Putting Ensembles to Work in Western Region

Matt Jeglum
Western Region HQ, Science and Technology Infusion Division, NWS

WHAT'S CHANGING in this new Strategic Plan?

Operations and Impact-Based Decision Support Service (IDSS):

- We will improve our Impact-Based Decision Support Services by developing standard levels of service, **providing every state and county critical preparedness and forecast and warning information.**
- We will **develop new IDSS tools** that improve collaboration with partners and deployed personnel, and catalog partners' impacts and decision points.
- We will shift to **a more collaborative, agile, and interconnected operational model** that combines our centers of expertise with our local knowledge of partners and geography.
- We will **simplify our products, services, and communications** so our partners and the public can better understand and apply them.

Science, Technology, Engineering, and Infrastructure:

- We will develop the **best unified earth-system modeling system in the world**, working hand-in-hand with the weather, water, and climate community.
- **Ensemble modeling will improve the accuracy and lead-time of our forecasts**, and will enable better quantification of forecast confidence.
- A **blend of models will provide a consistent starting point** for NWS forecast operations.
- **Integrating the power of human skill with the efficiency of new computing technology** will revolutionize hazard forecasting, enabled by machine learning and advanced probabilistic tools.
- We will **make our data and forecasts easier to find and use**, allowing broader development and application of new tools, techniques, and information across the Enterprise.
- We will **engineer our infrastructure** to better meet expectations for security, reliability, and availability.

The ultimate goal is to produce calibrated probabilistic forecasts that allow the NWS to provide decision support for weather *impacts*, with climatological context.

The 4 steps to get there:

1. **Production of high quality post-processed ensemble data.**
   - This includes the ensemble and its reforecasts/reanalyses, the post-processing techniques, and gridded mesoscale analyses.
2. **Tools to visualize and interpret ensemble output.**
   - Ideally these are cloud based and include GIS capabilities.
3. **Forecasters fluent in interpreting and communicating ensemble output.**
   - Studies have shown that some professional forecasters do not understand probabilities.
4. **Public and partners with the ability to apply probabilistic information to decision making.**
   - Social science shows that the baseline understanding is there.

“GFS and EC” forecasting is currently commonplace, but it leaves too much on the table!

“The 12Z GFS stays relatively dry through Tuesday but the Euro has patchy precipitation during the entire extended forecast. Therefore, there is quite a bit of uncertainty in the extended precipitation through Wednesday.”

Looking at 2 deterministic models is never enough to characterize the uncertainty in the extended!

“The GFS aims it directly at the … while the EURO and NAM push it slightly farther northward. For now, will continue to side with the EURO/NAM output and the current forecast reflects this…“

We like to think we can pick the winning team. Don’t confuse getting lucky with being smart.

We have made significant progress on integrating ensemble tools into the forecast in WR, but we have a long way to go.

