

Preprocessing Atmospheric Precipitation Forecasts to Produce Ensemble Forcing for NWS Hydrologic Forecasts

John Schaake

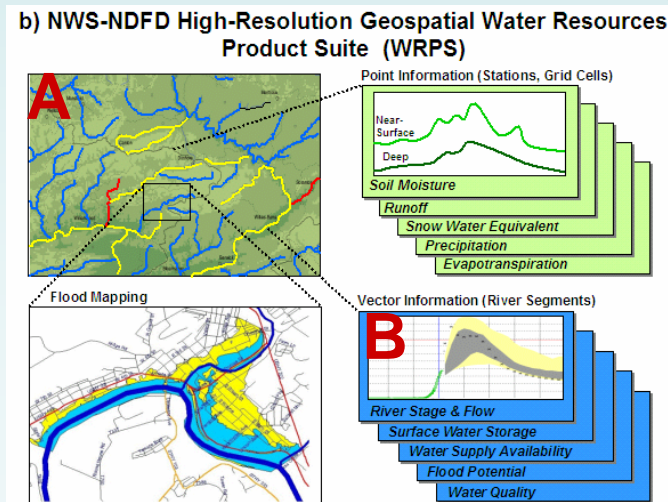
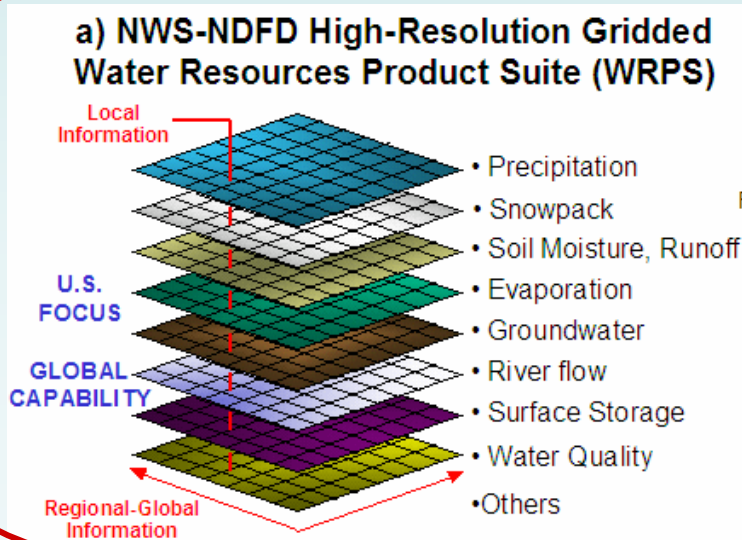
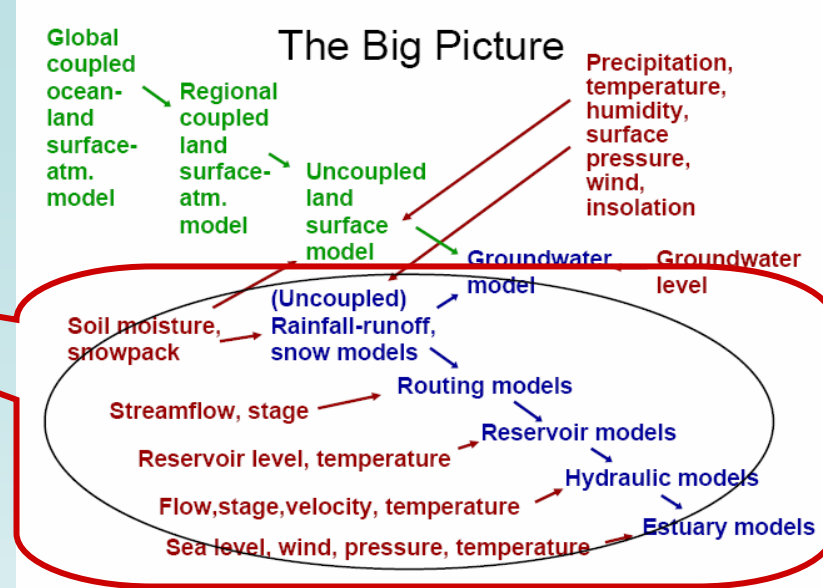
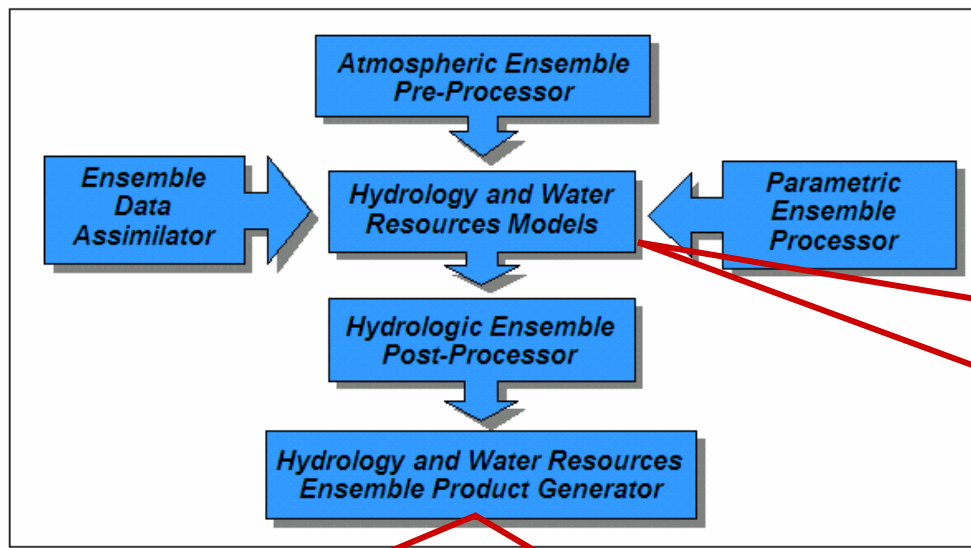
**Consultant, Office of Hydrologic Development, National
Weather Service**

QPF Workshop

Boulder

June 6, 2006

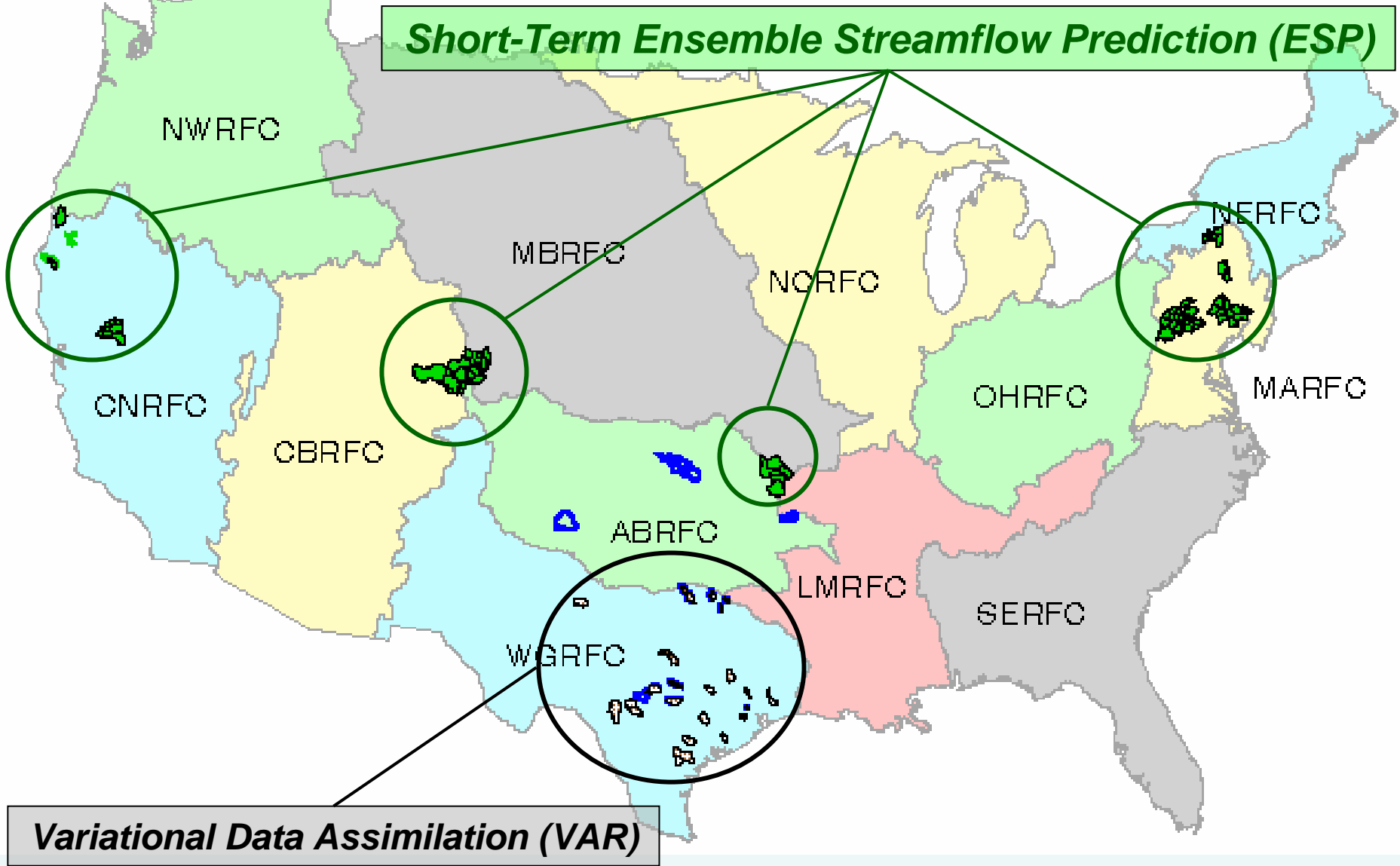
Where are we going?



