Hydrometeorological Testbed (HMT) Ensemble Modeling Status

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Overview

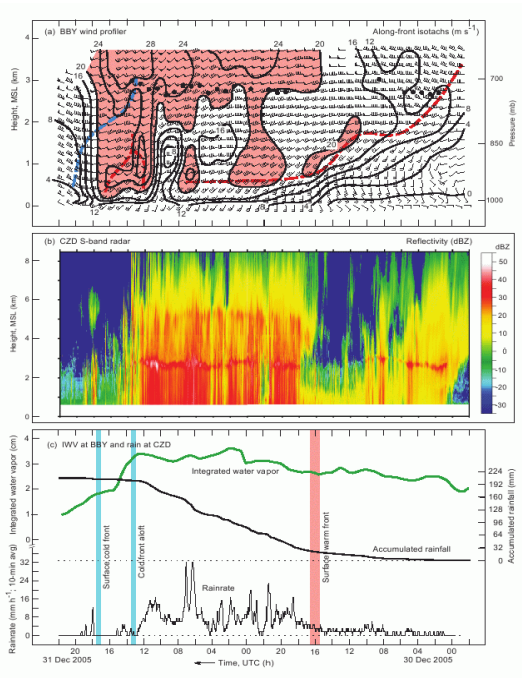
- 2009-2010 HMT ensemble forecasting system design
- Some 2009-2010 season results
- Potential future changes and linkage to DET.

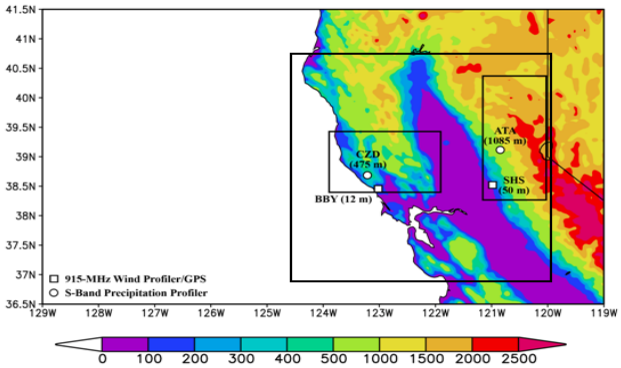
ESRL/GSD HMT Role

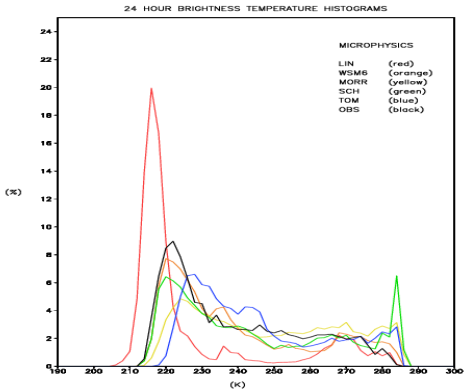
❖ **Goal is to improve forecasts of rain and snow and associated hydrology**

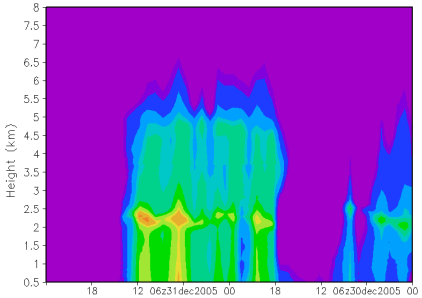
ESRL/GSD group roles:

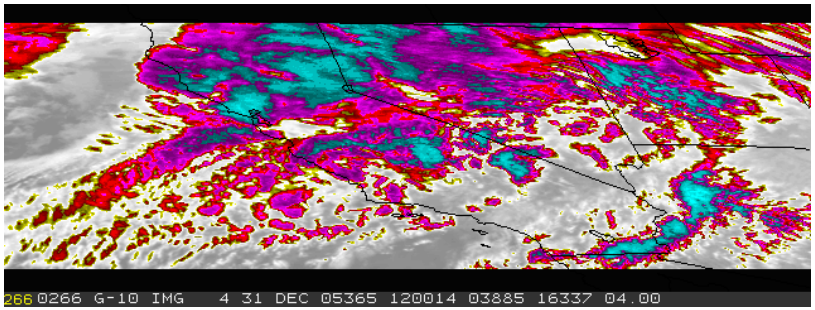
- Design of the LA ensemble
- Provide real time ensemble precipitation forecasts
- Provide numerical model support for PSD moisture flux tool
- Collaborate with PSD colleagues in addressing various scientific questions



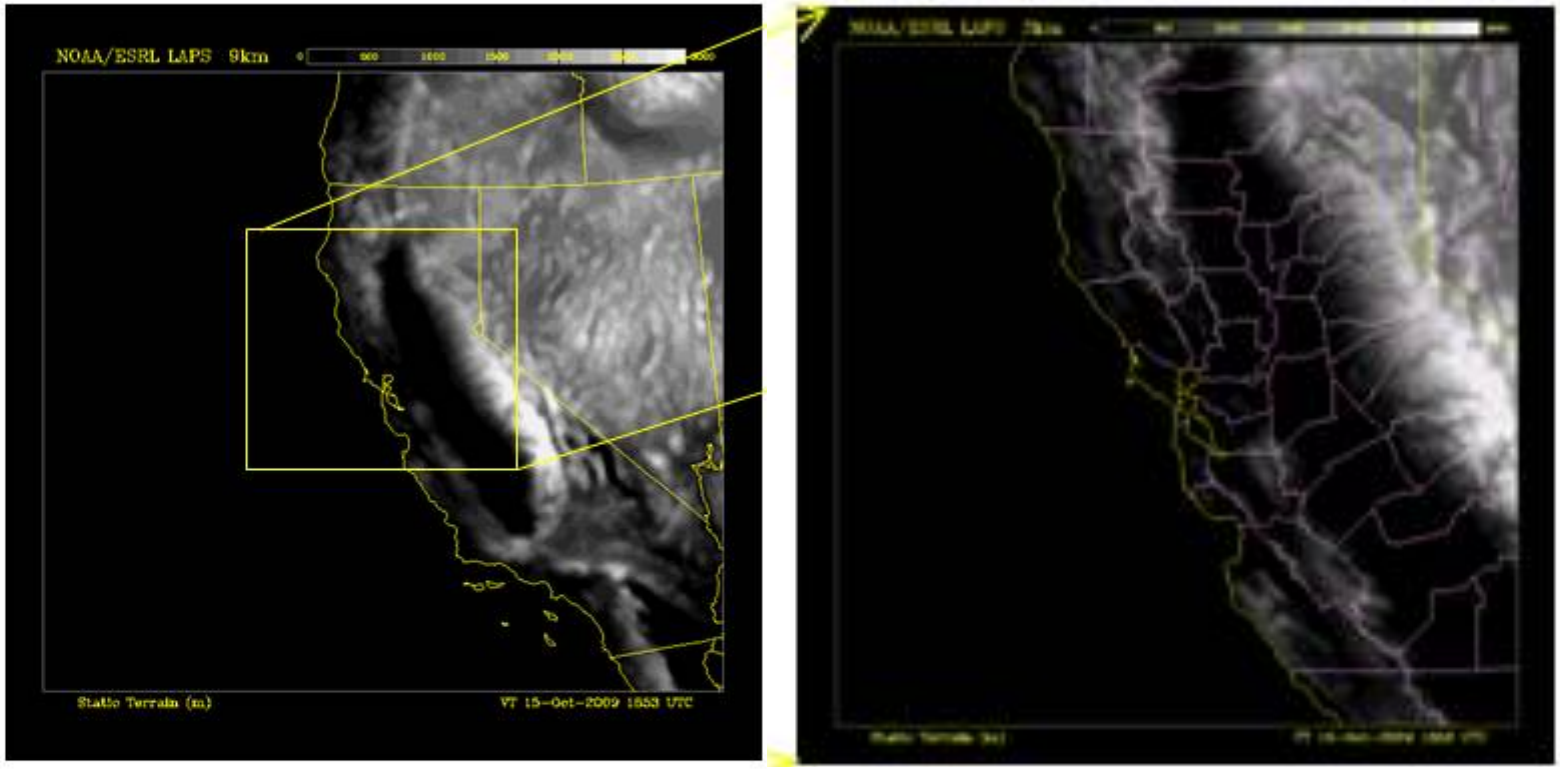








EXPERIMENT DESIGN 2009-2010



Nested domain:

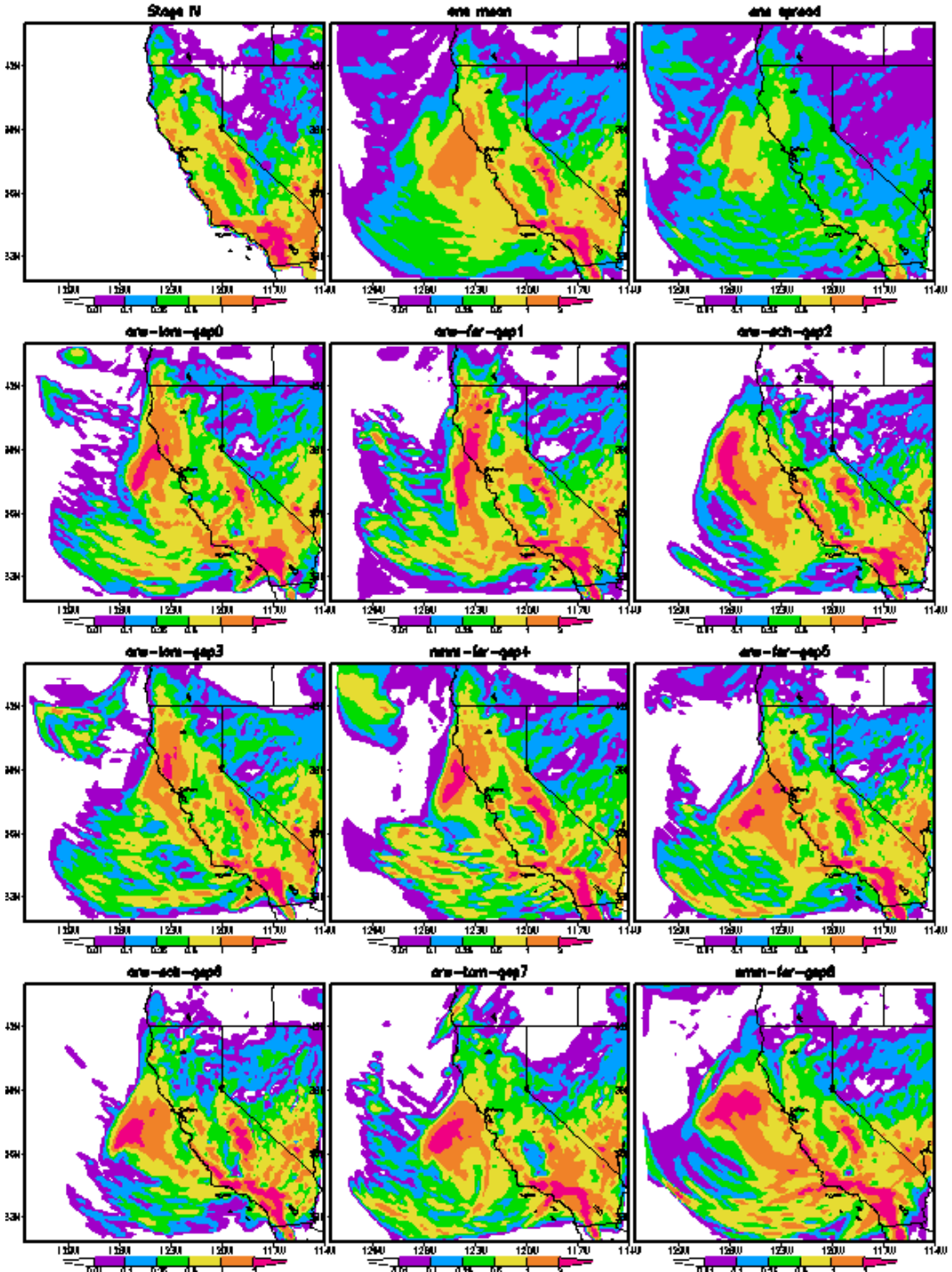
- Outer/inner nest grid spacing 9 and 3 km, respectively.
- 6-h cycles, 120hr forecasts foe the outer nest and 12hr forecasts for the inner nest
- 9 members (listed in the following slide)
- Mixed models, physics & perturbed boundary conditions from NCEP Global Ensemble

- 2010-2011 season everything stays the same except initial condition perturbations?

QPF

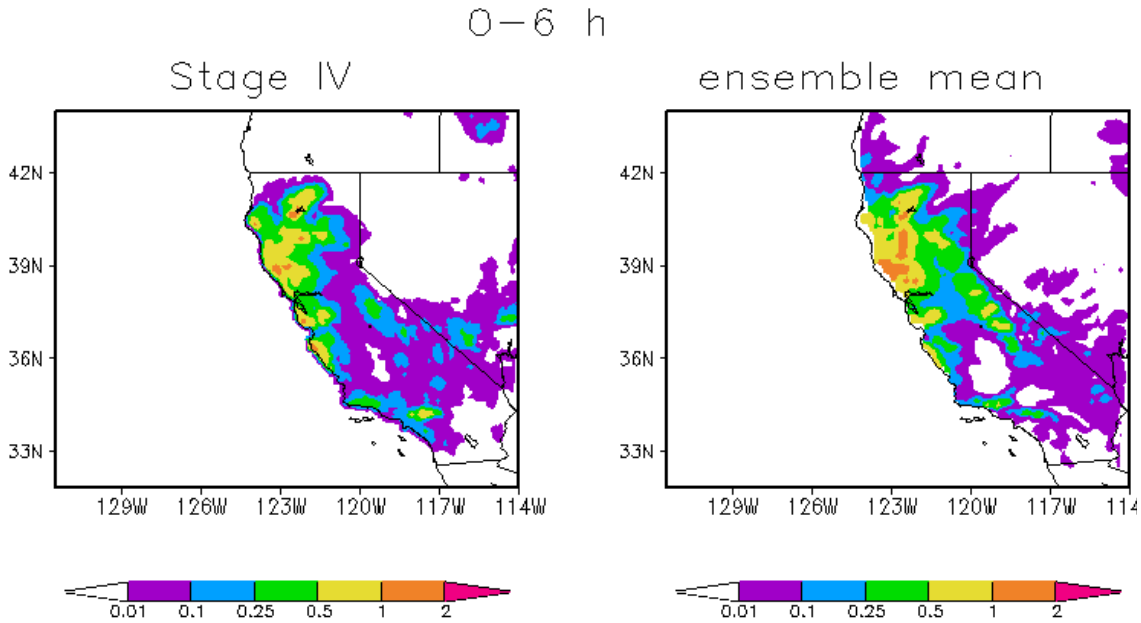
Example of 24-h QPF
9-km resolution

9 members:
ARW-TOM-GEP0
ARW-FER-GEP1
ARW-SCH-GEP2
ARW-TOM-GEP3
NMM-FER-GEP4
ARW-FER-GEP5
ARW-SCH-GEP6
ARW-TOM-GEP7
NMM-FER-GEP8

