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Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

CMOS BULLETIN SCMO

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....from the President's Desk

CMOS friends and colleagues:

Preparations are well advanced for the 39th CMOS Annual Congress in Vancouver, May 31 – June 3 2005 on the "**Sea to Sky**" theme. With over 400 abstracts submitted, it promises to be a very stimulating scientific program covering our Society's broad spectrum of interests. There also will be a full day of CMOS meetings on May 30, and enjoyable evening events, including our Annual General Meeting, during the Congress. We noticed an encouraging surge in membership applications around the abstract submission deadline, which is just one indication of the crucial role that our Congresses play. With the April 15 pre-registration deadline rapidly approaching, I hope you will register soon and come join us as we share our scientific advances, recognize our outstanding colleagues through a variety of prizes, awards, and Fellows appointments, celebrate together, and conduct important business in the evolution of CMOS.

The following is a brief update on other items that have been discussed at our recent Executive and Council meetings. Arrangements have been made for presentations that are now in progress by our 2005 Tour Speaker, Dr. Maurice Levasseur. Applications submitted by Centres for Science Fair matching funds have been approved. We continue moving ahead on reciprocal relations with some other societies. In particular, we have approved a joint meeting with the Canadian Geophysical Union for our 2007 Congress in St. John's. Letters of introduction and requesting meetings were sent to Environment Minister Stéphane Dion and Geoff Regan, Minister of Fisheries and Oceans. We have participated in an "Assessment Strategies" survey on assessment practices of professions and occupations in Canada. Fisheries and Oceans Canada has generously renewed the agreement for space and services for our national CMOS office until March 2008. The members of CMOS Council are also the members of the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), and in this capacity they have a key role in electing the members and the chair of the CFCAS Board. The structure of the CFCAS Board is governed by the formal Agreement among CMOS, Environment Canada and the Foundation. The Board has 12 members including the chairperson. The normal term of Board members is three years, with one third of the terms expiring each year, although terms are renewable. Thanks to the infusion of additional funding last year, the renewal process is in progress with the help of a CMOS Nominating Committee for the CFCAS Board of Trustees. The nominations will be considered at the CFCAS members meeting in Vancouver on May 30. These and many other important items, such as our CMOS budget, proposed amendments to our constitution and by-laws, and appointment of a CMOS Privacy Officer will be considered at our Vancouver Congress Annual General Meeting. I look forward to seeing you there.

Harold Ritchie, CMOS President / Président SCMO

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Inside / En Bref

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CMOS exists for the advancement of meteorology and oceanography in Canada.

Le but de la SCMO est de stimuler l'intérêt pour la météorologie et l'océanographie au Canada.

CMOS Bulletin SCMO

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

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Cover page: The pictures shown on the cover page illustrate the significant amount of snow left behind by the January 23/24, 2005 blizzard in the Maritimes. Pictures show a) the low visibility before nightfall on the 23rd; b) the author's car buried in the snow on the 24th; c) a truck crawling between steep snow banks; d) heavy drifting of snow; e) author's driveway after the blizzard; and f) downtown New Glasgow on the 24th. To learn more, please read the article on **page 35**. Photos are courtesy of Chris Fogarty, Dartmouth, NS.

Page couverture: Les images en page couverture illustrent l'amoncellement considérable de neige laissé par le blizzard du 23/24 janvier 2005 dans les Maritimes. Les photos illustrent a) la faible visibilité avant la tombée de la nuit le 23; b) le véhicule de l'auteur enterré dans la neige le 24; c) un camion qui avance péniblement entre deux hauts bancs de neige; d) la forte rafale de neige; e) l'entrée de garage de l'auteur après le blizzard; f) le centre ville de New Glasgow le 24. Pour en apprendre plus, prière de lire l'article en **page 35**. Les photos sont la gracieuseté de Chris Fogarty, Dartmouth, N.É.

Impacts of the Blizzard of January 23/24, 2005 in the Maritimes

by Chris Fogarty[1]

Résumé (traduit par la direction): Le 21 janvier 2005, une tempête hivernale complexe s'est développée sur les États de la Prairie américaine laissant une couverture de neige de l'état du Wisconsin jusqu'à Terre-Neuve. Le système a provoqué des conditions de blizzard sur une bonne partie du Midwest, sur la Nouvelle-Angleterre et sur l'océan Atlantique en territoire canadien avec des chutes de neige de plus de 50 cm (20 pouces) enregistrées sur de grandes parties des régions affectées. À Boston, on a enregistré les plus fortes chutes de neige et en quelques endroits de la Nouvelle-Écosse, on a brisé des records de chutes de neige pour une journée du mois de janvier.

Introduction

A complex winter storm system formed over the Plain States on 21 January 2005 leaving a blanket of snow from Wisconsin to Newfoundland. The system brought blizzard conditions to much of the Midwest U.S., New England and Atlantic Canada with snowfalls of 50+ cm (20 inches) recorded over large portions of the affected areas. It was one of Boston's heaviest snowfalls on record, and broke one-day snowfall records for the month of January in parts of Nova Scotia.

1. The Synoptic Situation

The complete storm track for this event based on data analysed by the Canadian Meteorological Centre and the Atlantic Storm Prediction Centre is shown in Fig. 1. As we can see, the evolution of this storm was complex and cannot be defined by a continuous trace of low pressure. The incipient cyclone formed over the Dakotas in an area of troughing that extended from the northwest to the southeast. The centre reformed over Iowa then tracked eastward through the Midwest and redeveloped east of the Appalachians over the ocean off New Jersey.

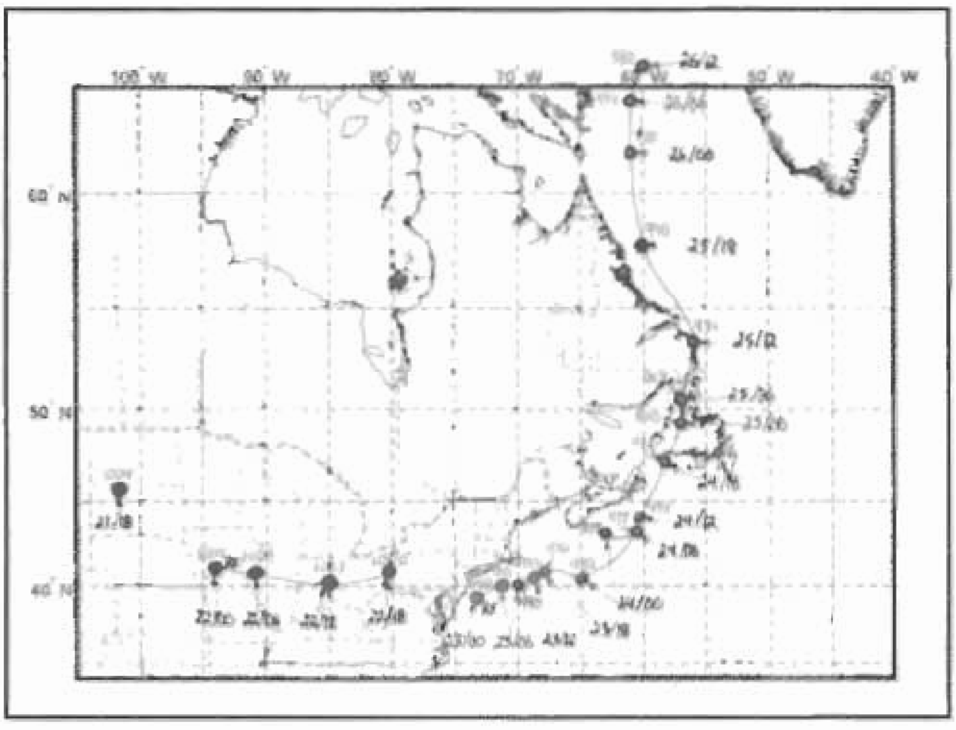

Fig. 1. *Cyclone track (filled circles – red in colour version) with central pressures labeled above the circle. Secondary low centres are shown by solid circles (blue in colour version). Times are DD/HH UTC. RF denotes re-formed centre.*

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[1] Meteorological Service of Canada, Dartmouth, NS, Canada

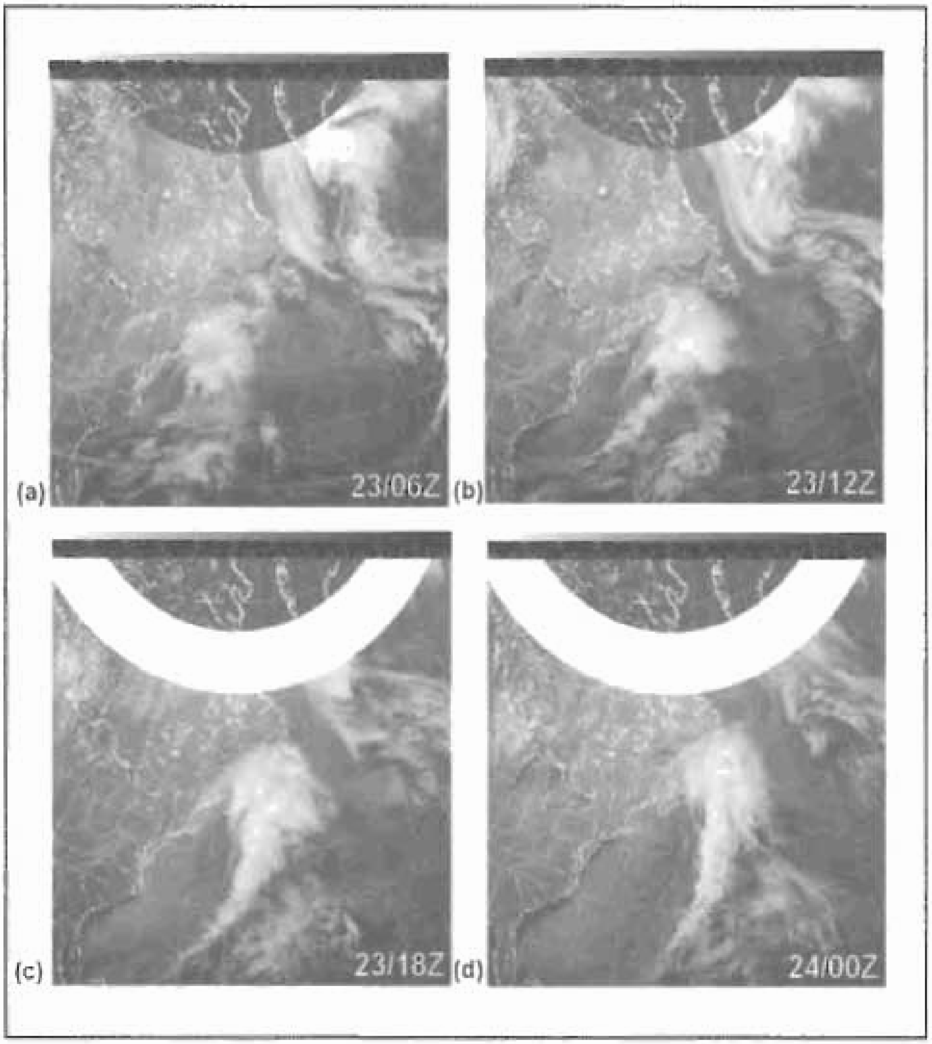

Fig. 2. *GOES-12 infrared imagery*

The storm then moved slowly eastward on 23 January bringing severe blizzard conditions to the heavily populated regions of the Eastern Seaboard including Boston and New York City and deteriorating conditions across the Maritime Provinces of Canada. Near hurricane force northeasterly winds were occurring on the coast of Massachusetts and south of Nova Scotia at the height of the storm. The storm had a complex structure with new low pressure centres forming within the large storm circulation on the 23rd. These centres are shown as the blue circles in the track map in Fig. 1. Early on the 24th two low centres merged just south of Sable Island followed by a temporary slowing down of the storm motion. By afternoon on the 24th the storm had been accelerating toward Newfoundland and eventually dissipated east of Baffin Island on the 26th.

A series of GOES-12 infrared satellite images are shown in Fig. 2 covering the peak period of blizzard conditions over mainland Nova Scotia. The storm became well developed during this period, and was becoming occluded aloft (Fig. 2d). It was then that the surface low was just east of the 500-mb low shown in Fig. 3. A subjective sea level pressure analysis from the Atlantic Storm Prediction Centre at 00 UTC on the 24th is shown in Fig. 4 corresponding to the satellite image in panel (d) of Fig. 2. Note that there were two low centres at that time – the southern one was the original centre while the northern one approximately 200 km south of Halifax was the new centre that formed in the vicinity of the thermal ridge (see Fig. 3). There was a very tight pressure gradient over Nova Scotia responsible for the high winds experienced there.

2. The Snowfalls

The initial swath of heavy snows moved across mainland Nova Scotia during the morning of the 23rd. The precipitation was located well ahead of the storm centre when it was still southeast of Cape Cod. This band brought the heaviest snowfall as seen in the radar image in Fig. 5, at a later time (2020 UTC). The heaviest snowfall rates associated with this band were 7 to 9 cm/hr! However, the maximum snowfall rates as inferred by the radar (see scale) were only around 1.5 cm/hr. This corresponds to an underestimation by a factor of 5 or 6. During the Great Maritimes Blizzard of 2004 (a.k.a. "White Juan") (Fogarty

2004) the underestimation factor was on the order of 3. This discrepancy may be explained by noting that the snow flakes appeared to be dry and very fine, therefore their individual backscattering cross sections would be small and this would tend to reduce Z (Z also proportional to $\sum D_i^6$, where D_i is the size scale of a snow particle). In addition, snow and ice crystal habits at temperatures in the observed –10 to –15°C range tend to be dominated by plates, which normally fall flat thereby reducing their cross-section as viewed by the radar. Another possible explanation likely has to do with the snow density. Radar reflectivity (Z) for snow is proportional to R^2, specifically, $Z = 2000R^2$ (e.g. Rogers and Yau (1989) p. 191) where R denotes precipitation in millimetres of water per hour. If the snow:water-equivalent ratio is large, then this could account for some of the discrepancy between reflectivity and inferred snowfall rates. Additionally, there could be radar calibration problems coming into play here, but it is beyond the scope of this report to go into details. The idea here is to make meteorologists aware of the issues.

Areas experiencing the heaviest snowfalls in the band depicted in the radar image in Fig. 5 picked up near 25 cm over the 3-hour period it took for the most intense snow to move through. On either side of the main snow band, snowfall rates averaged 1 to 2 cm/hr. The period of snow experienced at most stations lasted between 24 and 30 hours. True blizzard conditions (visibility less than or equal to ¼ statute mile, wind speeds greater than 60 km/h) were generally experienced for 12 to 18 hours (e.g. during the latter half of the period over which snow was falling).

Total snowfall amounts from this blizzard are shown in the contour analysis in Fig. 6. This analysis is highly subjective, using a combination of reports from official weather stations (airport sites) and independent estimates. In addition, knowledge of the terrain and the observed snowfall pattern from radar imagery is incorporated into the analysis. For example, there were no confirmed reports of greater than 70 cm, but in all likelihood, such amounts would have been experienced over the highlands (denoted by "**70+?**" in Fig. 6). The axis of maximum snowfall parallels the storm track (Fig. 1) as expected. Close to the storm along the Atlantic coast of Nova Scotia, amounts were less.

Measuring the snowfall was a challenge after the winds increased and there was intense blowing and drifting. Nipher snow gauges are used at many sites included in the analysis and a snow:water-equivalent ratio of 10:1 is normally used to estimate the snowfall. However, in this storm, the 10:1 ratio was inappropriate given the very cold temperatures that made the snow density quite low. In New Glasgow (in north central Nova Scotia at the location of the 64-cm report in Fig. 6) and Elmwood, PEI (at the position of the 59-cm report) a ratio of 12:1 was estimated. In other areas (further away from the water) the ratio may have been more like 15:1. The size of the snowflakes plays a big part in this (larger flakes means more air between snow particles when they fall), but I noticed that flakes were generally quite small during the blizzard. Temperatures during the blizzard ranged from –12 to –8°C which is much colder than we are used to seeing in these regions. Normally we experience temperatures between –4 and 0°C during big snow events. There was a significant amount of cold air in place over the region prior to the arrival of this storm and only weak warm advection at the surface during the storm.

There were two confirmed snowfall records set with this storm. Yarmouth and Greenwood both broke one-day snowfall records for the month of January.

3. The Winds

Strong northeast winds were experienced with this system, which combined with the large volumes of powdery snow, resulted in extreme blizzard conditions. The strongest winds were recorded at Baccaro Point on Nova Scotia's extreme southern tip. Winds at this exposed site were sustained at 105 km/h (57 kts) and were gusting to 130 km/h (70 kts) out of the northeast (040° true) at the height of the storm. This station normally experiences high winds from the east and northeast, but it is quite uncommon for them to reach sustained speeds of 100 km/h or more! These winds were recorded about one hour prior to the analysis in Fig. 4. We can see that southwestern Nova Scotia is within the tight pressure gradient to the northwest of the storm centre. A QuikSCAT image valid at ~22 UTC 23 January in Fig. 7 shows the distribution of winds around the storm.

