NCEP Short-Range Ensemble Forecast (SREF) system status and plan

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Evolution of the NCEP SREF

	IC uncertainty	Physics uncertainty	Model resolution	Forecast length	Ensemble members	Daily cycles	Bias correction	Downscale	Products
2001	BV	Multi-model (MM, Eta and RSM)	48km	63hr	10	09, 21z	x	x	Indiv, mean, spread, prob
2003		Multi-model + Multi-physics (MMMP, add ETA_kf)			15		x	x	
2004		MMMP (add more diverse physics schemes to Eta)	40km	87hr			x	x	
2005		MMMP (add NMM and ARW)			21		x	x	
2006						03,09,15,21z	x	x	
2007							basic fields	x	
2009	11 BV and 10 downscaled ETR	MMMP (less Eta and more WRF, add more physics scheme to RSM)	32/35km	87hr (hrly output to f39)				x	
2011								Dual resolution to 4km (HREF)	Hrly aviation (NARRE-TL)
2012	Blended between BV and ETR	Discard Eta and RSM and add NMMB	16km				Add precipitation	Add statistical downscaling to 5km	Add min, max, mode, 10, 25, 50, 75, 90%, clusters, mean bufr,2 bestmember, weight-mean

2012 SREF upgrade

- Model Change
  1. Model adjustment (eliminate Eta and RSM legacy models and add new NEMS-based NMMB model)
  2. Model upgrade (two existing WRF cores from v2.2 to version 3.3)
  3. Resolution increase (from 32km/35km to 16km)
  4. All models run with 35 levels in the vertical and 50 mb model top.

- IC diversity improvement
  1. More control ICs (NDAS -> NMMB, GDAS -> NMM, RAP blended @ edges w/GFS -> ARW)
  2. More IC perturbation diversity (blend of regional breeding and downscaled ETR)
  3. Diversity in land surface initial states (NDAS, GFS, and RAP).

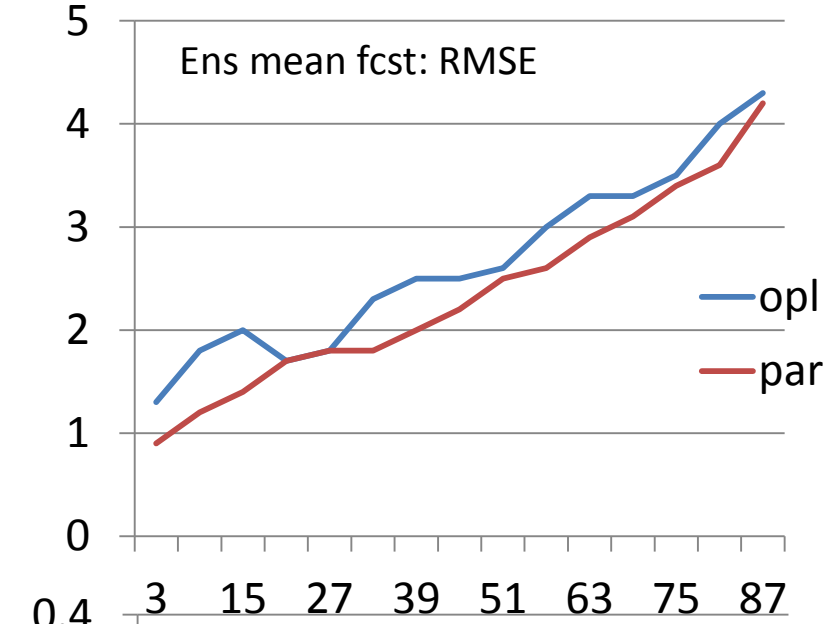
- Physics diversity improvement
  1. More diversity of physics schemes (flavors from NAM, GFS, HWRF, NCAR and RAP)

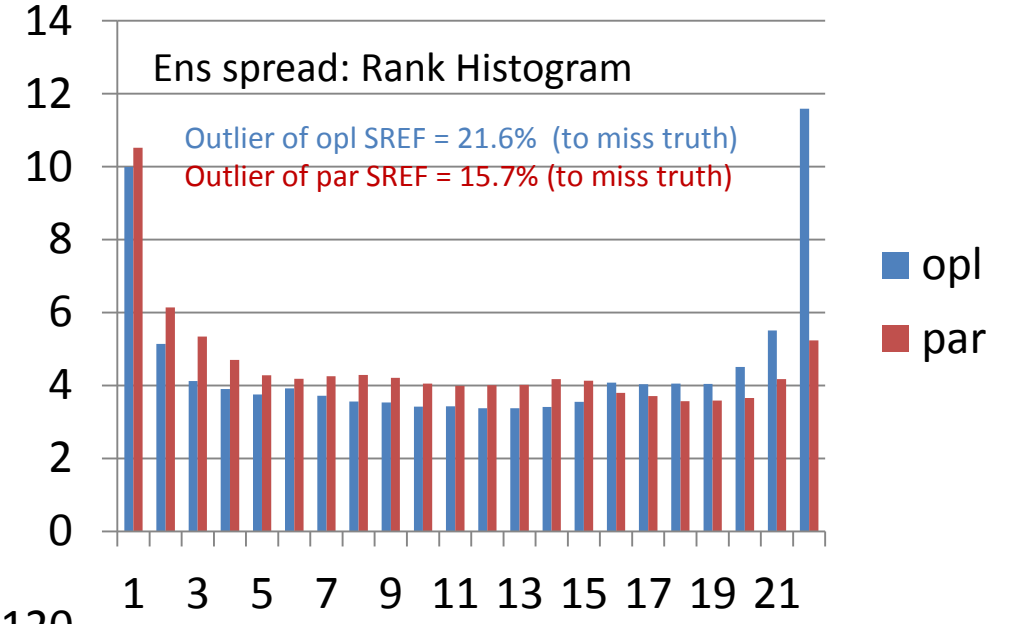
- New capabilities of post-processing & product generation
  1. precipitation bias correction (individual members and ensemble mean)
  2. clustering and associated mean/prob/spread within a cluster
  3. member performance ranking (different weights for different members)
  4. downscaling to 5km using RTMA and associated ensemble products.

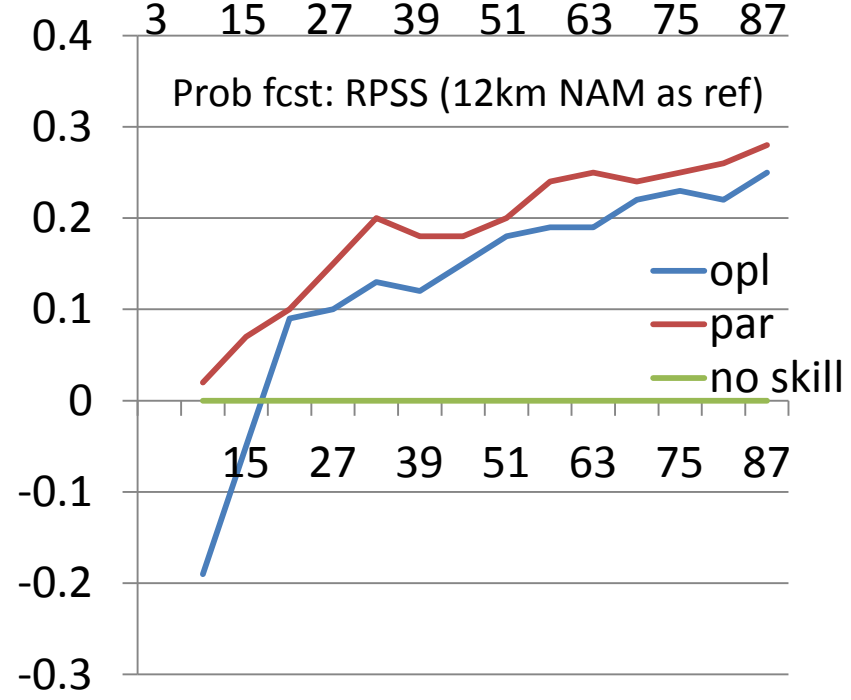
- New ensemble products
  1. max/min, mode, 10-25-50-75-90% forecasts
  2. probs of severe thunderstorm, lightning, dry lightning, fire weather (SPC) as well as LLWS, composite reflectivity and echo top
  3. addition of hourly ensemble product output from 1-39 hr.
  4. ensemble mean bufr

