

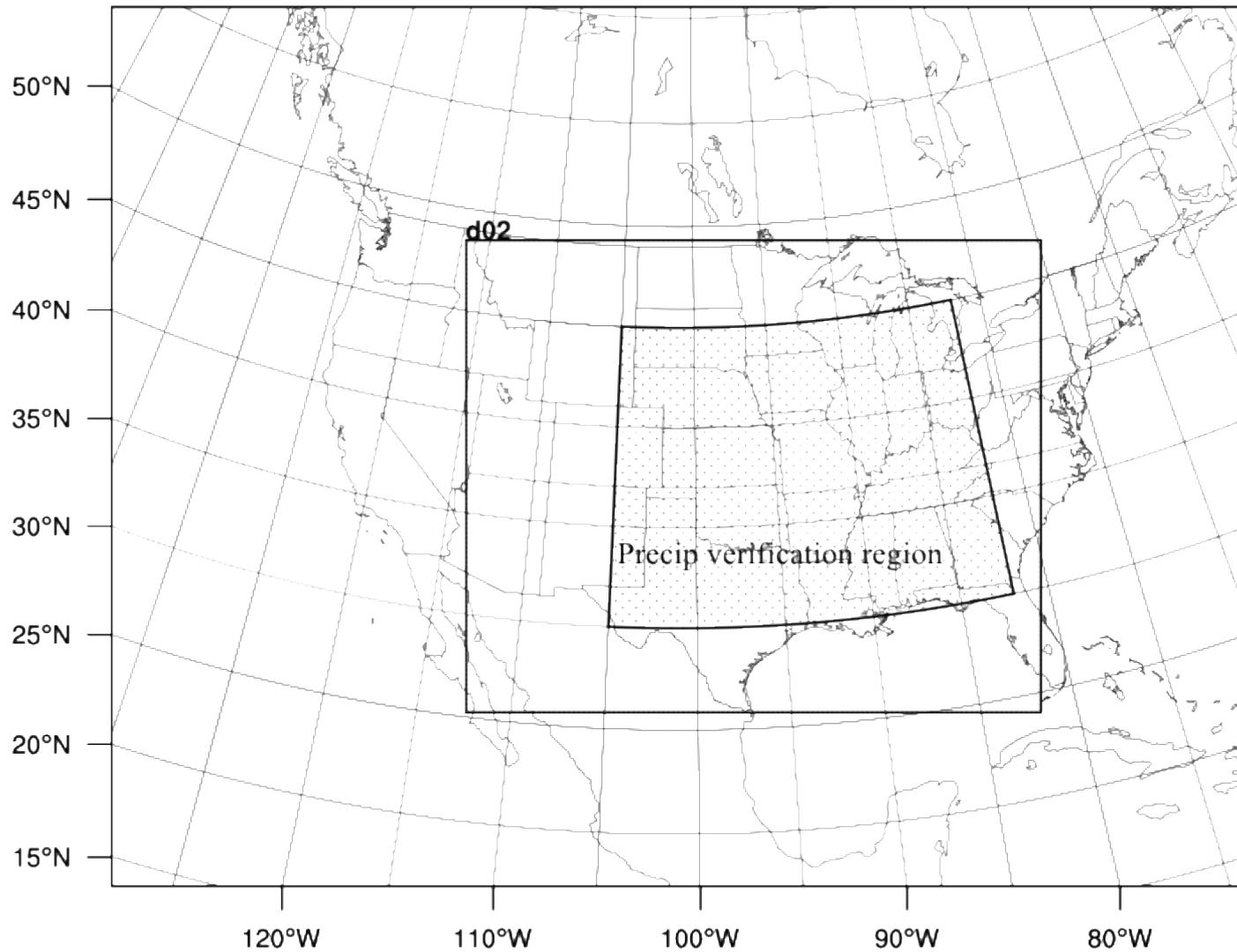
# **Preliminary precipitation verification of some MPEX forecasts**

**Craig Schwartz and Kevin Manning  
(or Kevin Manning and Craig Schwartz)**

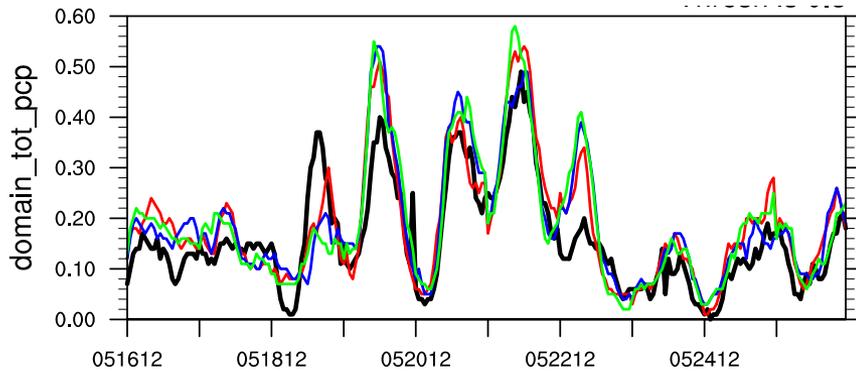
# Verification information

- Retrospective evaluation of NCAR-produced MPEX forecasts
  - EnKF-initialized ensemble of WRF model forecasts
  - GFS-initialized deterministic WRF model forecasts
- 30-member ensembles initialized from 1200 UTC (36 cases total)
- All statistics are aggregated hourly over many cases
- NCEP Stage IV precipitation considered the “truth”

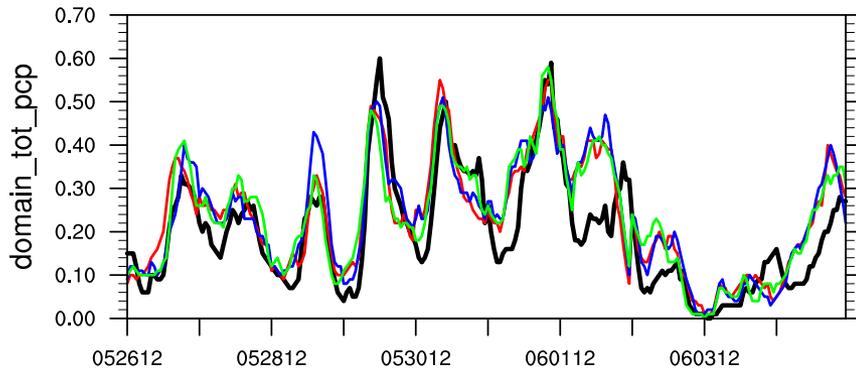
# WRF domains and verification region



# Precipitation “calendar”

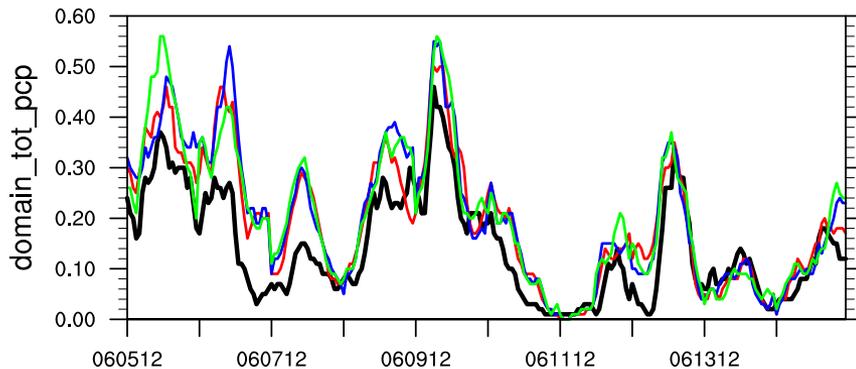


Normalized total precipitation over the verification domain, each hour from 1200 UTC May 16 to 1200 UTC June 15



**BLACK: Stage IV**

**Colors: Randomly-chosen ensemble members**

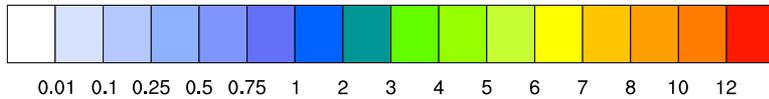
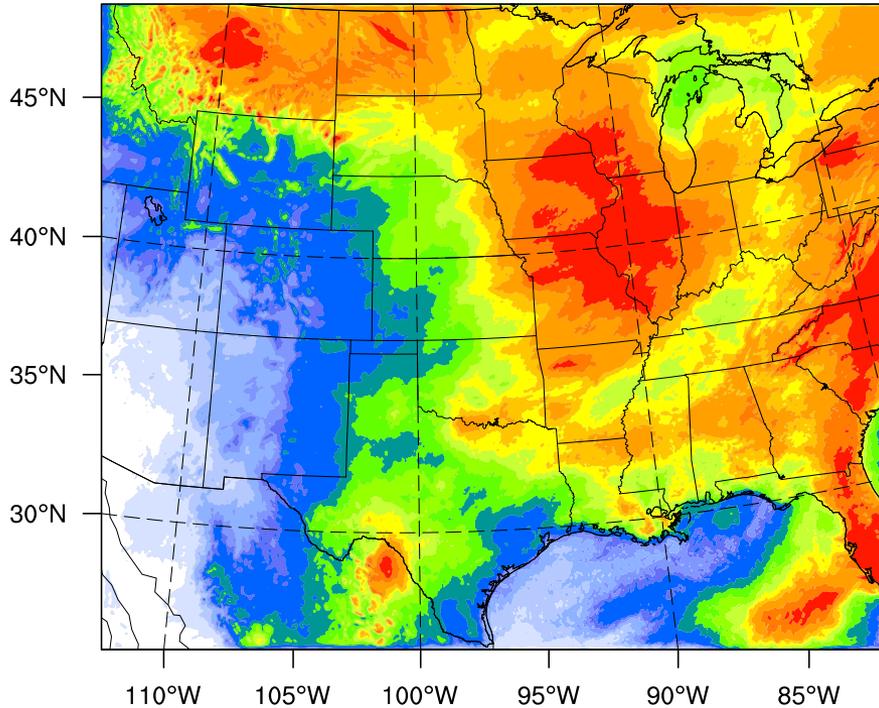


Date

# Average daily precipitation

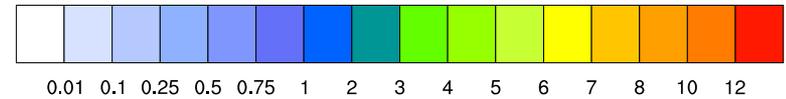
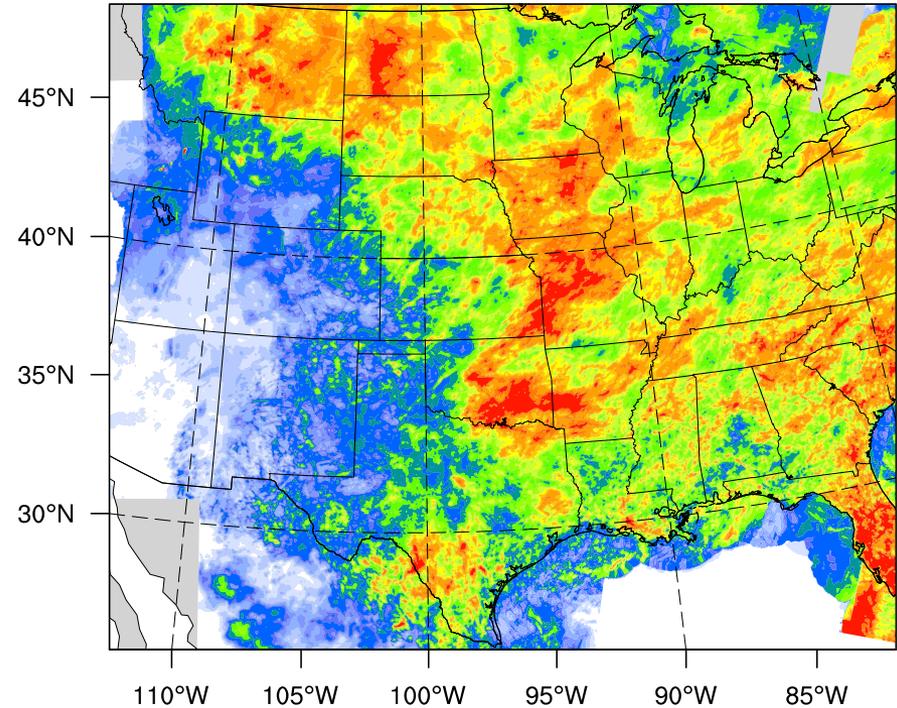
- 0-36-hr precipitation averaged over 1200 UTC initializations from May 14 to June 15

