

Extreme convection of the tropical belt between America and Africa:

Diurnal Variations and Climatological Rainfall Contribution

Manuel D. Zuluaga,

K. L. Rasmussen, A. Gingrey and R. A. Houze Jr.

University of Washington

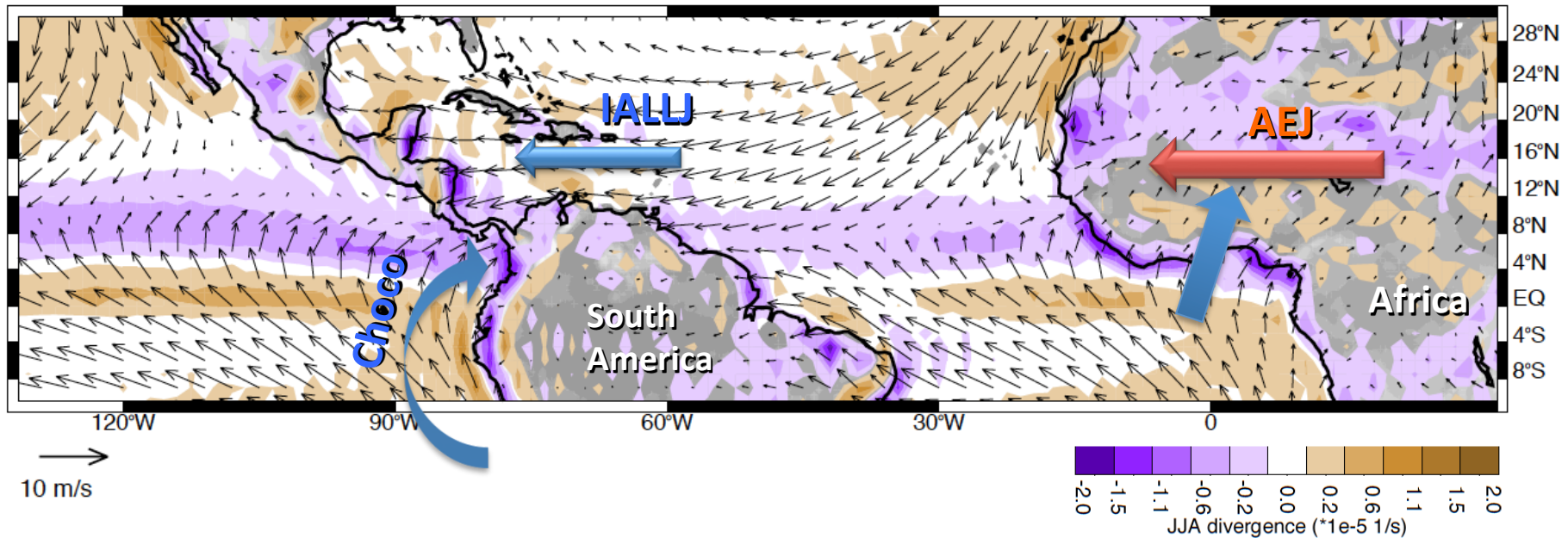
Convection II

31st Conference on Hurricanes and Tropical Meteorology

March 31, 2014

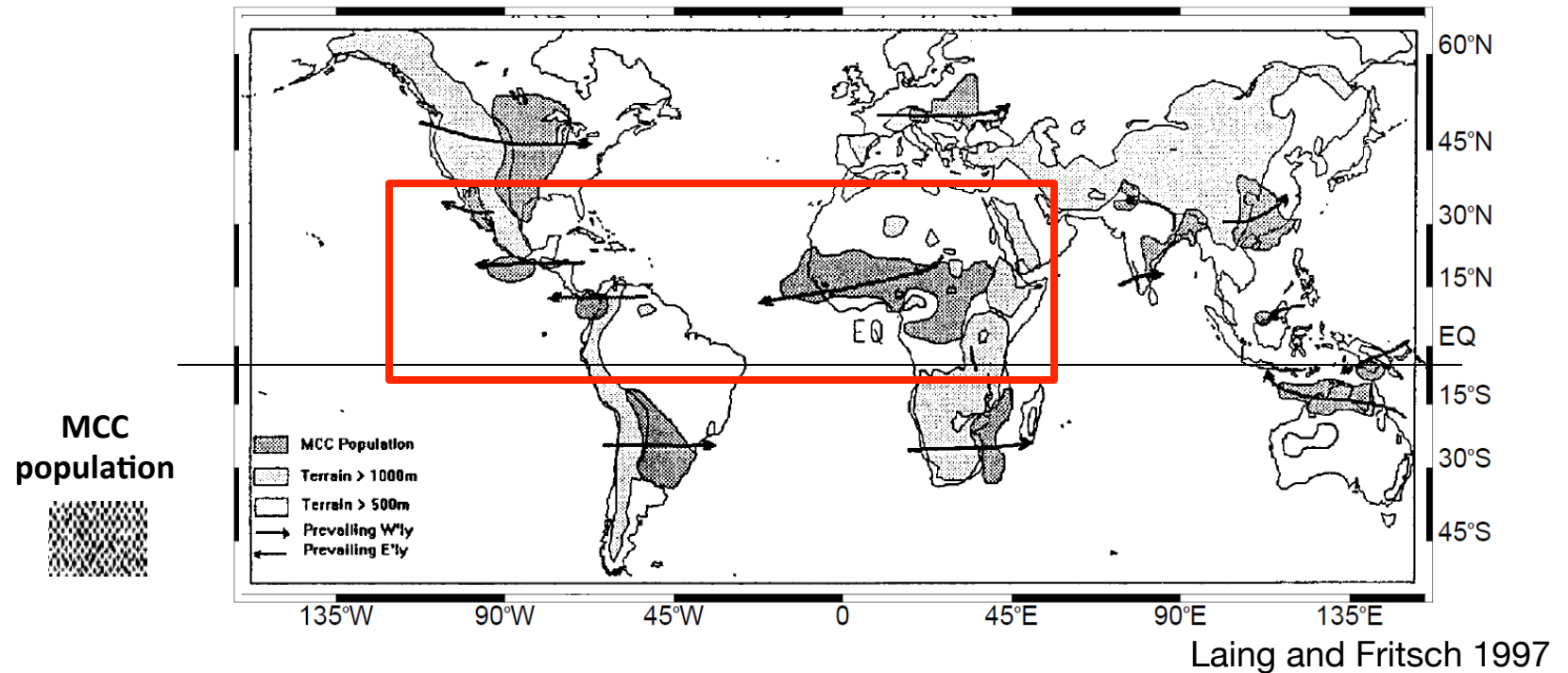
JJA Divergence and Wind climatology

Surface - ERA Interim



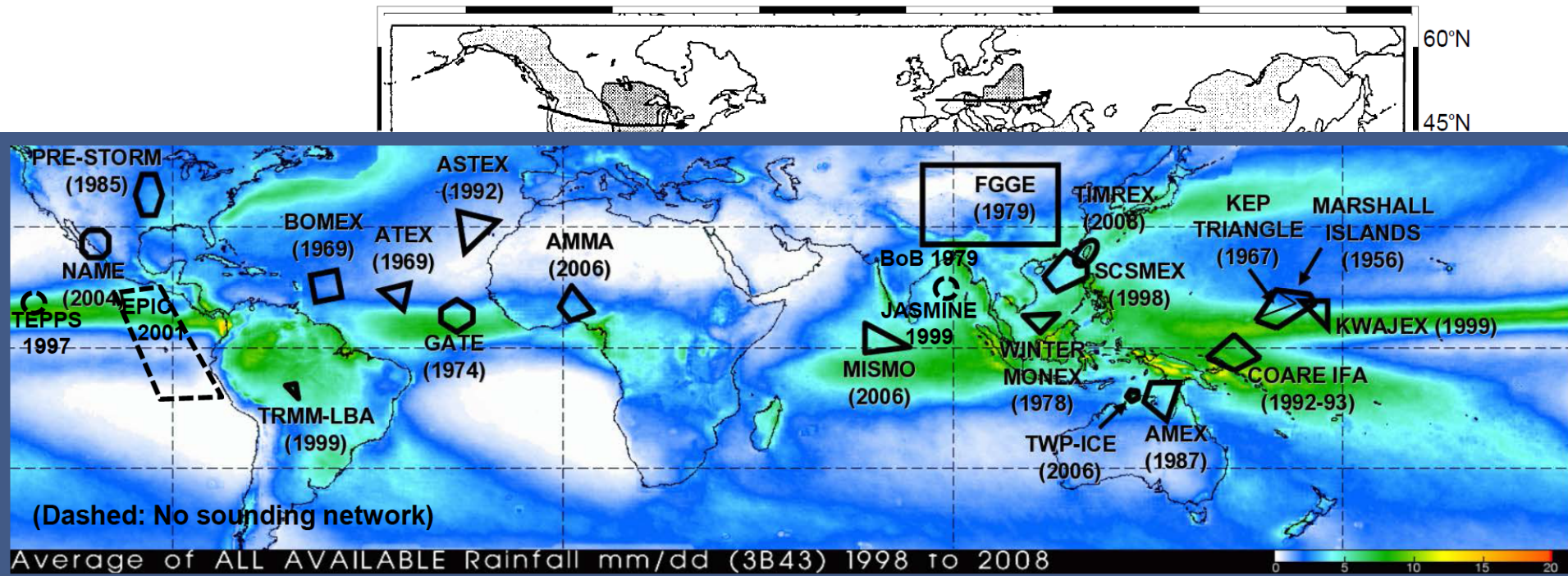
- Region where the ITCZ **intersects** Africa and America landmasses
