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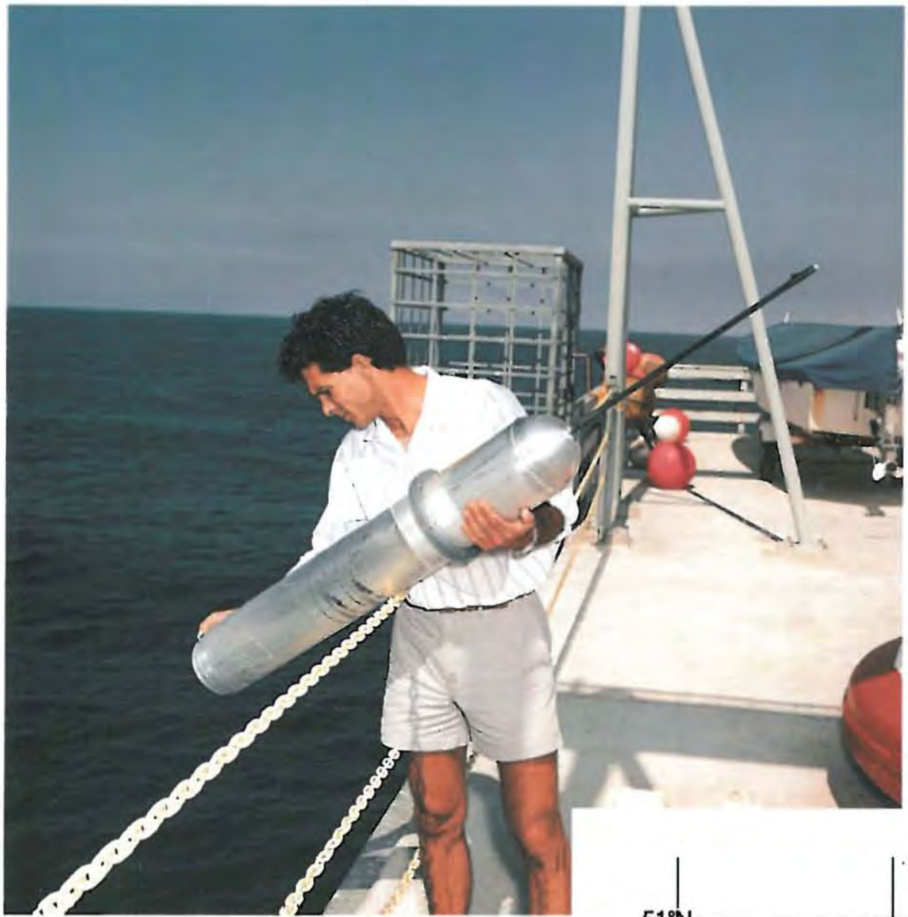
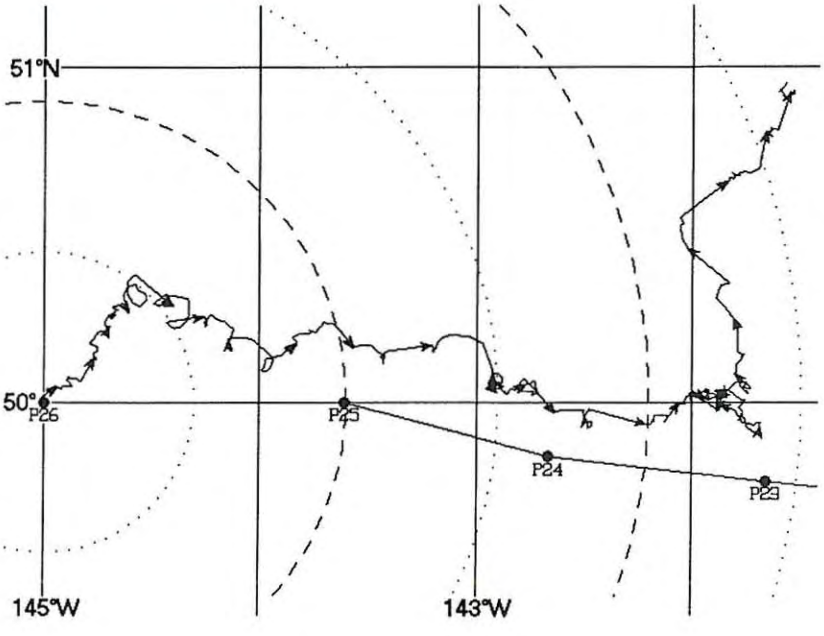


Profiling ALACE Float



CMOS Bulletin SCMO

"at the service of its members
au service de ses membres"

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Cover page: An important moment for oceanographic science when a sensor is being deployed in the ocean to measure the physical properties of the sea water, thus providing information of the variability, both in space and in time, of temperature and salinity. Here an ALACE Buoy is being deployed at Station Papa in the Pacific Ocean (50^{0}N, 145^{0}W). The bottom picture provides a bird's-eye view of the parth followed by the buoy from its deployment while P23 - P26 represent fixed oceanographic stations along line "P". Data from the buoy are transmitted to shore through Système Argos along with buoy position. After pre-processing, the data are transmitted on the GTS for assimilation into the IGOSS System, thus benefiting the global oceanographic programmes including the climate programs (See inside story page 28).

Page couverture: Un moment important pour la science océanographique lorsqu'un senseur est largué dans l'océan pour mesurer les propriétés physiques de l'eau de mer, donnant ainsi une image temporelle et spatiale de la variabilité de la température et de la salinité. Ici, une bouée ALACE est larguée à la station Papa dans l'océan Pacifique (50^{0}N, 145^{0}W). L'image du bas donne une vue à vol d'oiseau du trajet suivi par la bouée depuis son larguage alors que les points P23 - P26 représentent des stations océanographiques fixes le long de la ligne "P". Les données mesurées par la bouée ainsi que sa position sont transmisent sur la côte en utilisant le système Argos. Après un pré-traitement, les données sont transmisent sur le SMT dans le cadre du SMISO. Ainsi les programmes océanographiques mondiaux, incluant les programmes sur le climat, bénéficient de ces mesures (Voir description du programme à la page 28).

Next Issue - Prochain numéro

The next issue of the ***Bulletin 24 (3)***, June 1996, will go to press by mid June. We need your contributions, short articles, notes, presentations, chronicles, etc, by early June. Don't miss your chance!

Le prochain numéro du ***Bulletin 24 (3)***, Juin 1996 sera mis sous presse vers la mi-juin. Vos contributions sont les bienvenues. Veuillez bien me les faire parvenir d'ici le début de juin. Ne manquez surtout pas votre coup!

INSIDE / EN BREF

Volume 24 No.2
April 1996 - Avril 1996

Inclus avec ce numéro, vous trouverez un numéro spécial sur le Congrès de la SCMO à Toronto.

Included with this issue, you will find a special number on CMOS Congress in Toronto.

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A lire dans le prochain numéro du CMOS Bulletin SCMO l'article de G.S. Strong, A.G. Barr et C.L. Hrynkiw sur les *"Inter-comparisons of the Vaisala and Airsonde Sounding Systems during BOREAS"*.

In the next issue of the CMOS Bulletin SCMO, don't miss the article written by G.S. Strong, A.G. Barr and C.L. Hrynkiw on *"Inter-comparisons of the Vaisala and Airsonde Sounding Systems during BOREAS"*.

The Atlantic hurricane season of 1995: Global warming or interannual variations?

Madhav L. Khandekar[1]

Abstract

The unusually large number of Atlantic hurricanes in 1995 has prompted speculation and concern about a possible link between global warming and increased storm activity world-wide. In this brief article hurricane data of the last 45 years are analyzed to show that the 1995 hurricane season in the Atlantic can be explained in terms of interannual variation and a combination of favourable environmental parameters.

INTRODUCTION

The Atlantic hurricane season of 1995 provided a challenge for operational meteorologists while stirring considerable excitement among climate modellers, long-range forecasters and ocean surface wave modellers. Operational forecasters and marine meteorologists from Miami, Florida to St. John's, Newfoundland were kept busy almost round the clock during the peak period from about 10 August to 15 September 1995 when named hurricanes (Erin, Felix, Gabrielle, Humberto, Iris, Jerry, Karen, Luis) kept rumbling across the north Atlantic one after another, like warplanes taking off from an aircraft carrier deck. Many of these hurricanes threatened coastal communities along the U.S. Atlantic seaboard and produced torrential rains, high winds and extensive flooding. Hurricane Felix, in particular, kept hovering off the coast of the Carolinas (U.S.A.) threatening the coastal residents like a scorpion threatening its prey (as seen by a radar) and after a couple of days, quietly slipped northeastwards along the warm waters of the Gulf Stream.Felix soon showed up in the Canadian Atlantic, generating 10 m waves at Peggy's Cove (a well-known tourist spot about 50 km west of Halifax, Nova Scotia) and producing torrential rains in parts of the Avalon Peninsula in Newfoundland. Felix also triggered a 30-35m (about 100 ft) 'rogue' wave which slammed the luxury oceanliner "Queen Elizabeth II" causing considerable damage. The huge wave was probably caused by an intense but narrow fetch which was 'trapped' in the peripheral region of the moving storm. (A storm moving rapidly in the same direction as the surface wind flow can sometimes produce a 'trapped fetch' condition which could generate unusually large waves).

With the arrival of the Fall season, hurricane vortices forming over the tropical Atlantic started to move westward along the warmer waters of the Caribbean Sea and continued their path further west into the Gulf of Mexico. Hurricanes Opal and Roxanne thrashed the U.S. Gulf states (Florida, Alabama), the Yucatan Peninsula of Mexico and moved northwestward threatening the coastal areas along the Mexico and U.S. border at Texas. Roxanne, after battering the Yucatan Peninsula, rejuvenated as she headed northwestward over the warm Gulf waters and, in the absence of any steering current, kept twisting and wobbling, probably under the influence of its upper air circulation (see Khandekar and Rao, 1971, 1975) before finally dissipating along the Texas - Mexican border. By mid-October, 17 named storms and hurricanes formed over the north Atlantic and somehow made their presence felt along the U.S.-Canadian east coast. By late October, the mid-latitude circulation started to strengthen and with a couple of cold air outbreaks over northeastern and eastern United States in early November, the north-south temperature gradient over the north Atlantic increased which in turn led to an increase in vertical shear of the westerlies thus bringing an abrupt end to the turbulent hurricane season of 1995. The unusually large number of hurricanes in the Atlantic has prompted climate modellers and prophets of global warming scenarios to claim a direct link between increased number of hurricanes and sea surface temperature warming over tropical oceans in general and over the tropical Atlantic in particular. (It may be noted here that over the western north Pacific, about 18 typhoons have been recorded so far by the end of October 1995, whereas the average number of typhoons over the western north Pacific, based on the last 20 years of data, is about 25 per year). Several moored buoys in the Canadian Atlantic as well as off the east coast of U.S.A. have dutifully recorded the impact of this year's hurricane onslaught, with significant wave heights of 7m or more for hurricane Felix and a whopping 17m for hurricane Luis at a buoy location about 800 km southeast of Halifax. The availability of good buoy data has prompted ocean surface wave modellers to simulate hurricane-generated extreme wave conditions using state-of-the-art wave models and carefully prepared wind fields which can provide realistic representation of hurricane circulations.