Over western and southern mainland Nova Scotia, coastal wind gusts were reaching near hurricane force (120 km/h) with inland gusts of 90 km/h. Further east where the pressure gradient was weaker, coastal gusts were around 90-100 km/h with inland gusts of 70-80 km/h. Winds in the offshore regions were blowing full storm-force with a few bands of hurricane-force winds. This is apparent in Fig. 7 and is consistent with a couple of ship observations (not shown) of hurricane-force winds.

4. The Weather Conditions

This was a blizzard in every sense of the term. Visibilities were reduced to ¼ statute mile for 12 to 18 hours, winds were steady at 50 km/h and gusted to 80 km/h at many sites, temperatures were very cold – especially at the onset of the storm when they were in the mid-minus teens Celsius. During the period of most intense snowfall rates, the visibility at my location in New Glasgow was as low as 1/10 of a mile due to the snowfall alone! This was at a time when the snowfall rate was near 9 cm/hr. The meteorologist's and observer's old rule of thumb using visibility to estimate snowfall rate seemed to apply. For example, the hourly rate of snowfall in cm was roughly equal to **x** where visibility in statute miles is 1/**x**. During the height of the blizzard, the rule has to be used with caution due to blowing snow. Winds remained very strong during the day on Monday the 24th even after the snow had stopped. Blowing snow persisted well into the afternoon over northern sections of the region.

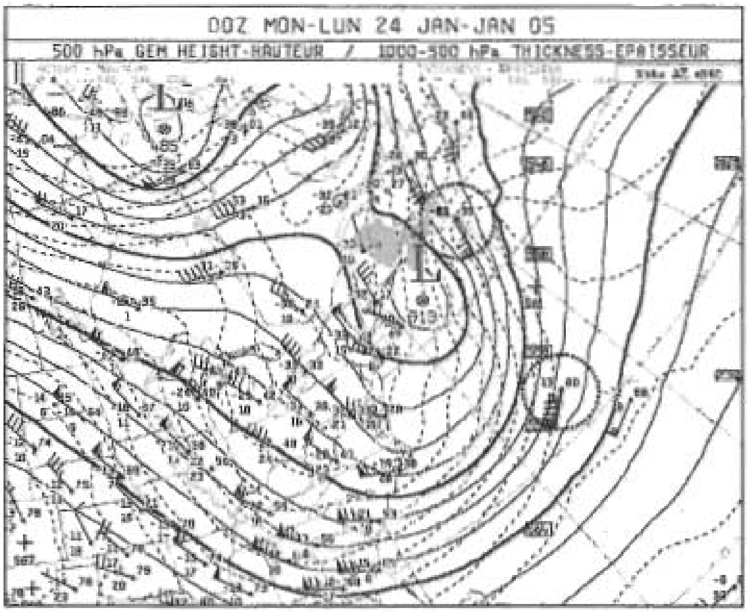

Fig. 3. *500 mb geopotential height and thickness analysis.*

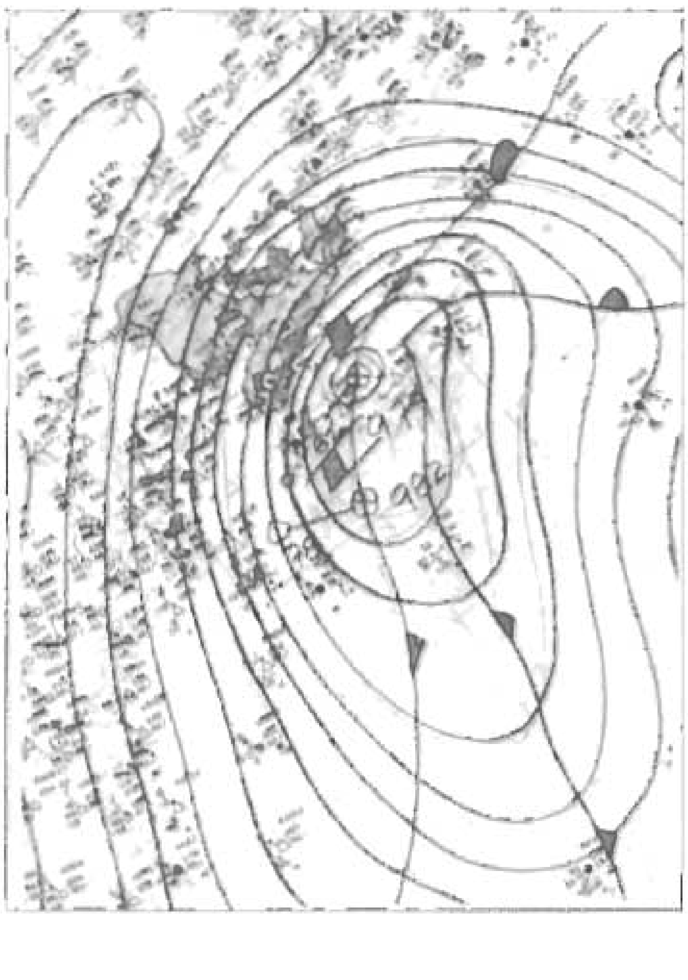

Fig. 4. *Subjective sea level pressure analysis from operations.*

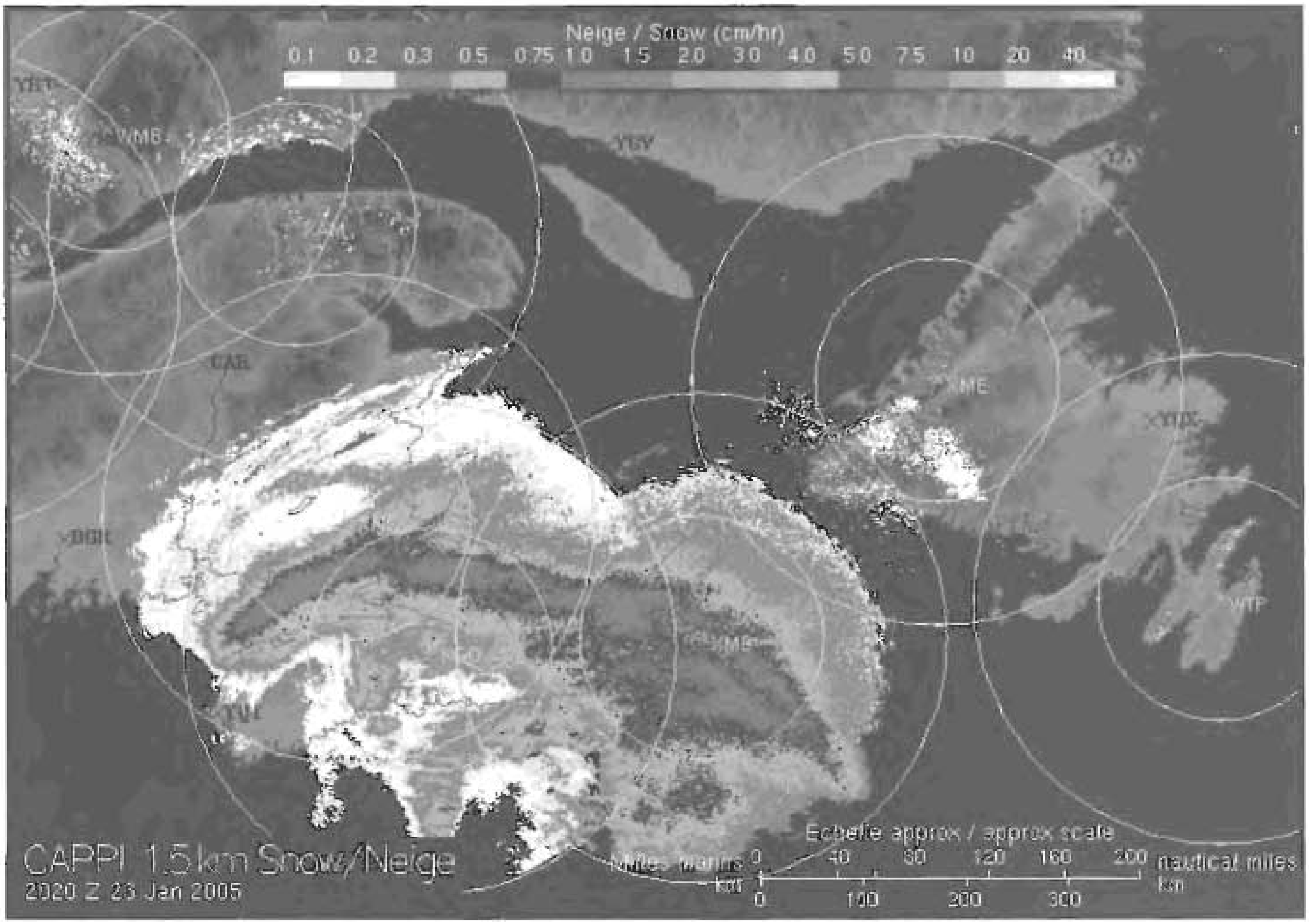

Fig. 5. *Radar composite showing 1.5 km CAPPI snowfall rate.*

Over eastern Cape Breton there was a brief period of freezing rain and ice pellets as the temperature rose to –2°C. There were also a few snow pellets mixed in with the snow during the heavy snowfall period over mainland Nova Scotia. This indicates the likelihood of embedded convective clouds in the storm.

Below is a series of METARS from Greenwood which echo conditions experienced at many other locations (note the snowfall denoted by /S/):

```
SPECI CYZX 231540Z 05019G28KT 1/8SM +SN +BLSN VV003
RMK SN8 WNDY HILL
        05021G37KT VIS VRB 0-1/4
METAR CYZX 231600Z 05022G27KT 1/8SM +SN +BLSN VV003
M12/M14 A2981 RMK SN8 WNDY
        HILL 06019G35KT VIS VRB 0-1/4 /S12/ SLP097
METAR CYZX 231700Z 05017G22KT 1/8SM +SN +BLSN VV002
M12/M14 A2976 RMK SN8 WNDY
        HILL 05019G34KT VIS VRB 0-1/4 /S21/ PEAK WND PAST
HR 05025G29KT
        SLP082
METAR CYZX 231800Z CCA 05022G29KT 1/8SM +SN +BLSN
VV002 M11/M13 A2966 RMK SN8
        WNDY HILL 05019G34KT PRESFR /S29/ SLP046
```

A graph of conditions at New Glasgow in Fig. 8 shows the evolution of various parameters including snowfall as a function of time.

5. The Impacts

There was significant drifting, and it was occurring almost everywhere, particularly in the lee of buildings and downwind of open fields. Drifts were on the order of 1 to 2 metres or 3 to 7 feet deep. In many case cars were nearly or completely buried in areas that picked up 60+ cm of snow. Schools were closed for 2 days in the worst hit areas, and businesses were closed on the Monday following the blizzard, which began on Sunday the 23rd. There were no power outages reported. Snowplows were taken off the streets and highways in several areas due to zero visibility. Several motorists were stranded on the highway near Amherst, Nova Scotia and the highway through Cobequid Pass was closed until 4pm on the 24th. It is suspected that this was the worst hit area (see 70+ cm area in Fig. 6 on mainland Nova Scotia).

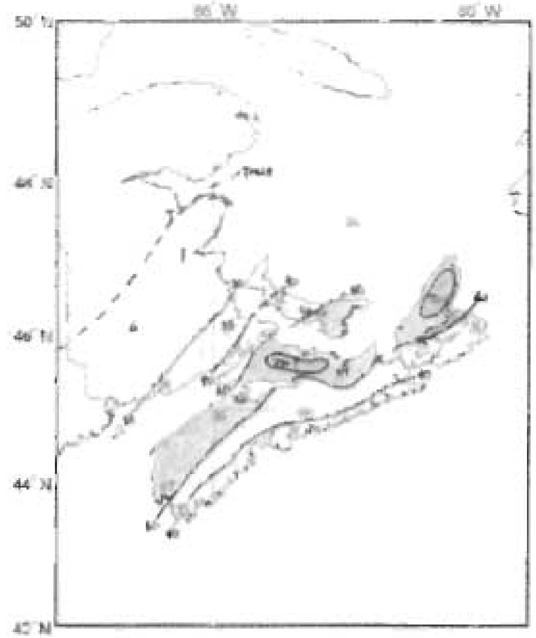

Fig. 6. *Subjective storm-total snowfall analysis in centimetres. Actual observations are shown in red (airport sites) and blue for independent sites (colour version only).*

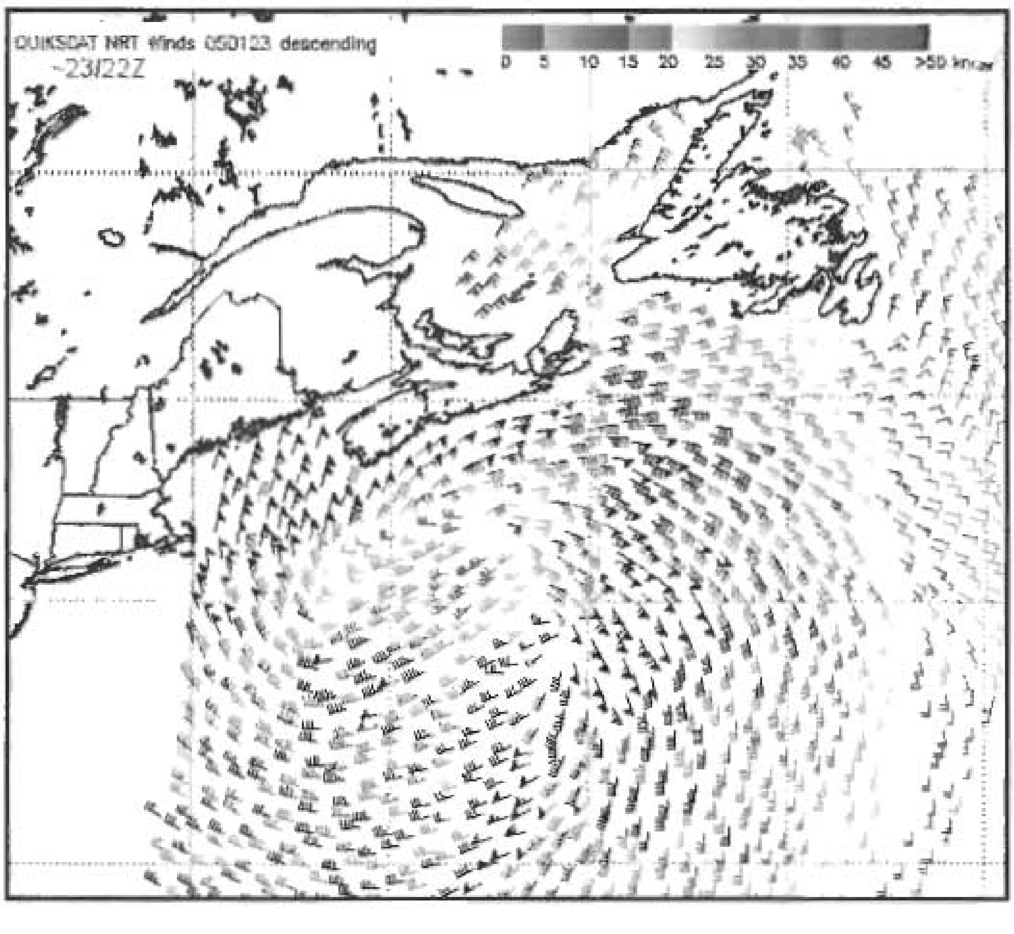

Fig. 7. *QuikSCAT analysis courtesy of Marine Observing Systems Team (http://manati.orbit.nesdis.noaa.gov/quikscat/)*

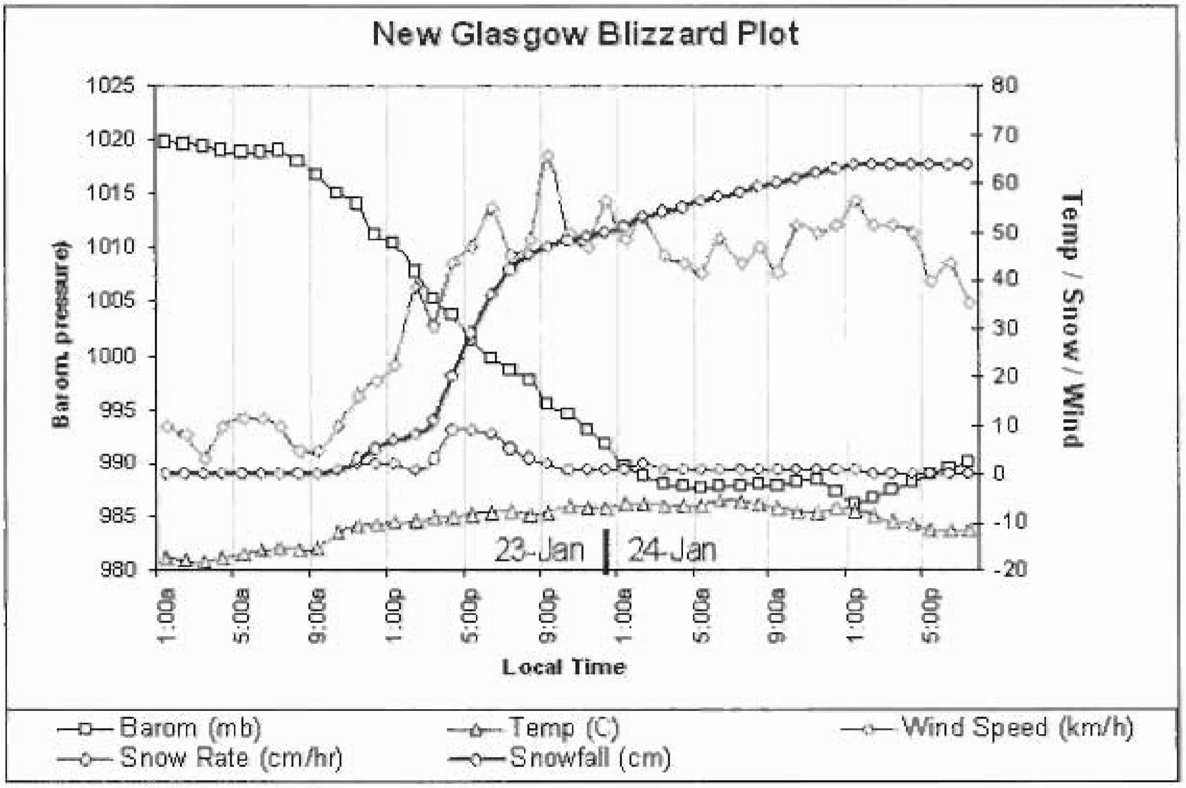

Fig. 8. *Time traces of various weather elements at New Glasgow, Nova Scotia.*

Storm surge was a concern and was forecast to be near 1 metre but there were no reports of significant coastal damage. A storm on 27 December 2004 packed a greater wallop in terms of wind, surge and waves, so a lot of the vulnerabilities to damage and erosion had likely been inflicted during that event. Fig. 9 contains a series of storm photographs from New Glasgow.