Improved accuracy, Reliable uncertainty estimates, Benefit-cost effectiveness maximized

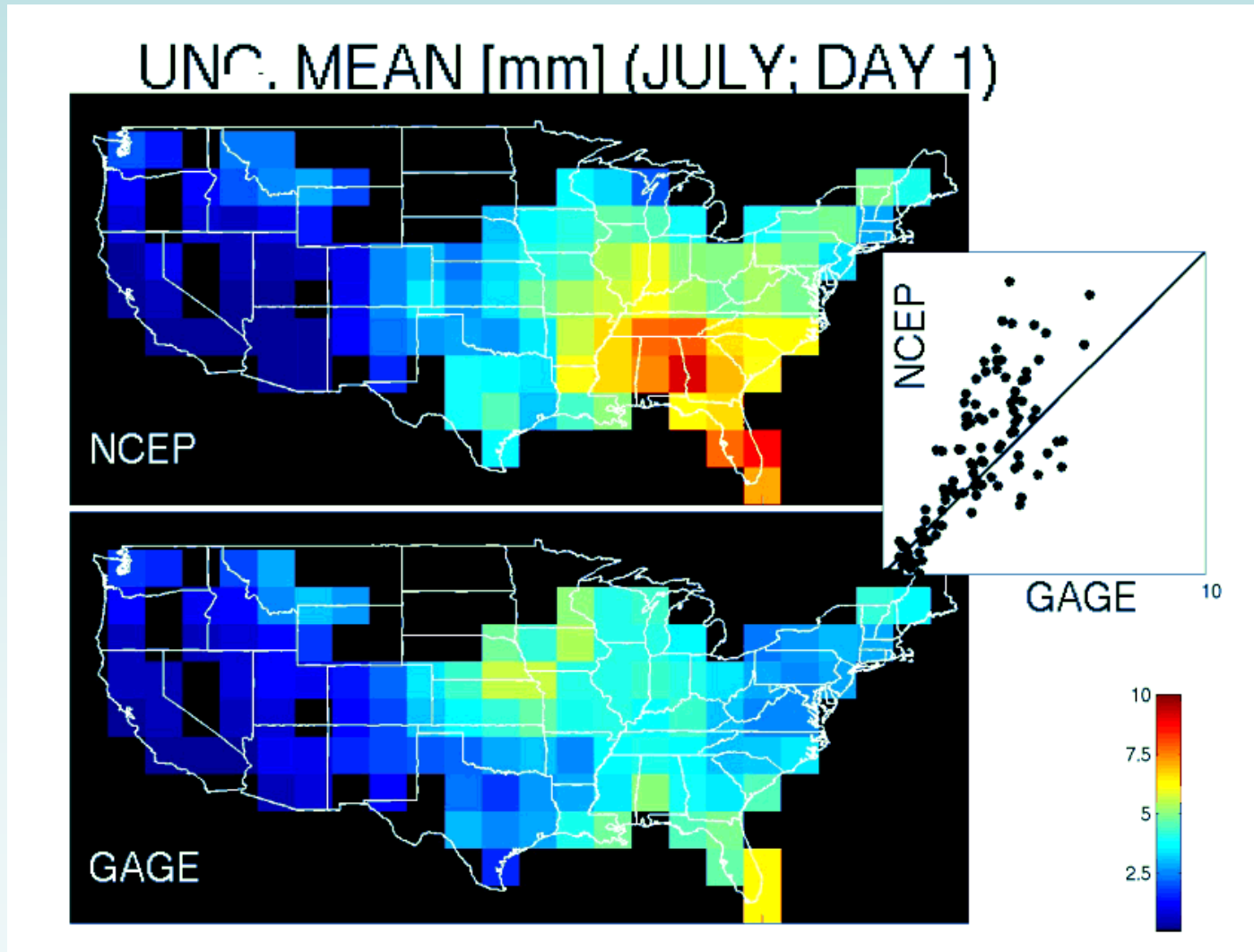
Current Experimental Operations

Short-Term Ensemble Streamflow Prediction (ESP)

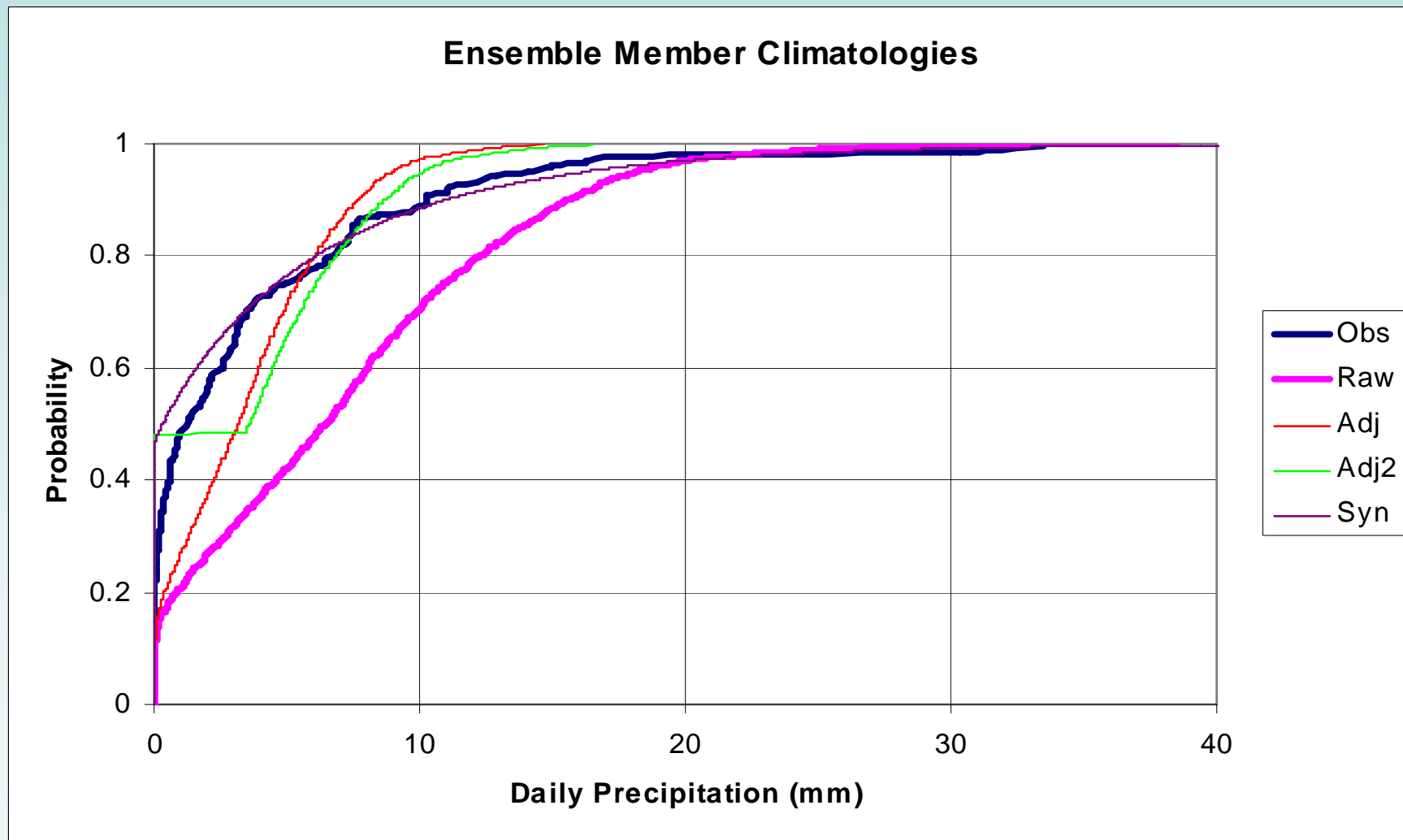


Variational Data Assimilation (VAR)