Ensemble mean



Average 36-hr accumulated precipitation (mm)

Stage IV

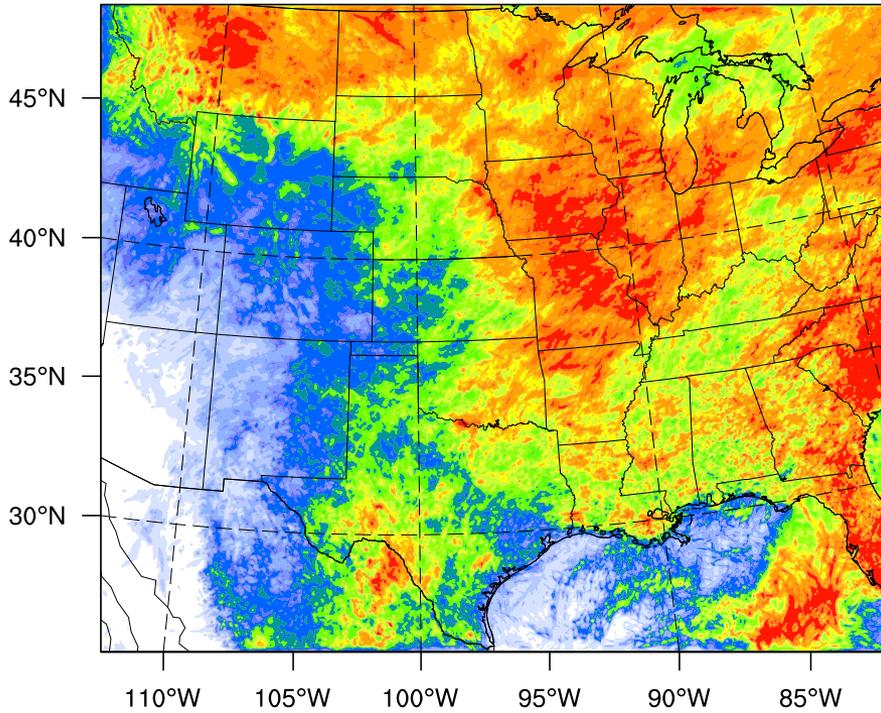


Average 36-hr accumulated precipitation (mm)

# Average daily precipitation

- 0-36-hr precipitation averaged over 1200 UTC initializations from May 14 to June 15

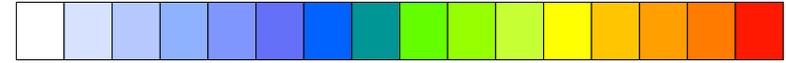
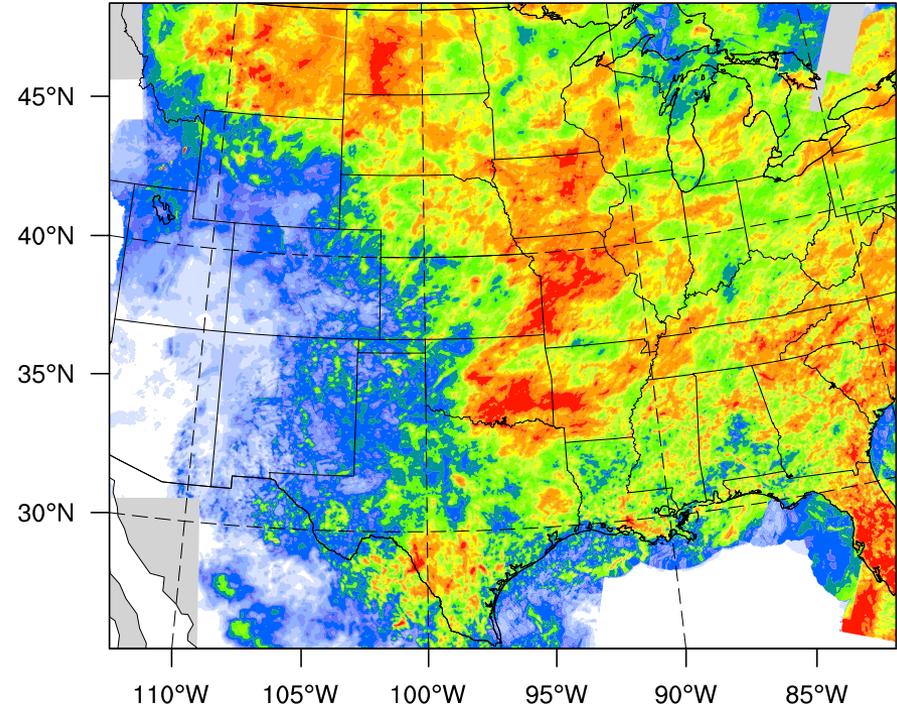
Ensemble member 1



0.01 0.1 0.25 0.5 0.75 1 2 3 4 5 6 7 8 10 12

Average 36-hr accumulated precipitation (mm)

Stage IV



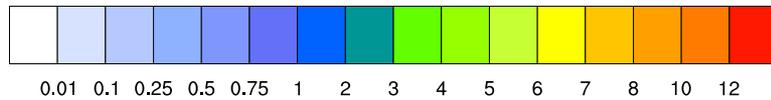
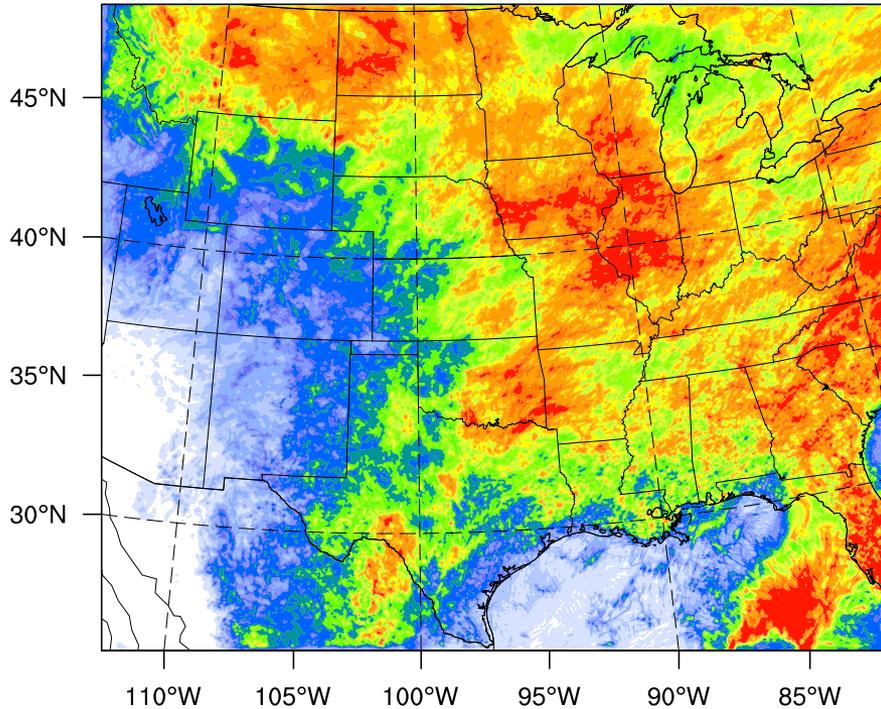
0.01 0.1 0.25 0.5 0.75 1 2 3 4 5 6 7 8 10 12

Average 36-hr accumulated precipitation (mm)

# Average daily precipitation

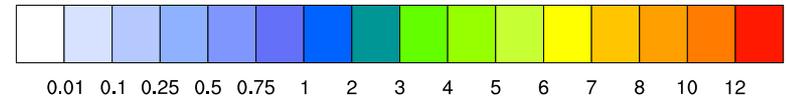
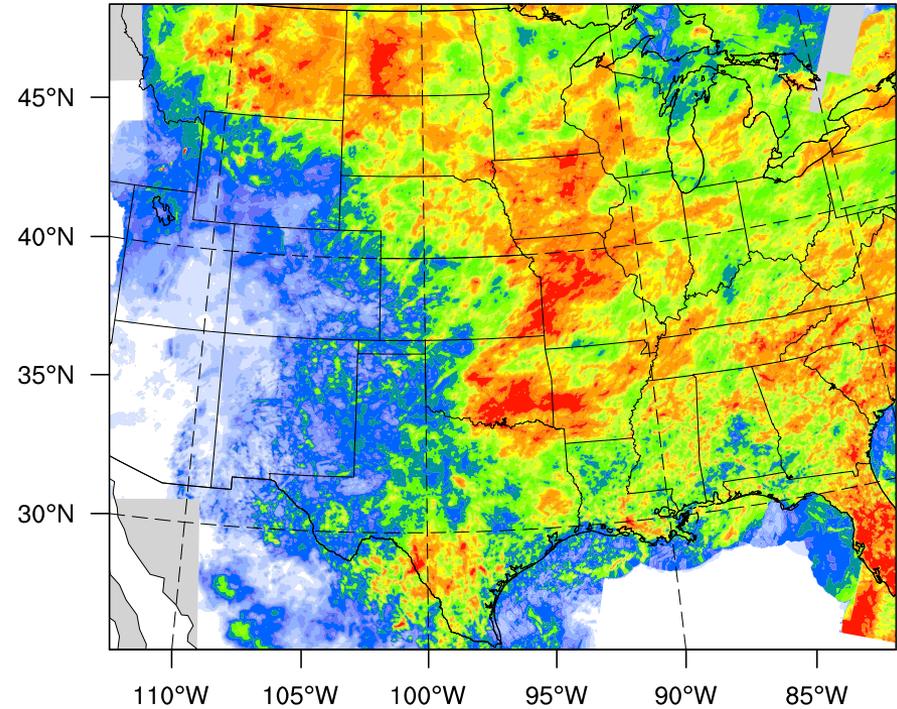
- 0-36-hr precipitation averaged over 1200 UTC initializations from May 14 to June 15

