Automated High-Resolution Ensemble-Based Hazard Detection Guidance Tool

Research to Operations Transition Plan

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March 7, 2016

Approval Page

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The below parties, by providing signatures, are satisfied with and approve of the transition plan outlined in this document, which may be reviewed on an annual basis and updated as needed.

For 4/15/16

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4.18.2016

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Table of Contents

1 Purpose/Objective

The weather ensemble era has benefited operational forecasters, providing them a much greater ability to assess the likelihood of specific hazardous weather phenomena. One downside, however, has been a significant increase in the volume of model guidance that must be synthesized, leading at times to information overload that can adversely affect the ability to extract key information from the ensemble guidance. While a variety of ensemble display tools have been developed (mean and spread, spaghetti-style plots, threshold exceedance plots, distribution diagrams, etc.), a strong need still exists for a coordinated research effort involving forecasters, ensemble model developers, and verification and communication experts to create improved ensemble guidance tools that help National Weather Service (NWS) forecasters communicate actionable forecast uncertainty information to their partners and the public.

The purpose of this Research to Operations Transition Plan is to describe an approach for transitioning the High-Resolution Ensemble-Based Hazard Prediction Tool (HPT) from a research platform to a long-term sustained operational capability within the NWS. HPT is a statistical postprocessing package focused on mesoscale high-impact weather features. Initially, the postprocessing utilizes outputs from available National Oceanic and Atmospheric Administration (NOAA) models: Rapid Refresh (RAP), High-Resolution Rapid Refresh (HRRR) and North American Mesoscale Rapid Refresh (NAMRR). The HPT is constructed in such a way that only minor adjustments will be needed to accommodate the next generation High Resolution Ensemble Forecasting (HREF) system, when it becomes operational. The HPT development procedure includes a strong interaction between developers and forecasters throughout the process. This interaction is facilitated by a risk communication research component. Research on NWS forecasters' practices and information needs will be conducted to help guide and enhance the effectiveness of the ensemble-based probabilistic information being developed. Data collection will focus on forecasters from the Weather Prediction Center (WPC) and Weather Forecasting Offices (WFOs), but data also will be gathered as it pertains to these forecasters' collaboration with others within NWS as well as with external NWS partners. For example, during events that pose significant risk, data may be collected from NWS briefings to better understand the uncertainty-related information needs and uses. Specifically, this research will include:

- understanding forecasters' critical challenges and needs for assessing and conveying precipitation-related and other forecast hazard uncertainty information;
- identifying critical gaps in forecasters' communication of actionable probabilistic information within the NWS and to NWS partners
- using the knowledge derived from the prior steps to guide development of ensemble-based probabilistic products that are useful to NWS forecasters in their assessment and communication of hazards; and
- identifying and using current and new metrics to assess the skill of probabilistic products.

A key goal of this project is to reduce information overload in the forecast environment and help provide reliable guidance that is useful and usable for forecasting and communicating high-impact mesoscale features.

2 Research background

The product being developed is an automated hazardous prediction "tool" (HPT; guidance grid and / or graphic) that will depict the location, timing, duration, and likelihood of hazardous mesoscale features including heavy rain (bands, regions, etc.), heavy snow (bands, regions), areas of low visibility, high winds, etc. The guidance is based on ensemble predictions provided by recent high-resolution model forecasts. The HPT will be flexible enough to process whatever HREF suite is operationally available at the time. The HPT is intended to synthesize the large amount of convective-allowing ensemble model guidance available to forecasters and provide post-processed guidance that can further inform their decision-making.

3 Business Case

3.1 The end users

- Primary users include:
    - NWS National Centers (WPC, SPC and AWC);
    - NWS operational forecasters (NCEP, WFOs, and Center Weather Service Units [CWSUs]);
    - NWS operational hydrologists (Regional Forecast Centers [RFCs] and WFOs).
- Secondary users include NWS partners.

