth in population of any comparable urban area in North America. Given the current concerns regarding the effects on health and vegetatioin of tropospheric ozone and the expected future growth of the area,Environment Canada, in cooperation with the National Research Council (NRC), the British Columbia Ministry of Environment, Lands and Parks, the Greater Vancouver Regional District (GVRD), and the University of British Columbia (UBC), initiated a multiyear, multiphased effort to address the ozone problem. The effort includes supplemental meteorological and air quality data collection, data analysis, emission inventory development, and the application of meteorological and photochemical models to simulate ozone episodes and evaluate the effects of emission reductions. The complex terrain and land-water features of the LFV area affect the transport and mixing of precursor pollutants and the production of ozone. This paper summarizes an application of the variable-grid Urban Airshed Model (UAM-V) photochemical modelling system to the LFV. The variable-grid Urban Airshed Model (UAM-V), an enhanced version of the current (U.S. EPA) regulatory version, is a three-dimensional grid model that numerically

simulates the relevant physical and chemical processes affecting the production and transport of tropospheric ozone. Although focused on the LFV, the UAM-V regional modelling domain for this application also included parts of Vancouver Island and the State of Washington. The study involved the preparation of inputs, evaluation of model performance of one multiday episode (17 to 20 July 1985), transfer of the base-case files and the model, and training in the use of the modelling system. The objective of the study was to provide the participants with a modelling system,capable of simulating the complex physical and chemical ozone-formation mechanisms operating in the LFV, which give air quality planners the ability to evaluate future ozone control strategies.

Notes

Aviation Forecast (FT) Verification and Monitoring System.

Hanssen, A. J.

National Weather Services Directorate, 4905 Dufferin St., Downsview, Ontario, M3H-5T4

Mandeville, R. P.

National Weather Services Directorate, 4905 Dufferin St., Downsview, Ontario, M3H-5T4

Wintjes, D.

Same as 2.

Speaker: Mandeville, R. P.

Time: Thursday 10:05

Abstract

Verification of aviation forecasts (FT) for twenty three stations across Canada was based on the Rank Probability Score (RPS) since 1982. It was done in the Regions and Training Branch on the HP-1000 computers, which were phased out in 1992. The objective of this project is to create a new aviation and monitoring system, which is very flexible and can support the Atmospheric Environment Program. Verification applications will be designed in conjunction with the user, maximising graphical presentations that show results in a simple and concise manner. The new system is a minute-by-minute verification of the forecasts. The FT's and corresponding observations (SA's), are completely parsed and deposited into an input database. The ceilings and visibility data are then categorized and compared. Statistical scores are calculated with climatology and persistance used as standards. Real-time monitoring of the SA's and AWOS reports is already being done. Reports with errors and inconsistencies can be analyzed and a

monthly report is presently prepared and sent to the AWOS working group. Any other bulletins, such as WW or RA can be monitored analyzed and statistics produced. All statistical information produced can be made available to clients and Regions through a number of dissemination avenues.`

Notes

Regular Overhead Projector

Development of a spectroscopic technique for the measurement of total reactive chlorine in the stratosphere

Harris, G.W.

Centre for Atmospheric Chemistry and Department of Chemistry, York University, 4700 Keele Street, North York, Ontario M3J 1P3

Johnson, T.J.

Same as speaker

Bonifer, J.

Max Planck Institute for Chemistry, Mainz, Germany

Crowley, J.

Same as 3

Fischer, H.

Same as 3

Speaker: Harris, G.W.

Time: Wednesday 14:15

Abstract

The total amount of reactive chlorine in the stratosphere, (Cly = ClONO2 + HCl + ClO + HOCl + ClO + ClOOCl) is an important parameter in studies of the partitioning of chlorine species and for the chemistry of ozone depletion. At present Cly must be inferred from measurements of the major chlorine source gases in the stratosphere and in the upper troposphere and from measurements of dynamical tracers such as N2O and CO2. We propose an in situ measurement method of Cly in which all the species containing reactive chlorine are converted to HCl, which is then measured

spectroscopically using a high sensitivity tunable diode laser technique. Conversion takes place in a heated gold tube to which sufficient NO and H2 are added. We demonstrate that ClONO2 is quantitatively converted to HCl, that the prototype system responds linearly to HCl, ClONO2 and (ClONO2 + HCl), with sufficient sensitivity for measurements in the lower stratosphere. We also note that our work confirms that similar conversion schemes used for measurement of NOy in the stratosphere will respond to ClONO2.

Notes

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

Zwack, Peter

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Olivier Hamelin

Ecole Nationale de la Meteorologie, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Santurette, Patrick

SCEM, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experiemental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies amoung the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the

cause of a region of upward motion or pressure falls provided the forecaster with enought confidence to follow the model guidence. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes

An Investigation of the Interactive Effect on Climate Sensitivity of Water Vapour, Lapse Rate, and Cloud Height Feedbacks

Harvey, L.D. Danny

Dept. of Geography, University of Toronto, Toronto, Ontario, M5S 1A1

Speaker: Harvey, L.D. Danny

Time: Wednesday 10:05

Abstract

An energy balance climate model with explicit radiative transfer and parameterized tropospheric temperature and humidity profiles is used to compute the effect on infrared flux and climate sensitivity of the following feedbacks: (i) a variety of relationships between total precipitable water in the troposphere and surface temperature; (ii) feedbacks between surface temperature and the vertical distribution of tropospheric water vapour at low latitudes; (iii) a feedback between upper tropical troposphere saturated humidity and water vapour amount in the stratosphere; (iv) feedback between surface temperature or meridional temperature gradient and lapse rate; and (v) feedback between surface temperature and cloud height at low latitudes. For the reference case of fixed relative humidity, lapse rate, and cloud top height, the global mean surface temperature response to a CO2 doubling is 1.85 C. Assuming a downward redistribution of low latitude water vapour as the climate warms, to the maximum extent suggested by recent cloud modelling studies, reduces the global warming to 1.2-1.5 C with variable lapse rate and cloud top height. Assuming a stronger downward redistribution of water vapour in relation to surface temperature change has a rapidly diminishing effect on global mean and tropical surface temperature response to a CO2 doubling, while slightly increasing the warming at high latitudes through the meridional temperature gradient-lapse rate interaction at middle-to-high latitudes. Taking into account possible cloud feedbacks not considered here, it is concluded that 1 C is an extreme lower limit to the global mean surface air temperature response to a CO2 doubling.

Notes

Application of indicators of ozone-NOx-hydrocarbon sensitivity to the SONTOS data set.

Hastie, D.R.

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3.

Narayan, J.

Same as 1.

Speaker: Hastie, D.R.

Time: Tuesday 16:20

Abstract

The control of tropospheric ozone concentrations can be achieved by controlling the concentrations of either or both of the chemical precursors, hydrocarbons and nitrogen oxides. Recently Sillman has suggested a series of chemical indicators to distinguish whether ozone concentrations would respond to changes in hydrocarbon concentrations (which he calls hydrocarbon sensitive) or nitrogen oxide concentrations (NO_{x} sensitive). These indicators are concentrations of NO_{y}, or concentration ratios such as CH_{2}O/NO_{y} which are obtained from field measurement programs. We have examined the use of these indicators and applied them to the Hastings data set from SONTOS. These indicators all point to ozone production at Hastings as being under NO_{x} control.

Notes

Modification of boundary layer roll dynamics by an induced tropospheric gravity wave field

Heuff, D.N.

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Allen, S.E.

Department of Oceanography, THe University of British Columbia, Vancouver, B.C., V6T 1Z4

Steyn, D.G.

Same as 1.

Speaker: Heuff, D.N.

Time: Wednesday 16:45

Abstract

The preferred scale of roll convection within the planetary boundary layer (PBL) has been observed to be larger than that predicted by linear theory. The current research focuses on coupled interactions of horizontal roll vorticies (HRVs) within the convective PBL, and an induced tropospheric gravity wave field which may exist in the overlying stable layer. It is suggested that the feedback between the gravity wave field and the PBL provides a mechanism for the formation of large aspect ratio roll circulations. A two-layer model has been developed in which the dynamics of the lower layer (representing the convective PBL) is treated by analogy to a modified Rayleigh-Benard convection model. Such an approach is justified if variations in the along axis direction are prohibited; thus the dynamics in the cross roll plane uncouple and roll circulations are driven by buoyancy effects alone. The governing nonlinear equations are transformed to wavenumber space via Fourier integral methods and the resulting integrodifferential equations for the Fourier coefficients are solved numerically. Implications of model results to atmospherically observed phenomena are presented.

Notes

Modelisation stochastique du niveau d'eau a la station de Quebec-Lauzon, estuaire du Saint-Laurent

Hilmi, Karim

Groupe de Recherche en Environnement C\^{o}tier (GREC) Dèpartement d'océanographie, Université du Quebec à Rimouski 300 allée des Ursulines, Rimouski (Québec) G5L 3A1 Canada

El-Sabh, Mohammed

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Chanut, Jean-Pierre

Groupe de Recherche en Environnement C\{^o}tier (GREC) Dèpartement d'océanographie, Université du Quebec à Rimouski 300 allée des Ursulines, Rimouski (Québec) G5L 3A1 Canada

Speaker: Hilmi, Karim

Time: Wednesday 16:25

Abstract

Les enregistrements du niveau d'eau horaire à la station de Quèbec- Lauzon située à la t\{^e}te de l'estuaire du Saint-Laurent, Canada, sont analysès \'{a} la fois dans le domaine fréquentiel (de 1970 à 1979) et dans le domaine temporel (durant l'année 1973). Les variations tidales expliquent 90 à 95% de la variabilité initiale du niveau d'eau observé entre 1970 et 1979. Les variations rèsiduelles (non tidales) de nature stochastique, bien qu'elles soient limitèes à moins de 10% des variations initiales du niveau d'eau, sont analysées et modèlisées selon la mèthodologie de Box et Jenkins en vue d'une meilleure prédiction des niveaux d'eau. La réponse du niveau d'eau résiduel au forçage atmosphèrique (pression atmosphérique et vents) se situe à une échelle de 2 à 28 jours; elle est de quelques heures à un jour pour les variations attribuables aux seiches longitudinales, aux cycles semi-diurne et diurne de la marée atmosphérique et aux périodes inertielles. Le débit d'eau douce contribue pour 29% à la variabilité mensuelle du niveau d'eau résiduel; les vents et la pression atmosphérique y contribuent respectivement pour 8,9% et 8,1%. La composante U du vent, parallèle à la c\^{o}te, agit davantage sur les variations du niveau d'eau residuél et y contribue pour 6,8%. Le coefficient de régression, liant le niveau d'eau résiduel à la pression atmosphérique, est estimé à -1,507 (cm/hPa) (+ ou - 0,345 (cm/hPa)). Comparé au coefficient du baromètre inversié, estimé à - 1 (cm/hPa), l'effet de la pression atmosphérique sur le niveau d'eau est amplifié par le débit d'eau douce et par les effets d'entra\^{i}nement du vent.

Notes

Anthropogenic aerosols viewed from space: the LITE Experiment

Hoff, Raymond M.

Centre for Atmospheric Research Experiments, Atmospheric Environment Service, R. R. #1, Egbert, Ontario, L0L 1N0

Strawbridge, K. B.

Same as 1.

Speaker: Hoff, Raymond M.

Time: Thursday 13:15

Abstract

In September 1994, NASA flew the Lidar In-space Technology Experiment (LITE) on board the space shuttle, Discovery. During the ten day mission, aerosol emissions from over 40 urban areas were detected across the globe. These regions were as small as

Winnipeg, Canada, and as large as the major industrial regions of the United States, eastern Europe, and the Far East. Examples of the aerosol signatures from these regions using LITE 532 nm data will be presented. Many of these regions are major sources of aerosols on a global basis. Emissions from the U.S. were seen to traverse across the Atlantic at least as far as the Azores and probably further. Sources in Asia were tracked several thousands of kilometres into the Pacific. With the expected global impact of these scatterers over remote regions, it has been predicted that cooling of the troposphere will occur. A range of expected optical depths in these plumes will be used to estimate the potential climate impact of these urban sources. The LITE data is the first truly global data set which can be used to analyse continent-to-continent transport of aerosols. Analysis of the LITE data coupled to global aerosol transport models will be discussed. Also of high interest is the potential for assimilating space borne lidar data for operational analysis systems, such as the numerical weather prediction (NWP) models. A project to put a spaceborne ozone Differential Absorption Lidar in space will be mentioned and the potential for improved data inputs to NWP models will be discussed.

Notes

Oral only

The structure of a warm front and the associated precipitation in a winter storm over eastern newfoundland: Mesoscale and cloud-scale numerical simulations

Hong, G.

Cloud Physics Research Division, Atmospheric Environment Service, 2121 Trans Canada Highway, Dorval, Que., H9P 1J3

Tremblay, Andre

Same as 1.

Zhang, Da-Lin

Department of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke Street West, Montreal, Quebec H3A 2K6,Canada

Li, C.Q.

Same as 3.

Speaker: Hong, G.

Time: Monday 15:55

Abstract

The storm, IOP 13 (Februray 26-27,1992) was particularly well-sampled with aircraft, Doppler radar, and other supporting instruments. Using these unique observations. Hudak et al. (1995) documented the nature of the warm front associated with this storm and proposed a conceptual model describing the qualitative features of the warm front. The associated precipitation was found in the form of banded structures parallel to the front. Within these bands were embedded precipitation cores, some parallel to the front, some perpendicular. In order to provided a better understanding of the important dynamical and microphysical processes within this storm and to assess the model performance, a set of mesoscale (25km horizontal resolution) and cloud scale (about 5km horizontal resolution) are being conducted using Canadian Mesoscale Compressible Community (MC2) model. The mesoscale convective scheme of Kain-Fritsch and the cloud scheme developed by Tremblay et al. (1996) are used. Preliminary results showed that the simulated storm is, in general, agreement with the observed. The simulation results will be presented. In particular, the simulated rinbands and embedded precipitation cores will be compared against the observons. We will also discuss the microphysical and dynamical features near the frontal zone. In the meantime, the validity of the model and schemes will be assessed.

Notes

The effects of longwave radiation in a small cumulus

Hong, G.

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Yau, M.K.

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Davies, Roger

Institute of Atmospheric Physics, University of Arizona, PAS Building #81, Tucson, AZ 85721, USA

Speaker: Hong, G.

Time: Wednesday 15:25

Abstract

The effects of longwave radiation on the development of a small cumulus cloud were investigated by a combination of three-dimentional radiative transfer model as well as slab-symmetric cloud dynamics model. It was found that longwave radiative cooling

substantially enhances the maximum cloud water content. The maximum increase reaches 96%. the total cloud water was also increased somewhat (maximum 20%). The effects of longwave radiative cooling in the different stages of the simulated cloud were further examined and analyzed. In the initial stage of the development, the augmentation of cloud water content near the cloud top and sides is traced mainly to the direct effect of longwave radiative cooling on microphysics. In the mature stage of the cloud, the increase of total cloud water content comes from a combination of the effects of radiation on microphysics and dynamics. The cooling from radiation and evaporation produces additional downward motion at the sides of the cloud. The enhanced low-level convergence invigorates the updraft promoting further cloud development. In the decaying stage, the negative buoyancy produced by cloud top radiative cooling and a higher liquid water load speeds up the decay process in the LW run. In a sheared environment, wind shear suppresses convection. In conjuction with horizontal momentum transfer, radiative cooling also results in a more negative temperature perturbation and a stronger downdraft on the downshear flank relative to the upshear side.

Notes

The use of ensemble forecasts for model validation.

Houtekamer, P.L.

RPN, Atmospheric Environment Service, Dorval, Quebec, H9P 1J3.

Lefaivre, L.

CMC, Atmospheric Environment Service, Dorval, Quebec, H9P 1J3

Speaker: Houtekamer, P.L.

Time: Tuesday 16:20

Abstract

An ensemble forecasting system has been set up in which it is attempted to simulate all sources of forecast error. Errors in the observations, in the surface fields and in the forecast model have been simulated. This is done in different ways for different members of the ensemble. The model error has been simulated by taking different model versions for different members of the ensemble. Currently we have modeled different e-folding times for the horizontal diffusion, different intensities of the vertical diffusion in the free atmosphere, different grids, different convection schemes, different radiation schemes, different treatments of mountains and different schemes for the gravity wave drag. The ensemble forecasts are validated against radiosonde observations. In this way we obtain every day some information on the quality of several aspects of the model. The information gathered over some period can be combined in a single least squares solution. Here the solution is the best model that can be obtained at a given truncation

using a given set of parametrizations. With the above system we can simultaneously validate several dependent aspects of the model. The "noise" introduced by observational errors and errors in the surface fields is automatically treated by the least squares procedure. The error bars on the validation results inform us to which extent the changes to the model are confirmed or rejected by radiosonde measurements.

Notes

Decadal variability in simplified models of the buoyancy-driven ocean circulation

Huck, Thierry

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Weaver, Andrew J.

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Colin de Verdiere, Alain

Laboratoire de Physique des Oceans, UFR Sciences BP 809 - 29285 Brest Cedex - FRANCE

Speaker: Huck, Thierry

Time: Thursday 09:45

Abstract

Observed in atmospheric and oceanic data, decadal oscillations have been reproduced in coupled ocean-atmosphere models as well as in ocean only models, forced by restoring or mixed boundary conditions. Here, we study the free modes of variability in the ocean only, with a coarse-resolution mid-latitude model based on the planetary geostrophic equations, forced by buoyancy fluxes at the surface and no wind-stress. A parameter sensitivity study of the oscillatory behaviour has been carried in order to determine the necessary processes defining the mechanism. Results suggest the horizontal tracer diffusivity has a critical damping effect, while the vertical diffusivity strongly enhances the oscillations. Convective processes and the beta-effect are found not to be necessary in sustaining the decadal variability and excludes the role of Rossby waves. The choice of momentum dissipation parameterization and boundary conditions influence the period and amplitude of the oscillation, but not its occurence. The possible effect of the zonal boundary has been eliminated in different ways, excluding the role of Kelvin waves. As the variability is mainly observed in the region of separation of the western boundary

current, we are now looking at 2-layer and 2-dimensionnal models to investigate an advective mechanism.

Notes

FLAME: a nonlocal model to study forest-atmosphere interactions

Inclan, M.G.

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Stull, R.B.

Dept. of Geography, The University of British Columbia, 1984 East Mall, Vancouver, BC, V6T 1Z2

Speaker: Inclan, M.G.

Time: Monday 17:15

Abstract

The newly developed Forest-Land-Atmosphere-ModEl (FLAME) based on first order nonlocal closure principles is presented. The model applies the transilient turbulence theory (Stull, 1993) to describe nonlocal vertical mixing between the atmospheric boundary layer and a forested land surface. The effects of canopy drag, wake turbulence, interference to vertical mixing by plant elements as well as the influence of heat and water sources/sinks from the canopy layers have been included in the transilient scheme. A radiation transfer model within the canopy and the equations for the energy balance at the leaf surface account for the partition of available energy into sensible and latent heat fluxes from the plant to the environment. The solution of the height- and angle-dependent leaf energy balance allows one to calculate the magnitude and location of the heat and water sources (sinks) from the physiological and morphological properties of the vegetation and the leaf temperature. The transport of heat and water within the soil is computed using a multilayer soil model, which consists of two prognostic equations for the soil temperature and the liquid water content. Some results carried out for idealized initial conditions are presented, in which the canopy height is chosen to 30 m. The vertical model domain is set to 3 km. Simulated profiles of air temperature and wind velocity within and above the canopy and the corresponding turbulent fluxes show the features usually observed in the field, as for example the counter-gradient fluxes in the trunk space. Of special interest is the contribution of eddies of different sizes to the total mixing within the canopy.

Notes

Climatic autostation operations at remote sites in Baffin Island, 1987-95: Overview and applications

Jacobs, John D.

Dept. of Geography, Memorial University of Newfoundland St. John's, NF. A1B 3X9

Headley, Angus N.

Atmospheric Environment Service, 4905 Dufferin St., Dwonsview, ON M3H 5T4

Speaker: Jacobs, John D.

Time: Monday 11:55

Abstract

Climatic autostations were installed in remote areas of special scientific interest in the interior of Baffin Island, Nunavut, beginning in 1987. When the field program ended in 1995, autostations had operated successfully at three terrestrial and two glacier locations between 64.6 and 70.4 degrees N for a total of 23 station-years. Based on the Campbell Scientific Inc. dataloggers and associated sensors, the stations recorded temperature, humidity, wind speed and direction, and ground (or ice) temperature on a one or three-hourly schedule. At two of the terrestrial sites, precipitation was recorded using a Fischer and Porter gauge with Nipher shield, while ultrasonic snow depth sensors were used on the glaciers. Installation and sampling schedules followed AES Guidelines for Co-operative Climatic Autostations (1989) and were intended to meet the Level 2 specifications of the AES National Archive. The sites were visited annually to service the equipment, download the data, and conduct surveys. Equipment failures were few, and at only one site was there significant damage by animals. Data sets produced in the autostation project are being used in studies of local and regional climates and climate change. Among contributions to the regional climatology is a 5-minute gridded monthly mean temperature set incorporating AES synoptic station data and referenced to the 1961-1990 normals period. Site and area-specific studies include investigations of climate and vegetation change in the interior lowlands of southern Baffin Island and the climatology of Barnes Ice Cap. The data sets have potential application to the regional hydroclimatology and to validation of arctic land surface climate model simulations.

Notes

Modelling the three-dimensional mean water circulation along the north coast of British Columbia

Jacques, Renée

Dept. of Oceanography, Univ. of British Columbia, Vancouver, B.C., V6T 1Z4

Foreman, M.G.G.

Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C., V8L 4B2

LeBlond, P.H.

same as 1.

Crawford, W.R.

same as 2.

Speaker: Jacques, Renée

Time: Wednesday 13:55

Abstract

A diagnostic three-dimensional finite element model is used in conjunction with observations to study the mean water circulation of Dixon Entrance, of its neighbouring estuary (Chatham Sound), and of its two main adjacent sea-ways (Hecate and Clarence Straits). The region is characterised by a complex topography, including numerous islands and high coastal mountains; a complex bathymetry, including banks, shoals, and deep channels; as well as highly stratified waters, mainly in late spring. The domain is bounded by a steep continental slope. The nonlinear model is forced with a baroclinic density field, a uniform wind field, the discharge of two main rivers (Skeena and Nass), and computed tides. The latter were obtained from a similar harmonic, barotropic, finite element model with a bottom boundary layer. The non-tidal currents, along with the process of tidal rectification, are studied and analysed. Emphasis is put on modelling the friction process. The model results are compared with current observations and the dominant eddy motions of the mean circulation are dynamically characterised.

Notes

none

Pressure tendency patterns associated with wintertime cyclonic storms

Jaskiewicz, Francine

Department of Meteorology, Pennsylvania State University, University Park, PA 16802

Clark, John H.E.

Department of Meteorology, Pennsylvania State University, University Park, PA 16802

Speaker: Clark, John H.E.

Time: Thursday 10:55

Abstract

Observed pressure tendencies for a number of North American storms consist of pulses of meso-alpha scale pressure falls originating near storm center and propagating northeastward in advance of the storms. These pulses go through a life cycle of amplification and decay such that a phase and group velocity can be associated with the resulting wave packet. Typical wavelengths and periods are 200 km and 10 h. Group velocities are close to the storm speed. Storms most conducive to this behavior have a broad region of stably stratified cold air ahead of the storm near the surface capped by overrunning warm air aloft. It is hypothesized that the pulses are associated with inertial gravity waves trapped in the stable air and triggered by low-level winds encountering the sloping warm frontal surface. Results from a two-dimensional, non-hydrostatic model are shown to substantiate this interpretation. It is suggested that the mechanisms involved in the triggering and evolution of these gravity-wave packets play an important role in cyclonic storm evolution and point to an important link between mesoscale and synotpic scale processes.

Notes

Homogeneous nucleation in supercooled clouds: results using a new equation of state.

Jeffery, Christopher

Dept. of Physics, University of British Columbia

Austin, Philip H.

Atmospheric Science Programme, University of British Columbia, Geography #217, 1984 West Mall, Vancouver, BC V6T 1Z2

Speaker: Austin, Philip H.

Time: Wednesday 13:15

Abstract

We have developed a new equation of state for liquid water that accounts for the free energy of open tetrahedral hydrogen bonds. This equation is 30-40 times more accurate than existing cubic equations of state across a wide range of temperatures and pressures, and quantitatively predicts the anomalous behaviour of water at supercooled temperatures. We use this equation to estimate the homogeneous nucleation rate of liquid water at cirrus cloud temperatures and pressures, and show that this new model can

explain the discrepancies (as large as a factor of 10^10) between aircraft and laboratory observations and previous predictions of homogeneous ice nucleation. The new homogeneous freezing equation also predicts the homogeneous freezing temperature T_H in the pressure range 0.1 - 2 kbar; laboratory measurements of T_H as a function of droplet diameter could provide an experimental test of the new equation of state.

Notes

The Relationship between SST Anomalies and PNA Pattern: Tropics versus Extratropics

Sheng, Jian

Canadian Centre for Climate Modelling and Analysis, P.O. Box 1700, Victoria, BC V8W 2Y2, CANADA

Speaker: Sheng, Jian

Time: Monday 16:35

Abstract

Both tropical and extratropical SST anomalies are known to be correlated with the mean monthly height field in the middle latitude. The relative importance of the two factors have been investigated. This study is based on rotated empirical orthogonal function (REOF) analysis of monthly SST anomalies for the period 1949-1988. In decreasing order of significance, the modes are denoted as REOF1, REOF2, ... REOF1 of the SST anomalies is strong and shows a clear El Nino signature. Higher SST modes are localized but not distinct, overlapping particularly in the northern Pacific. The time series of REOF1 reveals the El Nino events, but the atmospheric patterns composited for periods of strong REOF1 do not show the PNA signal as clearly as might be expected. The next REOF of SST in the Pacific is a weaker extratropical mode, but the 500mb height composites show a clear PNA signature and the amplitude is relatively strong. Synoptic scale eddy activities associated with these ! mo! des are also studied. In each of the two cases, the eddies reinforce the PNA pattern in a positive sense.

Notes

A Simulation of the Pinatubo Aerosol Climatic Effects Using the Canadian Climate Centre General Circulation Model

Jonathan H. Jiang

Centre for Research in Earth and Space Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

S.R. Beagley

Same as 1

John C. McConnell

Same as 1

de Grandpré, J.

Same as 1

W.F.J. Evans

Trent University, Peterborough, Ontario

Speaker: Jonathan H. Jiang

Time: Tuesday 16:40

Abstract

The eruption of Mount Pinatubo in June 1991 provide an important case study on short-term climate system responses to an increased stratospheric aerosol loading. We use the Canadian Climate Centre General Circulation Model (CCC GCM II) to simulate the Pinatubo aerosol climatic effects. The AVHRR AOT data is inserted into the model at about 18 km, to represent the Pinatubo aerosol loading with temporal and latitudinal variations. The model predicts that global averaged impact of the Pinatubo eruption is a cooling of 0.4^oC near the surface and a warming of 5.3^oC in the lower stratosphere. The largest temperature departures found from the model calculation are the summer coolings over the Northern Hemispheric land regions, and they are significant at a 95\% confidence level. The global temperature departure patterns simulated by the model agree with several published observational temperature anomalies, and are consistent with a few other general circulation model simulations. The simulated annual temperature departure pattern over Canada is similar to the observed annual mean Canadian surface temperature anomaly pattern, especially during the summer. We also compared the Pinatubo aerosol effect with the effect from an uniform stratospheric aerosol layer, which is also placed at 18 km in the model. It is shown that the stratospheric warming due to the Pinatubo aerosol loading is much different with that due to the uniform aerosol layer. In some regions near the surface the model with the Pinatubo aerosol loading better simulates the observed temperature departure pattern than the model with the uniform aerosol layer.

Notes

A Possible Pinatubo Signal in Canadian Surface Temperature Observations

Jonathan H. Jiang

Centre for Research in Earth and Space Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

W.F.J. Evans

TRENT UNIVERSITY

John C. McConnell

Same as 1

Speaker: Jonathan H. Jiang

Time: Tuesday 16:20

Abstract

To evaluate the observed surface temperature anomalies after the June 1991 Mount Pinatubo eruption, 42 years of climate records at 40 Canadian weather stations are examined. The 1992 temperature departures from the 1951-80 mean have been computed, and the Student's t-tests are applied to examine the significance of the temperature changes. It is shown that the significant winter warmings in western Canada, summer coolings in central land area and the annual mean coolings in northeast regions are the most striking features of the Canadian surface temperature anomalies after the Pinatubo eruption. Many weather stations in the eastern region had record low temperatures during the summer of 1992. The 1991-92 winter warmings in the west is likely to be caused by the 1991-92 El Nino Southern Oscillation (ENSO) effect. After the ENSO effect is removed, this western winter warming pattern becomes insignificant, and the annual mean coolings in the central and eastern Canada are significant at 90% to 95% confidence level. Our results is in agreement with a number of other observational and model simulation results. change feature is part of a larger pattern of climatic change in the world as a whole, and is likely due to the Pinatubo aerosol loading.

Notes

On wave drag, form drag and the parameterization of subgrid scale topography

Jingnan Zhou

Department of Earth and Atmospheric Science, York University, 4700 Keele St.,North York,Ontario, Canada.

Peter A. Taylor

same as 1.

Ying Qi

Atmospheric Environment Service, Toronto, Canada

Speaker: Jingnan Zhou

Time: Tuesday 10:25

Abstract

Form drag and wave drag have received considerable attention recently for the parameterization of effects of steady flow over subgrid-scale topography for large-scale atmospheric models. However, most form drag studies are limited to neutrally-stratified boundary-layers and microscale topography while gravity-wave drag studies often ignore or over-simplify the boundary-layer and any effects of turbulence. The two types of drag have been treated separatedly in most parameterization schemes, although they may well co-exist and gravity wave fluxes may not be constant with height. A linearized model for stably-stratified planetary boundary-layer flows over 2-D topography ranging from microscale to mesoscale has been developed and the use of a height dependent wave drag, or "local drag" is proposed. For z > h (the maximum height of the topography) this is the wave drag, as defined above, and including the stress carried by evanescent waves. In 2-D it can also be thought of as the form drag across a streamline. Local drag formula will be discussed for F (=Ug/NL) > 1 and F < 1 cases over sinusiodal terrain with the following conclusions. (1) The traditional, inviscid theory, wave drag cannot be extended into the boundary layer for parameterization purposes. Instead, the local drag links the surface drag with wave fluxes above the boundary layer. (2) In the F > 1 case, based on the profile of local drag, it is confirmed that the topographic drag is mainly limited to the lowest layers of larger scale models, so surface drag is enough to represent the topographic drag. The surface drag initially increases with F, but finally decreases. (3) In the F < 1 case, there is a net drag on the boundary layer, but most of the local drag can propagate into the upper layers. The boundary layer can reduce wave fluxes above the boundary layer by 20 to 40% (compared to inviscid theory) for typical surface roughnesses, although drag on the boundary layer may increase by 10%.

Notes

High Resolution Measurements of Snowfall

Paul Joe

Environment Canada, 4905 Dufferin St., Downsview, Ont., M3H 5T4

Brian Sheppard

Same as 1.

Norman R. Donaldson

Same as 1.

Speaker: Paul Joe

Time: Thursday 09:25

Abstract

High temporal measurements of snowfall are needed for the short term prediction of weather conditions that affect anti/deicing operations at airports. Environment Canada has been conducting an experiment at L. B. Pearson International Airport near Toronto, ON and at the Center for Atmospheric Research Experiments near Alliston, ON sites to evaluate instruments and develop techniques for the measurement and short term prediction of snowfall. New instruments that produce measurements every minute include small microwave radars -- the Precipitation Occurrence Sensing System -- and several optical sensing systems -- Vaisala FD12P, HSS and the WiVis. These instruments differ in two important ways from the traditional and standard approach of the catchment systems. They are passive which reduces wind effects that plague catchment systems and they can produce high temporal estimates - every minute versus every six hours. The locations of the experiment were chosen because of the presence of existing snowfall measurement standards at those sites that could be used for intercomparison and because they were located under the coverage of a weather radar. Techniques for the short term extrapolation of the weather radar patterns have also been developed.

