

NWP Development Activities at ESRL/GSD Associated with the Hydrometeorological Testbed Project

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Outline

- HMT project overview
 - 4 slides courtesy Dave Kingsmill
- ESRL/GSD role
- Results
 - Oral presentation by Chris Anderson, next
 - Poster by Huiling Yuan
 - Poster by Isidora Jankov
- Next HMT field campaign

STIP Integrated Planning Team for Hydrologic Services (September 2002)

Key Information Gaps

- **Quantitative Precipitation Information (QPE & QPF)**
 - Unbiased Precipitation Estimates with Reliability Information
 - Reliable 0-6 Hour Precip. Nowcasts
 - Longer-term, Unbiased Model QPFs
- **Hydrologic Forecasting**
 - High-resolution Flash Flood Forecasts & Warnings
 - Probabilistic River Forecasts Using 0-3 day QPF and Seasonal Precipitation Forecasts

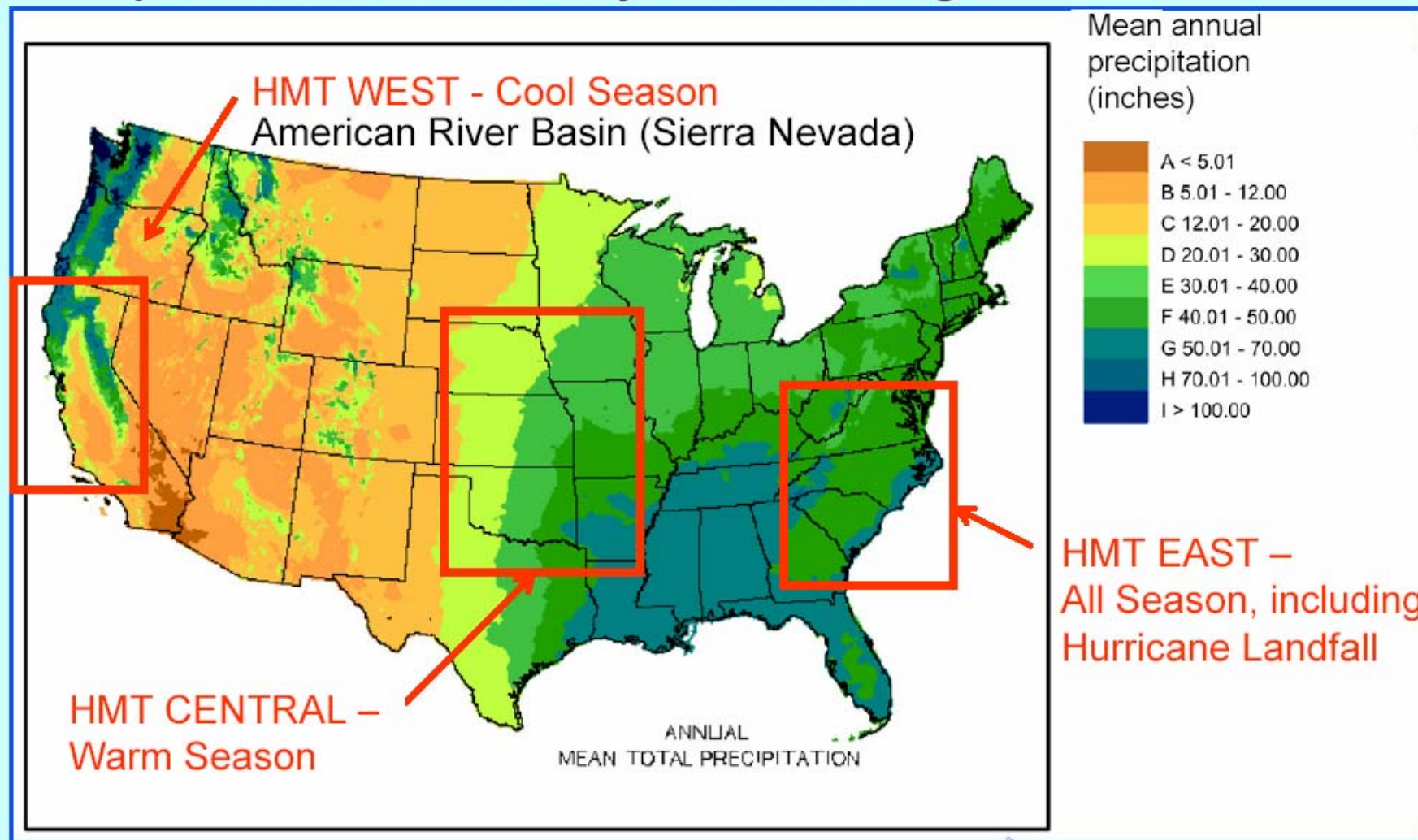
STIP IPT for Hydrologic Services

Outstanding R&D Needs

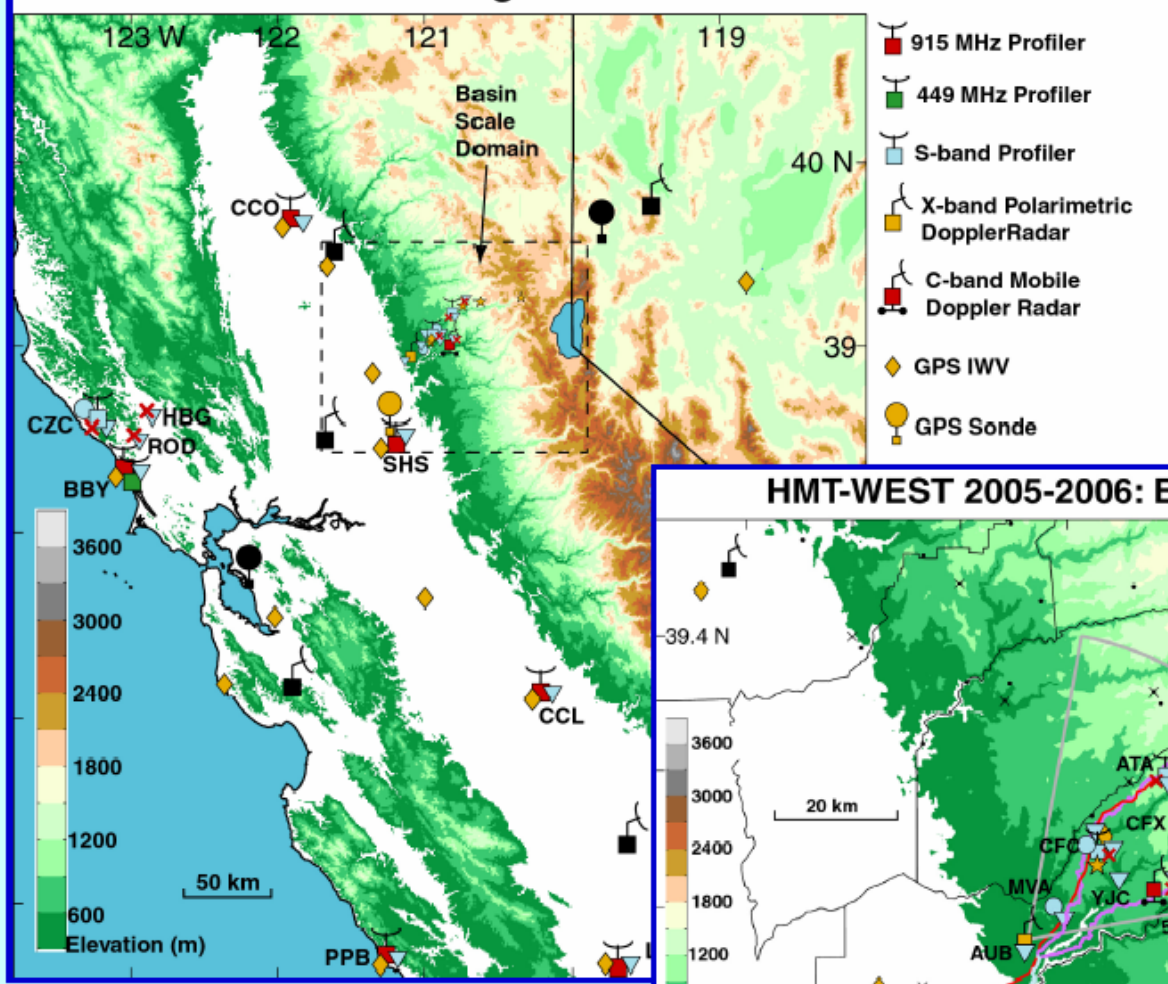
- *Develop QPE Techniques That Optimally Blend Next-generation Radar, Satellite (e.g, GPM), and Rain Gauge Data*
- *Improve Short-Term Radar-Satellite Precipitation Nowcasting Techniques Blended with NWP Forecasts*
- *Develop High Resolution Hydrologic Forecast Models of Water Excess-Deficit at Ungauged Locations*
- *Develop Ensemble NWP and Hydrologic Model Forecasts with Associated Reliability Information*
- *Improve NWP Model Physics and Increase Assimilation of Existing Observational Datasets*
- *Implement Hydrometeorological Testbeds to Demonstrate & Evaluate Next-Generation Datasets, Forecast Techniques, & Models*

