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

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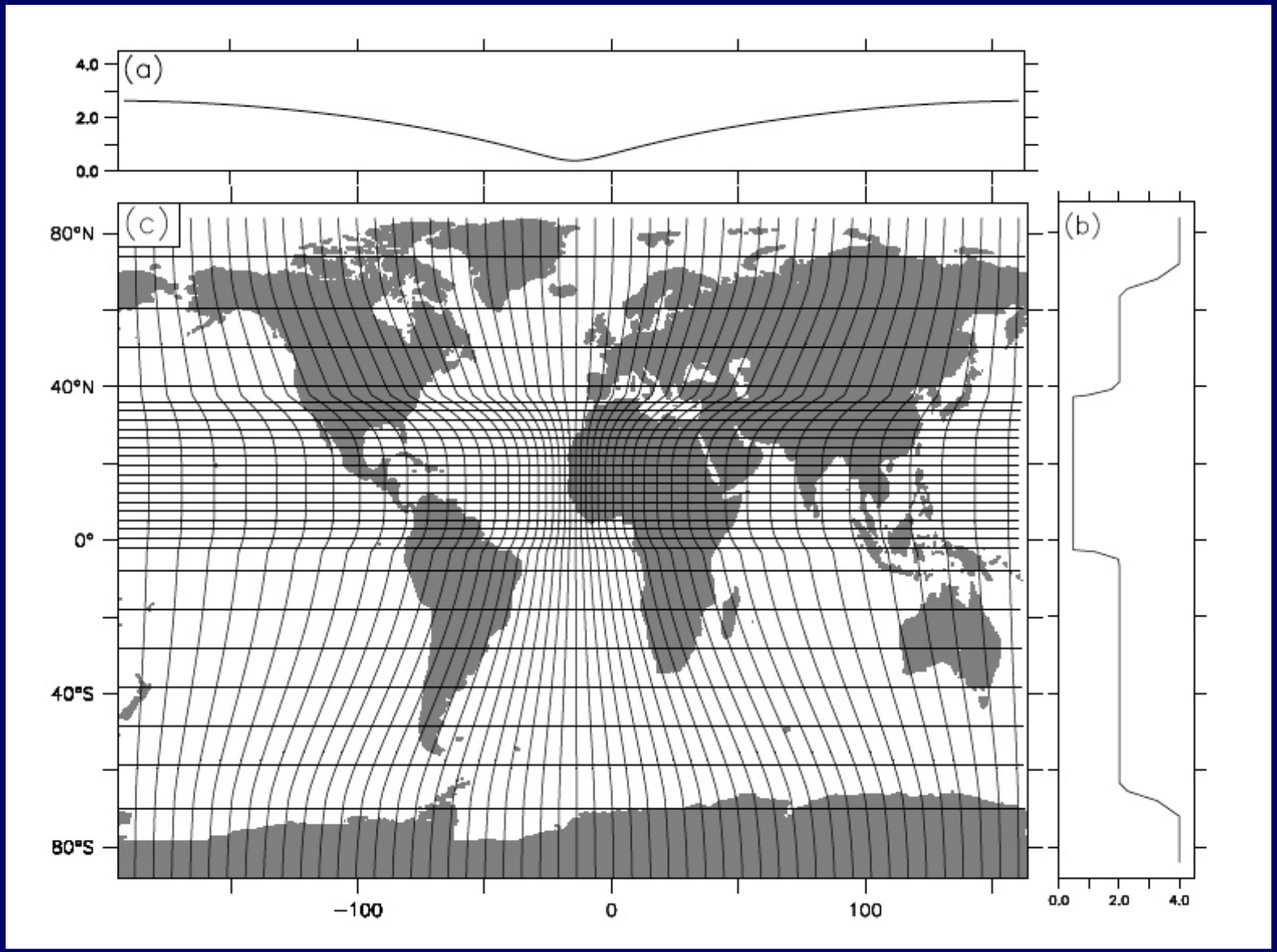
CAM-EULAG: Simulation

- Cores: EULAG (stretched-grid & uniform), FV
- Physics: CAM3 (same settings as for FV)
- Experiment: AMIP-type, observed SSTs
- Horizontal resolutions :
  - 2˚x2.5˚ [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

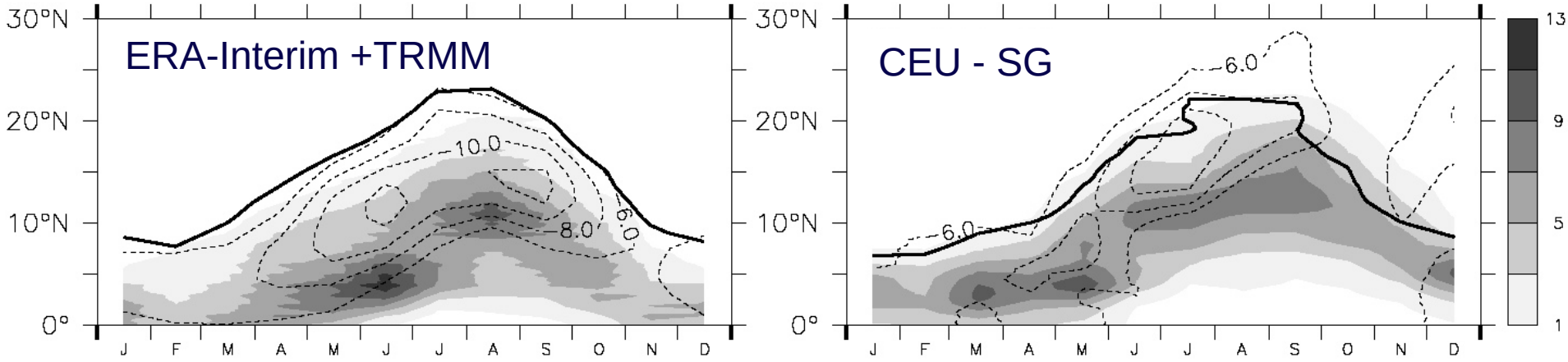


Extreme Precipitation: Observed & Simulated Behavior

- **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 ≥ 99%
  - Focus on "widespread" events: ≥ 15 simultaneous daily extreme events

CAM-EULAG: West Africa Annual Cycle

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

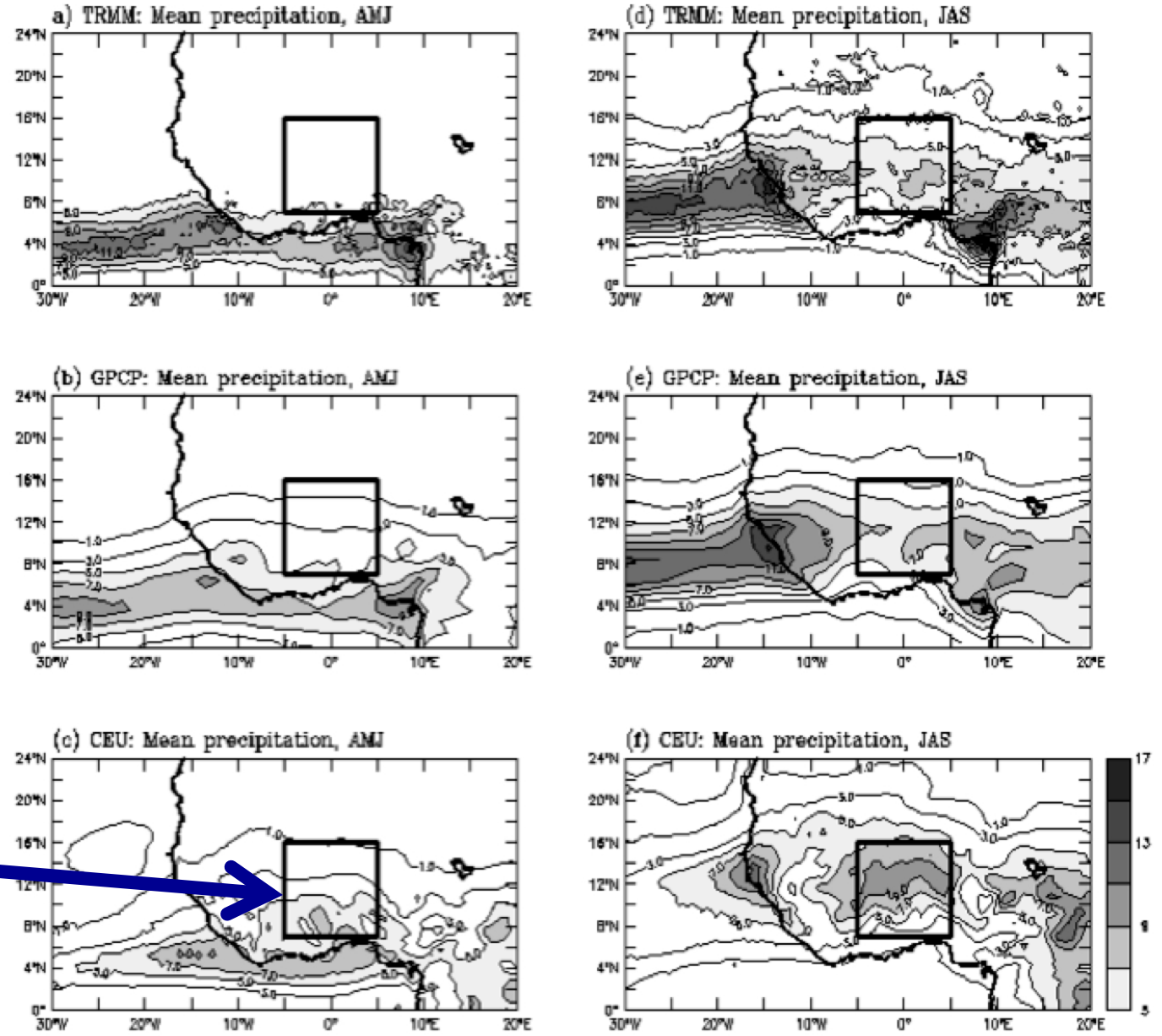


Region: 10 W – 10 E

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

Seasonal Average Precip. [mm/d]