Notes

Detection of Atmospheric Trace Gases Using Matrix Isolation Fourier Transform Infrared (MIFTIR) Spectrscopy

Johnson, T.J.

Centre for Atmospheric Chemistry and Dept. of Chemistry, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Khoo, K.Z.

Centre for Atmospheric Chemistry and Dept. of Chemistry, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Harris, G.W.

Centre for Atmospheric Chemistry and Dept. of Chemistry, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Speaker: Johnson, T.J.

Time: Thursday 15:25

Abstract

Matrix isolation Fourier-transform infrared (MIFTIR) spectroscopy is a technique whereby either trace or chemically labile species are "trapped" in a host maxtrix that is transparent to infrared radiation over a range of spectroscopic interest. A system has been constructed for atmospheric trace gas detection whereby ambient air is passed over a 77K coil such that the O$_2$ and N$_2$ do not condense; the resulting condensate is a matrix of CO$_2$ along with trace gases that have been pre-concentrated by the inverse of the atmospheric CO$_2$ mixing ratio (i.e. by a factor of ~3000). The collected CO$_2$ matrix is then briefly re-evaporated and directly re-condensed onto the walls of a spectroscopic integrating sphere and studied by infrared analysis. The integrating sphere provides enhanced sensitivity for studying weak absorptions. Preiliminary results for several species will be presented from a field campaign conducted at a forest site near Borden, Ontario in August of 1995.

Notes

Some results from MC2 with on-line Chemistry

Kaminski, Jacek W.

Department of Earth and Atmospheric Science, York University, 4700 Keele St., North York, Ontario, M3J 1P3

Neary, L.

Same as 1.

Plummer, D.A.

Same as 1.

McConnell, John C.

Same as 1.

Speaker: Kaminski, Jacek W.

Time: Wednesday 16:05

Abstract

The Mesoscale Compressible Community Model (MC2) is a non-hydrostatic 3-D meteorological nested model. We have added modules to the MC2 to form a prototype on-line photochemical oxidants model that can be used to study ozone formation. The resolved transport is effected by a semi-Lagrangian algorithm while small scale transport is effected by the PBL transport and shallow convection. We have also added modules to describe emissions, dry deposition and photochemistry. The photochemical mechanism is based on the Acid Deposition and Oxidants Model (ADOM) gas phase chemistry. The chemistry is being run on-line with the meteorology. While making greater demands on computing power, running the chemistry on-line alleviates, to some extent, the need for storage of large meteorological fields and potentially allows for greater consistency between the dynamical fields produced by the meteorology and the advection of trace gas species. In order to assess the effects of transport and resolution on ozone generation we have run the model in a nested mode. In particular, the model has been used to investigate ozone production in the Windsor-Quebec corridor. We have used initial and boundary conditions from the York Global Chemical Transport Model interpolated onto a 60 km grid and this run has been nested to a 20 km grid. Results for the period July 31st-August 9th will be presented. We will look at the effects of resolution on ozone generation and distribution. The results from this run have also been nested to 5 km and in order to investigate lake breeze effects on chemistry and will be presented by Plummer et al at this meeting.

Notes

Nonlinear stability of geostrophic ocean fronts

Karsten, R.H.

Dept. of Mathematical Sciences, University of Alberta, Edmontin, Alberta, T6G 2G1

Speaker: Karsten, R.H.

Time: Monday 11:15

Abstract

Large scale ocean fronts play an important role in ocean dynamics. When they are stable they can act to block both vertical and horizontal motion while instability can lead to wave motion and the production of warm core eddies. Most of these fronts can be characterized by a small Rossby number and therefore are, to leading order, geostrophic in nature. Recently, in an attempt to model fronts with large isopycnal deflections, intermediate lengthscale, non-quasigeostrophic, frontal models have been developed. These models, while physically simple in that they use the shallow-water approximation and represent the ocean as a two-layer fluid, lead to cubicly nonlinear equations. In this talk , the nonlinear stability characteristics of several of these models is examined. The

models differ in the scaling of the layer depths and beta plane forcing. In the linear theory, stability is determined through the relationship of the potential vorticity gradients in the two layers. But, as the models have differing leading order potential vorticities and they give rise to contrasting linear stability results. Weakly nonlinear analyses illustrates that nonlinear terms can act to stabilize or destabilize flows depending on a relationship of zonal and meridional wave structure. Numerical solutions illustrate both the linear and weakly nonlinear behaviour and further illustrate the differences of the models. In the end, the large variances between the models is discussed in terms of the accuracy of the approximations made and the physical processes involved.

Notes

An operational expert decision support system for real-time automatic recognition of severe summer storms in radar data

Keck, Anthony J.

Environment Canada, Prairie and Northern Region, 266 Graham Avenue, Winnipeg, Manitoba, Canada, R3C 3V4

Legal, Louis

Environment Canada, Prairie and Northern Region, 266 Graham Avenue, Winnipeg, Manitoba, Canada, R3C 3V4

Pizzi, Nicolino

Institute for Biodiagnostics, National Research Council, 435 Elice Avenue, Winnipeg, Manitoba, Canada, R3B 1Y6

Westmore, David

Infomagnetics Technologies Corporation,11-1329 Niakwa Road East, Winnipeg, Manitoba, Canada, R2J 3T4

Speaker: Keck, Anthony J.

Time: Wednesday 10:25

Abstract

Volumetric radar data processing (RDP) has been installed on Environment Canada weather radars. The RDP system makes images at various levels available every five minutes. Meteorologists must deal with large amounts of information. Weather radar data is examined by meteorologists to locate patterns that represent existing or potential severe summer weather. There is no simple one-to-one relationship between severe storms and

features in the radar data. This makes the analysis process both time consuming and uncertain. Environment Canada has been working with InfoMagnetics Technologies Corporation (IMT) since 1993 to develop artificial intelligence(AI) techniques to help meteorologists identify severe storms in radar data. IMT has built an intelligent radar decision support system that incorporates the techniques used by meteorologists to detect severe storms and has evaluated classification systems to detect embedded features that the meteorologist may not be able to see with the unaided eye. This system was installed in the Manitoba Environmental Services Centre and used by operational meteorologists during the summer severe weather season in 1995. The Radar Decision Support System (RDSS) is described and the results of severe weather forecasters' first experience with the system are presented. Storm cell data were analyzed. Two classification strategies were used: unsupervised learning using the fuzzy c-means clustering algorithm and supervised learning using an artificial neural network architecture. The best overall result was achieved with the artificial neural network: a classification accuracy of eighty percent in discriminating between hail and tornadic cells from an independent sample.

Notes

Assessing the Skill in the Long-Range Forecasting Techniques

Khandekar, Madhav,

Atmospheric Environment Service, Environment Canada, Downsview, Ont. M3H 5T4

Shabbar, Amir

Same as 2.

Speaker: Khandekar, Madhav,

Time: Monday 10:55

Abstract

With renewed interest in long-range forecasting, several studies on long- range (or long-lead) forecasting have been reported in recent literature. Two distinctly different long-range forecasting techniques are being pursued at present. The dynamical/numerical technique based on coupled atmosphere-ocean models and statistical/empirical technique based on (statistical) correlation analysis. In this paper, the skill achieved by the two different techniques as reported in recent literature is analyzed and its variation with respect to seasons is discussed. The skill is assessed in the context of North America with particular reference to Canada and U.S.A. where the two different techniques have been predominantly developed and applied. Further, the impact of large-scale atmospheric features like ENSO (EL Nino-Southern Oscillation) and LNSO (La Nina-Southern Oscillation) on the skill is analyzed and discussed. A multivariate statistical technique based on canonical correlation analysis has been developed recently for long-range

forecasting over Canada. Some of the results based on this technique will be discussed and prospects for developing operationally skillful long-range forecasts for Canada will be briefly considered.

Notes

Measurements of Biogenic Hydrocarbon Emissions from Native Canadian Trees

Byron Kieser

Centre for Atmospheric Chemistry, York University, 4700 Keele Street, Downsview, Ontario, M3J 1P3

Valerie Young

Centre for Atmospheric Chemistry, York University, 4700 Keele Street, Downsview, Ontario, M3J 1P3

Gordon Drewitt

Department of Geography, University of British Columbia, B.C.

Speaker: Byron Kieser

Time: Tuesday 11:15

Abstract

The emission of volatile (non-methane) hyrocarbons from trees is one of the largest global sources af reactive hydrocarbons. The use of numerical models to further our understanding of the chemical evolution of the atmosphere requires accurate information about the trace gas exchange between trees and the environment. Isoprene, a highly reactive hydrocarbon, is emitted by most tree species as a by-product of photosynthesis, and the instantaneous emission rate is a function of both light and temperature. A wide range of monoterpene hydrocarbons, which are also highly reactive, are continuously emitted by several species, as a function of temperature. The results of measurements made on a variety of native Canadian trees will be discussed. The tree species studied were: Black spruce, jack pine and quaking aspen, at remote boreal sites in Saskatchewan; douglas fir, black cottonwood, and hemlock in the Fraser Valley, B.C.; maples (silver, red, sugar, black and manitoba) at York University in Toronto. Emission rates for isoprene and a range of monoterpenes (alpha & beta-pinene, limonene, etc.) have been measured by an enclosure method or by a micrometeorological gradient method. The goal of the measurements is to characterize the emissions from important Canadian tree species and to develop algorithms useful in predicting emissions based on climatological data.

Notes

The Severe Weather Climatology of the Toronto Region: Effects of Lake Breezes

King, Patrick

Environment Canada (ARMA), 4905 Dufferin St, Downsview ON M3H 5T4

Leduc, Michael

Regional Centre: Toronto Office, 4905 Dufferin St, Downsview ON M3H 5T4

Speaker: King, Patrick

Time: Tuesday 16:20

Abstract

Animations of satellite and radar data will be used to illustrate the effects of lake breezes on the development of convection. THis will be compared with the severe weather climatology of southern Ontario to illustrate possible links. One case will use radar to illustrate the development of a tornadic storm which forms on a lake breeze front and moves counter to the flow aloft. Results indicate that weak tornadoes often form on lake breeze fronts just to the north and west of Metropolitan Toronto. Most of the severe weather which has occurred in the city proper appears to have been associated with derechoes and downbursts.

Notes

VGA compatible LCD panel for computer animation

The Barrie Tornado: A severe weather event triggered by a lake breeze?

King, Patrick

Environment Canada (ARMA), 4905 Dufferin St, Downsview ON M3H 5T4

Leduc, Michael

Regional Centre: Toronto Office, 4905 Dufferin St, Downsview ON M3H 5T4

Speaker: King, Patrick

Time: Tuesday 16:00

Abstract

Animated satellite and radar imagery will be used to illustrate the interaction of lake breeze induced convergence zones with cold fronts to produce severe weather. It appears that convergence zones associated with Lakes Huron and Erie often interact in the region of St marys, Ontario and extend north eastward. This provides a rich source of low level vorticity which may trigger tornadoes if the synoptic situation provides sufficient Convective Available Potential Energy and mid-level shear. An example will be shown which clearly illustrates this phenomenon on a non-severe day. A loop of satellite data from 31 May 85 will show some similarities which strongly suggest that the Barrie tornado was triggered by an encounter between a strong cold front and interacting lake breezes.

Notes

VGA compatible LCD panel for computer animation

A numerical study of the ERICA IOP2 marine cyclone

Kong, Fanyou

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A 2K6

Yau, M.K.

Same as 1

Speaker: Kong, Fanyou

Time: Thursday 13:55

Abstract

A numerical study is conducted using the MC2 non-hydrostatic, semi-Lagrangian semi-implicit limited-area model to investigate the evolution and structure of the second strongest extratropical marine cyclone during the ERICA (IOP2). Diagnosis of cyclogenesis based on the model output and some sensitivity tests are also carried out to study the influences of deep convection on the storm's explosive deepening process. For the later purpose, an explicit condensation scheme containing warm rain and ice-phase microphysics processes is developed within the MC2 framework. The control simulation successfully produces the observed cyclone's evolution and structure characteristics. The sea level central pressure falls 40 mb within 24 hours, 3 mb less than the observation. The 30 hour simulated low center deviates from the observation by less than 75km. The cloud signature is excellently in agreement with the satellite imagery. Besides the well simulated warm and cold frontal precipitation bands, the coastal frontal precipitation accompaning IOP2 storm is also successfully reproduced excepting some position deviation. Different condensation approaches can generate quite similar deepening rate

and storm track. However, the explicit microphysics scheme produces much stronger low level PV, especially along the cold front zones, and leads to more fully seclusion of the cyclone center as well. The inversion of PV anomaly of moist vs. dry run shows that the low and mid level diabatic condensation contributes a major role to the cyclone's deepening besides the horizontal thermal advection within the lower boundary.

Notes

Vortex Caps Atop Ocean Seamounts

Kunze, E.

Oceanography, U of Washington, Box 357940, Seattle, WA 98195-7940, USA

Speaker: Kunze, E.

Time: Thursday 15:25

Abstract

Velocity profiles and time-series collected over Fieberling Seamount in the eastern North Pacific reveal a 200-m thick anticyclonic vortex cap over the summit plain with relative vorticities ~O(-0.5f). This vortex cannot be interpreted as a Taylor cap. Current-meter records (Brink, 1995, J. Geophys. Res.) show a fortnightly modulation of the vortex strength of +/-0.5f, and the profilers find a negative potential vorticity core of -0.3fN^2 associated with the vortex core. These features suggest that tidal rectification is as or more important than Taylor-Proudman dynamics in maintaining the vortex against decay by the intense dissipative processes in the layer (turbulent decay timescales of 3 days).

Notes

Wave--mean-flow interaction theory in quasi-geostrophic and semi-geostrophic dynamics.

Kushner, P.J.

Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, NJ 08542 USA.

Speaker: Kushner, P.J.

Time: Thursday 08:45

Abstract

Linear quasi-geostrophic (QG) wave--zonal-mean-flow interaction theory, based on the Eliassen-Palm (E-P) flux diagnostics, has provided much insight into the way large-scale eddies drive the zonal-mean atmospheric general circulation. In this talk, two generalizations of the classical linear QG theory will be presented. First, it will be shown how the linear QG theory can be generalized to include the effects of finite amplitude disturbances. Second, it will be shown how the QG theory can be extended to semi-geostrophic (SG) dynamics. The theoretical approach underlying these generalizations is the use of the `pseudomomentum' wave-activity invariants, which are finite-amplitude generalizations of the classical E-P wave-activity. Significant differences between the QG and SG theories and implementation of the SG E-P flux diagnostics into the Canadian Middle Atmosphere model will be discussed.

Notes

Coupled Kelvin-wave and mirage-wave instabilities in semi-geostrophic dynamics

Kushner, P.J.

Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, NJ 08542 USA.

McIntyre, M.E.

Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Silver Street, Cambridge CB3 9EW, UK

Shepherd, T.G.

Department of Physics, University of Toronto, Toronto M5S 1A7, Canada

Speaker: Kushner, P.J.

Time: Tuesday 14:50

Abstract

A weakly unstable mode, associated with the phase-locked coupling of counterpropagating coastal Kelvin waves in the presence of barotropic shear, is found in semi-geostrophic (SG) dynamics. The SG mode accurately represents a similar mode found in the Euler equations as long as the aspect ratio of particle motion is much smaller than f/N, where f is the Coriolis frequency and N is the buoyancy frequency. In the opposite limit, in which particle motion is purely vertical, the Euler equations allow only the trivial solution but the SG equations support a `mirage' wave that exists in the absence of any physical restoring mechanism.

Notes

Estimating evaporation rate from lakes: comparisons between model formulations and turbulent closures

Kwan, Joyce

Centre for Research in Earth and Space Science, York University, Ontario, M3J 1P3

Taylor, Peter A.

Dept. of Earth and Atmospheric Science, York University, Ontario, M3J 1P3

Xu, Dapeng

Same as 2.

Speaker: Kwan, Joyce

Time: Tuesday 11:35

Abstract

Evaporation from lakes can be enhanced when cold air overlays a warm water surface. A similar phenomenon can also occur when a water body is subject to thermal pollution. Water vapour is transported away from the surface by turbulent diffusion. Because lakes (or reservoirs), unlike oceans, are of finite sizes and surrounded by various land surface covers, we should consider that lake evaporation can also be affected by changes in surface conditions from land to water surfaces, such as surface roughness and temperature, and can be influenced by upstream profiles of humidity and wind speed. These factors are also associated with the growth of an internal boundary layer. In this numerical study, lake evaporation by turbulent diffusion and local advection, associated with changes in the surface conditions below an internal boundary layer, are investigated. Water vapour fluxes from finite-sized open water surfaces are estimated in a two-dimensional implicit finite difference model. Turbulent closures used are the simple turbulent closure, commonly called "mixing length hypotheses" (Taylor, 1970 & 1971) and a second moment turbulent closure (Mellor and Yamada, 1982). Model results include airflow over step changes in various surface covers under neutral and non-neutral stratification. Comparisons are made with semi-empirical formulae, the Penman and mass transfer equations, where local advection has not been included. Comparisons are also made with available experimental data from small and medium sized lakes.

Notes

Precipitating systems over the Mackenzie River Basin: Climatology and numerical simulation of a cold season event

Lackmann, G. M.

Dept. of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke St. West, Montreal, Quebec H3A 2K6

Gyakum, J. R.

Same as 2.

Speaker: Lackmann, G. M.

Time: Tuesday 10:25

Abstract

A climatology of 600 precipitation events in the Mackenzie River Basin (MRB) is compiled using daily precipitation records from 12 surface stations from 1962 through 1989. These events are defined as calendar days on which at least 2.5 mm of precipitation is reported at 5 or more of the 12 stations. A characteristic cold-season synoptic evolution involves the eastward extension of a surface cyclone centered over the Gulf of Alaska into the southern MRB. Composites of this type of event, constructed using National Meteorological Center gridded data, reveal a warm-frontal structure and lee cyclone over the southern MRB at the onset of precipitation. The composite indicates that both lower-tropospheric thermal advection and topographically- forced upslope flow north of the lee cyclone are active in forcing ascent and precipitation. Composites of Q-vector divergence confirm the presence of quasi-geostrophic (QG) forcing for ascent over the southern MRB at the onset of precipitation. Planetary-scale flow anomalies evident in the 500 hPa geopotential height field include a ridge centered over the West Coast of the United States and a trough over the Gulf of Alaska. Enhanced geostrophic southwesterly flow between these features is hypothesized to facilitate moisture transport into the MRB from over the eastern Pacific Ocean. To test this hypothesis, the Mesoscale Compressible Community model (MC2) is used to simulate a representative case. The model adequately represents the lee cyclone and precipitation event. Calculations of vertically integrated moisture flux reveal a moisture plume advancing northeast from over the eastern North Pacific Ocean into the southern MRB at the time of the precipitation event. Piecewise quasi-geostrophic potential vorticity inversion confirms what is indicated by the composite: that the plume of moisture is transported into the MRB due in part to flow induced by the West Coast ridge and the Gulf trough.

Notes

2 overheads preferred (but not required)

Testing the Canadian Land-surface Parameterization Scheme (CLASS) for Subarctic Open Woodlands

Lafleur, P.M.

Department of Geography, Trent University, Peterborough, Ontario, K9J 7B8

Skarupa, M.R.

Applications of Modelling in the Natural and Social Sciences, Trent University, Peterborough, Ontario, K9J 7B8

Speaker: Lafleur, P.M.

Time: Wednesday 09:45

Abstract

The land-surface sub-component of the Canadian Climate Center general circulation model (CLASS) has been tested in stand-alone mode with several years of data from a subarctic open forest near Churchill, Manitoba. The open forest environment presents some interesting challenges for CLASS and discussion of optimization of the model to meet these challenges is presented. CLASS is shown to perform moderately well for unoptimized and optimized versions. Soil moisture deficits had the greatest effect on CLASS's performance. The need for improved hydrology in organic soil environments is recognized.

Notes

The Performance of the CANadian WAve Model, CANWAM, Against Moored Buoy Data

Lalbeharry, Roop

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Khandekar, Madhav

Same as 1.

Speaker: Lalbeharry, Roop

Time: Wednesday 11:55

Abstract

Through the collaborative efforts of the international WAve Modelling (WAM) Group, a state-of-the-art ocean surface wave model WAM has been developed and is being used in research or operational mode in many countries. A global version of the WAM is running in an operational mode at ECMWF (European Centre for Medium-range Weather Forecast), Reading, United Kingdom, and at FNMOC (Fleet Numerical Meteorology and

Oceanography Centre), Monterey, California, U.S.A. The Meteorological Research Branch of the Atmospheric Environment Service (AES) is in the process of implementing a regional version of the WAM called CANWAM in AES operational forecasting system. The CANWAM operates on two grids, one covering the northwest Atlantic and the other covering the northeast Pacific, with a grid spacing of 1.0 x 1.0 degree everywhere. The CANWAM is being driven by 10 m level winds generated by the Canadian Meteorological Centre (CMC) operational weather prediction models. A brief description of the wave model will be presented and results of preliminary verification of the wave model products against moored buoy data, as well as wave model products generated by the ECMWF and FNMOC global WAM models, will be discussed.

Notes

Preliminary Results from the Cyclone Frequency Diagnostic Subproject of the Atmospheric Model Intercomparison Project (AMIP)

Lambert, Steven J.

Canadian Centre for Climate Modelling and Analysis, Climate and Atmospheric Research Directorate, Atmospheric Environment Service, University of Victoria, P.O. Box 1700, MS 3339, Victoria, B.C., V8W 2Y2.

Speaker: Lambert, Steven J.

Time: Monday 14:45

Abstract

The Atmospheric Model Intercomparison Project compares the simulations made by the majority of the world's General Circulation Models. The simulations are performed using specified observed sea surface temperatures and sea ice extents for the ten-year period 1979 to 1988. The cyclone frequency climatology and its interannual variability as simulated by several models participating in the AMIP exercise is presented. The model simulations are compared to one another and, where possible, to observations.

Notes

Assessment of the mean albedo in the UQAM sub-scale cloud scheme for climate models.

Landry, Claude

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Blanchet, Jean-Pierre

Same as 1.

Speaker: Landry, Claude

Time: Wednesday 15:45

Abstract

Beside the macroscopic properties of clouds like coverage, water content, precipitation or structure, the climate simulations by models are sensitive to cloud optical properties. On a typical large scale model, the spatial resolution is too low to represent explicitly the high variance of cloud properties. The new cloud scheme developed at UQAM is based on a parameterization of subgrid turbulence to represent cloud variability. Using a method based on the Independent Pixel Approximation (IPA) of Cahalan (1989, 1994), we found that our cloud scheme reproduces well gamma distribution of optical depth by Barker (1995) and observed distributions of optical depth in stratocumulus clouds. The calculated mean albedo is on average 10% lower than the homogeneous distribution. Hopefully this model will provide better description of clouds in climate simulations and improve the global assessment of climate change.

Notes

Recent simulations of the Canadian Regional Climate Model (Invited)

Laprise, René

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Caya, Daniel

Same as 1.

Giguère, Michel

Same as 1.

Bergeron, Guy

Same as 1.

C\^{o}té, Hélène

Same as 1.

Speaker: Laprise, René

Time: Wednesday 13:50

Abstract

The Canadian RCM developed at UQAM is based on the MC2 (Mesoscale Compressible Community) model kernel developed by André Robert and colleagues of the Cooperative Centre for Research in Mesometeorology (CCRM). This MC2 model solves the fully elastic non-hydrostatic field equations by a semi-implicit and semi-Lagrangian marching scheme (Laprise et al. 1996, Atmos-Ocean). Two subgrid-scale physical parameterisation packages are available in this RCM: the Canadian GCMii (McFarlane et al. 1992, J. Clim.) and GCMiii (including CLASS surface scheme) packages. The results of recent simulations will be reviewed, including: * A study of development time of mesoscale details in a 45km simulation nested with T32 GCM data, * A comparison of 10 and 30 level simulations, * Preliminary results of 5 year simulations of 1x and 2x CO2 scenarios. On-going projects aimed at validating this RCM with observations will also be described.

Notes

A 3Dvar data assimilation system based on the incremental approach

Laroche, Stéphane

Data Assimilation and Satellite Meteorology Division, Atmospheric Environment Service, Dorval, Québec, H9P 1J3

Gauthier, Pierre

Same as 1.

Pellerin, Simon

Same as 1.

Speaker: Laroche, Stéphane

Time: Wednesday 16:25

Abstract

The background error statistics used in the current global and regional statistical interpolation of the Canadian Meteorological Center (CMC) are representatitve of the error averaged over a period of about two months and its correlations are assumed to be homogeneous and isotropic. This results in correlations having characteristic lengths larger than 300 km. The resolution of the analysis increments being controlled to a great extent by those of the correlations, a resolution of T80 (in triangular spectral truncation) seem to be sufficient to properly resolve the increments as long as the innovations are

computed with respect to the background state at the full resolution of the model. Following Courtier et al. (1994), an incremental approach has been introduced in the global 3D variational data assimilation system (3Dvar) developed to replace the currently operational statistical interpolation system this year (Gauthier et al. 1996). This substantially reduces the computational cost of the 3Dvar while keeping the results virtually unchanged. Results will be presented first on how this contributed to reduce the cost of the global variational analysis for the CMC operational spectral model at a resolution of T199L21. It will be shown how this approach can also be applied to obtain an analysis for a regional model by computing the innovations with respect to the regional forecast but producing the analysis increments globally at a lower resolution with only minor changes to the 3Dvar system. Preliminary results will be presented.

Notes

'CityView' and 'StingLess' - real-time radar support to the City of Edmonton.

Larochelle, Bruno B.

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Beaubien, Raymond

Northern Alberta Environmental Services Centre, Edmonton, Alberta, T6B 2X3

Nichols, Thomas R.

Atmospheric Environment Branch, Prairie and Northern Region, Edmonton, Alberta, T6B 2X3

Speaker: Beaubien, Raymond

Time: Wednesday 11:15

Abstract

A system to deliver customized real-time radar data to the City of Edmonton Transportation and Recreation departments has been developed and is being offered to the City as a commercial service. A low level Doppler scan from the Carvel radar facility provides the matrix of reflectivity data over the city. The City staff can view the data by running a custom designed viewing program, which allows interaction with the data. The program automatically retreives new data via the Internet every 10 minutes. The system drives two specific products: The 'CityView' product will be used by the drainage section of the Transportation Department to monitor storm rain rates and accumulations in real-time. This may help them decide where to divert water to prevent or minimize flooding. The product archive will be used by the drainage system design engineers, who can look at flooding events to analyse the problems with the system. The 'StingLess' product was

tailored to the Parks and Recreation department where it will be used for the mosquito land/air spraying program in the greater Edmonton area. The City currently maintains a network of 130 simple rain guages, which is read by a crew several times per summer. The 'StingLess' will provide an equivalent network of 900 rain guages in real-time. The department is also looking at using the product to increase the efficiency of tree watering operations.

Notes

SpotCast - a new forecast delivery system.

Larochelle, Bruno B.

Northern Alberta Environmental Services Centre, Edmonton, Alberta, T6B 2X3

Beaubien, Raymond

Northern Alberta Environmental Services Centre, Edmonton, Alberta, T6B 2X3

Speaker: Larochelle, Bruno B.

Time: Monday 11:45

Abstract

A forecast delivery system has been developed which promises to be able to deliver forecasts with high spatial and temporal resolution (a spot forecast) to a large clientele. The process starts with the Forecast Preparation Assistant (FPA), where NWP data are graphically edited and weather systems are described by the forecaster. Data from FPA are then sent to the SpotCast system (PC based), which processes the data and sends it to an Internet server. The final forecast products are delivered to the clientele via a viewing program, which runs on the client's home computer. This program has the ability to retrieve the appropriate forecast data package from the Internet and then interactively display the data to the user. The product is aimed at a fairly large market - small to medium sized weather sensitive operations. A few examples of the potential market... golf courses, ranchers, grain growers, road construction, snow removal, oil rigs, municipality maintenance etc. Billing of customers is done via a log file on the Internet server. The system is mostly a commercial services venture but may also be able to feed several base weather products at a typical Environmental Services Centre. Work is being done to see how SCRIBE data could be used to feed the system. Plans are to start offering the SpotCast products on a commercial basis by September 1, 1996.

Notes

The Role of Twilight in the Thermal and Dynamical Balance of the Polar Stratosphere.

Larocque, Marc

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Blanchet, Jean-Pierre

Same as 1.

Koshyk, J.N.

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada, M5S 1A7

Speaker: Blanchet, Jean-Pierre

Time: Thursday 14:35

Abstract

The so called cold pole problem has long been a systematic error in Global Circulation Models. In this paper, we show that the minute radiative heating due to twilight in the Sub-Antarctic region can trigger intense planetary wave activity along the stratospheric jet. As a consequence, the meridional heat flow due to transient and standing eddies increases 5 to 8 fold during Austral winter. The responsible forcing is a persistent solar heating spot anomaly of about 4C/day traveling around the Earth atmosphere with a one day period. This excess heat term has maximal impact when reaching the center of the stratospheric jet. A simplified parameterisation of twilight heating due to spherical geometry of the Earth's atmosphere is developed for the CCC MAM/GCM/RCM family and validated against detailed calculations.

Notes

Relationships among CCN, aerosol size distribution and ion chemistry from airborne observations over the Bay of Fundy in August-September, 1995

Leaitch, W. Richard

Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Li, S.-M.

Same as 1.

Liu, P.S.K.

Same as 1.

Banic, C.M.

Same as 1.

Macdonald, A.M.

Same as 1.

Isaac, George A.

Same as 1.

Couture, M.D.

Same as 1.

Strapp, J. Walter

Same as 1.

Speaker: Leaitch, W. Richard

Time: Thursday 16:25

Abstract

Observations of the number concentrations of cloud condensation nuclei (CCN) active at about 0.3% supersaturation and the size distribution of particles with diameters from 0.13-3 micrometres were made over the Bay of Fundy, Nova Scotia during August and September, 1995. Generally, the CCN concentrations were comparable to those of particles >0.13 (m. A notable exception to this statement was in smoke advected from a forest fire in which the CCN were numerous, but fewer than the measured particles. Overall, comparisons with the ion chemistry and physical data suggest that the measured inorganic ions, mainly sulphates, and organic ions determined much of the ability of the particles to act as CCN.

Notes

Improving the Medium Range Forecasts with the Canadian Meteorological Centre Ensemble Prediction System

Lefaivre, L.

Canadian Meteorological Centre Atmospheric Environment Service, Dorval, Quebec, H9P 1J3

Houtekamer, P.L.

Recherche en Prevision Numerique Atmospheric Environment Service, Dorval, Quebec, H9P 1J3

Speaker: Lefaivre, L.

Time: Thursday 10:55

Abstract

The underlying idea of ensemble forecasting comes from the fact that operational analyses are not perfect because of the unequal distribution of the observational network and variable quality of the observations. Thus the resulting analysis does not represent the "true" state of the atmosphere. Minor modifications to the analysis may in some cases improve the quality of the forecast. By integrating several "perturbed" analyses with a low resolution model, more information can be obtained than from only one forecast done at high resolution. This is because the mean of the forecasts can produce a better forecast (the averaging smooths out the unpredictable smaller scales) and that the spread in the forecasts can give an idea of its uncertainty. An experimental analysis cycle has been set to produce the perturbed analyses. This cycle uses different sets of observations and is driven by different models. The observations are perturbed by the addition of random values, of the order of their observational errors. Driving models are all at T63 resolution and use either different convection schemes or different parameters of physics options. At the moment, a total of 8 perturbed analyses and a control run (unperturbed observations and a "mean" driving model) are made on a regular basis, with 10 day forecasts done from 00Z analyses. All the forecasts are produced using the same driving model as the one used in the assimilation cycle. Perturbed analyses are available in quasi real time since January 1996, and ensemble forecasts up to day 10 have been compared to the operational model (T199). The root mean square (RMS) scores at 500 hPa, performed against radiosondes both for the operational model and the ensemble mean, show that ensemble mean forecasts over Northern Hemisphere improve upon the operational model as early as day 3. At the moment, the RMS spread within members of the ensemble seems too low, as it should be comparable to the RMS of the mean.

