

Comparison of Orographic QPF from Time-lagged and Multiple Model Ensembles

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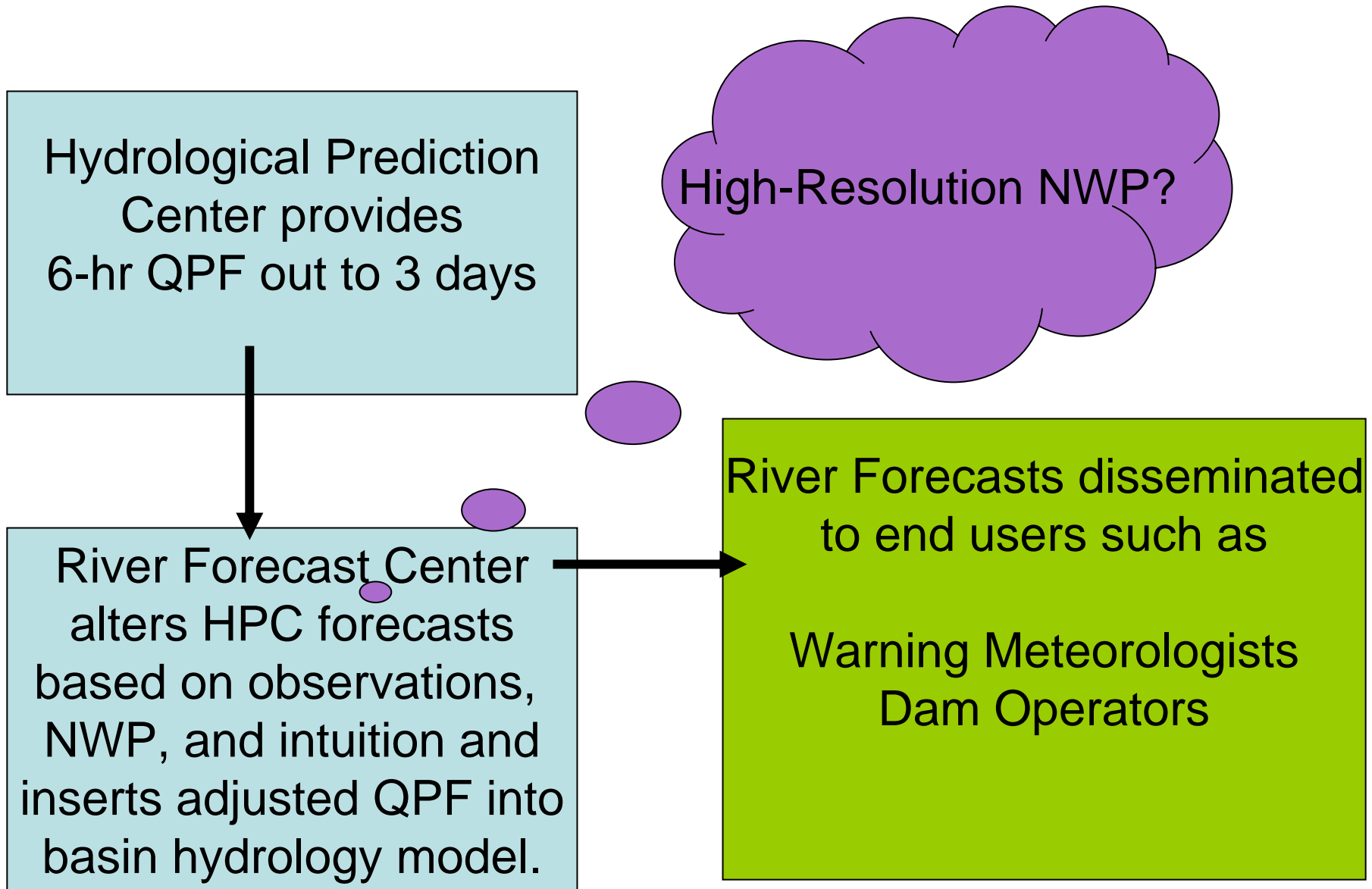
²Cooperative Institute for Research in the Atmosphere



What is HMT?

- The Hydrometeorology Testbed (HMT) is a concept aimed at accelerating the infusion of new technologies, models, and scientific results from the research community into daily forecasting operations of the National Weather Service (NWS) and its River Forecast Centers (RFCs).