3.2 Societal and economic benefits

- HPT will improve forecast accuracy of high-impact weather features (rain bands, snow bands, low ceilings).
- HPT and associated social science evaluation will improve development and communication of useful and usable probabilistic hazard information.
- HPT and associated objective evaluation will improve forecaster confidence in using probabilistic products.
- HPT will aid forecasters' assessment of high-impact weather threats by:
    - allowing more rapid synthesis of model ensemble guidance;
    - serving as a first guess for various forecast elements (e.g. probability of precipitation exceeding a specific thresholds);
    - facilitating trend-monitoring to guide short-term forecast updates.
- HPT will enhance forecasters' communication of uncertainty information to their partners

3.3 User Requirements

In recent years operational forecasters have gained access to an expanding suite of ensemble forecasts and products, providing them an ability to assess uncertainty information related to hazardous weather phenomena. One consequence is a notable increase in the volume of model guidance that needs to be processed and synthesized, leading at times to information

overload. Although a variety of ensemble displays have already been developed, there is a strong need to create improved ensemble-based hazard prediction tools that will aid forecasters in their decision-making and communication of forecast uncertainty to partners and the public.

As far back as 2008, a comprehensive survey of U.S. NWS operational forecast managers (Novak et al. 2008) identified a crucial need to make the description of uncertainty information in existing or new products and services a collaborative effort between ensemble developers, forecasters, academic partners, and users. One of the key findings of the survey was forecasters' desire to have an event- or feature-specific verification tool (e.g., Ebert and McBride 2000 and Davis et al. 2006) to assess value of existing ensemble prediction systems, particularly for high-impact events. The forecasters' answers implied that if such a tool showed value added by ensemble systems over deterministic forecasts for high-impact events, they would rapidly adopt use of ensemble forecasting systems as the main guidance (Novak et al. 2008). Among operational forecasters participating in a 2011 survey, the highest-ranked issues with ensemble use related to the lack of ensemble tools/graphics (http://itpa.somas.stonybrook.edu/CSTAR/Surveys.html).

3.4 Current system

Early development started in 2009 with the HRRR Convective Probability Forecast (HCPF). This work included identification of general convection hazards in HRRR forecasts, followed by testing various spatial and temporal filters and modulating the number of members for optimal performance. In 2011-2012 the HCPF was expanded to include tornado potential. In 2013 real-time production was initiated, along with a GRIB2 LDM feed from Global Systems Division (GSD). In 2014, the focus was on improving real-time probabilistic verification of HCPF with Multiple-Radar/Multiple-Sensor (MRMS) radar mosaic data. The prototype system has a Readiness Level (RL) of 6 (prototype demonstration, full-scale realistic engineering feasibility demonstrated in actual application).

3.5 Justification/acceptance criteria for transition

Acceptance will depend on the user groups recommending the implementation, based on forecaster feedback gathered via multiple testbed and real-time evaluations. Criteria for acceptance will include:

- HPT running reliably on the Integrated Dissemination Program (IDP).
- HPT performance and utility.
- Positive evaluation by forecasters on the content, skill, and usability of the model-based products/tools. Feedback will be collected through:
    - testbed activities (Hazardous Weather Testbed; HWR, Flash Flood and Intensive Rainfall; FFaIR, Winter Weather Experiment; WWE) in years 1 and 2, and Operations Proving Ground near the final stages of the tools/products;
    - observations of and interviews with forecasters.
- Effective collaboration with Forecasting A Continuum of Environmental Threats (FACETs)-related activities.
- Completion of forecaster training on the HPT.

- Compliance with the proposed timeline.

4 Capabilities and Functions

4.1 Current Capability

As mentioned above, the prototype system has a Readiness Level (RL) of 6 (prototype demonstration, full-scale realistic engineering feasibility demonstrated in actual application). It has been running in real time and producing grids that have been delivered to Aviation Weather Center (AWC) and Storm Prediction Center (SPC) for the last five years. Over the next three years the RL will be advanced to level #8 by expanding the system to include additional Numerical Weather Prediction (NWP) models, developing more products tailored to forecasters' needs, and transitioning the final system to operations. Two project teams (NCEP/EMC, ESRL/GSD) have extensive experience working with the National Centers for Environmental Protection (NCEP) Central Operations (NCO) on transitioning modeling systems to operations, which will greatly facilitate this transition. **The process of increasing the RL of the system and its implementation to operations is described in section "Schedule and Deliverables".**

In terms of concept of operations, NOAA/ Earth Systems Research Laboratory (ESRL)/GSD provides overall project management. A final version of the product will demonstrate and provide the capability, and "get in the queue" for IDP on-boarding as a separate "implementation phase."