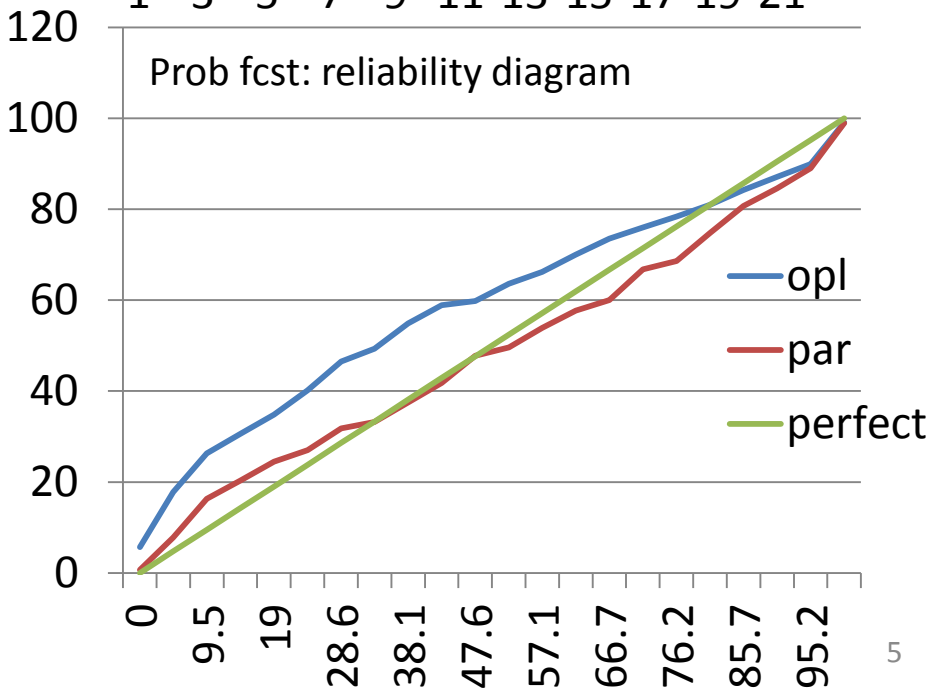
Performance evaluation

Evaluation of SLP (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

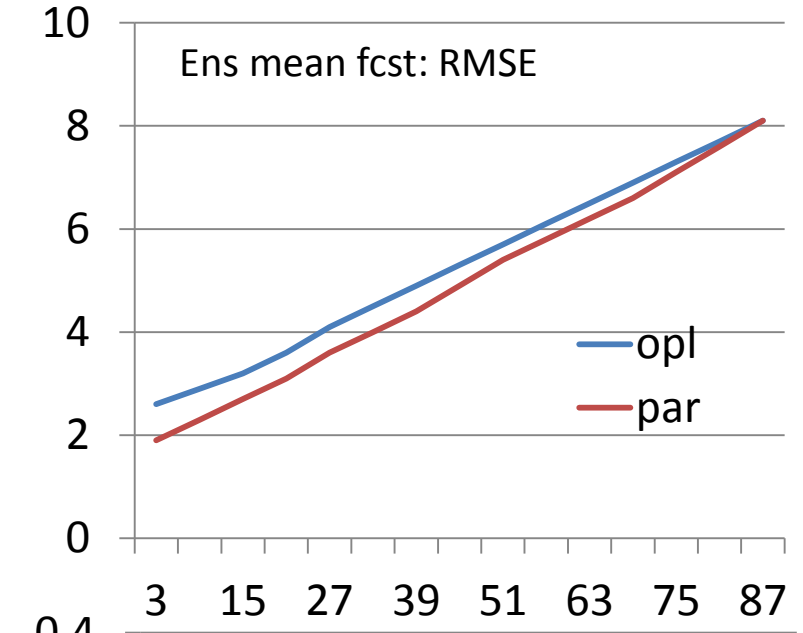


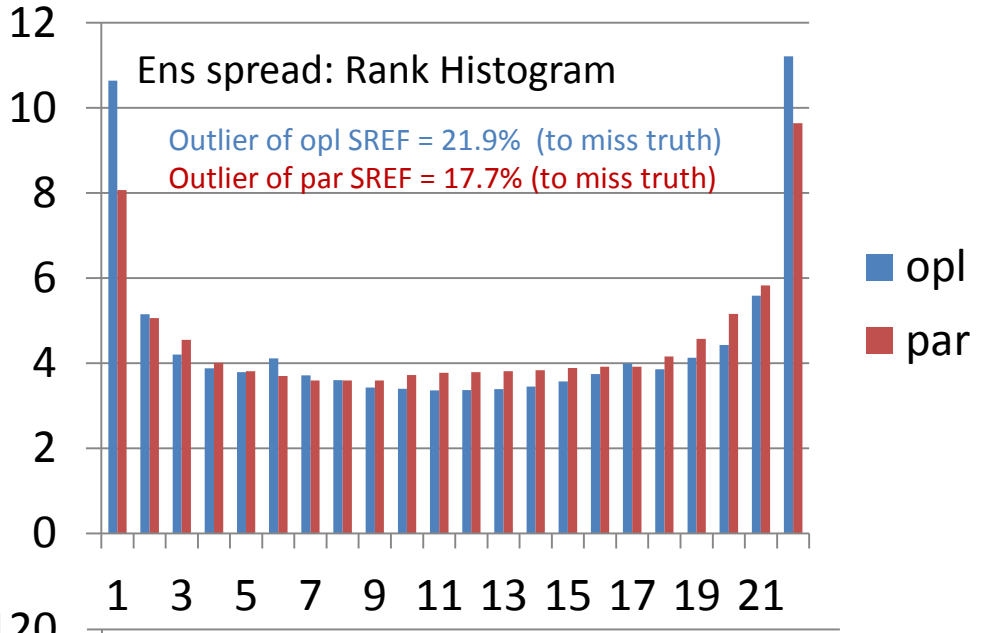


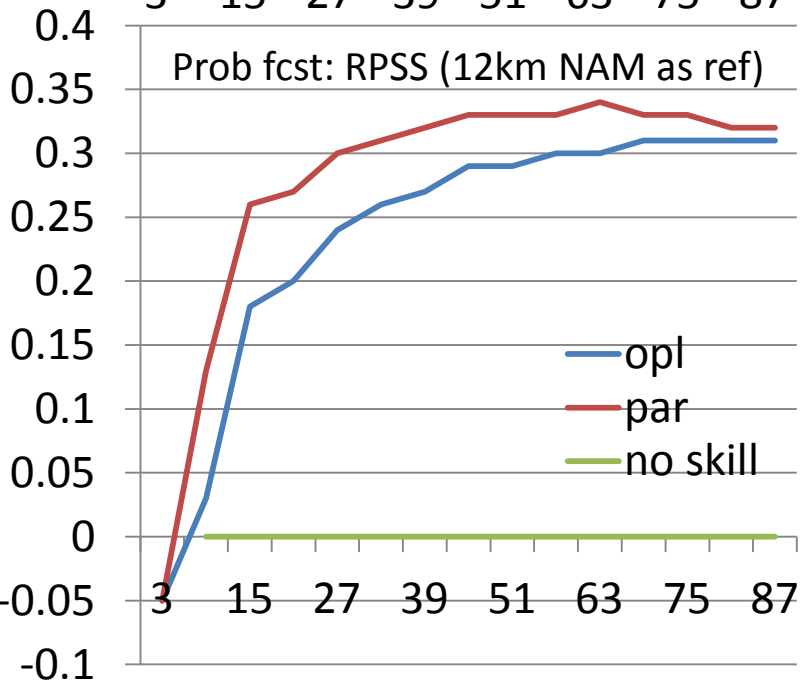


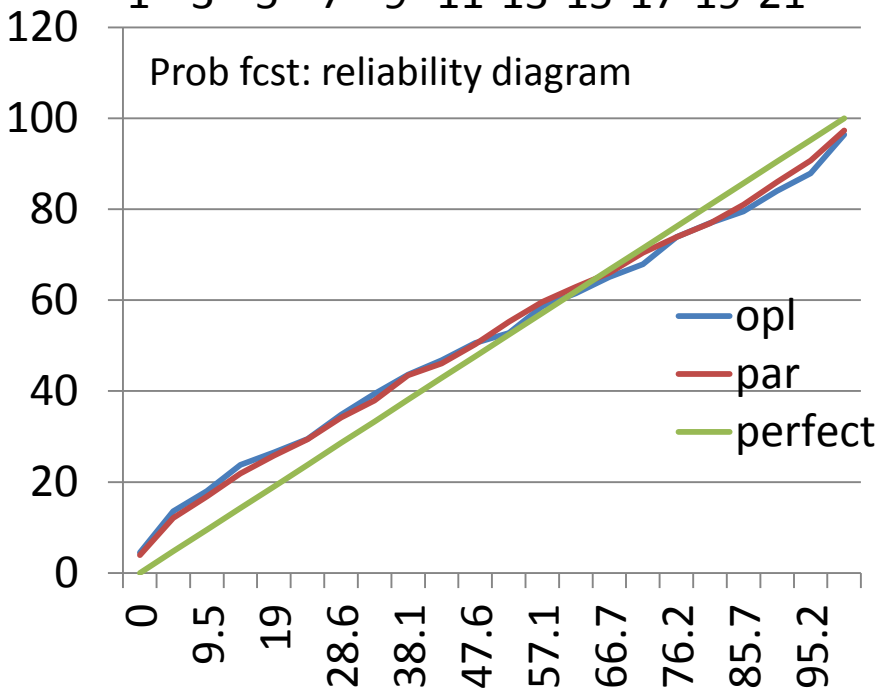


Evaluation of 250U (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

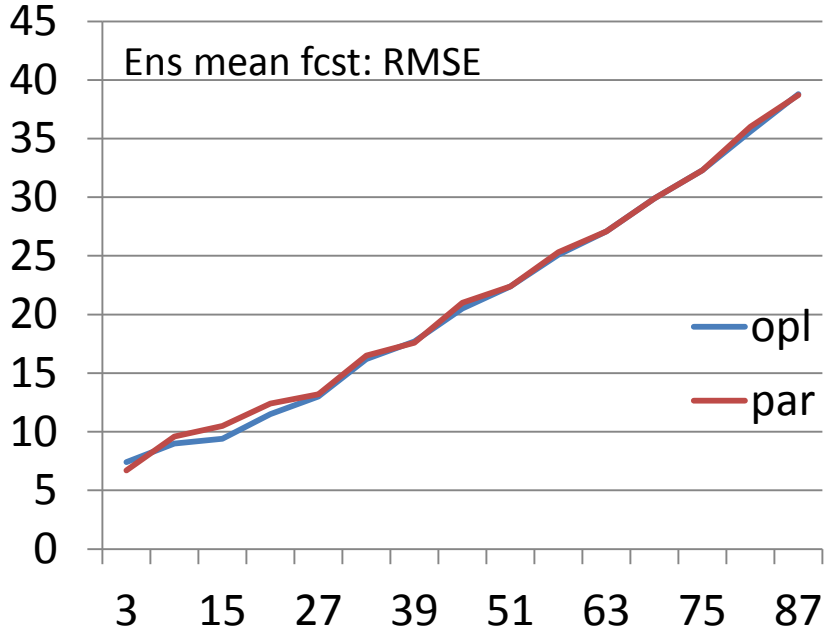


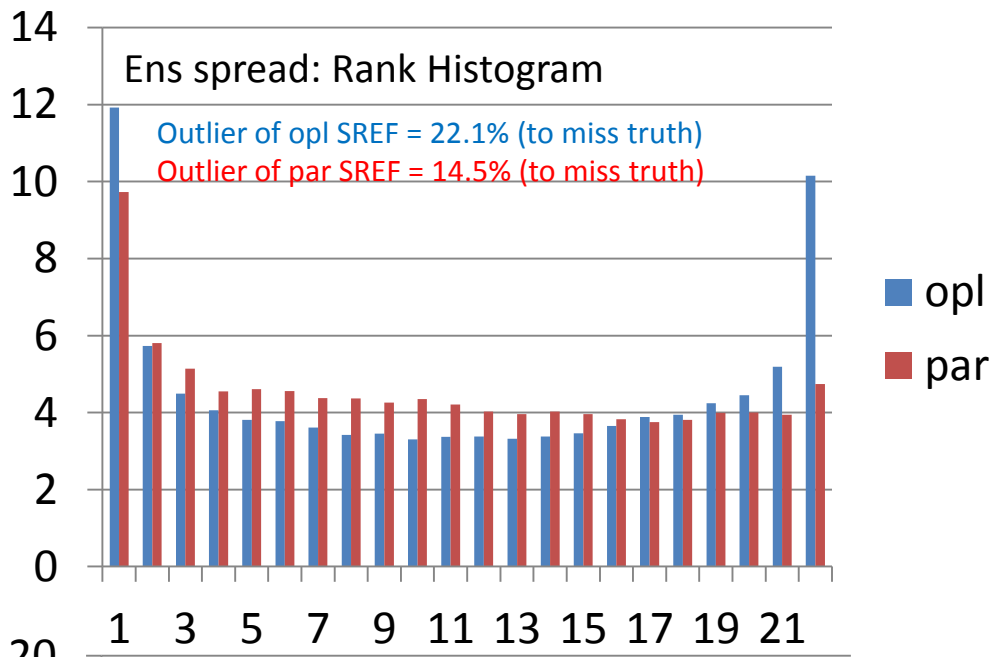


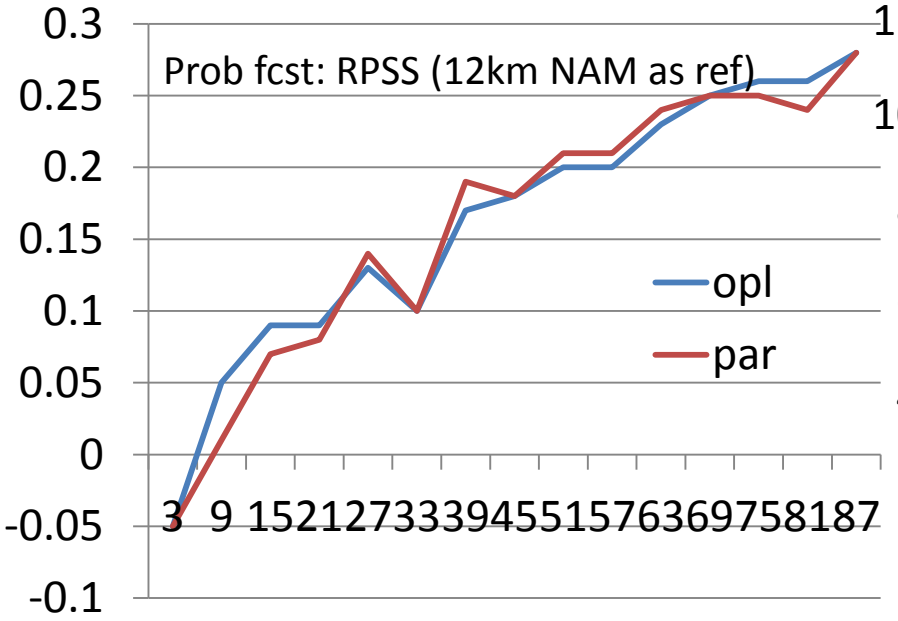


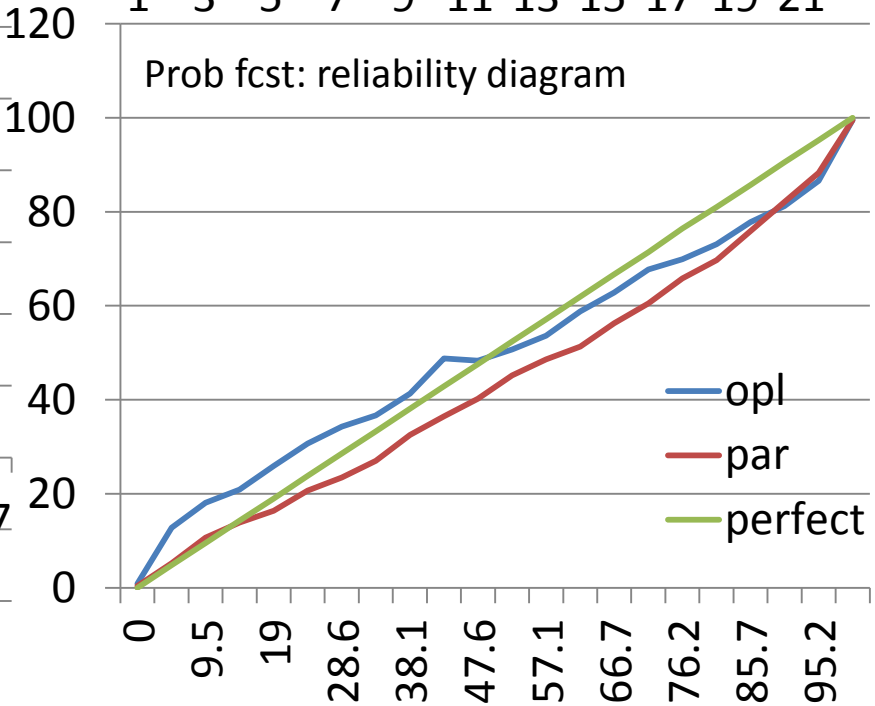


Evaluation of 500H (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

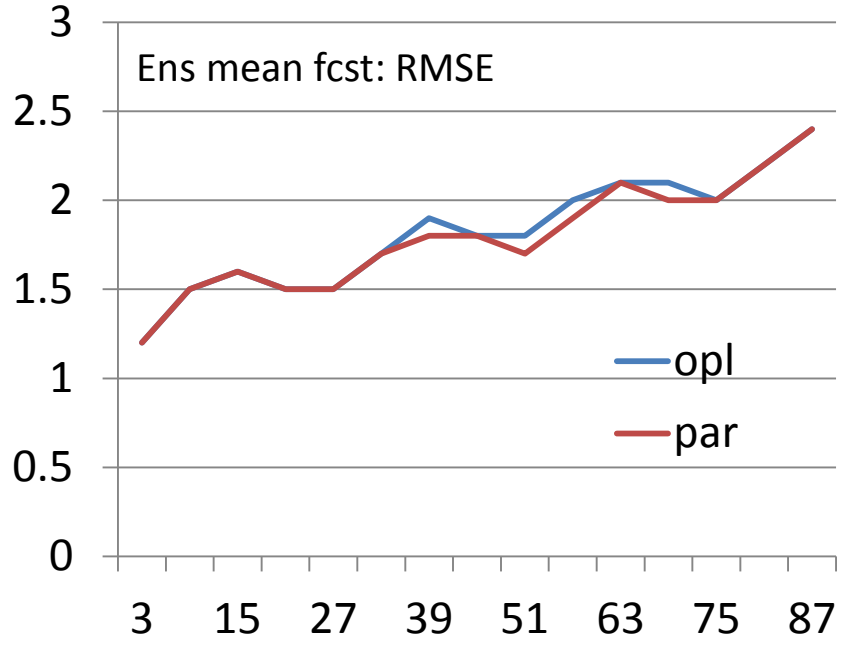


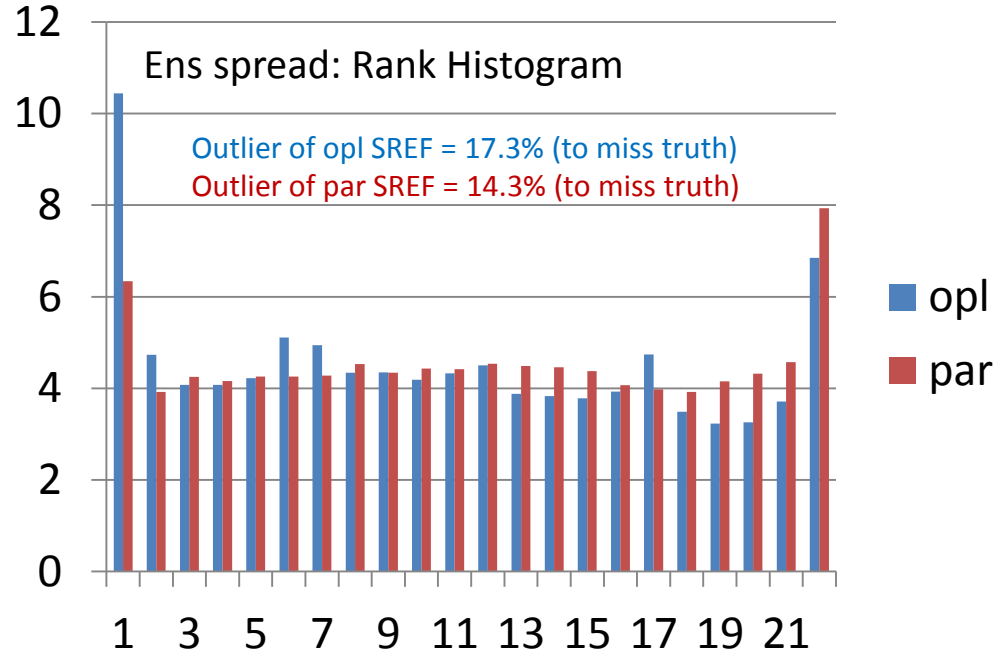


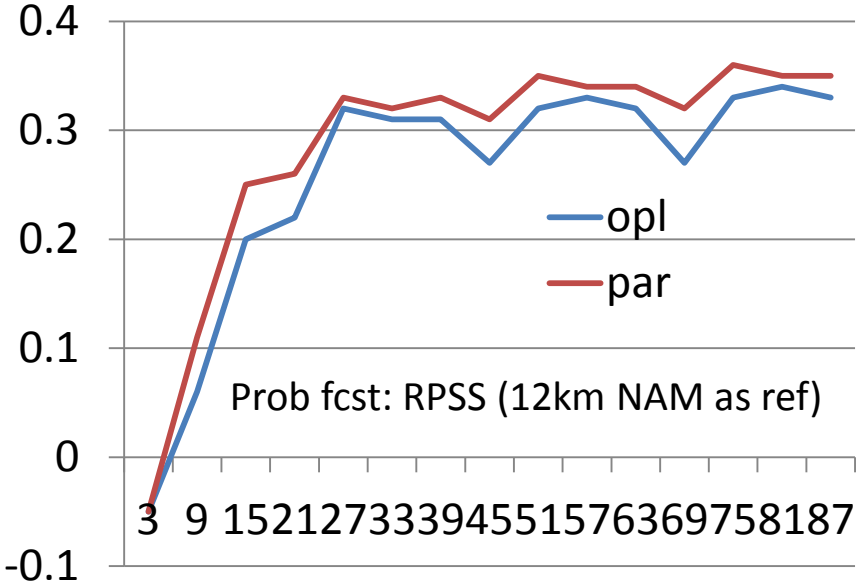


