

# Research using University of Utah precipitation and cloud feature database

- current and future

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# Acknowledgments

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- 
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# Current ongoing research topics

- Precipitation validation

What types of precipitation systems have large differences between radar and microwave retrievals?

- Precipitation contribution from different types of systems

What kind of precipitation systems (size, depth, with lightning?) contribute to the local rainfall in different seasons and local times?

- Organization of convection

Morphology of organization of convection

Latent heating vertical structure vs. organization of convection

- Lightning and properties of convection

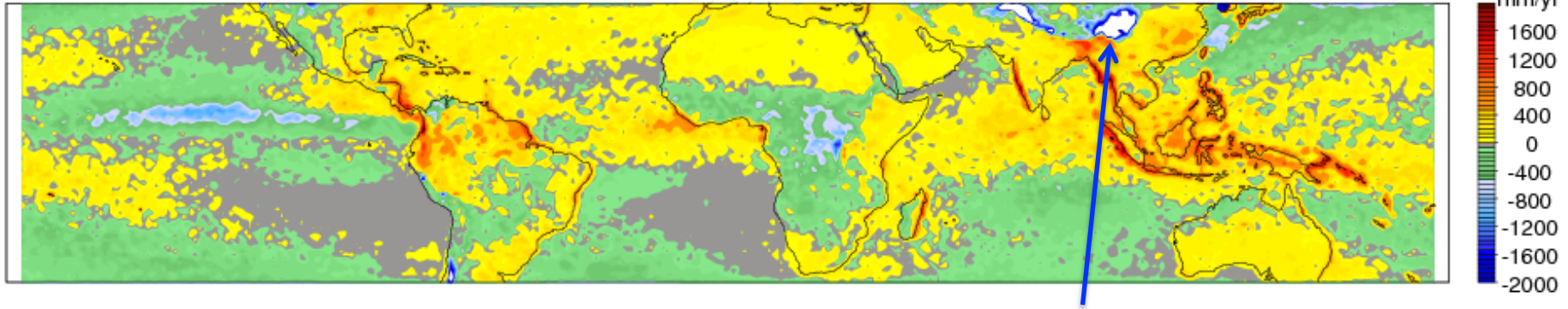
What types of convection have lightning? What are the relationships between the properties of thunderstorms and lightning flash count?

- Extreme precipitation rates

Where do we have extreme precipitation rates, and why?

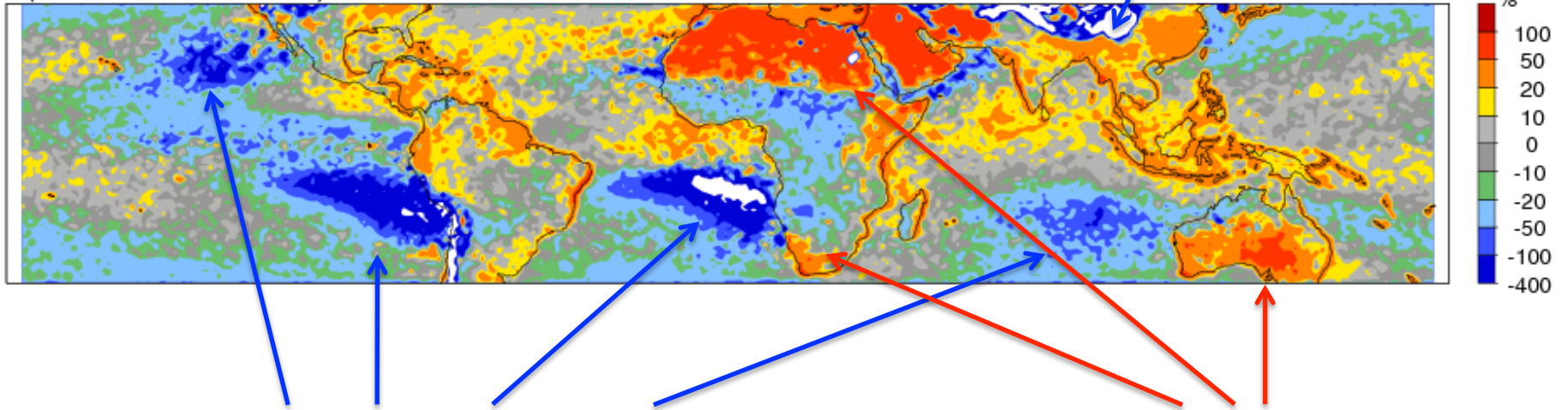
# Differences between precipitation estimates

