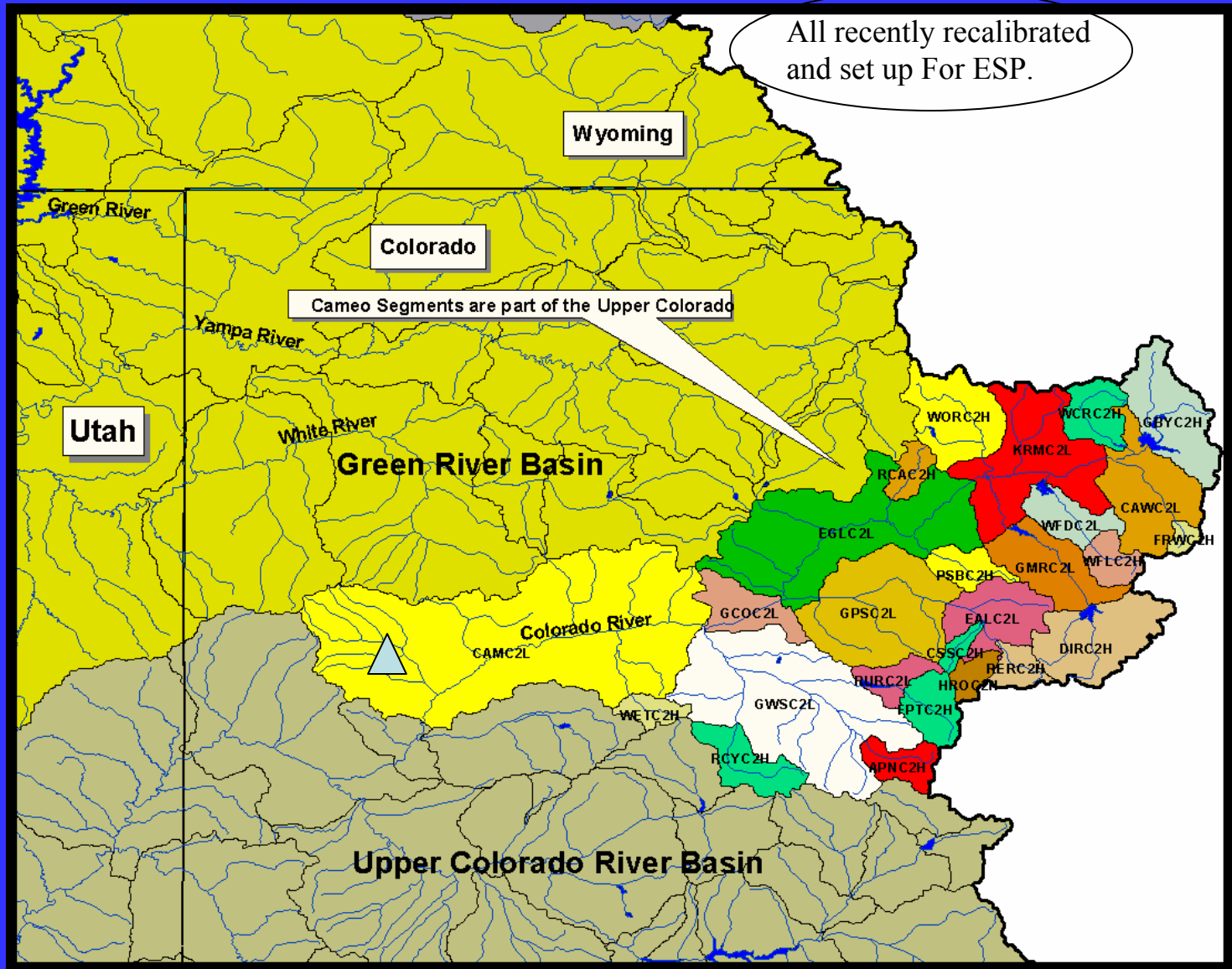


CBRFC AHPS PROJECT



**Application and verification
at the CBRFC**

Project Area: 27 Segments Above Cameo, Colorado River



ESP Example

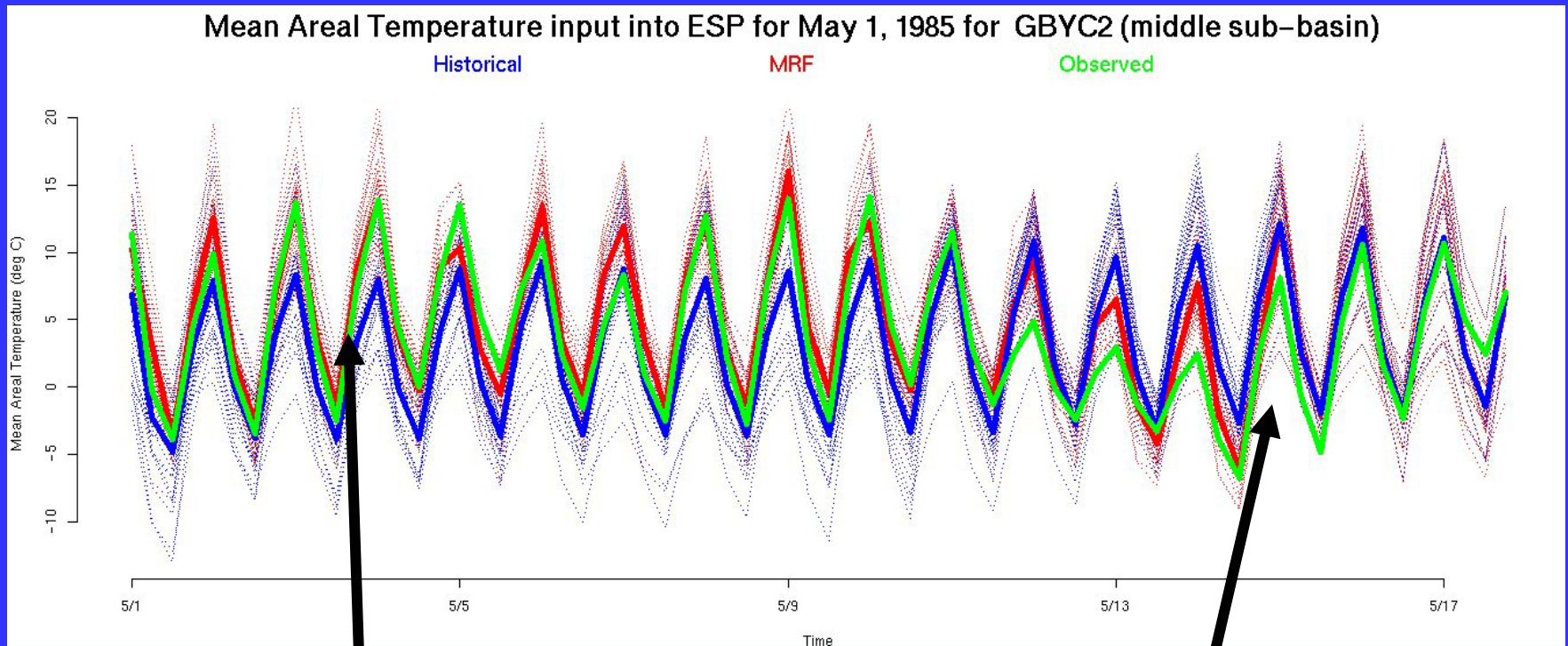
Probabilistic forecast (or model) verification requires a large dataset. This