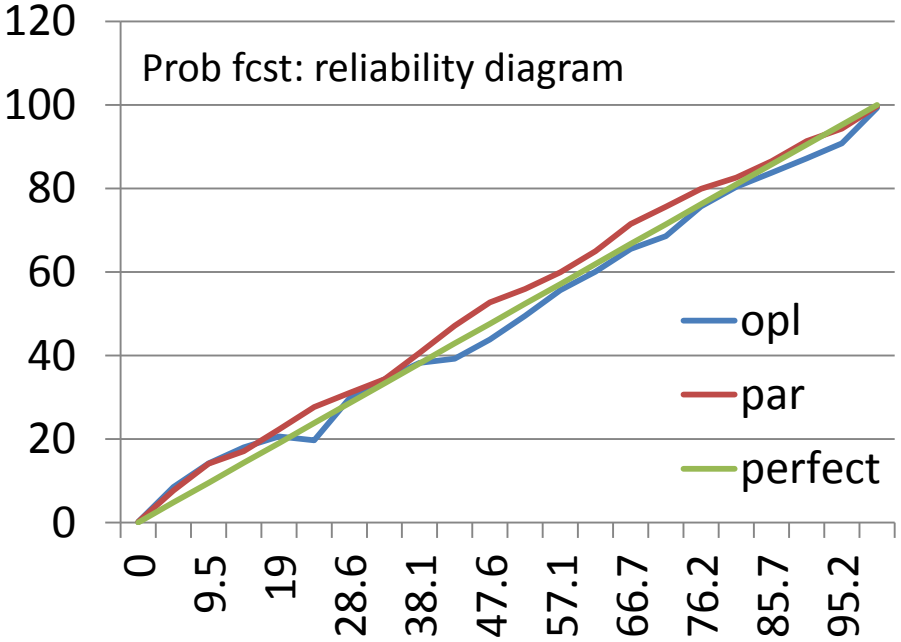


Evaluation of 2mT (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

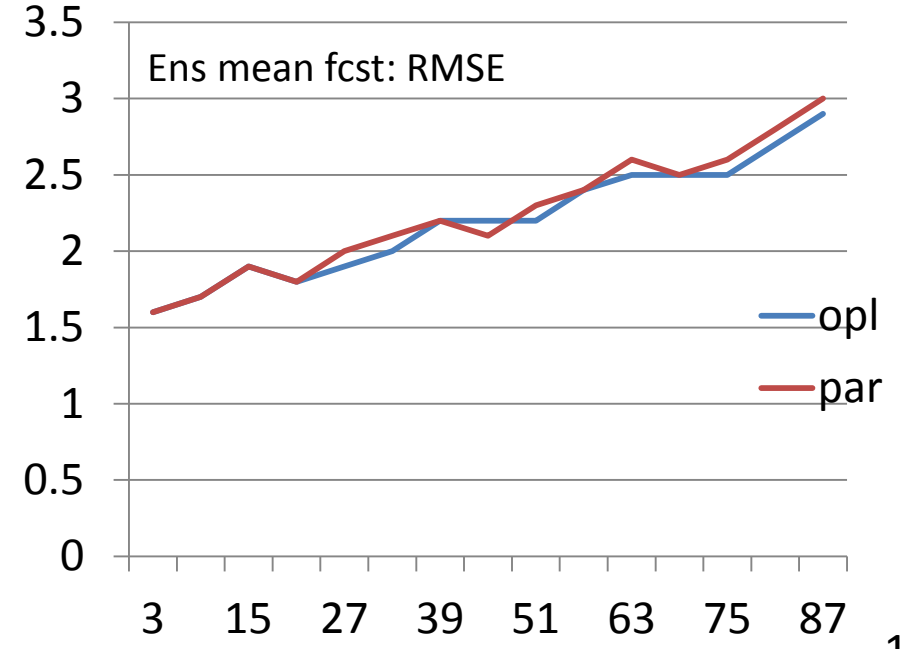


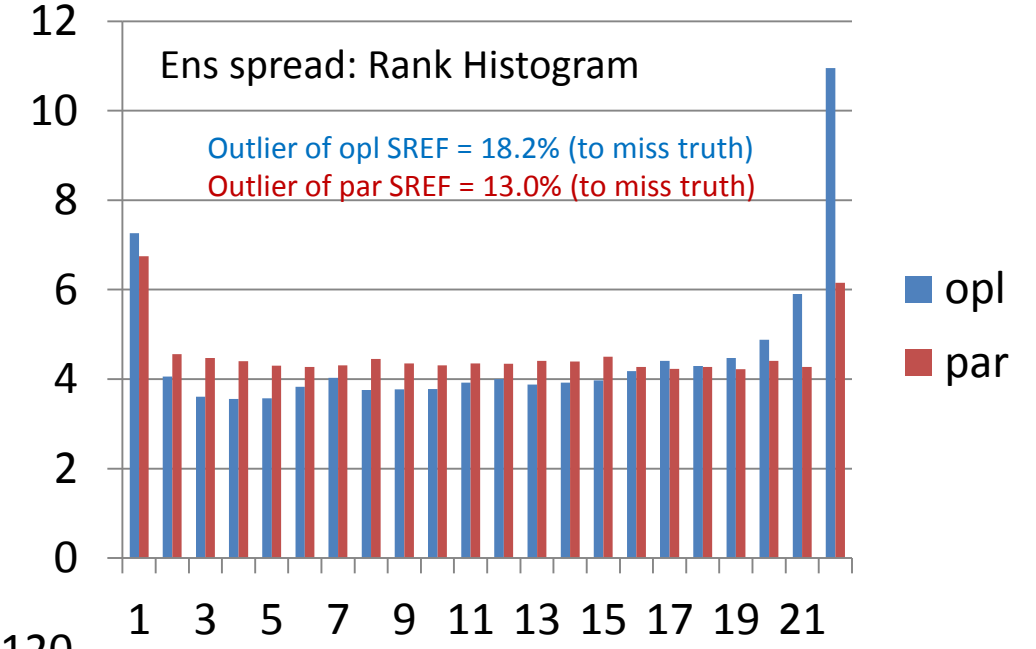


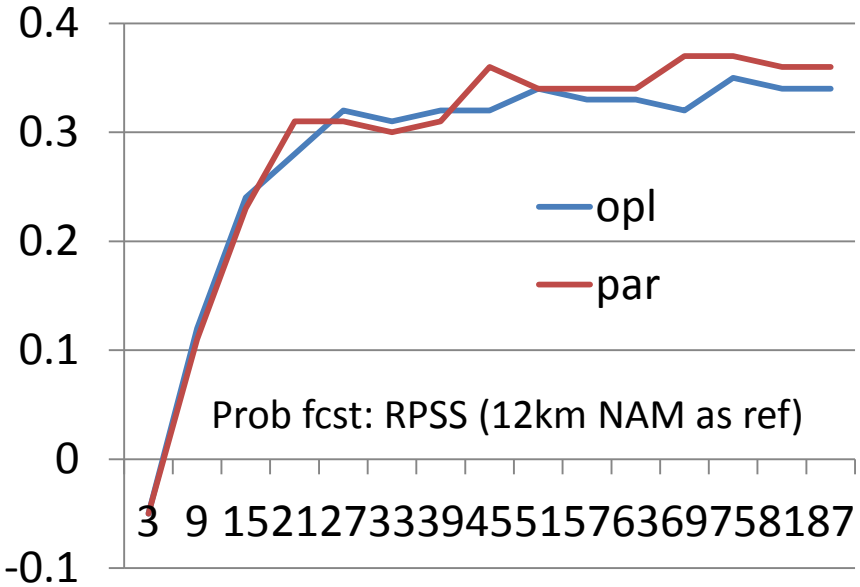


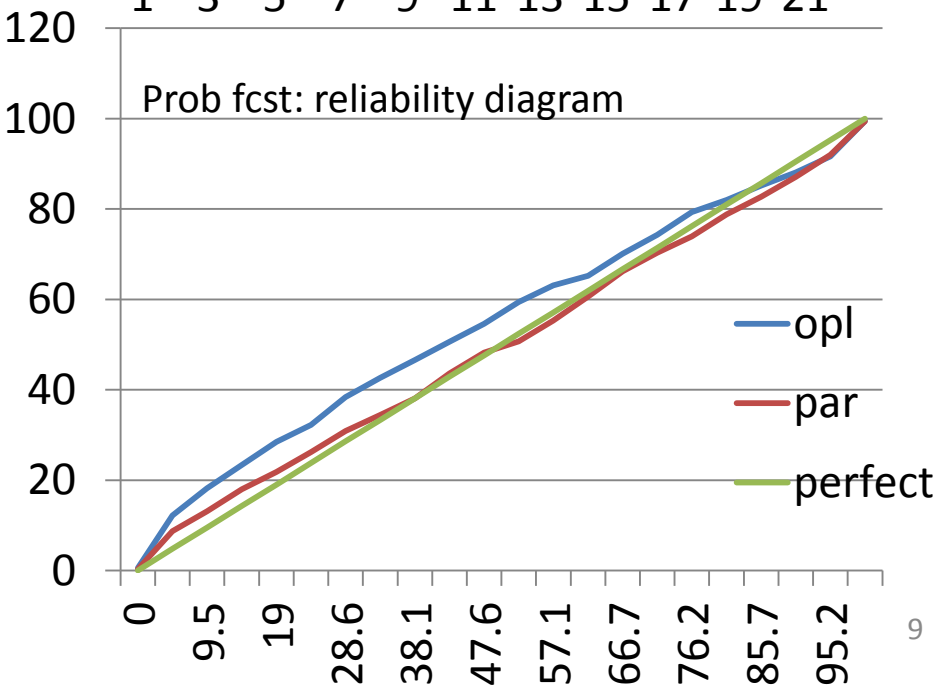


Evaluation of 2mTd (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

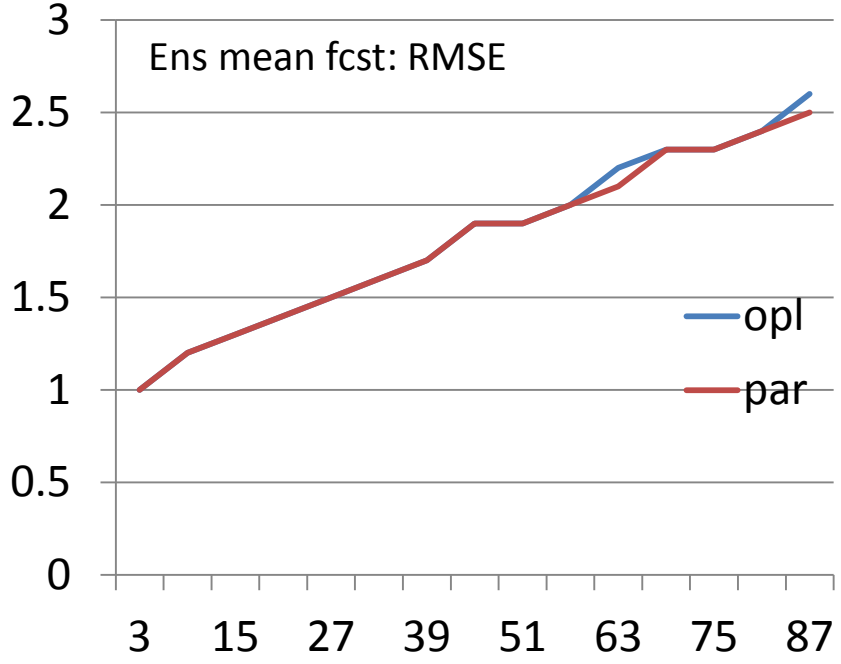


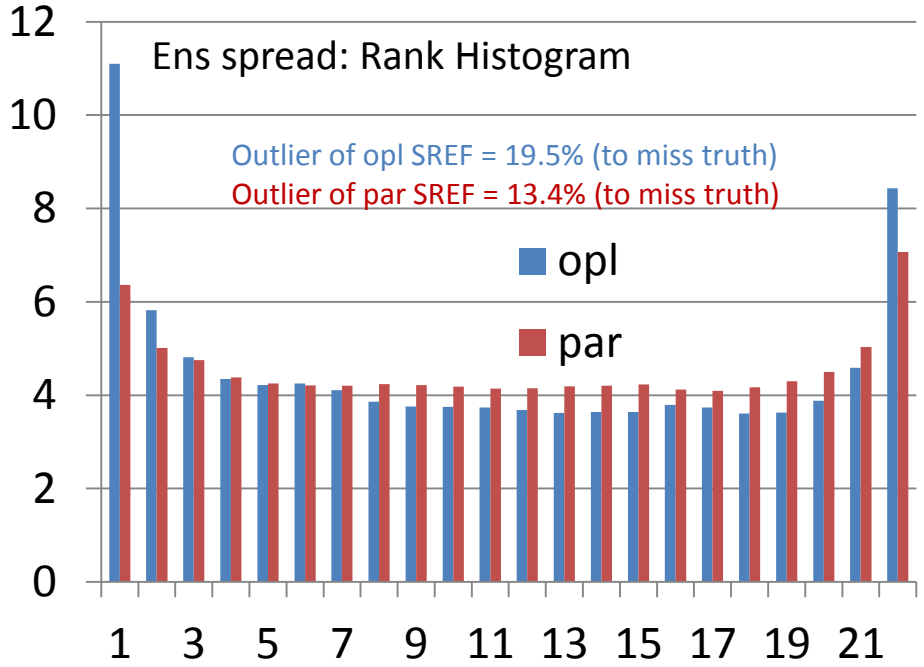


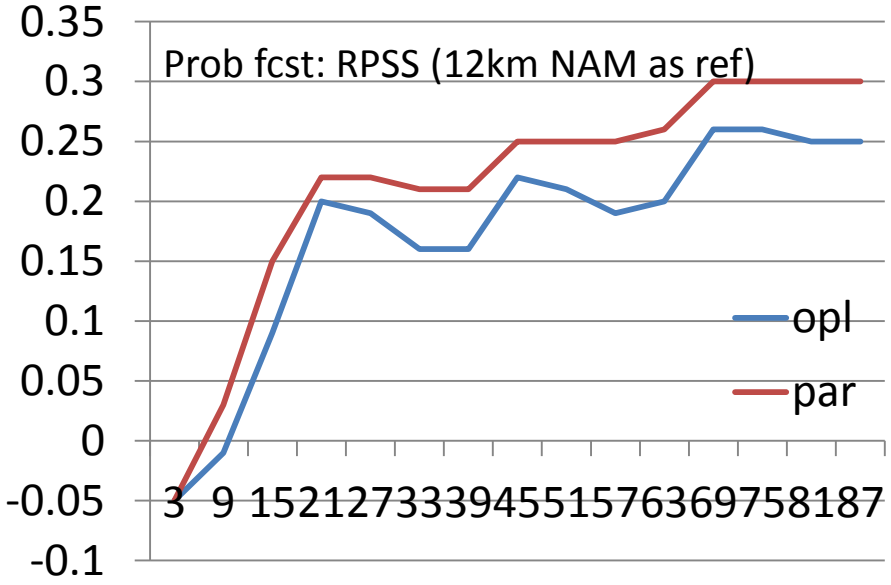


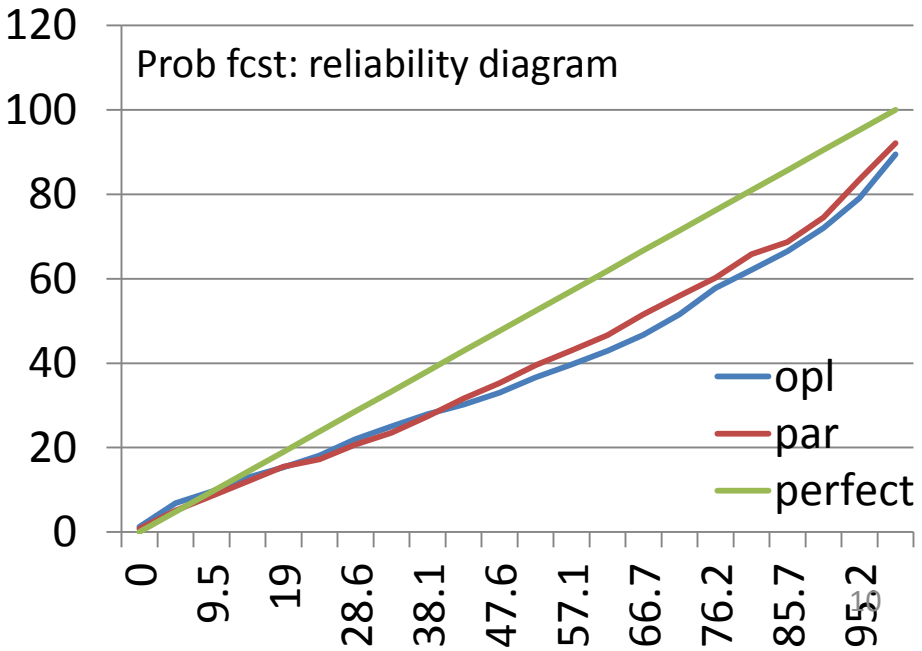


Evaluation of 10m-U (opl SREF vs. par SREF, Oct. 23 – Dec. 31, 2011)

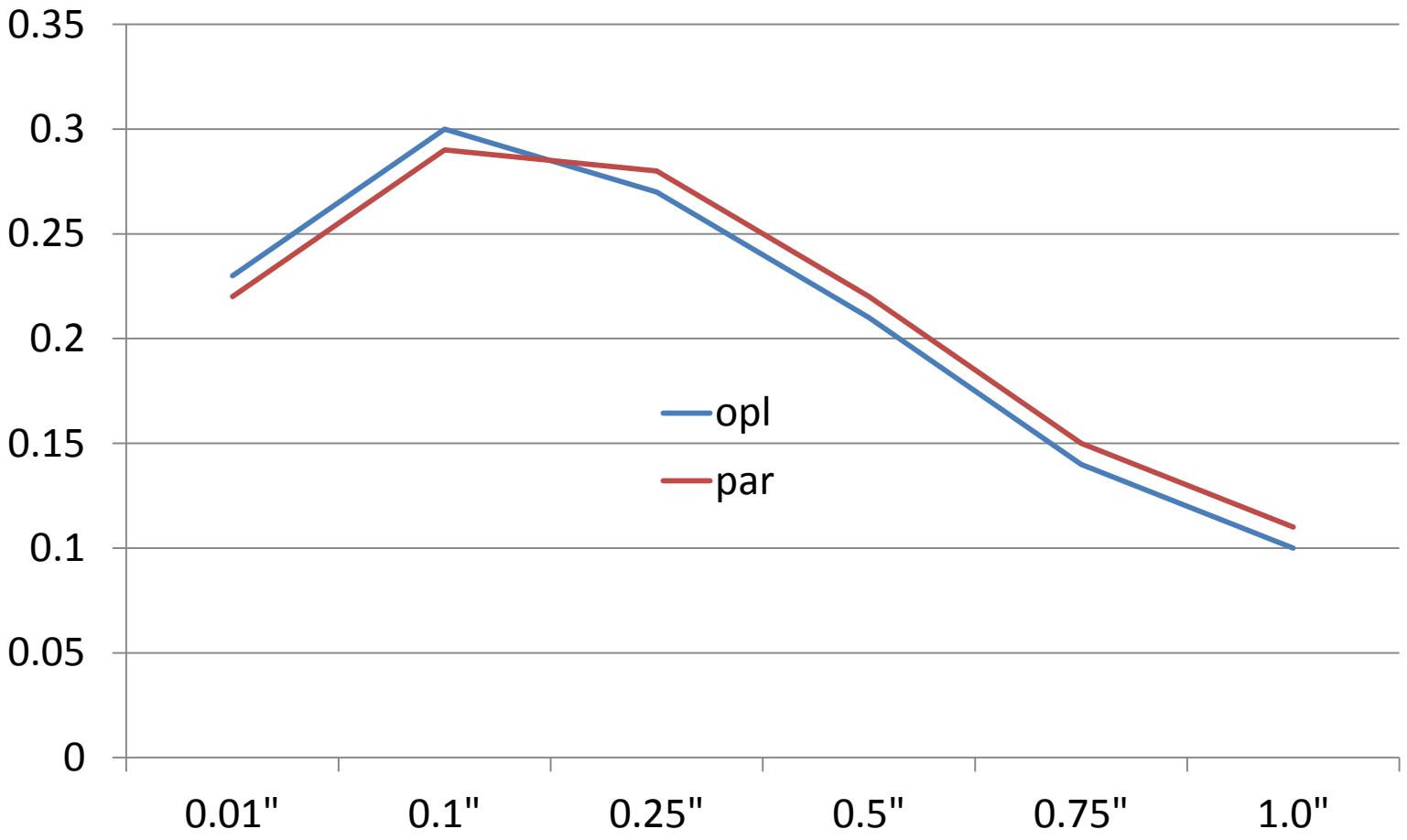




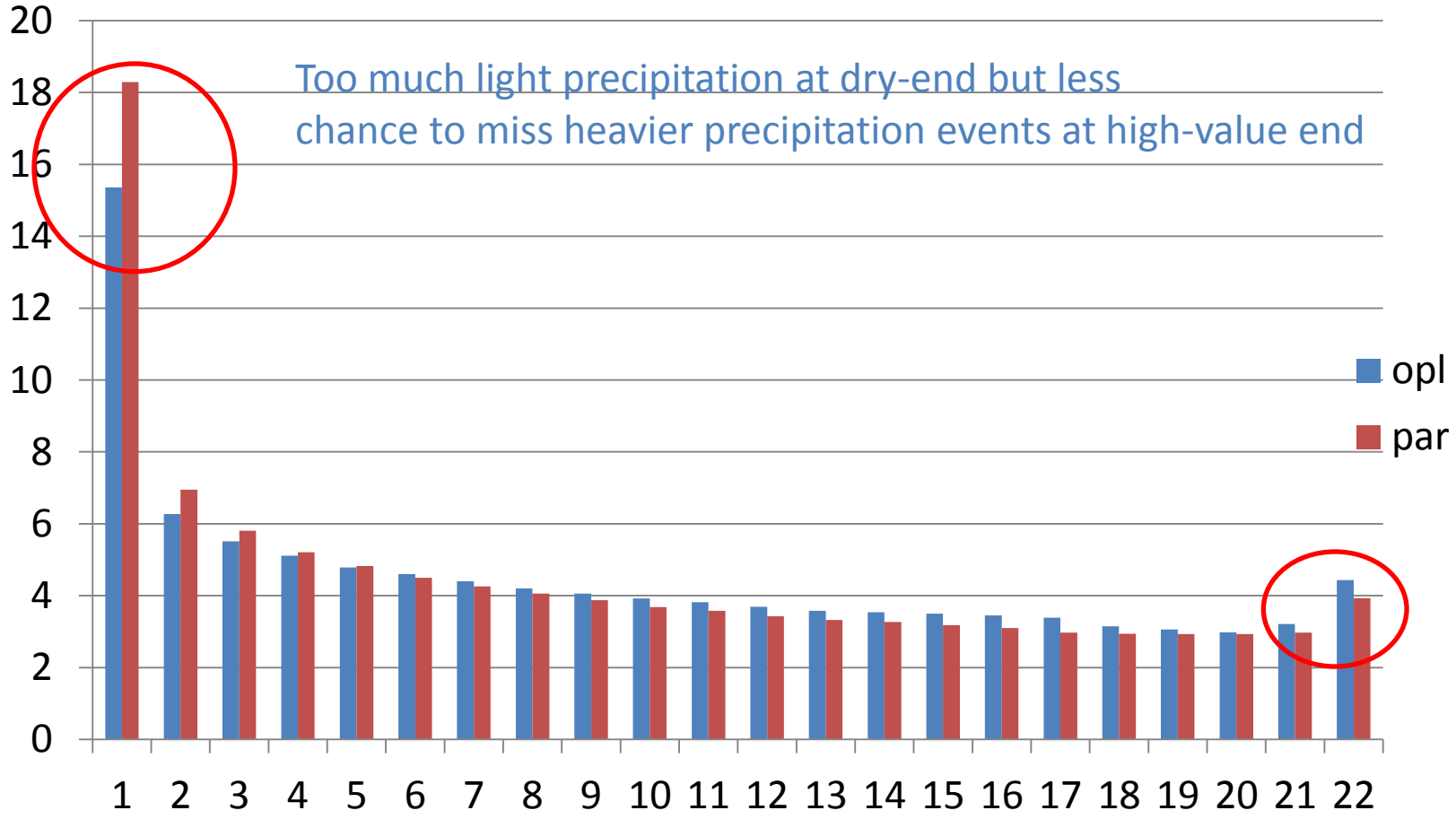




Ensemble mean precipitation forecast: ETS of 24hr-accumulation (against CCPA, Oct. 23 – Dec. 31, 2011)