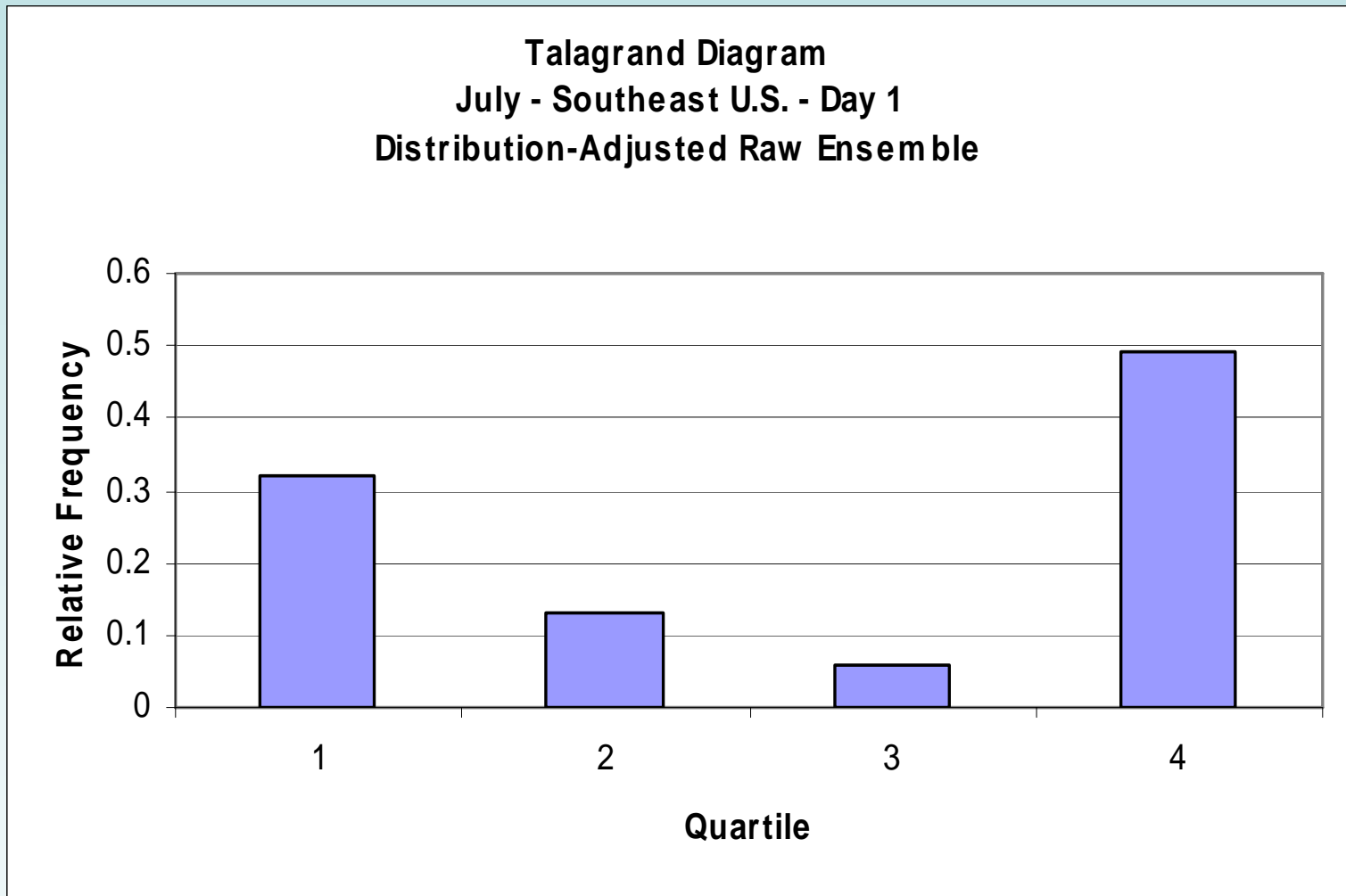
NCEP Global Ensemble Forecasts



Cumulative Distributions of Adjusted Ensemble Members



Uncertainty Analysis of Global Ensemble Precipitation Forecasts



AHPS PreProcessor

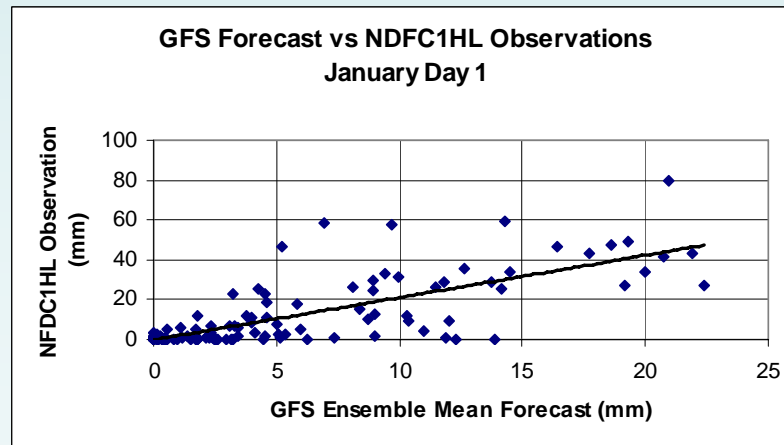
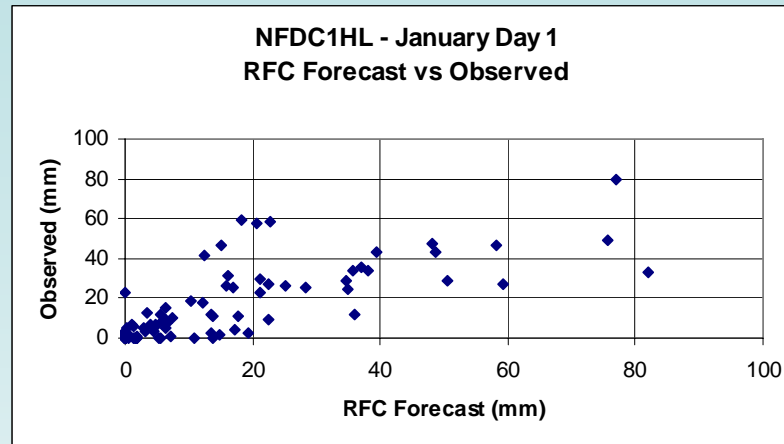
Performance Objectives

- Preserve skill of the single-value forecasts (at all space and time scales)
- Remove forecast biases
- Produce reliable probabilities
- Account for space/time scale dependency
- Simple, efficient and robust

AHPS PreProcessor Science Strategy

- Develop basic capability using existing “single-value” forecasts and observations (RFC-HPC and GFS ensemble mean forecasts)
- Apply to specific RFC Sub-basin areas using limited RFC and HPC archives of QPF. Account for temporal scale dependency.
- Expand to gridded regions – include additional spatial scale dependency.
- Develop general Bayesian approach to using GFS ensemble forecasts
- Other approaches (e.g. analogs)?

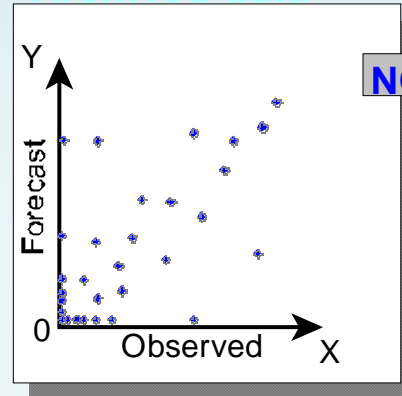
Precipitation Forecasts and Observations California – January Day 1



Use Single-Value Forecast to Construct Forecast Probability Distribution

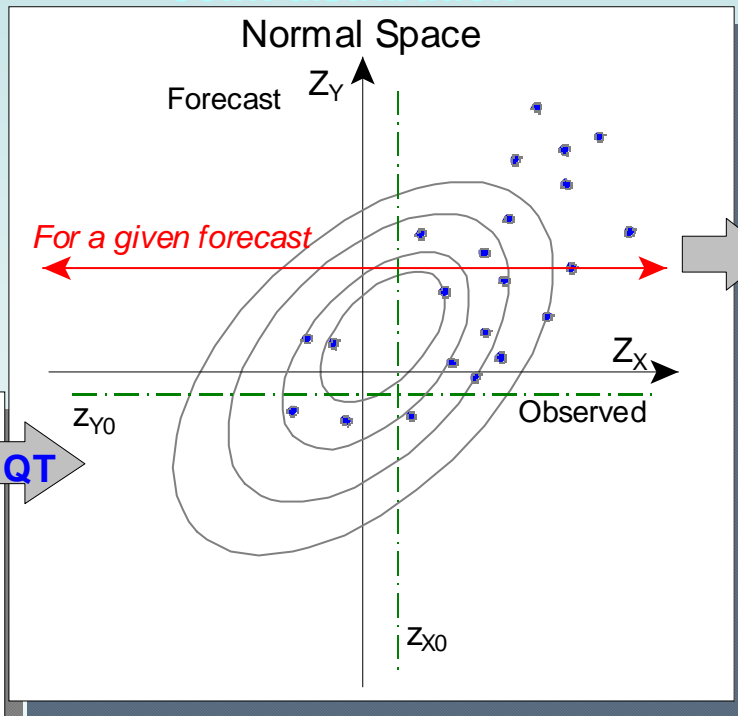
No assumption of normality for observed & forecast distributions

Archived data

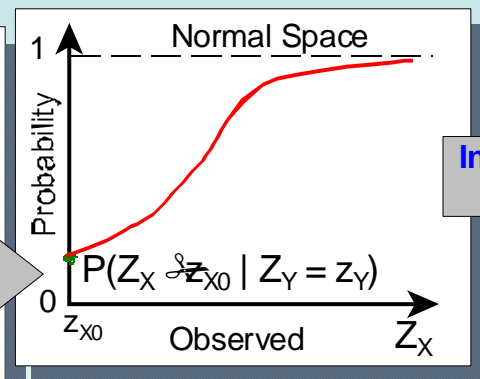


NQT

Joint distribution



Conditional Distribution



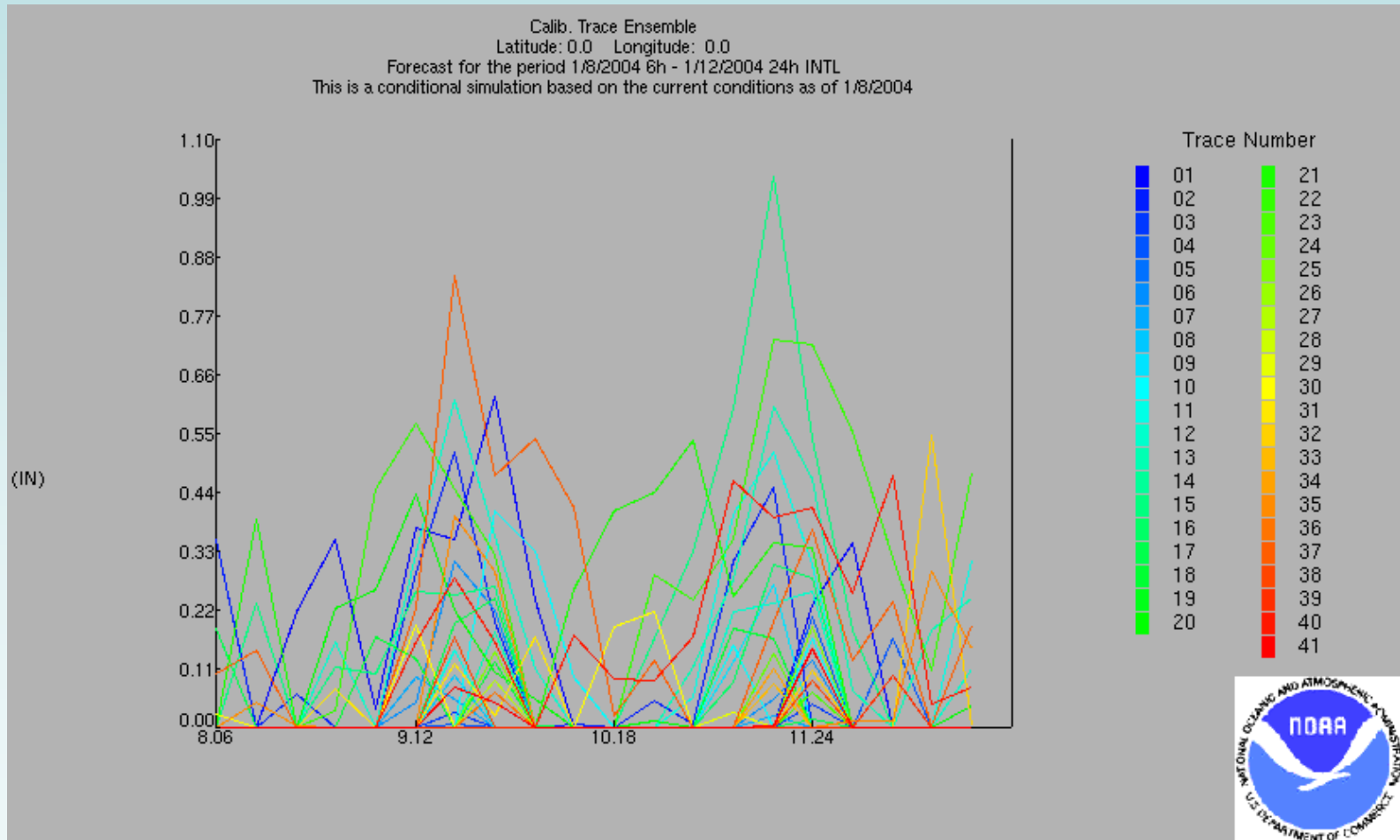
Inverse NQT

PQPF given a QPF

Construct Ensemble Members

- Divide total forecast period into sub-periods for:
 - Individual time-steps
 - Aggregate time periods
- Estimate forecast probability distribution for each sub-period
- Construct ensemble members using Schaake Shuffle
- Resolve differences between member values for aggregate periods and time-step periods