Hydrometeorology Testbed Program (HMT)

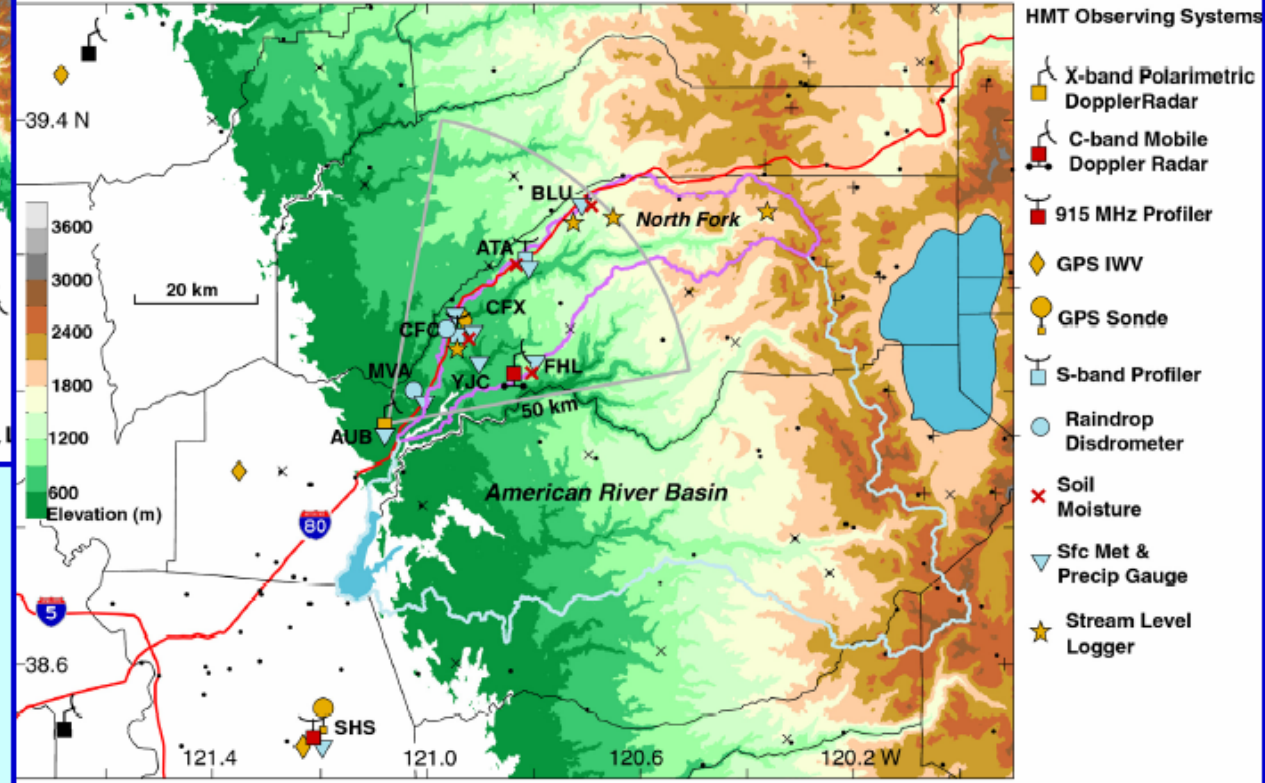
The national Hydrometeorological Testbed program will be implemented incrementally in different regions of the U.S.



HMT-WEST 2005-2006: Regional Scale Domain



HMT-WEST 2005-2006: Basin Scale Domain



- HMT Observing Systems**
- X-band Polarimetric Doppler Radar
 - C-band Mobile Doppler Radar
 - 915 MHz Profiler
 - GPS IWV
 - GPS Sonde
 - S-band Profiler
 - Raindrop Disdrometer
 - Soil Moisture
 - Sfc Met & Precip Gauge
 - Stream Level Logger
- Operational Observing Systems**
- NWS WSR-88D
 - ALERT Precip. Gauge
 - RAWS Precip. Gauge
 - SNOTEL Precip. Gauge

ESRL/GSD modeling strategy for HMT

- 5 models, finest nest $dx=3\text{km}$, LAPS hot start diabatic initialization
 - WRF/ARW with NAM Ibc
 - WRF/ARW with RUC Ibc
 - RAMS with NAM Ibc
 - RAMS with RUC Ibc
 - MM5 with NAM Ibc
- Every three hours, out to 12 hrs
- Time-lagged ensemble members

We'd have also used WRF/NMM but we didn't have the code for nesting working right at the time.

HMT Presentations

Comparison of Cold Season QPF and PQPF from Time-lagged and Multiple Model Ensembles