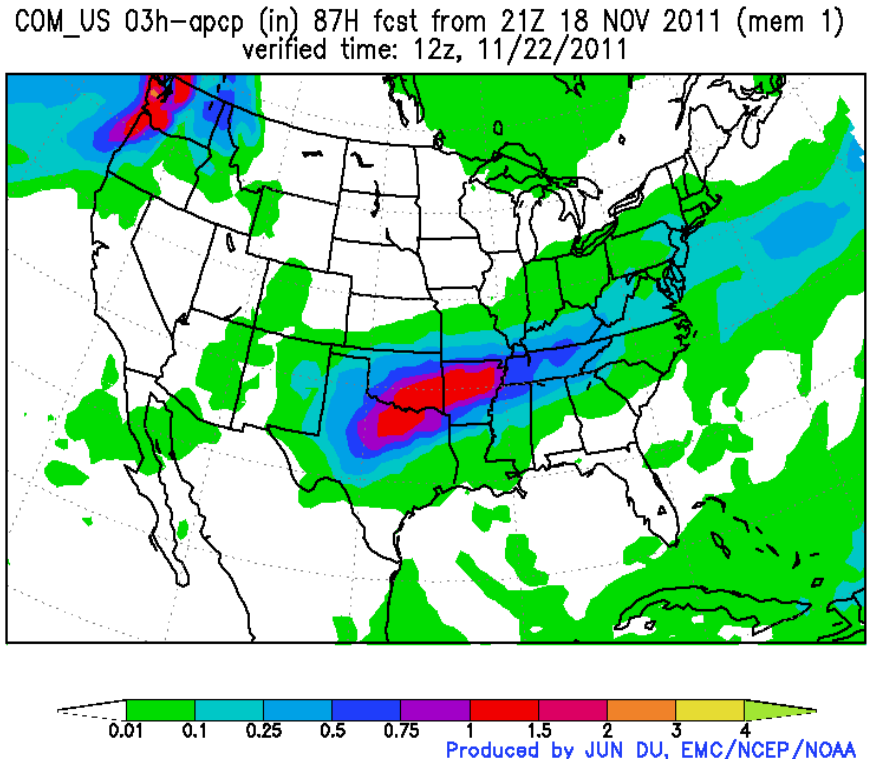


Ens spread: Rank Histogram of 24hr-accumulated precipitation at F87hr (Oct. 23 – Dec. 31, 2011)

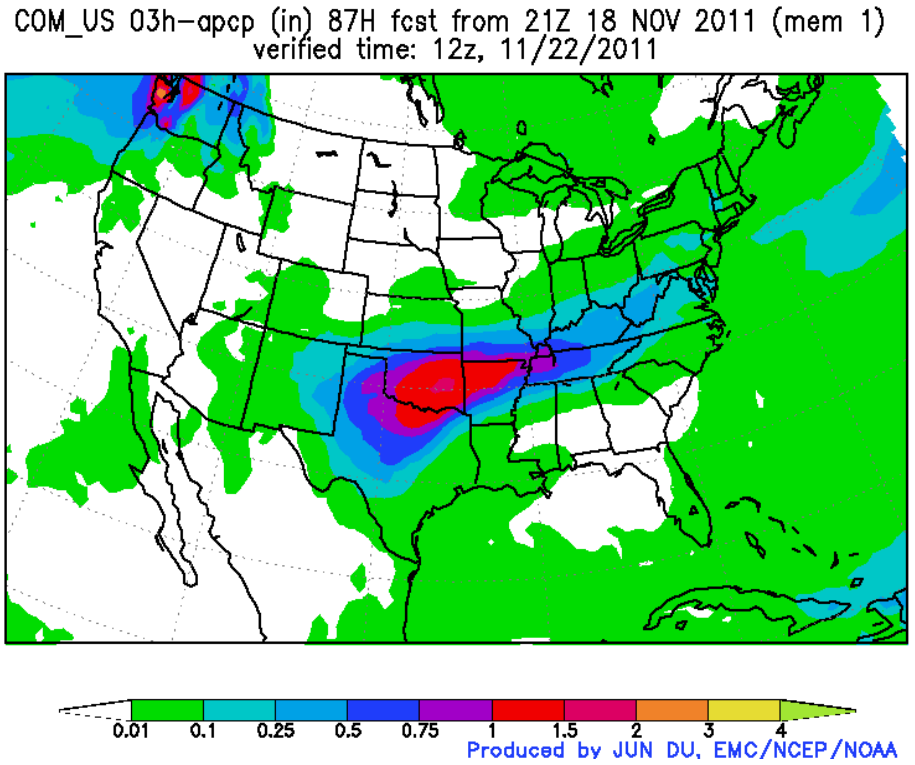


SREF mean forecasts of 24h-accumulated precipitation at F87 (21z, Nov. 18, 2011)

32km SREF mean (opl)



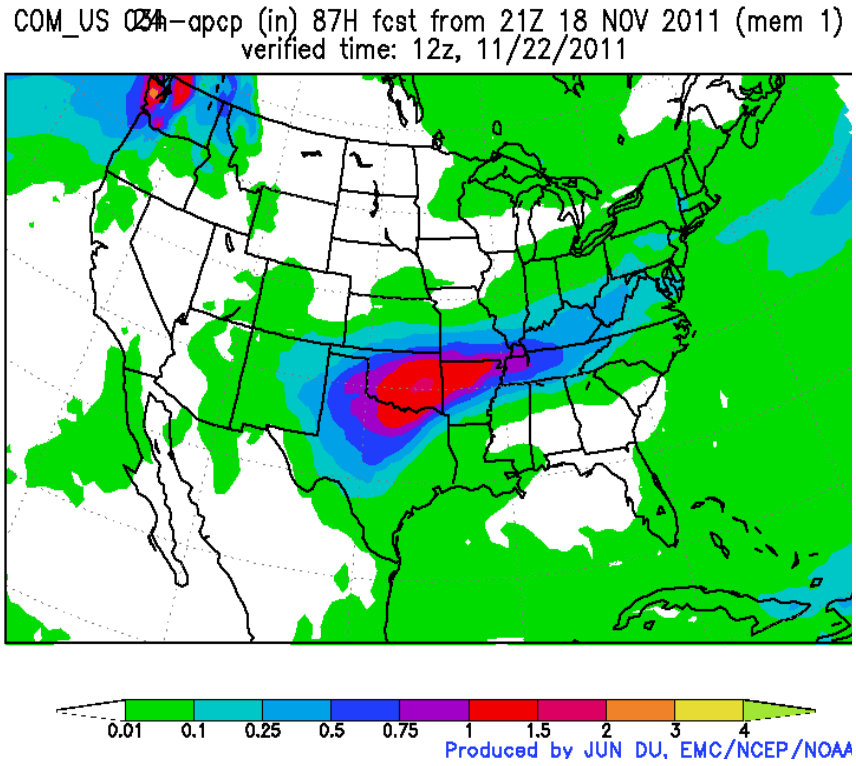
16km SREF mean (par)



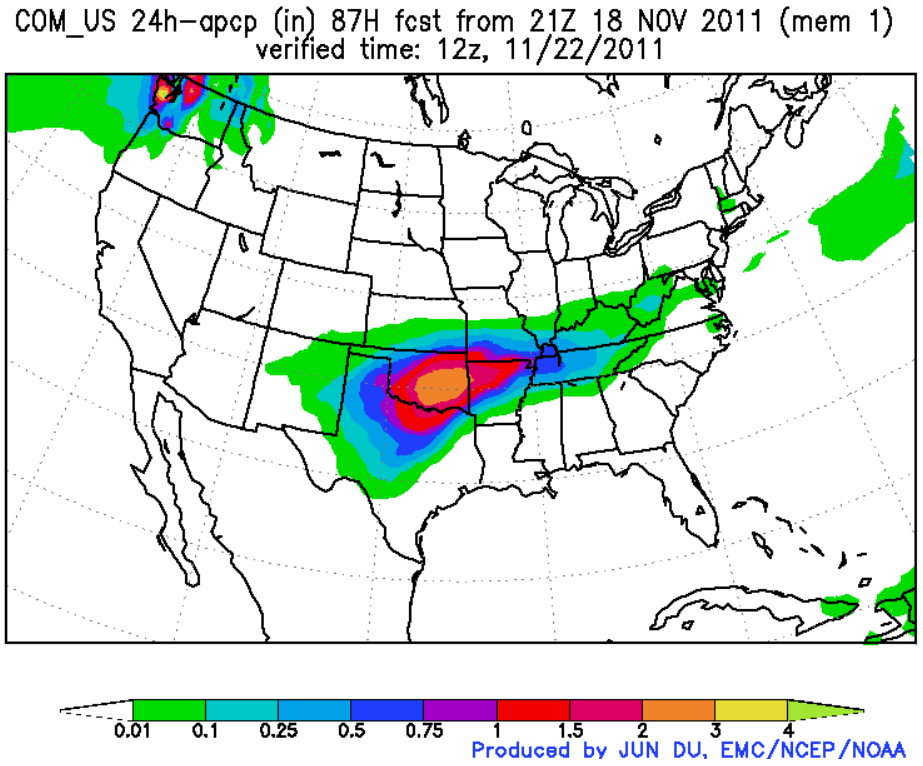
Bias correction can effectively remove over-predicted light precipitation area!

(frequency-matching method similar to that used in GEFS)

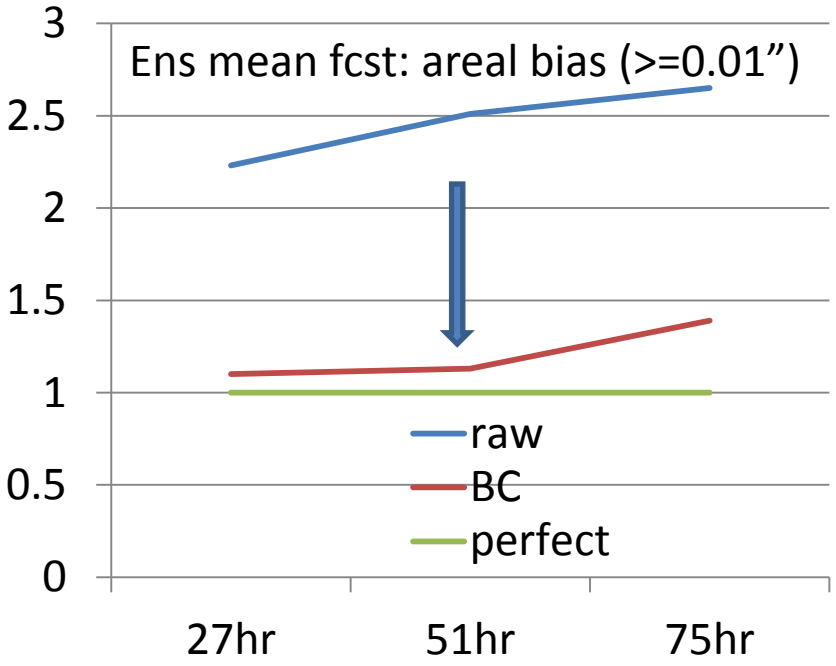
16km SREF mean (raw)

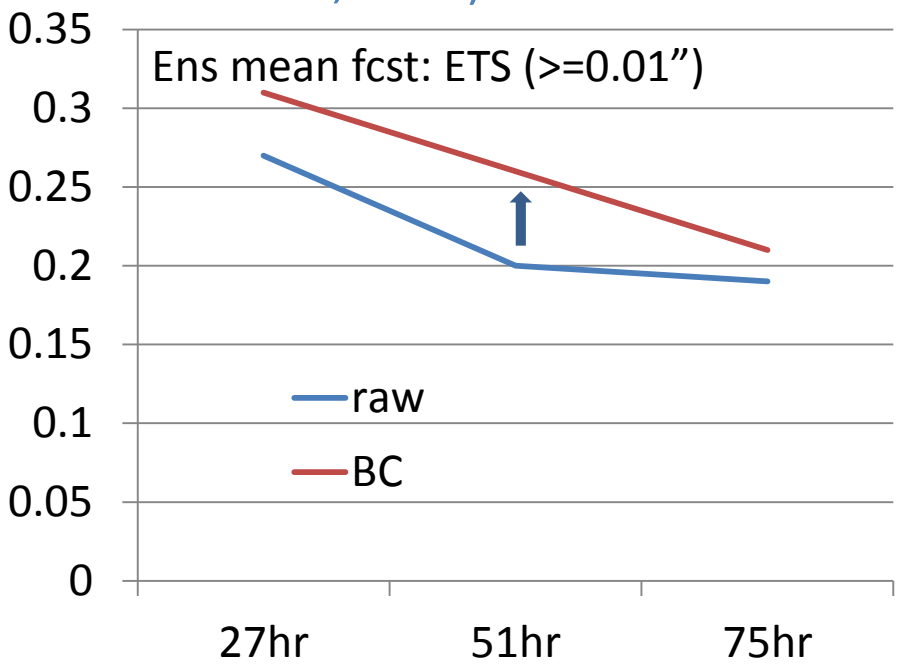


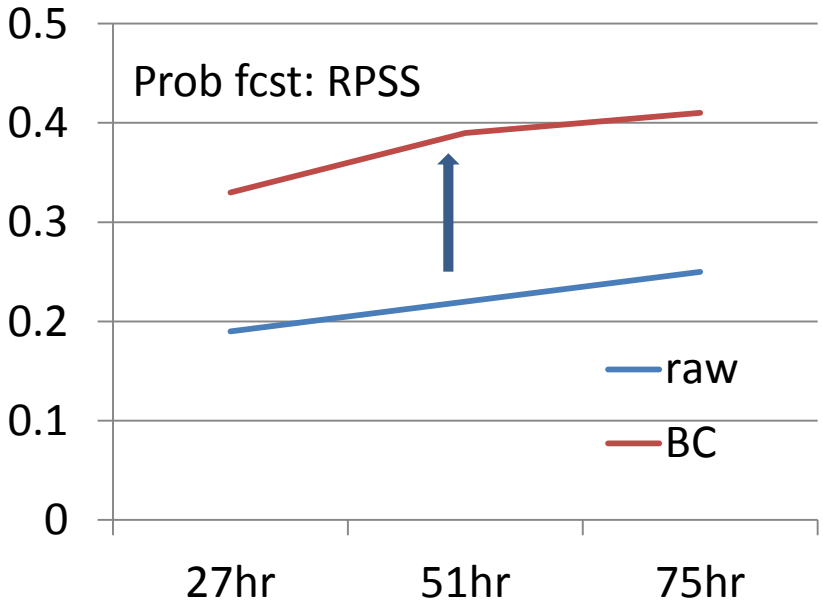
16km SREF mean (bias corrected)



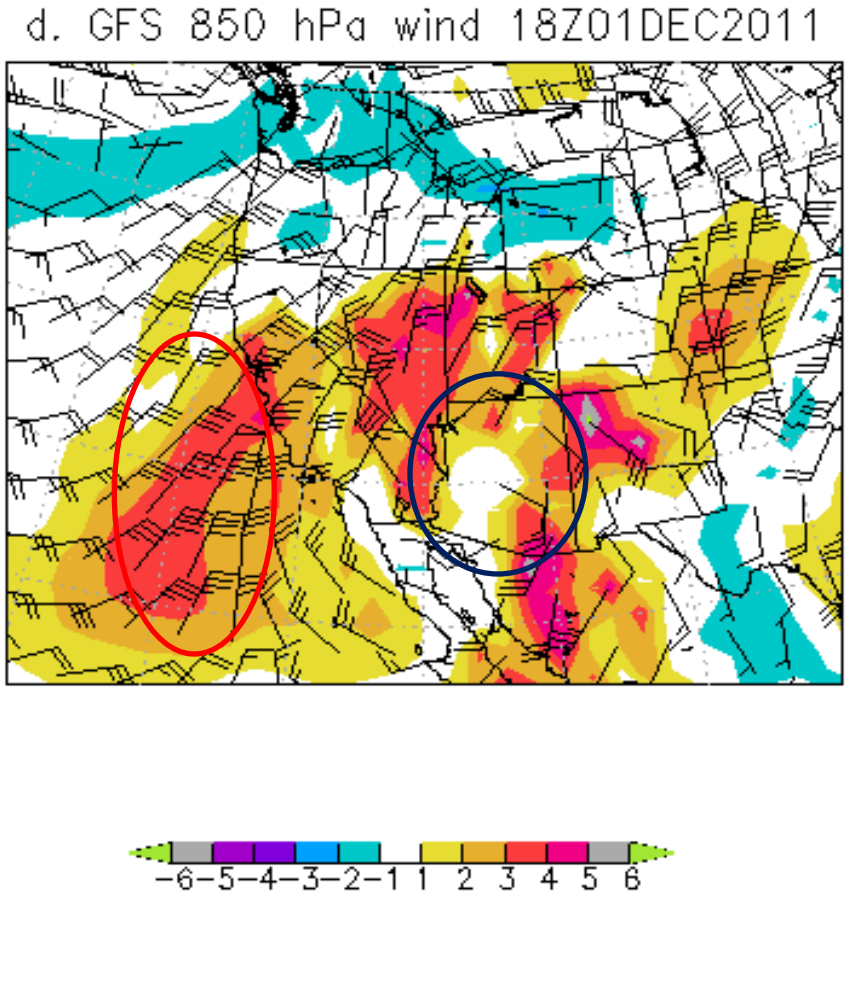
Precipitation bias correction verification (against CCPA, using 12km NAM as reference for RPSS, Nov. 10- Dec. 31, 2011)