GFS initial conditions



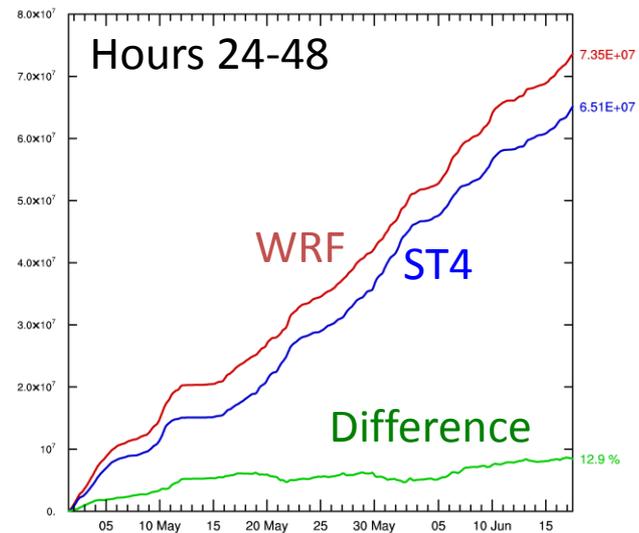
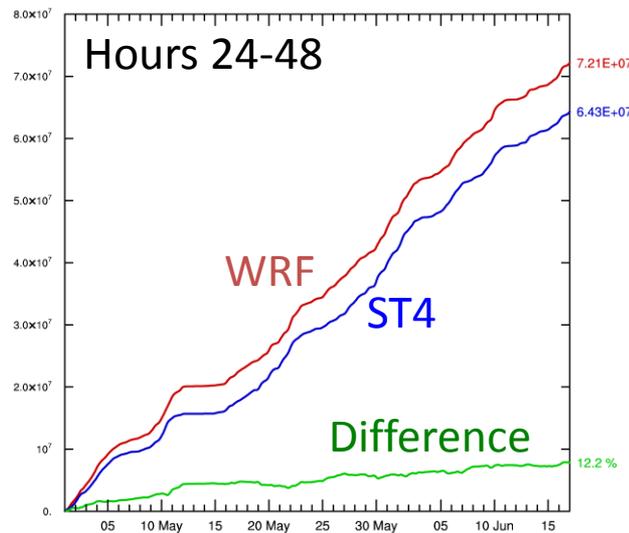
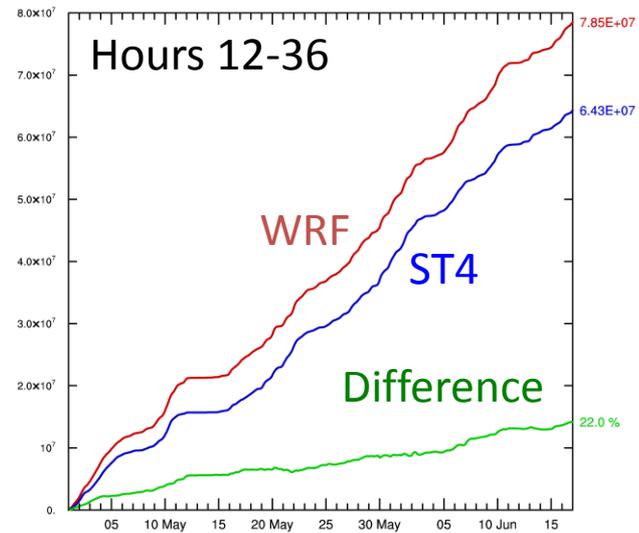
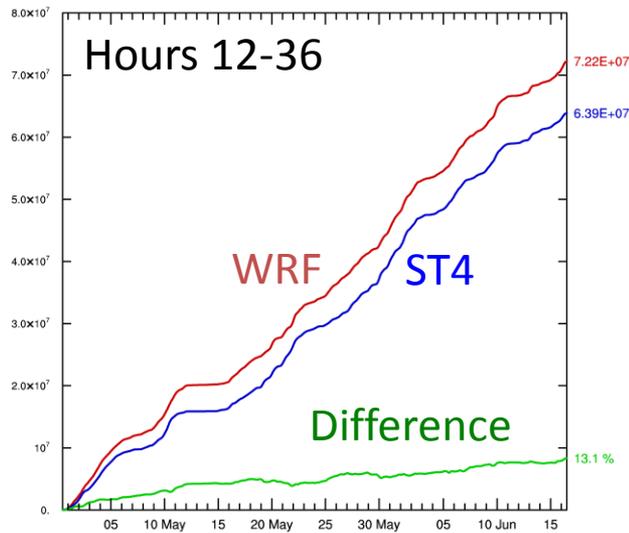
Average 36-hr accumulated precipitation (mm)

Stage IV



Average 36-hr accumulated precipitation (mm)

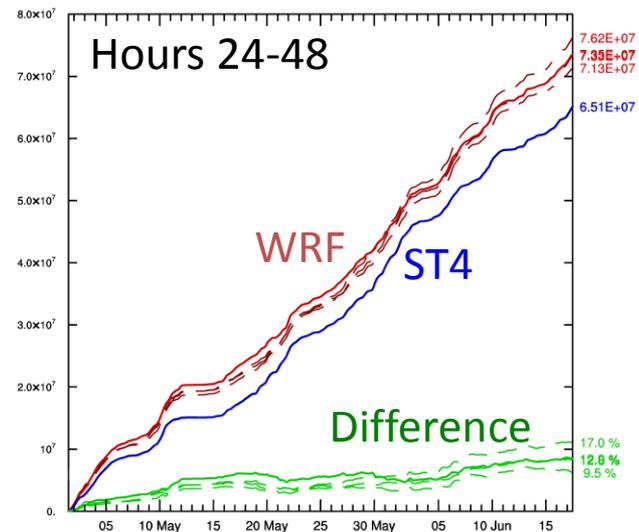
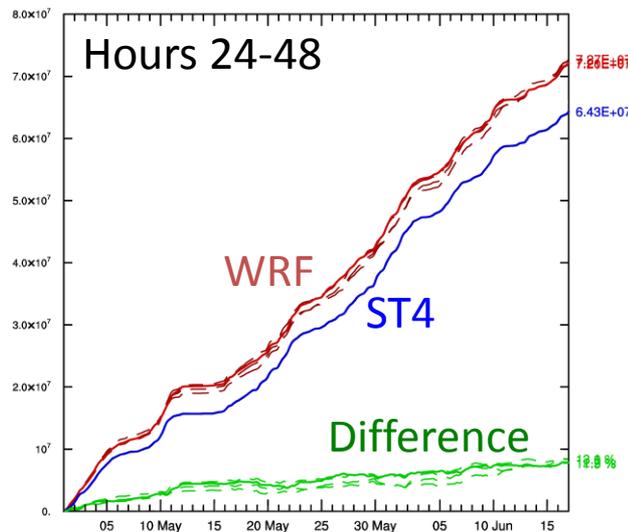
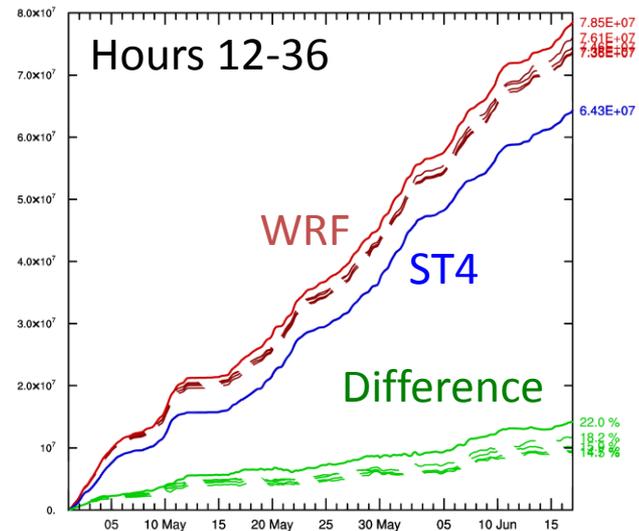
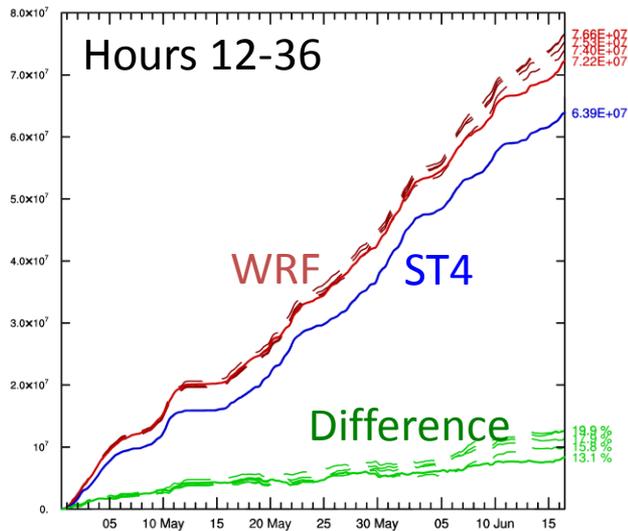
# Total accumulation in verification region accumulated over experiment duration