6. Summary

The blizzard of 23/24 January 2005 was an exceptional snowfall event in Nova Scotia and Prince Edward Island bringing near 2 feet (60 cm) of snow and intense blowing and drifting. Despite the complicated storm track, the storm was well forecast. Blizzard warnings were posted on Saturday, 22 January for 30 to 50 cm of snow. Forecast amounts were later increased to 60-70 cm for some areas. The storm tracked very near Sable Island (44N, 60W), which is the so-called "benchmark" region for heavy snowfall events in Nova Scotia, southeast New Brunswick and Prince Edward Island. The Great Maritime Blizzard of 2004 (Fogarty 2004) also tracked over or very near Sable Island and delivered mammoth snowfalls to much of the Maritimes. The forward speed of this year's storm was erratic since there were two occasions when a new low centre formed over the Atlantic. The first reformation was just south of Cape Cod early on the 23rd and the second was south of Nova Scotia late on the 23rd. These reformed centres led to temporary slow-downs in the overall movement of the circulation, which likely helped maintain persistent snows over southern New England and the Maritimes.

The blizzard was unusual in that temperatures were very cold, generally between –8 and –12°C during the height of the storm. Wind chill was a big concern with air temperatures of –10°C and winds of 50 km/h; the wind chill was around –22°C. The density of snow was lighter than usual, so it readily drifted. The intensity of snow reduced visibility to 1/10 of a statute mile, a level that I have not seen for many years. This corresponded to a snowfall rate of 8 to 9 cm/hr, which lasted for about 3 ½ hours. Had this intense period of snow not occurred, the storm wouldn't have been so exceptional. This was a dangerous storm for anyone being outdoors. Several motorists had to be rescued after becoming stranded on the Trans-Canada highway. Snowplow operators were simply unable to keep up with the volume of snow and intense drifting.

Acknowledgment:

I wish to thank my colleague Doug Mercer for his help with the data collection and interpretation.

References:

Fogarty, C. T., 2004: The Great Maritimes Blizzard of February 18-19, 2004. *Canadian Meteor. and Oceanogr. Soc. Bul.*, **32**(4), 100-106.

Rogers, R. R., and M. K. Yau, 1989: A Short Course In Cloud Physics, Pergamon Press, 293 pp.

Fig. 9. *Various photographs taken during and after the blizzard in New Glasgow. (a) before nightfall on the 23^{rd} with 1/10SM visibility, (b) author's car almost buried on the 24^{th}, (c) a truck crawls through steep snow banks, (d) heavy drifting, (e) author's driveway after the "big dig", and (e) downtown New Glasgow (note the pedestrian compared to the size of snow banks).*

Sea Surface Temperatures from the West Coast Meteorological Buoys show an Unusually Warm 2004 Summer

by Jim Gower[1]

The array of 17 meteorological buoys off the west coast of Canada has been providing surface weather data in BC coastal and offshore waters for about the past 15 years. Last summer, the time series from all buoys showed anomalously warm sea surface temperatures. In the buoy data record the rise observed was equalled only during the El Niño event in 1998. The spatial pattern of the summer 2004 anomaly shows greater warming offshore and to the north, in contrast to the El Niño event where greatest warming was close to the coast and in the south.

Figure 1 shows the SST anomaly time series for the 17 buoys. All data shown are derived from monthly averages computed from hourly measurements. Months for which less than 300 measurements are available are not plotted. All buoys showed the warm anomaly in the summer of 2004, in most cases measuring water warmer by an average of 1 to 1.5° C for the period May to August 2004. Most of the buoys also show a similar degree of warming over the longer period June 1997 to March 1998, associated with the 1997/98 El-Niño.

Figure 2 shows the buoy locations. Three buoys are in deep water about 400 km offshore, six are along the exposed BC coast, a further six are in the relatively sheltered waters of Dixon Entrance (46145), Hecate Strait (46183, 46185), Queen Charlotte Sound (46204) and the Strait of Georgia (46131, 46146), and a further two buoys are in narrow inlets, 46181 in the north, off Kitimat, and 46134 in the south, near the Institute of Ocean Sciences.

All data shown in Figure 1 are anomalies computed from monthly average sea surface temperatures by subtracting the annual cycle for each buoy. Figure 3 shows data from buoy 46145, both as monthly averaged SST values which show the strong annual cycle ranging in this case from about 6 to about 14°C, and as anomalies with the mean annual cycle subtracted, showing positive and negative excursions of about 1°C amplitude. The annual cycle used here for each buoy is a combination of an annual sinusoid and second harmonic, with amplitudes and phases chosen to give a best fit to the monthly data. The warming associated with the El Niño at the end of 1997 occurred at the end of a cooling trend in surface temperatures on the west coast in the 1990s. Temperatures have slowly warmed since then. The trend for the total record for this buoy is a slow cooling, with a rate significantly less than the global average warming of about 0.3° C in 20 years.

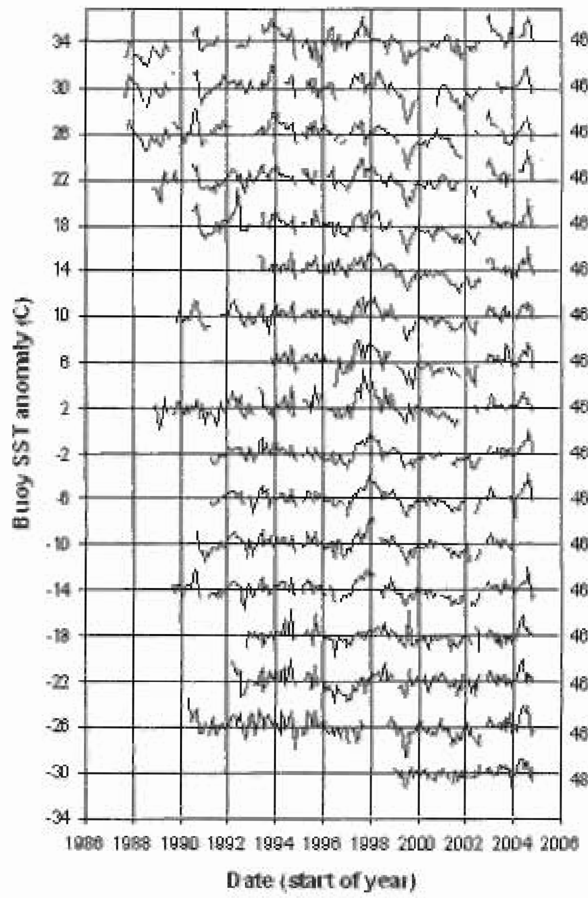

Figure 1. Sea surface temperature anomalies computed from SST data from the 17 west coast buoys. Anomaly temperatures are offset 4° C from one buoy to the next. Buoys are ordered north to south in four series, starting with the three offshore buoys at the top, followed by the 6 buoys close to the exposed coast, followed by the 6 buoys in sheltered waters, and finally the two buoys in inlets (see Figure 2 for map). All buoys show a similar short-lived (about 3 months) positive temperature anomaly during the summer of 2004. Many show the longer-lived warm anomaly associated with the 1997/98 El Niño.

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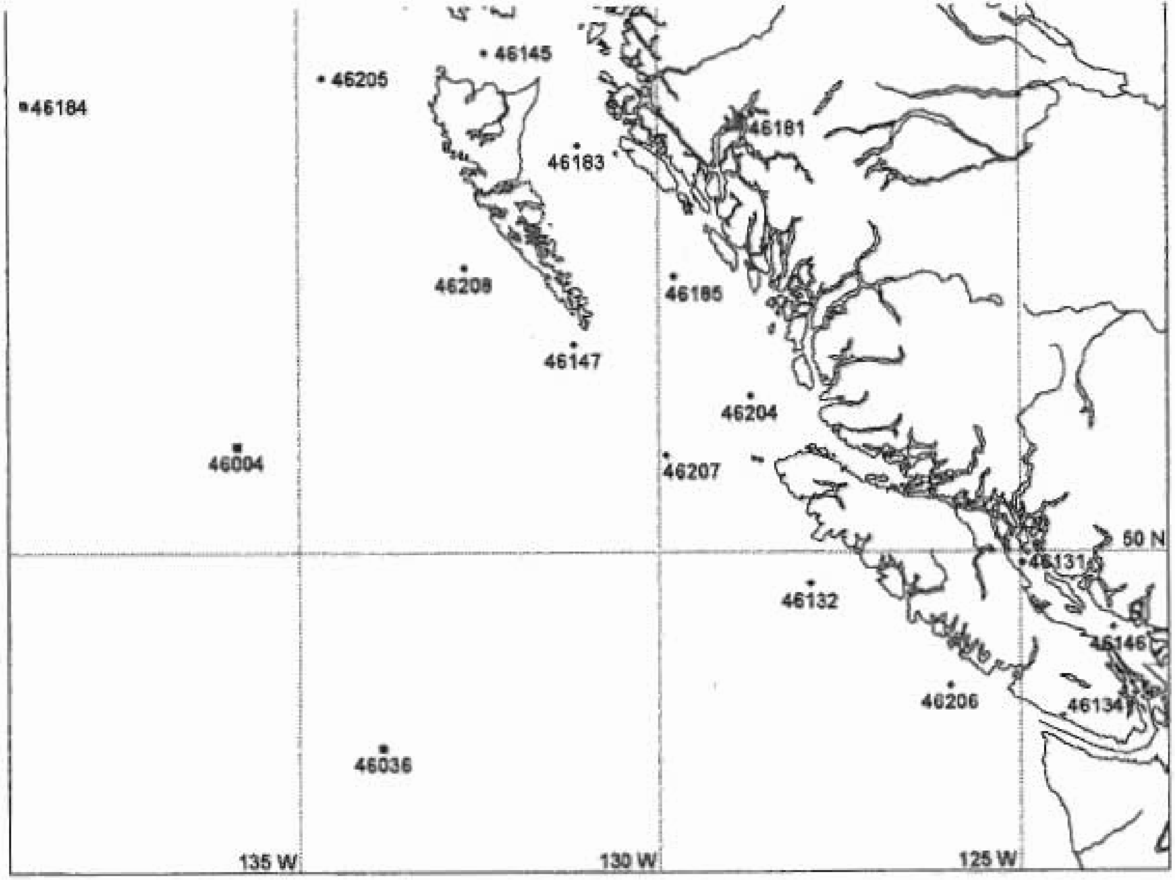

Figure 2. Locations of the Canadian meteorological buoys. Buoys are identified by their World Meteorological Organization (WMO) codes. Buoys 46184, 46004 and 46036 are larger Nomad buoys located about 400 km from the BC coast. All others are 3-metre discus buoys.

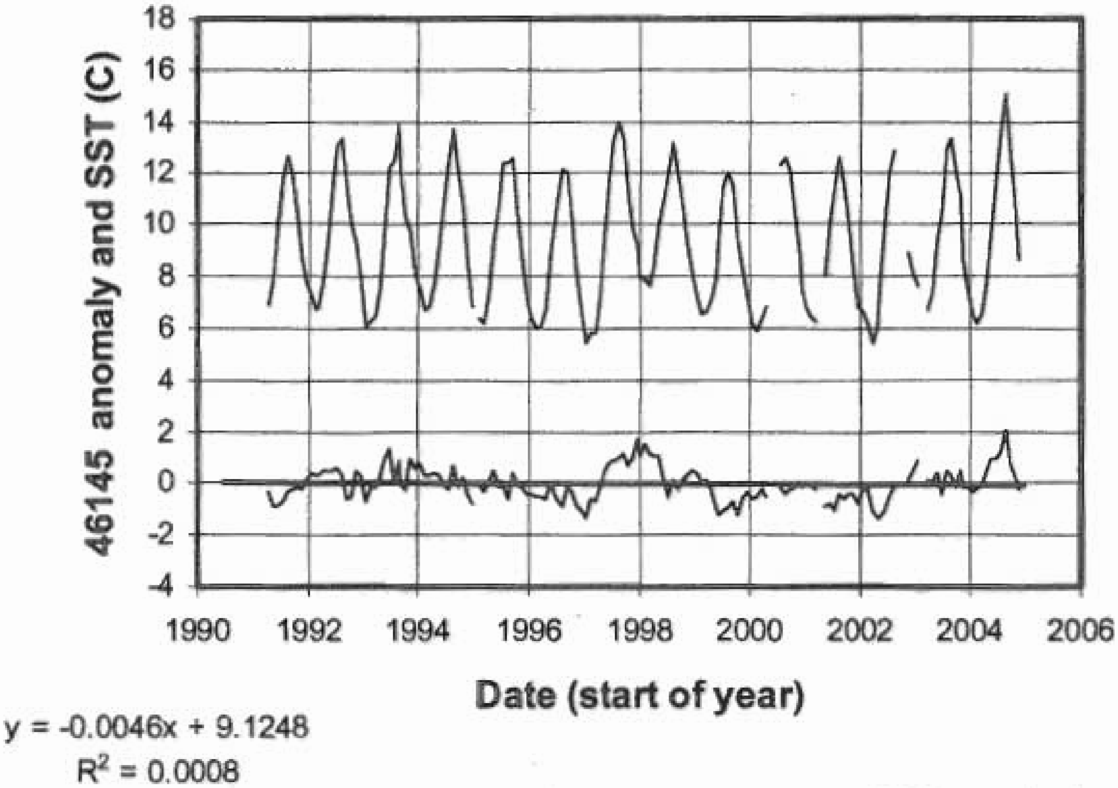

Figure 3. Data for buoy 46145 in Dixon Entrance showing the monthly average SST time series (upper plot) and the computed anomalies (lower) on the same temperature scale. The best fit to the anomaly time series shows a very slight cooling trend.

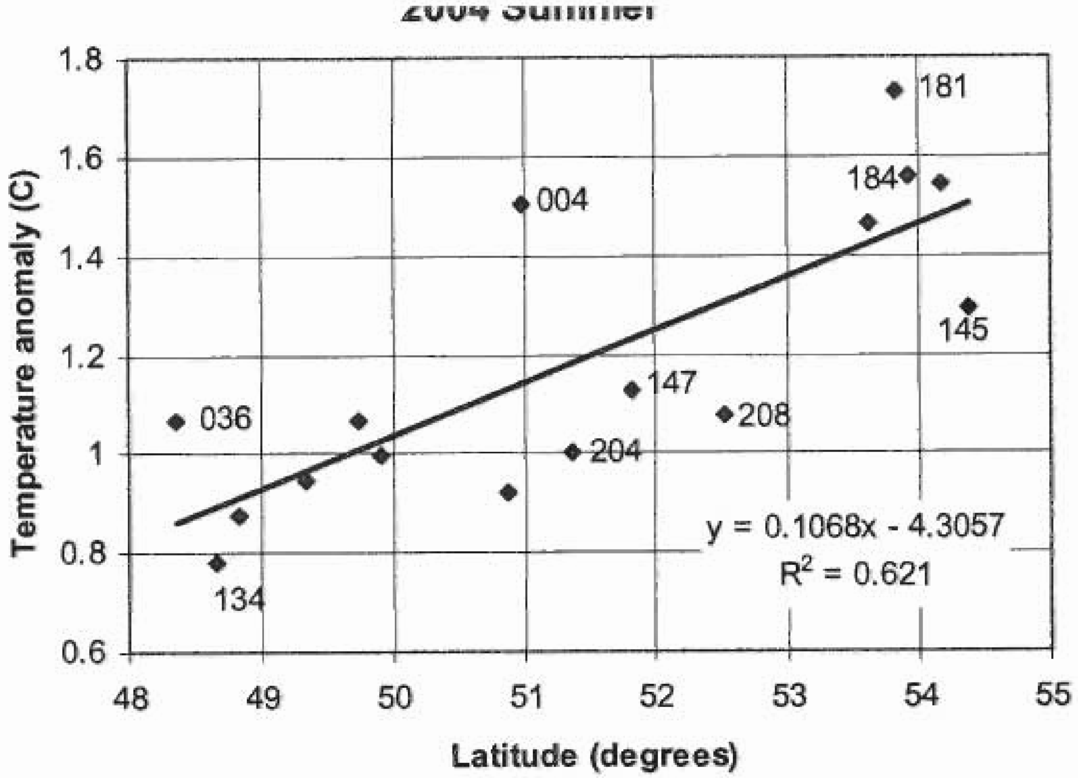

Figure 4. Magnitude of the summer (May to August) 2004 temperature anomaly, plotted against latitude. The best fit line to all anomalies shows a strong trend with latitude with the magnitude of the anomaly increasing by about a factor of two from south to north. Some buoys are identified with the last 3 digits of their WMO code. Buoys 036, 004 and 184 are the offshore buoys. Buoy 181, showing the greatest anomaly, and, buoy 134, showing the least, are in sheltered inlets.

