Precipitation Forecast Verification from Operational Weather Models

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Motivation

- The new generation of numerical weather models at convection permitting scales (i.e., ≤ 5 km grid spacing) resolve small convective features
- However, traditional methods for precipitation forecast verification often heavily penalize small displacements of these convective features (e.g., correlation coefficient and equitable threat score)
- Neighborhood verification methods such as fractions skill score (FSS) consider grid cells within a prescribed distance and partially compensate for small displacement errors

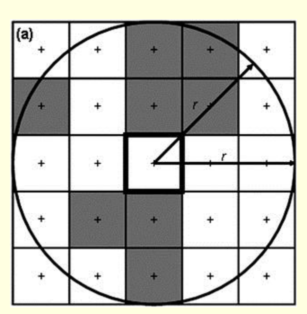
Methodology

- FSS (Roberts and Lean 2008) is a variation of Fractions Brier Score (FBS; Roberts 2005) that utilizes the fraction of neighboring grid cells exceeding a specified accumulation threshold from the forecast (P_M) and observation (P_O) fields:

$$FBS = \frac{1}{N}\sum_{i=1}^{N}(P_M(i) - P_O(i))^2$$

$$FSS = 1 - \frac{FBS}{FBS_{worst}}, \text{ where}$$

$$FBS_{worst} = \frac{1}{N}\sum_{i=1}^{N}(P_M(i)^2 + P_O(i)^2)$$



(From Fig. 3a of Schwartz et al. 2009)

- FSS divides this FBS by the hypothetical worst FBS from the forecast and observed fractional probabilities (P)
- We compute fractional probabilities (P) within a 60 km radius of influence and 1/16th degree verification grid (0.0625° × 0.0625°)
- 6 h precipitation observations are from the NCEP Stage IV dataset (~ 4 km) derived from gauges and radar estimates
- Bias score also computed:

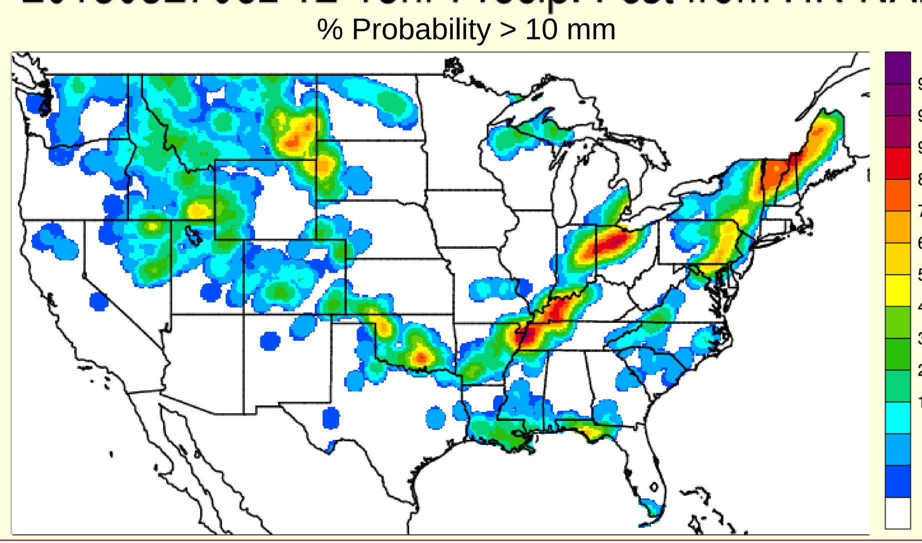
$$Bias = \frac{\sum_{i=1}^{N} P_M(i)}{\sum_{i=1}^{N} P_O(i)}$$

Real Time Forecast Probabilities

- The fractional probabilities for various six-hour precipitation accumulation thresholds can be a useful field for forecasters
- Fine scale details of high-resolution forecasts (whose exact placement is often devoid of skill) are smoothed, but indications of the chance of localized heavy accumulations are preserved