The final system will include the following features:

- Operational models (HRRR initially, and NAMRR when it becomes available) will provide input data for the HPT.
- Forecast calibration and product generation will be performed in real-time, as soon as the input data is available.
- HPT output will be in GRIB2 format, which is compatible with second generation of Advanced Weather Interactive Processing System (AWIPS-II) and NCEP Advanced Weather Interactive Processing System (NAWIPS) and widely used across the weather enterprise.
- Product validation, quality assurance, and improvements to calibration techniques will be transferred from GSD to the Environmental Modeling Center (EMC)/NCO on a yearly basis to ensure that the product meets user requirements.
- All HPT output will be archived on NOAA mass storage.

4.2 Planned End State

The end result consists of reliable, calibrated probabilistic guidance for a variety of hazards, running operationally on a central server. NCO will own and operate the code in its end state, with guidance available from ESRL/GSD during normal working hours to correct any unforeseen issues. If possible products will be transmitted in real-time over the AWIPS-II Satellite Broadcast Network to all national centers and WFOs. The backup dissemination option will be through NOAA National Operational Model Archive and Distribution System (NOMADS).

It should be emphasized that this plan is for implementation of statistical post-processing methods for existing, operational numerical weather prediction models. Technical aspects of the transition are much less complex than, for example, an entirely new model. Adding our products to the AWIPS-II data stream is analogous to adding a small number of additional fields from an operational model, and as such will result in negligible increases in bandwidth usage, and require minimal changes to AWIPS-II software.

5 Transition Activities

The transition of the HPT into operations will occur incrementally. The process will begin with a limited number of products made available to national centers and evaluated at testbeds (WWE, HWT, FFaIR, etc.). With time, the number of products will increase and the HPT will gain additional exposure in the Operations Proving Ground and WFOs. In the final phase of the project, the full suite of products will be generated operationally on IDP and made available to all user groups.

5.1 Line Office Transition Managers Committee (LOTMC) role

Projects will be reviewed on a semiannual basis to ensure they are responsive to mission requirements and identify R&D outputs ready to be transferred to operational status. As with all transition projects, the LOTMC must evaluate the portfolio of funded projects to:

- Confirm that activities are executed on schedule and as outlined in the transition plan;
- Ensure that Transition Project Leads are reporting progress in accordance with NOAA Administrative Orders (NAO) 216-115 and NAO 216-105;
- Ensure that Transition Project Leads are actively addressing any risks and execution concerns (i.e., statement of work concerns);
- Determine when and if a project has achieved all stated objectives and qualifies for higher RL classification, or if a project is mission proven and is eligible for operational deployment;
- Evaluate and approve or disapprove of all project course changes; and
- Determine if a project needs to be discontinued for failure to meet stated objectives.

If, during the course of project delivery, the LOTMC determines that the information assurance and / or resources are not sufficient to sustain continued research or full deployment,

the LOTMC may recommend termination of Research to Applications, Operations, and Services (R2X) funding prior to completion.

5.2 Factors & Needs for Transition to NWS Operations

- Numerical model guidance:
  - Initial operational capacity will require the use of HRRR. At later stage there is the intention for inclusion of NAMRR followed by members of HREF.
- Data Collection: None.
- Equipment and Software Upgrades:
  - AWIPS-II usage in national centers, minor changes to AWIPS-II software.
- Staff Training: Forecaster training on new postprocessing methodologies.
- Redundant Capability Maintenance: None.
- Post-Transition Support: 24/7 availability on the IDP.

6 Schedule and deliverables

6.1 Implementation Plan

If the detailed plan is needed we will work with NCO colleagues on its development.

If the demonstration of this project is successful, then the operational implementation phase of this project will follow NWS operational implementation process. GSD will render any help NWS needs in development of the operational implementation plan.

6.2 Milestones and Deliverables

- Year 1
  - General Goal(s): Develop a preliminary set of precipitation, winter weather, and severe weather products for evaluation at testbeds.
  - Specifics:
    - Winter weather hazards and Probabilistic Quantitative Precipitation Forecast (PQPF) disseminated in GRIB2 format from ESRL LDM to WPC NAWIPS for WPC Winter Weather Experiment by January 2016.
    - Winter weather hazards on the web by January 2016.
    - Severe weather hazards disseminated from ESRL LDM to the National Severe Storms Laboratory (NSSL) NAWIPS and AWIPS-II for SPC/NSSL Spring Experiment by May 2016.
    - Refined version of PQPF and flash flood guidance from ESRL LDM to WPC NAWIPS for WPC Flash Flood and Intensive Rainfall experiment by July 2016.