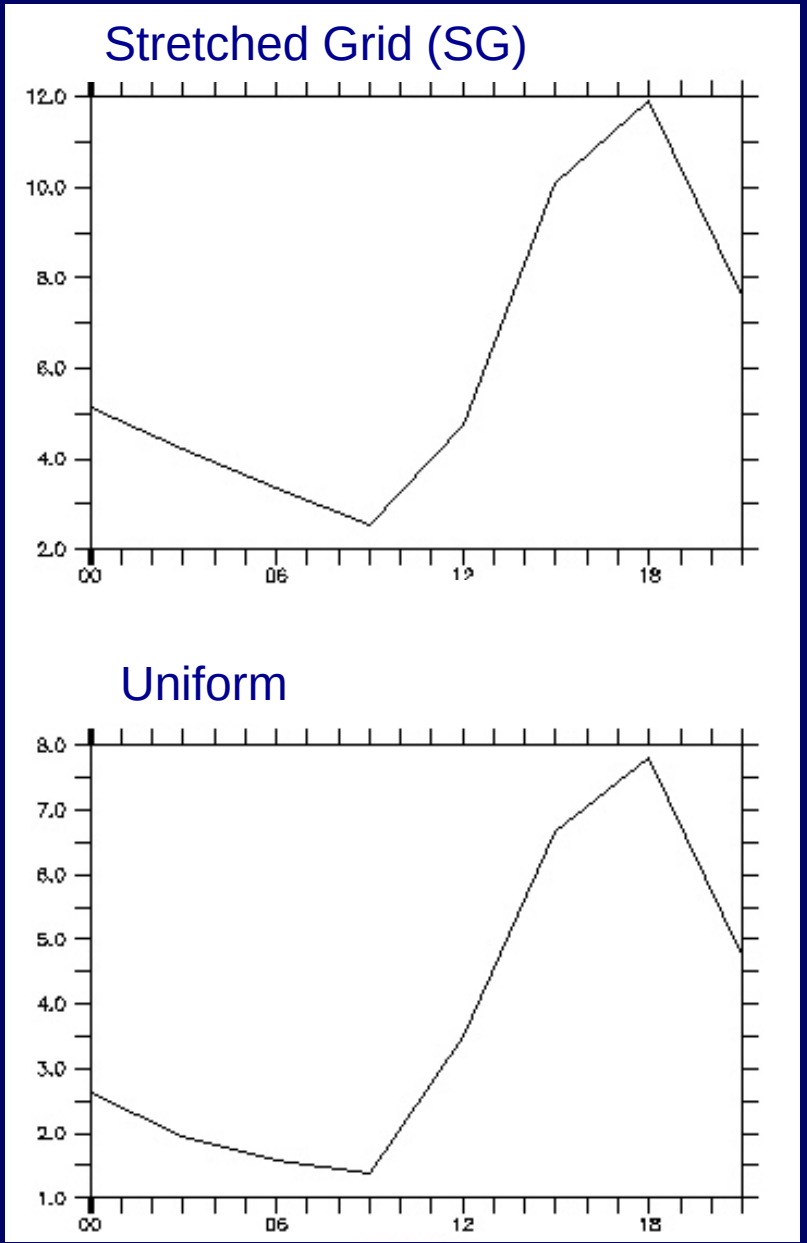
(6 N – 16 N,
5 W – 5 E)



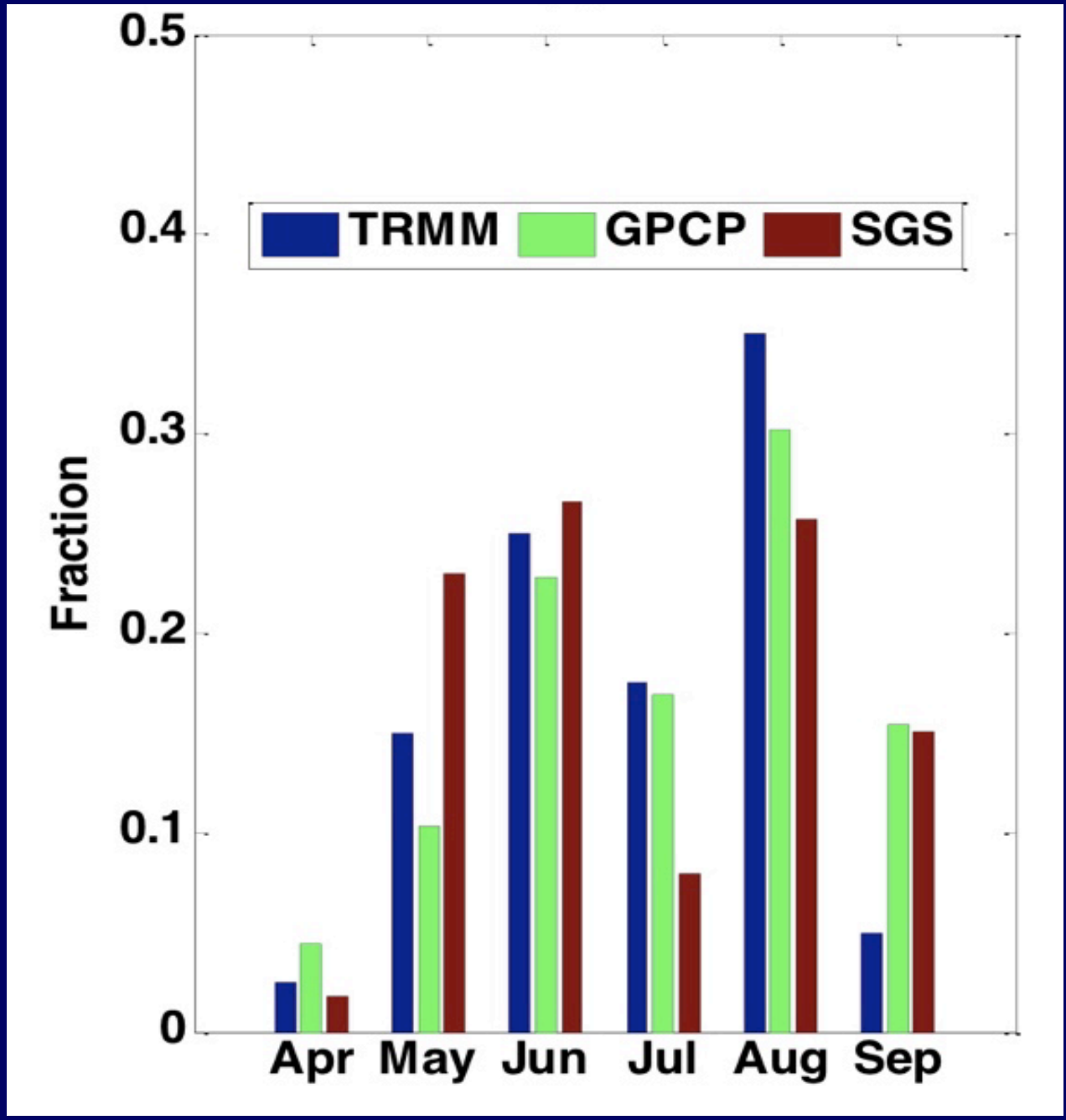
CAM-EULAG: Precipitation Diurnal Cycle [mm/d]

