

West African Extreme Daily Precipitation in Observations and Stretched-Grid Simulations by CAM-EULAG

William J. Gutowski, Jr.¹

Abayomi Abatan¹

Babatunde J. Abiodun²

Joseph M. Prusa³

¹Iowa State University, Ames, IA

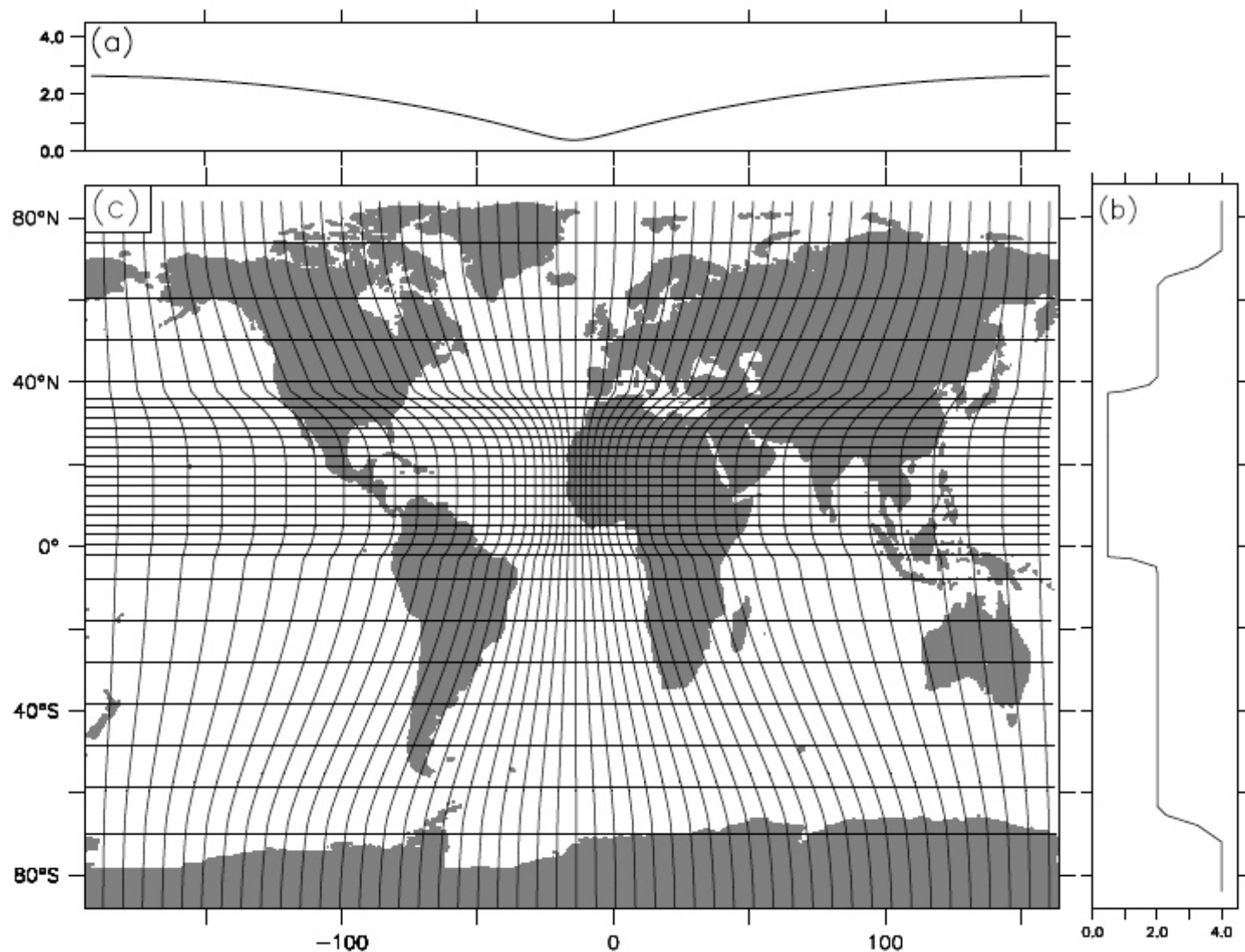
²University of Cape Town, South Africa

³Teraflux Corp., Boca Raton, FL

CAM-EULAG: Simulation

- **Cores:** EULAG (stretched-grid & uniform), FV
- **Physics:** CAM3 (same settings as for FV)
- **Experiment:** AMIP-type, observed SSTs
- **Horizontal resolutions :**
 - $2^\circ \times 2.5^\circ$ [CAM-EULAG uniform; FV]
 - Stretched-grid (CEU-SG): 0.5° over West Africa
- **Vertical grid:** 26 levels
- **Period:**
 - 1996 – 2007 (discard first two yr.)

