The Precipitation Characteristics of Global MODIS Cloud Regimes and Tropical Regime Aggregates

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Motivation and approach

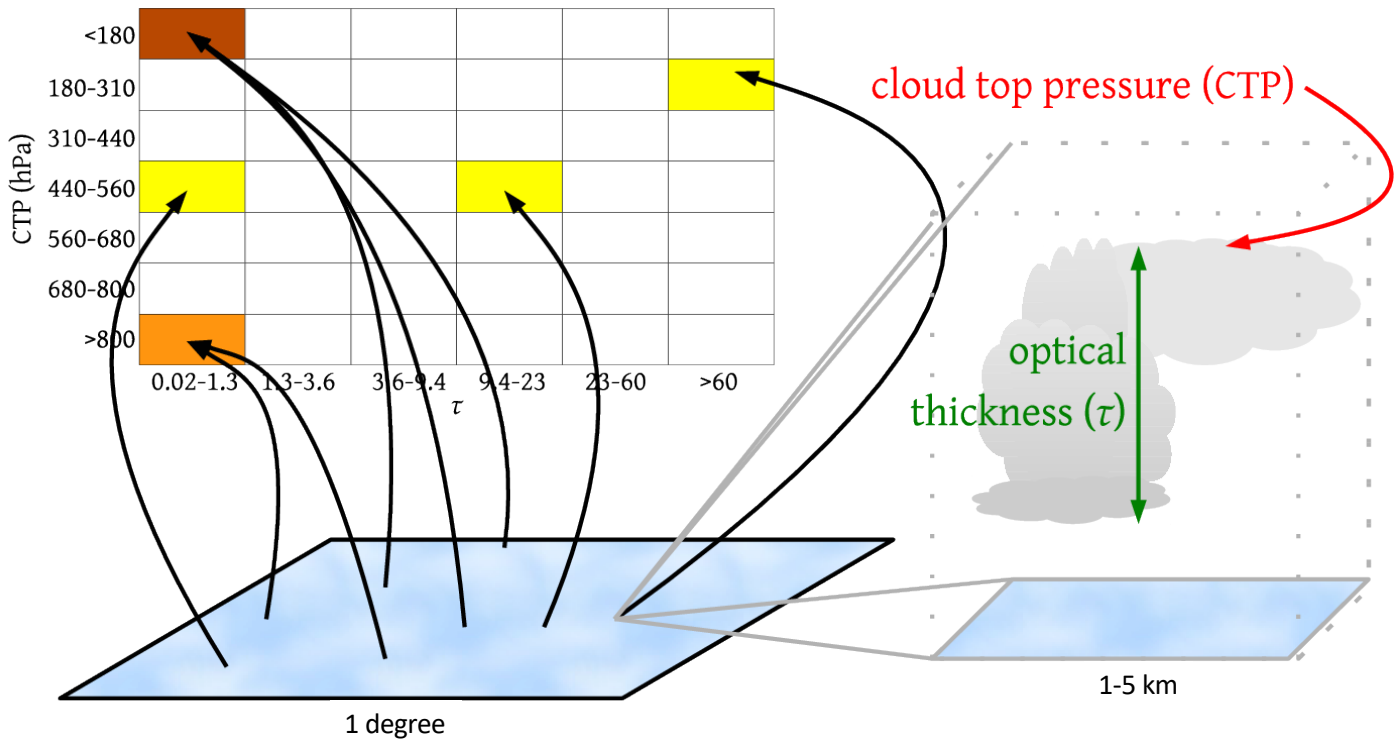
Questions

- How is precipitation partitioned among the various prevalent daytime cloud systems?
- What precipitation characteristics are expected given information about clouds? Conversely, given precipitation information can we guess the nature of the clouds it originates from?
- Can precipitation variability be traced back to track cloud variability?
- To what degree are models capable of producing the partitioning?