Notes

A finite element semi-Lagrangian ocean model using adaptive meshes

Le Roux, D.Y.

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Lin, Charles A.

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Staniforth, A.

Service de l'environnement atmosphérique, 2121, route Trans-canadienne, Dorval (Québec) H9P 1J3, CANADA

Speaker: Le Roux, D.Y.

Time: Thursday 16:05

Abstract

We use for the first time in ocean modelling the combination of finite element and semi-Lagrangian methods on an unstructured triangular mesh. A barotropic two dimensional flow is simulated by discretizing the shallow water equations. The semi-Lagrangian treatment of advection is combined with a semi-implicit treatment of gravitational oscillations, which ensures second-order accuracy in time with Courant numbers that exceed unity. The treatment of Rossby waves is at least fourth order accurate on an unstructured mesh. Experiments in the Gulf of Mexico are performed with realistic bathymetry. We simulate the trajectory of a typical anticyclonic eddy shed off the Loop Current. An anisotropic mesh generator can be used effectively to improve both accuracy and efficiency of the model.

Notes

video

Chemical and Physical Characterizations of Atmospheric Aerosols over Southern California During Lidar-In-Space Technology Experiment (LITE)

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Macdonald, A.M.

Same as 1.

Strapp, J. Walter

same as 1.

Speaker: Li, S.-M.

Time: Thursday 13:35

Abstract

In September 1994 during the Lidar-In-Space Technology Experiment (LITE), aerosol particles have been characterized over southern California. Several aspects of aerosol particles were investigated. It was found that (1) High levels of particle chemical concentration were found at altitude from near surface level to 6.5 km; (2) Soluble organic mass in particles, from the sum of the measured organics, was about 9% of the total particle mass (TPM), and was evenly divided among 5 organic. (3) Measured ions were not in ionic balance unless the derived H+ ion was included. (4) Accumulation mode aerosol particles contained high levels of nssSO4= and NH4+, which accounted for about two thirds of the particle mass in this size range. (5) The organics in particles have lower refractive indices than sulfate. (6) The particle volume size distributions shows two populations. Reasons and implications of these results will be discussed.

Notes

Atmospheric Transient Activity and Mean-Seasonal States in the North Pacific

Lin, Hai

Dept. of Atmospheric \& Oceanic Sciences and Centre for Climate and Global Change Research, McGill University, Montreal, Quebec H3A 2K6

Derome, Jacques

Same as 1.

Lin, Charles A.

Same as 1.

Speaker: Lin, Hai

Time: Monday 11:15

Abstract

The atmospheric transient activity and its implication for seasonal predictions is investigated for two different flow regimes in the North Pacific. Using observed data, as well as the output from two models (a GCM and a simple Q-G model), it is shown that there is much weaker subseasonal transient activity over the North Pacific when the mean-seasonal anomaly in that region is cyclonic than when it is anticyclonic. In view of the above, it is hypothesized that during winters with a cyclonic mean-seasonal anomaly in the North Pacific, the atmospheric response to an external steady forcing would be less

distorted by the transient eddies, and hence more predictable. To test this hypothesis, an ensemble of six AMIP simulations for the same 10 years conducted at the Canadian Centre for Climate Modelling and Analysis is analyzed. It is shown that during winters when the AMIP ensemble mean has a cyclonic seasonal anomaly in the North Pacific, the scatter among the six runs for that winter is smaller than that for a winter with an anticyclonic flow anomaly. A comparison between the ensemble-average mean-seasonal forecasts and the observations also shows that the forecast error in the North Pacific is positively correlated with the ensemble-mean 500 hPa geopotential height in that area. The above results, based on a relatively small sample, suggest that the quality of mean-seasonal forecasts will depend on the nature of the flow regime, and that an expanded study based on more cases and different geographical areas would be warranted.

Notes

A Quasi-geostrophic Global Atmospheric Model with Simplified Heat Flux from the Ocean

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Lin, Charles A.

Same as 1.

Derome, Jacques

Same as 1.

Speaker: Lin, Charles A.

Time: Monday 15:05

Abstract

The Molteni-Marshall three-level quasi-geostrophic global model is modified to include the latent and sensible heat exchange with the underlying ocean, as a first step toward a air-sea coupled model for climate variability study. The heat exchange in the model is parameterized by the difference between temperature in the lowest layer of the model and the observed climatological sea surface temperature. The wind speed at the lowest level is also taken into account in the simulation of the exchange coefficient.. A 31485-day perpetual winter integration is made, which can be divided into 300 independent winters of 90 days by omitting the 15 days between consecutive 90 day periods. Diagnoses are made to assess the performance of the model. The simulated climatology of winter mean geopotential height and transient activity are in general agreement with the observations.

Meridional transports of heat and momentum in the model atmosphere are quite reasonable. We also observe significant interannual variations in the 90-day averaged 500 hPa geopotential height, with its leading EOF mode being similar to PNA pattern. Longer integrations (131072 days) are conducted to examine decadal to interdecadal variability in the model. The spectrum averaged over 10 such runs shows some structure with a red background.

Notes

Coupled Global Atmosphere-Ocean Modelling with a Simplified Atmosphere

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Greatbatch, R.J.

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Kozlowski, J.

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Lin, Hai

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Speaker: Lin, Charles A.

Time: Thursday 11:15

Abstract

A quasi-geostrophic atmospheric model has been coupled to a primitive equation ocean circulation model for climate studies. The atmospheric component is based on the 3-level T21 spectral model of Marshall and Molteni, modified to allow for sensible and latent heat exchange at the air-sea interface. The oceanic component has 12 levels, and a spatial resolution of 4.5 and 3.75 degrees in latitude and longitude respectively. The atmospheric model dynamically resolves the synoptic variability due to baroclinic distrubances. A flux adjustment is used in the coupling procedure. We present results of a 200 year simulation of the coupled model.

Notes

A Simulation of the Effects of Gulf of Mexico Sea Surface Temperature Anomalies using the Canadian Regional Climate Model

Shao, Y.

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Lin, Charles A.

Same as 1.

Laprise, René

Department of Earth Sciences, University of Quebec at Montreal Montreal, PQ H3C 3P8

Speaker: Lin, Charles A.

Time: Tuesday 11:35

Abstract

The Canadian Regional Climate Model(CRCM) has been used to investigate the effects of Gulf of Mexico sea surface temperature (SST) anomalies on the regional climate. Two sets of experiments have been performed, consisting of a control run and simulations with two different imposed Gulf SST anomalies. The first is a uniform increase or decrease of the SST by 5K over the entire Gulf. The second uses SST anomalies characteristic of warm core rings shed off the Loop Current in the Gulf. The experiments are carried out for either 15 or 30 days, and statistics are computed after discarding the first 5 days of the integration. The response to the SST anomalies are qualitatively similar in the two cases, except the response to the 5K SST anomaly over the entire Gulf is stronger due to the much larger extent of the anomaly. For a positive SST anomaly, the precipitation and moisture over the Gulf and the southeast U.S. both increase. The 1000 mb temperature field shows a clear warming over the Gulf and adjacent areas, delineating the imposed SST anomaly. A low level cyclonic circulation forms over the Gulf and southeast U.S. region, while an anticyclonic flow develops at the upper levels. An analysis of the vorticity budget will be presented.

Notes

A version of this Abstract was inadvertently submitted on February 20 as "The Effect of Gulf of Mexico Sea Surface Temperature Anomalies on the Climate of Canadian Regional Climate Model", by Lin, Laprise and Shao. The current version supercedes the earlier version. Sorry about the inconvenience caused!

A Z-R relationship for Alberta

Lingyan Xin

Northern Alberta Environmental Services Centre, Edmonton, Alberta, T6B 2X3

Speaker: Lingyan Xin

Time: Wednesday 11:35

Abstract

Data from the City of Edmonton rainguage network (18 guages) have been corellated with data from the Carvel Doppler radar data from 1991-1995 in order to derive a new Z-R relationship for convective rain in Alberta. This new relationship will be used to improve the accuracy of rainfall amounts and rates for the NAENSC operations and real-time radar products which are being delivered to the City. The relationship may eventually be used at other prairie radar sites if it proves to be more accurate than the current Marshall-Palmer relationship currently in use.

Notes

Explicit Simulation of Hurricane Andrew (1992) with MM5

Yubao Liu

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Da-Lin Zhang

Same as 1.

M.K. Yau

Same as 1.

Speaker: Yubao Liu

Time: Thursday 14:15

Abstract

In this study, we attempt to simulate explicitly the internal structures and evolution of Hurricane Andrew (1992) using the non-hydrostatic, triply nested mesh (54/18/6-km) and movable grid version of the PSU/NCAR mesoscale model (MM5, Grell et al. 1995). The

54/18-km mesh model is initialized at 1200 UTC 21 August 1992, when the storm began to deepen, with the NMC analysis that is enhanced by rawinsondes and the Navy SST field. A bogus mesovortex is introduced into the initial conditions to represent the early circulation of the storm. The 6-km mesh model is initialized at 1500 UTC 22 with the data interpolated from the 18-km simulation and then integrated for 45 h, covering the most rapid deepening stage of the system and its landfall over the Florida peninsular. The modified Betts-Miller scheme coupled with the Tao microphysics scheme is used for the 18- and 54-km mesh integrations, whereas the storm is explicitly simulated over the 6-km mesh using Tao's 5-category microphysics package. We have obtained an extremely successful simulation of Hurricane Andrew, such as its track, minimum pressure at 920 mb, the deepening rate of 72 mb in 36 h, eye-wall structures and spiral rainbands, as verified against real-time satellite observations, Miami's radar data, surface reports and aircraft data. For example, Figure 1 shows that the simulated evolution of Hurricane Andrew's central pressures and maximum surface winds compares favorably to the observed. Figure 2 provides a 3-D view of the rain field (rain mixing ratio > 0.03 g kg-1), superposed with wind vectors at h = 800m at the landfall (i.e., 0800 UTC 24 August) of the hurricane. (The terrain height is contoured at 5-m intervals.) It is apparent that the MM5 simulates very well the compact eye, intense eyewall, and spiral rainbands of the hurricane, as compared to that observed by the Miami radar (Wakimoto and Black, 1994). A strong wind ring, > 60 m s-1, is also evident near the eyewall. The 6-km explicit simulation also produces many meso-beta-scale features that are similar to those published in the previous hurricane case studies and conceptual models. The impacts of using different cumulus parameterization and grid-scale microphysics scheme as well as other physical processes have been examined. It is found that cloud microphysics plays an important role in reproducing the right intensity of the storm. The results reveal that appropriate bogusing of the initial vortex, use of the non-hydrostatic high resolution model, proper cloud microphysics parameterization and the realistic SST field are instrumental in generating the observed internal structures and evolution of Hurricane Andrew.

Notes

slide

A Parameterization for Moist Convective Adjustment including Slantwise Convection

Ma, Liang

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Yau, M.K.

Same as 1.

Speaker: Ma, Liang

Time: Tuesday 10:05

Abstract

The global distribution of Slantwise Convective Available Potential Energy (SCAPE) and Convective Available Potential Energy (CAPE) are obtained from an analysis of the CMC global dataset. Significant areas of SCAPE were found over the mid- to low-latitude oceans. In most regions, SCAPE coexists with CAPE, and the excess of SCAPE over CAPE can be comparable to the magnitude of CAPE itself. Because areas with SCAPE are extensive and present NWP models and GCMs generally do not include slantwise convection, it is desirable to develop a generalized parameterization for moist convective adjustment including slantwise ascent. To include both upright and slantwise convection in a baroclinic atmosphere, an analytic Lagrangian parcel model in a two dimensional plane perpendicular to the thermal wind in a conditionally unstable state was constructed. It was found that saturated parcels when displaced first move more or less vertically with a convective time scale until it reaches the point of neutral buoyancy for vertical convection. Thereafter they move laterally with an inertial time scale until the point of neutral buoyancy for slantwise convection. During the process, heat is transported vertically and momentum is transported in a slantwise direction. Based on this work and other studies in conditional symmetric instability (CSI), a generalized moist convective adjustment scheme was constructed. When the atmosphere is conditionally unstable to slantwise convection only, the absolute momentum is adjusted to a constant value along a surface of neutral buoyancy. When the atmosphere is conditionally unstable to vertical convection, the thermodynamic field is adjusted vertically with the convective time scale to yield a reference state neutral to vertical convection. The absolute momentum is adjusted to a slantwise neutral state relative to the new reference thermodynamic state. This step is justified because momentum transport is assumed to occur on a much slower inertial time scale. Results of applying this parameterization in some idealized conditions will be presented.

Notes

Simulations of a mesoscale storm using a quasi-nonhydrostatic model

MacDonald, A.E.

Forecast Systems Laboratory, Boulder, Colorado, USA

Lee, J.L.

Same as above

Speaker: Lee, J.L.

Time: Thursday 13:15

Abstract

In rescent years, a new type of limited-area model has been developed to accurately describe smooth atmospheric motions. These models have been proven to be well-posed by slowing down the speed of the vertically propagate gravity waves rather than increasing their speed to infinity as in the hydrostatic primitive equations. Consequently, the lateral boundary problem for the hydrostatic limited-area model is always ill posed, whereas boundary conditions for these well-posed models can be chosen so that solutions exist and are smooth up to the boundaries. A quasi-nonhydrostatic (QNH) and fully compressible model has been developed based on the mathematical foundations of well-posedness. The physical packages currently in QNH include an explicit cloud physics parameterization suitable for NWP, the Mellor-Yamada turbulent scheme, a broad-band radiation parameterization, a surface-energy budget package, and dissipation. The QNH model have been tested through various analytic solutions for different scales of motion, e.g., the meso-alpha and meso-beta scales. These test cases include dynamical frontogenesis processes, mountain waves, hurricane (typhoon), vortex, sea-breeze, etc. The QNH model is currently applied to the real data case for the March 9th storm of 1992. The Mesoscale Analysis and Prediction System (MAPS) data on the 12Z, March 8 are initialized as initial data for the QNH model. The boundary data are interpolated from the 3-h MAPS analysis data. The QNH model is able to accurately simulate the mesoscale storm during its life span. The simulated storm smoothly enters the model domain from the western boundary and moves across the model domain and finally exists from the eastern boundary after 48 hours. We believe the smooth transition of lateral boundary flow shown in QNH is due to its well-posedness formulation which is theoretically impossible for the ill-posed hydrostatic model.

Notes

overhead transparency projectors

Frontal Wave Generation in the Nongeostrophic Eady Problem

MacKay, M.D.

Atmospheric Environment Service, Climate Processes and Earth Observation Division, Downsview, Ontario, Canada.

Moore, G.W.K.

Dept. of Physics, University of Toronto, Toronto, Canada.

Speaker: MacKay, M.D.

Time: Monday 14:25

Abstract

\begin{center} ABSTRACT \end{center} The generation of mesoscale frontal waves in a two-dimensional primitive equation frontogenesis model is investigated. Frontogenesis is forced by the shearing-deformation induced by a growing baroclinic wave. Some of the mathematical properties of the (inviscid) model are briefly discussed before results of a nonlinear simulation are reported. In particular, the mathematical model is shown to conserve potential vorticity (materially), as well as total energy for the case of uniform background shear. A nonlinear numerical model is then used to simulate the lifecycle of a nongeostrophic two-dimensional Eady wave. The numerical model incorporates simple eddy viscosity so that integration beyond frontal collapse can be examined. A stationary wave was found to develop near the surface front just prior to frontal collapse in the lower 4 km of the domain. It has been suggested in previous studies that such waves produced in frontal zones are in fact gravity waves, though no such identification is attempted here. The wave eventually develops into a split frontal updraft which forces another stationary wave extending up the tropopause fold and along the tropopause, though only weak penetration into the stratosphere was observed.

Notes

The validation of the Canadian Oxidants Mechanism using Smog Chamber Data

Makar, P.A.

Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, Canada, M3H 5T4

Li, S.-M.

Same as 1.

Bottenheim, J.W.

Same as 1.

Shepson, P.B.

Departments of Chemistry and Earth and Atmospheric Sciences, Purdue University, Indiana, USA

Speaker: Makar, P.A.

Time: Wednesday 16:25

Abstract

The validation and testing of a new gas-phase chemical reaction mechanism for tropospheric chemistry modelling is described. The mechanism makes use of recent

advances in our knowledge of hydrocarbon reaction pathways to result in significant improvements over earlier work for the modelling of nitrogen oxides, ozone and volatile organic compounds. Numerical simulations using the new mechanism are compared to measurement data from controlled experiments in smog chambers. Numerical simulations and comparisons to the Acid Deposition and Oxidant Model mechanism are also made. The latter reaction mechanism has been used in several Canadian regional air quality models. The difficulties and caveats in the use of smog chamber data will also be discussed. For some chambers and for less reactive hydrocarbons, reactions occurring on the wall are inferred to have equal or greater importance than the gas-phase chemistry. For these hydrocarbons, the chamber data can be of little use in mechanism validation. For more reactive hydrocarbons, these problems have a relatively minor effect on the simulation results.

Notes

The updateable model output statistics

Marcel Vallée

Recherche en prévision Numérique, 2121 Trans-Canada Highway, Dorval, Québec, H9P 1J3

Laurence J. Wilson

Atmospheric Environment Service, 4905 Dufferin, Downsview, Ontario, M3H 5T4

Speaker: Marcel Vallée

Time: Thursday 11:15

Abstract

The updateable model output statistics (UMOS) procedure has been proposed as a way of keeping MOS equations up to date in an environment of frequently changing operational models. We have begun a project to implement a UMOS system at CMC to replace the current operational statistical perfect prog (PP) interpretation system at the Canadian Meteorological Center (CMC). Perfect prog equations have been run operationally at CMC for several years. While these require little maintenance effort, they have gradually become outdated in the face of much higher resolution operational models. The resolution of model variables is now much greater than the resolution of observational (analysis) datasets available to develop of PP equations. This, along with the greater variety of predictors available from models has intensified the impetus to replace the PP equations with MOS equations. The main features of the new system are its "operational" development design, by which most of the data preparation for equation development is done automatically in real time; and the method of blending data from a new model with data from the previous model to ensure both stability of the equations and early use of

data from the new model. The result is a smooth and early transition from equations based on the old model version to equations based on the new model version, that is, a responsive MOS development methodology. The first predictand to benefit from UMOS is probabilty of .2mm water equivalent or more of precipitation (POP) over a 6 hour period. At this moment, the UMOS system is still in development but preliminary verification results of this first application will be presented and compared with the current PP forecasts.

Notes

Overhead projector

An Investigation Into the Beaufort Sea Gyre Reversal

Mavriyannakis, John

Department of Physics University of Toronto 60 St. George Street Toronto, Ont

Moore, G.W.K.

Department of Physics University of Toronto 60 St. George Street Toronto, Ont

Speaker: Mavriyannakis, John

Time: Monday 17:15

Abstract

North America's Arctic is a region of vast climatological diversity, and the Beaufort Sea Gyre Reversal is merely a single, yet interesting facet this diveristy. The Beaufort Sea Gyre Reversal represents a changing in the relative motion of the gyre from being cyclonic, to being anti-cyclonic due to the instalation of a low pressure system in the polar region. It is hypothesized that the time of the reversal is dependent on the introduction of a decrease in temperature as brought on by the autumn season. The results that have been revealed indeed support the idea that the reestablishment of the cyclonic motion of the Beaufort Sea Gyre does on average occur at the beginning of the autumn season. There is though variability in the time of the reversal and it is this temporal variation in the development of this reversal then was the main focus of this research. As well, the affect of ENSO events on the inception of this event were also examined and a strong signature of this event is evident in the results that have been attained.

Notes

Poster Presentation

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

Zwack, Peter

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Olivier Hamelin

Ecole Nationale de la Meteorologie, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Santurette, Patrick

SCEM, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experiemental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies amoung the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the cause of a region of upward motion or pressure falls provided the forecaster with enought confidence to follow the model guidence. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes

Ozone photochemistry in the Canadian Middle Atmosphere Model

McConnell, John C.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

de Grandpré, J.

Same as 1.

Sandilands, J.W.

Same as 1.

Beagley, S.R.

Same as 1.

Speaker: McConnell, John C.

Time: Thursday 08:45

Abstract

The modelling of ozone photochemistry is one of the main components of the next generation of middle atmosphere models. It is an essential tool for the assessment of the impact of the natural and anthropogenic perturbations on the middle atmosphere. The chemistry module incorporated in the Canadian MAM model(see poster) has provided a means of studying the coupling between dynamic and chemistry processes. The module runs on-line and can also be used to study the feedback on the general circulation by radiatively active species such as ozone, water vapor and methane. The current version includes essentially gas phase processes but work is under way to also incorporate some parameterization of heterogeneous processes. From the latest model results, some details of the odd-oxygen budget due to various catalytic cycles will be presented. The analysis will show the contribution of the HOx, NOx and ClOx chemistry in the lower stratosphere, the NOx domination of loss in the upper stratosphere as well as the domination by water related chemistry in the mesosphere. Other results showing the feedback on the temperature field due to ozone photochemistry will be presented.

Notes

QILAK: a global chemical transport model for studying tropospheric chemistry and transport.

McConnell, John C.

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Templeton, Edna M.J.

same as 1

de Grandpré, J.

Same as 1.

Beagley, S.R.

Same as 1.

Kaminski, Jacek W.

Same as 1.

Speaker: McConnell, John C.

Time: Wednesday 16:45

Abstract

We are developing a 3-D global chemical transport model (QILAK) to study oxidant chemistry in the troposphere and lower stratosphere from the surface to 10 mb . The model can be driven by climatological or objectively analysed (OA) wind fields. The semi-Lagrangian transport code was supplied by Phil Rasch (NCAR) and uses shape-preserving interpolation. At present we use the vertical resolution of the wind fields. Convection is based on the Prather scheme with statistics from the CCC climate GCM. Simple rain out is included, also using statistics from the climate model. Dry deposition is specified as a velocity, with a land/ocean mask. The oxidant chemistry scheme includes O$_x$, NO$_y$, HO$_x$, C2-C4 alkanes, C2-C3 alkenes, C1-C2 carbonyl compounds and PAN. There are 38 chemical species in all, with 70 chemical reactions and 17 photolysis reactions. Global monthly surface emission fields for NO$_x$, CO and NMHC represent the estimated seasonal influx due to anthropogenic, biomass burning, biogenic and natural sources, including lightning. A 1-year model simulation using the 1994 6-hour OA wind fields from the Canadian Meteorological Centre forecast Model, SEF, at T32 horizontal resolution ($\sim$4° x 4°) will be presented. Validation of the model is proceeding by comparing our results with observations. The effects of convection are evident in many of the fields: in particular the CO fields show the effects of tropical biomass burning and the lofting of the combustion products into the upper troposphere. Similar effects are evident in the MAPS and TROPOZ CO data sets. We will present a comparison of the results with an emphasis on hydrocarbons and CO.

Notes

A new tool in meteorological and climate research

Hudak, D.R.

Atmospheric Environment Service, King City, Ontario

McCoubrey, Andrew

Dept. of Electrical Engineering, McGill University, Montreal, Quebec

Synergy, R. P.

Synergistic Researches, Toronto, Ontario

Maksh, M. A.

Mark IV Industries, Mississauga, Ontario

Speaker: McCoubrey, Andrew

Time: Monday 17:15

Abstract

The Race to the Stratosphere Project seeks to re-establish meteorological kites as important tools for scientific research. Its goals are threefold. They are firstly to demonstrate that high altitude kite ascents are possible; secondly to develop and test modern electronic equipment for gathering accurate and precise scientific information; and thirdly to establish that high altitude kites provide a cost effective means of providing stable airborne instrument platforms for a variety of applications. Model simulations indicate that a single kite on a single string could reach an altitude 4000 m and multiple kites on a single string could reach 10000 m. In both cases the kite line drag is the height limiting factor in the ascent. The kite will be built in the shape of a small biplane tethered to a smart winch at the ground. A computer, as small as a postage stamp, will acquire data and pilot the kite. The most suitable atmospheric condition in which to carry out the initial experiments is in the mountain waves to the lee of The Rockies. Historical records indicate that Southwestern Alberta during the autumn has a maximum in frequency of lee waves. Current technology would permit the measurement by kites not only of basic fields such as pressure, temperature, humidity, and winds but also derived fields such as aerosol components, ozone concentrations, electric fields, solar and infrared radiation fields and turbulence. It is concluded that kites could be a valuable tool in meteorological and climate research.

Notes

poster

Coupling of Prognostic Clouds and Convection in a Radiative-Convective Model of the Tropical Atmosphere

McFarlane, N.

Canadian Centre for Climate Modelling and Analysis, Atmospheric Environment Service, University of Victoria, PO Box 1700 MS 3339, Victoria, British Columbia, Canada V8W 2Y2

Abdella, K.

Same as 1

Speaker: McFarlane, N.

Time: Tuesday 09:45

Abstract

Recent studies (e.g. Hu and Randall, 1995) have demonstrated that low frequency oscillations in the tropics may arise in response to coupling between radiative cooling, latent heat release in cumulus convection, and surface fluxes of heat and moisture. We have found such responses in experimental simulations made with a radiative-convective model which includes a column version of a new physical processes module for the CCCMA GCM. In addition to a state of the art radiation scheme this new module also includes a prognostic cloud water scheme, a cumulus mass flux convective parameterization, and a boundary layer scheme which is based on a new second order turbulent closure formulation using a prognostic equation for turbulent kinetic energy. The new module will be described briefly and results from various sensitivity experiments made with the radiative-convective model are presented to demonstrate the nature of the simulated temporal variability and its sensitivity to aspects of the cloud microphysical parameterizations.

Notes

Observations of Atmospheric Tides by the Wind Imaging Interferometer (WINDII) on the Upper Atmosphere Research Satellite

McLandress, C.W.

Institute for Space and Terrestrial Science, 4850 Keele Street, North York, Ontario, M3J 3K1

Shepherd, G.G.

Centre for Research in Earth and Space Science, York University, North York, Ontario, M3J 1P3

Solheim, B.H.

Same as 2.

Speaker: McLandress, C.W.

Time: Thursday 13:15

Abstract

Remote sensing of the earth's atmosphere by satellite has proved invaluable to our understanding of the dynamics of the earth's middle and upper atmosphere. Data from the Upper Atmosphere Research Satellite (UARS), which was launched in September 1991 and is still in operation, have provided an unprecedented view of this region. This talk focusses on the Wind Imaging Interferometer (WINDII), one of the ten instruments on board UARS. A brief discussion of how WINDII actually measures winds is followed by a description and presentation of some of the analyzed wind data. Attention is focussed on atmospheric tides which are a dominant component of the circulation at these altitudes and readily seen in the WINDII data.

Notes

Assessing the impact of a wavelength-dependent non-Lambertian reflecting surface on the calculation of J-values

McLinden, Chris A.

Dept. of Physics and Astronomy, York University, North York, Ontario, M3J 1P4

McConnell, John C.

Same as 1.

Griffioen, Erik

Same as 1.

McElroy, C. T.

Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Speaker: McLinden, Chris A.

Time: Wednesday 15:45

Abstract

An important quantity in the accurate calculation of the rates of photodissociation of atmospheric species (J-values) that photolyze in the visible and near UV in the atmosphere is the surface albedo since much of the extra-terrestrial solar flux is transmitted to ground. We have developed a technique to estimate a wavelength-dependent albedo, valid for any type of surface as long as a functional form for the bi-directional reflection function can be specified. This technique has been applied towards estimating the wavelength-dependent effective ocean albedo along the flight track of a NASA ER-2 high altitude research aircraft in the range 300-770 nm. All estimates of albedo make use of nadir radiance measurements from a spectroradiometer installed on the wing of the ER-2 combined with results of a multiple-scattering model. The flights used were part of the ongoing STRAT (Stratospheric Tracers of Atmospheric Transport) campaign. Calculations have been made for both Lambertian and non-Lambertian surfaces. In the case of the non-Lambertian surface, an attempt was made to account for the specularly-reflected component (in the absence of clouds beneath the aircraft) and the anisotropy of cloud reflected radiance (in the presence of clouds beneath the aircraft). In addition, J-values for O(^{1}D), NO$_2$ and NO$_3$ are calculated and the effect of assuming a Lambertian vs. non-Lambertian surface is assessed as well as a wavelength-dependent vs. wavelength-independent albedo.

Notes

The parameterization of gravity wave momentum deposition based on the unified Doppler spreading-diffusive theory of wave spectra

Medvedev, A.S.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Klaassen, G.P.

Same as 1.

Speaker: Medvedev, A.S.

Time: Monday 14:45

Abstract

We present a new subgrid parameterization of gravity wave (GW) drag for GCMs. The scheme is based on our recent theory of GW spectra. Our approach treats the low-frequency part of the GW spectrum as an additional background flow for higher-frequency waves. Interactions of harmonics with the nonlinear induced wind produce

frequency shifting and amplitude damping. The unified theory combines aspects of Hines' Doppler spreading theory with the diffusive theory of Weinstock. Evolution of vertical wavenumber spectra with height and an associated GW drag are computed in the parameterization. The numerical scheme has been tested in the mechanistic version of NCAR Community Climate Model 2 and in the Canadian Middle Atmosphere Model, a general circulation models that extend to the mesosphere. A Universal form of spectrum was taken as a source of GW in the troposphere. Results of simulations suggest that parameterizations based on a separate account for extra- and intrawaves (i.e., waves going faster or slower than a local mean wind) cannot successfully reproduce the observed wind structure. A more general version of our scheme, which takes into account both extra- and intra-harmonics in the creation of the RMS wind associated with waves, allows us to significantly improve the model results. Details of the implementation and the sensitivity of the scheme to the shape of the source spectrum will be discussed.

Notes

Adjustment of atmospheric motions towards nonlinear balance: the slow manifold and ``spontaneous'' gravity wave generation

Medvedev, A.S.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Klaassen, G.P.

Same as 1.

Speaker: Medvedev, A.S.

Time: Wednesday 10:05

Abstract

A multiple time scale asymptotic technique is used to analyze interactions between vortical modes with non-zero PV, and divergent gravity wave (GW) motions. This dynamics can be represented as a ``slow'' transport of PV associated with vortical motions, and a ``fast'' redistribution of divergence over surfaces of constant PV by GW. We have shown, that the curvature of this surfaces defines the strength of wave forcing, while the time scale of balanced motions control the time scale of forced waves. If the system described by primitive equations allows for a spatial dispersion of excited ``free'' GW, they propagate away minimizing the energy for a fixed distribution of PV. The remaining non-propagating low-frequency ``evanescent'' waves constitute higher order corrections to a pure vortical (geostrophic) balance. If all GW are ``evanescent'', the ``superbalance'' or slow manifold is established. However, this state can be disturbed by the ``spontaneous'' generation of transient GW. The mechanism of this generation is shown to be Doppler shifting of ``evanescent'' harmonics into a propagation range with

intrinsic frequencies greater than the inertial one. Once they appear near the source region, these transient waves propagate away with ``fast'' group velocities. It has been shown in our analysis, that although GW do not contribute to PV, they participate in an advection of PV, and hence take part in determining the evolution of the balanced state. Therefore ``spontaneous'' generation introduces an uncertainty to the evolution of the ``balanced'' flow. The parameterization of gravity wave sources associated with the described mechanism has been developed and implemented into our recent spectral parameterization of GW spectra and GWD drag (Medvedev and Klaassen, JGR, 1995). Results of numerical calculations using high resolved CMC data show aspects of this mechanism, and demonstrate that these sources produce wave amplitudes and wave drag which are consistent with those found in observations and general circulation models.