CAM-EULAG: Stretched Grid



Extreme Precipitation: Observed & Simulated Behavior

◆ Observation-Based Fields

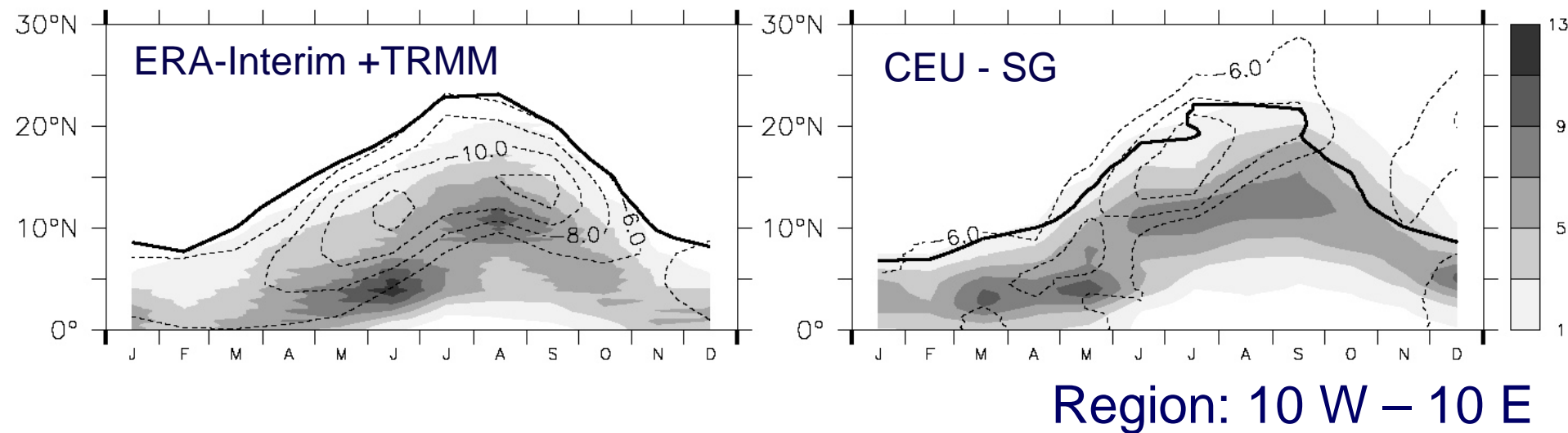
- Precip: TRMM (0.25°) & GPCP (1°)
- Other fields: ERA-Interim Reanalysis

◆ Analysis

- Target region: West Africa (6N-16N, 5W-5E)
- “Precipitation event” = Daily precip ≥ 0.0 mm at a grid point
- Pool all “events” in the target region
- Focus on precipitation intensity $\geq 99\%$
- Focus on “widespread” events: ≥ 15 simultaneous daily extreme events

CAM-EULAG: West Africa Annual Cycle

(Abiodun et al., *Acta Geophys.*, 2011)

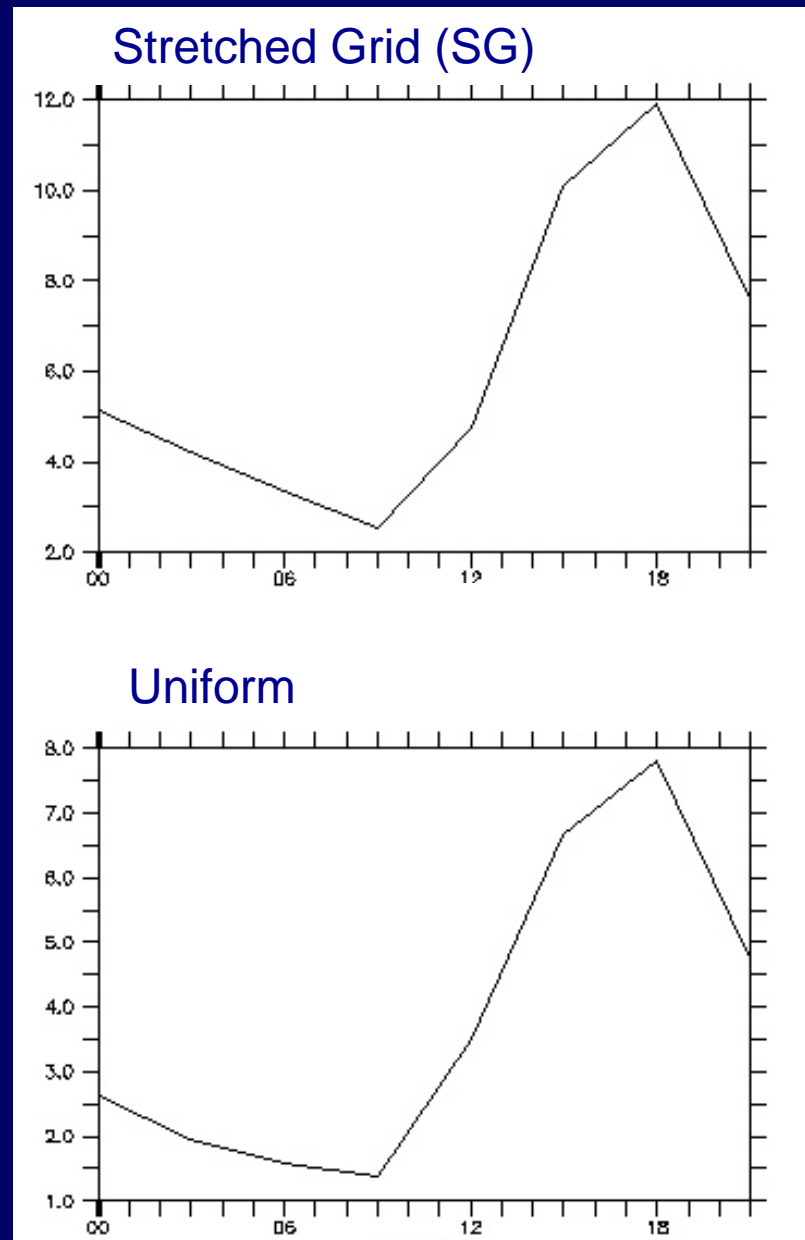


Precip [mm/d], 600 hPa Zonal Wind [dashes]
Intertropical Discontinuity [solid line]

CAM-EULAG: Precipitation Diurnal Cycle [mm/d]