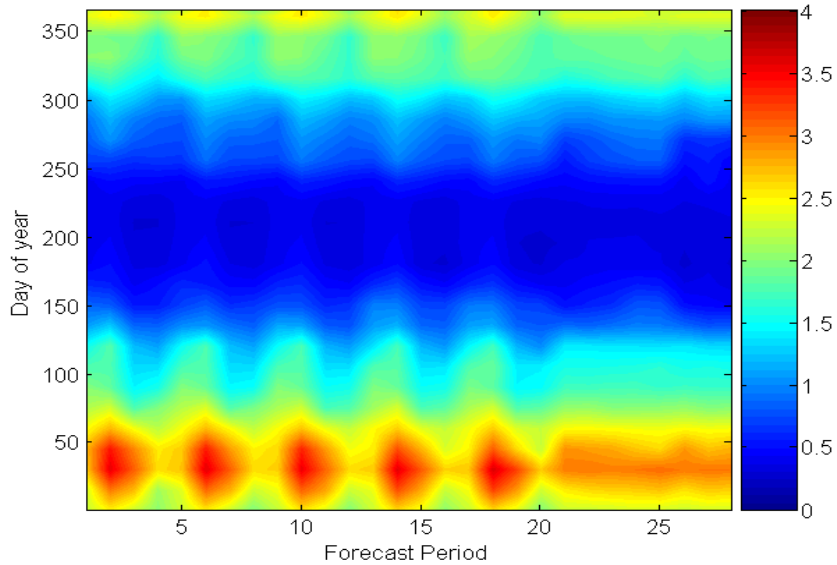
Example Ensemble Precipitation Forecast



Example Results for North Fork American River, CA

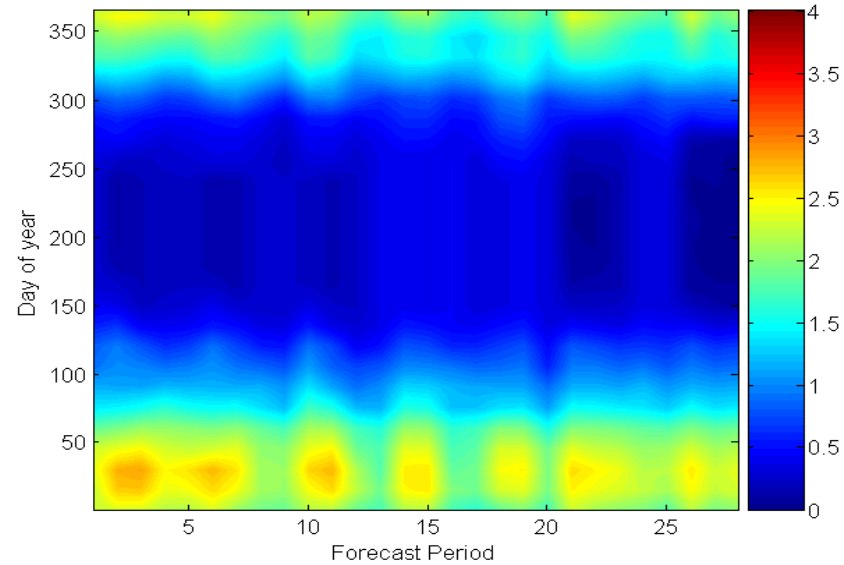
- Parameter Estimation (RFC and GFS Forecasts)
 - Average precipitation
 - POP
 - Conditional mean
 - CCV
 - RHO
- Dependent Validation (RFC and GFS Forecasts)
 - Ensemble mean RHO
 - Bias
 - CRPSS
 - All Events
 - Wet Events
 - BSS – Rain / No Rain
 - BSS – Upper tercile wet events

RFC Average Observation



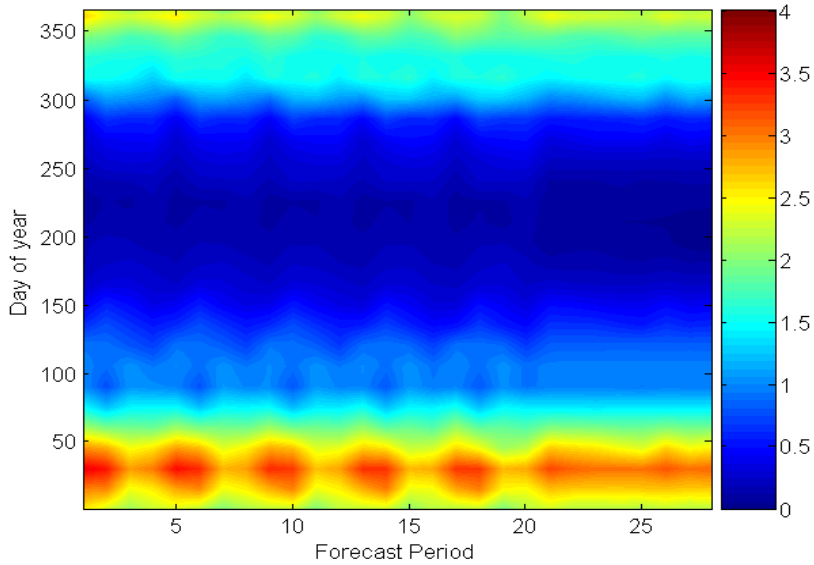
(a)

RFC Average Forecast



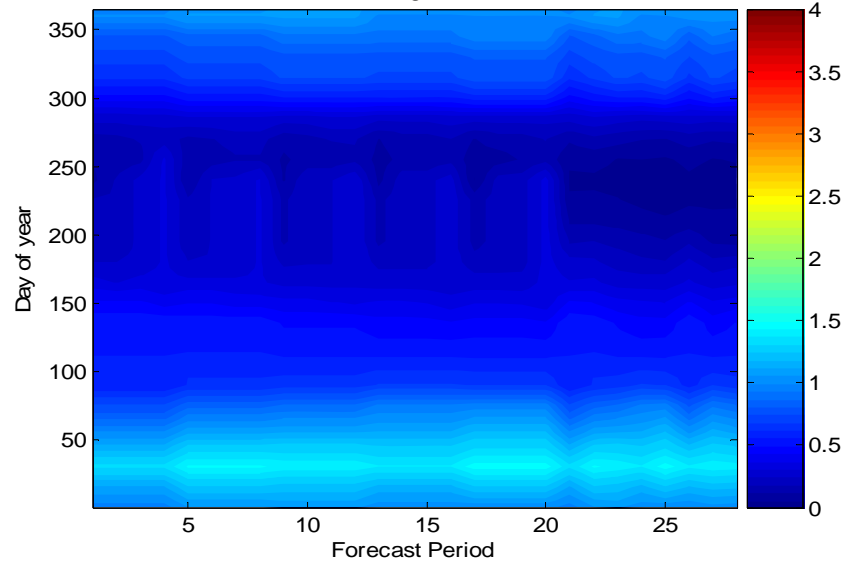
(b)

GFS Average Observation



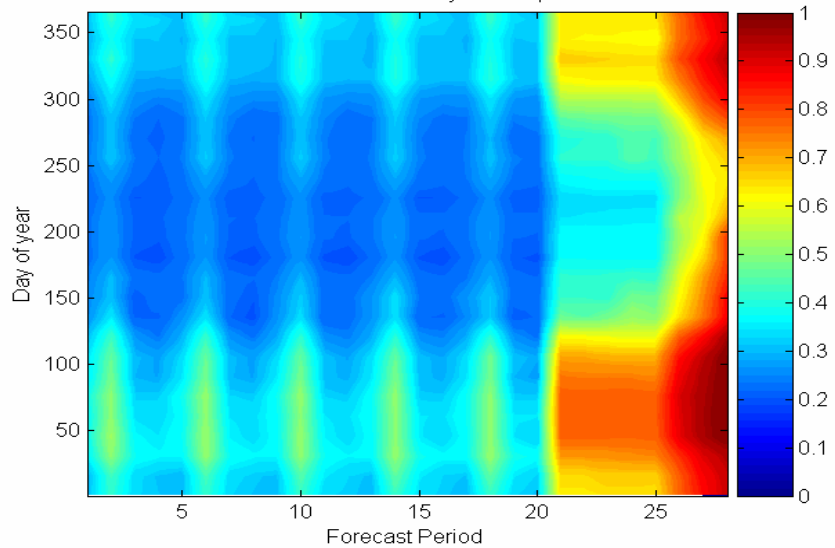
(c)

GFS Average Forecast



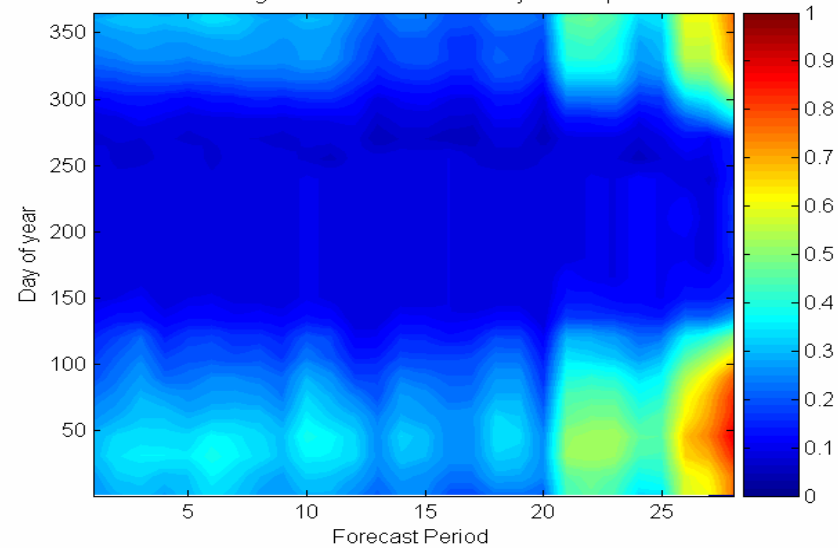
(d)