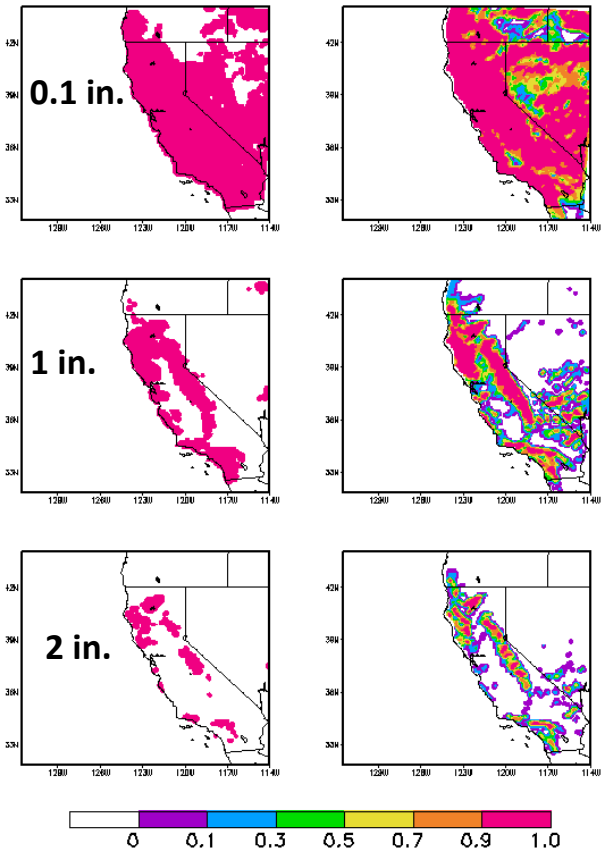


HMT QPF and PQPF

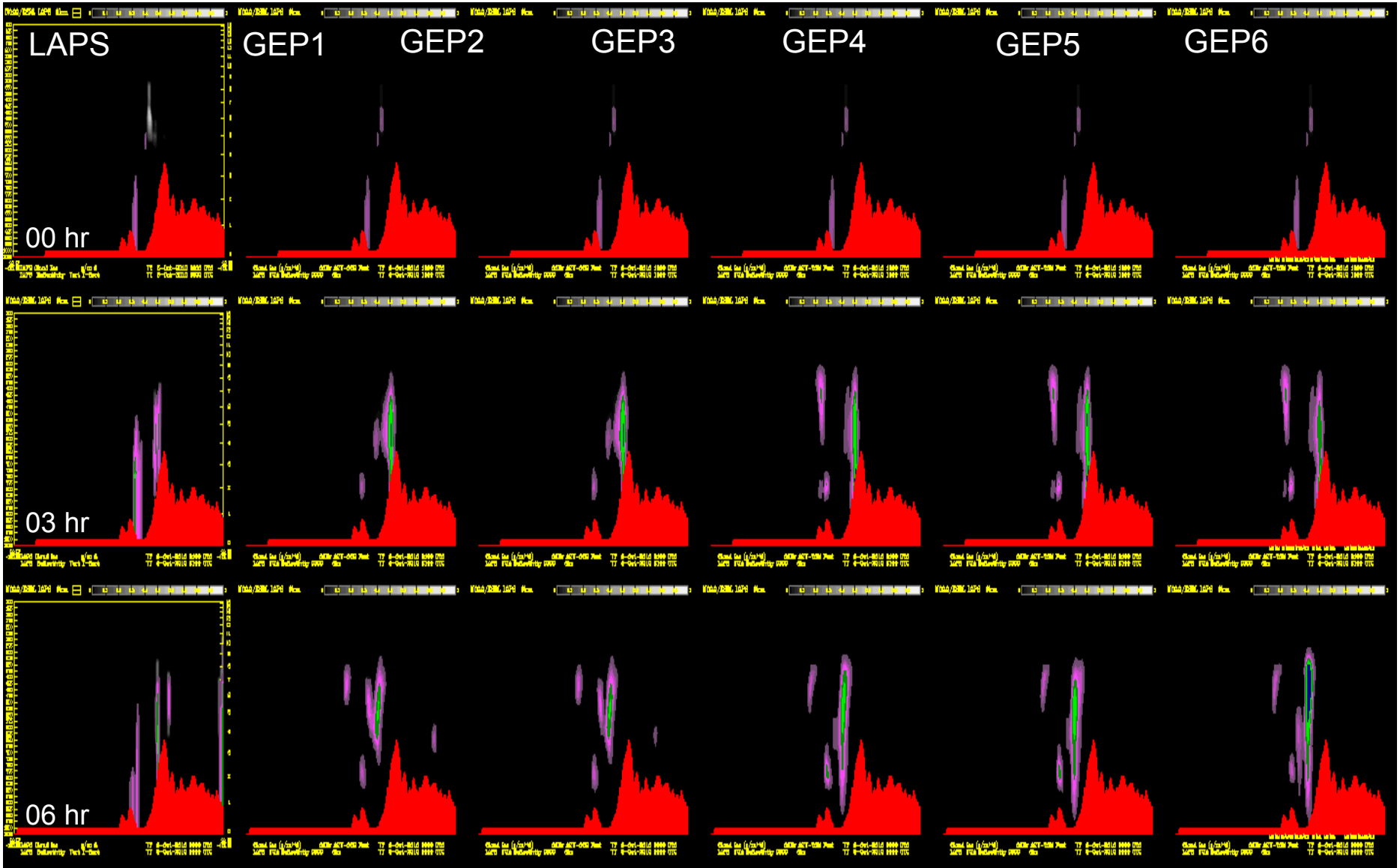
48-hr forecast starting at 12 UTC, 18 January 2010