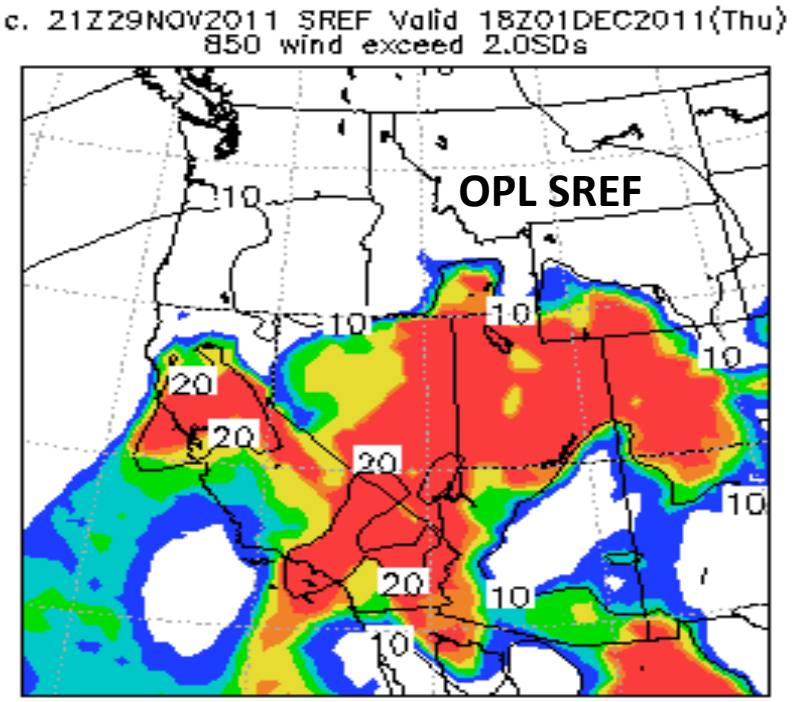


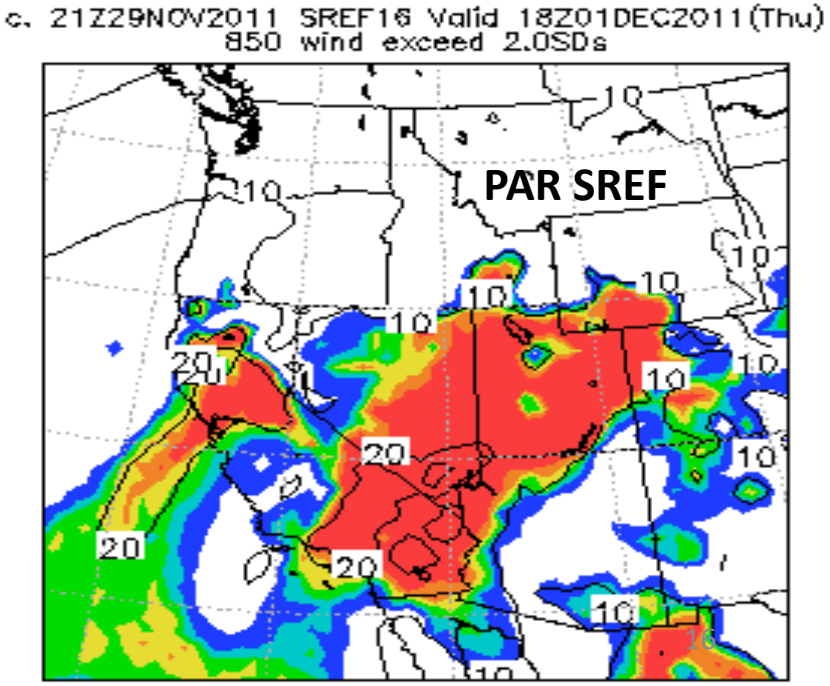




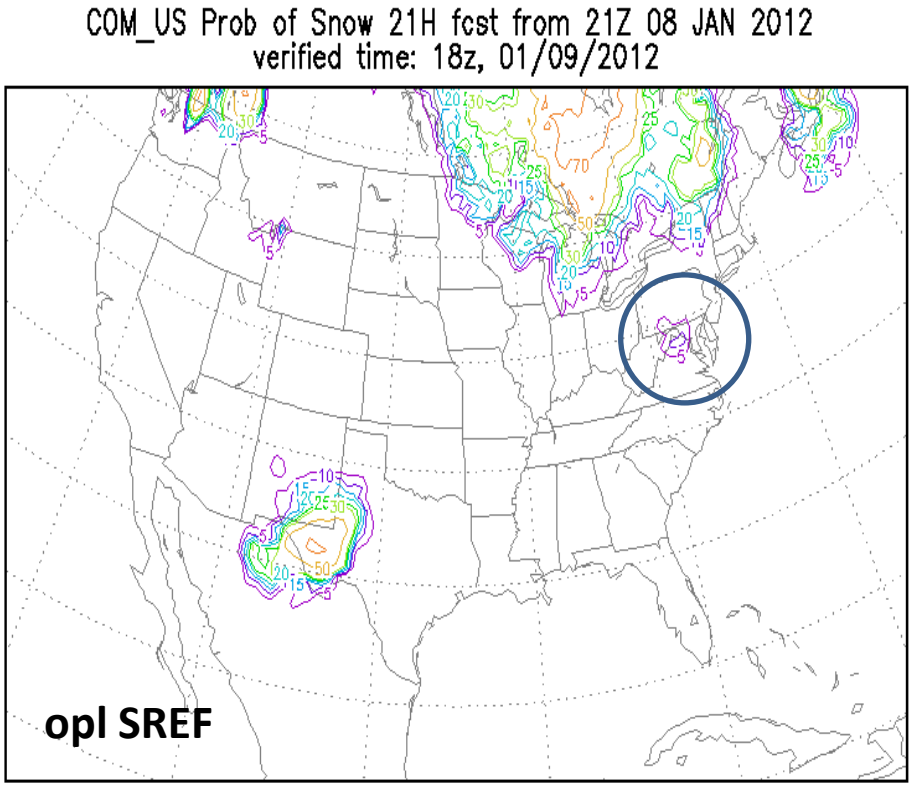
Dec. 1, 2011 West Coast High-Wind Event (R. Grumm)



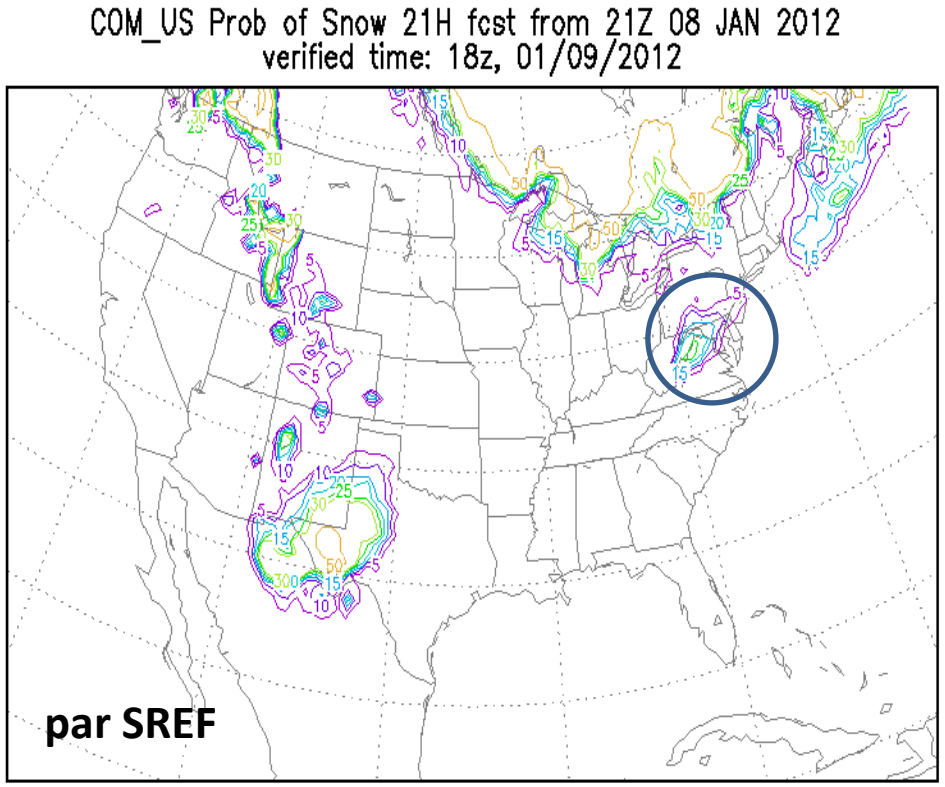




Surprising Snow Event of Washington DC (afternoon of Jan. 9, 2012)

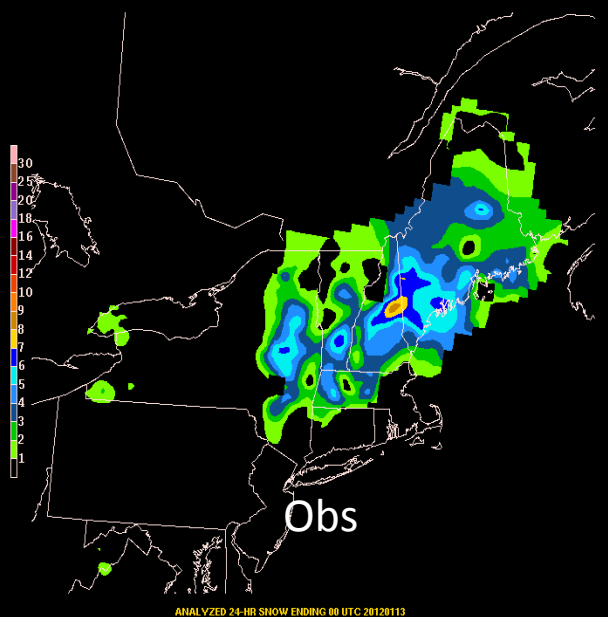


Produced by JUN DU, EMC/NCEP/NOAA

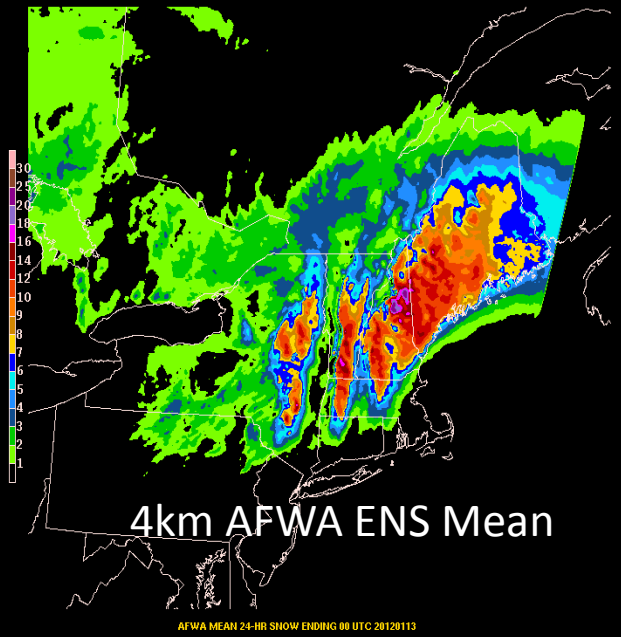


Produced by JUN DU, EMC/NCEP/NOAA

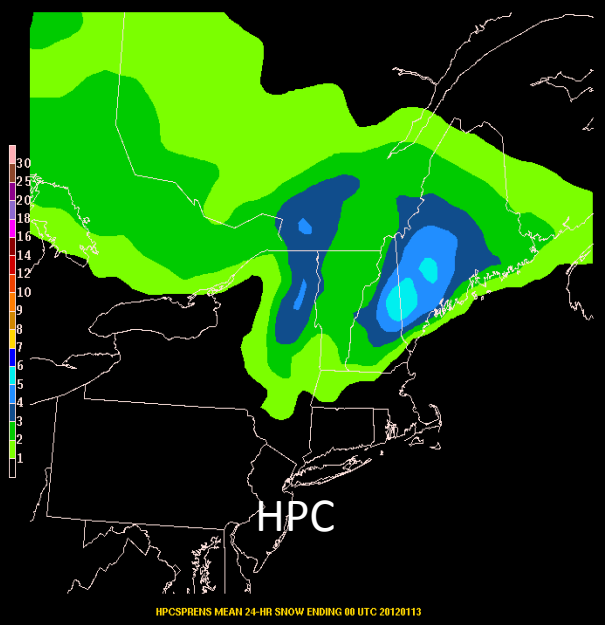
Day 1 forecast of 24h snow amount ending at 01/13/2012



