Integrating Probabilistic Data into Operations for a Deterministic Forecast Process

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“ In a review of 300+ journal articles...

*Nearly all of the studies ... indicate that people make **better decisions**, have **higher trust** in information, and/or display a **greater understanding** of forecast information when shown a **probabilistic forecast** instead of a deterministic one.*

*Ripberger et al. (2022), **Weather Climate and Society***

Social science has stated we need to integrate more probabilistic data. How do we incorporate that into a deterministic forecast database?

*“The real value of weather forecasting is not primarily about getting it ‘right’ or ‘wrong’ but to support decision making**. This is best achieved through the use of probabilities.**”*

-Anders Persson, ECMWF

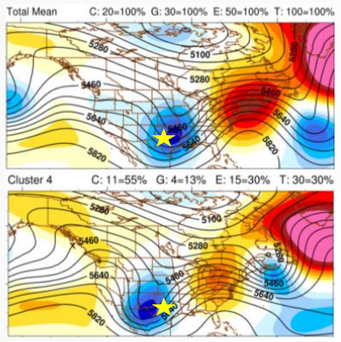
National Blend of Models (NBM)

- Post-processes numerous NWP guidance and blends them together to create deterministic and probabilistic output
- Provides several probabilistic elements including precipitation type and snow level

ForecastBuilder

- Software program in use across much of the NWS to help create the gridded forecast database
- Populates, has common tools, and derives elements like snow and ice accumulation
- Utilizes NBM probabilistic data to both populate and QC check

Mixing Deterministic and Probabilistic Data Example #1, near Dallas, TX



Ensemble Mean: Implying most forecasts are: Clear, Cold, Dry

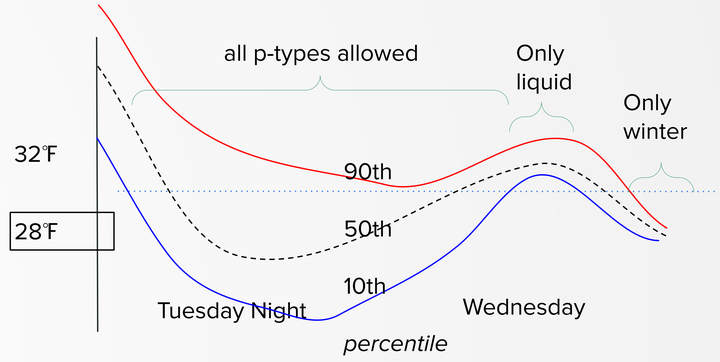
Cluster 4 (30% probability): A forecast of: Warmer, Widespread Rain, Cloudy

Appropriate Forecast: Partly cloudy. A 30% chance of rain. Low 28.

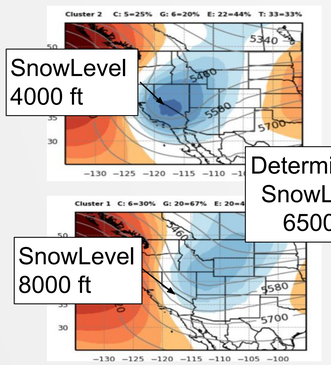
Consider: There is no reasonable forecast of freezing rain, why should we be forced to forecast it?

Technique in ForecastBuilder for Example #1

Rather than letting the forecast temperature dictate what precipitation type is allowed, ForecastBuilder uses the spread of possible temperatures from the NBM. This is shown in the example below for two sample time periods, which allows for the more appropriate forecast.



Mixing Deterministic and Probabilistic Data Example #2, “mountain site”



“Snow level”, defined as where 0.5℃ wet-bulb temperature intersects terrain, is commonly used in the Western U.S. to quickly determine precipitation type.

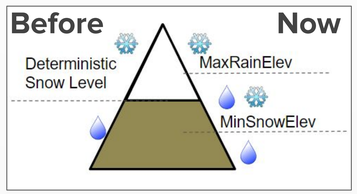
If the elevation at the given spot is 5000 ft, then the precipitation type from:

Cluster 2 (top): snow
Cluster 1 (bottom): rain
Deterministic (ensemble mean): rain

Consider: The deterministic forecast hides the snow potential at lower elevations.

Technique in ForecastBuilder for Example #2

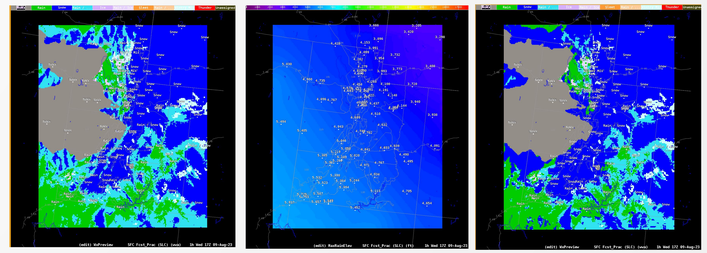
Rather than letting the deterministic snow level dictate what precipitation type is allowed before, ForecastBuilder uses the 10th and 75th percentiles of NBM snow level, which we’ll call MinSnowElev and MaxRainElev, respectively, to dictate what precipitation types are allowed. This approach better reflects the spread that can exist in the NWP guidance.



Appropriate Forecast for Example #2: Chance of both Rain and Snow

How Example #2 Can Look Gridded

Lets say this happens over Utah and the forecaster identifies that the MaxRainElev will end up lower than forecast. Below the forecaster subtracts 500 ft on the MaxRainElev, which results in more snow (blue) than mixed (white) or rain (green)



Before *MaxRainElev* *After*

Key Point: This approach allows NWS forecasters to create and communicate a forecast that better reflects the ensemble spread