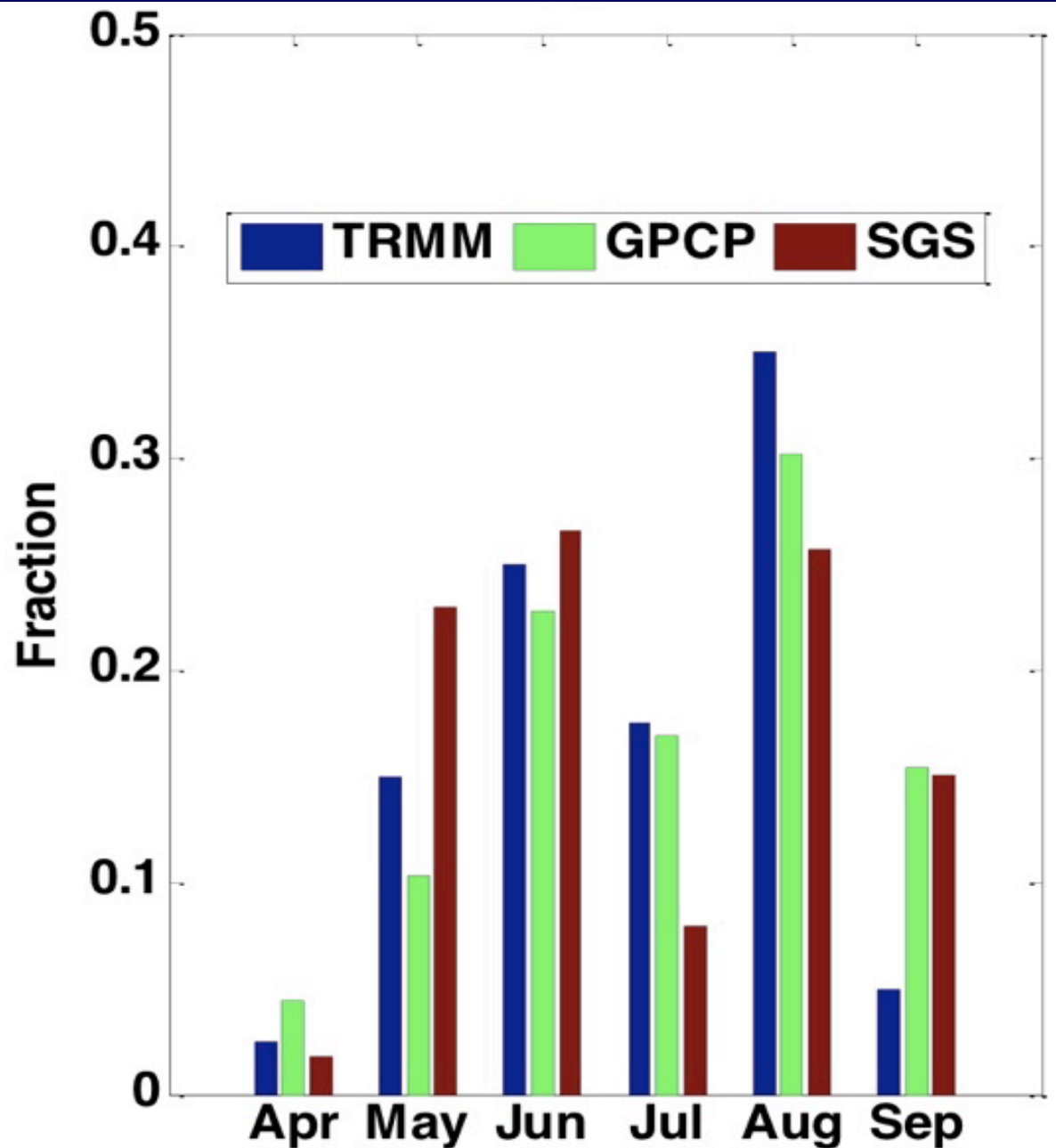
TRMM Data:
Diurnal Range ~ 2.5 – 9.5 mm/d
Diurnal Max ~ 16-20 hr UCT
(Lee et al., JGR, 2007)

(Region: 10 W – 5 E)