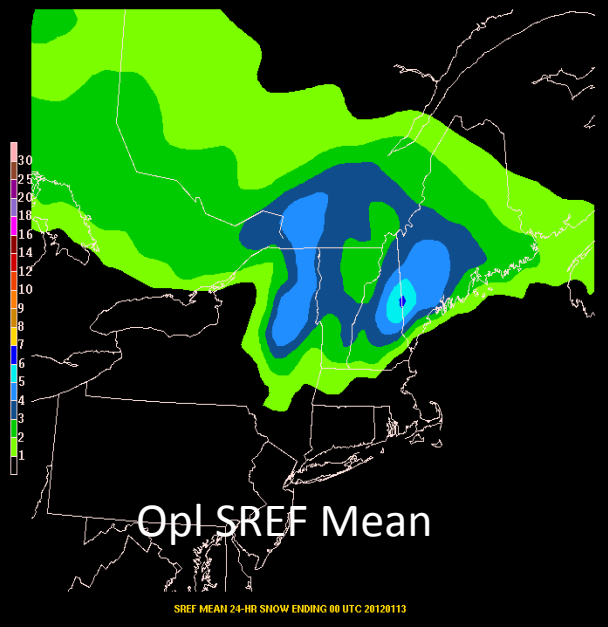
Obs



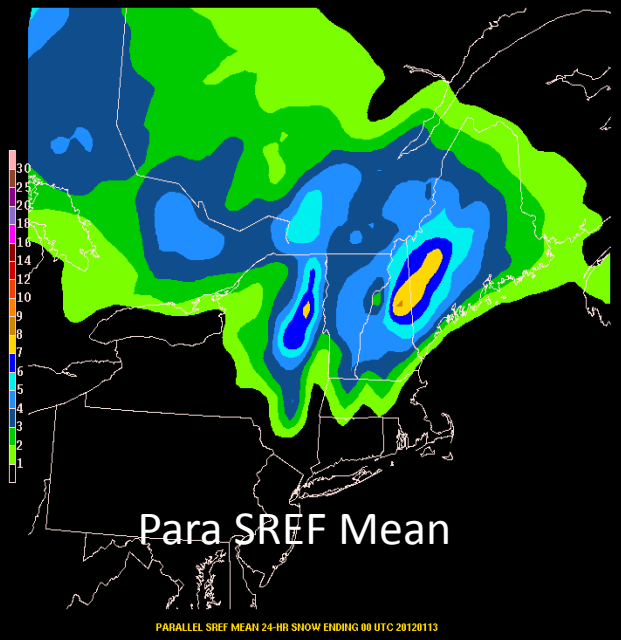
4km AFWA ENS Mean



HPC

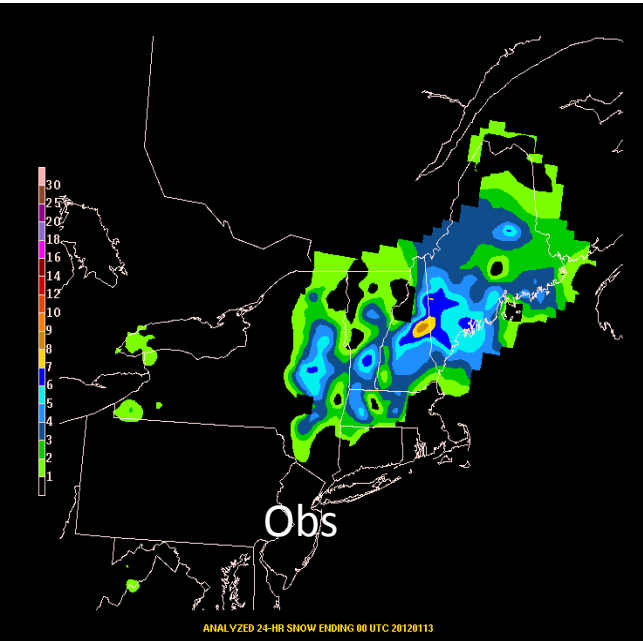


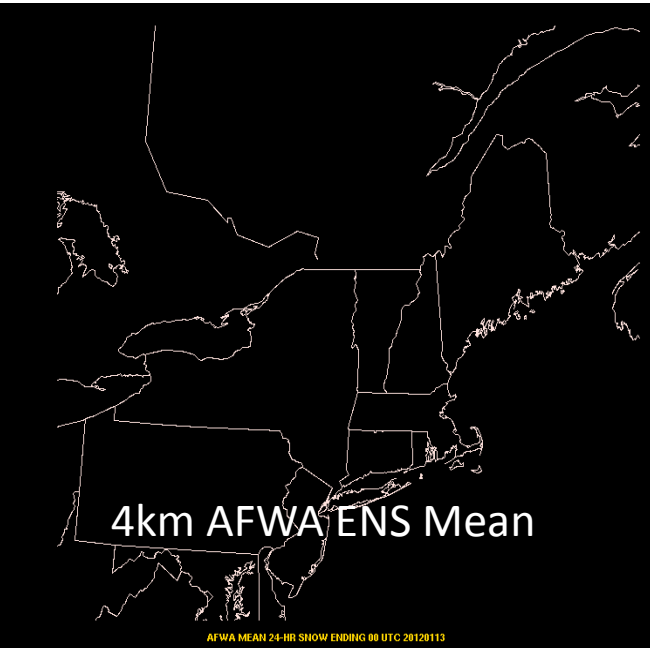
Opl SREF Mean

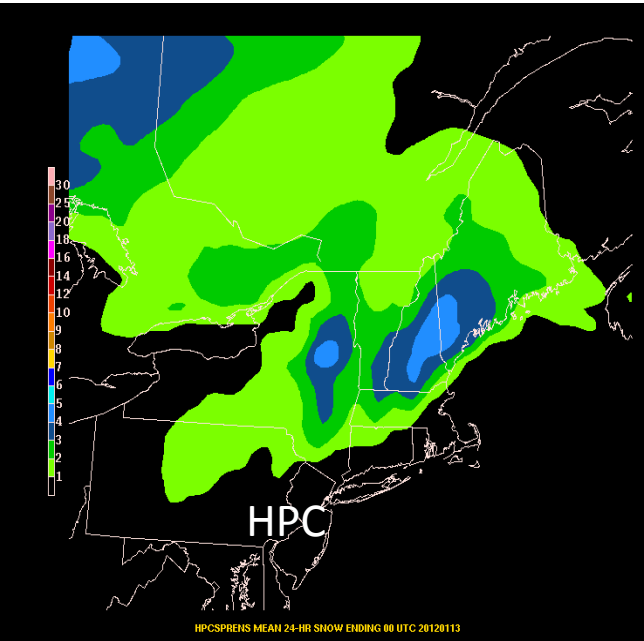


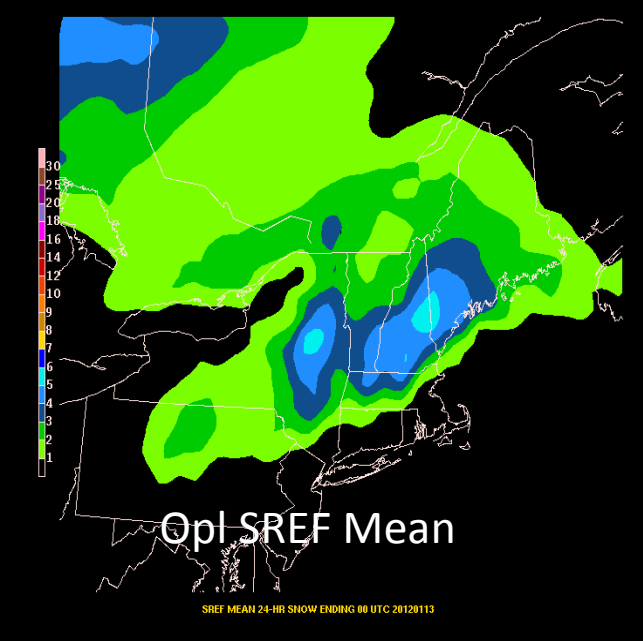
Para SREF Mean

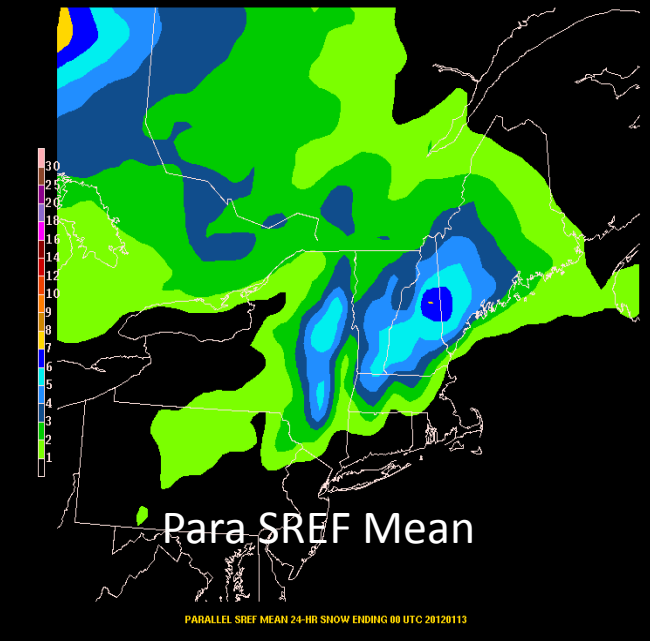
Day 2 forecast of 24h snow amount ending at 1/13/2012











HPC Winter Weather Experiment (2011-2012) result: mean snowfall forecast -- SREFp vs. SREF

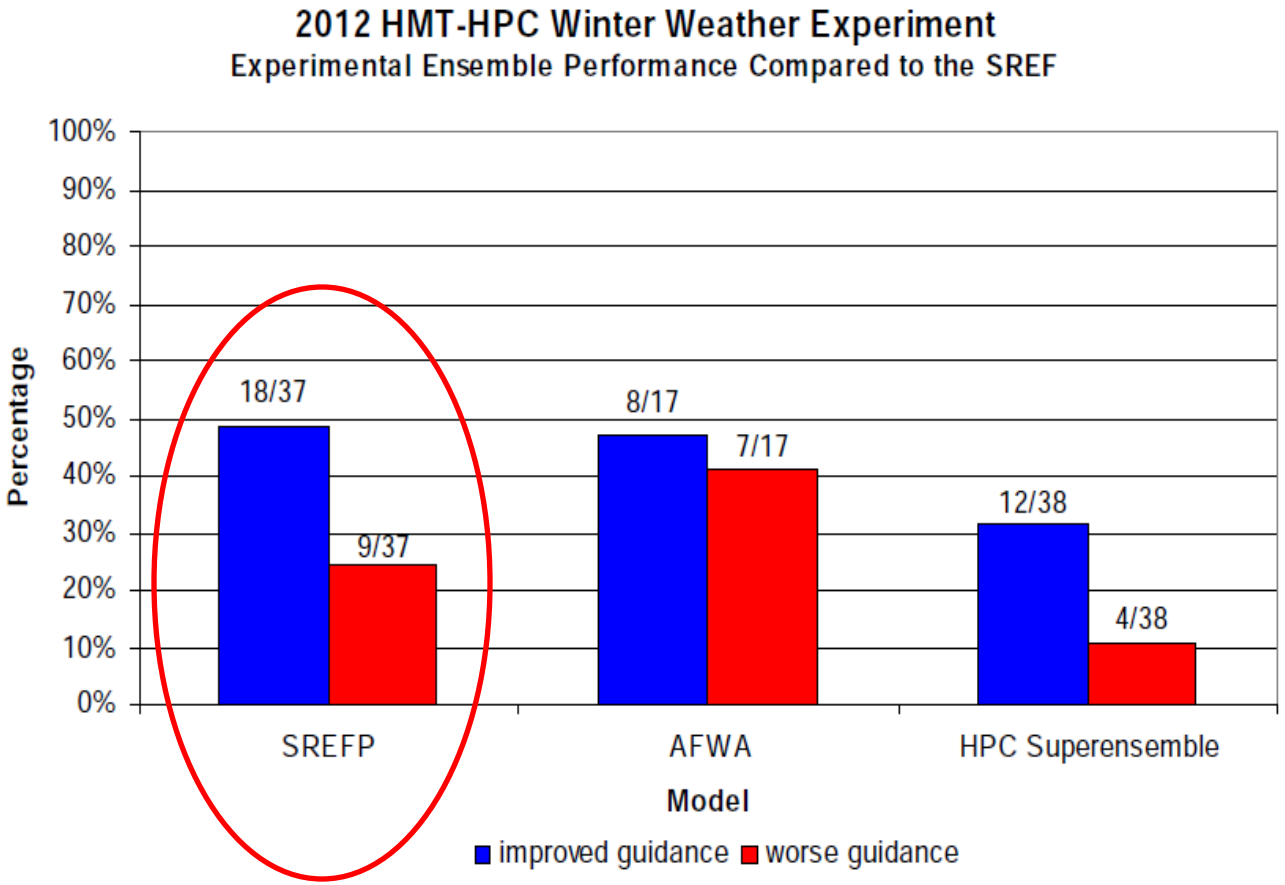
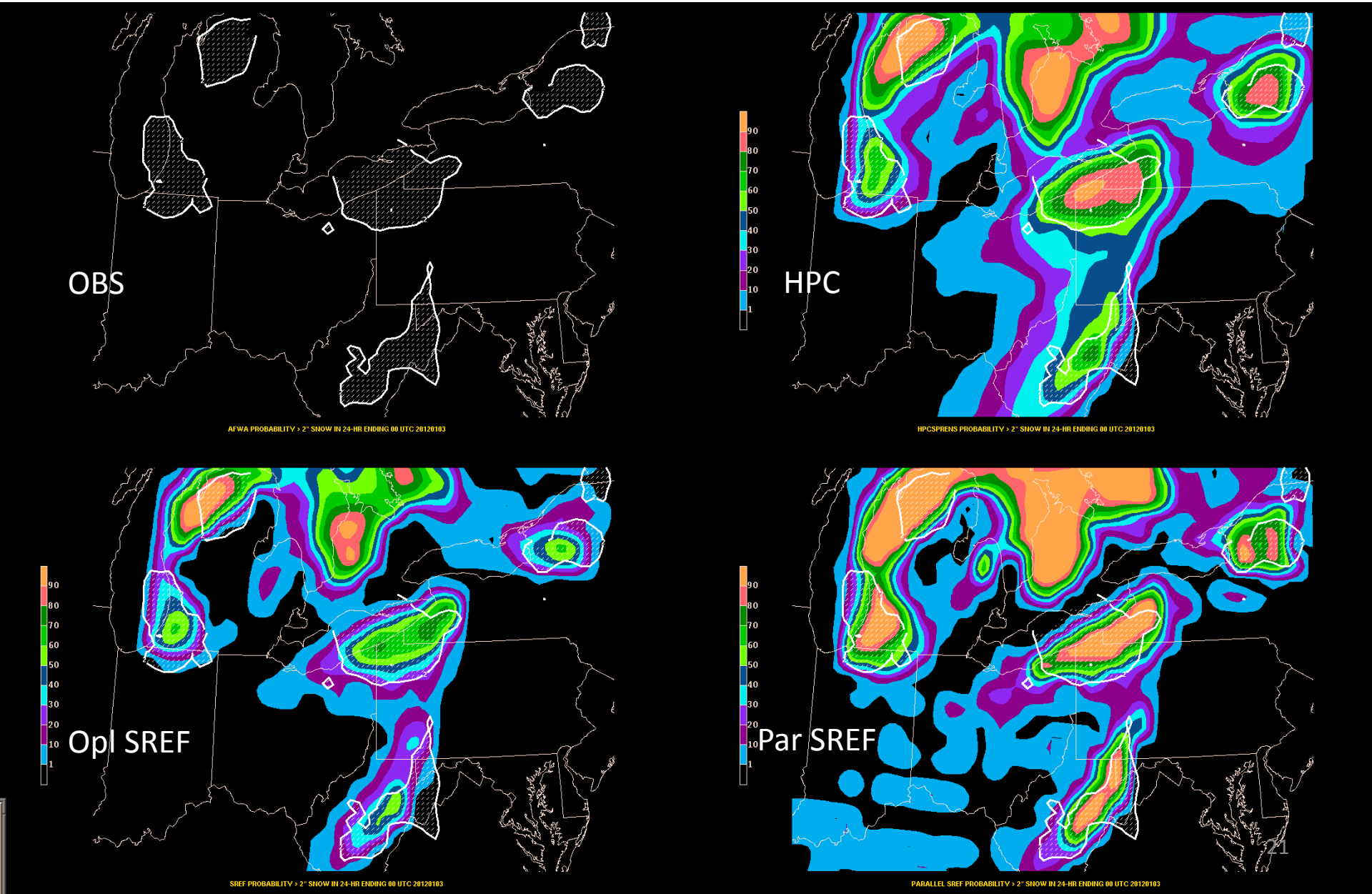


Figure 1. Experimental ensemble performance based on participant feedback from subjective model evaluations conducted during the 2012 HMT-HPC Winter Weather Experiment. Participants were asked to determine whether the ensemble mean snowfall forecasts from the 00Z experimental guidance (21Z SREFP) were much better, better, about the same, worse, or much worse than the guidance provided by the operational 21Z SREF, based on observations from the gridded HPC snowfall analysis. The AFWA ensemble was only available for the Day 1 (24-48hr) forecast period.

HPC Winter Weather Experiment: probabilistic forecasts of snow > 2” during Jan. 2-3, 2012



HPC Winter Weather Experiment (2011-2012) result: "capture" of 2"/24h event -- SREFp vs. SREF

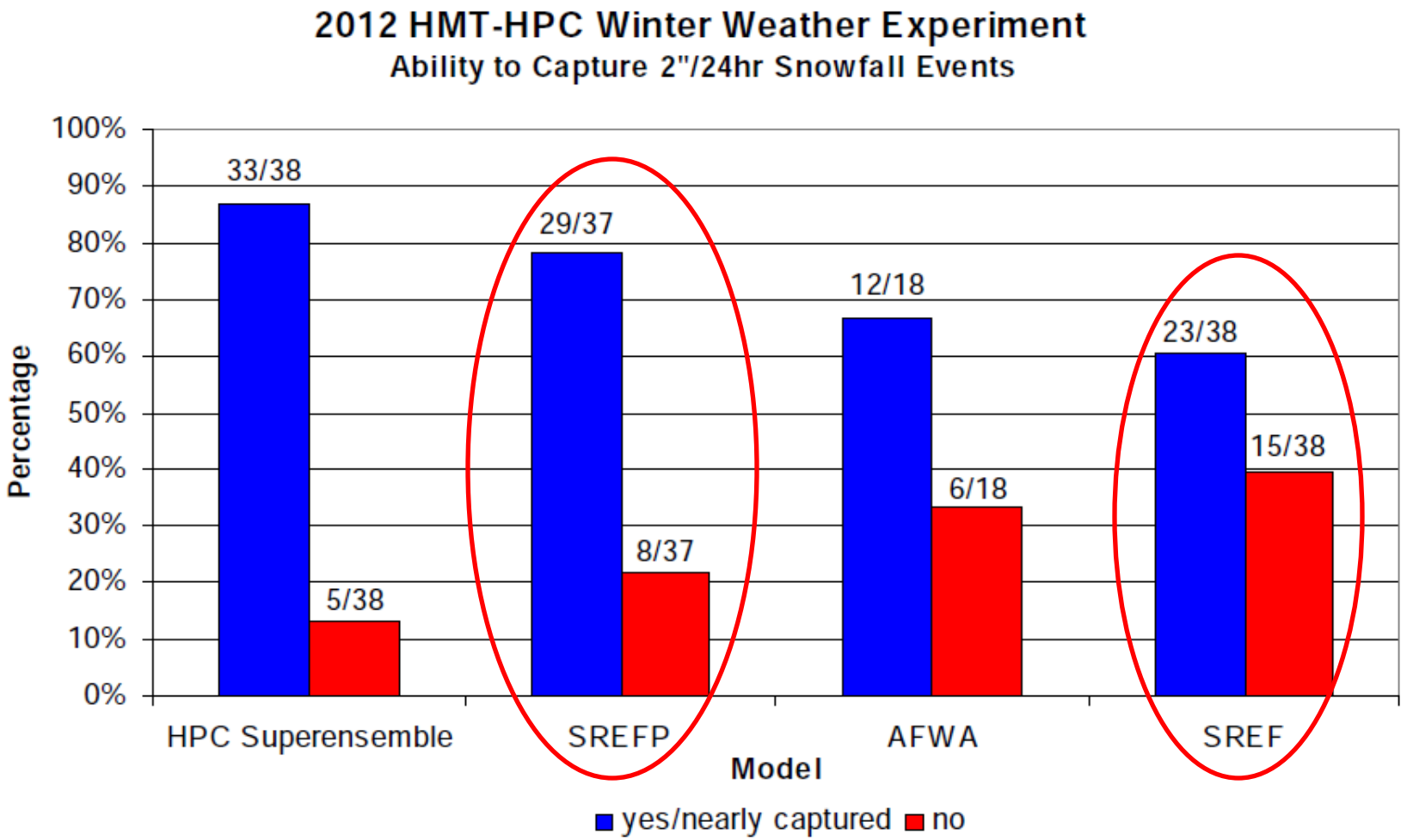
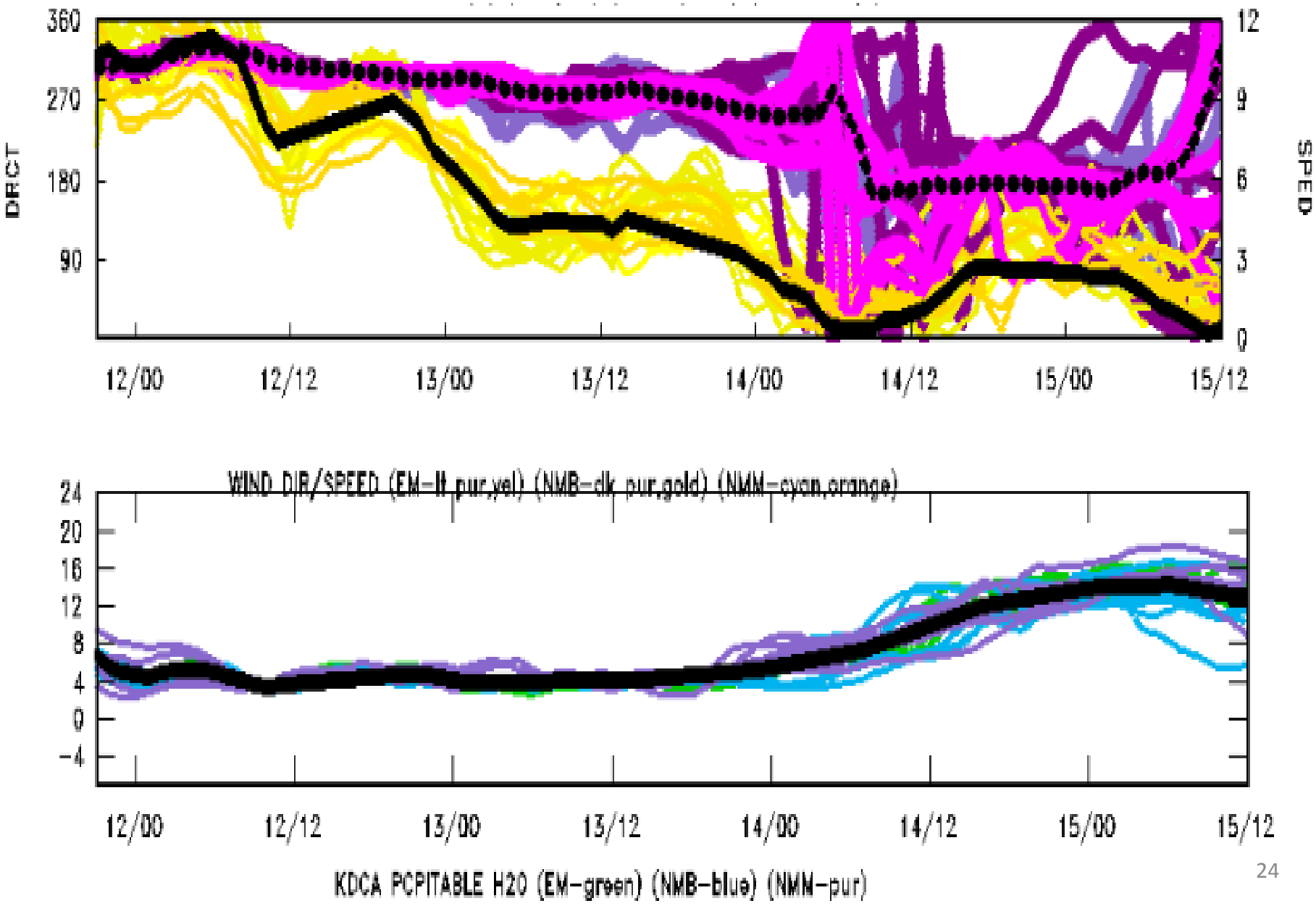


