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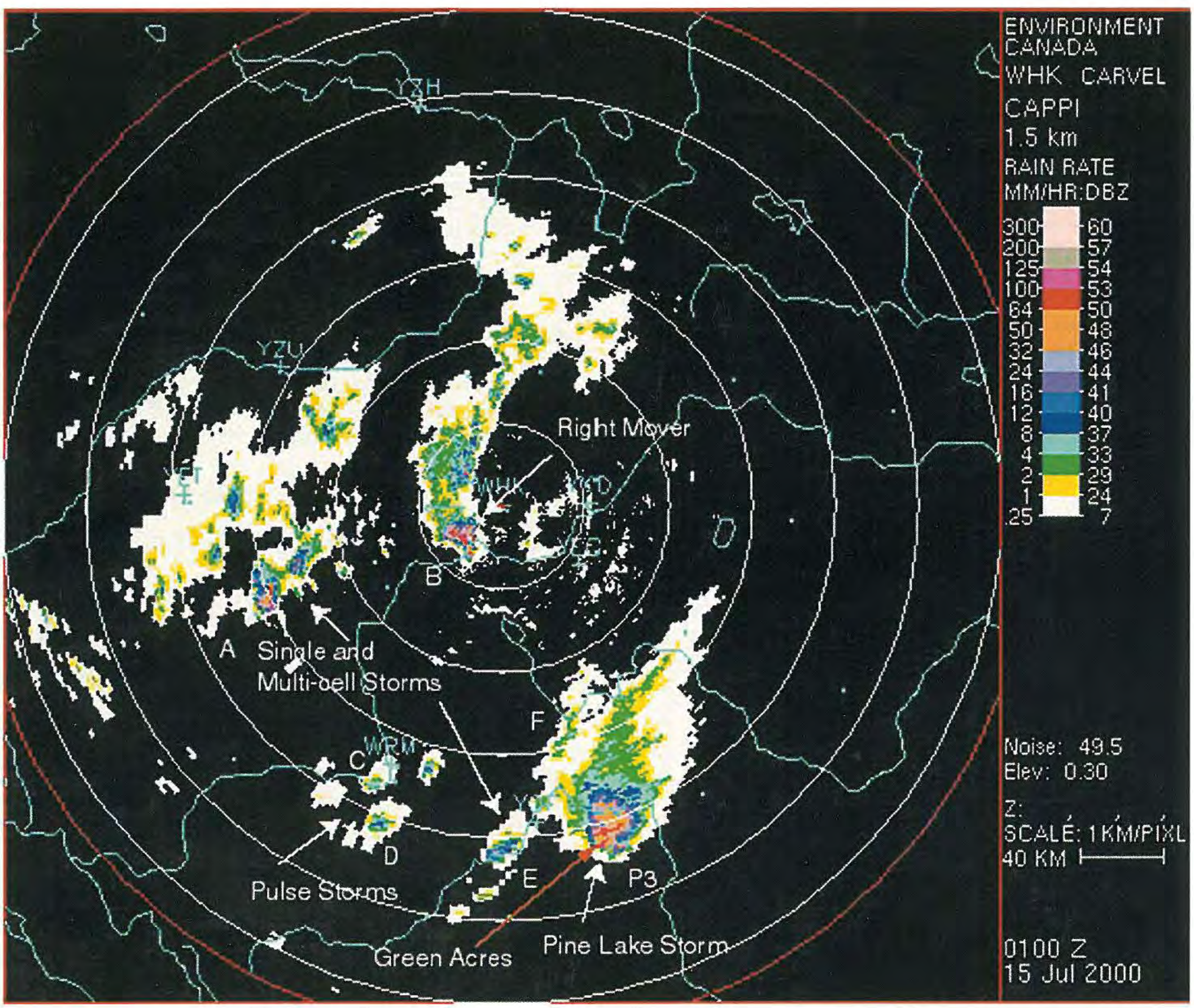

CMOS Bulletin SCMO
"at the service of its members
au service de ses membres"

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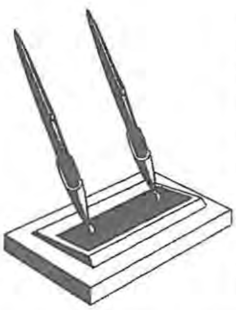
Cover page: 1.5 km CAPPI image at the time of tornado touchdown. Pine Lake is located at azimuth 165° and a range of 167km from the radar. WRM is Rocky Mountain House, YQF is Red Deer and WHK is the Carvel Radar. The range rings are spaced every 40 km. The colours represent either rain rate (mm/hr) or reflectivity factor (dBZ). The tip of the red arrow points to the Green Acres Trailer Park. The tornado was classified as F3 at this time and had just crossed the lake at this point. To learn more, read the article on page **172**.

Page couverture: Image CAPPI à 1,5 km au moment où la tornade a touché le sol. Pine Lake est situé à l'azimut de 165 degrés et est à 167 km du radar. WRM représente Rocky Mountain House, YQF est Red Deer et WHK, c'est le radar de Carvel. Les cercles de distance sont espacés de 40 km chacun. Les couleurs représentent soit le taux de précipitation (mm/h) ou le facteur de réflectivité (dBZ). L'extrémité de la flèche rouge identifie le parc à roulottes de Green Acres. La tornade a été classée d'intensité F3 à l'échelle Fujita au moment où elle venait tout juste de traversée le lac. Pour en savoir plus, lire l'article en page **172**.

....from the President's Desk



I have been holding off writing this until after the Federal election. If Mr. Anderson returns to Environment or is succeeded by someone else, I will take the opportunity of mentioning to either one that "the time to increase funding to government agencies (and talking of MSC in particular) is in the first budget of a new mandate". Let us hope Cabinet can be persuaded that MSC's need for substantial investment is real and urgent, both for refurbishment and replacement of aging equipment, to maintain public services without the necessity to generate revenue, and to continue to conduct high quality research and development.

Le travail de la fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA) continue et les rencontres du comité pour la revue des applications auront lieu en décembre. Nous espérons que les premières subventions de projets seront aussi annoncées en décembre. La création de la fondation et son "enfance" ont été une période intéressante et j'espère que tout le travail de nos membres, nommément Ian Rutherford, Neil Campbell et, en particulier Dick Stoddart, sera apprecié.

Among other things, over the past two months CMOS organised a meeting between local (mostly Toronto) representatives of Canada's private sector meteorology and atmospheric environmental community and MSC managers, including the Assistant Deputy Minister. The well-attended meeting, held at the Pelmorex/Weather Network offices in Mississauga on October 27, was an excellent opportunity for a frank exchange of views between MSC and the private sector, over issues concerning MSC's involvement in commercial activity, through the sale of data and especially through bidding on commercial contracts. A report on the meeting should be available soon, but in advance of that I would like to note that there really does now seem to be an opportunity to try and improve relations between these two groups and to look forward to developing an expanding and more secure private sector. As a university teacher, I would love to see a broader, more diversified range of career opportunities for our graduates. Much of the past decade, with MSC and its erratic hiring plan as "the only game in town" for those seeking a career in operational meteorology, has been tough on university departments with undergraduate meteorology programmes, and especially so on their graduates. Things are a lot better now - let us hope they stay that way!

For any of you who did not receive, or "inadvertently" discarded, your CMOS/SCMO renewal letter, let me reiterate one or two of the points that I made in that communication.

Volume 28 No. 6
December 2000 - décembre 2000

Inside / En Bref

Articles

Our regular sections / Nos chroniques régulières

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"The final line of the song "*Le temps des cathédrales*" which opens and closes the Canadian musical "*Notre-Dame de Paris*" predicts "*La fin de ce monde est prévue pour l'an deux mille*". Assuming they were wrong, it is time to renew your membership in the Canadian Meteorological and Oceanographic Society - at rates which are still an amazing bargain for year one of the 21st Century - in the traditional way of counting!

Having just received a renewal notice from the UK Royal Meteorological Society with basic membership at £43.00 (about CAN$95), I realise what a bargain CMOS rates are - but I should also issue a warning that an increase is likely next year. I also wrote,

"What can I offer by way of encouragement? The Society includes members with a range of backgrounds and professional interests. For researchers in government and the private sector, and for the university community, faculty, researchers and students, it is their "learned society", publishing the research journal Atmosphere-Ocean, organising talks and seminars in local Centres, including the tour speaker, and the Annual Congress - a definite focal point for the presentation of much research in atmospheric and ocean science, and always a great opportunity to meet up with old and new friends, students and colleagues from across the country.

For the operational weather forecaster or oceanographer, in government or the private sector, we are trying to be more involved as co-sponsors or sponsors of practical workshops, trying to get more applied articles in the CMOS Bulletin SCMO and trying to engage more of you in the organisation and running of the Society. We need more members from this professional sector, and we need ideas on what to do in order to attract and retain them! A small but increasing number of our members are TV or radio weather presenters and we are actively engaged in trying to improve the quality of weather presentation in the media."

I also added a paragraph seeking donations: "If you have read through this far, let me just add that one way in which we try and promote our profession among University students is through scholarships, and that we are now seeking donations for a new undergraduate scholarship (details of which were given in the April 2000 Bulletin). The renewal form has a line for donations to that and other charitable activities of the Society. Please give it some thought as you complete the form!"

Most of you will have already sent in your renewals, but if not I hope you will get to it soon and keep our membership numbers growing. We also want you to get involved!

Thanks (I think) to Neil Campbell, I spent much of last Friday doing a taped interview with Leslie Cameron for a CBC Undercurrents programme on *"The Business of Weather*" or a similar, yet to be finalised title. They also interviewed one of our York student members and have plans to meet with MSC and Weather Network personalities (who are also CMOS members). I am not sure how many seconds, if any, of air time this will actually yield, and I was horrified that the CBC crew insisted on recording in my cluttered and chaotic office, but we will see! I hope I did better than in my last TV interview, some years ago in England. I was trying vainly to explain the cause of Southampton's double high tides in a live news broadcast. In England the M2 and M4 are motorways (highways) as well as lunar tidal components and I don't think anyone understood what on earth I was talking about! I am told the Undercurrents programme should be broadcast some time in January, so stay tuned!

Another of last week's activities, wearing my York and CMOS hats, was to make a presentation (on Energy, The Atmosphere and You) to a National Aboriginal Achievement Foundation youth career fair in Toronto. In preparing for this and wanting to bring in some topical material, I had noted a couple of articles in the previous week's Globe and Mail (Nov. 16 and 18). The first was by Donald Johnston (OECD Secretary General) entitled "Colour nuclear power green". After painting a rather inaccurate picture of the prospects for solar and wind energy, and clearly under the influence of the nuclear physics lobby group, he then proposed that, given the present greenhouse gas-induced global warming, *"We must also have a public education campaign to dispel myths and fears about nuclear energy." The reality of these "myths and fears*" was the topic of the article two days later by Geoffrey York (the Globe and Mail's Moscow correspondent) entitled "Nobody told us anything". This documents his travels to Siberia to visit residents on the banks of the Tom, recently declared the world's most radioactive river.

While, in principle, nuclear power, may sound like the perfect solution to our hunger for (cheap?) energy, the risks remain enormous and we should not forget the disasters and near-disasters that have been caused by the nuclear power industry. Before we rush off to follow Donald Johnston onto the nuclear bandwagon, let's give a little more thought to energy conservation and renewables. It is probably true that, even in the future, wind and solar power cannot supply all of our energy needs but they do provide a significant fraction of the energy consumed in some countries (e.g. Denmark) and certainly warrant more attention than Donald Johnston was willing to pay them. They could certainly help in meeting the Kyoto commitments!

If this reaches you before the holidays let me wish you and your families all the best for the December and New Year holiday season. As I noted above, some of us regard January 1st of 2001 as the start of the new decade, century and millennium so it is a transition of some significance.

Bonne année à tous!

Peter Taylor,
President / Président

CMOS Bulletin SCMO
Next Issue - Prochain Numéro

Next issue of the *CMOS Bulletin SCMO* will be published in February 2001. Please send your articles, notes, workshop reports or news items at the earliest to the address given on page ii. We have an **URGENT** need for your articles.

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en février 2001. Prière de nous faire parvenir au plus tôt vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page ii. Nous avons un besoin **URGENT** d'articles.

Verification of GEM Precipitation Forecasts in the Prairies During the Summer Convective Season

by John M. Hanesiak[1]

Résumé: Cet article fait partie de l'étude sur la vérification des précipitations du modèle Global Environnemental Multi-échelle (GEM) qui a été utilisé par les prévisionnistes comme un outil afin de prévoir les précipitations entre 0 et 48 heures. Cette étude tente de quantifier la précision de GEM à prévoir, pour les saisons du printemps et de l'été de l'an 2000, l'occurrence de précipitations à sept sites dans la région des Prairies, incluant: les montagnes de Jasper et Banff; le versant sous le vent des montagnes des villes de Calgary et d'Edmonton; et le paysage des prairies des villes de Saskatoon, Regina et Winnipeg. On y arrive par la vérification des prévisions des hauteurs de précipitations (QPF) du modèle, en utilisant toutes les précipitations mesurées sur une période de 24 heures à chacun des sites entre le 11 avril et le 7 septembre de l'an 2000. En général, les résultats indiquent que la probabilité de détection (POD) du modèle GEM est très élevée (près de 0,9) dans les régions montagneuses; toutefois, on note que l'indice de fausse alarme (FAR) est aussi très élevé (>0,6). À mesure qu'on s'éloigne des montagnes, la probabilité de détection (POD) tend à demeurer relativement élevée tout en constatant une légère diminution de l'indice de fausse alarme (FAR). La crédibilité du modèle est assez faible dans les montagnes (près de 0,3) et ailleurs elle se situe entre 0,45 et 0,6 pour la prévision au jour un, ce qui est légèrement plus faible que pour les saisons automnale et hivernale. Pour la prévision au jour deux, la crédibilité du modèle est plus faible de 10 à 15 %. Il y a un léger avantage à utiliser l'intégration du modèle de 12Z (12 TU) pour les prévisions des hauteurs élevées de précipitations (QPF) au jour un, ce qui est différent pour le scénario automnale et hivernal. La crédibilité du modèle GEM augmente dramatiquement dans la plupart des sites à mesure qu'augmente la quantité prévue des hauteurs de précipitations pour un événement particulier.

Introduction

This article is the continuation of a precipitation verification study of the Canadian Meteorological Centre's (CMC) Global Environmental Multi-Scale Model (GEM) done by Hanesiak (2000). The goal of the study is to assist operational meteorologists in predicting precipitation between 12-48 h when using numerical weather prediction (NWP) guidance in the Prairie Storm Prediction Centre (PSPC) region. All NWP models provide precipitation amount and occurrence guidance through the Quantitative Precipitation Factor (QPF) output (see Hanesiak, 2000 for an example). Common QPF verification techniques can be found in Gandin and Murphy (1992), Schwartz and Benjamin (1998), and Ebert and McBride, (1997), just to name a few. Newer techniques to improve precipitation forecasts include neural networks to indicate which combination of meteorological fields are most likely to correctly predict a precipitation event (see, for example, Hall et al., 1999).

