Simple- and Modified-Poor Man's QPF Ensembles and a Neural Network Approach

Ying Lin and Vladimir Krasnopolsky
NOAA/NWS/NCEP/EMC
IMSG

AMS 24th Conf on WAF/20th Conf on NWP

25 Jan 2011

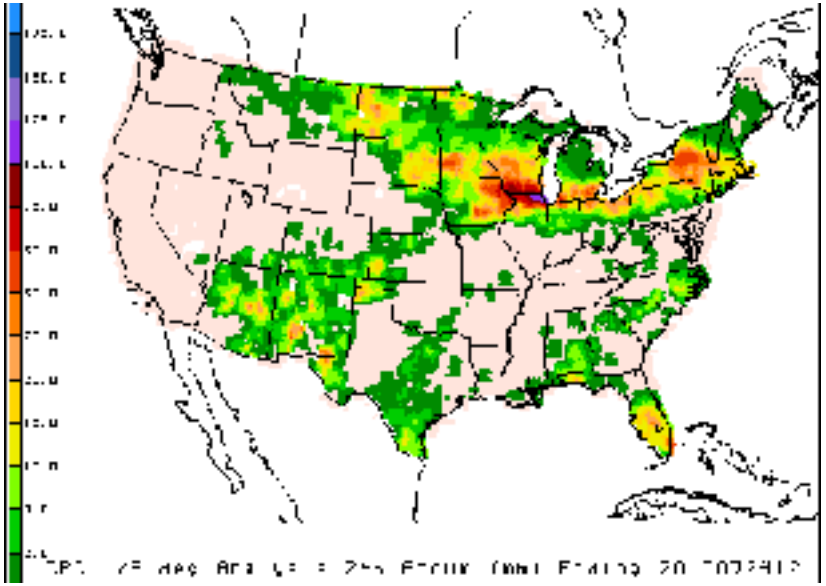
A simple Multi-model QPF Ensemble

"MEDLEY": simple arithmetic averaging of eight operational forecasting models:

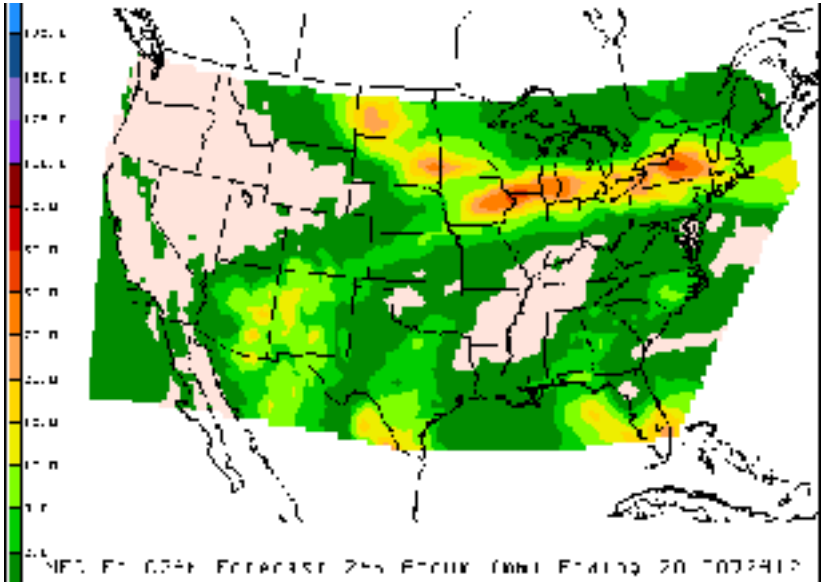
- NCEP's NAM and GFS
- CMC (Canadian Meteorological Centre) regional and global models
- DWD (Deutscher Wetterdienst)
- ECMWF (European Centre for Medium-Range Weather Forecasts)
- JMA (Japan Meteorological Agency)
- UKMO (UK Met Office)