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

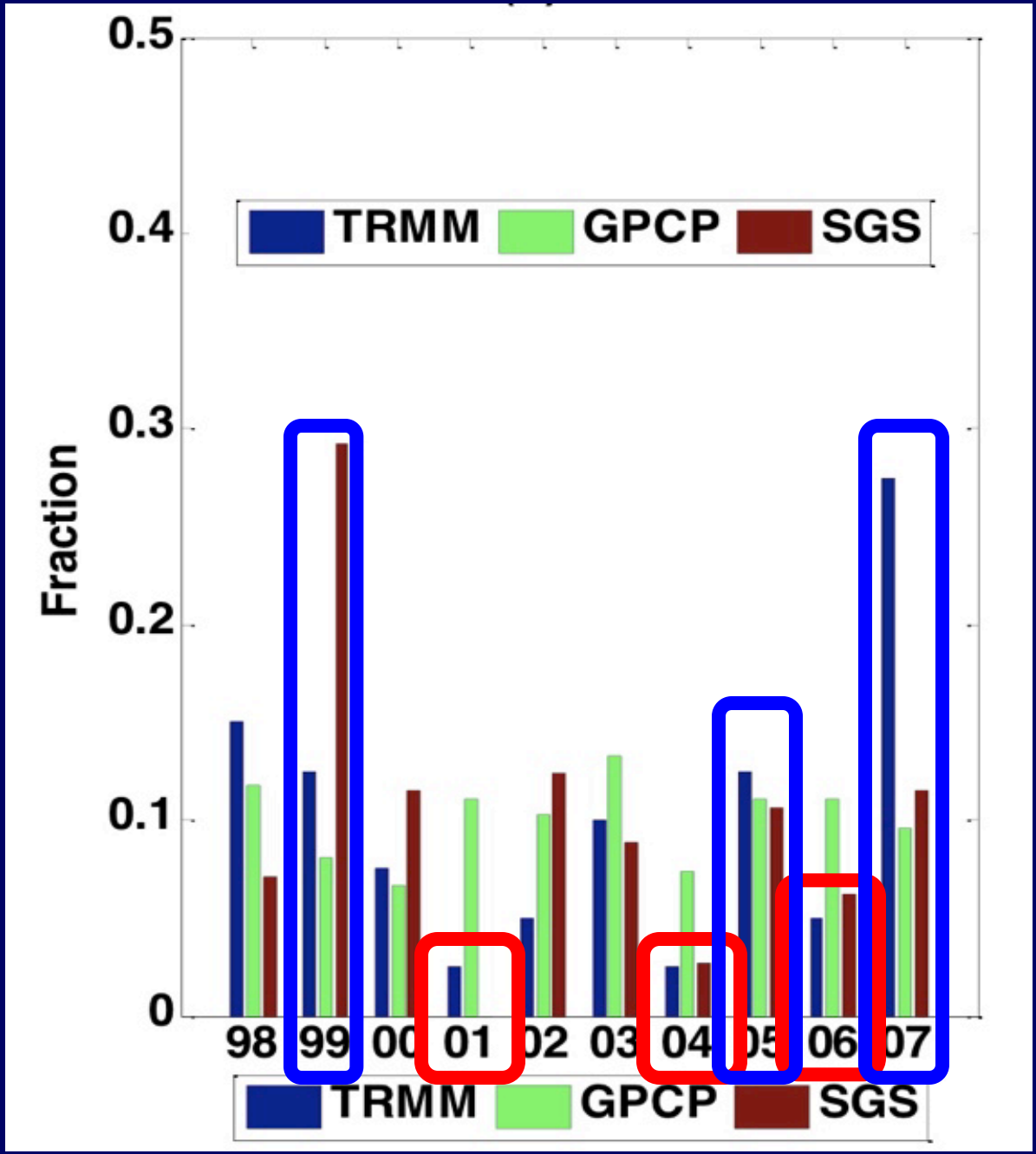
(Region: 10 W – 5 E)