- Extreme convection is affected by **local convergence**: African Easterly Jet, Intra-Americas Jet, and the Chocó low-level Jet. Monsoonal flow

Location of extreme events associated with MCC



- Tropical America and Africa are **favored location** for mesoscale convective complexes, which include the largest and most intense convective systems

Location of extreme events associated with MCC

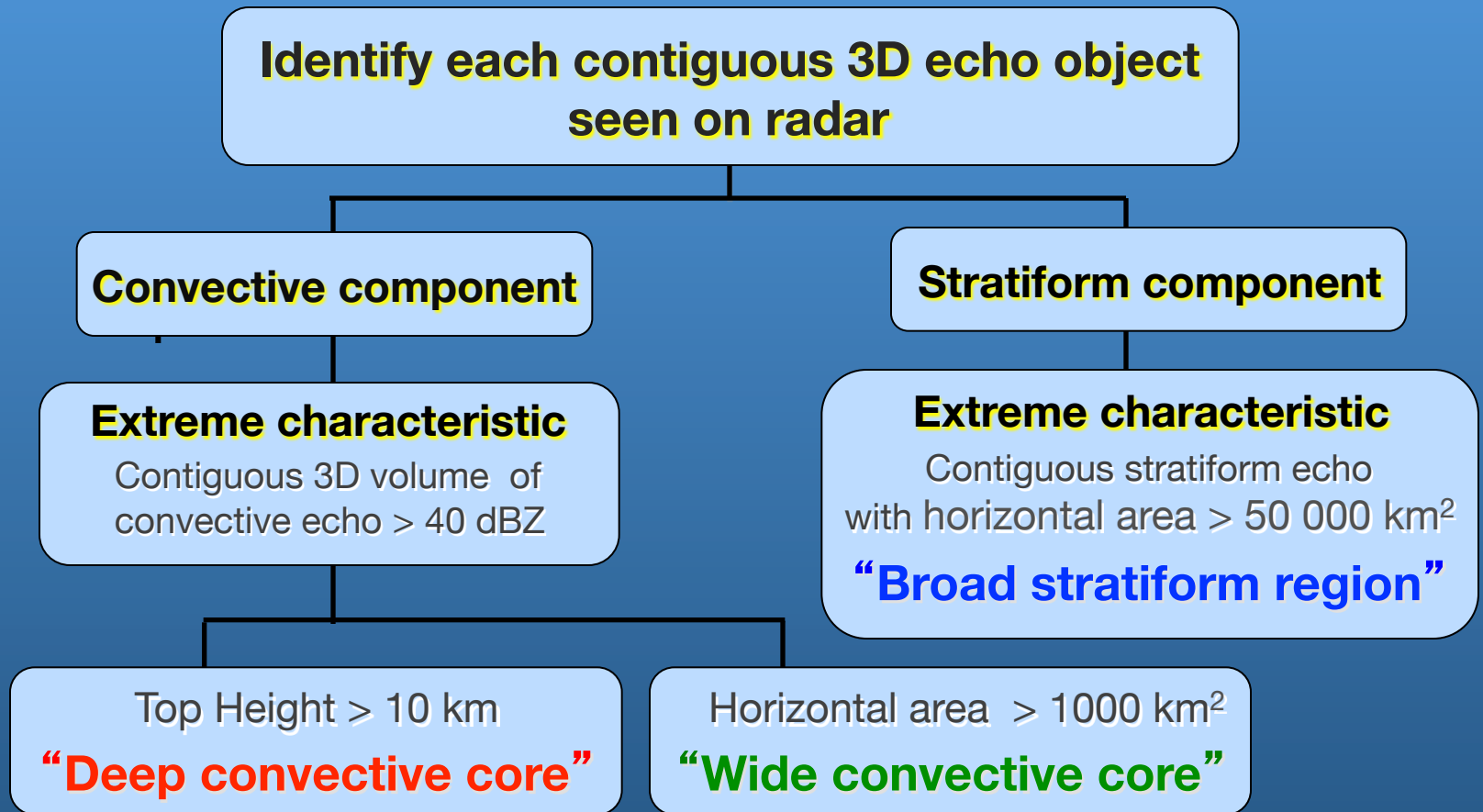


- Tropical America and Africa are favored location for mesoscale convective complexes, which include the largest and most intense convective systems
- Studies have concentrated in different regions around the world, but not much for **Meso-America**