RFC Observed Probability of Precipitation



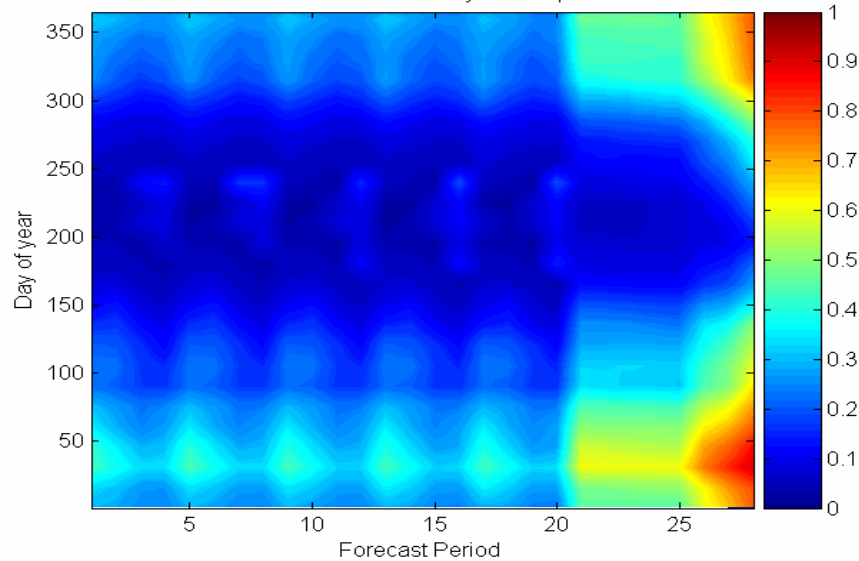
(a)

RFC Average S.V. Forecast Probability of Precipitation



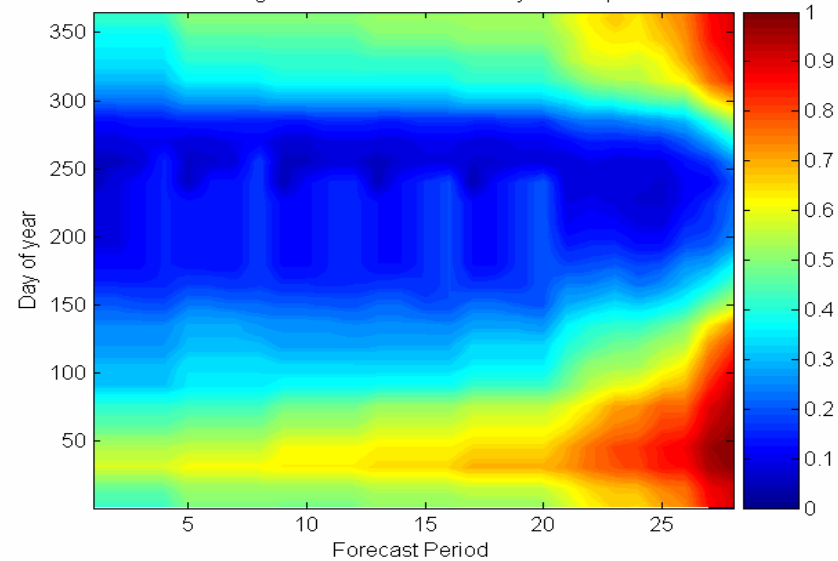
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GFS Observed Probability of Precipitation



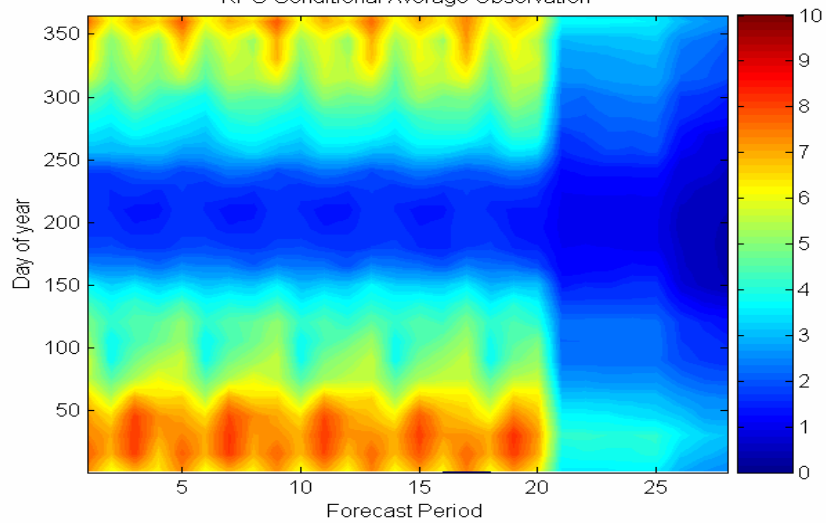
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GFS Average S.V. Forecast Probability of Precipitation



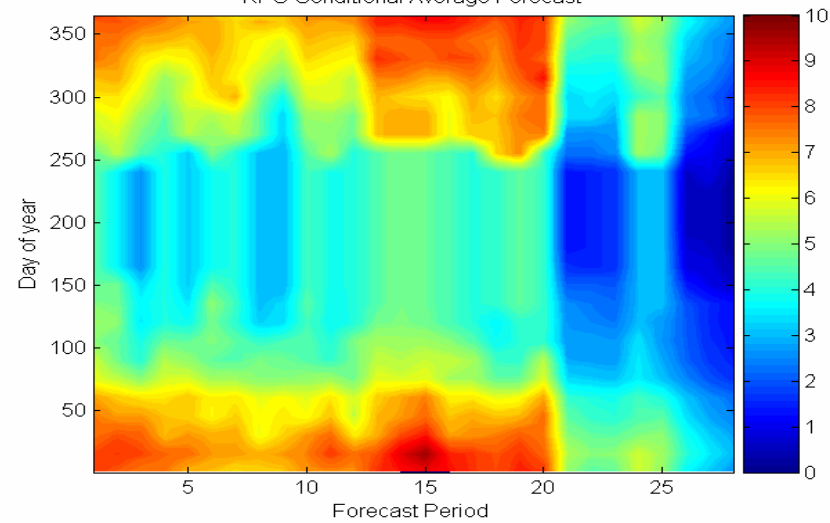
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RFC Conditional Average Observation



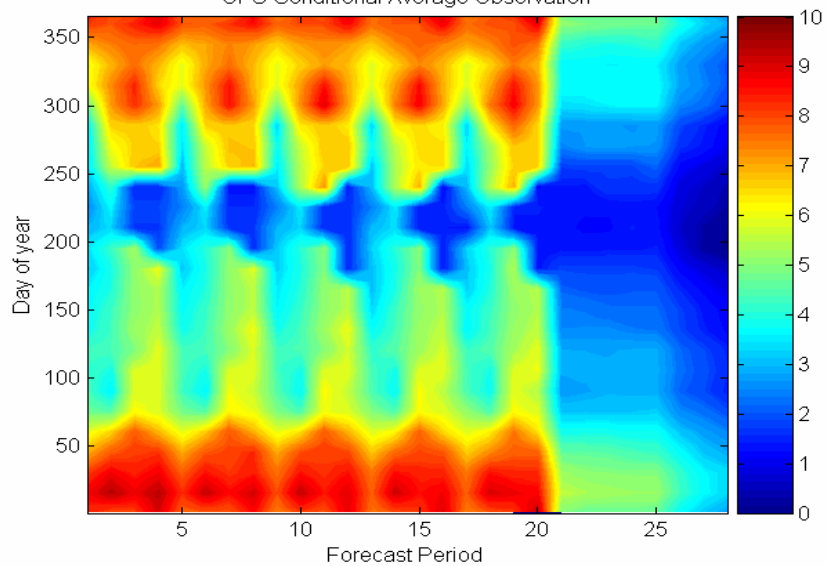
(a)

RFC Conditional Average Forecast



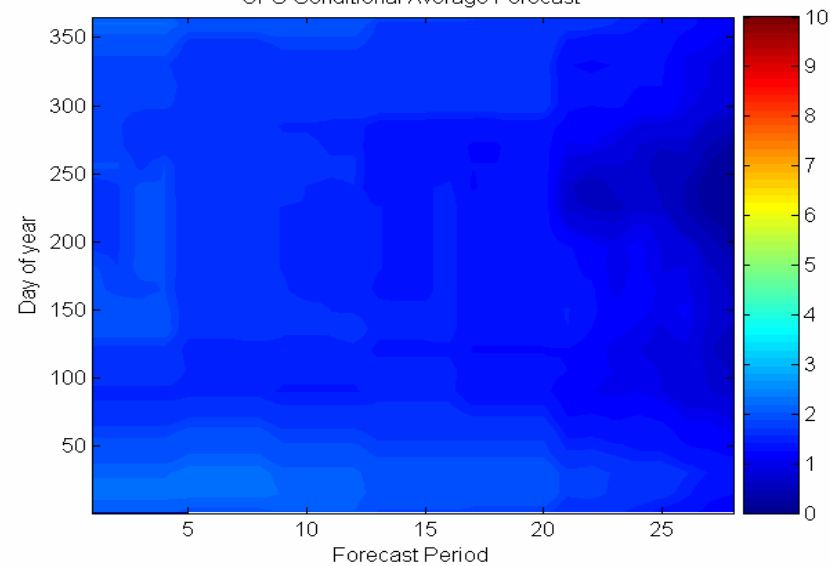
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GFS Conditional Average Observation



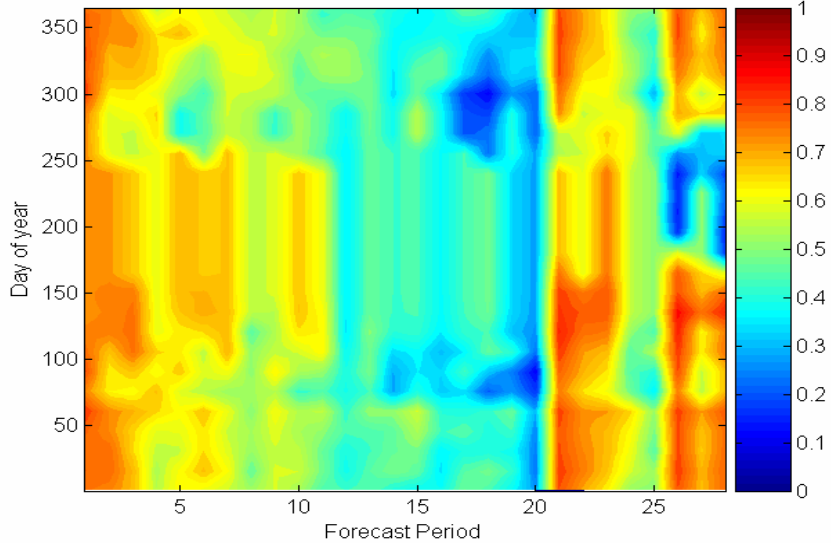
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GFS Conditional Average Forecast



