Hydrometeorological Testbed (HMT) Ensemble QPF

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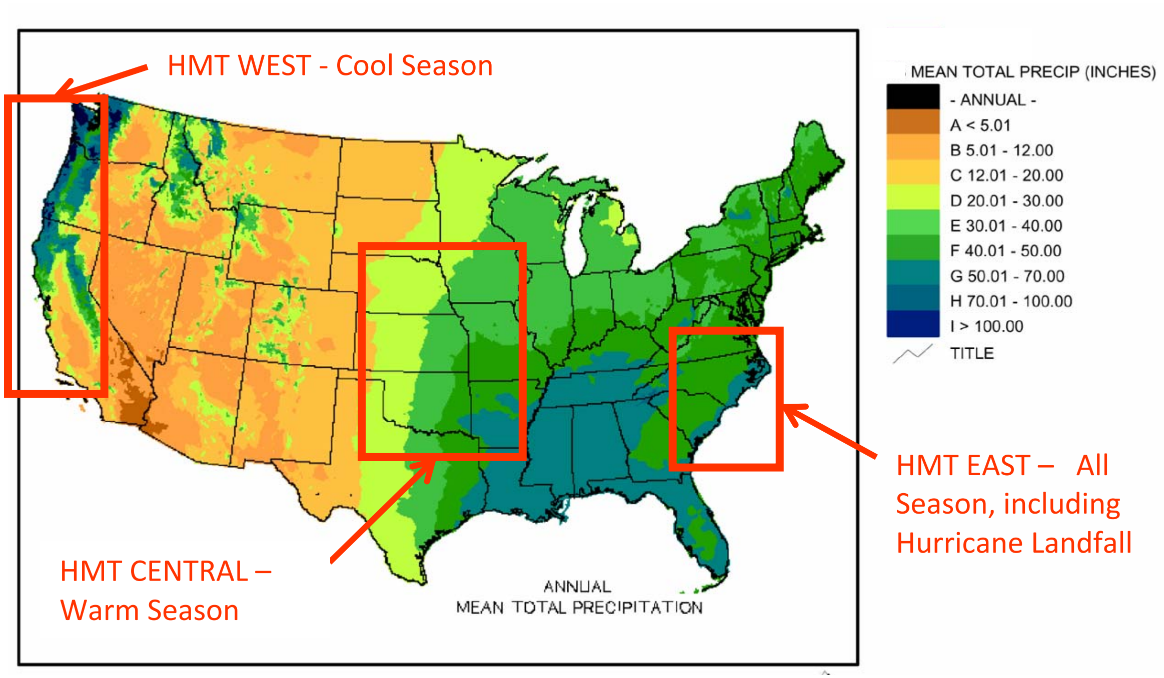
Outline

- HMT overview
- Role of ESRL/GSD in HMT
- Some 2009-2010 season results
- Potential future changes in the ensemble design

HMT Overview

- Goal is to improve forecasts of rain and snow and associated hydrology
- Uses local-state-federal, and private-public-academic partnerships

Benefits: Accelerates improvements in QPF and flood forecasting, with impacts on transportation, ecosystems, emergency management, flood control and water spply. Science and field tests will advise on how best to fill gaps in observational and modeling systems.

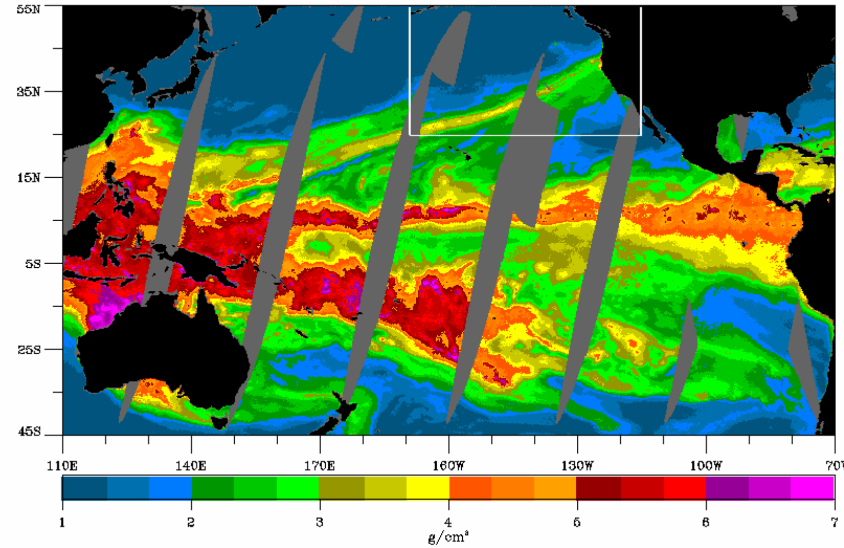


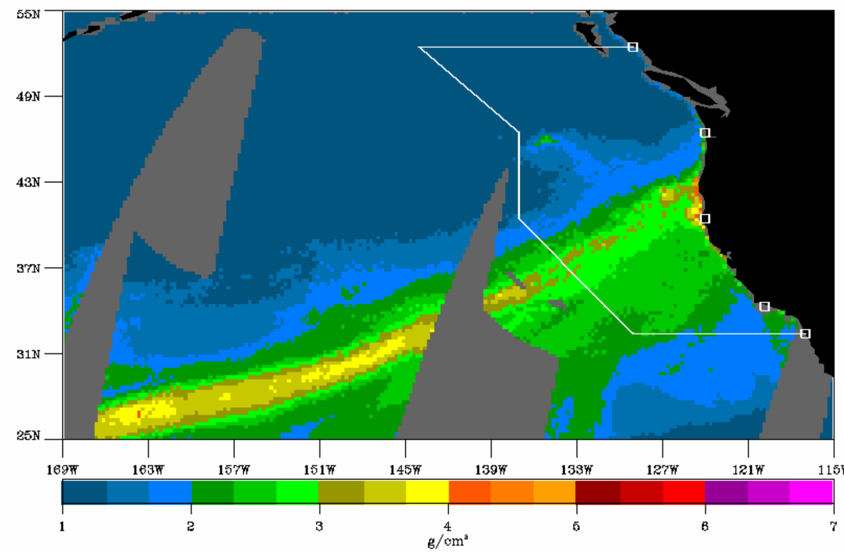
ATMOSPHERIC RIVERS

o During the winter season significant precipitation events in California are often caused by land-falling "atmospheric rivers" associated with extra tropical cyclones in the Pacific.

o Atmospheric rivers are elongated regions of high values of vertically integrated water vapor over the Pacific and Atlantic oceans that extend from the tropics and subtropics into the extratropics and are readily identifiable using SSM/I.

o Due to the terrain steepness and soil characteristics in the area, a high risk of flooding and landslides is often associated with these events.