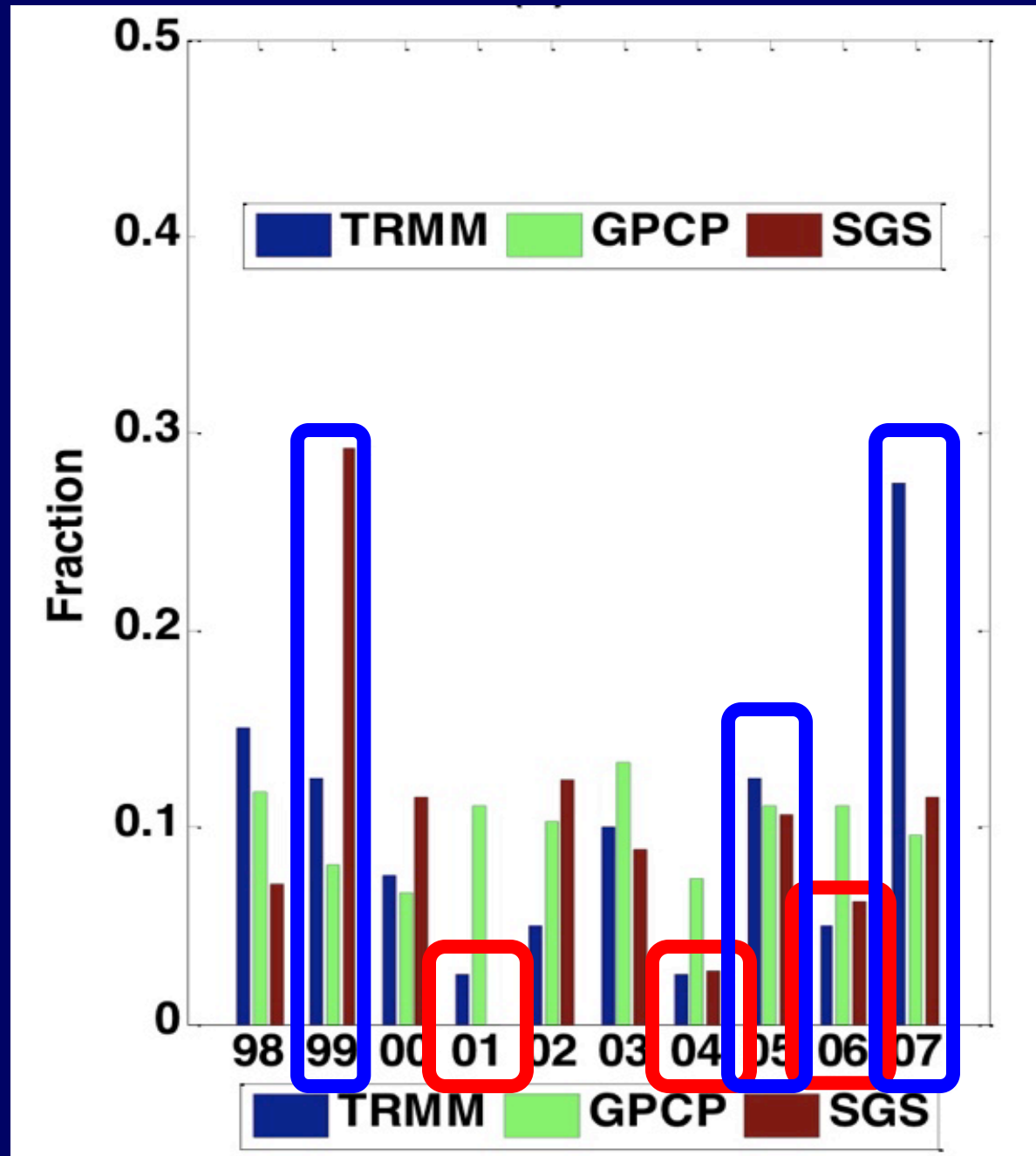


Hour of Day

Monthly Timing of Extreme Precipitation



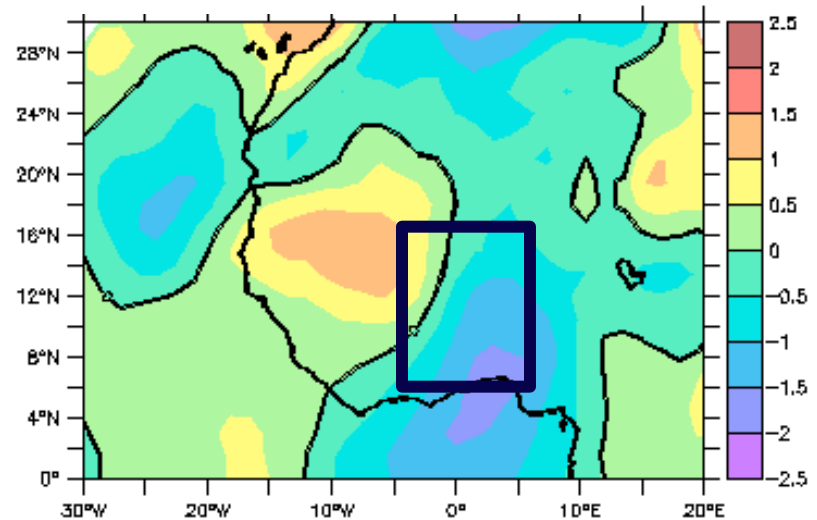
Interannual Variability of Extreme Precipitation



