

## PARTICIPATION OF WSFO BUFFALO IN THE LAKE ONTARIO WINTER STORMS (LOWS) PROJECT

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### INTRODUCTION

In January and February of 1990 the Lake Ontario Winter Storms (LOWS) project monitored meteorological conditions over the eastern basin of Lake Ontario and upwind. The project applied advanced remote sensing techniques to lake effect storms to determine if the new technology could be used to provide more accurate forecasts and nowcasts of the location and intensity of snowbands. The project was sponsored by Niagara Mohawk Power Corporation, and involved the coordinated efforts of a number of other groups, including the NWS offices at Buffalo and Syracuse, NOAA's Wave Propagation Laboratory, Atmospheric Environment Service (the Canadian NWS), and researchers from the university community and the private sector. Now that the data gathering portion of the project has been completed, I would like to summarize our forecast efforts, and discuss some of the preliminary knowledge personnel at WSFO Buffalo have gained from the field program.

### FORECAST PROCEDURE

Throughout the duration of the LOWS project, forecasters at WSFO Buffalo were provided with reports from some of the project's advanced remote sensing equipment such as wind profilers and microwave

radiometers. WSFO Buffalo evaluated these high-resolution data sets and, as appropriate, used them to support and augment its regular warning and forecast programs. Project managers were able to make use of the forecasts to deploy personnel and equipment during lake effect snow events.

The forecaster on-duty was responsible for the issuance of a "Lake Snow Outlook" (LSO), which was appended to the standard State Forecast Discussion (SFD) 4 times a day. Each afternoon, a member of the forecast committee (other forecasters from the research and university communities) would call our office and discuss their forecast ideas with us, so that we could come up with a consensus forecast. This had been suggested as the best way to approach the forecast problem for these types of field programs (Doswell and Flueck, 1989). After a consensus was arrived at, the Buffalo forecaster would brief the LOWS project manager by phone about the potential for a lake effect snow event on Lake Ontario during the ensuing 48 hour period. Long range weather trends (a week in advance) were also prepared on request, based on the average 500 mb pattern encircling the northern hemisphere. In addition to the telephone briefing, we also issued a tape recorded telephone outlook which was available to all project participants. Twice each day, when time permitted, hard copies of forecast aids and

State Forecast Discussions were FAXED to the Operations Center at Niagara Mohawk in Syracuse. In addition, a full synopsis and outlook were issued as time permitted, over the Niagara Mohawk Electronic Mail (E-Mail) system.

### FORECAST PRODUCTS

One of our top priorities at Buffalo was to develop an objectively based forecast procedure for the field study that would produce consistent results regardless of who was issuing the forecast. This would also allow us to compile a more objective verification of forecasts issued for the field program. We have been using a computer generated product that was developed by our office over the years as an aid in daily lake snow forecasting. However, this product was unable to fully account for many of the synoptic scale forcing parameters that are important in lake snow forecasting, because the information is not available in alphanumeric form on AFOS. Therefore, a synoptic scale checklist was developed for use during the field program as a supplement to the computer generated forecast product.

The checklist monitored such synoptic scale forcing features as 500 mb vorticity advection, the location of the vorticity maximum, and the existence of synoptic scale cyclonic and anticyclonic curvature to the pattern, both at the surface and aloft. Studies by Jiusto et al. (1970), and Broumas (1977) noted the importance of synoptic scale motions in lake effect snow. Warren Snyder, from WSFO Albany has recently included these parameters as part of the forecast procedure in a PC-based lake snow forecasting program. An example of the synoptic checklist (Figure 1), and the computer generated product (Figure 2) that were used at WSFO Buffalo during the field program, and the Lake Ontario Snow Outlook (Figure 3) issued by WSFO Buffalo are included at the end of this report.