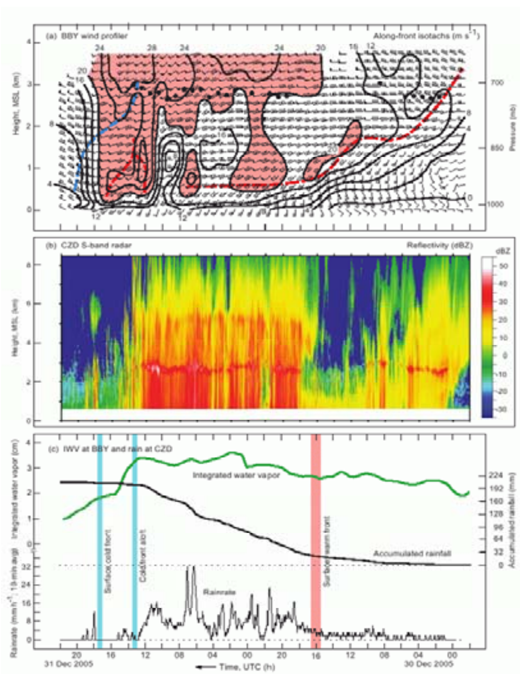


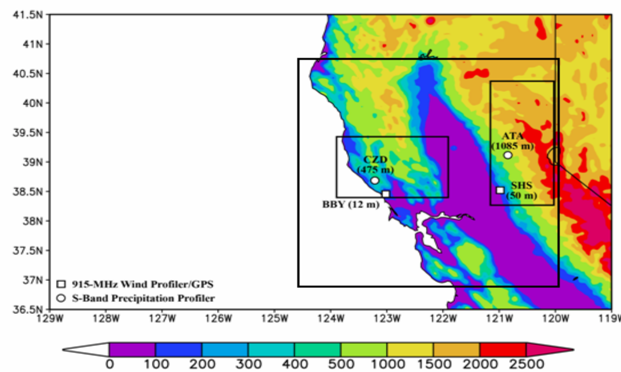


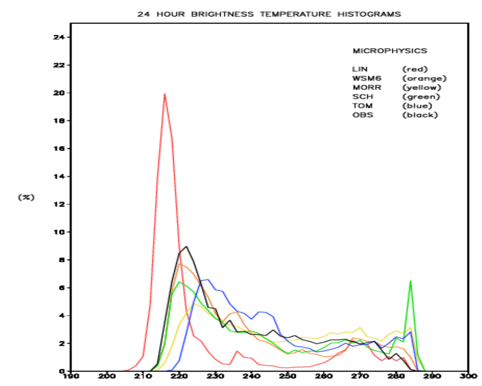
ESRL/GSD HMT Role

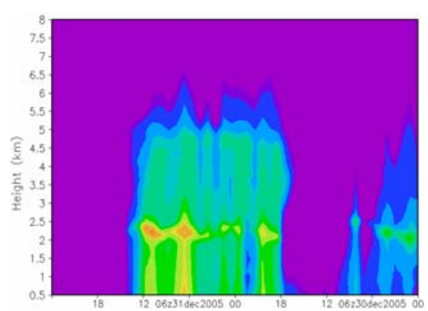
ESRL/GSD group roles:

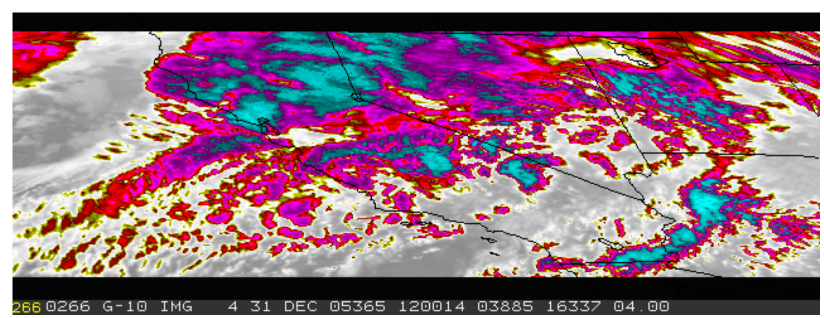
- Design of the LA ensemble
- Provide real time ensemble precipitation forecasts
- Collaborate with colleagues in addressing various scientific questions