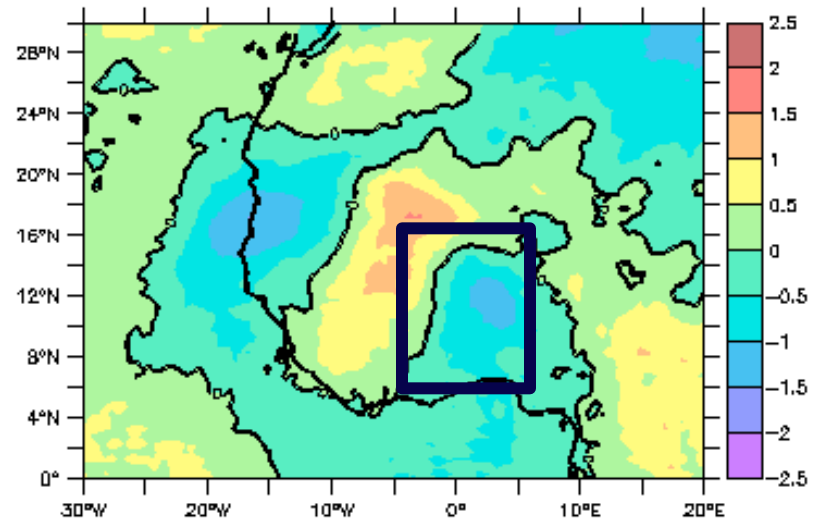
Composite Anomaly Meridional Wind

JAS
700 hPa
Day Before

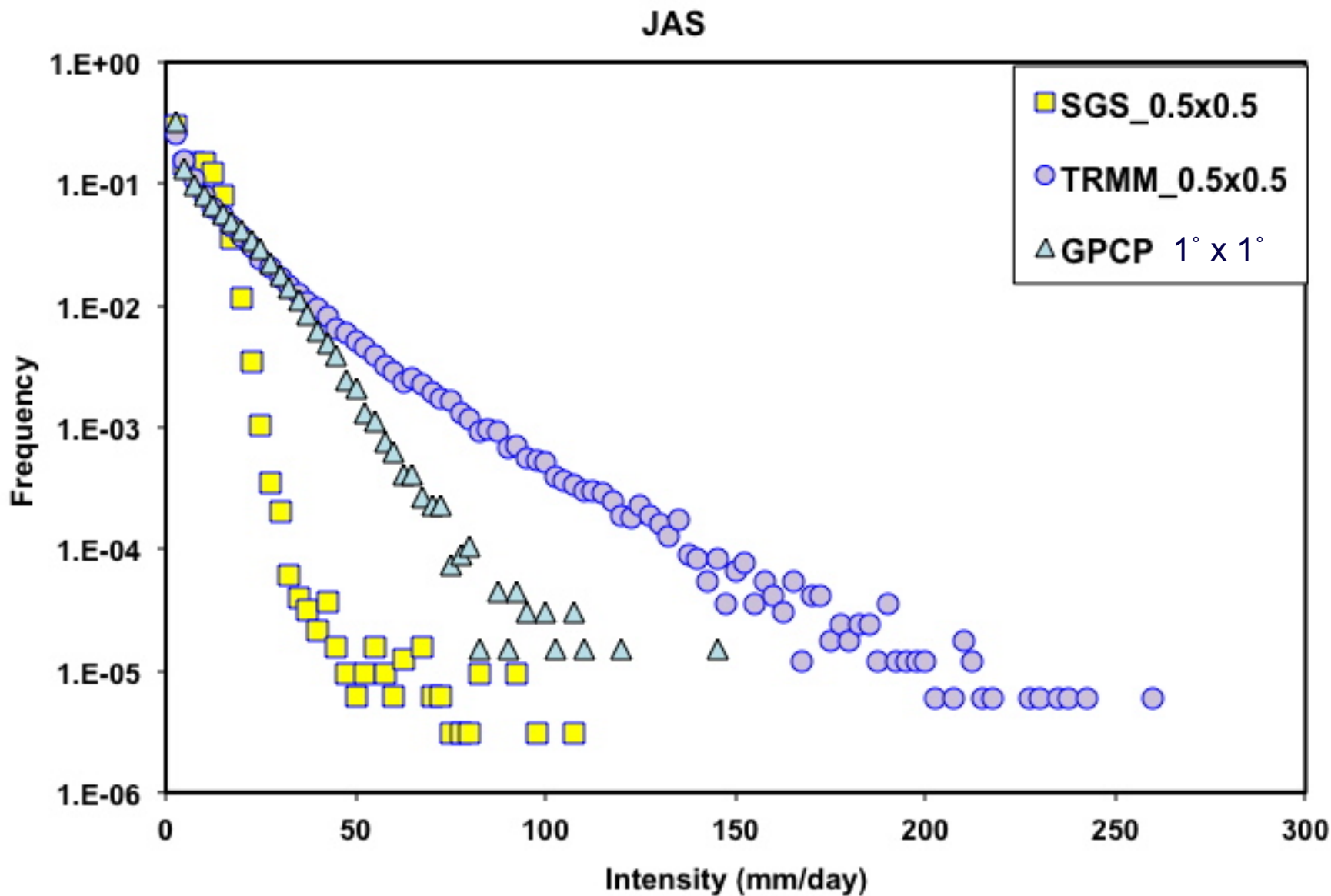
ERA-Interim + TRMM