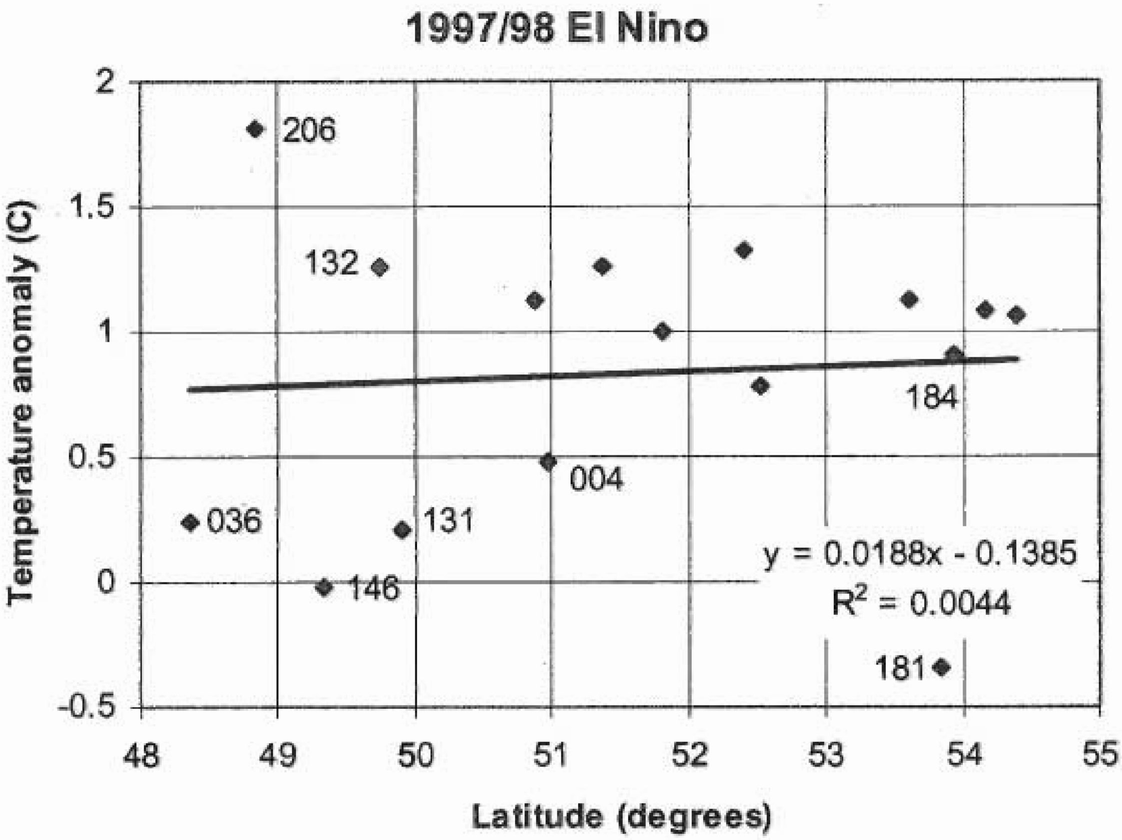

Figure 5. Temperature anomalies associated with the 1997/98 El Niño (average for June 1997 to March 1998), plotted against latitude. Some buoys are identified with the last 3 digits of their WMO code. The best fit line to all anomalies shows close to zero trend with latitude. Largest anomalies are measured close to the exposed coast, especially at the southernmost buoy 206.

Figure 4 shows the variation of the anomaly magnitude (average anomaly for the four months May to August, 2004), plotted against latitude of the buoy. Magnitude of the anomaly is about twice as great at the northern limit of BC waters compared to the southern limit. The offshore buoys, 46036, 46004 and 46184 tend to show greater anomalies. Buoy 46181 showing the greatest anomaly, and 46134 showing the least, are in sheltered inlets.

For comparison, Figure 5 shows the anomaly magnitudes associated with the 1997/98 El-Niño (average anomaly for the ten months June 1997 to March 1998) plotted against latitude. The offshore buoys 46036, 46004 and 46184 show relatively smaller anomalies for this event. Three other buoys show very small anomalies. Buoys 46131 and 46146 are both in the Strait of Georgia and buoy 46181 off Kitimat recorded a negative anomaly. Buoy 46134 was installed only at the end of 1998. All other buoys show a similar anomaly of about 1° C, except the southernmost buoy off the west coast of Vancouver Island which gives the largest anomaly, of 1.8° C.

Given the Canadian buoy data alone, the summer 2004 anomaly can be interpreted in terms of a general warming of this part of the north-east Pacific with increasing effect offshore and at more northern latitudes. The smaller anomaly at buoy 46134 and the greater anomaly at buoy 46181 suggests a stronger south-to-north gradient in the warming over land. In contrast, the El Niño anomaly is known to be driven by advection of coastal water along the coast from the south, explaining the higher anomaly at buoy 46206, and the lower effects offshore. Surface water in coastal inlets such as the Strait of Georgia (buoys 46146 and 46131) and Douglas Channel by Kitimat (buoy 46181) did not share the general warming in this El Niño.

The Canadian buoy data need to be linked to data from other sources, but are clearly providing a useful part of the climate picture.

6th International Conference on Urban Climate (ICUC6) Göteborg, Sweden, June 12th - 16th 2006

The International Association for Urban Climate (IAUC, www.urban-climate.org) and Göteborg University, in co-operation with the World Meteorological Organization invite you to the Sixth International Conference on Urban Climate (ICUC-6). ICUC-6 will be held 12-16 June, 2006 in Göteborg, Sweden. The deadline for submission of abstracts is 10th November, 2005. Abstracts will be submitted via the web (http://www.urban-climate.org)

We welcome papers seeking to understand the nature of the atmosphere in urban environments or to the application of such knowledge to the better design and operation of settlements. Scales of interest range from individual built elements (roofs, walls, roads) through whole buildings, streets, factories, parks, clusters of buildings and neighborhoods, to whole cities and urban regions and their impacts on weather and climate at scales up to those of global change. The focus can be original research into the physical, biological and chemical atmospheric processes operating in built areas; the weather, climates and surface hydrology experienced in built areas; the design and testing of scale, statistical and numerical models of urban climates; or reports on the application of climatic understanding in architectural design or urban planning. Papers may relate to new concepts, methods, instruments, observations, applications, forecasting operations, scenario testing, projections of future climates, etc. Sessions that focus on major field studies or other projects or topics may be proposed.

Appropriate topics include, but are not restricted to: Airflow over cities, including turbulence, urban roughness and drag, changes of wind speed and direction, urban circulation systems, and wind engineering; Anthropogenic Heat; Building climates (interior and exterior) and the climatic performance of built features; Carbon exchanges in urban areas; Cities and global change; Climate-sensitive urban design and planning; Climates of paved surfaces such as roads, streets, highways, runways and parking lots; Climatic performance of urban trees, lawns, gardens, parks, green roofs, irrigation, rivers, lakes and reservoirs; Emergency response planning; Exchanges of heat, mass and momentum between the urban surface and its boundary layer; Forecasting urban weather, comfort, hazards, and air quality; Interactions between urban climate and the emission, dispersion, transport, transformation and removal of air pollutants; Models, and their evaluation, of the urban atmosphere at all scales and urban surface-atmosphere exchanges; Remote sensing of cities and urban climate; Road climatology in cities, including influence from traffic and other city-related objects; Short- and long-wave radiation in polluted air and urban visibility; Topoclimatology of cities, including the effects of coasts, valleys and other landforms; Urban biometeorology relevant to the functioning of plants, wildlife and humans; Urban climates in high latitude settings; Urban heat islands, their nature, genesis and mitigation; and Urban impacts on surface moisture, dew, evaporation, humidity, fog, cloud and precipitation

For further information, please see http://www.urban-climate.org (links: ICUC, then ICUC6) or email Prof. Sven Lindqvist, chair of the local organizing committee (sven@gvc.gu.se) or Prof. Sue Grimmond (grimmon@indiana.edu), President IAUC. The official language of ICUC-6 is English.

The Bratt's Lake Precipitation Intercomparison Project: Estimating the Systematic Errors in Measuring Precipitation Using the Geonor Accumulating Precipitation Gauge

by Courtney Campbell[1] and Craig D. Smith[2]

Résumé: (Traduit par la direction) Le projet d'étude comparative des précipitations au lac Bratt a débuté en décembre 2003 afin d'étudier les erreurs systématiques en utilisant le capteur de précipitation Geonor T-200B, actuellement le modèle de référence du SMC pour les mesures automatiques des précipitations quelles que soient les conditions météorologiques. Au site expérimental du lac Bratt, situé sur le sud de la Saskatchewan, plusieurs capteurs Geonor ont été aménagés selon une disposition variée, à l'abri de l'écoulement des vents. On les a comparés avec des mesures manuelles en rapport avec la référence internationale pour les capteurs, soit le capteur de la Référence Comparative aménagée avec écran à Double Paroi (RCDP). Sans égard aux saisons, les comparaisons entre les deux se sont avérées en bon accord entre les précipitations mesurées par la RCDP et les capteurs Geonor aménagés de façon similaire avec écran à double paroi octogonale, suggérant ainsi une grande efficacité de capture avec les capteurs Geonor. Des comparaisons entre les capteurs Geonor avec écran à double paroi octogonale et un capteur Geonor avec écran Alter ont été examinées. Les résultats ont montré une corrélation négative forte entre l'efficacité de capture pour le capteur Geonor avec écran Alter et la vitesse du vent au niveau du capteur. Ce résultat peut être utilisé afin de produire une courbe préliminaire pour la correction du vent dans l'aménagement du capteur Geonor avec écran Alter dans les Prairies et l'Arctique.

Abstract: The Bratt's Lake precipitation intercomparison project was initiated in December of 2003 to examine systematic errors in measuring precipitation using the Geonor T-200B precipitation gauge, the current MSC standard for the automated measurement of all-weather precipitation. Several Geonor gauges have been installed at the Bratt's Lake facility in southern Saskatchewan in various wind-shield configurations and have been compared with manual measurements made with the international reference gauge the Dual Fence Intercomparison Reference (DFIR). Intercomparisons have shown a good agreement between precipitation measured by the DFIR and the Geonor installed within a similar double octagonal wind fence, regardless of season, suggesting high catch efficiencies for the Geonor in this configuration. Intercomparisons were then made between the Geonor in the double octagonal fence and a Geonor in an Alter shield. Results showed a strong negative correlation between catch efficiency for the Alter shielded Geonor and wind speed at gauge height. This result can be used to produce a preliminary wind-correction curve for the Alter-shielded Geonor for installations in the prairies and arctic.

1. Introduction

The measurement of precipitation is subject to numerous inaccuracies that cause differences between "true" precipitation and that which is measured by the instrument. Phenomena such as evaporation, wetting loss, splashing, blowing snow (into or out of the collector), and wind-induced bias can lead to systematic underestimations of precipitation that can be as high as 100% (Goodison *et al.*, 1998).

Wind is widely understood to be the most significant environmental variable influencing the systematic error in precipitation gauge measurements, due primarily to the wind-field deformation over the gauge orifice which in turn affects falling precipitation (Goodison *et al.*, 1981; Sevruk, 1982; Sevruk and Hamon, 1984). As wind flows around and over the precipitation gauge, it is displaced and accelerates over the top of the gauge body. Lighter precipitation particles (i.e. snow) are blown over the gauge orifice, resulting in an underestimation of precipitation. The magnitude of underestimation varies greatly with the falling velocity of particles, wind speed, and the aerodynamic properties of a particular type of gauge (see Annex 1 in Goodison *et al.*, 1998 for a more detailed description).

The Geonor T-200B precipitation gauge has recently been adopted by the Meteorological Service of Canada as the standard for automated measurement of all-weather precipitation. Although previously tested in Canada (and world-wide) for accuracy and reliability, these tests have been conducted primarily in environments characterized by heavy snow and light winds (i.e. Southern Ontario). Intercomparisons need to be extended and continued in the Canadian prairies and arctic where winter precipitation events are characterized by light, dry snow and high wind speeds. The Bratt's Lake facility, as described below, experiences nearly ideal conditions for this experiment.

The first objective of this study is to compare an automated Geonor precipitation gauge installed in an octagonal vertical double fence wind shield (Geonor-DF) to the

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Tretyakov manual gauge also installed in an octagonal vertical double fence wind shield. This second configuration, called the Double Fence Intercomparison Reference (DFIR) has been recommended by the World Meteorological Organization (WMO) as the international reference for measuring solid precipitation (Goodison *et al.*, 1998). This intercomparison will determine if the Geonor-DF underestimates precipitation as compared to the international reference.

The second objective of this study is to determine the relationship between catch efficiency (CE) of the Alter shielded Geonor (Geonor-Alter) and the wind speed at gauge height (for both rain and snow). This intercomparison will lead to the derivation of wind-correction curves for the Alter shielded Geonor that can be applied at various time scales (i.e. over a storm period, daily, hourly, etc.) to other Geonor derived observations in similar prairie and arctic environments.

2. Site Description

The Bratt's Lake research facility is located 30 km SSW of Regina, Saskatchewan (Figure 1) and is co-located with the Baseline Surface Radiation Network (BSRN) site. The facility is centered in an agricultural area which exhibits very little topographical relief. Vegetation cover is limited to low-lying crops so gauge exposure is maximized by the absence of trees and brush. This long fetch and high exposure results in relatively high wind speeds at any time of the year. The average annual temperature and precipitation for this region is 2.8°C and 388 mm respectively. Snowfall (> 0.2 cm) occurs on average 57 days of the year and comprises approximately 22% of the annual precipitation.

Figure 1: Location of Bratt's Lake, Saskatchewan

A variety of precipitation gauges and meteorological instrumentation are installed in the measurement compound at Bratt's Lake. The two octagonal vertical double fence wind shields contain a manually observed Tretyakov gauge (DFIR) and an automated Geonor gauge (Figure 2a). These large wind fences, being 12 metres in diameter and 3 metres in height, have been constructed at opposite ends of the compound to minimize interference with each other. Several Alter-shielded Geonor gauges (Figure 2b) have been installed in the compound for intercomparison with the larger wind shields. Other gauges, such as the Belfort 3000, Hydrological Services TB3 tipping bucket, Canadian Nipher, sonic snow depth sensor, and a pit gauge were installed in the compound but are not incorporated into this analysis. Wind speed and direction were measured in the centre of the compound at a height of 2 metres (approximately gauge height). Air temperature sensors were also placed in proximity to the precipitation gauges.

3. Methods

Three Geonor T-200B precipitation gauges were installed at Environment Canada's Bratt's Lake research facility in November of 2003: one in an octagonal vertical double fence wind shield (DF) and two with Alter wind shields (Figure 2). All three automated gauges recorded precipitation accumulations at 15-minute intervals. The manual DFIR was measured daily (typically at 8:30 LST) until February of 2004 at which time the frequency of measurement was doubled (second observation at approximately 17:00 LST).

Precipitation events observed at the site were binned according to precipitation type (as identified by the manual observer's record) for the period between December-2003 and August-2004. Mixed precipitation was removed from the analysis and will be examined at a later time. Due to the discrepancy in observation frequency of the automated and manual gauges, 15-minute accumulations observed by the Geonor-DF were summed over the observation period of the DFIR (rounded to the nearest quarter-hour).