The present study attempts to quantify the accuracy of the GEM in predicting precipitation occurrence in seven locations in the prairie region including the mountains (Jasper, Banff), leeward side of the mountains (Calgary, Edmonton) and prairie landscape (Saskatoon, Regina, Winnipeg) during the spring and summer convective seasons of 2000. This is done by validating model QPF forecasts using measured 24-h precipitation totals at each of the sites between April 11 and September 7, 2000. This study is slightly different than Hanesiak (2000) since it also includes the probability of a correct precipitation forecast according to forecast amount. That is, an attempt is made to show whether the GEM precipitation forecasts improve with higher forecast amounts. The verification method utilizes the probability of detection (POD), false alarm ratio (FAR), and credibility (Cred) statistics over the geographic locations above according to various forecast amounts.

2. Data and Methods

The study period ran from April 11 to September 8, 2000 giving a total of 149 days and 298 model runs for the statistical comparisons. Two days were missing (April 30 and May 1) due to model data loss. The locations of interest included Jasper (WJW), Banff (WZG), Edmonton (YEG), Calgary (YYC), Saskatoon (YXE), Regina (YQR), and Winnipeg (YWG). Out of the total number of days, WJW had 40 days, WZG had 33, YYC had 41, YEG had 49, YXE had 35, YQR had 36 and YWG had 40 with precipitation amounts ≥ 1.0 mm (see below for why this was utilized). These numbers increase by at least 20 days for each location if the typical precipitation threshold of ≥ 0.2 mm is used. Interestingly, this represents 1.5-2 times as many precipitation days as those in the previous Fall and Winter even though there were 2 weeks' less data in the convective season. It has been noted by forecasters in PSPC that a higher than normal precipitation-day total occurred for the summer of 2000 in the Canadian prairies. This occurred due to and in conjunction with a primarily wetter and cooler than normal June.

The verification data consisted of 24 h total accumulated precipitation cited by the daily weather bulletin for each location. The total precipitation for a given day is defined over a 24 h period ending at 12Z on the following day.

[1]Prairie Storm Prediction Centre, Meteorological Service of Canada, Winnipeg, Manitoba

GEM GRIB data were used to give precise 12 h QPF point estimates for each location in 6 h forecast time increments between 12-48 h from each model run (00Z and 12Z). The 12 h GRIB QPFs were summed to ensure it temporally matched the 24 h observed totals for each location and model run. To retain consistency with the previous study, if the 12 h QPF total summed from the 6 h GRIB data was less than 1 mm, a precipitation forecast event was not recorded for that site. The 1 mm threshold was used since forecasters typically use the 12h total QPF chart as a means to assess whether precipitation will occur or not.

In addition, to illustrate whether the GEM QPF forecasts are more accurate for higher forecast precipitation amounts, the data were binned according to forecast amounts and then checked to see if an actual precipitation event occurred (i.e. >0.1 mm). GEM forecasts were binned into < 0.2 mm, 0.2 to < 1 mm, 1 to < 5 mm, 5 to < 10 mm, 10 to < 20 mm, and ≥20 mm since these are typical contouring intervals on forecast charts. Obviously, as forecast amount increased, the less number of cases took place which limits the statistical analysis for extreme precipitation cases. Data were binned for each location separately since each location would likely be affected by different meteorological processes in many cases.

For all of the cases above, the probability of detection (POD), false alarm ratio (FAR) and credibility of the model forecast (Cred) were computed as in Hanesiak (2000) for the day-1 and day-2 forecast. The probability of detection (POD) can be defined as,

$$POD = X / (X + Y)$$

where X is the number of times the GEM is correct and Y is the number of times it under-predicts or misses a rain event. POD quantifies the likelihood of the GEM correctly predicting precipitation occurrence when it *actually occurred*. The false alarm ratio (FAR) can be defined as,

$$FAR = Z / (X + Z)$$

where Z is the number of times the GEM over-predicts or falsely forecasts rain. FAR quantifies the likelihood that the GEM will falsely forecast precipitation. Similarly, the credibility of the model forecast can be computed as,

$$Cred = X / (X + Z)$$

The credibility can also be defined as the probability of precipitation (POP) that quantifies the likelihood the model will correctly predict precipitation given that it *did forecast* precipitation.

In the cases where forecast amounts are concerned, the study does not show how well the GEM predicts actual amounts but whether it predicts a precipitation event more accurately when a higher QPF is forecast. Therefore in these cases, the POD = 1 when the GEM predicts rain >0.1 mm since Y = 0 by definition here. Hence Cred + FAR = 1 and only Cred is shown in the figures. When the GEM predicts <0.2 mm of rain, Z = 0, Cred = 1, and FAR = 0, so POD is the meaningful variable in this case; however the POD essentially defines how credible the GEM is in predicting a dry day and is shown as Cred in the figures.

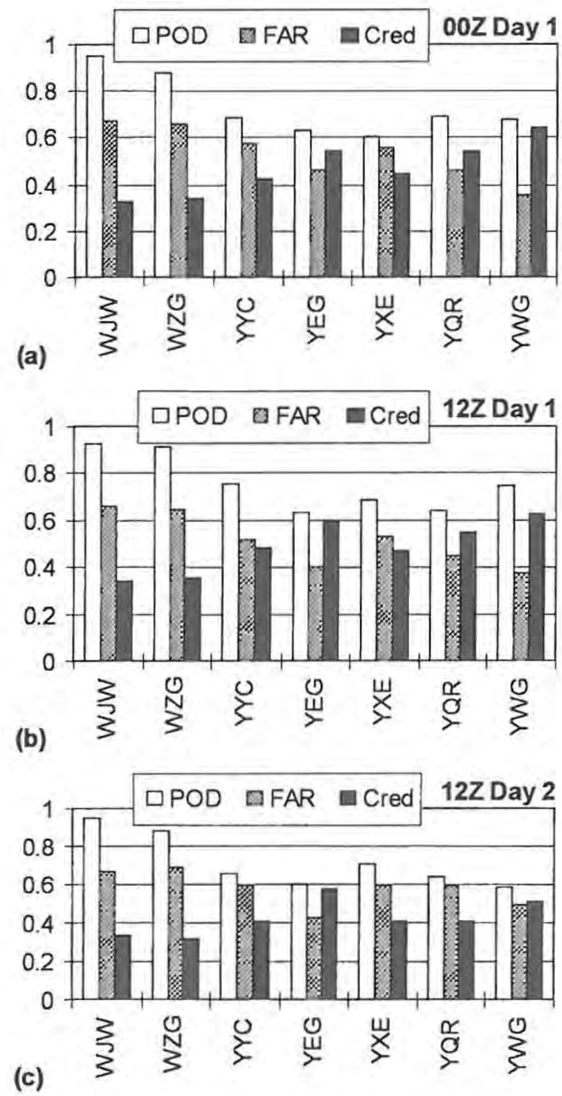
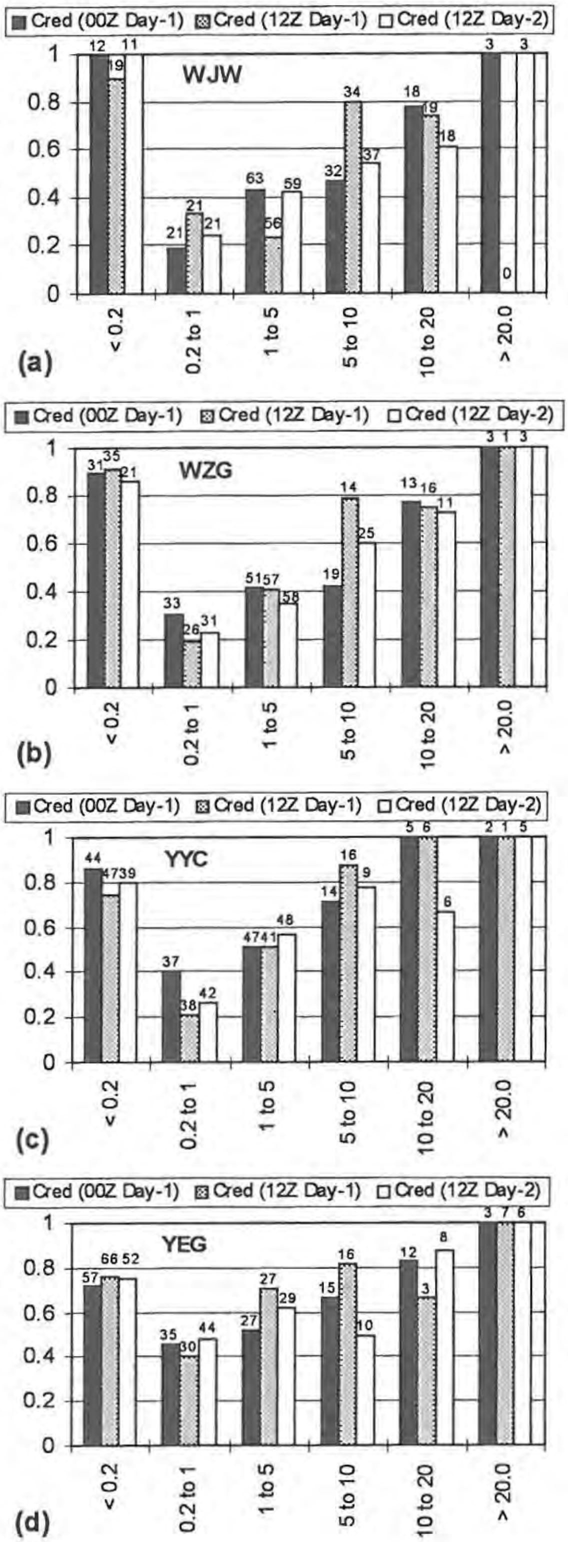


Figure 1a-c: The POD, FAR and Credibility for a) 00Z GEM day-1 forecasts, b) 12Z GEM day-1 forecasts and, c) 12Z GEM day-2 forecasts. Results use a precipitation threshold of 1 mm.

3. Results and Discussion

Overall, the GEM 00Z day-1 forecast performs rather poorly in the mountainous and foothill regions (WJW, WZG, YYC) with the Cred between 30-40%; not much improvement occurs in the 12Z forecast (Fig. 1). GEM over-predicts the frequency of mountainous precipitation even in the convective season as shown by the high POD and FAR; recall that the same was observed in fall and winter (Hanesiak, 2000). Between YEG and YWG, the model's 00Z credibility ranges between 50-63% with a small increase in the 12Z forecast (Fig. 1). This implies the GEM is slightly less credible for the convective season compared to stratiform type or synoptic scale precipitation. The POD and FAR remain fairly consistent between 00Z and 12Z for prairie regions. The 12Z GEM day-2 forecasts are nearly the same or slightly less credible than the day-1 forecast (Fig. 1), with the highest credibility (52-57%) not much better than tossing a coin (Fig. 1). The POD and FAR remain high in the mountains for the day-2 forecast.



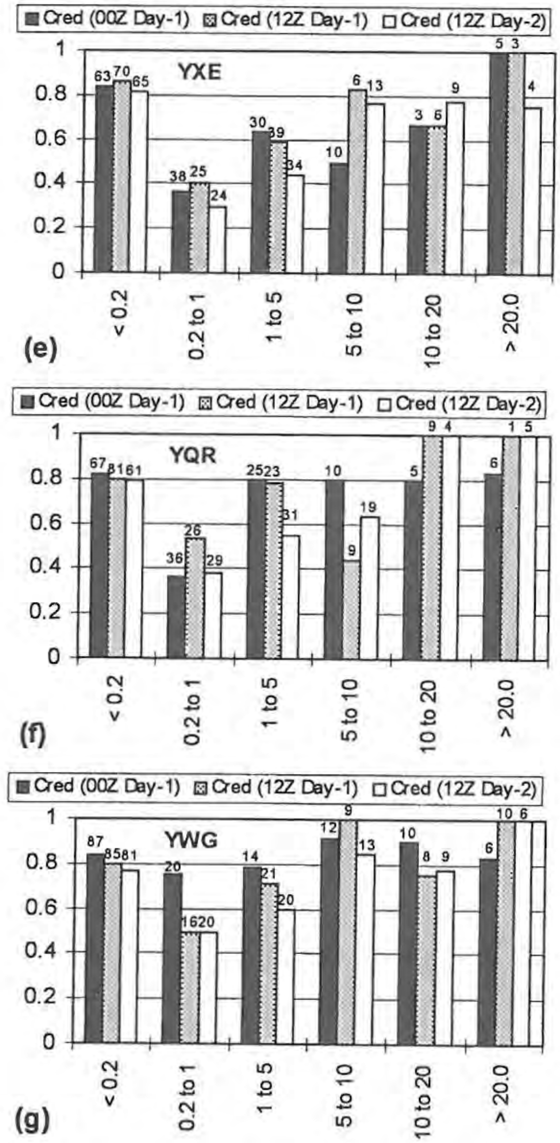


Figure 2a-g: GEM credibility for the 00Z day-1, 12Z day-1 and 12Z day-2 forecasts according to forecast rain amounts for each location. The number of GEM forecasts for each precipitation amount is shown above each bar.

When binning the GEM precipitation forecasts into amounts, interesting results are revealed. In the mountains, the GEM 00Z day-1 credibility is low (20-40%) for forecast amounts <10 mm but increases to 80-100% when amounts ≥ 10 mm are forecast; note there is a relatively low number of cases in the highest amount category (Fig. 2a,b).

The results suggest the following minimum probability of precipitation (POP) that should be assigned to the 7 forecast locations during the convective season when using GEM for QPF guidance (Table 1).

Location	POP (%)	Location	POP (%)
WJW	30 (30)	YEG	50 (50)
WZG	30 (30)	YXE	40 (40)
YYC	40 (40)	YQR	50 (40)
		YWG	60 (50)

Table 1: Minimum POP that should be assigned to each GEM day-1 forecast location during the convective season in the absence of other information. Day-2 data are in brackets.

In YYC and YEG, the GEM credibility increases dramatically as the forecast amount increases (Fig. 2c,d). Very poor credibility (near 20%) exists in YYC when amounts between 0.2 - 1 mm are forecast, however, a forecaster can be at least 70% sure that rain will fall when the GEM forecasts >5 mm for day-1. YXE has very similar statistics to YEG where the GEM is 60% accurate for a rain event when amounts between 1-5 mm are forecast and increases thereafter (Fig. 2d,e). YQR and YWG have very high credibilities (greater than 70%) when the GEM forecasts amounts between 1-5 mm and remain high in most cases beyond 1-5 mm (Fig. 2f,g). In fact, model credibility increases for smaller forecast amounts eastward from the mountains.

The data also show there is not much of an advantage (if any) of using the 12Z model run for day-1 for smaller forecast amounts (<5 mm) but there is an advantage in most cases for larger amounts. Obviously, if the GEM indicates at 00Z that YWG will receive 5 mm or more rain over 24 h and the 12Z data shows similar or greater amounts, a very high probability of precipitation should be forecast for day-1. Generally, the 12Z day-2 forecasts are less accurate at most locations for smaller precipitation amounts but are comparable to day-1 forecasts when larger amounts are forecast (even in the mountains). This gives a forecaster more confidence in the GEM when a larger precipitation event is forecast. However, the smaller number of cases in the large QPF amount category may affect the results.

Another interesting result is when the GEM predicts no precipitation for any given location. In this case, a forecaster can be at least 80% sure in most cases that precipitation will not occur on day-1 when the model predicts no rain (Fig. 2). This also applies to the day-2 forecast. In fact, when the GEM predicts no precipitation in WJW, we can be almost 100% sure that no rain will occur (see Fig. 2a).