- Development of new capabilities of Model Evaluation Tools (MET)/Method for Object-based Diagnostic Evaluation (MODE) as agreed by the team.
- Quantitative evaluation of the product using enhanced MET/MODE.
- Be engaged with FACETs/GSD AWIPS-II team to facilitate future integration of the HPT into /Probabilistic Hazard Information (PHI)-enabled Hazard Services on AWIPS-II.
- Communicate with FACETs team on social science aspects of the projects.

- Year 2
  - General Goal(s): Refine the initial products and expand the suite to additional winter, flash flood and aviation related hazards.

  - Specifics:
    - Initial aviation hazards disseminated from ESRL LDM to AWC NAWIPS for AWC Summer Experiment by August 2016.
    - Refined winter weather hazards and PQPF disseminated from ESRL LDM to WPC NAWIPS for WPC Winter Weather Experiment by January 2017.
    - Refined severe weather hazards disseminated from ESRL LDM to NSSL NAWIPS and AWIPS-II for SPC/NSSL Spring Experiment by May 2017.
    - Refined version of PQPF and flash flood guidance from ESRL LDM to WPC NAWIPS for WPC Flash Flood and Intensive Rainfall experiment by July 2017.
    - Quantitative evaluation of the product using MET/MODE.
    - Continue an engagement with FACETs team.

- Year 3
  - General Goal(s): Finalized the product suite and transition to operation IDP system.

  - Specifics:
    - Aviation hazards disseminated from ESRL LDM to AWC NAWIPS and AWIPS-II for AWC Summer Experiment and Operation Proving Ground by August 2017.
    - Demonstration of the capability during the WPC Winter Weather Experiment on January 2018.
    - "Get in the queue" for IDP on-boarding as a separate "implementation phase."
    - Complete AWIPS-II necessary configuration changes at WFOs nationwide.
    - Continue an engagement with FACETs team.

6.3 Transition Plan Update Schedule

The Research to Operations Transition Plan will be reviewed annually and updated as needed.

7 Roles and Responsibilities (for the TRANSITION)

- GSD personnel, will be responsible to demonstrate and provide the capability, and "get in the queue" for IDP on-boarding as a separate "implementation phase."
- GSD will provide a technical document for the product to facilitate the transition and future maintenance.

8 Budget overview

8.1 Current system

Subject to availability of appropriated funds, the demonstration part of this project is funded by the USWRP at a cost of 2.25M over three years starting in June 2015.

8.2 Cost of transition

Estimated cost for the transition is ~1.0 FTE (200K) each for GSD and NWS, likely split among different personnel, for one year. Although mostly leveraging the existing IT infrastructure (Weather and Climate Operational Supercomputing System [WCOSS] and IDP), additional funds for technical support and hardware (storage and/or processors), may be needed. The 1 FTE estimate for a year includes preparation of training manuals and training execution. Once the system is in operations, GSD personnel would be responsible for responding to any potential issues with the code that NCO personnel is unable to address. This cost will be absorbed by GSD.

The transition cost provided in this section is subject to availability of appropriated funds.

9 Impacts of Transition

9.1 Budget spend plan

GSD – 1 FTE ($200k) for transition, training material development, initial IDP troubleshooting
NWS – 1FTE ($200k) for training execution
NCO – $25-50k for new IDP hardware
Total: $425-450k

The spending plan provided in this section is subject to availability of appropriated funds.

9.2 Risks and Mitigation

The primary risk for the HPT transition is encountering potential technical issues or changes to AWIPS-II software. We have already begun to mitigate this risk by initiating communication with NCO and the GSD AWIPS-II team in the first few months of the project. Hence we consider this a low risk.

References

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2. Ebert, E. E., and J. L. McBride, 2000: Verification of precipitation in weather systems: Determination of systematic **errors**. *J. Hydrol.,* **239,** 179–202.
3. Novak, R. D., B. A. Colle, S. E. Yuter 2008: High-Resolution Observations and Model Simulations of the Life Cycle of an Intense Mesoscale Snowband over the Northeastern United States, *Monthly Weather Review*,Volume 136, Issue 4, pp. 1433-1456.