2015052706z 12-18hr Precip. Fcst from HR-NAM

% Probability > 10 mm



Model Comparison of Precipitation Forecast Skill: FSS (r=60 km)

Models Compared:

- High-Resolution Rapid Refresh (HRRR; ~3 km horizontal grid spacing)
- NCEP High-Resolution Window (HIRESW) using WRF-ARW core (~4.2 km)
- NCEP HIRESW using WRF-NMMB core (~3.6 km)
- High-Resolution North American Mesoscale (HR-NAM; ~5 km)
- North American Mesoscale (NAM; ~12 km)
- Rapid Refresh (RAP; ~13 km)
- Global Forecast System (GFS; 0.25°; 0.5° prior to 15 January 2015)
- Global Ensemble Forecast System (1.0°; 21 members)
- Short Range Ensemble Forecast (SREF) using WRF-ARW core (~16 km; 7 members)
- SREF using WRF-NMM core (~16 km; 7 members)
- SREF using WRF-NMMB core (~16 km; 7 members)
- Equally weighted average of fractional probabilities from all 11 models
- Equally weighted average of fractional probabilities from all 4 high-resolution models

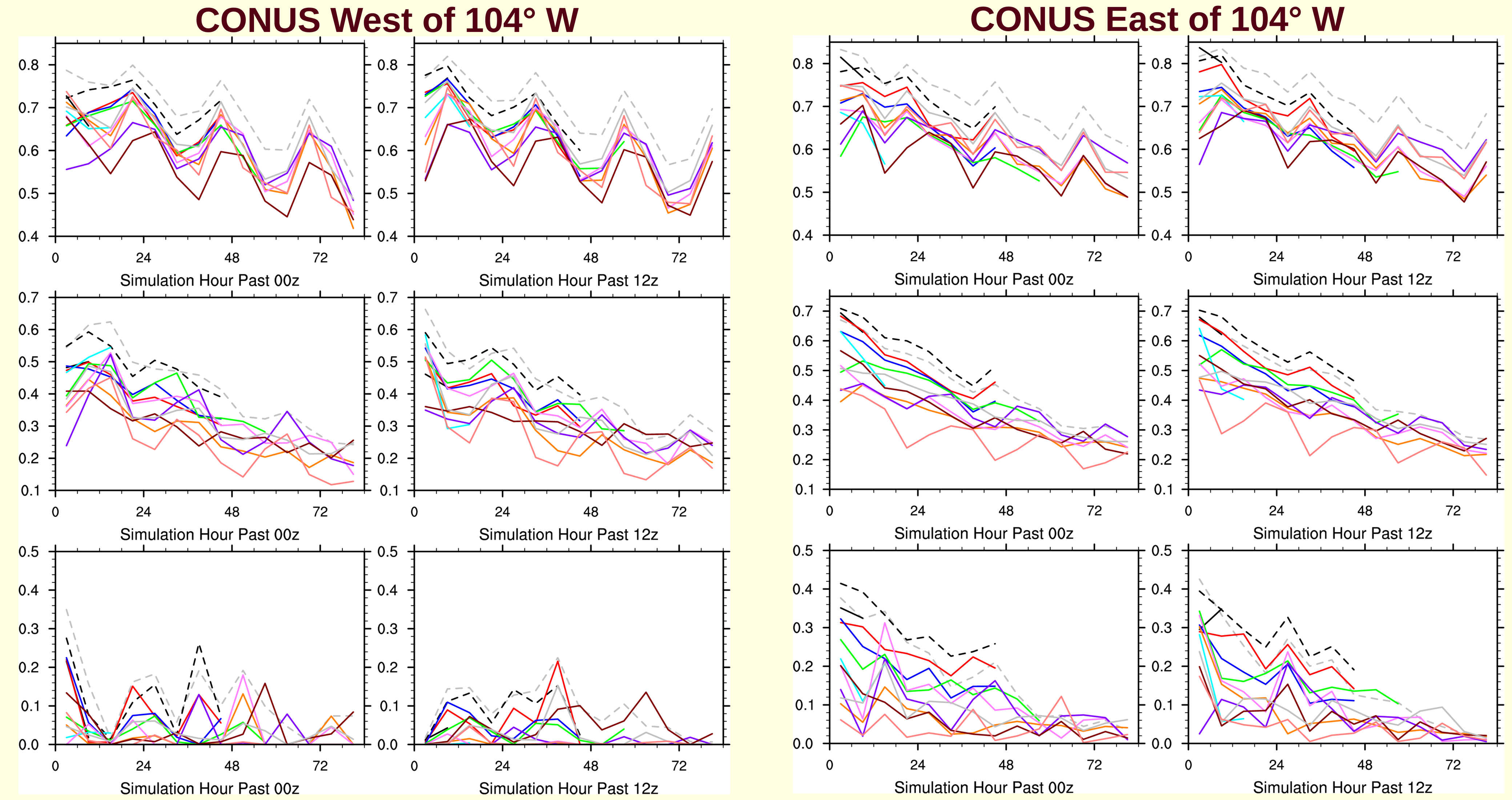
Warm Season (April-Sept. 2015) FSS

CONUS West of 104° W | CONUS East of 104° W

1 mm

10 mm

50 mm



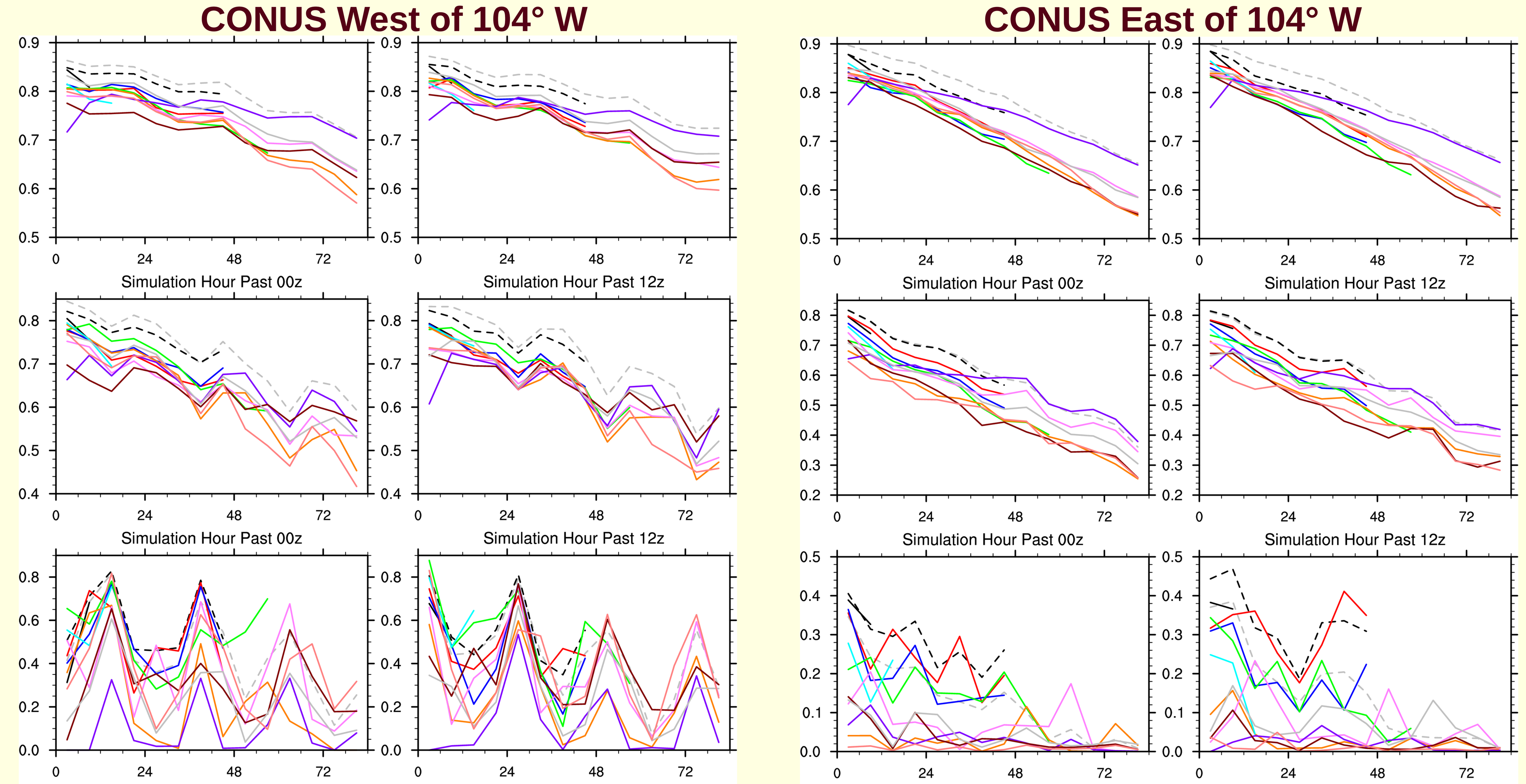
Cold Season (Oct. 2014 - March 2015) FSS