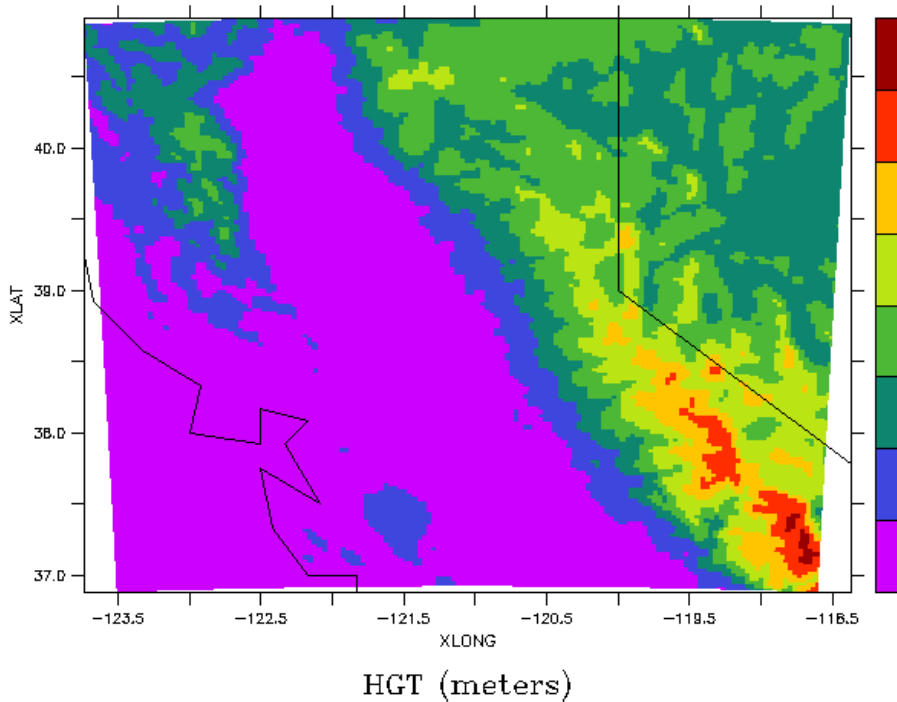
Forecast Information Flow



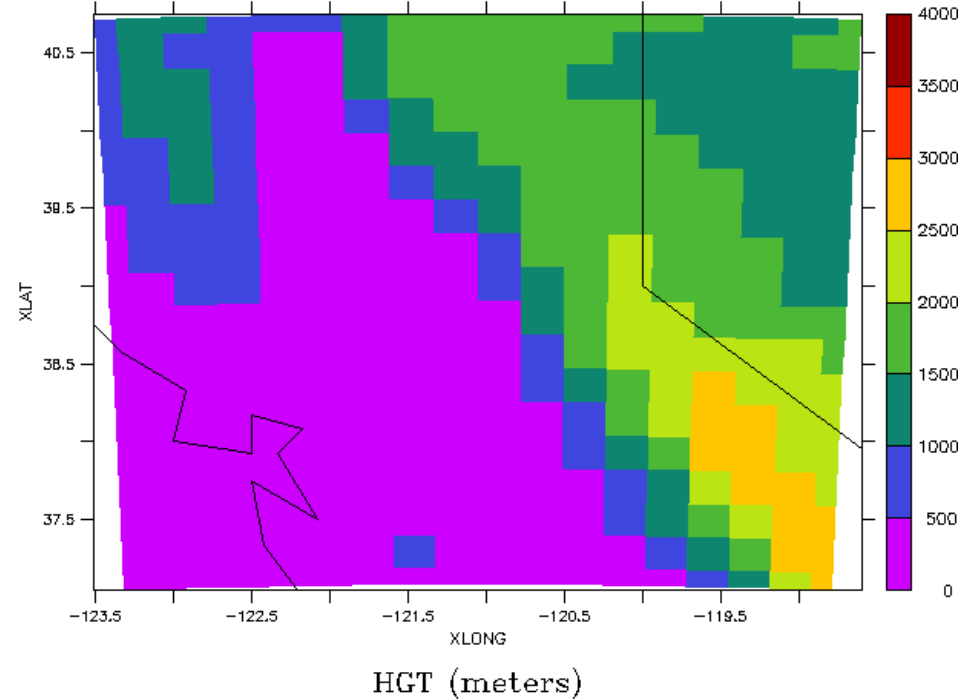
Forecast Questions

- Will forecasters find added value in viewing high-resolution NWP?

