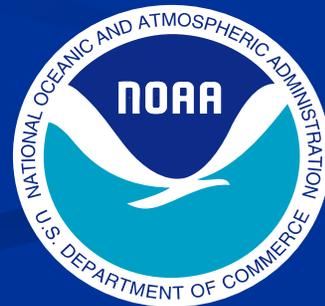


# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

A Briefing for NCEP

NOAA/NWS Forecast Uncertainty Steering Team and the  
National Uncertainty Requirements for Operations (NURO) Team

Lee Anderson  
NWS HQ OST  
December 2007



# NWS Field Office and National Center Requirements for Forecast Uncertainty Information (Briefing Outline)

- NOAA\NWS Forecast Uncertainty Team
- NURO Team Project Overview
- The NURO Team
- Project Mission and Goals
- Current Forecast Uncertainty Tools
- Survey to Obtain Uncertainty Information
- Preliminary Findings and Recommendations
- Conclusions

# The NOAA\NWS Forecast Uncertainty Steering Team

## Project Mission and Goals

- Team Leader: Paul Hirschberg
- Team Mission: advise and coordinate work on forecast uncertainty products, services, and information.
- Team Roles:
  - Communicate forecast uncertainty activities, needs and opportunities with NOAA and external users.
  - Develop a plan for generating and communicating forecast uncertainty.
  - Advises NWS senior management about topics related to forecast uncertainty.
- Team Membership: NWS Regional Offices, NCEP, Most NWS HQ Offices, and OAR.
- Sub-groups: NWS Uncertainty Requirements for Operations Team (NURO) and NWS Uncertainty Product Team (NUPT)

# NURO Team

## Project Mission and Goals

- NURO Team is a sub-group of the NWS Forecast Uncertainty Steering Team.
- Team Mission:
  - Identify available uncertainty guidance (e.g., Gridded MOS, ensembles) for NWS field offices and NCs.
- Team Goals:
  - Identify available uncertainty tools and training needs for offices.
  - Identify recommendations about future uncertainty tools and requirements.
- Forecast Uncertainty: having limited knowledge to describe a future state of a weather, water, or climate system.

# NURO Team

- Lee Anderson (NWS OST)
- Mary Mullusky (NWS HSD)
- Andrea Bleistein (NWS OST)
- Michael Brennan (NCEP HPC)
- David Bright (NWS SPC)
- Suzanne Lenihan (NWS OCWWS)
- Greg Mann (NWS WFO Pontiac, MI)
- Dave Novak (NWS ERH)
- John Schaake (NWS OHD)
- Paul Schultz (NOAA ESRL GSD)

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Current Available Forecast Uncertainty Tools

- Team compiled preliminary lists of:
  - Currently available uncertainty guidance available in AWIPS and N-AWIPS, and ATCF,
  - Other guidance available on web, and
  - Current NWS products including uncertainty estimates.
- Feedback and changes provided by NWS HQ Service Chiefs and NC SOOs.
- Current uncertainty guidance tools were used to help design NWS survey.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Current Available Forecast Uncertainty Tools

- Several NWS groups (e.g., NCEP, MDL) provide valuable forecast uncertainty guidance (HPC guidance, GMOS, ensembles).
  
- Examples of NWS products containing uncertainty:
  - Tropical cyclone track graphics,
  - Long-term river forecasts,
  - Climate outlooks, and
  - Text products (e.g., Zone Forecast Product).

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Survey Goals

- The main goals of the internal survey on obtaining uncertainty guidance were:
  - Obtain uncertainty guidance requirements from NWS operations,
  - Identify barriers in using and communicating uncertainty information, and
  - Identify current forecast processes or products that would benefit from providing forecast uncertainty information.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## The Survey

- Three qualitative surveys were completed with NWS field managers.
- Quantitative survey was administered by web to WFOs, RFCs, and National Centers (NC).
  - CFI Group programmed and hosted the survey, provided basic analysis, and recommendations.
  - Survey content based on qualitative in-depth interviews and input from the NURO team.
  - Survey contained 21 questions, some with multiple parts.
  - Respondents included most managers at field offices and NCs.
  - Survey response rate was about 59%.
  - Survey was available for about four weeks.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Forecast Uncertainty Training

- Finding: Forecast uncertainty guidance training has not occurred in a majority of the respondent's offices.
- Finding: Several respondents reported that a better understanding is needed about:
  - customer uncertainty requirements,
  - applying uncertainty guidance and communicating uncertainty information to users.
- Recommended training topics include:
  - probabilistic QPF,
  - post-processing,
  - AHPS and probabilistic outlooks,
  - ensemble guidance interpretation and verification,
  - applied statistics,
  - weather risk management, and
  - decision support systems.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Forecast Uncertainty Training