Monthly Timing of Extreme Precipitation

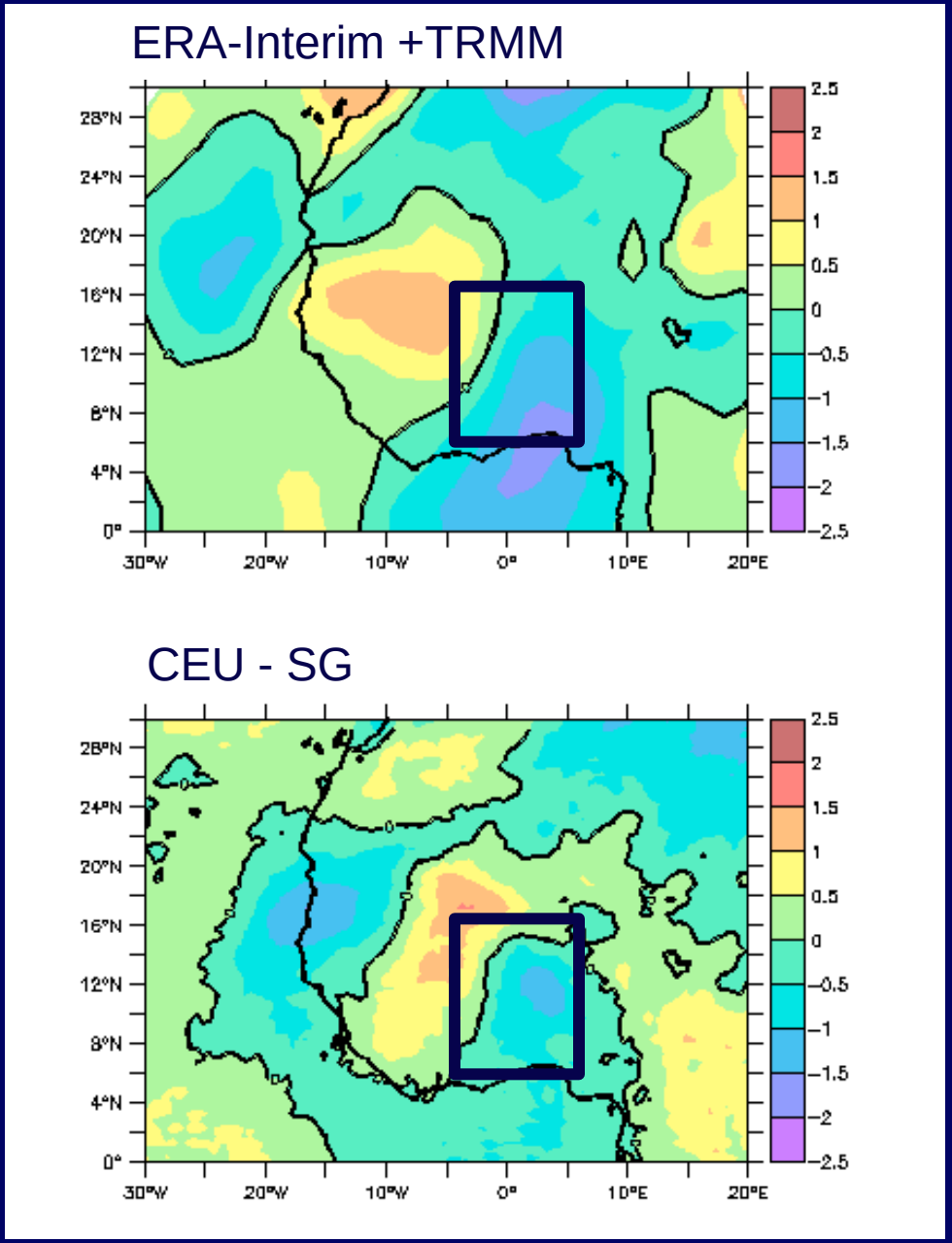


Interannual Variability of Extreme Precipitation



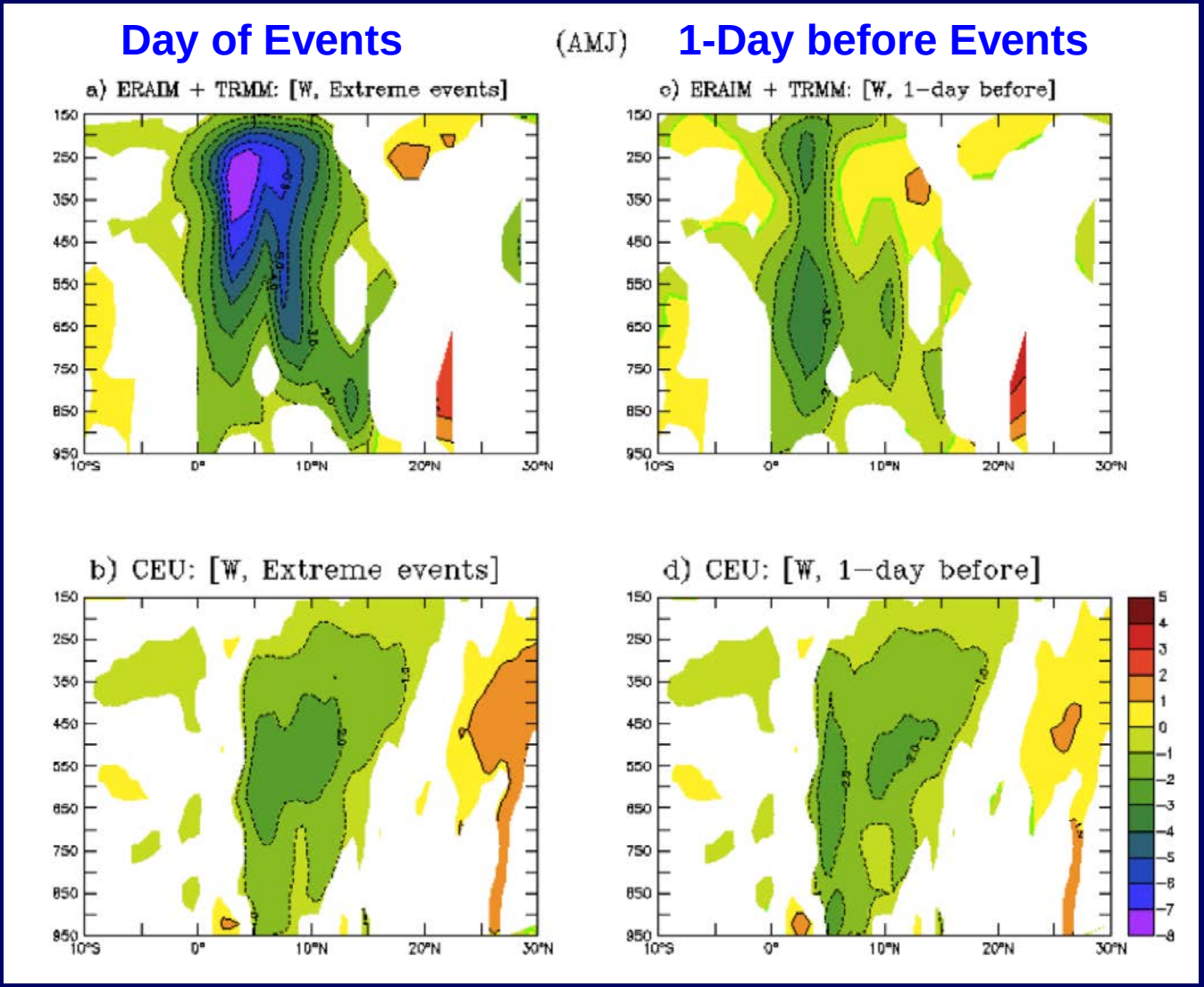
Composite Anomaly Meridional Wind

JAS
700 hPa
Day Before