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TABLE I: Summary of Atlantic tropical cyclone data; 1950-1994 (from Gray et al 1994)

Year	NS	NSD	H	Year	NS	NSD	H	Year	NS	NSD	H
1950	13	98	11	1966	11	62	7	1982	5	16	2
1951	10	58	8	1967	8	58	6	1983	4	14	3
1952	7	40	6	1968	7	26	4	1984	12	51	5
1953	14	64	6	1969	17	84	12	1985	11	51	7
1954	11	44	8	1970	10	24	5	1986	6	23	4
1955	12	82	9	1971	13	63	6	1987	7	37	3
1956	8	30	4	1972	4	21	3	1988	12	47	5
1957	8	38	3	1973	7	33	4	1989	11	66	7
1958	10	56	7	1974	7	32	4	1990	14	68	8
1959	11	41	7	1975	8	43	6	1991	8	22	4
1960	7	30	4	1976	8	45	6	1992	6	51 est.	4
1961	11	71	8	1977	6	14	5	1993	8	53 est.	4
1962	5	22	3	1978	11	40	5	1994	7	28	3
1963	9	52	7	1979	8	44	5	1995	19	65 est.	12
1964	12	71	6	1980	11	60	9	Mean	9.4	47.3	5.8
1965	6	40	4	1981	11	61	7	S.D.	3.0	20.4	2.2

In addition, wave climatologists (e.g. Swail, 1995) are taking a closer look at the Atlantic wave climatology to determine if the recent years' storm data may influence the extreme wave climate of the north Atlantic. In view of these and other recent studies on the possible impact of global warming on cyclone frequency (Lambert, 1994), it is tempting to inquire whether the unusually large number of hurricanes in the Atlantic for 1995 is a possible consequence of global warming or is just part of interannual variation?

Atlantic hurricane activity and large-scale atmospheric circulation

For ready reference, consider Table I (shown above) which provides values of three Atlantic hurricane parameters, named storms (NS), named storm days (NSD) and hurricanes (H) for the years 1950 to 1995. The last two rows of this table provide values of mean and standard deviation for the three parameters. Table I reveals several interesting aspects of Atlantic hurricane activity and its interannual variation as summarized below:

1. The number of named hurricanes is always smaller than the total number of named storms in any given year by about 30 to 40 percent on an average; however, in some years (e.g. 1950, 1951, 1963, 1980) the number of hurricanes is very close to the total number of storms, suggesting that under favourable conditions, a larger number of named storms could reach hurricane intensity.

2. For the 1995 hurricane season, there were 19 named storms of which 12 reached hurricane intensity, suggesting that the prevailing environmental conditions particularly during the peak months of August and September were favourable for almost all named storms to reach hurricane intensity.

3. The number of named storms or hurricanes since 1985 shows no systematic increase in the total number of storms or in the number of storm days indicating that the observed data over the Atlantic does not support any direct impact of possible greenhouse warming on hurricane activity.

In a series of papers, Prof. W. Gray and his co-workers (See Gray et al, 1994) at the Colorado State University (U.S.A.) have made pioneering studies on seasonal prediction of Atlantic hurricane activity using large-scale atmospheric and oceanic anomalies and related indices. Among the important predictors uncovered by Gray and his co-workers are: stratospheric quasi-biennial oscillation (QBO) and the associated wind shear between 50-mb and

30-mb level, El Nino/Southern Oscillation (ENSO), West African rainfall, Caribbean basin sea level pressure anomaly and the associated upper tropospheric zonal wind anomaly. Gray et al have developed suitable indices of these parameters for the pre-hurricane season as well as for the hurricane season and appropriate combinations of these indices are used to develop statistical regression equations to predict hurricane-related parameters as shown in Table I. According to Gray et al the westerly phase of the QBO, colder phase of ENSO associated with negative sea surface temperature anomalies in the equatorial central and eastern Pacific, above average precipitation in the western Sahel and Gulf of Guinea region off West Africa and negative anomalies for Caribbean basin sea level pressure as well as for upper tropospheric zonal wind, favour increased hurricane activity in the Atlantic. For the 1995 hurricane season, various indices associated with the above-mentioned predictors were all favourable before and during the hurricane season and this favourable combination of global and regional parameters led to the formation of an unusually large number of named storms and hurricanes for the 1995 season. Interestingly, the sea surface temperature anomaly over the north tropical Atlantic was zero or slightly negative during the peak months of August and September, indicating that increased sea surface temperature value associated with possible greenhouse warming was not considered to be relevant for the 1995 hurricane season.

Concluding remarks

The active Atlantic hurricane season of 1995 was primarily due to favourable (westerly) phase of the QBO, increased west African rainfall during the pre-hurricane season and also during the hurricane season, and slightly below-normal sea surface temperature values in the equatorial eastern Pacific. The unusually large number of named storms and hurricanes for the 1995 season can be explained in terms of interannual variation and as a consequence of favourable combinations of several large-scale atmospheric and oceanic parameters.

What is in store for 1996? Some of the coupled atmosphere-ocean models of the tropical Pacific suggest a small positive sea surface temperature anomaly in the equatorial eastern Pacific for the summer of 1996. This, together with the probability that the stratospheric QBO will be entering into an easterly phase by mid-1996, suggests that the 1996 hurricane season will be much less active than the hurricane season of 1995. A recent analysis by Prof. Gray and his co-worker Chris Landsea (see EOS, Vol.76, No.50, 12 December 1995) seems to suggest that the 1996 hurricane season should be calmer.

Acknowledgements

I would like to thank Bill Hogg of the Climate Research Branch, AES, for reviewing the manuscript and for suggesting several useful changes. Thanks are also due to Ms Ruth Tung of the Meteorological Research Branch, AES, for her prompt assistance in typing the manuscript.

References

Gray, W., C.W. Landsea, P.W. Mielke, and K.J. Berry, 1994: *Predicting Atlantic basin seasonal cyclone activity by 1 June.* Weather and Forecasting, 9, 103-115.

Khandekar M.L. and G.V. Rao, 1971: *The mutual interaction of multiple vortexes and its influence on binary and single tropical vortex systems,* Monthly Weather Review, 99, 840-846.

" " 1975: *Interaction between the lower and upper level circulation of a tropical vortex and its influence on the vortex trajectory,* Arch. Fur Meteor. Geophy und Bioklim. Series A, 24, 19-32.

Lambert S.J. 1994: *The effect of enhanced greenhouse warming on winter cyclone frequencies and strengths,* J. of Climate, 8, 1447-1452.

Swail V., M. Parsons, B.T. Callahan and V.J. Cardone, 1995: *A revised extreme wave climatology for the Canadian east coast,* Preprints 4th Int'l workshop on wave hindcasting and forecasting, Banff, Alberta, Oct 16-20 1995, pp 81-91, Environment Canada, Downsview, Ontario.

Who is Alace? What is she?

by Howard Freeland[1]

A new device, a profiling ALACE float, is available for the exploration of the oceans. I have managed to purchase several of these for use in the N.E. Pacific and in the Labrador Sea and have now acquired some experience working with the device. I would like to share this experience, and this short article will, I hope, outline how well the device is working and what it can do for us.

The device itself was first designed by Webb Research (Falmouth, Mass.) to allow the exploration of currents in remote areas of the global ocean. ALACE is an acronym for "Autonomous Lagrangian Current Explorer". The ALACE is designed to sink to a pre-determined depth and drift for a predetermined time. At the end of that time the float adjusts its buoyancy, rises to the surface, is fixed by the Système Argos satellite, and then returns to its pre-set depth. A recent innovation has involved adding a CTD to the float so that on the way up a CTD profile is obtained; some have dubbed the modified float a Palace (Profiling ALACE). Anyway, it is one of these that was deployed at Station Papa (Figure 1), in the N.E. Pacific, at a depth of 850 metres, and I am going to call it an Alace float from now on. Though the Alace itself is manufactured in Falmouth, Mass., the original concept comes from Scripps Institute of Oceanography (Russ Davis) and the integration of a CTD into the Alace body is still handled entirely by the groups at Scripps.

The Alace float consumes power when it transmits its data to the Argos satellite, and when it adjusts a piston to change its buoyancy; however, the latter adjustment dominates the power requirements. The standard Alace has energy sufficient for about 100 repeat trips between a parking depth of 1,000 metres and the surface. The energy demand is roughly proportional to pressure, so it will have energy sufficient for only 50 trips if it is launched to drift at 2,000 metres.

In its present configuration the float should have power sufficient to execute up to 130 profiles. I set the first float to ascend once every 5 days. The object was to explore the evolution of the open ocean mixed layer, and 5 days is about the storm interval, so we should get measurements for about 650 days, or 1.8 years.

Figures 1, 2 and 3 summarize the performance of our first Alace deployment. As of writing, the float has completed 28 cycles between 850 metres and the surface. The plots of potential temperature (Figure 2) and salinity (Figure 3) show the steady deepening of the thermocline as early fall turned to winter. More intriguing is the double halocline that can be seen in early fall that deepens and then merges with the main halocline near profile number 11.

The conductivity sensor is an inductive type sensor, made by FSI and appears to be stable. The float reported a salinity of 34.291 psu at 850 metres depth shortly after deployment, and a value of 34.290 psu at the same depth 105 days and 21 profiles later. So it appears that the conductivity sensor is stable and that nothing is growing on the sensor. Anti-fouling chemicals help maintain this stability, but it should also be noted that a device that spends most of its time 850 metres down is probably not a healthy place to live.

An Alace float is extremely easy to deploy. Prior to deployment the unit is activated and completes a self test. Some hardware is then attached and the unit is deployed from a vessel maintaining way of 1 to 2 knots. I am informed by the electronics technician who deployed the first one at Station Papa that, "...even a Ph.D. could deploy it."

Data from the Alace float are received by Système Argos, converted to E-Mail messages and transmitted to the user. I usually receive the messages after normal work hours, and so process the data from home. (This is *the way* for a sea-sick oceanographer to explore the ocean). Conversion of the highly compressed E-Mail message to a final CTD profile is a more complex task than I had expected. The Scripps group that integrate the CTD into the Alace have put great effort into maximising the information content of the Argos messages, and hence have adopted an impressive data compression algorithm. Essentially, the CTD data comprises measurements in 60 bins, and four Argos messages are transmitted representing data in bins 60-46, 45-31, 30-16 and finally 15-1. In each message the actual value of temperature and conductivity in the first bin of each message (bins 60, 45, 30 and 15) is converted to a bit string and transmitted *en clair*. For each successive bin only the difference in the number of bits is transmitted to a maximum of 256 bits for temperature and 64 bits for conductivity. If the Alace passes through a region of very high temperature gradient (about 2.2°C/10 metres) then the difference becomes 257 bits and is transmitted as one bit. Thus there is no unique transformation from the received message to a CTD profile. Usually a little common sense, and a graphical editing program, allows easy conversion

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of the received bit strings to a rational bit string. But occasionally it has required a considerable amount of effort, and some degree of imagination, to determine the most probable CTD profile from the received message.

Finally, this discussion would not be complete without a discussion of costs. I have been able to submit only rather small orders to Webb Research and so have not been able to take advantage of some large reductions in cost associated with large orders. A profiling Alace float, ready to go into the ocean, is presently costing me US$17,900 per unit delivered to IOS; at C$1.00 = US$0.73 that becomes C$24,500. However, the single unit presently operating in the N.E. Pacific is continuing to operate without the attention of a ship. The John P. Tully could be used for getting CTD profiles, and would cost about $10,000 per day. So the profiling Alace float is worth a little more than 2 days of ship time. The float can be deployed from almost any vessel, and, in its present configuration, should supply 130 profiles, for a cost of $188/profile. The cost would be even lower if we could expect to recover the float. In principle, this is possible, but it would not really be a rational thing to do. The Alace float barely penetrates the sea surface when it rises to the surface and would be a very difficult optical target at sea. I would anticipate spending several days searching for an Alace float, at a cost of $10,000/day, and either failing to find it, or finally seeing it moments before it gets sucked into the propeller of the John P. Tully. The costs of an attempted recovery will always be too high. However, at a cost of $188/profile this is clearly a technology that should be considered in any major attempt to monitor the state of the ocean, in GOOS, for example.

Beside the CTD profiles we also get the drift trajectories. Despite its name the device is not a Lagrangian device. In the configuration of the one presently in the N.E. Pacific, we get periods of drift at 850 metres followed by a 20 hour drift at the sea surface. In the diagram shown above the drift is summarised. The arrows indicate the deep drift segments and the wiggly lines the drifts at the surface. It is clear that the deep drifts are highly correlated with the surface drifts, and also that my intention to "park" the device at Station Papa by deploying it at 850 metres was a failure.