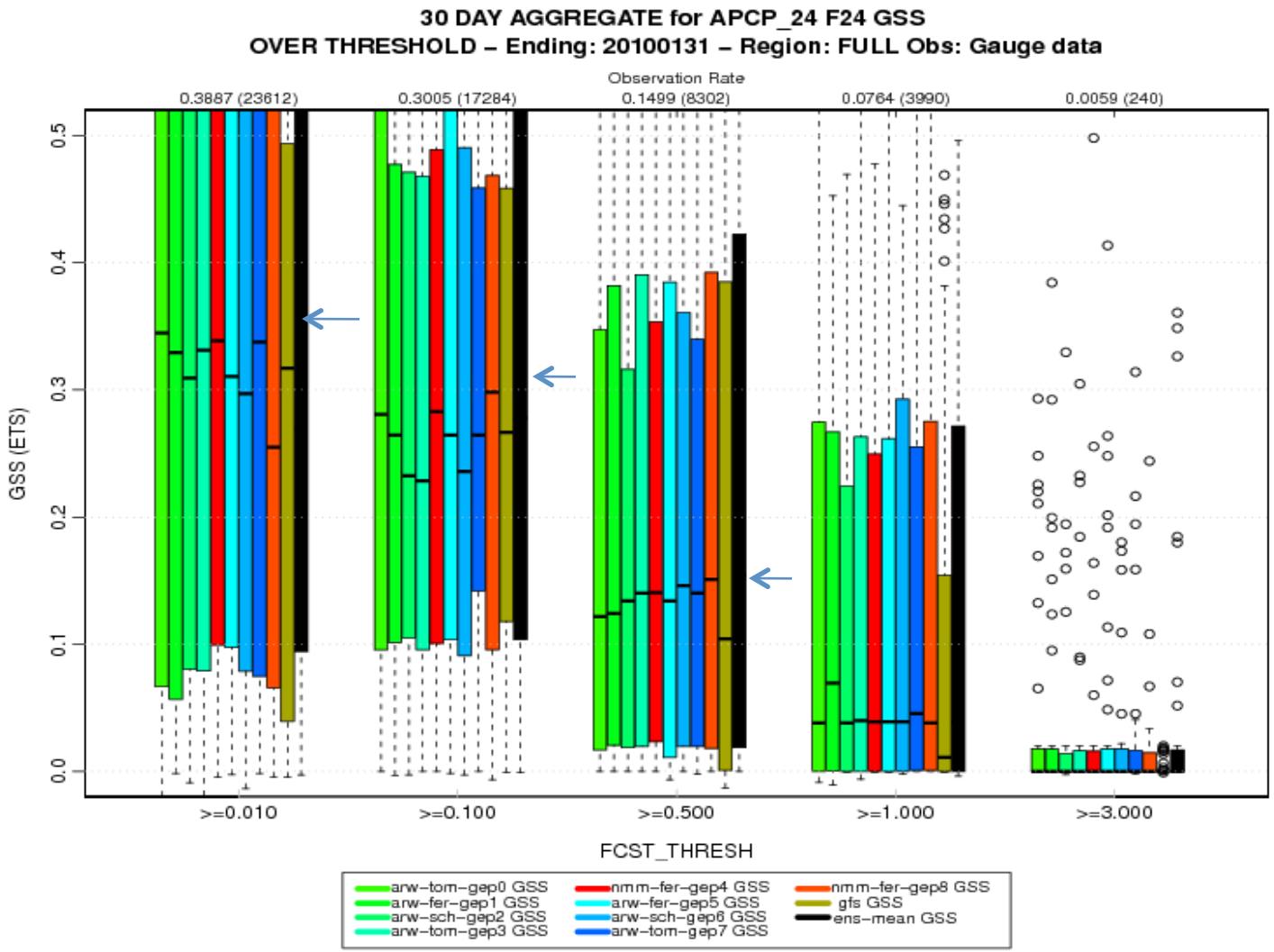
24-hr PQPF



Xsect Reflectivity 06 Oct. 2010 18UTC



Real-time QPF verification for HMT-West

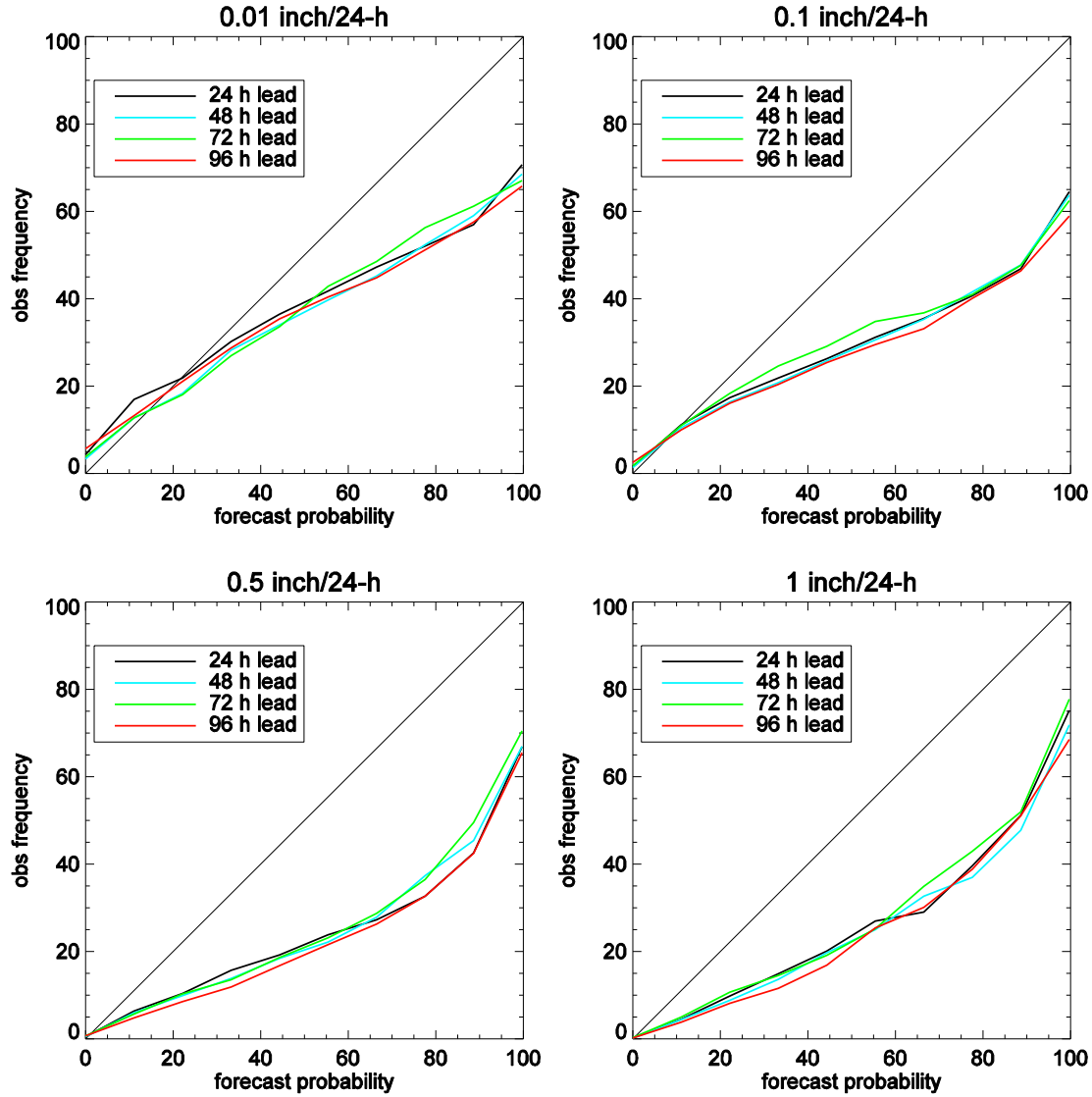


Reliability of 24-h PQPF

Reliability diagrams of 24-h PQPF
9-km resolution
Dec 2009 - Apr 2010

Observed frequency vs forecast probability
Overforecast of PQPF
Similar performance for different lead times

Brier skill score (BSS):
Reference brier score is Stage IV sample climatology
BSS is only skilful for 24-h lead time at all thresholds and for 0.01 inch/24-h beyond 24-h lead time.