4. Conclusions

The purpose of this article is to address the accuracy of the GEM in predicting the occurrence of precipitation during the summer convective season in 7 forecast locations in the Prairie Storm Prediction Centre (PSPC) region. This includes mountainous regions, leeward side of the mountains and prairie landscape. Overall, the POD is very high in mountainous regions since the GEM produces precipitation too frequently in those locations compared to observations, similar to the fall and winter cases in Hanesiak (2000). This also makes the FAR very high in the mountains. The GEM also does not perform well near the foothill regions (such as Calgary). As expected, the GEM QPF credibility is slightly less in summer over the prairie landscape than in the fall and winter when comparing results here to Hanesiak (2000), although not significantly less.

When the GEM forecasts higher precipitation amounts, its credibility increases dramatically for both the day-1 and day-2 forecasts in most locations studied here. GEM credibility increases for smaller QPF forecast amounts with increasing distance from the mountains. This applies to both day-1 and day-2 forecasts. There is only a slight advantage of using the 12Z QPF forecast for day-1 when the model forecasts higher precipitation amounts. There is no noticeable difference between the 00Z and 12Z forecasts for smaller precipitation amounts.

A forecaster can be at least 80% sure in most cases that precipitation will not occur on day-1 when the GEM predicts no rain for the locations studied here. This also applies to the day-2 forecast.

Ongoing data analysis over several years will increase the degrees of freedom for each geographic location, making the statistics here more reliable. Future work will also examine why the GEM fails in some cases and not in others. This is a more meaningful analysis to a forecaster since he/she could tie model predictor fields to a forecast precipitation event and possibly say "yes" it will precipitate, or "no" it won't. A method for this approach is neural networks that can determine the "best" predictor fields for precipitation for a given location and type of precipitation (convective or stratiform). This is still primarily a statistical approach but has underlying physical reasoning for a precipitation event since the predictors will be associated meteorological parameters.

Acknowledgements

Appreciation is extended to Jay Anderson and Danny Vandevyvere (PSPC) for helpful comments and Dave Ball (PSPC) for GRIB data extraction.

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The 1900 Galveston Hurricane in Canada

by John D. Reid[2]

Résumé: Dans toute l'histoire Nord-Américaine, le mois de septembre a été marqué, au cours de ce centenaire, par une catastrophe naturelle, soit un ouragan des plus meurtriers. On se souvient dans les chansons et les contes que cet ouragan a causé plus d'accidents mortels aux États-Unis que les événements combinés comme le feu légendaire de Chicago, le tremblement de terre de San Francisco et l'inondation de Johnstown. Cette forte tempête, un ouragan de catégorie quatre, a endommagé la côte du Texas le 8 septembre 1900 avec des vents de 115 miles à l'heure. C'est le chiffre officiel, mais aucun anémomètre n'a pu résister aux rafales de l'ouragan. On a estimé des vents à 125 miles à l'heure avec des rafales jusqu'à 150. Des marées de 15 à 20 pieds, dues à la tempête, ont inondé l'île de Galveston. Le jour suivant, par un dimanche ensoleillé, une personne sur six (au moins 6 000) a été ensevelie dans l'effondrement d'édifices, ou encore les corps ont été abandonnés au caprice de la décrue de l'inondation. La tragédie au Texas a fait la manchette des journaux internationaux pendant des jours. Il n'est pas surprenant qu'on ait surveillé le trajet de la tempête vers le Canada ; cette tempête demeurait encore destructrice. Les accidents mortels au nord de la frontière, même avec seulement un centième de ceux du Texas, ont été plus nombreux que l'ouragan Hazel en 1954 qui a tué 84 personnes. Ce fut plus que les événements combinés comme la tempête de verglas en 1998, la tornade d'Edmonton en 1988 et la tornade de Pine Lake en l'an 2000.

Introduction

September saw the centenary of the most deadly hurricane, and natural disaster, in North American history. Remembered in song and fable, it caused more US fatalities than the legendary Chicago Fire, San Francisco Earthquake, and Johnstown Flood combined.

This mighty storm, a category four hurricane, battered the Texas coast on September 8th 1900 with 115 mile per hour winds. That's the official figure, but no anemometer could withstand the hurricane blast. Estimates ranged to 125 miles per hour with gusts to 150. A fifteen to twenty foot storm surge drowned Galveston Island. The next day, a bright blue Sunday, one in six Galveston citizens – at least 6,000 – lay entombed in collapsed buildings, or bodies dumped at the whim of the receding flood.

The tragedy in Texas was the lead story in newspapers internationally for days. It's perhaps not surprising that the continuation of the storm in Canada has been overlooked; yet it remained a killer. Fatalities north of the border, while only one hundredth those in Texas, still meant more deaths than from Hurricane Hazel in 1954, which killed 84. And more than the 1998 Ice Storm, 2000 Pine Lake and 1988 Edmonton tornadoes combined.

History of the Storm

The storm was first noticed on August 27th in the equatorial mid-Atlantic. Still getting organized, it drifted westward through the Greater Antilles with moderate winds. Nothing was moderate about the rain. Miles of railway roadbed were washed away in Jamaica. Santiago de Cuba was inundated by 10 inches of rain in just eight hours on Monday, September 3rd; two feet before it was over.

Ships were cast ashore in Florida from Palm Beach south to the Keys on September 5th. Gaining energy from tepid Gulf waters, the storm made a beeline for Galveston and its rendezvous with history.

The story of the hurricane in Galveston is told by Erik Larson in *Isaac's Storm*: the book's title taken from the officer in charge of the Galveston office of the US National Weather Service — Isaac Cline. Larson weaves together the stories of Cline, Galveston, the hurricane and the centralized operation of the US weather service. Cline (1900) wrote his own report shortly after the storm. Neither Cline nor Larson bothered much with what happened to the storm after Galveston.

What happened is it beat its way north through Texas, Oklahoma, Kansas and Iowa. On the morning of Tuesday, September 11th, its tropical storm characteristics fading, the system was near Des Moines, Iowa, with a pronounced trough to the northeast. Five inches (127mm) of rain fell in Minnesota.

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[2]Scientist Emeritus, Environment Canada

By 8 p.m. on Tuesday evening the MSC surface pressure analysis (Figure 1) shows a binary structure with one pole, associated with the continuation of the tropical system, over southwest Michigan, and the other over Georgian Bay. Winds in Chicago, where the storm reaped another three lives, reached 80 miles an hour.

The Storm in Canada

The storm complex headed east. Ontario shook. Winds clocked at up to 50 miles an hour, pounded Toronto on Tuesday evening. Windows were smashed across the City, in homes, offices, churches and the Parliament building. Trees toppled and telegraph wires lashed about in the gale. Boats battered by boisterous eight to ten foot seas dragged anchors or broke moorings. Skiffs were up-ended and cast ashore.

Greater damage was inflicted further south and west. In the Niagara Peninsula, and along the Lake Erie shore, apples, pears and peaches ready for picking were ripped from the tree. Losses were estimated as half the value of the crop, about $1,000,000.

A flour mill fire in Paris, Ontario, escalated into a local disaster as strong westerly winds blasted the flames. Wooden buildings flared like tinder, all too familiar a situation in those days. A devastating fire had scorched Ottawa just five months earlier. Damage to the Paris Post Office, Customs House, Bank of Commerce and numerous small shops and businesses exceeded $250,000. Three quarters of the business district was in ashes, less than half of it insured.

There was only one fatality in Ontario, a worker at Niagara Falls keeping storm-derived debris clear of sluice intakes overnight was found drowned, and thought to have lost his footing.

Just south of the border it was a different story. Two ships were lost in Lake Erie. Eleven drowned when the steamer John B. Lyon foundered five miles off Conneaut, Ohio. Two additional lives were lost when the schooner Dundee sank 15 miles from Cleveland In Buffalo a woman cleaning up debris was electrocuted by fallen wires.

Well north of the storm track there was significant rainfall. Some of the larger storm totals were: 58 mm at Bruce Mines (46° 18'N, 83° 55'W); 53 mm at Parry Sound; 54 mm at Emsdale (45° 30'N, 79° 13'W); 39 mm at Huntsville; 73 mm at Uplands (45° 48'N, 79° 25'W); and 78 mm at Haileybury.

Further east, the *Ottawa Evening Citizen* reported the highest winds in that City as 30 miles per hour at 9am on Wednesday the 12th. Yachts at Britannia and Aylmer were stranded on the shore or dragged their anchors. The steamer tug Albert, in difficulties in gusty winds, had to release a load of 14,000 logs it was towing. They littered the shore of Lac Deschênes.

Figure 1: MSC Surface Pressure Analysis on September 11, 1900 at 8 PM.

As if becoming breathless, racing toward Montreal, the storm was losing its punch. The system was centred on Montreal at 8 a.m. on the 12th with troughing elongated east-west. The isobars indicated a storm surge into the Bay of Fundy (Figure 2).

Most of Québec appears to have escaped lightly as the storm scooted east. Rainfall totals were: 36 mm at Ste. Agathe; 59 mm at Québec City; and 28 mm at Chicoutimi.

Passing through the Gaspé and northern New Brunswick the system regained energy. Precipitation totals were 74 mm at Bic (48° 22'N, 68° 42'W) and 100 mm at Percé. To the south amounts declined:, 64 mm at Bathurst (NB), 35 mm at Chatham (NB), and 30 mm at Fredericton.

By 8 p.m. on Wednesday the 12th the storm centre lay offshore Port-aux-Basques (Figure 3).

Most damage and loss of life were at sea. From Percé, one fishing company wrote to the Meteorological Service of

Canada (MSC Archives, 1900) that they lost 30 boats and six men.

In New Brunswick, eight small fishing schooners of the Gloucester County fleet, the Anglesea, Emma, Fly, Frances, Garfield, Hibernia, Nellie and Penguin were lost off PEI. The local *Courrier des Provinces Maritimes* listed 38 Acadian crew members drowned. Two other fishing schooners, from Caraquet, the Japan and Midnight, were believed to have foundered.

Further south, an exceptionally high tide drove up the Petticodiac River. A chance alignment of the earth, sun and moon meant that a naturally high tide reinforced the Bay of Fundy storm surge. The moon and sun were on opposite sides of the earth so the gravitational effect on the tide was not as large as possible, but it was, nevertheless, the highest tide since the locally renowned Saxby Gale thirty years earlier (Ruffman, 1999; Reid, 2000). In that case, too, a storm surge reinforced a naturally high astronomical tide.

Prince Edward Island was more fortunate than New Brunswick. Only one Island vessel, the 35 ton Reality, was wrecked, at Cascumpec Bay (Alberton). The crew of four drowned. Island newspapers reported other vessels ashore, likely some of those from New Brunswick. The catalogue of losses onshore included: at Seacow Head a lobster factory totally demolished; at McDonald Point 600 lobster traps washed away; at Wilmot a large barn and windmill blown down. Fruit was torn from the trees in Island orchards.

Although the *Halifax Morning Chronicle* described it as the worst storm in Nova Scotia since the 1873 August Gale, another hurricane, there was only minor damage in Halifax — fences downed and slates blown off roofs. The 237 ton Clyde, was lost at Margaree, Cape Breton, but with no deaths. The six-member crew of the Greta were not so fortunate, and one man, James Butler, was lost off the Annie SB.

The storm crossed to Newfoundland, not then part of Canada, from Corner Brook to Gander. News trickled in. Not until October 4th could Newfoundland's *Western Star* newspaper confirm 82 schooners, with displacements up to 67 tons, ashore or foundered, and another 100 seriously damaged. At least 50 lives were reported lost while hope for 25 others was almost abandoned.