### NEW TECHNOLOGY

LOWS provided a host of forecast information to the project participants, and we were given the opportunity to use some of the project's new technology in real-time at WSFO Buffalo. Of main interest was the wind profiler data that was available from two separate sites along the south and northeast shores of Lake Ontario. As was anticipated, we weren't able to use this information directly to issue our forecasts, primarily due to our unfamiliarity with the new technology. In addition, the profilers were downstream of most of our forecast area, which was of little use in short term forecasting. Nevertheless, the ability to evaluate this new information in conjunction with standard observations and analyses provided a unique opportunity for the forecasters.

Time-height cross sections from the profilers were posted in the forecast area on an unscheduled basis, so forecasters could become familiar with the new technology. Synoptic scale maps (e.g., 850 mb heights and Surface Pressure) were posted along with the profiler data, so that we could compare these data.

Research teams are currently analyzing profiler and RASS (Radio Acoustic Sounding System) data for a significant freezing rain event that was handled poorly by the NMC models during the project. Results of these studies will no doubt be extremely valuable, because this is the first time we have had the chance to evaluate wind profilers for operational forecasting in the Great Lakes area.

Although Doppler radar data were not available to the forecasters in real-time, processed data will eventually be made available to our office by NOAA's Wave Propagation Laboratory. We hope to get an "advanced viewing" of this new technology in regard to lake effect snow sometime in the future.

We also had the unique opportunity to evaluate forecasts from a mesoscale numerical model that is being developed by Penn State University. The model operates on a 30 km grid over the eastern U.S. centered around Penn State, and includes all of the eastern Great Lakes.

The mesoscale model recognizes the thermal and frictional effects of the Great Lakes in greater detail. Forecasts from the model produced encouraging results for precipitation and moisture fields generated by lake induced snowbands. This is the first time I have seen a model of this capacity produce results that even approach the "real world" with lake snow forecasting. (I am extremely excited about the prospects of a model like this one to predict lake effect precipitation!) We were able, on request, to have output from this model FAXED to us at the forecast office, and in two cases, we used the model as input to the decision making process in a lake snow forecast. The model was one for two in these forecasts, with one hit and one bust.

### SUMMARY

As you can see, our office spent a lot of time and effort during the months of January and February of this year participating in LOWS. In my discussions with forecasters, I asked for their thoughts about the study. All suggested that the requirement to spend more time and effort on this specific forecast, increased their awareness of the problems associated with Lake Ontario snows. Because that region is at the extreme downwind side of our "area of responsibility" we sometimes are guilty of typical downwind biases, as well as the "out of sight-out of mind" bias for areas that are not in your own backyard. Concentrating on the area this winter has really given us an opportunity to fine-tune our forecasting skills there.

Although we did not work on a day-to-day basis with the new technology, we were at least introduced to it. Forecasters were able to see wind profiler data, model out-

put from a fantastic mesoscale numerical model, and evaluate new forecast aids which were developed on-station for the project. We were also able to test a new way to archive numerical model data and graphics.

Our office was asked to participate in this project because of our knowledge of lake snow forecasting. The forecasting program was very interesting, and we hope to learn a great deal more from the information gathered during the field program. In addition, the project gave us the unique opportunity to work with specialists from the research and university communities. This occurs at a time when the NWS is beginning to introduce new technology and interact more with the research community.

### REFERENCES

- Broumas, S. 1977: Vorticity and other relationships in lake effect storms. Unpublished report, National Weather Service Forecast Office, Buffalo, N.Y.
- Doswell, C. E. and J. A. Flueke, 1989: Forecasting and Verifying in a Field Research Project: DOPLIGHT '87. *Weather and Forecasting*, Vol 4, No. 2, pp 97-109.
- Jiusto, J.E., Paine, D.A., and M. L. Kaplan, 1970: *Great Lakes Snowstorms Part 2. Synoptic and climatological aspects*. ESSA Grant E22-13-60 (G) ASRC, SUNY at Albany, NY.