Chris Anderson

NEXT

Bias correction of PQPF

Attributes Diagrams

IOP10, IOP12, IOP14

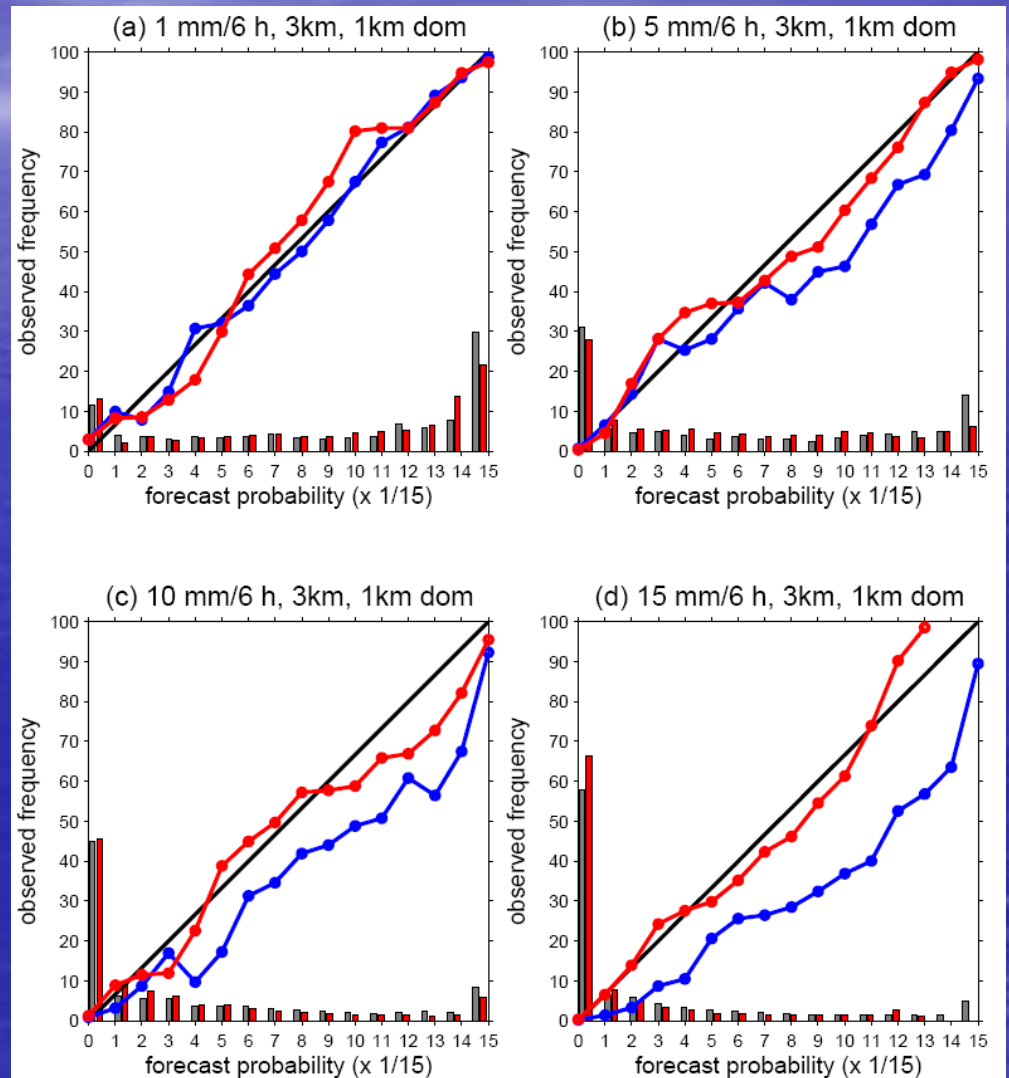
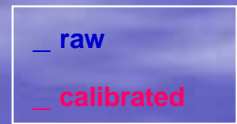
Cross validation

Over the ARB domain

Thresholds:

1, 5, 10, 15 mm/6 h

Internal histograms are frequency intervals



*Extreme precipitation events and
bias correction of PQPF during the
HMT 2005-2006 winter campaign*

Huiling Yuan



Poster 4.31, Tuesday noon-2:30

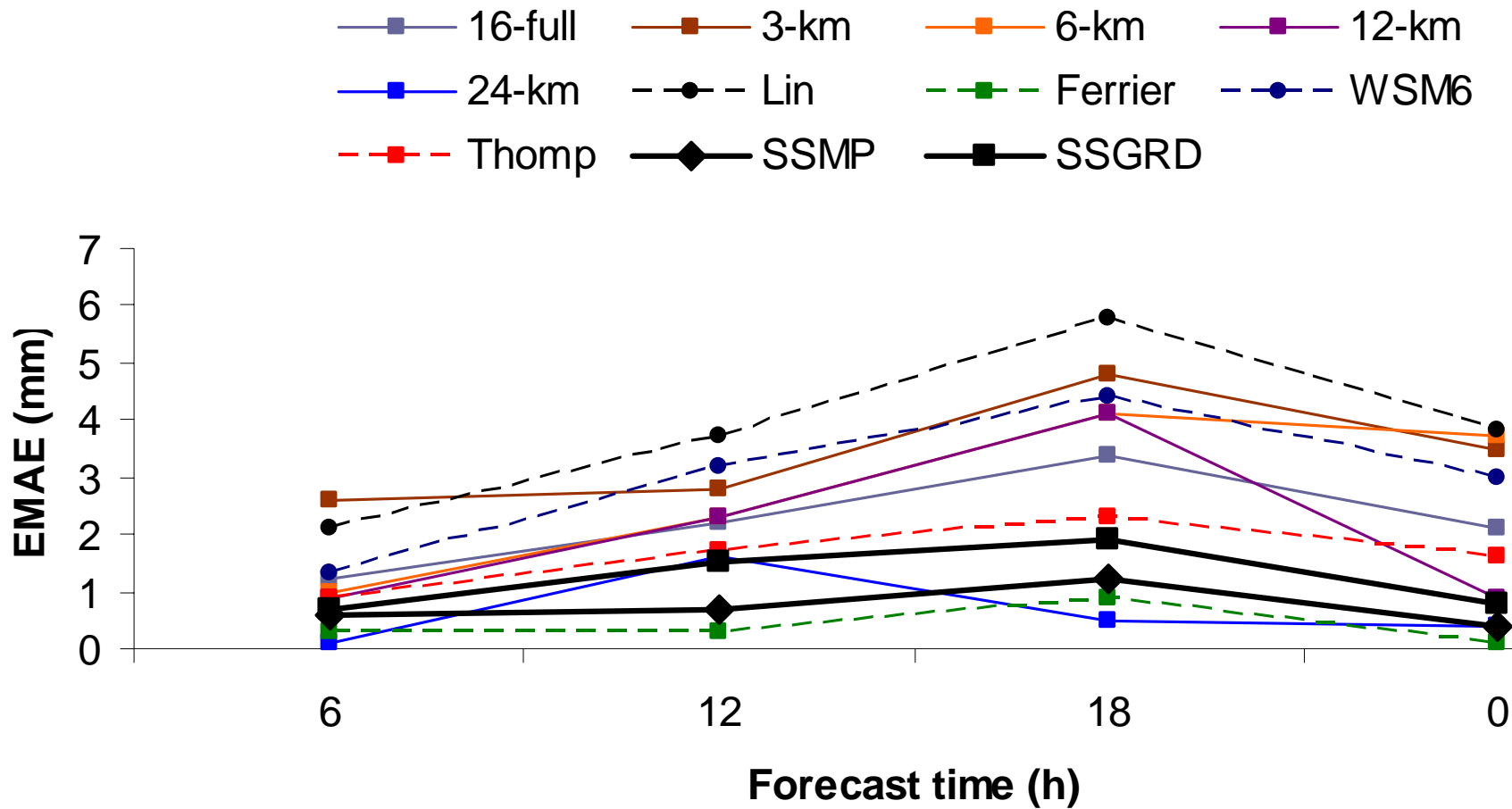
大家好!
欢迎到**Boulder**来!

Ensemble design

Procedures for measuring the relative value of candidate ensemble members, given:

- What's being predicted
- Finite computing resource
- Model options
 - WRFs
 - MM5
 - RAMS
- LBC options
 - RUC
 - NAM
 - GFS
- Grid resolution
 - Nesting options
- Physics options
 - Microphysics
 - PBL
 - Surface
 - Radiation
- Update frequency
 - New initialization data
- Initialization options
 - Standard initialization
 - LAPS hot start
 - GSI
- Ensembling methods

Preview



An Optimal High-Resolution Ensemble For Cold Season QPF

Isidora Jankov



Poster 4.12, Tuesday noon-2:30

Next year's HMT field campaign

- Reconfigure ensemble based on Isidora's results
- Run models out long enough to cover four 6-h periods (00-06Z, 06-12Z, etc.)
 - 24 or 27 hrs for 3-hr cycle
- Real-time bias-adjusted products using Huiling's methods
- Verification by NPVU
 - raw
 - post-processed
- Delivery of products to CNRFC, WFOs

