

COMET Final Report S02-38658

Applying high-resolution mesoscale models to winter precipitation forecasting

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SECTION 1: PROJECT OBJECTIVES AND ACCOMPLISHMENTS

We have successfully accomplished several goals of our COMET Partners Project. These are summarized below:

a) Development and implementation of an ensemble prediction system

A short-range, real-time, high-resolution mesoscale ensemble prediction system has been developed at the U.I. Atmospheric Sciences department, in conjunction with NSF funding on ensemble prediction methods. This system consists of seven model simulations centered on the Midwest, and is run daily at 0000 UTC, with a 1200 UTC cycle recently added. Ensemble fields are plotted and made available online at <http://blizzard.atmos.uiuc.edu/rt>. In order to span the range of uncertainties in short-range prediction, the ensemble set consists of multi-physics (varying planetary boundary layer and cumulus parameterization schemes), multi-analysis (NCEP Eta vs. Global Forecast System grids), and multi-model (MM5, Workstation Eta, and WRF) members. The ensemble applications include short-range forecast guidance for the National Weather Service as well as research into ensemble performance, spread and verification in warm- and cool-season Midwest weather.

Model	#Runs Comments		Initial Data Grid	
MM5	4 multi-physics	Eta 12	km	
Workstation Eta	2	multi-analysis	Eta / GFS	12 km
WRF	1	under testing	Eta	25 km

b) Development and generation of products tailored to winter precipitation forecasting

As part of our COMET efforts, we developed winter weather forecasting products within the U.I. ensemble system with an emphasis on prediction of winter precipitation type and amount. These products, selected after collaboration between the Atmospheric Sciences Department and the Lincoln NWS, were designed to forecast the range of possible winter precipitation scenarios and aid prediction of the timing, location, type and amount of precipitation falling in the Midwest, and particularly within the Lincoln NWS county warning area.

Product dissemination to the Lincoln, IL National Weather Service was carried out via the World Wide Web. The products included predictions of surface and 850 mb isotherms (i.e. freezing lines), maximum temperature in the column (to isolate layers of warm air aloft), skew-T/log-P diagrams, precipitation type, and precipitation (liquid

equivalent) amount. These products included individual model forecasts and spaghetti plots to help in identification of prediction clustering and outliers in the mesoscale forecasts. These forecast products were used and evaluated by Lincoln, IL National Weather Service forecast personnel throughout the 2002-2003 cool season.

The Lincoln, IL office carried out special rawinsonde launches at up to 6-hour resolution during three winter precipitation events in central Illinois in support of this Partners project. One disappointment of the project was the lack of severe winter weather during the 2002-2003 winter season. No significant freezing rain events occurred, nor was there any period of exceptionally heavy snowfall. Six minor snowfall events were documented in central Illinois. One major forecast bust occurred when an expected severe freezing rain event failed to occur.

After each significant winter precipitation event, discussions were held between National Weather Service personnel and U.I. Atmospheric Sciences staff by email and phone. The focus of these discussions included suggested improvements to the products and the performance of the real-time modeling system in the winter precipitation event.

SECTION 2: SUMMARY OF UNIVERSITY/ NWS/DOT EXCHANGES

The interaction between NWS and University personnel included several meetings at the Lincoln office and at the University of Illinois, email and phone exchanges between participants, and collaboration between the Lincoln office and University graduate student Marcia Estrem. The topics for discussion included

- pre-season planning - University of Illinois ensemble modeling system
- research and operational goals for the upcoming winter
- purchase of PC workstation for dedicated COMET project use at Lincoln office
- logistics of PC preparation for NWS use, including specialized software installation
- planned communication prior to, and scheduling and staffing necessary for, special rawinsonde launches at ILX for this project
- post-mortem discussions following local winter precipitation events, including assessment of ensemble model utility in snowfall and mixed precipitation forecasts
- use of NWS shift log to record forecaster perceptions regarding ensemble products
- additional ensemble modeling products requested by NWS forecasters, including soundings and spaghetti diagrams over the local IL region
- preparation of conference article for Weather Analysis and Forecasting conference
- Weather Analysis and Forecasting class from the University of Illinois visited the Lincoln National Weather Service Office during Spring, 2002.