DATE: 1/12/12 Z

LAKE ONTARIO  
SYNOPTIC SCALE CHECKLIST FOR LAKE EFFECT PRECIPITATION

0-12HR 12-24HR 24-36HR 36-48H

1. Will vorticity lobe of greater than 18 cross lake: (+20)	-	-	+20	-
2. If not, will vorticity lobe of 12-18 units cross lake: (+10)	+10	-	-	-
3. Will a vorticity max cross the lake directly: (+10)	-	-	-	-
4. Will cyclonic curvature be occurring (sfc through 500mb): (+5)	+5	-	-	-
5. Will combination occur: anticyclonic curvature at surface: (0) and cyclonic curvature aloft:	-	-	-	-
6. If yes to 5, go to 8...else anticyclonic curvature aloft: (-10)	-	-10	-	-10
7. Will anticyclonic curvature at the surface be occurring: (-10)	-	-	-	-10
8. To determine potential inversion: Is NGM T5-T3 > 3 degrees: (-10)	-	-10	-10	-
Is NGM T5-T3 > 1 degree: (-5)	-	-	-	-
A. SYNOPTIC SCALE WEIGHTING	+15	-20	+10	-20

LAKE EFFECT GUIDANCE CHECKLIST

1. Will T(lake) - T(850) < 10 degrees through the period: (-35)	-	-	-	-
2. Will T(lake) - T(850) >= 10 degrees and < 13: (0)	-	-	-	0
3. Will instability class be CONDITIONAL: (+10)	+10	+10	+10	-
4. Will instability class be MODERATE: (+20)	-	-	-	-
5. Will instability class be EXTREME: (+30)	-	-	-	-
6. Will 850mb/BL wind direction be between 850-210 degrees: (-35)	-	-	-	-
7. Will 850mb/BL wind be 320-040 or 220-230: (0)	-	-	-	-
8. Will 850mb/BL wind be 240-310: (+20)	+20	+20	+20	+20
B. LAKE EFFECT GUIDANCE WEIGHTING	+30	+30	+30	+20

FORECAST VERIFICATION BASED ON SYNOPTIC/LAKE EFFECT GUIDANCE COMBINATION

FORECAST PERIOD	0-12HR	12-24HR	24-36HR	36-48HR	FORECAST DECISIONS
SYNOPTIC (A) + LAKE EFFECT (B) =	+45	+10	+40	0	60 > 40
FORECAST	GO	ALRT	GO	NO	ALERT TO 40
					NO 60 <

FIGURE 1: Lake Ontario Synoptic Scale Checklist for Lake Effect Precipitation of 1200 UTC January 12, 1990.