3-km Terrain



24-km Terrain



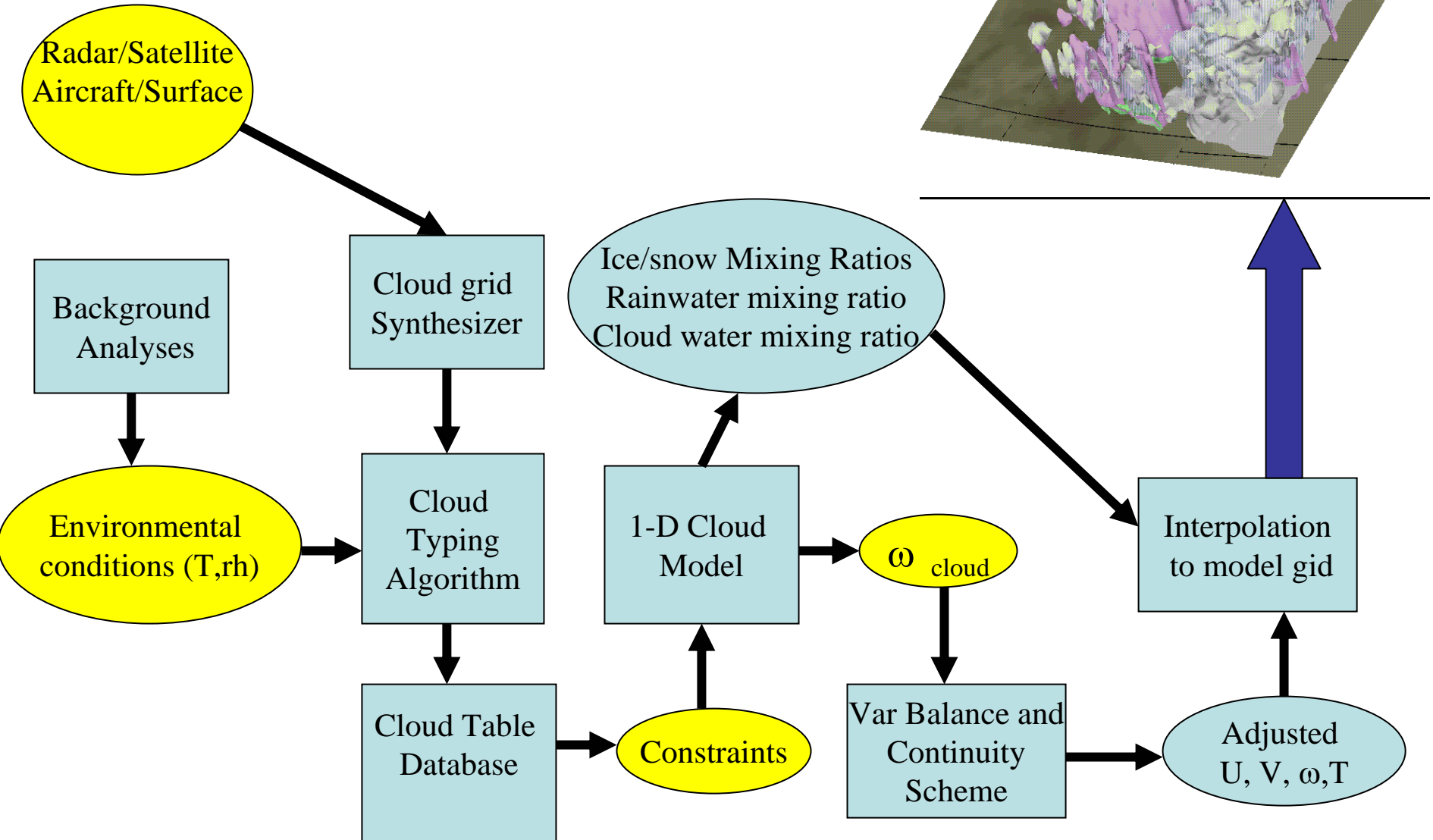
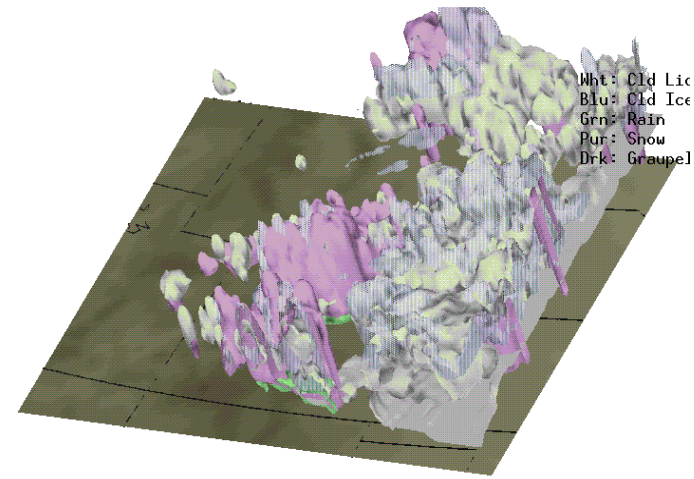
Forecast Questions

- How can high-resolution NWP be linked directly with existing basin models?
 - Operational Procedure
 - CNRFC extracts 181 points from the HPC 32-km grid; forecasters adjust QPF at these points; adjusted QPF is ingested by Mountain Mapper for spatial interpolation; interpolated fields are inserted into the Sacramento Model
 - Parallel Procedure
 - Provide NWP QPF (statistically corrected) at 181 points to Mountain Mapper and, ultimately, the Sacramento Model