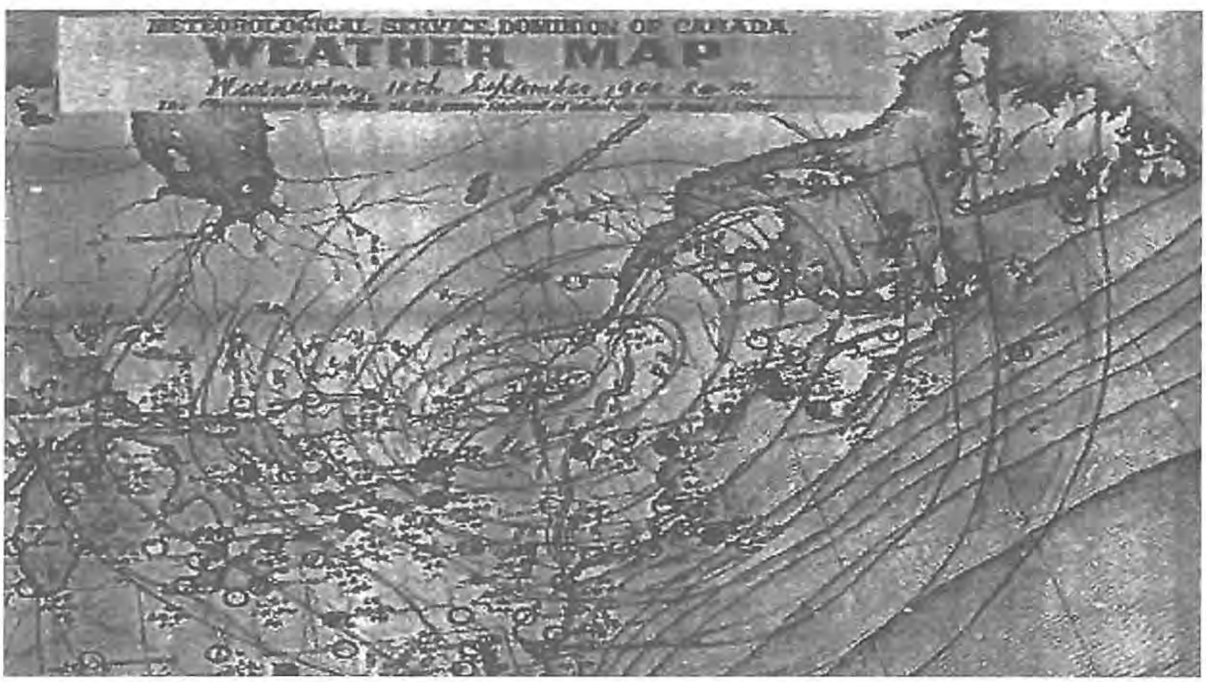

Figure 2: MSC Surface Pressure Analysis on September 12, 1900 at 8AM

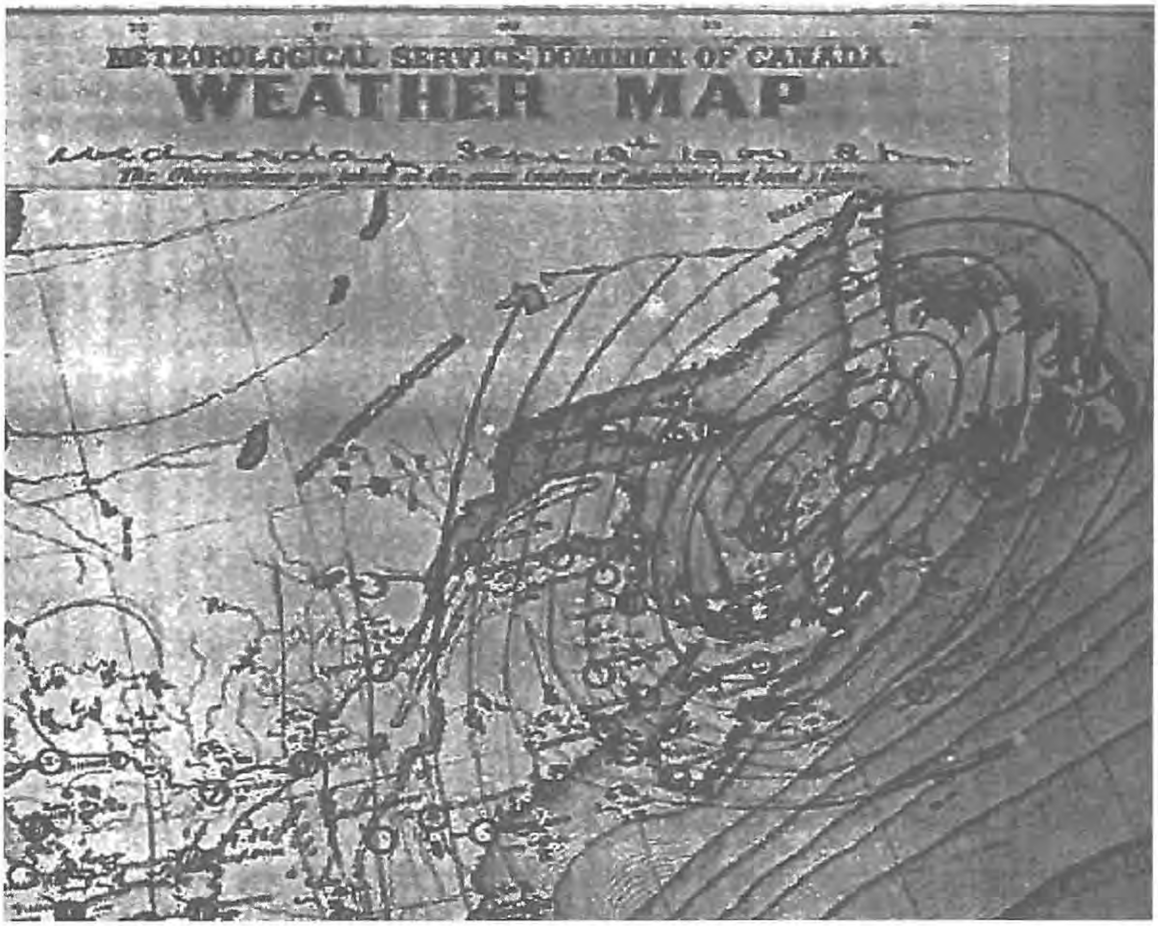

Figure 3: MSC Surface Pressure Analysis on September 12 1900 at 8PM

Some of the larger storm total precipitation measured by the sparse network of Newfoundland stations included: 86 mm at Point Riche (50° 42'N, 57° 25'W), 70 mm at Point Amour (Labrador, 51° 28'N, 56° 51'W), and 43 mm at St. John's. Channel (Port-aux-Basques) received 38 mm and Cape Norman (51° 38'N 55° 54'W) 29 mm.

The fishing fleet of St. Pierre et Miquelon was decimated (Sasco, 1970). Nine schooners and 120 men were reported lost leaving 50 children without fathers. One of the capsized schooners, the "Ali Baba", was towed into port at St. Pierre with thirteen bodies inside so bloated that only one was recognizable.

Warnings in Canada

To its credit, Canada's Meteorological Service issued warnings for this storm from the Lower Lakes to the Atlantic, although only a few hours in advance. Weather forecasters had very little information to work with — twice-daily telegraphed weather observations from 34 Canadian and 60 US centres. And they had to work quickly. Useful forecasts could only be made for about a day in advance so time was critical. Within 90 minutes of receiving the observations, forecasts were flowing, or rather should have been flowing, back out by telegraph to coastal signal stations, newspapers and community offices.

A vexing problem was how to inform ships at sea. September 1900 was before radio — still a year before Marconi's first reception of a trans-Atlantic signal. The warning system was a network of coastal stations that hoisted various combinations of cones and drums atop a mast to signal a storm. Orders to hoist the signals were telegraphed from Toronto. It was an effective system too: in a report to Parliament the harbour master at Tignish, PEI, described a case in 1899 where many fishermen's lives had been saved by the signal.

That September, even the storm signals failed. On September 14th the Acting Director of the Meteorological Service wrote to the Superintendent of the Great North Western Telegraph Company complaining that although warning messages had been sent out at 10:30 p.m., and should have been received no later than 8 a. m., delivery was recorded as: Digby - 10:30 a.m.; Yarmouth - 11:30 a.m.; Liscomb - 4:40 p.m.; Tignish - 3:00 p.m.; St. Andrews - 11:10 a.m. The warning seems never to have reached Northern New Brunswick and Gaspé communities.

Despite these problems it is clear the warning system was generally considered a success. It was after this storm that Newfoundland commercial interests expressed interest in having Canada provide weather service. In a letter to his US counterpart, the Director of the MSC, Frederick Stupart, wrote on 31 December that "our Canadian forecast and storm signal system will very shortly be extended throughout Newfoundland."

Fatalities

A detailed survey of newspapers and government reports identified 86 Canadian (including Newfoundland) fatalities from the storm. That's a conservative estimate. These were people who were either identified by name, or where the number of crew of a vessel clearly stated to be lost were given.

Many other people likely fell victim. A letter to the head of the Meteorological Service from Percé, mentioned above, lists six fatalities but without additional information one cannot be sure they are not accounted for elsewhere. There are numerous similar ambiguous cases of newspaper reports in the Maritimes.

The Newfoundland reports are particularly troublesome. Newspapers report vessels missing or unaccounted for in one issue, but fail to resolve the question in subsequent editions.

Extra-tropical Storm Transition

Lacking any information on the three-dimensional structure of this storm - this was well before upper air soundings were systematically taken - and having no access to the synoptic data, one can do little more than speculate on the storm's apparent redevelopment on the East Coast. The collapse of the bipolar structure evident on the surface map for 8 p.m. on the 11th of September, suggests the remnant tropical system gradually came into phase with a wave in the Westerlies. Perhaps a more detailed analysis of the type conducted by Abraham et al, (1999) on the 1869 Saxby Gale would show this to be a similar type of transition.

Acknowledgments

I thank the staff of the National Library of Canada (Ottawa), National Meteorological Library (Downsview), and Meteorological Service of Canada (Climate Services, Downsview) for assistance with contemporary information sources.

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A Quick Look at the Pine Lake Storm

by Paul Joe[1] and Dennis Dudley[2]

Résumé: Le 14 juillet 2000, entre 18 h 45 et 19 h 15 environ (heure avancée des Rocheuses), une tornade dévastatrice a frappé la région de Pine Lake et a touché le parc à roulottes de Green Acres. On a rapporté qu'il y avait eu douze morts, cent trente blessés et plus de treize millions de dollars de dommages. L'orage se trouvait approximativement à 150 km au sud du radar de Carvel, situé à environ 40 km au nord-ouest d'Edmonton. Le radar exécute dans les 5 premières minutes un balayage de l'horizon sur 24 angles d'élévation. Dans les 5 minutes suivantes, il fait un balayage Doppler de 4 angles d'élévation. Le radar de Carvel possède une largeur de faisceau de 1,1 degré. Il est de bande C (longueur d'onde de 5 cm) avec une portée maximale de 256 km lorsqu'il opère en mode non Doppler et une portée de 113 km en mode Doppler conventionnel. En mode de phase aléatoire, le radar a une portée de 226 km. Dans ce dernier mode, l'information de la phase de l'impulsion radar de retour est comparée avec celle notée de la plus récente impulsion radar transmise et ainsi qu'à celle de l'impulsion antérieure, pour en extraire respectivement les échos du premier et second trajet. Présentement, on est limité à une vitesse non ambiguë de 16 m/s. Ce balayage de phase aléatoire est une innovation technologique récente, utilisée pour la première fois au radar de King dans un but opérationnel. Il fait maintenant partie de la stratégie de balayage des radars du projet national de radars. Le radar de Carvel a été transformé en radar Doppler en 1991 et modernisé en l'an 2000 selon les normes du projet national de radars. Dans cet article, on examine une série d'images CAPPI à basse altitude de 1,5 km au-dessus du sol et plusieurs images en vitesse radiale à partir du balayage de phase aléatoire. Finalement, on fait un bilan des dommages sur le trajet de la tornade.

Introduction

On 14 July 2000, at about 6:45 pm to 7:15 pm MDT, a devastating tornado struck the Pine Lake area and hit the Green Acres Trailer Park. Twelve deaths, one hundred and thirty injuries and more than thirteen millions of dollars of damage were reported. The storm was approximately 150km south of the Carvel radar which is located about 40 km north west of Edmonton. The radar performs a 5 minute 24 elevation volume scan and then a 5 minute 4 elevation Doppler scan sequence. The Carvel radar is a 1.1° beamwidth, C Band radar with a maximum range of 256 km when operating in non-Doppler mode, and a range of 113 km in primary Doppler mode and 226 km in "random phase" mode. In this latter mode, the phase information of the return pulse is processed with the phase from the current and the previously transmitted pulse to retrieve the first and second trip echoes, respectively. At the moment, it is limited to an unambiguous velocity of 16 m/s. This "random phase" scan is a recent technological innovation pioneered for operational use at the King Radar and used on all National Radar Project radars. The Carvel radar was initially Dopplerized in 1991 and upgraded in 2000 to National Radar Project standards.

In this quick look, we examine a sequence of low-level CAPPI's made at 1.5 km above the ground, several of the radial velocity images from the random phase scan and report on the damage track.

Overall Description

Figure 1 (also shown in colour on front cover page) shows the low-level CAPPI time or 0100Z 15 Jul 2000. The core of the storm at this time (marked as P3), located at about 165° azimuth and between 150-180 km range, has a very large, intense core and has a single cell structure. This has all the features of a typical Alberta supercell storm: a high reflectivity core (> 50 dBZ); a strong reflectivity gradient on the southwest flank indicative of strong inflow, strong updraft and a weak echo region; a "V" downwind structure indicative of the environmental air flowing around the core of the storm and a large size indicative of a long lived storm.

CAPPI is an acronym for Constant Altitude Plan Position Indicator. It is a display of a horizontal slice through the three dimensional radar volume.

There are single and multi-cellular storms (marked C and D) just to the south of Rocky Mountain House (marked WRM). These storms and the ones forming in the rear of the Pine Lake storm (marked E and F) have quite a different character. These storms are shorter lived, less intense and also have a pulse-like nature where they grow and decay within 30 to 60 minutes but initiate a new storm

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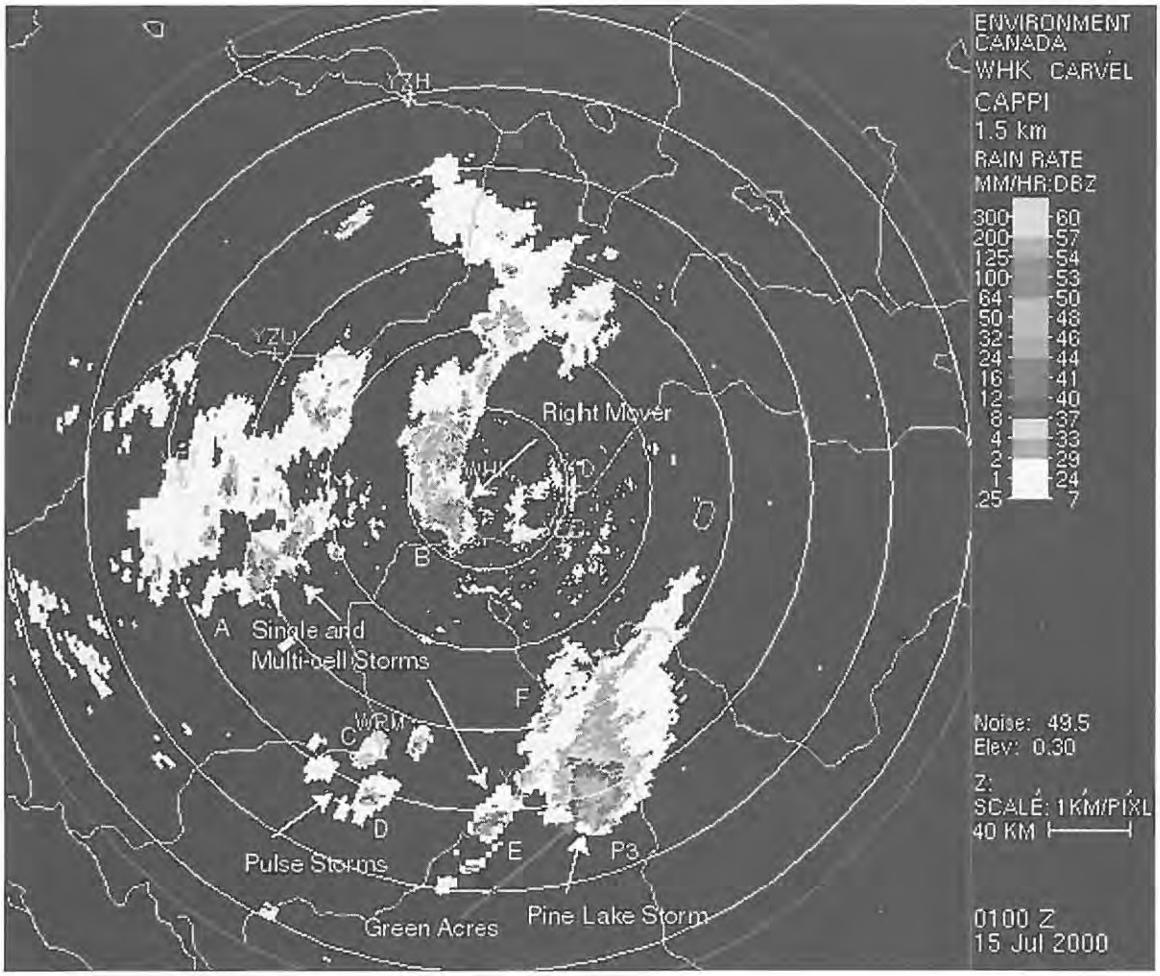

Figure 1: 1.5 km CAPPI image at the time of tornado touchdown. Pine Lake is located at azimuth 165° and a range of 167km from the radar. WRM is Rocky Mountain House, YQF is Red Deer and WHK is the Carvel Radar. The range rings are spaced every 40 km. The colours represent either rain rate (mm/hr) or reflectivity factor (dBZ). The tip of the red arrow points to the Green Acres Trailer Park. The tornado was classified as F3 at this time and had just crossed the lake at this point (see Fig. 6). The letters refer to Fig. 2 and 3. Note: this figure is also shown in colour on front cover page.

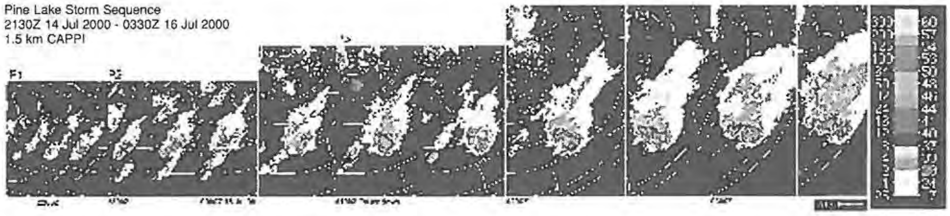

Figure 2: Sequence of 1.5 km CAPPI images centred on the Pine Lake storm showing the storm evolution. The sequence begins at 2130Z 14 July 2000 and ends 0330Z 15 July 2000. The storm continues beyond radar range. The tornado touchdown time was approximately 0100Z. The P1-P4 markers are reference points for the text and Fig. 3. Note the development of storms to the south of the Pine Lake storm at 2300Z that track to the west and north of the storm without becoming severe. Note: this figure is also shown in colour on back cover page.