Radar - Microwave



problem over cold surface, high terrain

(Radar - Microwave) / Radar

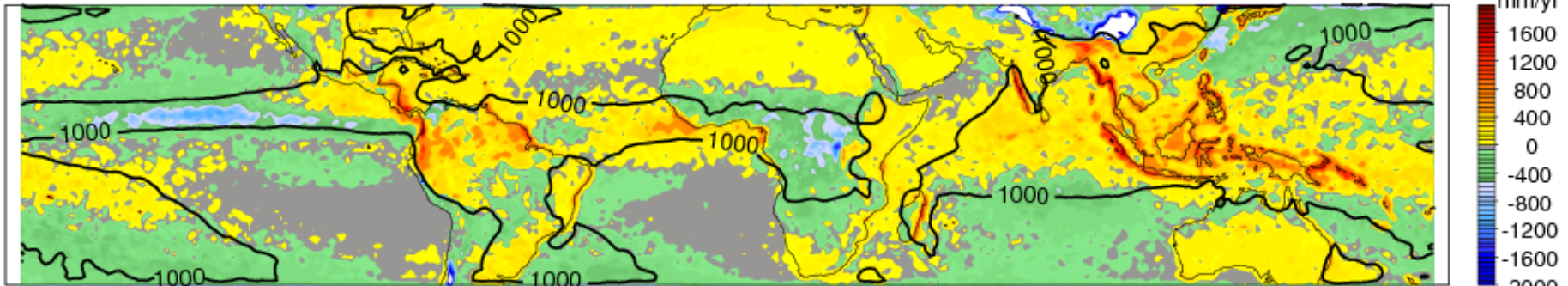


Stratocumulus is beyond sensitivity of PR  
Radar < Microwave

TMI has difficulty with desert regions  
Radar > Microwave

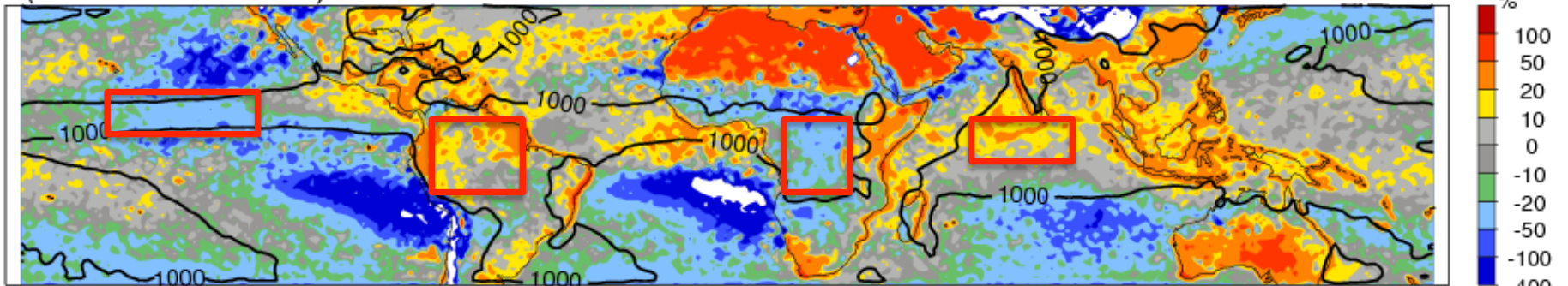
# Where do we have differences and why?

Radar - Microwave



contour is 1000 mm/yr annual rainfall from radar

(Radar - Microwave) / Radar

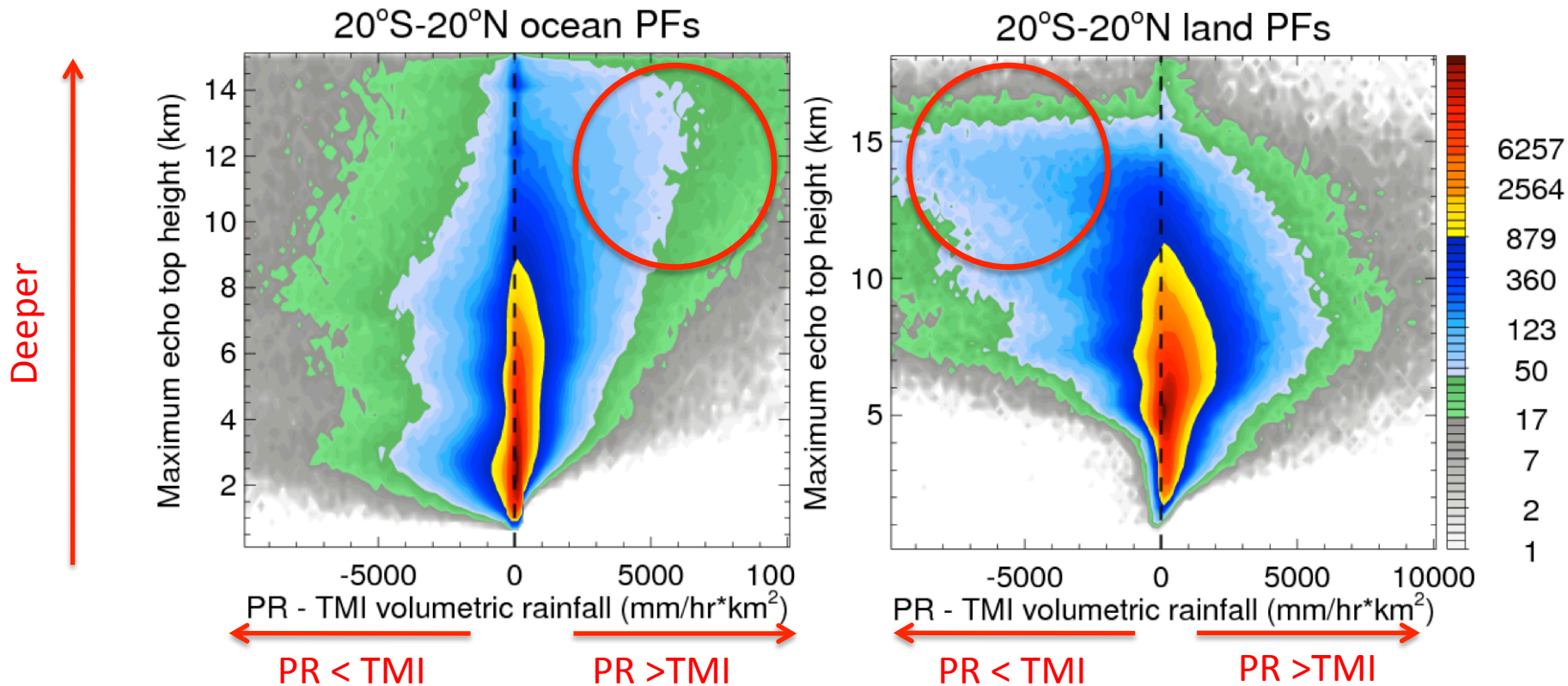


contour is 1000 mm/yr annual rainfall from radar

Questions:

- Ocean: Why does radar estimate 20% more over north Indian Ocean, but 20% less over east Pacific?
- Land: Why does radar estimate more over Amazon, but less over Africa?