Notes

Assimilation de mesures du contenu total d'ozone avec un système d'assimilation variationnelle 3D

Mereyde, F.

Direction de la Recherche en Météorologie, Environnement Canada, Dorval, Québec

Génin, Y.

Same as 1

Gauthier, Pierre

Same as 1

Ritchie, Harold

Same as 1

Dastoor, A.P.

Same as 1

Speaker: Mereyde, F.

Time: Wednesday 14:15

Abstract

En considérant, en première approximation, que l'ozone se comporte comme un traceur passif, le modèle spectral canadien est utilisé pour produire des prévisions dynamiques du champ d'ozone. Pour ce faire, le toit du modèle a été élevé à 1 hPa et une coordonnée

verticale hybride est utilisée. Ces changements apportés au modèle sont décrits dans Ritchie (1996). L'analyse variationnelle 3D de Gauthier et al. (1996) a été adaptée pour pouvoir assimiler des mesures du contenu total en ozone et produire des analyses du champ d'ozone. Les premières expériences utilisent des analyses aux 24-hres de la distribution horizontale du contenu total en ozone provenant du NMC et ces données artificielles sont assimilées pour tester la qualité de l'analyse qui en résulte. Des prévisions sont ensuite produites et utilisées pour raffiner notre estimé des statistiques d'erreur de prévision. Dans un deuxième temps, des données réelles sont assimilées: ces données proviennent de l'estimé du contenu total en ozone tel que mesuré par TOVS. Les covariances d'erreur d'analyse sont produites en quelques points sélectionnés pour estimer la qualité de l'analyse. Finalement, au moment de la conférence, des analyses préliminaires utilisant des données de GOME (Global Ozone Monitoring Experiment) seront présentées.

Notes

Synthetic blocking onsets

Michelangeli, Paul-Antoine

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Vautard, Robert

Laboratoire de Météorologie Dynamique du CNRS, université P. et M. Curie, boite 99, 4 place Jussieu, 75252 Paris cedex 05, France

Speaker: Michelangeli, Paul-Antoine

Time: Thursday 09:45

Abstract

A large part of the low-frequency extratropical variability is due to the occurrence of some particular large scale circulation flow patterns, the weather regimes. Although the spatial structures of these atmospheric states are actually correctly known, their transitions, consequently their onsets, are poorly understood. Onset of the european blocking is studied in terms of large and small scale behaviour. It is found to be related to the simultaneous occurrence of an enhanced baroclinic wavetrain and a particular phase of a retrograding high-latitude wavenumber 1 influenced by a Branstator-Kushnir mode. This phenomenology is identified both on observations and on outputs of a simple QG model. Several synthetic blocking onset experiments are performed with different initial conditions on the small and large scale in order to study the importance of each phenomenon for the onset of blocking.

Notes

The WMO Climate Reference and Historical Canadian Climate Database rain gauge network assessment using statistical optimal interpolation methods.

Milewska, E.

Climate Research Branch, Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Speaker: Milewska, E.

Time: Thursday 15:45

Abstract

Gandin's point-to-point and Kagan's point-to-area optimal interpolation methods were applied to forty years (1953 to 1992) of monthly, seasonal and annual total precipitation records from 325 combined WMO Climate Reference and Historical Canadian Climate Database stations for the purpose of assessing representativeness of the network. An isotropic and homogeneous exponential function was used to model the spatial variation of the ratios of precipitation to 30 year normals. Values of the correlation at a short distance from stations ranged from a low in winter of 0.82 in December, to a high in fall of 0.92 in October, with spring values only slightly lower than fall and summer values similar to winter. This difference from unity was assumed to be due to observational errors, microclimatic variations and the small number of paired stations available at distances less than 60 km. Because of the changing nature of precipitation, the most rapid decrease of correlation with distance was for July, 0.48 at 150 km, and the slowest in October, 0.65 at 150 km. The maximum relative interpolation errors as defined by Gandin for the mid point of the line segment between two station were calculated for various distances and ranged from 0.58 to 0.74 at the average interstation distance of 175 km (errors less than 0.5 are desirable). A series of maps depicting the interpolation confidence intervals and the percentage of error in relation to actual precipitation were produced. The Kagan method rendered negligible errors in the estimates of area average precipitation, mainly due to low average coefficients of variation. It appears though as this method might be more applicable to use with small networks of daily precipitation.

Notes

Time-series Analysis of Structures Transporting Heat, Moisture, CO2 and Ozone during Stable and Unstable Conditions over California Agricultural Land.

Mitic, Constance M.

Dept. of Natural Resource Sciences, Macdonald Campus of McGill University, 21,111 Lakeshore Rd., Ste-Anne-De-Bellevue, PQ, H9X-3V9, Canada

Massman, W. J.

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, 80526

Schuepp, P.H.

Same as 1.

Speaker: Mitic, Constance M.

Time: Monday 10:35

Abstract

Local climate prediction requires nested climate models operating at increasingly smaller scales, and incorporating increasingly realistic description of surface-atmosphere exchange. Of particular interest is the degree of mixing that occurs between various scalars (heat, moisture and gases) exchanged from co-located (or approximately co-located) surface sources and sinks and the driving forces operating on the coherent structures that dominate the exchange. The analysis presented here will use data from the California Ozone Deposition Experiment (CODE) in 1991, from aircraft and stationary near-surface platforms. Airborne observations were obtained by the Canadian Twin Otter flux aircraft, operating at 30 m above the surface over mixed irrigated and non-irrigated land, dominated by growing cotton and senescent safflower, and tower data from irrigated grape and cotton. Airborne data were obtained under daytime, unstable conditions and tower data from both unstable daytime and stable nighttime conditions. The aircraft data show the effect of surface forcing, with 85% of the dominant coherent structures driven by surface-generated density gradients or buoyancy, with a preponderance of structures transporting H2O, CO2 and ozone simultaneously, due to the co-location of sources for moisture, CO2 and ozone in stomatal exchange of vegetation, in addition to an apparent non-physiological sink for ozone over non-photosynthesizing surfaces, possibly related to destruction of ozone through NO from the soil. Structure sizes are generally smaller for the upward moving structure than for subsiding ones, as expected. Under the stable, nighttime conditions examined in our study over grape and cotton, vegetation remains a source for H2O and a sink for ozone, but becomes a source for CO2 (respiration) and a sink for heat. Thermal gradients appear to drive the bulk of the nighttime multicomponent flux, while shear seems to dominate the single-component transport.

Notes

Oral Presentation; Overhead Projector

Prediction of Daily Respirable Particulate Matter Levels for Southern Ontario

Montpetit, J.

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Burrows, William R.

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Conway, F.

Environmental Services Branch, Atmospheric Issues Division, 4905 Dufferin St., Downsview, Ontario, Canada, M3H 5T4

Speaker: Montpetit, J.

Time: Thursday 14:35

Abstract

In order to include respirable particulate matter (PM10) in the Air Quality Advisory Program of Ontario, Environment Canada investigated the development of a forecasting tool that will guide the human specialist in predicting the PM10 levels for the next 24 hours. The Classification and Regression Trees (CART) method was selected because it has been relatively succesful in forecasting severe ozone episodes. Surface and upper-air meteorological predictors, and other predictors, were matched with each observation of daily PM10 levels. Decision trees are then built by CART and the fit with data is analyzed to assess the forecasting capability of the method. Correlation analysis and other measures of skill, using a threshold value based on current Air Quality Objective, suggest that CART could be as promising with PM10 as it was with ozone. For example, correlation factor of 0.8 or more were obtained at many sites.

Notes

On the Spatial and Temporal Variability of Surface Heat Fluxes over the North Atlantic During Winter

Moore, G.W.K.

Department of Physics,University of Toronto,Toronto, Ontario, M5S 1A7

Speaker: Moore, G.W.K.

Time: Thursday 09:05

Abstract

The exchange of sensible and latent heat across the air-sea boundary represents an important coupling between the ocean and atmosphere. The energy transferred by these fluxes plays a crucial role, on a variety of spatial and temporal scales, in the atmospheric and oceanic circulation. Traditional climatologies of the oceanic surface heat flux, based on marine ship reports, have been unable to give reliable estimates as to the magnitude of the fluxes in data sparse regions such as the high latitude marginal seas of the Arctic Ocean. In additional, they lack sufficient temporal resolution to provide an estimate as to the variability of the fluxes on timescales of one month or less. In this paper a new technique that does not suffer from these short comings will be introduced. It makes use of the ECMWF's archive of objectively analysed fields to diagnose the surface heat flux fields. As will be shown, this new approach allows one to estimate the temporal and spatial variability of surface heat fluxes over the North Atlantic on both the fast, i.e. less than one month, and slow, i.e. greater than one month, timescales. With regards to the mean values of the sensible and latent heat fluxes, there is good agreement with the conventional climatologies in the mid-latitudes. The mean values derived are also consistent with the long-term climatologies for the various Ocean Weather Ships stationed in the North Atlantic, including those at high latitude locations in the Labrador and Norwegian Seas. It will be shown that the transfer of heat and moisture across the air-sea interface is a highly episodic process with the variance about the mean of the same order as the mean itself. It will also be shown that the occurrence of extreme events characterized by large fluxes of heat from the ocean to the atmosphere are not uncommon. Evidence will be presented that supports the hypothesis that there is a relationship between the North Atlantic Oscillation and the low-frequency variability in the surface heat flux fields. The implications that these results have with respect to such processes as water mass transformation and deep water formation will also be discussed.

Notes

Explosive cyclogenesis over the North Atlantic: Some results based on a new long term climatology

Moore, G.W.K.

Department of Physics,University of Toronto,Toronto, Ontario, M5S 1A7

Speaker: Moore, G.W.K.

Time: Thursday 11:15

Abstract

In the past 15 years there has been a dramatic increase in our knowledge of the physical processes that govern the development of explosively developing cyclones. Most climatologies of these events are based on relatively short time periods and as a result questions as to the inter-annual variability in their frequency and location of occurrence have been left unanswered. In this paper, some initial results will be presented that are

based on a new climatology of explosively developing cyclones over the North Atlantic that is based on a 40 year time series of objectively analysed sea-level pressure fields. As will be shown, the approximate order of magnitude increase in the length of the underlying time series, as compared to previous climatologies, allows one to establish that there are indeed two locations within the basin in which the probability of the occurrence of an explosively developing cyclone is high. In addition to the location within the region of the Gulf Stream, which has been the focus of most work on explosive cyclones, there is also a location to the East of Newfoundland where these events are not uncommon. Evidence will also be presented that suggests that the processes responsible for the events that occur in these two locations are dramatically different. In particular, it will be shown that the events that occur to the East of Newfoundland appear to be the result of an interaction between two cyclones.

Notes

Necessary conditions for mesoscale cyclogenesis in the Labrador Sea

Moore, G.W.K.

Department of Physics,University of Toronto,Toronto, Ontario, M5S 1A7

Speaker: Moore, G.W.K.

Time: Tuesday 15:10

Abstract

In the past several years, it has been recognized that the Labrador Sea is a region in which small and short lived mesoscale cyclones known as polar lows often develop. In this presentation we use an existing climatology of these events to develop a better understanding of the synoptic scale environment in which these disturbances develop. As will be discussed, 3 statistically significant synoptic scale anomalies were found. It appears that the existence of all three anomalies are necessary for the development of a polar low in the Labrador Sea. The role that each of these anomalies plays in the development of polar lows will also discussed. Evidence will also be presented that there is a sub-class of mesoscale cyclones whose development is markedly different from that usually associated with Labrador Sea polar lows. The paper concludes with a brief discussion of the factors that control the inter-annual variability in the number of polar lows that form in the Labrador Sea.

Notes

Hydrologic responses of forested wetland to signals from the Canadian LAnd Surface Scheme

Munro, D. Scott,

Dept. of Geography, University of Toronto, Erindale Campus, Mississauga, Ontario, L5L 1C6

Bellisario, Lianne

Same as 1.

Speaker: Munro, D. Scott,

Time: Wednesday 10:05

Abstract

The Canadian Land Surface Scheme (CLASS) converts data records of precipitation, radiation, temperature and other climate variables to surface inputs, or signals, to which the seasonal hydrologic regime of the surface responds. Among the most important signals are the net precipitation and evaporation modelled by CLASS, to which the hydrology responds through changes in seasonal water storage. In the Beverly Swamp wetland south of Guelph, Ontario, such changes are best reflected in the winter snowpack, and in the soil water table during summer. Here CLASS is driven by a multi-year data set comprised of three successive summer and winter periods in Beverly Swamp where sufficient snow, ice and water table data were collected to assess model performance. In winter, when evaporation is minimal, model predictions of net precipitation explain much of the snow accumulation. Model predictions of net precipitation and evaporation are closely related to water table variation observed in summer, except during flood periods when surface flow from surrounding areas can mask the effects of surface-atmosphere exchange. Despite concerns that evaporation may be underestimated during drier surface soil layer periods, and that predicted soil temperature may be too cool during the winter, CLASS appears to be a highly effective tool to use in modelling the seasonal hydroclimate of this type of surface and its possible responses to climatic change.

Notes

Large-scale circulation in an open-ocean region of the North Atlantic derived from climatology by variational method.

Nechaev, D.A.

Dept. of Oceanography, Dalhousie University, B3H 4J1, N.S., Canada

Yaremchuk, M.I.

Same as 1.

Thompson, K.R.

Same as 1.

Speaker: Nechaev, D.A.

Time: Wednesday 11:15

Abstract

Annual mean and seasonal circulation of the upper 1000 m of the North Atlantic between 40$^\\circ$N--55$^\\circ$N and 40$^\\circ$W--20$^\\circ$W is studied via the inversion of climatological data in the framework of a numerical model based on reduced dynamics (the so-called P-model). The data utilized are surface drifter trajectories from the MEDS database, Bunker monthly mean atmospheric climatology and Levitus climatological monthly means of temperature and salinity. The model is controlled by initial and boundary conditions for buoyancy and atmospheric buoyancy-momentum fluxes. Unknown boundary conditions and errors in atmospheric forcing are represented by a set of Fourier amplitudes describing sesonal cycle as functions of the corresponding spatial coordinates. The model fits climatology within error bars. The role of the drifter data in constraining the barotropic mode of variation is discussed.

Notes

none

Trends in sea ice clearing dates in northern Baffin Bay

Newell, J.P.

Dept. of Geography, University of Saskatchewan.

Speaker: Newell, J.P.

Time: Monday 15:05

Abstract

A dataset of sea ice clearing dates for Melville Bay is used to investigate climate change in northern Baffin Bay. This dataset was selected as an index of climate conditions since it can be derived from both modern and historical data sources. In addition, the clearing dates for Melville Bay are significantly correlated with mean July ice cover in Baffin Bay which allows this dataset to be used a proxy climate record for all of Baffin Bay. Analysis of these data indicate a trend towards increasing ice severity since the early 1950s with a marked deterioration in ice conditions following 1963. The main factors controlling the Melville Bay clearing date are atmospheric circulation over northern Baffin Bay in spring and sea ice export out of Baffin Bay via Davis Strait. The clearing date may also be related to the strength of the West Greenland Current. All of there

factors can be related to large scale atmospheric circulation patterns. Long-term trends in Melville Bay clearing dates and teleconnections to climate and ice conditions in other regions are also investigated.

Notes

Chaotic mixing and transport in Rossby-wave critical layers

Ngan, K.

Dept. of Physics, University of Toronto, Toronto, Ontario, M5S 1A7

Shepherd, T.G.

Same as 1.

Speaker: Ngan, K.

Time: Wednesday 11:55

Abstract

Despite their crucial role in meteorological and oceanographical applications, mixing and transport remain poorly understood. Typically, a flux gradient relation of some sort is invoked, but this can be problematic. The length scale characterizing tracer gradients is often no greater than that of the eddies themselves. A completely different approach to mixing and transport is suggested by the phenomenon of chaotic advection: in chaotic advection, chaotic particle trajectories are generated by regular (but time-dependent) Eulerian velocity fields. Previous geophysical applications of chaotic advection, while intriguing, were completely kinematic and dynamically inconsistent. In this work, a simple, dynamically consistent model of mixing and transport in Rossby-wave critical layers is obtained from the well-known Stewartson-Warn-Warn (SWW) solution of Rossby-wave critical-layer theory. Chaotic advection in the model is a consequence of interactions between stationary and transient Rossby waves; the SWW solution is thought to be a useful conceptual model of Rossby-wave breaking in the stratosphere. Mixing and transport in the model are characterized with a number of quantitative diagnostics, and with particular emphasis on the dynamics of the tracer field itself. The parameter dependences of the diagnostics are examined. The robustness of the results is investigated by stochastically perturbing the transient-wave phase speed. Applications to more realistic flows (e.g. shallow-water flow on the sphere) will be discussed.

Notes

Sensitivity Study of Canadian Global Spectral Model Forecasts of Hydrological Parameters over the Mackenzie River Basin

Nils Ek

Recherche en prévision numérique, Atmospheric Environment Service, Dorval, Québec H9P 1J3

Harold Ritchie

same as 1.

Speaker: Nils Ek

Time: Tuesday 10:05

Abstract

As part of the Mackenzie GEWEX Study (MAGS), Canadian global spectral forecast model predictions of surface water and energy fluxes over the Mackenzie River basin were examined. The goal of the work reported here was to gauge the performance of the currently operational model, and to establish a benchmark with which to compare future work. Two nine-member ensemble forecasts of one month duration were produced from perturbed analyses generated using the bred-modes technique, for a spring and a summer case. The perturbations are comparable in magnitude to observational errors. As diagnostics we use the spatial averages, over the basin, of the forecast accumulated surface energy and water fluxes. The ensemble of these area- averages was computed from the set of forecasts. The sensitivity to initial conditions was estimated by the ensemble standard deviation of the area-averages. We construct time series of the ensemble statistics of the area-averages to track the evolution of the estimated error, concentrating on the accumulated precipitation, and the accumulated precipitation minus surface evaporation (P-E). The precipitation exhibits moderate variability, which increases with time; similar trends were observed for the surface energy budget fields. P-E exhibits the greatest relative sensitivity to the initial perturbations. Relative to the ensemble mean, the ensemble standard deviation of P-E becomes large after the end of the second week, when it makes a noticeable, abrupt increase. This investigation suggests that spectral model forecasts of hydrological parameters on the basin scale have some value out to about two weeks.

Notes

overhead projector

Raindrop terminal velocity profiles in stratiform rain

Nissen, R.

Department of Physics, University of Toronto, Toronto, Ontario M5S 1A7

List, R.

same as 1

Speaker: Nissen, R.

Time: Tuesday 17:00

Abstract

Profiles of raindrop terminal velocities weighted by reflectivity were determined for several stratiform cold rain events. Volume scan Doppler data collected by the University of Toronto X-band radar were processed using an Extended Velocity Azimuth Display (EVAD) algorithm. Data from vertically-pointing scans were also considered. The derived profiles were compared with values determined from a Joss-Waldvogel disdrometer (JWD) at the ground and a 2DP laser spectrometer aloft. Profiles for raindrops of constant diameter, constructed using terminal velocity equations, were also plotted for comparison. The results demonstrate that for cold rain of stratiform nature and light to moderate rainrates (1.5 to 3.0 mm/h) the derived terminal velocity profiles were consistent with those for raindrops of constant drop diameter. This indicates very little in the way of raindrop size evolution, at least among the larger drops. There is also good agreement with the derived values from the JWD and 2DP data. At times evidence of large raindrop breakup just below the melting layer could be observed.

Notes

poster

Flux Mapping over Complex Terrain, based on Airborne Observations from Grid Flight Patterns in BOREAS

Ogunjemiyo, Segun O.

Dept. of Natural Resource Sciences, Macdonald Campus of McGill University, 21,111 Lakeshore Rd., Ste-Anne-De-Bellevue, PQ, H9X-3V9, Canada

Kaharabata, S.

Same as 1.

Schuepp, P.H.

Same as 1.

Desjardins, Raymond L.

Center for Land and Biological Resources Research, Agriculture and Agri-Food Canada, Ottawa, K1A 0C6

MacPherson, Ian J.

Institute for Aerospace Research, National Research Council of Canada, Ottawa, K1A 0R6

Speaker: Ogunjemiyo, Segun O.

Time: Thursday 10:05

Abstract

Airborne flux observations fill a gap between the locally constrained observations of energy and gas exchange from fixed towers and the large-scale spatial domains covered by satellite-based remote sensing and global circulation models (GCMs). Grid-type flight patterns over areas typically between 200 km^2 and 300 km^2 are an integral part of most recent international land surface climatology projects. The average flux observed over such areas, and the flux maps obtained from repeated passes over them, are expected to provide not only regionally representative averages of fluxes, but also a quantitative appreciation of spatial variability of fluxes at scales that may be accessible to high-resolution, nested climate models. We will present the current status of analysis of grid flights flown by the Canadian Twin Otter research aircraft over two 16 km x 16 km study areas in the Boreal ecosystem-atmosphere study (BOREAS) in 1994. A total of 23 grid flights have been analyzed, each consisting of a repeated 9-line pattern flown at 30 m above the surface. The resulting patterns are compared against satellite- and aircraft-based remote sensing observations of the radiometric properties of the surface, including land surface classification schemes. The analysis takes into account footprint considerations, i.e. the effective upwind areas sampled by above-surface flux observations, as deduced from trace gas release studies also conducted over BOREAS. Results show that the very high spatial complexity of the northern, Boreal ecosystem and the highly dynamic and deep convective boundary layers lead to great temporal variability in observed patterns, precluding a simple scheme of association between surface properties and local turbulent exchange processes. The few emerging features of local source/sink distribution for sensible heat, latent heat and CO2 that can be discerned over the given sites, and their link to radiative surface properties, will be discussed.

Notes

Oral Presentation; Overhead Projector

Plane-parallel albedo bias from satellite observations

Oreopoulos, Lazaros

Department of Atmospheric and Oceanic Sciences, McGill Univ., 805 Sherbrooke St. W., Montreal, PQ, H3A-2K6

Davies, Roger

Institute of Atmospheric Physics, PAS Building #81, University of Arizona, Tucson, Az 85721

Speaker: Oreopoulos, Lazaros

Time: Tuesday 09:45

Abstract

This study finds the plane parallel cloud albedo bias (PP bias) from satellite observations under various conditions and assumptions, and suggests ways to correct for it. The PP bias is defined as the difference between the plane parallel cloud albedo (the albedo calculated under the assumption that cloud water is homogeneously distributed) and the independent pixel (IP) albedo, which accounts for horizontal water variability, but neglects horizontal photon transport. The size of the regions for which PP bias computations are carried out are of the same order as the grid sizes of Numerical Weather Prediction and General Circulation Models. The range of visible PP bias is found to be very large, ranging from about 0.03 to about 0.30 depending on the assumptions used, the observation and illumination geometry, and the size of the region over which the bias is calculated. As expected, the larger the region over which cloud water is assumed to be homogeneously distributed, the larger the PP bias. Broadband PP biases are slightly smaller than visible biases, but the bias in the broadband reflected solar flux at cloud top still ranges from 30 to 70 Wm^-2, which is significantly higher than many of the well-studied climate forcings. We examine the dependence of the PP bias on the assumptions made to retrieve cloud optical thickness, its dependence on solar zenith angle, the effect of data resolution, and a number of other factors, using both AVHRR LAC data and Landsat data for illustrative purposes. The correction of the PP bias and its implementation in large-scale models is also investigated. There are two major findings. The first is that when the reduction factor of Cahalan et al. (J. Atmos. Sci., 51, 1994) is used to adjust regionally averaged optical depths, the corresponding albedos are quite close to the IP values on average. The second is that cloud optical thickness often follows a lognormal distribution, which may be used to calculate "approximate IP" albedos that are very close (within 0.01) to the actual IP albedos.

Notes

Numerical study of cold fronts in the PBL

Pagowski, Mariusz Z.

Dept. of Earth and Atmospheric Sciences, York University, North York, Ontario, M3J 1P3

Speaker: Pagowski, Mariusz Z.

Time: Monday 16:35

Abstract

The two-dimensional high resolution model has been developed to study the behaviour of cold fronts in the Planetary Boundary Layer. Two versions, hydrostatic and non-hydrostatic, exist. The fronts are shallow surface fronts introduced by realistic along-front geostrophic wind fields but not by the usual most unstable Eady wave. This approach is considered more appropriate for studying fronts in the boundary layer. Turbulence is parameterized with the 1.5 order closure scheme of Mellor and Yamada. Soil temperature, which constitutes the lower boundary condition, is determined from a 10-layer soil model in an inter- active scheme with the atmosphere. We note that the inclusion of soil parameterization in the model permits us to obtain more realistic frontal boundary-layer structures and circulations. The boundary layer in most of the models of fronts reported so far (and specially those using the Eady wave approach) was induced by the shear resulting from very high values of the along front wind (resulting in about 40 m/s at 1km height) which we consider rather unrealistic. We show that the shear alone cannot be responsible for the frontal boundary layer and the thermal surface forcing is very significant in building the frontal PBL. We eveluate the importance of thermal surface forcing and differential cloud cover in determining the strength of the surface front and its movement. The effect of surface roughness and soil thermal properties on the behaviour of fronts are also studied. Finally we analyze the frontal internal boundary layer, analyze turbulence profiles and verify similarity of fronts and gravity currents.

Notes

Oceanic Influences on Low-Frequency Atmospheric Variability

Pandolfo, Lionel

Dept. of Earth and Ocean Sciences, University of British Columbia, Vancouver, British Columbia, V6T 1Z4

Speaker: Pandolfo, Lionel

Time: Monday 16:15

Abstract

The structure and sources of the low-frequency modes of variability in multi-year integrations with the NASA/Goddard Institute for Space Studies General Circulation

Model (NASA/GISS GCM) have been investigated for all seasons and both hemispheres. Numerical simulations either including or neglecting the boundary forcing due to temporally-varying sea surface temperatures (SSTs) were considered. Using teleconnectivity analysis and principal component analysis, the prominent modes of intraseasonal and interannual variability present in the NASA/GISS GCM Model II' were determined for both types of simulations. The spatial distributions of fluxes of wave activity associated with the various modes were evaluated in order to determine the sources of the low-frequency circulation regimes. The differences in spatial structures and sources of the low-frequency modes between the (control) GCM integration using climatological SSTs and the GCM integration using temporally-varying SSTs will be discussed.

Notes

Global Tropospheric NOX: A comparision of QILAK fields and measurements

Pathak, Jagruti

Centre for Research in Earth and Space Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Templeton, Edna M.J.

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de Grandpré, J.

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Beagley, S.R.

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario M3J 1P3

Kaminski, Jacek W.

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario M3J 1P3

Speaker: Pathak, Jagruti

Time: Tuesday 17:00

Abstract

NOX is an essential ingredient in the production of tropospheric ozone and model fields must be thoroughly validated. We are developing a 3-D global chemical transport model (QILAK) that goes from the surface to 10 mb to investigate levels of tropospheric oxidation and possible anthropogenic impacts due to increased NOx levels with increased industrialization and also due to the current fleet of subsonic aircraft. The model is currently driven by objectively analysed (OA) wind fields. The semi-Lagrangian transport code was supplied by Phil Rasch (NCAR) and uses shape-preserving interpolation. We include convection and rain out driven with statistics from the Canadian Climate Center climate GCM. Dry deposition and an empirical PBL are also included. The chemistry scheme includes O$_x$, NO$_y$, HO$_x$, C2-C4 alkanes, C2-C3 alkenes, C1-C2 carbonyl compounds and PAN. There are 38 chemical species in all, with 70 chemical reactions and 17 photolysis reactions. Global monthly surface emission fields for NO$_x$, CO and NMHC represent the estimated seasonal influx due to anthropogenic, biomass burning, biogenic and natural sources, including lightning. We will present a comparison of the NO$_x$ and NO$_y$ fields generated during a 1-year model simulation using the 1994 6-hour OA wind fields from the Canadian Meteorological Centre forecast Model, SEF, at T32 horizontal resolution with data from insitu measurements in the atmosphere. The measured data fields are taken from publicly archived, insitu measurements of NO, NO$_x$ and NO$_y$ in the atmosphere by ftp from University of Michigan.

Notes

poster

A comparision of tropospheric ozone from a 3-D global Chemical transport model, QILAK, and measurements

Pathak, Jagruti

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Kaminski, Jacek W.

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario M3J 1P3

Speaker: Pathak, Jagruti

Time: Wednesday 11:55

Abstract

Ozone in the troposphere largely controls the levels of OH, often called the tropspheric detergent. Ozone is generated by the interaction of reactive hyrdrocarbons, NOx and sunlight and is generated in industrial societies and often exported. However, it can also be generated by biomass burning if sufficient NOx is produced simultaneously. In order to assess the extent and global significance of such problems we are developing a 3-D global chemical transport model (QILAK) that goes from the surface to 10 mb. The model is currently driven by objectively analysed (OA) wind fields. The semi-Lagrangian transport code was supplied by Phil Rasch (NCAR) and uses shape-preserving interpolation. We include convection and rain out driven with statistics from the Canadian Climate Center climate GCM. Dry deposition and an empirical PBL are also included. The chemistry scheme includes O$_x$, NO$_y$, HO$_x$, C2-C4 alkanes, C2-C3 alkenes, C1-C2 carbonyl compounds and PAN. There are 38 chemical species in all, with 70 chemical reactions and 17 photolysis reactions. Global monthly surface emission fields for NO$_x$, CO and NMHC represent the estimated seasonal influx due to anthropogenic, biomass burning, biogenic and natural sources, including lightning. We will present a comparison of the ozone field generated during a 1-year model simulation using the 1994 6-hour OA wind fields from the Canadian Meteorological Centre forecast Model, SEF, at T32 horizontal resolution with a variety of sources of tropospheric ozone data ranging from sondes to aircraft data.

Notes

Hot Air Balloon Forecast Program at St. Louis, Missouri

Pedigo, D. Joseph

National Weather Service, 12 Research Park Drive, St. Charles, MO, USA, 63304

Speaker: Pedigo, D. Joseph

Time: Thursday 11:55

Abstract

Hot air ballooning has become one of the fastest growing sports in the United States. Specific forecasts for hot air balloonists have been made for the St. Louis area since July 3, 1991. Detailed forecasts are prepared twice daily by staff members at the National Weather Service. This information is broadcast 10 times daily by the Flight Service Station on the FAA's Telephone Information Briefing Service. This recorded message, updated hourly, includes the latest surface observations, surface wind forecasts, geostrophic wind, boundary layer and upper level wind forecasts, radar information, and an outlook for the next flying period (i.e. "near sunset today, near sunrise tomorrow"), within the forecast area of responsibility. The Hot Air Balloon Forecast has become the most popular product the Flight Service issues, averaging 2000 to 2500 requests per month year-round. Since hot air balloonists are so vulnerable to meso and microscale weather phenomena, the National Weather Service uses the latest computer outputs, wind profilers, and a host of WSR-88D Doppler radar products (e.g. Velocity Wind Profile (VWP)) to construct site-specific forecast products which are far superior to the current aviation terminal forecasts. This presentation will focus on the Hot Air Balloon program at WSFO St. Louis. This program is the first of its type. The overview will include: (1) a verification of forecasts completed during 1992 and the first half of 1993, (2) suggestions how other forecast offices could participate in developing a similar program, and (3) ways the National Weather Service and FAA, or other federal or private concerns could supply state-of-the-art information for the balloonists in any aviation community.