00-24h Forecast ending 2010072412

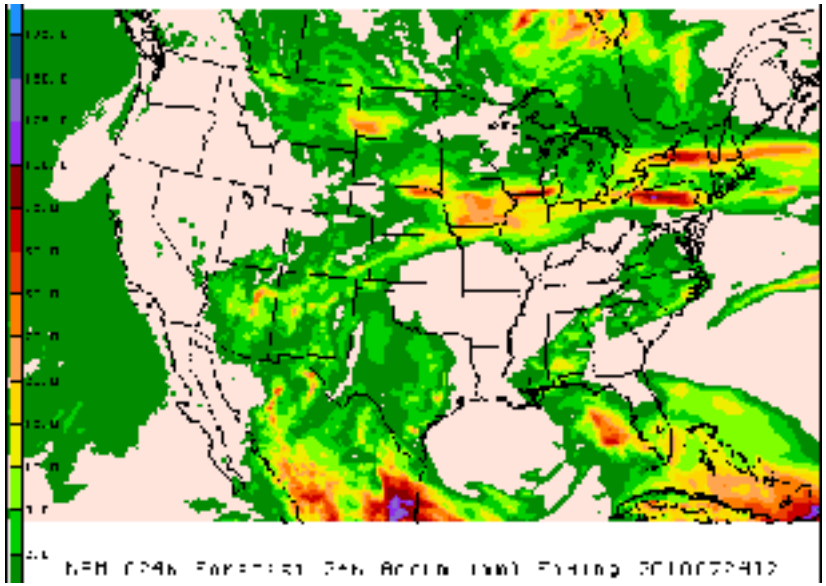
Verifying analysis



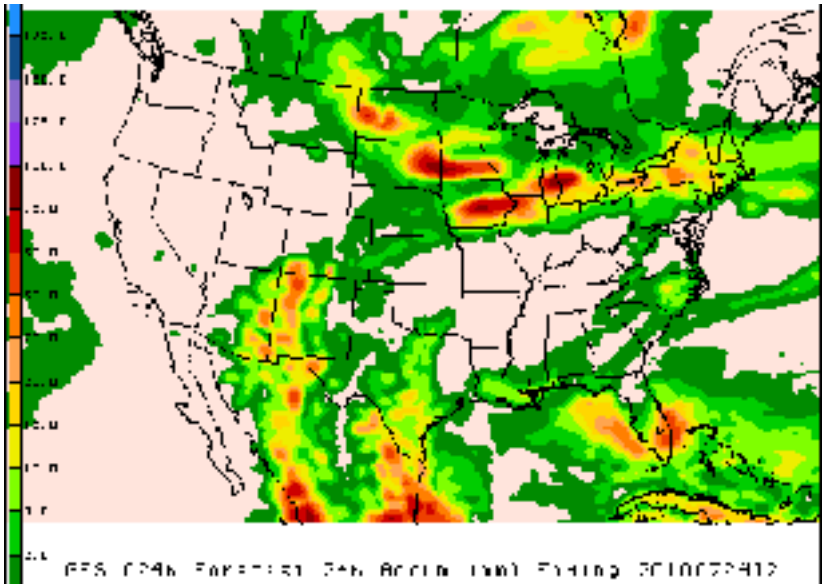
MEDLEY



NAM

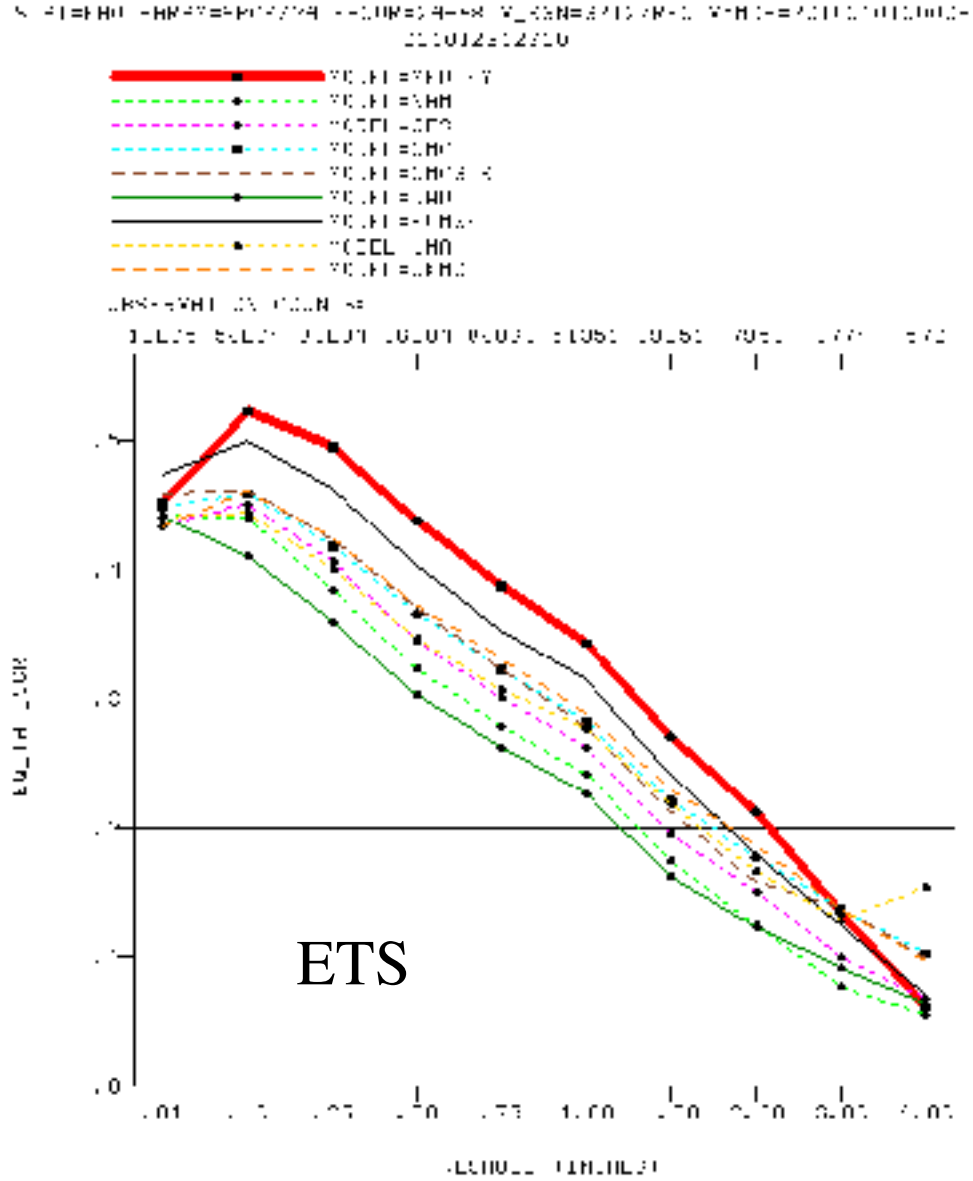


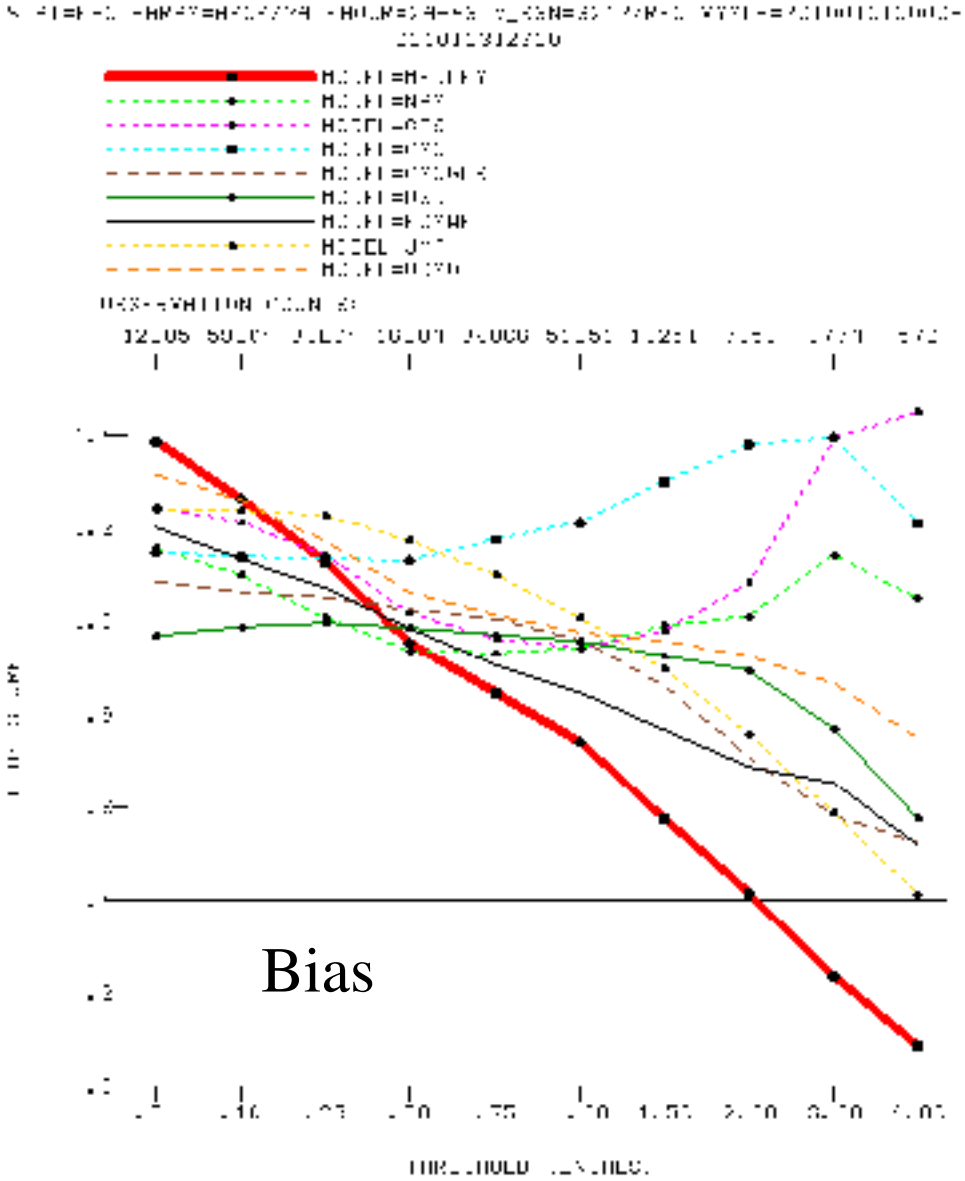
GFS



MEDLEY and the 8 "member" models, 24+48h fcsts

Jan – Dec 2010





Comparing MEDLEY to Component Models

Advantages: better placement of precipitation areas, overall higher ETS

Disadvantages (from simple averaging):