is accomplished through reforecasting.

Reforecasts done for every basin for every day between 1979 – 1999.

Reforecasts made with both reforecasted MRF and historical MAT/MAPs.

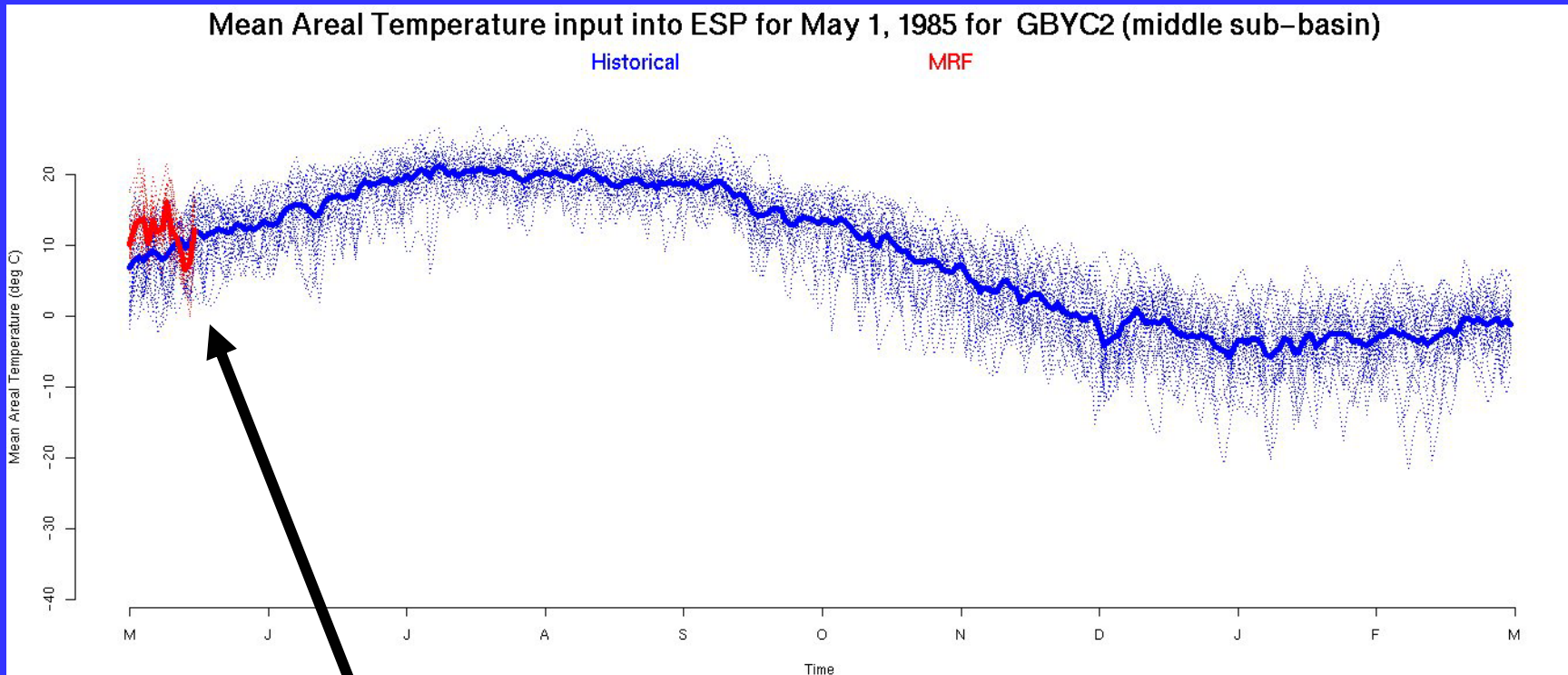
Following example from Granby, CO (GBYC2) reforecast for May 1, 1985.