Before comparisons could be made between the DFIR and the Geonor-DF, the DFIR accumulations were adjusted for known systematic biases attributed to wetting loss and wind under catch. Wetting loss was determined by wetting the collection cylinder of the DFIR, dumping out the excess water, and determining the depth equivalent of the water that remained in the cylinder (wet weight – dry weight) according to the procedure described in Annex 5 of Goodison *et al.* (1998). The average wetting loss of the two commonly used DFIR collectors at Bratt's Lake was 0.13 mm per observation ± 0.03 mm. Wind bias was corrected using the procedure described by Golubev (1986) and modified by Yang *et al.* (1993). These studies corrected the wind bias in the DFIR as compared to a bush-shielded gauge (BUSH) in Valdai, Russia. Corrections are shown for various precipitation types but only corrections for dry snow and rain are utilized in this study. According to Yang *et al.* (1993), these are:

Dry Snow:

$$BUSH/DFIR(\%)=100+1.89*W_s+6.54E\text{-}4*W_s^3+6.54E\text{-}5*W_s^5$$
$$(N=52,\ r^2=0.37)$$

Rain:

$$BUSH/DFIR(\%)=100.35+1.667*W_s-2.40E\text{-}3*W_s^3$$
$$(N=120,\ r^2=0.22)$$

where BUSH/DFIR is the ratio of catch during a storm event for the two gauges, and W_s is wind speed (m/s) at gauge height. These equations suggest a DFIR CE of approximately 0.86 and 0.93 for dry snow and rain respectively at a wind speed of 5 m/s. Each non-zero DFIR observation of rain or snow at Bratt's Lake was adjusted accordingly.

The second objective of this study was to determine a preliminary relationship between wind speed and CE for the Geonor-Alter (where CE is defined as the ratio of the catch of the Geonor-Alter to the Geonor-DF). As a first attempt to determine this relationship, a storm-event time scale was selected. 15-minute observations were accumulated into precipitation events (where an event ended with 8 continuous hours of no precipitation) and the precipitation totals for the events were compared. Wind speed at 2 metres' height was averaged over the same period as the precipitation event. This accumulation frequency was chosen for this analysis for several reasons: 1) wind speed averages would only include data observed during the precipitation event and exclude extraneous observations, and 2) accumulations were typically over longer time periods resulting in larger accumulations therefore reducing spurious catch efficiency results (i.e. when the absolute difference in catch was small but the relative difference was large). Events with accumulations less than 1.0 mm were excluded from the analysis (for the same reason as in the example above). Precipitation typing was accomplished using a "best guess" from the manual observations in combination with 15-minute temperature observations. Precipitation events identified as mixed by the observer and those that occurred when temperatures were between -5°C and +5°C were excluded.

4. Results

Observations from the DFIR and Geonor-DF gauges over the study period showed that the Geonor-DF appeared to under-measure both solid and liquid precipitation. The percentage catch of the Geonor-DF compared to the DFIR (for snow and rain) are shown in Table 1. On average, the Geonor-DF under-measured snow by 3% and rain by 12% (with standard deviations of 30% and 14% respectively).

	Snow	Rain
n	17	33
Total DFIR (mm)	83.7	266.2
Total Geonor-DF (mm)	82.1	234.2
Average DFIR / Geonor-DF (%)	97.4	88.0
Standard Deviation (%)	30.0	13.7

Table 1: Summary of snow and rain observations > 1.0m, December 2003 - August 2004

This bias is confirmed by the scatter plots (Figure 3). Although the correlation between the two gauges was higher for rain than for snow (r^2=0.99 and 0.74 respectively), the regression line was closer to the 1:1 line for snow. There appeared to be no significant relationship between the underestimation of the Geonor-DF gauge and wind speed for both rain and snow. The fact that Geonor-DF CE was higher for snow than for rain is in contradiction with theory and cannot be explained at this time. It is possible that this is a product of the relatively small data sample. It should also be noted that several outliers have been removed from this analysis that may be attributed to possible gauge capping and manual DFIR observational errors.

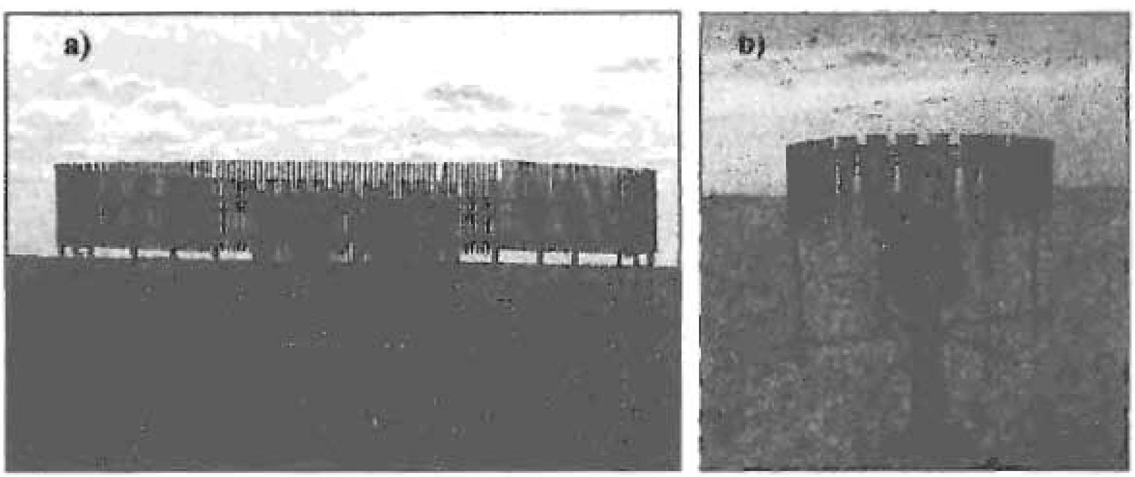

Figure 2: Geonor with a) octagonal vertical double fence shield and b) Alter shield

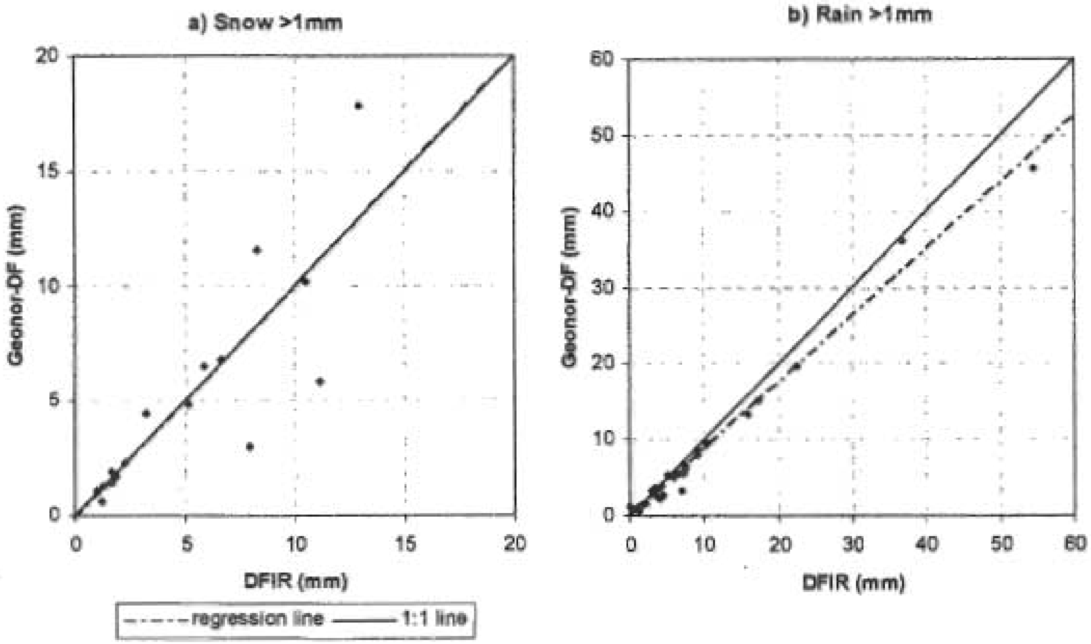

Figure 3: Scatter plot showing comparisons between precipitation events measured by the DFIR and the Geonor-Alter precipitation gauges for a) snow and b) rain events

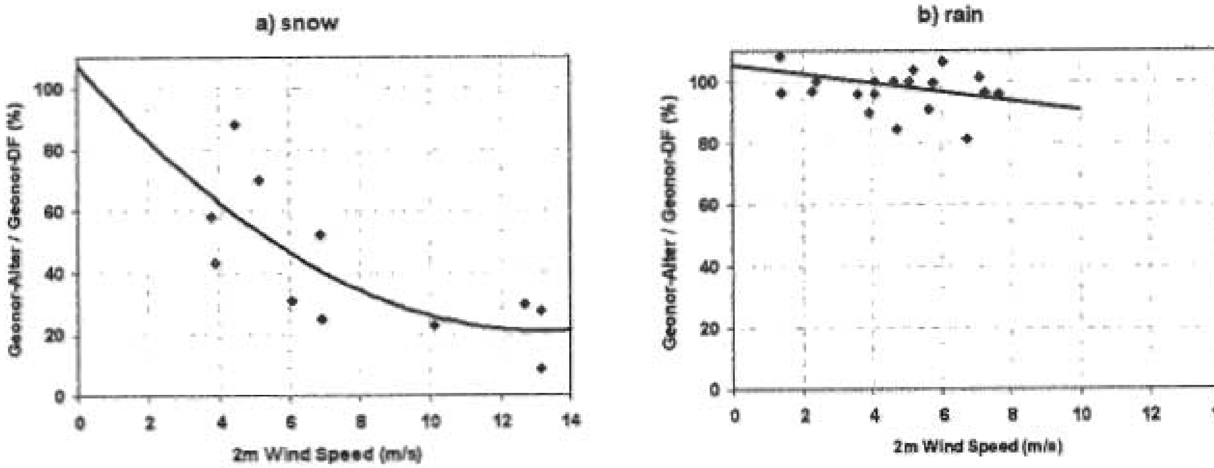

Figure 4: Relationship between catch efficiency and wind speed for the Geonor-Alter shielded precipitation gauge for a) snow and b) rain

To determine wind-induced under catch of the Geonor using a conventional Alter shield, the ratio of Geonor-Alter to Geonor-DF (not adjusted for underestimation compared to the DFIR) was plotted with wind speed for all precipitation events (divided into rain and snow) with accumulations greater than or equal to 1 mm (Figure 4). As noted previously, the 1 mm threshold was used to prevent spurious catch efficiencies when absolute differences in gauge measurements were small but the relative differences were large. To prevent these spurious values of CE, previous authors have limited analysis to events greater than 3 mm (i.e. Yang *et al.*, 1993) but this would significantly reduce the size of this already limited data set. Regression analysis was conducted and the resulting sample size, r^2 values and equations of the best fit lines are shown below:

Snow:
$CE(\%) = 0.49*W_s^2 - 13.10*W_s + 107.23$ ($N=11$, $r^2=0.55$)

Rain:
$CE(\%) = -1.46*W_s + 105.38$ ($N=120$, $r^2=0.22$)

It is recognized that the small number of events and the absence of events with low wind speeds results in some uncertainty as to the accuracy of these models. This is especially true for snow events, of which there are only 11, with no events having an average wind speed below 3 m/s. Also, previous studies (i.e. Goodison *et al.*, 1998) would suggest that the CE for most precipitation gauges will reach 100% at some non-zero wind speed. Although lack of data at low wind speeds for the snow CE curve shown in Figure 4a prevents us from confidently extending the curve lower than 3 m/s, we can speculate that an extrapolated curve would reach a CE of 100% at wind speeds near 2 m/s. This suggests that a wind under catch adjustment for the Geonor-Alter for snow is only required at wind speeds greater than 2 m/s. Adjustments for rain would be relatively small and are therefore not crucial.

5. Discussion

Results of the Geonor-DF and DFIR comparison showed that the Geonor-DF appears to underestimate both snow and rain by an average of 3% and 12% respectively. Regression analysis showed a linear relationship between the two gauge measurements with r^2 values of 0.99 (rain) and 0.74 (snow). However, not enough confidence can be put into these results at this time to recommend adjustment of the Geonor-DF. There seems to be no relationship between the underestimation of the Geonor-DF and wind speed at gauge height. It is unknown why the Geonor-DF underestimate was greater for rain than for snow as this seems to contradict previous findings. Much of this uncertainty is due to the small data set.

Although it remains unclear as to the adjustments required for the Geonor-DF (to match DFIR measurements), it is certain that solid precipitation measured using the Alter shielded Geonor gauge will require adjustment for wind-induced under catch. Preliminary results from an event-based intercomparison suggested that adjustments for snow will be required at wind speeds greater than 2 m/s and that underestimates could be as high as 50% at wind speeds of 5 m/s. Underestimates of rain by the Geonor-Alter are low and therefore adjustments will be small and usually unnecessary.

Aside from the requirement for more data to refine these correction curves, more analysis is needed to develop curves for various time scales. One of the greatest advantages of automated instrumentation is the availability of data at high temporal resolution (for both precipitation and wind) which may allow for corrections at smaller time scales (i.e. 1-6 hours) whereas historical corrections have been limited to the manual observational period (12 or 24 hours). Also, higher resolution data will allow for a more precise definition of the period in which the precipitation is actually occurring, resulting in a more refined CE-wind speed relationship. Furthermore, the Bratt's Lake intercomparison program will benefit from the installation of a Precipitation Occurrence Sensing System (POSS) which will provide high temporal resolution (1-minute) data for precipitation occurrence and typing. This instrument will eliminate much of the guess work in precipitation typing during transitional precipitation events, resulting in more precise relationships.

6. Acknowledgements

The authors wish to thank Dr. David Halliwell and Ormanda Niebergall (Air Quality Research Branch, Meteorological Service of Canada) for their assistance during site installation and continued on-site support. Also special thanks to the Gooding family for their assistance with the manual precipitation measurement program.

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Robert William Stewart

21 August 1923 — 19 January 2005

Bob Stewart made brilliant discoveries about turbulence, surface waves, air-sea interaction, and in many other areas of physical oceanography. He was an inspiration and a generous and kind mentor for numerous graduate students and junior scientists, a wise and effective science manager, and an exemplary ambassador for Canada as a member and chair of numerous international organizations. His death is a great loss to our community, but his scientific and personal influence live on.

Bob was born in Smokey Lake, Alberta, and raised in Olds and Calgary. His father was a Methodist minister who later obtained Bachelor's and Master's degrees from the University of Alberta and became a high school teacher in Calgary. Bob's mother, née Florence Berry, was from Lancashire and met Bob's father when he was in England recovering from wounds sustained in World War I. She later taught in Cheltenham but came to Canada after her marriage in 1921.

Bob's schooling was largely in Calgary. He particularly enjoyed history, but also excelled in mathematics. On graduation from high school in 1941 he accepted the single scholarship offered to an Alberta student by Queen's University. He originally registered in Mechanical Engineering but later heard about and enrolled in an elite program in Engineering Physics. He became friends with physics professor J. K. Robertson who took Bob on as a summer student. This led to Bob's first two papers, on the index of refraction in thin films. He graduated in 1945 in uniform, having enlisted in the army as a volunteer although he had earlier been deemed unacceptable for military service because of severe astigmatism. As the war ended, Queen's got Bob released from the army to help teach first-year physics to armed forces personnel returning to universities. Bob also completed a Master's degree, in 1947, on electric discharges in gases.

J. K. Robertson had contacts at Cambridge and suggested that Bob go there for a Ph. D. An Ontario government scholarship provided support for this and Bob was accepted at St. John's College. He told the tutor there that he was prepared to do anything except nuclear physics and was sent to see G. I. Taylor whose group at the time included George Batchelor, Alan Townsend, and Werner Heisenberg (who had been told to stop working on nuclear physics and had decided to return to turbulence, the subject of his thesis!). G. I. accepted Bob as a student and was an inspiration to him, although he was away for much of Bob's three years in Cambridge. For his Ph.D. thesis Bob made the first measurements of triple correlations in turbulence, using an apparatus of his own design.

While at Cambridge, Bob took up lacrosse and enjoyed the company of his team mates, who were mostly from northern England with accents that reminded Bob of his Lancashire grandfather. Bob received a "half blue" for playing for the university team. In one game, however, he broke his leg badly; the injury caused him problems for the rest of his life.

Bob returned to Canada in 1950, to a position at the Pacific Naval Laboratory in Esquimalt. He suggested making turbulence measurements in the ocean, first testing newly built hot film anemometers in water tunnels. The project was tied to the detection of submarine wakes but these proved elusive so he, Harold Grant and Tony Molliet moved on to their famous study near Seymour Narrows, measuring the spectrum of turbulent velocity fluctuations over a range from about 100 m to 1 mm and providing the first convincing confirmation of Kolmogorov's "-5/3" power law.

This work was partly done after Bob had taken a position at UBC in the Department of Physics and the new Institute of Oceanography. During this period Bob realized that the Reynolds stress concept so valuable in turbulence could also be used to study the interaction between water waves, currents and other phenomena. The referee for his first paper didn't like it, but revealed his identity! This led to a very fruitful collaboration and several classic papers by Bob and Michael Longuet-Higgins.