SECTION 3: PRESENTATIONS AND PUBLICATIONS

The data and experience gathered during the COMET partners project led to the following case studies and analysis:

Mesoscale analysis of 14 February 2002 mixed precipitation event, notable as a severe mixed precipitation event that did not verify. The analysis is being carried out by graduate student Marcia Estrem as part of a Mesoscale class at the University. Her results will be shared with the Lincoln office when complete.

Weather Analysis and Forecasting Conference (San Antonio, TX) preprint and presentation by Brian Jewett of the U.I. Atmospheric Sciences department:

Lincoln, IL Science and Operations Officer Llyle Barker presented a seminar at the Department of Atmospheric Sciences in April, 2003.

Jewett, B. F., M. K. Ramamurthy, R. M. Rauber, J. Grim, L. J. Barker III, and D. Smith, 2002: Mesoscale ensemble prediction of winter precipitation in a severe winter storm. *Preprints, 19th Conf. on weather Analysis and Forecasting/15th Conf. on Numerical Wea. Pred.*, San Antonio, TX, Amer. Meteor. Soc., 64-65.

SECTION 4: SUMMARY OF BENEFITS AND PROBLEMS ENCOUNTERED

4.1: SUMMARY OF BENEFITS TO UNIVERSITY OF ILLINOIS

The Partners Project with NWS, Lincoln has benefited the University in several new ways. The Department of Atmospheric Sciences now has formal research collaboration with the National Weather Service office in Lincoln. Department personnel and Lincoln staff now collaborate in several activities beyond this Partners proposal. For example, we regularly discuss areas of common interest during Central Illinois AMS chapter meetings, and Lincoln and UIUC personnel participated in the recent Midwest Extreme and

Hazardous Weather Regional Conference held in Champaign. The UIUC classes on Weather and Forecasting reflect an increased emphasis on mixed precipitation and localized heavy snow, problems shared by the ILX office during the cool season. Graduate student Marcia Estrem's work with the Lincoln office during the COMET Partners project has led her to develop an independent research effort with Kevin Knupp of the University of Alabama-Huntsville to use the Mobile Integrated Profiling System (MIPS) this upcoming winter as her Masters thesis project on winter storms.

The primary difficulty encountered during the Partners project was the planned transmission of our regional ensemble prediction model data to the Lincoln office. Our computer staff worked with the Lincoln Information Technology Officer to ingest our model data into the ILX AWIPS system. Several technical software issues prevented the completion of this effort, which remains a goal of future collaboration. As a result, our data was made available to the Lincoln office entirely via web products.

4.2: SUMMARY OF BENEFITS TO NATIONAL WEATHER SERVICE OFFICE

WFO Lincoln benefited from our participation in this project in several important ways. First and foremost was an increase in the level of interaction and science sharing between ILX and UIUC. This closer relationship has lead to a heightened interest in applied research within the office's staff.

As discussed above, a major example of the enhanced interaction includes the organization of the AMS Midwest Extreme and Hazardous Weather Regional Conference held October 17-18 in Champaign. This conference was heavily supported by both the NWS and UIUC with seventeen of the forty presentations including a co-author from at least one of the two organizations. Six members of the WFO staff were available to attend this valuable meeting. A presentation is being prepared by some of the attendees to be given to the remainder of our staff. In addition, a staff member presented at the weekly seminar series at UIUC discussing a previous example of collaboration between the NWS and the research community. Several UIUC students recently visited the WFO to attend the 2003 ILX Winter Weather Workshop.

The availability of the UIUC ensemble datasets and their use in our operational forecast decisions has benefited the staff in both winter weather and convective situations. The UIUC suite has been used to supplement the NCEP operational models and ensembles in the local forecast process. The additional soundings launched as part of the project provided real-time input and validation of ongoing watches, warnings, and forecasts.

As mentioned above, the primary deviation from the original proposal was the method in which the UIUC data was made available to the ILX operational staff. Originally, the use of AWIPS was envisioned as the primary display tool. However, we were unable to set up this ability prior to the start of the 2002/2003 winter season. Extensive use is made of the Internet to access other non-routine data sources, and using the UIUC ensemble website to access the model information was not a hindrance in using the data in forecast formulation.