AMS 2023: NWS Forecast Uncertainty Breakout Session

Suggested Resources

"Weather forecasts possess no intrinsic value. They only acquire value through their ability to influence the decisions made by users of the forecasts." - Alan Murphy (1993)

Table of Contents

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About the National Weather Service

About the NWS

National Weather Service Organization

NWS Careers

- Student Opportunities in the National Weather Service: This StoryMap does not include all opportunities at all offices. It is recommended that you reach out to specific offices for the latest and most up to date information.

Home - NWS Eastern Region - Virtual Lab

- The About Us section has a lot of information on the various offices, programs and activities within the National Weather Service and NOAA.

Future Direction of Meteorology and the National Weather Service

2019-2022 NWS Strategic Plan (keep an eye out for a new strategic plan coming out this year)

WMO's Vision 2030: Future of weather and climate forecasting

NOAA's Research Council's 2020-2026 Vision

Evolving the National Weather Service to Build a Weather-Ready Nation: Connecting Observations, Forecasts, and Warnings to Decision-Makers through Impact-Based Decision Support Services

NWS Operational Workforce Analysis

Books and Recommended Readings

Superforecasting: The Art and Science of Prediction (Tetlock & Gardner)

Traits of Leaders and Superforecasters:

- Philosophic Outlook = Cautious, Humble, Nondeterministic
- Thinking Style = Open-Minded, Curious, Reflective, Numerate
- Work Ethic = Growth Mindset, Grit, Solution-Oriented
- *Forecasting Style* = Probabilistic, Analytical, Dragonfly-Eyed, Thoughtful Updaters, Intuitive Psychologist

Thinking in Bets: Making Smarter Decisions When You Don't Have All the Facts (Annie Duke)

Thinking Fast and Slow (Daniel Kahneman)

Atomic Habits (James Clear)

Leaders Eat Last (Simon Sinek)

Ted Lasso (Apple TV)

Recorded Webinars

- NWA Town Hall 2021 - Vision to Modernize the Forecast Process (Video)
- The Human Constant: What They Didn't Teach You While Deriving Equations (Ryan Ellis - YouTube)

Informational Learning Modules

- Foundations in Probabilistic Forecasting - MetEd Training Module
- NWP: Applications of Probabilistic Principles - MetEd Training Module
- Communicating Probabilistic Forecasts - MetED Training Module

Communication and Social Science Resources

Probabilistic Communication Recommendations:
https://crcm.shinyapps.io/probcom/#section-practical-recommendations

- The National Weather Service commissioned researchers at the University of Oklahoma / Institute for Risk and Resilience / Center for Risk and Crisis Management to complete a systematic review and assessment of 300+ papers pertaining to forecast communication.

Risk Perception and Vulnerabilities: https://crcm.shinyapps.io/WxDash/

- An interactive platform that provides access to data from the *Extreme Weather and Society Project*

NWS Social Science VLab Page: https://vlab.noaa.gov/web/nws-social-science

Neighborhoods at Risk: https://nar.headwaterseconomics.org

CDC Social Vulnerability Index:
https://data.cdc.gov/Health-Statistics/Social-Vulnerability-Index-2018-United-States-trac/4d8n-kk8a

Forecast Tools and Resources

National Blend of Models (NBM) (General Information)
The National Blend of Models (NBM) is a nationally consistent and skillful suite of calibrated forecast guidance based on a blend of both NWS and non-NWS numerical weather prediction model data and post-processed model guidance. The goal of the NBM is to create a highly accurate, skillful and consistent starting point for the gridded forecast. This new way to produce NDFD grids will be helpful providing forecasters with a suite of information to use for their forecasts. The NBM is considered an important part of the efforts to evolve NWS capabilities to achieve a Weather-Ready Nation.

NBM 1D Viewer
Useful for a quick glance at NBM deterministic and NBM probabilistic percentile statistics for a specific site. The use of percentile statistics can help determine upper- and lower-bound solutions, as well as gauge confidence in a particular outcome. Past model runs can be loaded to see how the NBM deterministic has been performing.

- NBM 1D Viewer

NBM Forecast Records
This tool can provide a quick look if the NBM is forecasting near-record or record-breaking temperatures. This can serve as a heads up and help provide context when messaging extreme or impactful temperatures.

- NATIONAL BLEND Records Display (PROTOTYPE)

Weather in Context
Similar to the NBM Forecast Records tool, this tool can provide a quick look at if forecasted temperatures are approaching or exceeding records. Clicking on temperatures in the site table will load a violin plot showing the distribution and percentiles of the guidance and how the NBM and NDFD compares. This can help build confidence in a certain outcome and help communicate that outcome.

- Weather in Context Prototype

WPC Day 3-7 Ensemble Cluster Analysis
When examining the large-scale pattern in the extended range, this guidance is good to look at first to see how the ensembles are distributed among the clusters before looking at the individual ensemble systems. 500 mb EOF Patterns and 500 mb Heights Clusters are good to examine here, but Cluster Phase Space can also be useful.

- WPC Day 3 -7 Cluster Prototype Page (Days 8-10 Found Linked at the Top)
- WPC QPF Cluster Prototype Page
- Understanding the WPC Cluster Analysis Tools

ECMWF ENS EFI/SOT

The Extreme Forecast Index/Shift of Tails tool has output for a variety of variables. This tool highlights anomalous values based on the model's climatology.

