Bias Correction to Improve the Skill of Summer Precipitation Forecasts as Produced by NMME System over CONUS

Bala Narapusetty[1,2], Dan Collins [2], Jon Gottschalck[2]
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1 – Innovim

2 – Climate Prediction Center, NOAA

Outline

- **Motivation**

  Bias correct seasonal precipitation forecasts with skillful T2m forecasts

- **Analysis**

  - Averaged precipitation and T2m skills of NMME models over CONUS for 1982-2010

  - Spatial patterns of precipitation skill for multi-model means over JJA

  - Observed correlations between precipitation and T2m in observations

  - quintile mapping between observed and forecasted T2m and subsequently correcting the forecast precipitation distribution based on the observed T2m-precipitation relationship

- **Results and Discussion**

  - RMSE differences between uncorrected and corrected precipitation

  - Recycled precipitation in summer plays an important role and T2m based correction improves the skill

Datasets used in this study

- **Forecast data**
  - Precipitation and T2m seasonal forecasts for 1982-2010 of the NMME models: CFSV2(24), CMC1(10), CMC2(10), GFDL(10), GFDL_FLOR(24), NASA GEOS5(11), NCAR CCSM4 (10), NCAR CESM (11)
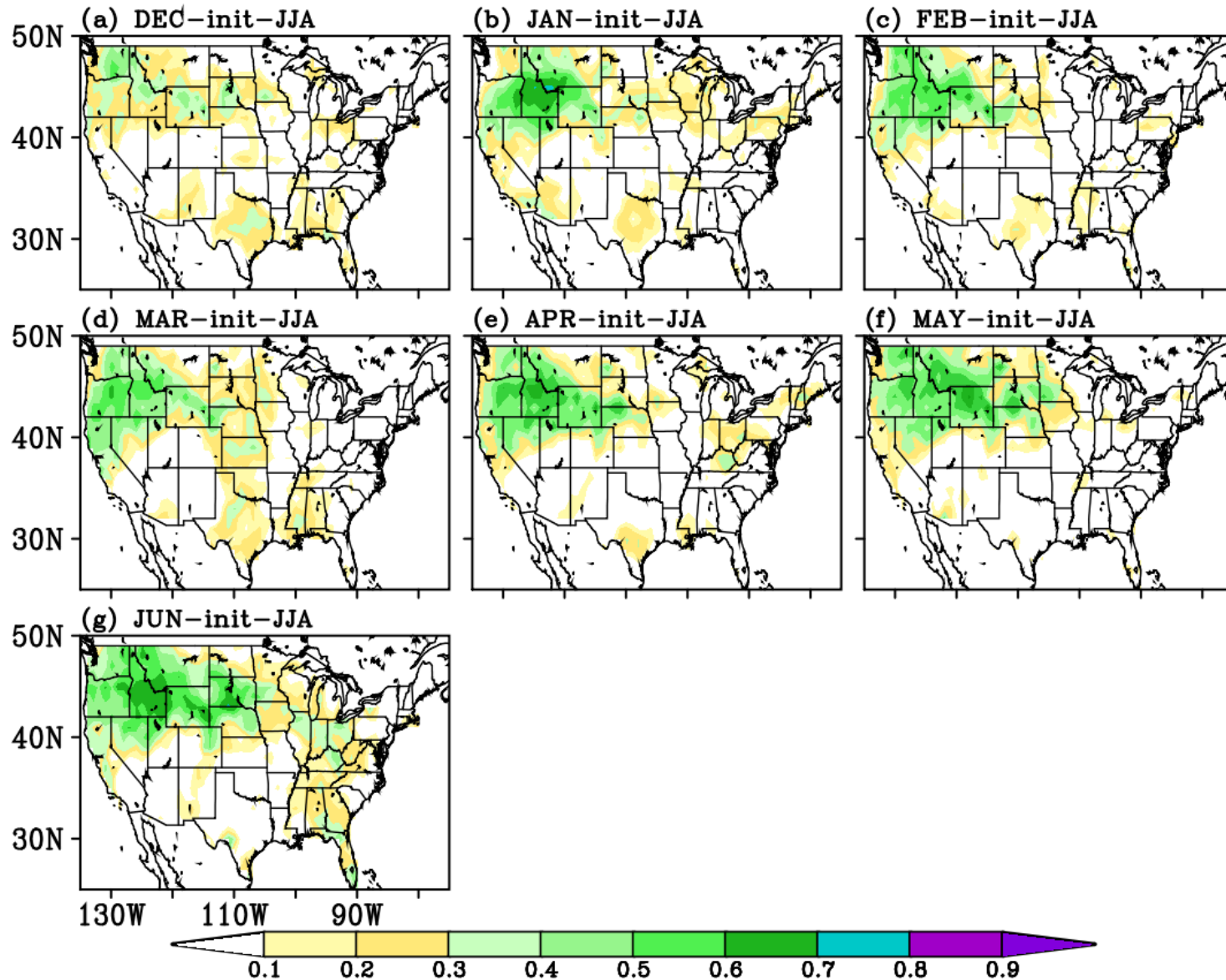
- **Observations**
  - Precipitation: CPC unified gauge-based optimally interpolated objective analysis (Xie et al., 2007; Chen et al., 2008)
  - T2m: Global Historical Climatology Network (GHC; Fan and Van den Dool (2008))