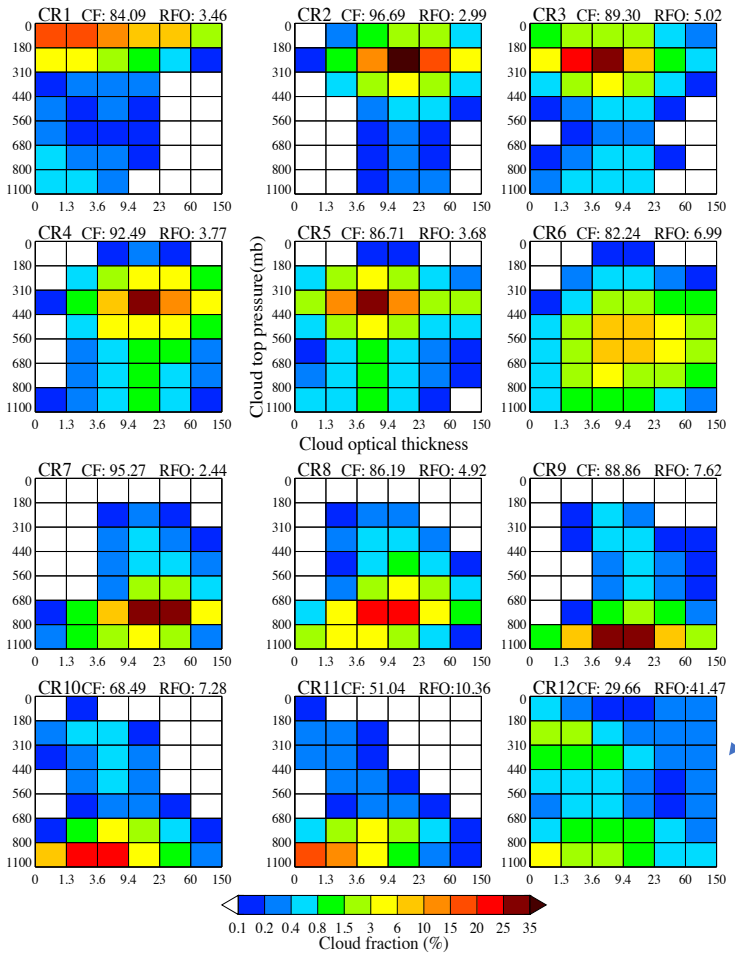
Approach

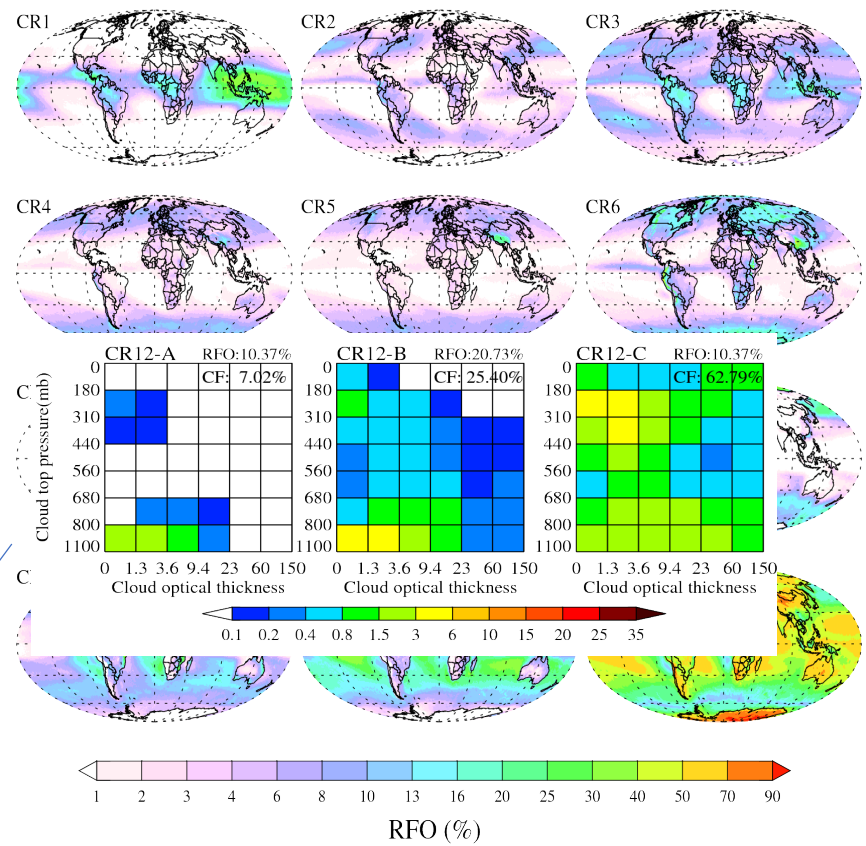
- Breakdown by “cloud regime” (CR), representing similar cloud (and meteorology?) conditions
- How can cloud regimes be defined?
  - Based on similarity of CTP-COT MODIS histograms
  - 1° resolution, two values daily: Terra and Aqua
- Match spatiotemporally with (higher resolution) precipitation data: IMERG or TMPA

MODIS Joint CTP-COT histograms



MODIS Collection 6 Cloud Regimes (CRs)