- ECMWF Extreme Forecast Index
- ECMWF Extreme Forecast Index Charts
- ECMWF Point-Based Products (EFI/CDF and Meteograms)
- How to Use EFI/SOT:
    - Extreme Forecast Index - EFI
    - EFI: Used to gauge the likelihood of an extreme event (0 to 1)
        - 0.5 or greater (irrespective of sign) signifies that the ensemble forecast is extreme relative to the model climate (M-climate).
        - 0.5-0.8 means unusual weather is likely.
        - 0.8 or greater indicates "very unusual" or extreme weather is likely. Values in this range also translate to member consensus on an extreme event.
    - SOT: Used to determine how extreme the forecast is (0 to 10).
        - Compares the top 10% of the EPS members and the M-climate's 90th and 99th percentiles.
        - Positive SOT values indicate that at least 10% of the EPS is forecasting an event greater than the 99th percentile of the M-climate.
    - When using EFI and SOTs together:
        - High SOT and EFI - Confidence is high in an extreme event
        - High SOT (1 or greater) but low to no EFI: Uncertainty is high, because a few members have an extreme event, but most members do not.
        - High EFI but low to no SOT: Confidence is high because most members have an anomalous event, but is not extreme.
    - Caveats:
        - Extreme does not necessarily mean high-impact or record-breaking conditions.
        - "Extreme" is based on model climatology.
        - Current conditions and seasonal context are still important in determining impacts.

Ensemble Situational Awareness Table (ESAT) NAEFS

Select "NAEFS Percentile" under the "Output" drop-down menu in these viewers to see how the forecast compares to climatology. Mean fields are useful in consolidating the members into a single view, but can "wash out" key differences and features shown by individual members, especially with increasing lead time.

- NAEFS ESAT

Ensemble Situational Awareness Table (ESAT) EPFT

This table shows the 100-year Average Recurrence Interval for 6- and 24-hour rainfall totals from different models. Forecasts with greater ARI can build confidence in the potential of a high-impact event.

- Extreme Precipitation Forecasting Table

NSSL WoFS Viewer

The Warn on Forecast System is useful for assessing storm-specific evolution and threats during the watch-warning gap. Output is probabilistic and ensemble-based, allowing for thorough analysis that can help with both forecasts and warnings, as well as communication to core partners. Environmental fields are also able to be viewed to assess the near-storm environment.

- https://cbwofs.nssl.noaa.gov/Forecast

SPC HREF Viewer

The HREF has percentile statistics and probabilistic output for several severe weather parameters under the “SPC Guidance”, “Severe”, and “Storm Attributes” tabs. Most items under these tabs have information on the item denoted by “[info]” on the right side of the list.

- SPC HREF Ensemble Viewer - 500 mb wind/height, ens mean
- Another HREF Ensemble Visualization Page: Ensemble Viz

CSU Machine Learning Prediction Severe Wx Forecasts

This probabilistic guidance is comparable to SPC's probabilistic outlooks from Day 1 through Day 8 and is based on the GEFS ensemble median. This is particularly useful in providing insight into severe weather potential in the extended forecast range.

- CSU-MLP
- Hill et al. (2020)

NCAR CAM Viewer

This guidance provides HRRR neural network-based and updraft helicity-based probability of severe hazards within a 4-hour window. As with the SSCRAM viewer, it can be used in conjunction with mesoanalysis to assess threat evolution in the near term.

- NCAR
- Sobash et al. (2020)
- NCAR Article

SPC SSCRAM Viewer

Provides the probability of severe hazards based on the RAP/HRRR forecast and SSCRAM technique. This can be used to complement mesoanalysis to determine threats in the near term.

- SPC SSCRAM+HRRR

SPC SREF Viewer

The SREF provides probabilistic output on numerous parameters associated with severe weather under the tabs along the top of the page. Threshold probabilities can be useful for assessing the upper-bounds of an environment capable of severe weather.

- SPC SREF SREF_H5_

CIMSS ProbSevere

Useful as a nudger and to gauge confidence in the severe or tornadic potential of a storm through a probabilistic approach.

- NOAA/CIMSS ProbSevere (Operational)
- NOAA/CIMSS ProbSevere v3

CIMSS ProbLightning

Similar to ProbSevere, this provides the probability of lightning in convection, and can help forecasters provide advanced notice to DSS events and aviation users of lightning potential.

- NOAA/CIMSS ProbSevere LightningCast

Probabilistic Winter Precipitation Forecast (P/WPF)

- WPC Probabilistic Winter Precipitation Guidance
- WPC Winter Weather Forecasts

Probabilistic Quantitative Precipitation Forecasts (P/QPF)

- WPC 6-Hour Probability of Precipitation Guidance for Days 1-3

WPC Probabilistic WSSI

Looking at the "Overall Winter Storm Impacts" or individual hazards and their impact level can help forecasters both gauge their own forecast and communicate the forecast and its potential general impacts in space and time.

- Winter Storm Severity Index Web Display

WPC Snowband Probability

Useful for gauging the likelihood and intensity of heavier snowfall. Assess for how members align in space, time, and magnitude to determine confidence in heavier snowfall occurring.

- https://origin.wpc.ncep.noaa.gov/snowbands/view.php
- About this page: Snowbands

Experimental Winter Snow Outlook (WSO)

Useful for gauging the likelihood of exceeding warning criteria. This should be used in context with the official NWS forecast and warnings. This product does not depict official warnings.

- Experimental Winter Storm Outlook (WSO)

Hydrologic Ensemble Forecast System (HEFS)

This guidance factors meteorological uncertainty and hydrologic modeling to produce hydrographs in percentile view. The output is available only for select sites that have probability forecasts, and will be located under the “Probability Information” tab as “Short-term Probabilistic Guidance (Experimental)” after selecting a forecast point. The percentiles can help forecasters gauge confidence in sites reaching certain stages and communicate potential impacts.

- MetED Module: https://www.meted.ucar.edu/sign_in.php?go_back_to=/hydro/HEFS/index.htm