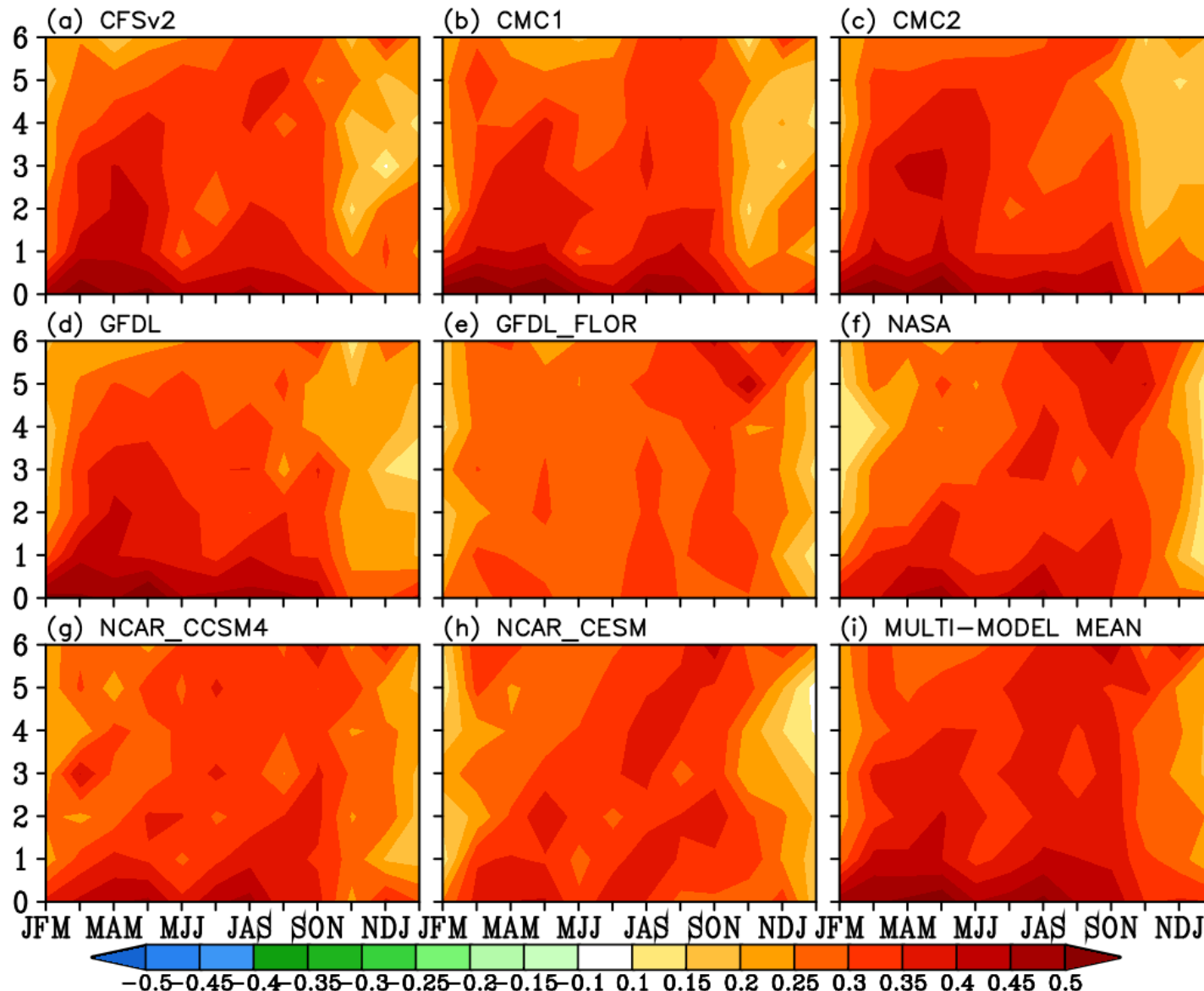# Averaged skill for 3-month aggregated precipitation forecasts over CONUS
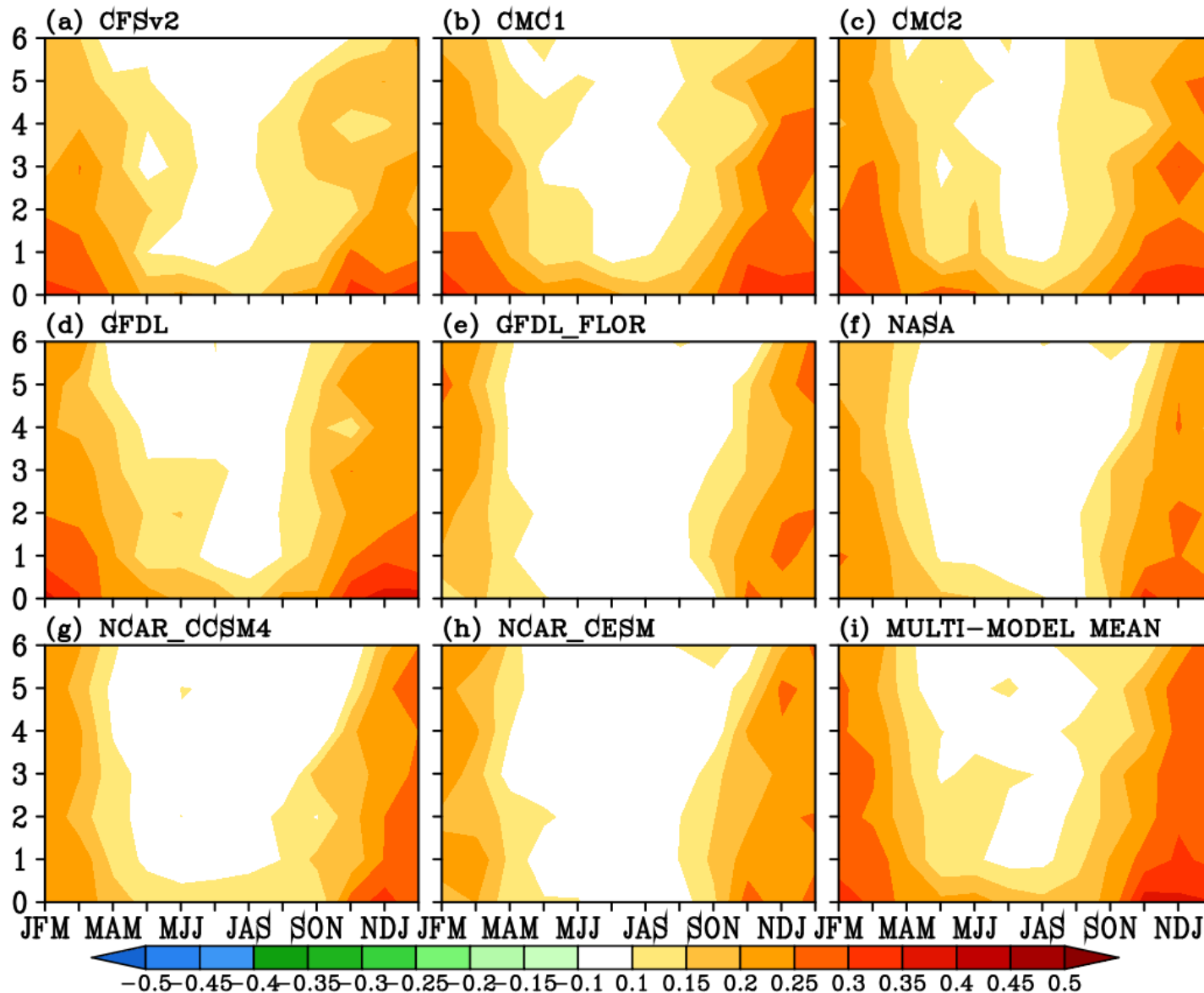
The X-axis label depicts the target month from aggregated 3 months