Input into ESP



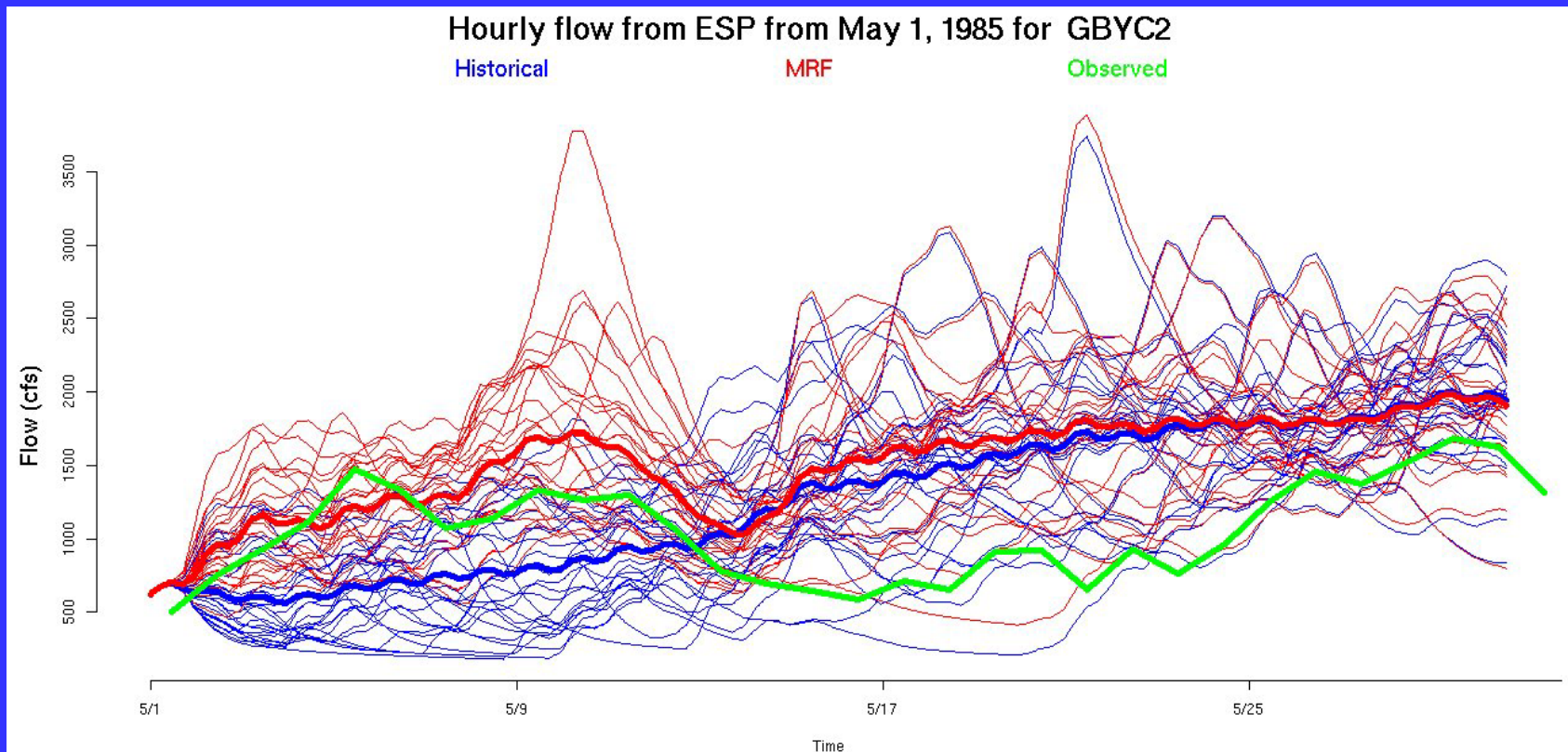
MRF derived MAT/MAPs are attached to historical years ("ensembles") and 'fed' to ESP. Note MRF is warmer in first week

