COMET FINAL REPORT

UNIVERSITY: University of Washington

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COOPERATIVE PROGRAM, SUBAWARD NO: S01-32797

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SECTION 1: SUMMARY OF PROJECT OBJECTIVES

The project has been a multifaceted National Weather Service/University of Washington initiative for improving the ability to understand and forecast the complex meteorology of the Pacific Northwest. The central objectives of this project are to further develop regional hydrological prediction and ensemble forecasting, as well as to continue the sustained and growing regional cooperation between the University of Washington and National Weather Service offices in the Pacific Northwest. More specific objectives of the proposed initiative include:

* The expansion, improvement, and evaluation of a distributed hydrological prediction system driven by the real-time MM5 forecasts made at the UW.
* Further development, evaluation, and dissemination of regional ensemble forecasts.
* Continued joint studies of local mesoscale weather features. A major project includes high-resolution simulations of Columbia Gorge flow.
*Continuation of a number of joint efforts, such as the Northwest Weather Workshop, student internships in NWS offices throughout the region, data exchanges, and other cooperative projects.

SECTION 2: PROJECT ACCOMPLISHMENTS

During past three years there has been significant progress in a number of areas:

a. One activity has been planning and running the annual Northwest Weather Workshops.

b. A major area of cooperation has dealt with hydrological prediction. A joint project, partially supported by COMET, has coupled a distributed hydrological model (DHSVM) with the real-time MM5 run at the UW. The real-time output from this hydrological modeling is available to the Seattle NWS office. Substantial improvements to the system have been tested during the past three years and several have been applied.

c. Major advances have been made in the area of regional mesoscale modeling and particularly in real-time regional numerical weather prediction. A major focus of NWS/UW joint research in this area is the development and evaluation of a regional short-range ensemble system. Brad Colman has been in an active participant in the planning and management of the regional ensemble system.

d. The student volunteer program has continued in which undergraduate students spend 3-10 hours per week at the Seattle forecast office. These students learn about the forecast process and NWS operations, and assist with a variety of tasks. A number of the UW interns have gone on to careers in the NWS.

e. University staff and WFO Seattle continue to manage the 915 MHz profiler with RASS installed at Sand Point. The data stream is being managed by the NWS/UW, with the data being archived at the UW. There has been a continuous and active interactive between the UW and NWS regarding the operation and interpretation of the data from this unit.

e. The regional mesoscale database has been further enhanced and is being made available to the NWS through MesoWest and directly into the Seattle AWIPS. A WFO forecaster has developed a GUI for more efficient forecaster utilization of the data.

f. Active and animated interactions have occurred between the Seattle NWS office and the UW on important local forecasting situations.

g. The NWS (Brad Colman) participated in IMPROVE field experiment post-field phase discussions and is an author of an article in the AMS Bulletin on the project.

h. Brad Colman has been participant in the Department weekly weather discussion and led the group on two occasions during the past six months.

i. The NWS has participated in a joint research project to evaluate means for producing and using uncertainty and probabilistic information. Sponsored by the Department of Defense, this project has included interviews with NWS forecasters by UW psychology and APL staff. Brad Colman and Chris Hill have participated in several meetings of this effort.

j. Cliff Mass has evaluated the NWS IFPS system and has written an article on it that was published in BAMS. He also gave a presentation at the Western Region MIC meeting on this topic.

k. A verification workshop was held at the UW to discuss various approaches to local forecast verification using the regional mesonet data

l. UW graduate student Eric Grimit has worked to create probabilistic products based on the ensemble system that are tailored to the needs of the Northwest NWS offices.

m. The UW is running the MM5 out to seven days at 36 and 12 km resolution for use in IFPS.

n. Completed a series of observational and modeling studies of the weather Columbia Gorge. Graduate student Justin Sharp has volunteered at the Portland NWS office.

SECTION 2: RELATED ACCOMPLISHMENTS

2.2.

WFO staff presented several lectures/seminars to UW Atmospheric Sci classes.

SECTION 3: SUMMARY OF BENEFITS

Benefits to the University resulting from the collaboration.

Some examples include:

a. The close relationship with the Seattle WFO has provided students with considerable exposure to operational forecasting. For example, several students are serving as volunteer interns at the Seattle WFO, and Brad Colman has lectured to several classes.

b. The cooperative relationship has made several data sets available to the university (e.g., 1 km visible satellite data, hydro data).

c. The cooperative effort has made possible the acquisition and operational transfer of the 915 MHz profiler data and Level II WSR-88D data.

d. The close association between the NWS and the UW has facilitated the employment of many UW students in the National Weather Service.

Benefits to the NWS office resulting thus far from the collaboration

a. The NWS continues to utilize Harry Edmon as a systems analyst resource. This has led to rendering the Hydrology Sun workstation more useful, which in

turn has resulted in more accurate flood forecasts on a number of occasions. The UW was also able to move a modified RIDDS program onto the Hydro Sun.

b. Once student volunteers become proficient in certain duties, time is freed up for NWS personnel to work on projects, etc. In addition, SCEP students have become proficient in Public Service Unit duties and have handled a coverage "gap" from 7am to 9am each morning. This has allowed forecasters to concentrate on meteorology and resulted in several more timely updates and more accurate forecasts.

c. Daily access to output from the MM5 mesoscale model ensembles by NWS forecasters has led to better deterministic forecasts. This was especially true for several borderline snow events. The MM5 forecasts have become more reliable and forecasters have become more familiar with model biases and behavior. This allows a smarter application of these data and an optimal mix of operational and experimental data streams in the local forecast process.

d. The Atmospheric Science department maintains the mesoscale network observations in real-time and as archives. The archives give NWS more time for studies, etc., since we do not have to devote resources to the archiving function. The real-time availability of the observations in a common format permitted a WFO forecaster to develop a GUI in C++ for displaying the data in an extremely forecaster-friendly manner. This has improved forecaster use of otherwise obscure data networks.

e. Free access to the University's data archive is also valuable. This archive includes microfilm of upper air and surface, all local surface observations including the non-standard set cooperatively collected, and many full resolution model grids. Several of the NWS forecaster studies relied upon this data archive.

f. Through the university-sponsored mesoscale modeling committee, the NWS developed closer ties with the Whidbey Island Naval Air Station meteorologists. As a result the WFO aviation focal point provided training to the Navy forecasters on several occasions, and the Navy forecasters have toured the WFO.