After processing is complete, about 10 minutes, I automatically generate a KKXX[3] file that is transmitted to MEDS and then on the GTS. Thus the data from Alace WMO number 578 are going directly into global data bases that are monitoring the climatic state of the world ocean.

[2:] Note from the Editor: at the time of printing, the Alace Float #578 was still operational and had completed 41 cycles.

[3:] Note from the Editor: KKXX is the IGOSS message code for sending Temperature/Salinity data onto the GTS.

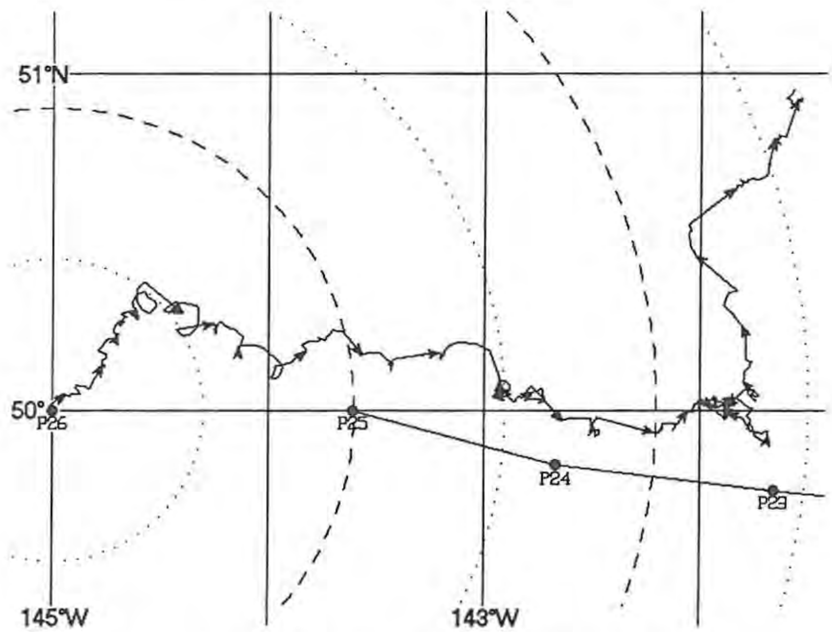


Figure 1: Buoy Track for ALACE Float #578

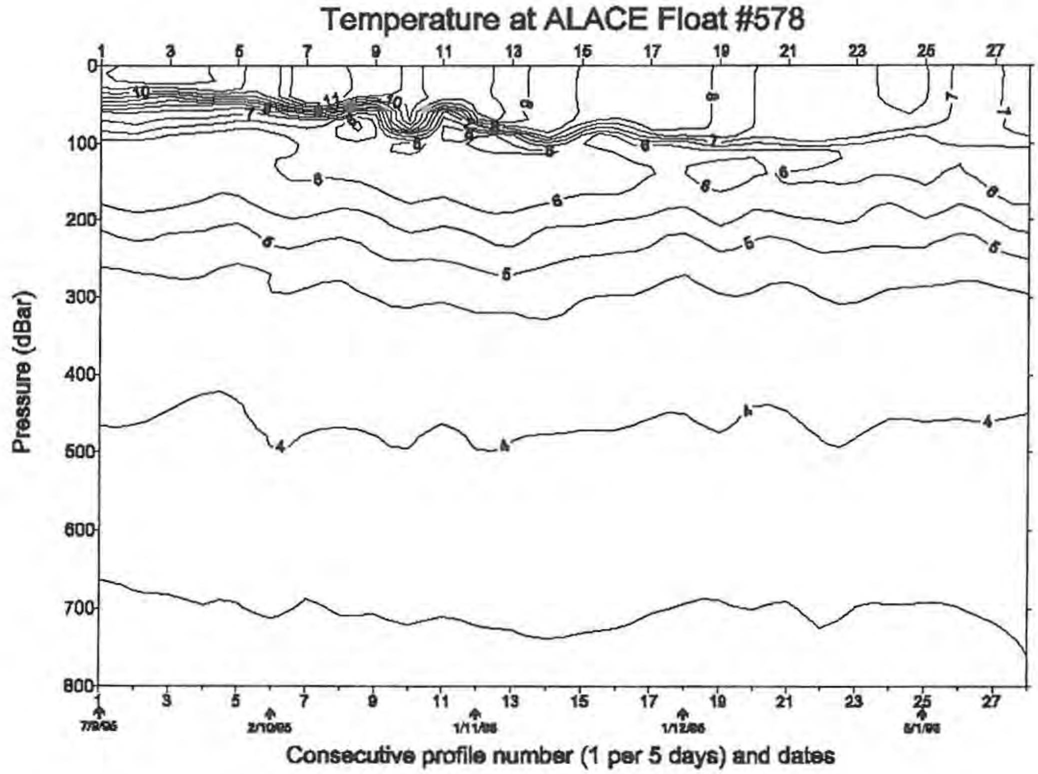


Figure 2

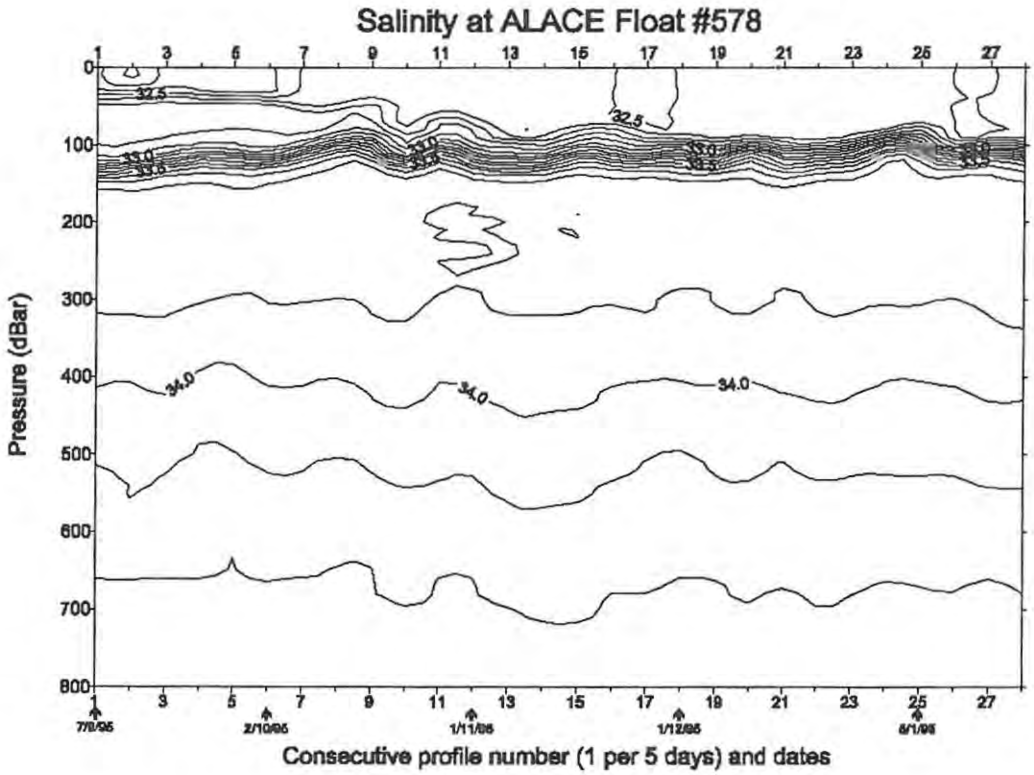


Figure 3

"Basic Physical Chemistry for the Atmospheric Sciences", by Peter V. Hobbs, University of Washington. Paperback, 200 pages, published by Cambridge University Press, 1995, at $19.95 (US).

Book reviewed by Norman Treloar, Atmospheric Chemist, Environment Canada, Winnipeg.

This paperback describes itself as covering "the fundamental concepts of chemical equilibria, chemical thermodynamics, chemical kinetics, solution chemistry, acid and base chemistry, oxidation-reduction reactions, and photochemistry", and is intended to be "an invaluable resource for a broad range of students". The book has the same outline as most introductory physical chemistry books, while adding some text and illustrative problems on atmospheric issues for the readership implied by the book's title. However, the "standard format plus atmospheric additions" approach may disappoint those wanting a book tailored to atmospheric issues.

The book covers nucleation during water condensation on p. 35, and the chemistry at solid surfaces is briefly treated on p. 58 and by implication again on p. 151 in connection with ozone depletion. But surface chemistry is not treated in a unified way, and its general importance to atmospheric processes may be overlooked by the reader.

Phase equilibria are also important for atmospheric processes. It might have been instructive to discuss changes in phase of water as a means of introducing pollutant transport processes, and to mention how Henry's Law and fugacity help to deal with the distribution and flux of pollutants in aquatic ecosystems.

Free radicals are defined in a footnote, and there is no further elaboration to support the text on photochemistry and stratospheric ozone. However, the book discusses the chemistry of ozone depletion much more extensively than most textbooks at this level. The most recent factual information on the Antarctic ozone problem dates from 1991, and for the Arctic 1989. Arctic ozone depletion has been less extensive than that in the Antarctic, but episodes of 30% or more depletion observed in recent years must be regarded as significant, so the statement that dramatic Arctic depletion has not been observed can be disputed.

It is good to see mention of the environmental importance of chemical processes such as: photosynthesis; fuel combustion to form the carbon dioxide largely responsible for climate change; acid precipitation; and reactions in sediments. These points are raised in the chapter on oxidation-reduction (redox) processes, and acid deposition is mentioned more relevantly in the preceding chapter on acids and bases. But, as in standard texts, redox processes are discussed mostly in terms of transition metal ions in electrolytic cells, and most of the redox chapter has little to do with atmospheric science. No details are given on the vital role of redox potentials in determining the fate and flux of pollutants in ecosystems.

Issues of interest to a meteorologist (for example) are raised when they fit the chemistry being discussed, but re-organizing the material in the context of atmospheric processes might have been more attractive to the readership implied by the book's title. For instance, a section describing the atmosphere in terms of the different chemical regimes observed with decrease in altitude could have led to a comparison of free radical, covalent and ionic processes, setting the stage for such atmospheric issues as photochemistry and ozone depletion, carbon dioxide formation and climate change, and pollutant transport and acid deposition. Separate discussion of phase equilibria and of surface chemistry could have led to a treatment of the atmospheric issues mentioned above.

Such a format would differ from that normally provided to the general student. For such a generalist the book is a good, inexpensive introductory text, introducing environmental concerns when they relate to the chemical principles raised. However, readers primarily concerned with atmospheric issues may find some expectations unfulfilled.

2 Books in search of a reviewer!

1) Introduction to Geochemical Modeling, by Francis Albarede, Cambridge University Press, 1995, ISBN 0 521 45451 4 hardback.

2) New Uncertainty Concepts in Hydrology and Water Resources, Edited by Zbigniew W. Kundzewicz, International Hydrology Series, Cambridge University Press, 1995, ISBN 0 521 46118 9 hardback.

If you are interested in reviewing one of the above books, please contact Dr John Lazier, Bedford Institute of Oceanography, Dartmouth, N.S. ☎ (902) 426-2558

"Dynamics of Atmospheric Motion"

John A. Dutton 1986, 617 pp. approx.$26.00
Paperbound, Dover Publications, Inc.
ISBN 0-486-68486-5

Book reviewed by Da-Lin Zhang
Associate Professor, Department of Atmospheric and Oceanic Sciences
McGill University.

This book, a new edition of The Ceaseless Wind, is an outgrowth of several dynamic courses taught by Dutton at the Pennsylvania State University. It is intended primarily as a text for atmospheric-science students at both the upper undergraduate and the graduate levels, but its completeness in treating many fundamental concepts and its mathematical rigor also make it a very useful reference book on the subject. Personally, I have used it in my teaching as well as in my research work.