Composite Anomaly Vertical Wind Extreme Precipitation Days

April – May - June



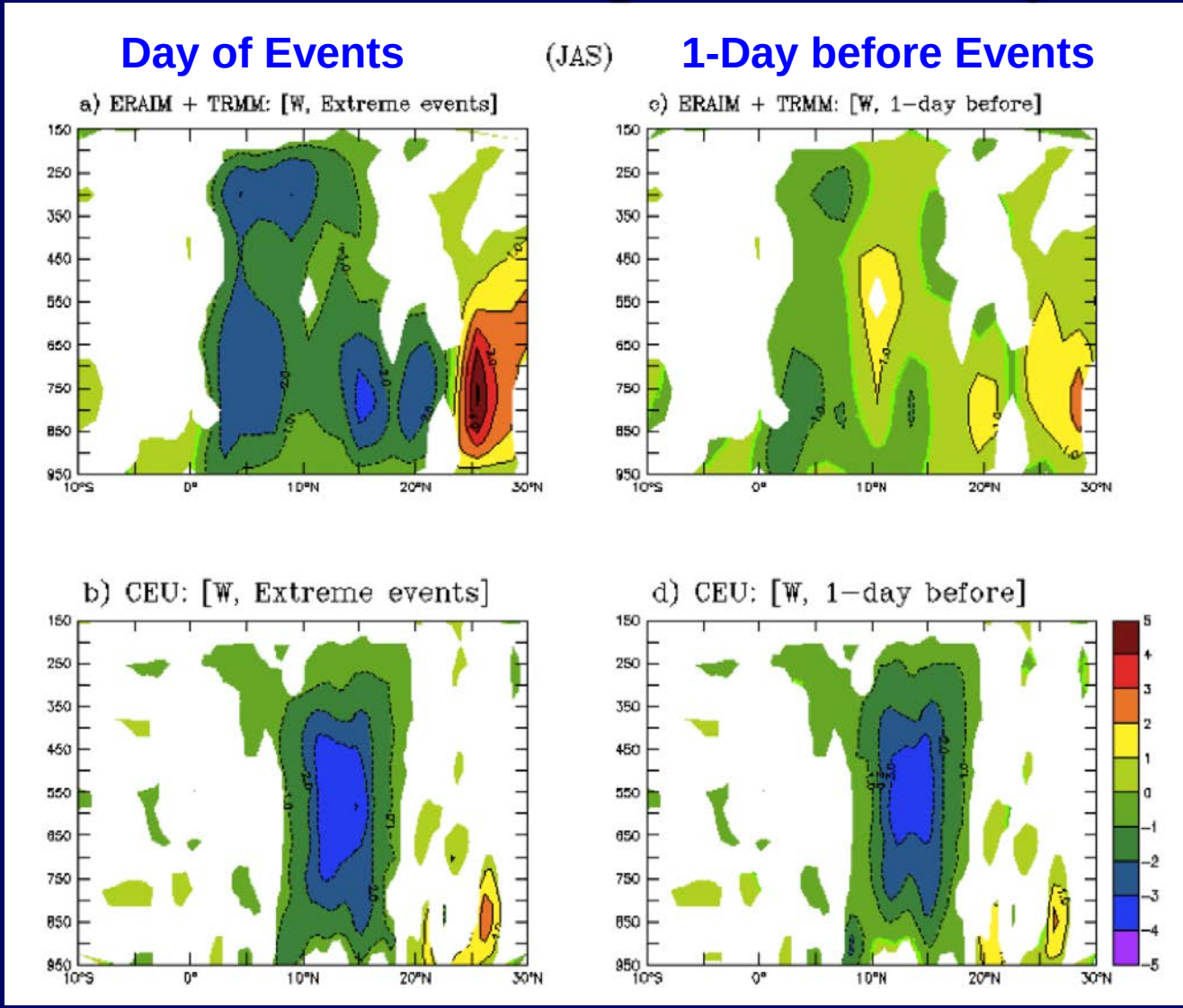
OBS.

CEU

[mb/s]

Composite Anomaly Vertical Wind Extreme Precipitation Days

July - August - Sept.

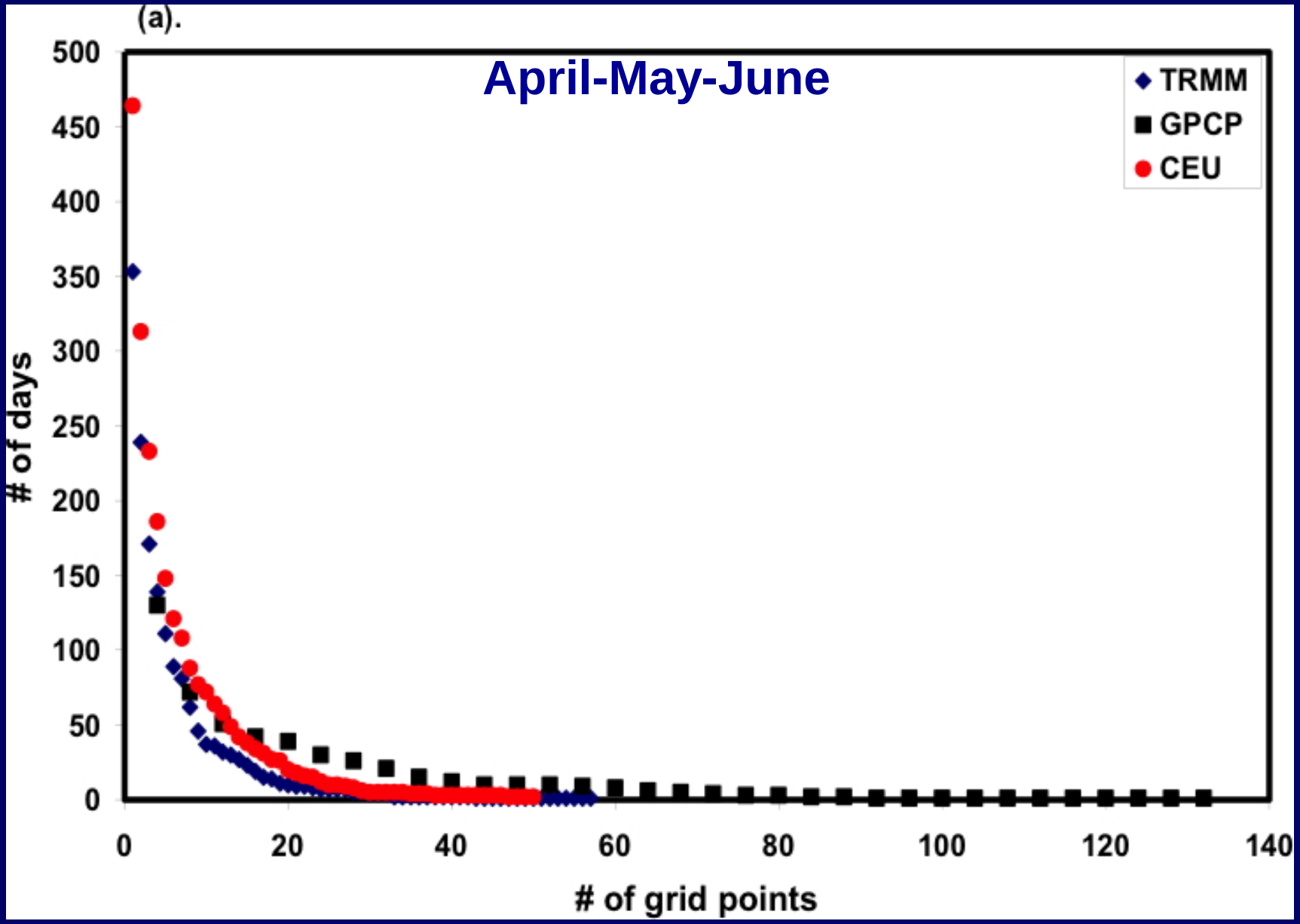


OBS.