Bob's interests also gradually moved into studying the role of turbulence in air-sea interaction. His group rapidly became world leaders, with many distinguished graduate students working on fluxes of momentum and heat, wave generation and other topics. During this period Bob also had visiting appointments at Dalhousie, the atmospheric physics group in Moscow (where he and E. A. Novikov produced new ideas on turbulent intermittency), Harvard, Pennsylvania State and Cambridge. He also made an educational movie on turbulence that is still shown.

Bob's interactions with Russian scientists grew out of a mutual interest in turbulence as well as his desire to maintain and foster scientific contact during the Cold War. He learnt Russian in preparation for his three-month visit in 1963 and later invited Russian scientists to visit UBC and to live in his home during their visit.

In 1970 Bob was hired as the first director of the Institute of Ocean Sciences (IOS), a position he held until 1979. He set his mark on the architecture of the building as well as the scientific style. His argument for a low-rise building to facilitate communication and collaboration was strengthened by the proximity of Victoria's airport! His influence nationally was also significant; he gave strong support for the establishment of a DFO scientific component in Québec, leading eventually to the establishment of Institut Maurice-Lamontagne.

Bob still found time for some science of his own while he was Director of IOS. He collaborated with Rick Thomson on vorticity mixing (a topic where G.I. Taylor had made a rare mistake). He also took a keen interest in mean sea level as an integrating measure of global change, though he stressed the need for careful separation of isostatic and eustatic changes.


Bob Stewart operating a Kelvin sounding winch on board HMCS Cedarwood in the Strait of Georgia in the early 1950s. (Photo courtesy of Bill English)

Bob's air-sea interaction work led to his appointment to the Joint Organising Committee for the Global Atmospheric Research Program in 1968; he chaired it from 1972 to 1976. In this and the Committee on Climate Change and the Oceans, of which he was a member from 1978 to 1990 and chaired from 1983 to 1987, he played a key role in establishing cooperation between different nations and in encouraging important programs such as the World Ocean Circulation Experiment.

These international commitments thus continued after Bob left IOS, first to be Assistant Deputy Minister, then Deputy Minister, of B. C.'s Ministry of Universities, Science and Communication (1979-84) and then as President of the Alberta Research Council (1984-87). From 1987-89 he was the interim director of the University of Victoria's Centre for Earth and Ocean Research, an attempt to consolidate and build on collaboration between UVic, IOS, and the Pacific Geoscience Centre.

A retirement symposium for Bob was held in 1989 (see ATMOSPHERE-OCEAN **29**, 1991), but he continued his international activities, notably with the International Council of Scientific Unions. He also continued to attend seminars at UVic, serve on graduate student committees, and join colleagues for lunch and wide-ranging discussions.

As a scientist, Bob relied heavily on his outstanding intuition. He was usually right, but always open to other views however crazy they seemed to him. One of the graduate students he inspired at UBC recalls "He was happiest (although always shocked and mortified) when one of us found real fault with one of his own arguments, and we took dreadful glee in doing it." Bob's wisdom and insight were often summarized in wonderful aphorisms. These include "A thought experiment need not be realistic, but it must be realizable", and, more tongue in cheek, "A scientist's stature can be judged by the length of time for which he or she has held up progress". He liked to illustrate the latter with examples from theories of surface wave generation.

As an international organizer, Bob exemplified the very best Canadian tradition of combining expertise with tolerance, understanding, and compromise. These qualities also showed in his actions as a science manager within Canada. In his personal life he was not religious but believed very strongly in the importance of compassion.

Bob's excellence has been recognized by numerous awards. He was particularly proud of his election to the Royal Society of London in 1970 (and not just because the other physics professors at UBC suddenly started taking him seriously!). He also received the Patterson Medal of the Meteorological Service of Canada (1973), the Sverdrup Gold Medal of the American Meteorological Society (1976), the Order of Canada (1980), CMOS's Tully Medal (1989) and various honorary degrees.

Bob is survived by his wife, Anne-Marie, four children, four grandchildren and a great-grandson. On 8 May 2005, his ashes will be scattered on Saanich Inlet from the CGCS Tully, a fitting tribute to a grandfather of Canadian oceanography.

A contribution from Bob's friends and colleagues

The State of the Nation's Ecosystems

Measuring the Lands, Waters, and Living Resources of the United States

The John Heinz III Center for Science, Economics and the Environment

ISBN 0-521-52572-1 Cambridge University Press, 2002
Paperback, US$25

Book reviewed by Charles Schafer[1]

This book is described by its authors as the first of a planned series aimed at providing a "blueprint for periodic reporting on the condition and use of regional ecosystems in the United States". Using a large suite of regional-scale indicators, it outlines "a prescription for taking the pulse of America's lands and waters" based on the rationale that "there is [presently] no periodic, comprehensive, and reliable compilation of essential information about the overall state of the nation's environment" at the regional scale. By default, the report details an approach and a framework for regional-scale assessment and monitoring that has applicability to any country that might be interested in developing an indicator framework for its regional ecosystems. The book was prepared with the help of a large number of senior advisors, a well-staffed design committee and subject-specific working groups drawn from government, academia, the private sector, and environmental organizations (totaling about 150 persons). The text's foreword pages note that the work has been completed "through an intense five-year collaborative process" and as an early step on a long path to a "well-grounded system of ecosystem and environmental reporting that the nation deserves."

The book's content is organized into three parts. Part I consists of three chapters that discuss issues of philosophy, framework and findings. The "findings" section places a strong emphasis on "What We Know and What We Don't Know." Part II contains seven chapters. The first of these (Chapter 4) defines the indicators that are used to characterize six United States ecosystems (i.e., *Coasts and Oceans, Farmlands, Forests, Fresh Waters, Grasslands and Shrublands*, and *Urban and Suburban Areas*). Each of these six ecosystems is the subject of an individual chapter in which indicators are defined and evaluated at the regional scale. Indicators are subdivided into four categories in each case: *System Dimensions, Chemical and Physical Conditions, Biological Components*, and *Human Uses*. Part III consists of an appendix that highlights issues on data availability and gaps. It also features a technical notes section featuring content that is referenced frequently throughout the six ecosystem chapters. Each ecosystem chapter is built around key questions and begins with a table that summarizes definitions of the indicators used for that particular ecosystem. The remainder of this review presents an in-depth inspection of Chapter 5 (*Coasts and Oceans*). Its structure is virtually similar to that used in the other five ecosystem chapters and it deals with material that will be familiar to many of the CMOS Bulletin readership. As such, it serves to elucidate the approach that has been used by the Heinz Center authors to assess contemporary regional ecosystem conditions and offers a model for the framework of future periodic reports.

The *Coasts and Oceans* chapter outlines results from nine regions (North Atlantic, Mid-Atlantic, South Atlantic, Gulf of Mexico, Hawaii, Southern California, Pacific Northwest, Gulf of Alaska, and Bering Sea). It begins with a general statement followed by a very short summary about the indicators being used. In this instance, sixteen indicators describe the condition and use of US. coasts and ocean space. Partial or complete data are available for only nine of these and five have data records that are long enough to be able to judge trends. The *Systems Dimensions* category comprises two indicators (*Coastal Living Habitats* and *Shoreline Types)*. The first one tracks changes in area of key habitat types and the second focuses on the nature of the shoreline itself. The *Coastal Living Habitats* indicator summary is virtually similar to all others noted throughout this book in that it is presented using three key questions: (1) What is this indicator and why is it important? (2) What does the data set show? and (3) Why can't this indicator be reported at this time? In many instances, the three key questions sections are accompanied by a very short and concise *Discussion* section.

There are four indicators associated with the *Chemical and Physical Conditions* category of Chapter 5 (areas with depleted oxygen, contamination in bottom sediments, coastal erosion, and sea surface temperature (SST)). There are no data reported for depleted oxygen or coastal erosion areas. In the first case, it is concluded that too few estuaries and coastal embayments are sampled frequently enough to allow reporting of this indicator at a regional or national scale. Coastal erosion data present difficulties because local assessments often use different methods that cannot be easily combined into a national-scale picture. The contaminated bottom sediment indicator is based on surveys of PCBs, PAHs and mercury. However, once again,

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[1] Emeritus Scientist, Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, Dartmouth, NS.
Geological Survey of Canada Contribution No. 2004106.

only an incomplete interpretation is offered at this time because "*No program exists to provide nationally consistent data*" on coastal sediment contamination. SST data are shown to be relatively complete and are used to track how regional average temperatures in any given year deviate from a fourteen year baseline average. Graphs that accompany the evaluation for this indicator show relatively high SST variability in the Bering Sea and North Atlantic regions after 1990 in comparison to more southerly situated regions.

The *Biological Components* category of Chapter 5 features six indicators. Three of these (at-risk native marine species, non-native species and harmful algal blooms) have either insufficient data for national-scale reporting or are in need of further ecosystem indicator development. For example, the non-native species indicator is said to suffer from a lack of nationwide monitoring programs or agreed-upon methods for combining information. The two other indicators in this category (condition of bottom dwelling animals and chlorophyll concentrations) only report recent data. Despite the amount of research that has occurred in these two fields over the past several decades, it appears that the tools needed to compare benthic communities with their undisturbed reference site counterparts have been developed only for three of the nine defined coastal regions covered in the report. The writers note that additional research is also necessary to insure that the indicators developed for different regions are comparable. In general, for this important benthic habitat indicator, it seems that only limited regional data are available for US. ocean areas out to 25 miles offshore. The chlorophyll indicator suffers from similar shortcomings and has apparently not been sampled frequently enough to produce comparable data that can be used for evaluating seasonal variations between regions. Only in the case of the *Unusual Marine Mortalities* indicator are the authors reasonably comfortable about reporting trends. However, even in this instance, they note that national-scale data on turtle, seabird, fish, and shellfish mortality events are just not available.

The last indicator category of the Coasts and Oceans chapter (*Human Uses)* contains four indicators. An anomalously large amount of regional data for *Commercial Fish and Shellfish Landings* and for the *Status of Commercially Important Fish Stocks* suggest real trends and permit regional comparisons. However, the authors go on to point out that reported aggregate landings figures do not reveal that fishing effort has shifted repeatedly from depleted to unexploited stocks and that these data represent only about 25% of all US. commercial fish stocks. The stocks included in the 25% figure account for approximately 75% of the weight of fish caught in US. waters each year. *Selected Contaminants in Fish and Shellfish* and *Recreational Water Quality* are two indicators that one would think - if only for public health considerations - might be possible to evaluate at the regional level. Surprisingly, however, both indicators apparently lack adequate data for US. national reporting purposes.

Although this book represents a formidable effort in establishing a US regional ecosystem baseline and reporting framework, it is equally powerful in communicating a "wake up" call to those state and federal agencies (and associated political entities) that are charged with managing and conserving US natural resources. Paging through the other chapters of this report makes it very clear that data *Not Adequate for National Reporting* is not a problem that is likely only confined to US. coast and ocean ecosystems. Given the technological and human resources of US government natural resource management and protection agencies, one can only surmise after reading this publication that the regional ecosystem data coverage situation in Canada is likely about the same or worse. This publication should have a prominent place in the general reference library of resource managers and environmental advocates. It also provides a detailed example of a regional ecosystems assessment approach that should be useful to strategic planners everywhere. Although it is not the sort of book I would expect to see on a scientist's reference shelf, it does have information germane to funding proposal preparation activities. If the reader would care to take a quick "cruise" through the entire report before deciding whether or not to invest in a hard copy, then just "logon" to the Heinz Center's web page (http://www.heinzctr.org) and click on the link for the report. The Center encourages direct feedback from its readership so feel free to contribute some constructive criticism on how to improve on this first attempt at evaluating the spatial and temporal dynamics of regional-scale ecosystems.

GLOBAL CHANGE and LOCAL PLACES

Estimating, Understanding, and Reducing Greenhouse Gases

by: The Association of American Geographers Global Change and Local Places Research Team

Cambridge University Press, July 2003
Hardback, ISBN 0 521 80950 9, 290 pages, US$75

Book reviewed by Pat Spearey[2]

During 1993, the Association of American Geographers initiated a project to develop methods to determine how localities contribute to global climate changes caused by greenhouse gas emissions, how these contributions alter over time, what occasions these switches, what control local residents exercise over these causes, and how mitigation and adaptation can occur locally. Four economically and environmentally diverse study areas in the United States were selected and a research team for each area assessed

[2] CMOS Member, Ottawa, ON

changes, from 1970 through to those likely by 2020, in human activities that alter greenhouse gas emissions and uptake.

Global Change and Local Places presents the findings of this research and their implications in twelve papers, to which a total of 29 geographers at US universities contributed. Tables, photographs, charts, and specialized information boxes augment easy-to-comprehend and generally non-technical texts. Numerous references to information sources, articles, and publications follow each paper including some website addresses. The majority are US publications and sites. There is an adequate index.

The study areas are labelled local but are not small. Each covers roughly one degree of latitude by one degree of longitude, about 12,300 square kilometres, nearly twice the size of the Niagara Peninsula. The local knowledge, scientific ability, and commitment to a long-term study of the four participating universities in the study areas were factors in the selection process which resulted in the chosen districts being: a crop and beef production region in Southwestern Kansas; an area containing a mix of manufacturing and forestry in Northwestern North Carolina; a restructured belt of heavy industry in Northwestern Ohio; and an open-face coal mining and lime production region in Central Pennsylvania.

Because of its proximity to Canada and its location within 500 miles of about 35% of the population of Canada, I chose the Northwestern Ohio study area, situated in the traditional industrial heartland of the United States and extending west, south and east of the city of Toledo on Lake Erie, for a review of study sources and findings. It is an area that has undergone significant changes during the past 30 years as a result of restructuring and, in contrast to the other three areas, reductions of industrial greenhouse gas emissions.

The Toledo area hosts four of the five most energy intensive industries in the United States: petroleum and coal products; chemical and related products; primary metals; and stone, clay and glass products. For these there are opportunities for emission reductions through both fundamental and incremental changes. Reductions of approximately 25% were achieved from 1970 to 1990 with roles played by foreign - mainly Japanese - investment, technical education, job creation schemes, and government regulations, acts and tax changes. The manufacturing emission declines were partly offset by growth in the transportation sectors as urban sprawl, commuting distances, and the numbers of private cars and industrial transport vehicles increased augmented by householder related increases. Agricultural emissions in the region were generally unchanged.

Other findings showed that : local industries are sceptical of the realities of global warming but realize the public relations value of voluntary participation; over half of householders are indifferent, ambivalent or unconvinced about global warming with rural respondents the most doubtful; and local government politicians and officials wish to foster pleasant, sustainable environments but must also be perceived to be favouring development and job creation. Householders also place global warming below air and water pollution reduction, favour technological to behavioural solutions and are not keen on less private driving. Plausible mitigation pathways suggested by these industrial, governmental and householding groups are: increase energy efficiency in production processes; fuel-efficient vehicles and better vehicle maintenance; smoother traffic flow; less urban sprawl allied to better urban planning; and brownfield redevelopment.

Prospects for the Northwestern Ohio area are a rise at a moderate rate in greenhouse gas emissions over the next 20 years related to a new economic growth cycle. Curbs of this rise are the most likely scenario rather than reduction. Efforts to diminish this rise in emissions should centre on technological changes as no major daily behavioural changes in the area are expected in the near future.

The later general papers in the book compare local, state- and United States-wide greenhouse gas emissions, cover the varying attitudes towards reductions in local areas, present ways of learning from local analogs (for example, the clean-up of Lake Erie pollution), focus on reduction potentials and strategies, and give the lessons learned from the project. The final paper indicates emission changes both pro and con are driven by and intertwined with national, state and local economic development, technology, affluence, socio-economic welfare, regulation, energy supply and price, and consumer demand. Policy-makers at national and global levels should develop mechanisms that will enable and empower local action to realize its considerable potential. The previously held slogan "Think globally, act locally" should be revised to "Act globally in order to act locally".

This useful, factual, non-controversial yet thought-provoking book, in which I detected neither obvious subject nor presentational errors, should be read by all persons involved in creating action plans to assist businesses and individuals adjust to positive and negative climate changes. National and local politicians, supporting officials, advisors, business managers, and interested laypersons are all encompassed in these groups. Knowledge and disciplinary boundaries need to be transcended in the large climate change arena.

War North of 80: The Last German Arctic Weather Station of World War II

by Wilhelm Dege
Translated from the German and edited by
William Barr

University of Calgary Press, Calgary, Alberta
ISBN 1-55238-110-2, Hardback cover, 361 p., [2004]
Price $49.95

Book reviewed by Morley Thomas[3]

During World War II operational meteorologists in Canada knew little or nothing about enemy weather observing stations in the Arctic. So, a few months ago, when I saw this book advertised, I purchased a copy. If you are an Arctic enthusiast interested in landforms and geomorphology, polar bear hunting and the many details of living in wartime Arctic isolation, this is the book for you. For meteorologists, however, the highlight of the book is the excellent 35-page introduction on manned German arctic weather stations written by the Canadian translator and editor, Professor William Barr.

Only one of the nineteen chapters in the book is devoted to weather observing. This six-page chapter, "Our Official Work," somewhat amplifies Barr's introduction and five appendices written by Barr and the author's son, Dr. Eckhart Dege. The appendices and the introduction make the book well worth a meteorologist's attention. A shorter German edition of the book, which is based on the Dege papers and memories, was published in Germany in 1954.