Objective

- Document the **frequency of occurrence** of various types of extreme cloud phenomena, describing the **diurnal cycle**
 - 15 Years of June-July-August radar reflectivity, and rain type from the TRMM Precipitation Radar (version 7)
- Describe their climatological **rainfall contribution**
 - Traditional Z-R relationship to estimate precipitation (Rasmussen et al. 2013)

TRMM PR objective identification

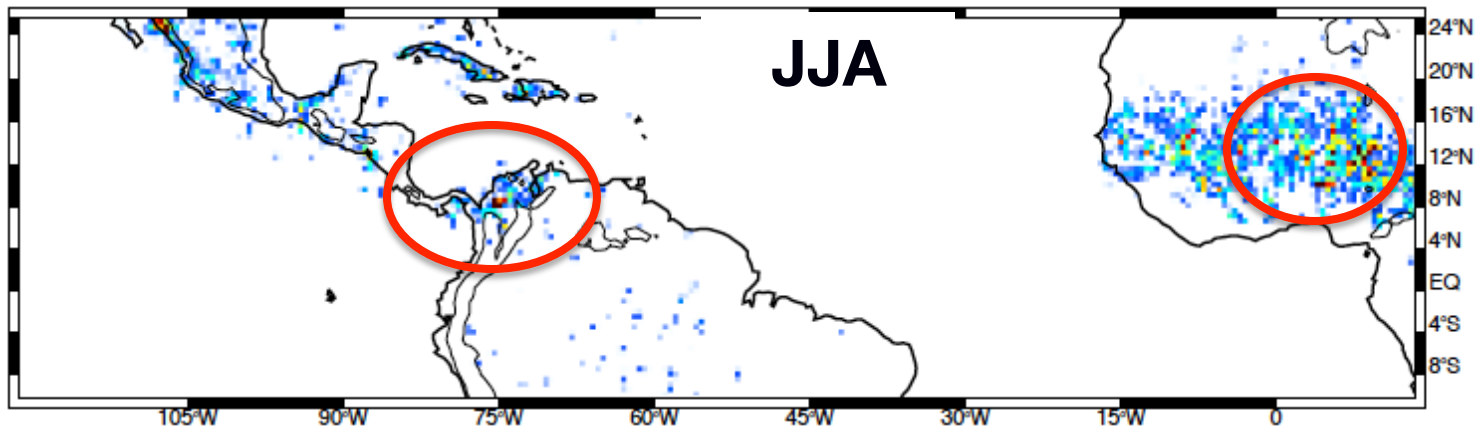




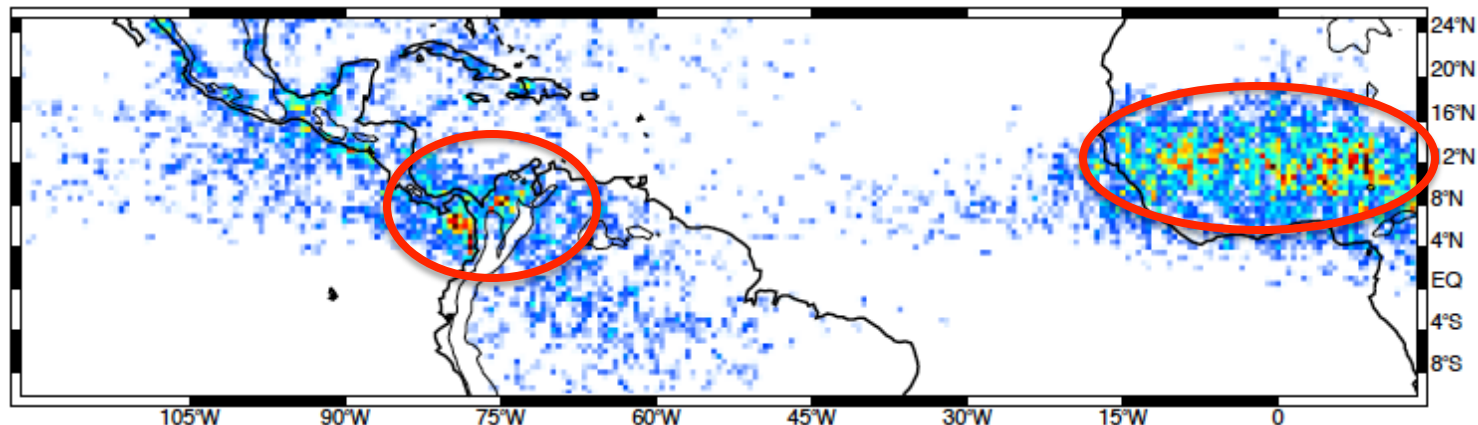
Spatial distribution of extreme convective elements

TRMM-PR probabilities

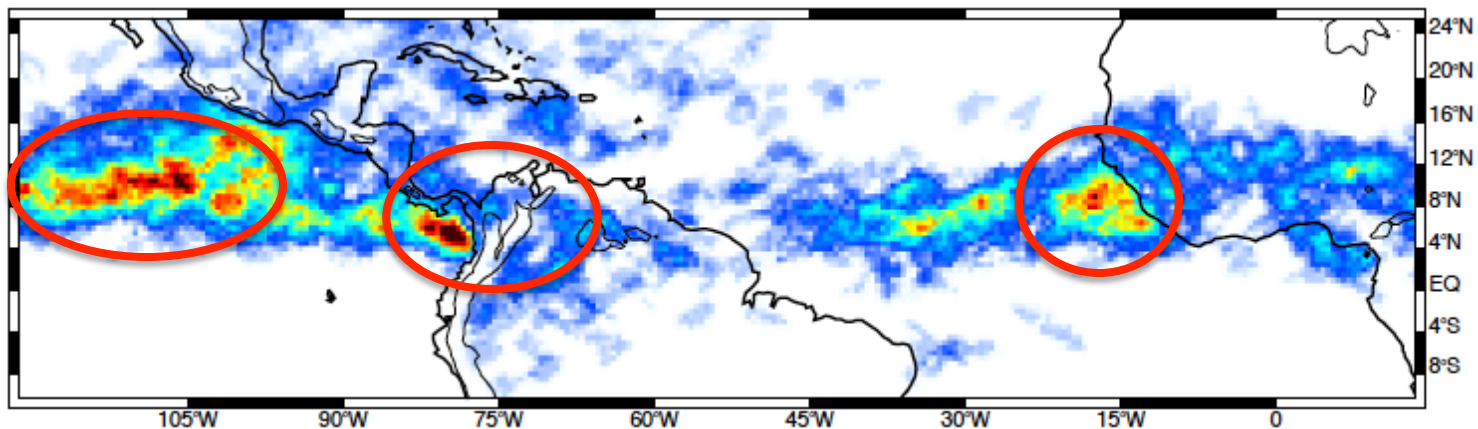
Deep
Convective
Cores



Wide
Convective
Cores



Broad
Stratiform
Regions

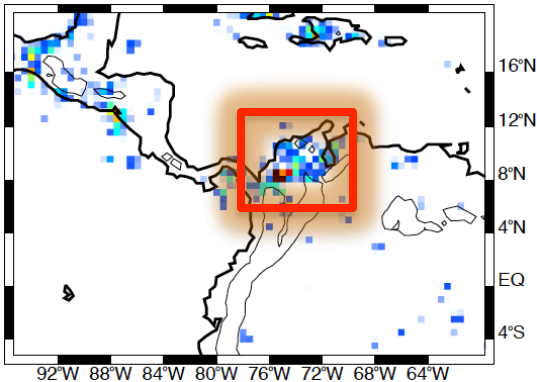


Zuluaga and Houze in prep.