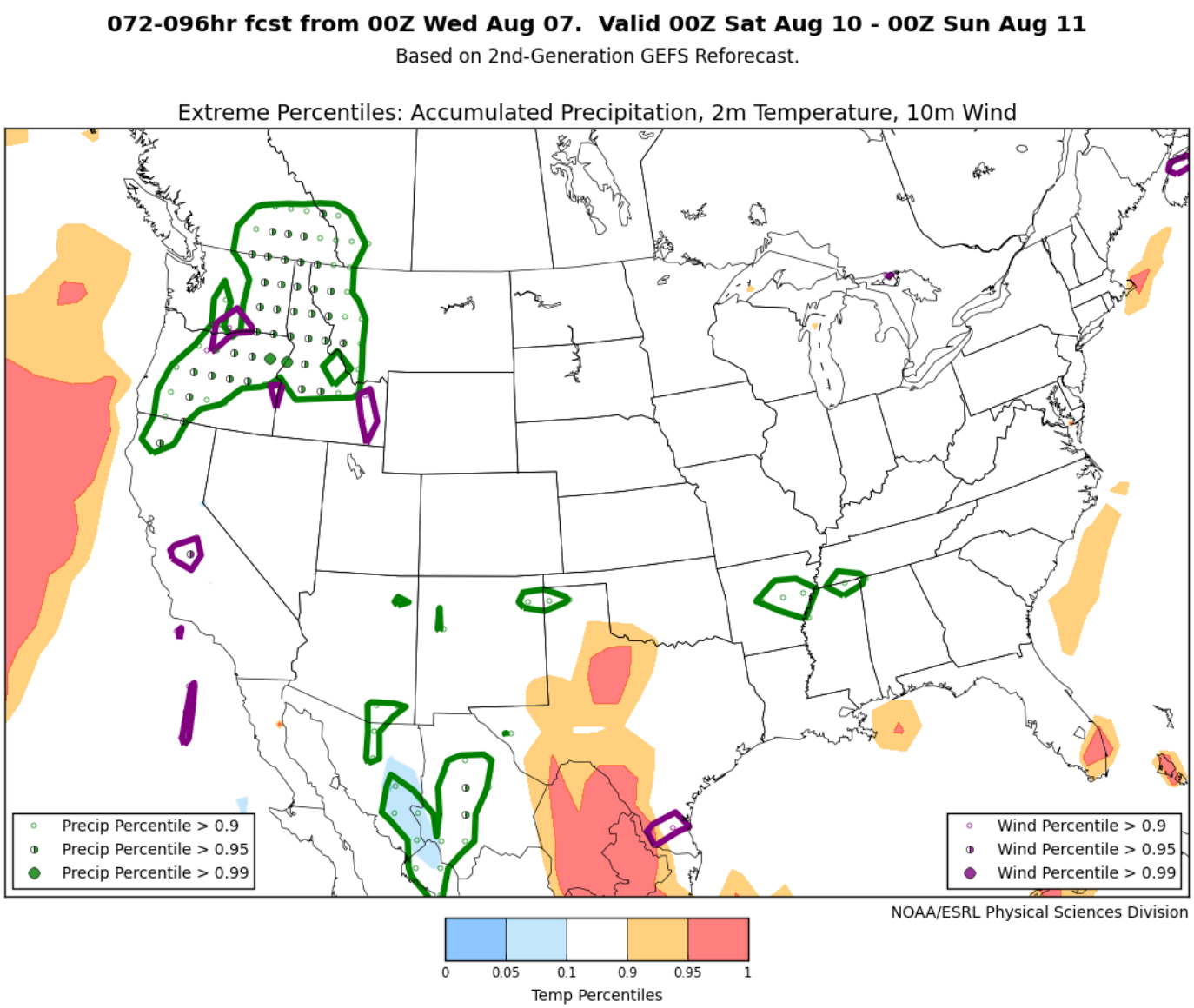
Culture change is a big part

“Forecasters are relinquishing their meteorological input into the operational product going to the user. Forecasters are operating more as communicators and less as meteorologists. Since this practice is increasing slowly with time, it can be called "meteorological cancer". By this is meant that today's forecaster can, if he chooses, and many do, come to work, accept (NBM) guidance, put this into words, and go home. Not once does he have to use his meteorological knowledge and experience. This type of practice is taking place more and more across the United States…”