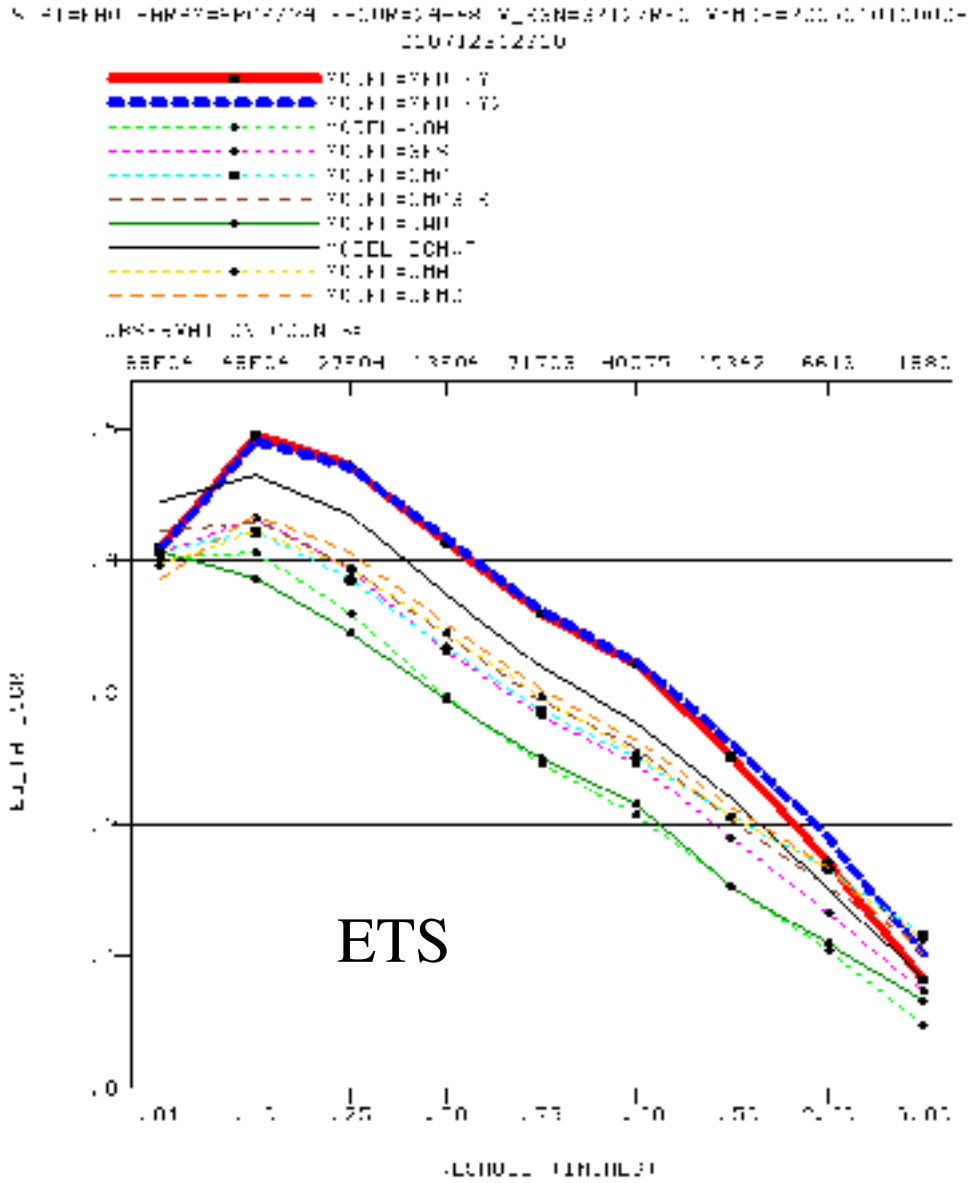
- High bias in low thresholds – large area of low precip
- Low bias in high thresholds – highs smoothed out

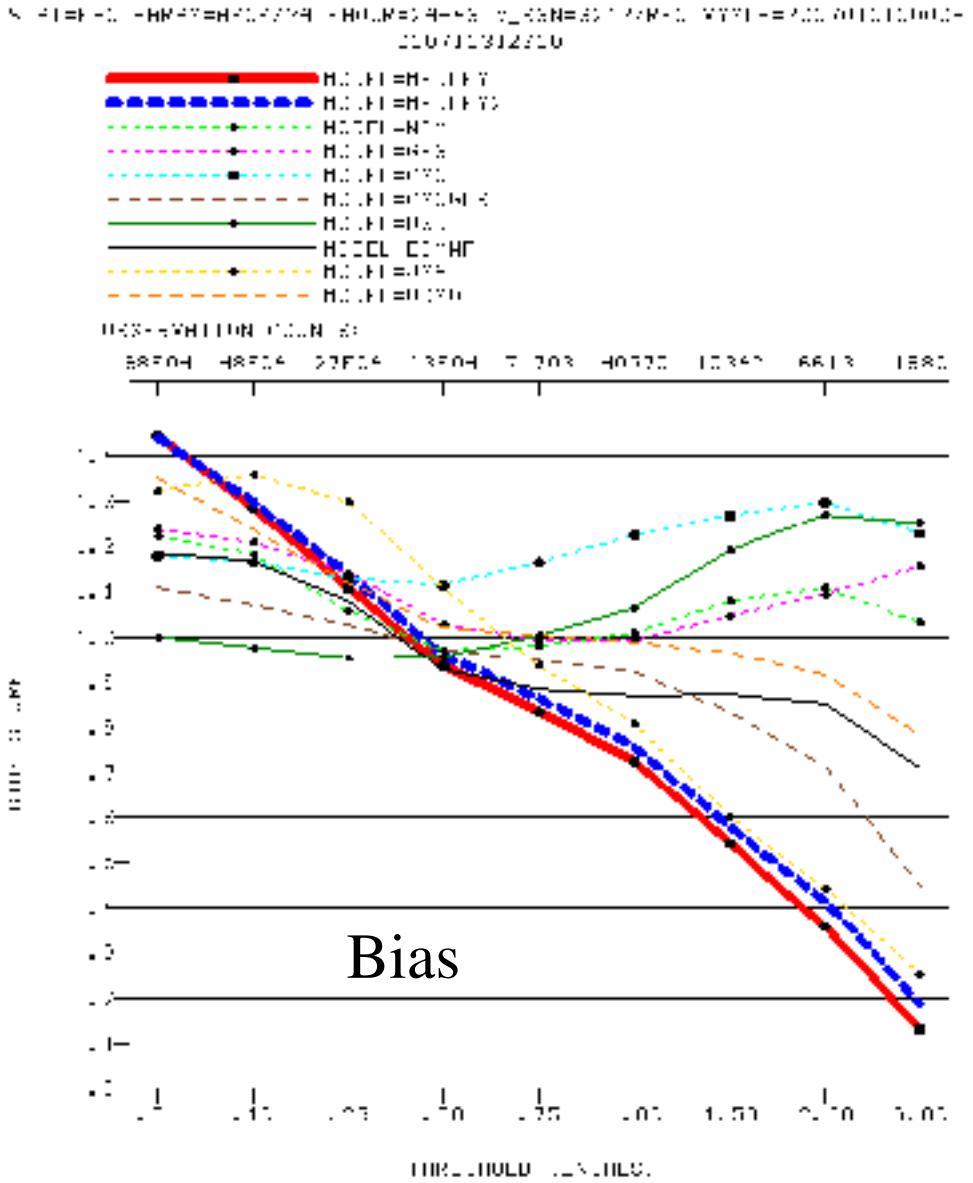
How to refine “MEDLEY”?