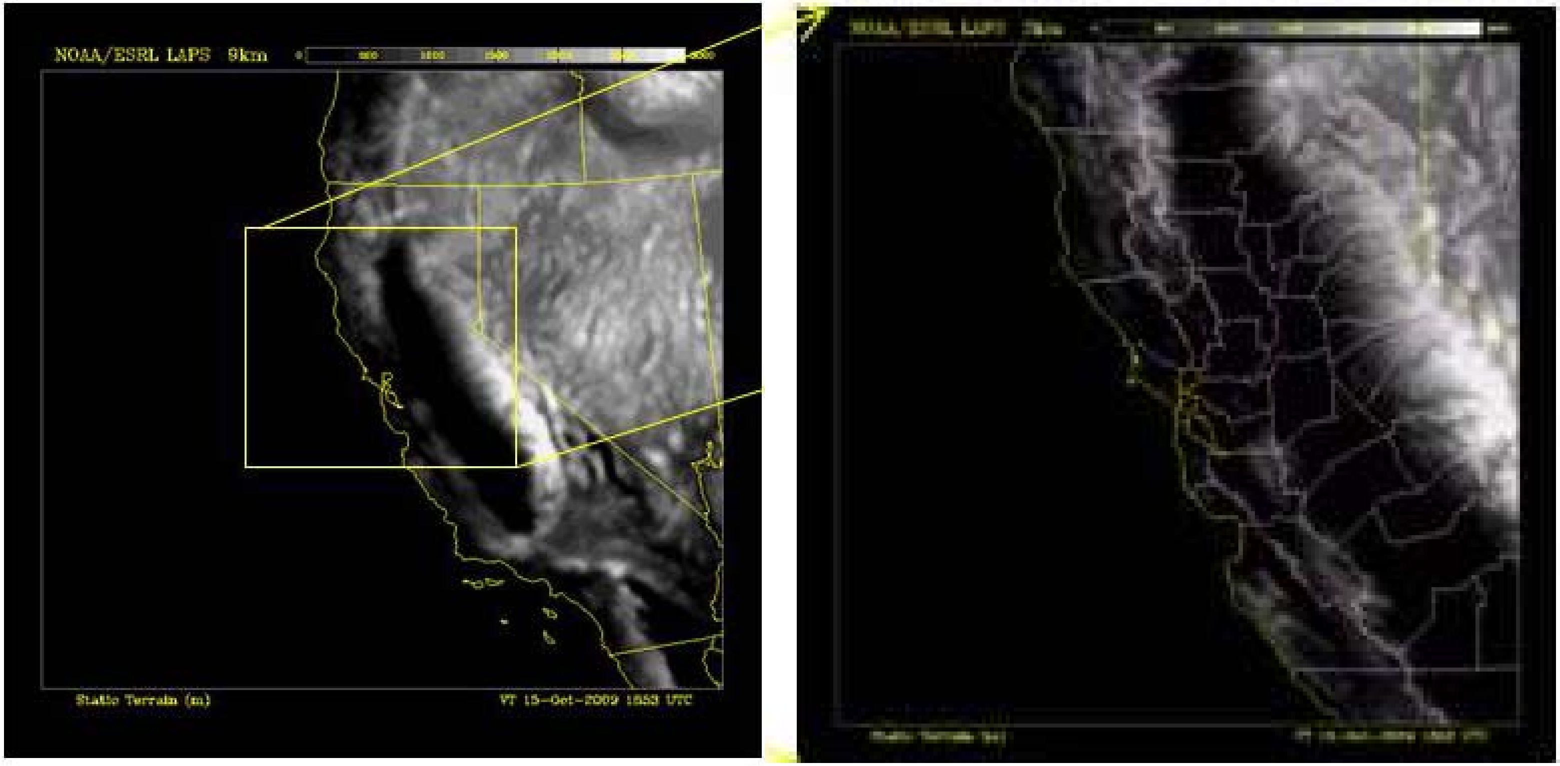








EXPERIMENT DESIGN 2009-2010

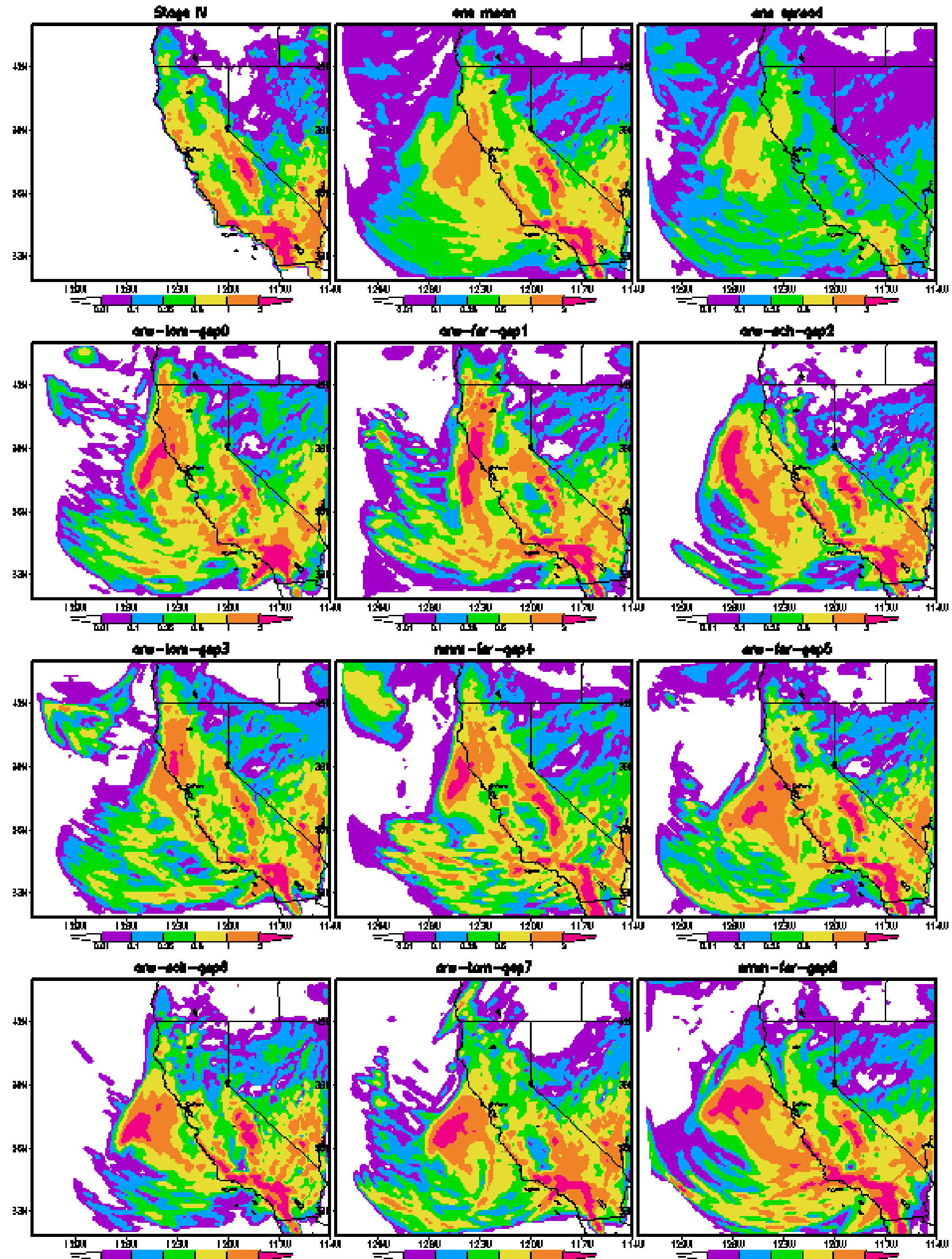


Nested domain:

- Outer/inner nest grid spacing 9 and 3 km, respectively.
- 6-h cycles, 120hr forecasts for the outer nest and 12hr forecasts for the inner nest
- 9 members (WRF-NMM and ARW)
- Mixed models, physics & perturbed boundary conditions from NCEP Global Ensemble
- 2010-2011 season adding initial condition perturbations and NMMB to the ensemble will be explored?

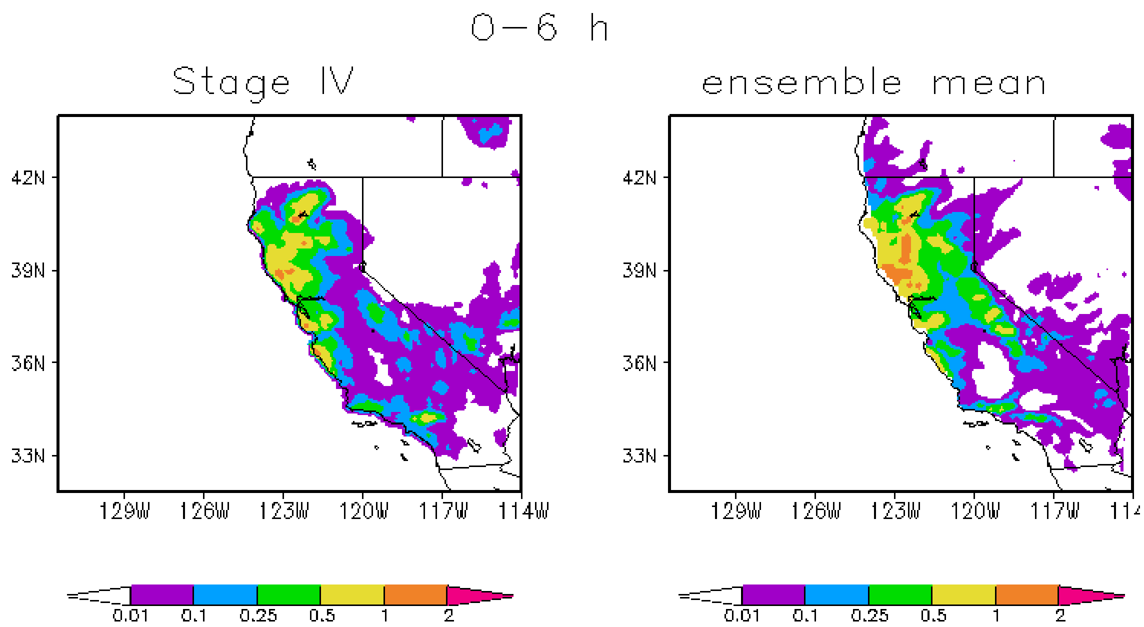
QPF

Example of 24-h QPF
For 9 ensemble
members for the
9-km resolution domain.

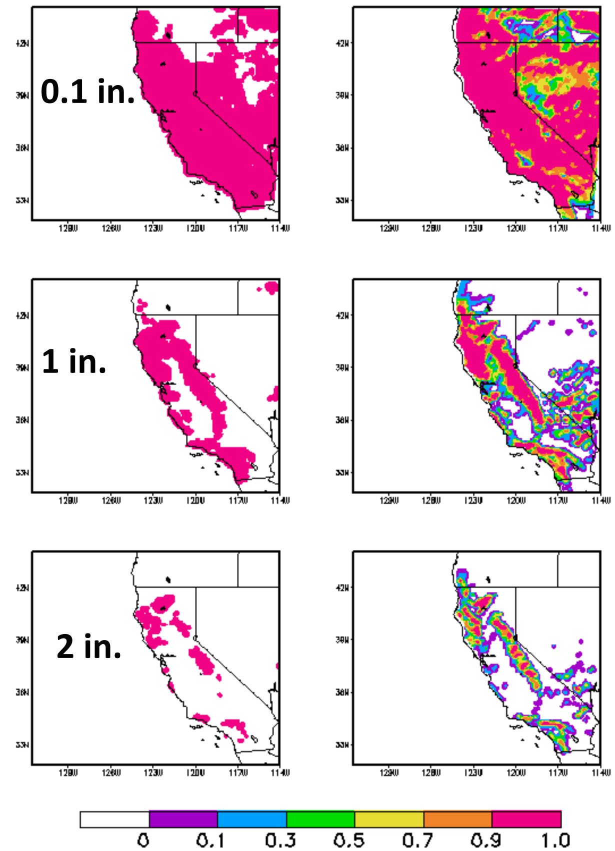


HMT QPF and PQPF

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



24-hr PQPF



Calibration of PQPF

Probabilistic Quantitative Precipitation Forecasts

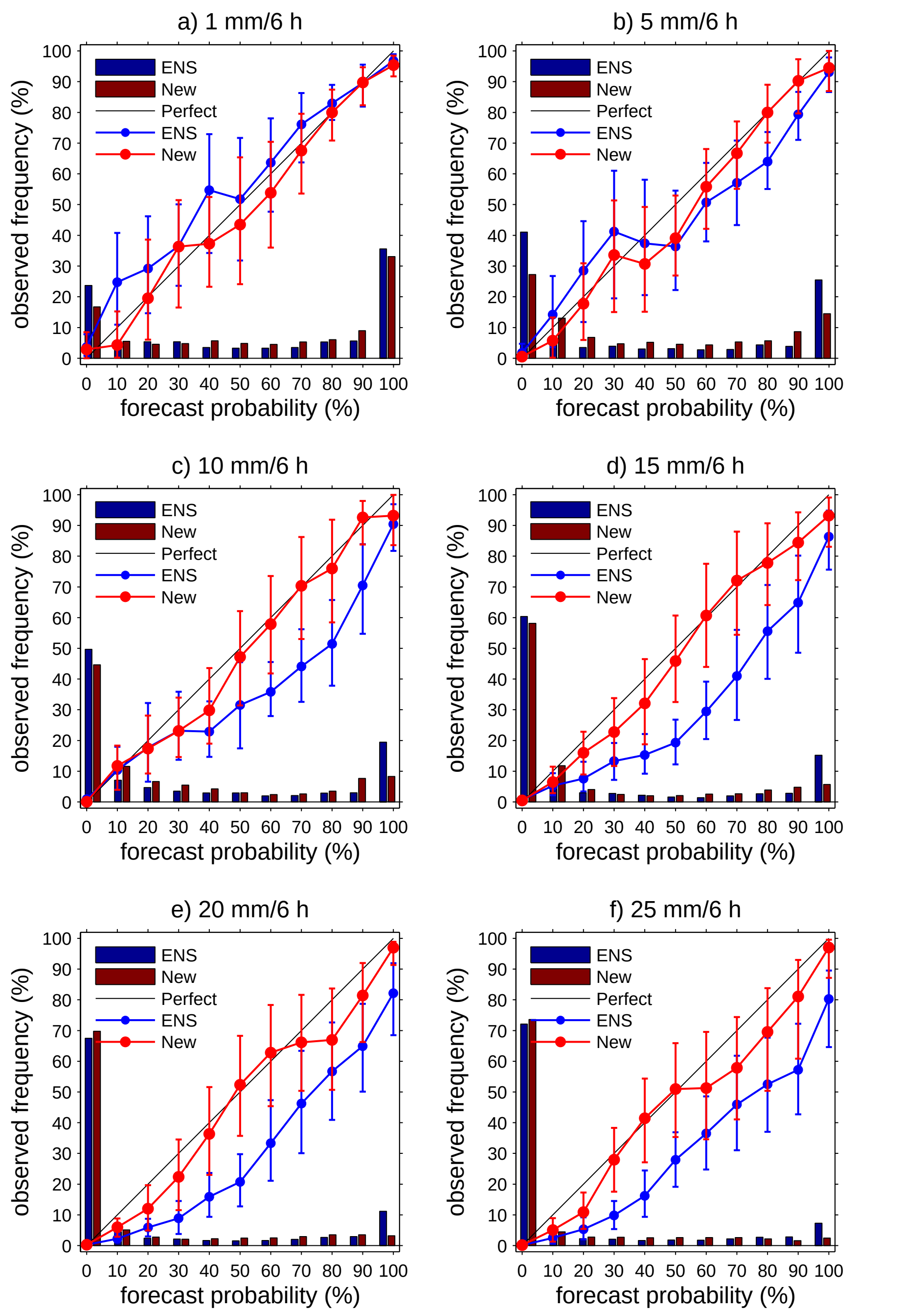
Four rerun HMT-West-2006 cases: IOP1, 4, 10, 12