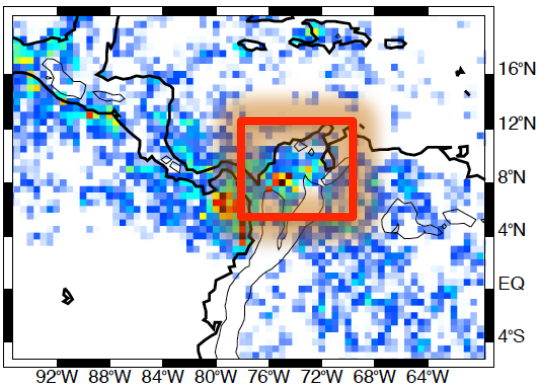
Diurnal cycle of extreme convective elements
over **the American** and Africa sectors

Diurnal cycle in the Northern Colombia

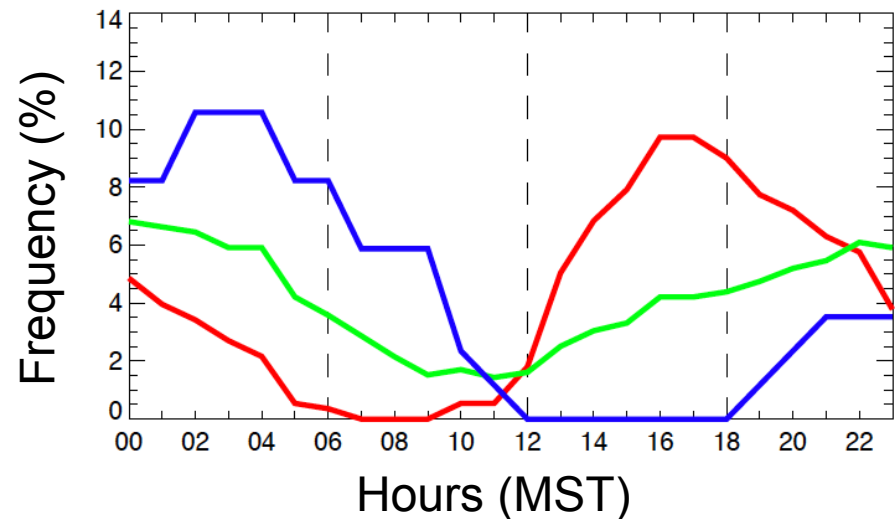
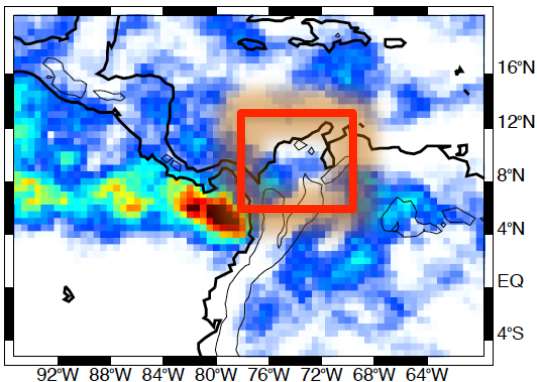
Deep
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Wide
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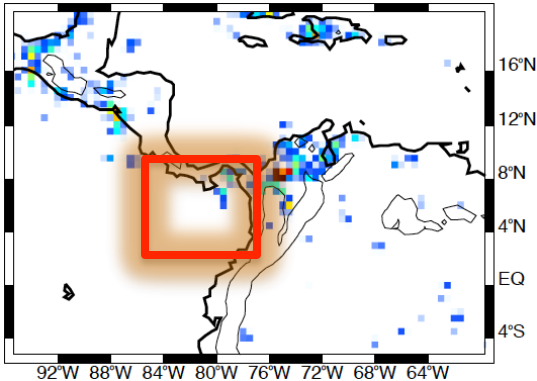
Broad
Stratiform
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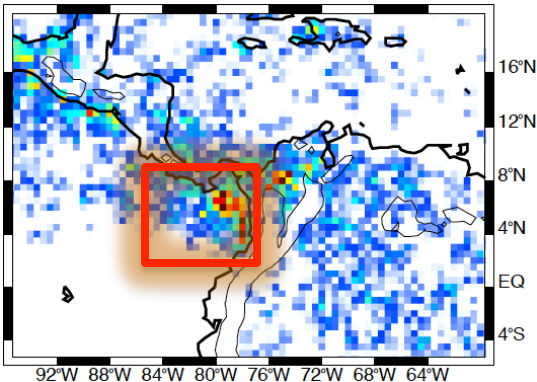
- Sequence of convective elements peaking:
 - DCC late afternoon
 - WCC mid-night
 - BSR early morning
- Similar cycle for Sahel region in Africa