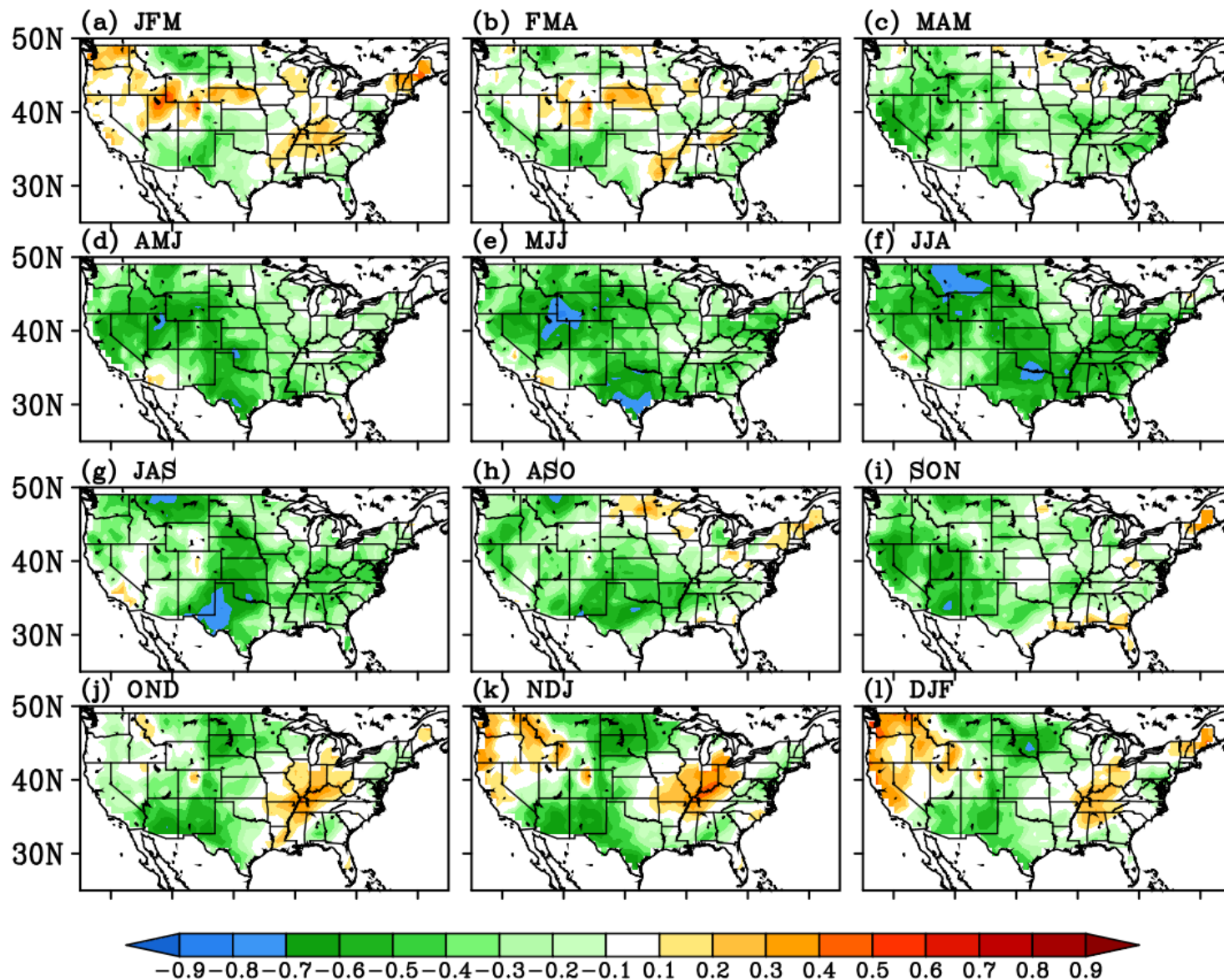# Multi-model ensemble skill for Target Season: JJA