Calibration of PQPF

Probabilistic Quantitative Precipitation Forecasts

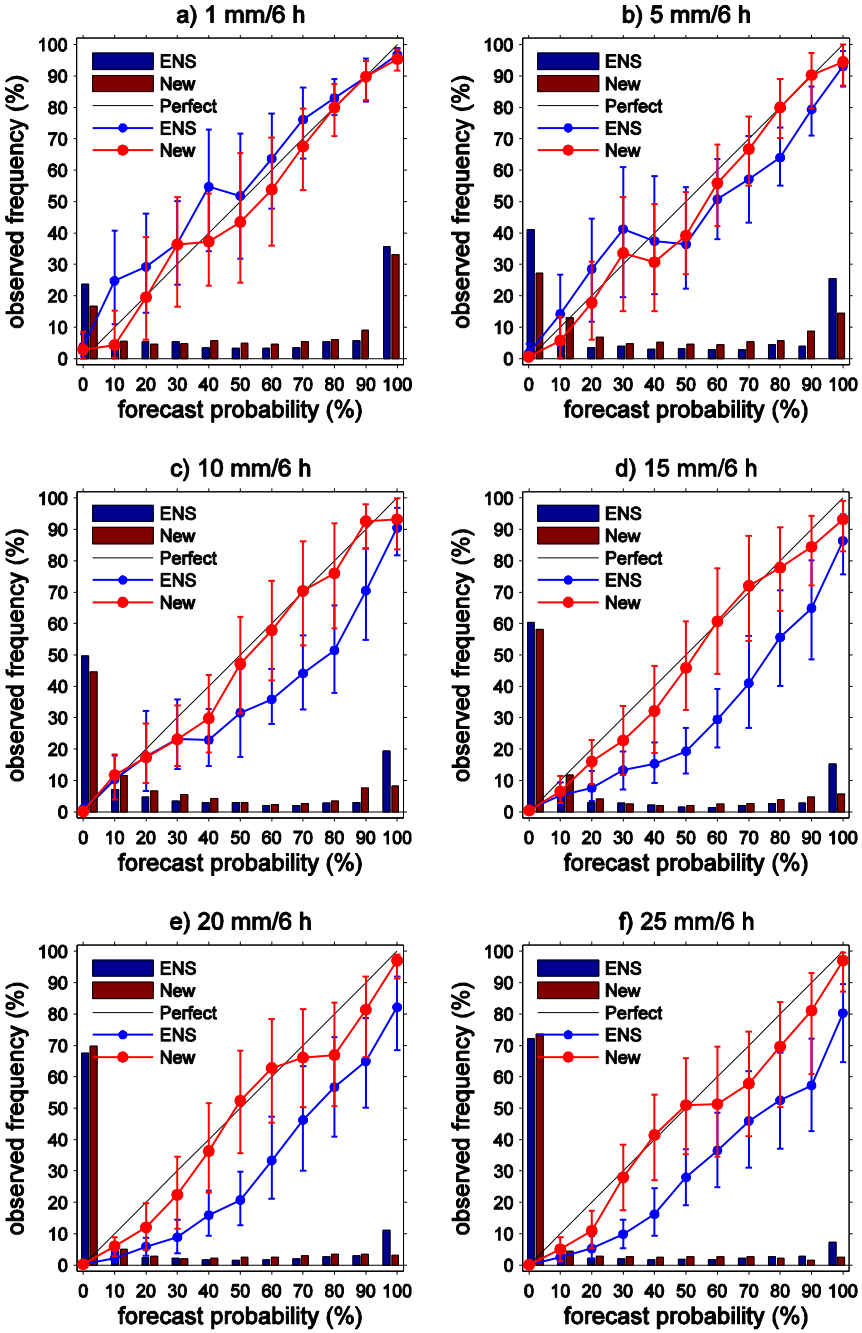
Four rerun HMT-West-2006 cases: IOP1, 4, 10, 12

Cross-validation over the ARB

Reliability curves are improved (red line along the diagonal) for the thresholds 1-25 mm/6-h