# PR and TMI differ in what types of precipitation systems?

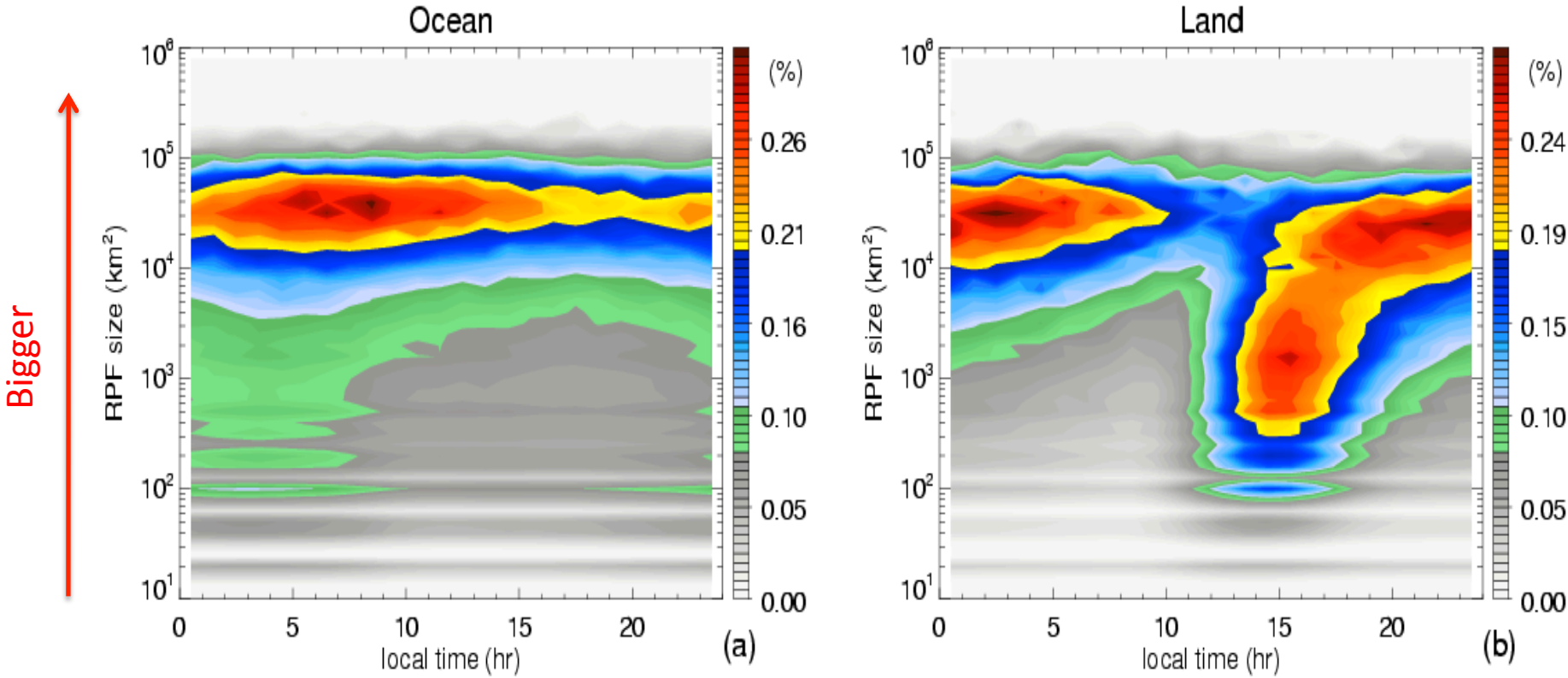


Unanswered question:

How do we use such information to help improve retrieval algorithms?

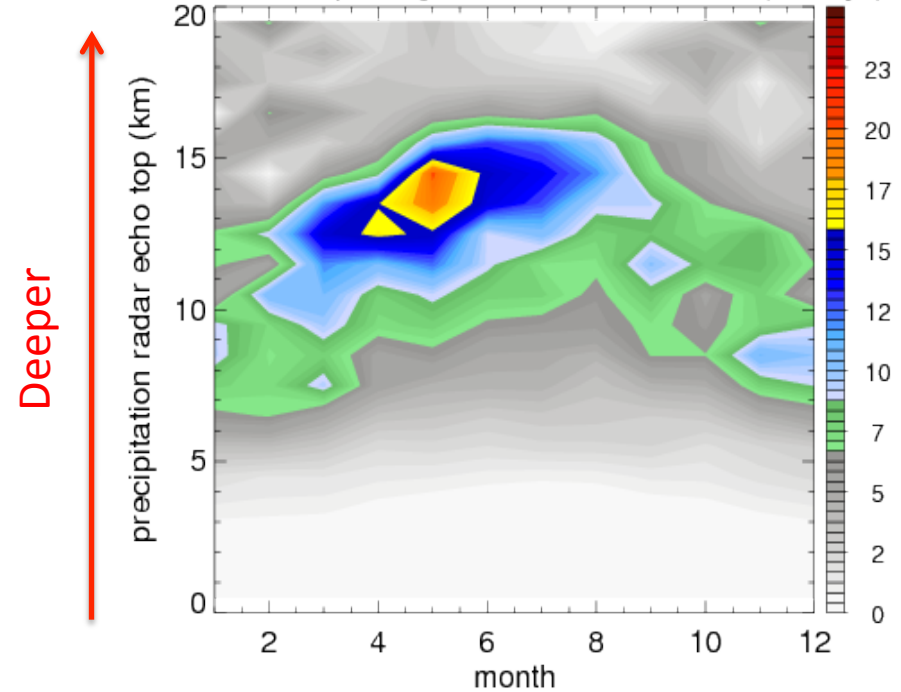
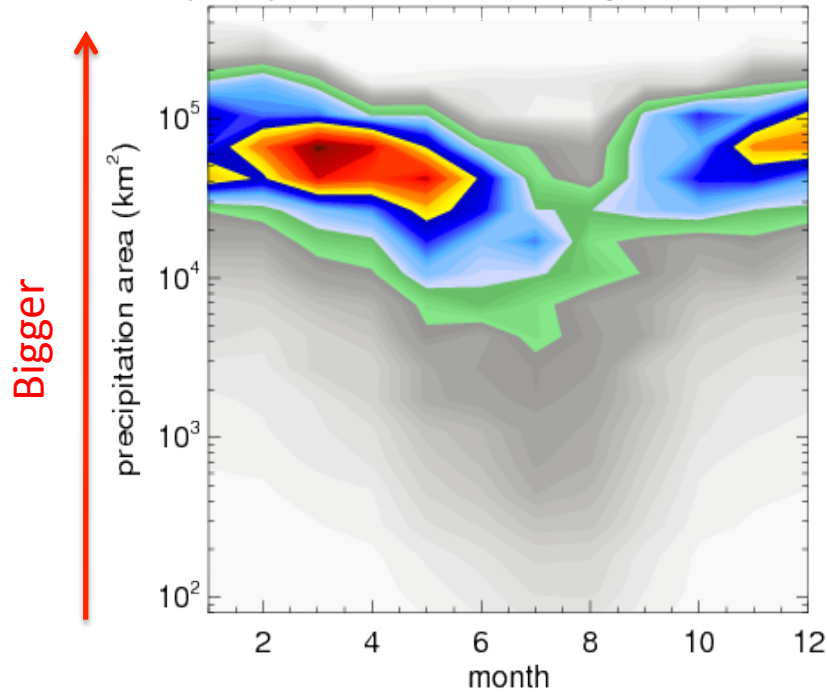
# Precipitation contribution from different types of systems