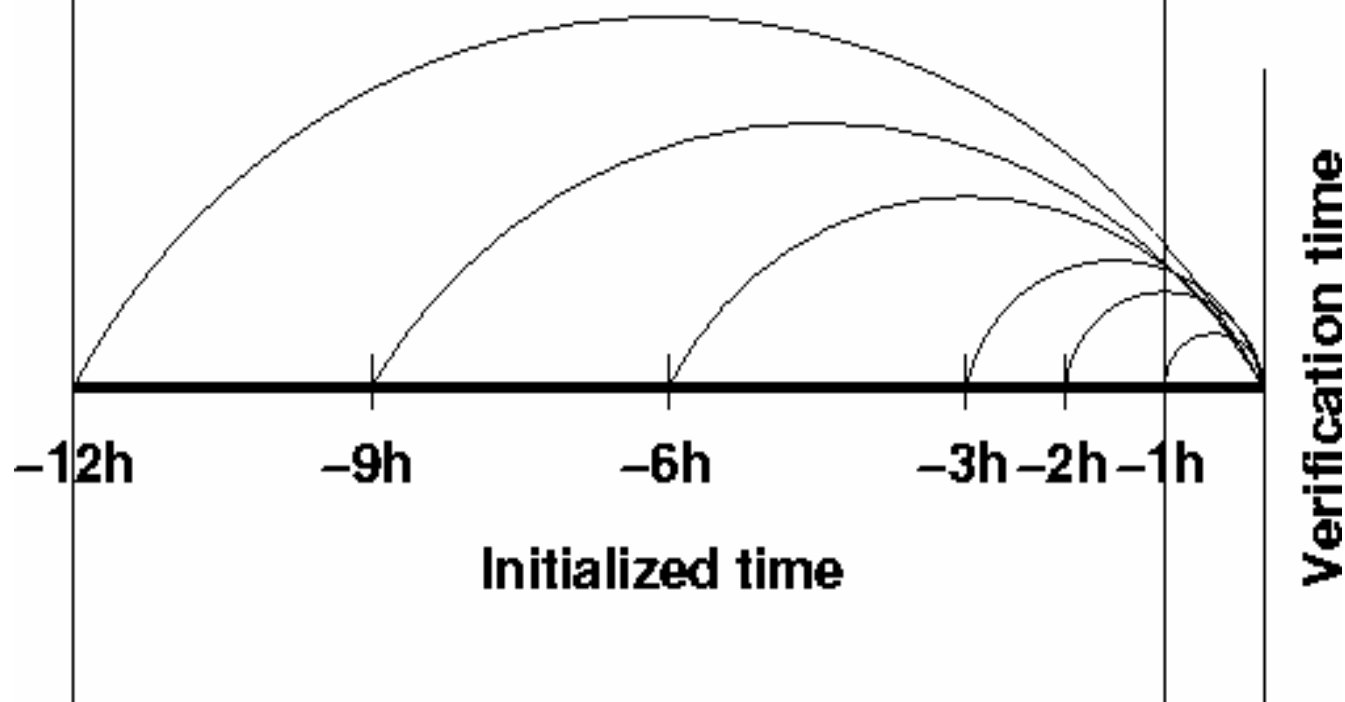
Strategies to Improve NWP QPF

- Multiple model ensemble
 - Addresses error due to model biases
 - RAMS, MM5, WRF (2)
- Time-lagged ensemble
 - Addresses errors in initial condition of clouds and precipitation particles (LAPS diabatic initialization).
 - Three-hour forecast cycle
- Use Ensemble Mean as NWP QPF

LAPS diabatic initialization scheme



Time-lagged Ensemble Member Pool



Ensemble Characteristics

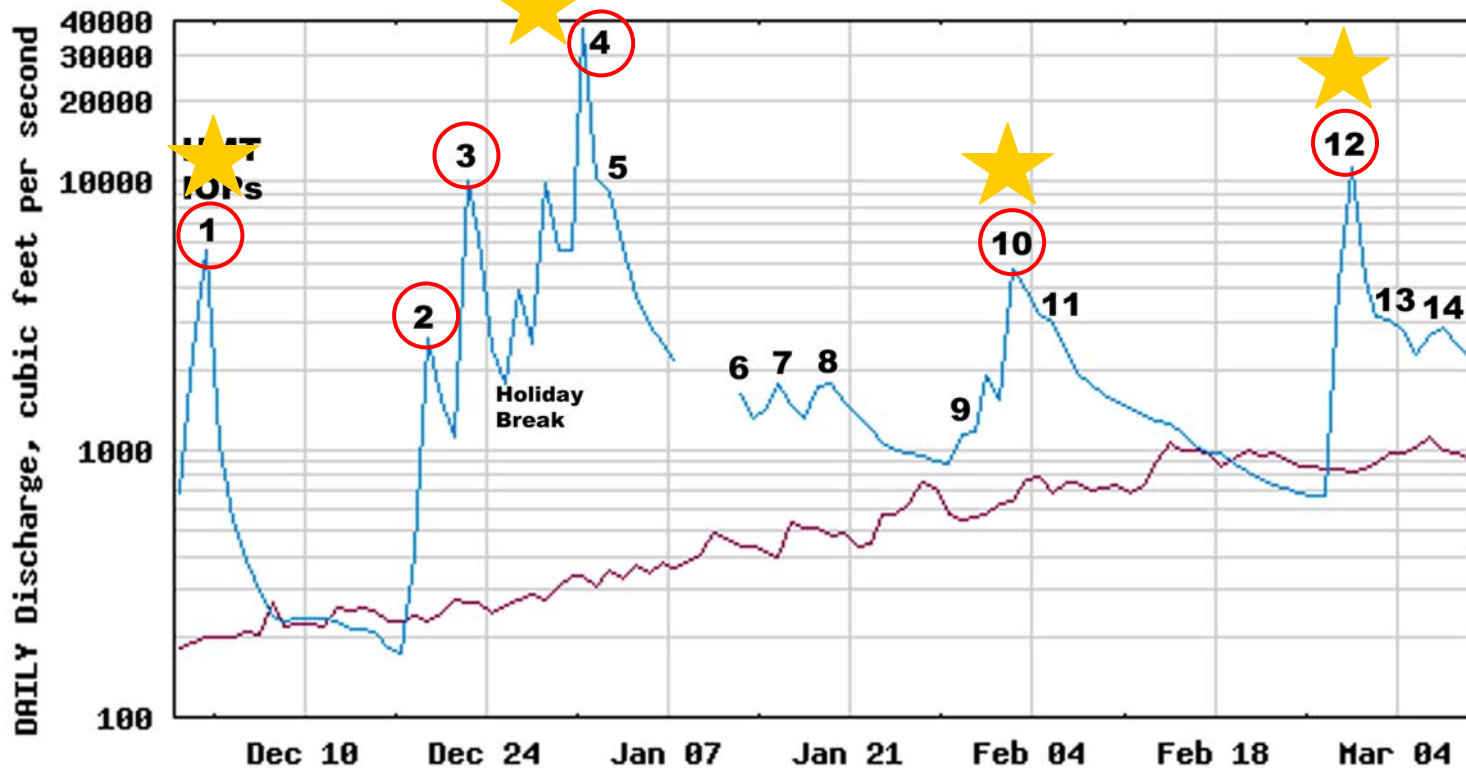
| | | |
|----------------------|---|---|
| Variable of Interest | 6-hr pcp | 6-hr pcp |
| Initialization | LAPS diabatic | LAPS diabatic |
| Boundary Conditions | NAM 212 Grid | NAM 212 Grid |
| Domain | 150x150; 3km | 150x150; 3km |
| Ensemble Composition | MM5 (Shultz) RAMS WRF (Ferrier) WRF (Thom) | Previous three forecast cycles (3-hrly) |