00 Z Initializations

12 Z Initializations

# Total accumulation in verification region accumulated over experiment duration

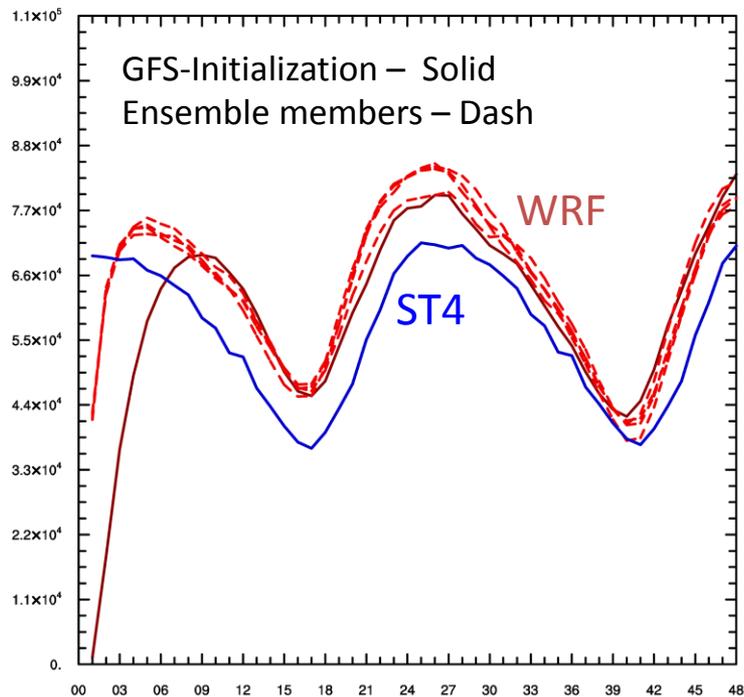


00 Z Initializations

12 Z Initializations

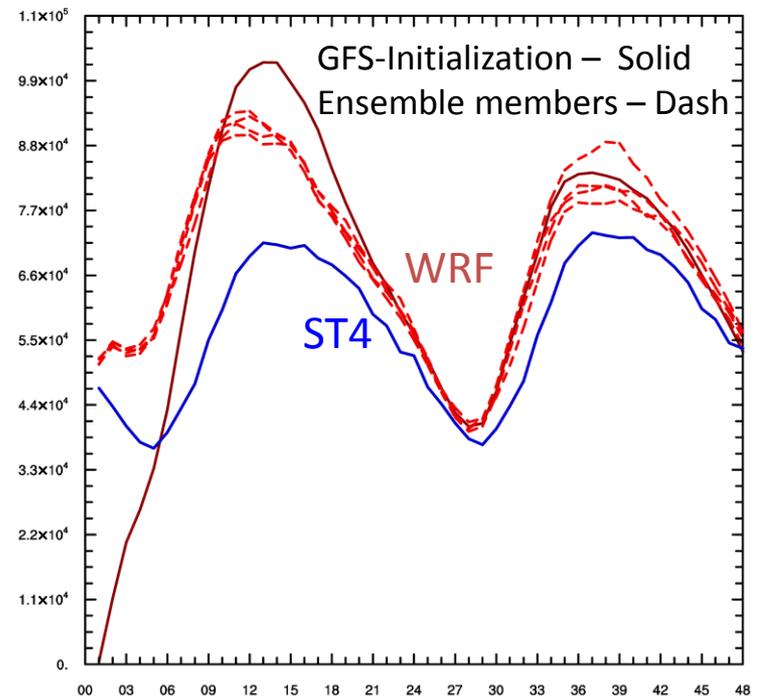
# Average forecast 1-hour accumulations

## 00Z initializations



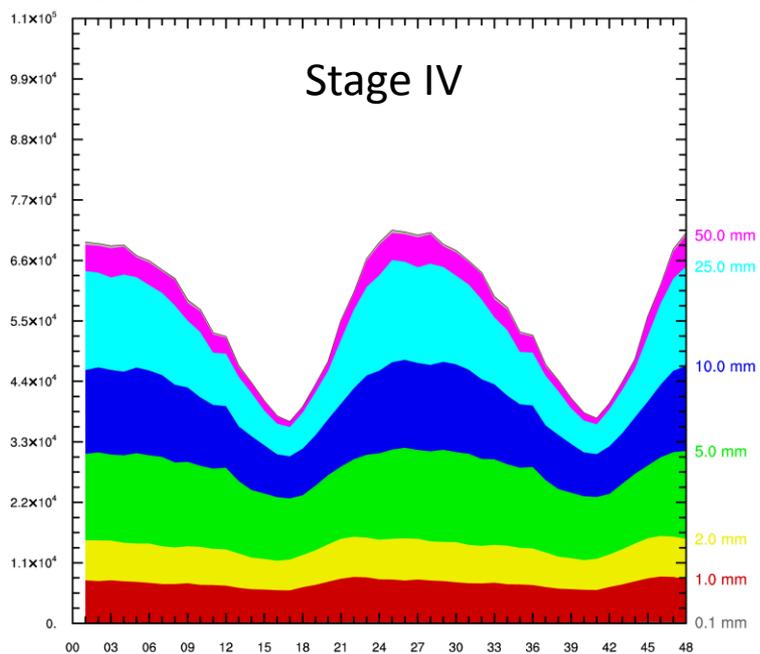
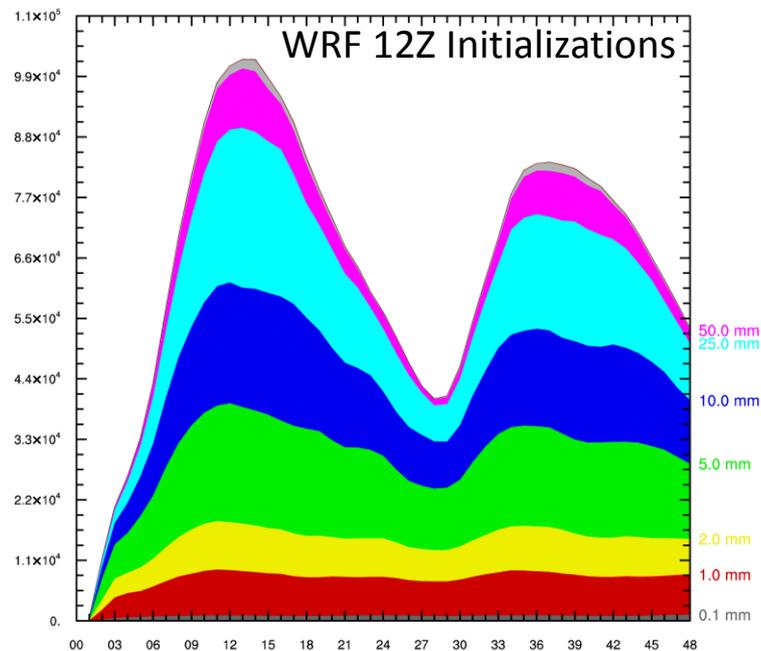
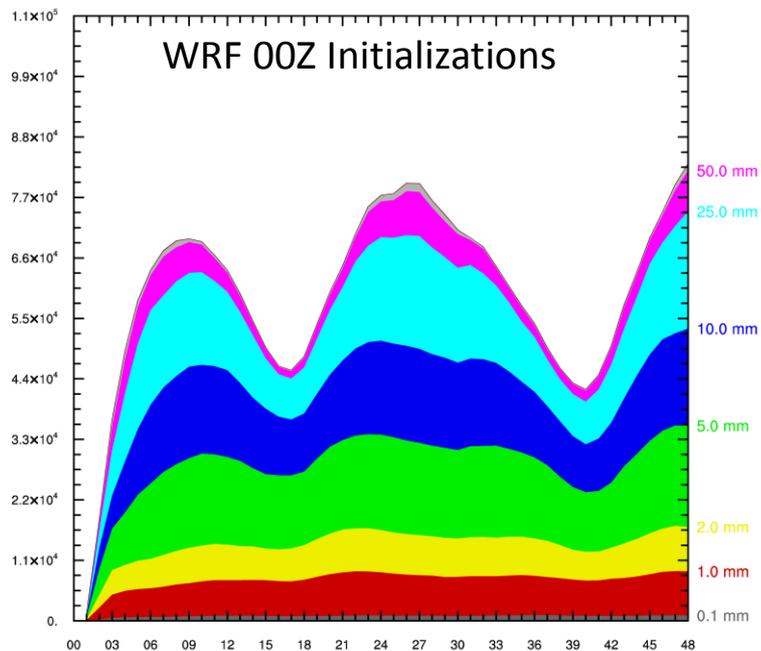
Forecast Hour

## 12Z initializations



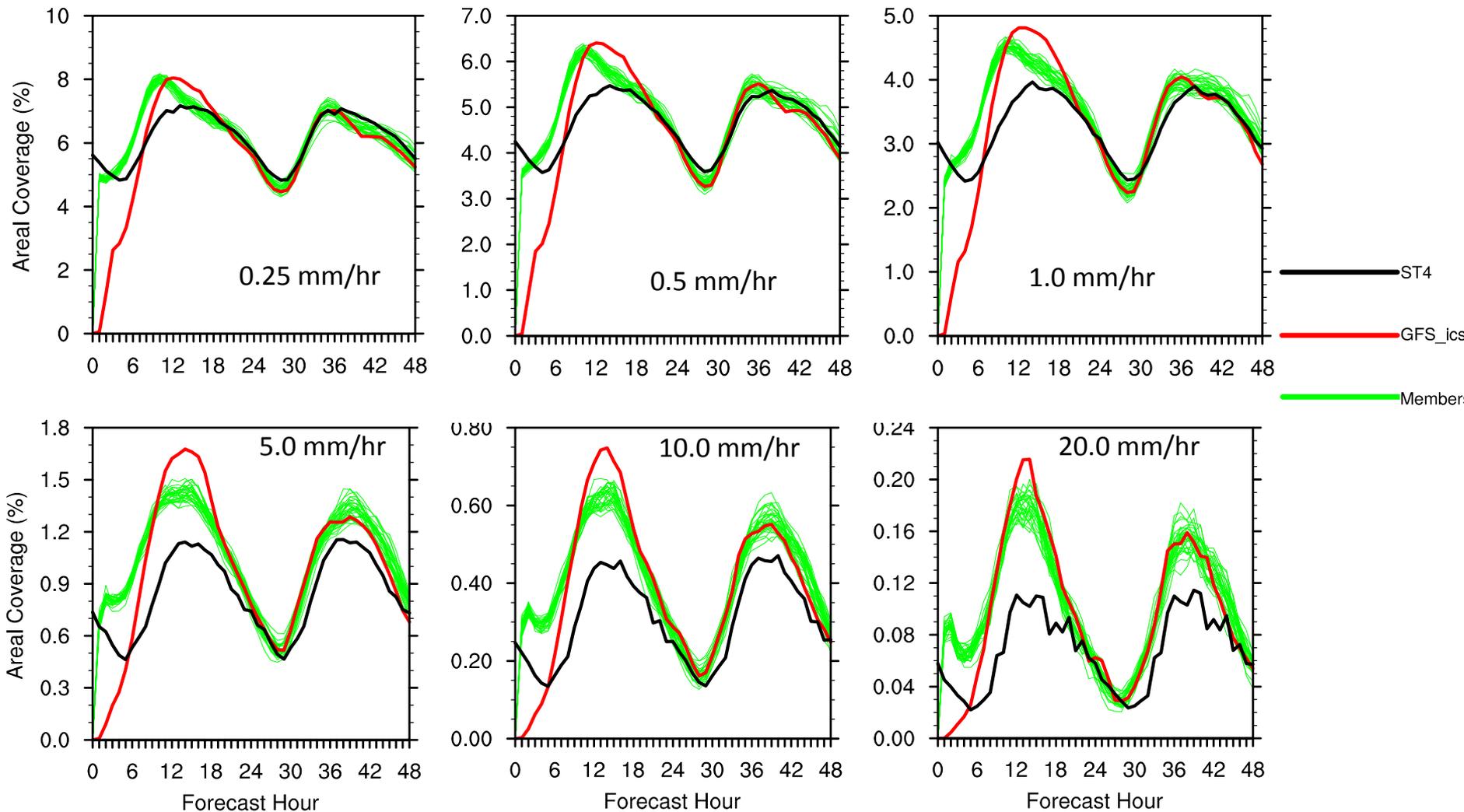
Forecast Hour

# Average forecast total 1-hour accumulations



# Areal coverages

- Aggregated over 36 cases (12 UTC forecasts)

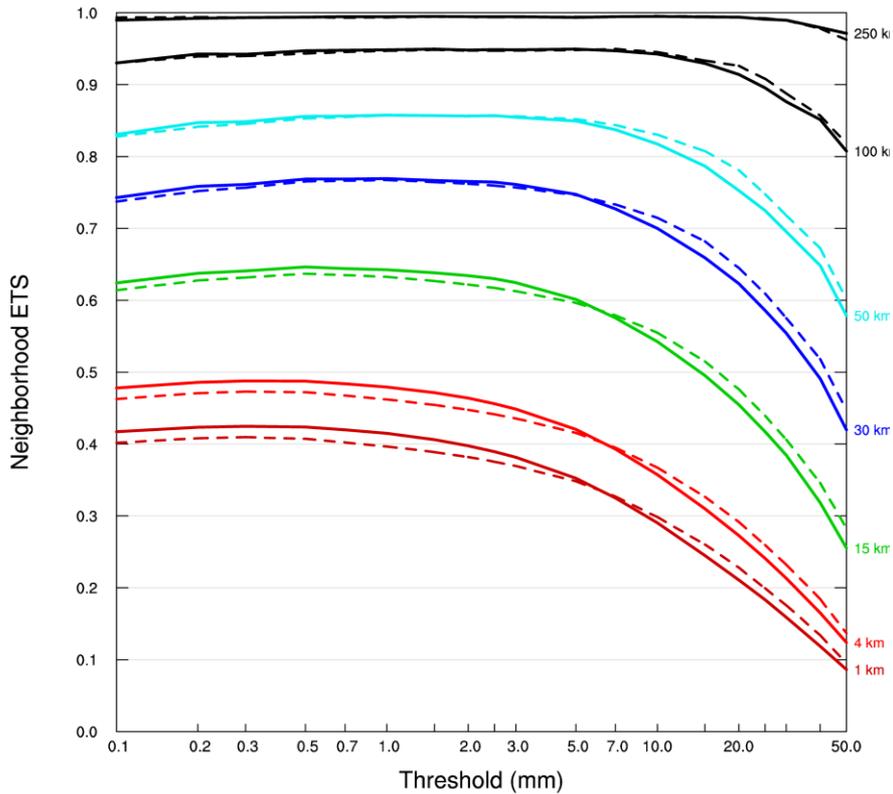


# Neighborhood approach

- Neighborhood Equitable Threat Score
  - Gives credit for “near misses” within a specified radius
- Fractions Skill Score
  - Similar approach as neighborhood ETS
- How does precipitation forecast skill vary...
  - with scale?
  - with diurnal cycle?
  - with initialization time?
  - with forecast lead time?