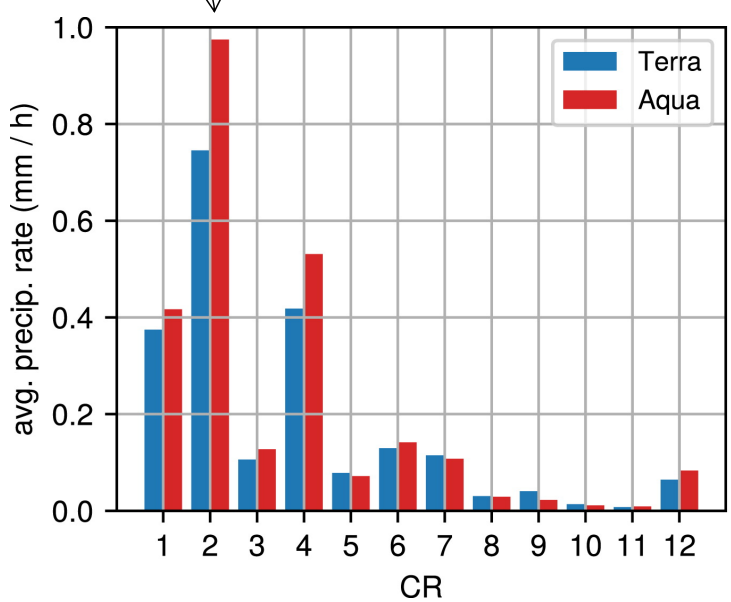


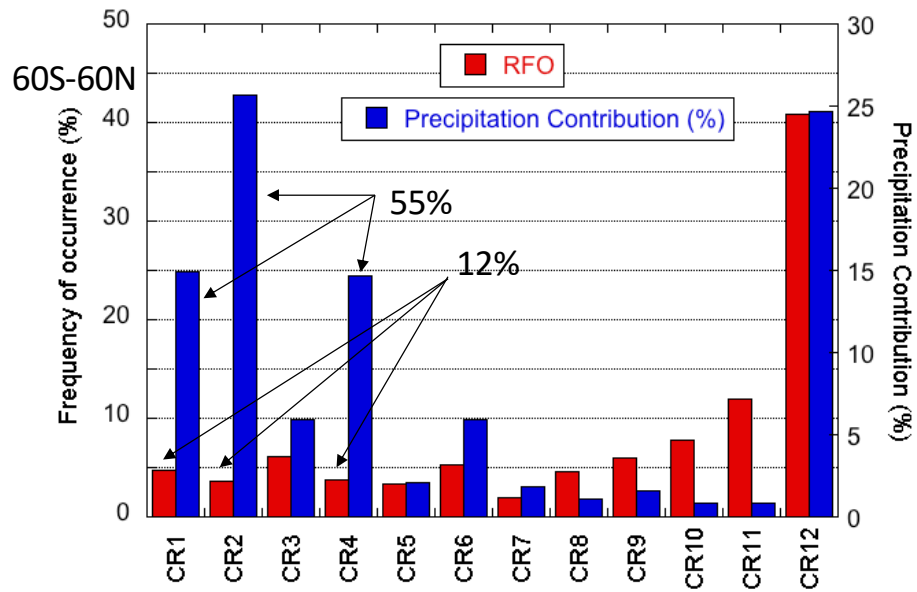
The precipitation of Global Cloud Regimes (per IMERG)