Input into ESP



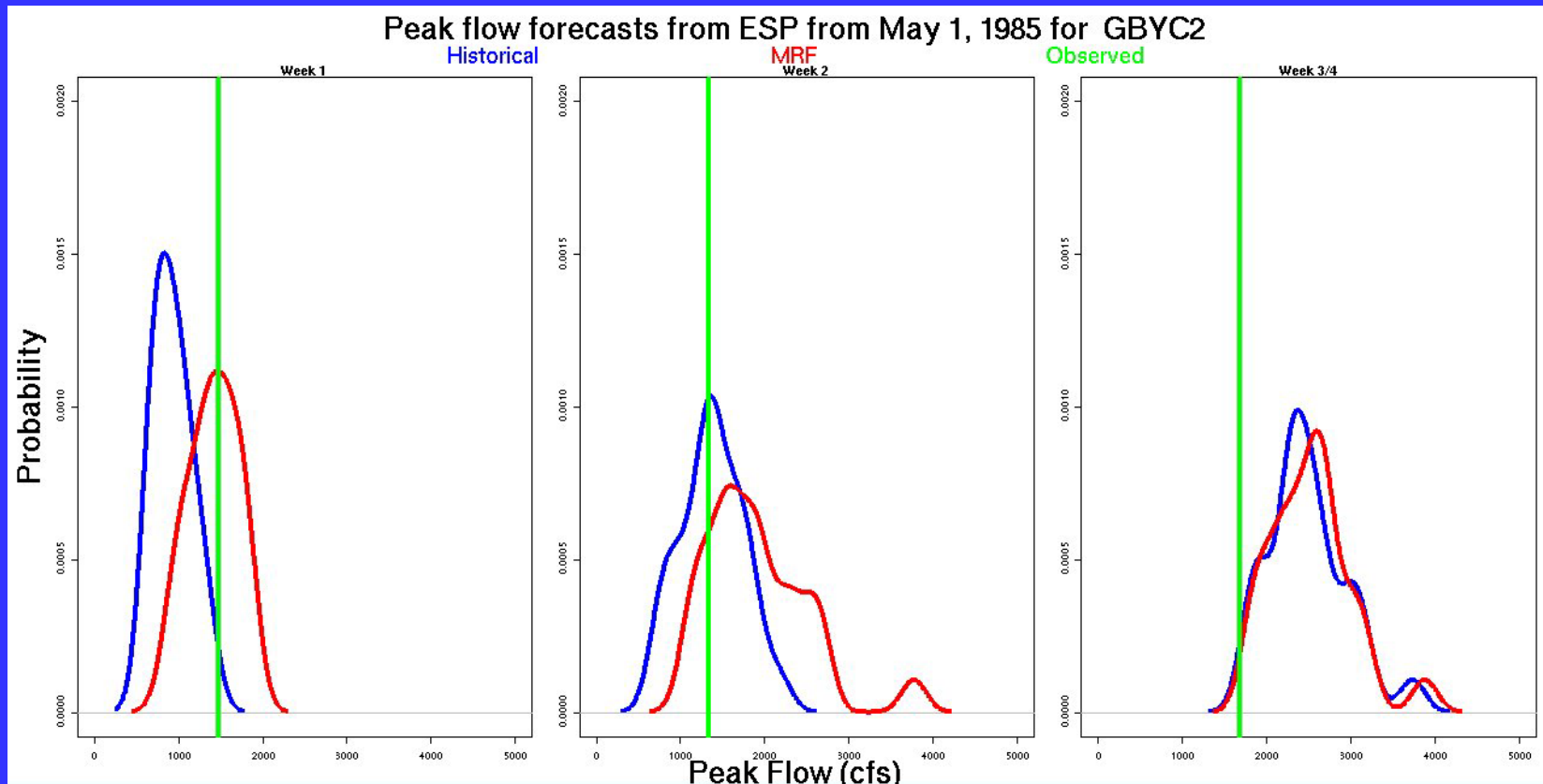
MRF derived MAT/MAPs related to the entire year of historical ensembles.

ESP flow time series



Hourly instantaneous flow ensembles are created by ESP and saved. MRF shows higher flows than historical when it is warmer (during the first week). These may be converted into probabilistic forecasts...