# 24-hour accumulations – 00 Z initializations compared to 12-Z initializations

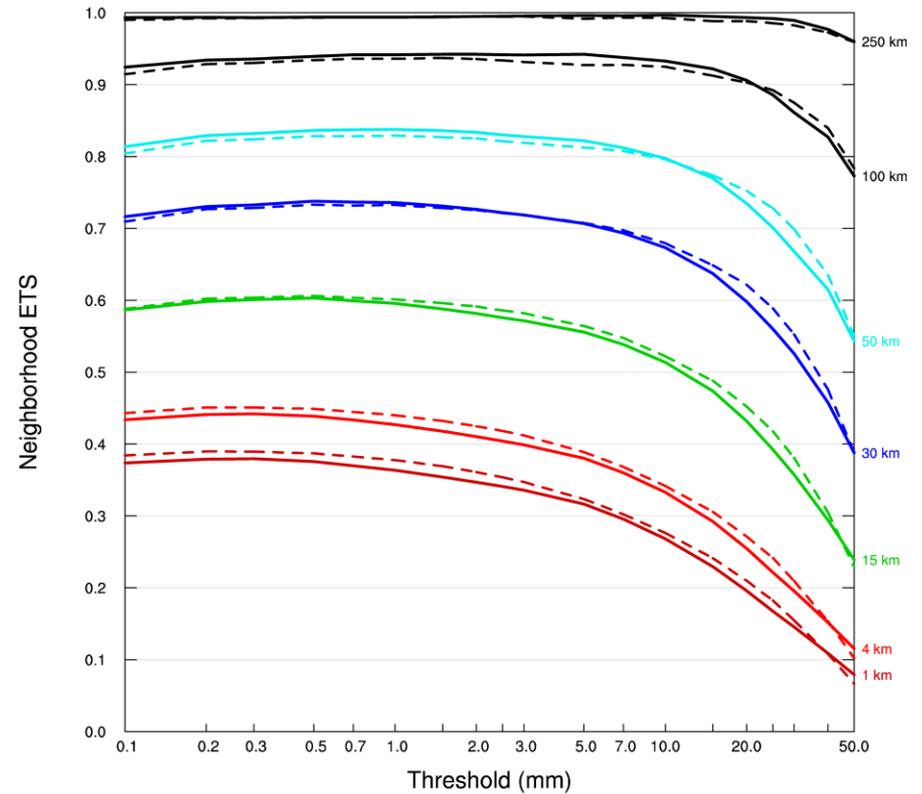
## 12 – 36 hour accumulation



— Start\_initdate: 2013043000 End\_initdate: 2013061500 accum\_period: 24 Valid 36 to 36  
- - - Start\_initdate: 2013043012 End\_initdate: 2013061512 accum\_period: 24 Valid 36 to 36

**Solid: 00 Z initializations**  
**Dash: 12 Z initializations**

## 24 – 48 hour accumulation

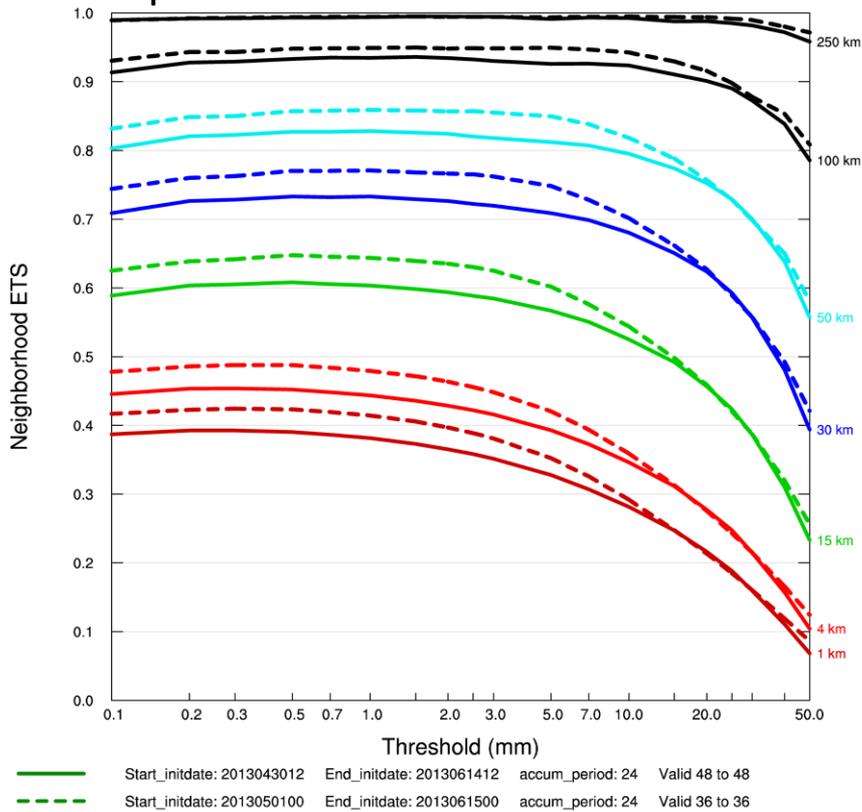


— Start\_initdate: 2013043000 End\_initdate: 2013061500 accum\_period: 24 Valid 48 to 48  
- - - Start\_initdate: 2013043012 End\_initdate: 2013061512 accum\_period: 24 Valid 48 to 48

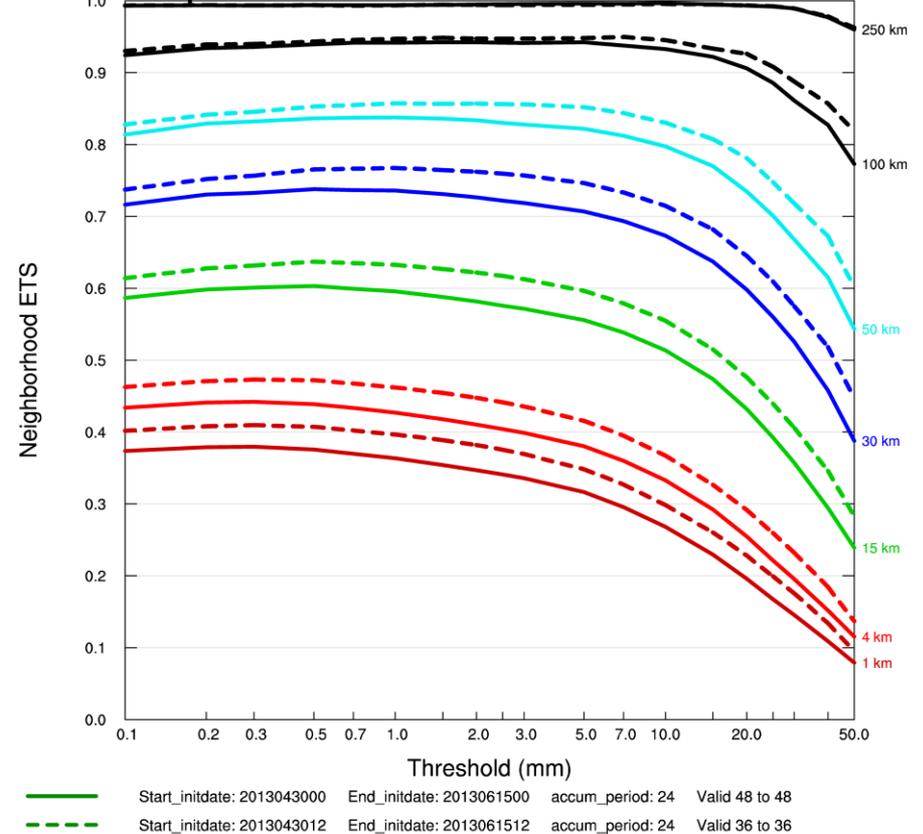
**Solid: 00 Z initializations**  
**Dash: 12 Z initializations**

# 24-hour accumulations – 24- to 48-hour forecasts compared to 12- to 36-hour forecasts

## 00Z update to an earlier 12Z initialization



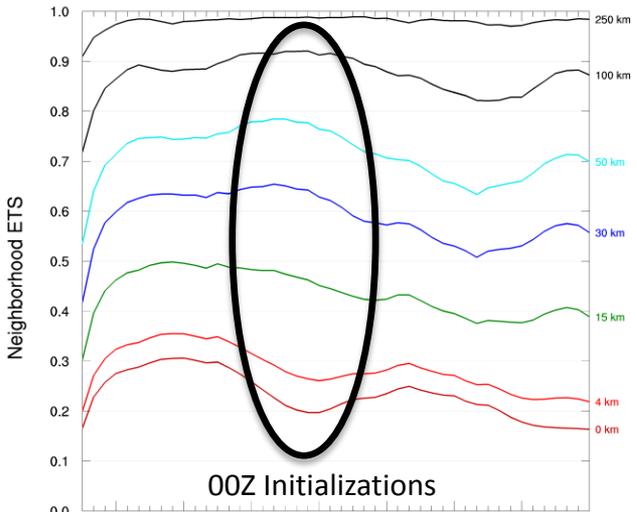
## 12Z update to an earlier 00Z initialization



Solid: 12 Z initializations, hours 24-48  
 Dash: 00 Z initializations, hours 12-36

Solid: 00 Z initializations, hours 24-48  
 Dash: 12 Z initializations, hours 12-36

Threshold = 1.0 mm in 3 hours

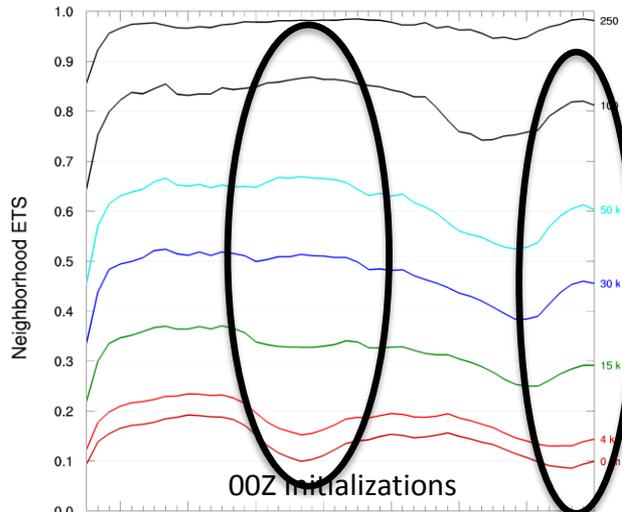


00Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 GMT

— Start\_initdate: 2013043000 End\_initdate: 2013061500 inittime\_interval: 0 Valid 3 to 48 by 1

Threshold = 5.0 mm in 3 hours

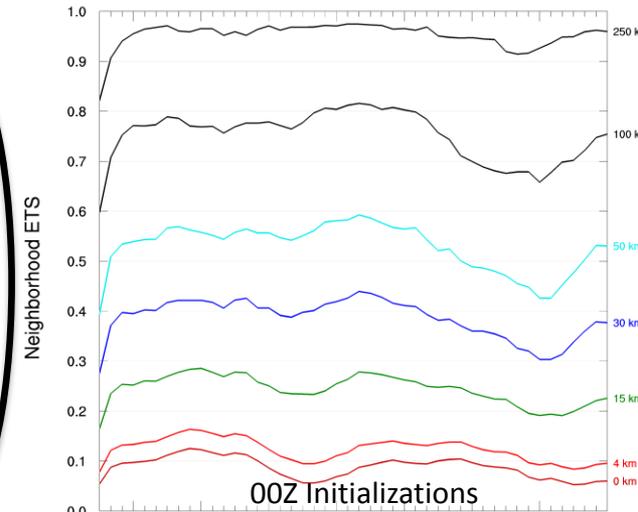


00Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 GMT

— Start\_initdate: 2013043000 End\_initdate: 2013061500 inittime\_interval: 0 Valid 3 to 48 by 1

Threshold = 10.0 mm in 3 hours

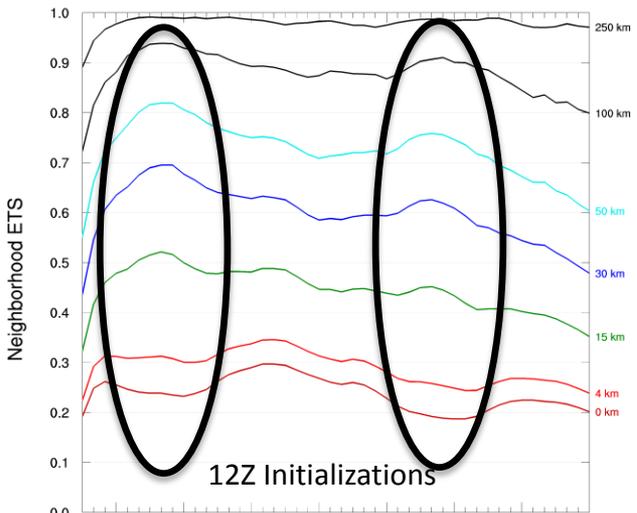


00Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 GMT

— Start\_initdate: 2013043000 End\_initdate: 2013061500 inittime\_interval: 0 Valid 3 to 48 by 1