Averaged skill for 3-month aggregated T2m over CONUS
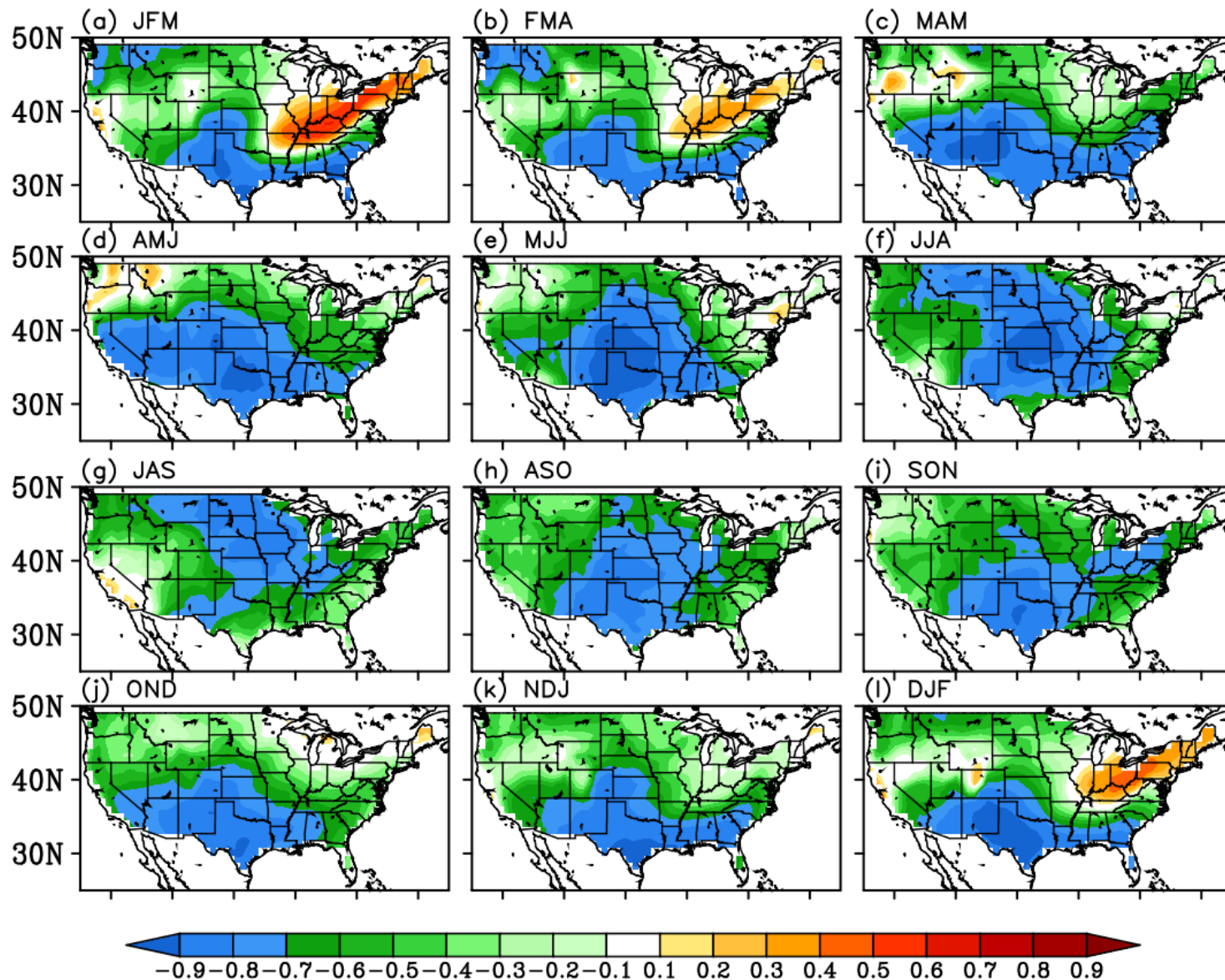

The X-axis label depicts the target month from aggregated 3 months
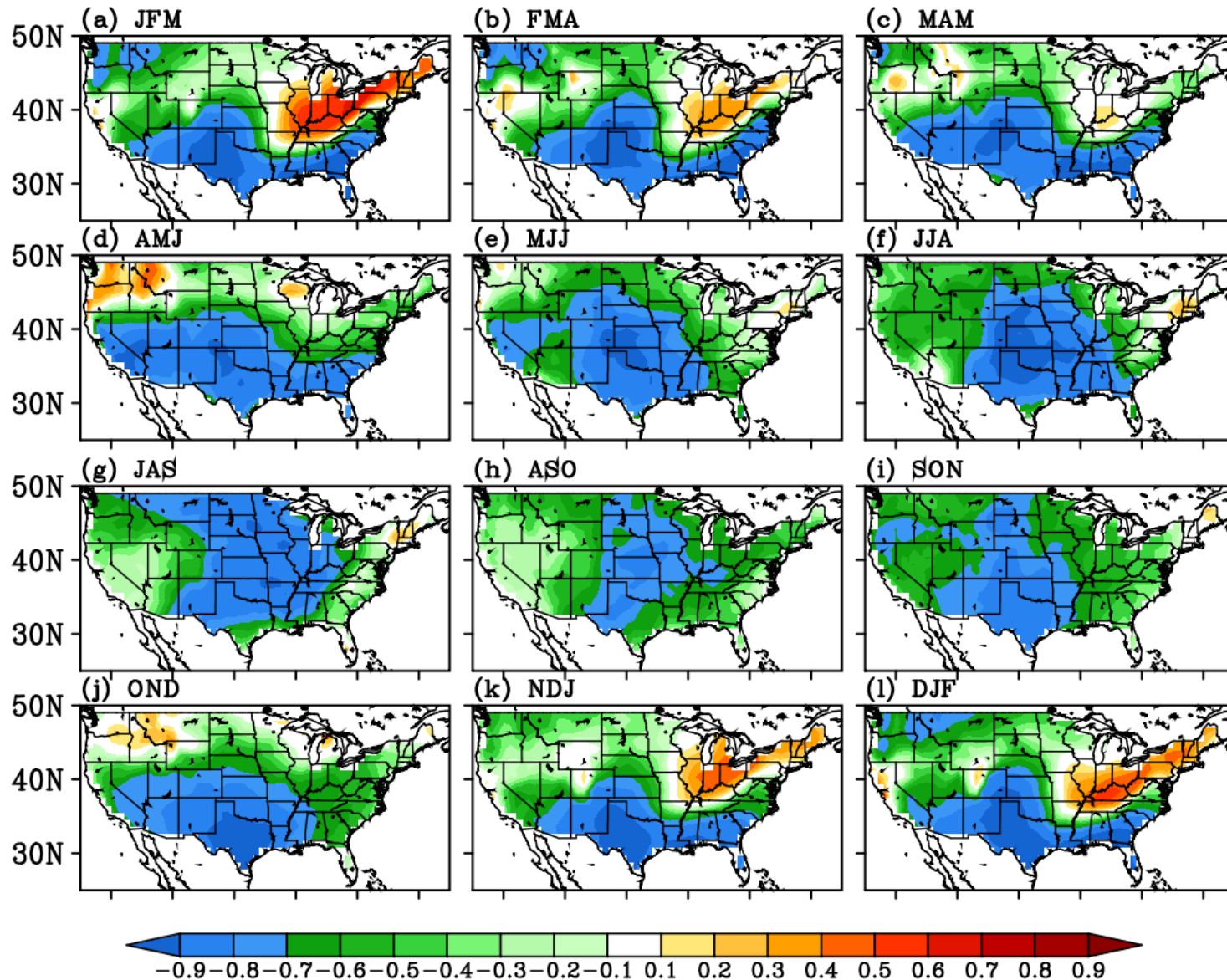
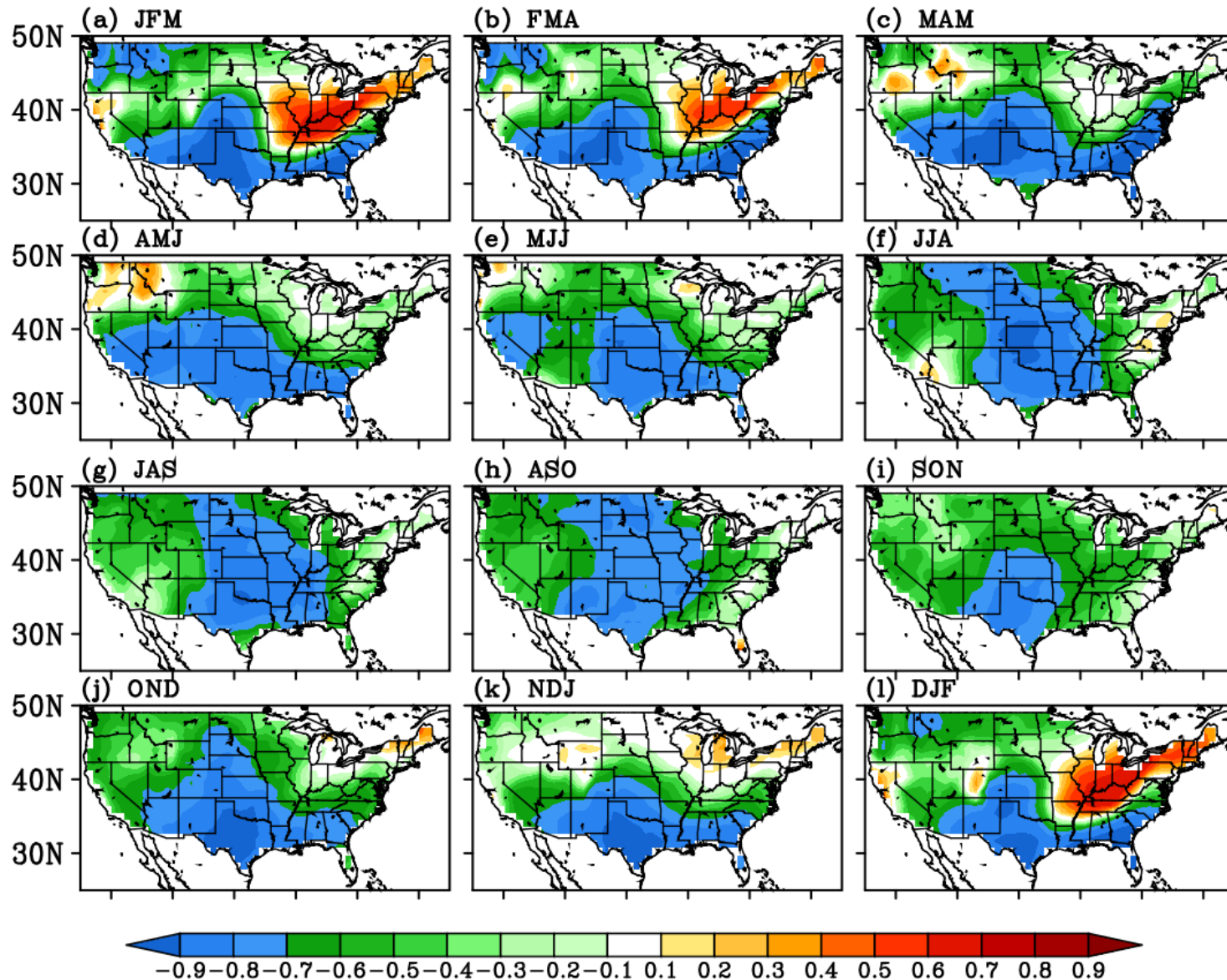# Correlation between precipitation and T2m in observations