## Diurnal variation



# Contributions vary seasonally and regionally

precip contribution from systems with different sizes & echo top heights over EAST\_US (mm/yr)

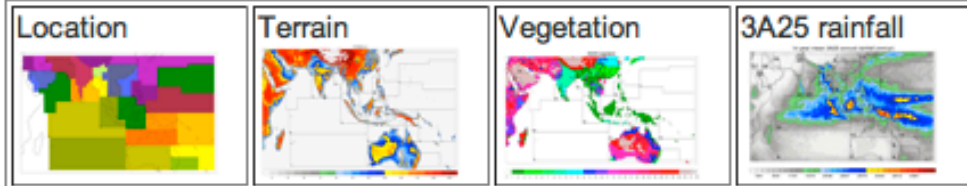




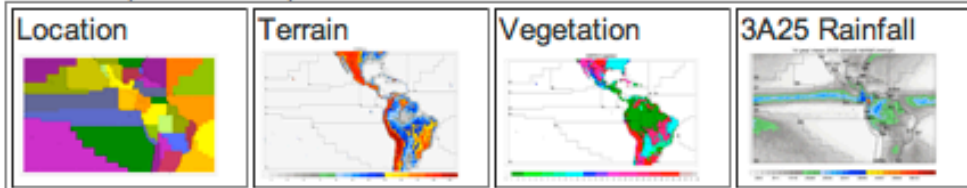
# Climatology of precipitation and clouds over 128 regions at:

<http://trmm.chpc.utah.edu/>

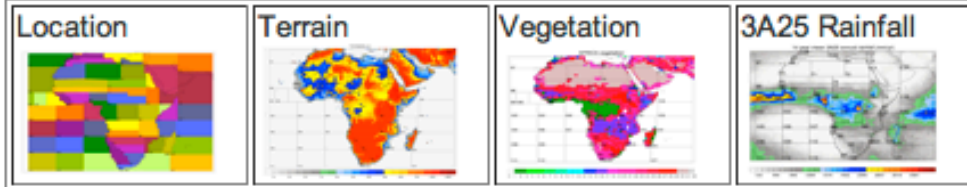
- Asian & Australia (boxes# 1-31) (Vegetation type description)



- America (box # 32-66)



- Africa (box # 67-128)



Click links below for climatology:

TRMM domain (36S-36N)

Tropics (20S-20N)

001: TIBET

002: N\_CHINA

003: S\_CHINA

004: BUMA

005: NW\_PACIFIC

006: SOUTH\_IDIAN\_OCEAN

007: AUSTRALIA\_DRYLAND

008: SE\_AUSTRALIA\_COAST

009: E\_AUSTRALIA\_OCEAN

010: MELANESIA

011: INDONESIA\_3

012: N\_AUSTRALIA\_COAST

013: E\_PACIFIC\_ITCZ

**Define your own region and find out the behavior of cloud and precipitation:**

Latitude: From  to  range from -36 to 36

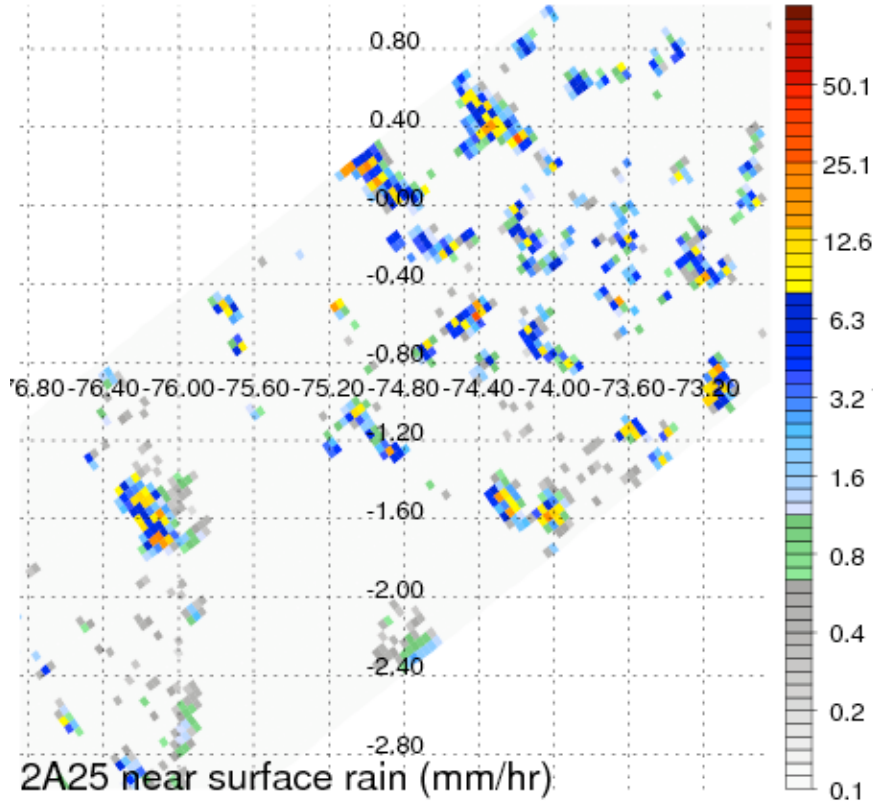
Longitude: From  to  range from -180 to 180