Diurnal cycle in the Colombian coast

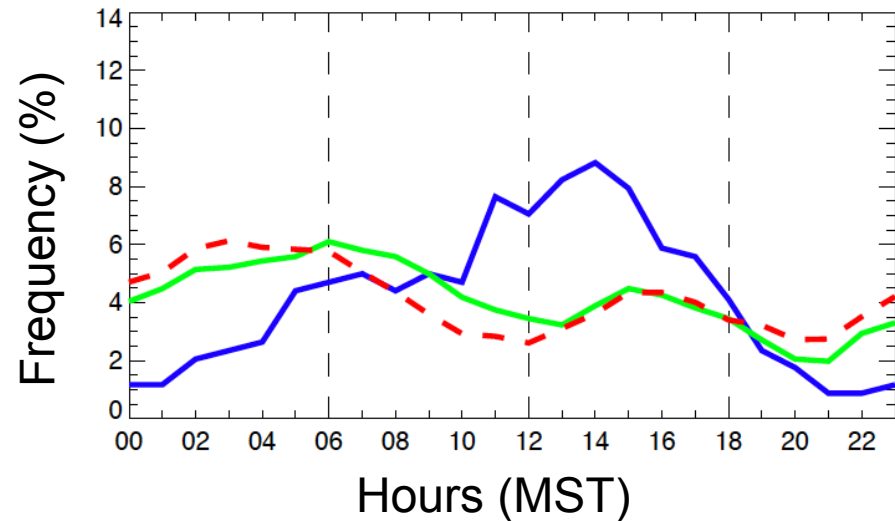
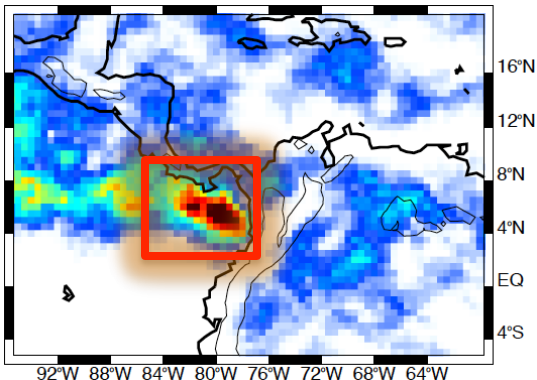
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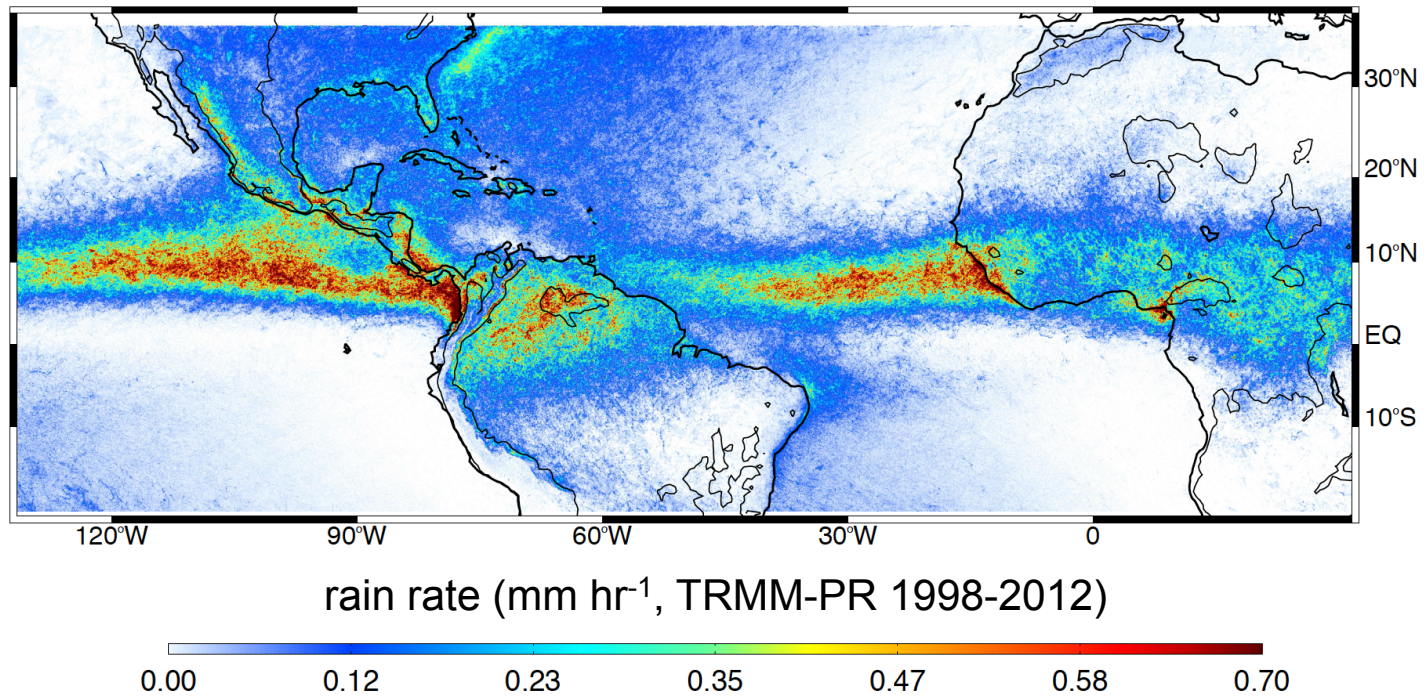


- Sequence of convective elements peaking:
 - DCC after mid-night
 - WCC early morning
 - BSR mid-day
- Consistent with the synoptic conditions during their occurrence
- Similar for the East Atlantic region



Climatological rainfall contribution of extreme convective elements

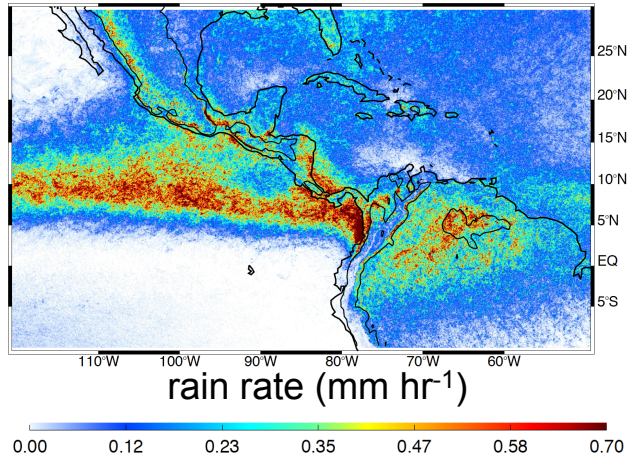
TRMM PR - JJA rainfall climatology



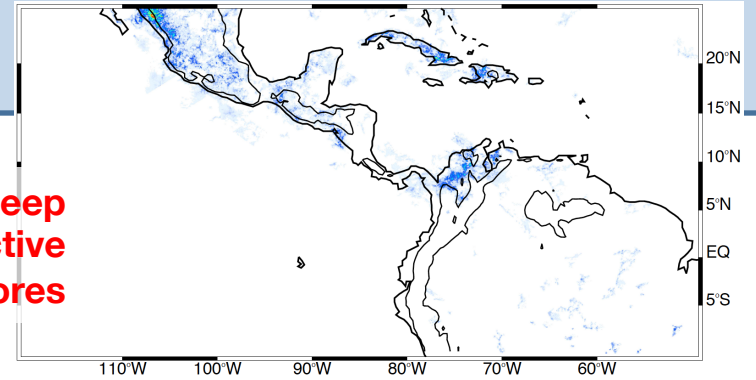
What percentage of the climatological rain rate is produced by extreme events?