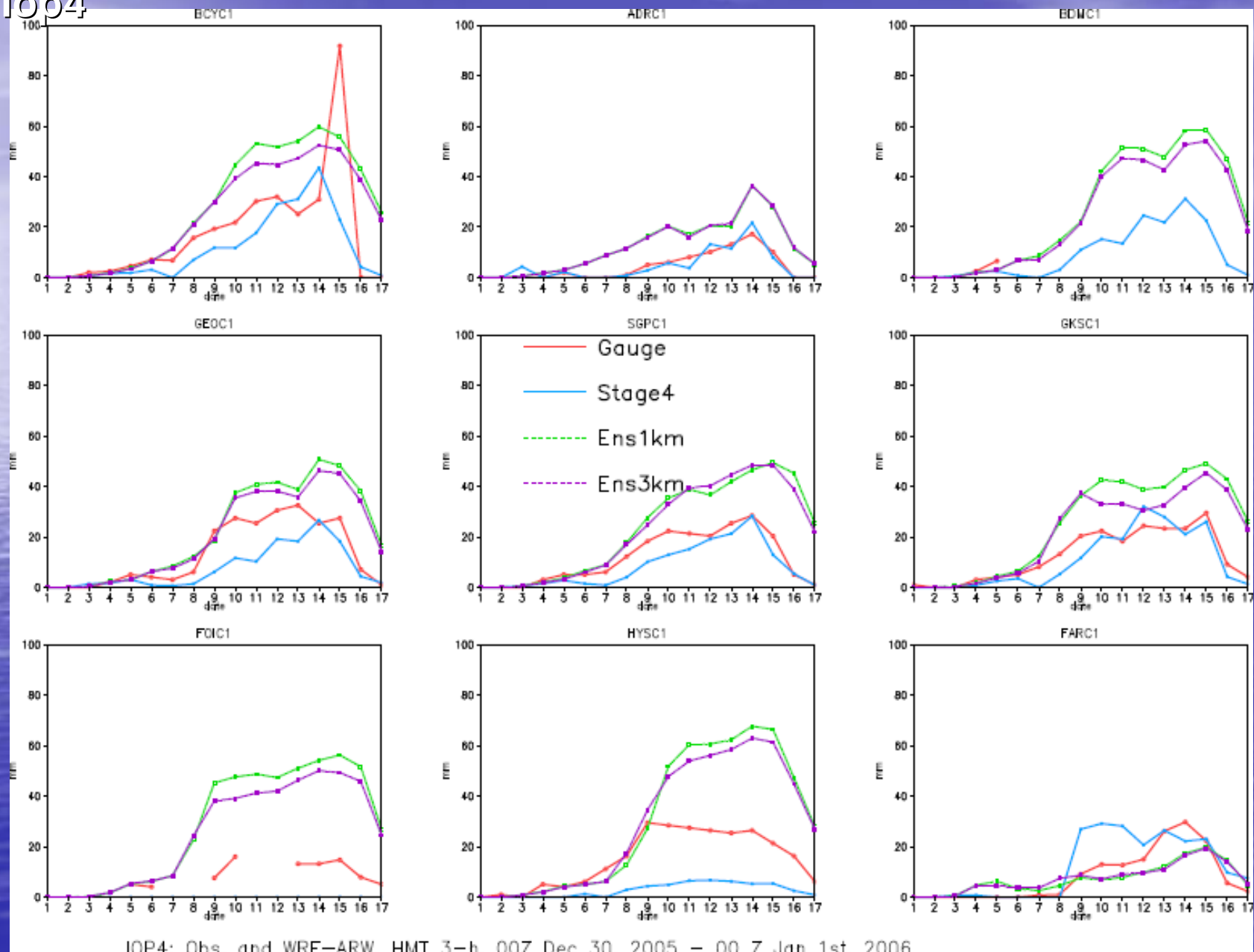
The End

谢谢

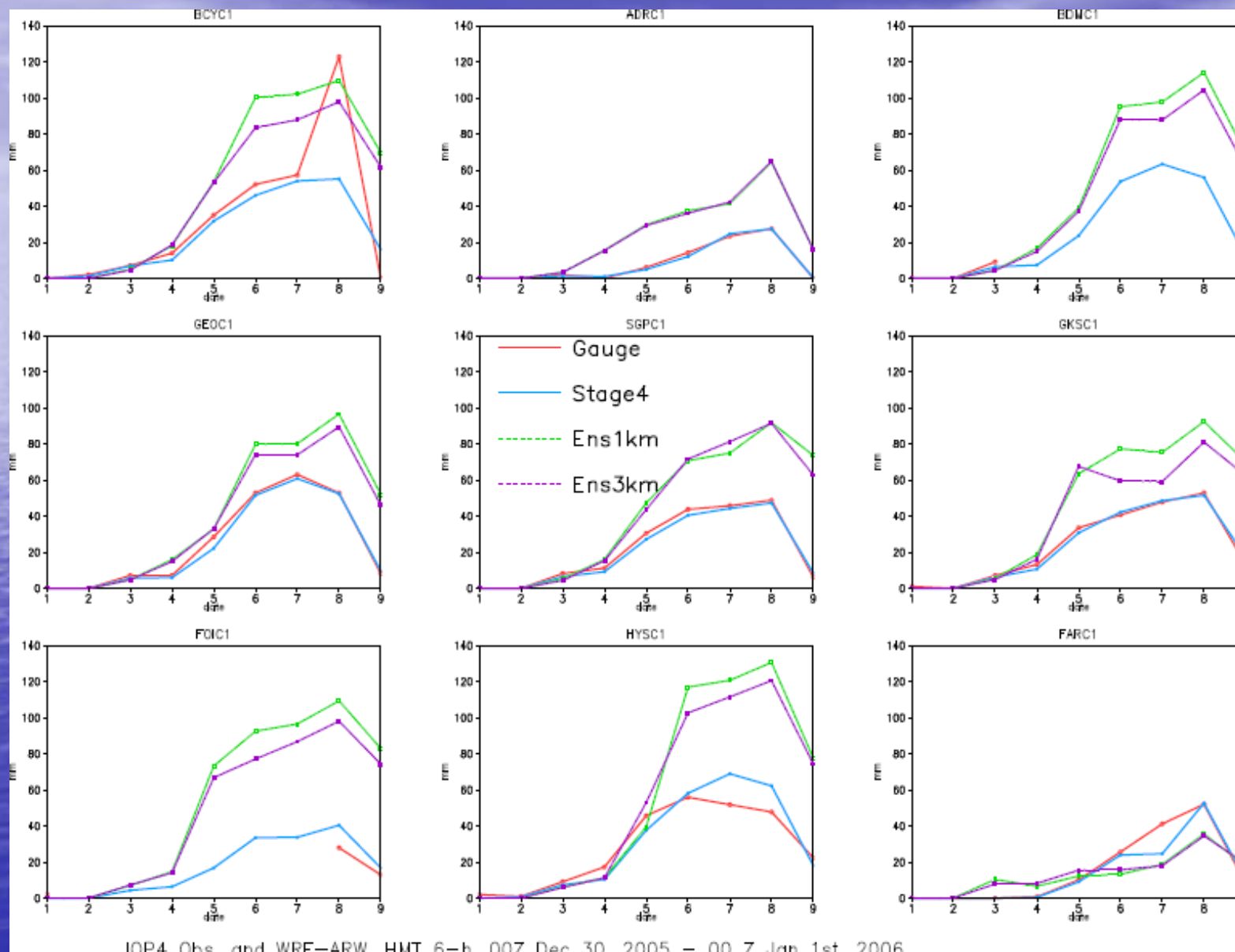


No, really, that's the end, we can
go on to Anderson now...