Hydrological Conditions during HMT

○ Indicates heavy precipitation events selected for study



USGS 11427000 NF AMERICAN R A NORTH FORK DAM CA

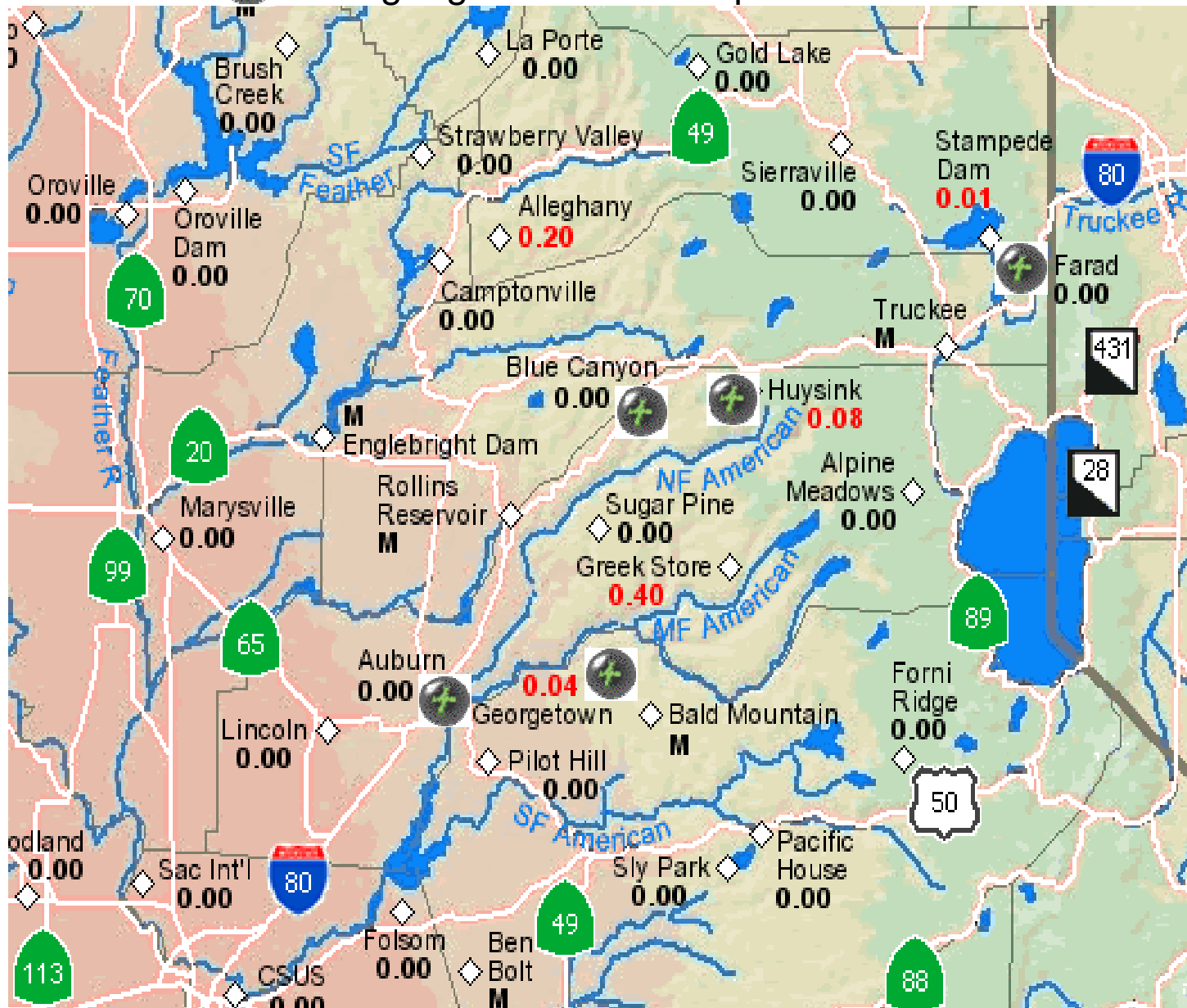


----- EXPLANATION -----
— MEDIAN DAILY STREAMFLOW BASED ON 63 YEARS OF RECORD
— DAILY MEAN DISCHARGE

Provisional Data Subject to Revision

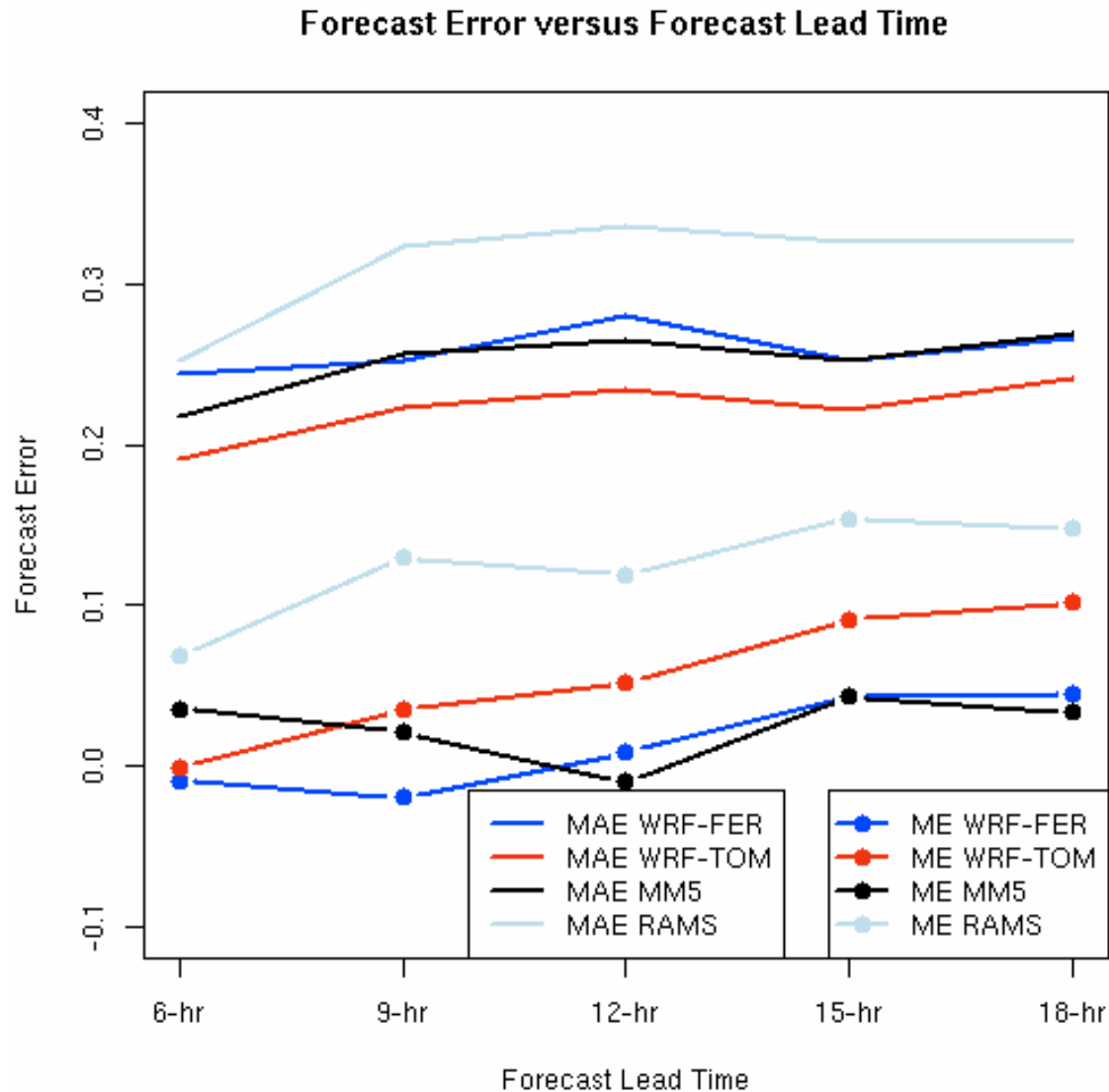
Rain Gauge Locations