This text is distinct in style from Holton's Introduction to Dynamic Meteorology in which more intuitive explanations of the weather are given, and it is also distinct in design from Gill's Atmospheric-Ocean Dynamics and Pedlosky's Geophysical Fluid Dynamics in which considerable attention is dedicated to oceanographic problems.

The book is divided into three parts with 15 chapters. The first part, "Foundations of Atmospheric Dynamics", proceeds with basic physical and mathematical concepts, and introduces the dynamical and thermodynamical fundamentals necessary to follow the subsequent chapters. This part concludes with Chapter 5 covering the transport theorem, orthogonal and nonorthogonal coordinates, vector and tensor analysis, and applications to atmospheric flows. The tensors notation presented in this chapter may be appreciated by some graduate students because it is so convenient mathematically.

In Part II, "The Equations of Atmospheric Motion", the full Navier-Stokes equations and approximate solutions are presented, followed naturally by a formulation of the equations of motion on a rotating earth in spherical, isobaric, isentropic and generalized coordinates. The extensive and rigorous mathematical derivations of the dynamical equations in these two chapters are typical of the book. Dutton's central ideas throughout are, however, to emphasize the interplay between the dynamics and thermodynamics that governs atmospheric motion and to integrate them together with the rotation and geometric aspects of the earth. In addition to two full chapters (3 and 8), the thermodynamic aspects of atmospheric motion are frequently discussed in the book, a feature that also distinguishes it from other dynamics texts.

Part III: The Theory of Atmospheric Motion, is the heart of the text which consists of seven chapters covering half of the book. The first two chapters are devoted to the geostrophic approximation, inertial oscillations, the omega equation, circulation theorems, potential vorticity, Rossby waves and Sutcliffe's development theory. Chapter 11 provides a rigorous and lucid derivation of atmospheric energetics and entropy equations in isobaric and isentropic coordinates, supplemented by observational results. The turbulent kinetic energy equations are also derived, followed by a brief discussion of the planetary boundary layer. A standard presentation of atmospheric waves is given in Chapter 12, but with a novel treatment of the mixed acoustic-gravity waves and energy flux. The next two chapters deal with approximate equations, following a scale analysis, for small-scale (anelastic) and large-scale (quasi-geostrophic) flows separately. Linear stability analysis is carried out at a more sophisticated level using the Miles and Howard theorem for small-scale flows, and the Charney and Stern theorem for large-scale motions. Quasi-geostrophic theory also includes a discussion of nonlinear baroclinic waves in relation to geostrophic turbulence. This portion of the text could be used for an advanced graduate-level course in dynamics. The Dover edition closes with a new chapter (15) which introduces the new discipline of metamodeling, defined as the study of the process of modeling and the properties of models.

This book is coherent, but not exhaustive. For example, one will not find discussion of mesoscale and tropical dynamics nor middle atmospheric dynamics and general circulation, all topics in which considerable progress has been made in the last decades. Nevertheless, the basic concepts and theories in atmospheric sciences are all thoroughly covered. Furthermore, the book has the pedagogical advantage of taking the reader over a wide range of technical difficulties, from elementary dynamics to reasonably advanced graduate-level material. Both students and researchers at the different stages of their careers will find Dynamics of Atmospheric Motion an outstanding book to own, and its paperback edition a true bargain.

More Tips to Broaden your Horizons!

The Department of Foreign Affairs and International Trade is offering tips and pointers to those who are interested in exporting their services overseas. The material, entitled "Take a World View ... Export Your Services" is available on six diskettes (English or French) at $49.95.

To order, contact: Canada Communications Group Publishing, ☎(819) 956-4800; Fax (819) 994-1498. Visa or Mastercard accepted. Fax order to 1-800-565-7757.

"Ocean-Atmosphere Interaction and Climate Modelling"
Boris A. Kagan. 1993.
English edition, 1995, translated from Russian by M. Hazin. 377 pp.
U.S. $79.95. Hardbound, University Press, Cambridge, New York and Melbourne.
ISBN 0 521 44445 4

Book reviewed by Stuart D. Smith, Bedford Institute of Oceanography, Dartmouth, N.S.

This is a serious book. It gives authoritative, rigorous, mathematical derivations starting from fundamentals and working through to recent advances. The translation from Russian is flawless, suffering neither from stilted style nor from unfamiliar renderings of technical terms. This text is not for beginners, but "is addressed to advanced students in oceanography, meteorology and environmental sciences as well as to professional researchers in these fields." For this intended audience it will be a valuable and comprehensive reference.

The first chapter sets the stage with an introduction to the climate system and its variability and predictability, and the second chapter uses a budget approach to define the present climate. The following three chapters cover small-, meso- and large-scale ocean-atmosphere interaction with a progression also from emphasis on processes to emphasis on models. The influence of surface waves on momentum and energy exchanges at the surface is considered, but neither the dynamics of waves nor the modelling of waves and wave climate is treated here. Sea ice is a component of models discussed, but the processes of ocean-atmosphere interaction for an ice-covered ocean are not discussed. With these exceptions, Kagan's terse style allows him to provide remarkably detailed coverage over a wide range of topics.

The final chapter treats equilibrium response to changes in atmospheric CO_2 and to several land parameters, and transient response to CO_2 changes. Returning to his own box model, Kagan tabulates projections of many elements of the climate system up to the year 2100, by which time he foresees a rise of 5° C in land surface temperature of his "northern box" which roughly corresponds to the latitudes of Canadian (or Russian) land mass.

The original Russian version was published in 1993, and it does not include references to work published since about 1990 such as the latest rounds in the ever-raging debate on the amount of warming expected in response to accumulation of CO_2 and other anthropogenic gases. It does, however, include references to Russian literature that may be unfamiliar to English-speaking readers.

William R. Cotton and Roger A. Pielke, "Human Impacts on Weather and Climate", Cambridge University Press, Cambridge, U.K., 1995, ISBN 0 521 49291, Paperback, 288 pp., U.S.$24.95.

Book reviewed by R.E. Munn, Institute for Environmental Studies, University of Toronto.

This book brings together a lot of information not usually found in a single volume. Part I deals with "The Rise and Fall of the Science of Weather Modification by Cloud Seeding", Part II concerns "Human Impacts on Regional Weather and Climate" and Part III deals with "Human Impacts on Global Climate", including that very worst of future scenarios - nuclear winter.

Cotton and Pielke are respected specialists in their fields, and this collaborative effort generally works. Although I don't know much about cloud seeding, I found Part I of the book interesting, particularly when the authors discussed the historical/political development of the field.

Part II is a little thin, and could have included more on urban climate, as well as Canadian examples, such as the studies of Keith Hage of ice fog in Edmonton. In this connection, the book seems to be written primarily for American readers. But Part II does contain interesting material on the regional weather/climate effects of landscape changes, irrigation, man-made lakes and deforestation.

Part III on global climate change has a lot of competitors in this field, including the various IPCC Reports, but the style here is such as to capture the reader's attention. However, and this is a general criticism of all three parts of the book, the text seems to have been written in 1990-1991 although not published until 1995. As evidence for this statement, there are 46 pages of references - but only 36 citations from 1991, 18 from 1992, and none from 1993, 1994 and 1995. At US$24.95, the price of the book is very reasonable.

Lately, you have read a new interesting book on meteorology or oceanography or, even better, on a related topic. You could share your comments (good or bad) with your CMOS colleagues. Please contact Dr John Lazier at Bedford Institute of Oceanography to discuss your project with him. ☎ (902) 426-2558.

HIGH ARCTIC WEATHER STATIONS (HAWS) 50[th] ANNIVERSARY - 1997

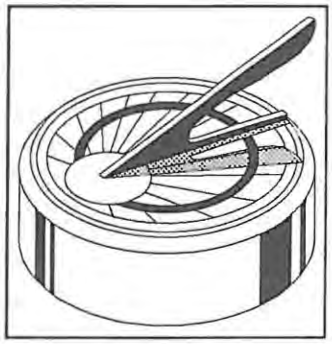
by Ken Fluto

Over the last couple of months several retired AES staff have had the occasion to discuss the upcoming anniversary of the High Arctic Weather Stations recognizing that many of us who worked at, with, or for these very special places and equally special people wanted the opportunity to participate in, or maybe even to create commemorative events for 1997. We recognized that over the last 48 years many hundreds of men and women have served at, been hosted by, or have contributed to the existence of these unique science platforms in the Canadian Arctic. Though primarily weather stations, they have served as sovereignty outposts, expedition camps, military staging and training bases, science research laboratories, survey bench marks and safe havens for almost 50 years. We realized that, in fact, we had no real idea just how many HAWS alumni existed let alone how one might contact them to renew acquaintances or to get something rolling on the celebration. What would people want and how could this be best facilitated? We need your ideas.

The HAWS were established between 1947 and 1950. They began as Joint Arctic Weather Stations when five sites were selected and built jointly by Canada and the United States: Eureka (1947), Resolute (1947), Mould Bay (1948), Isachsen (1948), and Alert (1950). The primary purpose was to provide weather data to improve forecasting, scientific knowledge and aviation safety in the Arctic. Over the last 50 years or so many meteorologists and environmental scientists either served as forecasters or conducted arctic atmospheric, hydrologic, ice, snow or other related studies that have contributed to the history of these isolated stations and advanced our understanding of this unique region of the globe.

We are developing a newsletter and our intent would be to continue to publish with expanded circulation and sharing of ideas and stories on a quarterly basis through to 1997 at least. In order to build a mailing list and collect ideas, stories, memories, etc., could anyone who has served at, been associated with, or visited these unique stations provide us with your name, address, your association with, the names of those you served with, any historical anecdotes and ideas for a Golden Anniversary celebration. Send your replies to:
Jack Armstrong, (204) 338-5907
471 Scotia Street Winnipeg, MB R2V IX9
Further information can also be obtained from:
Mike Balshaw 832-3019; Dennis Stossel 275-0747;
Ken Fluto 889-3313; Mark Hacksley 488-0548.
Telephone area code 204.

News from the Scientific Committee



The Committee met in Toronto in December 1995. The Committee welcomed the news that Paul-André Bolduc was taking on responsibilities as the new Editor of CMOS Bulletin SCMO. Getting written material is always a challenge for the Editor; Howard Freeland, a member of the Scientific Committee, knows this only too well! It was then suggested to come up with a long list of suggestions for articles appropriate for the style of the Bulletin. Committee members individually made commitments to supply or solicit articles. Look for them soon. One suggestion put forward was to routinely include abstracts of PhD dissertations in the atmospheric and oceanographic (A/O) sciences from our Canadian university departments. How about it department and section heads? We would like to know about the graduates you produce, and their work.

In the past, the Society has issued authoritative statements on A/O issues. The last was on "Natural disasters". The committee seemed interested in developing another statement, particularly given the increased ability to publicize these through means such as the CMOS new home page. At its next teleconference, the committee will consider proposals for topics. We invite suggestions from all CMOS members. How about "Reliability of severe storm predictions", or "Impacts of the erosion of data monitoring systems", or "New understanding for extended range prediction - ENSO". Your suggestions are welcome, send them to the committee secretary: StrongG@nhrisv.nhrc.sk.doe.ca.

John D. Reid, Chair of the Scientific Committee.

World Climate News

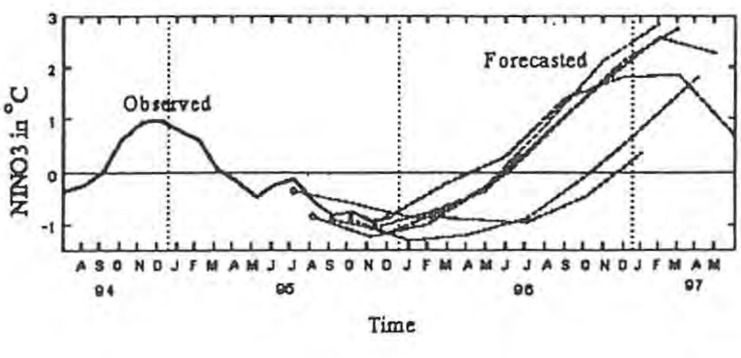
The World Meteorological Organization is publishing a newsletter "World Climate News". Available free of charge, it contains brief articles on current international climate events and programs, including a listing of forthcoming conferences. The January 1996 issue included articles on GCOS, the proposed El-Nino International Research Institute, and the Arctic Climate System Study (ACSYS). To enter a subscription write to: The Secretary General, World Meteorological Organization, Case Postale 2300, Ch-1211, Geneva 2, Switzerland. Specify whether you want the English or French version.