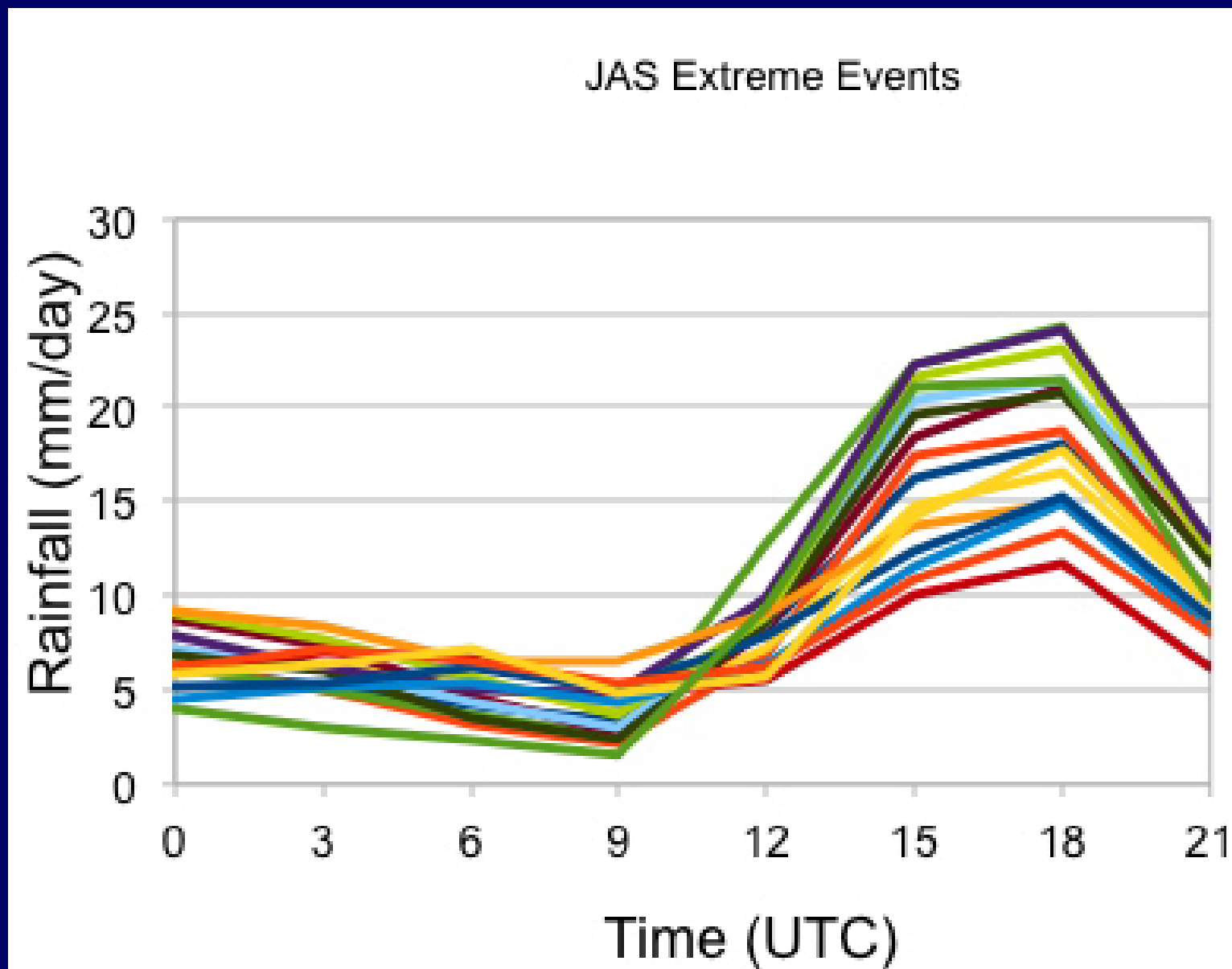
CEU - SG



Normalized Frequency vs. Intensity

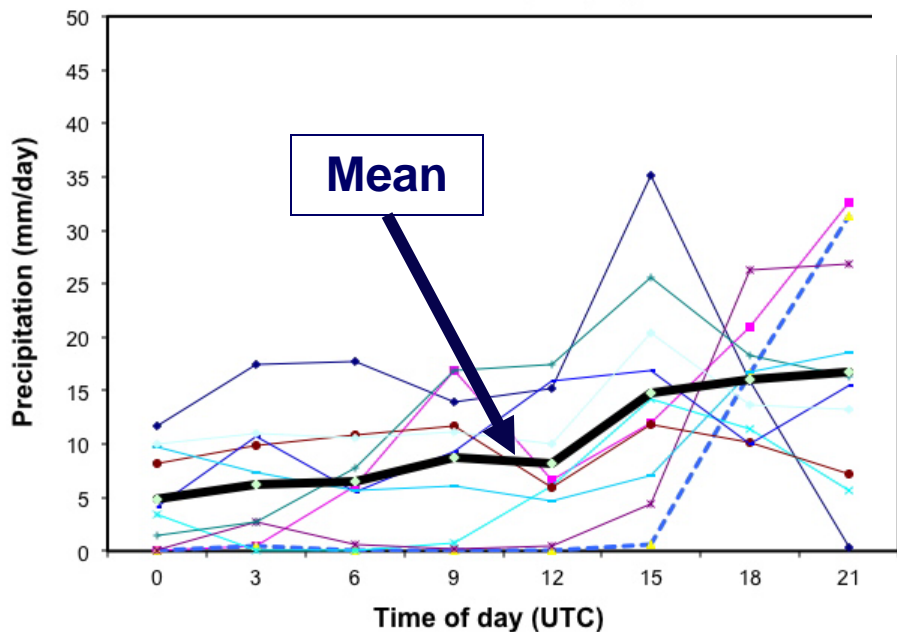
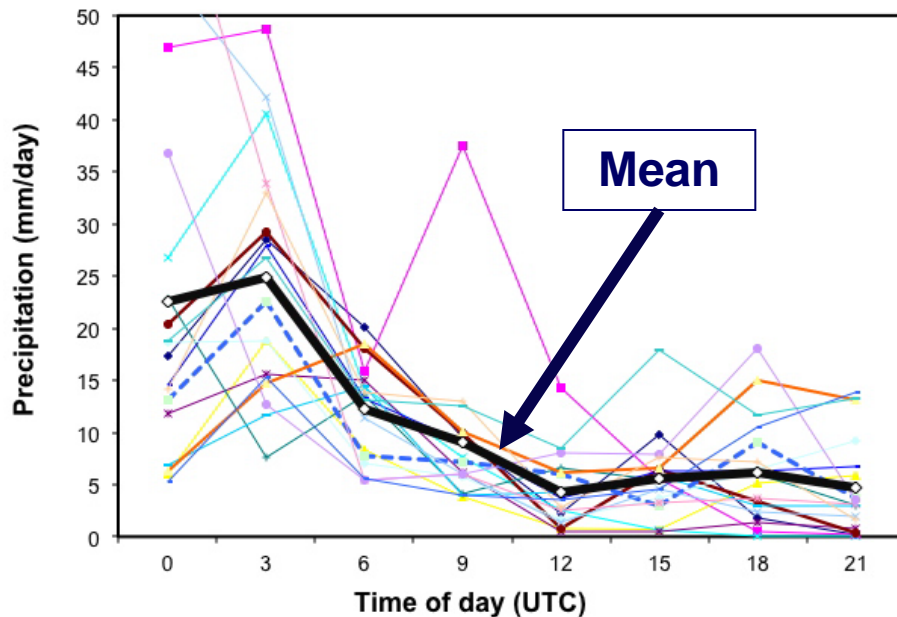