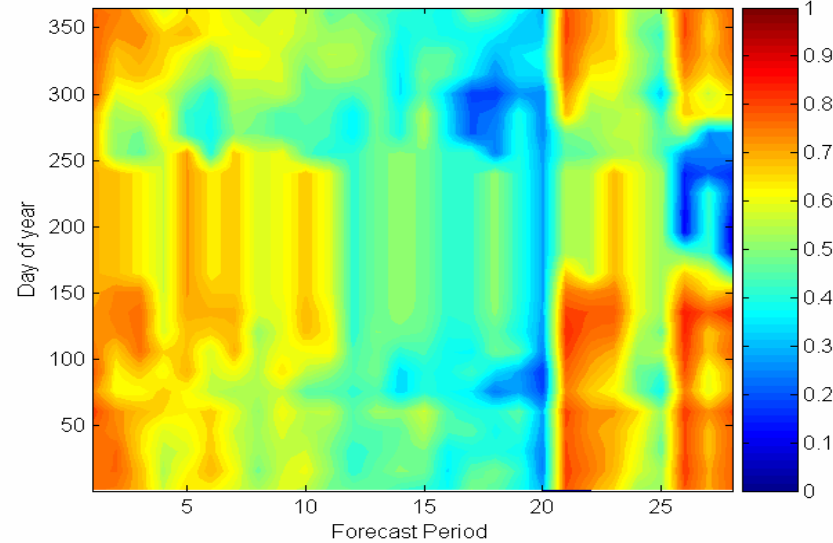
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RFC Precipitation Forecast vs Observation Correlation



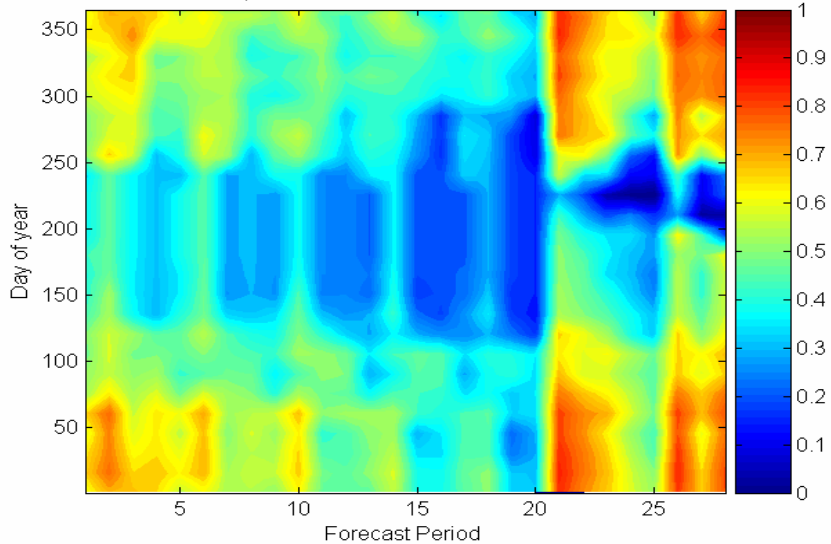
(a)

RFC Precipitation Ensemble Mean Forecast vs Observation Correlation



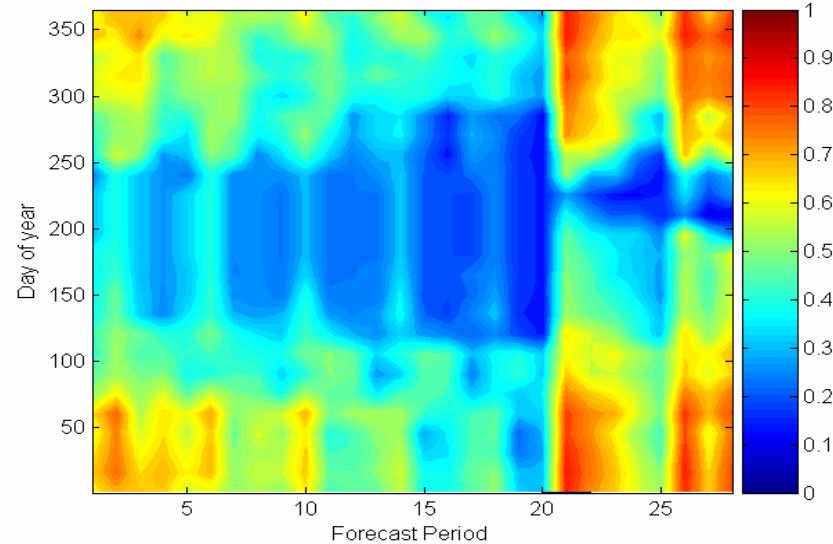
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GFS Precipitation Forecast vs Observation Correlation



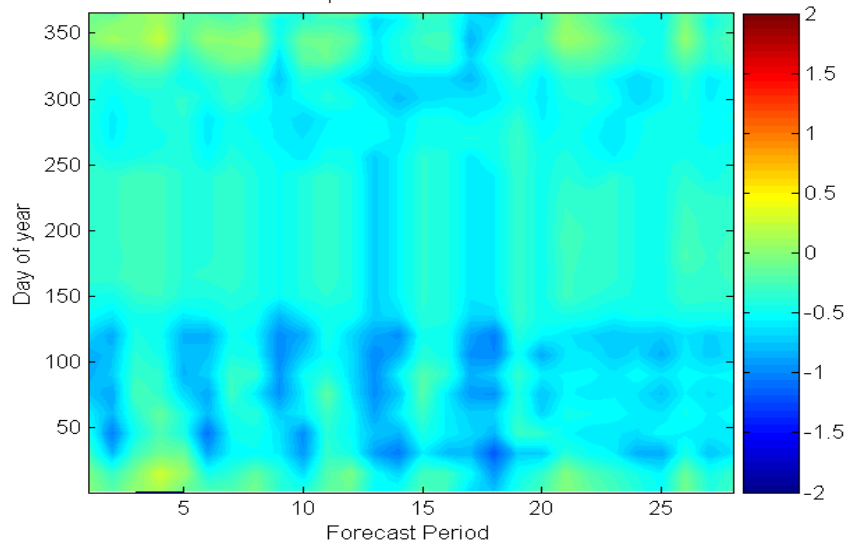
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GFS Precipitation Ensemble Mean Forecast vs Observation Correlation



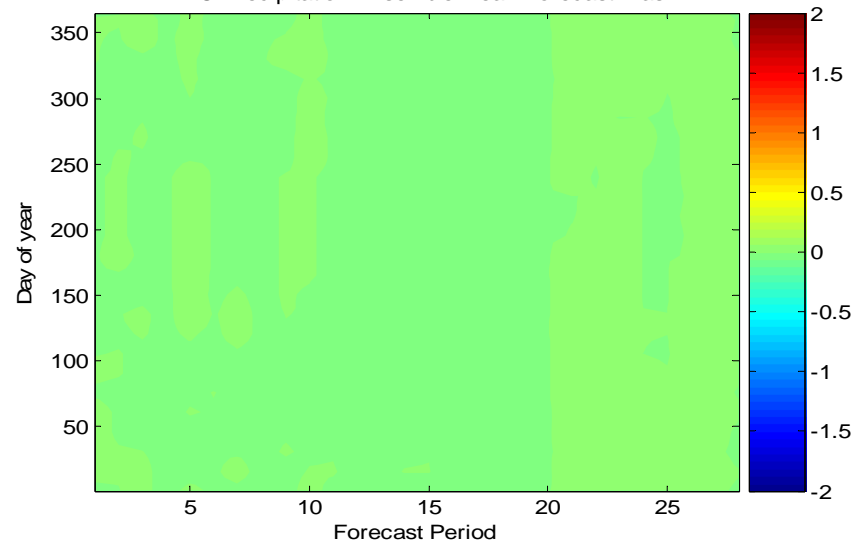
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RFC Precipitation S.V. Forecast Bias



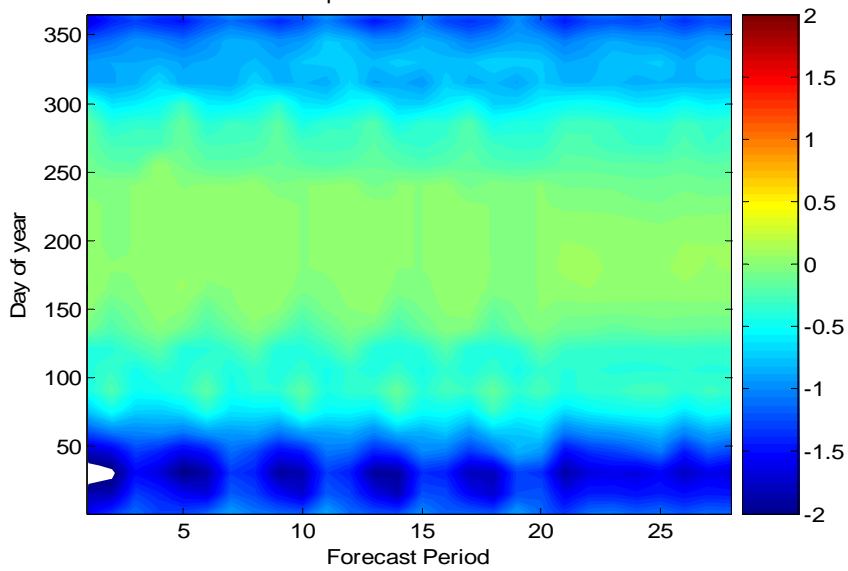
(a)