Forecasting El Nino with neural network models by the UBC Climate Prediction Group

The UBC Climate Prediction Group (consisting of William Hsieh, Benyang Tang, Fred Tangang, Jingxi Lu and Adam Monahan) is now issuing regular seasonal forecasts of the average tropical Pacific sea surface temperature (SST) in the NINO3 region (5°N-5°S, 150°W-90°W), which is widely used as an El Nino index. The forecasts are available over the World Wide Web (address: http://www.ocgy.ubc.ca/).

Neural network models were originally developed in the field of artificial intelligence. Our forecast model, by incorporating a data assimilation scheme much like adjoint data assimilation, is a significant improvement over our earlier neural network models in handling noisy data. Normally, when a neural network is trained, only the network weights are adjusted to minimize a cost function which measures the difference between the network output and the data. In our data assimilating neural network, not only the weights, but also the network input are adjusted. The inputs of our neural network consist of the NINO3 SST index and the first 4 wind stress EOF coefficients. For more details of our model, see our Web page.

The figure below shows our latest forecast using a neural network trained with data up to January 1996. The solid line is the observed SST, and the 6 dashed lines are forecasts up to 18 months initiating from July to December 1995. The forecasts starting from July and October 1995 predicted a return to normal condition by the end of 1996, while the other 4 forecasts predicted considerable tropical warming in the 1996-97 winter. Thus, there is a possibility of another El Nino, and we will be updating our forecasts on a monthly basis over the Web. In addition, we plan to issue forecasts of other tropical variables and climate conditions in our Canadian domain, in the near future.



The Icelandic Meteorological Office is seeking aviation forecasters

Many Icelanders moved to Canada over 100 years ago. The Icelandic Met. Office is wondering if any of our current or retired meteorologists, possibly of Icelandic origins, might like to move to Iceland and work as aviation forecasters in one of the most active weather areas in the world. The base salary for forecasters is $45,000 Canadian and income tax is approximately 25%.

If you are interested, please contact Michel Houde at: ☎ (416) 739-4941 or via InterNet houdem@aestor.am.doe.ca. His teamlink connection is houdem@am@aestor.

12th Symposium on Boundary Layers and Turbulence July or August 1997 Vancouver, B.C., Canada

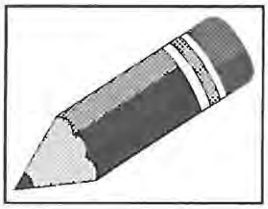
The 12th Symposium on Boundary Layers and Turbulence will be held during the last week of July or first week of August 1997. We are in the early planning stages, but the symposium might meet at the University of British Columbia (UBC) in Vancouver, Canada. The call for papers will be announced soon, and might request electronic submission of abstracts via E-Mail. The American Meteorological Society and the Canadian Meteorological and Oceanographic Society are co-sponsors.

Possible session topics include: microstructure in oceans and atmospheres, coherent structures, nonlocal closures, convective PBLs, stable PBLs, scalar concentration fluctuation and diffusion, boundary-layer clouds, entrainment processes, atmospheric PBL modelling, simulations including LES and DNS, oceanic boundary layers, turbulence instrumentation developments, new field program results, surface-flux parameterization, surface layer, moisture budget, effects of surface heterogeneities, aggregation & area averaging, biosphere models. turbulence in vegetative canopies, complex terrain, GCIP results, commemorative session for the 30th anniversary of the Kansas surface-layer experiment and analysis techniques including wavelets, fractals, and chaos.

For further information, please contact the program chair: Roland Stull, Atmospheric Science Programme, Dept. of Geography, University of British Columbia, 1984 West Mall, Vancouver, B.C., V6T 1Z2, Canada. ☎(604) 822-5901; Fax: (604) 822-6150; E-Mail: rstull@geog.ubc.ca.

CMOS PEOPLE ON THE MOVE - LES GENS DE LA SCMO EN ACTION

DR. DANIEL WRIGHT OUR NEW CO-EDITOR OF ATMOSPHERE-OCEAN OCEANOGRAPHY



CMOS wishes to welcome its new Oceanographic Co-Editor for Atmosphere-Ocean, Dr. Daniel G. Wright, a respected research scientist at the Bedford Institute of Oceanography. Dan's interests span a broad range of dynamical problems in the deep ocean and on the continental shelf. His most recent work (with Dr. Thomas Stocker) has led to the development of a suite of simple dynamical models for simulating the global climate system on timescales of decades to millenia. The resulting international recognition has placed Dan in the forefront of research into climate variability.

Dan has also made important contributions to studies of continental shelf dynamics on the Labrador, Newfoundland, and Scotian Shelves and in the Gulf of Maine. Highlights of his Labrador/Newfoundland Shelf work include identification of a mechanism by which atmospheric pressure fluctuations over Hudson Bay generate subtidal, oscillating flow in Hudson Strait and coastal-trapped waves on the Labrador Shelf. In addition, he and John Lazier explored the annual cycle in the Labrador Current and, using models and theoretical arguments, demonstrated that the cycle is buoyancy-driven. In the Scotian Shelf/Gulf of Maine region, Dan has contributed significantly to the understanding of many dynamical features, such as tidal rectification, frontal circulation, instability of coastal currents, and the wind-driven circulation.

Born in Kingston, Ontario, Dan graduated in Mathematics from Laurentian University in 1975, winning both the Lieutenant Governor's Silver Medal and the Governor General's Gold Medal. He then pursued his Ph.D. in Oceanography/Applied Mathematics at the University of British Columbia, where he graduated in 1978. After a post-doctoral fellowship at Woods Hole Oceanographic Institution (1979-80), Dan returned to Canada's east coast for two years (1980-81) as a research associate at Dalhousie University before joining the Bedford Institute of Oceanography in 1982.

Dan has been an Associate Editor for Atmosphere-Ocean since 1992,and has proven to be a thoughtful and incisive reviewer on many occasions. He was named CMOS Reviewer of the Year for 1992. Moreover, the quality of Dan's own research has been recognized by the Society when it awarded him the President's Prize at the 26th Annual Congress in Quebec City. In light of these facts, we look forward to Dan's tenure as Oceanographic Co-Editor and to the continued success of the journal under his guidance.

DR. PETER BARTELLO OUR NEW CO-EDITOR OF ATMOSPHERE-OCEAN METEOROLOGY

Peter Bartello has been a research scientist at the Numerical Prediction Research Division (RPN) of the Atmospheric Environment Service since 1992. His research interests are in the field of geophysical fluid turbulence. He received his doctorate in dynamic meteorology from McGill University in 1988. He was then awarded a Postdoctoral Fellowship in Canadian Government Labs and spent a year at the Institute of Ocean Sciences in Sidney, B.C., where he studied the influence of Rossby wave propagation on the turbulent diffusion of tracers. Following this he spent a year working on models of NWP prediction error statistics at RPN in Dorval, Québec. In 1990 he obtained the NSERC post-doctoral fellowship, which he held at the Institut de Mécanique de Grenoble, France, where he began work on rotating stratified turbulence which he has continued at RPN.

Dr. Bartello's research aims at representing timescales and lengthscales that are unresolved in current geophysical fluid models. This is achieved by appealing to such techniques as dimensional analysis, statistical mechanics, perturbative methods and idealized numerical modelling which resolves the turbulence explicitly. He is currently concentrating on the dynamics of the atmospheric mesoscale.

Note from the Editor:

As announced in the last issue of the CMOS Bulletin SCMO (Vol.24, No.1), we are producing here the bibliographies of the new CMOS A/O Editors. May we take this opportunity to wish them good luck in their new endeavour.

SHEILA BOURQUE
OUR NEW TECHNICAL EDITOR OF ATMOSPHERE-OCEAN

Upon graduating from the University of Western Ontario with a B.Sc. in physics, Sheila Bourque joined the Atmospheric Environment Service in 1973. After completion of her training on Meteorologist Operational Course No. 30, she spent several years with AES's Stratospheric Ozone research group. From there, her career shifted to informatics services where she worked for a number of years primarily in client support areas providing an interface between the science community and the systems designers.

She came to her current position in AES's Ice Services Branch from the AES Training Branch where she had spent three years promoting science education in the schools and with the general public. During this time, Sheila chaired the Local Arrangements Committee for the CMOS-hosted Third International Conference on School and Popular Meteorological and Oceanographic Education which was jointly sponsored with the RMS and AMS. This highly successful conference brought educators from many countries to discuss ways and means of using meteorology and oceanography as platforms to promote science education at all levels of pre-college education. She still maintains ties with the education community and has a keen interest in science education in the schools.

GILLES TARDIF
CMOS "OFFICIAL" TRANSLATOR FOR A-O ABSTRACTS

Gilles completed High School in Quebec City in 1962 and after a stint in the Air Force he took the Meteorological Technician course. He first served as a MetTech at Chapais and Quebec City followed by four years in operations at CMC and nine years in flight services. For many years he did weather radio broadcasts for private stations and the CBC.

In 1979 Gilles was transferred to Toronto where he made a career change, shifting from operations to publications and editorial work. While in Toronto he reviewed and edited AES documents on training, climate and instrumentation. Gilles also reviewed a number of WMO manuals, in particular the WMO International Meteorological Vocabulary, a project that took three years to complete.

Gilles started proofreading the A-O Abstracts in the mid-80's under Ed. Truhlar's guidance. This work gradually led him into translation of the Abstracts which he has been doing for quite a number of years. In addition to this role, he prepares the Annual Review for the Society.

Gilles retired in 1995, but, as you can see, he still keeps his hand in with CMOS.

GILLES TARDIF
TRADUCTEUR "OFFICIEL" DE LA SCMO POUR LES RÉSUMÉS D'A/O

Gilles a complété ses études secondaires à Québec en 1962 et après une période dans l'armée de l'air, il a suivi le cours de technicien météorologue. Au début, il a travaillé comme technicien en météorologie à Chapais et à Québec; puis Gilles a travaillé quatre années aux opérations du CMC et neuf ans au service en vol. Pendant de nombreuses années, il faisait les prévisions météorologiques pour des chaînes privées et la CBC.

En 1979, Gilles a été muté à Toronto où il changea de carrière, passant des opérations au travail d'édition et de rédaction des publications. À Toronto, il a servi comme rédacteur et réviseur des documents du Service de l'environnement atmosphérique sur la formation, le climat et l'instrumentation. Gilles a également révisé un bon nombre de manuels de l'OMM, en particulier le Vocabulaire météorologique international de l'OMM, un projet qui s'est échelonné sur trois ans.

Gilles a commencé la correction d'épreuves des résumés d'A-O au milieu des années 1980 sous la direction d'Ed. Truhlar. Ce travail le mena graduellement à traduire les résumés, travail qu'il fait depuis quelques années maintenant. Il prépare également la revue annuelle de la Société.

Gilles a pris sa retraite en 1995, mais comme vous pouvez le constater, il garde encore la main à la pâte avec la SCMO.

Note de l'Éditeur

Tel qu'annoncé dans le dernier numéro du CMOS Bulletin SCMO (Vol.24, No.1), nous publions ici les bibliographies des nouveaux Éditeurs de la publication A/O de la SCMO. Nous leur souhaitons bonne chance dans leurs nouvelles fonctions.