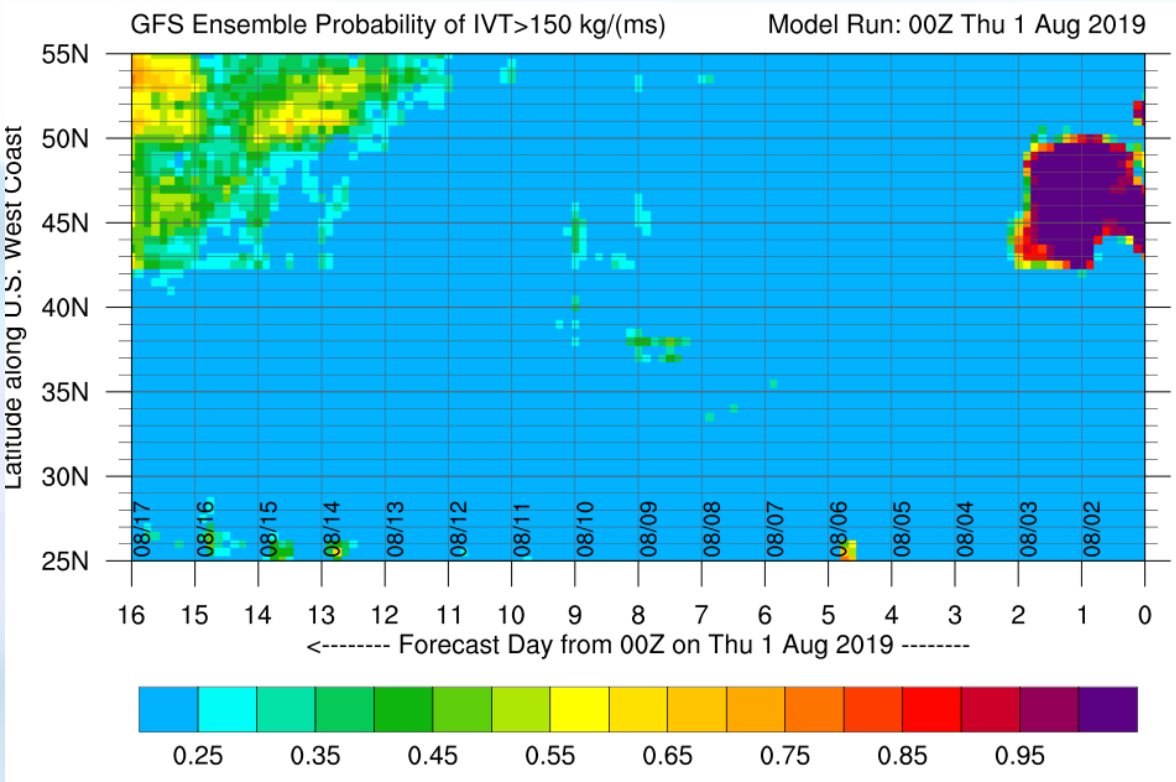
Len Snellman
Chief, Scientific Services Division
NWS Western Region HQ
BAMS, February 1977

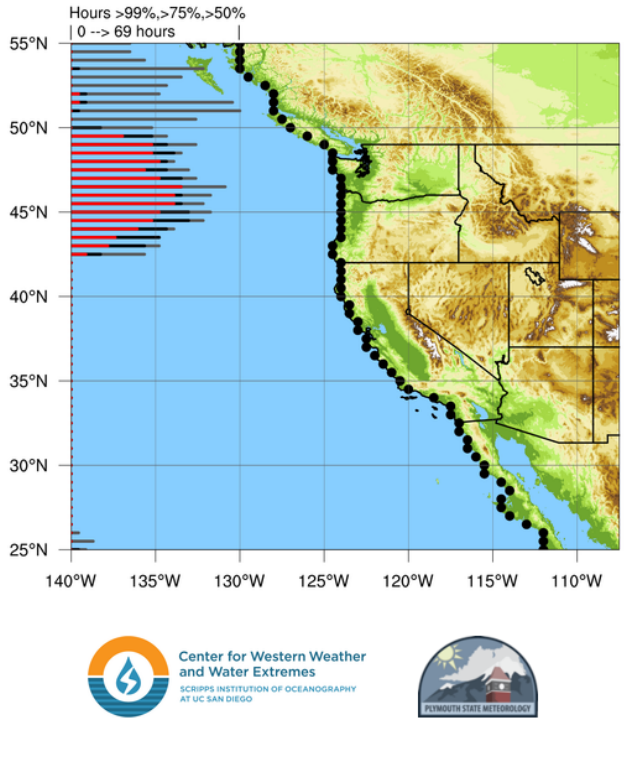
“You want me to go with this ensemble tool when the last 3 GFS runs have been so similar to each other?!?”