Appendix-A: Detailed milestones and deliverables

Year 1 (May 1, 2015 - April 30, 2016)
Months 1-3

● Coordination meeting amongst participating organizations to ensure roles, responsibilities, reporting, etc. (GSD, EMC, NCAR, WPC,WFOs)
● Meetings and discussion on product generation to identify specific features and formats of interest to forecasters (GSD, EMC, WPC, NCAR)
● Meetings and discussion to identify necessary variables, metrics for evaluation, WFOs to include in study, interview protocol (NCAR lead)
● Establish SVN code repository for initial version of hazard generation software (GSD)
● Produce initial set of test products with time-lagged ensemble HRRR (GSD)

Months 4-9

● Modify code to include additional input datasets (EMC NAM CONUSnest) (GSD, EMC)
● Modify code to include additional predictors/criteria for initial set of winter products (snow bands, precipitation type, etc.), targeting WPC WWE, Jan. 2016 (GSD, EMC)
● Transfer grib2 format grids to WPC and NWS forecast offices for forecaster use and to the National Center for Atmospheric Research (NCAR) for MODE verification (GSD, WPC, NCAR)
● Develop preliminary verification system on NOAA supercomputer (e.g. Zeus or Theia) for 1-2 ensemble products and initial operating capability for Ensemble-MODE evaluation of snowbands (NCAR)
● Visit WPC to observe use of uncertainty in forecast process and interview forecasters (NCAR, WPC)
● Prepare and execute evaluation of initial set of cold season products during 2016 WPC Winter Weather experiment (WPC ~ 4 mos. effort)
● Participation in WPC WWE, Jan/Feb 2016 (GSD, NCAR, EMC)

Months 10-12

● Meeting to discuss initial feedback from WPC WWE, obtain recommendations for refinements and enhancements to winter weather hazard guidance (GSD, EMC, NCAR, WPC, WFOs)
● Demonstrate initial MODE capabilities and explore use of MODE Time Delay (MODE-TD) on variables relevant to snowband prediction (NCAR)
● Visit WFO, observe use of uncertainty in forecast process, interview forecasters (NCAR)
● Identify enhancements needed to verification system per user feedback (NCAR)
● Provide preliminary guidance on communication of uncertainty based on forecaster interviews (NCAR)

Year 2 (May 1, 2016 - April 30, 2017)
Months 13-18

● Participation in WPC FFaIR, summer 2016 (GSD, NCAR, EMC)
● Creation of refined warm season hazard detection products, with initial focus on heavy precipitation, but also including severe weather hazards (GSD, EMC).
● Testing and refinement of warm season hazard detection products (GSD, EMC)
● Add NAM-RR model output to hazardous product detection package, pending NAM-RR operational implementation.
● Enhance MET system to extend capability to rainbands and intense rain swaths (NCAR)

● Transfer grib2 format warm season hazard detection grids to WPC and NWS forecast offices for forecaster use and to NCAR for MODE verification (GSD, WPC, NCAR)
● Perform Research to Operations (R2O) work, now including active engagement with WFOs and GRIB2 data displays in AWIPS II including evaluation of initial set of warm season intense precipitation products (WPC ~ 4 mos. effort)
● Participation in WPC FFaIR, summer 2016 (GSD, NCAR, EMC)
● Visit WPC and demonstrate enhanced verification capability (NCAR)

Months 19-24
● Coordination meeting to refine planning for enhancements to cold season hazard detection products and plan for transition to operations (GSD, EMC, NCAR, WPC, WFOs)
● Perform additional R2O work, continuing active engagement with WFOs and GRIB2 data displays in AWIPS II (WPC ~ 2 mos. effort)
● Participation in WPC WWE, Jan/Feb 2017 (GSD, NCAR, EMC)
● Second WFO visit to conduct additional forecaster interviews (NCAR)
● Integrate additions to MODE and MODE-TD into MET repository, identify final enhancements needed for verification system per user feedback (NCAR)
● Provide additional guidance on communication of uncertainty based on forecaster interviews (NCAR)
● Preliminary testing on NCEP computer of prototype hazard detection system using input from HRRR and NAM CONUSnest / NAM-RR (GSD, EMC)
● Coordination meeting to refine plan for enhancements to warm season hazard detection products, further planning for transition to operations (GSD, EMC, NCAR, WPC)