Threshold = 1.0 mm in 3 hours

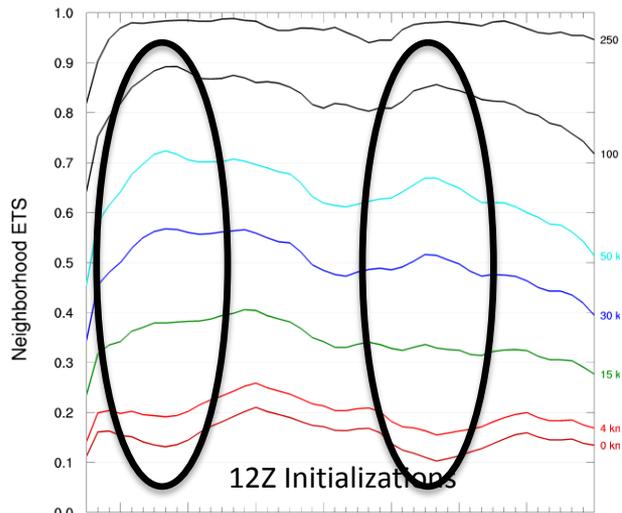


12Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 GMT

— Start\_initdate: 2013043012 End\_initdate: 2013061512 inittime\_interval: 0 Valid 3 to 48 by 1

Threshold = 5.0 mm in 3 hours

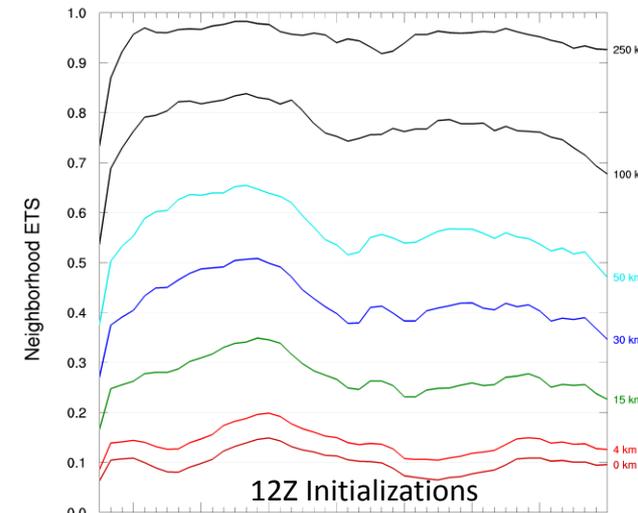


12Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 GMT

— Start\_initdate: 2013043012 End\_initdate: 2013061512 inittime\_interval: 0 Valid 3 to 48 by 1

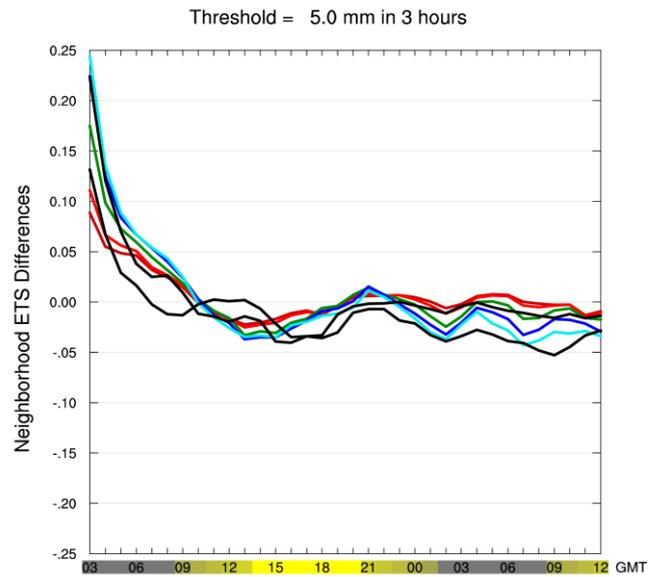
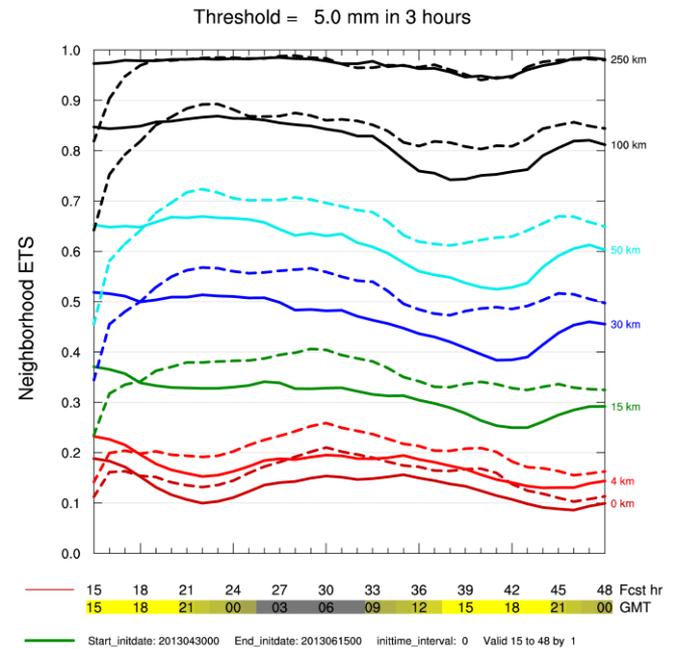
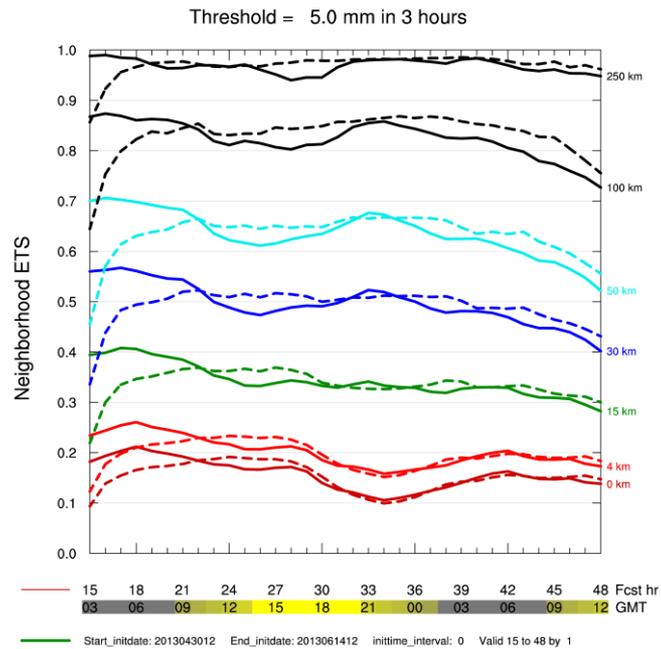
Threshold = 10.0 mm in 3 hours



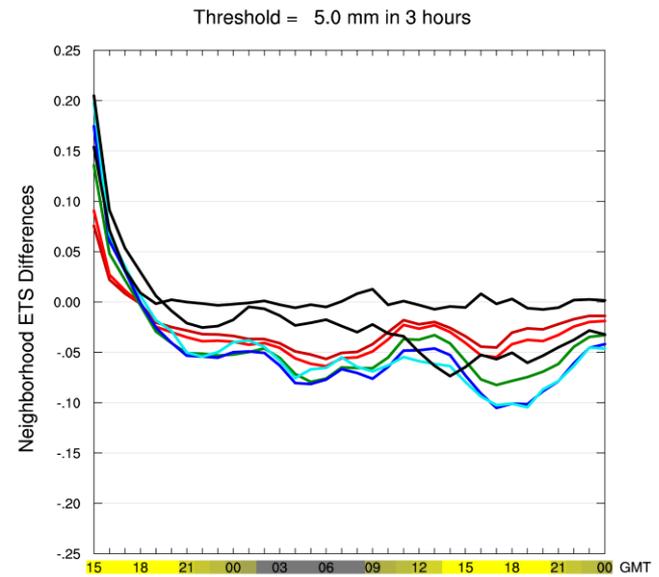
12Z Initializations

— 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 Fcst t  
 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 GMT

— Start\_initdate: 2013043012 End\_initdate: 2013061512 inittime\_interval: 0 Valid 3 to 48 by 1