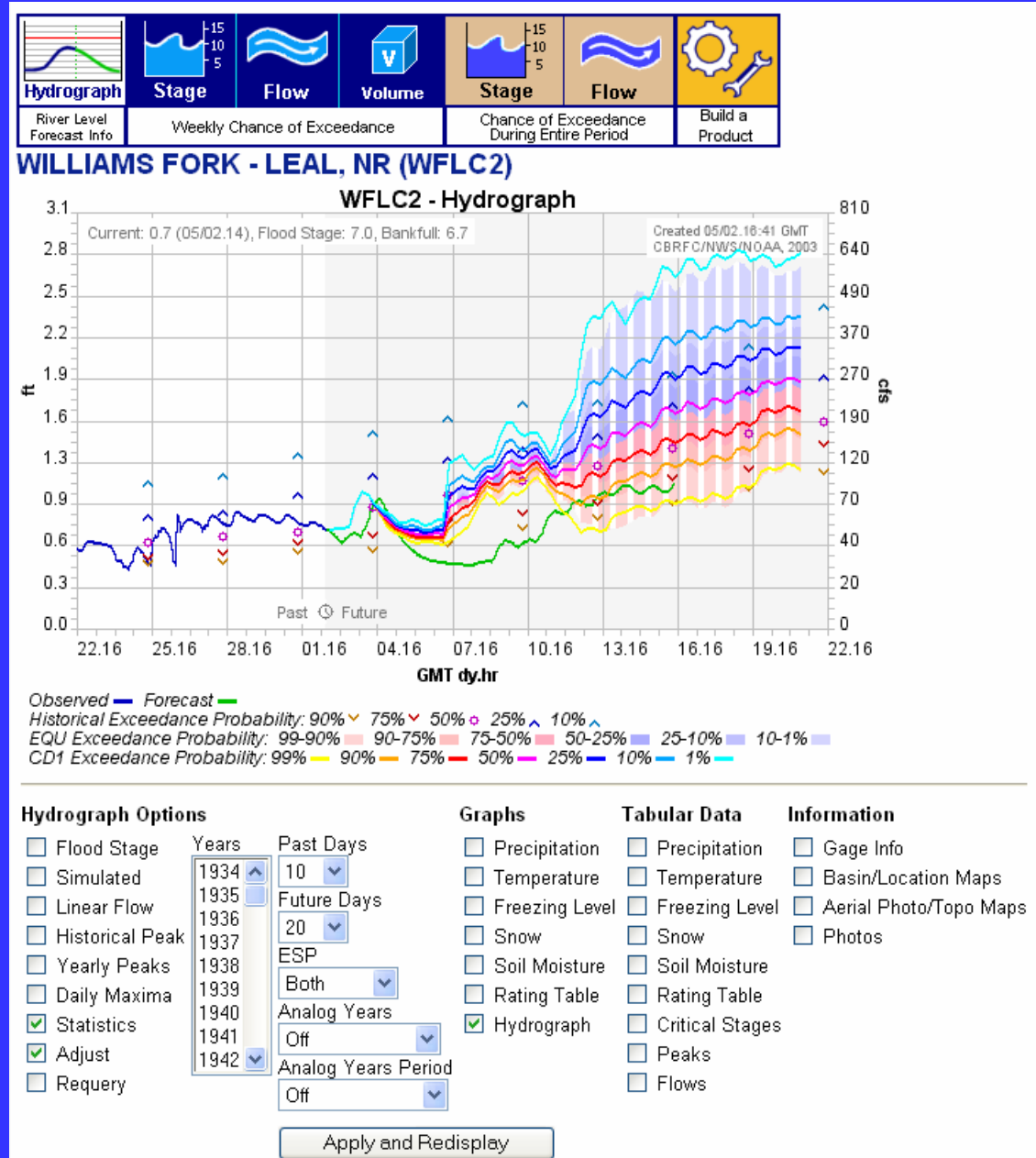
ESP peak flow



Peak flow forecasts shown as Probability Density Functions (PDFs). MRF shows higher probabilities in higher flows for two weeks.

Web Page Example

Probabilities from ESP (shaded) Using Historical MAPs and MAPs Equally Weighted and ESP (lines) Using Maps And Mats Derived from The MRF Ensembles Plotted with Deterministic Forecast and Historical Exceedance Values