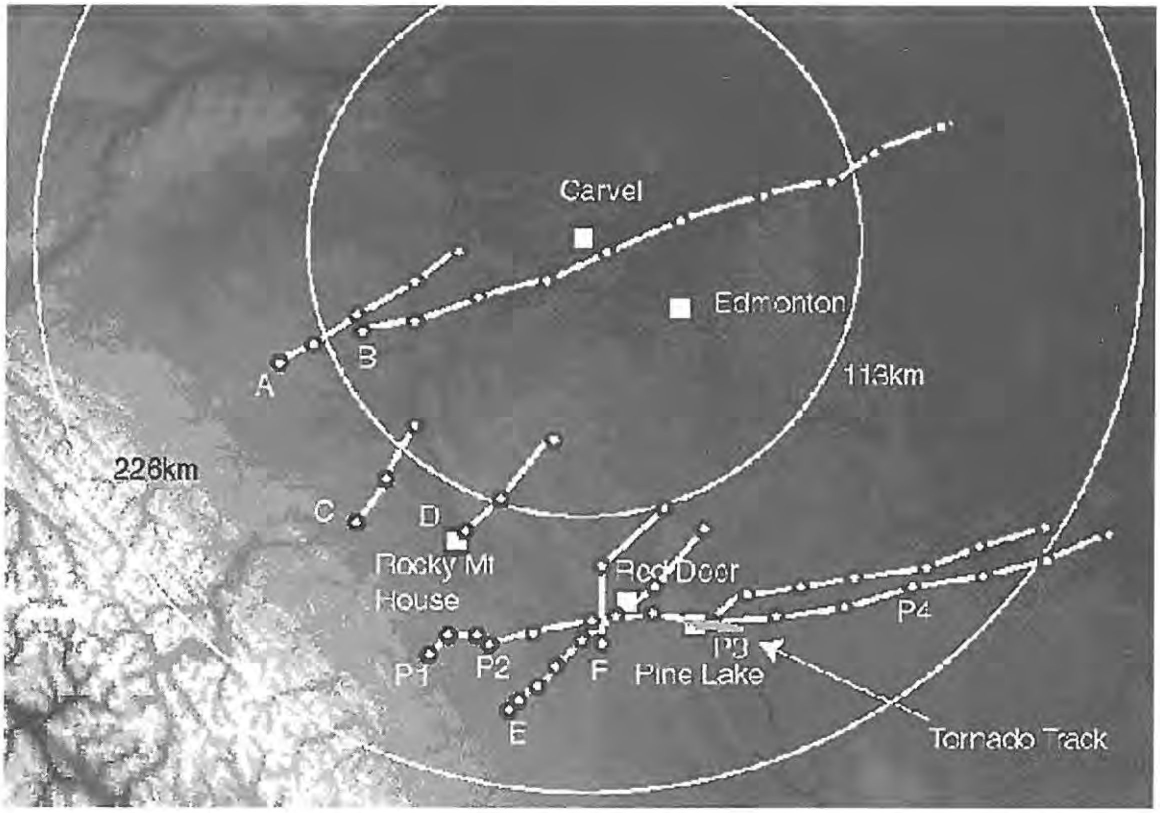

Figure 3: Selected storm tracks are overlaid on a topographic image. All of the tracks this day moved from the SW to the NE like tracks A, C, D, E and F except for track B and P1-P4 which is the Pine Lake storm. B and P1-P4 were very long-lived storms. The topographic image is used to show that the initiation of the storms was in the foothills of the Rockies. The storms A, C, D were pulse-like in nature (unlike the Pine Lake Storm) where they grew and decayed within about an hour and new cell growth occurred ahead of the old cells. Note that the markers for Edmonton and Red Deer are for the airports and not city centres. In order not to clutter the figure, only representative selected tracks are presented here.

about 10-20 km away directly in the downwind direction. There are also storms to the north and just SW of the Carvel radar (marked A). They will not be discussed but the later one (marked B) was also a "right mover".

Life Cycle

Fig. 2 (also shown in colour on back cover page) shows a sequence of 13 images, spaced 30 minutes apart, beginning at 2130Z 14 July 2000 and ending at 0330Z 15 July 2000 showing the life cycle of the storm. This is a long lived storm (and it continues beyond radar range)! Fig. 3 shows the tracks of selected storms. The Pine Lake storm is marked by the letters P1 to P4. The tracks are overlaid on a topographic background to show the location of the initiation of the storms in the foothills of the Rocky mountains.

> A note about the time conventions. MDT is Mountain Daylight Time. Z is Zulu or Greenwich Mean Time. Note that 0000Z is the same as 1800MDT.

> In the severe storm parlance, single cell, multi-cell, pulse and supercell storms have technical definitions that involve the three-dimensional structure and temporal evolution of the storm. In order not to bog the reader down with these details, the definitions are omitted and the reader is directed to the bibliography for details.

At about 2300Z (P2), the Pine Lake storm elongates forming several cell cores, they intensify and become single cellular in nature (either some cores decay or they merge - not clear from the low level CAPPI). From 2300Z to 0100Z, the storm becomes more and more intense and takes on a "supercellular" structure. The other notable observation is that the storm becomes a "right mover" at 2300Z (P2) again typical of the severe supercell storm (Fig. 3). The general motion of the storms is from SW to NE (A,C,D,E)[3]. The Pine Lake Storm and storm B (Fig. 3) moved from about 260°, which is about 40° to the right of the general storm motion.

[3] Remember that in order not to clutter the figure, only representative selected tracks are presented in Fig 3.

Around tornado touchdown time, the storm again elongates and begins to split (P3). In other case studies, the leftmost storm of the pair dissipates soon after the split and it may rotate anti-cyclonically. However, in this case, both storms are long lived (>3 hours) and appear to rotate cyclonically (see next section). Both storms maintain low-level, low-intensity linear echo features, marking the inflow from the rear of the storm (see 0130 and 0200Z).

One of the fundamental limitations of Doppler radar is the limited velocity range. Typically, one thousand pulses are transmitted per second and the phase difference between successive pulses is used to calculate the velocity. Since the phase of the sinusoidal Electro-magnetic wave repeats every three hundred and sixty degrees, the measured phase difference is also limited to three hundred and sixty degrees or one wavelength. The maximum velocity, called the SyQuest Velocity, is computed using the time between pulses, the wavelength and the speed of light. For the Carvel radar, the SyQuest velocity is around 16 m/s. Just as the phase repeats, the velocity repeats and this is called velocity aliening.

Velocity Structure

Fig. 4 (also shown in colour on back cover page) shows a zoomed-in Doppler radial velocity image of the storm from the "random phase" scan at 0030Z (about 30 minutes before touchdown) and at 0240Z. The image is complex to interpret in that the Nyquist velocity is 16 m/s and some of the data are aliased. In addition, the echo is in the "2nd trip" and the echo was not always retrieved. The image shows two rotation signatures of the mesocyclone which classifies the storm as a supercell. The mesocyclone location is overlaid with a circle to help the reader locate the feature.

On the figure on the left (0030Z), which is 30 minutes before tornado touchdown, the maximum outbound (from the radar) velocities are about 19 m/s on the left of the circle and the maximum in-bound velocities are about 25 m/s over a 7 km distance (a 44 m/s velocity differential over 7km) detected at a range of 160km. There is a gap in the data which is either due to a lack of radar echo or due to non-retrievable second trip echo. Fig. 5 is a photograph taken around this time, which provides visual confirmation of the circulation. A multiple vortex tornado was observed shortly after this picture was taken by Brad McLeod. During the mature phase of the storm, the funnel was enshrouded in rain.

On the figure on the right (0240Z), which is two-and-half hours after touchdown, the mesocyclone signature is well defined and detectable at a range of 210 km. The maximum outbound and inbound velocities are about 12 and 15 m/s over about 2 km (27 m/s velocity differential over 2km). At this range, the radar beam is 3.4 km wide and at a height of 4 km. There is a hint of another cyclonic rotation associated with the "left mover" (dashed circle, at a range of 170km), but only the outbound portion of the circulation can be observed.

The random phase processing to retrieve the second trip echo is very new technology arising out of the National Radar Project and research and development at the King Radar. It is a technological breakthrough partially overcoming the range limitation problem in Doppler radar technology. The detection of the mesocyclone in this particular case is a clear and outstanding example of its capabilities. This is the defining case for this technology.

Damage and Tornado Track

The tornado touched down 8.5 km west of Pine Lake at approximately 6:45 PM MDT. Initially, damage (Table 1) was light and spotty (F0). However, as the tornado tracked eastward it grew in size and intensity. At 3 km west of Pine Lake, it was producing moderate continuous damage (F1) in a narrow swath directly west of the Green Acres Trailer Park. The tornado grew to maximum intensity (F2-F3) just as it crossed Range Road 251 and entered the trailer park at 6:55 PM. Here, the tornado core tracked directly down the centre of the trailer park cutting a swath of total destruction 250 metres wide (Fig. 6 and Fig. 7). Wind speeds of 200-300 km/h threw cars and trucks up to 50 metres. Trailers, motorhomes and other RV's were stripped and left unrecognizable. Many pads were wiped clean with RV's missing entirely. Damage to buildings include near-total destruction of a well-constructed cottage with only flooring and one wall left partially standing and total destruction of a cinderblock washroom and laundry facility, the roof of which was not found. The owner of the trailer park sustained F2 damage to his home which was located in the southwest corner of the trailer park, just south of the tornado core.

The majority of damage in the tornado core at Pine Lake appeared to be F2 in intensity (up to 250km/h) with some limited evidence of F3 damage (vehicles tossed 50 metres). However, clear F3 damage was found on the eastern shore. One home in particular was totally destroyed with only its floor remaining (Fig. 8). The walls and roof were not found.

The tornado continued eastward and maintained at least moderate intensity for 5 km east of the lake. It began to track southeastward and weaken somewhat as it moved east of Range Road 243. In this area, light to moderate damage was found. The tornado weakened further and finally dissipated 2.5 km east of Highway 21 at Township Road 360 around 7:15 PM. The tornado covered a total distance of 24.5 km on the ground, varied in width from 50 metres to 1600 metres, and was on the ground for approximately 30 minutes.

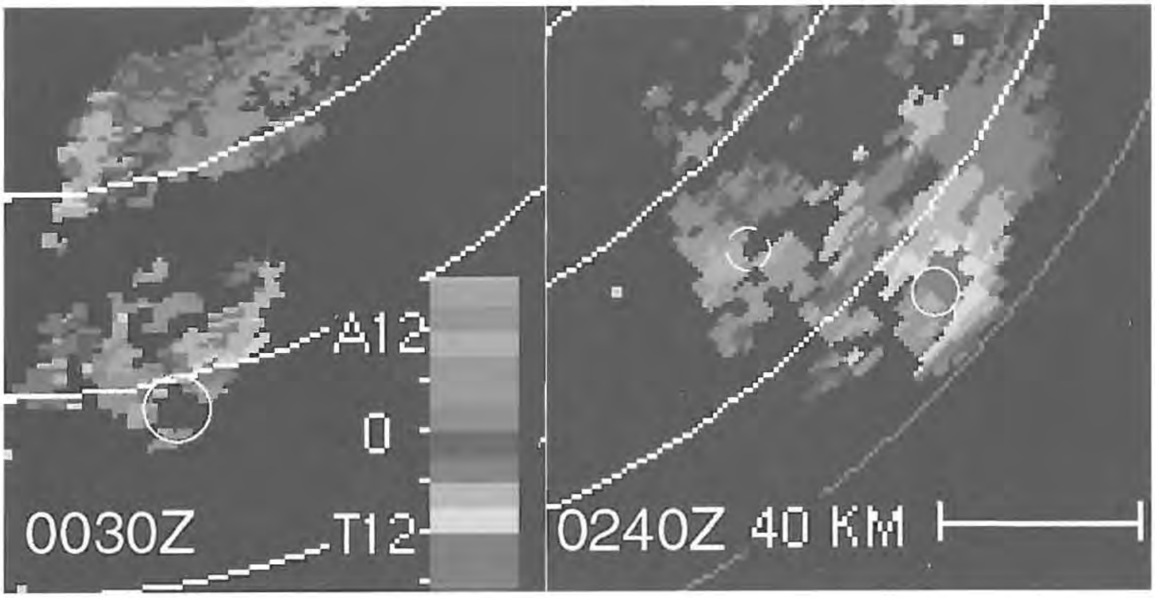

Figure 4: Radial velocity images of the Pine Lake storm. The images are from a 0.3° PPI conical surface. The left image is at 0030Z 15 July 2000, 30 minutes before tornado touchdown, and the right image is at 0240Z 15 July 2000. The radar is located off the image to the upper left. Each pixel is a kilometre square. The red and blue colours indicate velocities away from and toward the radar, respectively. The echoes shown in the images are in the "second trip", that is, beyond 113 km from the radar. The storm is at about 165 km and 215 km from the radar on the left and right images, respectively. The Nyquist velocity is 16 m/s. In the left image, the arrow indicates velocities that are "aliased", that is, where the velocities are actually about 22-25 m/s toward the radar and not 12-15 m/s away from the radar as shown. The patchiness in the image is a result of "unretrievable" second trip echo. The yellow circles indicate the location of the mesocyclone indentified by a couplet of away and toward velocities aligned across a radar azimuth. The couplet at 0030Z is confounded by unretrievable data and velocity aliasing but the couplet at 2240Z is a "classic" rotation signature where the image is filled in and there is not velocity aliasing. The dashed circle at 0240Z is perhaps another rotation couplet. Note: This figure is also shown in colour on back cover page.

Figure 5: Photograph taken at 0035Z 15 July 2000 (10 min before tornado touchdown) of the Pine Lake Storm. The view is 6 km NW of the Green Acres Trailer park. The view is looking towards the west. (Photo copyrighted and courtesy of Brad McLeod.)