Mean rates and contributions

Stronger PM precipitation

1 degree=100 IMERG (V05) values per grid cell



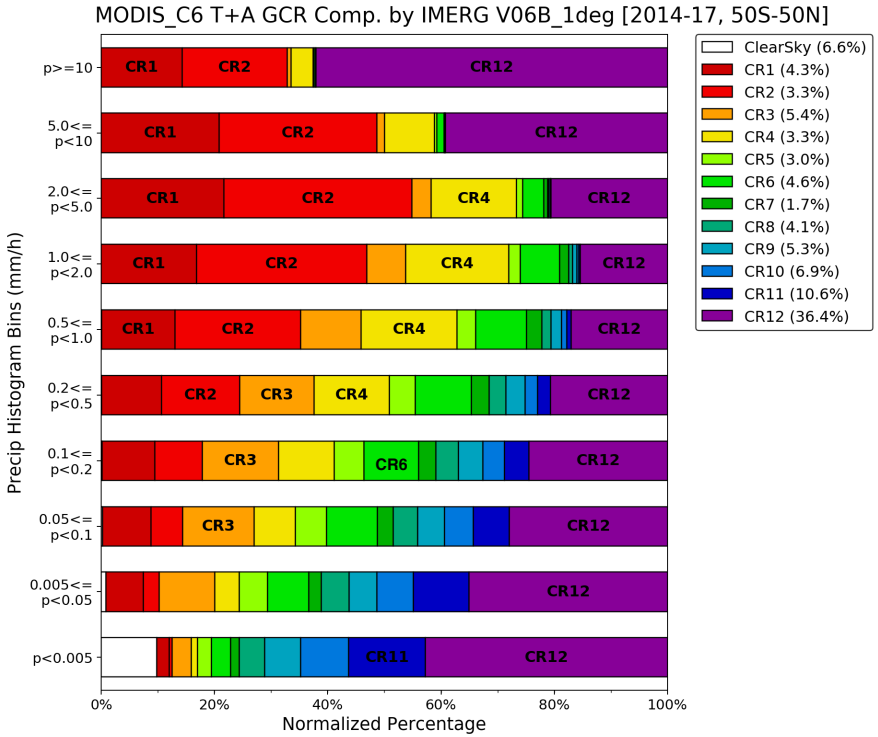


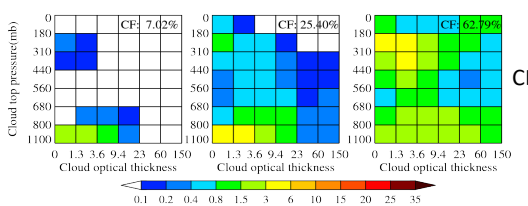
April 2014 – March 2017

Tan and Oreopoulos 2019, JCLI

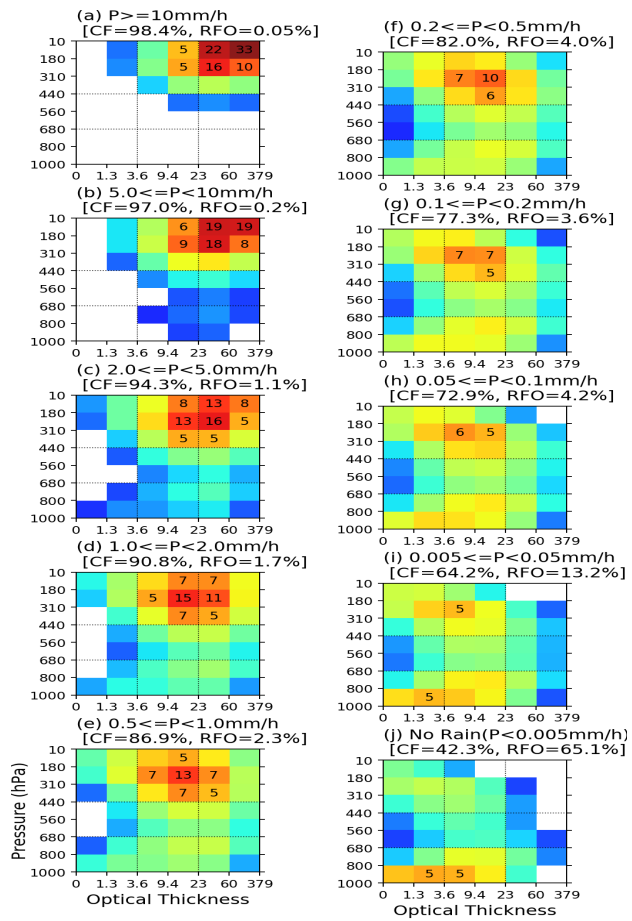