Year 3 (May 1, 2017 - April 30, 2018)
Months 25-36
● WPC support, consisting primarily of transition work(testing and feedback of prototype systems), with active engagement with WFOs in AWIPS II (WPC ~ 6 mos. effort)
● Participation in WPC FFaIR, summer 2017, focus on evaluation of pre-implementation version of warm season hazard detection guidance tools (GSD, NCAR, EMC)
● With feedback from WPC and NWS forecasters and NCAR colleagues, complete additional refinement of initial hazard detection system for initial operational implementation (GSD, EMC)
● Continue transfer of grib2 format grids to WPC and other national forecast centers and NWS forecast offices for forecaster use and to NCAR for MODE verification (GSD, WPC, NCAR)
● Participation in WPC WWE, Jan/Feb 2018, focus on evaluation of pre-implementation version of cold season prototype hazard detection guidance tools (GSD, NCAR, EMC)
● Coordinate and work with NCO on transition of initial operational hazard detection system to NCO (EMC, GSD)
● Visit WPC to conduct final interviews, provide final recommendation for communicating uncertainty for precipitation features to WPC and WFOs, transition verification system to WPC and provide user support.(NCAR)
● Subject to NWS approval, initial operational hazard detection system implemented as NCEP operation product, providing NWS forecasters at national centers and regional offices with automated high-resolution model ensemble-based hazard guidance tools.

Appendix-B: Certifications

MEMORANDUM

TO: John Cortinas, Director, OAR Office of Weather and Air Quality

SUBJECT: R2O Transition Project Proposal Certification

As outlined in the requirements for the OAR Office of Weather and Air Quality Announcement of Opportunity for Research to Operations Transition proposals, this memorandum serves as the certification letter signed by the Assistant Administrator, or their designate, from the R&D unit and the National Weather Service, as the operational unit.

The proposal meets the requirements and priorities of the competitive announcement, and is consistent with the strategic plans and priorities of the OAR and the NWS. Moreover, the proposal contains basic information describing a transition path, including dependencies for transitioning the results into operations, making it eligible to proceed with considering this proposal for funding.

Project Title: Refinement and Evaluation of Automated High-Resolution Ensemble-Based Hazard Detection Guidance Tools for Transition to NWS Operations

NWS Co-PI: Dr. David Novak

OAR Co-PI: Dr. Stan Benjamin

FOR 3/25/15

Louis Uccellini, Date
Assistant Administrator, NWS

Craig McLean, Date
Assistant Administrator, OAR

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Silver Spring, MD 20910
OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH

MEMORANDUM FOR: John V. Cortinas, PhD.
Director, Office of Weather and Air Quality

FROM: CDR Michael F. Ellis
Chief of Staff

SUBJECT: R2O Transition Project Proposal Certification

As outlined in the requirements for the Oceanic and Atmospheric Research (OAR), Office of Weather and Air Quality Announcement of Opportunity for Research to Operations Transition proposals, this memorandum serves as the certification letter signed by the Assistant Administrator, or their designate, from the Research and Development unit and the National Weather Service (NWS), as the operational unit.

The proposal meets the requirements and priorities of the competitive announcement, and is consistent with the strategic plans and priorities of the OAR and the NWS. Moreover, the proposal contains basic information describing a transition path, including dependencies for transitioning the results into operations, making it eligible to proceed with considering this proposal for funding.

Project Title: Refinement and Evaluation of Automated High-Resolution Ensemble-Based Hazard Detection Guidance Tools for Transition to NWS Operations

NWS Co-PI: David Novak, Director, NOAA/NCEP Weather Prediction Center

OAR Co-PI: Stan Benjamin, Chief, NOAA/ESRL/GSD Environmental Modeling Branch

Louis W. Uccellini, Ph.D.	Date	Craig N. McLean	Date
Assistant Administrator, NWS		Assistant Administrator, OAR	

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service
National Centers for Environmental Prediction
Weather Prediction Center
5830 University Research Court
College Park, Maryland 20740

March 20, 2015

MEMORANDUM FOR: John Cortinas

FROM: David Novak
WPC Director, HMT-WPC Testbed Manager

SUBJECT: Certification of testbed activity associated with USWRP Proposal

I certify that the proposed testbed demonstration work outlined in, "Refinement and Evaluation of Automated High-Resolution Ensemble-Based Hazard Detection Guidance Tools for Transition to NWS Operations" can occur in the Hydrometeorological Testbed – Weather Prediction Center (HMT-WPC) if selected for funding.