CONUS West of 104° W | CONUS East of 104° W

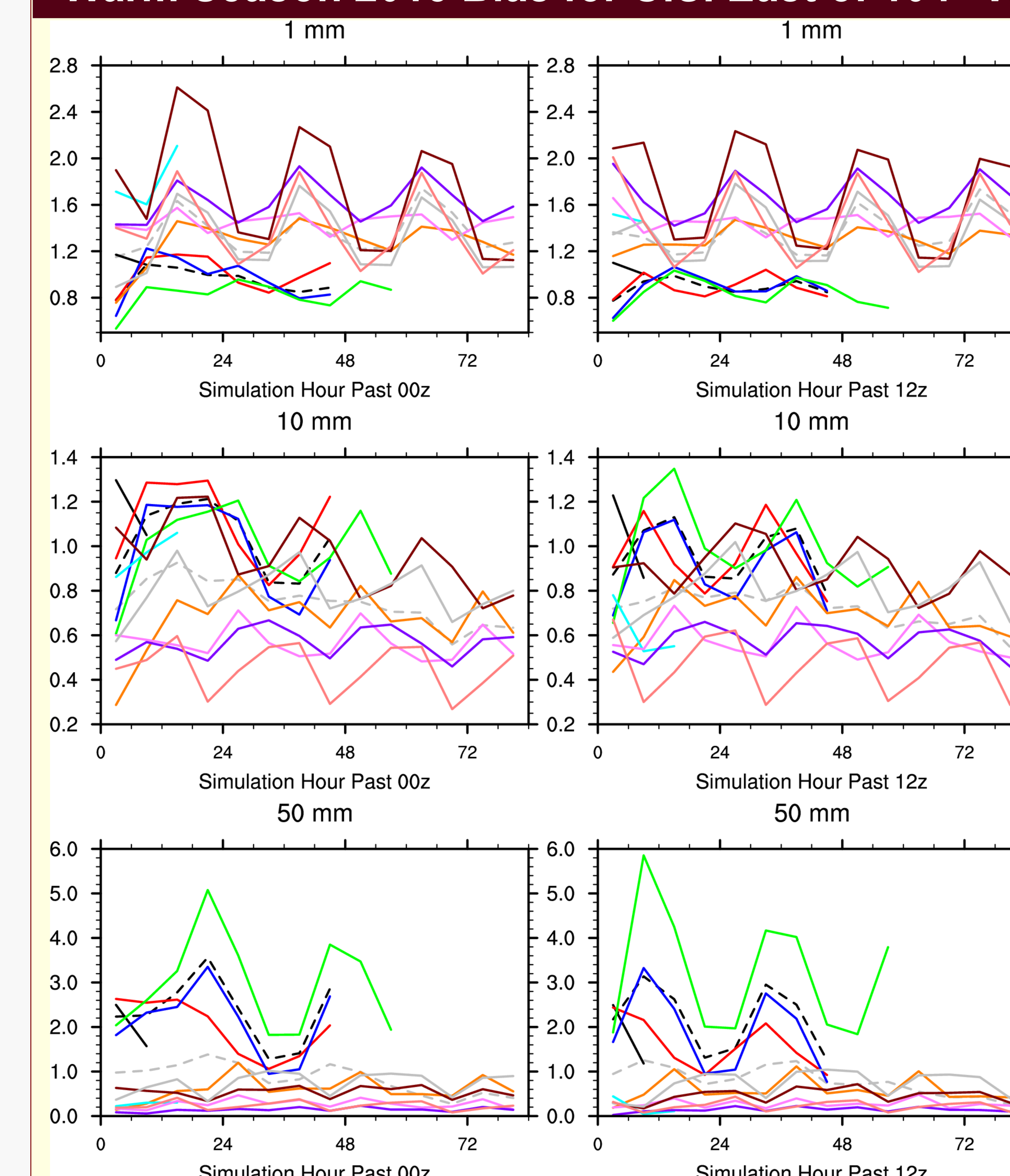
1 mm

10 mm

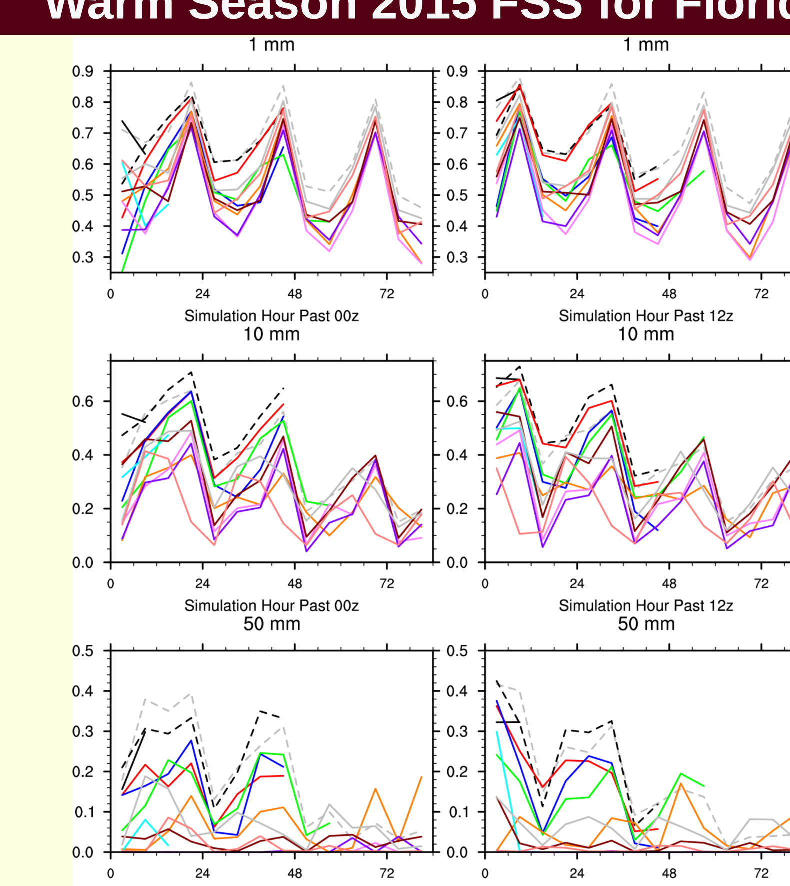
50 mm



Warm Season 2015 Bias for U.S. East of 104° W



Warm Season 2015 FSS for Florida



See More Results Online at:

http://fuelberg.met.fsu.edu/~marchand/apcp/pcpveri.html