# Anomaly correlation between precipitation and t2m in the multi-model ensemble (Target#1)

Anomaly correlation between precipitation and t2m in the multi-model ensemble (Target#2)

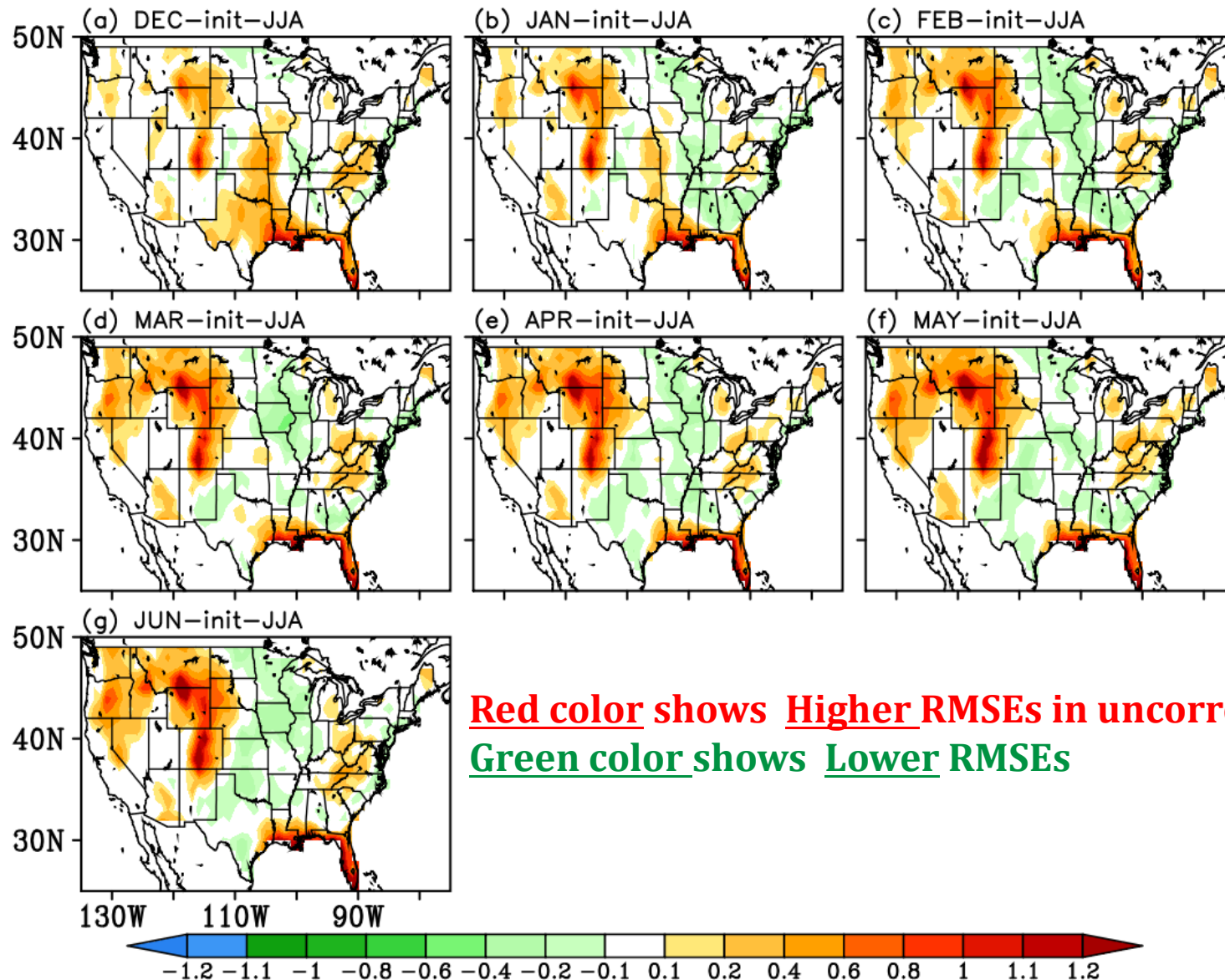# Anomaly correlation between precipitation and t2m in the multi-model ensemble (Target#3)