Diurnal Cycle – CEU Extremes



Diurnal Cycle – TRMM AMJ Extremes

Early Morning Max

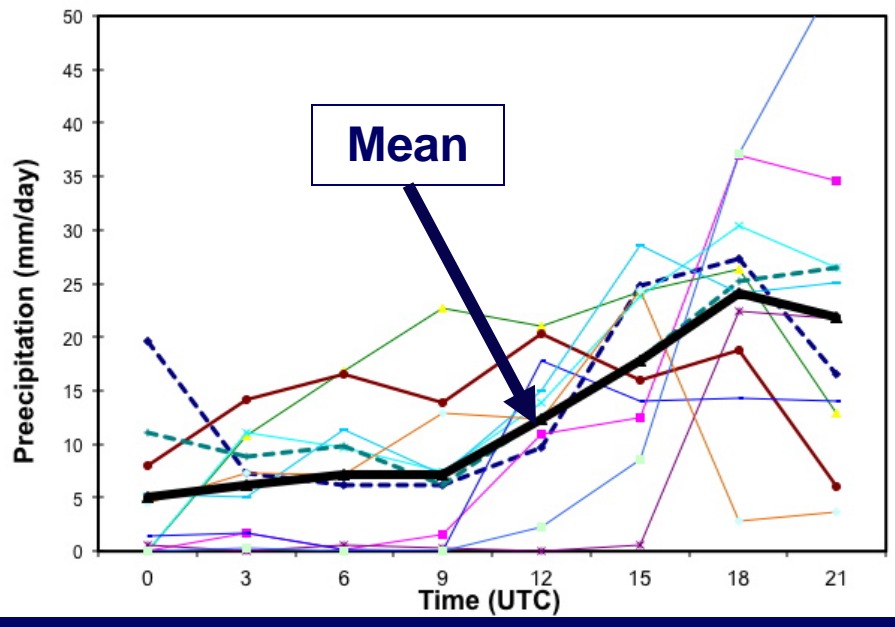
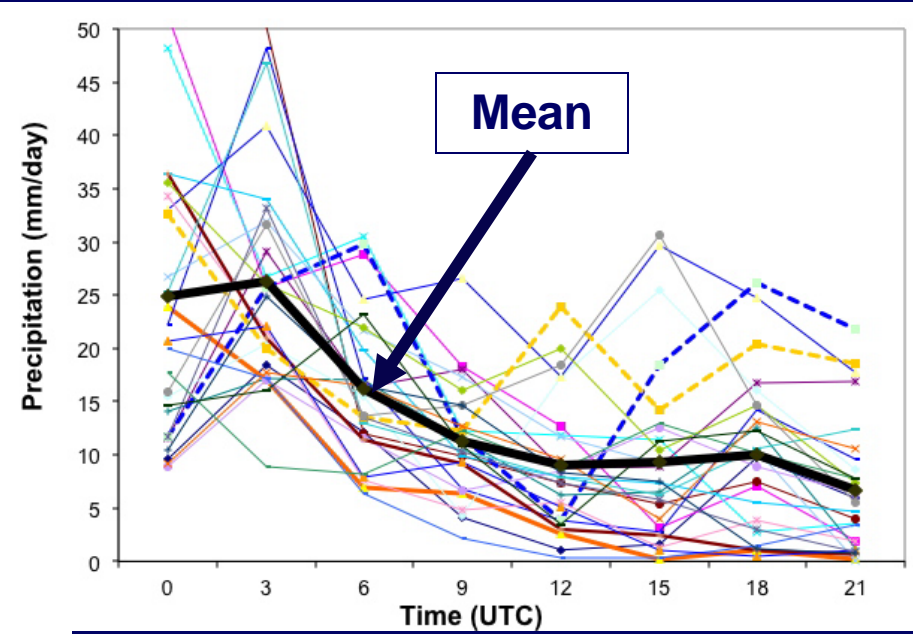