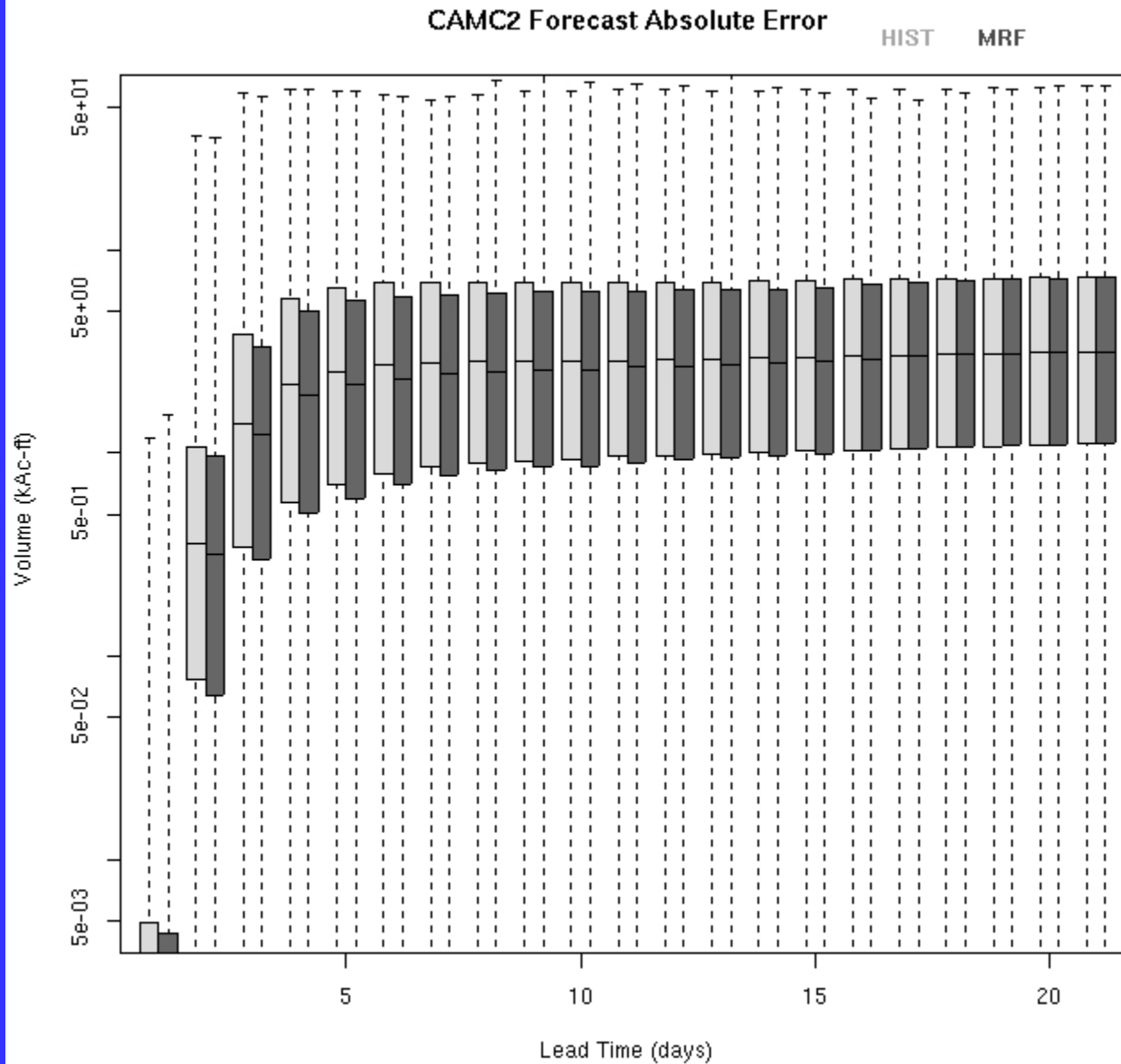


ESP Forecast Verification

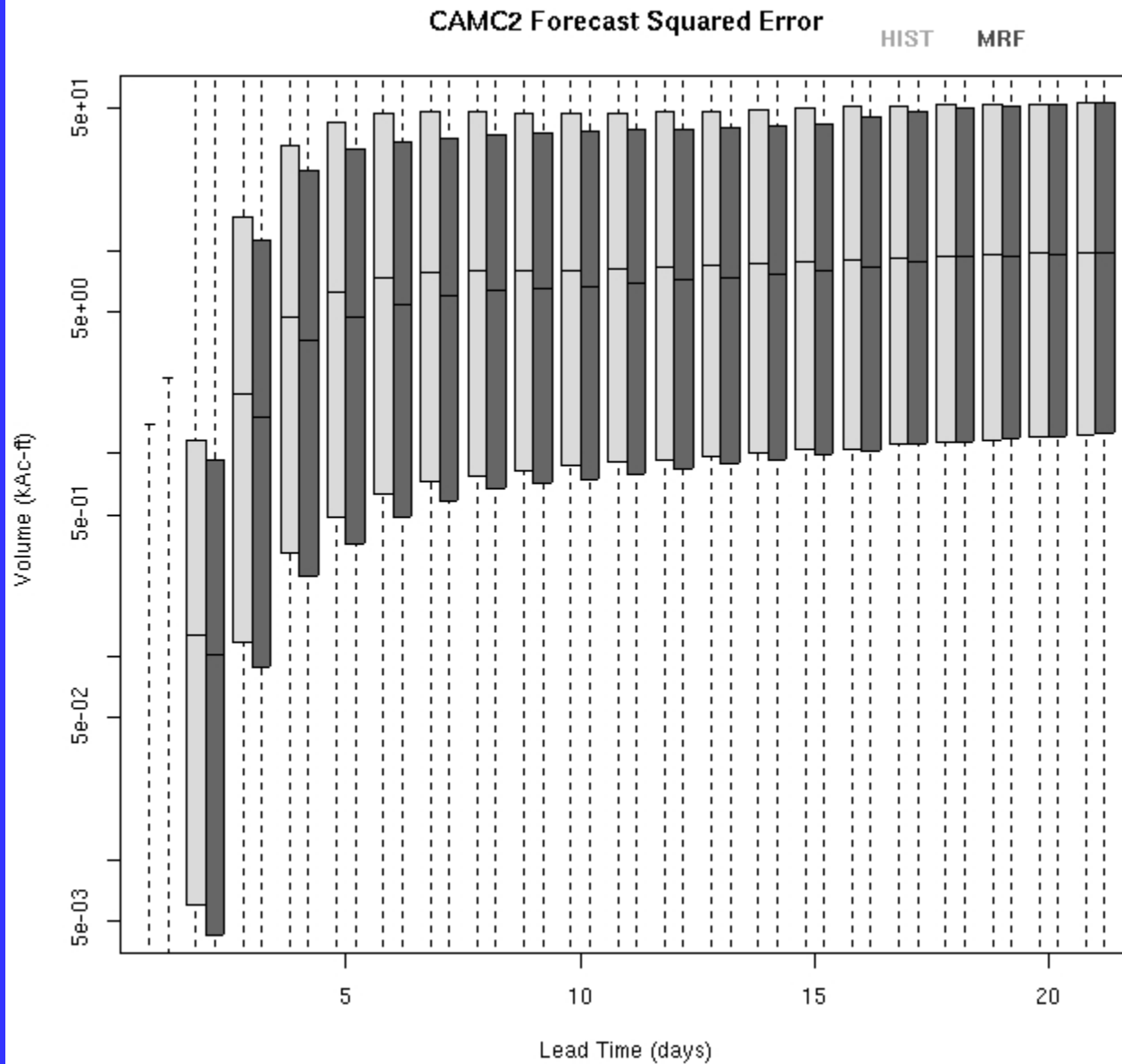
ESP forecasts may be verified as DETERMINISTIC forecasts. Traditional verification statistics such as Mean Absolute Error (MAE) and Mean Squared Error (RMSE) may be tallied from each forecast trace within an ensemble to show mean error statistics for the entire ensemble.