Notes

Overhead Projector

Radar forecasting of severe weather

Pestieau, Paul

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Torlaschi, Enrico

Same as above

Zawadzki, Isztar

Dept. of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke West, Montreal, QC, Canada, H3A 2K6

Speaker: Pestieau, Paul

Time: Wednesday 10:05

Abstract

weather, with particular effort on tornado and microburst touchdown lead times. In the summer of 1994 several storms that produced tornadoes and microbursts were observed in the Montreal area. From these datasets of reflectivity and doppler velocity, time sequences were constructed with respect to height of maximum shear and reflectivity within the parent storms. These time-height sections show the falling precipitation cores associated with microbursts as well as the descent of maximum shear associated with mesocyclonic signatures. Although these features gave adequate lead times these were not as good as those reported in literature. A mesocyclone detection algorithm was found useful for forecasting tornadic events with lead times of up to an hour. A time record of cyclonic momentum was found to be helpful as well. A variational analysis method, used to retrieve the 3D wind fields allowed the computation of vertical velocity and divergence. The vertical velocity for both tornadoes and microbursts was partially conclusive but the progression of divergence at various heights proved to be of great help in establishing lead times for microbursts. We believe that the combination of the various methods used in our work can result in lead times consistent with those of previous studies.

Notes

The Importance of Lagrangian History in Parameterizations of Mixing and Transport

Pierrehumbert, R.T.

Dept. of Geophysical Sciences, University of Chicago, 5734 S. Ellis Ave., Chicago, IL 60637

Speaker: Pierrehumbert, R.T.

Time: Tuesday 13:50

Abstract

Choices of Eulerian vs. Lagrangian descriptions of fluid flow are often treated as a matter of viewpoint and convenience. While this may be true at the microscopic level, we will argue that on a coarse-grained level there are important aspects of mixing that are crucially sensitive to the Lagrangian histories of air parcels, and which cannot be adequately captured by Eulerian concepts such as eddy diffusivity. These aspects particularly come to the fore when considering nonlinear physical process such as condensation, isotope fractionation, or chemical reaction. To some extent, they even come into play when treating the effects of microscale diffusion. Problems of current interest in atmospheric science call for a new approach to mixing parameterization, which retains more Lagrangian history information. We illustrate this first by consideration of the difficulty in getting adequate mass transfer information from convective adjustment schemes common in general circulation models. Lagrangian history effects are discussed in terms of examples drawn from the following phenomena: (1) Lagrangian chaos in isentropic back-trajectories, (2) Determination of relative humidity, (3) Isotope fractionation in precipitation, (4) Stratosphere/Troposphere exchange, and (5) The problem of parcel identity in characterizing cross-isentropic convective transport. We also discuss in general terms why the advection-diffusion problem, even though still linear, is much richer than the pure advection problem. We conclude by developing some desiderata for a fully Lagrangian Monte-Carlo based tracer transport scheme for use in general circulation models.

Notes

A Temporal Model of Arctic Sea Ice Concentrations

Piwowar, Joseph M.,

Waterloo Laboratory for Earth Observations, Department of Geography, University of Waterloo, Waterloo, ON, N2L 3G1

LeDrew, Ellsworth F.,

Same as above.

Speaker: Piwowar, Joseph M.,

Time: Monday 16:15

Abstract

Sea ice plays an integral role in the global climate system, affecting climate through changes in its surface albedo, insulative properties, thermal capacitance, and brine capacitance. We are examining the hypothesis that any changes in the global mean temperature should be observable in the Arctic sea ice cover through image analyses of passive microwave remote sensing data. In this research, the image analysis method of spectral mixture analysis is extended to evaluate its applicability to temporal spectra

instead of radiance spectra. In particular, temporal mixture analysis (TMA) is applied to the nine year record of Arctic sea ice concentrations derived from the Scanning Multichannel Microwave Radiometer (SMMR) to determine the principal temporal spectra of sea ice concentrations at work in the Arctic. The analyses suggest that a simple model consisting of only four distinct temporal processes - three describing seasonal variations; one identifying a non-seasonal component - can describe the temporal characteristics of Arctic sea ice concentrations on an annual cycle. This can significantly improve how climate models treat the polar ice cover, many of which currently model the Arctic sea ice cover as a solid slab of ice one metre thick. Further, TMA is shown to be an effective tool for identifying changes between groups of temporal sequences (e.g., one year time series) and a reference sequence (e.g., a long-term normal).

Notes

ARMA Modelling of Arctic Sea Ice Concentrations

Piwowar, Joseph M.,

Waterloo Laboratory for Earth Observations, Department of Geography, University of Waterloo, Waterloo, ON, N2L 3G1

LeDrew, Ellsworth F.,

Same as above.

Speaker: Piwowar, Joseph M.,

Time: Monday 15:55

Abstract

The historical archive of repetitive remote sensing imagery is rapidly approaching the thirty year "climatic normal" time span presenting numerous possibilities for documenting the current, or changed, state of the Earth's environment. A heightened global awareness of anthropogenically induced climate changes mandates the development of innovative tools for environmental monitoring using new and existing data sets. One way to help us better understand a system, such as the Arctic sea ice regime, whose spatial scale or complexity might otherwise put it beyond our physical and mental grasp, is to model it. In this analysis ARMA (AutoRegressive - Moving Average) time series models are fit to monthly time series of sea ice concentration represented by each pixel in the nine year Scanning Multichannel Microwave Radiometer (SMMR) data record in order to derive a spatial summary of the temporal characteristics of monthly sea ice concentrations in the Arctic. ARMA modelling revealed that 62% of the 27,500 time series in the Arctic sea ice zone are shown to be adequately represented by AR(1) models. From a geophysical perspective, this is not surprising since an inter-month coherence is expected due to the persistent nature of sea ice arising from its thermal

inertia. The results of the temporal modelling show that this is not consistent across the Arctic sea ice zone, however. As might be expected, the strongest autoregressive autocorrelations are found in the central Arctic Basin and generally become weaker closer to the southern limit of the seasonal ice extent.

Notes

A modeling investigation of the effects of lake breeze circulations on the formation and distribution of oxidants in southern Ontario.

Plummer, D.A.

Centre for Research in Earth and Space Science, York University, 4700 Keele St., North York, Ontario M3J 1P3.

Neary, L.

Same as 1.

Kaminski, Jacek W.

Same as 1.

McConnell, John C.

Same as 1.

Speaker: Plummer, D.A.

Time: Wednesday 10:25

Abstract

During the summers of 1992 and 1993 an intensively instrumented measurement site was operated at Hastings located approximately 140 km to the north-east of Toronto, a city of approximately 3 million people. This site formed part of the Southern Ontario Oxidants Study (SONTOS). The purpose of the study was to elucidate factors contributing to elevated levels of tropospheric ozone in the Windsor - Quebec City corridor. Frequently during the course of the study a rapid increase in the concentration of ozone (typically 30 to 40 ppb in less than 15 minutes) and other trace species was observed to occur after 5:00 PM local time. The increase in ozone concentrations coincided with a change in the wind direction, a decrease in temperature and an increase in the relative humidity. It is believed that late in the afternoon a lake breeze circulation brought a polluted plume of air, possibly originating from Toronto earlier in the day, inland from Lake Ontario, despite the fact the measurement site was located more than 40km north of the Lake Ontario shoreline. Due to the frequency of these type of events and the fact that the

measurement site was well removed from the Lake Ontario shoreline it is believed that lake breeze circulations exert a strong influence on the distribution of elevated levels of ozone in southern Ontario. The current study focuses on the use of a modified version of the Mesoscale Compressible Community model (MC2), a fully compressible, non-hydrostatic meteorological model, to study the effects of lake breeze circulations on the formation and distribution of high levels of ozone in southern Ontario. A photochemistry module, based on the Acid Deposition and Oxidants Model (ADOM) gas phase chemistry, has been added to the MC2 model, as have modules to describe emissions and dry deposition. The model is run in a nested manner to allow a high resolution study of the interaction of lake breeze circulations with ozone precursor laden plumes of air leaving Toronto. We will present preliminary results from this study focusing on the generation and transport of ozone and also the aging of the NOx and hydrocarbons in the plume.

Notes

Sublimation of snow: a climatological manifestation of surface hydrology processes

Pomeroy, J.W.

National Hydrology Research Institute, Environmental Conservation Service, Environment Canada, 11 Innovation Boulevard, Saskatoon, Saskatchewan, S7N 3H5

Speaker: Pomeroy, J.W.

Time: Wednesday 08:45

Abstract

The processes that govern sublimation of surface snow to water vapour are largely overlooked by hydrological and global circulation models. Seasonal magnitudes of the sublimation flux can be large and are critical to obtaining water and energy balances on the winter land surface. Particularly large sublimation fluxes are concomitant with interception of snow in coniferous forests and wind transport of snow in open areas. Up to 60% of cumulative snowfall can be intercepted in mid-winter by conifers. This intercepted snow has a surface area 60-1800 times that of surface snow, and sublimates rapidly. Sublimation fluxes amount to 30-40% of annual snowfall in the boreal forest, resulting in large, episodic latent and sensible heat fluxes. On windswept prairies and tundra, the wind speed above which blowing snow occurs increases with temperature and the height of exposed vegetation. Blowing snow sublimation fluxes are extremely sensitive to wind speed as the wind both lifts and transports snow in the atmosphere and ventilates the particles. On a monthly basis from 10-15% of the Earth's land surface sustains blowing snow. Annual blowing snow sublimation fluxes on the Canadian Prairies comprise from 20% to 70% of annual snowfall, the higher values occurring over long fetchs. Annual blowing snow sublimation fluxes just north of the arctic treeline are estimated from 20% to 28% of annual snowfall; values exceeding this amount are

anticipated on arctic plains. Despite short fetches in alpine terrain, small-scale advection of sensible energy permits a significant sublimation flux from exposed sites. The large spatial variability of these fluxes is due to their sensitivity to snowcover and vegetation/terrain characteristics as well as to the fluxes of sensible and radiative energy. This surface interaction presents a challenge in developing physically-based models that has been addressed with spatially-distributed snow process modelling. Relatively simple models, when spatially distributed, have been able to match measured sublimation losses and may be suitable for implementation in global climate models.

Notes

Monitoring of the Absorption of NIR Radiation by Clouds

Puckrin, E.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Evans, W.F.J.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Speaker: Puckrin, E.

Time: Tuesday 11:15

Abstract

It has been found from previous FTIR spectral investigations that cumulus clouds strongly absorb NIR solar radiation in the 1 - 4 micrometer region. Since the FTIR technique is labour intensive, there is a requirement for a simple instrumental method for long term studies of the NIR absorption by clouds. A Kipp and Zonen pyranometer and a LICOR silicon solar cell pyranometer were tested and put into routine operation. Since the silicon LICOR instrument does not have a response beyond 1 micrometer, the difference between the two sensors provides a measure of the percentage of short wave radiation absorbed by clouds. On a clear day, the pair difference is less than 3%, on cloudy days this pair difference is typically around 6 to 8% and has been observed to be as high as 14% on some occasions under heavy, overcast cumulus clouds. By using a simple model developed from the FTIR spectral observations, the absolute flux absorbed by clouds can be estimated. The typical pair difference of 8% implies an absorption of about 80 W/m2. This amount is consistent with other recent measurements of the anomalous cloud absorption effect.

Notes

A Measurement of the Greenhouse Radiation Associated With Carbon Tetrachloride

Puckrin, E.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Evans, W.F.J.

Physics Department, Trent University, Peterborough,Ontario K9J7B8

Speaker: Puckrin, E.

Time: Tuesday 16:00

Abstract

Ground-based, thermal emission measurements of the cold, clear sky have been made showing the primary emission band of carbon tetrachloride, which is located in the 786-806 wavenumber region. A spectrum of non-carbon tetrachloride emission features has been simulated using the FASCD3P radiation code with measured radiosonde parameters of pressure, temperature and humidity. The simulated spectrum has been used to extract the carbon tetrachloride thermal emission band from the longwave spectrum of the atmosphere. A tropospheric mixing ratio of 17030 pptv for carbon tetrachloride was determined from these measurements. The associated downward greenhouse flux measured at the surface was estimated to be 0.09 W/m2. This flux is about one third and one fifth of that corresponding to the chlorofluorocarbons CFC-11 and CFC-12, respectively.

Notes

Two-dimensional multiresolution wavelet analysis on scale- dependent errors of the mc2.

Qi, Ying

Atmospheric Environment Service, 4905 Dufferin Street, Toronto, Ontario, M3H 5T4

Speaker: Qi, Ying

Time: Thursday 16:25

Abstract

The potential application of two-dimensional wavelet theory was explored explored in meteorology. Using two-dimensional multiresolution wavelet analysis, scale-dependent errors of the MC2 as a limited-area model are discussed and some pictures of the model errors which could not be obtained by traditional spectral analysis will be presented. The major conclusions are: (1) The model always overpredicts the cascade of energy in the limited -area model atmosphere. When the impact of the larger-scale environmental field

on the limited area atmosphere is weak, the faster cascade of energy can lead to stronger dissipation than reality; when the environmental impact is strong, the faster cascade can result in overpredicting of the smaller- scale (i.e., mesoscale or subsynoptic-scale) processes. (2) The maximum spectrum of error variance mainly occurs around the model domain scale, which may be due to the prescribed lateral nesting boundary layer of a limited-area model. One of the reasons is that lateral nesting zones can destroy the first - order derivatives of nesting variables. However, at the model domain scale, the relative errors are minimum. This evidence further confirm that the prescribed lateral boundary condition is a favorable factor in the atmospheric predictability of a limited-area model. (3) The relative errors increase with the decrease of height. The maximum error occurs at the lower level of the model, which may be caused by the simplified surface or boundary layer processes.

Notes

Equilibrium Climate Simulations of the Direct Effect of Sulphate Aerosols

Reader, M.C.

Canadian Centre for Climate Modelling and Analysis, University of Victoria, PO Box 1700 MS 3339 Victoria, B.C., V8W 2Y2

Boer, G.J.

Canadian Centre for Climate Modelling and Analysis, University of Victoria, PO Box 1700 MS 3339 Victoria, B.C., V8W 2Y2

Speaker: Reader, M.C.

Time: Thursday 13:15

Abstract

Equilibrium climate simulations, designed to investigate the direct radiative effect of sulphate aerosols, have been performed using the CCCma second-generation general circulation model (GCMII). The equilibrium climate response to large changes in greenhouse gas and direct aerosol forcing, such as may occur by the middle of the next century, has been examined. The inclusion of a projected sulphate aerosol increase reduces the globally and annually averaged climate warming at the time of CO_2-doubling from 3.4 K to 2.7 K. The pattern of change induced by the aerosols has both "global" and "local" aspects that are investigated and described.

Notes

The influence of solar 11-year cycle on the equatorial and high-latitude middle atmosphere

Reddy, R.S.

Dept. of Physics and Atmospheric Sciences, Jackson State University, Jackson, MS 39217

Reddy, S. Remata

Dept. of Physics and Atmospheric Sciences, Jackson State University, Jackson, MS 39217

Yang, Hai-Show.

Dept.of Physics and Atmospheric Sciences, Jackson State University, Jackson, MS 39217

Heard, Jr.P.

Dept. of Physics and ATmospheric Sciences, Jackson State University, Jackson, MS 39217

Speaker: Reddy, S. Remata

Time: Monday 17:15

Abstract

The possible relationship of sunspots with weather and climate has long been a subject of study. Soon after the discovery of the 11-year cycle in sunspots, the question was raised as to a possible relation between solar changes and terrestrial weather. Since then considerable work has been done in many countries to find the relationship between sunspot numbers on one hand and the weather or climate on the other, with the objective of long-term forecasting. The literature on the subject is very large but the question of the influence of sunspots on terrestrial weather and climate is still a matter of controversy due to evidence being often localized, isolated and controdictory. An extensive and most critical survey of the evidence for quasi-periodicities of weather and climate and around the 11- and 22-year period has been made by Pittock(1978). There has been a resurgence of studies relating to the variations in solar activity and variations in atmospheric circulations over tropical as well as middle and high-latitudes. Recent studies have identified the influence of the solar cycle on the quasi biennial oscillation(QBO) which modifies the middle and high-latitude stratospheric temperatures and winds (Labitzke and VanLoon, 1987; Reddy and Godson, 1987). A comprehensive study has been undertaken to examine the above aspects with particular reference to major stratospheric warmings and to the equatorial QBO using long-term data for temperatures and winds. The powerful statistical techniques including the maximum entropy spectral technique(MEST) have been utilized for the investigations. The study has pointed out a significant 11-year solar cycle in the energetics of the equatorial lower stratosphere and in temperatures of the high-latitude lower stratosphere.

Notes

poster/oral

Aqueous chemistry of peroxynitric acid in the marine boundary layer

Régimbal, Jean-Michel

Dept. of Chemistry, York University, North York, Ontario, M3J 1P3

Mozurkewich, Michael

Same as 1.

Speaker: Régimbal, Jean-Michel

Time: Tuesday 17:00

Abstract

The chloride:sodium ratio in the sea-salt aerosol is lower than in seawater, a phenomenon known as the chloride deficit. The acid displacement of HCl cannot account for the kinetics of this process. Another possibility is the oxidation displacement of chloride as HOCl or molecular chlorine. Peroxynitric acid (HOONO2) could be a potent enough oxidant to oxidise chloride. We will describe a spectroiodometric method of quantifying simultaneously HOONO2 and the ever-present H2O2 in dilute solutions. We have used this method to determine low pH (1.6 to 4) rate constants for a number of different reactants of HOONO2 as well as for its thermal decay. The latter was found to be 3.3x10^-4 s^-1 at pH 1.66 and 294 K. With bromide, we see a catalytic decay with a rate constant of 3.6 M^-1 s^-1 under the same conditions. Reaction with chloride is much slower, with an upper limit of 10^-2 M^-1 s^-1. Copper (II) also catalyzes the HOONO2 decay with a rate constant of 1.57 M^-1/3 s^-1. Results with iron ions will also be presented. Our results for the reaction with nitrous acid show a different stoichiometric ratio than was previously reported in the literature. The same thing can be said of the H2O2 decays we observed.

Notes

poster

The Southern Ontario Oxidant Study (SONTOS): An Overview

Reid, N.W.

Science and Technology Branch, 2 St. Clair Ave. West, Toronto, M4V 1L5

Speaker: Reid, N.W.

Time: Tuesday 16:00

Abstract

The Southern Ontario Oxidant Study (SONTOS) was initiated in 1992, with the overall objective of elucidating further the factors which give rise to high concentrations of ozone at ground level in Ontario. More specifically, the objective is to contribute to the provision of a mathematical model or models, having high scientific credibility, which will be used in the development of ozone control strategies for the Windsor-Quebec City corridor. SONTOS has been a cooperative venture, under the coordination of the Canadian Institute for Research in Atmospheric Chemistry (CIRAC), with public and private sector funding partners. Scientific participants have been drawn from an equally wide base. Two major field measurement campaigns took place, in the summers of 1992 and 1993. Additional measurements have been made in the summers of 1994 and 1995, with considerable emphasis on the analysis and interpretation of all the measurements. Major contributions, to date, from SONTOS include: Delineation of the role of the Great lakes in the delivery of high ground-level ozone concentrations to areas in Southern Ontario. Evaluation of the relative contributions of local production versus importation of ozone at the rural measurement site. Collection of a detailed set of atmospheric data (chemical and physical parameters), which will continue to be of value for some time in the assessment of atmospheric chemistry in Ontario, and in the evaluation of mathematical models. This paper will provide an overview of the study and some of its results. More details will be included in companion presentations.

Notes

Linear Stability of 2-D Semi-Geostrophic Equations

Ren, Shuzhan

Dept. of Physics, University of Toronto, Toronto, Ontario M5S 1A7

Speaker: Ren, Shuzhan

Time: Monday 17:15

Abstract

Linearized equations in physical coordinates for the 2-D barotropic, semi-geostrophic model are presented (2-D SGP). In these equations, the Coriolis parameter can be a function of y. Although the energy and potential vorticity in the linearized 2-D SGP are not conserved, it can be proved that pseudomomentum and pseudoenergy are two conserved quantities. Based on these two quantities, sufficient conditions for stability are obtained. By assuming that the disturbances have normal mode form, we derive the

bound for both stable and unstable phase speeds of normal mode disturbances. The result is analogous to Howard's semi-circle theorem in 2-D QG. The upper bound for the most unstable growth rate is also estimated. The result indicates that in addition to the shear of the basic flow, the absolute vorticity of the basic flow is also an important factor to bound the unstable growth rate. Numerical results on unstable growth rates for 2-D SGP and the quasi-geostrophic model (QG) are presented. We use a cosine type jet flow as the basic flow in the numerical calculations. The results show that for the QG case, disturbances with long wavelength are unstable while those with short wavelength are stable; this is also true for the SGP case. However, for the SGP case, with the increase of Rossby number, disturbances with long wavelength become more unstable than those in QG.

Notes

Mesoscale Cyclones in the Canadian Arctic

Renfrew, Ian A.

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7

Moore, G.W.K.

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7

Speaker: Renfrew, Ian A.

Time: Monday 17:15

Abstract

A series of mesoscale vortices were observed in the Canadian Arctic during the autumn of 1994. The meso-cyclones were of scale 500-700km and had a coherent signature through the lower half of the troposphere. They developed in a baroclinic zone, but over mainly ice covered seas. Satellite imagery shows a distinct vortex centre with a well defined cold frontal cloud band spiralling southwards in the 2nd and 3rd disturbances. The vortices were observed during the Beaufort and Arctic Storms Experiment (BASE) - an interdisciplinary field program involving meteorological research aircraft, doppler radar, an ice-breaking ship, an enhanced ground observing network and portable satellite receiving capabilities. An Intensive Observation Period (IOP10) focussed on the series of meso-cyclones: several dropsonde flights were made both through the underlying baroclinic zone and one of the vortices, so a comprehensive data set was available for investigation. Analysis of the observed data is coupled with numerical modelling experiments to determine the nature of these unusual meso-cyclones.

Notes

poster preferred

Instability of buoyancy-driven currents

Reszka, M.R.

Dept. of Mathematical Sciences, University of Alberta, Edmonton, Canada, T6G 2G1

Swaters, G.E.

Dept. of Mathematical Sciences, University of Alberta, Edmonton, Canada, T6G 2G1

Speaker: Reszka, M.R.

Time: Monday 11:35

Abstract

Swaters (Phil. Trans. R. Soc. Lond. A, 1993) developed a model describing the baroclinic dynamics of buoyancy-driven currents and fronts over a sloping continental shelf. This model is based on a sub-inertial approximation to a two-layer shallow water system which allows for large amplitude isopycnal deflections. Because cubic nonlinearities are present within the governing equations, however, it has proven difficult to analytically solve the linear stability problem for all but the most simple mean flow profiles. Nevertheless, we have been able to make progress for some highly idealized frontal configurations. Here, we report on our progress in understanding the nonlinear instability problem associated with a piecewise-linear coupled front. A weakly nonlinear analysis is developed for marginally unstable modes for this configuration. Emphasis is placed on describing numerical simulations in a singly, and doubly periodic channel, for the fully nonlinear model. The numerical scheme is believed to give qualitatively correct results despite the highly nonlinear and sensitive nature of the governing equations. The algorithm is Leapfrog in time, with Jacobian terms approximated via the Arakawa (1966) scheme. Our simulations detail the formation of isolated warm-core eddies as a result of the baroclinic instability of a buoyancy-driven coupled front and subsequent warm-core ring mergers that result.

Notes

video

A Convenient Hybrid Coordinate Treatment for Finite Element Spectral Models

Ritchie, Harold

Recherche en prévision numérique, Dorval, Quebec H9P 1J3.

Speaker: Ritchie, Harold

Time: Tuesday 11:15

Abstract

The Canadian global spectral forecast model that is used for global data assimilation and medium and long range forecasts at the Canadian Meteorological Centre treats the primitive equations using the spectral technique in the horizontal, the linear finite-element technique in the vertical and a semi-implicit semi-Lagrangian time integration scheme. The current operational version of the model uses a conventional sigma vertical coordinate on a regular (unstaggered) grid varying from unity at the earth's surface to a nonzero value at the model top. Presently the representation of the stratosphere is rather coarse, with the upper most model sigma levels being .010, .045, .090., .140, .190. The forecast range for this global system has recently been increased to monthly and seasonal scales, and work is in progress to also do stratospheric data assimilation and prediction. Consequently there is a need to improve our stratospheric modelling, especially for the benefit of our longer range and stratospheric ozone forecasts. For this purpose, modifications have been made to introduce a hybrid vertical coordinate and to raise the model top to approximately the stratopause with an assocaited increase in the number of vertical levels. In the new hybrid version all linear (semi-implicit) vertical operators keep the same form as in the sigma version. The scheme is coded so that all additional nonlinear terms arising from the coordinate transformation are treated explicitly at the middle time level, which exploits the simplicity of a three-time-level discretization. This formulation also removes a problem that has been diagnosed at the upper boundary of the model. By examining the thermodynamic equation it can be seen that the conventional imposition of a zero vertical velocity on the upper sigma boundary forces the mountains to be reflected in the temperature field at the model top when the trajectories pass over the mountains. This can be seen, for example, over the Himalayas in 48 hour forecasts of the temperature at 1 hPa with a sigma version of the model, whereas no evidence of this pathological behaviour is present in the corresponding forecast with the hybrid version of the model. Results of verification experiments comparing the hybrid and sigma versions of the model will also be presented.

Notes

Coriolis Term Time Truncation Errors

Ritchie, Harold

Recherche en prévision numérique, Dorval, Quebec H9P 1J3.

Speaker: Ritchie, Harold

Time: Tuesday 16:40

Abstract

Even with its semi-Lagrangian semi-implicit time integration scheme, the time step of the three-time-level Canadian global spectral forecast model is limited by a stability constraint imposed by the explicit treatment of the Coriolis terms. This limitation can be removed by a three-dimensional extension of the implicit treatment that has been used for the Coriolis terms in a two-time- level spectral shallow water model. In addition to removing the stability constraint, preliminary tests and an analysis of the one-dimensional shallow water equations suggest that this treatment can reduce the time truncation errors in three-time-level models.

Notes

Canadian acid deposition monitoring and long-term results

Ro, C.U.

Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario M3H 5T4

Vet, R.J.

Same as 1.

Ord, D.

Same as 1.

Sukloff, B.

Same as 1.

Shaw, M.

Same as 1.

Speaker: Ro, C.U.

Time: Thursday 14:15

Abstract

Canadian and United States agencies have been monitoring the chemistry of precipitation and acid deposition since the late 1970s. During the 1980s the number of monitoring networks and stations in both countries grew rapidly as acid precipitation became more of a public concern. During the 1990s, however, governmental budget pressures forced most networks to reduce the number of measurement sites. This contribution reviews the status of precipitation chemistry monitoring in eastern North America from 1980 to 1993 and, by combining data collected from the various networks, it explores the relationship

between integrated wet deposition and anthropogenic emissions of sulphur and nitrogen. The basis is formed by the data compiled in the Canadian National Atmospheric Chemistry (NAtChem) Data Base and Analysis Facility, a facility implemented by the Canadian federal and provincial governments to combine all Canadian and U.S. acid precipitation data from selected major networks.

Notes

Reference Climate and Hydrometric Networks: Environment Canada's Strategy for Long-Term Monitoring of Climate Change and Variability

R. Paul Ford

Environment Canada, 4905 Dufferin Street, Downsview Ontario, M3H 5T4

Ted R. Yuzyk

Same as 1

Paul J. Pilon

Same as 1

Don Gullett

Same as 1

Speaker: R. Paul Ford

Time: Thursday 16:05

Abstract

Environment Canada is reducing the resources it allocates to its monitoring activities by ~35% over a three year period in order to meet departmental budget reduction targets. All monitoring programs are being rationalized and realigned to address the key Departmental priorities for data and information. The Department's two largest monitoring networks: climate (~2500 stns.) and hydrometric (~2500 stns.) are currently under review. Documenting and understanding climate change and variability is a high priority in the Department and as such significant effort is being placed on defining and maintaining a core network of reference stations that can best address this issue. Criteria are being developed and applied to screen both climate and hydrometric monitoring stations to determine which stations have the most potential for providing information on changing processes or trends. Each of these networks are being reviewed on a sectoral basis to determine which stations are the most suitable and then a more integrative approach applied in order to provide a more complete hydrologic perspective. The

purpose of these reference networks is to ensure that long-term data sets will be maintained that are of a high level of quality, continuous, consistent and representative both on a temporal and spatial basis. The criteria that have been developed and that will be used to define these networks will be reviewed. The process and schedule for defining these networks will be outlined. We also have an electronic demonstration of the database that can be incorporated into the poster session.

Notes

Electronic poster also available for viewing.

An Empirical Normal Mode (ENM) Diagnostics of the Observed Low-Frequency Variability in the Mid-Latitude Troposphere

R. Wang

Recherche en Prevision Numerique, Service de l'Environnement Atmospherique, 2121, Voie de Service nord, porte 508, Route Trans-Canadiene, Dorval, Quebec, CANADA H9P-1J3

Gilbert Brunet

same as 1.

Bernard Dugas

same as 1.

Speaker: R. Wang

Time: Thursday 09:25

Abstract

The mid-latitude atmosphere displays an apparent complexity of various scales that often appears in the form of more or less continuous red-spectra. Despite of this, many studies show convincingly that there are large scale evolving patterns with distinctive spatial structures and time scales which allow an identification by suitable analysis techniques. The Branstator-Kushnir Oscillation with a period of about 21-25 days is a typical example observed in northern hemisphere winter (Branstator, 1987; Kushnir, 1987). The most commonly used method is the empirical orthogonal function (EOF) technique which separates the different scales by an optimization of the variance representation. While EOF analysis has been successful in many applications in the meteorological community, its inherent restrictions have become more and more apparent when dealing with dynamical systems. In particular, it is well-known that EOF analysis is a powerful tool for condensing information contained in a given data set, but that it is rarely possible

to give a physical interpretation of the EOF patterns themselves, as they are highly data-dependent. Recently Brunet(1994) proposed a technique called empirical normal mode (ENM) introducing certain dynamical constraints to the EOFs. As a result, the ENMs are able to capture the dynamical features (space-time scales) that are intrinsic to the oscillatory components of the underlying physical system while their variance contribution is a natural consequence of the scales. Thus the ENM technique bridges the dynamical and the statistical approaches. In the present paper, the ENM method will be applied to 12-hourly NMC analysis data based on individual winters as well as 10-consecutive winters in order to derive some of the detailed features of the observed variability in physical space as well as in the phase spaces spanned by the ENMs. In particular, our analysis will be focused on low-frequency variabilities in the mid-latitudes such as those reported in Branstator (1987) and Kushnir (1987). The purpose of this study is to provide a more precised diagnostics of the the low-frequency variability in the hope of shedding some light on the statistical basis to medium- and long-range weather-forcastings. Preliminary results derived from the AMIP integration of the Canadian SEF and GCMII will also be presented.

Notes

Integration of biogenic VOC emissions inventories with 3-D global chemical transport modelling

Sadek, Magda

Centre for Earth and Space Science, York University, North York, Ontario, M3J 1P4

McConnell, John C.

same as 1

Speaker: Sadek, Magda

Time: Tuesday 10:25

Abstract

Ground-level release of reactive hydrocarbons, often called Volatile Organic Compounds (VOCs), acting in concert with NOx and sunlight, play a significant role in the formation of tropospheric ozone. Anthropogenic sources of VOCs such as vehicle exhaust contribute to ozone production. Although such sources are significant contributors, biogenic VOCs can, on an areal basis outweigh anthropogenic sources. Biogenic VOC emissions increase with increasing temperature up to a critical point. Thus in North America and Europe, the relative balance between anthropogenic and biogenic sources is seasonally dependent. At York we are building a 3-D global chemical transport model and modifying the MC2 model to include chemistry in order to investigate ozone production. Clearly, one of the important aspects of such modelling will be the the proper

inclusion of biogenic VOCs and we have been investigating current systems for their inclusion in an on-line manner. The USEPA currently employs BEIS II (Biogenic Emissions Inventory System), a FORTRAN based model to account for biogenic emissions for regional scale (county level) models. Alternatives to BEIS include BIOME which relies on the statistical package SAS in conjunction with an ARC/INFO vector based GIS interface to regionally parameterize biogenic emissions. Input data for both models includes land use/land cover (LULC), leaf biomass, temperature, sunlight and emission factor literature correlations. We will present the capability of the current biogenic VOC models and compare with anthropogenic emissions. We will also present some preliminary results from test runs within the MC2 model.