LAKE EFFECT GUIDANCE: ONTARIO INITIALIZED 12/12z

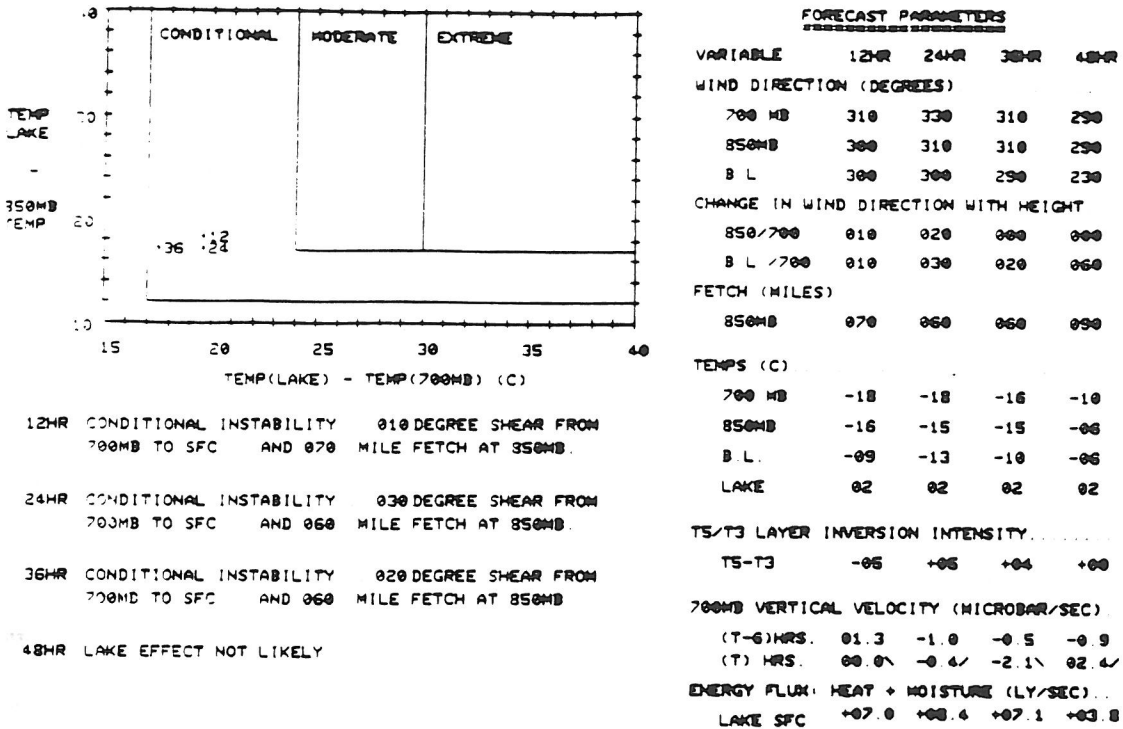


FIGURE 2: Automated Lake Effect Snow Guidance for 1200 UTC January 12, 1990.

TTA000 KBUF 121939  
 STATE FORECAST DISCUSSION  
 NATIONAL WEATHER SERVICE BUFFALO, NY  
 238 PM EST FRI JAN 12 1990

(PRELIMINARY SFD FOR LAKE ONTARIO SNOW PROJECT)

.NY WRN...SNOW SQL WRNG ZN4.  
 SNOW BLWG SHW ADV ZNS 1/21/22/2.

LAKE ONTARIO SNOW OUTLOOK

SYNOPSIS...ATTH RATHER DIFFUSE BANDS OVR EAST END OF LAKE AND BTR ORGANIZED NW/SE STRMS OVR WRN END. 1ST HS SHRT WV CROSSES LAKE THIS EVE...AND BTR ORGANIZED NW/SE BANDS SHOULD DVLP ALNG SE SHR AND INLAND TWRD SYR. SOME CAPPING COULD OCR OVRNGT AS NVA CROSSES RGN...LNKG THE BANDS. ON SAT...NXT SHRT WV SLIDES SE AND CROSSES LAKE DRG AFTN. FEELING NOW IS THAT BAND COULD RE-INTENSIFY AND ORGANIZE INTO SINGLE BAND OVR SYR (NW/SE) LT MRNG THRU ERLY AFTN. ACITIVY MAY MENADER NORTH SAT NGT...AS SFC RDG WORKS ITS WAY IN...THEN DSPT BY SUN. EXT OUTLOOK.. ZONAL SPLIT FLOW DVLPS OVR U.S. NXT WK...AND THAT WIL GIVE US ALL A GOOD CHANCE FOR FULL DE-BRIEFING.

NOW THRU 7 PM...GO...RATHER DIFFUSE SINGLE BAND SE END OF LK ONTARIO WITH MULTIPLE BANDS (NW/SE) REFORMING OVR LK.  
 7PM TO SAT 7AM...GO...MULTIPLE BANDS SOUTHEAST OF LAKE ONTARIO POSSIBLY WEAKENING OVRNGT.  
 SAT 7AM TO 7PM...GO...MULTIPLE BANDS MAY ENHANCE AND ORGANIZE INTO BAND FOR AML AND SYR.  
 SAT 7PM TO SUN 7AM...ALERT...MULTIPLE BANDS COULD DRIFT NORTH OVRNGT... THEN DSPT BY SUN MRNG.

TAM/JJP

FIGURE 3: Lake Ontario Snow Outlook issued by WSFO Buffalo at 1930 UTC January 12, 1990.