Excluding worst performers from the ensemble:

MEDLEY2: as in MEDLEY, but exclude the two models with the worst performance (average ETS for the thresholds of 0.1”, 0.25”, 0.5”, 0.75” and 1”/day) in the preceding 30 days

MEDLEY, MEDLEY2 and the 8 "member" models, 24+48h fcsts, Jan – Dec 2007

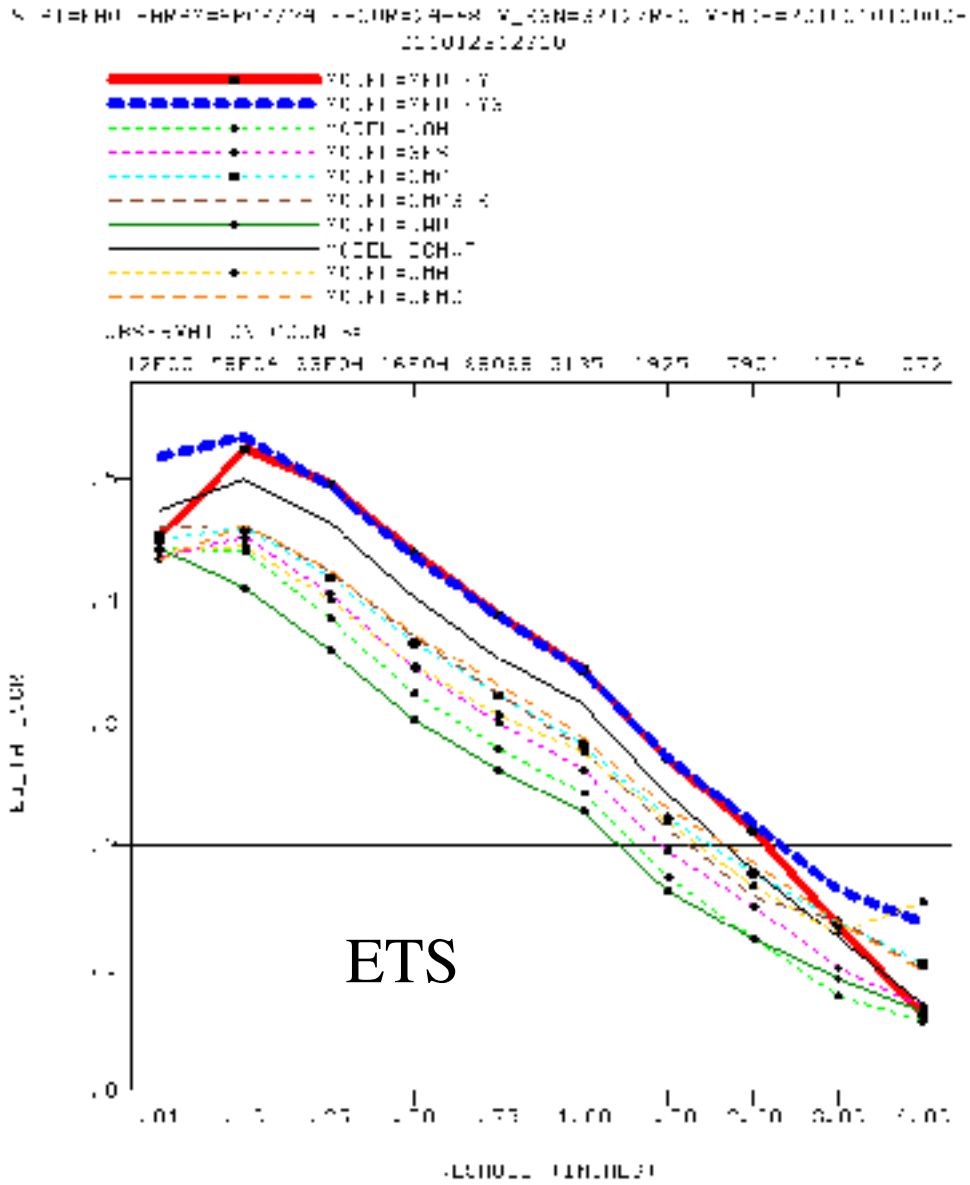


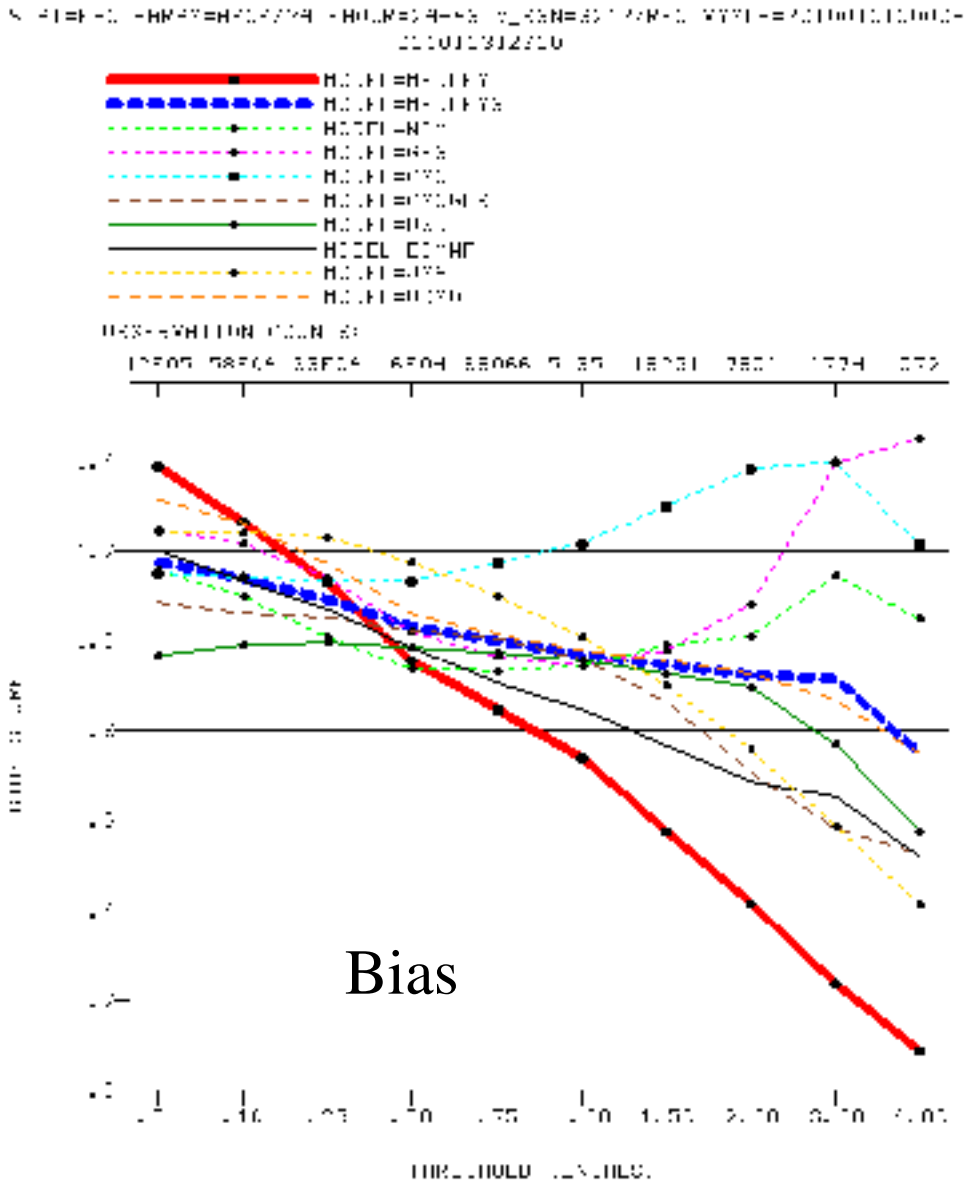


Probability Matched "MEDLEY"