CR contributions to rainfall intensity

Ensemble mean joint histograms corresponding to precipitation bins

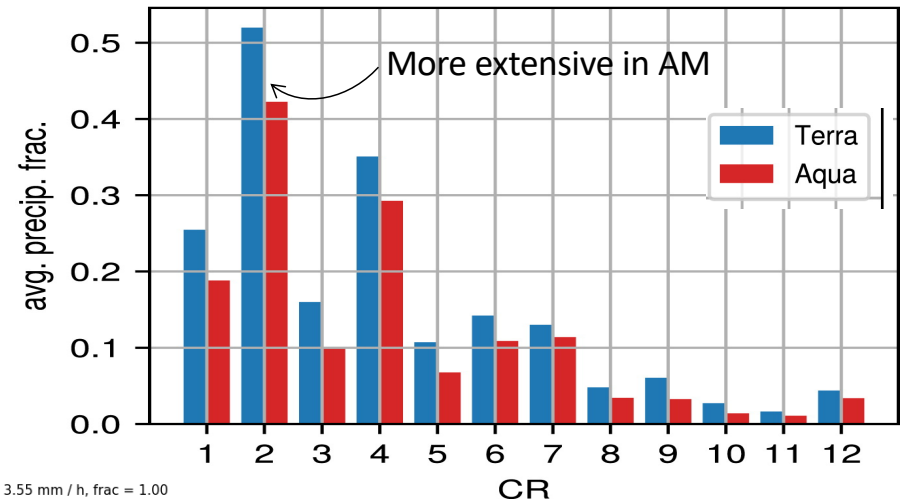




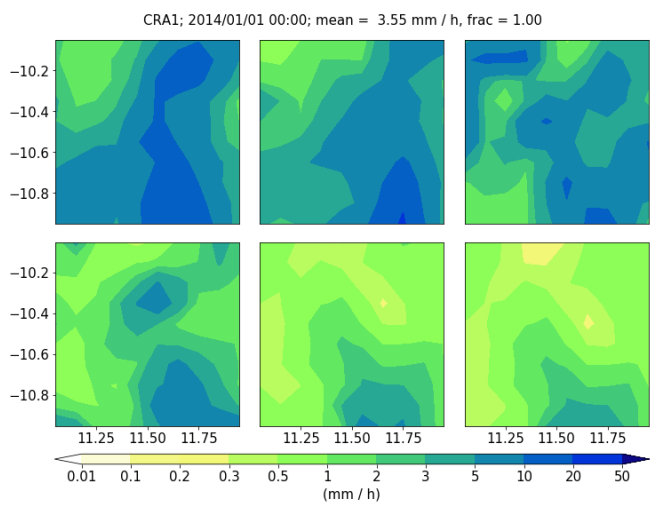
CR12 subregimes

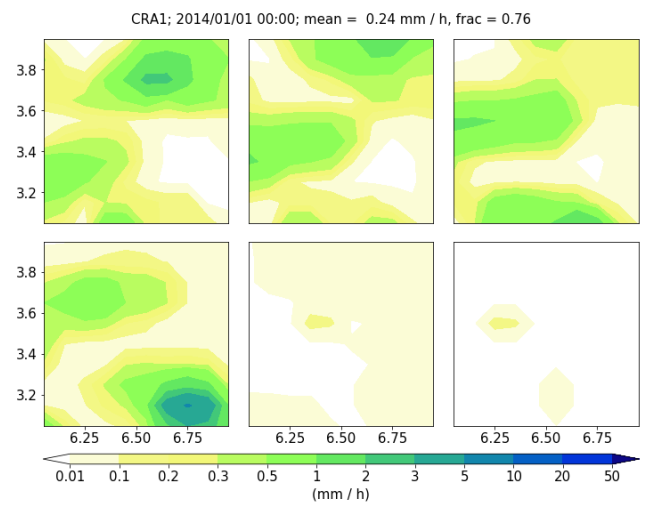