Evening Max



Diurnal Cycle – TRMM JAS Extremes

Early Morning Max



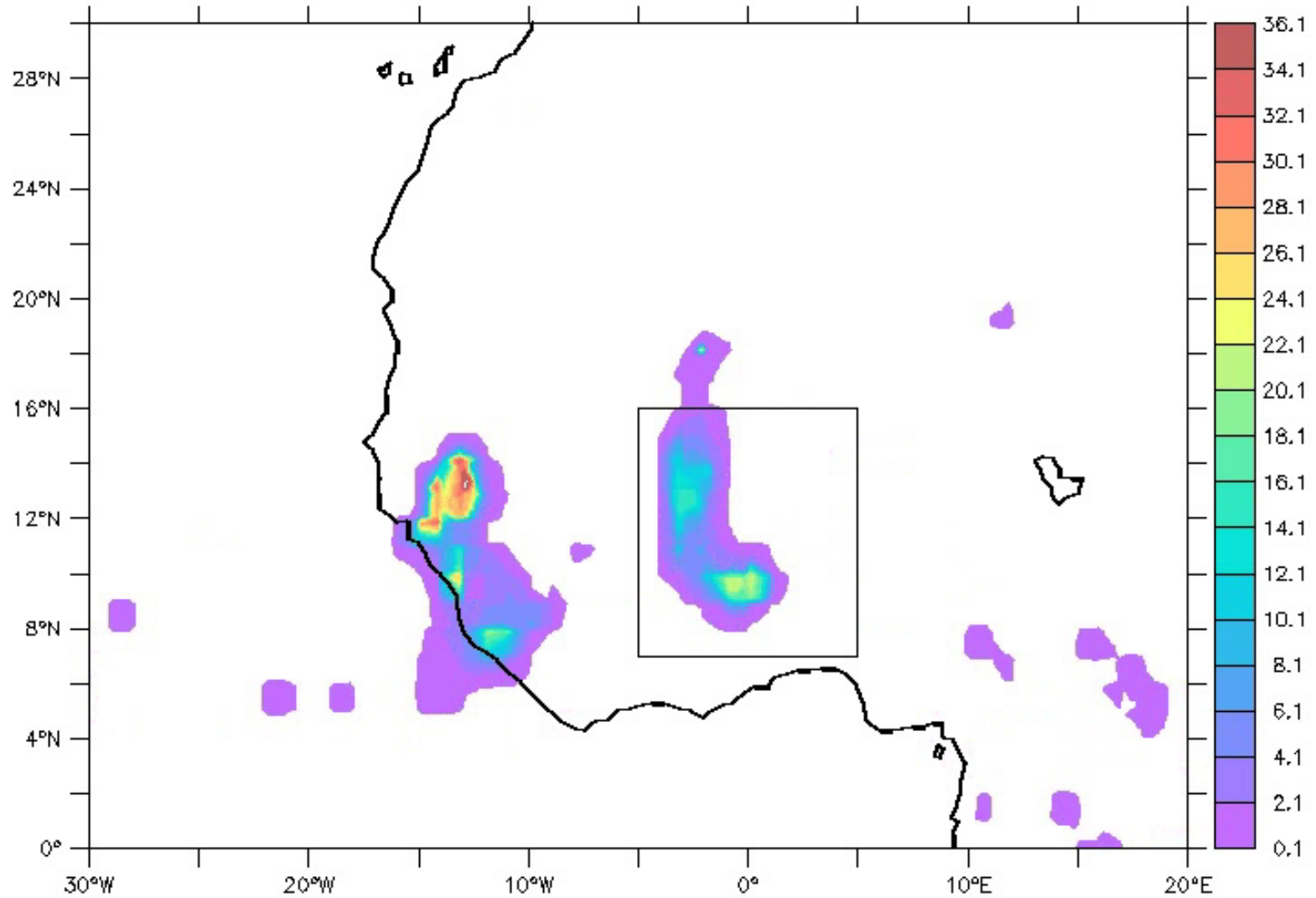
Evening Max



TRMM: Squall Line

TRMM 21 UTC

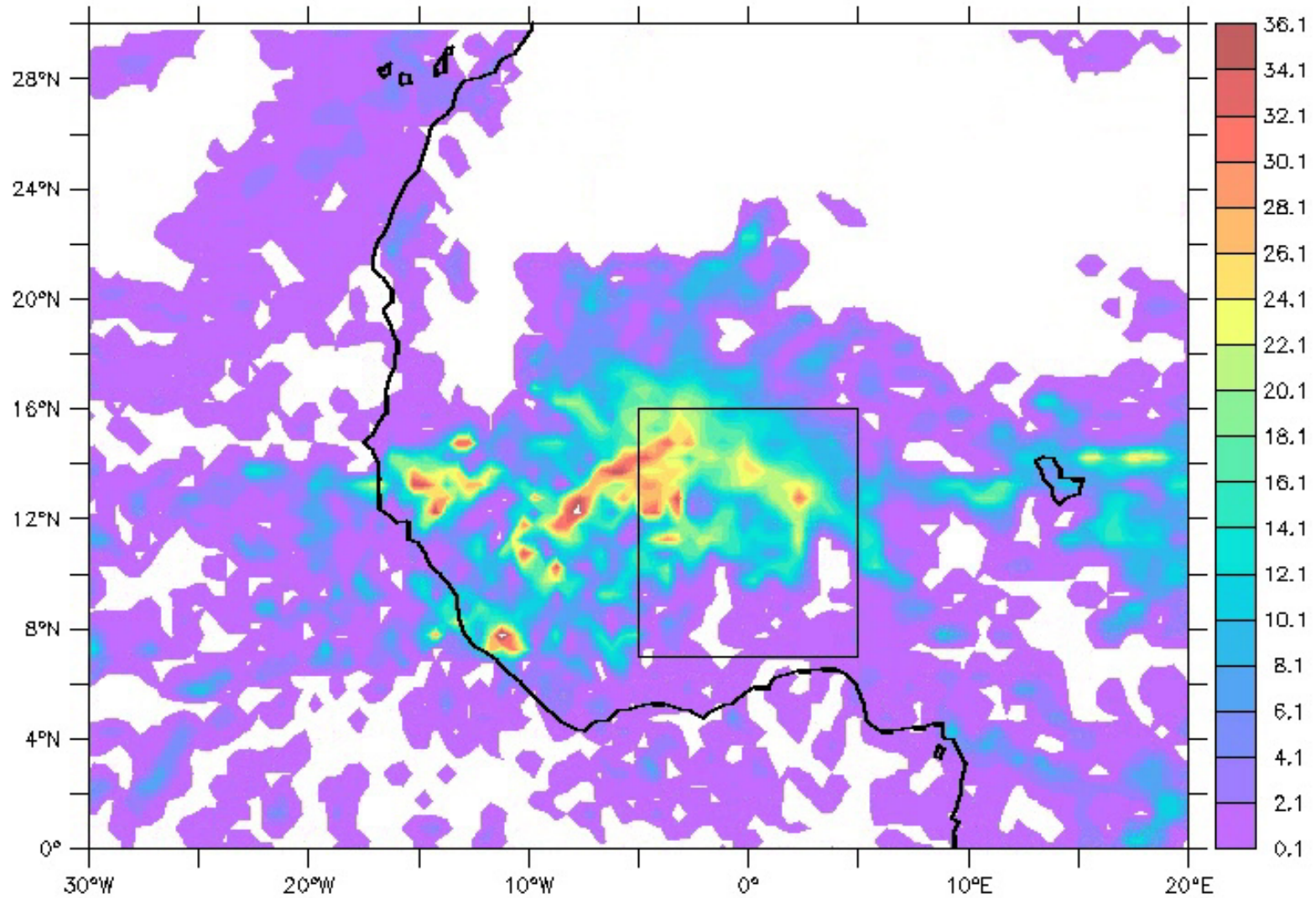
(mm/hr)



CEU: Stationary Convection

SGS 21 UTC

(mm/hr)



... and more persistent episodes of daily extremes

SUMMARY

- ★ CAM-EULAG SG simulates well several aspects of mean climatology of West Africa, including diurnal cycle
- ★ CAM-EULAG SG simulates well some aspects of extreme precipitation
- ★ However, simulated extremes weaker than observations and are stationary
- ★ Extremes also tend to show daily persistence
- ★ Needed?
 - Resolution sufficient for squall lines
 - Or perhaps a super-parameterization approach can promote the needed propagation (M. Moncrieff, pers. comm.)

Thank you!