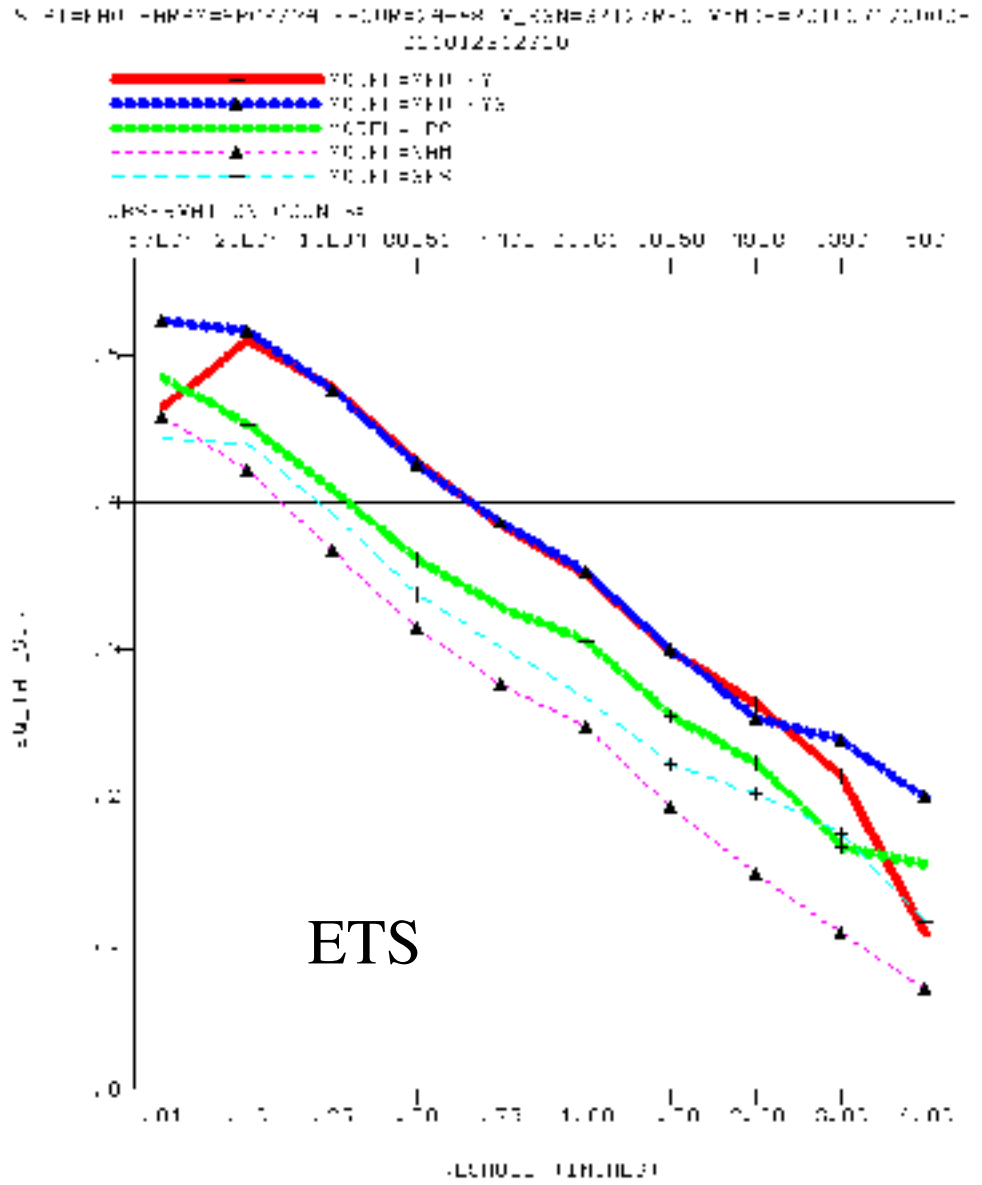
Let the rain rate distribution in the ensemble mean match that of the rain rate distribution of the pooled ensemble members (Ebert, 2001).

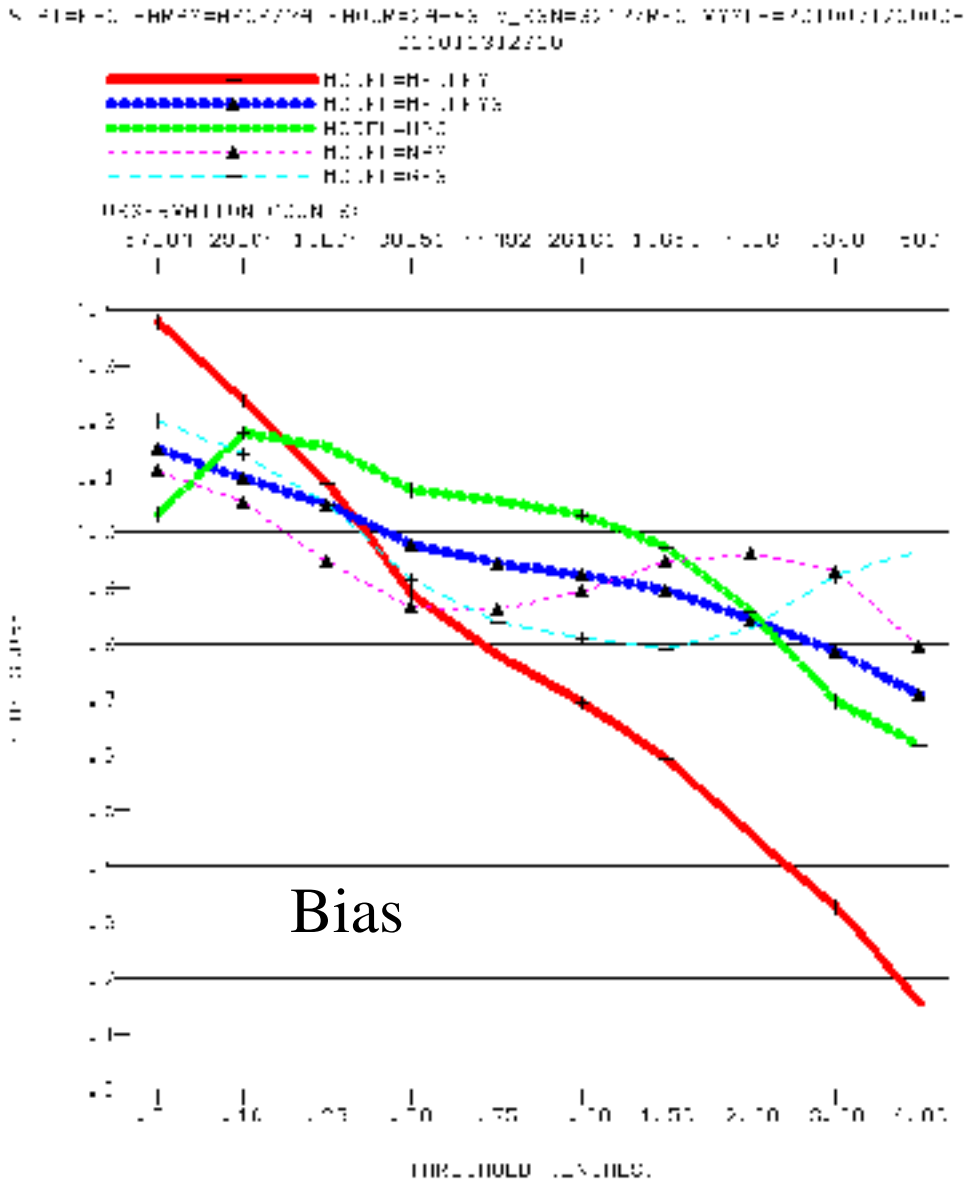
MEDLEY and MEDLEY3 (probability-matched) and the 8 "member" models, 24+48h fcsts, Jan – Dec 2010