DR. DANIEL WRIGHT
NOUVEAU CO-DIRECTEUR SCIENTIFIQUE D'ATMOSPHÈRE-OCÉAN OCÉANOGRAPHIE

La SCMO souhaite la bienvenue au nouveau co-directeur scientifique à l'océanographie pour Atmosphère-Océan, le Dr. Daniel G. Wright, un chercheur scientifique respecté de tous à l'Institut d'océanographie de Bedford. Les intérêts de Dan portent sur les problèmes dynamiques des eaux profondes et sur le plateau continental. Ses recherches les plus récentes (avec le Dr. Thomas Stocker) ont mené au développement d'un des modèles dynamiques simples pour simuler le système climatique mondial sur des échelles de temps allant de la décennie au millénaire. La reconnaissance internationale qui en est découlée a placé Dan à l'avant-plan de la recherche en variabilité climatique.

Dan a également fait d'importantes contributions à l'étude des dynamiques du plateau continental sur les plates-formes du Labrador, de Terre-Neuve et scotian et celles dans le golfe du Maine. Les points culminants de son travail sur les plates-formes du Labrador/Terre-Neuve comprennent l'identification d'un mécanisme par lequel les fluctuations des pressions atmosphériques au-dessous de la baie d'Hudson génèrent un écoulement dans le détroit d'Hudson et des ondes côtières piégées sur la plate-forme du Labrador. De plus, John Lazier et Dan ont étudié le cycle annuel du courant du Labrador et, utilisant des modèles et arguments théoriques, ont démontré que le cycle est causé par la poussée hydrostatique. Dans le domaine de la plate-forme Scotian/golfe du Maine, Dan a contribué de manière significative à la compréhension de plusieurs caractéristiques dynamiques, telles que le redressement causé par la marée, la circulation frontale, l'instabilité des courants côtiers et la circulation des vents.

Né à Kingston en Ontario, Dan a terminé ses études en mathématiques à l'Université Laurentienne en 1975, gagnant la médaille d'argent du Lieutenant-gouverneur ainsi que la médaille d'or du Gouverneur-général. Il a ensuite poursuivi ses études au niveau du doctorat en océanographie/mathématiques appliquées l'Université de la Colombie-Britannique, où il obtenu son diplôme en 1978. Après un stage post-doctoral à la Woods Hole Oceanographic Institution (1979-1980), Dan est revenu sur la côte est du Canada pendant deux ans (1980-1981) comme chercheur associé à l'Université Dalhousie avant de se joindre à l'Institut d'océanographie de Bedford en 1982.

Dan est directeur scientifique associé à Atmosphère-Océan depuis 1992, et a prouvé à maintes reprises qu'il est un réviseur consciencieux. Il a été nommé en 1992 Réviseur de l'Année à la SCMO. De plus, la qualité des recherches de Dan a été reconnu par la Société lorsqu'elle lui a remis le prix du président lors du 26^{e} congrès annuel à Québec. Dans ce contexte, nous attendons avec impatience le travail de Dan en tant que co-directeur scientifique en océanographique et au succès soutenu de la revue sous sa direction.

DR. PETER BARTELLO
NOUVEAU CO-DIRECTEUR SCIENTIFIQUE D'ATMOSPHÈRE-OCÉAN MÉTÉOROLOGIE

Peter Bartello est chercheur scientifique à la Division de recherche en prévision numérique (RPN) de Service de l'environnement atmosphérique depuis 1992. Sa recherche porte sur la turbulence dans les fluides géophysiques. Il a reçu son doctorat en météorologie dynamique de l'Université McGill en 1988. Il a obtenu une bourse postdoctorale de recherche dans les laboratoires du gouvernement canadien qui lui a permis de passer une année à l'Institut des sciences de la mer à Sidney, C.-B. où il a étudié l'influence des ondes Rossby sur la diffusion turbulente des traceurs. Ensuite, il a travaillé durant un an sur des modèles statistiques d'erreurs de prévision météorologique à RPN, Dorval, Québec. En 1990, il a reçu une bourse postdoctorale du CRSNG qui lui a permis de faire un stage à l'Institut de mécanique de Grenoble, en France, où il a entrepris sa recherche sur la turbulence stratifiée en rotation qu'il poursuit actuellement à RPN.

La recherche de M. Bartello a pour but de représenter les échelles temporelles et spatiales non résolues par des modèles actuels de fluides géophysiques en utilisant des techniques telles que l'analyse dimensionnelle, la mécanique statistique, des méthodes perturbatives et la modélisation numérique idéalisée qui résout la turbulence. Il se concentre présentement sur la dynamique de la méso-échelle atmosphérique.

SHEILA BOURQUE
NOTRE NOUVELLE RÉDACTRICE TECHNIQUE À ATMOSPHÈRE-OCÉAN

Après avoir terminé ses études à l'Université Western Ontario avec un B.Sc. en physique, Sheila Bourque s'est jointe au Service de l'environnement atmosphérique en 1973. Ayant complété son cours de météorologie opérationnelle No. 30, elle a passé de nombreuses années avec le groupe de recherche en ozone stratosphérique du Service de l'environnement atmosphérique. Ensuite, sa carrière pris un virage vers les services informatiques où, pendant de nombreuses années, elle a travaillé principalement dans le support au client en offrant un lien entre la communauté scientifique et les concepteurs de systèmes.

Avant d'occuper son poste actuel au Service des glaces du Service de l'environnement atmosphérique, Sheila a travaillé pendant trois ans à la Direction de la formation où elle faisait la promotion de l'enseignement des sciences dans les écoles et dans le public en général. À ce moment, Sheila siégeait au Comité local d'organisation de la Troisième conférence internationale sur l'enseignement de la météorologie et l'océanographie populaire et dans les écoles. Cette conférence de la SCMO était parrainée conjointement par la RMS et l'AMS. Cette conférence internationale remporta un grand succès et de nombreux éducateurs de plusieurs pays sont venus discuter des moyens d'utiliser la météorologie et l'océanographie comme plate-forme pour promouvoir l'enseignement des sciences à tous les niveaux d'enseignement pré-universitaire. Sheila conserve toujours des liens avec la communauté de l'enseignement et porte un vif intérêt à l'enseignement des sciences dans les écoles.

HOMMAGE à E. (ED) TRUHLAR
de Ted Munn, Toronto.

Ed Truhlar a pris sa retraite comme Directeur des publications de la SCMO et rédacteur technique d'ATMOSPHÈRE-OCÉAN après de nombreuses années de services dévoués à la Société. Ed a un talent naturel pour transformer un texte boiteux en merveilleux anglais. Ses connaissances des questions de grammaire anglaise, de la structure des phrases et de l'orthographe sont étendues et il peut détecter une erreur typographique plus rapidement que quiconque. De plus, son expérience approfondie des publications météorologiques au Canada lui confiait le statut de personne-ressource importante au sein de la Société.

Au tout début d'ATMOSPHÈRE, Ed en a été le rédacteur en chef pendant quatre ans et ensuite il est devenu rédacteur technique d'ATMOSPHÈRE-OCÉAN. Il a également été rédacteur technique de CHINOOK de 1985 jusqu'à ce que la publication cesse ses activités. Il a été éditeur de la revue annuelle de la SCMO et du programme du Congrès pendant de nombreuses années tout en siégeant aux réunions du Comité des publications aux différents congrès annuels de la Société. Ed a pris sa retraite du Service de l'environnement atmosphérique en 1991, mais a tout de même continué à se rendre à Downsview trois jours par semaine pour s'occuper des affaires de la SCMO.

J'ai rencontré Ed au début des années 1960 lorsqu'il travaillait à la section du rayonnement atmosphérique de la Division de la recherche et de la formation du Service de l'environnement atmosphérique. Plus tard, il m'a aidé comme membre de la rédaction de BOUNDARY-LAYER METEOROLOGY, en gardant pendant mon absence la «salle de rédaction» ouverte pendant de longues périodes, parfois jusqu'à un mois. En 1975, Ed s'est rendu à Genève pour quatre mois en mission spéciale pour l'OMM, afin de s'occuper du surplus de travail dans les notes techniques de l'OMM qui attendaient d'être imprimées.

En conclusion, j'aimerais citer une lettre datée du 9 mai 1989 de Dave Phillips à la Société concernant les résultats de la Conférence de Toronto sur le changement de l'atmosphère (un volume de 483 pages):

> *"À mon point de vue, il existe une personne à qui mérite l'honneur du succès de ce volume - Ed Truhlar. M. Truhlar a rédigé les documents, a fait la recherche sur les références et a contribué de ses idées sur le design et le contenu du volume. Il n'y a rien de surprenant là-dedans. Au cours des années, je me suis toujours attendu à ce haut standard du travail d'Ed. Son travail est presque toujours remis à temps, sans plaintes, et de plus, il ajoute à la copie finale une pointe d'esprit ou un jeu de mots."*

Bon travail Ed Truhlar!

Note from the Editor: The English version of this tribute to Ed Truhlar has been published in Vol.23 No.6 of the CMOS Bulletin SCMO, December 1995, page 19.

CMOS President takes a new job!

On the 1st of April 1996, your President will have left the Atmospheric Environment Service to become Director of the **C**entre for **R**esearch on **C**omputation and its **A**pplications (CERCA), through the Interchange Canada program, which facilitates the exchange of employees between the Public Service and organizations in other sectors located in Canada. The assignment is for a period of two years. The CERCA is a Montréal-based non-profit organization whose main objective is to intensify the technology transfer from universities to industry through the regrouping of scientists in Québec who use numerical methods for scientific applications. One of the members of CERCA is the AES and CERCA conducts a number of research projects in the field of atmospheric and oceanic sciences. I still intend to be active in the business of the Society and will continue serving on the CMOS Council.

Dr. Michel Béland, Président de la SCMO.

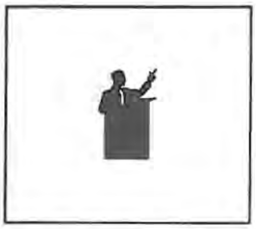
CHANGES IN THE ATMOSPHERIC ENVIRONMENT IN CANADA

John D. Reid[1]
Environment Canada

Résumé

Cet article examine brièvement les tendances passées et futures des pluies acides, du brouillard et de l'amincissement de la couche d'ozone dans deux régions agricoles principales des Prairies et de l'Ontario/Québec. Des découvertes récentes sur le changement du climat sont présentées en détails. Enfin, les implications des changements dans le programme de l'environnement atmosphérique du gouvernement fédéral sont signalées dans le domaine de l'agriculture.

Introduction



This audience needs no reminding that agriculture remains of critical importance in Canada. The statistics speak for themselves. Agricultural related activities in 1994 accounted for eight per cent of our Gross Domestic Product, or $70 billion, and seven per cent of total Canadian exports. Geographically two areas are most significant: 47 per cent of total cash receipts for agricultural commodities are from the three Prairie provinces, and 43 per cent from Ontario and Quebec. Natural and human-induced changes to the environment, particularly the vagaries of weather and climate, which form the major uncontrolled determinant of agricultural production, differ considerably between these areas. Year-to-year changes of 10% in total production are common, so it pays to understand environmental influences and how they might change.

Atmospheric Changes

The atmospheric change issues of concern today are the big five: ozone layer depletion, greenhouse gas-induced climate change, acid rain, smog, and hazardous air pollutants (toxic chemicals).

The toxic chemicals are so varied, from organic pesticides to heavy metals, and with so many different effects it is difficult to make generalizations. Usually the effects occur close to local sources, although there are documented cases of long-range transport and accumulation of pesticides in the arctic food-web. They will not be considered further here.

To motivate the discussion the table below (Table 1), from information compiled by Don MacIver (AES, Downsview), shows the direct impacts of the four major elements of the changed atmosphere for the major Canadian agricultural crops. CO_2 has a fertilizing effect on them all. Beans, barley and soybean are sensitive to UV-B. And beans and corn are sensitive to smog, O_3. Indirect effects, from impacts on climate to differential effects on crop and weed species, may often be as significant as the direct effect. They may also be non-linear with respect to the magnitude of the effect. In a recent study of global average crop yields, where both the CO_2 fertilizing effect and the climate impacts were considered, a two degree Celsius increase in temperature raised the yield of wheat, rice, soybean and maize. A four degree increase depressed yields. Synergistic effects may also be important and reinforcing or countervailing.