- Recommendation:
  - Develop additional needed field office training about uncertainty guidance to help connect ensemble use (and other uncertainty guidance) and forecast uncertainty expression.
  - Share best practices about uncertainty applications.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Numerical Weather Prediction and Uncertainty Guidance

- Finding: Ensemble data most needed by respondents includes all members of Global Forecast System (GFS) Ensemble and the NCEP Short Range Ensemble Forecast (SREF).
  - NCs' forecasters were most interested in accessing ensemble data from:
    - NCEP GFS Ensemble,
    - the ECMWF,
    - all individual SREF members, and
    - the North American Ensemble Forecast System (NAEFS).
- Recommendation: Consider providing forecasters with enhanced ensemble information within resource and system limits, and in AWIPS. Consider possible enhancements to model biases.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Numerical Weather Prediction and Uncertainty Guidance

- Finding: Many WFO respondents indicated a preference for viewing individual ensemble members for high-impact events.  
NC forecasters access all ensemble members.

Most of the WFO respondents preferred to view up to about 10 members for high impact events given a large ensemble set.

NC forecasters have access to the entire GFS ensemble and SREF membership, and therefore, indicated a preference to have access to all ensemble members.

- Finding: NWS forecasters want verification information, including ensemble verification, especially for high-impact events.
- Recommendation: Provide enhanced ensemble verification information to help forecasters with applications for high-impact events. Develop high-impact weather events verification.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Numerical Weather Prediction and Uncertainty Guidance

- Finding: Preferred formats for visualizing uncertainty in meteorological fields were spaghetti diagrams, mean, and spread plots.

These visualizations are the methods available in AWIPS. Other presentations of the data are useful too such as exceedance probabilities.

- Recommendation: Provide forecasters with additional visualization capabilities with ensembles in AWIPS II and GFE, within system limitations, to aid analysis and forecasting. Possible visualizations include:
  - plume diagrams, PDF, and
  - exceedance probability.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations Numerical Weather Prediction and Uncertainty Guidance

- Finding: The most commonly used methods to assess forecast uncertainty, except for model ensembles, were local research studies, forecaster experience, model comparisons, and climatology.
  - Other methods included:
    - numerical model consistency,
    - forecaster tools and rules of thumb,
    - observations, and
    - verification.
  
- Recommendation: Provide best practices about application of forecast uncertainty at field offices and NCs.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations New Products and Policy

- Finding: Some of the most common required forecast parameters that would benefit from the addition of uncertainty information include:
  - Precipitation type and amount,
  - Winds,
  - Temperatures (e.g., maximum and minimum),
  - Winter weather elements,
  - Stream flow forecasts, and
  - Tropical cyclone forecast variables.
  
- Recommendation: Incorporate uncertainty information in the development of new NWS products and services, and modify existing products as needed. Apply requirements and other input from various resources including NCs, regional and field offices, AMS committees, research groups, and remainder of the Weather Enterprise.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations New Products and Policy

- Finding: Forecasters want involvement in generating or interpreting uncertainty in forecasts.
  - Many forecasters believe significant involvement should occur. Main themes:
    - Forecasters should adjust objective guidance, and
    - Forecasters' involvement should only include communicating and interpreting products.
  
- Recommendation: Develop an NWS plan to continue incorporate uncertainty into operational products and services using input from NWS groups and customer requirements.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations New Products and Policy

- Finding: Most WFOs have not generated local formal uncertainty information or products for external users. Communication of forecast confidence frequently occurs verbally with users.
- Recommendation: Develop national product uncertainty guidelines.
- Finding: Most uncertainty information requests have been from, but not limited to, emergency managers, fire weather officials, and water resources managers. Many requests focused on high-impact events.
- Recommendation: Forecast uncertainty information should be provided to customers at all application levels.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Findings and Recommendations NWS Technological Systems

- Finding: Barriers are present in communicating some forecast uncertainty information.
  - Some limitations include:
    - Text and graphical limitations,
    - Different interpretations between forecasters and customers about the uncertainty information, and
    - Lack of user requirements.
- Recommendation: Obtain user requirements to help determine ways of communicating forecast uncertainty.
- Recommendation: Systems must rapidly incorporate and develop uncertainty information that produce and convey uncertainty information.

# NWS Field Office and National Center Requirements for Forecast Uncertainty Information

## Preliminary Conclusions

- Enhancements may be needed with some uncertainty guidance, training, and visualization capabilities.
- Training requirements will be submitted to the National Strategic Training and Education Plan (NSTEP) group.
- A collaborative effort should continue among various NWS groups, HQ, and the Weather Enterprise to advance forecast and observation uncertainty information for users benefits
- Develop a plan to incorporate additional uncertainty guidance information into new or existing products and services.