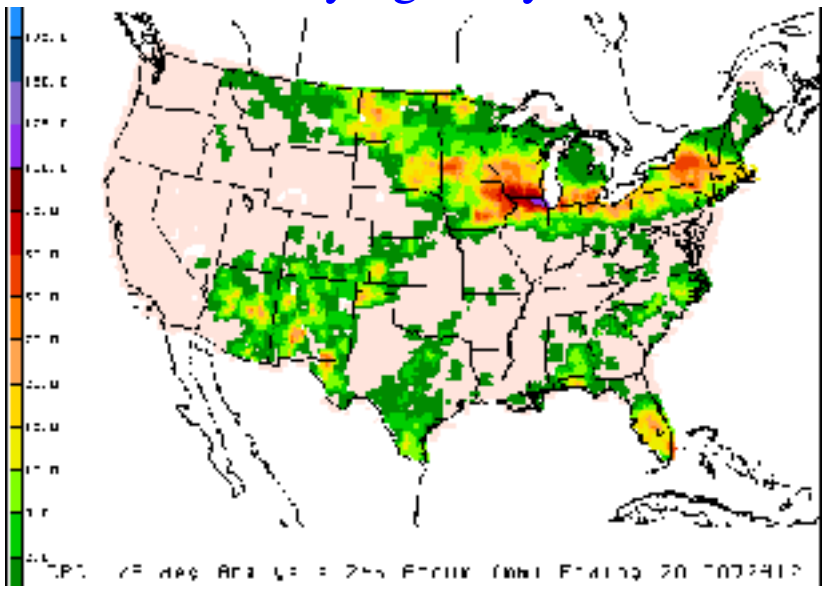
MEDLEY, MEDLEY3 (PM), HPC, NAM and GFS, 24+48h fcsts, 12 Jul – 31Dec 2010



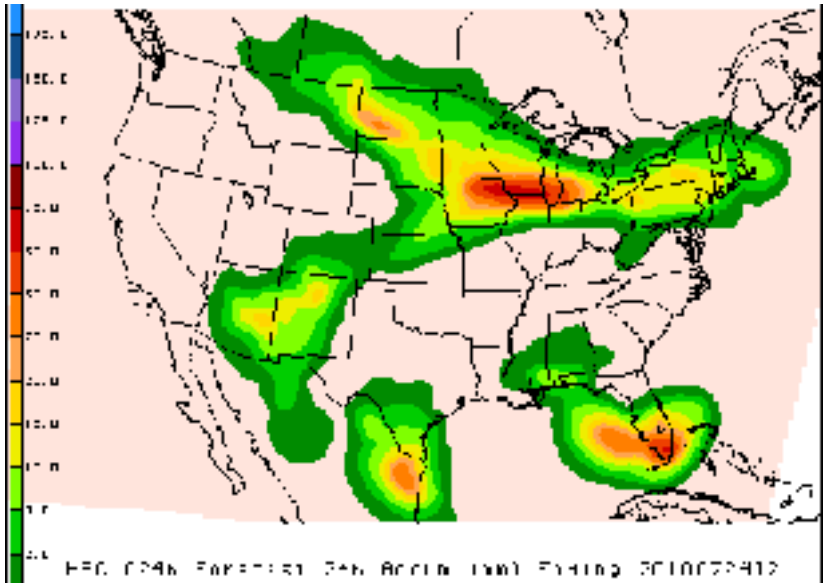


00-24h Forecast ending 2010072412

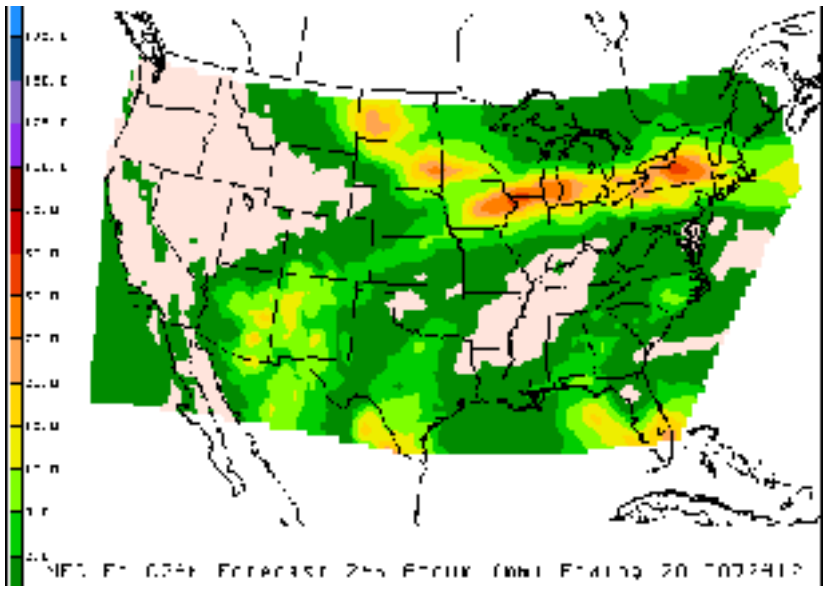
Verifying analysis



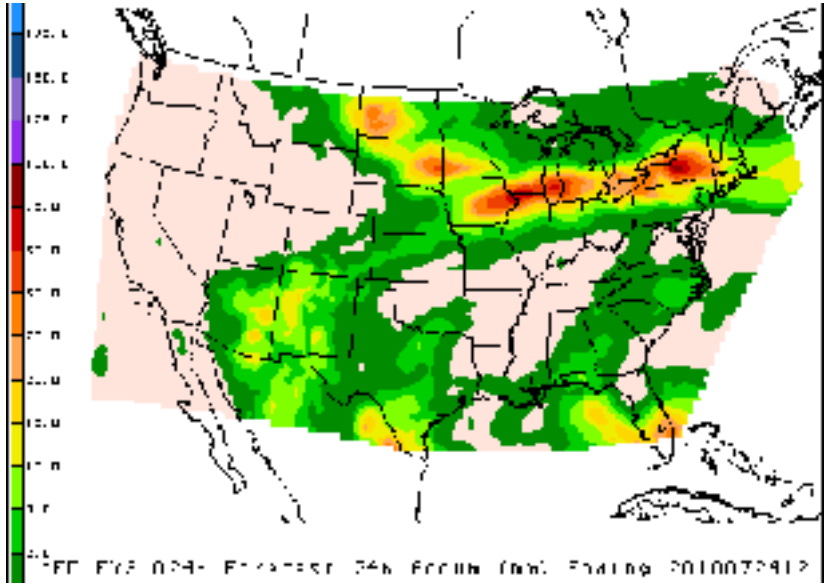
HPC



MEDLEY



MEDLEY3(PM)