Tropospheric Ozone / Smog

Photochemical smog is a mixture of several oxidizing chemicals, including ozone. In the air we breathe, ozone is a harmful pollutant that causes damage to lung tissue and plants. There is evidence of harm to growth of some species at ozone concentrations as low as 40 ppb, less than half the Canadian ambient 1 hour maximum acceptable air quality objective, and a third that in the USA.

A map of smog exceedences shows that most occur in Ontario and Quebec as a result of transboundary air flow from the US and domestic sources. The importance of transboundary airflow from the US is evident as the most impacted area in Ontario is along the shore of Lake Erie. Economic losses of millions of dollars to agriculture are estimated. Exceedence on the Prairies may be local or, particularly in the spring, due to downward transport of ozone from the stratosphere where concentrations are naturally up to 100 ppb.

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[1] *Presentation made on July 10 1995 to the Canadian Society of Agrometeorology: Agricultural Institute of Canada 75th Anniversary Conference in Ottawa*

Crop	CO_2	UV-B	O_3	SO_2
Beans	P	S	S/I	
Barley	P	S	T	T
Soybean	P	S	T	
Corn	P	T	S	
Wheat	P	T	I	T

Table 1: Sensitivity of selected crop species to the direct effects of common atmospheric stresses. P means positive effect for CO_2 increase; S means sensitive to increase; T means tolerant of increase. I means intermediate in tolerance.

The ozone problem is highly episodic with considerable year-to-year variability. Only a decade or so of monitoring data are available and trends are not significant over the period. Despite several years of concern over the issue, and promises of adherence to a federal-provincial plan, not much has been achieved. In the absence of measures that really bite, the expected increase in automobile numbers and other sources will likely overwhelm measures to limit smog precursor emissions.

Acid Rain

Acid rain was a cause célèbre fifteen years ago when many Canadians were all going around with "stop acid rain" buttons. Now that in eastern Canada sulphur emissions have been reduced thirty per cent, the US has started phase one of its reduction program, and companies are finding that good environmental sense also makes good business sense, the pressure is off. We still have areas in Ontario and Quebec with sulphate deposition in excess of the benchmark 20 KG per hectare per year, and understand that environmental effects can be found for depositions of half that level. The US will reduce their emissions by 40 per cent by 2010.

The impacts of acid rain on agriculture are practically insignificant. Soils are so intensively managed that acid input is overwhelmed. And direct impact, that is to say burning, has not been demonstrated in field conditions.

Ozone Layer

We are fortunate in Canada to have good quality instrumental records of total ozone which acts as a shield to protect Earth's surface from the sun's harmful ultraviolet radiation. Total stratospheric ozone varies as a result of natural phenomena such as the changes in air masses, violent volcanic eruptions, sunspot cycles and the quasi-biennial oscillation. In addition it is now clear that anthropogenic ozone-depleting substances have been eroding the ozone layer and increasing ultraviolet radiation.

As typified by the record for Edmonton, mid-year total ozone burden for the Prairies has decreased from about 346 Dobson Units in 1960 to 320 DU in 1994. For the same period the Toronto record shows decreases from 350 DU to 328 DU. Each one per cent decrease in ozone increases biologically-active ultraviolet radiation by typically 1.4 per cent, so Canadian crops are experiencing about ten per cent more UV stress than 35 years ago.

Although many crops are UV sensitive the good news is that, as shown by measurements of atmospheric concentrations, international agreement has already slowed emissions of ozone-depleting substances to the point that a slow recovery of the ozone layer will commence in the next decade. A possible fly in the ointment is the threatened reneging by the United States to funding the Montreal Protocol Multilateral Fund. It supports developing countries in meeting the incremental costs of alternate technologies to those which use ozone-depleting substances.

Climate Change

There is no debate that life on earth benefits from a natural greenhouse warming effect of some 33 degrees Celsius due to water vapour and carbon dioxide in the atmosphere. The controversy is over the additional 1 - 4 degrees global warming and other climate changes predicted if carbon dioxide levels were to double from pre-industrial values. Nevertheless, some changes are clear.

Measured increases in carbon dioxide worldwide are 10 per cent since 1958, and 25 per cent since the start of the industrial revolution. There have also been increases in emissions of sulphate aerosol precursors which can regionally mitigate the greenhouse effect.

Global annual average temperatures have increased about 0.5 degrees Celsius in a century, albeit with local variations. For the Prairies there has been a gradual warming from the 1890s to the 1940s, then a cooling to the 1970s, and a resumption of the warming into the 1990s. Overall the region has warmed a statistically significant 0.9 degrees Celsius over the last century. For the Ontario/Quebec agricultural belt, warming is 0.7 degrees.

Climate change is more than temperature change, but much less work has been done on trends in other climatic parameters. It may be that in some regions climate change will manifest itself more in these other parameters than in temperature. Analysis soon to be published by Gullett and Skinner of AES finds precipitation to have increased in Ontario/Quebec and decreased in the Prairies, all trends for the period 1895 to 1992, with a caveat about changes in observational techniques. They also find increasing cloudiness in the Great Lakes area over the past 50 years.

A recent interesting analysis of long-term monthly mean temperature records was published in April 1995 in *Science* by David Thomson of Bell Labs. Using techniques from communications theory he has analyzed variations in the phase of the annual temperature cycle. You can think of this as the time of year when the maximum temperature occurs, although the technique considers the whole annual cycle. His longest record is for the English Midlands and shows a steady drift of the phase at a rate equivalent to that of the precession of the equinoxes, with two exceptions. The first is a sudden shift in 1752 accounted for by the switch from the Julian to Gregorian calendar. The other is a secular shift in the rate of change of phase starting in the 1940s.

Thomson has made these calculations for many stations worldwide. The period of record for Canadian stations is considerably shorter, but analysis for Calgary and Ottawa also shows phases shifts.

Calgary shows that since the late 1950s the phase of the annual cycle has shifted to become a week later. Between 1890 and the 1950s there had been a slow, likely insignificant, drift toward smaller phase (earlier seasons). Ottawa shows a similar trend although not as marked, a drift to smaller phase until the 1970s and then a rapid increase reflecting a delay of the phase by about three days.

Thomson does not define the mechanisms that cause the deviations from precession-dominated phase shifts. Toward the end of his paper he provides a suggestive analysis that correlates these changes with the increase in carbon dioxide. However, unambiguously attributing climate change directly to increasing carbon dioxide is dubious when effects of volcanic eruptions, aerosol and aerosol precursor emissions, El Niño, and so on, are also known climate influences.

What we can be more certain of is that there is no indication that our society's interest in exploiting fossil fuels will abate. A doubled CO_2 world seems likely by the end of the next century unless there is a dramatic turn of events. Even vocal climate skeptics, like Pat Michaels at the University of Virginia, acknowledge that continual and systematic increases in the greenhouse effect would prevail to warm the global climate. The debate is by how much, when, and what will be the consequences.

Unfortunately, consequences are the most challenging aspect to come to grips with. Even the results of sophisticated general circulation models have to be treated with considerable caution, particularly for prediction of elements of the hydrologic cycle and on a regional scale that is key for agriculture. General findings, such as that on the Prairies the climate is likely to get warmer with generally less soil moisture, appear robust. Water will be at a premium and it is prudent to plan for this now in making long-term commitments.

Response

Each of the issues above is being addressed individually, but a growing trend is to try to link how they are treated.

The table below (Table 2) shows how preventative actions for issues in the rows will influence the issues in the columns. The biggest single message is that addressing any of these issues will have a moderate-to-strong interaction with the climate problem -- a reflection of the pervasiveness of fossil fuel combustion as the source of environmental problems. There is scope to be efficient for maximum benefit to more than a single problem.

Organizational Changes

I'd like to close this talk by noting some of the changes occurring in the organization from which I come, the Atmospheric Environment Service, that are significant for agriculture. Under departmental reorganization and the federal program review, many activities have been reoriented. AES is smaller without its former regional organization. The structure of Environment Canada has been regionalized. Many atmospheric activities, including operational weather and climate services, are now managed regionally and reflect new priorities. Through the federal program review a considerable part of Environment Canada's budget for services to agriculture has been removed -- the thinking being that if there is economic benefit, the user should pay. The department's scientific effort is being focussed to support the public good mission of government, notably to deal with priority issues such as climate change.

Most traditional clients will notice a change. Across the country there is a reduction in the number of weather service offices and a continuation of the trend to automate observations. Environment Canada still provides a readily accessible basic weather service out of the tax base but of a more limited type. Basic data, such as that needed for agroclimatic studies should still be available at incremental cost.

The situation in Manitoba is a good example. Weather offices have been closed in Brandon and Dauphin but service through the media and weatheradio are still available. Callers can obtain a basic public weather service with a local call to a sponsored telephone line that includes limited farm weather information, like drying conditions, in rural areas. Specialized forecasts are available on a 1-900 line at a cost of $0.95 per minute. Consultation services are available with a forecaster using another 1-900 number at a charge of $3.95 for the first three minutes and $1.50 for each additional minute. That's really good value for individual service.
Many of us know the work of Rick Raddatz, lead meteorologist, Winnipeg Climate Centre. In the past in Winnipeg highly specialized information for various agricultural sectors was provided thanks to operational techniques he has developed for real-time climatology.
A large number of products such as soil moisture, thermal stress, crop stage and yield projections for various crops were developed and delivered. This was all done without any attempt to recover the full costs of developing and providing the services. Now the provision of such services will be on full cost recovery and the future of this work will depend on the market as well as other priorities. Looking south we now see US agricultural weather services being transferred totally to private companies.

Conclusions

The main message I want to leave with you is that the atmospheric environment for agriculture is changing, as it has always done. But the risk of significant change due to human-induced causes in the atmospheric environment, and climate in particular, is increasing over anything experienced since large-scale agriculture started in Canada some 200 years ago. Anyone who thinks agriculture is robust enough to be immune from such change need only contemplate the change in the East Coast fishery in twenty years.

	CO_2 / Climate	UV-B	Ozone / Smog	Acid Rain
CO_2 / Climate	H	L	M	M
UV-B	M	H	L	L
Ozone / Smog	M	L	H	M
Acid Rain	M	L	M	H

Table 2: Interaction of Air Issues. The degree to which addressing the issue on the left will affect the issue across the top.

OCEANS INTERNATIONAL ORGANIZATIONS

Geoff Holland[1]
Department of Fisheries and Oceans

Résumé

Cet article présente un survol de la structure des organisations internationales qui sont impliquées dans les sciences océaniques et décrit leurs fonctions principales. Il décrit également de quelle manière les organisations internationales rendent service à la communauté politique, scientifique et régionale et discute enfin des défis modernes auxquels s'adressent ces organismes.

Introduction

When I was asked whether I would give a talk on international ocean organizations, I must admit I didn't hesitate to accept. After many years of personal involvement in the international arena, I thought I could handle it. However, on second thought it is the holiday season and intergovernmental negotiations are hardly Christmas carol material. Intergovernmental affairs, as a topic, are about as interesting as public conveniences. They can be important, even very important, but if you don't need them you don't spend any time thinking about them. Anyway I will try to pass on some information about ocean sciences and intergovernmental organizations without being overly boring.

I have organized my talk into the following three topics:

1) the uniqueness of the ocean environment;
2) the Intergovernmental Oceanographic Commission and other organizations involved in the oceans; and,
3) issues and international linkages.

The uniqueness of the ocean environment

I am going to start this talk with some words on time scales. Time scales have a bearing on governmental and intergovernmental policies and actions. There are obvious differences in the political treatment of the urgent versus the important. This tendency can become critical when action needs to be taken to avert consequences many decades into the future.

Starting from the need to study the environment in order to understand the processes involved and how to predict changes, a fundamental difference between the ocean and atmosphere is in the time scales of their respective processes.