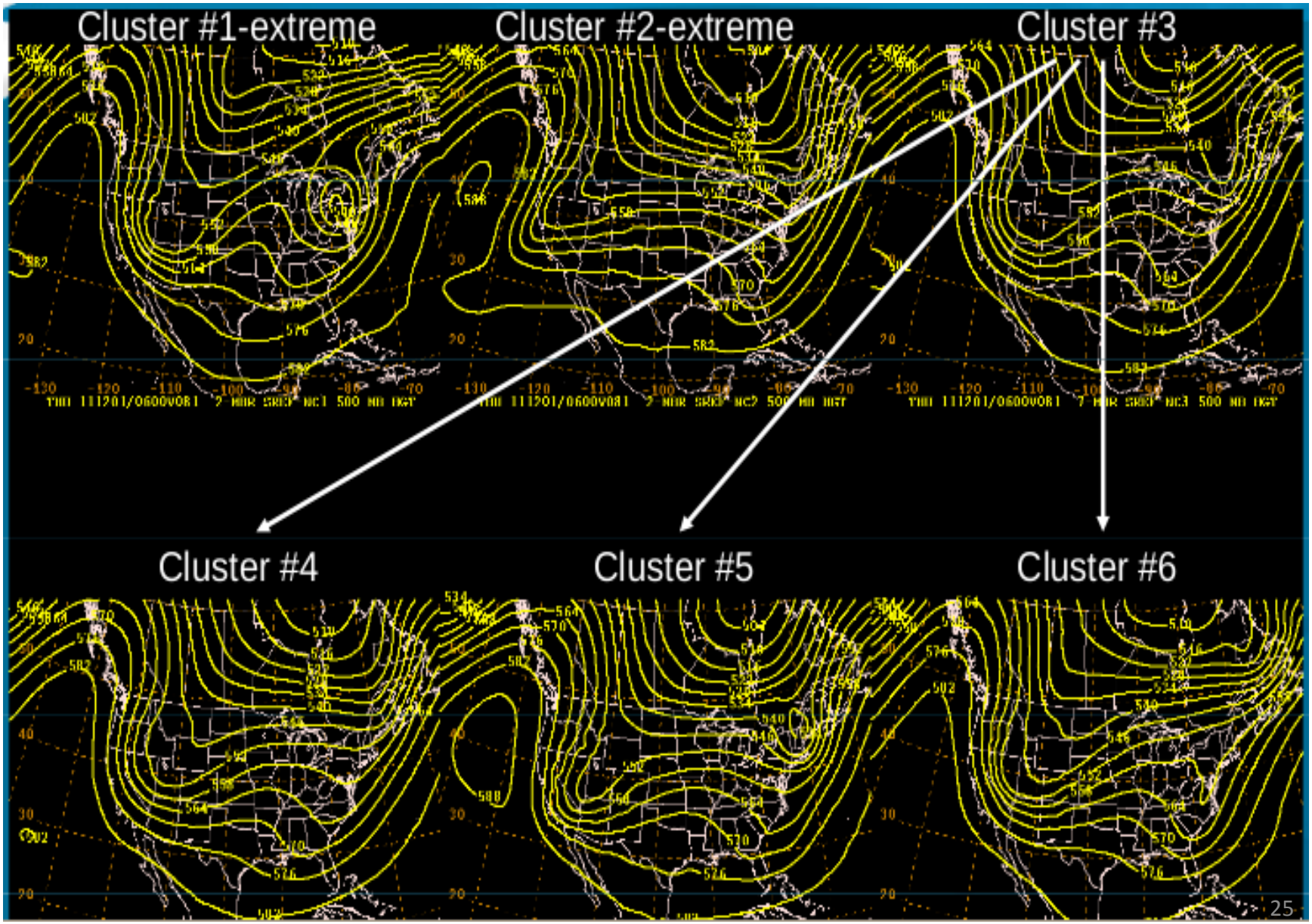
Figure 2. Ability of the experimental ensembles to capture the 2in/24hr snowfall events with the model 1% probability contour. "Nearly captured" represents cases in which there were only very small areas of observed 2 inch snowfall outside of the 1% probability contour. The AFWA ensemble was only available for the Day 1 (24-48hr) forecast period.

New products

Ensemble mean bufr forecast at a station



Ensemble Clusters



34 cluster-mean fields

Two clustering methods
– NCEP & OU

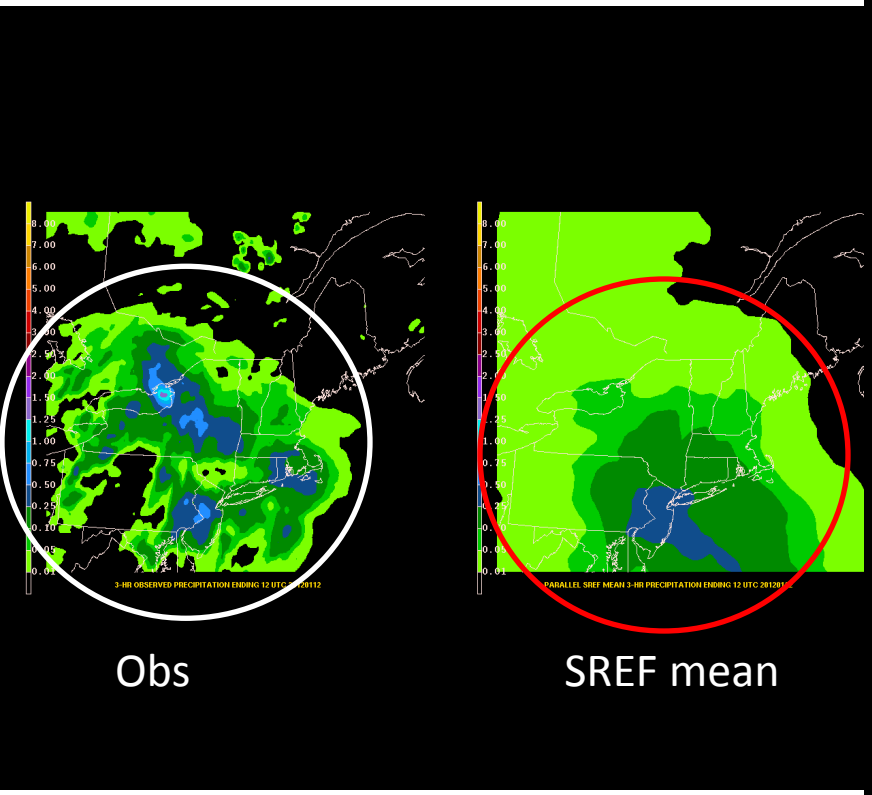
NCEP: varied cluster numbers depending on synoptic situation

OU: fixed 6 clusters

to meet different user needs such as dynamical downscaling

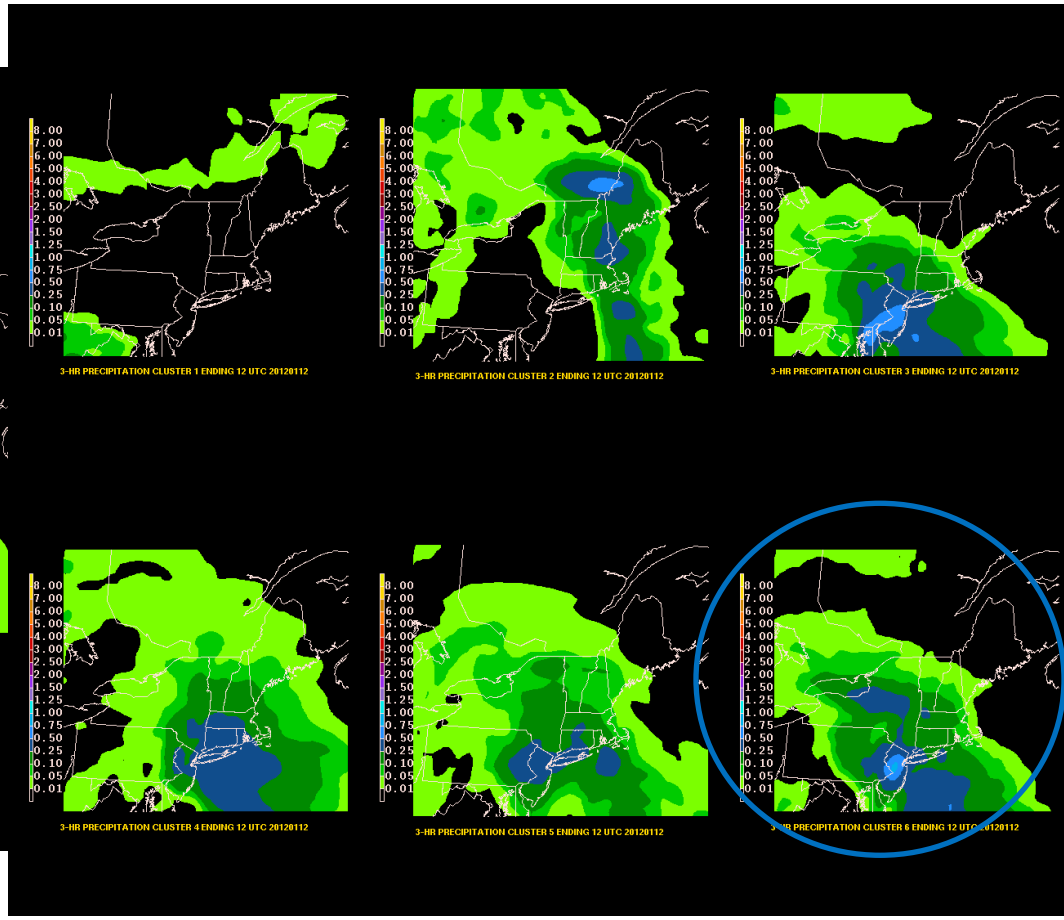
surface	T2m, Q2m, RH2m, U10m, V10m, Precip, SLP, PW
height	1000, 805, 700, 500, 300, 250mb
U	1000, 850, 700, 500, 300, 250mb
V	1000, 850, 700, 500, 300, 250mb
RH	850, 700, 500, 300mb
T	850, 700, 500, 300mb

HPC Winter Weather Experiment: do ensemble clusters add any value on top of the 21-member full SREF mean?