Notes

Modeling the chemistry of ozone, halogen compounds and hydrocarbons during arctic spring

Rolf Sander

Centre for Atmospheric Chemistry, York University, North York, Ontario M3J 1P3, Canada

G.W. Harris

Centre for Atmospheric Chemistry, York University, North York, Ontario M3J 1P3, Canada

Speaker: Rolf Sander

Time: Monday 10:35

Abstract

The box model `MoccaIce' has been developed to study the chemistry of the Arctic boundary layer. It treats chemical reactions in the gas phase, as well as in/on aerosol particles. Photochemical reactions are switched on during daytime. The photolysis rates vary according to the solar declination during polar sunrise. Apart from the standard tropospheric HO_x, CH_4, and NO_x chemistry, the chemical reaction mechanism includes sulfur, chlorine, and bromine compounds. In addition, the chemistry of C_2-C_5 hydrocarbons has been incorporated. Results of polar sunrise observations indicate the presence of Br and Cl atoms during ozone depletion events. In sensitivity analyses we investigate conditions under which halogen radicals are formed and discuss their contribution to ozone depletion. Observations during ozone depletion events have also shown decreased concentrations of light hydrocarbons and increased concentrations of HCHO, relative to their background values. Model results will be compared with data from field measurements.

Notes

Development of a Reduced-Jacobian Numerical Solver for Chemistry

Sandilands, J.W.

Department of Physics and Astronomy, York University, North York, M3J 1P3

McConnell, John C.

Department of Earth and Atmospheric Science, York University.

Speaker: Sandilands, J.W.

Time: Tuesday 17:00

Abstract

As part of an effort to develop a chemical solver for use with three-dimensional climate and forecast models, we have produced an efficient and accurate solver for chemical species that includes diurnal forcing. The motivation of this work was to produce a fast chemistry solver based on the implicit Euler finite difference approximation to the chemical continuity equation for a set of chemical species. This particular form of the chemical continuity equation is appealling due to its mass conservative property. In this paper we will compare the Reduced-Jacobian technique (so dubbed as it uses an optimized form of the Jacabian from the more familiar Newton's method), with more widely accepted chemical solver techniques, i.e., the Gear method. We will investigate the speed and accuracy of this technique for a chemical set that comprises O$_x$, NO$_x$, HO$_x$, ClO$_x$, BrO$_x$ and CH$_4$ oxidation gas phase chemistry for various heights, ranging from the stratosphere to the mesosphere. We conclude than in comparision to the widely established Gear method, the RJ method is much faster, and under proper constraints can provide Gear-like accuracy, thus making it a good candidate for inclusion in three-dimensional models.

Notes

would prefer to have this as a poster

Developing an Interactive Chemistry Solver for Inclusion with SEF, The Canadian Global Weather Forecast Model

Sandilands, J.W.

Department of Physics and Astrnomy, York University, North York, Ontario, M3J 1P3

Neary, L.

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Ritchie, Harold

Recherche en Prevision Numerique

McConnell, John C.

same as 2

Kaminski, Jacek W.

same as 2

Speaker: Sandilands, J.W.

Time: Wednesday 13:55

Abstract

We have developed an efficent numerical chemical solver for ozone chemistry in the middle atmosphere. Heating due to ozone in the lower stratosphere can play a major role on the stratospheric heat budget. At present we are introducing this chemical solver into the Canadian Global Weather Forecast Model (SEF) in order to investigate the chemical impact on stratospheric heating rates and dynamics for longer term forecasts. We will report preliminary results of this work. This will include a discussion of some model tracer studies, the impact of spectral transforms and lagrangian interpolators on tracer behaviour, and results from the inclusion of the chemistry solver. Initial model runs done with the chemistry will be "non interactive", i.e., the chemical species concentrations (mostly ozone and aerosols) do not interacts with the model heating code. In the future, this work will be extended upon to include the interaction of the chemistry with the model thermodynamics in order to assess the impact of the chemical component of stratospheric heating.

Notes

Dispersion Modelling in Northern B.C.

O'Kane, S.

Air Quality Modelling and Assessment, Levelton Associates Consulting Engineers, Richmond, B.C. V6V 2H9

Schutte, A.

Air Quality Modelling and Assessment, Levelton Associates Consulting Engineers, Richmond, B.C. V6V 2H9

Newburger, M.

Same as 1

Speaker: Schutte, A.

Time: Wednesday 13:15

Abstract

Levelton Associates operates two advanced weather monitoring systems in the Peace River district of Northern B.C.. In addition to standard tower mounted meteorological instruments, a 3 axis monostatic acoustic SODAR is used. SODAR data during winter, high pressure, arctic outbreaks revealed the existence of multiple, low level atmospheric layers. In areas of industrialization, this can have a significant impact on the ground level concentration of airborne pollutants. Stack plumes from different sources can be trapped at different levels and move in different directions. Thus, for numerical modelling, a source specific "mixing layer" should be specified for the correct evaluation of ground level concentrations downwind of the sources. Other problems that arise with dispersion modelling in northern latitudes will also be discussed.

Notes

none

Energetics of the barotropic wind driven gyre model

Scott, Robert B.

Dept. of Atmospheric and Oceanic Sciences, McGill Unviersity, Montreal, Quebec, H3A 2K6

Straub, David

Same as 1.

Speaker: Scott, Robert B.

Time: Wednesday 11:35

Abstract

State of the art OGCMs have horizontal resolution of the order of 50 km and the sub grid scale Reynolds stresses are generally parameterized using eddy viscosities. The resulting dissipative term removes both energy and enstrophy from the large scale flow. In the steady state, energy is input to the system by the winds and is removed by the viscous dissipation. Much of the sub grid scale flow represented by the eddy viscosity, however, is associated with geostrophically balanced eddies, which are not believed to be dissipative (in the sense that quasigeostophic turbulence cascades energy to larger scales). As the resolution increases, the eddy viscosity should tend to its small molecular value. A natural question arises: Does the nature of the overall energy balance change as the eddy viscosity becomes small? In particular, are there solutions for which the flow arranges itself so as to shut off the energy input flux? To address these questions we need to focus our computational efforts on the horizontal resolution, and therefore require a simplified model. Cessi, P. and Ierley, G.R. in J.Phys.Oceanogr., 25, 1196-1205, have solved the barotropic quasigeostrophic potential vorticity equation for a rectangular ocean and idealized double gyre wind-stress. They found multiple equilibria with qualitatively different velocity fields. For these solutions, we investigate the nature of the energy balance. We are particularly interested in the limit of low horizontal eddy viscosity (high Reynolds number).

Notes

The Impact of El Nino and La Nina on temperature and precipitation patterns over Canada

Shabbar, Amir,

Atmospheric Environment Service, Environment Canada, Downsview, Ontario, Canada M3H 5T4

Khandekar, Madhav

Same as 1.

Bonsal, Barry

Same as 1.

Speaker: Shabbar, Amir,

Time: Monday 10:35

Abstract

The impact of the two phases of El Nino-Southern Oscillation (ENSO), namely El Nino and La Nina, on the surface temperature and precipitation fields over Canada will be presented. Gridded surface temperature data of 91 years (1900-1990) and 500-1000 hPa

thickness data of 49 years (1946-1994) have been analyzed statistically in the context of El Nino, La Nina and normal years. For precipitation, rainfall data of a representative network of stations over Canada are used. Using a composite analysis, the present study conclusively demonstrates that significant positive surface temperature anomalies spread eastward from the west coast of Canada to the Labrador coast from the late fall to early spring (November through May) following the onset of El Nino episodes. The accompanying temperatures in the lower troposphere show a transition from the Pacific/North American (PNA) pattern to the Tropical/Northern Hemisphere (TNH) pattern over the North American sector during the same period. Conversely, significant negative surface temperature anomalies spread southeastward from the Yukon and extend into the upper Great Lakes region by the winter season following the onset of La Nina episodes. While western Canadian surface temperatures are influenced during both phases of ENSO, eastern Canadian surface temperature effects are found during the El Nino phase only. The impact of ENSO on the Canadian surface temperatures is the strongest during the winter season and nearly disappears by spring (April and May). The largest positive (negative) anomalies are found to be centered over two separate regions, one over the Yukon and the other just west of Hudson Bay in the El Nino (La Nina) years. Preliminary analysis of precipitation data suggests that an El Nino (La Nina) event is generally associated with above (below) normal precipitation over western Canada. This study provides strong basis for developing long-range forecasting technique for Canada using ENSO related indices.

Notes

Contingent Valuation of Environment Canada's Pre-recorded Weather Information Telephone Messages

Shaykewich, Joseph E.

Policy, Program & International Affairs Directorate, Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario, M3H 5T4

Speaker: Shaykewich, Joseph E.

Time: Monday 11:25

Abstract

This paper discusses the use of contingent valuation techniques for the valuation of services to sectors of the Canadian Public in general and focusses on a specific study of the value of pre-recorded weather message services provided to business users. Difficult-to-value pure public goods (and near pure public goods) present an interesting problem when faced with making decisions amongst alternative means of satisfying public demands. The Contingent Valuation (CV) Method uses surveys to create hypothetical markets in the good so that respondents can directly express their willingness to pay for changes in the supply of nonmarketed goods under specified contingencies. Within AES

this method has been used to obtain benefit estimates that can be used in making decisions about the provision of public goods such as pre-recored weather information services and weatheradio services. The results of the application of this method to the valuation of pre-recorded weather messages will be discussed.

Notes

video

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

Zwack, Peter

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Olivier Hamelin

Ecole Nationale de la Meteorologie, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Santurette, Patrick

SCEM, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experiemental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies amoung the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the cause of a region of upward motion or pressure falls provided the forecaster with enought

confidence to follow the model guidence. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes

Sensitivity of Seasonal Forecasts to Horizontal Resolution in Semi-Lagrangian and Eulerian Schemes

Sheng, Hua

Recherche en prévision numérique, Dorval, Quebec H9P 1J3.

Ritchie, Harold

Same as 1.

Derome, Jacques

Department of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke St. W., Montreal, Quebec H3A 2K6

Speaker: Sheng, Hua

Time: Monday 11:35

Abstract

In order to assess the sensitivity of the low-frequency variability in seasonal forecasts to the horizontal resolution in semi-Lagrangian and Eulerian schemes, northern winter (December, January and February) simulations for ten years (the AMIP period, 1979-1988) have been performed using various combinations of model resolution and formulations in the operational Canadian global spectral forecast model. Comparisons have been performed between semi-Lagrangian (SL) versions with linear unaliasing and Eulerian (EU) versions with quadratic unaliasing running with triangular truncation on the same Gaussian grids, namely: SLT31(EUT21), SLT63(EUT42) and SLT95(EUT63). The simulations are assessed by comparing the forecasts to the corresponding analyses of mean states, including mean sea level pressure, cross sections of temperature, zonal wind and meridional stream function, as well as eddy meridional fluxes of momentum, heat and water vapor. The results show that the latitudinal and geographic distributions of the sea level pressure improve with increased horizontal resolution in the range of spectral truncation from SLT32(EUT21) to SLT95(EUT63). Evaluating the mean of zonal wind

one finds the positions of southern hemisphere subtropical jet cores become more realistic with increased horizontal resolution from SLT31 to SLT95. The value of jet centers is slightly stronger (about 2 metre/second) than in the observations. One common deficiency from both the semi-Lagrangian scheme and the Eulerian scheme is the stratospheric easterly bias (about 20 m/s). The cross section of temperature shows the semi-Lagrangian scheme agrees favorably with observation at the tropical tropopause, while discrepancies are present over the polar regions. Especially at the south polar tropopause it is colder than observation and the Eulerian scheme. Various other diagnostics related to moisture and heat budget variables will also be presented.

Notes

Sponge-layer feedbacks in middle atmosphere models

Shepherd, T.G.

Dept. of Physics, University of Toronto, Toronto, M5S 1A7, Canada

Semeniuk, Kirill

Same as 1

Koshyk, J.N.

Same as 1.

Speaker: Semeniuk, Kirill

Time: Thursday 15:45

Abstract

Middle atmosphere models generally employ a sponge layer in the upper portion of their domain. It is shown that the relaxational nature of the sponge allows it to couple to the dynamics at lower levels in an artificial manner. In particular, the long-term zonally symmetric response to an imposed local force or diabatic heating is shown to induce a drag force in the sponge that modifies the response expected from the ``downward control" arguments of Haynes {\it et al.} (1991). In the case of an imposed force, the sponge acts to divert a fraction of the mean meridional mass flux {\it upwards\/} that, for realistic parameter values, is approximately equal to $\exp (-\Delta z/H)$ where Δz is the distance between the forcing region and the sponge layer, and H is the density scale height. This sponge-induced upper cell causes temperature changes above the forcing region that are of comparable magnitude to those below the forcing region. In the case of an imposed diabatic heating, the sponge induces a meridional circulation extending through the entire depth of the atmosphere. This circulation causes temperature changes above the imposed heating region that are of opposite sign, and comparable in

magnitude, to those at the heating region. Some simulations using a middle atmosphere general circulation model are described, which demonstrate that this sponge-layer feedback can be a significant effect in parameter regimes of physical interest. Zonally symmetric (two dimensional) middle atmosphere models generally employ a Rayleigh drag throughout the model domain. It is shown that the long-term zonally symmetric response to an imposed local force or diabatic heating in this case is also seriously distorted from that expected from downward control, even for a very weak drag coefficient.

Notes

Issues in Middle Atmosphere Modelling (Invited)

Shepherd, T.G.

Dept. of Physics, University of Toronto, Toronto, Ontario M5S 1A7

Speaker: Shepherd, T.G.

Time: Wednesday 16:00

Abstract

Atmospheric general circulation models have traditionally focused on the troposphere, with no serious attention paid to the middle atmosphere (stratosphere and mesosphere). However the middle atmosphere has received increasing attention in recent years, for a number of reasons: e.g. depletion of the ozone layer, both in polar regions and in mid-latitudes; the role of ozone and CFCs in surface warming (the greenhouse effect); radiative effects of volcanic and other aerosols in the stratosphere; and the possibility that global change might be able to be detected first in the middle atmosphere. The middle atmosphere is also of interest in its own right, and exhibits a number of quite distinctive phenomena. For these reasons, and others, major climate modelling centres around the world are increasingly being led to extend their model domains upward, to include a representation of the middle atmosphere. Within Canada, this effort is being accomplished within the context of the Canadian MAM project. This talk will present an overview of some of the current issues and challenges in general circulation modelling of the middle atmosphere.

Notes

An overview of the climatology for the IFC year 1994 at selected Boreas/SRC mesonet sites.

Shewchuk, S.R.

Atmospheric Sciences Section, Env. Tec. Div., Sask. Research Council, 15 Innovation Blvd, Saskatoon, Saskatchewan S7N 3X8

Speaker: Shewchuk, S.R.

Time: Wednesday 10:25

Abstract

SRC has had in place for NASA for several year now the surface meteorological infrastructure mesonet for the BOREAS project in western Canada. Results for the Intensive Field Campaign (IFC) year 1994 indicate that at least for the southern area sites that this year was warmer than normal with below average amounts of precipitation. A summary of other meteorological variables including soil temperature, wind speed, bright sunshine and solar radiation will also be presented. A warm spring and a very mild fall period were offset by an unusually cold February. The annual average temperature was 0.6 degrees C above the 30 year average temperature at the SRC Climate Reference Station, for example, with the extreme maximum temperatures occurring in September in the IFC year instead of the more usual summer months of July and August. There were ten sites in total in this mesonet with the majority of them being above the canopy boreal forest sites. However two southern sites were tied into the agricultural belt of Saskatchewan. They provide a good overview of airmass climatology for the project.

Notes

The effect of seamount geometry on the residual flow generated by topographic rectification of a barotropic tide and subsequent particle trapping.

Shore, J.A.

Department of Oceanography, University of British Columbia, Vancouver, B.C., V6R 1Z4

Allen, S.E.

Same as 1.

Speaker: Shore, J.A.

Time: Wednesday 13:35

Abstract

A persistent closed circulation around a seamount has important implications for nutrient, contaminate and biological particle distributions. Numerous studies have focussed on the varied aspects of the formation and dynamics of these flows -- we restrict our attention to

tidal rectification. Specifically, the effect of seamount geometry on the residual flow generated by topographic rectification of a barotropic tide will be investigated. The response of the residual field to changes in seamount height, base width and slope will be presented. In addition, we consider the effect of these changes on particle retention. Consistent with a semi-analytic solution, results show that the wider the seamount (with its percentage depth remaining unchanged) the smaller the energy transfer from the tide to the residual flow. Furthermore, the magnitude of the maximum residual velocity increases exponentially with increasing seamount height. The energy contained within the region above the seamount similarly increases. Results from the particle tracking studies show that while a larger shelf region enhances retention, an increase in flank slope causes a decrease in particle trapping.

Notes

Measurements of Intermittency in the Spectrum of Atmospheric Gravity Waves

Sica, R. J.

Department of Physics, The University of Western Ontario, London, Ontario, Canada N6A 3K7

Speaker: Sica, R. J.

Time: Monday 15:05

Abstract

The Rayleigh-scatter experiment on the Purple Crow Lidar has made high temporal-spatial resolution measurements of atmospheric density perturbations from 30 - 90 km. Parametric models have been applied to these measurements to estimate temporal and spatial power spectral densities. Results from these studies include "images" of the rapid fluctuation, or intermittency, in the spectral shape and power. Contrary to some previous studies, the vertical spatial spectral slope remains near -3 as a function of height. Individual features in the spectrum have been tracked using Prony's method, which reveals a dynamic spectral evolution with time. The temporal spectra show some extremely large amplitude enhancements, particularly at high frequencies.

Notes

Using MC2 to Model Lake Breezes in SW Ontario and SE Michigan and their Impact on Boundary Layer Ozone Transport

Sills, D.M.L.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, CANADA, M3J 1P3

Speaker: Sills, D.M.L.

Time: Monday 15:05

Abstract

The major objective of the Southern Ontario Oxidant Study (SONTOS) is to elucidate the factors that lead to episodes of high ground-level ozone in the Windsor-Quebec City Corridor. Using meteorological data from SONTOS and the Southeast Michigan Ozone Study (SEMOS), it is found that lake breezes occurred on more than half of summer days in the SW Ontario / SE Michigan area. Since lake breeze circulations dominated the boundary layer flow on these days, their impacts must be considered when analyzing the local and regional transport of ozone. Well-developed lake breezes were accompanied by high ground-level ozone concentrations in SW Ontario and SE Michigan on August 14, 1993. Rapid changes in observed ozone concentration at several stations are shown to be associated with the passage of lake breeze fronts. Meteorological conditions on this day are modelled using the Mesoscale Compressible Community (MC2) model with 5km horizontal grid spacing. A passive tracer is employed within the model to simulate the transport of ozone in the boundary layer. Two mechanisms for ozone transport are tested. Output from MC2 is compared to surface meteorological and chemical observations and GOES-7 visible satellite imagery to assess the model's accuracy.

Notes

presentation

A Revised Lake Breeze Index

Sills, D.M.L.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, CANADA, M3J 1P3

Speaker: Sills, D.M.L.

Time: Thursday 13:35

Abstract

In 1962, Biggs and Graves proposed a Lake Breeze Index based on dimensional analysis of fundamental quantities that describe the lake breeze. The resulting index is calculated by dividing the square of the average afternoon inland wind speed by the specific heat capacity of dry air and the temperature difference between the water and maximum inland temperatures. Using data from western Lake Erie, they found that lake breezes could be predicted with an accuracy of up to 97% making the index a useful tool for forecasting lake breeze events or hindcasting such events to develop lake breeze

climatologies. However, Biggs and Graves' scheme excludes days with an onshore gradient wind from the analysis and assumes lake breeze inactivity on days with the maximum inland air temperature less than the lake water temperature. It is shown here that lake breezes are possible under both of these conditions leading to questions about the reported accuracy of the scheme. This study uses data from northern Lake Erie to re-assess the accuracy of the Lake Breeze Index and proposes a more accurate and robust Revised Lake Breeze Index that considers all days including those with an onshore gradient wind, replaces lake water temperature with lake air temperature, and uses a temperature difference offset to correct temperature measurement biases. A Land Breeze Index is also proposed and tested. Both the Revised Lake Breeze Index and the Land Breeze Index achieve up to 97% accuracy when applied to the northern Lake Erie data.

Notes

presentation or poster

Lake Breeze Circulations Resulting in Elevated Ozone Concentrations at Hastings, Ontario

Sills, D.M.L.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, CANADA, M3J 1P3

Moroz, W.J.

W.J. Moroz Associates, RR2, Hastings, Ontario, CANADA, K0L 1Y0

Speaker: Sills, D.M.L.

Time: Tuesday 17:00

Abstract

The major objective of the Southern Ontario Oxidant Study (SONTOS) is to elucidate the factors leading to the production of high oxidant concentrations in the Windsor-Quebec City Corridor stretching across southern Ontario and southern Quebec. Detailed surface atmospheric chemistry and meteorological measurements were made at a rural site near Hastings, Ontario (137km northeast of Toronto and 36km inland from Lake Ontario) during July and August of 1992 and 1993. It was found that on several occasions during the study, ozone concentration experienced a rapid increase late in the day. Using visible satellite imagery and surface meteorological observations, these increases in ozone concentration at Hastings are shown to be associated with the arrival of the Lake Ontario breeze front. Meteorology and air chemistry data are presented for three cases: August 6, 1992 and August 8 and August 26, 1993. Mechanisms for ozone transport to the Hastings site are also discussed.

Notes

poster

On the relationship between Arctic sea ice and atmospheric circulation anomalies north of 45N

Slonosky, Victoria C.,

Dept. of Atmospheric and Oceanic Sciences, and Centre for Climate and Global Change Research, 805 Sherbrooke St. W., McGill University, Montreal, Quebec, H3A 2K6

Mysak, Lawrence

Same as 1

Derome, Jacques

Same as 1.

Speaker: Slonosky, Victoria C.,

Time: Monday 15:55

Abstract

The relationship between Arctic and northern North Atlantic sea ice concentration anomalies, in particular those associated with the "Great Salinity Anomaly" (GSA) of 1968-1982, and atmospheric circulation anomalies is investigated. Empirical orthogonal function (EOF) analyses were performed on winter and summer sea ice concentrations, sea-level pressure, 500 hPa heights and 850 hPa temperatures: these data cover the post-World War II era. The leading mode (EOF 1) of winter sea ice concentration describes the ice anomaly patterns associated with the GSA, and temporal correlation coefficients between this mode and the leading EOFs of the atmospheric variable were calculated. Spatial maps of the temporal correlation coefficients between EOF 1 of winter sea ice concentration and the atmospheric anomaly fields were also calculated. Significant correlations (at 95 and 99 percent levels) were found to exist between EOF 1 of winter sea ice and the atmospheric anomaly fields at various lags. It appears that interactions persisting for 12 to 18 months exist between sea ice cover in the the northern North Atlantic and atmospheric circulation patterns.

Notes

High Latitude Water Vapour Transport: Some Preliminary Results

Smirnov,V.

Department of Physics, University of Toronto, Toronto, Ontario, M5S 1A7

Moore, G.W.K.

Department of Physics,University of Toronto,Toronto, Ontario, M5S 1A7

Speaker: Smirnov,V.

Time: Monday 11:35

Abstract

In this presentation, we will discuss some preliminary results that we have obtained regarding high latitude water vapour transport. This process is important because of the important role that water vapour plays in the climate system. Previous studies have made use of radiosonde data and have been able to document some features of annual cycle of this important process. Detailed information as to the spatial and temporal variations of this process are at present not fully documented or understood. In order to address these important issues, we have begun a project that used the objectively analysed fields from the ECMWF to study the high latitude transport of water vapour. In this presentation we will present some preliminary findings regarding the transport of water vapour into the Mackenzie River Basin and across the Arctic Circle. In both instances, the transport is highly variable in time with transient synoptic scale disturbances being responsible for much of the transport. The prospect of using this sort of analysis to determine the spatial distribution of the evaporation-precipitation field in data sparse high latitude regions will also be dicussed.

Notes

ASGASEX 1993, the Air-Sea Gas Exchange Experiment

Smith, S.D.

Ocean Circulation Section, Bedford Institute of Oceanography, DFO, P.O. Box 1006, Dartmouth, NS B2Y 4A2

Anderson, R.J.

Same as 1

Speaker: Anderson, R.J.

Time: Thursday 09:25

Abstract

The ocean is a sink of atmospheric CO2, and a quantitative understanding of the flux of CO2 at the sea surface is an important element in projecting future atmospheric concentrations and their impact on climate. Most of the resistance to CO2 exchange is in the surface water film, and processes surface such as breaking of wind waves that disrupt this film expedite the gas flux. The flux depends mainly on the sea-air difference in partial pressure or fugacity of CO2, and on the wind speed or sea state. It can be estimated by analogy with the flux of other natural or injected tracer gases, but this requires a knowledge of how the flux depends on diffusivity of the gases in water, and the question remains of how carbonate buffering in the water column affects the flux process. CO2 flux can be measured directly by eddy correlation analysis of time series of turbulence in the atmospheric surface layer. This technique has been successful in agricultural micrometeorology, but smaller fluxes over water place greater demands on the sensor used to detect concentration fluctuations. Until recently there have been relatively few CO2 eddy flux measurements at sea, all at shoreline sites where both air and water boundary layers are apt to vary in complex ways. Reported CO2 eddy fluxes have been much larger than estimates using gas exchange rates inferred from tracers. The Air-Sea Gas Experiment (ASGASEX) made use of Measuring Platform Noordwijk, located in the North Sea 9 km from the Dutch coast, which is one of the very few offshore sites available for research and suitable for eddy correlation measurements. CO2 eddy flux was measured with two independent systems, together with a number of relevant parameters including water vapour and sensible heat flux, wind and wind stress, mean CO2 concentrations in air and water, waves, wave breaking, and bubble clouds in the water column. Results are presented. As in earlier experiments, the eddy fluxes were larger than expected from tracer-derived exchange rates. A controversy remains as to the implications of these higher fluxes. A new experiment, planned to help to answer these questions, will take place at and around MPN in the fall of 1996.

Notes

Parameterization of sulphate production in convective clouds

Leighton, Henry

Dept. of Atmospheric and Oceanic Sciences, McGill Univ.

Song, Qingyuan

Dept. of Atmospheric and Oceanic Sciences, McGill Univ.

Speaker: Song, Qingyuan

Time: Thursday 16:05

Abstract

Clouds not only play an important role in transforming and redistributing chemical species, but they also modify the size distribution of atmosphere aerosol particles through heterogeneous chemical reactions. The latter effect may significantly increase aerosol light-scattering efficiency and therefore has implications for global climate change. However, it is computationally impractical to include an explicit convective cloud scheme in global climate models and most regional models, and hence an explicit description of aqueous chemistry is not feasible. We have developed a parameterization that describes oxidation of S(IV) by hydrogen peroxide and ozone in convective clouds. Based on reaction rate equations, the parameterization is an explicit function of the concentrations of ambient chemical species such as sulphur dioxide, hydrogen peroxide,ozone,ammonia and nitric acid. It also depends on gross cloud parameters such as average cloud water content, cloud base height, cloud thickness, average cloud lifetime and cloud total water content, which may, in principle, be extracted from GCMs or regional models. Thus, given ambient chemical profiles and these cloud parameters, the scheme may be applied in large scale models to obtain a better insight into in-cloud sulphate production. The parameterization scheme has been formulated and tested by comparisons with a well-established 3-D cloud chemistry model for a series of cases with different chemical and dynamical conditions. Results have shown a satisfactory agreement between our parameterization scheme and the 3-D model. Comparisons with the 3-D model suggest that it is superior to the cloud chemistry module of ADOM.

Notes

Instabilities of large- and small-amplitude internal gravity waves

Sonmor, Len

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Klaassen, G.P.

Same as 1.

Speaker: Sonmor, Len

Time: Monday 16:55

Abstract

We investigate linear instabilities of internal gravity waves using a Floquet analysis that accounts for finite wave amplitude, time dependence, spatial periodicity, tilt, offset shear and buoyancy fluctuations, and 3D disturbances. This approach yields a pattern of dominant instabilities that is consistent with previous limits and approximations, recent 3D time-dependent simulations, and observations. At the same time, it reveals relationships among instabilities of large- and small-amplitude waves previously supposed to be independent. For example, 2D convective instability does not switch on at

a threshold amplitude, but rather persists to small amplitude, where it becomes parametric subharmonic instability (PSI). PSI in turn is a form of slantwise static instability in a sheared and time-dependent environment. Even the 3D shear-aligned instabilities found by Thorpe [JFM 1994] and Winters and Riley [Dyn. Atmos. Oceans 1992] do not have an amplitude threshold when the phase angle is not vertical; they connect to higher-order resonant instabilities at small wave amplitude. Some important features of the simple resonant form persist to large wave amplitude; these explain, among other things, why high-frequency waves are not subject to shear-aligned instability.

Notes

Effects of temporal and horizontal variations on gravity-wave interactions in the middle atmosphere

Sonmor, Len

Dept. of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3

Klaassen, G.P.

Same as 1.

Manson, Alan

Institute of Space and Atmospheric Studies, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 5E2

Speaker: Sonmor, Len

Time: Thursday 10:05

Abstract

Middle-atmosphere research has followed the lead of oceanography in recognizing the importance of interactions within the gravity-wave spectrum, in the establishment of observed spectra, and in wave dissipation. The effects of the temporal and horizontal fluctuations that are present in the gravity-wave portion of the atmospheric winds remain largely unexplored. These have been investigated in an oceanic context [Broutman GAFD 1984, JPO 1986; Flatté et al. JGR 1985; Broutman and Young JFM 1986; Bruhwiler JFM 1995], and found to yield significant one-sided effects. It is unclear how to apply these results to the middle atmosphere, with its much larger mean shear, density diminution, and predominantly tropospheric sources resulting in descending phases at higher levels. We modify the eikonal (raytracing) methods of the aforementioned oceanic studies, to investigate these effects using a model that more closely represents atmospheric conditions.

Notes

Simulations of arctic aerosol spectrum by means of the Regional Climate Model

Barrie, L.A.

Atmospheric Environment Service, 4905 Dufferin Street Downsview, Ontario M3H 5T4 Canada

Blanchet, Jean-Pierre

C2GCR and Department of Earth Sciences, University of Quebec at Montreal, P.O.Box 8888, Stn "Downtown", Montreal, Quebec H3B 1B4

Gong, S.L.

Atmospheric Environment Service, 4905 Dufferin Street Downsview, Ontario M3H 5T4 Canada

Spacek, Lubos

C2GCR and Department of Earth Sciences, University of Quebec at Montreal, P.O.Box 8888, Stn "Downtown", Montreal, Quebec H3B 1B4

Speaker: Spacek, Lubos

Time: Monday 11:15

Abstract

The principal aim of our simulations is to study interactions between aerosols, clouds, precipitation and radiation. There is more anthropogenic sulfates in the Arctic then several decades ago and they can affect the climate in different manners. New parameterizations have been introduced into the Regional Climate Model in order to simulate some of those interactions. The aerosol particles are distributed into 8 intervals with diametres ranging from .01 to 2.00 microns. They are formed by gas-to-particle conversion and grow by coagulation and are in general accumulated in the vicinity of the accumulation mode near .1 micron. Those tracers are transported by the atmosphere and undergo in accordance with their diametres gravitational settling, in-cloud and below-cloud scavenging. The first result showed some resemblance with observations. Parameterizations are being further improved by adding more chemistry. In the final stage the aerosol interaction with clouds, precipitation and radiation will be simulated in a more complex manner. The results will lead us at better understanding of the role of aerosols in the actual evolution of the climate at higher latitudes.

Notes

Mesospheric Temperature Measurements Over London, Ontario Using Sodium Resonance Fluorescence Lidar

Sparrow, C.S.

The University of Western Ontario, London, Ontario, Canada N6A 3K7

Argall, P. S.

Same as 1.

Sica, R. J.