Internal histograms: Frequencies changed

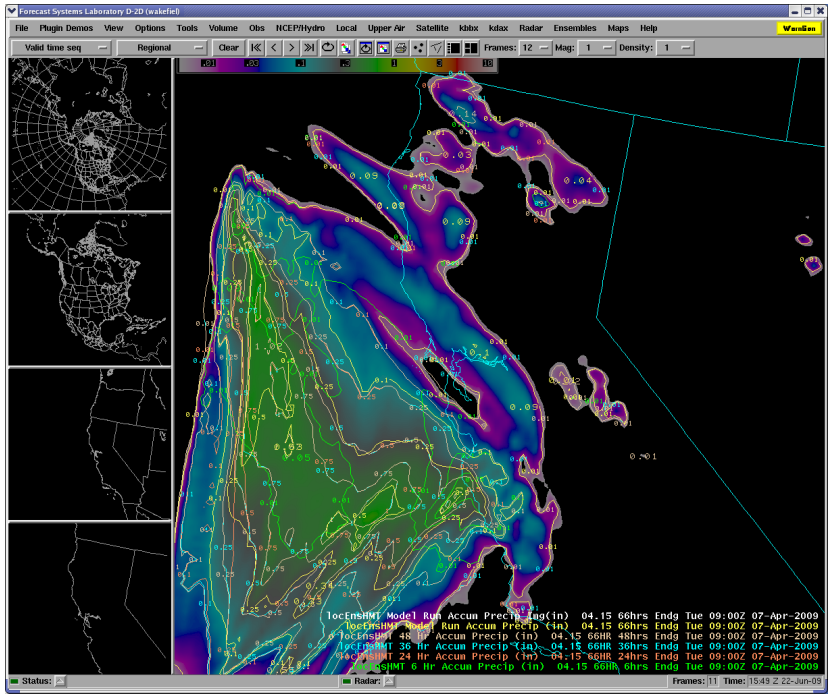
Yuan et al. 2008, JHM

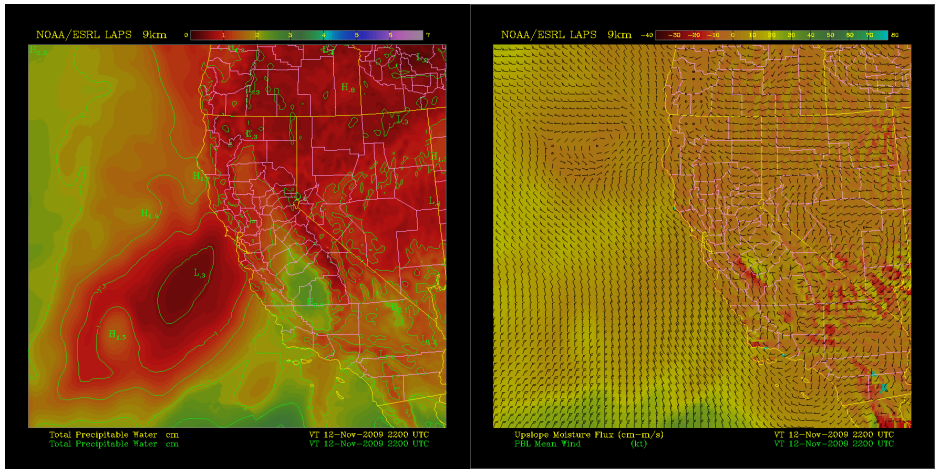


ENSEMBLE OUTPUT DISPLAY

The ensemble output has been available
To WFOs through ALPS

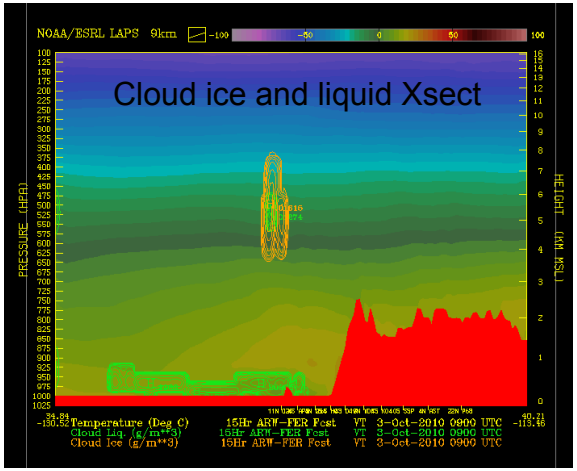
http://laps.noaa.gov/forecasts/

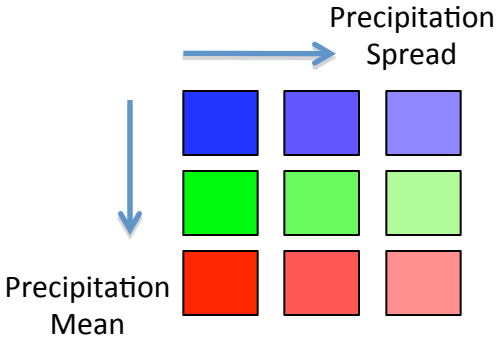


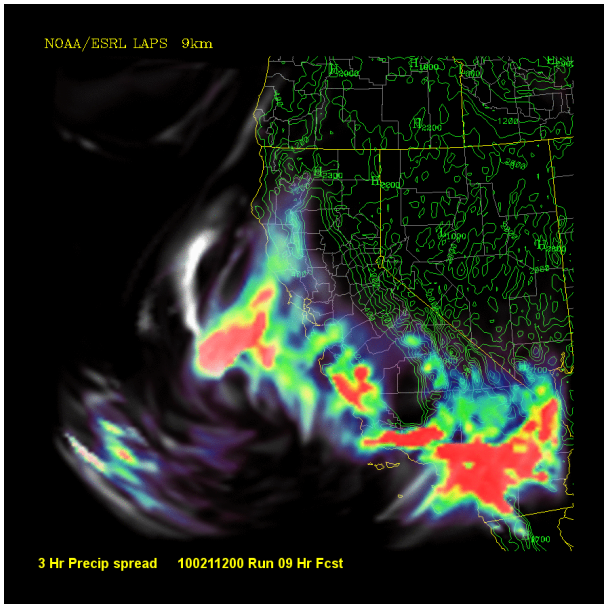


TPW (cm)

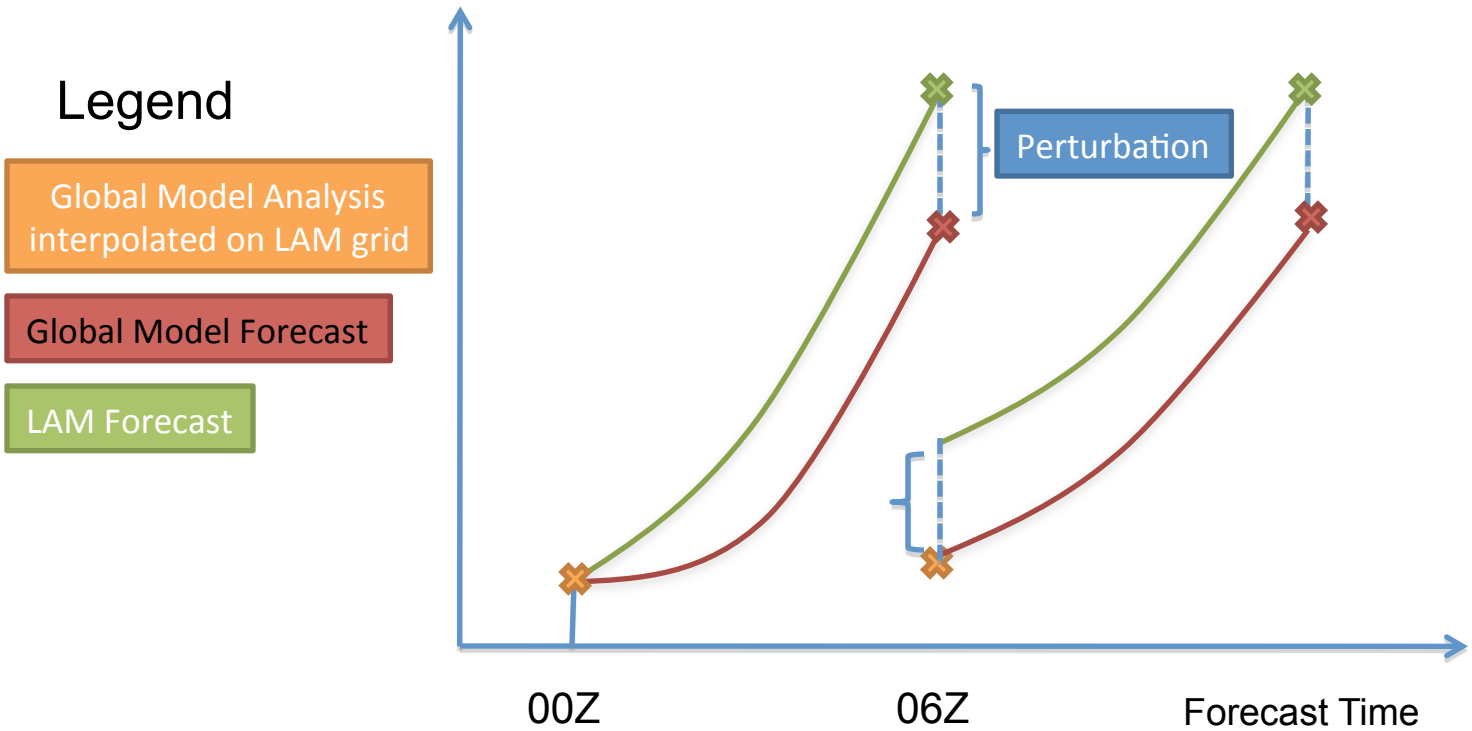
PW Flux (q x v)