Uncertainty in verification dataset, 3-h Stage IV and gauge, iop4



Uncertainty in verification dataset, 6-h Stage IV and gauge, iop4



IOP 14

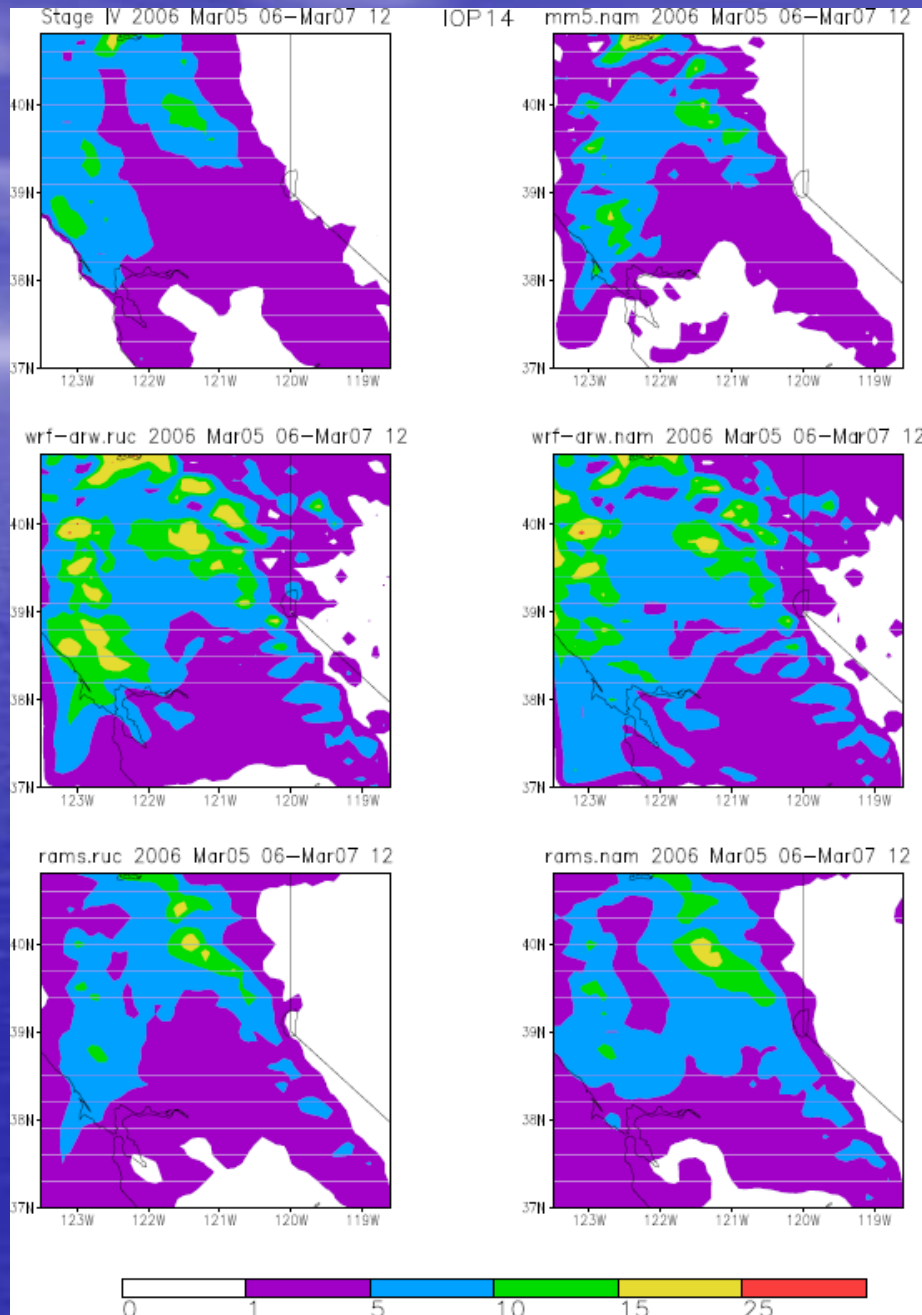
Mar 05 16z – Mar 07 12z

Valid: per 6 h

Averaged precipitation

Unit: mm/6 h

(Mar 07 18z, Stage IV
data missing over the
study domain)



Attributes Diagrams for IOP 14

Mar 05 16z – Mar 07
12z, 2006

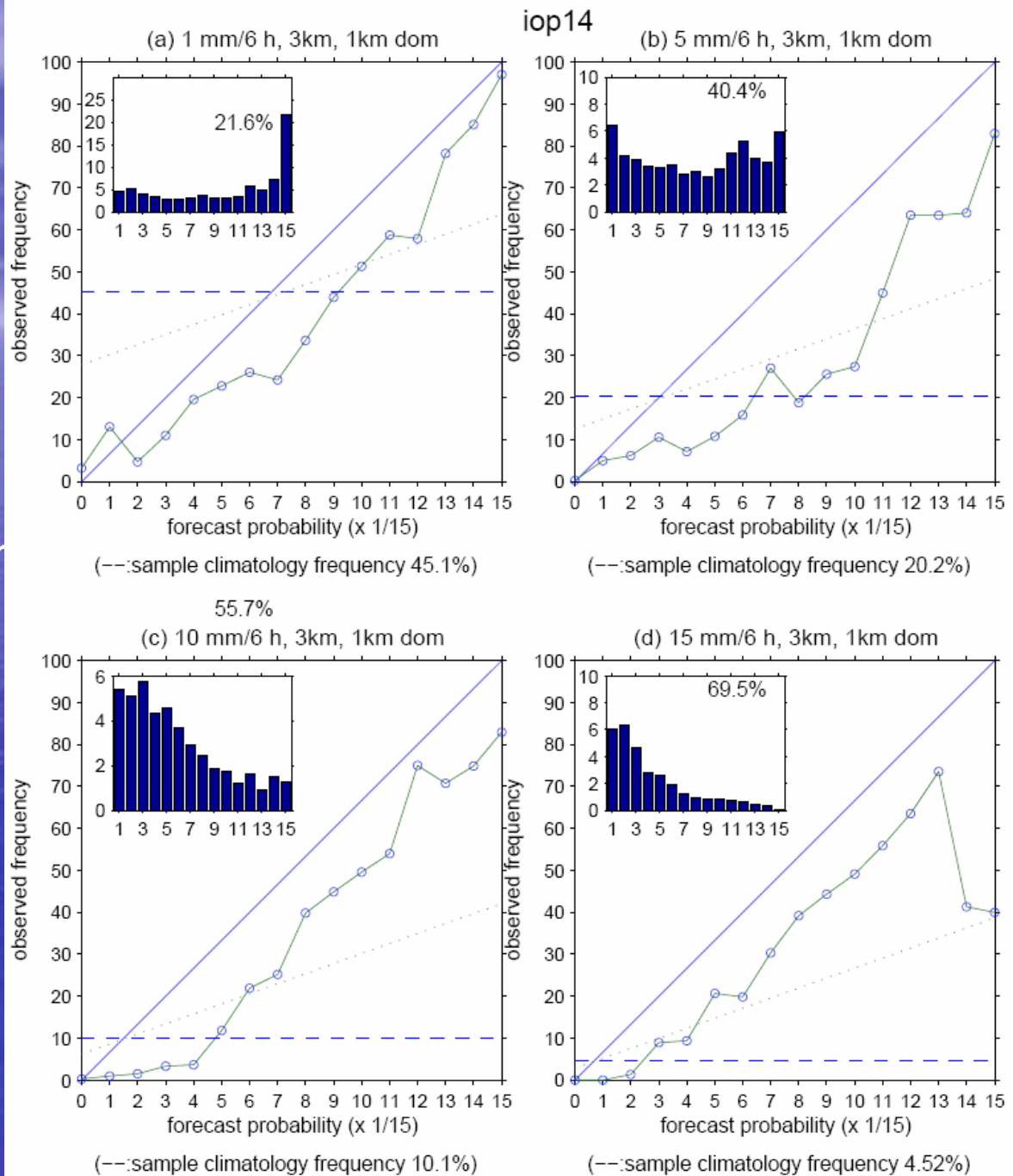
Valid: per 6 h

Over the ARB domain

Thresholds:

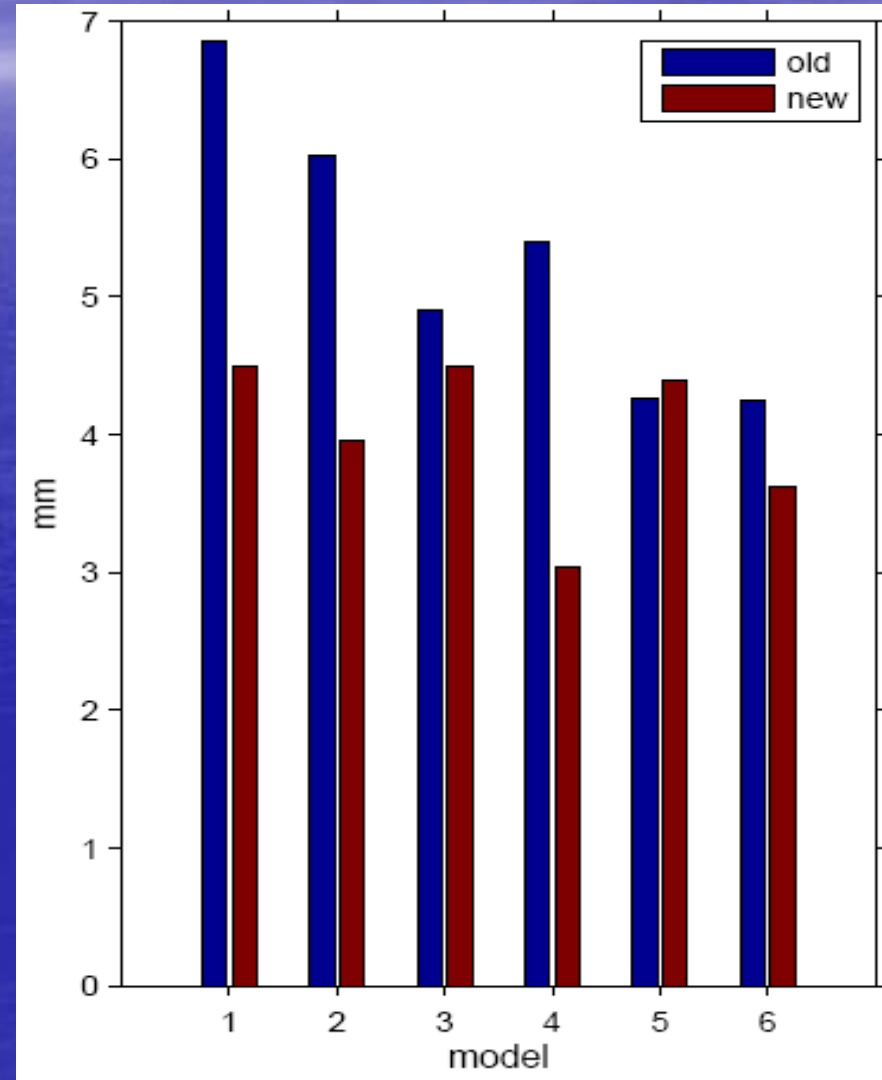
1, 5, 10, 15 mm/6 h
Reliability curves

Internal histograms:
Frequency for each
prob. category,
(inside number
shows 0% category)



RMSE of precipitation. (>0.25 mm) before and after correction

1. wrf-nam,
2. wrf-ruc,
3. rams-nam,
4. rams-ruc,
5. mm5-nam
6. Total (15 members)
 - 3 members for each model
 - Similar to 15 members calibration