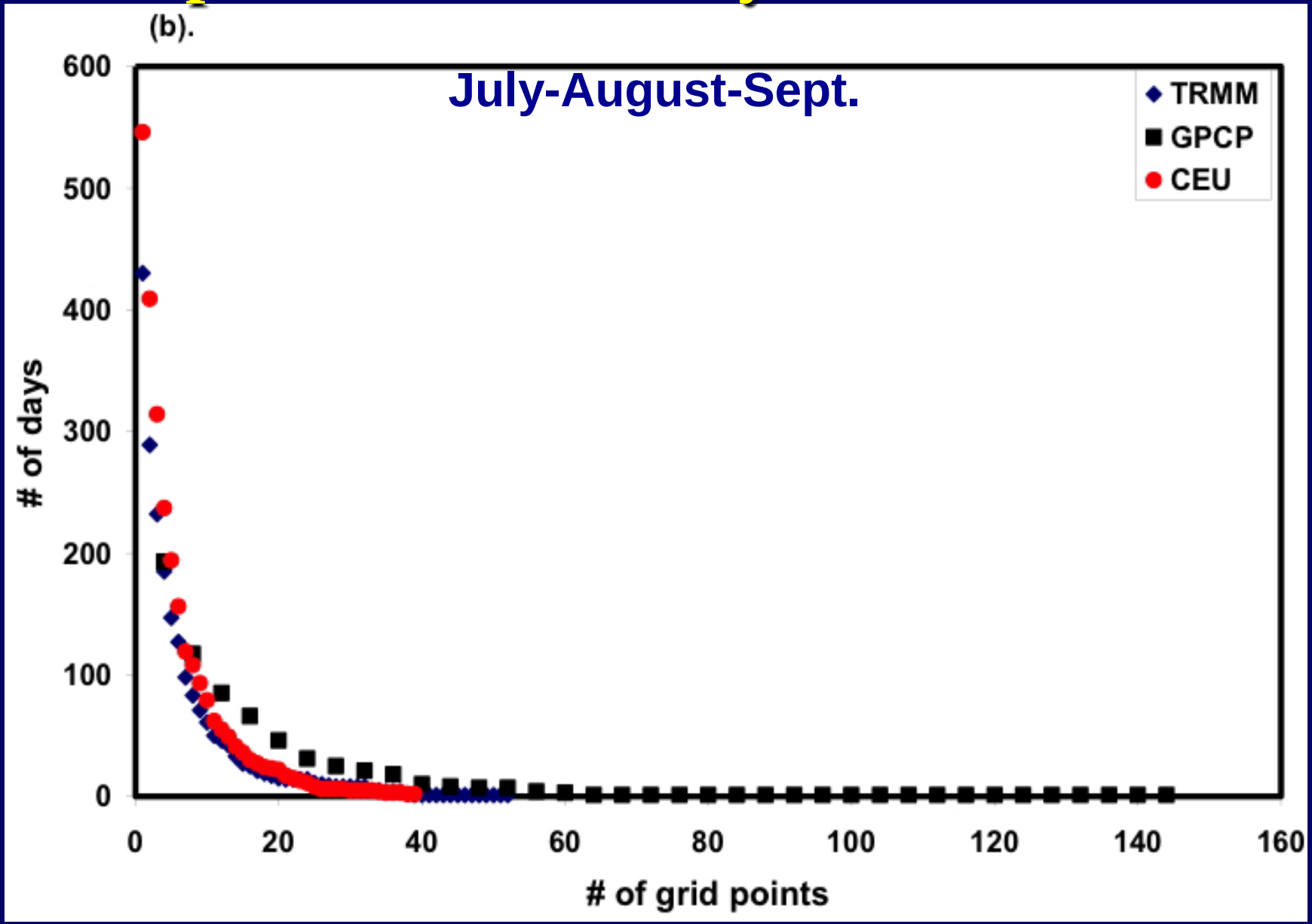
CEU

[mb/s]