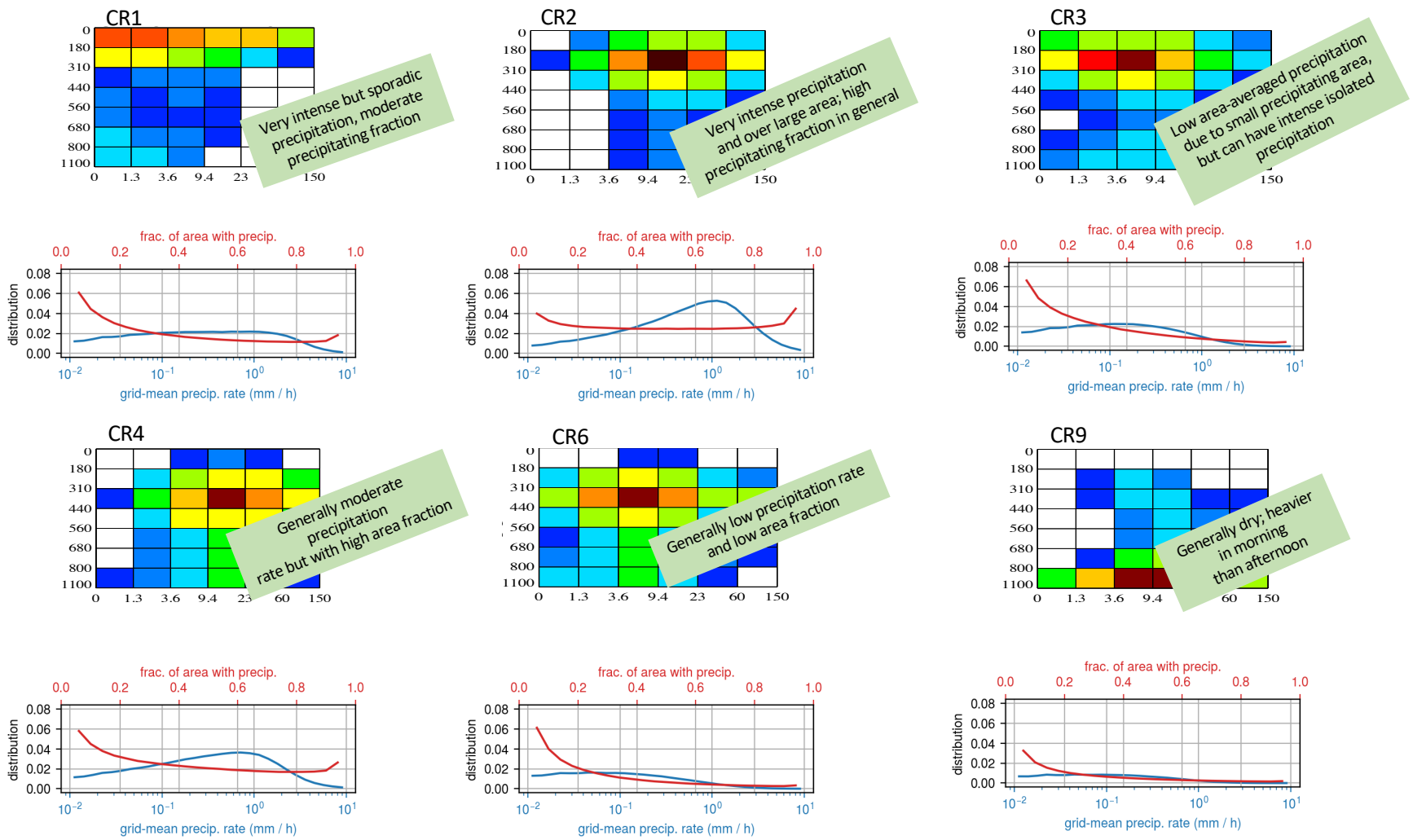
Subgrid variability



Tan and Oreopoulos 2019, JCLI



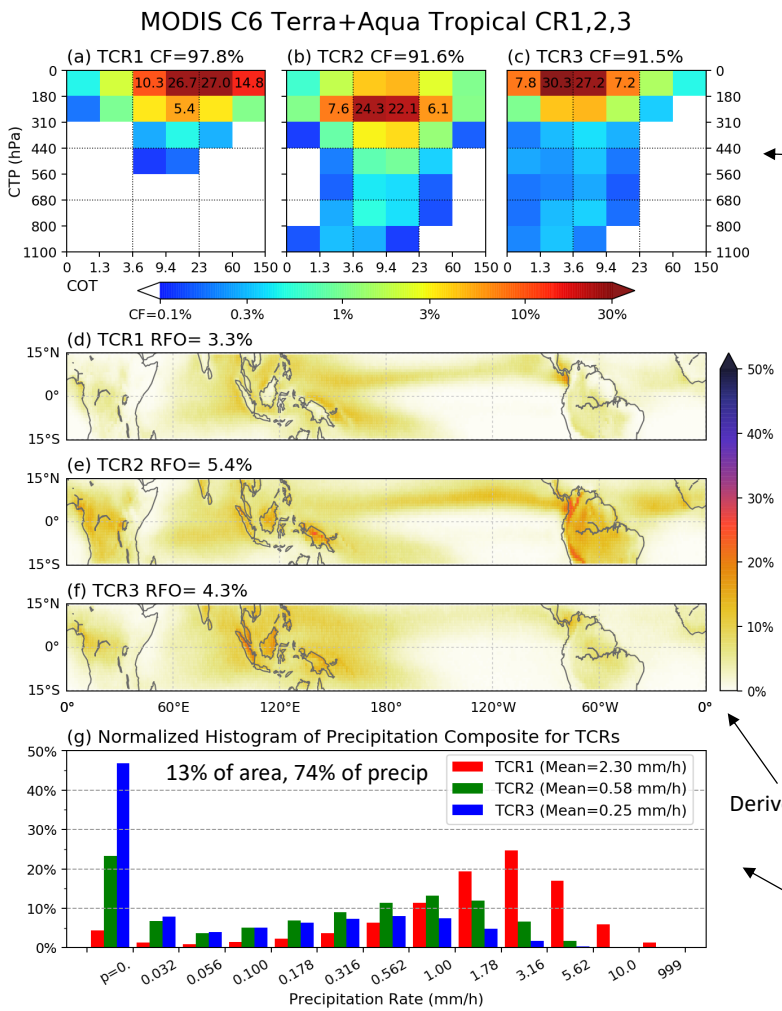




Tan and Oreopoulos 2019, JCLI

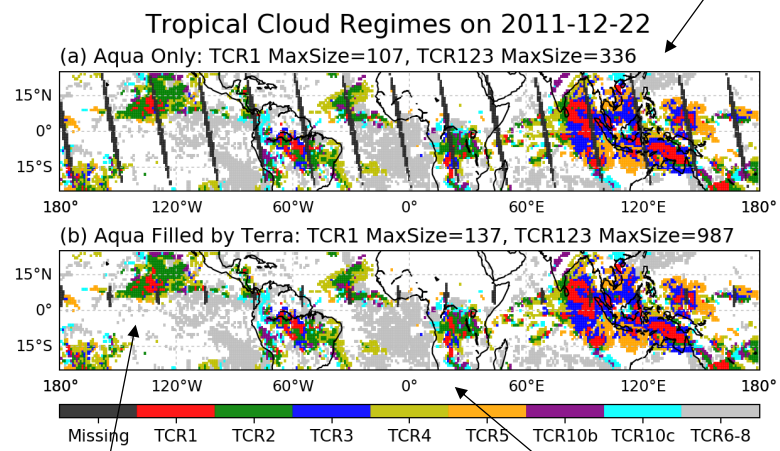
The precipitation of Tropical Cloud Regime aggregates (per TMPA)