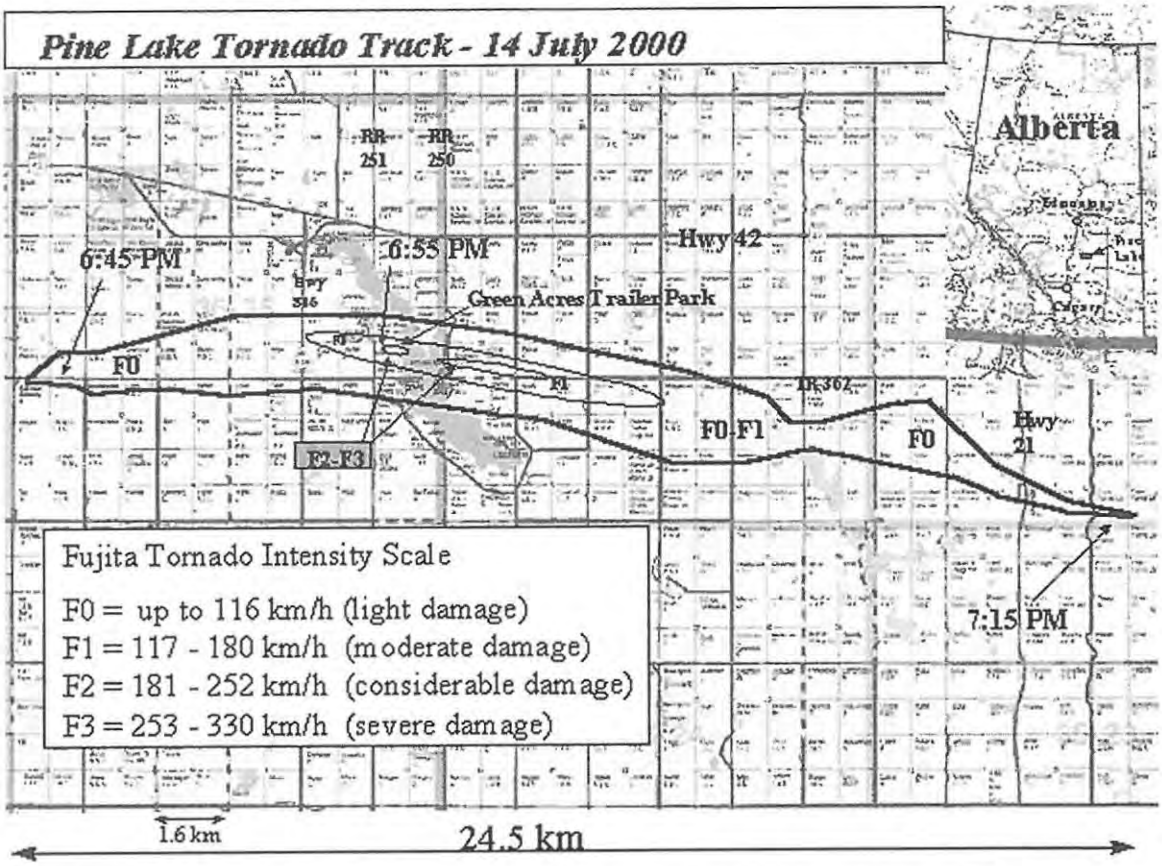

Figure 6: The path of damage caused by the Pine Lake Tornado, July 14, 2000 from RCMP GPS aerial survey completed July 16, 2000. Wind speed estimates from damage survey by Environment Canada. The Fujita Tornado Intensity Scale is a scale of wind damage intensity in which wind speeds are inferred from the analysis of damage.

Table 1 Reported Damage Reports

6:10 PM	southeast Penhold	strong wind	wind estimated 60-80km/h
6:19 PM	12 E Red Deer	Large Hail - golfball size	smashed a car window
6:40 PM	14 km southeast Red Deer	Wind damage	roof torn off shed
6:42 PM	near Haynes	Large Hail	15-20 mm in diameter
6:55 PM	Pine Lake - Green Acres Trailer Park	Tornado - F3	12 Killed, 130 injured
7:10 PM	East of Pine Lake	Tornado - F1 (same tornado as above) Large Hail - golfball size	house mostly destroyed, machine shed gone, mobile home gone, crops destroyed by hail.
7:12 PM	North of Scollard	small hail	10 mm diameter hail
8:35 PM	near Stettler	wind damage and hail	power lines down, hail 18 mm in diameter
8:50 PM	near Castor	large hail	golfball sized hail
10:11 PM	near Provost	large hail	golfball sized hail
10:17 PM	near Hughenden	small hail	10 mm hail

Note that the list provided in the above table only includes occurrences reported to Environment Canada through the Caroline - Red Deer - Stettler corridor (along the main storm track). Other events may have occurred in these areas but were unreported to Environment Canada. Other information may refine or adjust this list.

Figure 7: Photo looking eastward showing the core damage. (Photo by Dennis Dudley.)

Figure 8 :Photo taken near the lake-shore at Green Acres Trailer Park looking eastward. In the foreground, remnants of a beach cottage with only the flooring and one wall remaining. In the background, a demolished washroom and laundry facility made of cinderblock (Photo courtesy of Dan Kulak)

A close-up examination of the damage track in the Pine Lake area shows the wind speeds diminishing to F1 strength on either side of the tornado core. In this area, a few vehicles were pushed short distances, some roofing material was peeled off roofs, and a few trailers overturned. The width of this moderate and continuous damage was 570 metres. Figure 6 also shows that there was light damage (F0) extending approximately 400 metres on either side of the F1 damage. Here, trees were pushed over or uprooted and some light damage from flying debris was found on vehicles, RVs and trailers.

Summary

The Pine Lake storm is an excellent example of a severe Alberta supercell storm. It starts out as an innocuous weak single cell storm in the foothills of the Rockies. It then becomes organized as a severe multi-cellular storm and begins to move eastward (to the right) over the plains, where it intensifies into a supercell storm and develops rotation. The storm develops a tornado and then splits into two. It appears that the storm is decaying after 6.5 hours but it moves out of radar range at that point. Unlike "classic" storm splits, the left mover doesn't diverge very much from the original path and the rotation appears to be cyclonic.

One interesting observation is that storms that formed near the Pine Lake storm moved in the general SW to NE direction (storms E and F and times 2300Z to 0200Z). Storm E formed near the Pine Lake storm and in the same environment. However, it did not propagate in the Pine Lake storm direction. Storm F is even more interesting in that it seems to have formed on the rear flank of the storm and then seems to be carried around to the west and then to the north west side of the main storm. This case highlights the essence of the severe weather warning problem. There are many storms that formed in the same "environment" as the Pine Lake storm but did not develop in the same manner. Why was the Pine Lake storm so favoured? An appropriate and vivid analogy for the challenge of issuing severe weather warnings is that of trying to identify which kernel of corn will pop first when making popcorn in an open frying pan.[4]

This event also demonstrates some of the leading edge capability of the National Radar Project radars. This is an outstanding example showing the ability of National Radar Project Radars to identify the mesocyclone in second trip echoes. This was not possible before.

The Pine Lake Tornado is rated an F3 tornado based on the maximum severity of damage found in the Pine Lake area. The tornado varied in size (50-1600 m) and intensity (F0-F3) along its 24.5 km path that extended from 8.5 km west of Pine Lake to 15 km east of the lake. It was at maximum strength as it tracked directly through the centre of Green Acres Trailer Park and for several kilometres eastward.

This article provides only a cursory look at the storm from looking at the 1.5 km CAPPI only. From a technical perspective, the strict classification of the storm into the various types requires a look at the three dimensional data. There are many other aspects of the storms that will be brought out in the detailed reports already under way.

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[4] Analogy courtesy of Phil Chadwick.

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DU NOUVEAU POUR LES PUBLICATIONS!

Plusieurs changements sont en cours au sujet de Atmosphere-Ocean (A-O) et du CMOS Bulletin SCMO.

À partir de 2001, nous ferons affaire avec une nouvelle firme de mise-en-page et un nouvel imprimeur, terminant ainsi notre très longue association avec les Presses de l'Université de Toronto pour A-O ainsi qu'avec M.O.M. Printing pour le Bulletin. Nous comptons économiser quelques milliers de dollars sur la mise-en-page avec Lynn's Desktop Publishing et réduire d'au moins deux semaines le temps requis pour la préparation des articles pour l'impression. Un contrat d'impression unique pour les deux publications avec Gilmore Printing Services sera aussi avantageux, en particulier si la tendance à un plus grand usage de la couleur se maintient.

Atmosphere-Ocean entre dans les lignes majeures en changeant de format à 8.5 x 11 po., avec le texte en deux colonnes. Ceci donnera plus de flexibilité pour l'insertion des graphiques, facilitera la lecture et rendra la photocopie ou l'impression à partir du site web plus économique. La fréquence de publication demeurera quatre fois par année.

Les frais d'auteur pour le nouveau format de A-O seront seulement $95.00 par page, ce qui représente une réduction d'environ 25% par rapport à l'ancien taux de $75.00 pour une page de 6 x 9 po.

Un CD-ROM (édition 2000) contenant tous les articles publiés dans A-O depuis 1990 est maintenant disponible.
Ce disque fonctionne sur la plupart des ordinateurs et est pourvu d'un moteur de recherche très puissant. Une édition mise-à-jour sera préparée annuellement. Le prix de l'achat initial est le même que pour l'abonnement à la formule imprimée, soit $35.00 pour les individus et $100.00 pour les institutions. Par la suite, le prix des mises-à-jour annuelles sera $20.00 pour les individus et $50.00 pour les institutions, pourvu que la version précédente ait été achetée par le même client. De plus, les abonnés qui commandent simultanément la version imprimée et la mise-à-jour du CD-ROM (i.e. l'édition 2001) bénéficieront d'une réduction de $10.00 sur le coût de la mise-à-jour.

Les articles publiés au cours de l'année continueront d'être disponibles gratuitement sur le site de la SCMO, sous la rubrique Atmosphere-Ocean et autres publications.

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Scientific Committee on Oceanic Research

http://www.jhu.edu/~scor/

Highlights of the 25th General Meeting
National Academy of Sciences, Washington, DC
October 16, 2000

(The full report will, as usual, be produced by the SCOR secretariat and distributed to national SCOR committees when ready.)

Canada was represented at the General Meeting by Dr. Bjorn Sundby, outgoing Secretary of SCOR, and by Dr. Michael Sinclair, Chair of Working Group 105.

1. Large Programs Development

A. *Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB)*

GEOHAB became a SCOR Program in 1998 and is co-sponsored by IOC and IGBP. The GEOHAB Science Plan was presented by Dr. Patricia Glibert on behalf of the Scientific Steering Committee. The external and internal reviewers expressed concern that the plan lacked focus and that it needed to be edited for clarity before publication. The assembly felt that the Science Plan is an important document that should get broad distribution and accepted the plan on the condtion that the reviewers concerns be addressed and the text be edited. Arrangements have been made for this to be done. The steering committess will now proceed to the next step in the evolution of this program: the Implementation Plan. As was noted in the report of last year's Executive Meeting, there is not yet a Canadian GEOHAB program. However, Canadian researchers have been active in developing the international GEOHAB since its inception. For more information, consult the GEOHAB web site: http://www.jhu.edu/~scor/GEOHAB.html

B. Surface Ocean - Lower Atmosphere Study (SOLAS)

SCOR and IGBP have jointly supported the development of a new international research program on ocean/atmospheric biogeochemical coupling, with the acronym SOLAS. The primary goal of SOLAS will be to address key interactions among the marine biogeochemical system, atmospheric chemistry, and climate. The program will be highly interdisciplinary, involving chemists, physicists, and biologists from both the marine and the atmospheric sciences.

An open science meeting, held in February 2000 in Damp, Germany, attracted 250 participants from 22 countries, and led to a SOLAS Science Plan that was presented at the General Meeting by Bob Duce on behalf of the SOLAS Editorial Team. The reviews of the plan were glowing and it was accepted by the general meeting. SOLAS has thus been accepted as a new international program of SCOR. For more information, consult the SOLAS web site: http://www.ifm.uni-kiel.de/ch/solas/main.html

It is worth noting that Canadian SOLAS is ahead of international SOLAS. An organizing meeting was held in Montreal in June 2000 and a SOLAS proposal spearheaded by Dr. William Miller is about to be submitted to NSERC. It appears that Canada is the first nation to develop its own SOLAS program.

C. Future of Global Ocean Biogeochemistry

SCOR and IGBP, the main international sponsors of JGOFS and GLOBEC, organised a workshop in Plymouth, UK, from 23-26 September 2000 to plan a framework for future marine global change research. A draft report of the meeting was presented to SCOR. The report identifies four issues, each of which is of interest to Canada and Canadian researchers:

- Ecosystem structure, function and feedbacks;
- Carbon storage;
- Continental margins;
- Fisheries.

To bring the program forward, a small international planning group will be established. Dr. Peter Burkhill (UK) will take the lead on behalf of SCOR. The group is asked to come up with its report before the end of 2001. Professor Alfonso Mucci (Canada) has been proposed as a member of this group.

In my opinion this project has the potential for becoming the next major new international oceanographic program. Canadian scientists should be aware of it. I have appended the draft document to this report.

2. New Working Groups

There were no working group proposals from Canada this year. I urge those who read this report and have ideas for new working group topics to contact members of the Canadian National SCOR Committee for advice on how to prepare a successful proposal for forwarding to SCOR. The deadline for receipt by SCOR is 3-4 months before the annual meeting in October. Working groups form the backbone of SCOR, and SCOR needs good proposals for working groups on exciting and emerging areas of marine science. There are plans for posting the guidelines for new working group proposals on the SCOR web site.

The General Meeting of SCOR approved the creation of two new working groups:

1) Marine phytoplankton and global climate regulation: The phaeocystis cluster as model.

This working group, proposed by Professor Winfried Gieskes (the Netherlands), will make an inventory of aspects that relate to cycling of biogeochemically relevant elements:

- Factors regulating bloom inception;
- The grazing issue: bottom up or top down control;
- Cellular response to environmental factors;
- Distribution patterns with molecular probes;
- Genetics: pathways of distribution and biodiversity in the cluster;
- Biogenic fixation and emission of climate-relevant gases;
- Cloud inception and characterization of condensation nuclei over blooms.

Dr. Maurice Levasseur (Canada) is on the proposed list of members.

2) Developing quantitative measures for marine ecosystems from environmental, ecological and fisheries perspectives

This working group was proposed by Dr. Philippe Cury (France). It is an outcome of the work of WG 105 (Impact of World Fisheries Harvest on Marine Ecosystems, Dr. Michael Sinclair, chair). The objective of this working group is to develop theory to evaluate changes in marine ecosystems from environmental, ecological and fisheries perspectives. The objectives of the group include:

- define generic measures that can be used in marine environments, fisheries, and exploited fish populations and ecosystems;

- formulate these measures in mathematical or statistical terms;

- assess when values of a measure are statistically and/or ecologically meaningful;

- apply these measures to specific data sets or specific models in order to evaluate their usefulness.

Professor Daniel Pauly and Dr. Jake Rice (Canada) are on the list of suggested members.

3. Reports from Existing Working Groups and Programs

WG 103: *The role of wave breaking on upper ocean dynamics.* M. Banner, chair. No Canadian members.

The work of this group is essentially completed and a manuscript will be submitted to a major journal early in 2001.

WG 105: *The impact of world fisheries harvests on the stability and diversity of marine ecosystems.* Canadian members: M. Sinclai (chair), D.Pauly, E. Melzer, H. Powles, J. Rice, R. Sumaila.

Dr. Michael Sinclair presented the final report of this group whose work culminated with an ICES/SCOR symposium on Ecosystem Effects of Fishing in Montpelier, France, in 1999. The proceedings have been published in the ICES Journal of Marine Science, Volume 57 (3), June 2000. See also http://www.ices.dk/symposia/ecoeff/ecoeffe.htm

WG 106: *Relative sea level and muddy coasts of the world.* Y. Wang, chair.Canadian member: Dr. C.Amos.

The work of this group is essentially completed and will be published as a book by Elsevier under the title "Muddy coasts of the world: processes, deposits and function: (eds. T. Healy and Y. Wang).

WG 108: *Double diffusion.* Y. Chasheckin and J. Fernando, chairs. Canadian members: A. Gargett and B.Ruddick.

The work of this group is in progress. Information can be found on their website: http://www.phys.ocean.dal.ca/programs/doubdiff/doublediffusion.html

WG 109: *Biogeochemistry of iron in seawater* (with IUPAC) D. Turner and K. Hunter, chairs. **No Canadian members.**

The main activity of the group was to prepare a book for publication in the IUPAC series 'Analytical and Physical Chemistry of Environmental Systems', published by John Wiley. There is a firm commitment to deliver the manuscript of the book to the publisher by the end of October.

WG 110: *Intercomparison and validation of ocean-atmosphere energy flux fields.* S. Gulev and P. Taylor, chairs. No Canadian members but note the workshop announcement.