Differences in RMSEs (mm day^{-1})
[Uncorrected] minus [Corrected]

Red color shows Higher RMSEs in uncorrected forecasts
Green color shows Lower RMSEs
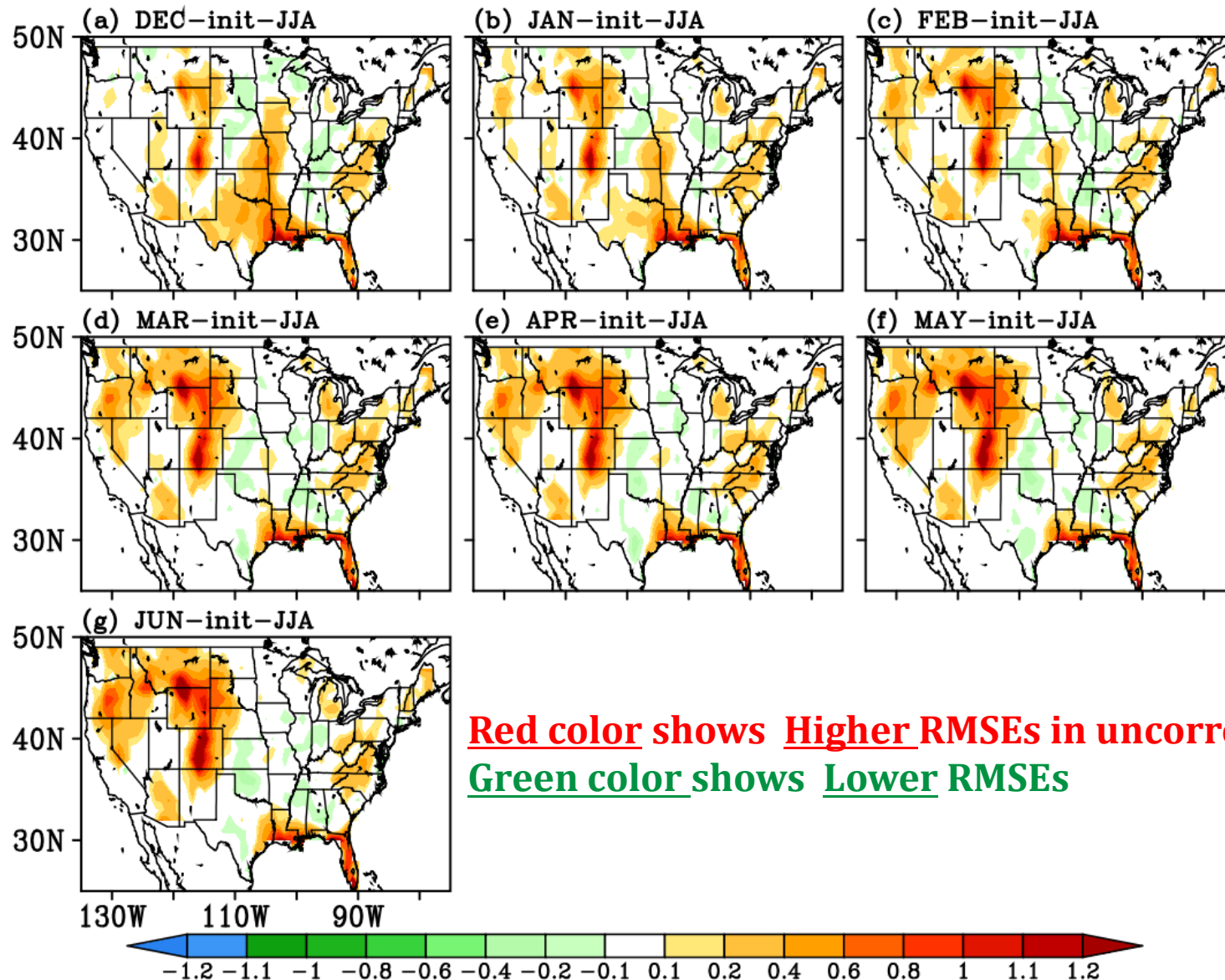
Improvement in the RMSEs by applying the bias correction method based on precipitation

Red color shows Higher RMSEs in uncorrected forecasts
Green color shows Lower RMSEs

Differences in RMSEs
[Precip based correction] minus [T2m based correction]