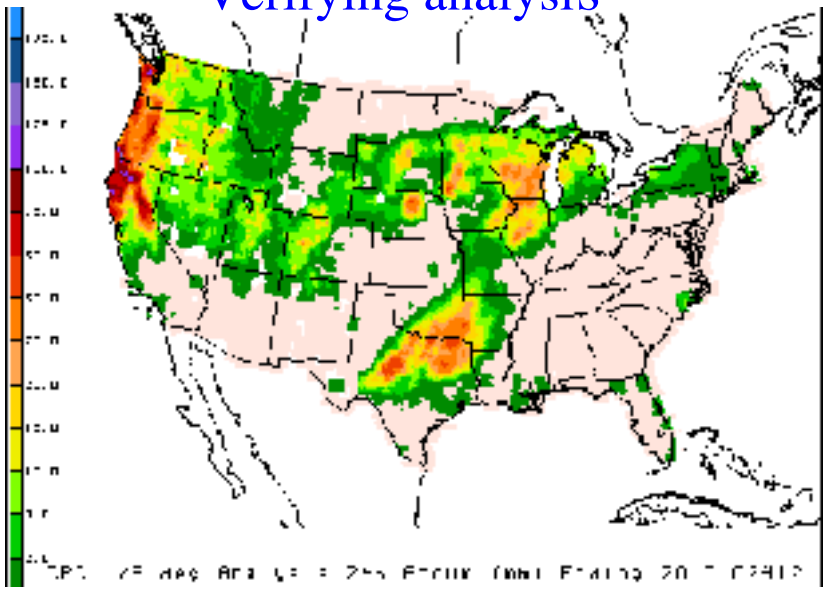
An alternative approach to multi-model ensembles

Develop a non-linear multi-model ensemble. Use past model QPF and verifying analysis data (precip amounts, Julian dates, lat/lon of each data point) to "train" the NN.

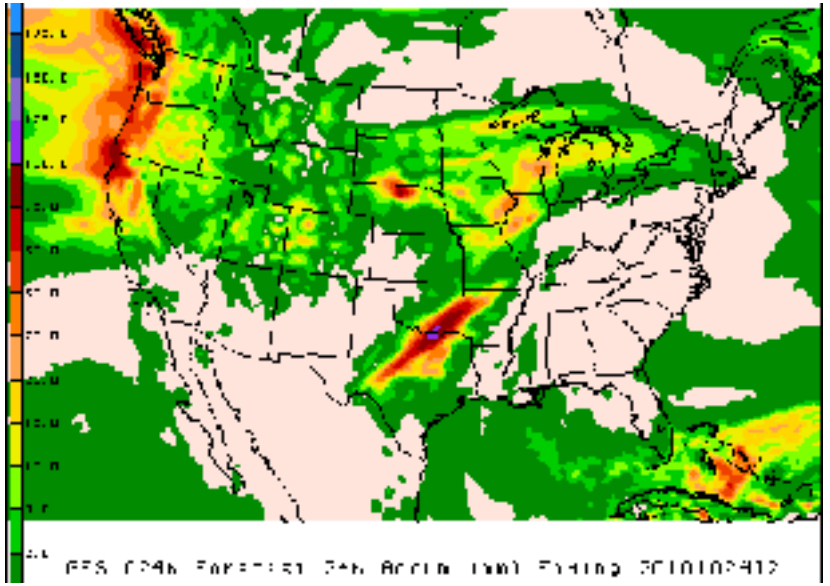
Additional info: Krasnopolsky, " Application of the neural network technique to develop a nonlinear multi-model ensemble for precipitation over ConUS". Paper 1.1, 9th Conf. on Artificial Intelligence and its Application to the Environmental Sciences.