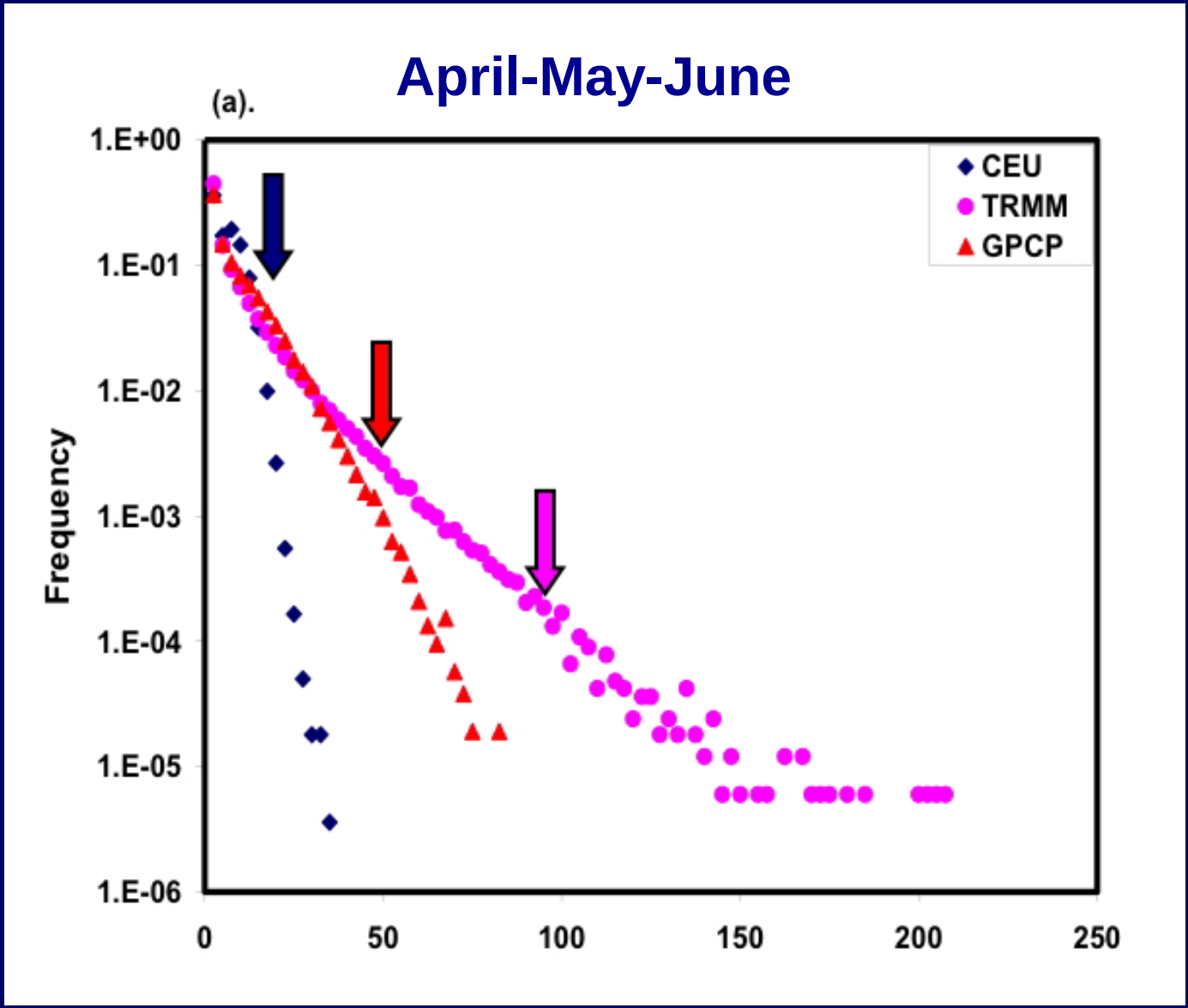
Spatial Simultaneity of Extremes



Spatial Simultaneity of Extremes



Normalized Frequency vs. Intensity



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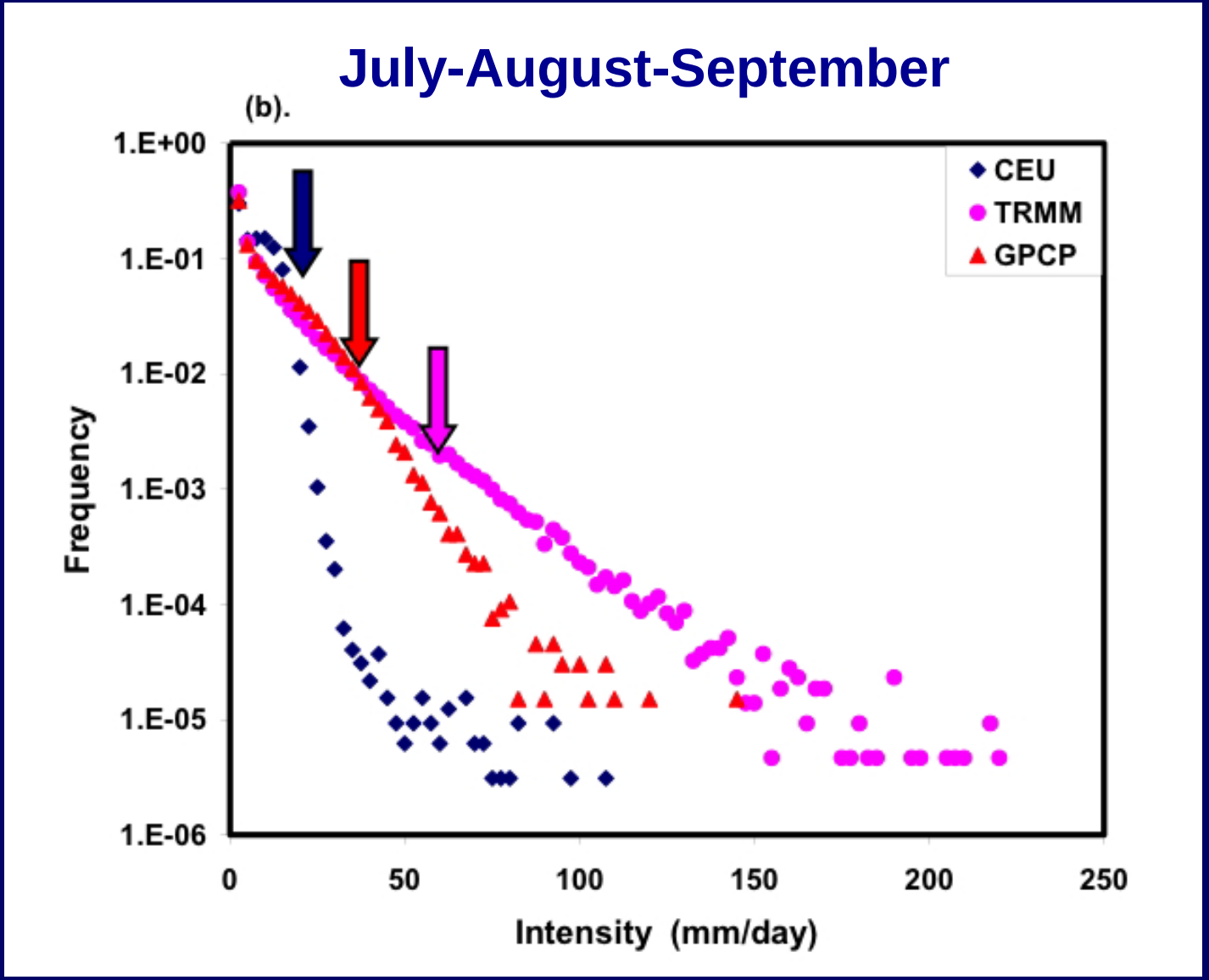
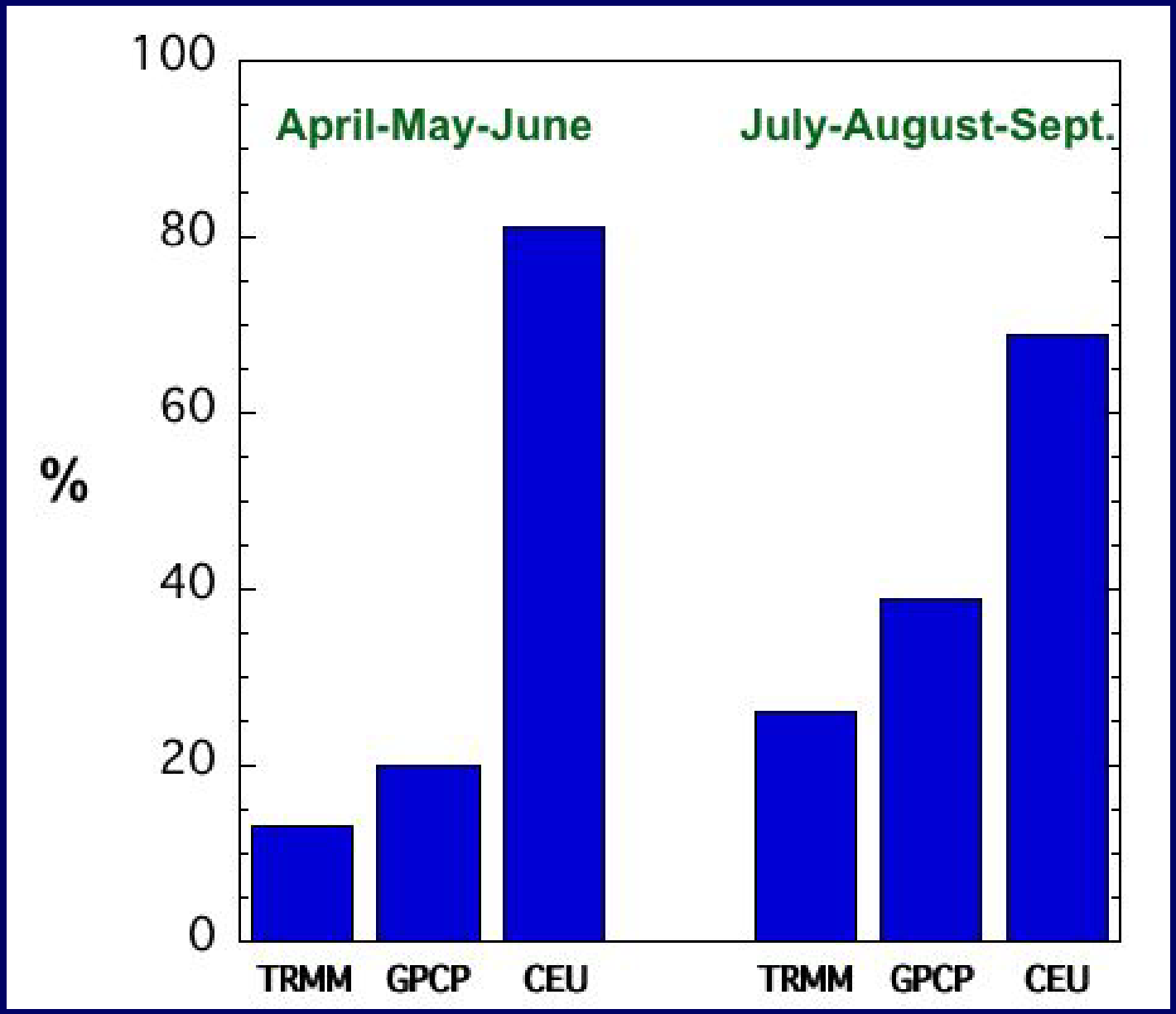
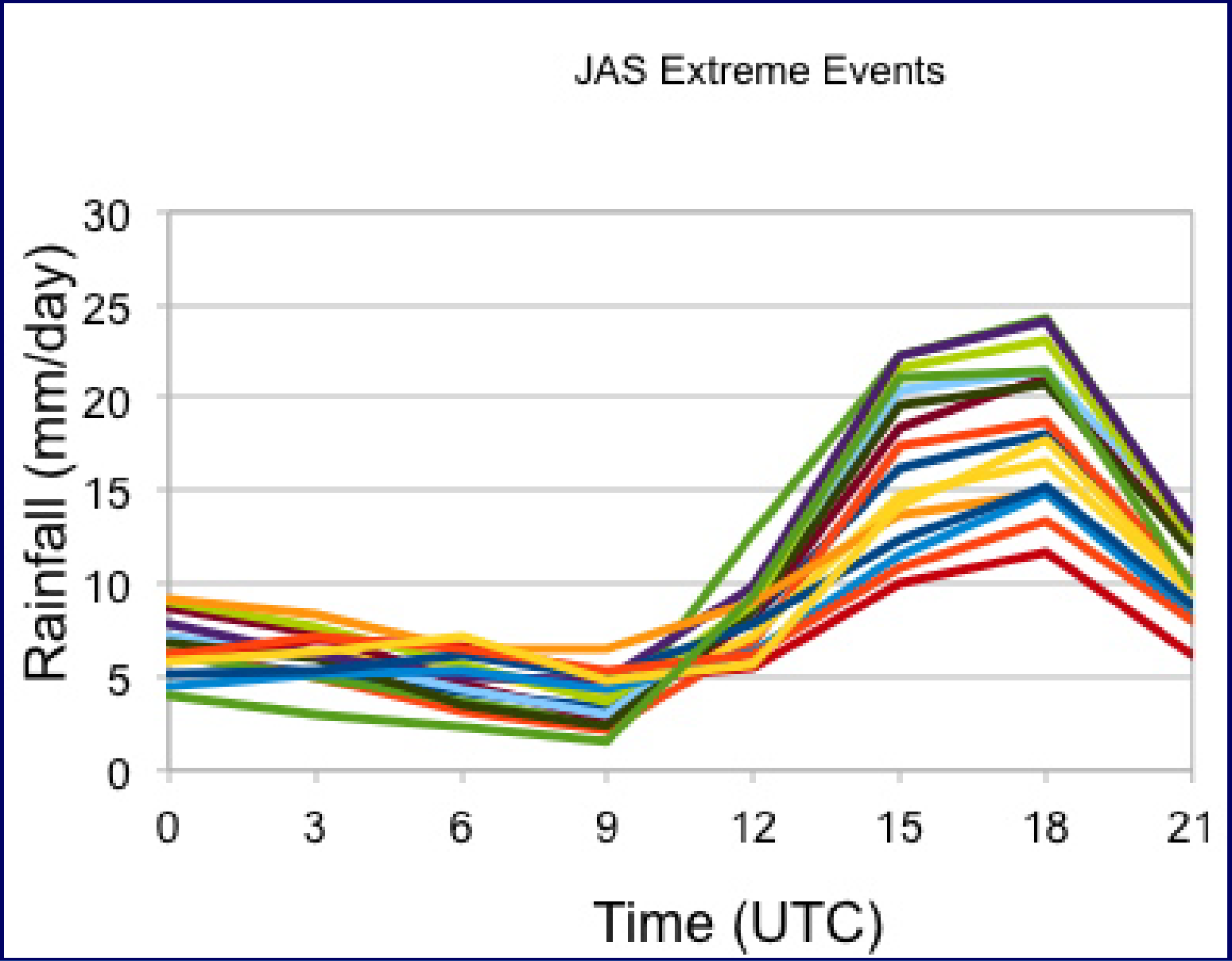