 Rain gauges selected for point verification



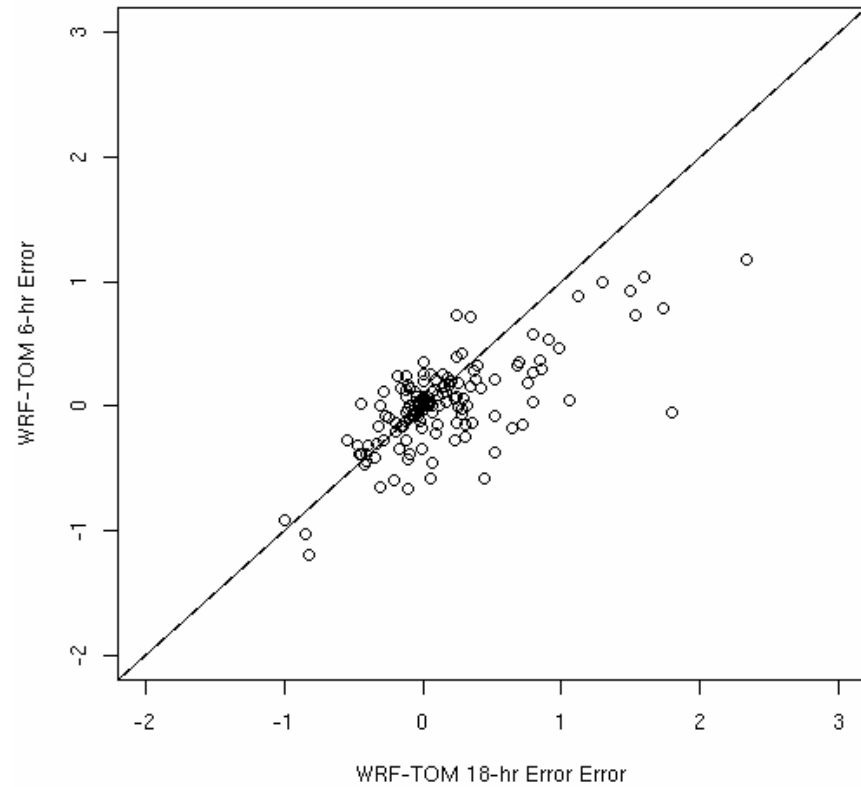
Source:
CNRFC

Error of Ensemble Members

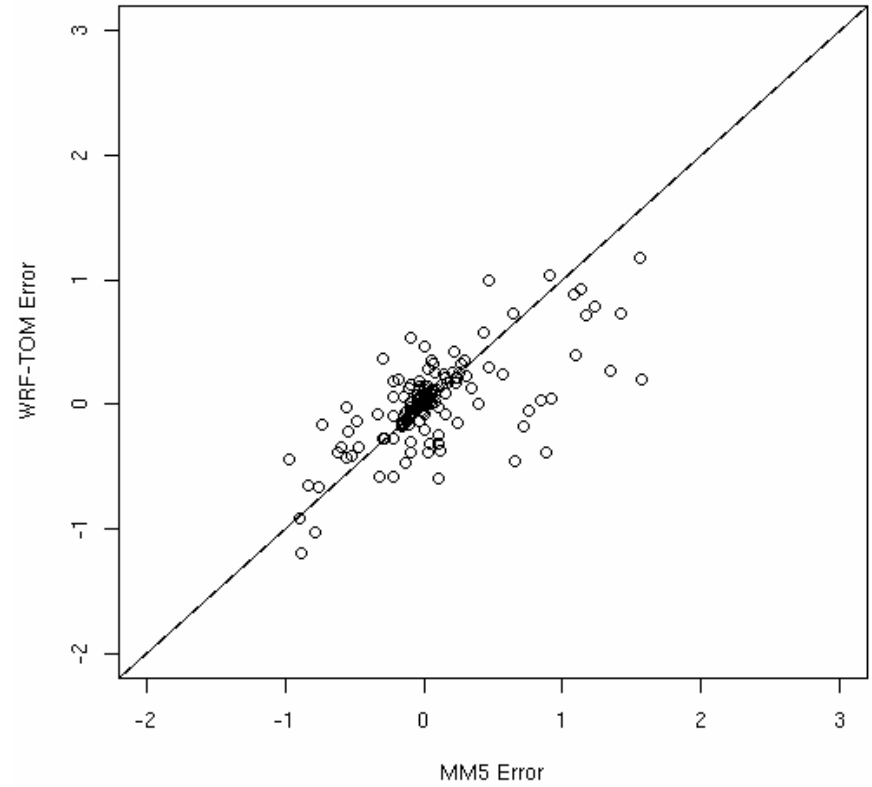


Scatterplot of Errors

WRF-TOM Lag Errors

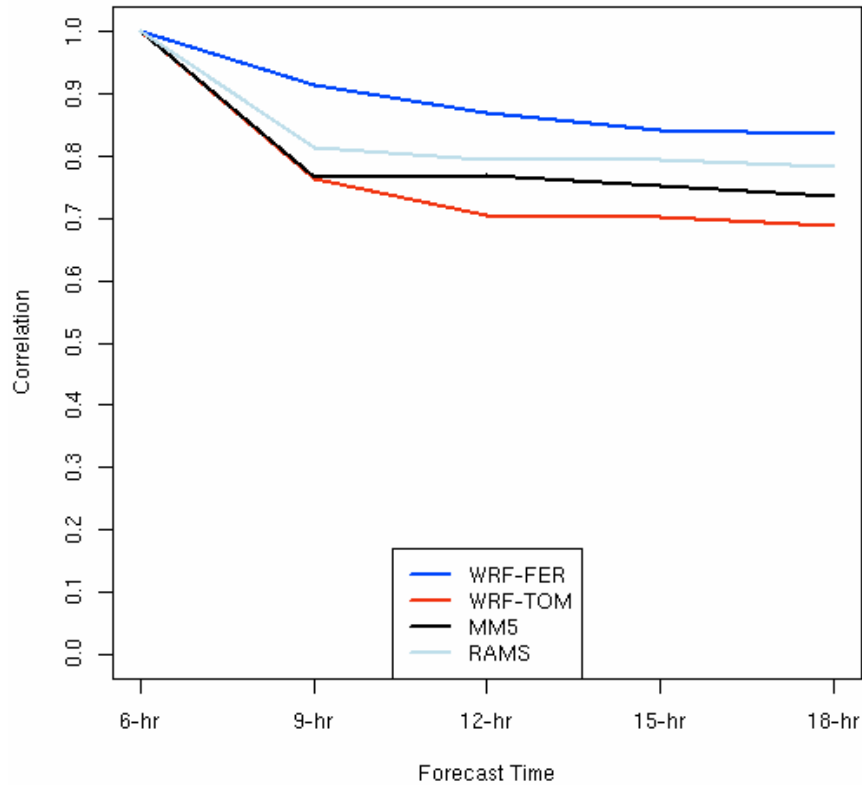


WRF-TOM Error versus MM5 Error

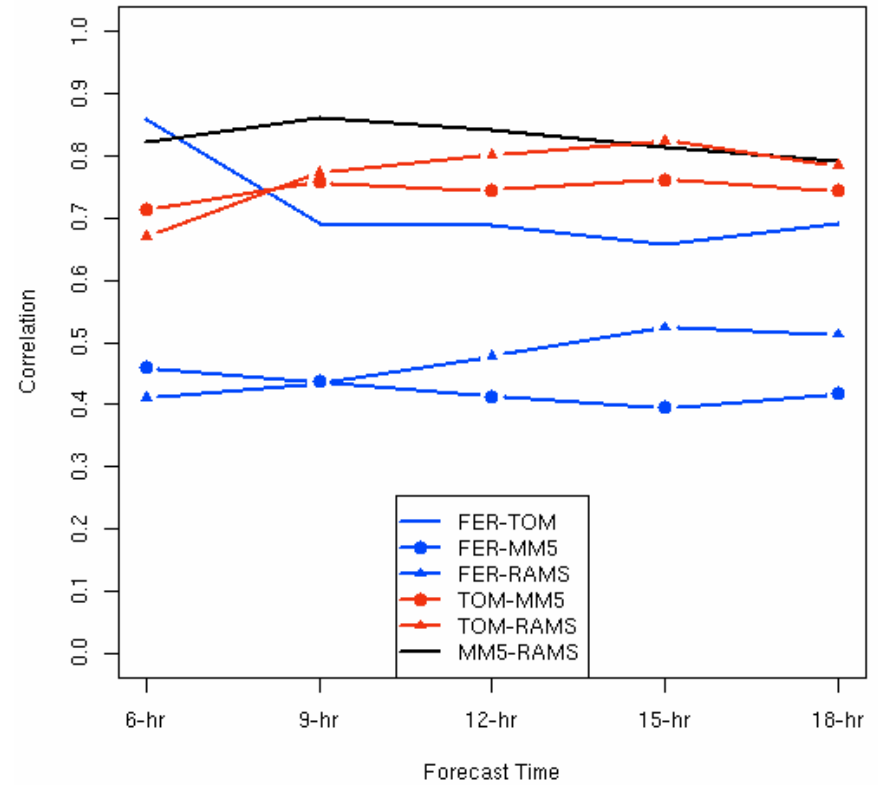


Error Correlation of Ensemble Members