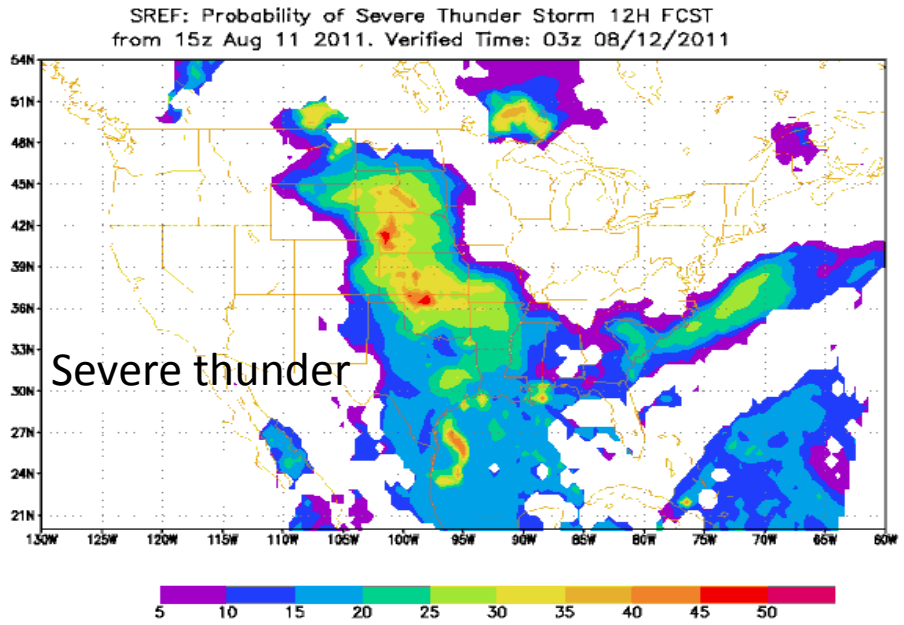


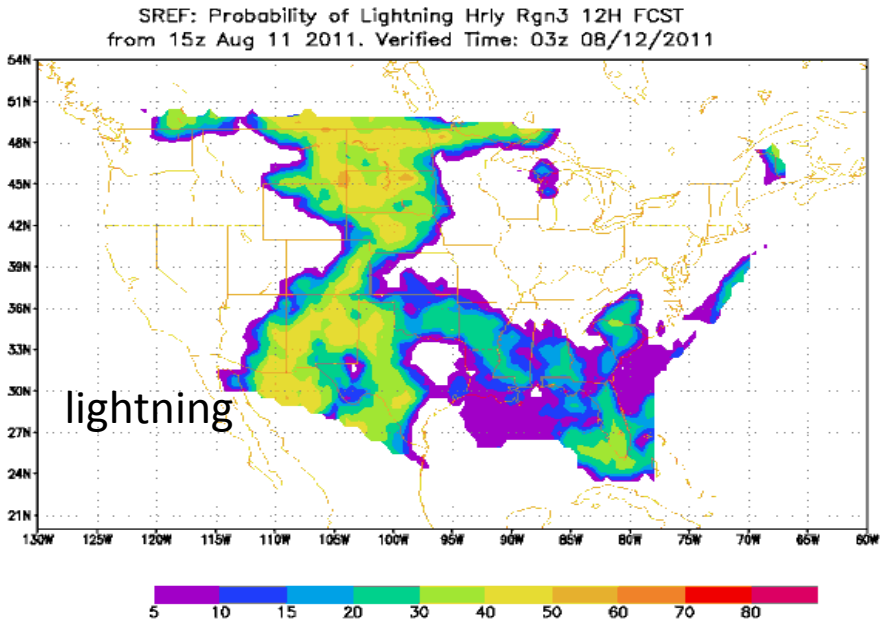
Obs

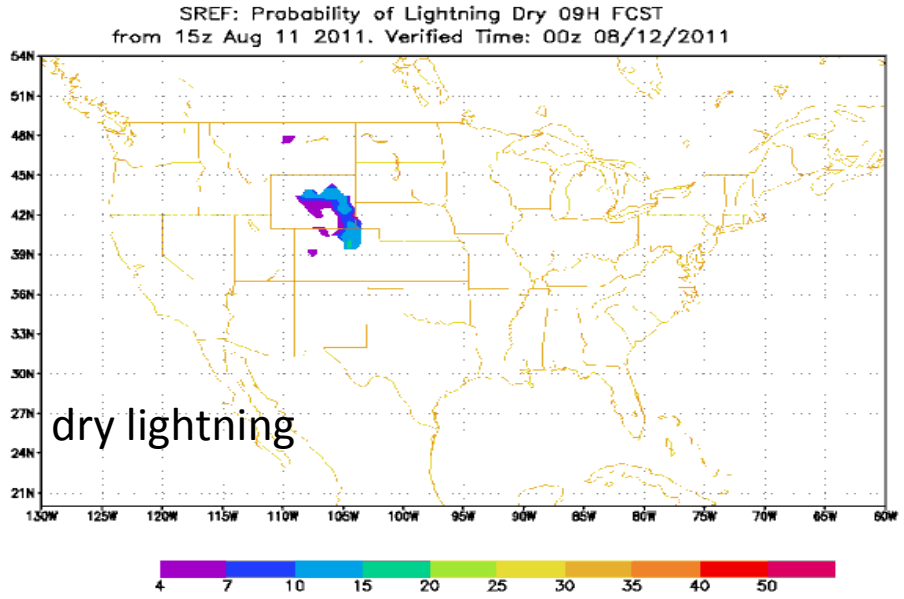
SREF mean

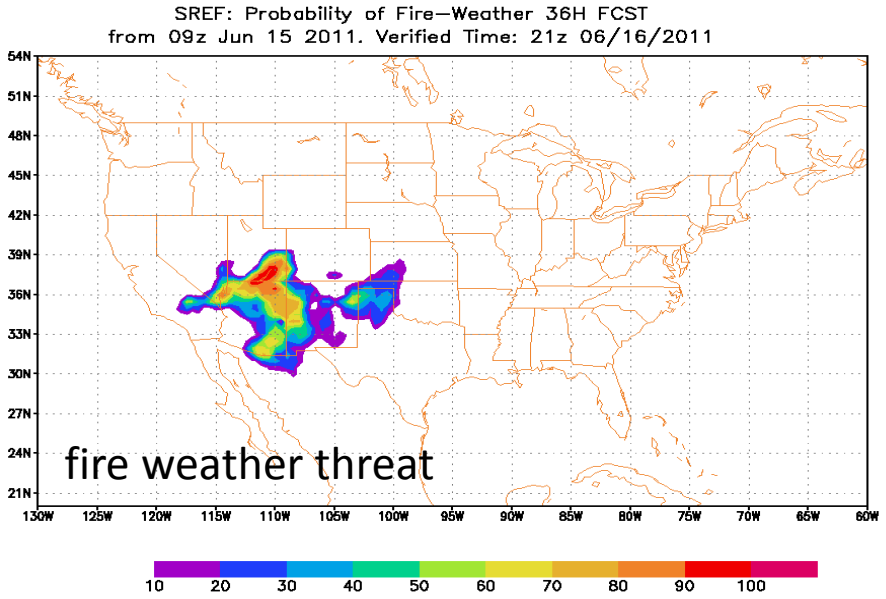


New products for convection and fire weather

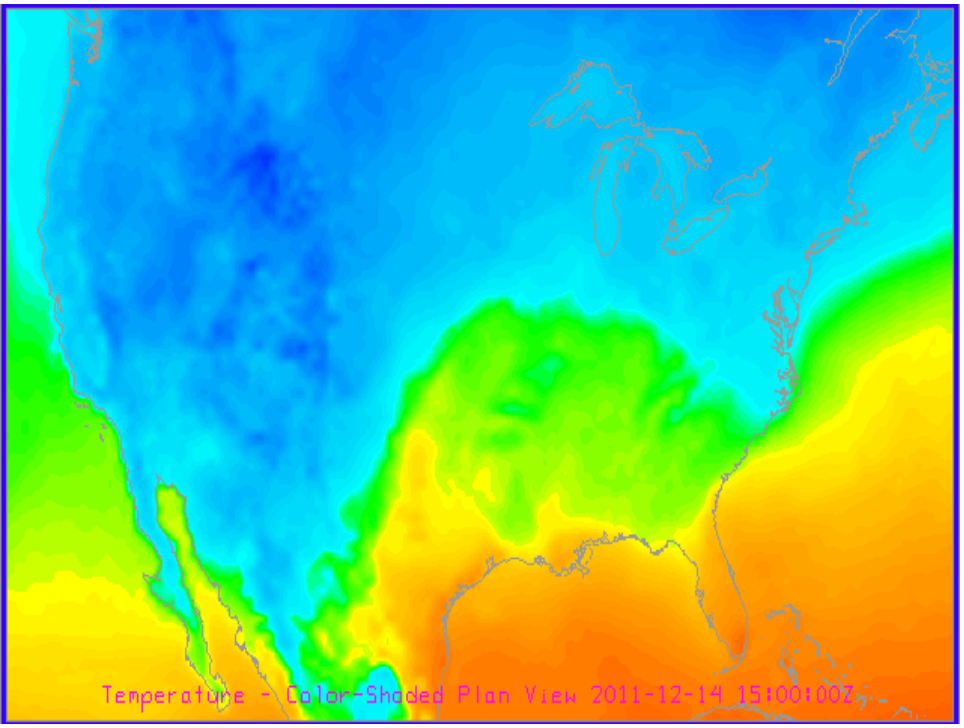


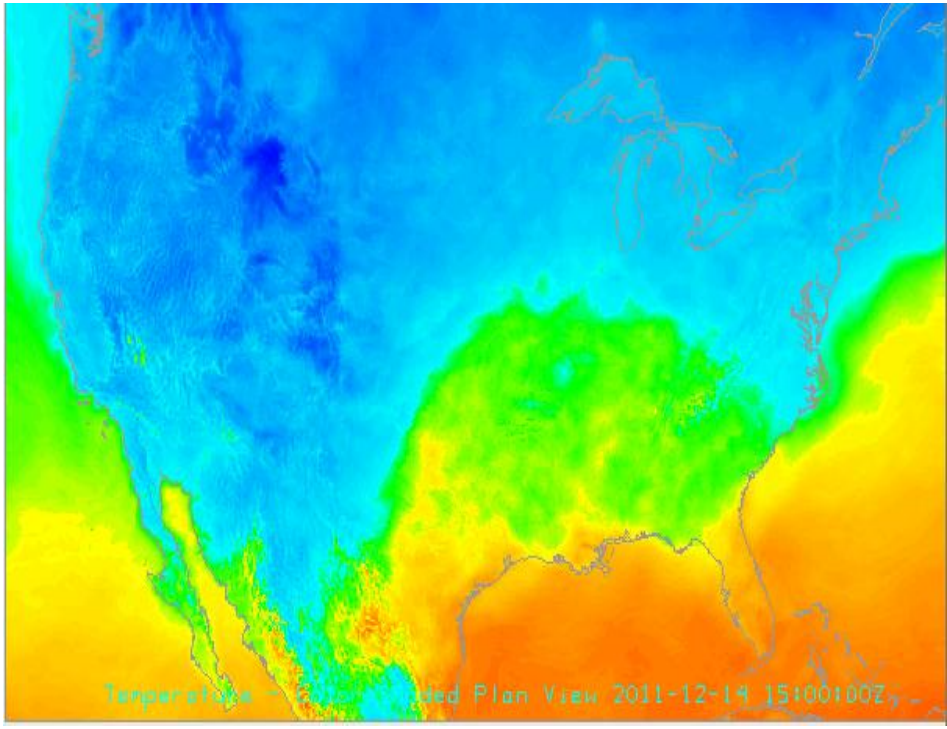






T2m (valid at 15Z, Dec. 14, 2011)



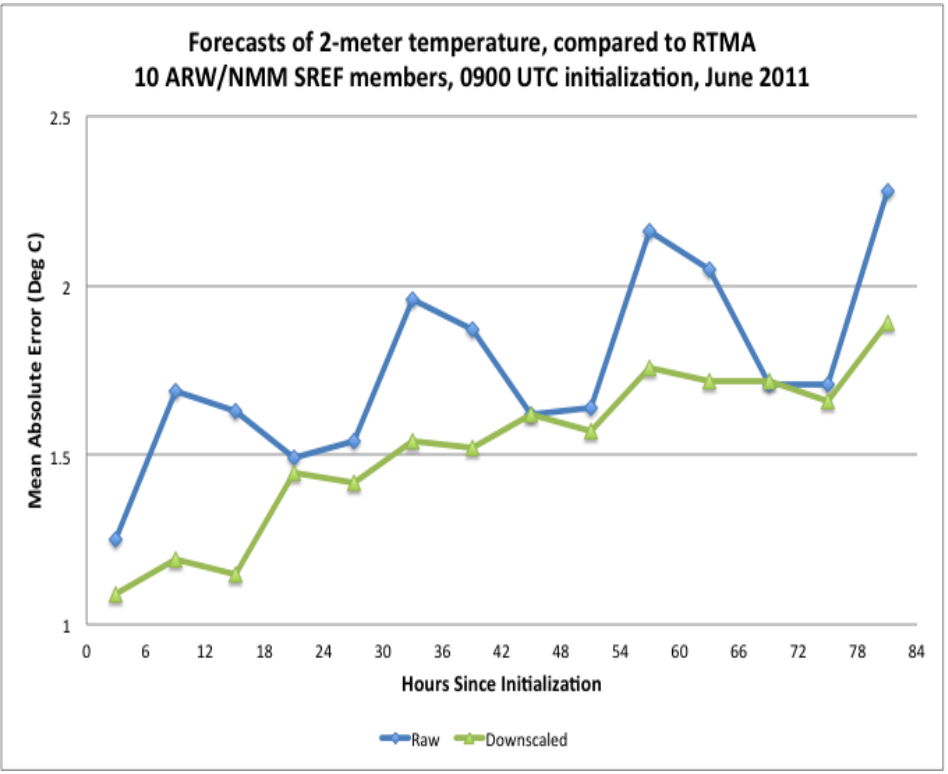


Before (40km)

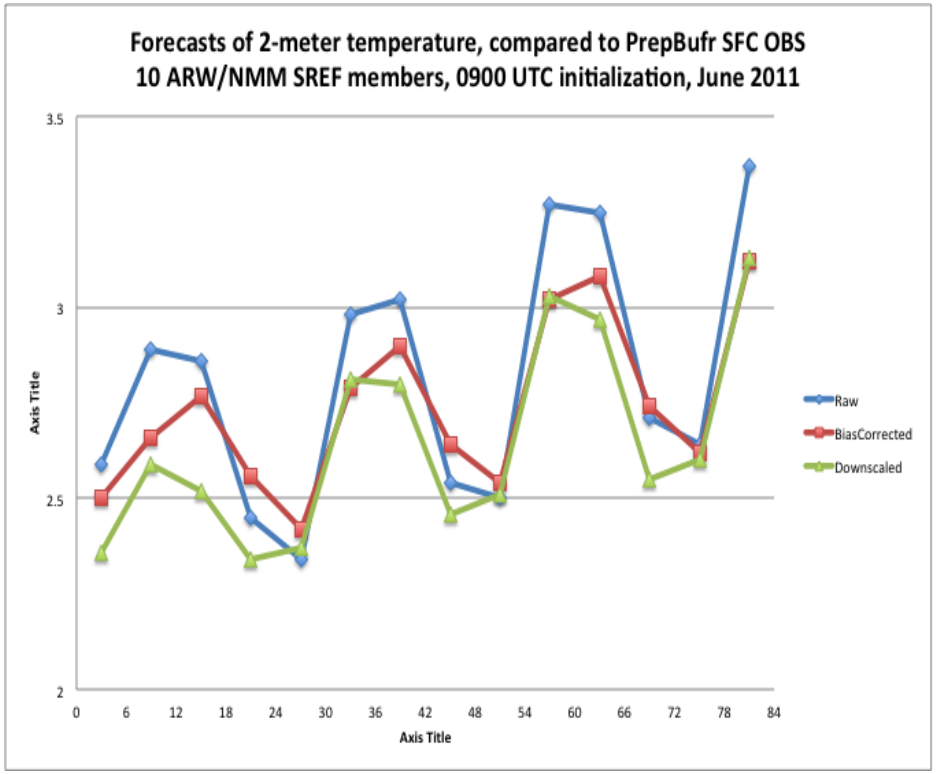
After (5km)

32km SREF downscaled to 5km NDFD grid using RTMA

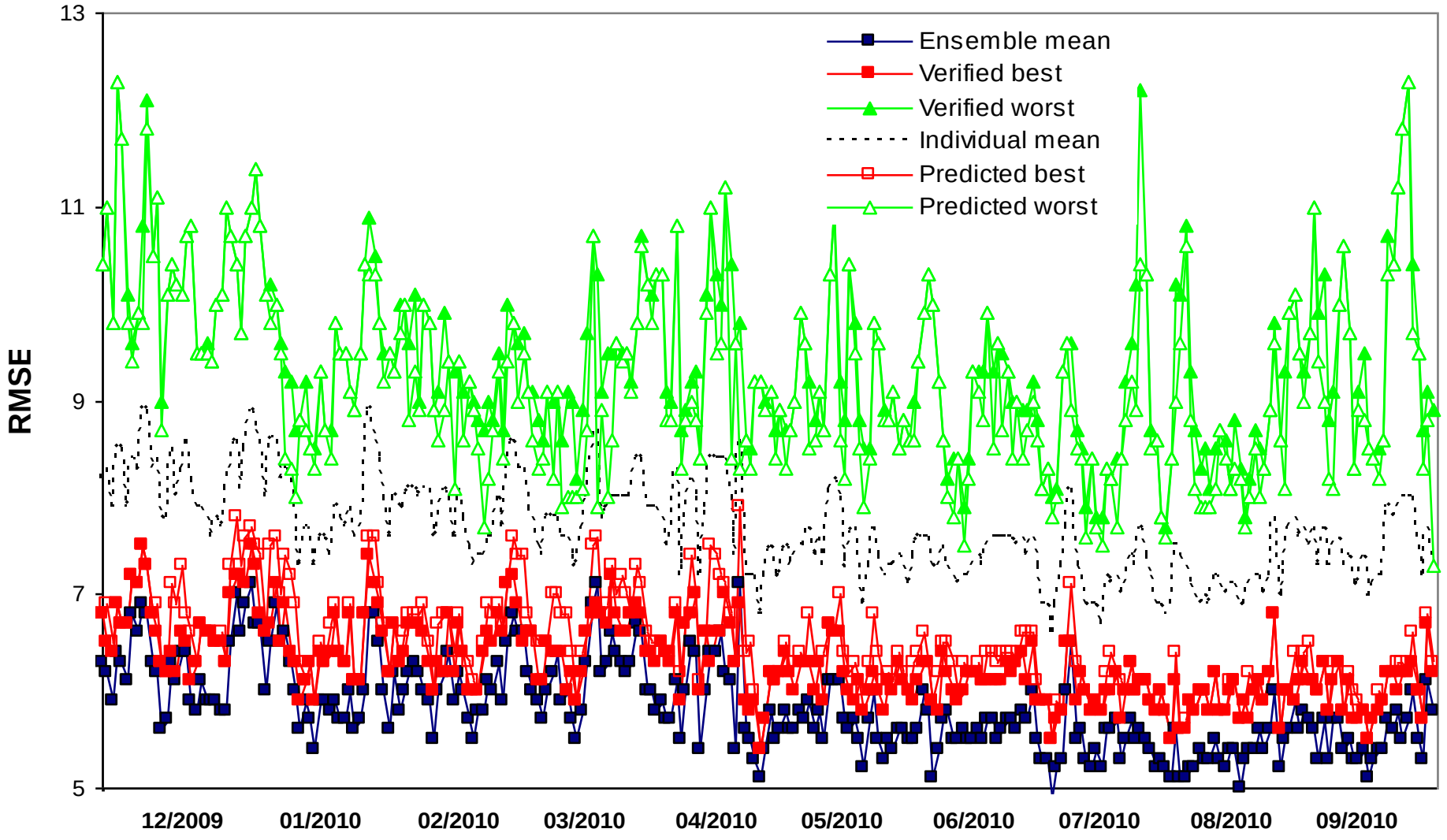
Against RTMA



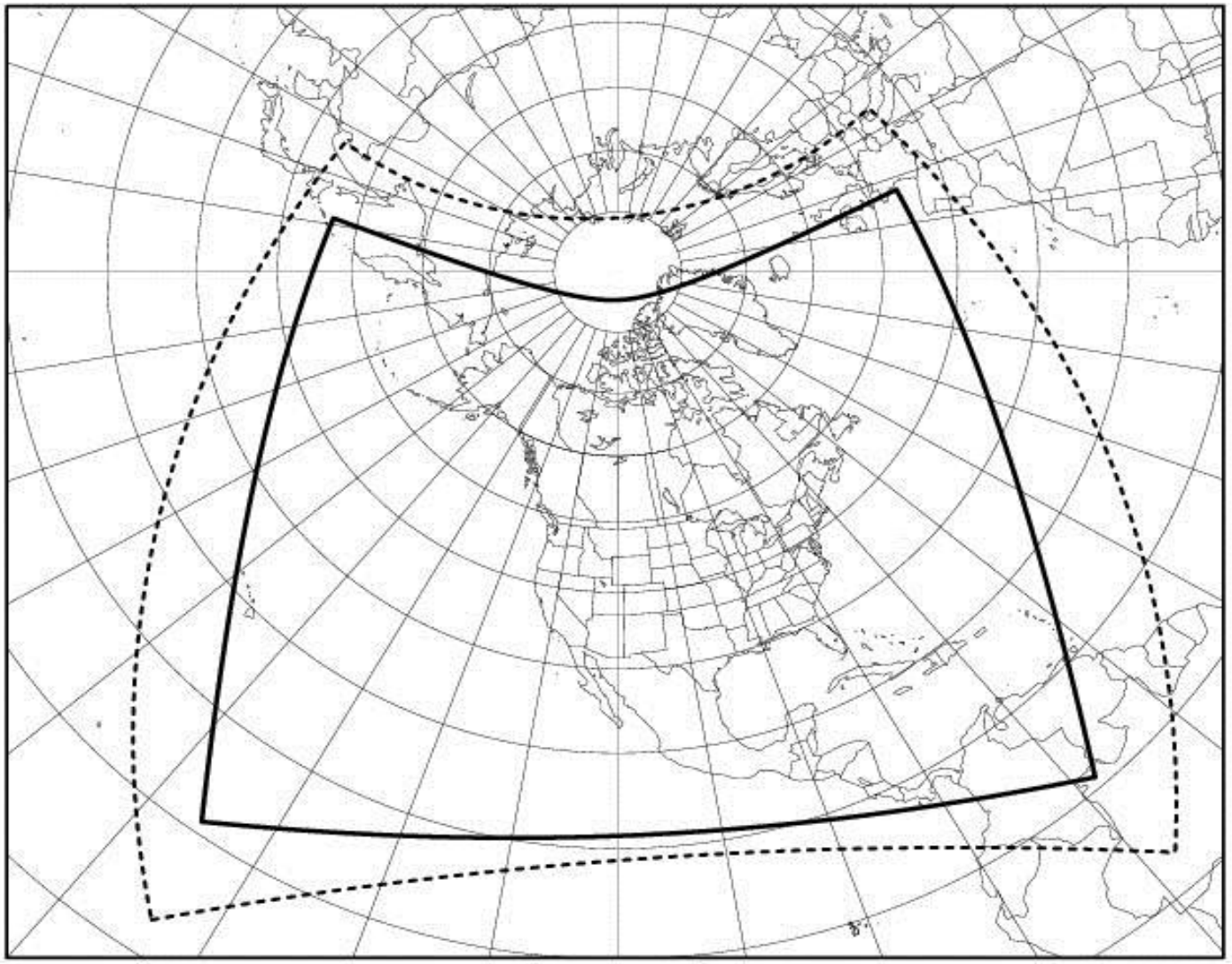
Against observation



Individual member' performance ranking (weights for each members): Du and Zhou 2011 MWR



16km North America domain (solid line) from SREF: our NAEFS_LAM data will be derived from this master grid



Plans

- 2012 SREF upgrade implementation: June/July, 2012
- EnKF IC perturbations
- ECMWF's Backscatter stochastic physics scheme
- 9km version of SREF (with DTC)
- NAEFS_LAM combined products with CMC REPS

NCEP is moving to a new building located at University of Maryland's research campus on August 17, 2012. Welcome to visit the new NCEP!