TRMM rainfall contribution by storm type

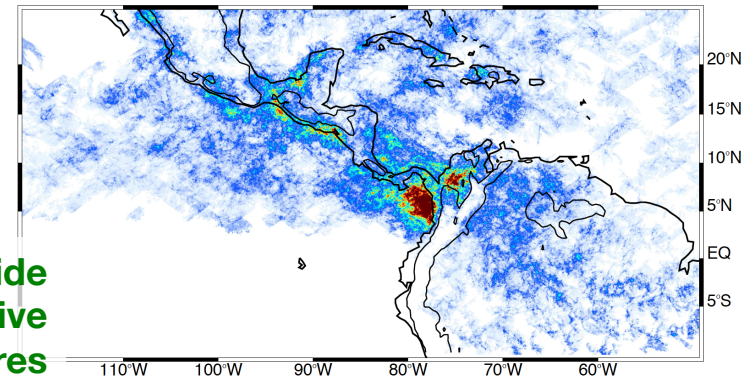
JJA TRMM rain rate climatology



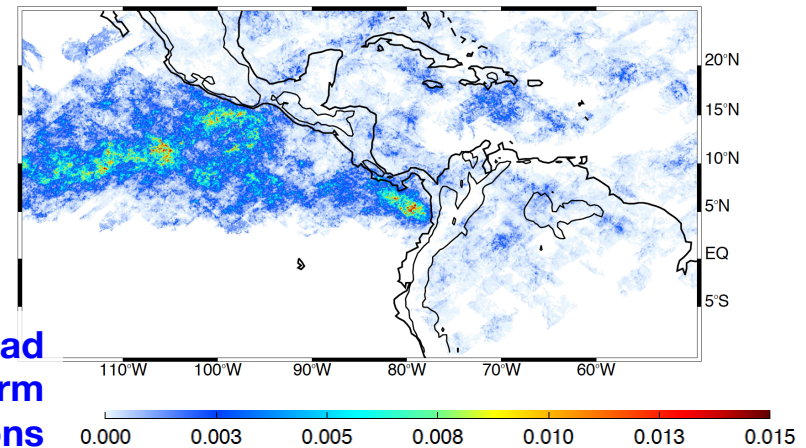
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Wide
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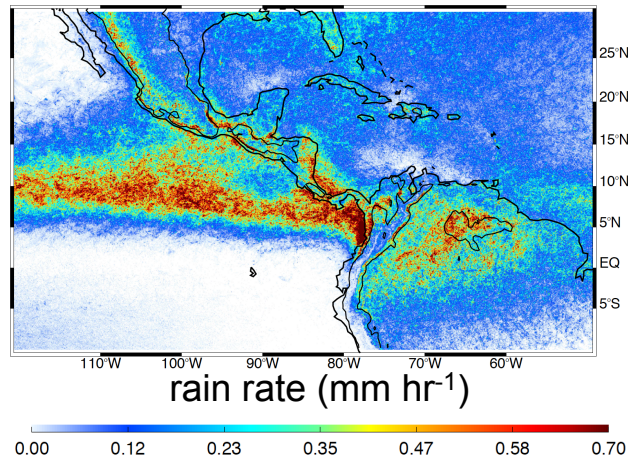


Broad
Stratiform
Regions



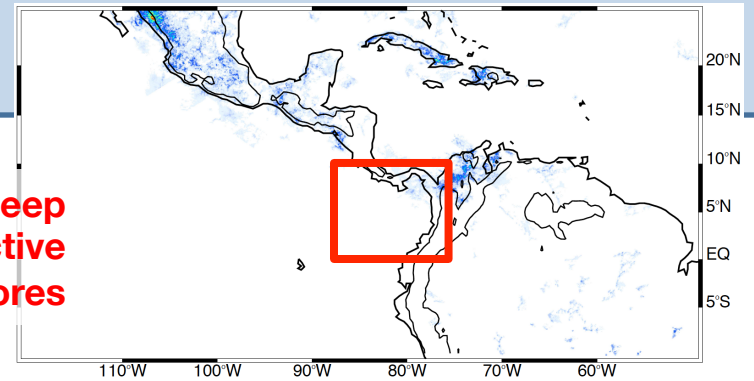
TRMM rainfall contribution by storm type

JJA TRMM rain rate climatology



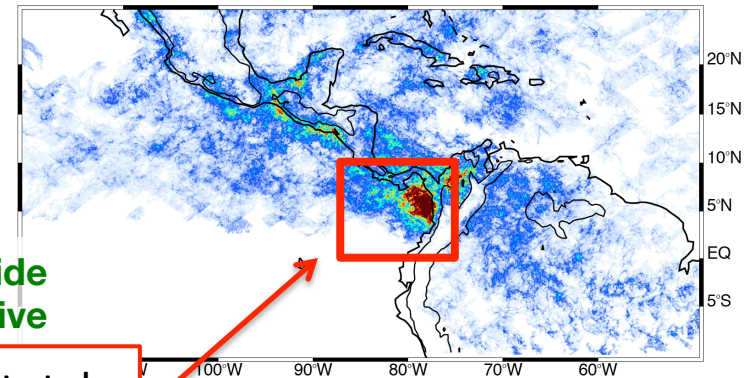
- Contribution of extreme categories in Colombian Coast: ~42%

Deep
Convective
Cores

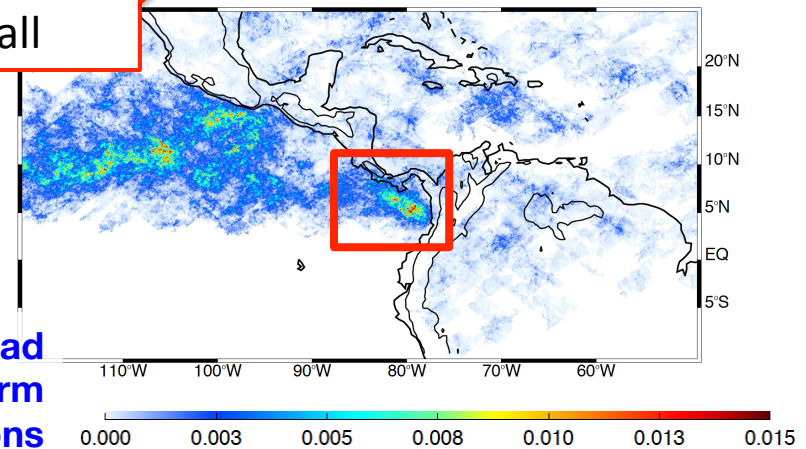


Wide
Convective

30% of total
rainfall

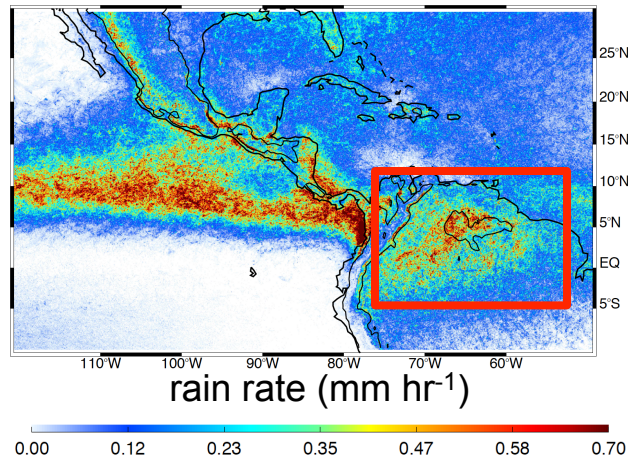


Broad
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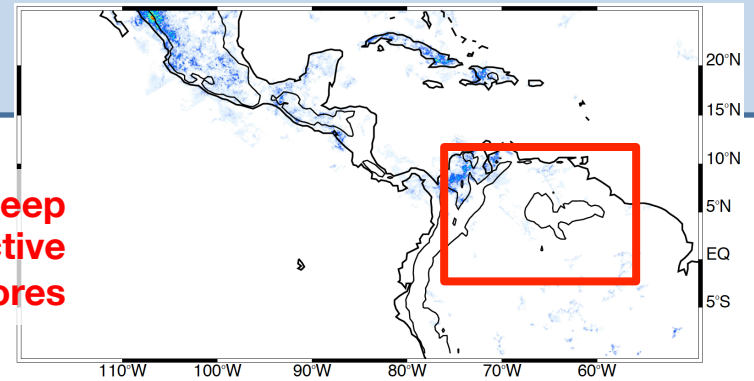
TRMM rainfall contribution by storm type