This group has a web site: http://www.soc.soton.ac.uk/JRD/MET/WGASF/ containing the full report of the outcome of the working group's activites plus the announcement of a WCRP/SCOR Workshop on intercomparison and validation of ocean-atmosphere flux fields, Washington, DC, 21-25 May 2001.

WG 111: *Coupling of winds, waves and currents in coastal models.* N. Huang and C. Mooers, chairs. No Canadian members.

The work of this group will culminate with a workshop at the University of Miami in Spring 2001.

WG 112: *Magnitude of submarine groundwater discharge and its influence on coastal oceanographic processes.* W. Burnett and E. Kontar, chairs. Canadian member: Leslie Smith.

This is undoubtedly the most active of all the working groups. It has attracted a great deal of attention and at last count has nearly 40 associate and corresponding members in addition to the 10 full members. Their activities are posted at the web site: http://www.jhu.edu/~scor/WG112.html which includes an extensive bibliography on submarine groundwater discharge investigations.

WG 113: *Evolution of Asian monsoon in marine records. Comparison between Indian and East Asian subsystems.* W. Pinxian, chair. No Canadian members.

This group is concentrating it efforts on the results of OSP Leg 184 to the South China Sea. A meeting is planned for May 2001.

WG 114: *Transport and reaction in permeable marine sediments.* B.P. Boudreau (formerly Canada) and M. Huettel, chairs. No Canadian members.

This group is very active and has an informative web site: http://www.mpi-bremen.de/SCOR-WG114/. An information paper can be found at http://www.skio.peachnet.edu/coop/issue11.pdf, and a second paper will appear in EOS.

WG 115: *Standards for the survey and analysis of plankton.*

This WG was established at the previoius SCOR meeting, but it has not yet started its work because of difficulties in finding someone willing to chair it.

WG 116: *Sediment trap and 234-Th methods for particulate organic carbon export in the upper ocean: Current status.* K. Buesseler, chair. No Canadian members.

This group has just been formed.

WG 117: *Synthesis of decadal to millennial climate records of the last 80 ky.* M. Sarntheim and J. Kennet, chairs.

The membership of this group has yet to be determined.

WG 118: *New technologies for observing marine life.* D. Farmer (Canada) chair.

The group will hold its first meeting in Sidney, BC, later this year.

JGOFS and GLOBEC

The Scientific Steering Committees submitted their annual reports to the General Meeting. The reports are substantial for these are very successful programs. Details will not be reported here, but the interested reader is referred to the SCOR webb site for information: http://www.jhu.edu/~scor/

4. Finance and Organization

1) Membership fee: It was decided to raise the membership fees for SCOR members by 1%, in accordance with ICSU guidelines.

2) Election of new officers: Professors John Field (President), Bjorn Sundby (Secretary), and Sergei Lappo (Vice-President) were not eligible for re-election. Professor Bob Duce (USA) was elected President, Dr. Julie Hall (New Zealand) was elected Secretary, and Professor Roberto Purini (Italy) was elected Vice-President. John Field remains on the Executive as Past President.

3) SCOR Secretariat: The search committee set up by SCOR, following the announcement of Elizabeth Gross that she intended to retire from full-time employment this year, selected Dr. Edward Urban to serve as her successor as the SCOR Executive Director. Dr. Urban accepted SCOR's offer and has assumed the Executive Director's responsibilities. Dr. Urban earned a Ph.D. in marine studies and a Masters of Business Administration from the University of Delaware in 1989. He decided on a career in science administration early on and from 1989 till last week worked for the U.S. National Research Council's Ocean Studies Board.

The new Executive Director will maintain the office at Johns Hopkins University with Wesley Anne Ross continuing as Executive Officer. Mrs. Gross will stay on as a part-time Finance Officer with responsibilities for grant and contract management and budget oversight.

Reported by Bjorn Sundby
Canadian nominated member to SCOR

Note: An electronic or a paper copy of this report is available from the Secretary of CNC/SCOR. If you wish to receive it, just send a note to the Secretary to that effect:

Paul-André Bolduc
Secretary CNC/SCOR
CMOS - SCMO
Suite 112, McDonald Building
University of Ottawa
150 Louis Pasteur Ave.
Ottawa, ON K1N 6N5

e-mail: paulandre.bolduc@sympatico.ca

Note from the Editor

The first decade of global change marine biogeochemistry has been synthesised by JGOFS, and the IGBP is also undertaking synthesis across its other mature programs. The time is right to take stock of these findings and plan a framework for future marine global change research. SCOR and IGBP, the main international sponsors of JGOFS and GLOBEC, organized a workshop in Plymouth, UK from 23-26 September 2000 to build on these and other findings. In developing this report, the participants noted both the exciting advances in quantifying variability and global change in the ocean, and also the pressing concerns that society is demanding of global change scientists. They also noted the need to plan synthesis and integration across all elements from the beginning of the developing new phase of global change research.

A report summarising their discussions has been written. It stipulates the preliminary stage in developing a framework for linking together existing and future elements of international marine global change research in the context of **Earth System Science**, the unifying concept underpinning the restructuring of the IGBP.

If you wish to receive this report, write to the CNC/SCOR Secretary. You may ask for an electronic copy (MSWord format) of the report. A paper copy is also available upon request.

The Canadian National Committee for SCOR

Chair: Dr. Kenneth Lee, MPO/DFO, Institut Maurice Lamontagne, Mont Joli, QC. LeeK@dfo-mpo.gc.ca
Secretary: Mr. Paul-André Bolduc. paulandre.bolduc@sympatico.ca

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9) Prof. Bjorn Sundby, INRS-Oceanologie, Rimouski, QC. b.sundby@uquebec.ca

Professor Edward Lozowski receiving the Andrew Thompson Prize in Applied Meteorology for 1999 from Geoff Strong, Chair, CMOS Alberta Centre on 3 October, 2000. Professor Lozowski, who could not be present for the official awards at CMOS Congress, Victoria, was cited for "his extensive research on ice accretion with application to hail, aircraft icing, transmission line icing and marine icing".

SOMETHING NEW FOR PUBLICATIONS !

Several changes are occurring with Atmosphere-Ocean (A-O) and the CMOS Bulletin SCMO.

Starting in 2001, we will deal with a new typesetting company and a new printer, ending a long association with University of Toronto Press for A-O and M.O.M. Printing for the Bulletin. We expect to save a few thousand dollars on typesetting using Lynn's Desktop Publishing and to also reduce the time required for preparing papers for printing by at least two weeks. A single printing contract with Gilmore Printing services should also be advantageous, especially if the tendency for increased use of colour is maintained.

Atmosphere-Ocean is entering the major leagues by changing its format to 8.5 x 11 inches, with a two-column layout. This will give more flexibility for the insertion of graphics, make reading more pleasant and make photocopying or printing from the web more economical. The frequency of publication will remain quarterly.

Publication fees for the new format of A-O are only $95.00 per page, which represents a saving of approximately 25% compared to the previous fee of $75.00 for a 6 x 9 inch page.

A CD-ROM (2000 edition) containing all papers published in A-O since 1990 is now available. This CD works on most computers and features a powerful search engine. An updated edition will be available each year. The price for a first purchase of the CD-ROM is $35.00 for individuals and $100.00 for institutions. Thereafter, the cost of annual updates will be $20.00 for individuals and $50.00 for institutions, <u>provided the previous edition has been purchased by the same client</u>. Moreover, subscribers who simultaneously purchase the printed version and the annual update of the CD-ROM (i.e. 2001 edition) will receive a $10.00 discount on the purchase of the update.

Papers published during the course of the year will continue to be available free of charge on the CMOS web site, under Atmosphere-Ocean and Other Publications.

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In our next issue (February 2001):

1) Tornado-day Climatology of Manitoba 1980-1999 by James Cummine and Michael Noonan, both from Meteorological Service of Canada, Prairie and Northern Region;

2) Weather Support to Military Contingency Operations - The Canadian Experience by Douglas Bancroft formerly with Environment Canada now with Department of Fisheries and Oceans.

Dans notre prochain numéro (février 2001):

1) Tornado-day Climatology of Manitoba 1980-1999 par James Cummine and Michael Noonan, tous deux du Service Météorologique du Canada, région des Prairies et du Nord;

2) Weather Support to Military Contingency Operations - The Canadian Experience par Douglas Bancroft auparavant avec Environnement Canada maintenant avec le ministère des Pêches et des Océans.

Minister Dhaliwal Announces appointments to Advisory Council on Oceans
September 17, 2000

OTTAWA -- The Honourable Herb Dhaliwal, Minister of Fisheries and Oceans, today announced the appointment of nine members to the Minister's Advisory Council on Oceans (MACO) at the 4th International Coastal Zone Canada 2000 Conference in Saint John, New Brunswick.

"These individuals bring a wide range of knowledge and ocean expertise and have been appointed on the basis of merit, the ability to bring oceans-related knowledge, and a thorough understanding of national and global oceans issues and opportunities. I am very pleased that they have agreed to accept my invitation to sit as Council Members on MACO," Minister Dhaliwal said.

The Council's Oceans Ambassadors, Dr. Art Hanson and Mr. Geoff Holland, were appointed on June 8, 2000, Oceans Day. Since their appointment, an on-line public nomination process was launched to assist them in developing a list of potential members to sit on the Council. Dr. Hanson and Mr. Holland have also talked to over 350 Canadians representing over 100 organizations as well as a number of other ocean stakeholders to seek views on potential candidates for the Council.

"MACO embodies the spirit of the Oceans Act, which encourages a collaborative approach to oceans management among government, Aboriginal groups, coastal communities, stakeholders and other Canadians. It will assist me to put into practice the important principles of sustainable development, integrated management, and the precautionary approach," the Minister said.

Members may serve on the Council for a period of up to three years.

Appointed to the Minister's Advisory Council on Oceans are: Mr. Terry Camsell, Ms. Terri Klassen, Ms. Sabine Jessen, Dr. Jon Lien, Dr. Elisabeth Mann Borgese, Dr. John Nightingale, Mr. Frank Pokiak, Mrs. Denise Verreault, and Mrs. Maureen Yeadon.

"I want to express my appreciation to Dr. Hanson and Mr. Holland for their hard work and their commitment to the pursuit of finding excellent candidates from across Canada for the Council," the Minister stated.

For more information, contact:

Ms. Heather Bala, Director of Communications
Office of the Minister, Fisheries and Oceans Canada
Ottawa (613) 996-0076

Le 17 septembre 2000

Le Ministre Dhaliwal annonce la composition du Conseil consultatif sur les Océans

OTTAWA -- L'honorable Herb Dhaliwal, ministre des Pêches et des Océans, a annoncé aujourd'hui les noms des neuf membres du Conseil consultatif du Ministre sur les océans (CCMO) à la 4e Conférence internationale Zone côtière Canada 2000, à Saint John (Nouveau-Brunswick).

"Ces personnes possèdent une expertise et des connaissances très variées; elles ont été choisies en fonction du principe du mérite, de leurs connaissances reliées aux océans et de leur compréhension des enjeux et des défis nationaux et internationaux dans le domaine des océans. Je suis très heureux qu'elles aient accepté de siéger au sein du CCMO", a indiqué le ministre Dhaliwal.

Les ambassadeurs des océans, MM. Art Hanson et Geoff Holland, ont été nommés le 8 juin 2000, lors de la Journée des océans. Un processus de nomination public en ligne a été instauré afin de les aider à établir une liste de membres potentiels pour le Conseil. MM. Hanson et Holland ont par ailleurs parlé à plus de 350 Canadiens représentant au-delà de 100 organisations ainsi qu'à d'autres intervenants du secteur des océans pour obtenir leur point de vue sur la composition du Conseil.

"Le CCMO traduit bien l'esprit de la Loi sur les océans, qui favorise, au chapitre de la gestion des océans, la collaboration entre les gouvernements, les groupes autochtones, les collectivités côtières, les intervenants et les autres Canadiens. Le Conseil m'aidera à appliquer les principes importants du développement durable, de la gestion intégrée et de l'approche de précaution", a déclaré le ministre.

Les membres pourront siéger au sein du Conseil pendant une période pouvant aller jusqu'à trois ans.

Les membres du Conseil consultatif du ministre sur les océans sont : M. Terry Camsell, Mme Terri Klassen, Mme Sabine Jessen, M. Jon Lien, Mme Elisabeth Mann Borgese, M. John Nightingale, M. Frank Pokiak, Mme Denise Verreault, et Mme Maureen Yeadon.

"J'aimerais remercier MM. Hanson et Holland pour leur excellent travail et pour la détermination dont ils ont fait preuve afin de trouver des candidats de choix dans l'ensemble du Canada pour le Conseil", a ajouté le Ministre.

Pour de plus amples renseignements:
Heather Bala, Directrice des communications
Bureau du Ministre, Pêches et Océans Canada
Ottawa (613) 996-0076

DM's Commendation for Dick Stoddart[1]

Former CMOS Treasurer and Current Ottawa Chapter Chairperson commended for his outstanding contributions to DFO

On July 7th, colleagues, family and friends gathered in the Peter Mitchell Room at 200 Kent Street to join Deputy Minister Wayne Wouters as he presented Dick Stoddart with the Deputy Minister's Commendation Award.

The award recognizes outstanding performance or exceptional contributions made by a DFO employee which further the Department's objectives. Dick's outstanding contributions to the advancement of the Ocean Science Program throughout his twenty-two year career with DFO have earned him this prestigious honour.

In his role as a Senior Advisor with DFO's Aquaculture and Oceans Science Branch, Dick has been instrumental in ensuring that the role of the oceans regarding climate change is understood and has been adequately accounted for in Canada's response. He also coordinated the DFO Science Program on Energy Research and Development since its inception. In addition, he has made significant contributions to the implementation of real-time oceanography, as well as to the coordination of departmental efforts for the National Ocean Science Program.

As a result of Dick's outstanding service to the Department, DFO continues to be highly regarded for its world-renowned scientific excellence in the ocean science community. Since retiring from the Department in January of 2000, he has served as Interim Executive Director of the Canadian Foundation for Climate and Atmospheric Sciences.

Mention élogieuse du SM à Dick Stoddart[2]

Ancien trésorier de la SCMO et président en titre du centre d'Ottawa honoré pour sa contribution exceptionnelle au MPO

Le 7 juillet dernier, collègues parents et amis de Dick Stoddart se sont rassemblés à la salle Peter Mitchell du 200 Kent pour applaudir ce dernier alors qu'il recevait la Mention élogieuse des mains du sous-ministre Wayne Wouters.

Le prix reconnaît le rendement extraordinaire ou les contributions exceptionnelles d'un employé du MPO au service des objectifs du Ministère. Dick mérite cet honneur pour ses contributions exceptionnelles au programme des sciences océaniques pour lequel il a oeuvré tout au long de ses 22 années au MPO.

Dans son rôle de conseiller principal à la Direction de l'aquaculture et des sciences océaniques du MPO, Dick a fait connaître le rôle des océans dans les changements climatiques et a veillé à faire prévaloir ce rôle dans la réponse du Canada. Il a également coordonné le Programme scientifique du MPO en recherche et en développement énergétiques depuis ses débuts. De plus, il a apporté de grandes contributions à l'application de l'océanographie en temps réel ainsi qu'à la coordination des efforts du Ministère dans le Programme océanographique national.