Appendix-C: Acronyms

1. AWC : Aviation Weather Center
2. AWIPS : Advanced Weather Interactive Processing System
3. CWSUs : Center Weather Service Units
4. EMC : Environmental Modeling Center
5. ESRL : Earth Systems Research Laboratory
6. FACET : Forecasting a Continuum of Environmental Threats
7. FFaIR : Flash Flood and Intense Rainfall
8. FTE : Full Time Employee
9. GSD : Global Systems Division
10. HCPF : HRRR Convective Probability Forecast
11. HPT : Hazardous Prediction Tool
12. HREF : High Resolution Ensemble Forecasting system
13. HRRR : High Resolution Rapid Refresh
14. HWT : Hazardous Weather Testbed
15. IDP : Integrated Dissemination Program
16. LDM : Local Data Manager
17. LOTMC : Line Office Transition Managers Committee
18. MET : Model Evaluation Tools
19. MODE : Method for Object-based Diagnostic Evaluation
20. MRMS : Multiple-Radar/Multiple-Sensor
21. NAM-RR : North American Mesoscale Rapid Refresh
22. NAO : NOAA Administrative Order
23. N-AWIPS : NCEP AWIPS
24. NCAR : National Center for Atmospheric Research
25. NCEP : National Centers for Environmental Prediction
26. NCO : NCEP Central Operations
27. NOAA : National Oceanic and Atmospheric Administration
28. NSSL : National Severe Storms Laboratory
29. NWP : Numerical Weather Prediction
30. NWS : National Weather Service
31. PHI : Probabilistic Hazard Information
32. PQPF : Probabilistic Quantitative Precipitation Forecast
33. R2O : Research To Operations
34. R2X : Research to Applications, Operations, and Services
35. RAP : Rapid Refresh
36. RFC : Regional Forecast Center
37. SPC : Storm Prediction Center
38. –TD : Time Delay
39. RL : Readiness Level
40. WCOSS : Weather and Climate Operational Supercomputing System
41. WFO : Weather Forecasting Office
42. WPC : Weather Prediction Center
43. WWE : Winter Weather Experiment

Appendix-D: Detailed transition deliverables for each organization involved

- (Parallel effort to HPT development) Develop and transfer AWIPS software tool(s) for display to be available to forecasters
    - work with GSD AWIPS group on this
- **Develop** hazard prediction tool (HPT) products - ESRL
    - Description: Ensemble-based guidance tool for prediction of various hazards (e.g., intense rainfall, heavy snow, etc.). For example, automated displays of ensemble forecast snowband positions and/or ensemble forecast heavy rain swaths.
        - write out GRIB2 records - probability for event
        - subsequent products for specific linear features (exceeding some threshold).
    - finalize software for initial HPT products
    - start with winter - PQPF, heavy snow, p-type
    - determine training for HPT product
    - ESRL will involve FACETs project in this state to follow and contribute ideas to HPT product development.
- **Evaluation** phase with ESRL **experimental** version (***"Science Evaluation")***
    - Determine metrics for objective evaluation
        - ESRL - use of precipitation and reflectivity verification. This will be the primary verification.
        - combined NCAR and ESRL to consider object-oriented metrics
    - Perform training
        - ~15-45-min PPT module to go to the field.
        - Conduct for OPG
    - objective evaluation also by NCAR with ESRL on best metrics
    - subjective evaluation
        - direct forecasters
            - WPC, WFOs, OPG.
        - FACETs representatives (NSSL, Tracy Henson/GSD)
        - social scientist partners
            - NCAR, FACETs
    - 1-2 month evaluation
    - At end: users write evaluation reports (1-2 page) for go/no-go for the candidate HPT product
- **Pre-implementation** of new HPT product on IDP - ESRL working with NCO
    - (need WPC contact point for transfer and IDP access)
    - transfer the HWD product
- ***"Functional evaluation"***
    - run HPT product on IDP for test period (2-4 weeks)
- Obtain **final NWS approval** (WPC Director, others?)
- Final implementation on IDP systems
- Repeat above for subsequent HPT products