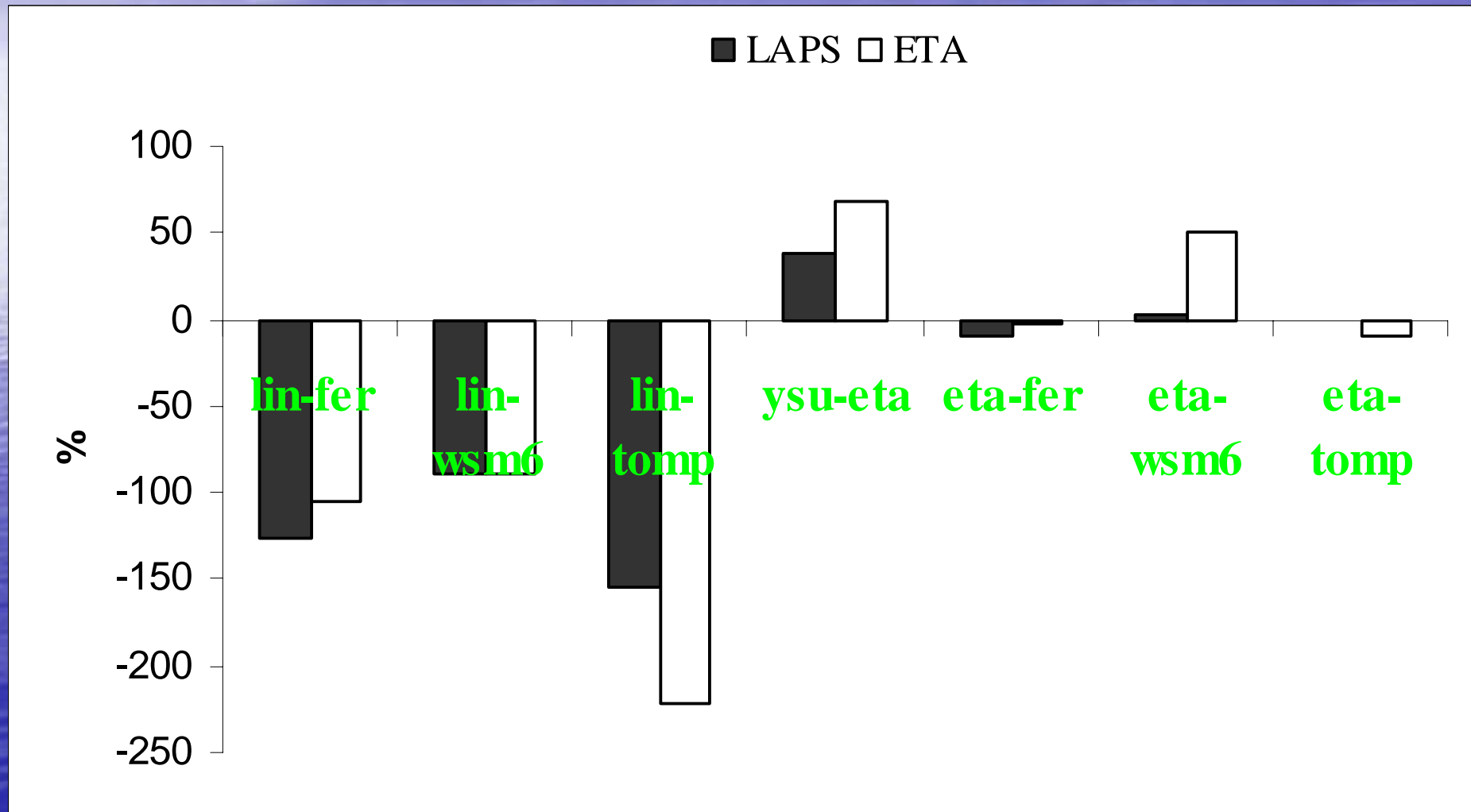


Ensemble design analysis

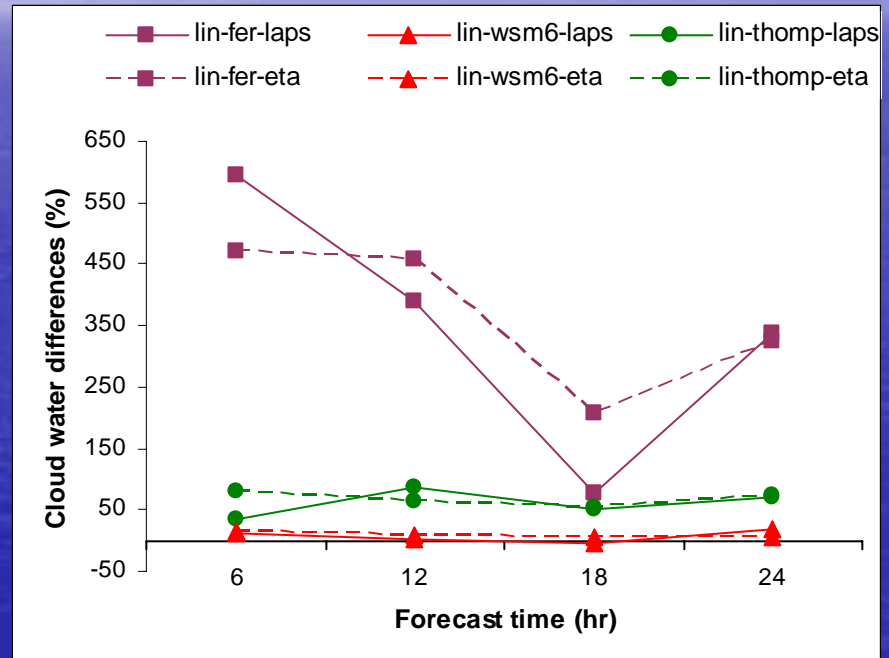
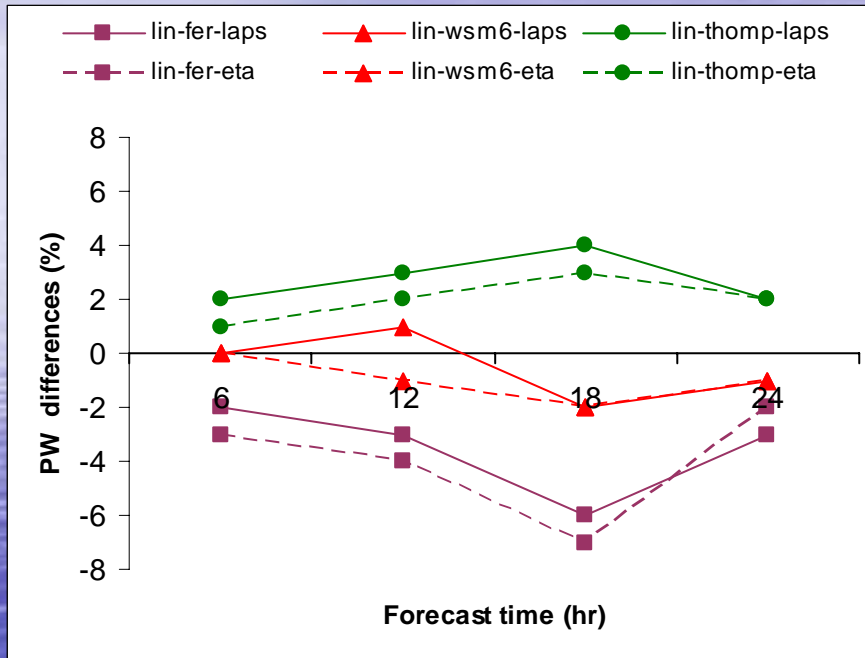
- Factor separation method explores improvement (+/-), relative to a control run, when changing a model option
 - Microphysics
 - PBL
 - Resolution
- Recommendations for next HMT field ex
- Recommendations to NCEP's SREF group?
 - Politicked again!

Factor Separation Method results

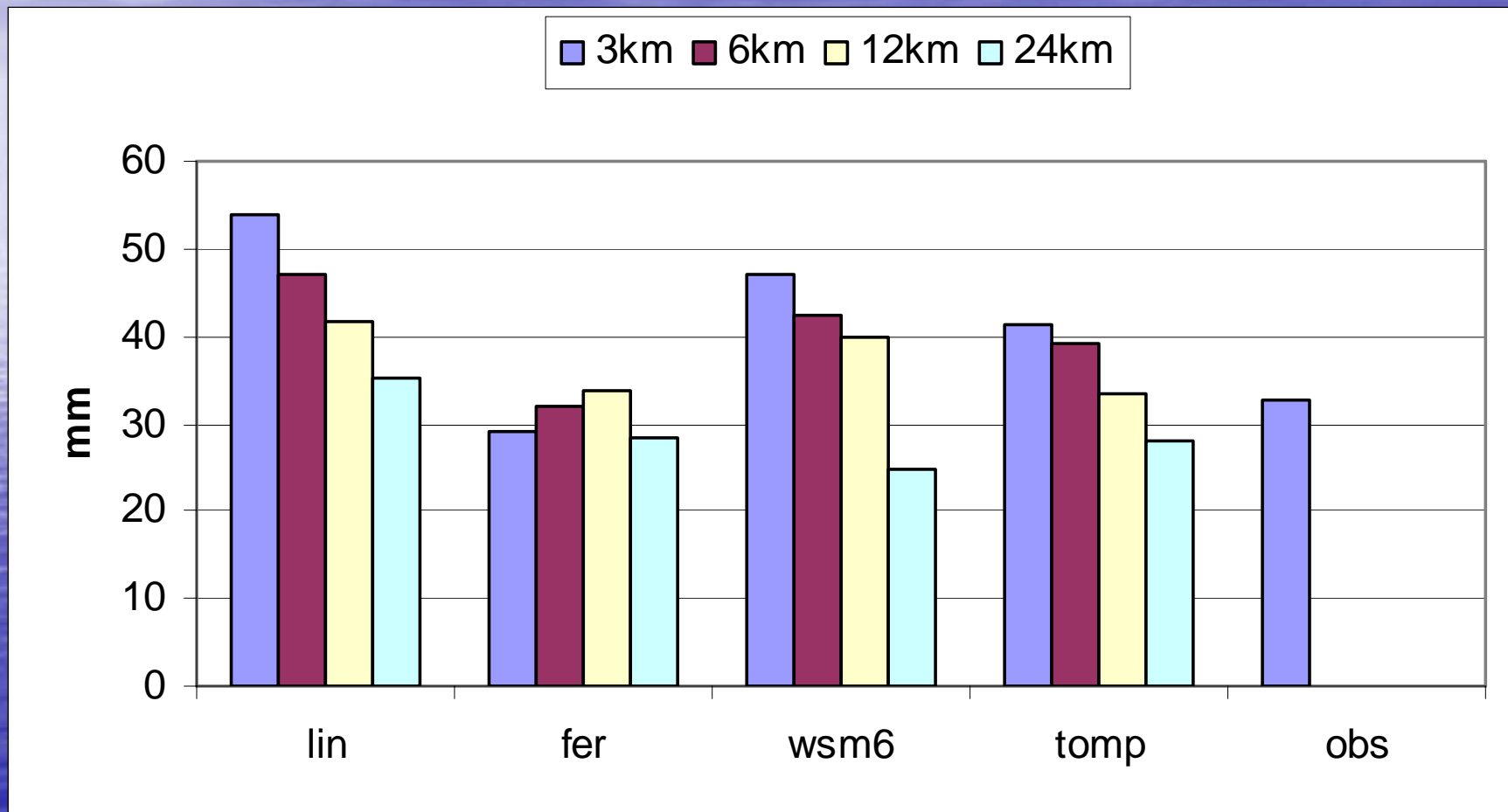
ARB rain volume



Changes in vertical integral of water vapor



3km vs. 6km vs. 12km vs. 24km



24h accumulation based on 6h forecasts.