Details - see poster 202 tomorrow

# Organization of convection

Isolated convection

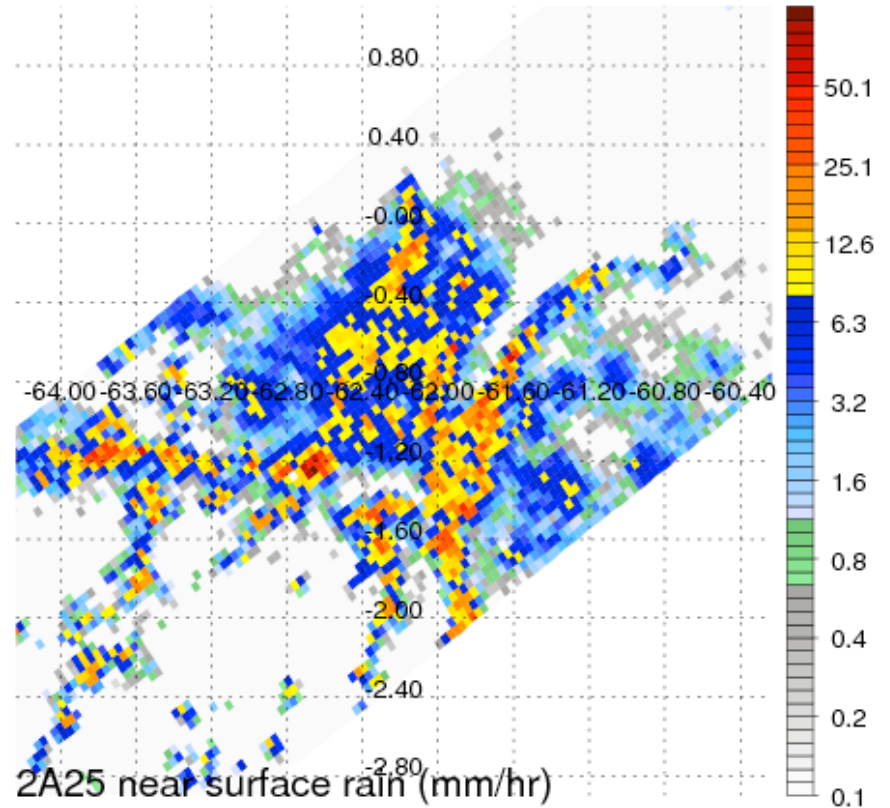
51697 2006-12-11 18:58 UTC



vs.

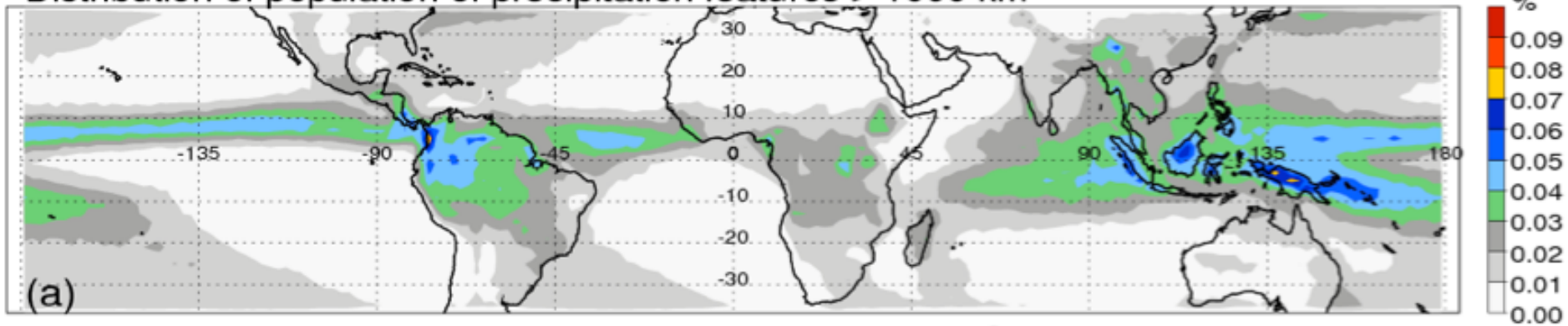
Organized MCS

48720 2006-6-3 18:55 UTC



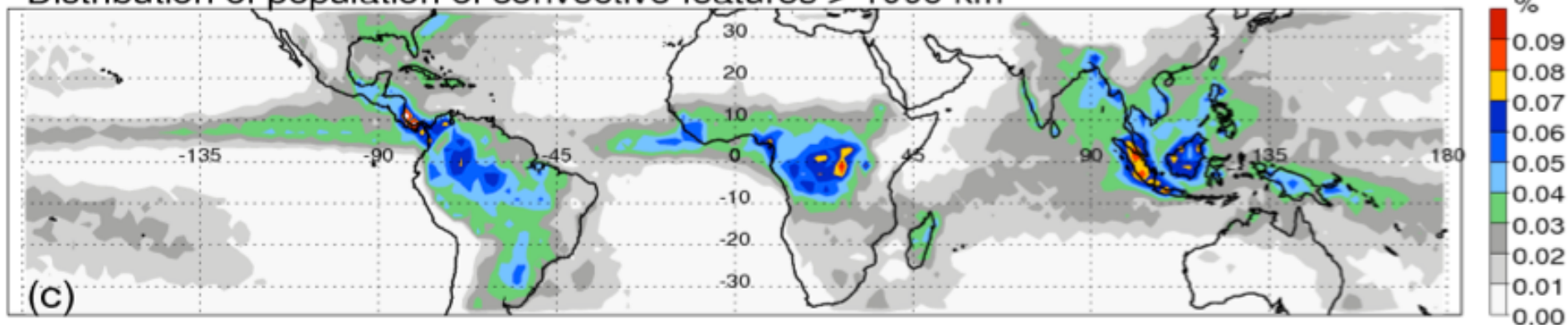
Large precipitation systems occur more often over ocean