To achieve a predictive capability is not only one of the objectives of scientific research, it could be argued that, for decision makers, it is the first priority. It is also the area where science has to accept that it may be fallible and that its predictions are open to interpretation and challenge. Policy makers can choose to ignore predictions where scientific opinion is weak or divided.

Weather forecasts, based on atmospheric measurements, are limited to about a week because this is the usual lifetime of cyclonic systems. Ocean eddies are the corresponding feature in the sea and they can last up to a year. Whereas atmospheric scientists generate routine weekly forecasts, similar predictions are rare in the ocean and verge on scales of months to years rather than decades.

Dr. John Steele of the Woods Hole Oceanographic Institution (WHOI) recently commented on the reverse situation in the biological time scales of terrestrial and marine ecosystems. He noted that on land, perennial grasses and trees have lifetimes of centuries, whereas the base of the food chain at sea, phytoplankton, has lifetimes of only days. Thus the impact of human activities can be very different on land than in the sea. Without going into details, he concludes, inter alia, that:

- marine ecosystems have time scales similar to the physical processes in the ocean and thus tend to be much more responsive to decade-scale alterations in their environment;
- regime shifts in fish communities can have major economic consequences without being ecological disasters.

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[1]Note from the Editor:
Mr. Geoff Holland was elected Chairman of the IOC last spring for a two-year term. This presentation was made on December 12, 1995, to the CMOS Ottawa Centre at their Christmas Luncheon.

The oceans also differ from the land in that they lack a constituency. The human population of the sea is virtually non-existent, even though coastal populations are growing extremely fast. Again this situation has a bearing on the type of problems receiving priority. Urgent issues and public pressures obviously tend to be concentrated close to the populace and the shoreline. Finally, ocean issues are often hampered by a lack of information and data due mostly to the difficulty and cost of conducting the required observational and research programs.

The Intergovernmental Oceanographic Commission and other organizations involved in the oceans

The Intergovernmental Oceanographic Commission (IOC) was formed in the late fifties. The original intent was to have an organization that could orchestrate the multilateral coordination of global ocean science. As its membership increased and ocean issues became more pressing the IOC expanded its mandate to include the establishment of guidelines and protocols for collecting, archiving and exchanging ocean data, assisting with capacity building, the transfer of ocean science and technology, the provision of scientific advice and the development of regional frameworks. The IOC has a membership of 125 member states and is an autonomous intergovernmental body within UNESCO, in Paris, having its own elected executive council, statutes and rules of procedure.

In common with many UN organizations, the IOC has no capability to undertake programs itself. The programs are implemented through the concerted action of its member states. The IOC performs a coordination and administrative role. In this way, the Commission has a significant influence on the planning and direction of the combined national efforts being directed towards ocean research and data collection, although it receives only about US$3 million annually from the UNESCO budget, and supplements by voluntary contributions from member states, notably the UK and the USA.

The IOC has about eighty subsidiary bodies; although some are relatively small, they nevertheless make a formidable array. Subsidiary bodies may be intergovernmental in nature or be made up of chosen experts. Often expert groups are formed when decisions are very difficult or intractable. Some committees are joint bodies with one or more of the other UN agencies, and a few operate with international science organizations such as the International Council of Scientific Unions (ICSU).

Subsidiary bodies may be grouped into bodies dealing with policy, ocean science and services and regional implementation.

Policy

The highest governing body of the IOC is the Assembly which meets every two years. An elected Executive Council, representing about quarter of the membership, meets in the intervening year. The technical assistance programs, organized under a working committee on training, education and mutual assistance fall under this policy category.

Intersecretariat matters of ocean science amongst the various UN agencies are dealt with by an Intersecretariat Committee with the IOC providing the administrative focus. The IOC is also the lead manager for the preparation of material on the oceans for the UN Commission on Sustainable Development. The Commission will be looking at ocean and air issues in 1996.

Ocean Science and Services

Under the science umbrella one finds committees dealing with climate, living resources, non-living resources and marine pollution. Under ocean services are programs of observation, data management, mapping and products.

As one would expect, ocean climate research programs are organized jointly with WMO, under the World Climate Research Programme, with the scientific oversight being provided by the Joint Scientific Committee which also involves ICSU. Of the ocean climate programs to date, the World Ocean Circulation Experiment (WOCE) and the Tropical Ocean Global Atmosphere (TOGA) have been the most significant. Because of the breadth of the climate issues, the interaction amongst UN and international organizations is quite complex.

On living resources, the IOC concentrates its efforts on ocean science aspects, rather than the fisheries per se. Its most successful program at the moment is the panel dealing with harmful algal blooms jointly sponsored by the Fisheries and Agricultural Organization (FAO).

On non-living resources, the main emphasis to date has been on coastal processes. At some stage, the Commission will likely become involved in sea-bed mining in partnership with the Sea-bed Authority.

There are many UN agencies involved in the broad spectrum of marine pollution. The IOC cooperates with these organizations through joint sponsorship of committees, panels and workshops. The parent body is the committee on Global Investigation of Pollution in the Marine Environment (GIPME). Under this committee, subsidiary bodies deal with the effects of pollutants and the provision of standards and methodology. The IOC also is a joint sponsor, with many other UN specialized agencies, of the Group of Experts on Scientific Aspects of Marine Pollution (GESAMP).

The mapping of the sea bed requires international cooperation for the coordination of data as well as the sharing of efforts in data collection and publication. The IOC works with the International Hydrographic Office (IHO) to produce products such as the General Bathymetric Chart of the Oceans (GEBCO).

The IOC coordinates the intergovernmental action on the Tsunami Warning Network in the Pacific Ocean through the Working Committee on Tsunamis.

For many years the Commission has facilitated the exchange of oceanographic data through the designation of national and regional centres, the preparation of standards and formats for data exchange and quality control and development of methodologies. This role is the responsibility of the Working Committee for the International Oceanographic Data and Marine Information Exchange (IODE), one of the oldest and most eminent committees in the IOC. The Integrated Global Ocean Station (now Services) System Working Committee (IGOSS) was formed to facilitate the operational exchange and analysis of ocean data in time-frames useful to ocean activities. It is now a joint working committee with the WMO. Its work has contributed to the ability of ocean scientists to exchange real time ocean data and to use these data in an operational mode. The IGOSS work on the real time analysis of sea level measurements in the Pacific led to the establishment of the working committee on Global Sea-Level Observing System (GLOSS). IGOSS also carried out much of the early effort on buoy data that led to the establishment of the Drifting Buoy Panel.

Every activity, policy and decision concerning the marine environment can be improved if an adequate ocean data base and analysis are available. Following the recommendations of the UN Conference on the Environment and Development, in 1993, the Commission established the Global Ocean Observing System (GOOS).

GOOS has recognized the diverse demands and specific requirements of ocean issues through the identification of five compatible but distinct modules dealing with ocean climate, ocean health, the coastal zones, marine living resources and the provision of ocean services. Each module has an associated panel dealing with the design aspects. The panel for the climate module is the Ocean Observation System Development Panel (OOSDP). The climate module also serves as the ocean component of the Global Climate Observing System (GCOS). The other panels are at various stages of development.

Regional Implementation

It is not my intention to spend much time on the regional network of the Commission. IOC regional bodies are, as one would expect, based on oceanic regions. In the more robust bodies, the IOC has its own regional secretariat. Regional organizations exist in the Caribbean, Western Pacific, Indian Ocean, Central Eastern Atlantic, North and Central Western Indian Ocean and the Southern oceans. Cooperation with other regional bodies such as the Permanent Commission for the South Pacific and the International Council for the Exploration of the Sea (ICES) and the North Pacific Science Organization PICES are but a few of the many regional initiatives.

Issues and International Linkages

Issues can be broken into the major categories, not totally independent, of:

- Marine Living Resources;
- Marine Non-Living Resources;
- Ocean Usage;
- Ocean Health; and,
- Ocean Processes.

Marine Living Resources

The major intergovernmental UN organization with responsibilities in this field is FAO, although the UN itself has taken on some responsibilities, such as for the negotiation of the Draft Convention on Straddling Fish Stocks etc. With the establishment of that Convention the role of regional fishing agreements will become more important. FAO obviously concentrates on the economically important stocks and the use of the fish stocks as a food source. IOC tends to address scientific matters such as the impact of ocean environments on the ecosystems and the marine information and knowledge important to fish health and abundance.

The non-fisheries part of marine living resources, from sea-weed to pharmaceuticals is expected to become increasingly important in the future. Aquaculture, already gaining in the percentage of total fish landings, will be even more vulnerable to ocean health considerations than the wild fishery. The possibility of farming wild fish stocks is a future consideration. All these activities will require the input of ocean science.

The Biodiversity Convention has important implications that will no doubt place additional responsibilities on the Commission once the Montreal secretariat gets established.

Marine Non-Living Resources

Apart from the extraction of hydrocarbons, marine mineral resources are not expected to become economically important for many years. The UN Sea-bed Authority is only just getting under way.

Ocean Usage Issues

This category is the most diverse of the five. It includes marine transportation, ocean disposal, desalinization, recreation and tourism, coastal zone development, use of ocean space, etc. For some of these activities, specific global intergovernmental organizations exist to facilitate with intergovernmental matters, i.e., the IMO for shipping and the London Convention for Ocean Waste Disposal. For those having no recognized responsible agency, global coordination will require the necessary information and predictive capability from which to create policies and make wise decisions. Operational ocean products such as marine weather and wave forecasts, ocean and current maps, tidal information and pollution data, are needed for day-to-day activities. The long-term forecasts of environmental change, anthropogenic impact, sea-level rise, etc. are also necessary for planning purposes. Many of the information requirements will be supplied by the individual and collective efforts of the IOC and WMO.

Ocean Health

The assessment of the impact of point and non-point sources of pollution, and the understanding of the physical and chemical processes involved, constitute the most complex and far-reaching problems in the state of the health of the ocean. Ocean health is a consideration for all users of the sea, either by impact or effect, as well as being an issue in its own right.

Possibly the most important recent event has been the adoption, in Washington last month, of the United Nations Environment Programme (UNEP) global plan of action for the prevention of marine pollution from land-based sources. Land-based activities supply about eighty per cent of marine pollution and the undertaking to tackle this problem is very significant. The global plan will be implemented through national and regional action plans. Canada is well-placed in this regard as the adoption of the Canada Oceans Act and the associated ocean management strategy should be synonymous with a national action plan.

Monitoring the state of global ocean health should be assisted by the ocean health module of the Global Ocean Observing System. For assessment GESAMP has already produced one assessment and plays a coordinating role in others. The global coordination of the scientific studies on the fate and pathways of pollutants should be a role for GIPME.

UNEP has been given the role of focusing the efforts under this initiative in cooperation with other relevant UN agencies, such as the IOC. The need to involve the organizations dealing with land practices affecting the watershed and run-off, is a complicating, but essential, issue.

Ocean Processes

The knowledge and understanding of the processes involved within the oceans and between the oceans and their external environments are essential for many global and regional problems. Ocean science for its own sake cannot be neglected with impunity.

The oceans play a large role in supplying the air and water environments in which we live, the climate and its variation, the food supply and other processes necessary for a liveable planet. Now civilization has reached the point where it threatens the environment upon which it depends. To compensate, our predictive capability must extend many decades into the future. We require enough time to generate remedial global policies and to overcome the inertia of the political system.

The IOC is planning to work with ICSU to assess the adequacy of the ocean sciences to meet these challenges. The two organizations are planning to conduct a review of ocean science in time for the UN Year of the Oceans in 1998.

Conclusions

The Intergovernmental Oceanographic Commission is an under-resourced, inefficient but entirely necessary part of the UN machinery. It cooperates across the broad spectrum of UN agencies dealing directly and indirectly with the marine environment. It has often been said that if it didn't exist already, it would have to be established, and I agree with that statement. One of its closest partners, for many reasons, is the World Meteorological Organization. The WMO president, John Zillman of Australia, has been a frequent participant in the IOC governing meetings and has agreed to work closely on issues of mutual interest.

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