Cross-validation over the ARB

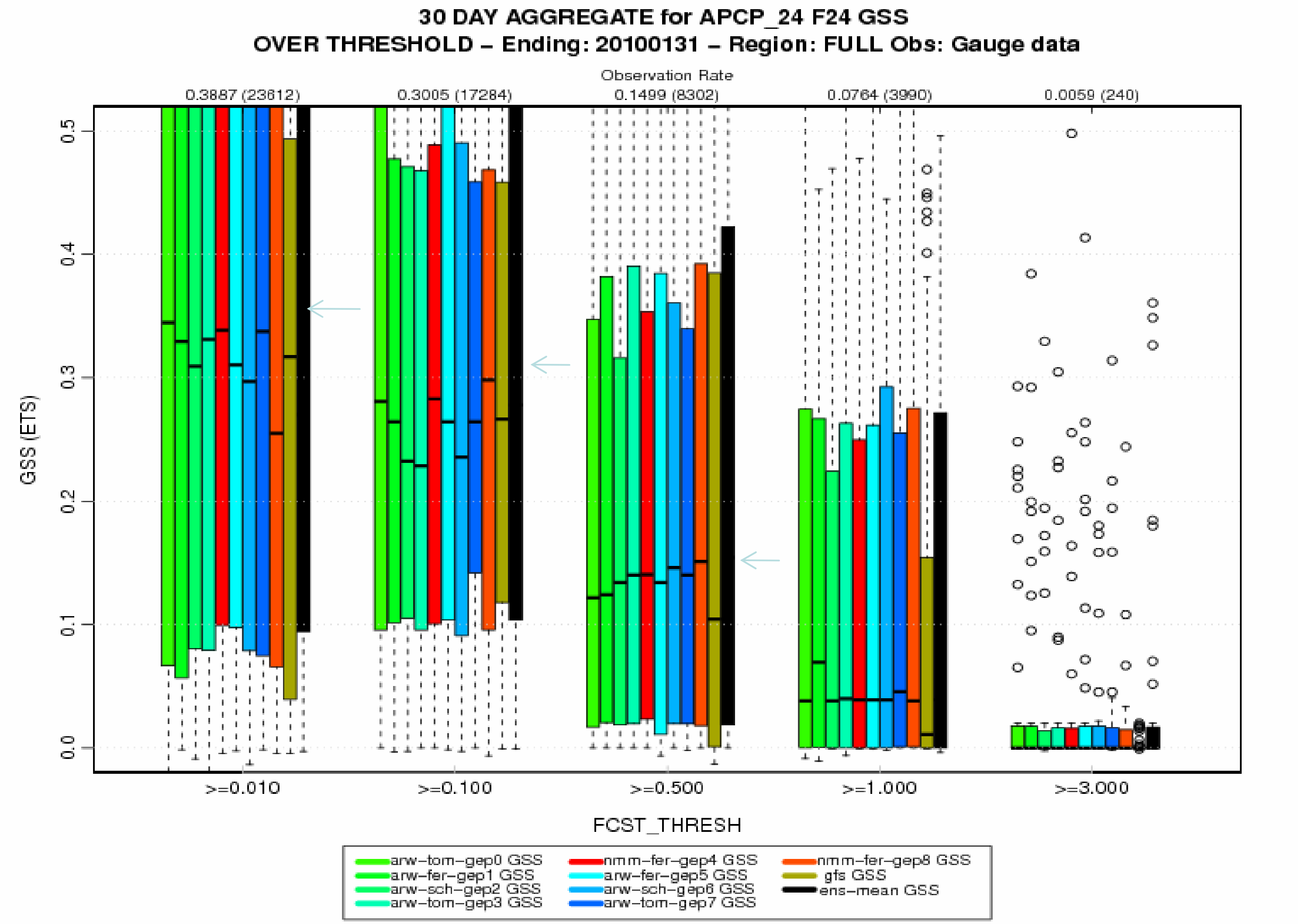
Reliability curves are improved (red line along the diagonal) for the thresholds 1-25 mm/6-h

Internal histograms: Frequencies changed

Yuan et al. 2008, JHM



Real-time QPF verification for HMT-West



OAR/ESRL/GSD/Forecast Applications Branch

THE DEVELOPMENTAL TESTBED CENTER (DTC)

Runoff experiments

Validation events: 5 IOPs

The distributed hydrologic model:

Two-Dimensional Runoff Erosion and Export (TREX) model

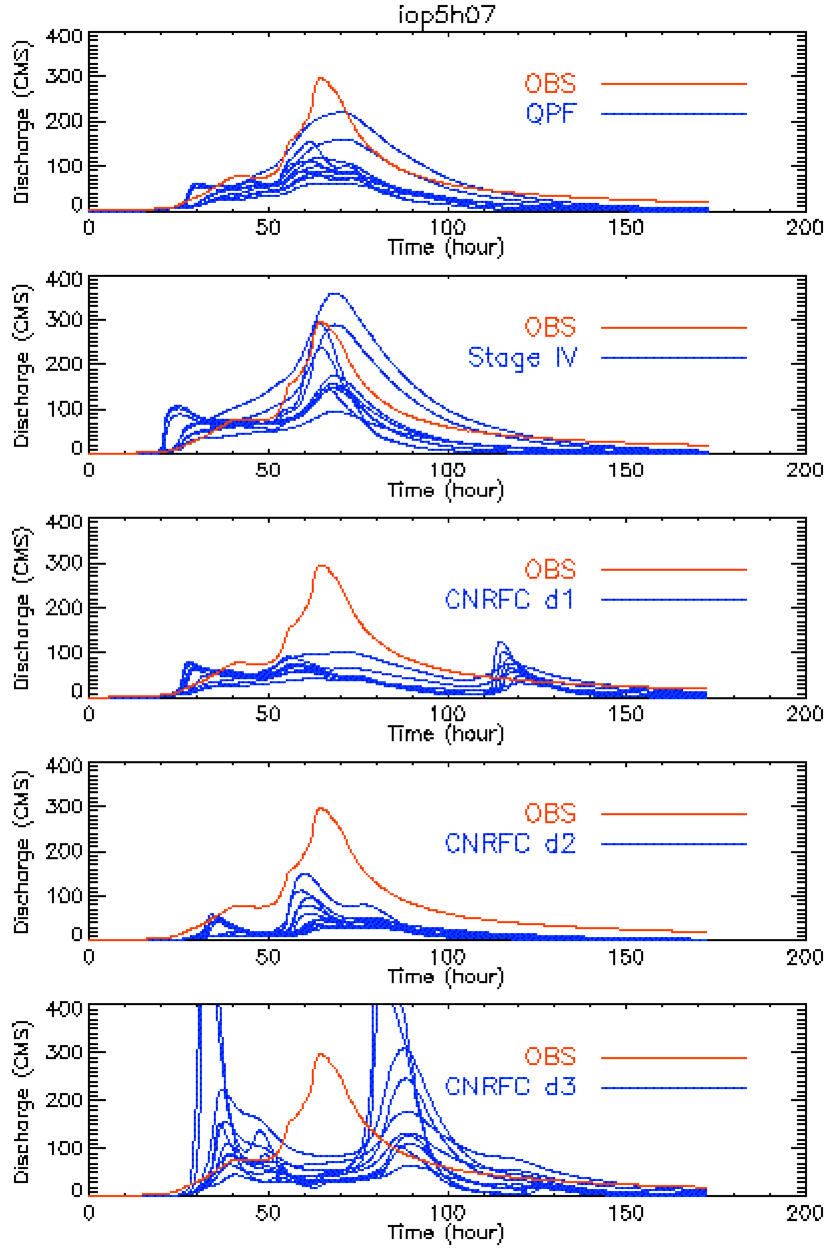
100 m^2 pixel

Ensemble created from 12 combinations of hydro model parameter perturbations using inputs from:

1) 0-6 h ensemble mean QPF, 3-km

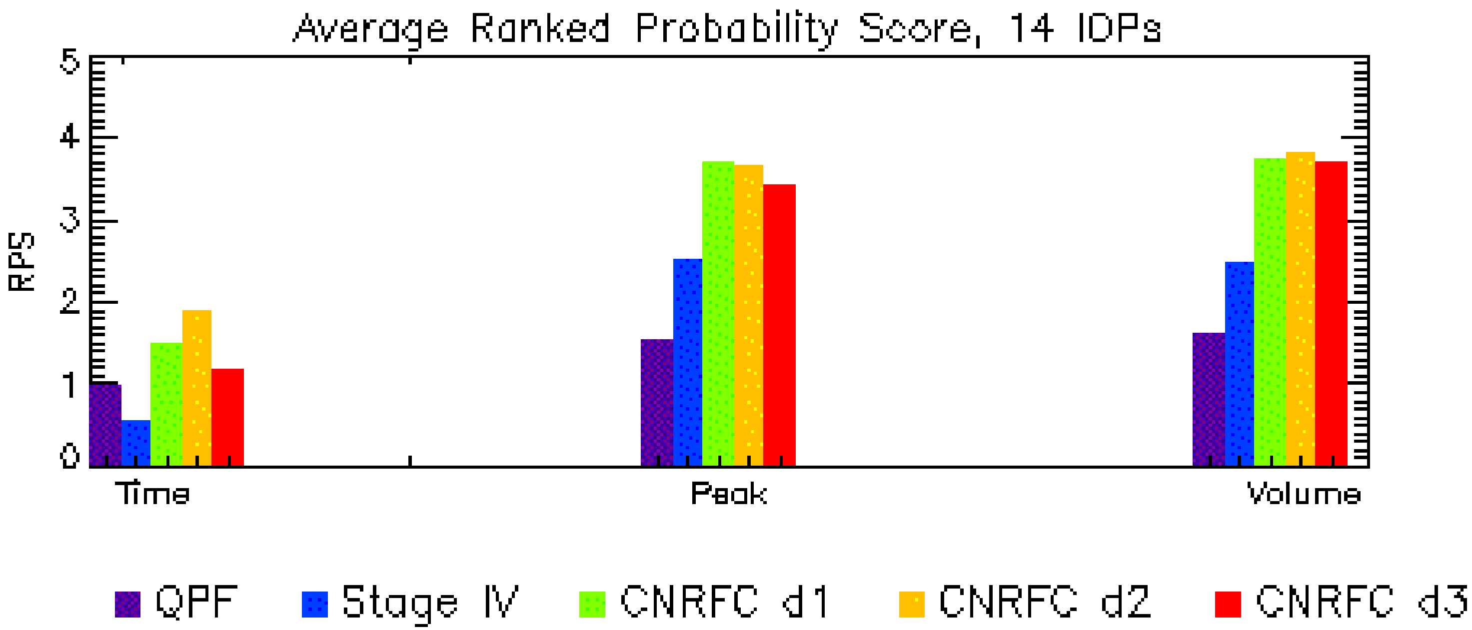
2) Stage IV QPE, ~ 4 km

3) CNRFC QPF day 1- day 3 forecasts, ~ 4 km



By Yuan, H. , J. J. Gourley, P. J. Schultz, J. A. McGinley, Z. Flamig, C.J. Anderson

Average skill scores for streamflow simulations from 14 IOPs

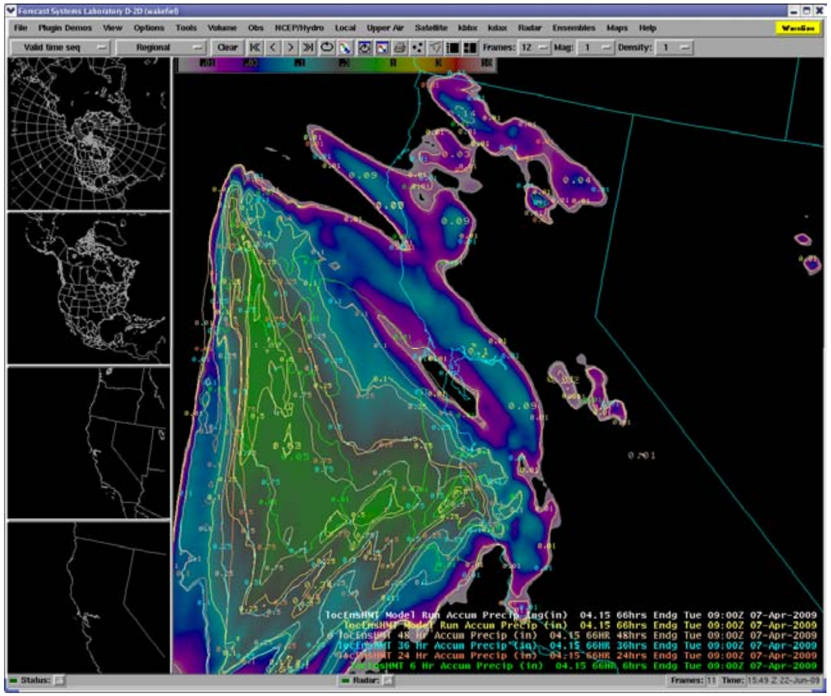


Ranked Probability Score (RPS) is computed for using the 0-6 h ensemble mean QPF, 6-h Stage IV, CNRFC day1 to day 3 forecasts with 14 IOPs during three winter seasoons.

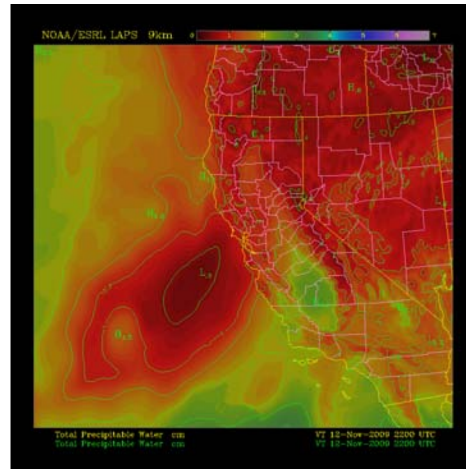
Smaller RPS is better. The high-reso ensemble QPF is the best in terms of peak and volume, and is worse than Stage IV input in the peak timing.