JJA TRMM rain rate climatology

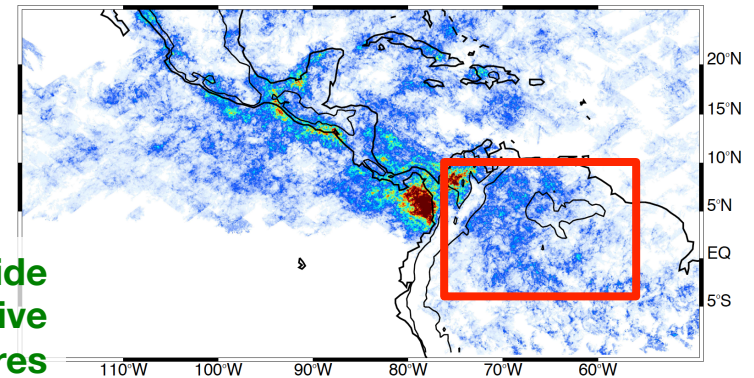


- Contribution of extreme categories in Colombian Coast: ~42%
- Not a large contribution from storms containing extreme categories over the Orinoco and Amazon basins

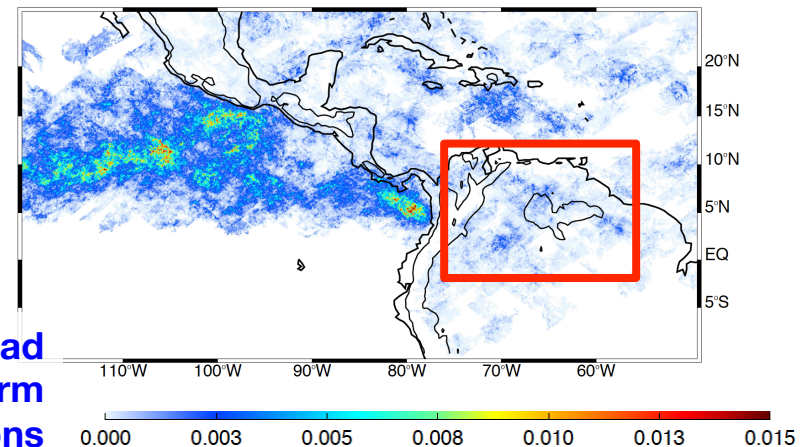
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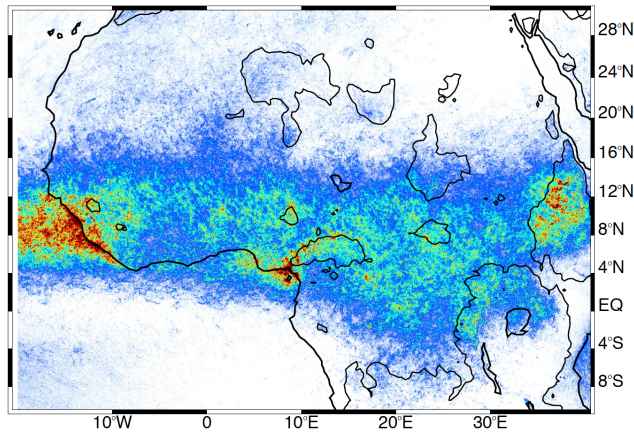
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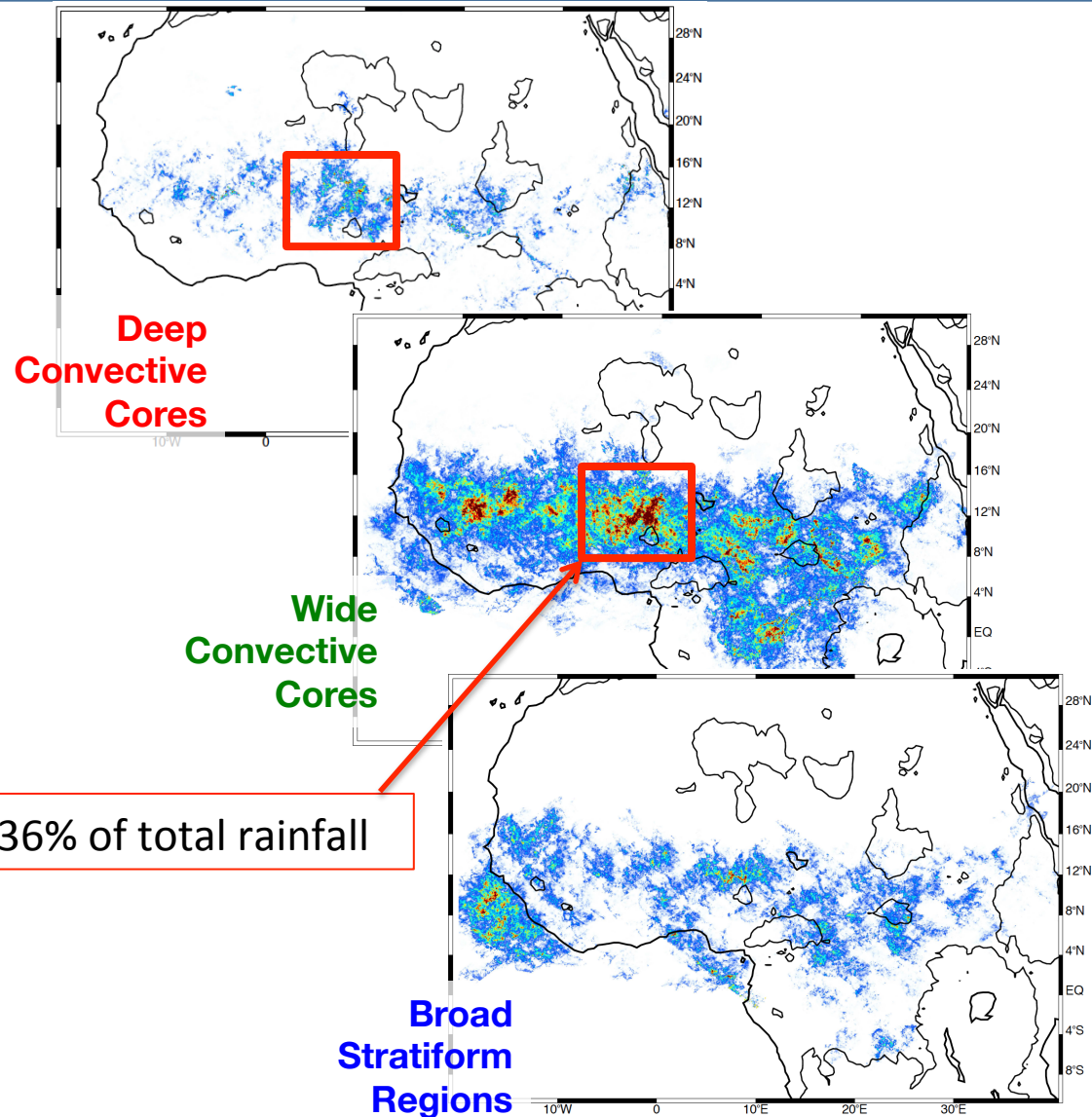