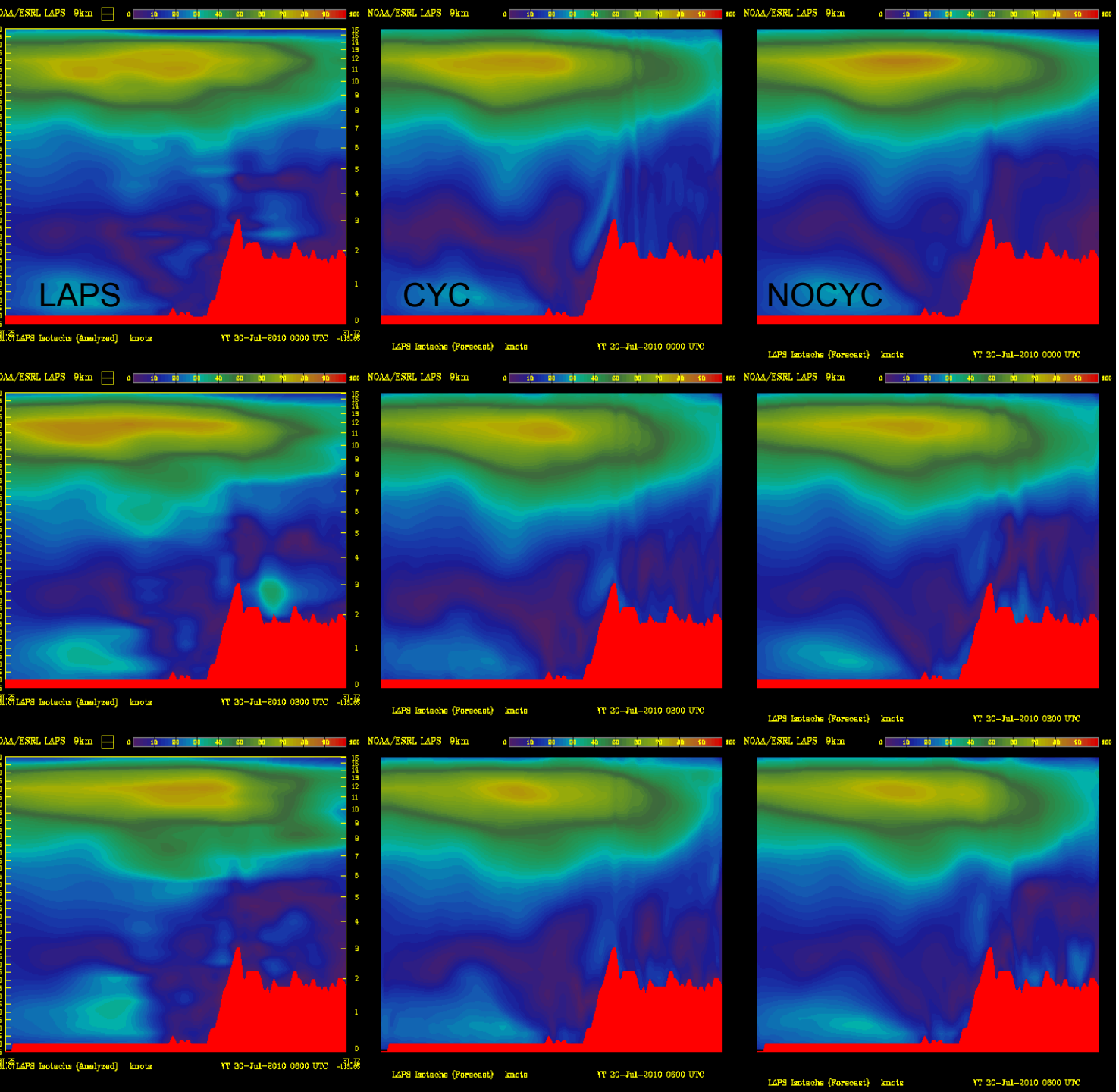




Cycling Initial Perturbations – Link with DET



Wind Speed
July 30 2010 00UTC

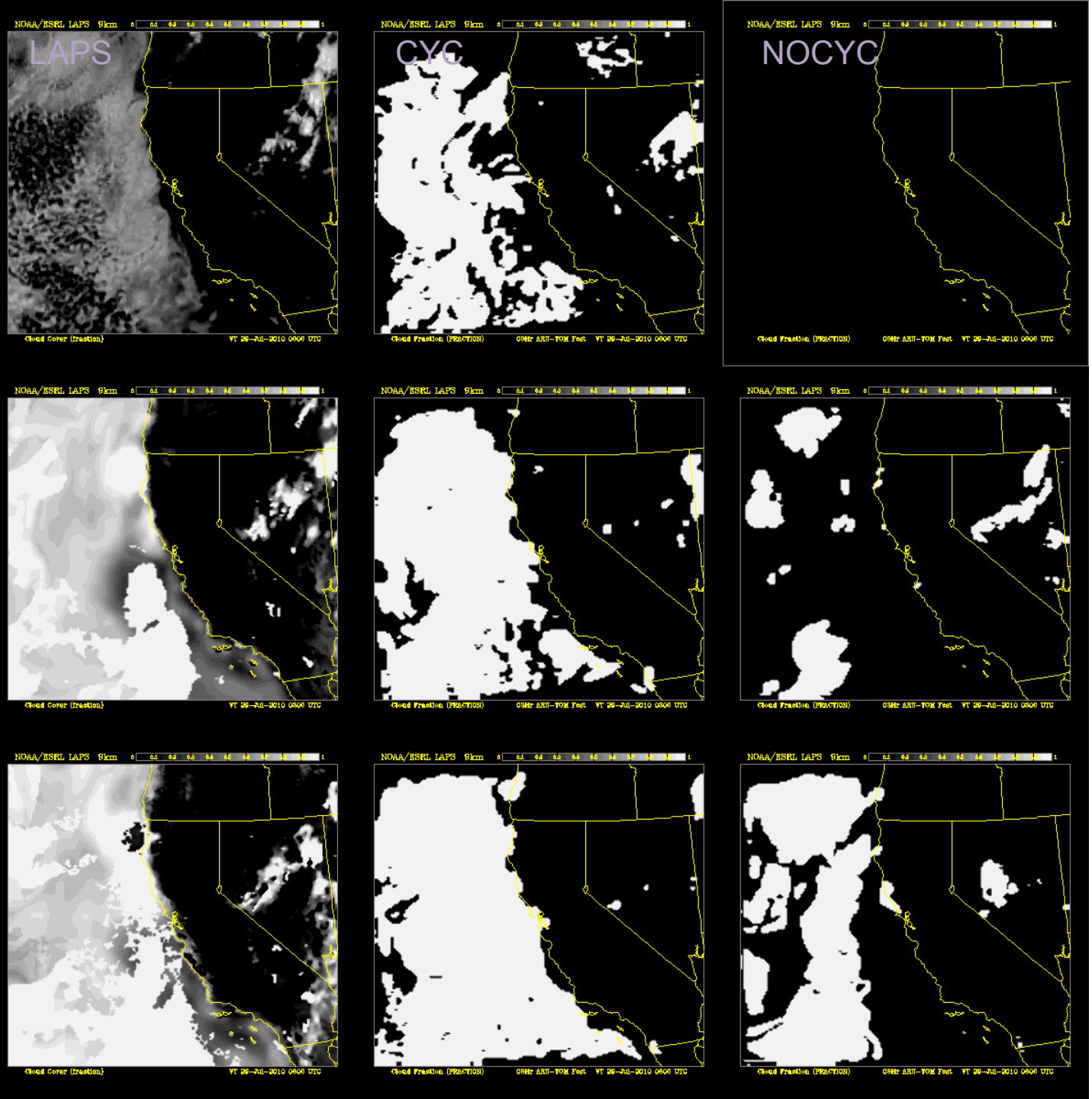


00hr

03hr

06hr

Cloud Coverage
July 30 2010 00UTC



00hr

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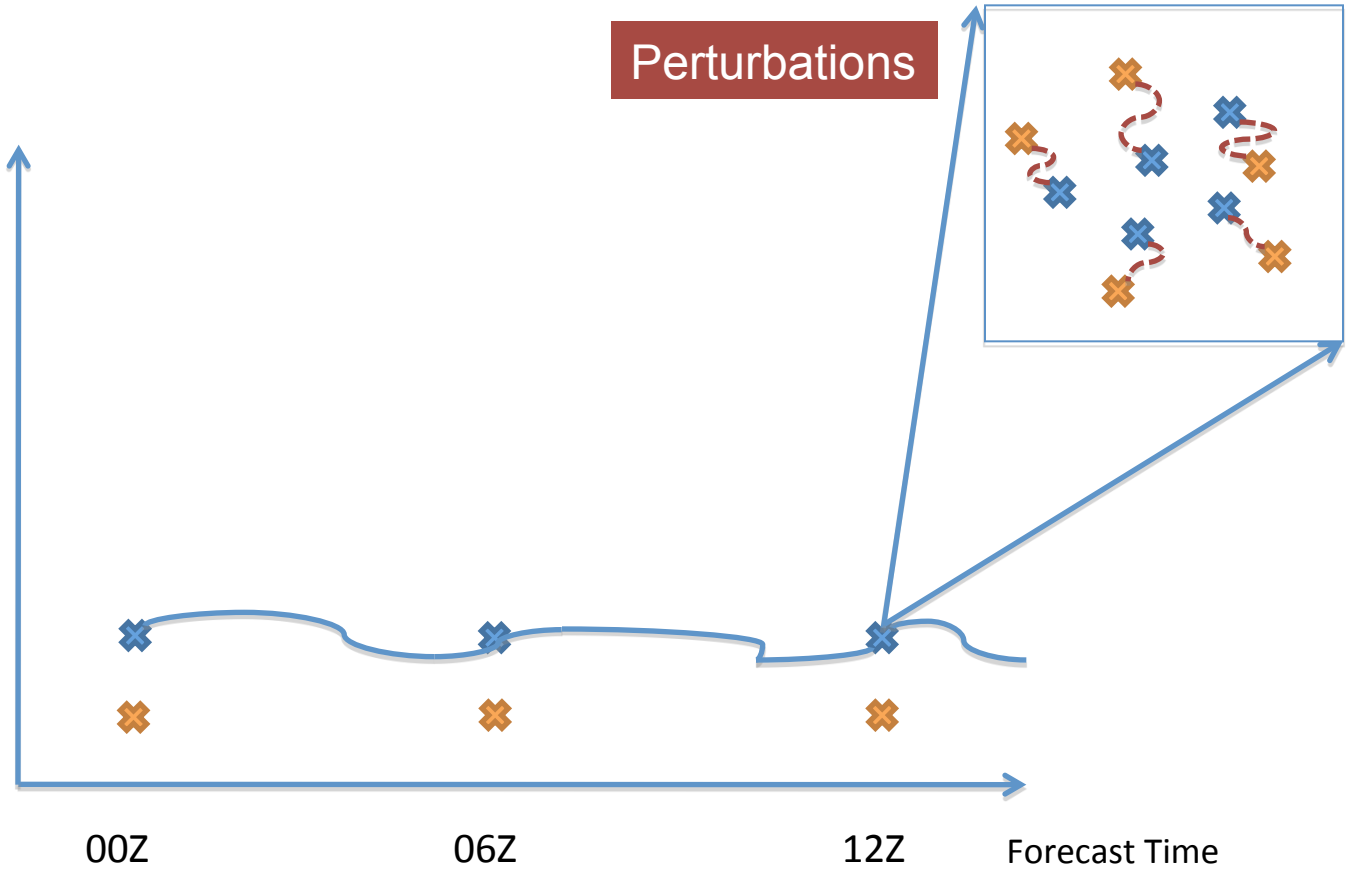
06hr

Initial Perturbations for HMT-10/11 "Cycling" GEFS (or SREF) perturbations

LAM forecast driven by global analysis

Global Model Analysis interpolated on LAM grid



HIGH-RESOLUTION MODEL RUN FOR PSD's MOISTURE-FLUX FORECASTING TOOL SUPPORT 2009-2010

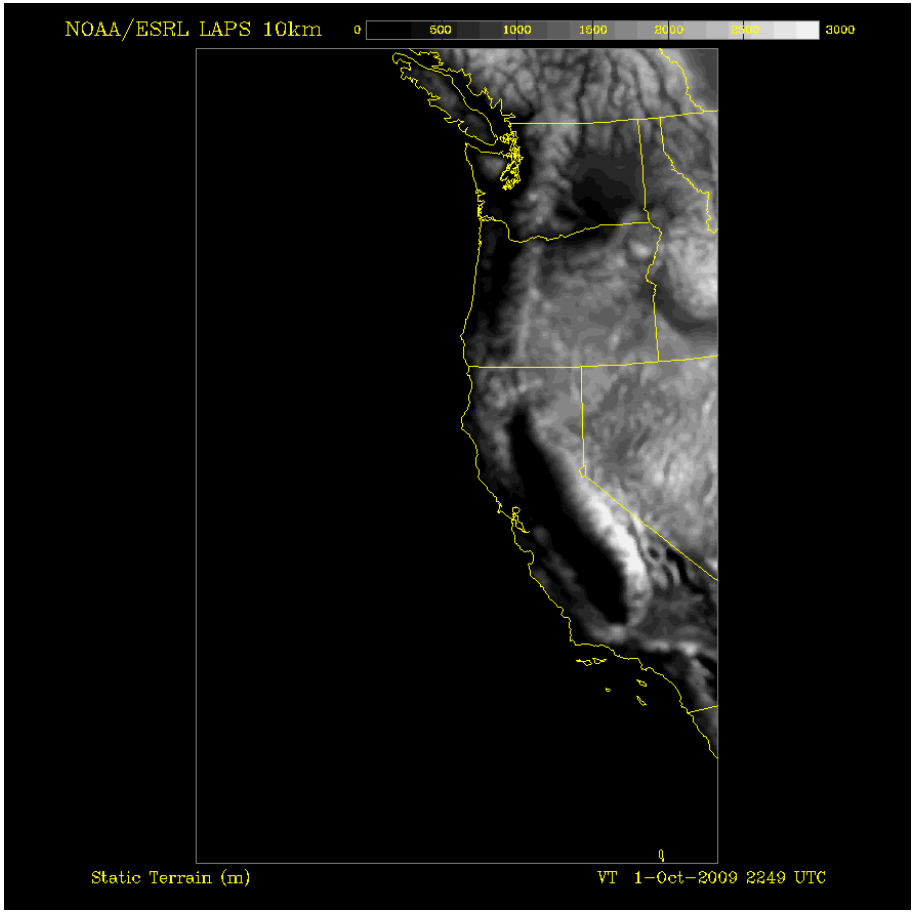
- Domain extended further north and south compared to the ensemble domain

- 10 km horizontal grid spacing

- Hourly update

- LAPS initial conditions with current data available ~25 min. after the hour.

- 12-hr forecast available ~40 min. after the hour.



Publications

Jankov, I., P. J. Schultz, C. J. Anderson, and S. E. Koch, 2007: The Impact of Different Physical Parameterizations and Their Interactions on Cold Season QPF in the American River Basin 2007. *Journal of Hydrometeorology*, Volume 8, pp. 1141–1151

Jankov, I., J-W Bao, P. J. Neiman, P. J. Schultz, H. Yuan and Al. B. White, 2009: Evaluation and Comparison of Microphysical Algorithms in WRF-ARW Model Simulations of Atmospheric River Events Affecting the California Coast. *Journal of Hydrometeorology* **10**, 847-870