ENSEMBLE OUTPUT DISPLAY

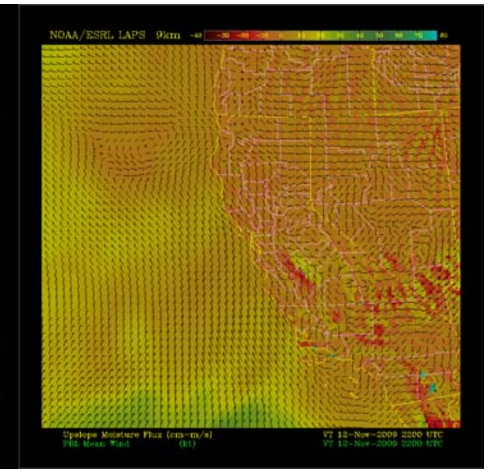
The ensemble output has been available
To WFOs through ALPS



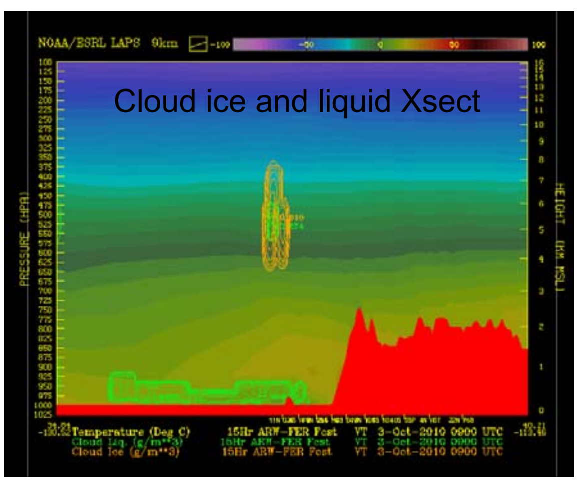
http://laps.noaa.gov/forecasts/

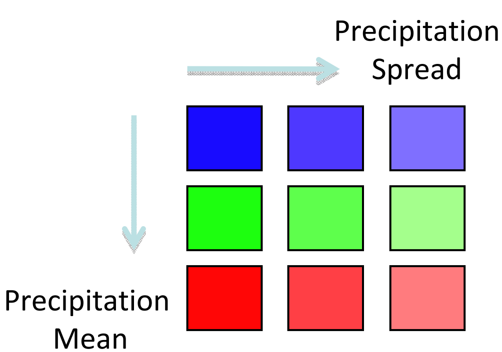


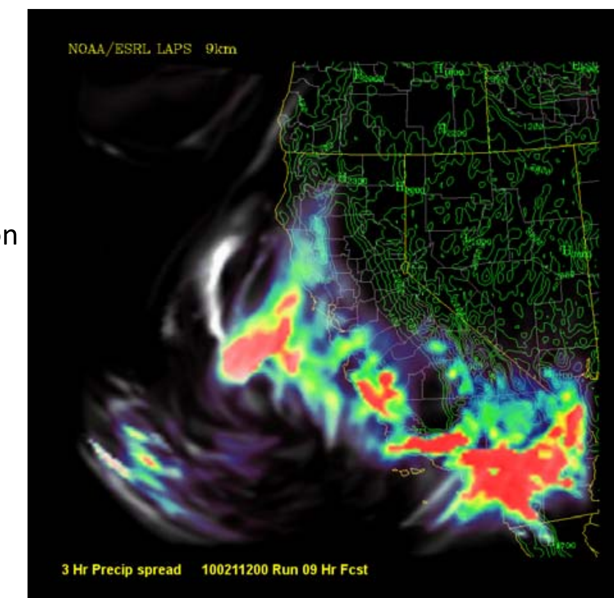
TPW (cm)



PW Flux (q x v)