In this case, all forecasts made between April 1 and July 30 are aggregated by forecast lead time.

ESP Forecast Verification



ESP Forecast Verification



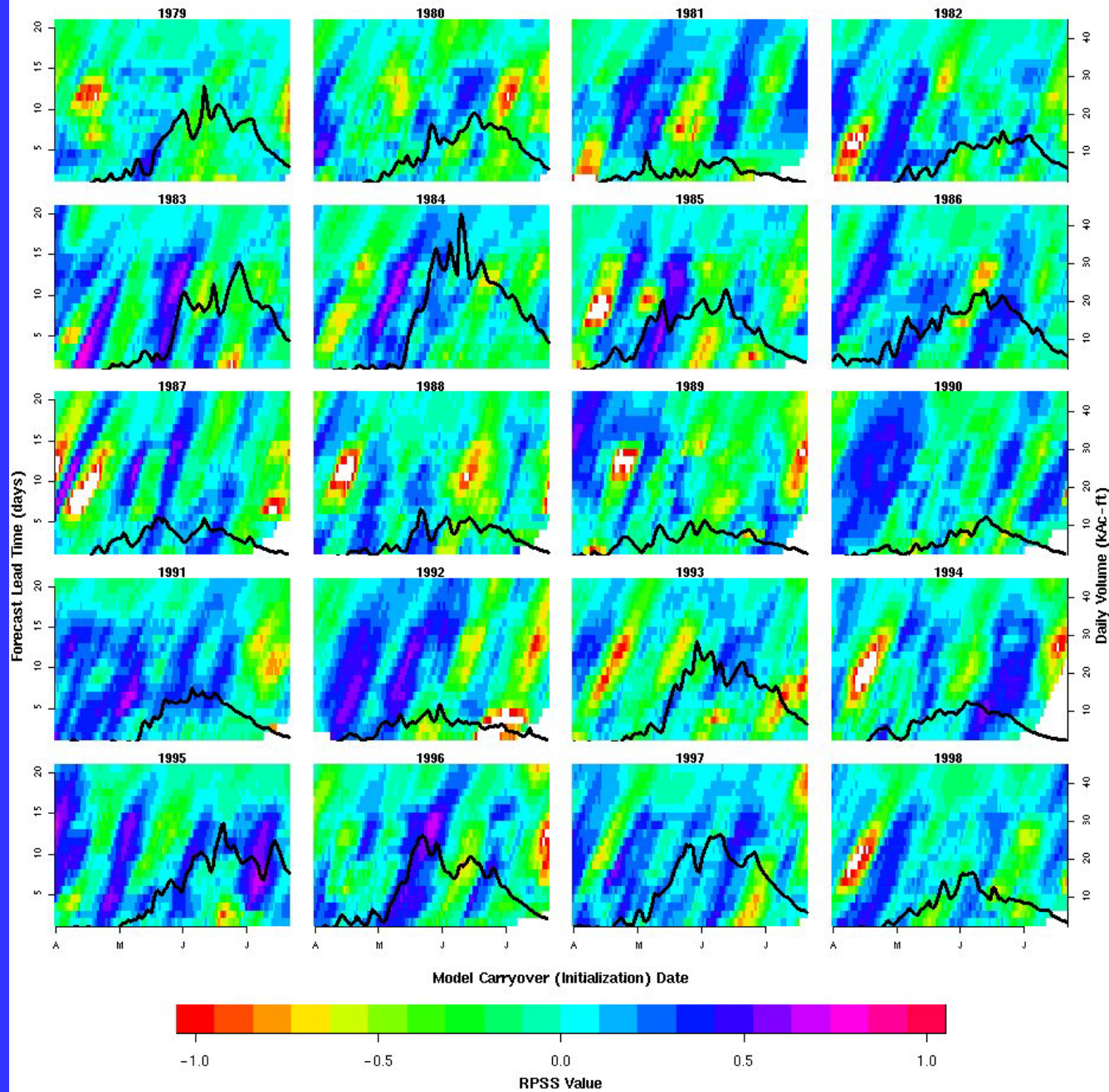
ESP Forecast Verification

ESP forecasts are verified as a PROBABILISTIC forecast empirically derived from the ESP flow ensembles.