Same as 1.

Speaker: Sparrow, C.S.

Time: Thursday 11:15

Abstract

The Purple Crow Lidar at the University of Western Ontario consists of a Rayleigh-scatter system and a sodium resonance fluorescence system. This talk will describe the results obtained thus far with the sodium lidar. This system measures kinetic temperatures of mesospheric sodium by probing the D2 line located near 589 nm. The transmitter emits pulses of light at a repetition rate of 20 Hz. The output frequency of the transmitter is tunable, with a full width at half maximum of 130 MHz, and is tuned across the sodium transition which has a width of 3 GHz. The absolute frequency of the transmitter is controlled by locking the laser to a calibration vapour cell containing atomic sodium through which a portion of the laser is retro-reflected, thereby allowing Doppler-free spectral features which can be used to tune the output laser to 1.5 MHz (equivalent to a temperature error of 0.2 K). In this way kinetic temperature measurements of atomic sodium at mesopause heights (85 - 105 km) can be made. These measurements can then be used to infer the effects of internal gravity waves at these heights and can also provide a starting temperature with which to seed the Rayleigh lidar system temperature integration. The first routine temperature measurements using a fully automated autolocking system will be presented.

Notes

Characterization of the aircraft icing hazard associated with supercooled drizzle.

Stewart G. Cober

Cloud Physics Research Division, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, Canada, M3H 5T4

George A. Isaac

Same as 1

J. Walter Strapp

Same as 1

Speaker: Stewart G. Cober

Time: Thursday 08:45

Abstract

Measurements of aircraft icing environments associated with supercooled drizzle have been made during the Second Canadian Atlantic Storms Program and the Canadian Freezing Drizzle Experiment. The data include measurements from 14 research flights, during which extended cloud regions with significant concentrations of supercooled drizzle droplets larger than 100 microns in diameter were observed. Formation mechanisms for the drizzle included melting re-cooling, condensation, and collision coalescence processes. Microphysical characteristics of supercooled drizzle regions included cloud droplet median volume diameters up to 1 mm, temperatures between 0 and -12 degrees Celsius, and liquid water contents up to 0.4 g m-3. Cloud droplet median volume diameter, liquid water content and temperature are related to aircraft icing severity envelopes used for aircraft certification. Cloud icing environments with median volume diameters larger than 40 microns are not currently included in certification envelopes. However, inclusion of such data is fundamental for the safe certification of aircraft by regulatory agencies since icing associated with supercooled drizzle has been hypothesised to cause enhanced aerodynamic penalties to aircraft. Consequently, our data have allowed a quantification of aircraft icing environments which did not previously exist. This presentation will focus on techniques for characterizing the observed icing environments, and on applying the results to expanding the safety certification envelopes.

Notes

Observation and modelling of boundary layer depth in a region with complex terrain and coastline. (Invited)

Steyn, D.G.

Atmospheric Science Programme, Department of Geography, The University of British Columbia, Vancouver, B.C, V6T 1Z2

Speaker: Steyn, D.G.

Time: Thursday 10:55

Abstract

The severity of summertime air pollution episodes in the Lower Fraser Valley has been shown to be strongly related to mixed layer depth (MLD) in the region. The valley is defined by a fairly complex coastline, and steep topography, and has a relatively flat floor. MLD growth (driven by turbulent entrainment) during summertime onshore winds is thus suppressed by horizontal advection of cool air from the land-sea interface, and enhanced by vertical advection in upslope flows along the valley walls. The balance between these three processes is spatially and temporally variable, resulting in a fairly complex spatial and temporal pattern of MLD variation. Data collected by a variety of instruments (downlooking lidar, ground based scanning lidar, continuous tether-sonde profiles of wind speed, wind direction and temperature, two-hourly profiles of wind speed, wind direction and temperature from free-flying balloon sondes acoustic sounde, profiles of turbulent kinetic energy and mean temperature derived from aircraft borne measurements, near-surface wind speed, wind direction and temperature from a network of 25 stations, surface energy balance at one location) during the Pacific '93 field study provide an unprecedented opportunity to investigate this phenomenon. These data provide a comprehensive picture of the spatial and temporal variation of MLD in the region. This variation will be explained, with some attention being paid to different representations of MLD by different measurements. The phenomenon is being modelled with a mesoscale metrorological model (CSU-RAMS) operating at a grid resolution of 2.5 km, and the applied MLD model of Gryning and Batchvarova. Modelling results will be presented.

Notes

An inconsistency between two classical models of the ocean's buoyancy driven circulation

Straub, David

Dept. Atmospheric and Oceanic Sciences, McGill Univ., 805 Sherbrooke O., Montréal, Qué. H3A 2K6

Speaker: Straub, David

Time: Thursday 10:55

Abstract

A two layer version of the Stommel-Arons model of the abyssal circulation is shown to be inconsistent with the closure scheme used in Stommel's conceptual box model of the thermohaline circulation (Stommel, 1961). The closure relates the strength of the exchange between two boxes, taken to represent the meridional overturning cell in the ocean, to the density difference between the boxes. Here, the Stommel-Arons model (Stommel and Arons, 1960) is used to argue that the difference in density, averaged over

regions corresponding to Stommel's boxes, is not indicative of the rate of exchange between these regions. More generally, it is argued that to a good approximation, the zonally averaged density field in the Stommel-Arons model is independent of both the sense and structure of the meridional overturning cell or cells. The reason for this is that, although western boundary currents make and $O(1)$ contribution to the zonally averaged meridional transport, they have only a small influence on the zonally averaged density field.

Notes

Evapotranspiration from Atmospheric Moisture Budgets

Strong, G.S.

Atmospheric Environment Service, 11 Innovation Boulevard, Saskatoon, Saskatchewan, S7N 3H5

Speaker: Strong, G.S.

Time: Tuesday 11:55

Abstract

The advantages and disadvantages of using radiosonde data to estimate regional evapotranspiration from atmospheric moisture budgets are discussed. Field estimates of moisture budget evapotranspiration are compared with those of several other techniques, including an examination of error sources. Results are discussed in terms of moisture budget studies for proposed MAGS (Mackenzie Basin GEWEX (Global Energy and Water Cycle Experiment) Study) field work.

Notes

Intracavity Laser Spectroscopy Using a Step-Scan Fourier Transform Interferometer

Strong, Kimberley

Centre for Atmospheric Chemistry and Dept. of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Johnson, T.J.

Centre for Atmospheric Chemistry and Dept. of Chemistry, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Harris, G.W.

Centre for Atmospheric Chemistry and Dept. of Chemistry, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Speaker: Strong, Kimberley

Time: Wednesday 14:35

Abstract

Intracavity laser spectroscopy (ILS) is a highly sensitive technique for measuring weak absorption features. When a lasing medium having a broadband gain characteristic, such as a dye laser, is discontinuously pumped to threshold power, several different cavity modes begin to oscillate. This yields an emission with a relatively broad spectral distribution. As time progresses, mode competition sets in, enhancing certain modes within the cavity relative to the others, leading eventually to a narrow CW line. A gas sample, whose absorption features are narrower than the width of the evolving laser pulse, can be placed inside the cavity. As the light resonates in the cavity, the total optical path through the gas increases, resulting in an absorption enhancement of as much as 10^7 times that of a single pass. A Fourier transform interferometer has been used in step-scan mode to make time-resolved measurements of the evolving intracavity laser pulse for a rhodamine dye laser. This novel approach allows the combination of relatively high spectral (e.g.

Notes

Dynamics of barotropic storm tracks.

Swanson, K.L.

Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, NJ 08542 USA.

Kushner, P.J.

As in 1.

Held, I.M.

Geophysical Fluid Dynamics Laboratory/NOAA, Princeton, NJ 08542 USA

Speaker: Kushner, P.J.

Time: Thursday 11:55

Abstract

The modulation of barotropic waves by longitudinal variations in the basic flow is analyzed with a view to constructing simple theories of the barotropic structure of storm-track eddies. The propagation of waves through basic states that consist of contours separating regions of uniform vorticity is studied. Such basic states are meant to represent in a simple way the effectively piecewise-homogenized regions of potential vorticity in the upper troposphere. Zonal variations in the basic state are induced by topographic forcing. Predictions of the effect of basic-state zonal variations on the amplitude and spatial structure of eddies and their associated particle displacements are made using conservation of wave action and of the linearized `pseudoenergy' wave activity. The predictions are confirmed using WKB theory and linear numerical calculations. The interaction of finite-amplitude disturbances with the basic flow is next analyzed numerically using nonlinear contour-dynamical simulations. These simulations lead to insights into the nonlinear breaking of the waves, and to conclusions concerning the behaviour of barotropic waves in more realistic flows.

Notes

The heat, moisture and momentum budgets of frontal precipitation systems

Szeto, K.K.

CCRP, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

Speaker: Szeto, K.K.

Time: Thursday 16:05

Abstract

High resolution cloud resolving models can provide valuable information to improve the parameterization of cloud effects in general circulation models (GCMs). In this study, the heat, moisture and momentum bugets of frontal precipitation systems developed under various environmental conditions are investigated with a 2-d cloud model. Some of these results will be compared to those obtained from a simple column model which includes a GCM-type prognostic cloud scheme. The significance of the model results to the problem of parameterizing frontal cloud systems in GCMs will be discussed.

Notes

The precipitation efficiency of high-latitude cold season storms

Szeto, K.K.

CCRP, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

Stewart, R.E.

Same as 2.

Speaker: Szeto, K.K.

Time: Wednesday 13:35

Abstract

High-latitude frontal precipitation systems are simulated with a 2-d cloud model. The sensitivity the precipitation efficiency (PE) of the model storms to various environmental conditions is investigated. It is found that the PE of the storms is affected by several highly-coupled factors: the low-level moisture supply, the intensity of the frontal circulation and cloud microphysical processes. Atmospheric circulations over the arctic region is affected by strong Coriolis effects. In addition, the region during the winter months is characterized by cold ambient temperatures, limited low-level moisture supply and high static stability. Model results show that the strong Coriolis effect and enhanced static stabilty over the region would limit the intensity of the vertical frontal circulation and the storm PE would be very low or zero under such conditions. During the fall when the background stratification is not excessively strong, the PE of the model storms is found to be very sensitive to the low-level humidity condition. If the surface relative humidity is sufficiently high (RH > ~ 80% w.r.t. ice), storms with relatively high PE (> 60%) are developed in the model. When the surface RH is low (< ~ 80%), all precipitation from the model storms would sublimate in the sub-cloud layers and a zero PE would be associated with such storms. Therefore, the PE of the storms over the region might depend critically on the conditions of the underlying surface (e.g. whether it is frozen or open sea surface). Part of these findings are in agreement with some of the observations taken during BASE.

Notes

Physiological cycles of cod in the Newfoundland region and their relationship to seasonal and interannual variations in the thermal environment.

Taggart, C. T.

Oceanography Dept. Dalhousie University, Halifax, NS. Canada, B3H 4J1

Colbourne, E. B.

Dept. of Fisheries and Oceans, P. O. Box 5667 St, John's NF. Canada, A1C 5X1

Morgan, J.

Same as 2.

Speaker: Colbourne, E. B.

Time: Tuesday 10:25

Abstract

The physiology of most fish species, as in most poikilotherms, show sinusoid-like cycles in body condition and maturation that are repeated each year. The phase and amplitude of these cycles can vary interannually in relation to feeding cycles and the environmental cycle as represented by the seasonal accumulation of heat of the water column above freezing. This approach is analogous to the growing-degree-days (GDD) concept often used in agriculture research and we have applied this approach to cod as their metabolic rates are in part determined by environmental temperature. As the phase and amplitude of the GDD cycle can exhibit significant interannual variability it can be expected that physiological cycles affected by GDD will also vary. The purpose of this research is to establish the normal GDD cycle for cod on the Grand Bank and its relation to the normal cod condition and maturation cycles and to identify sources of variation in the seasonal cod condition estimates. Our results indicate that the normal maturing cycle in cod is strongly predetermined by the normal condition cycle which is in turn, strongly correlated with the GDD.

Notes

Formation and growth of sulfuric acid aerosol particles.

Tai, Xiuyu

Center of Atmospheric Chemistry and Department ofChemistry, York University, 4700 Keele Street, North York,Ontario M3J 1P3, Canada

Mozurkewich, Michael

Same as 1.

Speaker: Tai, Xiuyu

Time: Tuesday 17:00

Abstract

Secondary sulfuric acid aerosol particles are formed in the atmosphere from the oxidation of emitted man-made sulfur dioxide and natural sulfur compounds. Acting as Cloud Condensation Nuclei (CCN),these particles might alter the earth's albedo and even offset global warming [Charlson, et al, Nature, 326, pp 655-661 (1987)]. Whether sulfuric acid aerosol particles will be activated to become cloud droplets at a certain R.H. depends largely on the particle size. But the formation mechanism of sulfuric acid aerosol particle is not known because the competition between condensation and nucleation is poorly understood. Furthermore it is very important to characterize formation and growth

process of these aerosol particles. A flow tube technique has been coupled with a tandem Differential Mobility Analyzer system to investigate the formation mechanism of sulfuric acid aerosol particles. These experiments provide the information for competition between condensational growth on pre-existing particles and formation of new particles. This study has been extended to a short residence time reactor in order to facilitate assessment of the formation mechanism of sulfuric acid aerosol particles at the initial stage. Experiments are in progress and a model simulation is being set up to propose the possible formation mechanism. In this poster, the details of experimental observation will be presented and possible mechanism will be discussed.

Notes

Poster

A status report on the development of an operational 4DVAR scheme

Tanguay, Monique

RPN, Atmospheric Environment Service, 2121 Route Transcanadienne, Dorval, Quebec, H9P 1J3

Polavarapu, Saroja

ARMA, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

Speaker: Polavarapu, Saroja

Time: Wednesday 13:35

Abstract

Four-dimensional variational assimilation (4DVAR) seeks the model trajectory which best fits observations distributed in space and time. Two major advantages over 3-dimensional schemes are: (1) the ability to directly extract the temporal information content of data and (2) the ability to spread the influence of data implicitly and according to the dynamics of the full weather forecast model. 4DVAR is being developed as a research tool by AES but it is hoped that ultimately this research will lead to an operational assimilation scheme. This seminar will describe the 4DVAR implementation for a global shallow water version of GEF (Global Finite Element model) currently being developed by RPN. The impact on 4DVAR of specific numerical methods such as the semi-Lagrangian advection scheme, iterative processes and the variable resolution grid will be discussed. Results from preliminary 4DVAR experiments will also be presented.

Notes

A Canadian Middle Atmosphere Initiative

Tarasick, D.W.,

Environment Canada, 4905 Dufferin Street, Downsview, Canada, M3H 5T4.

Brunet, Gilbert

Environment Canada, 2121 Voie de Service nord, porte 514, Route Trans-canadiene, Dorval, PQ, H9P 1J3 Canada

Daley, R.

Naval Research Laboratory, Monterey, California, USA

Gauthier, Pierre

Same as 2.

Ward, W.E.

ISTS, Petrie Science Bldg., York University, North York, M3J 1P3 Canada.

Speaker: Tarasick, D.W.,

Time: Wednesday 14:35

Abstract

The middle atmosphere is increasingly recognized as an important component of the Earth's environment in issues such as ozone depletion, global change and long-range forecasting. Environment Canada's Middle Atmosphere Initiative was begun in 1995 with the object of developing an integrated Canadian middle atmosphere modeling, data assimilation and (space and ground-based) monitoring capability. Middle atmosphere modeling capability (for the purpose of data assimilation) will be enhanced both through modifications to the existing middle atmosphere model and the Canadian Meteorological Centre global forecast model. In the longer term this initiative is expected to have significant impact on the future development of the Canadian middle atmosphere observation system. The assimilation of satellite observations into a middle atmosphere model is a powerful technique that derives maximum value from satellite data by combining and reconciling them with other observations and with prior information on atmospheric structure and fundamental dynamics. The value added to very expensive satellite data, compared to using them alone or in individual comparison with models, can be very significant. The result is both an improved model and an enhanced data product. The data assimilation system can also be used in direct support of the design and optimization of middle atmosphere instruments (through observation system simulation

experiments) and post-launch calibration and validation. The assimilation of satellite data with middle atmosphere models should be viewed, in the future, as an essential component of the observation program. The existence of data assimilation and observation system simulation capability for the middle atmosphere implies that collaboration between the data assimilation team and the instrument designers should begin at the instrument design phase. This enhanced middle atmosphere capability is expected to yield improvements in standard meteorological forecasts, particularly on the longer timescale, as well as improved analyses of middle atmosphere phenomena related to ozone variation and depletion, and to climate change. Parcel trajectory analysis from NWP output will become much more reliable. A middle atmosphere modeling and data assimilation system will also provide a powerful tool for the study of global ozone transport. We report here on our progress to date in development of a middle atmosphere data assimilation system in Canada.

Notes

Reactive hydrocarbons in rural Southern Ontario: their distribution and role in oxidant production.

Taylor, R.

Ontario Hydro Technologies, Research Division, 800 Kipling Ave., Toronto, Ontario M8Z 5S4.

Niki, H.

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3.

Fu, B.

Same as 2.

Young, Valerie

Same as 2.

Melo, O.T.

Same as 1.

Speaker: Taylor, R.

Time: Tuesday 11:55

Abstract

Hydrocarbon compounds are precursors of tropospheric ozone. As part of SONTOS (Southern Ontario Oxidant Study) campaign in 1993, we undertook concentration measurements of a range of hydrocarbons at the Hastings, Longwoods and Binbrook sites, as well as from an aircraft. This allowed us to investigate the distribution of individual hydrocarbons over the study area and their relative importance in local oxidant production. We found that the biogenic hydrocarbon isoprene is the dominant reactive non-methane hydrocarbon at the Hastings site but is less important at the other sites. Examination of the relative concentrations of a range of hydrocarbons has led to information on the dominant processes in hydrocarbon removal and the importance of local sources in explaining the observed hydrocarbon concentrations.

Notes

Measurements of Atmospheric Carbon Monoxide with a Length Modulated Radiometer

Tolton, Boyd T.

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada, M5S 1A7

Kelman, Ilan

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada, M5S 1A7

Drummond, James R.

Dept. of Physics, University of Toronto, Toronto, Ontario, Canada, M5S 1A7

Speaker: Tolton, Boyd T.

Time: Monday 16:15

Abstract

A ground-based remote sounding instrument to measure atmospheric carbon monoxide has been built and succesfully operated at the University of Toronto. This is the first remote sounding instrument to utilise a new form of correlation radiometer known as a Length Modulated Radiometer. The operating principle of the LMR is the modulation of a static gas cell path length by means of an optically inert filler material. Measurements of atmospheric CO were made with the instrument in downtown Toronto and at the Centre for Atmospheric Research Experiments (CARE) near Egbert Ontario, in the fall of 1994. This paper will discuss these measurements, the improvements which have been made to the instrumentation since that time, and the methods by which the system can be calibrated and the data analysed. This instrument is being used as a validation system for the measurement methodology for the MOPITT instrument which will be launched on the EOS-AM1 satellite later in this decade. In the future it is hoped that the instrument can be

developed into a semi-automatic system for the validation of the satellite-based MOPITT instrument.

Notes

An analysis of stratospheric warmings using empirical normal mode

Tran, D. H.

Dept. of Atmospheric and Oceanic Sciences and Centre for Climate and Global Change Research McGill University 805 Sherbrooke St. W., Quebec, H3A 2K6

Brunet, Gilbert

Recherche en Prevision Numerique Service de l'Environnement Atmospherique 2121, Voie de Service nord, porte 508 Route Trans-canadiene, Dorval, Quebec, H9P 1J3

Derome, Jacques

Same as 1.

Speaker: Tran, D. H.

Time: Thursday 13:55

Abstract

The Empirical Normal Mode (ENM) analysis procedure is an extension of the Empirical Orthogonal Function (EOF) analysis which yields modes that are eigenfunctions of dynamical equations when the dynamics are linear and conservative. In this study we perform an ENM analysis on NMC global data from 700 hPa to 1 hPa for 11 winters which include four major stratospheric warming events. The meridional-vertical structures of the modes are obtained for individual zonal wave numbers and the frequency of the modes is estimated. We have found that the modes which are important during stratospheric warming events have large potential vorticity structures North of 60°N at about 10 hPa. The warming and wave breaking are most clearly exhibited at this level. By using only three modes to reconstruct the potential vorticity field during stratospheric warmings, we can recover a significant part of the flow structure, including the planetary wave breaking.

Notes

Video

A mixed-phase cloud scheme. Part II: Comparison with aircraft measurements collected during the Canadian Freezing Drizzle Experiment (FDE).

Tremblay, Andre

Atmospheric Environment Service, Cloud Physics Research Division, 2121 Trans Canada Highway, Dorval, Quebec, H9P 1J3.

Glazer, Anna

Same as 1.

Cober, Stewart G.

Atmospheric Environment Service, Cloud Physics Research Division, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

Isaac, George A.

Same as 3

Speaker: Tremblay, Andre

Time: Wednesday 14:35

Abstract

Clouds and precipitation play a fundamental role in weather and climate processes. Partly due to excessive computational load, and to the lack of data for initialization and validation, large-scale models cannot reach the level of sophistication actually found in cloud resolving models. For these reasons, NWP models and GCM tend to implement efficient, but simplistic cloud schemes. To be useful, these schemes must represent realistically the key cloud processes associated with the evolution of weather systems and climate. In particular, cloud phase is closely related to the radiation budget and hydrological cycle and is an important aspect to consider in atmospheric models. However, the partition of the condensate into supercooled liquid water and ice crystals is currently modeled with a function of temperature only. It is felt that this approach does not correctly represent the physics of mixed-phase clouds and may influence negatively the results of simulations. In this communication, aircraft observations of mixed phase clouds will be presented and used to evaluate an alternative mixed-phase cloud scheme. The aircraft data were collected during the Freezing Drizzle Experiment in March 1995 (12 flights) in the Newfoundland area. The characteristics of mixed-phase clouds will be inferred from measurements taken with a Nevzorov total water probe and a King liquid water probe mounted on a Convair-580 aircraft. These data will be used to determine the properties of mixed-phase clouds in term of key meteorological parameters and a statistical description will be constructed. A set of cloud-scale simulations with the new mixed-phase cloud scheme and other schemes will be performed to match each of the FDE flights and comparisons with aircraft observations will be given. Finally

recommendations for mesoscale and large-scale modeling of mixed-phase clouds will be suggested.

Notes

GENASIS: A line-by-line Radiative Transfer Tool for the Atmospheric Sciences

D.S. Turner

Meteorological Research Branch, Atmospheric Environment Service 4905 Dufferin Street, Downsview, Ontario, M3H 5T4

James R. Drummond

Department of Physics, University of Toronto, 60 St. George Street, Toronto, Ontario, M5S 1A7,

Zhen Z. Yu

Same as 2.

J. Cormier

Same as 2

Speaker: D.S. Turner

Time: Monday 17:15

Abstract

A line-by-line radiative transfer model (LBLRT) has been use by the University of Toronto atmospheric group for over fifteen years. The GENeral Atmospheric Spectral Integration Suite, GENASIS, is the latest revision. LBLRTs calculate absorption spectra by explicitly applying known theoretical spectroscopy wherever possible. Consequently, LBLRT calculations are generally accepted as "truth" from which virtually all radiative transfer parameterizations used by remote sensing and climate studies are ultimately derived. GENASIS has been applied to a wide range of problems in remote sounding of the earth's atmosphere and has been validated against other LBLRT codes. A description of GENASIS and some of its current applications will be presented.

Notes

poster

Nonlinear instability through explosive resonant interactions

Vanneste, Jacques

Dept. of Physics, University of Toronto, Toronto, Ontario M5S 1A7

Speaker: Vanneste, Jacques

Time: Monday 10:35

Abstract

In most geophysical models, the conditions for the nonlinear stability of steady flows are much more restrictive than the conditions for their linear (spectral) stability. This suggests that purely nonlinear mechanisms can amplify infinitesimal disturbances and destabilize flows which are spectrally stable. Explosive resonant interaction is the simplest mechanism of this type; it appears as a consequence of the weakly nonlinear interaction in a triad of waves with positive and negative pseudoenergy. Its role in barotropic and baroclinic instability constitutes the subject of this paper. Specifically, it is shown how the equations describing weakly nonlinear wave interactions in shear flows can be derived in a systematic fashion, and how linear characteristics of the waves -- the dispersion relation and the sign of the pseudoenergy or the pseudomomentum -- govern their nonlinear evolution. Multilayer quasi-geostrophic models of baroclinic instability are considered in detail: the relationship between the conditions for linear instability, explosive interaction, and nonlinear stability are described, and it is used to establish that Arnol'd's stability conditions are necessary as well as sufficient. The saturation of the explosive interaction is investigated in a three-layer model by deriving rigorous upper bounds on the disturbance energy. The extension of the results to continuous models, where the modes possessing a critical level play a crucial role, is also discussed.

Notes

Modelling a sulphate aerosol production event in SONTOS.

Verheggen, B.

Department of Chemistry and Centre for Atmospheric Chemistry, York University, North York, Ontario, M3J 1P3.

Narayan, J.

Same as 1.

Hastie, D.R.

Same as 1.

Harris, G.W.

Same as 1.

Mozurkewich, Michael

Same as 1.

Plummer, D.A.

Centre for Research in Earth & Space Science, York University, North York, Ontario, M3J 1P3.

McConnell, John C.

Department of Earth and Atmospheric Science, York University, North York, Ontario, M3J 1P3.

Speaker: Verheggen, B.

Time: Thursday 13:55

Abstract

Aerosols are believed to be intimately involved in, and produced by, tropospheric oxidant chemistry. Such particles have been proposed as a significant sink for atmospheric free radicals. Field data to support either of these involvements is limited. During the SONTOS field measurements at the Hastings site, there was an occasion where the concentration of SO_{2} increased from 1.5 ppbv to over 5 ppbv. This appeared to be related to increases in both the nucleation mode and total particles. This strongly suggests the SO_{2} is being oxidised to increase the particulate sulphate. To study this process we have modified the existing York 1-D hydrocarbon/NO_{x}/CO photochemistry model through the addition of gas phase SO_{2} oxidation chemistry and particle formation and growth. This model is able to explain the rate of SO_{2} oxidation, the production of new particles and the growth of existing particles.

Notes

Value-added by the meteorologists to the objective forecasts

Verret, Richard

Development Branch Canadian Meteorological Centre 2121 Trans-Canada Dorval, Quebec H9P 1J3

Babin, G.

Same as 1.

Parent, R.

Same as 1.

Speaker: Verret, Richard

Time: Thursday 13:55

Abstract

The statistical forecasts of temperature and probability of precipitation (machine forecasts) issued at a set of Canadian stations over the past year have been verified and compared to the manually produced local forecasts (person-machine mix forecasts). The forecasts valid for Today, Tonight and Tomorrow have been considered in the study. The statistical forecasts are based on the Perfect Prog multiple linear regression approach and two sets of forecasts are generated operationally at the Canadian Meteorological Centre, one from the Regional model and the other one from the Global model outputs. The local forecasts have been decoded from the public forecast bulletins produced locally and disseminated on the Canadian communication system. The verification system used in the experiment is based on the following framework. All available surface observations, synoptic, hourly and supplementary aviation observations are used to create a truth file at a set of stations. The truth file is basically a matrix which includes all observed weather elements with a time resolution of one hour, taking into account the special observations produced at non-standard times. The weather elements are cross-checked between themselves to validate the observations and thus create the truth, assumed to be the actual representation of the weather that really occurred. For instance, the temperature observations available at each hour, are cross-referenced against the maximum/minimum temperatures reported in the synoptic observations, to establish the true maximum/minimum temperatures on a local time window and to identify inverse temperature trends. Similar treatment is done to assess occurrences of precipitation. The truth files are generated once a day at each station, for the past 24 hours. On the other hand, a similar set of matrices are generated for the forecasts. The forecast matrices and the truth matrices can then be compared and the validity and skill of the forecasts assessed. The comparative verification results have been stratified into four three-month seasons. The Signal Detection Theory has been applied to assess the differences in skill of the local and objective probability of precipitation forecasts. Although the skill of the objective statistical forecasts and that of the local forecasts vary significantly from station to station, the results indicate that overall the local forecasts improve upon the objective forecasts in the short term period (Today). However, little or no value added by the local forecasts can be measured for the Tonight or Tomorrow periods. The seasonal trend in the skill of the objective and the local forecasts is similar.Specific events where the temperatures depart significantly from climatology have also been examined. The experiment has also shown that the regional distribution of the biases of the statistical temperatures shows some systematic behavior that could be improved.

Notes

The land surface in the climate system (Invited)

Verseghy, Diana

Climate Research Branch, Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Speaker: Verseghy, Diana

Time: Wednesday 14:25

Abstract

The state of the earth's surface constitutes an important boundary condition for any atmospheric model. For climate modelling in particular, a relatively comprehensive treatment of the earth's surface is important because of the long thermal and hydrological memory of land areas and oceans relative to the atmosphere. Land surface areas cover only about 30% of the earth's surface, but pose special problems to modellers because of their extreme spatial heterogeneity and the varieties of surface cover - soil, vegetation, snow, ice and inland water - that have to be considered. Considerable advances in land surface modelling for GCMs have been made over the last ten years. Currently a variety of programmes are underway, both nationally and internationally, aimed at the further development, intercomparison, testing and refinement of land surface models over a wide range of scales from the single-column to the continental. Canadian researchers are world leaders in several particular areas of land surface scheme development, such as streamflow generation, snow modelling, and the simulation of greenhouse gas fluxes from peatlands. This talk will give a broad overview of work in progress in all of the above areas.

Notes

overheads, oral

A Simulation of Holocene Optimum Climate Using the CCC AGCM

Vettoretti, G.

Department of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7

McFarlane, N. A.

Atmospheric Environment Service, University of Victoria, Victoria, B.C., Canada V8W 2Y2

Peltier, W. R.

Same as 1.

Speaker: Vettoretti, G.

Time: Thursday 14:15

Abstract

Long timescale variations in the Earth's orbital parameters, including precession, obliquity and eccentricity, result in oscillatory evolution of the incident solar radiation at the top of the atmosphere. Past numerical experiments concerning the Earth's climatological response to these variations have formed a basis on which to address fundamental issues in paleoclimatology and have helped to illustrate the influence of the main factors which have served to determine the climate state of the atmosphere and oceans throughout the geologic past. A first such simulation that we shall discuss involves application of the Canadian Centre for Climate Modelling and Analysis Atmospheric General Circulation Model to simulate the climate state in the time interval centred upon 6000 years before present. This model simulation was integrated for 10 years of model time with a 2 model year adjustment period and boundary conditions constrained to the assumption that sea surface temperatures were the same as today and that CO_2 concentrations were approximately 280 ppmv during the Holocene Optimum. A second simulation employing the same atmospheric model coupled to mixed layer ocean and thermodynamic sea ice modules has also been performed. Both simulations have been run at triangular truncation 32. The results of these experiments indicate that numerous statistically significant departures of the various primary atmospheric variables from the modern control experiment are identifiable. Most notable are the increased surface heating and cooling of the continental land masses in the Northern Hemisphere during summer and winter, respectively. The seasonal mean behaviour of the atmosphere, in particular within the highly sensitive latitudinal band from 0°-30°N, exhibits statistically significant departures from the control simulation during the summer season. A comparison of the fixed SST experiment with the mixed layer calculated SST experiment is made to assess the impact of a responsive ocean surface and to address the CLIMAP analysis in which an attempt was made to calculate the sea surface temperatures of the Holocene Optimum. Of interest in this calculated SST experiment is the recession of the sea-ice boundary during the Holocene Optimum due to the increased insolation at high latitudes during Northern Hemisphere summer. In general, the structure of the Northern Hemisphere circulation is so strongly affected by the change in orbital configuration that we can conclude with a good degree of confidence that the stationary wave and monsoon flow patterns must have been markedly different from present day.

Notes

none

Modelling of Acid Deposition in High-Elevation Fog

Walmsley, John L.