(a) DEC-init-JJA (b) JAN-init-JJA (c) FEB-init-JJA

(d) MAR-init-JJA (e) APR-init-JJA (f) MAY-init-JJA

(g) JUN-init-JJA

Red color shows Higher RMSEs in precip based forecasts
Green color shows Lower RMSEs
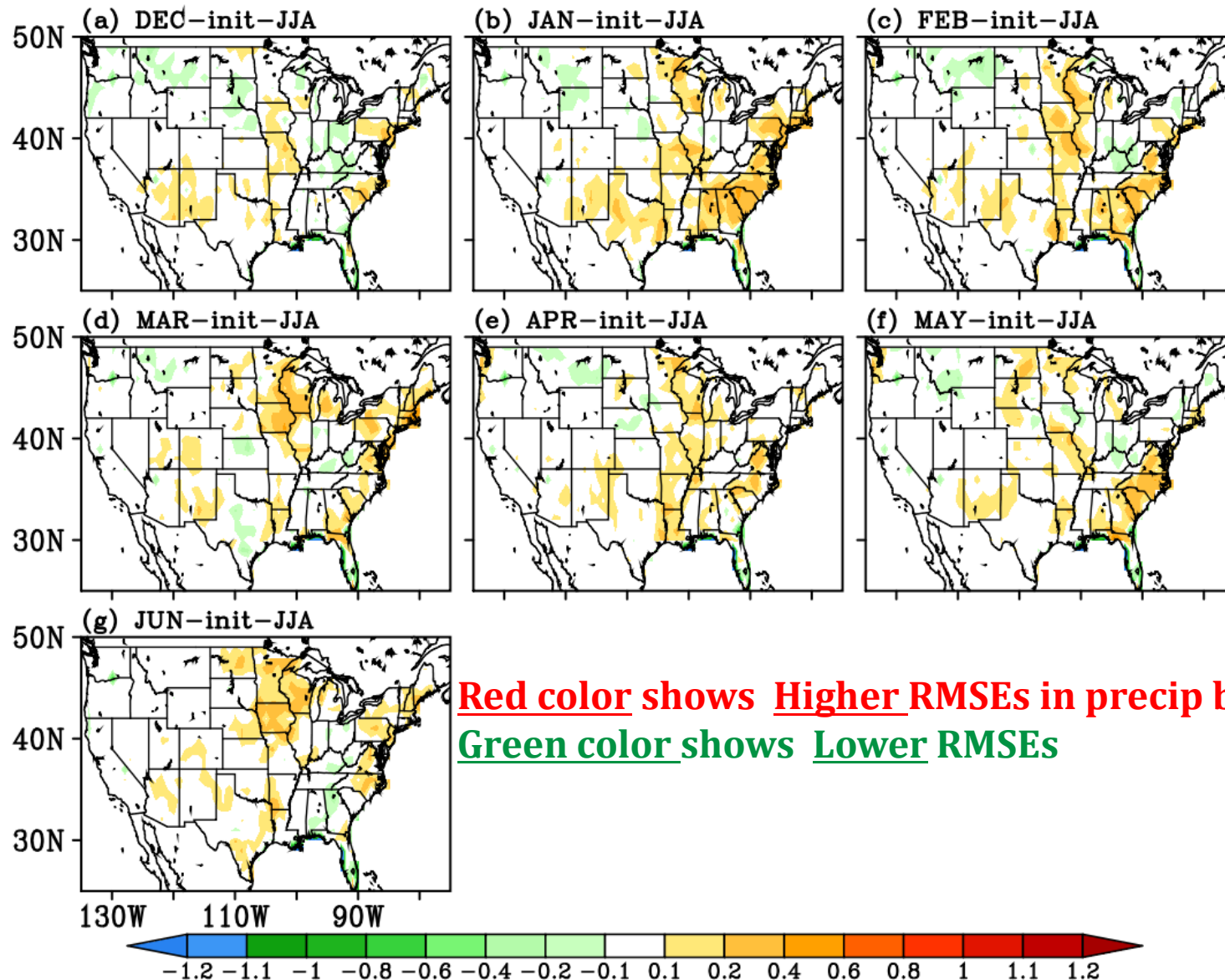
Evaporation reaches its peak over the eastern half of CONUS in JJA
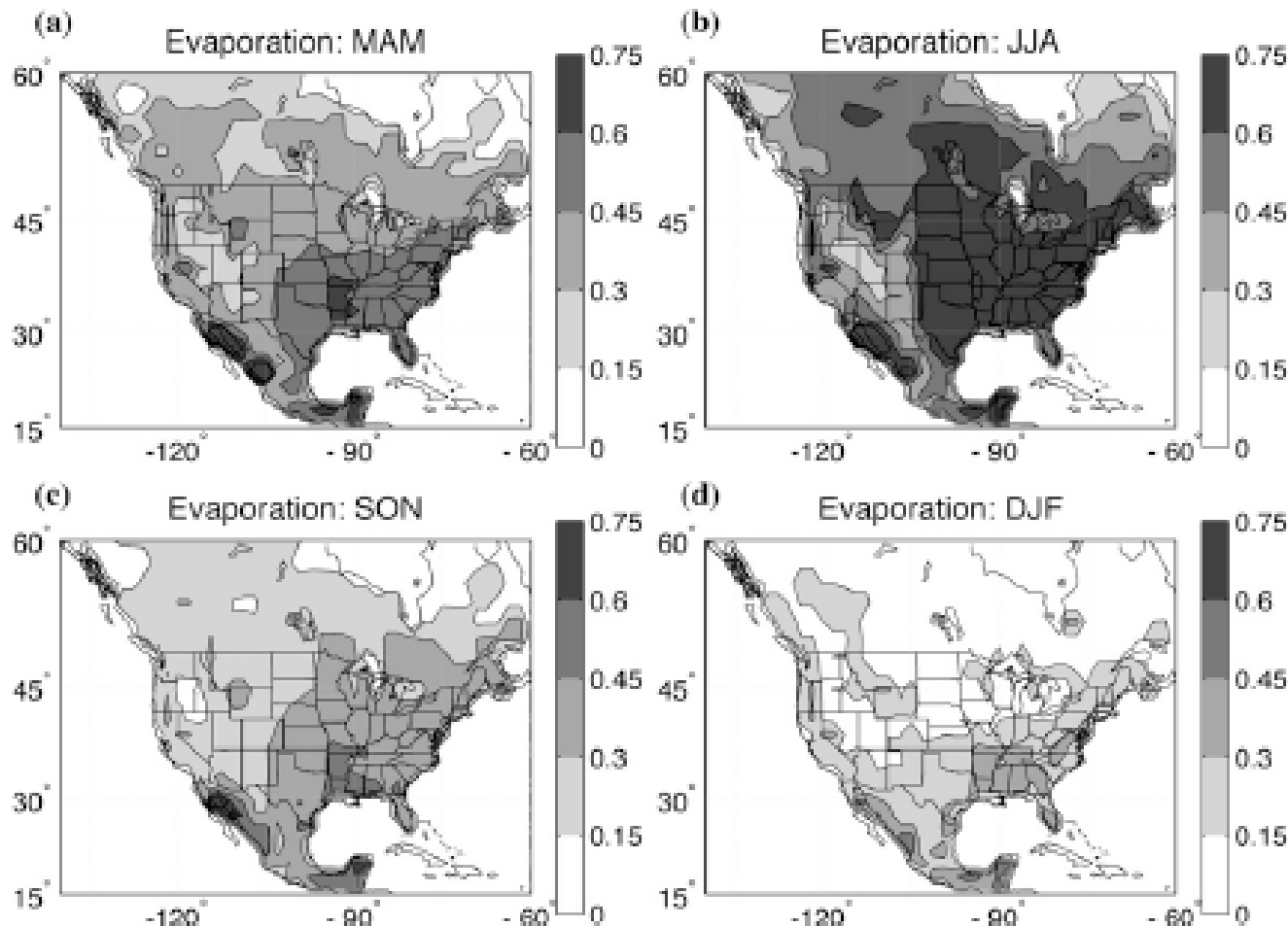