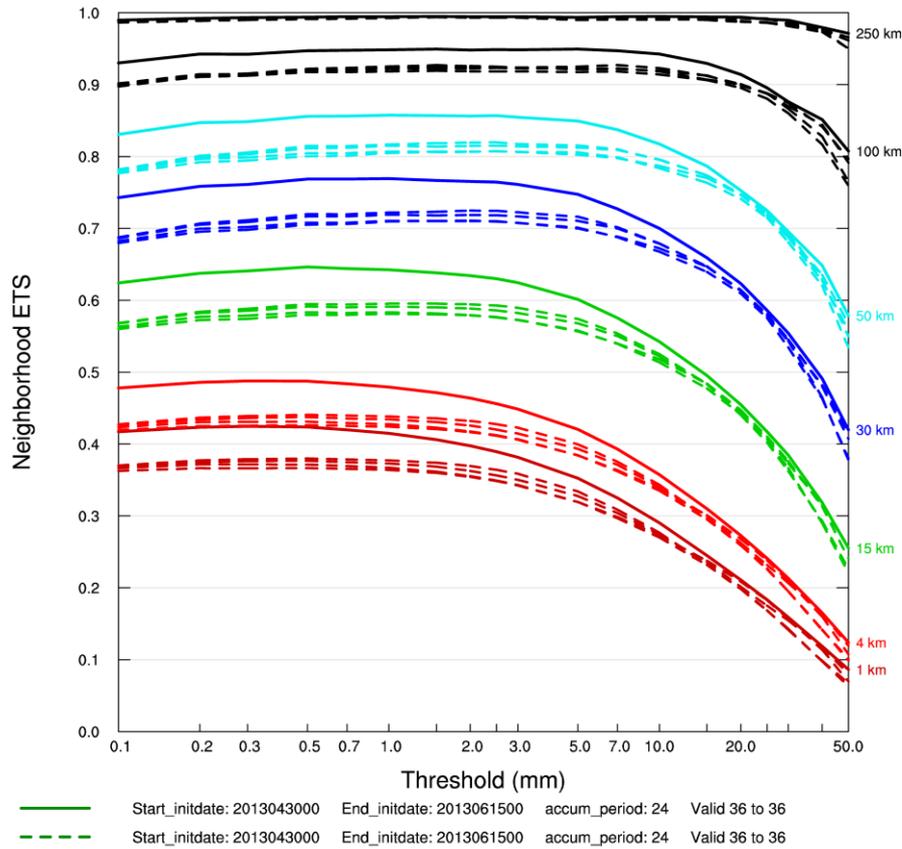


12 Z initialization & 00 Z update

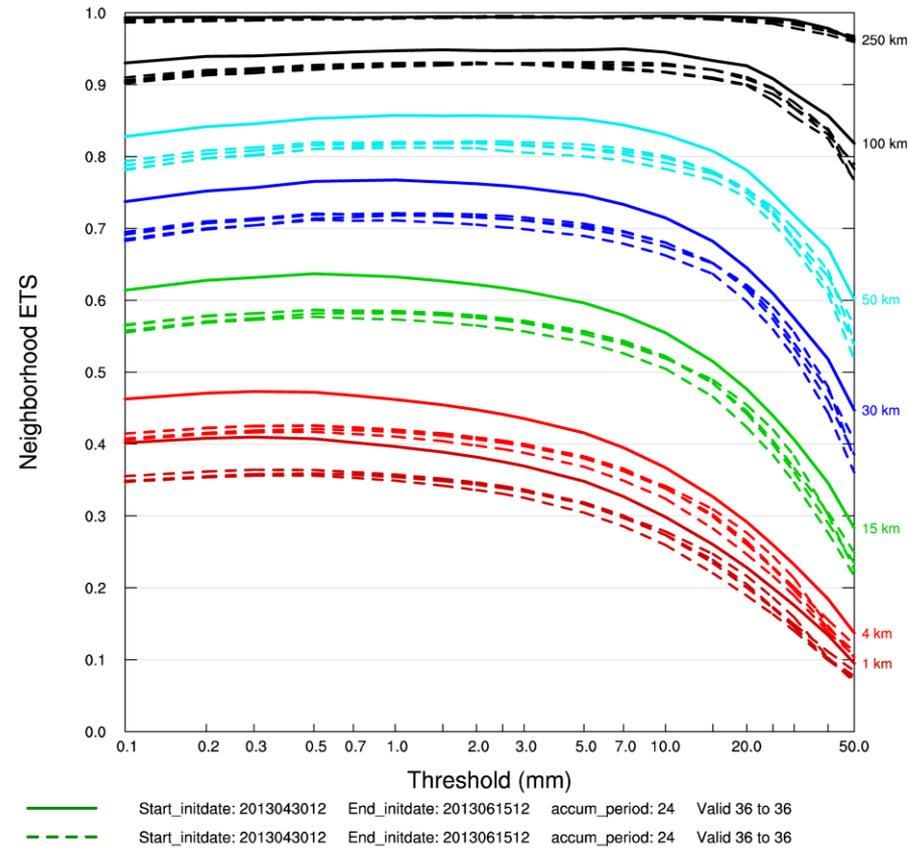


00 Z initialization & 12 Z update

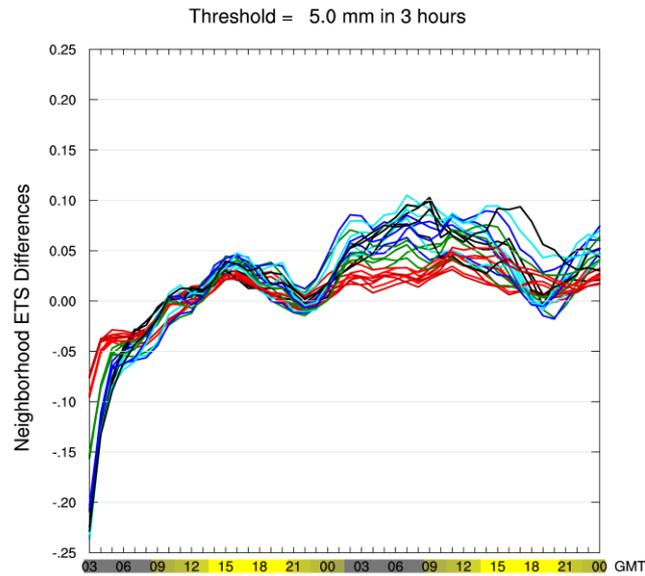
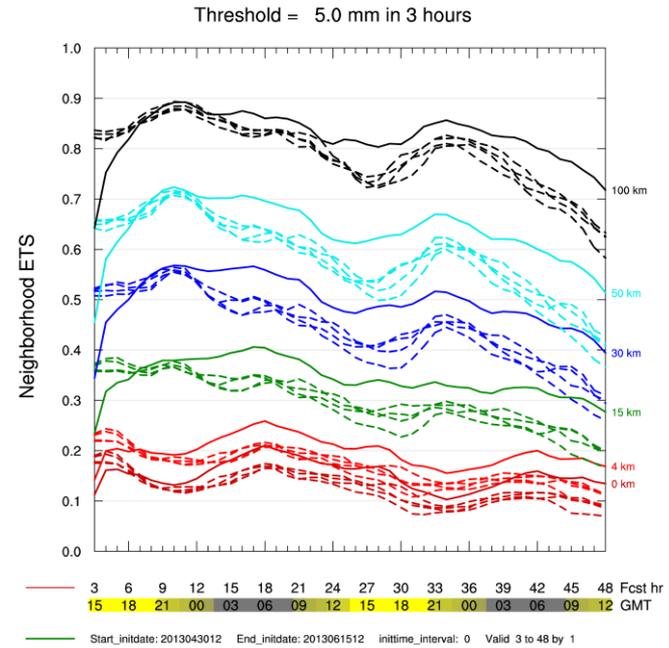
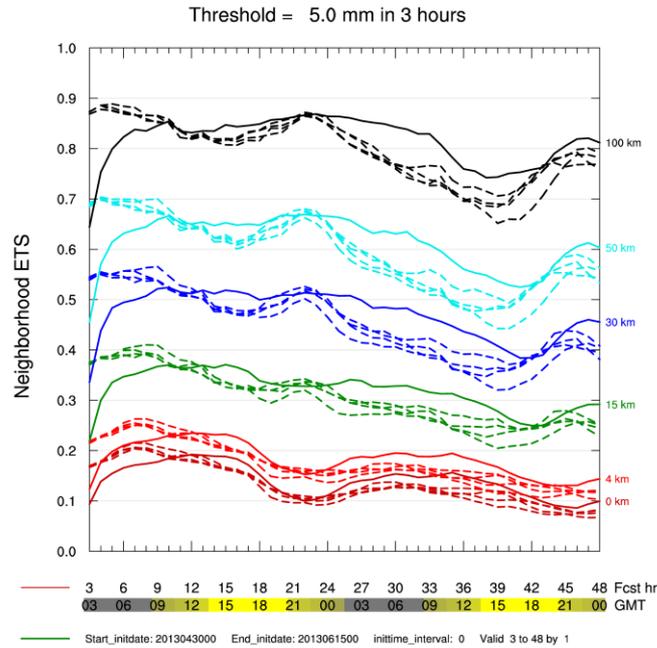
## Ensemble members (dash) as compared to GFS initialization (solid) 24-hour accumulations (forecast hours 12 to 36)