Grâce aux services exceptionnels de Dick au Ministère, le MPO continue de jouir de sa réputation internationale d'excellence dans la communauté scientifique. Depuis sa retraite en janvier dernier, il a occupé le poste de Directeur exécutif par intérim de la Fondation canadienne pour les sciences du climat et de l'atmosphère.

DFO Scientist Goes for the Gold[1]

Congratulations to Dr. Jim Gower, of the Institute of Ocean Sciences in Pacific Region. Jim was recently awarded the prestigious Gold Medal for remote sensing (satellite studies of the environment). The award, introduced in 1986 by the Canadian Remote Sensing Society, recognizes a significant new, or long-term, contribution to the field of remote sensing.

As part of the Canadian space program, DFO had invested in the production of an airborne instrument that pioneered a special technique for remote sensing. Demonstration of the technique from space had been delayed until this year when first examples from the American satellite scanner were available. A European instrument, very similar to the Canadian one, will be launched in 2001. Jim is a member of the science team for this instrument, and the team is hoping that it will do even better than the U.S. model.

Jim has been a member of American, Canadian and European scientific teams for satellite oceanography for many years and has contributed greatly to advances in remote sensing. He is well respected by both his colleagues at DFO and throughout the international science community. A well-deserved award.

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1 First published in Oceans, September-October 2000.

2 Première publication dans Océans, Septembre-Octobre 2000.

Un scientifique du MPO vise l'or[3]

Félicitations à Jim Gower de l'Institut des sciences de la mer, région du Pacifique. Jim a reçu dernièrement la prodigieuse Médaille d'or de télédétection (études par satellite de l'environnement). Le prix, établi en 1986 par la Société canadienne de télédétection, rend hommage à des percées importantes ou à des contributions de longue date dans le domaine de la télédétection.

Dans le cadre du Programme spatial canadien, le MPO a investi dans la production d'un instrument aéroporté qui a donné lieu à l'élaboration d'une technique spéciale de télédétection. L'essai de cette technique à partir de l'espace avait été reporté jusqu'à cette année alors que des premiers exemplaires du scanner satellite américain ont été disponibles. Un instrument européen, très semblable au dispositif canadien, sera lancé en 2001. Jim fait partie de l'équipe de mise au point de cet instrument et espère que celui-ci aura un rendement encore meilleur que le modèle américain.

Jim est membre d'équipes scientifiques d'océanographie par satellite américaines, canadiennes et européennes depuis de nombreuses années et a apporté une contribution de taille à la télédétection. Il est très respecté tant par ses collègues du MPO que par la communauté scientifique internationale. Un prix bien mérité.

General Announcement
A.G. Huntsman Award 2000

The A.G. Huntsman Foundation is pleased to announce that the winner of the 2000 A.G. Huntsman Award is Dr. William J. Jenkins. Dr. Jenkins is a Canadian citizen who received his education at McMaster University.

Having spent most of his career at the Woods Hole Oceanographic Institution in the US, he recently has joined the Southampton Oceanography Centre, UK.

This major Canadian award recognizes Dr. Jenkins' important contributions to the development of the tritium-helium dating technique and it's application to studies of ocean circulation, mixing and productivity. The analytical methods developed by Dr. Jenkins utilize the large-scale production of tritium in the oceans by atmospheric testing of nuclear weapons in the 1950s and 1960s, and provide unique tools for studying mixing processes in the upper ocean. As the tritium has decayed and undergone dilution by mixing, it has been essential for Dr. Jenkins to continually improve the sensitivity of his methods. He has developed state-of-the-art advection-diffusion models and three-dimensional graphic simulations which allow estimation of water mass velocities and mixing rates over time scales that were previously inaccessible. He was also one of the first to point out that simple vertical mixing processes could not explain the observed distribution of tracers, and developed quantitative models which demonstrate the importance of isopycnal mixing and advection. He also showed that tritium-helium ages could be used to calculate oxygen utilization rates and that these were higher than expected. These results led to the conclusion that earlier measurements of new production were too low. He has also made fundamental contributions to solid earth geochemistry through studies of seafloor hydrothermal systems. He is one of those rare people who can make superb measurements and formulate sound, quantitative models for the insightful interpretation of these data. Throughout his career, his research has illuminated key oceanographic processes and advanced our understanding of global climate processes.

The award is to be presented by the Royal Society of Canada at a special ceremony at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia at 1400 on Tuesday, 12 December 2000. The presentation will be followed by the annual Huntsman Lecture, given by Dr. Jenkins, and a reception.

The A.G. Huntsman Award was established in 1980 by the Canadian marine science community to recognize excellence in research and outstanding contributions to marine sciences. The award was created to honour the memory of Archibald Gowanlock Huntsman (1883-1972), a pioneer Canadian oceanographer and fishery biologist. It honours those men and women, of any nationality, who have had and continue to have a significant influence on the course of marine scientific thought. The A.G. Huntsman Award reflects the multifaceted nature of marine research and is presented annually in one of three categories: marine geosciences, physical/chemical oceanography, or biological oceanography. The A.G. Huntsman Award is funded by Fisheries and Oceans Canada, Natural Resources Canada, the Province of Nova Scotia, and the Canadian Association of Petroleum Producers.

Further information can be obtained on the Huntsman Award by writing the A.G.Huntsman Foundation, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, Canada. The category for the 2001 award will be biological oceanography.

Donald Gordon
Marine Environmental Sciences Division
Bedford Institute of Oceanography
PO Box 1006, 1 Challenger Drive, Dartmouth
Nova Scotia B2Y 4A2
Phone: (902) 426-3278; Fax: (902) 426-6695
E-mail gordond@mar.dfo-mpo.gc.ca
http://www.bio.gc.ca/bio/huntsman/huntsman.htm

[3] Première publication dans Océans Septembre-Octobre 2000.

RSI Awarded LANDSAT 7 Contract

RADARSAT International (RSI) of Richmond, Canada, announced on October 24, 2000, that they have been awarded a contract by the U.S. Department of Agriculture (USDA) to supply LANDSAT 7 data for agricultural monitoring of the United States. The indefinite delivery/indefinite quantity (ID/IQ) contract has a potential value in excess of $800,000 US if all items of the contract are exercised. An option exists in the contract for the USDA to renew the contract for an additional four years.

RSI was selected for the contract based on their ability to meet product specification, cost-effectiveness and their reputation for excellent service and product delivery. High-quantity processing of the LANDSAT 7 data will take place in RSI's production facility in Richmond, Canada, using the advanced algorithms of their Product Generation System (PGS). The processed imagery will supply crop production and crop condition information for up to 66 million square kilometres of US agricultural lands.

"This contract will see RSI deliver high volumes of LANDSAT 7 optical data to an operational client - the USDA. It demonstrates that RSI is not only the world's leading supplier of Synthetic Aperture Radar data and products, but increasingly of optical satellite data and products" said Kevin O'Neill, RSI Sales Director - Western North America.

RSI is a world-leading provider of data products, information services, and training based on satellite imagery acquired from most commercial Earth-observation remote sensing satellites. Their global markets range from natural resource management and environmental monitoring to defence and mapping. RSI has its headquarters in Richmond, British-Columbia (Canada), and offices in Ottawa, Ontario (Canada), Gatineau, Québec (Canada) and Farnham (United Kingdom).

Wind Farming in PEI

As a sign of its commitment toward addressing climate change concerns, Prince Edward Island has signed a Memorandum of Understanding with the federal government to examine the feasibility of establishing a wind farm at North Cape. The press release is available at http://www.gov.pe.ca/news/

A Community-based Environmental Observation Program

The Nova Scotia Museum of Natural History has received $185K from the Climate Change Action Fund to revive a 100-year-old local nature observation program using schools, community groups and keen individuals to observe the natural response to climate change. For information, access http://www.cciw.ca/eman-temp/weeklies/century_ago.html

NEPTUNE Project Update

NEPTUNE will be the world's first big undersea network to monitor the seafloor and the ocean above it. The Canadian report on the "Feasibility of Participation in the NEPTUNE Undersea Observatory Network" has now been completed and submitted to governments. It is available at http://www.neptunecanada.com

State of the World's Ecosystems

A report released on 21 October by the World Resources Institute states that the world's freshwater systems are so degraded that their ability to support human, plant, and animal life is greatly in peril. The report, "Pilot Analysis of Global Ecosystems: Freshwater Systems", is available at http://www.wri.org/wri/wr2000. Other reports will be released in the next six months covering agro-ecosystems, coastal areas, forests, and grasslands.

Just Fish: Ethics and Canadian Marine Fisheries

A team of scientists examined justice in the Canadian fisheries in order to seek an ethical foundation upon which to base guidelines for fisheries policies and decision-making in the future. "Just Fish", the result of their work, argues that Canada could - and must - become a world leader in developing fisheries management institutions that can protect the interests of both fish and the fishers. For information, access http://www.fisheries.ubc.ca/Projects/Ethics/ethics.htm

Marine Activity and Risk Analysis in the Coastal Zone

The goal of a multi-partner GEOIDE project entitled "Marine Activity Geomatics and Risk Analysis in the Coastal Zone" is to determine the leading causes of marine incidents and accidents. The information collected will be analysed with the Search and Rescue Marine Analysis Program (SARMAP) GIS. The Canadian Coast Guard, partners in the project, will rely on the risk model to assist with planning for the acquisition and deployment of Search and Rescue resources. For information, email Ronald Pelot at ronald.pelot@dal.ca

LONG-RANGE WEATHER AND CROP FORECASTING

WORKING GROUP MEETING IV

REGINA 2001

The *ad hoc* Long-Range Weather and Crop Forecasting Working Group Organizing Committee warmly invites you to attend a workshop at **Regina, Saskatchewan, CANADA** from March 5 to 6, 2001.

The purpose of this year's workshop is to unite representatives from the scientific and user communities for discussions on seasonal weather forecasting and its application to agriculture and water resources. Researchers, meteorologists, operational forecasters, agronomists, producers, and user representatives from across Canada and beyond will gather in Regina to address the latest issues in seasonal climate prediction and crop forecasting. In addition to individual presentations, the meeting will feature distinguished keynote speakers and working group sessions covering a broad array of topics.

Topics for presentation at the Regina 2001 workshop include:

- *Progress in seasonal forecasting in the past 10 years*
- *Science/user dialogue*
- *The impact of global warming on climate variability and seasonal forecasting*
- *Causes of the North American growing season conditions in 1999 and 2000*

The two-day workshop in Regina will be the fourth in a series of *ad hoc* meetings organized by the **Long-Range Weather and Crop Forecasting Working Group**. The first meeting was held in 1993 at the National Hydrology Research Centre in Saskatoon. The Canadian Wheat Board hosted the second meeting in 1995 in Winnipeg. The third, and most recent, workshop was held in 1997 at the Canadian Meteorological Centre in Dorval, Québec. These meetings have been highly successful in bringing together representatives from the research, forecasting, and user communities to review the progress of seasonal climate predictions.

If you wish to participate in this year's workshop, please contact...

Ted O'Brien, Prairie Farm Rehabilitation Administration, Prairie Agroclimate Unit, Regina, Saskatchewan,
Tel. (306) 780-6000 Email: obrient@em.agr.ca

For more information, visit our website: http://www.agr.ca/pfra/conf2001.htm

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Saskatchewan Research Council (SRC)

35th Congress of the Canadian Meteorological and Oceanographic Society
May 27 - June 01, 2001
Winnipeg, Manitoba Canada

Call for Papers

EXTREME Weather

The 35th Congress of the Canadian Meteorological and Oceanographic Society (CMOS) will be held from May 27-June 01, 2001, at the Sheraton Hotel in Winnipeg, Manitoba, Canada. The theme of the 35th CMOS Congress is **Extreme Weather**. Papers are being solicited on all aspects of extreme weather events found globally such as severe thunderstorms, tornadoes, tropical cyclones, flooding, droughts, blizzards, etc. Particular emphasis should be placed on forecasting, impacts, warning and emergency preparedness, remote sensing, numerical, atmosphere-ocean interactions, and climate modelling and variability, as they relate to extreme weather. All presentations relating to this topic and additional related topics which can tie into the overall theme are welcomed. A pre-print volume is being planned which will contain all accepted abstracts. The final date for abstract submission is February 28, 2001. Contributing authors are encouraged to submit as early as possible for this major international conference.

For more information, please contact:

Jay Anderson, Prairie Storm Prediction Centre
Suite 150 123 Main Street
Winnipeg, MB Canada R3C 4W2
phone: 204-984-7923; fax: 204-983-0109
e-mail: jay.anderson@ec.gc.ca

35e congrès de la Société canadienne de météorologie et d'océanographie
27 mai - 1er juin 2001
Winnipeg (Manitoba) Canada

Demande de communications

Météo EXTRÊME

Le 35e congrès de la Société canadienne de météorologie et d'océanographie (SCMO) se tiendra du 27 mai au 1er juin 2001 à l'hôtel Sheraton de Winnipeg (Manitoba), Canada. Le thème de ce 35e congrès portera sur les conditions météorologiques extrêmes. Nous acceptons dès maintenant toute proposition de communication traitant d'un ou plusieurs aspects des conditions météorologiques extrêmes dans le monde telles que les orages violents, les sécheresses, les tempêtes de neige, etc. L'accent doit être mis sur les méthodes de prévision, les impacts, la diffusion d'avertissements, la capacité d'intervention en cas d'urgence, la télédétection, les données numériques, l'interaction entre l'atmosphère et l'océan, la modélisation du climat ou les changements climatiques, et le sujet doit être traité dans le cadre des conditions météorologiques extrêmes. Toutes communications traitant de ce sujet ou de domaines connexes ayant un rapport avec le thème principal seront examinées. Nous prévoyons publier un volume préliminaire contenant tous les résumés acceptés. La date limite pour la présentation des résumés est fixée au 28 février 2001. Nous conseillons aux auteurs désirant soumettre un résumé à cette grande conférence internationale d'envoyer leur dossier le plus tôt possible.

Prière de contacter Jay Anderson pour plus de renseignements:

Centre de prévision des orages des Prairies,
123, rue Main, bureau 150
Winnipeg (Manitoba) Canada R3C 4W2
Téléphone : (204)-984-7923; Fax: (204)-983-0109
Courriel : Jay.Anderson@ec.gc.ca

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Figure 2

Sequence of 1.5 km CAPPI Images of the Pine Lake Storm

Série d'images CAPPI à 1,5 km, centrée sur la tornade de Pine Lake

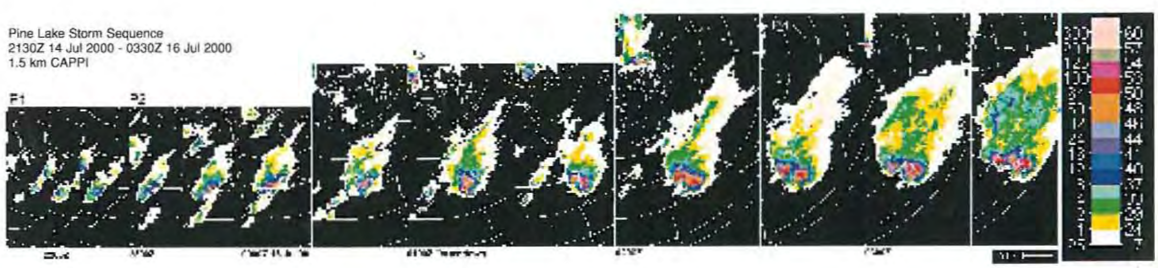

Figure 4

Radial Velocity Images of the Pine Lake Storm

Images en vitesse radiale de la tornade de Pine Lake