Sample NN forecast: 00-24h fcst ending 2010102412, 1 of 2

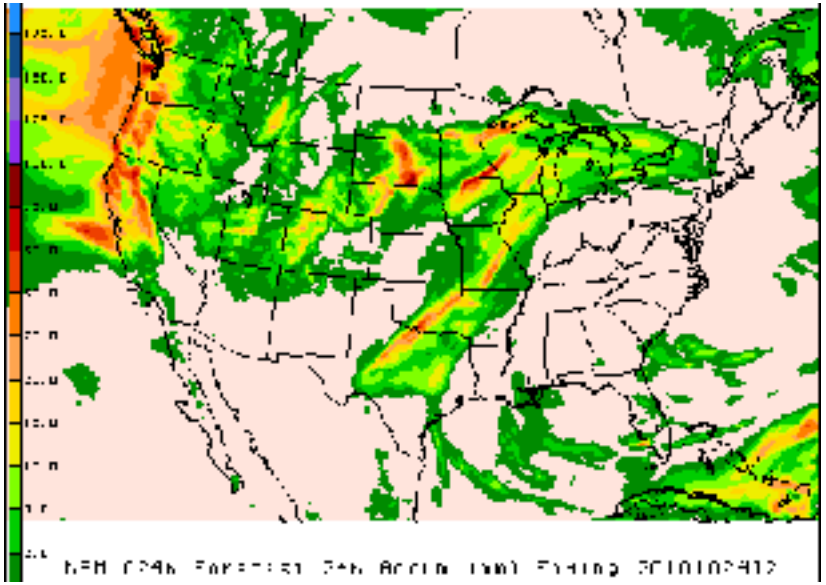
Verifying analysis



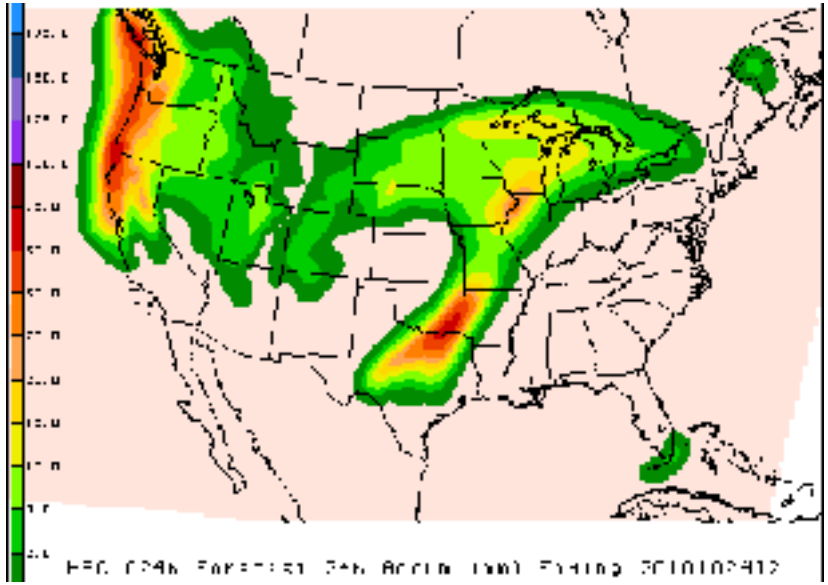
GFS



NAM

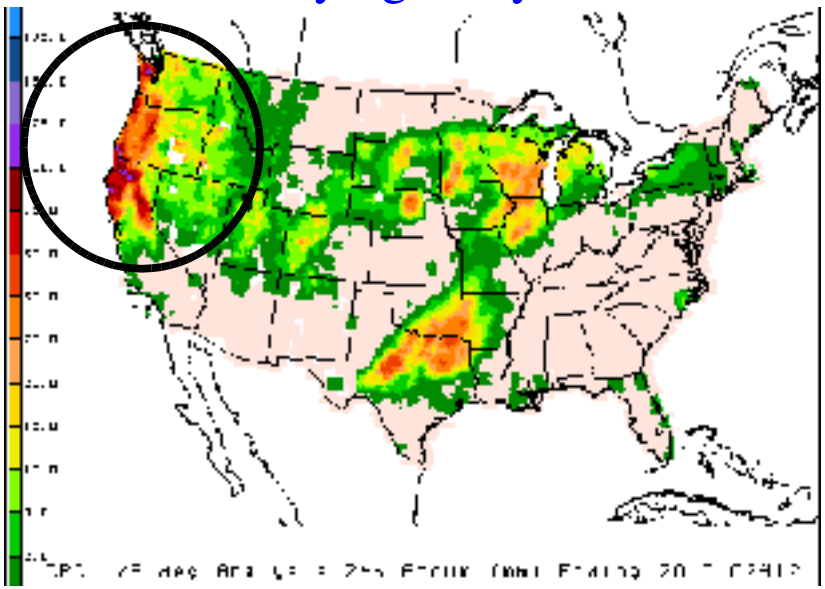


HPC

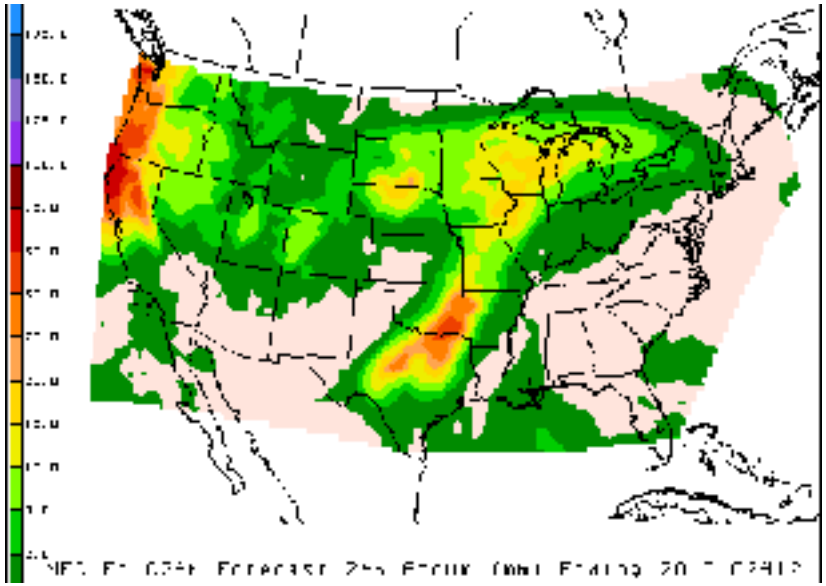


Sample NN forecast: 00-24h fcst ending 2010102412, 2 of 2

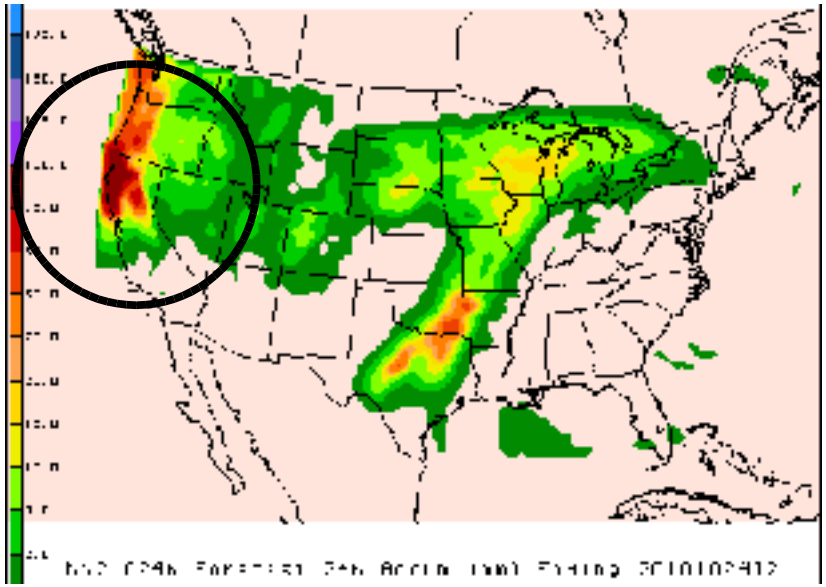
Verifying analysis



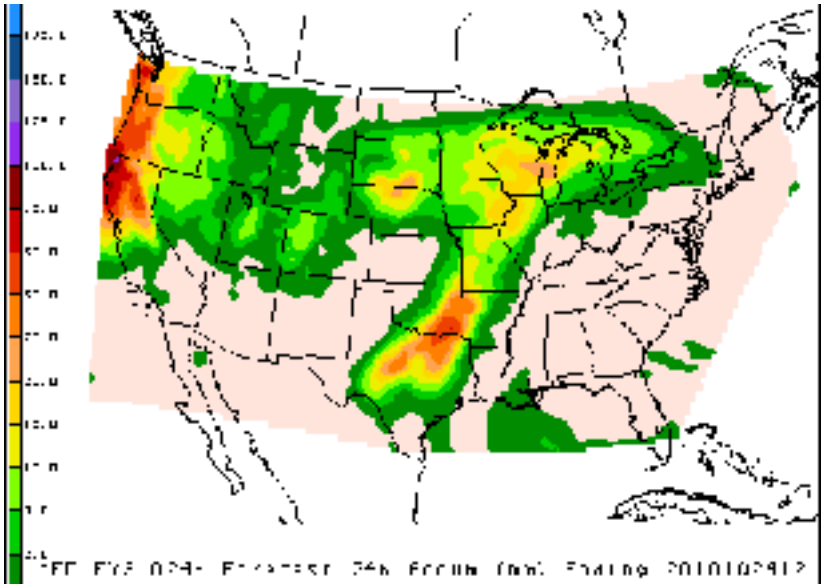
MEDLEY



NN2



MEDLEY3 (PM)



Conclusions

Simple ensemble mean produces a product that is too "smoothed out"

Withholding two poorly-performing members from the ensemble improves performance slightly

Probability-matching improves ensemble greatly

Neural network approach promising – more details are preserved

Future Plans

"MEDLEY" on a higher resolution grid to benefit from higher resolution members

Bias adjustment to individual members' precipitation forecasts (as in SREF – Jun Du)

Further refine neural network approach