Distribution of population of precipitation features  $> 1000 \text{ km}^2$



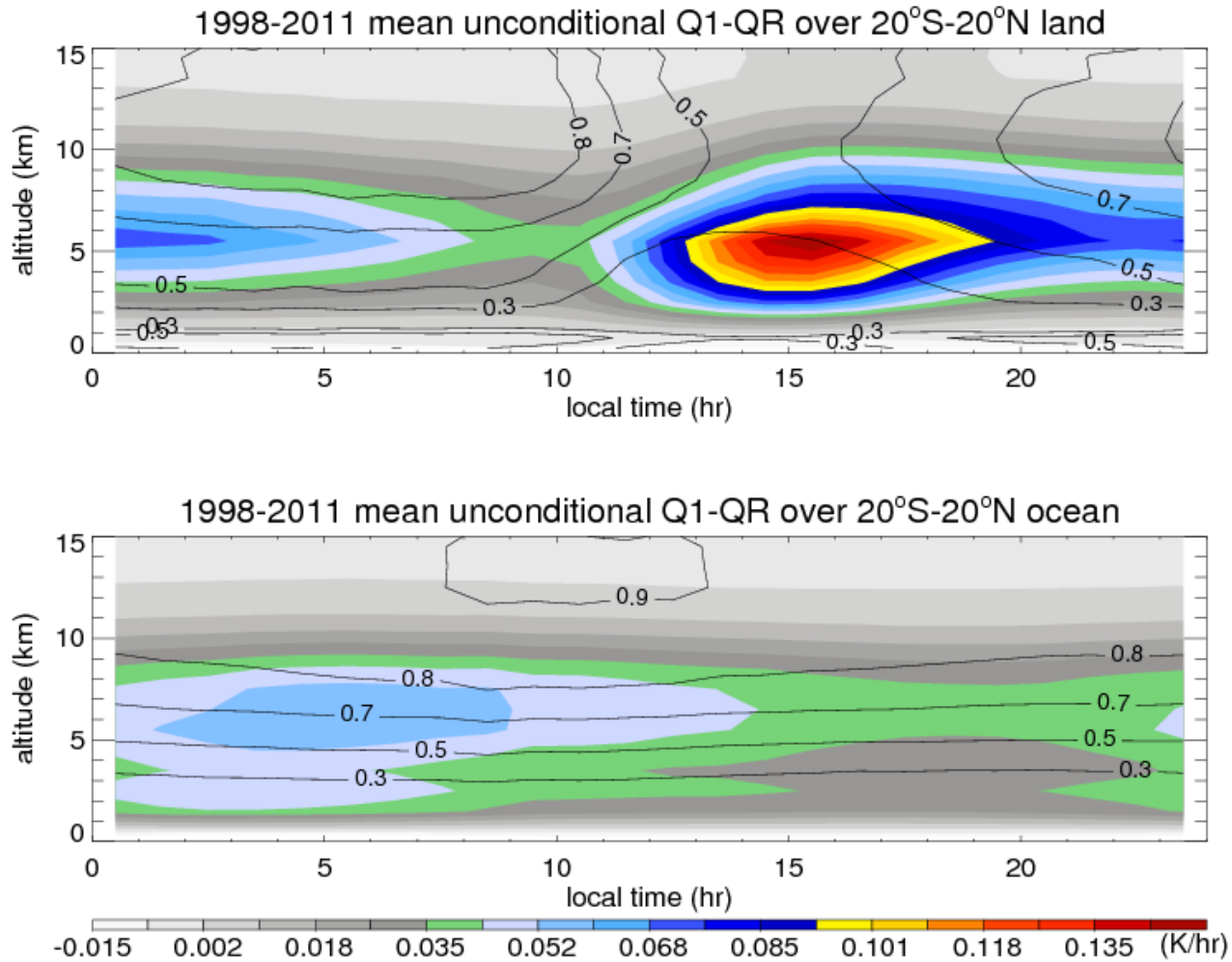
Large organized convection regions occur more often over land

Distribution of population of convective features  $> 1000 \text{ km}^2$



# Diurnal variation of latent heating and contribution from MCSs

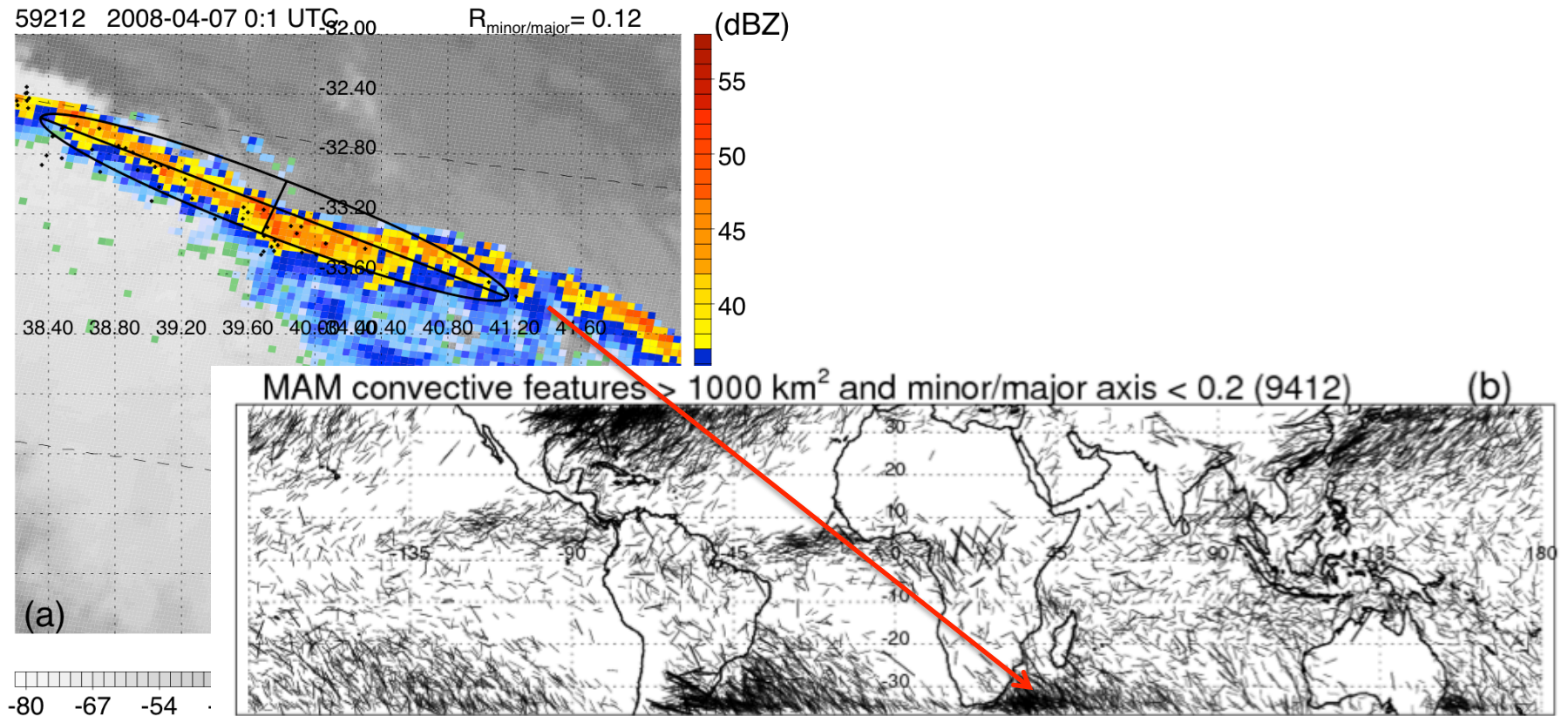
V7 2H25



Contours show the contribution from MCSs (PF > 2000 km<sup>2</sup>)