Error Correlation with 6-hr Forecast

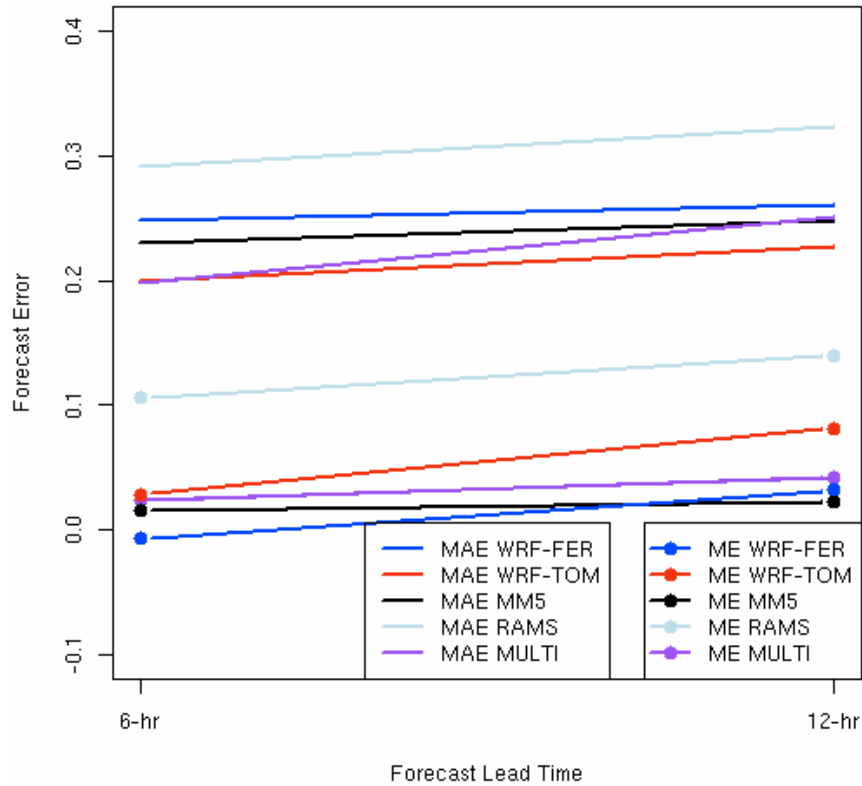


Error Correlation among Models

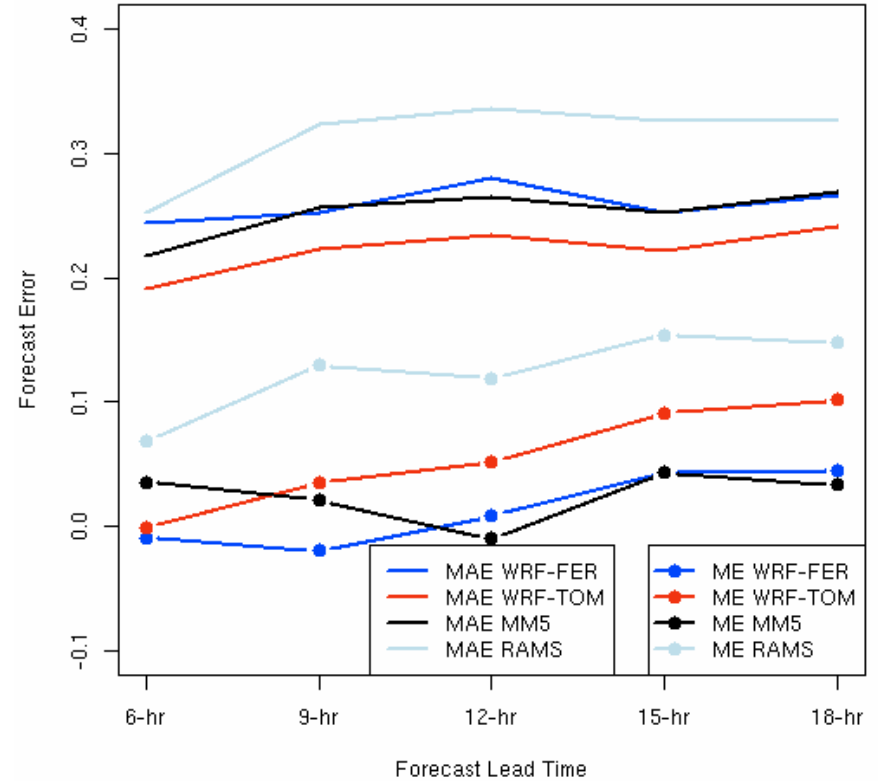


Error of Ensembles

Ensemble Error versus Lead Time



Forecast Error versus Forecast Lead Time



What We've Learned So Far

- Forecasters want high-resolution NWP forecasts out to 24 hours.
- Accuracy of the mean of an ensemble forecast is indistinguishable from deterministic forecasts in first 12 hours.
 - Suggests synoptic-scale errors are dominant.
 - Indications of added value beyond 12 hours.
 - Correlation between absolute error of mean and ensemble variance ranges 0.4 to 0.65.
- Diabatic initialization improves the forecast of precipitation in the first six hours to the point of being the most accurate forecast period.