# Short-term Probabilistic Guidance Product (Experimental)

What:

The Short-Term Probabilistic Guidance Product contains a graphical depiction of the short-range (0-10 days) river forecast uncertainty predicted by the HEFS. At each forecast time-step (typically every 6 hours), the graphic conveys a range of possible river stages, and corresponding flows, at a particular forecast location. These possibilities are shaded using different categories of forecast probability, ranging from most likely to less likely. These probability ranges (uncertainty bounds) are derived from the ensemble forecasts produced by HEFS at each forecast time-step.

In the example below, the forecast for 2pm EDT on March 12 indicates a roughly 25% chance that the river level will exceed 7.3 feet (Moderate Flooding). It also indicates a roughly 5% chance that the river will exceed 11.0 feet (above the Major Flooding level).

Also, the forecast for 8pm EDT on March 18 indicates a roughly 10% chance that the river will exceed 6.5 feet (Minor Flooding) at that time in the forecast horizon.
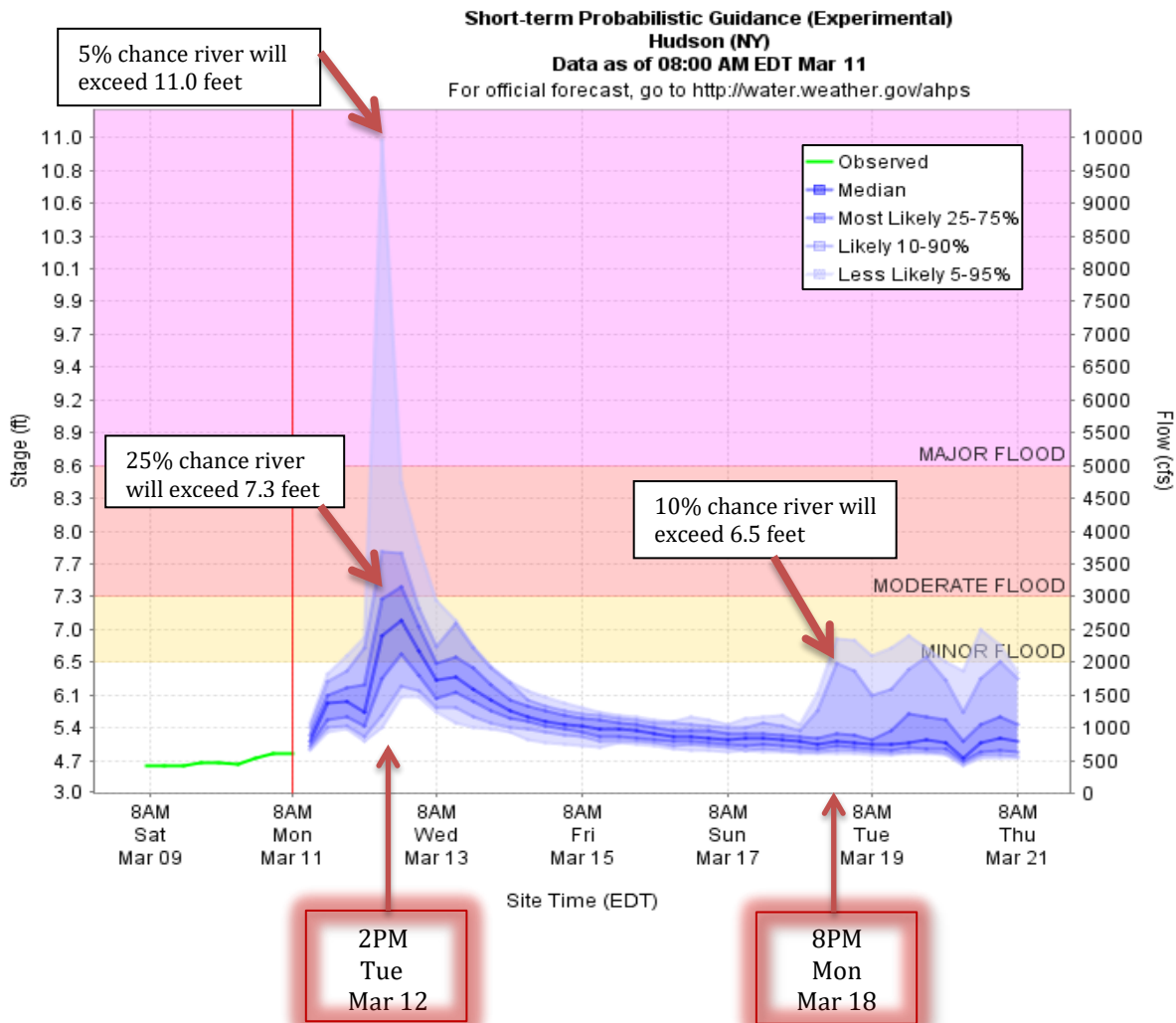
How:
Ensemble forecasting is a practical and effective approach to quantifying uncertainty. In contrast to single-valued forecasts, ensemble forecasts provide a collection of possibilities. Each ensemble member represents one possible and equally likely outcome and, collectively, all of the ensemble members aim to capture the range of possible outcomes and their associated probabilities.

If the total uncertainty is not adequately quantified, the forecast probabilities will not be sufficiently accurate; in other words the ensemble spread will not consistently "capture" the observed streamflow. The uncertainty in our river forecasts originates from two main sources: 1) weather forecasting or "forcing" uncertainty (i.e., uncertainty about the future values of temperature, precipitation and any other forcing variables used by the hydrologic models); and 2) hydrologic uncertainty (i.e., all of the uncertainties associated with hydrologic modeling, including the initial conditions, model parameters, model structure, etc.).

The NWS has developed and implemented the Hydrologic Ensemble Forecast Service (HEFS), in order to produce accurate ensemble forecasts that better quantify the uncertainties in our river forecasts. The HEFS utilizes weather and climate forecasts from a variety of sources, including the River Forecast Center (RFC) precipitation and temperature forecasts, as well as ensemble mean forecasts from NWS numerical weather prediction models. Biases in the weather forecasts are calculated and corrections are applied. A post-processing option in the HEFS also provides the capability to capture the hydrologic uncertainty in the streamflow predictions and correct for biases in the forecast probabilities.

Why:
The typical river forecasts produced by the NWS are single-valued forecasts ([example](#)), which are known to be imperfect. They are based on models with imperfect descriptions of physical processes. They utilize parameters that are estimated with limited data, and that limited data includes measurement and other errors.

These imperfections are reflected in the differences between the river forecasts and the corresponding river observations (at gage locations). The differences generally increase with forecast lead time and can be much larger for extreme events (e.g., floods). A single-valued forecast does not provide information about the forecast uncertainty (i.e., the range of possible outcomes and their associated probabilities).

Quantifying and providing explicit estimates of the uncertainty in our river forecasts is one of the most pressing needs of operational hydrologic forecasting. Ultimately, the goal is to support informed, risk-based, management of water resources and hazards.