Details - see poster 120 after this talk

# Global distribution of convective lines



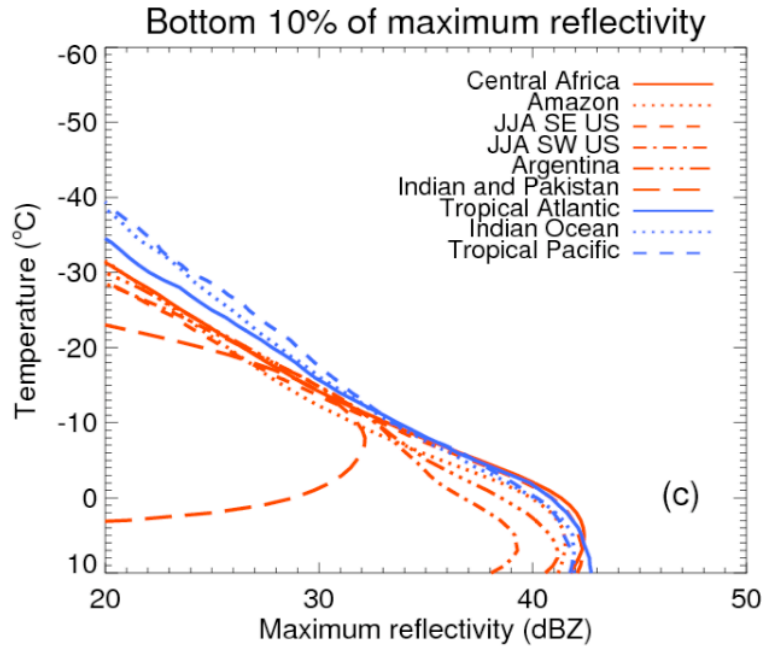
## Unanswered questions:

How do we use such information to help improve climate models?

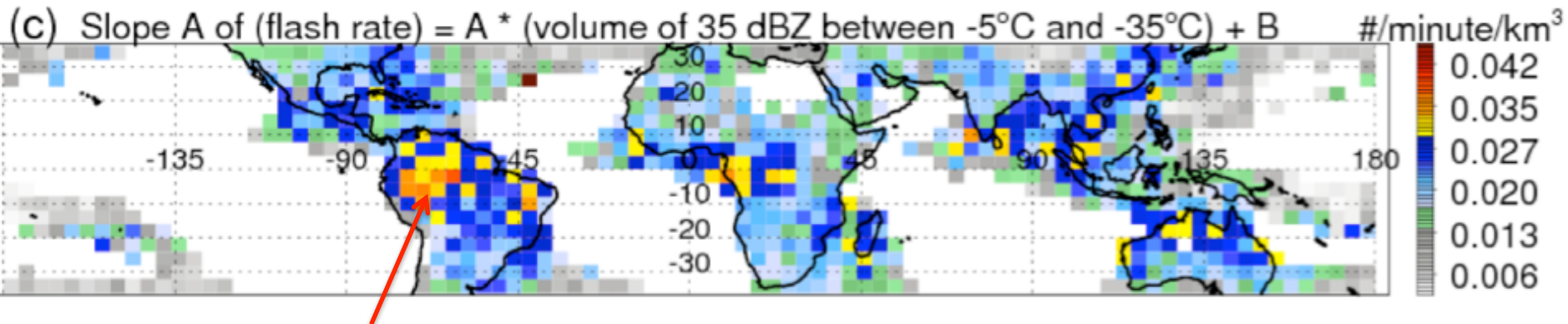
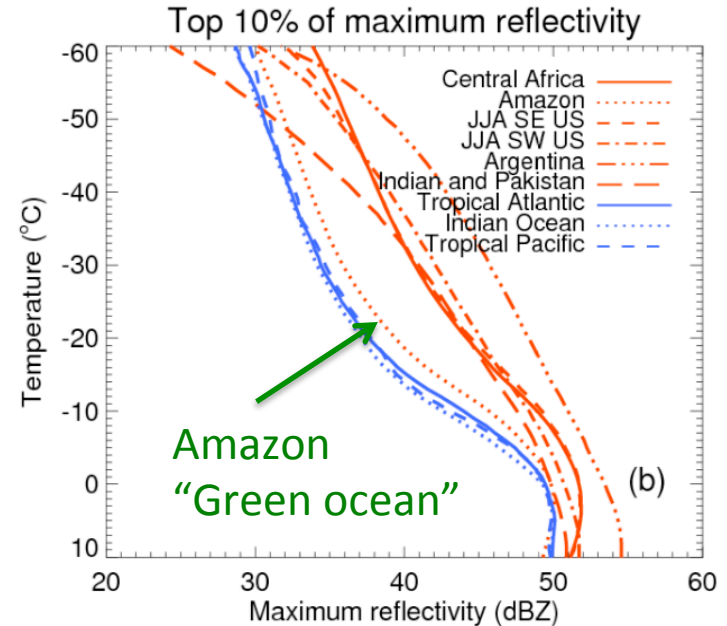
Specifically, their cumulus parameterization?