FIG. 2. (a) Seasonal-mean evaporation rate (1024 kg m2 s21) for March–May. Data derived from 3-h integrations of the RII atmospheric model. (b) Same as (a) but for June–August. (c) As in (a), but for September–November. (d) As in (a), but for December–February.

Source: Anderson BT, Ruane AC, Roads JO, Kanamitsu M (2009) Estimating the influence of evaporation and moisture-flux convergence upon seasonal precipitation rates. Part II: an analysis for North America based upon the NCEP-DOE Reanalysis II Model. J Hydrometeorol 10:893–911

Recycled precipitation is higher in JJA, which could explain why Our T2m based corrections fare better than the precipitation
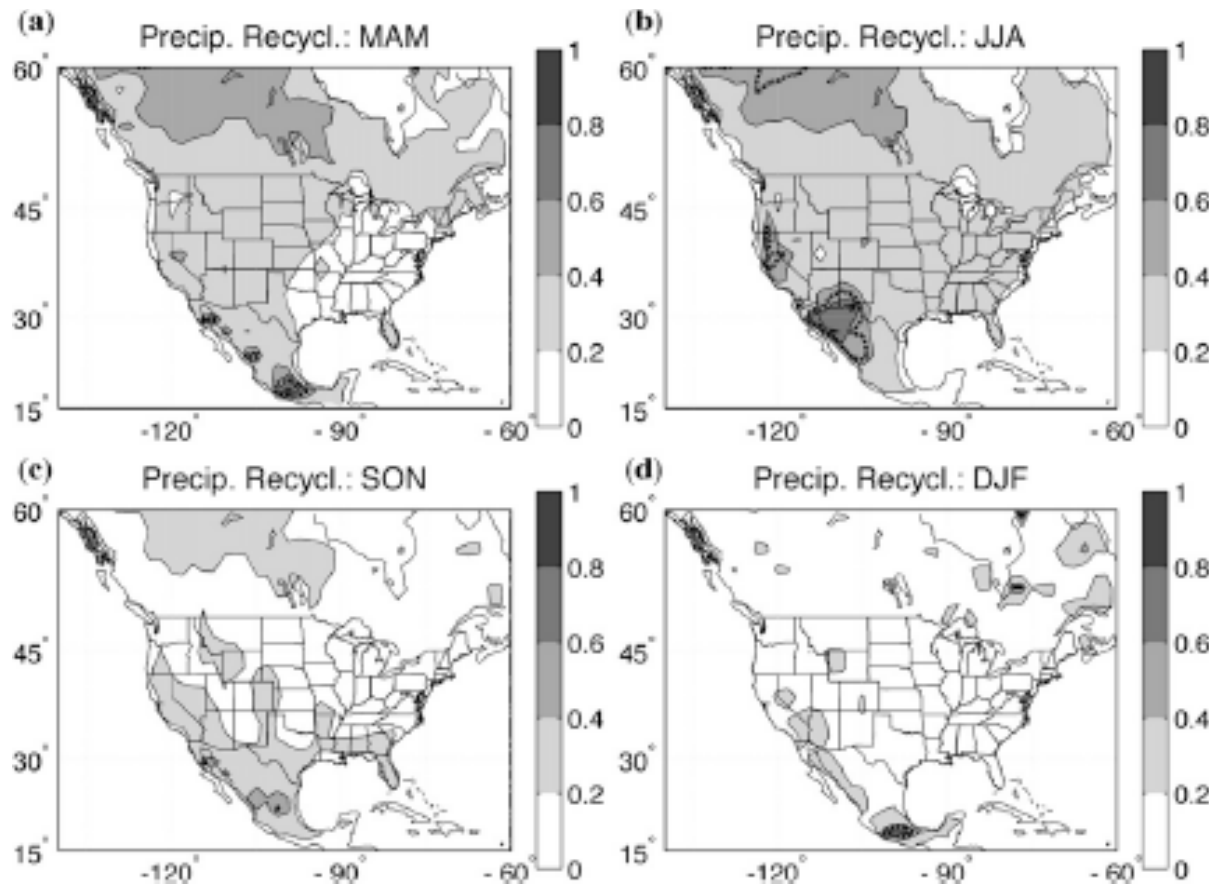

FIG. 4. (a) Seasonal-mean precipitation-recycling ratio for March–May derived from Brubaker et al. (1993). Estimates based upon 3-month averages of evaporation and vertically integrated moisture fluxes for the respective months. Length scale, L,is 500 km. Data derived from 3-h integrations of the RII atmospheric model. Contour and shading interval is 0.2; thick dashed line indicates r 5 0.5 value. (b) As in (a), but for June–August. (c) As in (a), but for September–November. (d) As in (a), but for December–February.

Source: Anderson BT, Ruane AC, Roads JO, Kanamitsu M (2009) Estimating the influence of evaporation and moisture-flux convergence upon seasonal precipitation rates. Part II: an analysis for North America based upon the NCEP-DOE Reanalysis II Model. J Hydrometeorol 10:893–911

Summary

- The strong negative correlation that exists between T2m and precipitation in summer can be used to improve the seasonal precipitation skill in the NMME models.

- The T2m based precipitation bias correction reduces the RMSE compared to traditional precipitation based method

- The T2m based correction captures the recycled precipitation in the eastern half of CONUS in summer more effectively

- The efficient replication of T2m-precipitation relations, which is interlinked with the SSTs of Intra-America seas could further explain the improved skill