Wilhelm Dege (1910-1979), with a degree in geography, taught school before the war. As a student and on vacations he became an Arctic enthusiast and had participated in three German prewar expeditions to Svalbard. He was fluent in Norwegian and when the Germans invaded Norway in 1940 he went there as a member of a German divisional headquarters. He then served three years as an ordinance officer until 1943 when, because of his Arctic experiences, he was inducted into the German Navy and sent for training in the operation and maintenance of Arctic weather observing stations. Surprisingly, as Barr notes in his introduction, the Luftwaffe also established and manned Arctic weather stations independently of the Kriegsmarine.

In early 1944 Dege was named to be the leader of a station the navy planned for the High Arctic. He was given responsibility for selecting the equipment and supplies and was astonished to find that the priority of his observing station ranked with that of the U-boat program, the highest in the navy. Anything he considered necessary to carry out his task was supplied despite wartime shortages. As he wrote "*It was only now that I became fully aware of the significance that these arctic weather detachments must have for the execution of the war.*"

A U-boat and a surface craft carried the detachment's equipment and supplies north from Norway in September 1944, successfully evading the Allies' patrols along the convoy route to Murmansk. A station site was chosen on the north side of Nordaustlandet, the second largest island in the Svalbard group. This site for the station was chosen because it was as remote as possible from Allied discovery and destruction. The station was code-named Haudegen (the German Navy used the leader's name in naming their Arctic stations) and was located just north of latitude 80 degrees. The U-boat and ship's crews assisted in landing the supplies and building the main and an auxiliary station before departing.

Dege and his ten assistants were all naval personnel; several of his crew had previous Arctic experience and most were classified as "radio-operator and weather service". The men took eight fixed-time synoptic observations a day. A daily radiosonde observation was commenced at 18:00 hours German Standard Time and whenever possible the balloon was visually followed for wind observations. All observations were transmitted to Tomso in Norway. The author writes that other observations at the station included "determinations of the salinity of the ice, measurements and sketches of the terraces, barometric height determinations, microclimatic measurements, and in addition reading the various instruments which had been set up in addition to those of a normal weather observing programme e.g. two Robitzsch actinographs, the Wild balance, the tide guage, etc."

Haudegen was an armed camp. Discovery and attack by Allied forces especially in the daylight period was always possible so loaded guns were kept in many places. During the polar night, polar bears were around the camp area often enough to require a rifle-carrying man to accompany the observer to the British-type thermometer screen for each observation. Generating hydrogen by a high pressure method was a particularly dangerous job and was done in a separate hut. The author acknowledges that snowfall measurements were "totally unreliable" since blowing and drifting snow rarely ceased and that "nothing on Nordaustlandet was as inconstant as snow cover." Dege became interested in the incursions of warm air which always occurred in three waves following close behind each other. "*The middle and most intense one would make the temperature shoot from minus 30 degrees to close to the freezing point commonly over a period of only one or two days.*"

The detachment was aware of the German unconditional surrender in May 1945 and began sending their weather reports in the clear. A Norwegian vessel did not reach them for their surrender until September 5. A prisoner of war in Norway, Dege handed over a box of meteorological observation journals to Sverre Pettersen, then chief meteorologist of the Norwegian Royal Air Force, and was

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[3] CMOS Member, Toronto, ON

put to work writing a report on Haudegen. Benefiting from special treatment Dege was home with his family in Germany by December 1. By the summer of 1952 he got back his private records written in Haudegen and in 1953 Norway released the official station records to him. His detachment members were eventually freed and by the 1960s began holding reunions, a remarkable tribute to Dege's leadership in the Arctic.

Mass Balance of the Cryosphere: Observations and modelling of contemporary and future changes

by Jonathan L. Bamber and Antony J. Payne, editors

Cambridge University Press ISBN 0-521-80895-2
December 2003, 644 pp. Hardcover, US$135

Book reviewed by Sarah Boon[4]

This book focuses on two components of the cryosphere: land ice (glaciers, ice caps and ice sheets) and sea ice. A wide range of well-known researchers contributed book chapters, including Greg Flato from the University of Victoria, Mark Meier from the University of Colorado, John Walsh from the University of Illinois, and Julian Dowdeswell from the University of Cambridge. The large number of contributors results in a book that covers a wide range of topics: observational and modelling techniques, recent and future mass balance trends, and implications for global sea level and climate variability.

The book is divided into five sections:

- Observational Techniques and Methods: three chapters describing the theory behind field-based and remote sensing (satellite-based) observations of land and sea ice mass balance;

- Modelling Techniques and Methods: three chapters describing modelling techniques for land and sea ice, including both static and dynamic mass balance responses;

- Mass Balance of Sea Ice: two chapters discussing actual sea ice observations and modelling results, including past conditions, long-term trends, and possible change;

- Mass Balance of the Ice Sheets: four chapters focusing on both measured and modelled mass balance and possible future conditions in Greenland and Antarctica;

- Mass balance of Ice Caps and Glaciers: four chapters discussing Arctic glaciers, worldwide glacier monitoring, the relation of glaciers to climate and sea-level change, and the conclusion of the book.

As a glaciologist, I was most interested in the land ice-related chapters. The chapter on field observations of mass balance provided a useful overview of current field measurement techniques, including photogrammetry, stake measurements, and GPS surveys. Following this chapter with the remote sensing chapter clearly shows that, although the two techniques can be used in isolation, they also complement each other quite well. The remote sensing chapter is especially useful in outlining which satellites are used, what each specifically does, and the type of data available. The modelling chapter is very straightforward, avoiding use of too much jargon and serving as a useful introduction to glacier modelling techniques. It also ties into the discussion of field observations and remote sensing by showing how these data can be used in modelling studies.

The more site-specific chapters, including Greenland, Antarctica, the smaller Arctic glaciers, and worldwide monitoring of glaciers, serve to place the previously discussed monitoring techniques into context. They also give a good overview of our state of knowledge about these areas. However, having a Canadian bias, I would have liked to see a more in-depth section on Canadian Arctic glaciers, to balance the detailed discussion of ice masses on Svalbard. I also think the book would benefit from a more in-depth discussion of alpine glaciers in North and South America and the European Alps, and their fluctuations, as the eight pages currently devoted to the subject are fairly brief.

The book is valuable for cryospheric researchers from the graduate level and up. Each chapter succinctly introduces a subject and covers its main points, while directing the reader to a wealth of up-to-date references for more detailed information. This book provides a good synthesis of our current state of knowledge of the cryosphere, its current status, and possible future response to a changing climate, although it doesn't introduce many new ideas. However, the synthesis itself is very useful, as cryospheric science crosses interdisciplinary boundaries, making it difficult to keep up with the relevant literature. This book gives a good overview of how far our studies of the cryosphere have advanced over the last 30 years, and also indicates knowledge gaps, which provide openings for future research.

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[4] UVTRL, Department of Geography, University of Victoria, BC

Hello to all retired and current AES / MSC colleagues!

A project to **archive and post on the web historic photographs of past meteorological graduating classes** is now a reality!

Susan Woodbury, Vice-President of the Canadian Meteorological and Oceanographic Society (CMOS) suggested the project. Thanks to her and the kind co-operation of CMOS, the first photos can now be seen at the following address:

http://www.cmos.ca/Metphotos/photoindex.html

You may wish to bookmark this web location but if you forget it, just visit the main page of CMOS at www.cmos.ca and enter "photos" in the search engine.

Thanks also must go to Joe Shaykewich who provided scanned photos for most of the archive. The Canadian Forces School of Meteorology in Winnipeg then re-scanned the original photos to achieve better resolution.

In order to improve and add to the archive, everyone's help is now requested.

Specifically:

▪ Many courses still lack a photo. Please check the link to your course. In general, we would like the graduating course photos as opposed to mid-term or pre-graduation "units" or "phases".

▪ Photos of major meteorological conferences are welcome also.

▪ The names have been typed in by hand and are editable. Eventually they will be searchable on "Google" and other web search engines. All names should be checked and any corrections sent. The style guide is "Don K Smith" as opposed to "Smith DK", or simply "Smith". No periods after any initials. First name can be the most familiar name used in the Service.

▪ Little is known about the "Masters-level Courses" where many people bypassed the BSc course and entered the

Mes salutations à tous les collègues et membres retraités du SEA/SMC!

Il me fait plaisir d'annoncer que nous venons d'atteindre une étape importante dans la réalisation **d'un projet ayant pour but d'archiver et d'afficher sur le web des photos historiques des diverses promotions de gradués en météorologie**.

C'est à Susan Woodbury, vice-présidente de la Société canadienne de météorologie et d'océanographie, que nous devons d'avoir proposé un tel projet. Grâce à elle et à l'aimable collaboration de la SCMO, il est maintenant possible de voir les premières photos à l'adresse suivante :

http://www.cmos.ca/Metphotos/photoindex.html

Vous voudrez possiblement marquer cet emplacement sur le web par un signet, mais, en cas d'oubli, vous n'aurez qu'à visiter la page principale de la SCMO à www.scmo.ca et à choisir «photos» sur le moteur de recherche.

Je me dois de remercier Joe Shaykewich qui nous a fourni des photos traitées au scanner pour la plus grande partie des archives. L'école de météorologie des Forces canadiennes s'est ensuite chargée d'en améliorer la qualité grâce à un second traitement au scanner.

Nous demandons maintenant l'aide de tous et chacun afin d'améliorer ces archives tant en qualité qu'en quantité.

Plus particulièrement :

▪ Pour plusieurs des promotions, nous n'avons encore aucune photo. Vérifiez si c'est le cas pour la vôtre en cliquant sur le lien approprié. De façon générale, nous préférons des photos prises au moment de la graduation à celles prises à mi-terme ou à d'autres phases du cours.

▪ Nous aimerions également recevoir des photos prises lors de conférences importantes en météorologie.

▪ Les noms des personnes furent insérés à la main et peuvent donc être édités. Éventuellement, il sera possible d'effectuer des recherches sur ces archives par le moyen de «Google» et autres moteurs de recherche sur le web. Il faudrait vérifier chacun des noms de personnes et nous fournir les correctifs nécessaires s'il y a lieu. Le modèle suggéré pour l'inscription des noms est «Don K Smith» plutôt que «Smith DK» ou simplement «Smith». Il ne faut pas ajouter le point (.) après des initiales. Pour ce qui est du prénom, il est suggéré d'inscrire celuile plus communément utilisé dans le Service.

▪ Nous savons très peu de choses des cours du niveau de la maîtrise grâce auxquels plusieurs personnes ont contourné le cours de niveau B.Sc. pour accéder

Service directly. Help from those graduates is needed. The "MOC" and "COM" courses are also missing.

■ Technicians courses are mostly missing. We would love to post any and all graduating courses from ASTS and other technical training establishments.

The Meteorological Service grew from strong relations with the Canadian Forces (CF)(DND). CFHQ (DMetOc) and CF Bases may hold extensive photo archives of meteorologists and meteorological technicians. These photos will be welcome as well. Depending on their direct connection to AES / MSC, we will priorize their posting in the event storage space is limited.

In conclusion, if you find you have a useful photo, but cannot get it scanned, it can be borrowed and returned by snail mail. Photos packed between two pieces of cardboard will be scanned quickly and returned in the same way. Please contact the email address below for mailing instructions.

Please scan any photos you send at the highest resolution possible (one megabyte filesize maximum); file size reduction will be done before posting on the web.

All photos and information about names may be sent to: jonesb@igs.net and they will be added upon receipt.

Bob Jones
Meteorologist, retired (Course #19)

directement au Service. Nous requerrons l'aide de ceux qui sont passés par cette filière. Il manque aussi beaucoup d'information à propos des cours «MOC» et «COM».

■ Les informations sont également fragmentaires pour ce qui est des cours pour techniciens.. Nous aimerions pouvoir afficher des renseignements à propos de tous les cours dispensés par ASTS et autres établissements d'enseignement technique.

Le Service météorologique fut renforcé grâce aux relations étroites maintenues avec les Forces canadiennes (FC) (MDN). Il est possible que le QGFC (DMetOc) et les bases des FC détiennent de vastes collections de photos d'archives de météorologues et de techniciens en météorologie. Ces photos sont également bienvenues. Dépendant de leur lien direct avec le SAE/SMC, leur affichage se fera suivant un ordre de priorité qui tiendra compte de l'espace disponible.

En conclusion, si vous croyez posséder des photos utiles mais que vous ne pouvez pas les traiter vous-même au scanner, faites-les nous parvenir par la poste et nous les traiterons rapidement avant de vous les retourner. Il est important de les emballer entre deux cartons pour l'acheminement par la poste. Pour des renseignements complémentaires sur la façon de procéder, contactez-moi à l'adresse électronique inscrite au bas.

Si vous traitez vous-même les photos au scanner, assurez-vous que la résolution soit la meilleure possible (capacité maximale du fichier de 1 mégabits). Nous nous chargerons de réduire la grandeur du fichier avant de faire l'affichage sur le web.

Faites parvenir vos photos et les renseignements à propos des noms à jonesb@igs.net et nous les ajouterons sur le site dès leur réception.

Bob Jones
Météorologue retraité (Cours #19)

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **juin 2005**. Prière de nous faire parvenir avant le **13 mai 2005** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page 34. Nous avons un besoin URGENT de vos contributions écrites.

Next Issue *CMOS Bulletin SCMO*

Next issue of the CMOS Bulletin SCMO will be published in **June 2005**. Please send your articles, notes, workshop reports or news items before **May 13, 2005** to the address given on page 34. We have an URGENT need for your written contributions.

39th Annual CMOS Congress
May 31 - June 3, 2005
Vancouver, British Columbia, Canada
Theme: "Sea to Sky"

Welcome from the Chairs of CMOS2005

On behalf of the Canadian Meteorological and Oceanographic Society (CMOS) we invite you to the CMOS **Sea to Sky** Congress to be held near beautiful Vancouver, British Columbia, Canada. The Annual CMOS Congress is the foremost venue in Canada for the interchange of ideas by the government, academic, and private sector oceanographic and meteorological communities and a great place to see what is happening in Canada.

We anticipate presentations on theoretical, observational, and technical aspects of oceanography and meteorology at all scales in regular sessions, including remote sensing of the oceans, atmosphere, and land, current meteorological and oceanographic observational programs, biological/physical coupling, regional and coastal oceanography, laboratory and numerical modelling of geophysical fluids, urban and biometeorology, climate modelling, prediction, and impacts, and weather forecasting issues. A number of special sessions, forming about one third of the scientific program have already been organized. An expanded program of posters is planned to foster more personal interactions.

In addition to contributed papers in special and regular sessions there will be plenary speakers on a range of topics, a commercial exhibitors gallery, social events including an icebreaker, the annual Awards Luncheon, the CMOS banquet, a partners program, and a daily weather briefing for aficionados.

Student CMOS members are welcomed and encouraged to apply for a Student Travel Bursary when submitting an abstract.

See you all there!

Rich Pawlowicz,
Chair, Scientific Program Committee

Laurie Neil,
Chair, Local Arrangements Committee

Conference Registration Information

Registration to the full congress includes abstract books, access to commercial exhibitors' booths, coffee breaks, lunches, Awards Luncheon, banquet dinner, and city bus tours. Please note that the early registration deadline is **April 15, 2005.**

Courtesy of Vancouver Tourism Bureau

39th Annual CMOS Congress Fee Schedule

Registration Type	Early Registration Price	Late Registration Price	One Day Ticket Price
CMOS Members	$ 420	$ 470	$ 145
CMOS Students	$ 210	$ 235	$ 100
CMOS Retired/Life Members	$ 210	$ 235	$ 100
Non-members	$ 480	$ 530	$ 170
Student Non-members	$ 240	$ 265	$ 120
Teachers' Day			$ 50

Additional Information

If you have any special needs (eg. meals, allergies, mobility), please send a message with the subject header SPECIAL NEEDS to Ken Kwok at congress2005@cmos.ca at least two weeks before the beginning of the congress.

If students wish to take advantage of special hotel rates, please send a message with the subject header STUDENT HOTEL RESERVATION to Ken Kwok at congress2005@cmos.ca. These rates are available on a first-come-first-served basis. Please indicate if you are willing to share the room with another student.

Meeting Registration Cancellation Policy
Notices of cancellation for a complete meeting or for a specific event must be received at the CMOS office by e-mail, fax or mail at least 7 working days before the first day of the event, in which case 90% of the amount involved will be reimbursed. We regret that cancellations at a later date or failure to attend will not qualify for a refund.

Notices must be addressed as follows:

by e-mail: accounts@cmos.ca
by Fax: (613) 990-1617
by mail: CMOS, P.O. Box 3211, Station D
Ottawa, ON, K1P 6H7 Canada.

Privacy Policy
All of the information that you will be submitting is subject to the CMOS Privacy Policy. For further information, please consult the CMOS Privacy Policy page on the web.

Hotel/Travel information
The Congress will be held at the Park Plaza, Vancouver Airport Conference Resort.