RFC Precipitation Ensemble Mean Forecast Bias



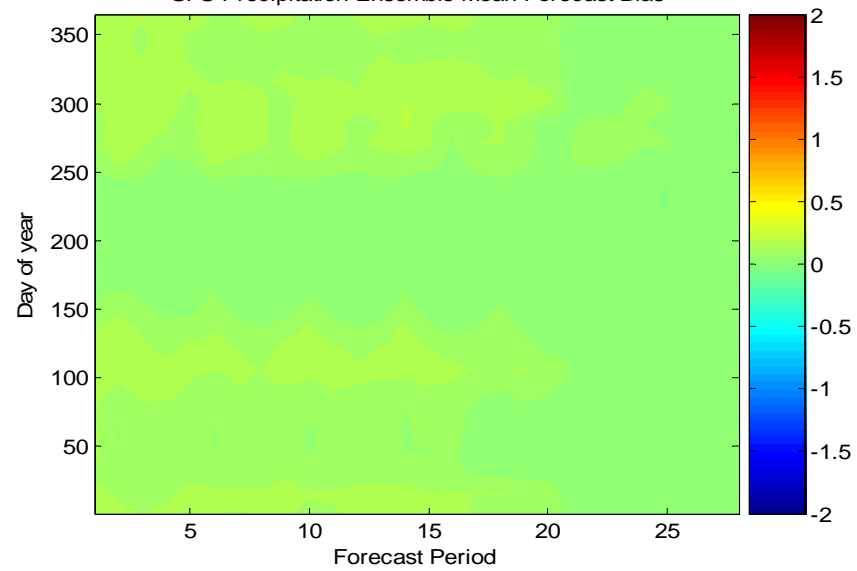
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GFS Precipitation S.V. Forecast Bias



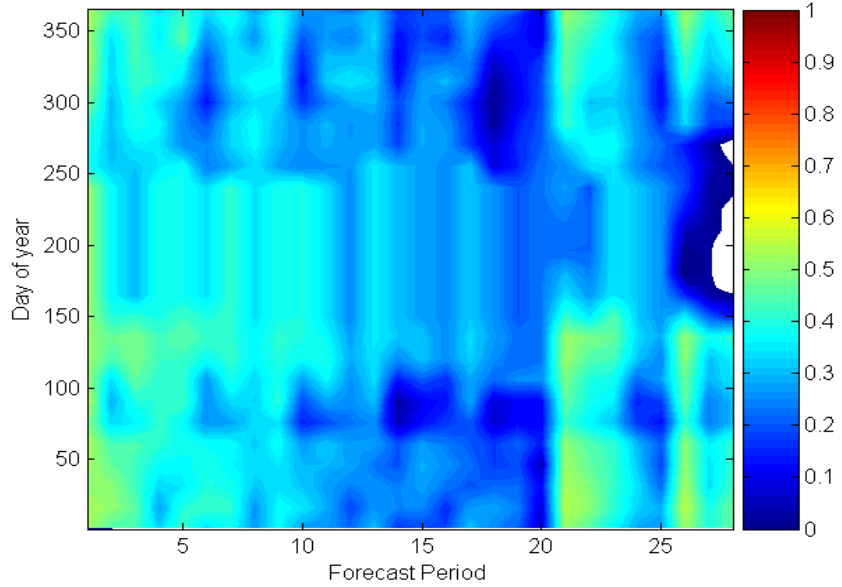
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GFS Precipitation Ensemble Mean Forecast Bias



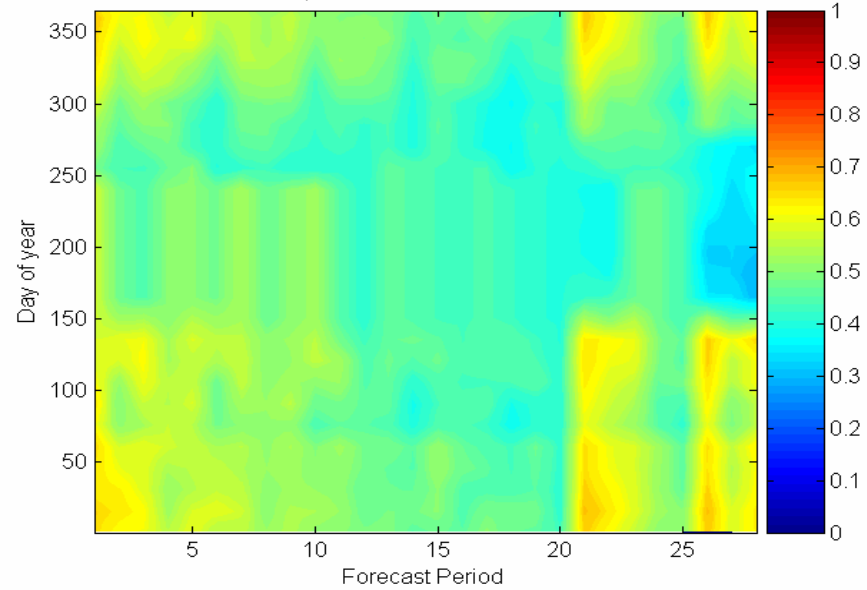
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RFC S.V. Precipitation Forecast CRP Skill Score



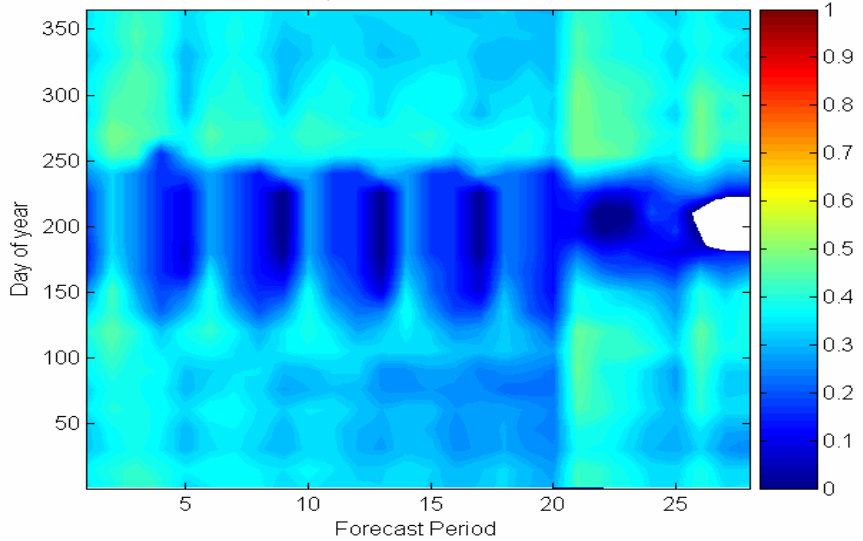
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RFC Precipitation Ensemble CRP Skill Score



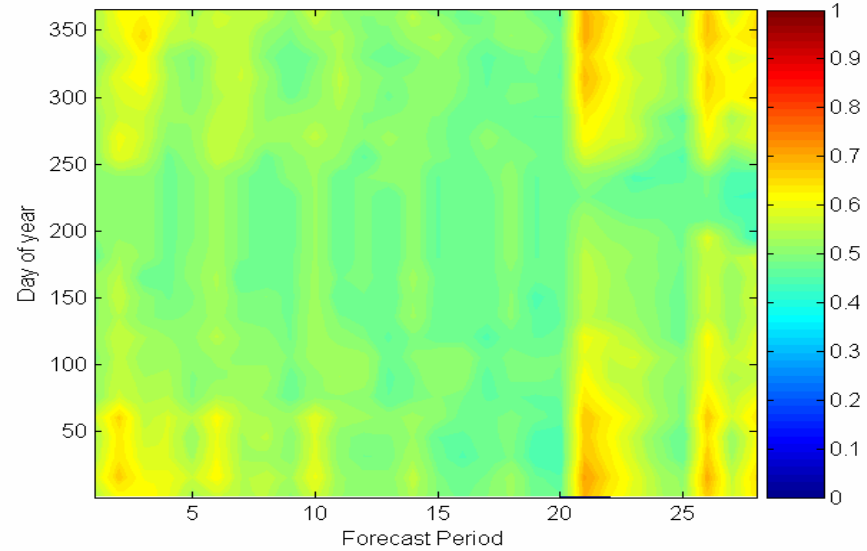
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GFS S.V. Precipitation Forecast CRP Skill Score



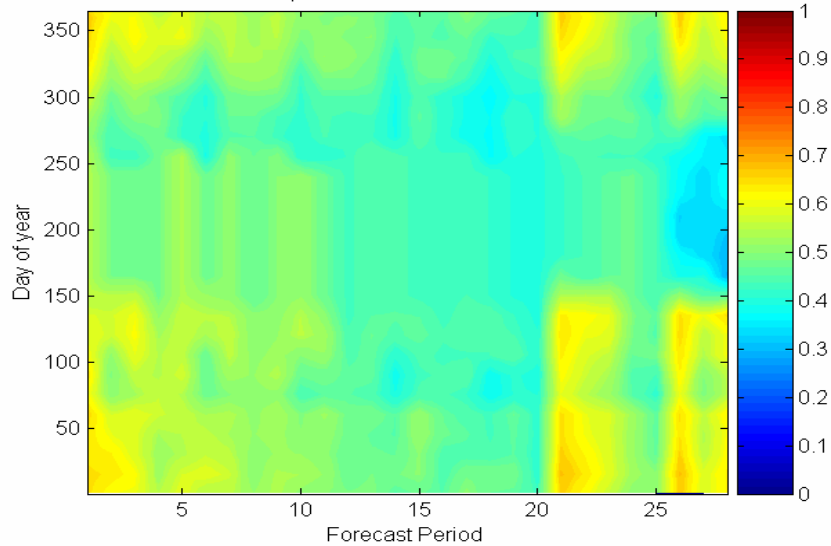
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GFS Precipitation Ensemble CRP Skill Score



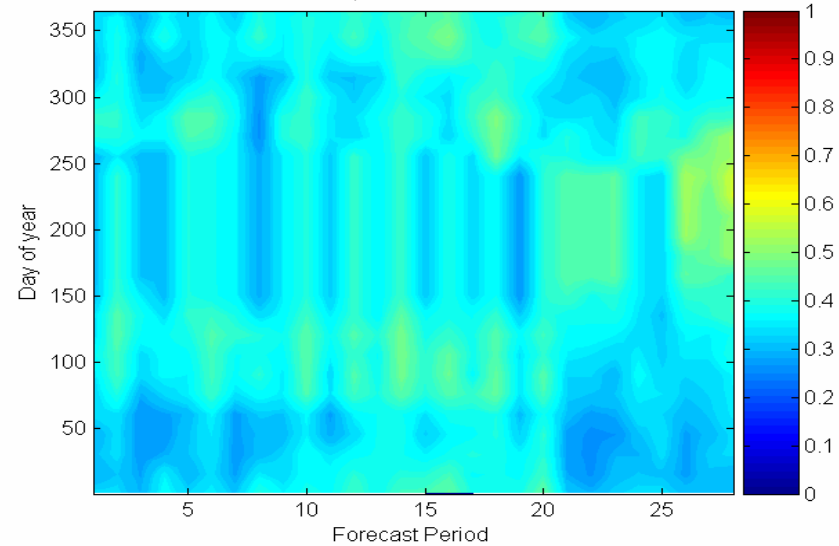
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RFC Precipitation Ensemble CRP Skill Score