% of Extremes as Consecutive-Day Events

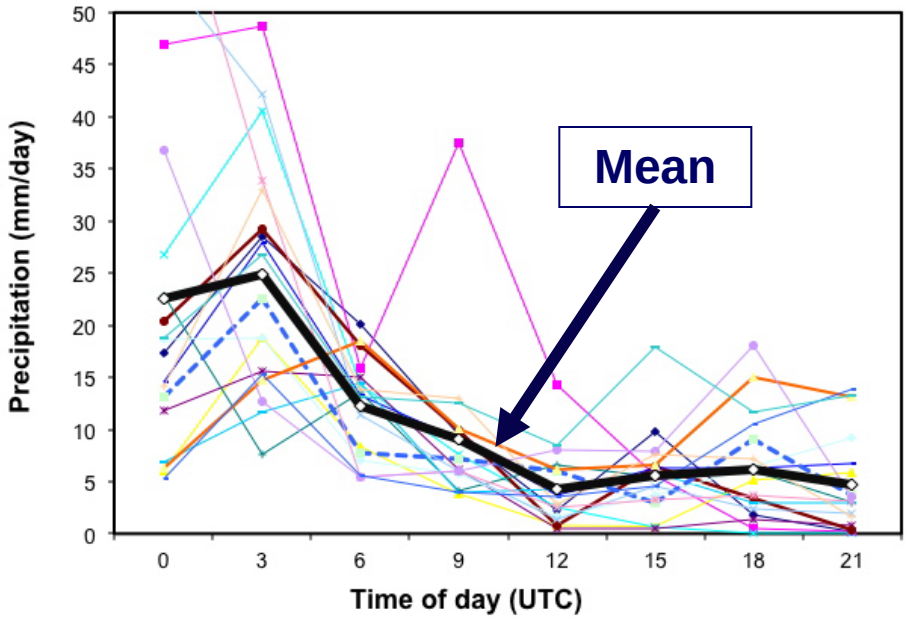


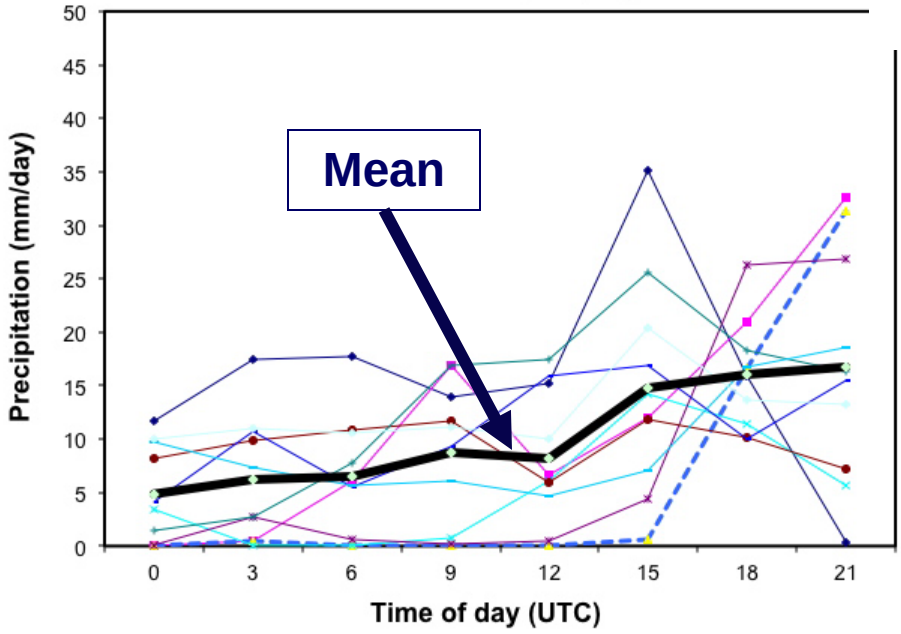
Dirunal Cycle – CEU Extremes



Dirunal Cycle – TRMM AMJ Extremes

Early Morning Max

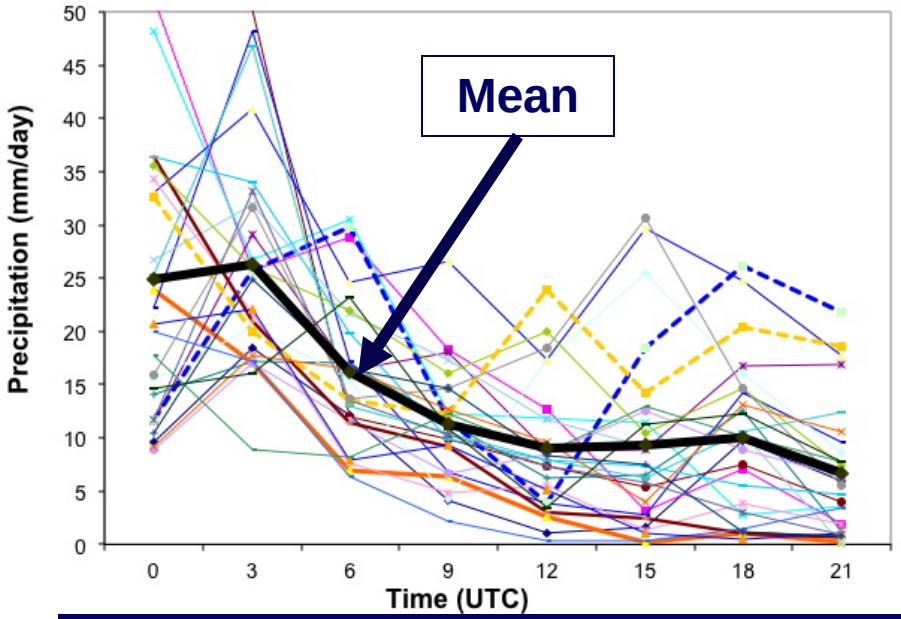


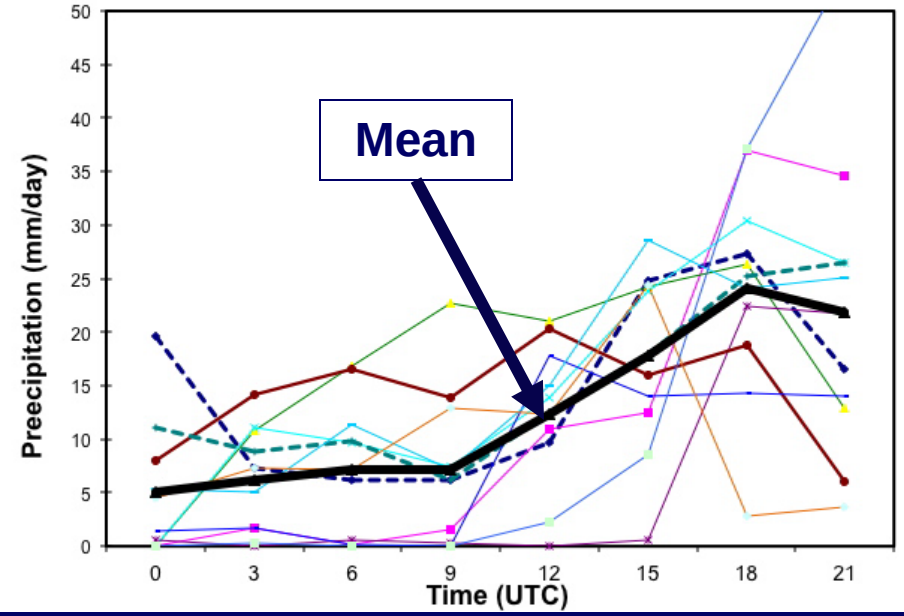


Evening Max

Dirunal Cycle – TRMM JAS Extremes

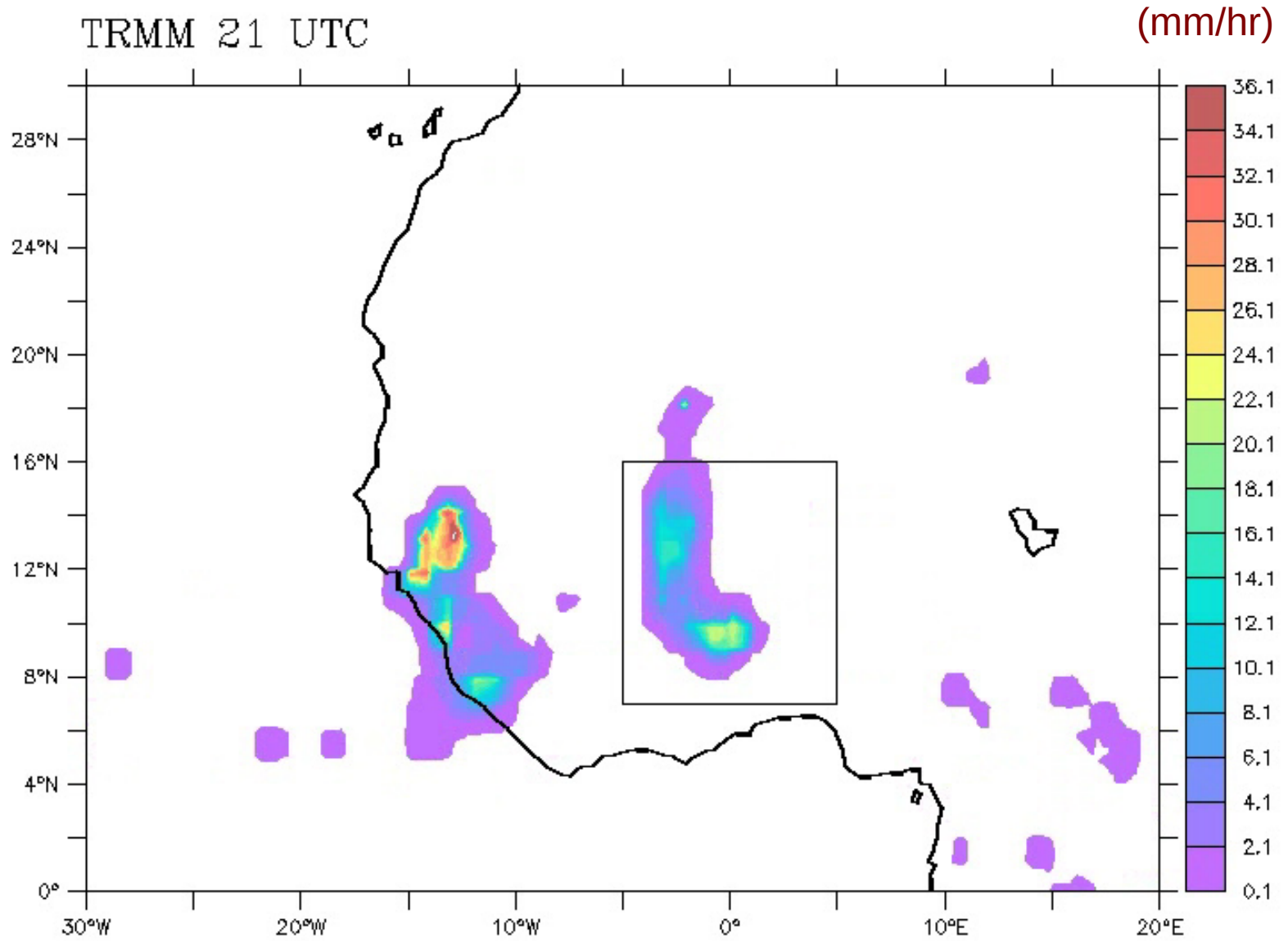
Early Morning Max



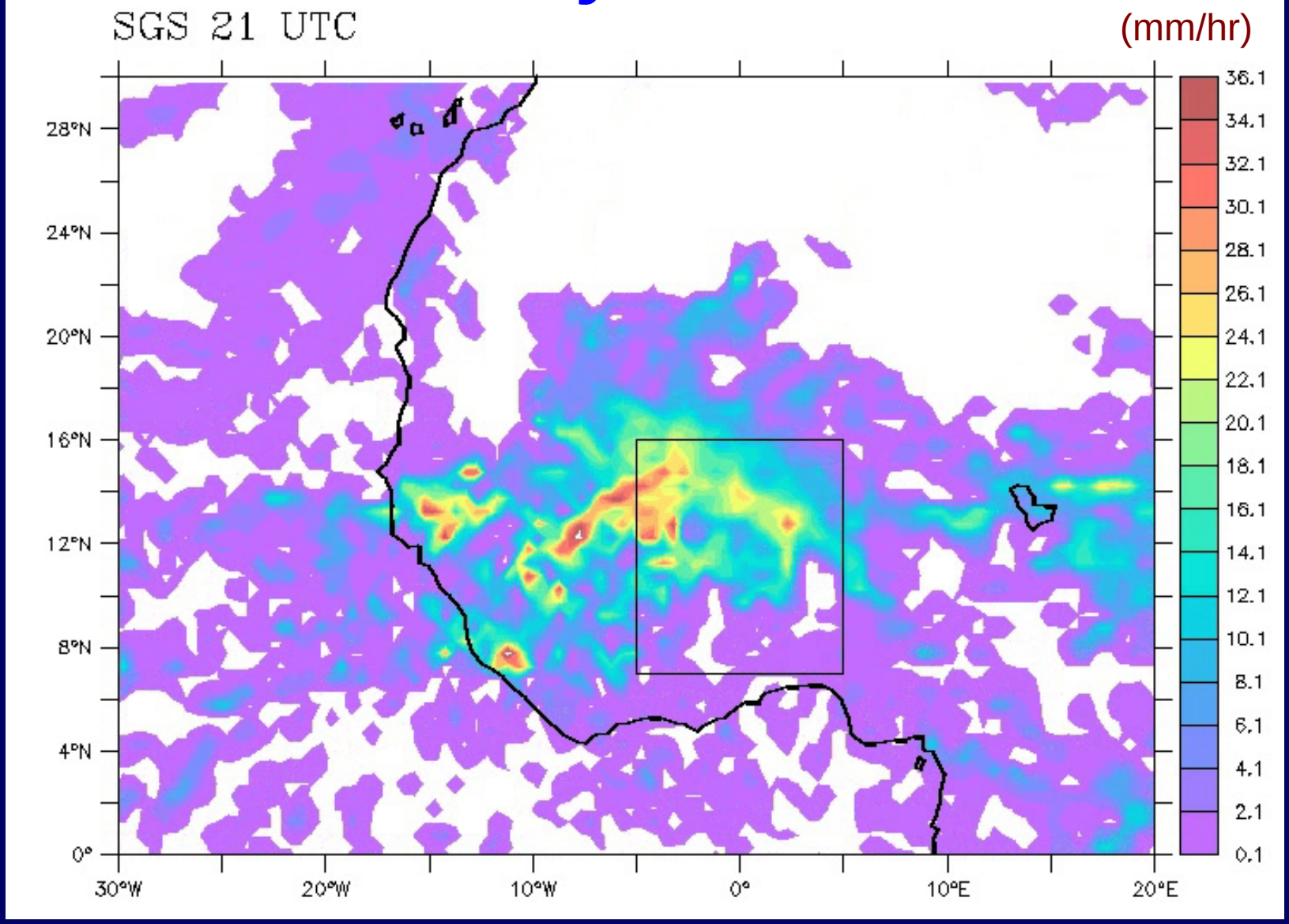


Evening Max

TRMM: Squall Line



CEU: Stationary Convection



… 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, NCAR, pers. comm.)

Thank you!