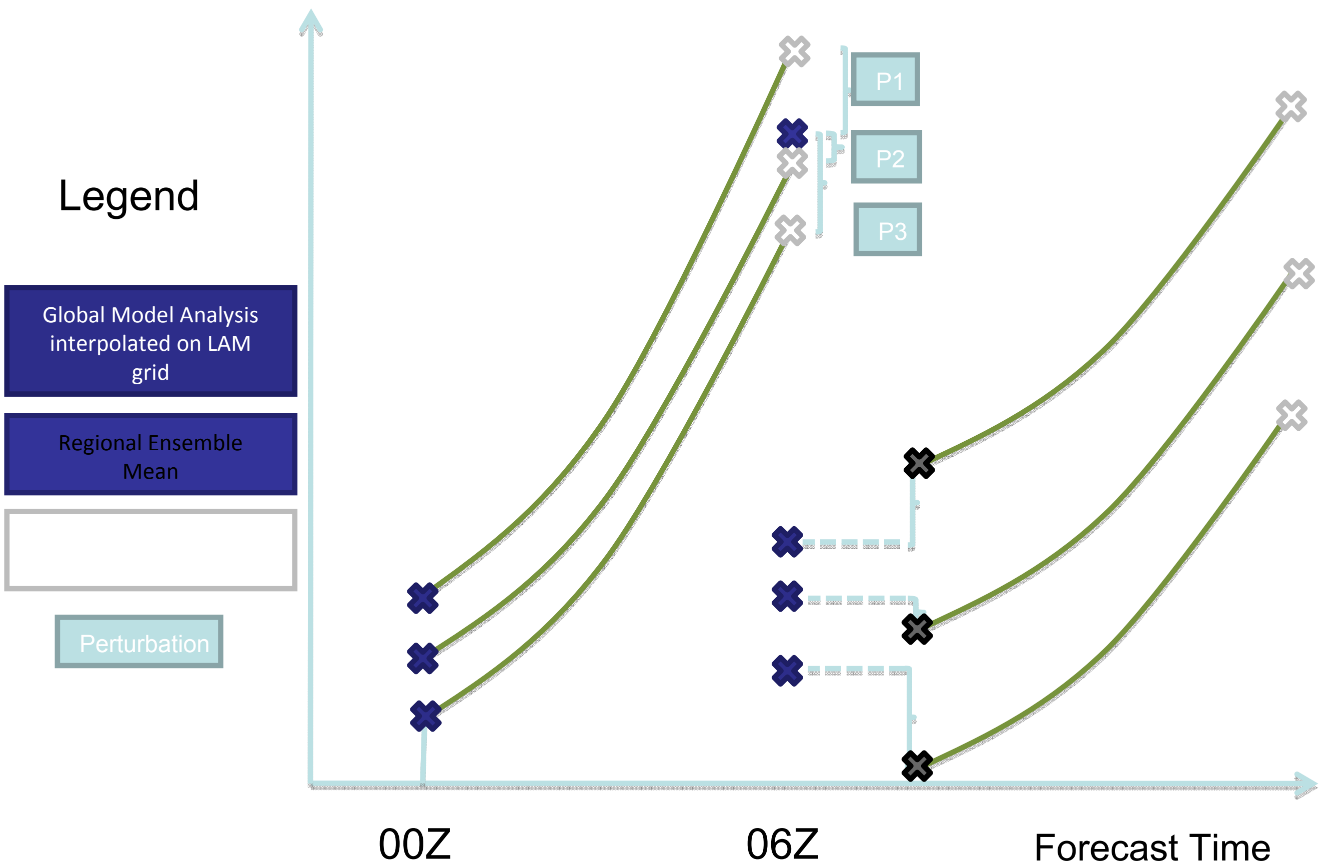






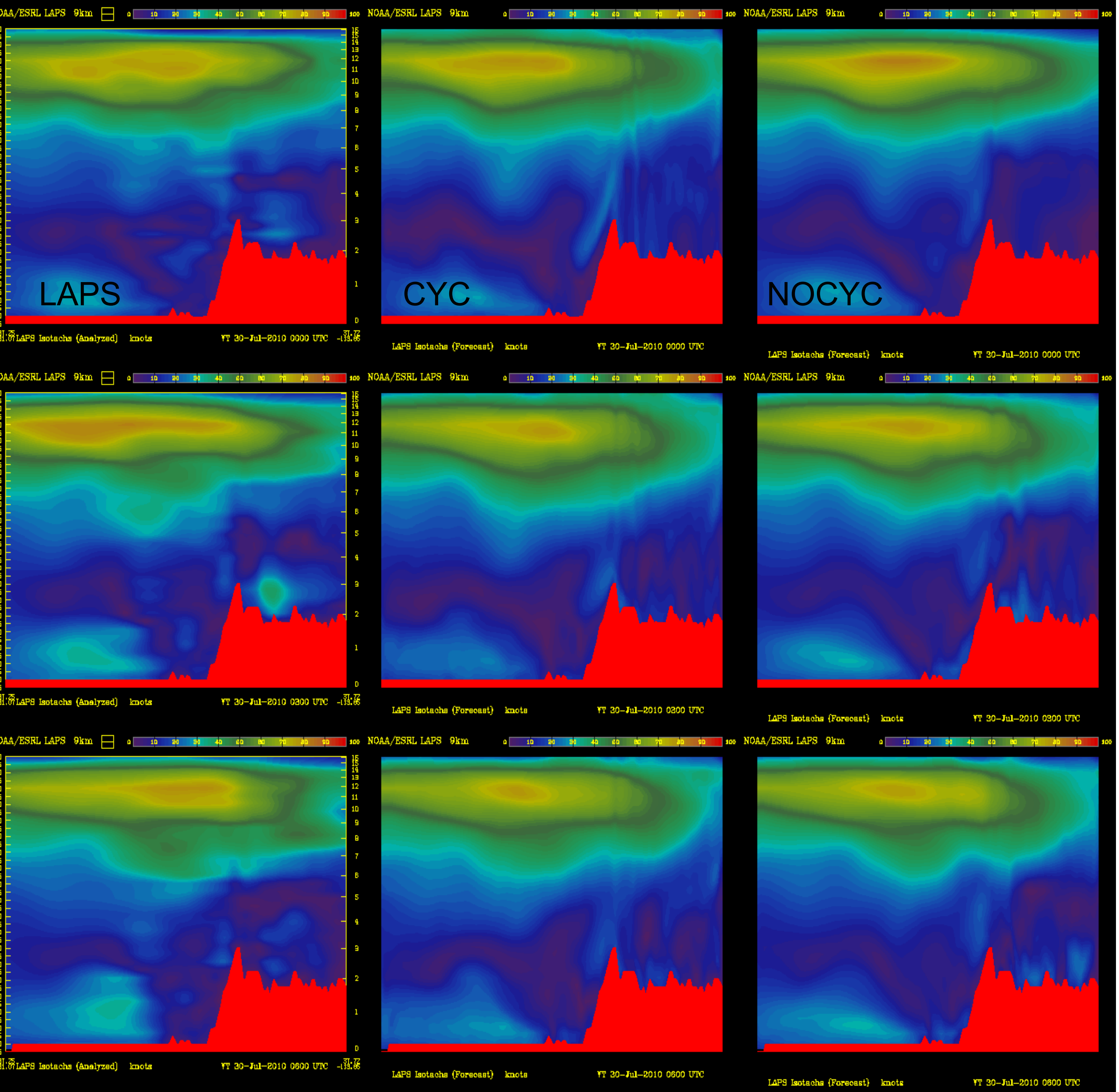
Xsect Reflectivity 06 Oct. 2010 18UTC

Cycling Initial Perturbations



The difference between the local model and regional ensemble mean is our 'local perturbation'

Wind Speed
July 30 2010 00UTC

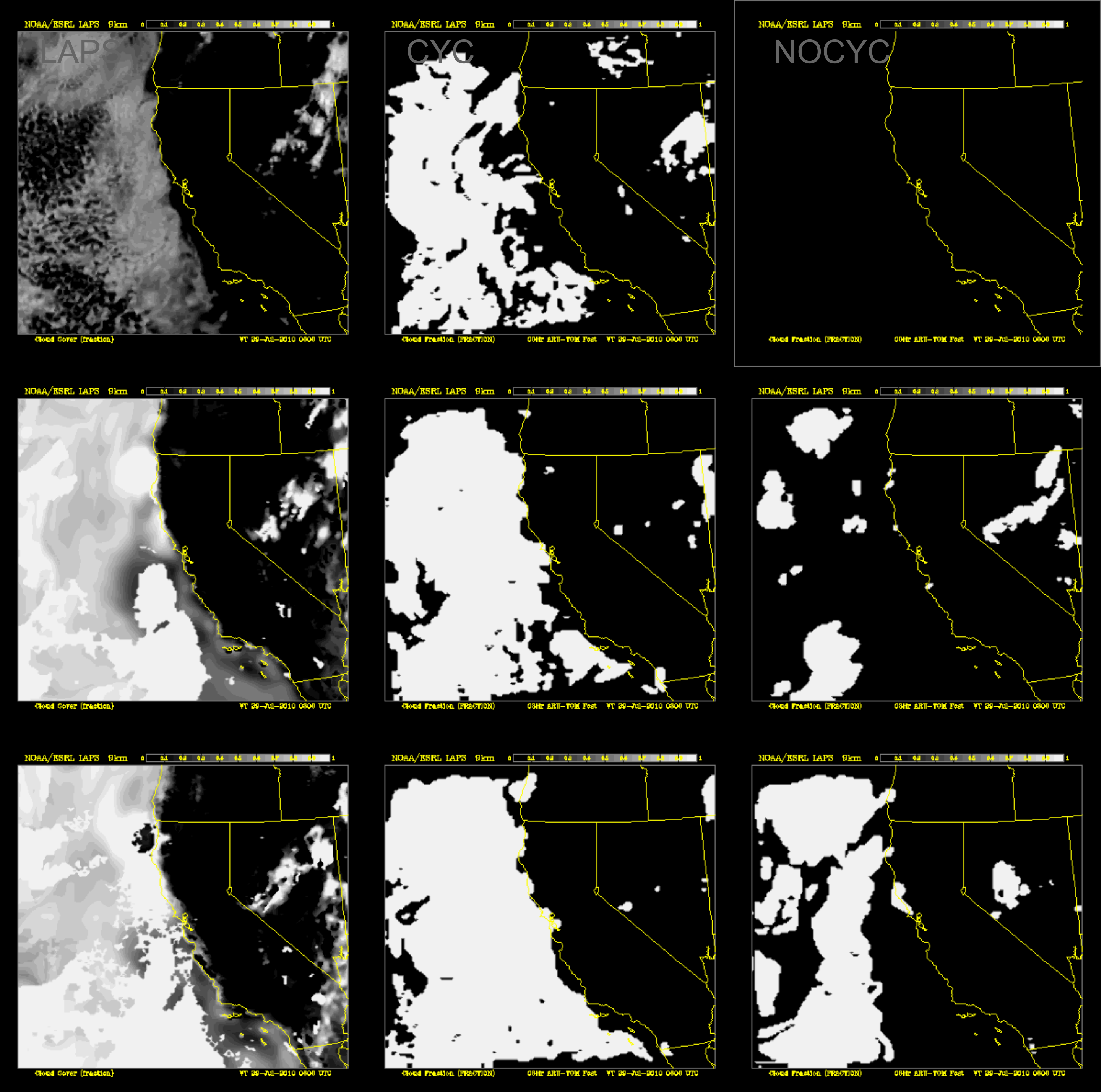


00hr

03hr

06hr

Cloud Coverage
July 30 2010 00UTC



00hr

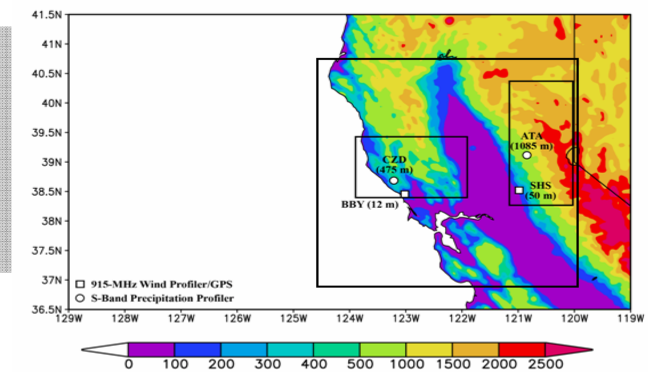
03hr

06hr

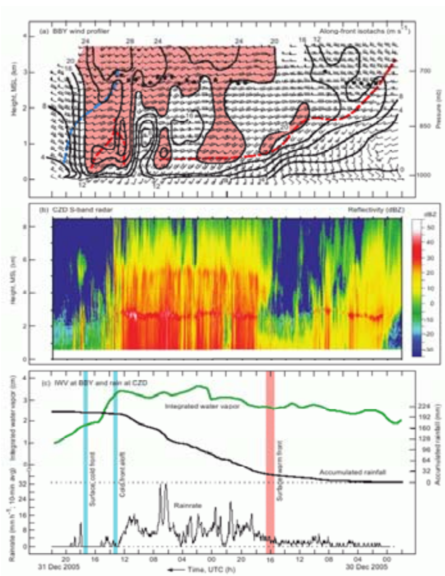
*Evaluation and Comparison of Microphysical Algorithms in WRF-ARW Model Simulations of Atmospheric River Events Affecting the California Coast 2009:JHM, **10**,847-870*

<u>SIMULATIONS</u>

- 5 “atmospheric river” events
- 3km grid spacing
- 4 different Microphysics (Lin, WSM6, Thompson & Schultz)