Park Plaza, Vancouver Airport Conference Resort
10251 St. Edwards Drive
Richmond, British Columbia V6X 2M9
Tel: 604.278.9611; Fax: 604.276.1121

All reservations (except student, see below) can be made by calling hotel Central Reservations Office at 1-866-482-8444. Callers must mention the group name C.M.O.S. Congress 2005 to ensure they receive the appropriate rate and are included in the guest room block.

Hotel Room Rates

Standard	$ 95
Park Club	$ 125
Park Club Suite	$ 145
Extra person (>2)	Add $ 20

Guest room rates for students are available by special reservation through CMOS only by contacting: ken.kwok@ec.gc.ca

Room types available are: Single, Double $65.00

All rates:
are net, non-commissionable;
apply per room, per night;
are subject to Provincial Tax of 10%;
are subject to Federal Tax of 7%;
are quoted in Canadian funds;
will be extended 3 days prior to and following your event, subject to availability; and
are subject to any other applicable tax.

Air Travel, Air Cargo & Car Rental
Air Canada is the official airline of the 2005 CMOS Congress. Contact Air Canada's North American toll free number at (800) 361-7585 or your travel agent and take advantage of special discounted airfares by quoting Convention Number CV053639. A 25% discount off applicable air cargo rates is also offered by quoting this number. Contact Air Canada Cargo or go to their webpage http://www.aircanada.ca/cargo

WestJet is also offering 10% off their "best air fare" at the time of conference booking, except during seat sales. Contact their Specialty Sales Dept. at (888) 493-7853 and quote convention number QC2432.

National Car Rental is the official car rental company for the 2005 congress. They can be reached at (800) 227-7368. Quote contract ID number 3712881 for special rates. Rates and more details can be found at the congress website http://www.cmos2005.ubc.ca/cmos_exhibitors.pdf

Teachers' Day
The Canadian Meteorological and Oceanographic Society (CMOS) invites your participation in their annual Teachers' Day during the 2005 CMOS annual congress. By participating at the Teachers Day you will:

- Be brought up-to-date on current meteorology and oceanography issues by various presentations;
- Tour the interesting and informative exhibit section;
- Discover new ideas and web resources to take back to the classroom;
- Participate in workshops with innovative hands-on activities, and lots of take-home materials;
- Learn more about Project Atmosphere Canada, high impact weather, how to integrate TV weather and the Canadian weather trivia calendar into your curriculum, warning preparedness, current oceanographic topics including Tsunamis.

Time: Friday, June 3rd 2005; 8:30 - 4:00 hrs.

Location: Park Plaza, Vancouver Airport Conference Resort
10251 St. Edwards Drive
Richmond, British Columbia
V6X 2M9 Canada

Registration fee has been set at $50 (includes buffet lunch). You may register at http://www.cmos2005.ubc.ca

For more information please contact Teachers day coordinator Pat Wong by email at pat.wong@ec.gc.ca or by phone at (604) 664-9065.

Recent Advances in Quantitative Remote Sensing of the Environment: QUARS 2005

This Summer School Program is organized by the CARTEL (Center for Research and Applications in Remote Sensing), Université de Sherbrooke and the Global Environmental and Climate Change Center (GEC3), in collaboration with other universities (McGill University, l'Université de Sherbrooke, l'Université du Québec à Montréal, Université de Montréal) and other partners including the Canadian Space Agency, the Canada Centre for Remote Sensing, the Association québécoise de télédétection. The Summer School Program will take place between June 3 and 13 2005 at the Université de Sherbrooke and is being coordinated by Alain Royer (Université de Sherbrooke) and Charles Lin (McGill University). For those interested, please visit the CARTEL website at http://www.USherbrooke.ca/Cartel or contact cartel@usherbooke.ca

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Tsunamis: Coastal Communities in British Columbia

The report entitled "*An Assessment of the BC Tsunami Warning System and Related Risk Reduction Practices*" examines monitoring and detection, emergency management, and public response. The study offers a series of conclusions that could be used to strengthen key components of Canada's west coast tsunami warning system and related risk reduction practices. The report is available at http://www.ocipep-bpiepc.gc.ca/research/resactivites/CI/2003-D001_e.asp.

Distribution of Canadian Hydrographic Charts

Since 1993, the Canadian Hydrographic Service (CHS) digital charts have been distributed by Nautical Data International Inc. (NDI) and its value-added resellers. Fisheries and Oceans Canada has terminated this agreement with NDI as of 4 February 2005. CHS will be considering digital distribution options over the coming months. For more information, please access http://www.charts.gc.ca/pub/en/help/chsndi.asp.

New Brunswick Wind Power Atlas

Researchers at the Centre de génie éolien of the Université de Moncton in New Brunswick have produced an atlas which indicates areas in the Province with potential for wind power generation. Most of these areas are located in the coastal zone. The research also indicates that colder climates can be beneficial for generating wind power: cold wind has more 'energy' than warm wind. The Wind Atlas (Atlas éolien) is available at http://www.umoncton.ca/cge

Online Access to BIO's Oceanographic Databases

Online access to a number of databases maintained by Ocean Sciences at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia is available at http://www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html. The databases include temperature-salinity profiles for the North West Atlantic, sea-surface temperature from satellite, monthly statistics of ocean currents and other moored instruments, and daily temperature observations from coastal thermographs.

2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship

Canada ranks sixth in the world in environmental sustainability out of 146 countries according to the latest Environmental Sustainability Index (ESI) produced by Yale and Columbia Universities. The ESI ranks countries on 21 elements of environmental sustainability covering natural resource endowments, past and present pollution levels, environmental management efforts, contributions to protection of the global commons, and a society's capacity to improve its environmental performance over time. The report is available at http://www.yale.edu/esi/

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nowCOAST Web Mapping Portal

The web mapping portal nowCOAST has been introduced by NOAA in a continuing effort to improve maritime safety and commerce and to monitor physical changes in weather, oceanographic and river conditions. nowCOAST provides the coastal community with real-time coastal observations and NOAA forecasts for major US estuaries and seaports, coastal regions and the Great Lakes. Users will have access to thousands of real-time observing stations and forecast locations. nowCoast is available at http://nowcoast.noaa.gov/.

New Publications and Reports

1) Documents associated with the World Conference on Disaster Reduction (18-22 January 2005 in Kobe, Japan), including *"Disaster Risk Management in a Changing Climate"*, an informal discussion paper prepared on behalf of the Vulnerability and Adaptation Resource Group, are available on the UN International Strategy for Disaster Reduction website at http://www.unisdr.org. The website also features a new section on disaster statistics, including selected statistics, tables, graphics and maps on disaster occurrence and their impact for the period 1994-2003.

2) The Coastal Connections newsletter is a publication of the National Oceanic and Atmospheric Administration Coastal Services Center. The February/March 2005 issue focuses on coastal and ocean economics. It is available at http://www.csc.noaa.gov/newsletter/2005/issue01.pdf.

3) Earth Ed /Éduc terre, an initiative of the New Brunswick Environmental Network, is a searchable catalogue with over 400 listings to assist teachers and other educators in locating relevant environmental education materials, speakers and field trips. It is available at http://www.nben.ca/earthed.htm.

Louis Fortier — Scientifique de l'année 2004

Les émissions scientifiques de la Société Radio-Canada ont choisi à l'unanimité Louis Fortier, l'aventurier de l'Arctique, comme scientifique de l'année 2004. Professeur et chercheur d'océanographie à l'Université Laval, Louis Fortier a été le leader de la mission CASES, l'étude du plateau continental arctique canadien *(CMOS Bulletin SCMO*, Vol.32, No.5, page 131). Louis Fortier a piloté la mission Amundsen qui a permis à une équipe internationale de chercheurs d'étudier la banquise arctique côtière.

Trevor McDougall Wins Canada's Top Oceans Award

Hobart oceanographer Trevor McDougall has won the 2005 Huntsman Award, Canada's top award in physical and chemical oceanography, for his "outstanding scholarship that has had a major influence on the development of marine scientific thought". Since this Award's inception in 1980 it has been given annually on a rotating basis between the various disciplines of marine science and Trevor is the seventh physical oceanographer to receive the award.

Dr. McDougall's career spans laboratory experiments, theoretical work, and the application and incorporation of this theory to the modern generation of ocean models. He has used a combination of physical insight and mathematical formalism to bring order and rigour to the study of a range of complex ocean processes. He has concentrated on fundamental issues in the field of ocean mixing, ocean thermodynamics, and particularly how the known conservation equations should be properly averaged and included in ocean models.

Several of his fundamental advances were initially controversial and some of his most highly cited papers were initially rejected by journals; so younger scientists, take heart!

McDougall's theoretical work over several years on neutral density surfaces and extensive collaboration with Dr. David Jackett of CSIRO Marine resulted in the Jackett-McDougall computer algorithm for a new density variable, called "neutral density", which has become a standard tool of observational oceanographers and inverse modellers around the world.

Many aspects of his work have now been incorporated into the standard ocean models around the world, most notably the MOM4 code (from GFDL Princeton). Through this route, his fundamental contributions to our understanding of ocean mixing and ocean thermodynamics have become incorporated into the climate projections published by the Intergovernmental Panel on Climate Change (IPCC). These projections of climate change are central to the decision-making process by which Governments base their environmental responses to agreements such as the Kyoto Protocol.

Dr. McDougall is a Fellow and Council member of the Australian Academy of Science and a Fellow of the Australian Meteorological and Oceanographic Society.

Dr. McDougall will receive the A.G. Huntsman award, presented by the Royal Society of Canada, at a special ceremony in Halifax, Nova Scotia in September 2005. Further information can be found at: http://www.bio.gc.ca/huntsman-e.html

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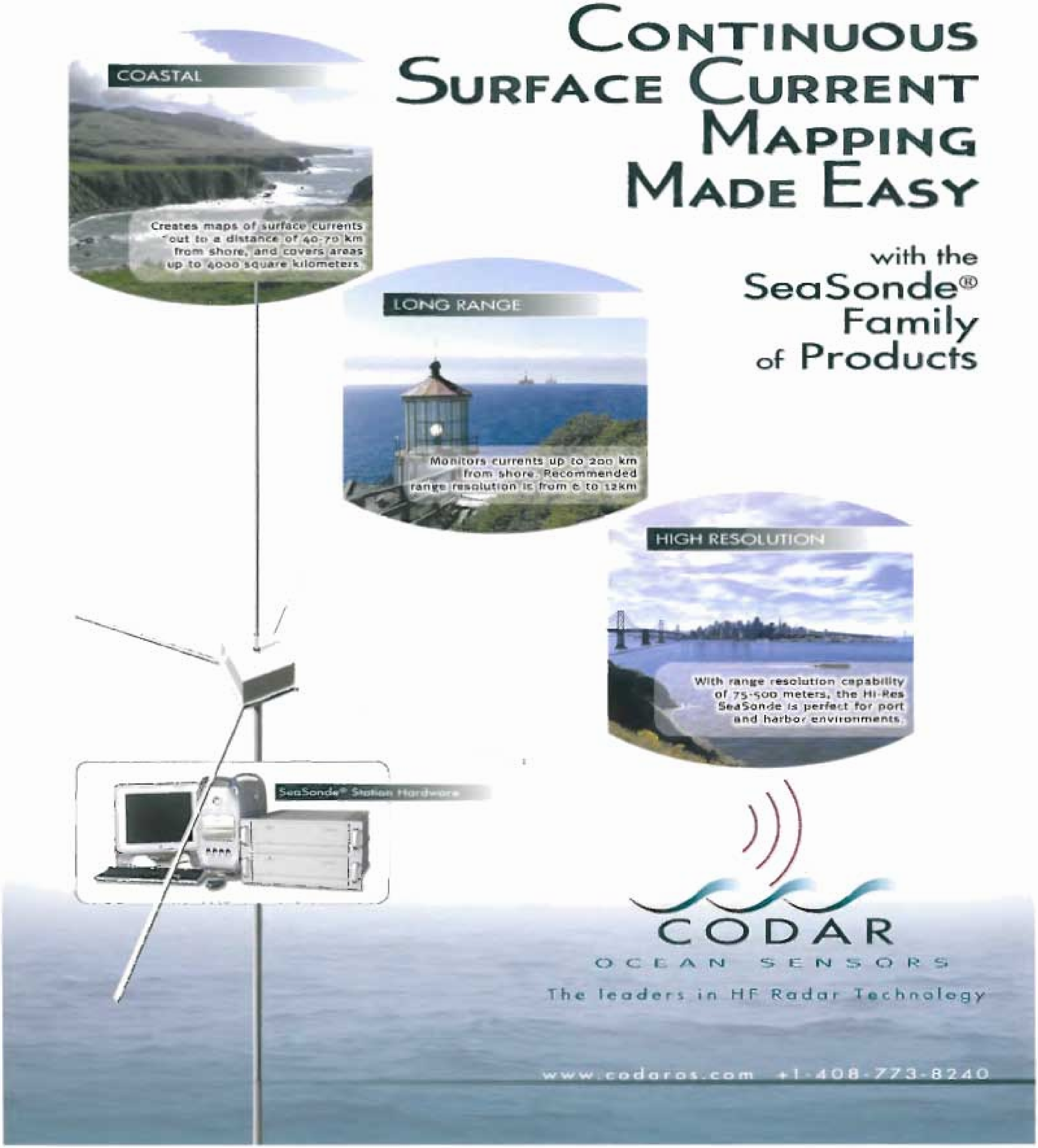
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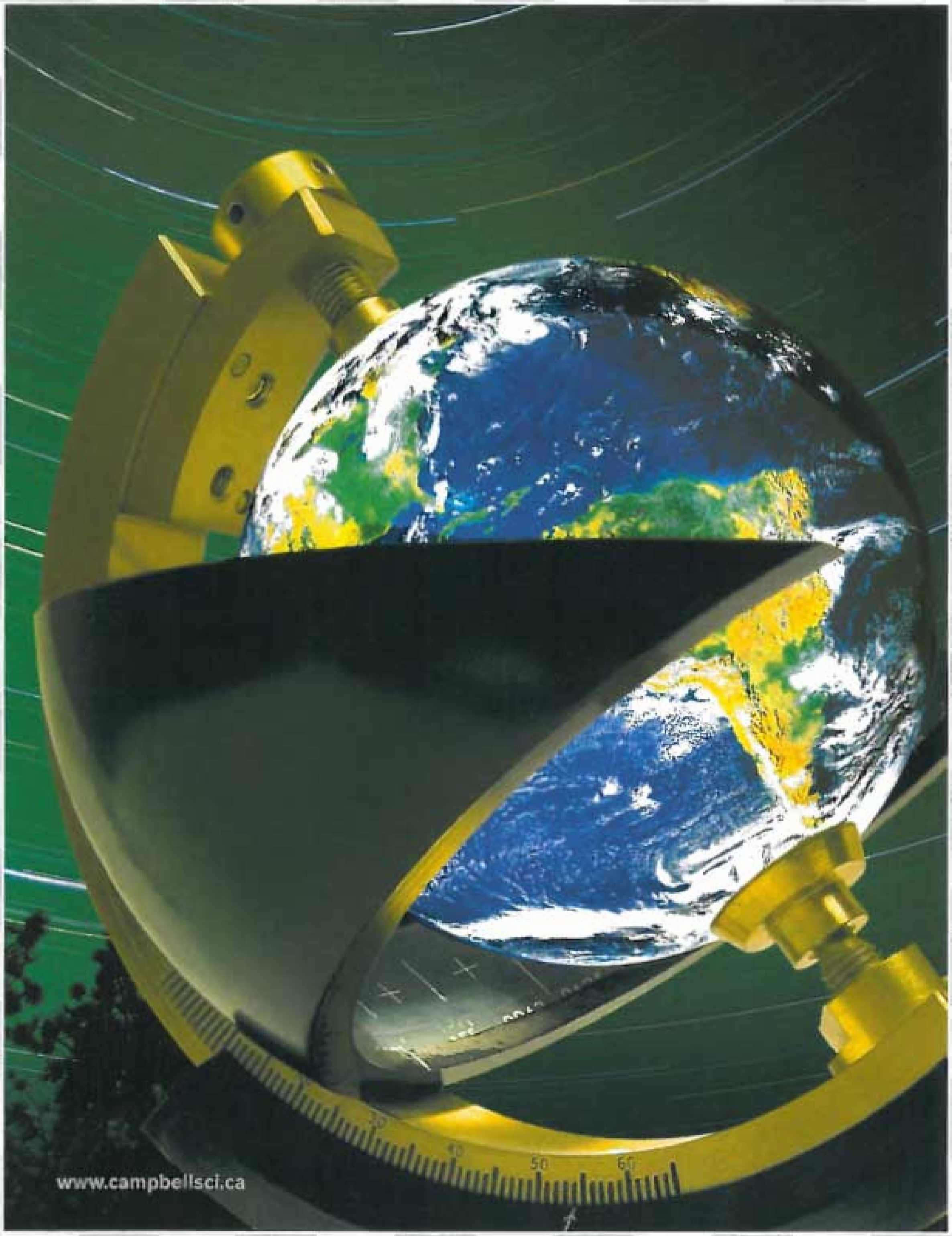
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