The Ranked Probability Score (RPS) and Ranked Probability Skill Score (RPSS) will be used quantify forecast skill improvement resulting from MRF.

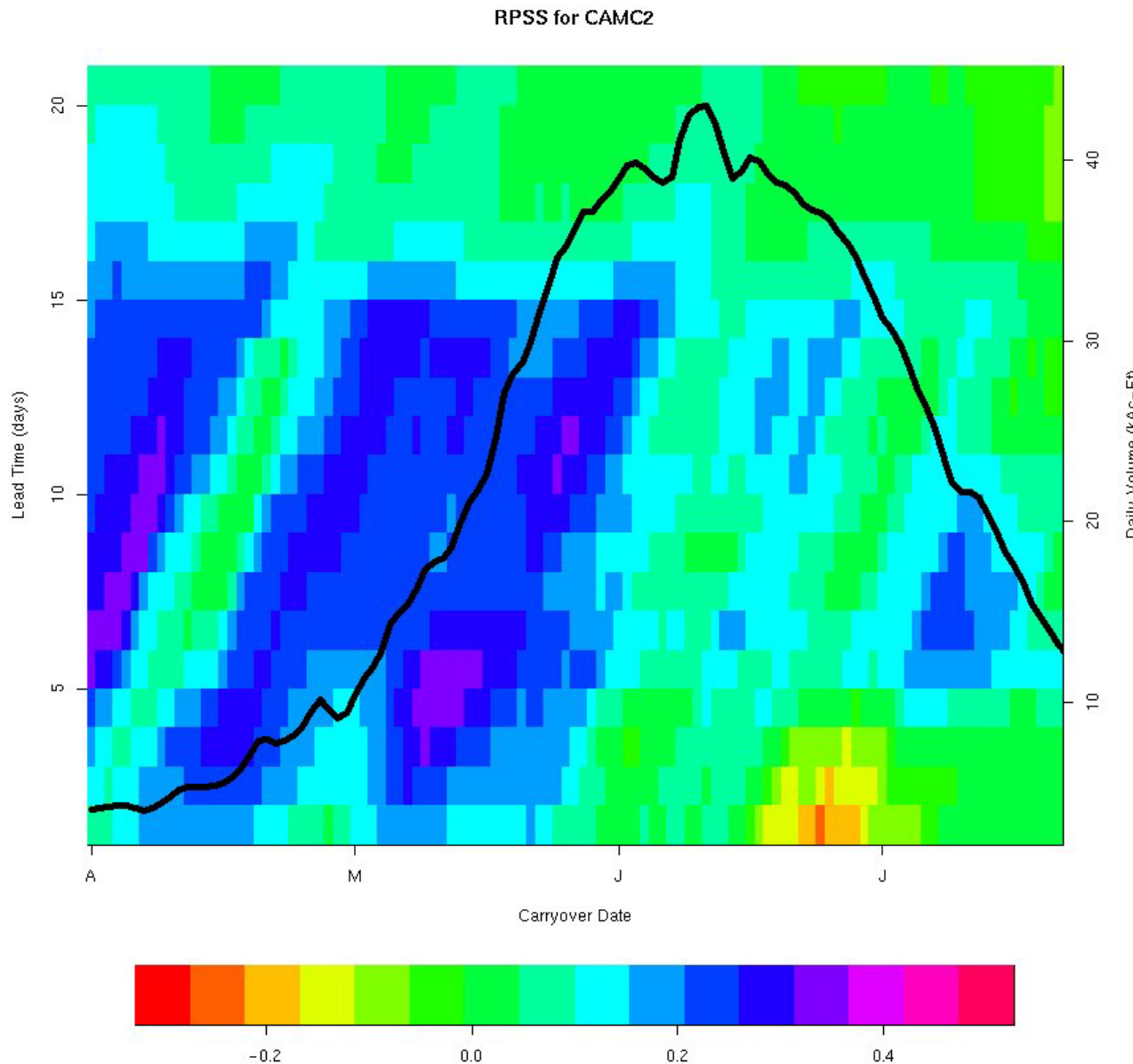
RPS values will be calculated based on ESP reforecasts using MRF derived MAT/MAPs described here as well as purely historical MAT/MAPs.

Ranked Probability Skill Scores (RPSS) for ESP reforecasts for flow for CAM2



ESP Forecast Verification

ESP Forecast Verification



Mean hydrograph and RPSS values...

Good forecast skill improvements during rising limb of hydrograph.

Parallel Efforts

- **Use of various methods to incorporate climate forecasts or indices into long range (day 15 – 365) ESP forecasts. Have shown forecast skill improvements up to 20% in Arizona basins.**
- **More rigorous verification including traditional and probabilistic forecast verification metrics.**

Future Plans

- **Use Statistical Weather/Climate Generator In Lieu of Historical Ensembles**
- **Use ETA Forecasts from reforecast project**
- **Investigate usage of meso-scale modeling in ESP**
- **Incorporate human derived forecasts**