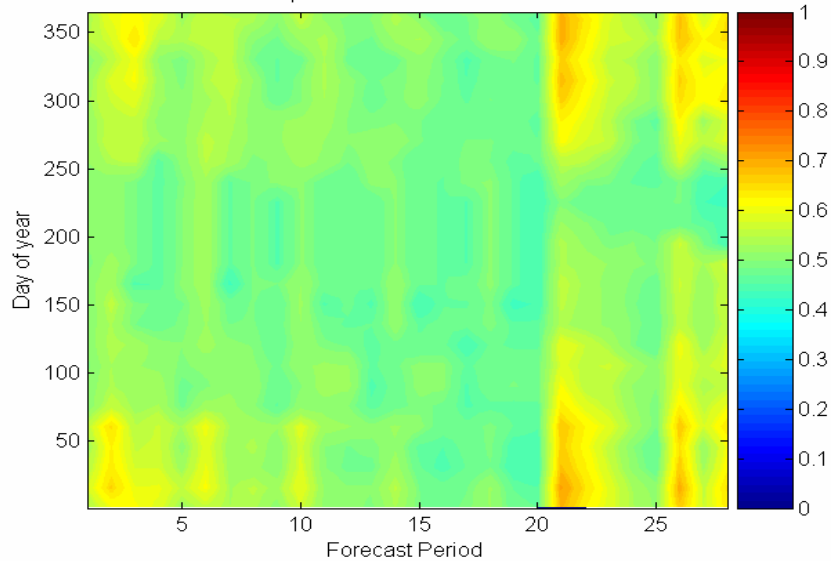
(a)

RFC Conditional Precipitation Ensemble CRP Skill Score



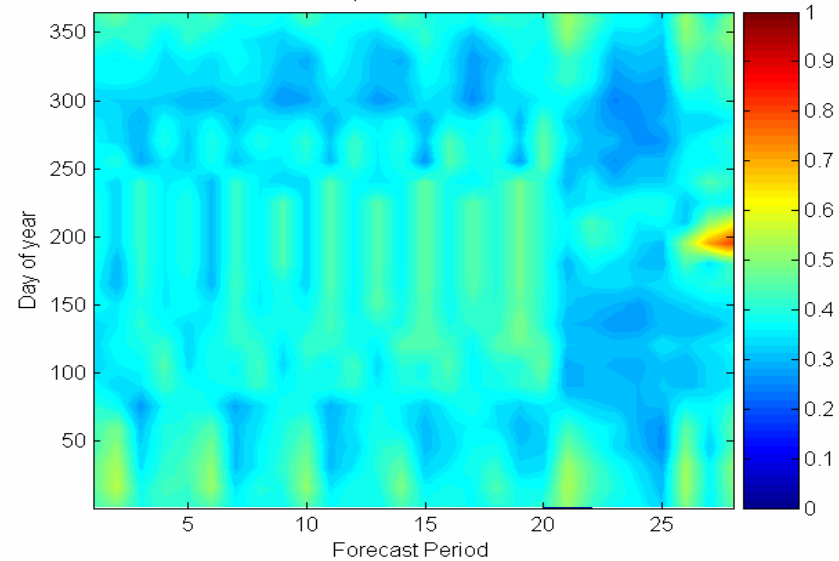
(b)

GFS Precipitation Ensemble CRP Skill Score



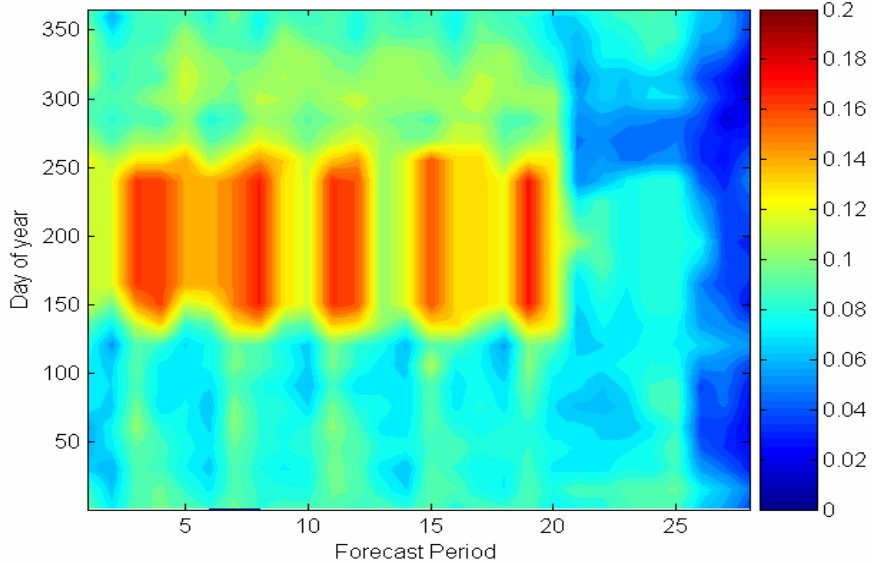
(c)

GFS Conditional Precipitation Ensemble CRP Skill Score



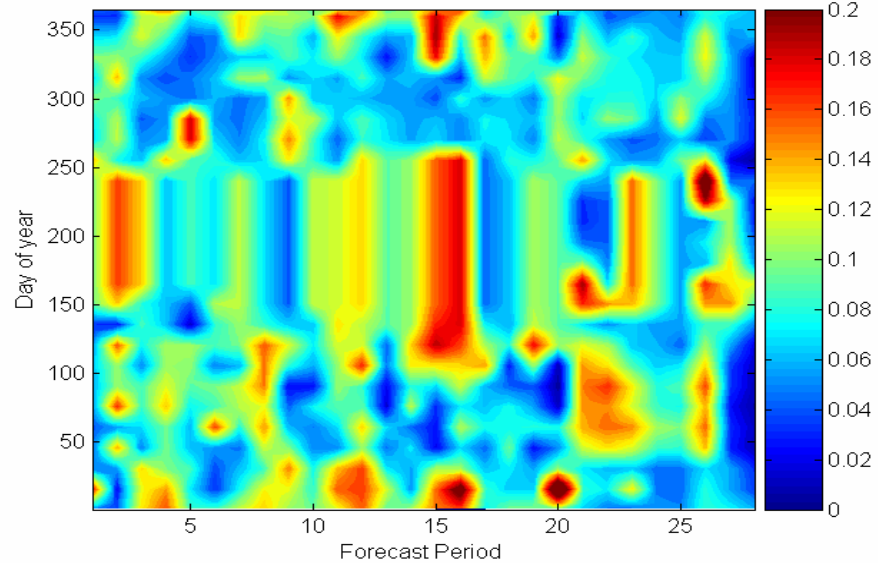
(d)

RFC Conditional Probability RMS Error



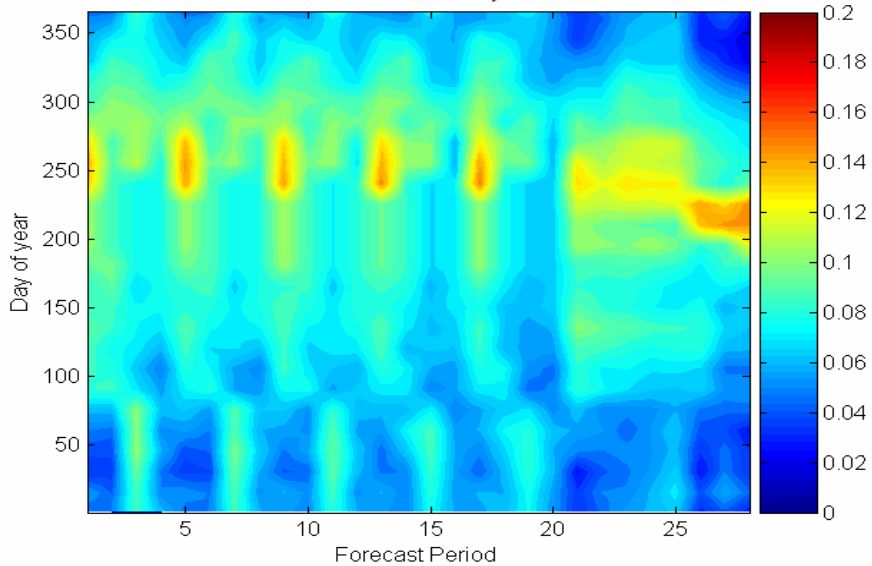
(a)

RFC Precipitation Ensemble POP RMS Error



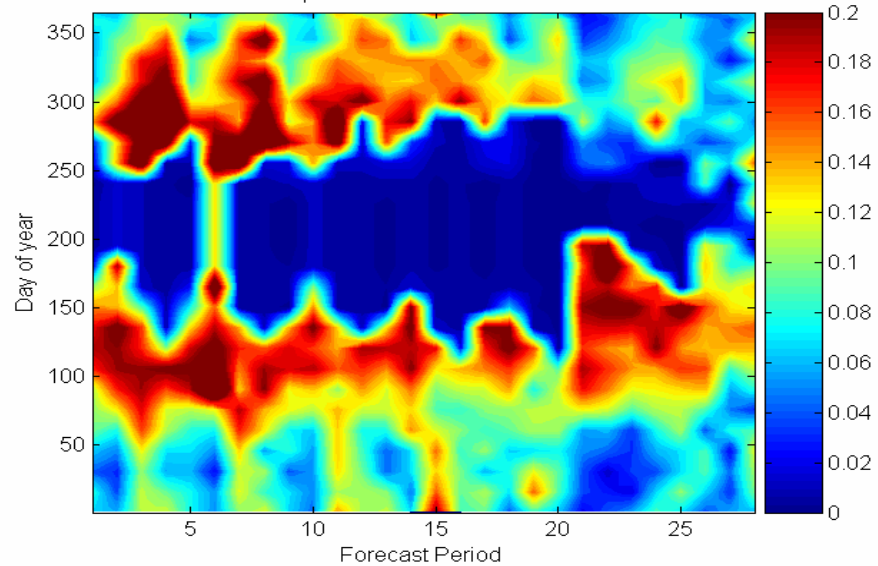
(b)

GFS Conditional Probability RMS Error



(c)

GFS Precipitation Ensemble POP RMS Error



(d)

Thank You