JJA rainfall climatology



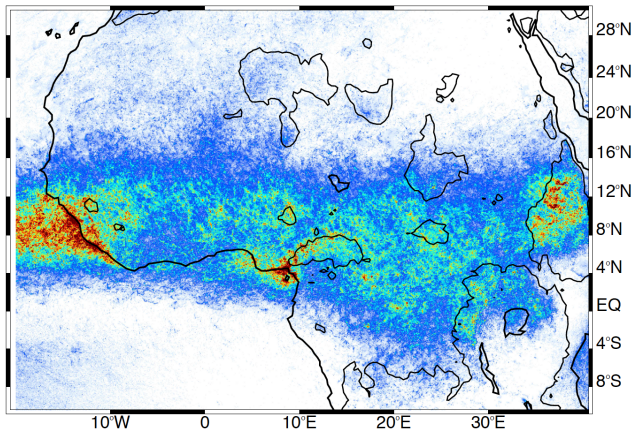
- Contribution of convective categories to the total warm season rainfall: ~ 47%

TRMM rainfall contribution by storm type



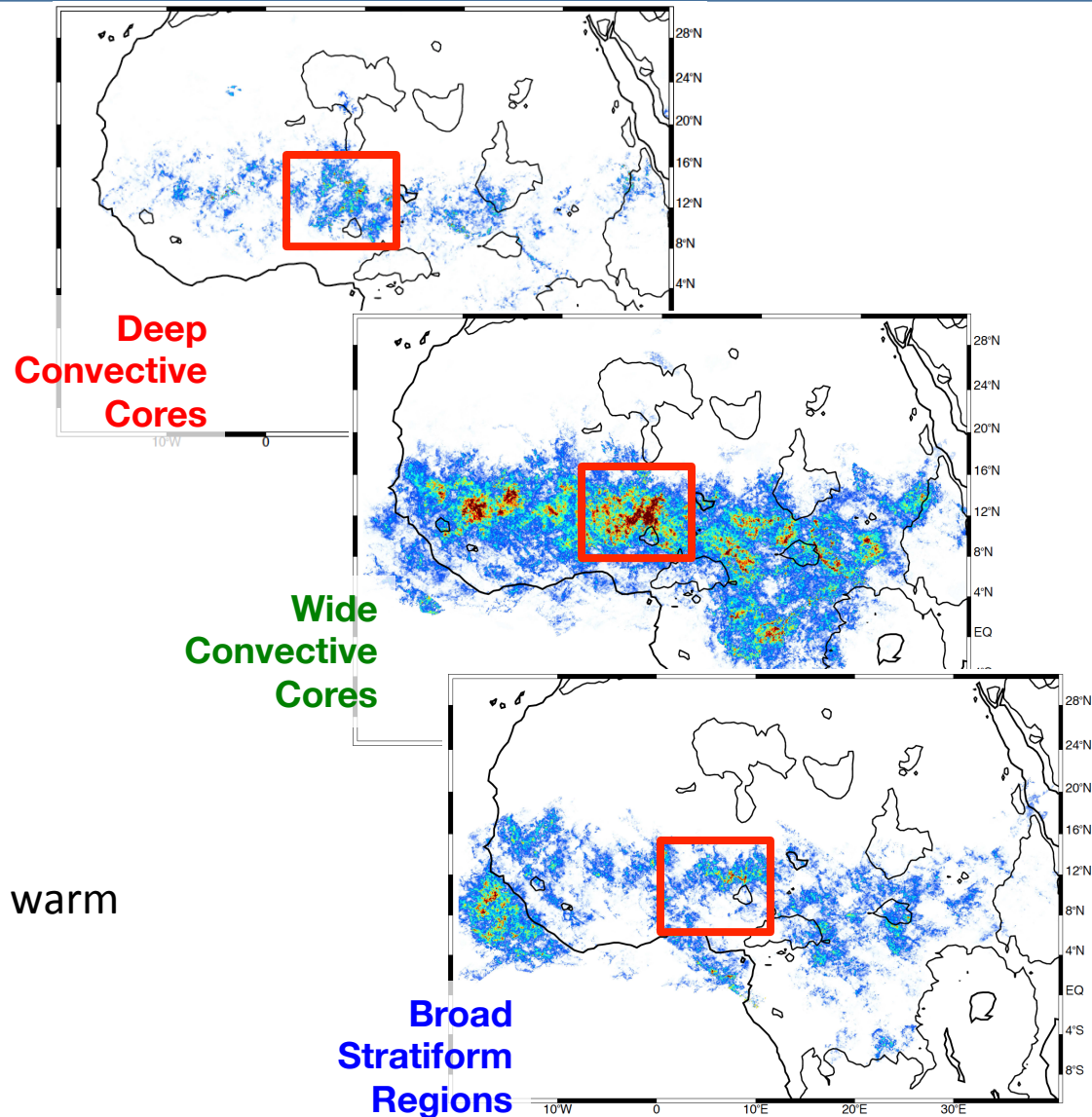
Rasmussen, Zuluaga, and Houze in prep.

JJA rainfall climatology



- Contribution of convective categories to the total warm season rainfall: ~ 47%
- Including BSR, ~ 58% of the total warm season rainfall

TRMM rainfall contribution by storm type



Rasmussen, Zuluaga, and Houze in prep.

Conclusions

- The occurrence of storms containing:
 - **Deep Convective Cores** are highly probable over continental regions, with a pronounced peak in frequency late in the afternoon, they are rare over oceans. Not significant in climatological rainfall contribution
 - **Wide Convective Cores** are located in the same regions as DCC over land, with a broader peak in frequency from mid-night to early morning. Significant rainfall contribution in regions affected by these type of storms
 - **Broad Stratiform Regions** are most frequent over the ocean, with less diurnal variation. Have important rainfall contribution, especially for events occurring over the ocean
- Systematic behavior of diurnal frequencies, **DCC** echoes preceding **WCC**, and **WCC** preceding **BSR**

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NASA grants NNX13AG71G, NNX10AH70G, DOE grant
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