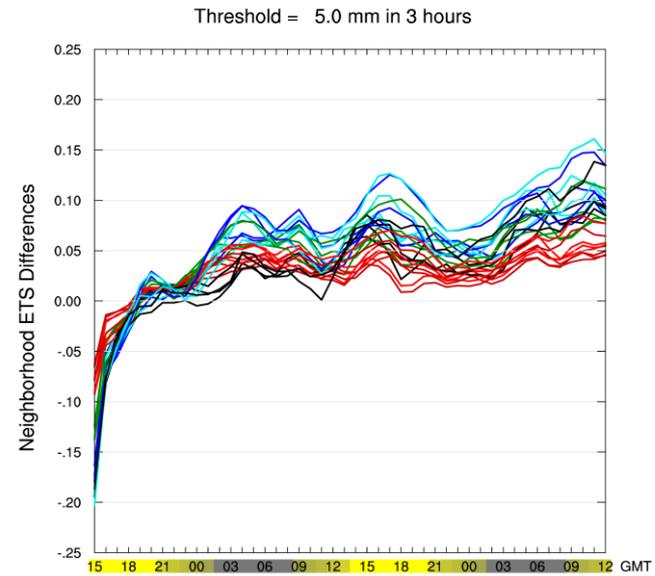
00 Z Initializations



12 Z Initializations



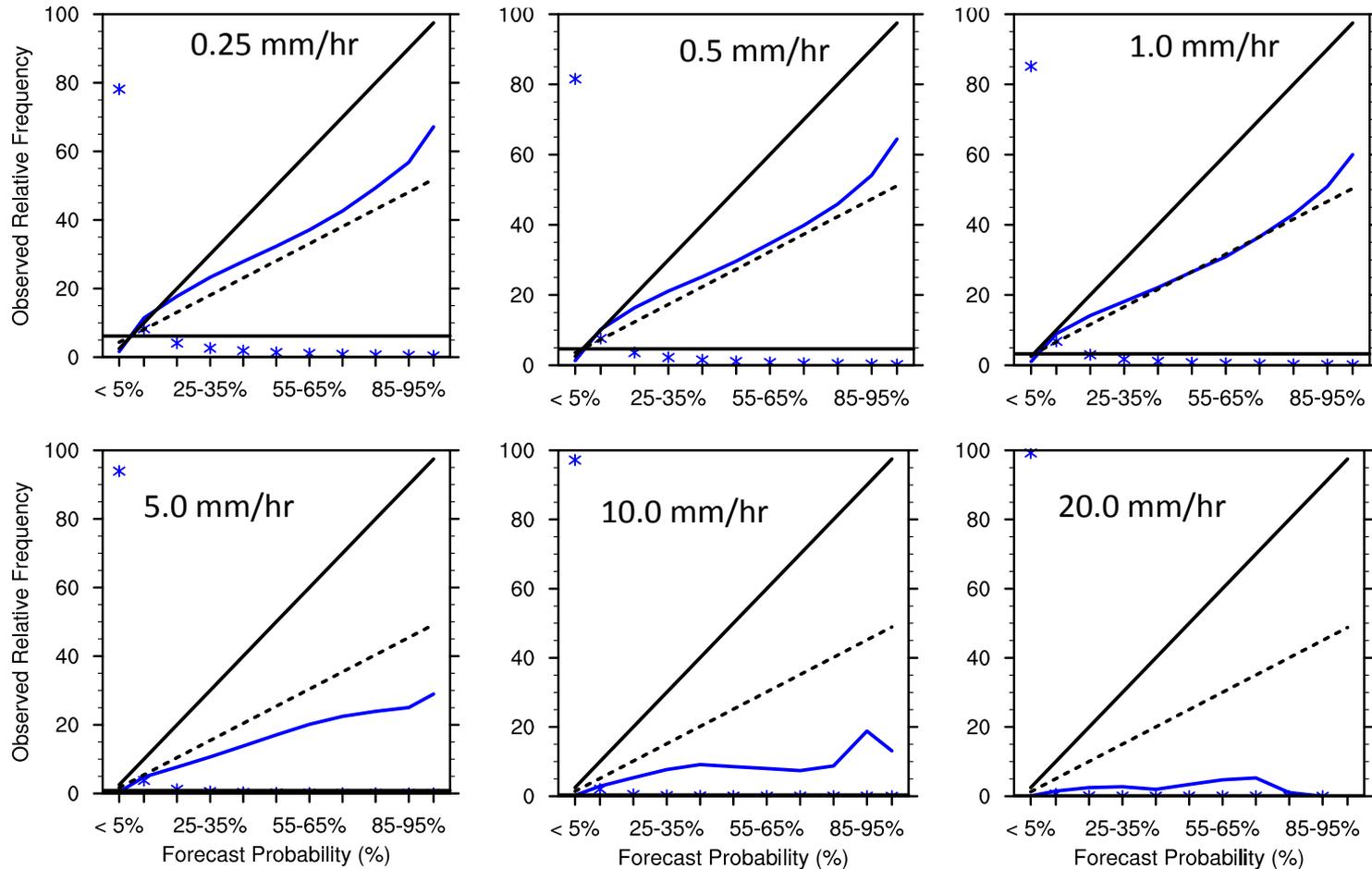
00 Z Initializations



12 Z Initializations

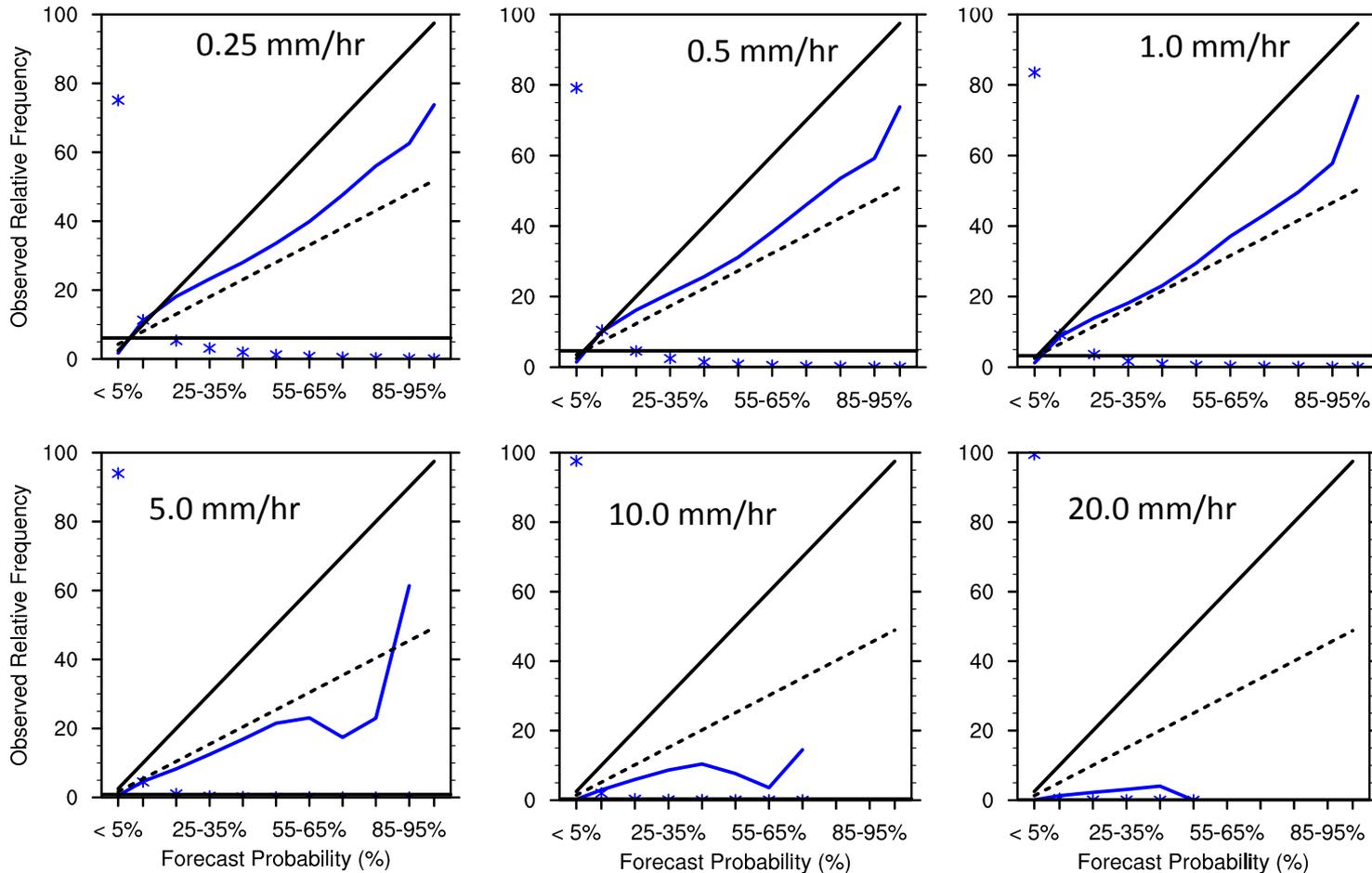
# Attributes statistics

- Aggregated hourly over first 18-hrs (first diurnal peak) for 36 cases (12 UTC fcsts)



# Attributes statistics

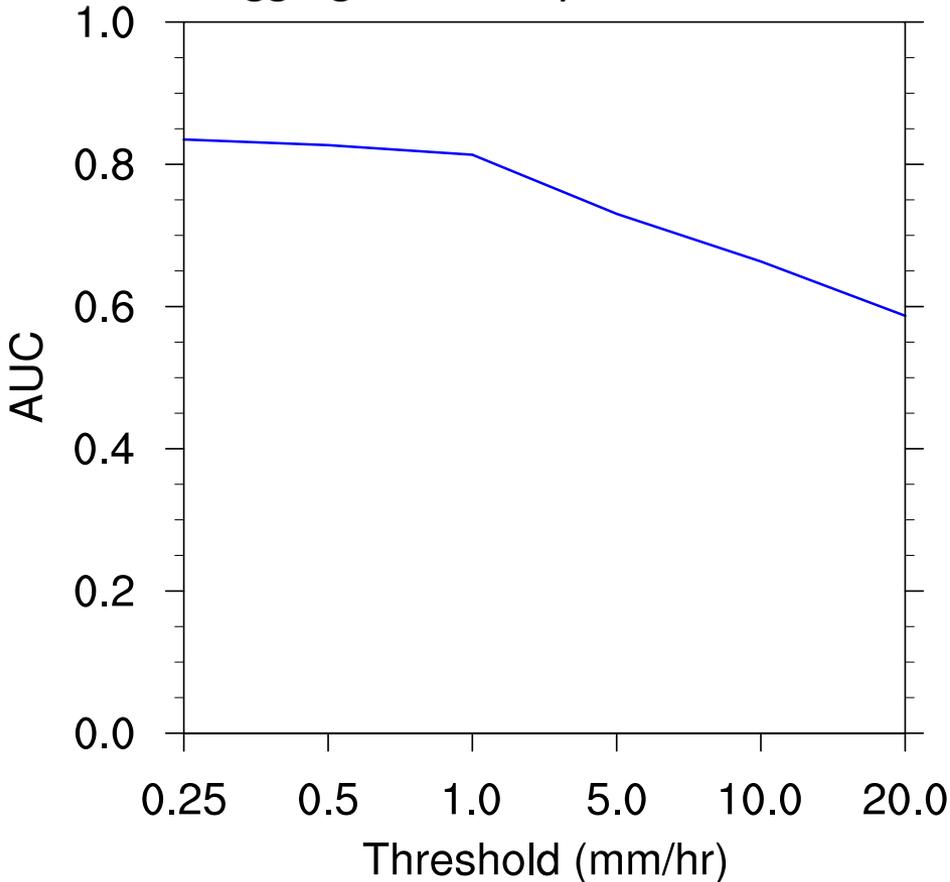
- Aggregated hourly between 24-42-hrs (diurnal peak #2) for 36 cases (12 UTC fcsts)



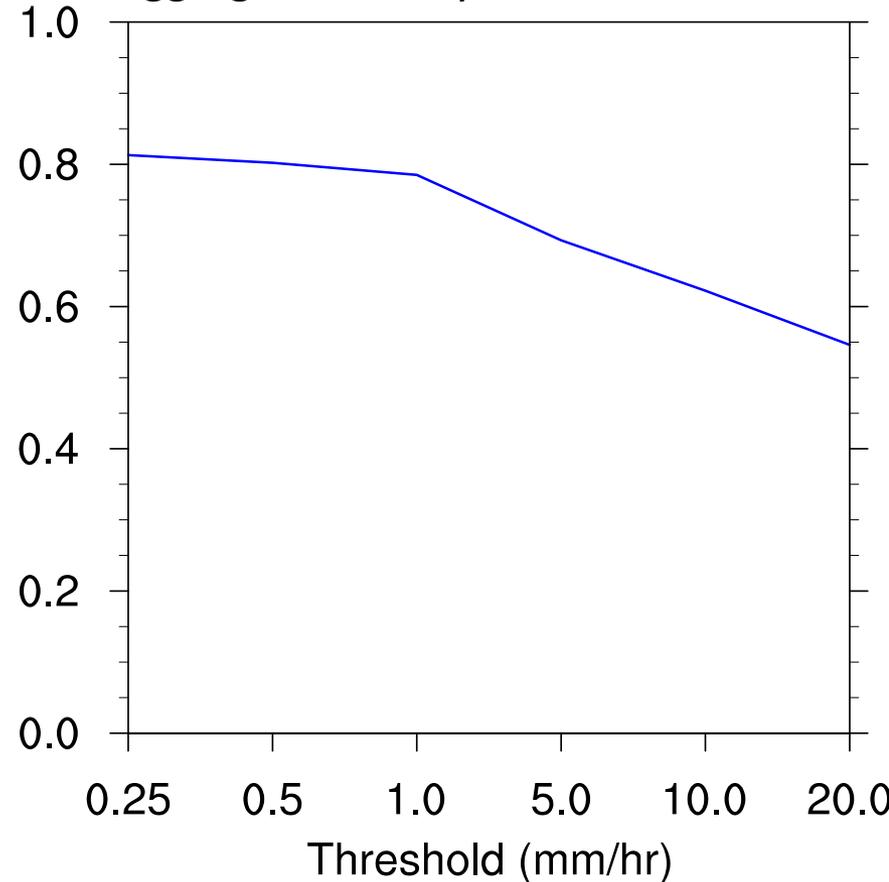
# Area under the ROC curve

- Aggregated over 36 cases (12 UTC forecasts)

Aggregated hourly over first 18-hrs

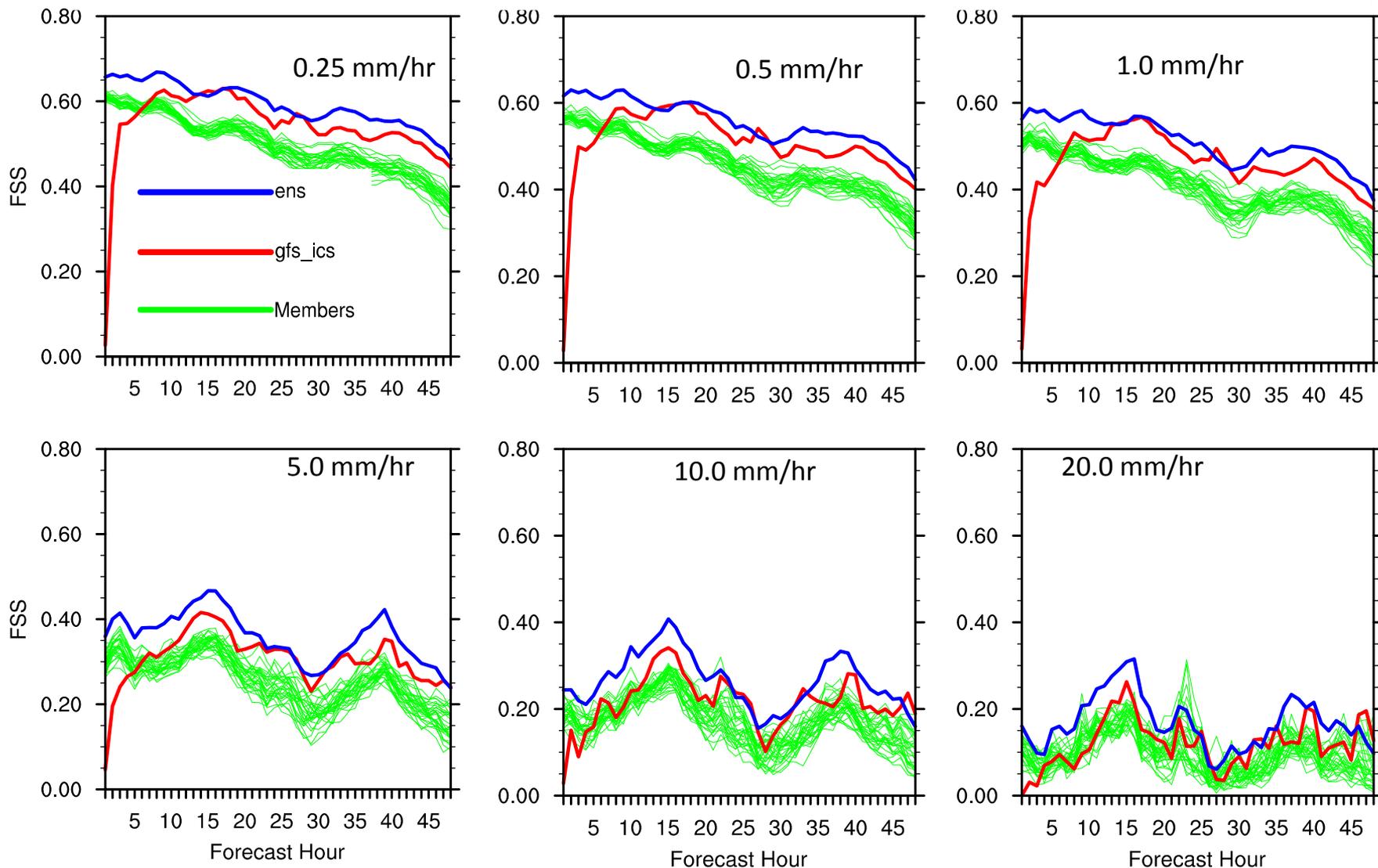


Aggregated hourly between 24-42-hrs



# Fractions skill score (FSS)

- Computed with a 50-km radius of influence and aggregated over 36 12 UTC fcsts



# Preliminary conclusions

- Forecasts initialized later were better than earlier-initialized forecasts
- Forecasts initialized at 12Z dramatically overforecast the peak precipitation amounts of the first diurnal cycle (12-15 hours after initialization).
- The ensemble did not have enough spread of precipitation, but it had skill at discriminating between events
- The GFS-initialized forecasts were better than any individual ensemble member
- The benefit of the ensemble comes from the probabilistic guidance