Change candidates with biggest potential impact

Statistically significant changes in MP when the grid spacing is kept the same

1. 3km Lin-Fer
2. 3km Lin-Tomp

1. 6km Lin-Fer

1. 12km Lin-Fer

1. 24km Lin-Fer
2. 24km Lin-Tomp

Statistically significant changes for the same MP but different grid-spacing

Lin: 3-12km, 3-24km, 6-24km

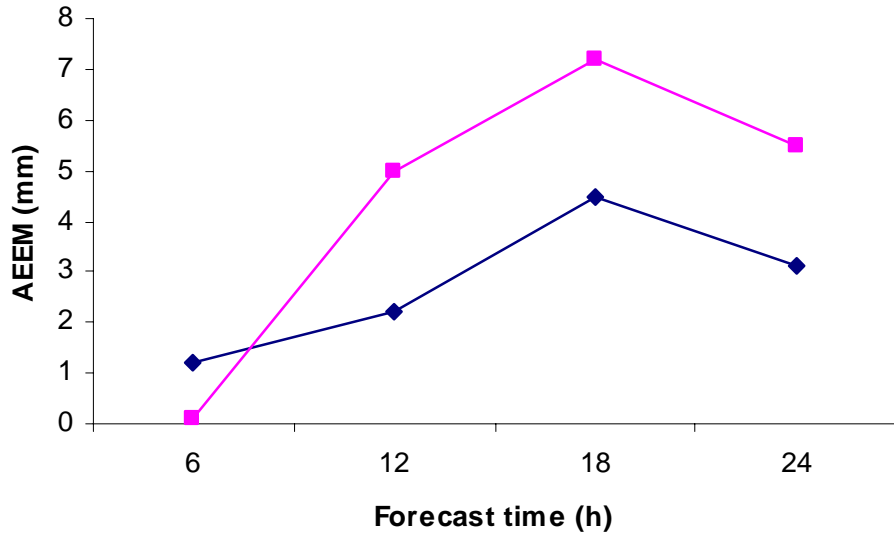
Fer: 12-24km

WSM6: 3-24km, 6-24km, 12-24km

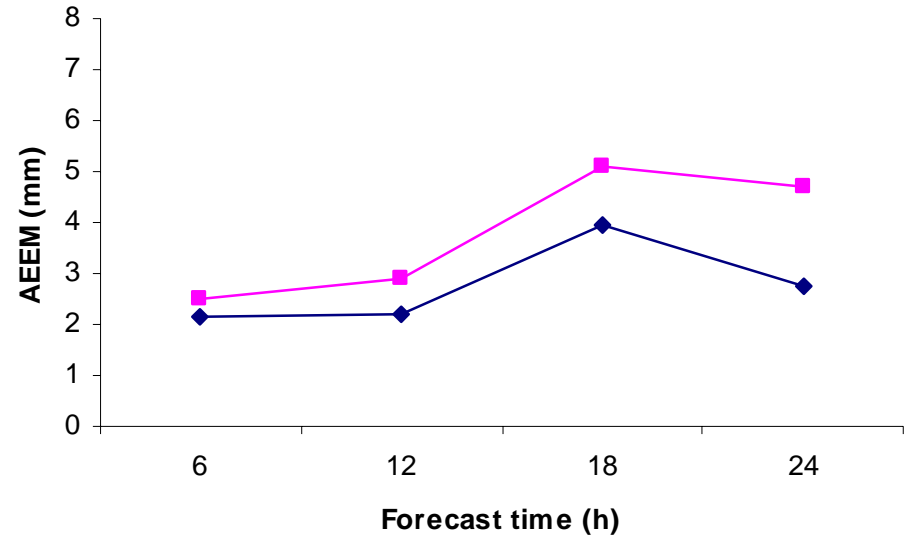
Thomp: 3-12km, 6-24km, 12-24km

Choices may be grid-scale dependent!

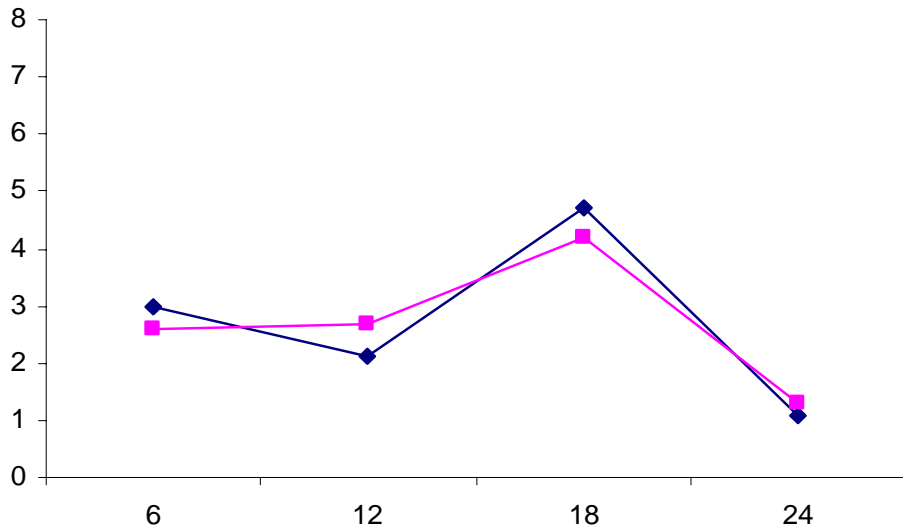
◆ 3km-lin-fer-thom ■ 3km-lin-w sm6



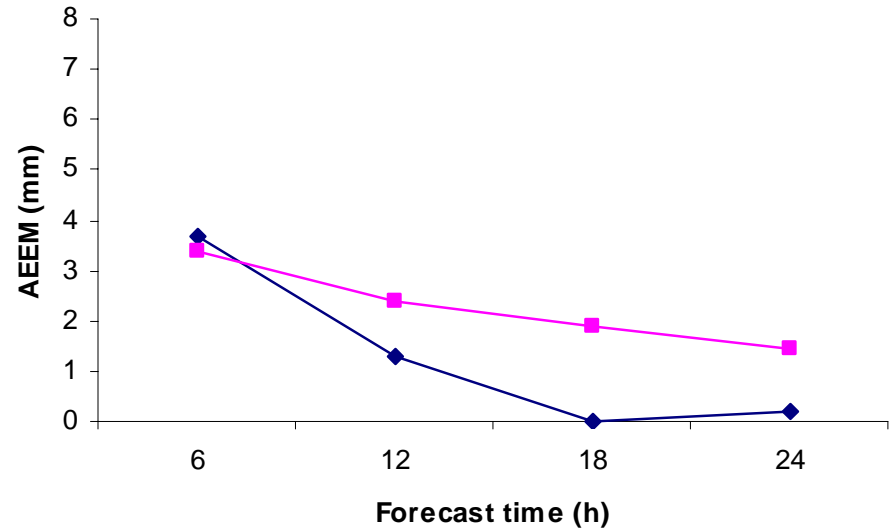
◆ 6km-lin-fer ■ 6km-lin-w sm6-thom



◆ 12km-lin-fer ■ 12km-lin-w sm6-thom



◆ 24km-lin-fer-tomp ■ 24km-lin-w sm6



Here's what happens ...

*24h accumulated ensemble mean for ensembles using SS members
(these are all hot-started)*

All 16 members (all MPs and all grid spacings) = **37.3 mm**

6-member ensemble (SS changes in MP for 3, 6, 12, 24 km) = **32 mm**

11-member ensemble (SS changes in MPs + SS changes in grid-spacing
For a specific MP) = **32.3 mm**

OBSERVED

= **32.7 mm**

Ensemble products

	00-06Z	06-12Z	12-18Z	18-00Z
Ensemble mean QPF				
Bias-corrected ensemble mean QPF				
6hr PoP > .25				
6-hr PoP > .5				
6-hr PoP > 1				
6-hr PoP > 3				

Pub plans

- Chris: Comparison of QPF and PQPF from time-lagged and multiple model ensembles
- Huiling: Evaluation and calibration of short-range PQPF from multi-model and time-phased ensembles during HMT-West 2006
- Isidora: "The impact of different physical parameterizations and their interactions on cold season QPF" -- *J. Hydrometeorology*
- Isidora: Different microphysics and different grid-spacing results -- *Wea. Forecasting*
- Chungu: Short-range quantitative precipitation forecast (QPF) and probabilistic QPF using time-phased multi-model ensembles