Jankov, I. L. D. Grasso, M. Sengupta, P. J. Neiman, D. Zupanski, M. Zupanski, D. Lindsey, D. W. Hillger, D. L. Birkenheuer , R. Brummer and H. Yuan, 2010: An Evaluation of Five WRF-ARW Microphysics Schemes Using Synthetic GOES Imagery for an Atmospheric River Event Affecting the California *Journal of Hydrometeorology (in the review process)*

Vukicevic, T., I. Jankov, and J. McGinely, 2008: Diagnosis and optimization of Ensemble Forecasts. *Mon. Wea. Rev.* 136, 1054-1074.

Yuan, H., J. A. McGinley, P. J. Schultz, C. J. Anderson, and C. Lu, 2008: Short-range precipitation forecasts from time-lagged multimodel ensembles during the HMT-West-2006 campaign. *J. Hydrometeor*., 9, 477-491.

Yuan, H., C. Lu, J. A. McGinley, P. J. Schultz, B. Jamison, L. Wharton, and C. J. Anderson, 2009: Evaluation of short-range quantitative precipitation forecasts from a time-lagged multimodel ensemble. *Wea. Forecasting*, 24, 18-38.

Questions?

Variational Ensemble Average

1) **Identify relocation vectors to align the fields**
   - Minimize magnitude of relocations
   - Can be used as discriminator (remove member “outliers”)

2) **Average the field**
   - Based on vector relocation (alignment)
   - Can be weighted (reduce influence of members with large relocations)

3) **Compare variational minimized mean to traditional average**