Tropical MODIS CRs (TCRs)



Centroids of most convective TCRs

snapshot



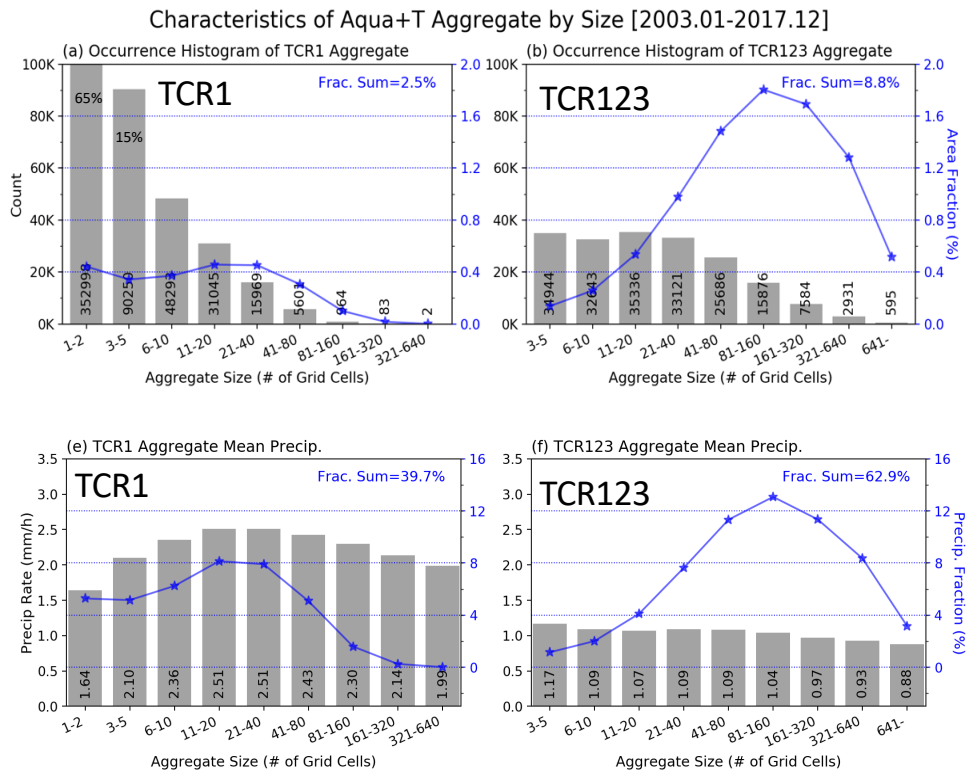
Derived 15S-15N, extended to 25S-25N

filling

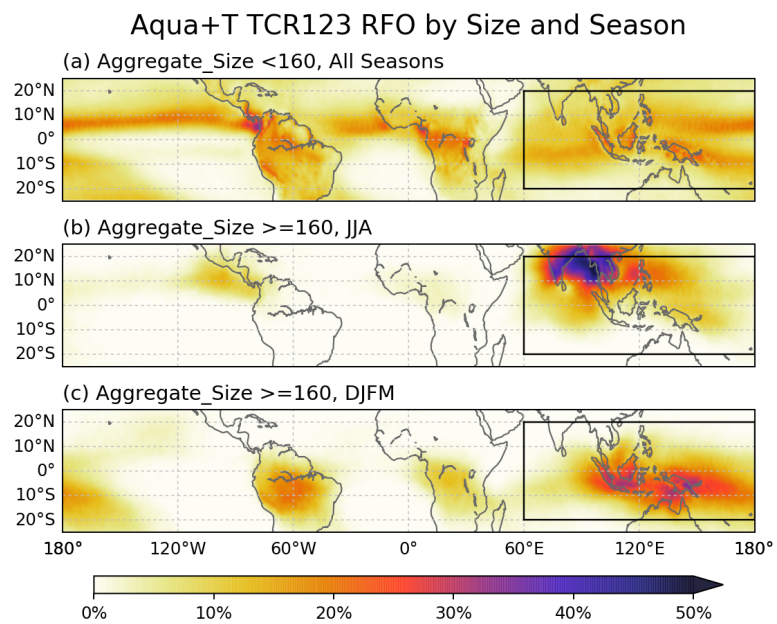
Jin et al. 2019, JGR, in review

Precipitation distribution of TCR1,2,3

TCR aggregate sizes and mean rainfall

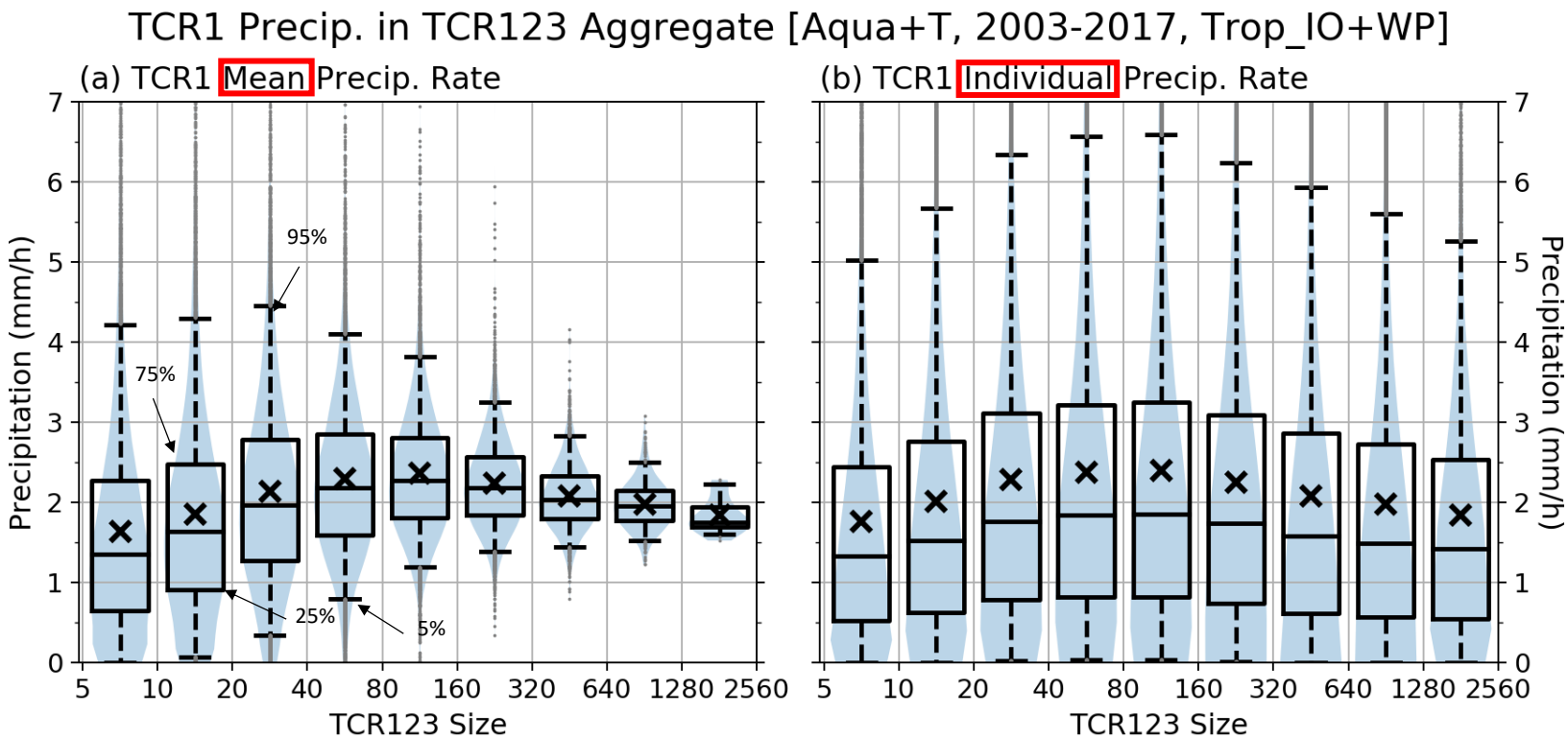


2003-2017



Jin et al. 2019, JGR, in review

Early PM TCR1 rainfall by aggregate size in MC and TWP



Jin et al. 2019, JGR, in review

Major Points

Global Regimes (IMERG)

- Systematic cloud classification improves understanding of patterns of precipitation.
- Different cloud systems (regimes) have distinct but also common precipitation characteristics with regard to means and subgrid variability.
- Cloud regimes occurring 12% of the time produce 55% of precipitation (in 60S-60N).

Tropical Cloud Regime Aggregates (TMPA; IMERG update in Jin et al. poster)

- Portions of the tropics are covered by convective cloud regimes that aggregate in superclusters.
- The rainfall characteristics of the aggregates/superclusters reveal the interplay between confined intense precipitation and the dilution of intensity impact as the system grows.
- Contribution to overall precipitation depends on the combination of the size of the superclusters, their number, and their precipitation intensity.