SECTION 4: PRESENTATIONS AND PUBLICATIONS

Publications

Sharp, J. and C. F. Mass, 2004: The climatological influence and synoptic evolution associated with Columbia Gorge gap flow events. Accepted in to *Weather and Forecasting*

Colle, B. A., M. F. Garvert, J. B. Wolfe, and C. F. Mass, "Microphysical Budgets and Sensitivity Studies for the 13-14 December 2001 IMPROVE-2 Event," J. Atmos. Sci. (IMPROVE Special Issue)

Garvert, M. F., B. A. Colle, and C. F. Mass, "Synoptic and Mesoscale Evolution of the 13-14 December 2001 IMPROVE II Storm System and Comparison with a Mesoscale Model Simulation," J. Atmos. Sci. (IMPROVE Special Issue)

Garvert, M. F., C. P. Woods, B. A. Colle, C. F. Mass, P. V. Hobbs and J. B. Wolfe, "Comparisons of MM5 Model Simulations of Clouds and Precipitation with Observations for the 13-14 December 2001 IMPROVE-2 Event," J. Atmos. Sci. (IMPROVE Special Issue)

Eckel, F. A. and C. F. Mass, 2004: Effective mesoscale, short-range ensemble forecasting. Accepted in *Weather and Forecasting.*

Stoelinga M. T., P. V. Hobbs, C. F. Mass, J. D. Locatelli, B. A. Colle, R. A. Houze, Jr., A. L. Rangno, N. A. Bond, B. F. Smull, R. M. Rasmussen, G. Thompson, and B. R. Colman, 2003: Improvement of Microphysical Parameterizations through Observational Verification Experiment (IMPROVE). *Bulletin. Amer. Meteor. Soc.*, **12**, 1807–1826

Vaughan J., B. Lamb, R. Wilson, C. Bowman, C. Kaminsky, S. Otterson, M. Boyer, C. Mass, M. Albright, J. Koenig, Alice Collingwood, Mike Gilroy and Naydene Maykut, 2004: A Numerical Daily Air-Quality Forecast System for the Pacific Northwest. *Bull. Amer. Meteor. Soc.*, **85**, 549–561.

McMurdie, L., and C. F. Mass, 2004: Major Numerical Forecast Failures in the Northeast Pacific. *Weather and Forecasting*, **19**, 338-356

C.F. Mass, 2003: Reply to Comments on "IFPS and the Future of the National Weather Service". *Weather and Forecasting*, **18**, 1305-1306

C. F. Mass et al;. 2003: IFPS and the Future of the National Weather Service. *Weather and Forecastin*g, **18**, 75-79

C. F. Mass et al;. 2003: Regional Environmental Prediction over the Pacific Northwest Prototype. *Bull. Amer. Meteor. Soc.*, **84**, 1353-1366

Sharp, J., and C. F. Mass, 2002: Columbia Gorge flow: insights from observational analysis and ultra-high resolution model simulation. *Bull. Amer. Meteor. Soc*., 18, 75-79

Grimit, E. P., and C. F. Mass, 2002: Initial results of a mesoscale short-range ensemble forecasting system over the Pacific Northwest, *Weather and Forecasting*, **17**, 192–205

Mass, C., D. Ovens, M. Albright, and K. Westrick, 2002: Does Increasing Horizontal Resolution Produce Better Forecasts?: The Results of Two Years of Real-Time Numerical Weather Prediction in the Pacific Northwest. *Bull. Amer. Meteor. Soc*., **83,** 407–430.

Westrick, K. J., P. Storck, and C. F. Mass, 2002, Description and evaluation of a hydrometeorological forecast system for mountainous watersheds. *Weather and Forecasting*, **17**, 250–262.

Colle, B.A., C. F. Mass, and D. Ovens, 2001: Evaluation of the timing and strength of MM5 and Eta surface trough passages over the eastern Pacific. *Weather and Forecasting*, **16**, 553-572

SECTION 5: SUMMARY OF PROBLEMS ENCOUNTERED

5.1 From the point of view of the academic partner: None

5.2 From the point of view of the forecaster partner: None

SECTION 6: PLAN OF WORK FOR THE NEXT YEAR

Work will continue on a number of cooperative projects:

1. Ensemble prediction: the real-time ensemble system will be expanded and new products will be developed. The UW and NWS will work to transfer these products to the NWS for display on AWIPS.

2. Hydrological prediction: the regional coupled MM5-DHSVM distributed hydrological system will be maintained and improved. The new NWS service hydrologist, Brent Bower, will be trained on the new system and will help with its development.

3. Planning for the next NW Weather Workshop.

4. NWS personnel will continue to participate in UW courses on weather forecasting and analysis. Furthermore, the active student intern program will be maintained.

5. UW/NWS interactions on local forecasting problems and difficult weather situations will continue.