Atmospheric Environment Service, Downsview, Ontario, M3H 5T4

Urquizo, Natty

Same as 1.

Schemenauer, Robert S.

Same as 1.

Bridgman, Howard A.

Department of Geography, University of Newcastle, Newcastle, NSW 2308, Australia

Speaker: Walmsley, John L.

Time: Thursday 15:45

Abstract

A method to estimate the volume of fogwater collected by a tree canopy in complex terrain is described. Included are assumptions about the probability of cloud, and about the shape and spacing of trees and their fogwater collection efficiency. Key components are the use of a computer model for wind flow in complex terrain and the calculation of liquid water content (LWC) as a function of height. Fogwater deposition rate is a linear function of LWC and wind speed. The method is applied to a 655 \(km^{2}\) area surrounding Roundtop Mountain, Quebec. Variations in the wind-velocity field just above the canopy are closely related to the main terrain features. Near the summit of Roundtop Mountain, variations in terrain height are more pronounced than those of treetop wind speeds. Patterns of fogwater deposition, therefore, strongly reflect the pattern of topographic contours, with modifications apparent due to spatial variations in wind speed. Calculated fogwater deposition values are typical of measured values in the literature. Acidic ion deposition from fogwater was more significant than that from precipitation over the higher elevations. The method was also applied to Mont Tremblant in a different region of Quebec. Monthly climatological data from a nearby weather station were used as input for the fogwater deposition calculations. The calculation method is still evolving. The goal is the development of a simple model that can be used over large geographic areas. In such applications, the model must be able to work with standard meteorological input data.

Notes

The Mesospheric Imaging Michelson Interferometer (MIMI).

Ward, W.E.

ISTS, Petrie Science Bld., York University, North York, Canada, M3J 1P3.

Gault, W.A.,

Same as 1

Shepherd, G.G.,

CRESS, York University, North York, Canada, M3J 1P3.

Tarasick, D.W.,

Environment Canada, 4905 Dufferin Street, Downsview, Canada, M3H 5T4.

Butner, G.,

CAL Corporation, 1050 Morrison Drive, Ottawa, Ont, K2H 8K7.

Speaker: Ward, W.E.

Time: Monday 14:45

Abstract

The Mesospheric Imaging Michelson Interferometer (MIMI) is a wide-angle imaging Michelson interferometer. It is proposed as part of a small satellite experiment, the Mesosphere Ozone Dynamics, which currently includes two other instruments, a gravity wave imager and a sun photo spectrometer (developed by AES). MIMI is similar to WINDII but is smaller, lighter and less expensive and is designed to observe the O$_{2}(^{1} \Delta)$ airglow in the mesosphere and upper stratosphere. The quantities to be measured include the horizontal wind field, the emisson rate (from which the ozone concentration may be determined) and possibly the temperature. The atmosphere will be sampled in four directions relative to the satellite track ($\pm$ 45° and $\pm$ 135°) so that gradients in the horizontal wind field parallel and perpendicular to the satellite track may be determined. With these measurements, the energetics and dynamics in the height range 45-90 km may be explored in detail. In this talk, the details of this instrument and the exciting possibilities of the associated data will be described.

Notes

Observations of the two-day wave with the Wind Imaging Interferometer (WINDII)

Ward, W.E.

ISTS, Petrie Science Bld., York University, North York, Canada, M3J 1P3.

Wang, D.Y.

Same as 1

Solheim, B.H.

CRESS, York University, North York, Canada, M3J 1P3.

Shepherd, G.G.,

Same as 3

Speaker: Ward, W.E.

Time: Thursday 13:35

Abstract

The Wind Imaging Interferometer measures the volume emission rate of, and winds from the Doppler shifts in, selected emissions in the airglow layer (in the mesopause region). Among the dominant dynamical features observed in this data are oscillations near solstice of 50 m/s amplitude, wavenumber 3, and a period of approximately two days. This oscillation also occurs in the emission rate data. This feature is identified as the so called two-day wave, a global oscillation corresponding to the third Rossby-gravity normal mode. In this talk the characteristics of this wave as seen in the WINDII data are presented and discussed.

Notes

The global water cycle for present and doubled CO2 climates simulated by the CSIRO9 GCM.

Watterson, Ian G.

CSIRO Division of Atmospheric Research, PB1 Aspendale 3195, Australia

Speaker: Watterson, Ian G.

Time: Tuesday 14:50

Abstract

The processes controlling the global distribution of precipitation and atmospheric water vapour are studied using the CSIRO9 GCM, which includes semi-Lagrangian transport of

water vapor and a 50 m slab ocean. The precipitation rate, P, and water column, w, averaged over Januarys and Julys from a 30-year present climate simulation compare well with observations. On the global scale, surface evaporation E has the largest influence on P. The simulated climatological water vapor flux is partitioned into monthly mean and transient components. The mean-flow flux is crucial to the distribution of both w and P, and converges on the tropical highs of both fields. The transient eddy flux is important in mid- latitudes. Potential and streamfunction representations of the flux fields are evaluated. The degree to which the simulated horizontal transient flux can be understood using linear eddy transport theory is examined. The convergent flux is largely down-gradient with respect to w, and is well represented as the product of the gradient of w and the variance of winds at 800 hPa. Possible changes in the hydrological cycle due to climate change are explored by examining the GCM's equilibrium doubled CO2 climate. The distribution of changes in P is most strongly influenced by changes in the mean flow flux. Changes in both the mean winds and the water column are important. In the zonal mean, changes in midlatitude transient fluxes are generally small, with the effect of the increased gradient of w countered by decreases in eddy variance.

Notes

Energy transports in present and greenhouse climates simulated by a GCM including dynamic sea-ice

Watterson, Ian G.

CSIRO Division of Atmospheric Research, PB1 Aspendale 3195, Australia

O'Farrell, S. P.

Same as 1

Dix, M. R.

Same as 1

Speaker: Watterson, Ian G.

Time: Thursday 13:35

Abstract

Energy transports within the climate system have an important influence on the surface temperature and hence on the warming due to increased greenhouse gases. However the transports are incompletely understood and often poorly modelled. This paper describes energy transport simulated by the CSIRO9 GCM for 1xCO2, 2xCO2 and 3xCO2 conditions. The model includes dynamic sea- ice, and hence heat transport (largely through latent heat) by the ice. This transport is shown to contribute typically $\pm$10

Wm^{-2} to the annual mean surface energy budget in the polar regions in the present climate, although its contribution to the mean meridional transport is small relative to that of the atmosphere and ocean. The focus here is on the results for the GCM with a slab ocean, in which the effective ocean energy transport is prescribed and unchanged in the warmer climates (the mean surface warming being 4.3K for 2xCO2, and 6.8K for 3xCO2). The mean poleward transport by the atmosphere is reduced by about 5% in the 2xCO2 case within the Northern Hemisphere, with little change in the south. This contrasts with the change at 2xCO2 in a transient simulation by the "coupled" model including a dynamic ocean, which feeds an increased absorption of heat by the Southern Ocean.

Notes

Modelling Stably Stratified Boundary--Layer Flow Over Low Hills

Weng, W.

Dept. of Earth and Atmospheric Science, York University, North York, Ontario M3J 1P3

Chan, L.,

Same as 1.

Xu, Dapeng

Same as 1.

Taylor, Peter A.

Same as 1.

Speaker: Weng, W.

Time: Thursday 11:25

Abstract

Since the first version of the Mixed Spectral Finite Difference model (MSFD) (Beljaars et. al, 1987) for neutrally stratified atmospheric surface--layer flow over complex terrain appeared, a several efforts have been made to refine and improve the model and its performance (Karpik, 1988; Ayotte et. al, 1994; Xu et. al, 1994). It is believed that the MSFD model can better predict the turbulent flow than the original Jackson and Hunt Model (1975). In this paper, we extend the MSFD model to include the effects of the stable stratification with $E-\kappa z$ turbulence closure and to study the influence of stability on boundary layer flow and its effects on propagating internal gravity waves and drag calculations. To allow internal gravity wave to propagate, we have constructed a

background flow so that wind velocity U and buoyancy frequency N are constants outside of the surface boundary layer with an assumption that there are momentum and heat fluxes sinks to achieve balance in the governing equations. Model results are compared with those of inviscid theory. It is found that there are elevated maxima of velocity perturbations inside the surface boundary layer with the turbulent boundary--layer model and that the velocity perturbation can be twice as large as that of inviscid flow. For Froude number, Fr, less than 1, internal gravity waves are generated. The wave drag primarily depends on Fr. For $0.5<Fr

Notes

Observations of Middle Atmosphere Thermal Structure and Gravity Wave Activity Above the High Arctic

Whiteway, James A.

Department of Physics, University of Toronto, Toronto, ON, Canada M5S 1A7

Carswell, Allan I.

Department of Physics and Astronomy, York University, North York, ON, Canada M3J 1P3

Speaker: Whiteway, James A.

Time: Thursday 10:55

Abstract

During the past four winters, lidar observations of middle atmosphere thermal structure have been carried out from the new stratospheric observatory near Eureka Weather Station on Ellesmere Island. An emphasis of this work has been on the properties and influence of atmospheric gravity waves. Since 1994, the lidar measurements have been complemented by an upgraded radiosonde system with 50 m vertical resolution. This combination of instruments can observe the evolution of the gravity wave spectrum through the troposphere and stratosphere. The location of Eureka is particularly interesting since its position relative to the stratospheric polar vortex (inside or outside) is quite variable. We can observe how the wave activity responds to large changes in the background dynamic state. The major finding, thus far, is evidence for critical level filtering of gravity waves generated by flow over the rough terrain in the vicinity of Eureka.

Notes

Interannual and seasonal variability in mixed layer water properties along Line P in the N.E. Pacific Ocean from 1989 to present.

Whitney, Frank A.

Institute of Ocean Sciences 9860 West Saanich Rd. P.O. Box 6000 Sidney, B.C. V8L 4B2

Speaker: Whitney, Frank A.

Time: Monday 14:25

Abstract

Over the past decade, surface nutrient, temperature and salinity data have been collected at 27 stations along Line P typically in late winter, spring and late summer each year. This section extends 1500 km from the coast of British Columbia to Ocean Station P (50 N, 145 W). From 1989 to 1994, late winter nutrient levels consistently decreased, declining to 60% of initial concentrations. In late summer, an area of nitrate depleted waters extends several hundred kilometers from the coast. This regime has been broadening concurrently with the general decrease in nutrients, extending as far as 1000 km from shore in 1995. Associated changes in salinity and temperature will be discussed in an attempt to explain the loss of nutrient from this area.

Notes

Enhancement of the Argos Data Collection and Geo-location System

Wingenroth, J. L.

Service Argos, Inc., 1801 McCormick Dr., Suite 10, Largo, MD 20774

Speaker: Wingenroth, J. L.

Time: Monday 17:15

Abstract

For over 15 years, the Meteorological and Oceanographic communities have relied on the Argos system to provide data from remote locations. Currently, over 50% of the platforms operating through Argos are buoys and floats moored or circulating in the oceans. These instruments directly measure parameters such as sea surface temperature and air pressure as well as indirectly measuring ocean circulation by their movement. Both Argos and GPS locations are utilized for the latter with both types of data available through Argos. With the launch of NOAA-K in late 1996 (the first of the K, L, M series of satellites), a new Argos instrument will be integrated into the system. Argos-2 has greater receiver sensitivity, more processing capacity, and operates on a wider bandwidth than the first-generation Argos. This will increase both the number of platforms able to be processed and the data handling capability of the system. In recent years, Argos has

expanded its international cooperation leading to an agreement with the Japanese space agency, NASDA. As a result, an Argos instrument is now scheduled to be flown aboard the Japanese satellite ADEOS-II, to be launched in 1999. With this instrument, Argos will introduce a two-way capability to enable remote control of User platforms. "Downlink messaging" will enable Users to turn transmitters on and off, control sensors, change sampling rates, avoid redundant transmissions and perform numerous other functions. These improvements as well as examples of Argos use in Meteorology and Oceanography are presented.

Notes

poster

Hamiltonian Averaging and Slow Dynamics

Wirosoetisno, D.

Dept. of Physics, University of Toronto, Toronto Ontario, M5S 1A7

Shepherd, T.G.

Same as 1.

Speaker: Wirosoetisno, D.

Time: Wednesday 10:25

Abstract

We apply a perturbative hamiltonian averaging procedure to a simple truncation of the shallow-water equations (based on Lorenz's 1986 model) to remove the fast oscillations from the dynamics. In contrast to the usual approach which assumes the complete absence of gravity-waves, this method allows the fast mode to have a finite amplitude without having to resolve their oscillations. For each fast mode, the resulting system has one fewer degree of freedom than the original system, although in the simplest cases the fast amplitude is constant. The approach is equivalent to approximating an invariant subspace which reduces, as the fast amplitude tend to zero, to the usual slow manifold when the latter exists; as in previous studies, this results in reduced, `balanced' dynamics with no gravity waves. In a more typical situation, however, the slow dynamics is chaotic, and such a manifold is unlikely to exist; in this case we often find an almost-conserved quantity (in the sense that the magnitude of its fluctuation is small) which can be used to define the so-called fuzzy slow manifold. We shall describe results from lower-order models, and discuss its generalization to more complex models.

Notes

Analysis of six years of atmospheric methane data from the Canadian baseline observatory at Fraserdale, Ontario

Worthy, D.E.J.

Environment Canada, Atmospheric Environment Service, Toronto, Canada

Trivett, N.B.A.

Same as 1

Kuhlmann, A.

Institut fuer Umweltphysik, University of Heidelberg, Heidelberg, Germany.

Ernst, M.K.

Same as 1

Levin, I.

Same as 3.

Speaker: Worthy, D.E.J.

Time: Tuesday 09:45

Abstract

Six years of atmospheric methane (CH4) measurements for the Canadian baseline observatory at Fraserdale (49(53'N, 81(34'W, 210m asl) are presented. The observatory is located on the south eastern perimeter of the Hudson Bay Lowlands (HBL) at (asl). These data are supplemented by continuous carbon dioxide, 222Radon and 13CH4 observations. The CH4 show seasonal cycle typical of remote sites in the northen hemispshere such as Alert (82(30'N, 62(20'W) except for the summer and early fall periods where a distinct secondary peak in concentration is observed. Short term variation are observed on time scales up to five days similar to Alert. Air mass trajectory climatology shows that the predominate sector for air masses is north to north west sometimes reaching as far north as Alert. Time series from Fraserdale often show a strong correlation with that of Alert offset by 4 to 6 days. The summer periods show strong diurnal cycles up to 100 ppbv. Isotopic analysis indicates this to be a wetland methane source. The magnitude of the diurnal cycle varies for year to year reflecting changes in the regional methane source strength. Interannual variations in the Fraserdale data set are compared to remote sites at similar latitudes and Alert and the the carbon dioxide and radon measurements at Fraserdale.

Notes

Modelling the North Atlantic: A Community Effort (Invited)

Wright, D.G.

Ocean Science Division, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, B2Y 4A2

Speaker: Wright, D.G.

Time: Thursday 11:35

Abstract

Associated with the most recent Canadian WOCE proposal, a request was made to the AES Climate Research Network to fund a "Community Modelling Effort focussed on the North Atlantic". The central goals of this project are: (1) to develop a realistic model of the North Atlantic; (2) to use the model to motivate and test conceptual ideas regarding the controlling factors for the circulation and water mass properties in the model and in the real world; (3) identify key model weaknesses through comparisons with observations; develop and implement modifications to correct these problems where possible; and (4) use the model outputs to improve interpretations of existing data sets and to assist in the development of future field programs. In this presentation we will briefly discuss the progress to date and plans for future work. We will then discuss what is meant by a "Community Modelling Effort" and how we might make this a reality rather than a concept. The main purposes of this presentation will be to let you know what is happening now, and encourage you to contribute to what will happen next.

Notes

Rapid Changes in Ocean Circulation and Atmospheric Radiocarbon

Wright, D.G.

Ocean Science Division, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, B2Y 4A2

T. Stocker

Physics Institute, University of Bern, 3012 Bern, Switzerland

Speaker: Wright, D.G.

Time: Tuesday 15:10

Abstract

An idealized, coupled, latitude--depth, global ocean--ice--atmosphere --biosphere model is used to investigate transient atmosphere--ocean exchange of tracers. Including radiocarbon into the model, we assess the evolution of the atmospheric concentration of radiocarbon during large-scale changes of the ocean's deep circulation. A physically reasonable adjustment of the runoff into the North Atlantic is invoked to achieve a transient response to realistic meltwater perturbations which closely resembles the Younger Dryas climate event. This allows the study of the evolution of atmospheric radiocarbon during rapid change of the thermohaline circulation and yields an estimate of how much the radiocarbon ``clock'' may be influenced by such changes. When the North Atlantic branch of the conveyor belt circulation is interrupted, the oceanic uptake of radiocarbon is reduced, hence the oceanic inventory decreases and consequently the atmospheric inventory increases. Thus, the reduction of North Atlantic overturning causes the radiocarbon clock to run too fast. Similarly, resumption of the North Atlantic branch of the conveyor after a period of collapse, lowers the atmospheric radiocarbon content and the clock runs too slow. Our model results suggest that the radiocarbon clock typically runs 50\% too fast as the Atlantic overturning collapses, and if the deep ocean reservoir is decoupled from the surface long enough, resumption of the conveyor can result in an age plateau extending over several hundred years. The available observations give some support for these conclusions.

Notes

On Turbulence Closure Models for PBL Modelling

Xu, Dapeng,

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Taylor, Peter A.

Same as 1.

Speaker: Xu, Dapeng,

Time: Thursday 11:45

Abstract

Constant for several turbulence closure models, based on data from the atmospheric boundary-layer, are proposed. They differ from those currently being used in engineering situations but are self- consistent and tuned to represent atmospheric boundary-layer turbulence. Issues associated with the equation for the dissipation rate of turbulent kinetic energy are addressed, specifically the constants in the equation are re-evaluated. in the

context of atmospheric boundary-layer modelling, we find that one of the constants, $C_{\epsilon 1}$, has to be a function of vertical distance, z, to satisfy the constraints provided by two idealized flow situations. The proposed constant sets are tested with a simple, one- dimensional, neutrally-stratified planetary boundary-layer flow over a horizontally homogeneous and aerodynamically rough flat surface. Comparisons of model results and observations as well as PBL similarity theory and large eddy simulation results show promise for improving boundary-layer predictions.

Notes

Meteorologically Adjusted Ground Level Ozone Trends in Ontario

Xu, Dapeng,

Department of Earth and Atmospheric Science, York University, 4700 Keele Street, North York, Ontario, M3J 1P3

Yap, David,

Environment Monitoring and Reporting Branch, Ontario Ministry of Environment and Energy, 125 Resources Road, East Wing, Etobicoke, Ontario, M9P 3V6

Taylor, Peter A.

Same as 1.

Speaker: Xu, Dapeng,

Time: Wednesday 11:15

Abstract

Meteorology plays an important role in ozone formation and transportation. As a result, the substantial variations in meteorological conditions (on all time scales) can exert such large impacts on ozone concentrations that they may mask any long-term trends in ozone that could reasonably be traced to changes in precursor emissions such as NO_x and VOC. In this paper, we present a regression model with features including a linear trend, seasonal variations (i.e. an annual cycle), meteorological parameters (temperature, sunshine hours and relative humidity) and a categorical variable. By comparing the trends obtained with and without considering meteorological impacts, we are able to estimate the meteorological effects. Moreover, with this regression model we believe that we can identify the ground level ozone trends associated with changes in precursor emissions.

Notes

On the estimation of covariances in variational assimilation schemes.

Yaremchuk, A.I.

Alfred Wegener Institute, Postfach 120161, 27515 Bremerhaven, Germany

Yaremchuk, M.I.

Dept. of Oceanography, Dalhousie University, B3H 4J1, N.S., Canada

Speaker: Yaremchuk, M.I.

Time: Wednesday 15:45

Abstract

An iterative method for estimating the covariances between linear functions of the control variables is proposed. The method is based on the expansion of the Hessian inverse in a generalized Fourier series and requires $\sqrt(C)$ computations of the cost function gradient, with C being the Hessian condition number. The method is applied to a variational assimilation scheme with 17,646-dimensional control space.

Notes

none

Effect of Rotation on the stability of Gravity Waves

Yau, Ka-Hing

Centre for Research of Earth and Space Sciences, York University.

Klaassen, G.P.

Department of Earth and Atmospheric Sciences, York University.

Sonmor, Len

Department of Earth and Atmospheric Sciences, York University.

Speaker: Yau, Ka-Hing

Time: Monday 10:55

Abstract

We employ a Floquet analysis to examine the breaking of inertio- gravity waves. Klostermeyer (1981) used similar method for analyzing the stability of internal gravity

waves with respect to two-dimensional disturbances. Fritts and Yuen (1989) has investigated the the stability of inertio-gravity waves with respect to two-dimensional disturbance under restrictive assumptions, in which wave structure is horizontally uniform and constant in time. the present analyses differ from the aforementioned ones in which the propagating nature of the basic finite amplitude wave is taken into account, and the three-dimensional perturbations are considered. We compare the results to the corresponding analyses for plane, non-rotating internal gravity waves in order to assess the influence of the Coriolis force on the stability of internal wave. Our findings show that rotational effect is much greater than it has been thought of (e.g. Fritts and Rastogi, 1985) in terms of both growth rates and structure of the dominant disturbance waves.

Notes

The mesoscale structure of ERICA IOP2 storm

Kong, Fanyou

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, H3A 2K6

Yau, M.K.

Same as 1

Speaker: Yau, M.K.

Time: Thursday 13:35

Abstract

A high resolution simulation of the ERICA IOP2 explosive marine cyclone using MC2 with a newly developed efficient explicit microphysics scheme has been carried out. In addition to reproducing well the cyclone's explosive deepening and its general characteristics, the simulation reveals many important fine structures. The simulated bent-back front exhibits several mesoscale perturbation, while both the primary and secondary cold fronts show very narrow (about 20km) and sharp baroclinic features. Periodic mesoscale precipitation cores are embedded along the cold fronts, with evidence of eddy-like and hook-look structures. As cyclogenesis proceeds, the primary cold front and the warm front gradually seperate from the bent-back front and the cyclone center near the triple point. A second triple point forms between the remaining bent-back front and the secondary cold front. The seperation process is triggered at the low levels because of mesoscale downdrafts. The deepest convections are found near the region of both triple points. Behind the cold-front and in the area of the cold air outbreak, shallow cumulus cloud streets, rotating cyclonically around the east side of the surface low center, are successfully simulated. Moreover, A double spiral signature of the cyclone center is evident in the low level vorticity field and hydrometeor field. The explicit condensation

scheme generates tremendous low-level PV within the frontal zones, with a magnitude comparable to that calculated from fine resolution observation data.

Notes

The Atmospheric Environment Service New National Climate Archives

Yves Durocher

Climate and Water Information Branch, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario M3H 5T4

Yip, Tsoi-Ching

Climate and Water Information Branch, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario M3H 5T4

Speaker: Yip, Tsoi-Ching

Time: Thursday 16:25

Abstract

The climatological archives have changed drastically over the last few years. On February 1, 1995, the Atmospheric Environment Service (AES) converted the climatological archives to Oracle database running under UNIX on a network of HP 9000 755 and 725 workstations. This new climatological archives are now updated much faster than before. The total disk storage of the new system is 0.5 terabytes. Part of this archives will be replicated on regional database servers to provide faster access to the most current data. For research projects, the system will maintain an additional set of ASCII files more suitable for large volume extraction. All hourly and synoptic observations are stored in just 24 hours following the end of the climatological day and daily climatological summary observations are derived from these in the same time frame. Users inside the Environment Canada fire walls can access the archives using several access methods ranging from the standard Archives extractors, the IDEO suite of GRP/GRFs, direct SQL scripts and soon from the PC based ODBC type linkage from Microsoft EXCEL and ACCESS (and others). In addition, catalogues of stations and data inventories as well as climatological data from selected representative stations will be posted on WEB sites which are outside of the fire walls thus accessible by every users on the WWW network.

Notes

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

Zwack, Peter

Department of Earth Sciences, Universite of Quebec at Montreal, P.O. Box 8888, Station A, Montreal, Quebec H3C 3P8

Olivier Hamelin

Ecole Nationale de la Meteorologie, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Santurette, Patrick

SCEM, 42 Avenue Coriolis, 31057 Toulouse CEDEX, France

Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experiemental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies amoung the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the cause of a region of upward motion or pressure falls provided the forecaster with enought confidence to follow the model guidence. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes

The Atmospheric Environment Service Climate and Water Data Service

Yip, Tsoi-Ching

Climate and Water Information Branch, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario M3H 5T4

Speaker: Yip, Tsoi-Ching

Time: Wednesday 11:35

Abstract

Environment Canada maintains archives of climate and water (stream flow and water quality) observations for Canadian land areas and coastal waters. The earliest records date back to 1840. Information is stored and made available in several formats including paper, microfilm/microfiche and digital files. Recent organizational changes at Environment Canada, and advances in computer technology have resulted in changes in the volume of observations, and the way observations are stored and made available. A wide variety of weather, marine, upper air, and stream and river flow observations from the climatic and water archives have long been used for the design of land and off-shore structures, applied environmental, forestry and agricultural studies, and atmospheric research. This paper presents an overview of the National Climatic and Water Archives and associated products and services. The characteristics of the observational data sets, such as quality control procedures, station history information, and the breadth and length of record are described. Emphasis is placed on an explanation of the new data sets, products and services available to users of the stored data. Plans for future products and access to the archives using means such as CD-ROMS and the Internet are also described.

Notes

High resolution simulation of precipitation and validation with Doppler Radar observations

Yu, W.

Centre de Recherche en calcul Appliqué, 5160, boul. Décarie, Montreal H3X 2H9, CANADA

Lin, Charles A.

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal H3A 2K6, CANADA

Benoit, R.

Service de l'environnement atmosphérique, 2121, route Trans-canadienne, Dorval (Québec) H9P 1J3, CANADA

Zawadzki, Isztar

Dept. of Atmospheric and Oceanic Sciences, McGill University, Montreal H3A 2K6, CANADA

Speaker: Yu, W.

Time: Monday 14:45

Abstract

Surface precipitation is a key input parameter for hydrologic models. Validation of the precipitation field simulated by an atmospheric model is a first step in the development of a coupled atmospheric- hydrologic model. The objective of the present study is to simulate the surface precipitation using the MC2 (Mesoscale Compressible Community Model) in a self-nesting mode. The spatial resolution will vary from 50 km, which corresponds to the resolution of the CMC regional operational analysis, to 5 km. These high resolution precipitation fields are then compared with those retrieved from a Doppler radar. The results from a case study will be presented.

Notes

A New Approach to a Global Surface Reflectivity Data Set at 2.4 micron

Yu, Zhen Z.

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Drummond, James R.

Same as 1.

Speaker: Yu, Zhen Z.

Time: Monday 16:35

Abstract

The channels of the MOPITT (Measurements of Pollution In The Troposphere) instrument which are sensitive to column amounts of CO and CH4 use reflected sunlight as a radiation source. The surface reflectivity of the planet therefore appears as an important parameter in performance estimates as well as a significant parameter in retrievals (although the retrieval algorithm is designed expressly to suppress sensitivity to this term). On examining the available data, it was found that this region of the electromagnetic spectrum is effectively "orphaned" between the visible surface imagers and the thermal infrared temperature sounders and very little data are available. A project

was therefore initiated to produce as good a surface mapping of the reflectivity as possible from existing data. The main thrust of the work has been to use Landsat TM band 7 data and surface vegetation data sets derived from the International Satellite Land Surface Climatology Project (ISLSCP) to produce a reasonably detailed global map of reflectivity at 2.4 micron region. A new approach has been designed to derive the surface reflectivity by taking a weighted average of the reflectivity values of several basic components of the underlying surface. The weight of each characteristic surface component comes from its fractional area derived from available global data sets. The method can be easily extended to achieve a higher-resolution mapping whenever relevant data become available.

Notes

Vorticity Line Frontogenesis

Zhao, Huiquan

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Cho, Han-Ru

Same as 2.

Speaker: Zhao, Huiquan

Time: Monday 16:55

Abstract

A new hypothesis of frontogenesis is proposed based on the classical Semi-geostrophic theory. With weak large scale deformation forcing, a pre-set mesoscale barotropic or weak baroclinic vorticity line along the 2-dimensional classical front direction will develop discontinuity at the surface in physical space within finite time. The large scale contraction and the nonlinear ageostrophic forcing intensify this mesoscale frontogenetic process in a rate faster than the larger scale exponential growth. Therefore, the mesoscale vorticity field first develops into a narrow and intense line-shaped frontal zone, and later collapses at the surface. The mathematical theory is developed and scale analysis is presented for the above two cases. The observational evidence of this type of frontogenesis is found within the Mei-yu front system. Mei-yu front is a frontal system occurred typically over south China, Taiwan and Japan area in the early summer. It is characterized by weak temperature contrast across the front, strong horizontal wind shear and low-level potential vorticity (PV). The front produced by a nonlinear model based on the above theory will be compared with the observations. Other properties derived from the model products will also be discussed.

Notes

An Application of Potential Vorticity Inversion to Improving the Numerical Prediction of the March 1993 Superstorm

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Speaker: Zonghui Huo

Time: Thursday 15:45

Abstract

In this study, a methodology is proposed to improve the model initial conditions, based on available surface temperature observations from ships, buoys and drifters. It is then tested with the numerical prediction of the 12-14 March 1993 superstorm that is initialized at its incipient stage over the Gulf of Mexico. In this methodology, we make use of the piecewise potential vorticity (PV) inversion technique and treat the temperature errors at the lowest level as a surrogate PV anomaly. After inverting the wind and mass perturbations from the surface thermal anomaly, assuming no PV perturbations at all levels, a three-dimensional, dynamically consistent set of errors are added to the model initial conditions to correct the representation of the lower troposphere over the data-sparse ocean. It is found that the numerical model prediction, initialized with the correct initial conditions, exhibits significant improvements in the early rapid deepening and track of the superstorm over the ocean, the development of a prefrontal squall line and the central sea-level pressure traces during the life cycle of the cyclone, as verified against available observations. The results show that the methodology proposed is promising in improving the representation of lower-tropospheric meteorological variables in the model initial conditions, based on available surface observations over data-sparse regions. This technique also has the potential to improve short-range numerical weather predictions and quantitative precipitation forecasts when combined with other remote-sensed observations.

Notes

Operational Use of Diagnostics of Numerical Model Forecasts: The French Experience

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Speaker: Zwack, Peter

Time: Thursday 13:15

Abstract

During the winter and spring of 1994, the experimental numerical model diagnostic package, DIONYSOS, was run daily on output from the state-of-the-art (full physics, spectral variable mesh, semi-implicit) French operational model ARPEGE. The diagnostics in DIONYSOS are calculated by assuming balanced flow and partition the vertical motion and vorticity and geopotential tendencies among the classical atmospheric forcings: vorticity and temperature advections, latent and sensible diabatic heating, friction and orography. The diagnostics, which correlate strongly to the model values, were made available to the forecasters at SCEM (French equivalent of CMC). In addition, many of the forecasters attended a series of presentations which explained the theoretical basis and some of the potential uses of DIONYSOS.. During the six month experimental period, the forecasters made use of DIONYSOS especially when the numerical model structure did not correspond to either standard conceptual models of the atmosphere or their experience. (An example of the former will be summarized during the presentation) In most of these non-standard cases, the ability to rapidly diagnose the cause of a region of upward motion or pressure falls provided the forecaster with enough confidence to follow the model guidance. In several cases, however, when the forcing was latent heating, which is known to be one of the less accurately parameterized effects, the forecasters deviated from the model guidance and their decision was later verified. Because of this experience, DIONYSOS is now being implemented at SCEM. This presentation will give an overview of DIONYSOS, the experience in France and summarize the diagnostics for a meteorological system that does not correspond to any conceptual model.

Notes