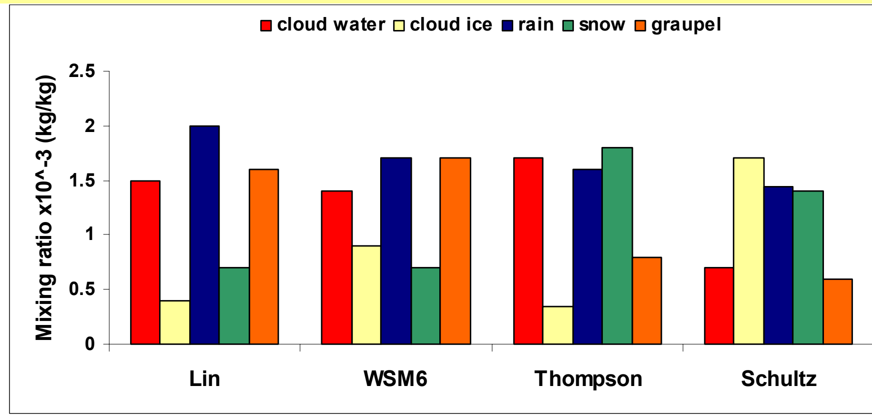


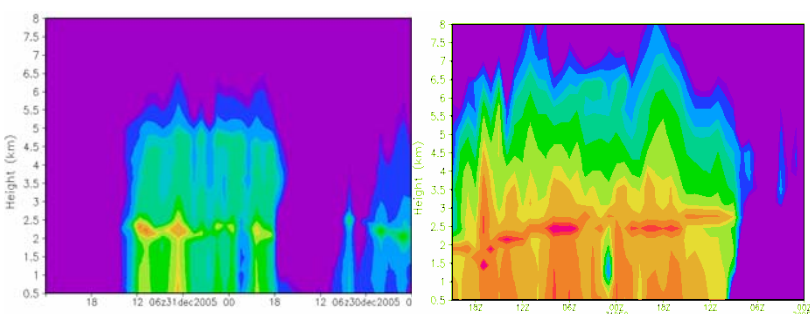
Integration domain



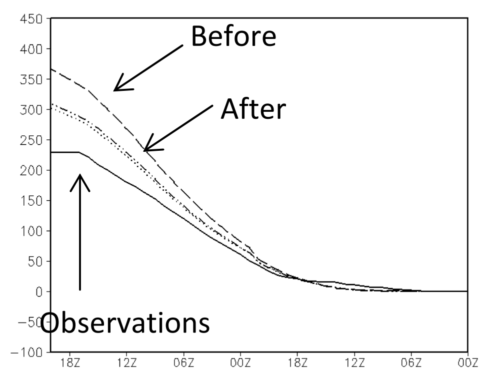
The model showed a tendency to overestimate the upslope wind component duration and intensity as well as moisture content.

MICROPHYSICAL ASSPECTS: WATER SUBSTANCE PARTITION





Comparison of synthetic reflectivity to S-band Radar Data (Obs. vs. Thompson)

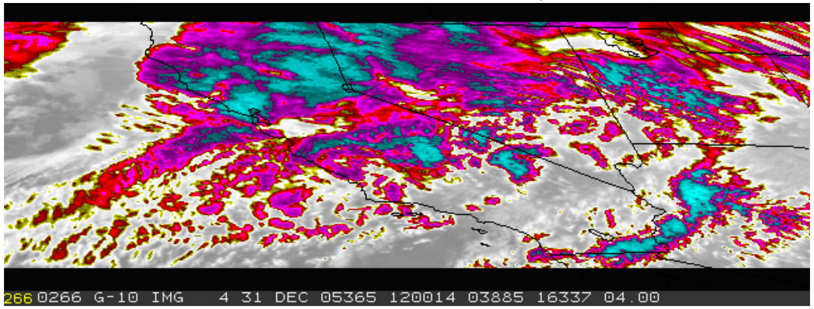


~50% decrease in precip. overestimation from model run using Lin scheme after adjusting some parameters (e.g. accretion of snow by graupel and lowering the threshold for conversion of snow to graupel)

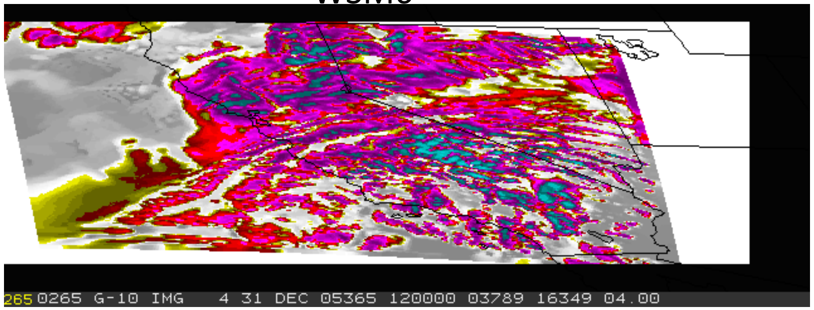
Possible use of synthetic satellite imagery, as an additional way to indirectly evaluate the performance of various microphysical schemes, was evaluated.

24-hr forecast valid at 31 Dec. 2005 at 12 UTC

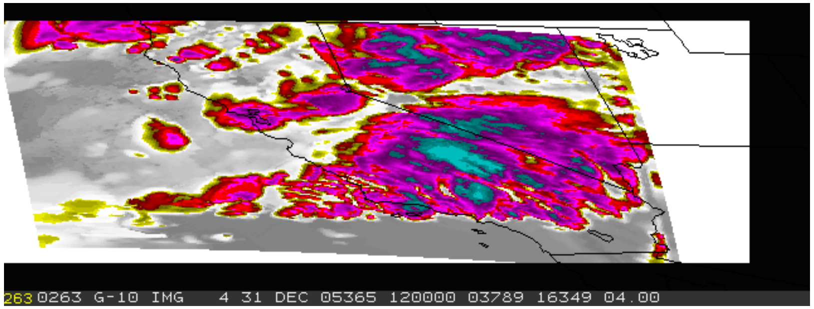
Observations-GOES-10 10.7μm

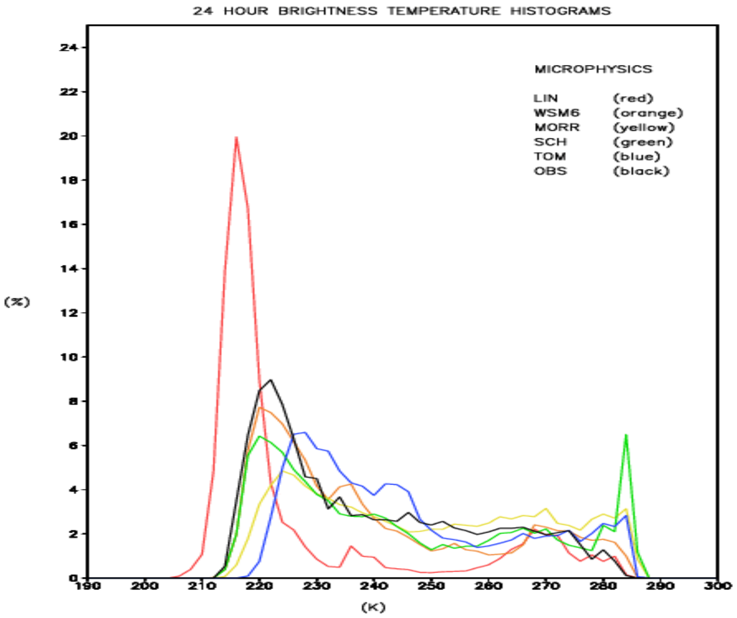


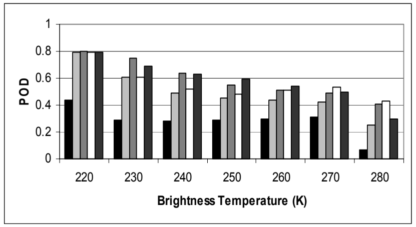
WSM6

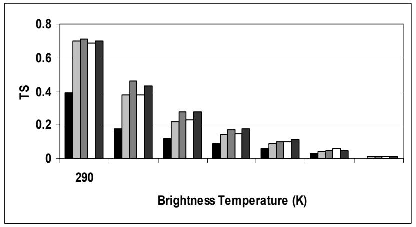


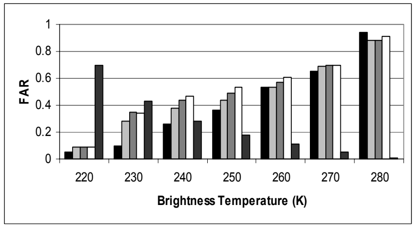
Schultz

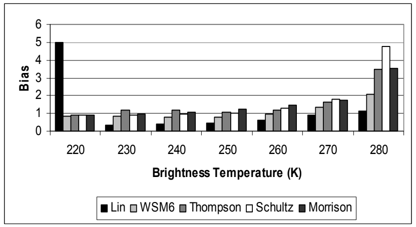












An Evaluation of Five WRF-ARW Microphysics Schemes Using Synthetic GOES Imagery for an Atmospheric River Event Affecting the California Coast. (In press) JHM.

Questions?