ESRL/PSD Extreme Percentiles

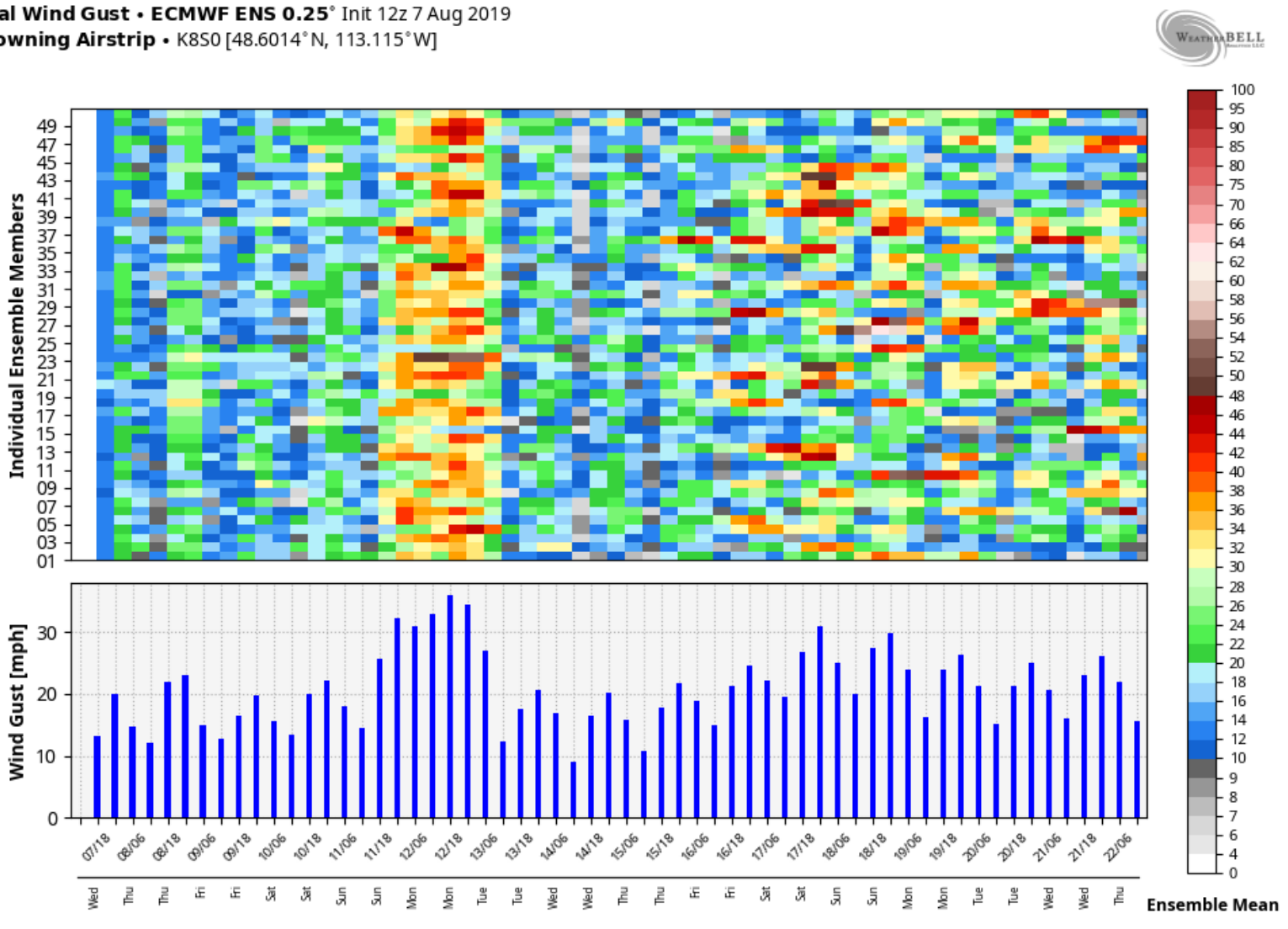


CW3E Atmospheric River Tools

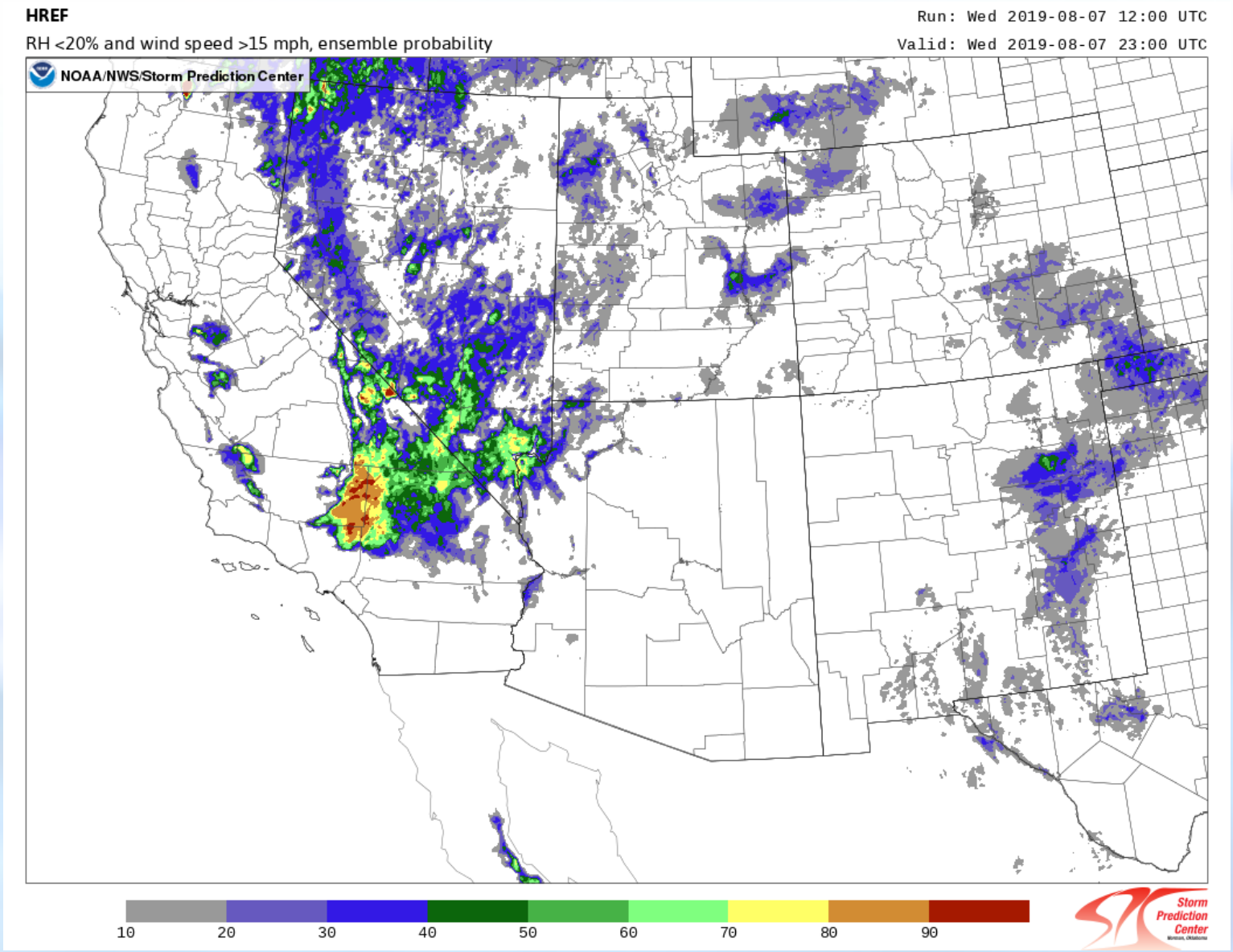




WeatherBell Full-res EPS



High Resolution Ensemble Forecast



NBM…and the importance of post-processing

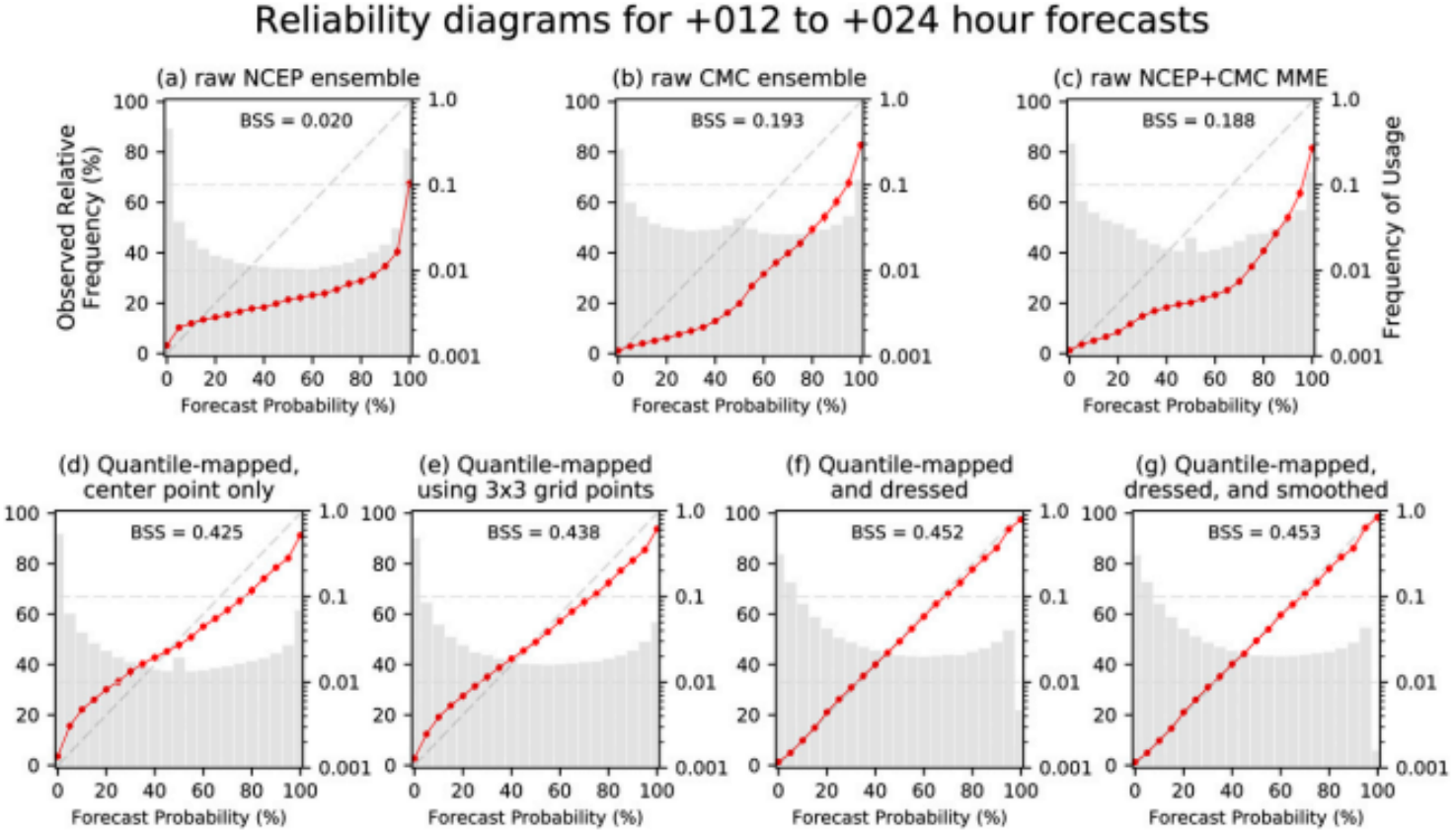


FIG. 10. Reliability diagrams (red curves) for +12- to +24-h POP12 forecasts over the CONUS, providing the observed relative frequency for a given forecast probability. Error bars represent the 5th and 95th percentiles from a 1000-sample bootstrap distribution generated by sampling case days with replacement. Histograms in gray show the overall frequency with which forecasts of a given probability are issued (scale on the right), and BSSs are noted. (a) Raw NCEP ensemble forecasts, (b) raw CMC ensemble forecasts, (c) raw multimodel ensemble forecasts, (d) postprocessed guidance after stochastic quantile mapping using the center point only, (e) after stochastic quantile mapping using 3 × 3 stencil of points, (f) after dressing, and (g) after smoothing.

Source: Hamill et al. (2017)

What are the greatest needs?

Ensemble system
Reforecast/Reanalyses
Gridded mesoscale analyses
Post-processing techniques
Climatological information
Visualization/manipulation tools
University education for probabilistic forecasting
NWS training for probabilistic forecasting
Changing the culture of how forecasts are made
Effective oral/written communicators
Comprehensive dissemination media
Partner relationships
Partners and public making decisions