# Lightning and properties of convection

## Weakest thunderstorms

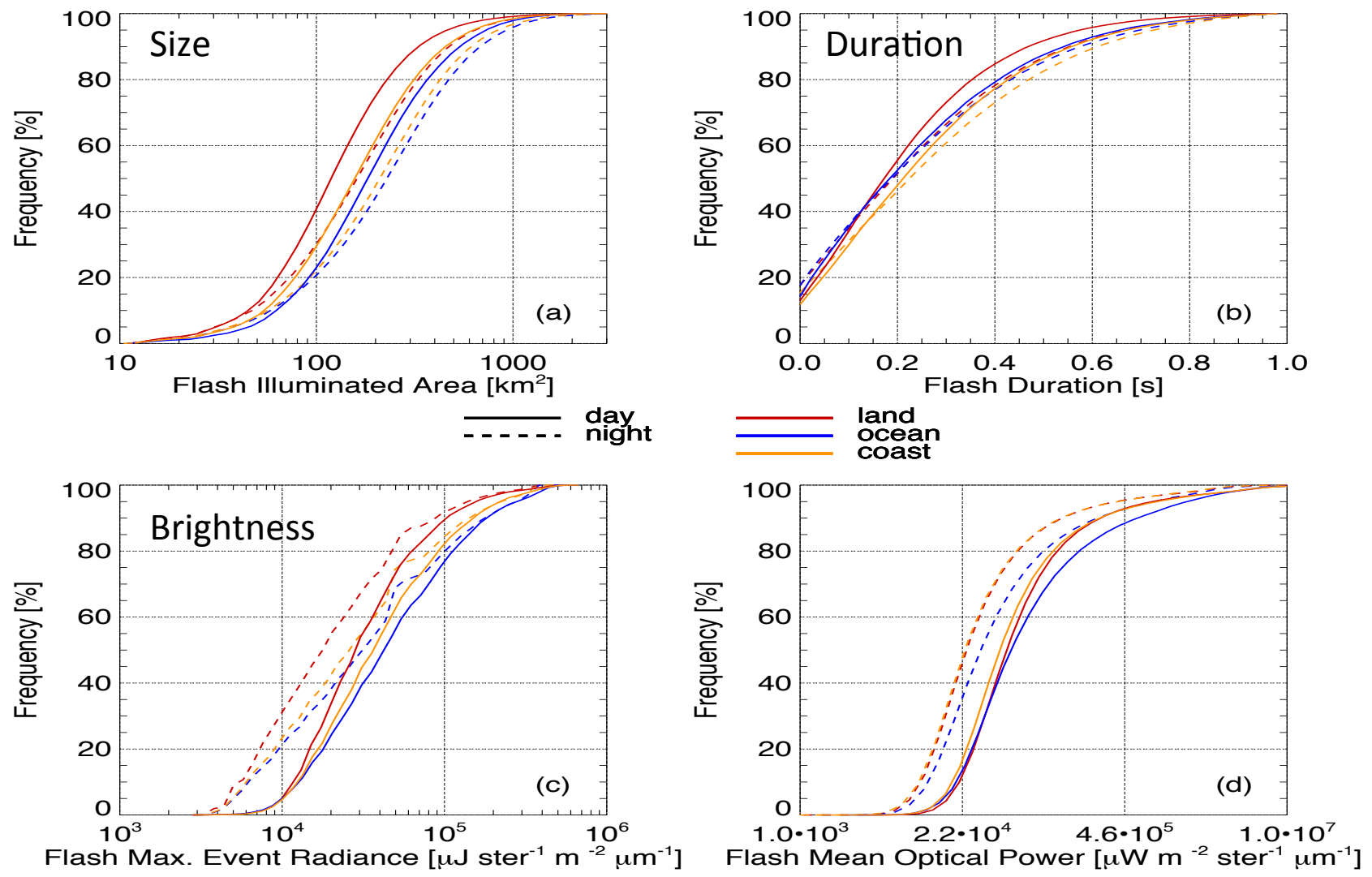


## Strongest thunderstorms



Given the same volume of high reflectivity in mixed phase regions, the Amazon has more lightning flashes. Why?

# Oceanic lightning flashes are larger, brighter and last longer



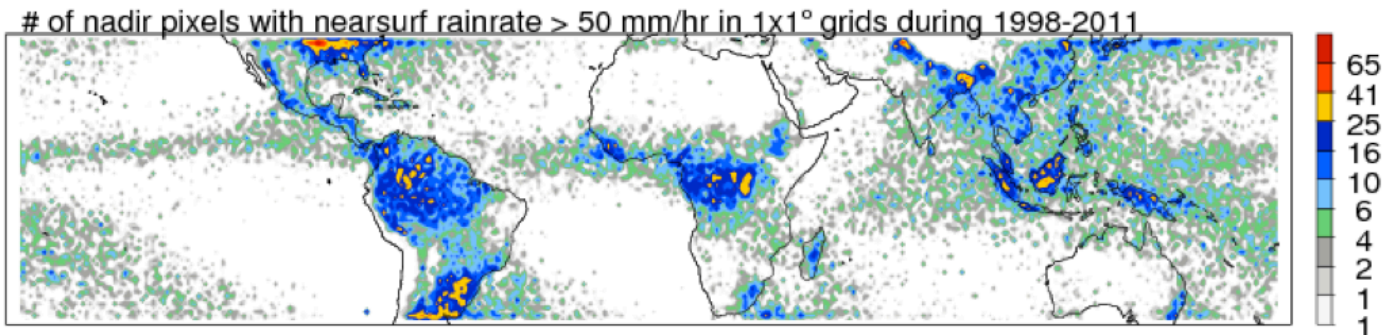
Unanswered question: Why?!?

# Extreme precipitation rates

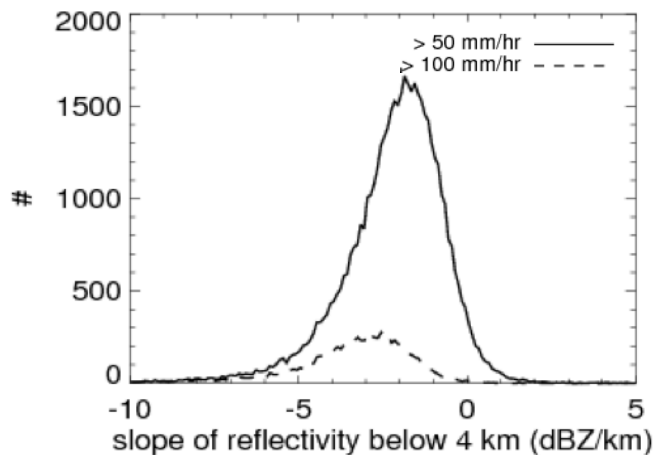
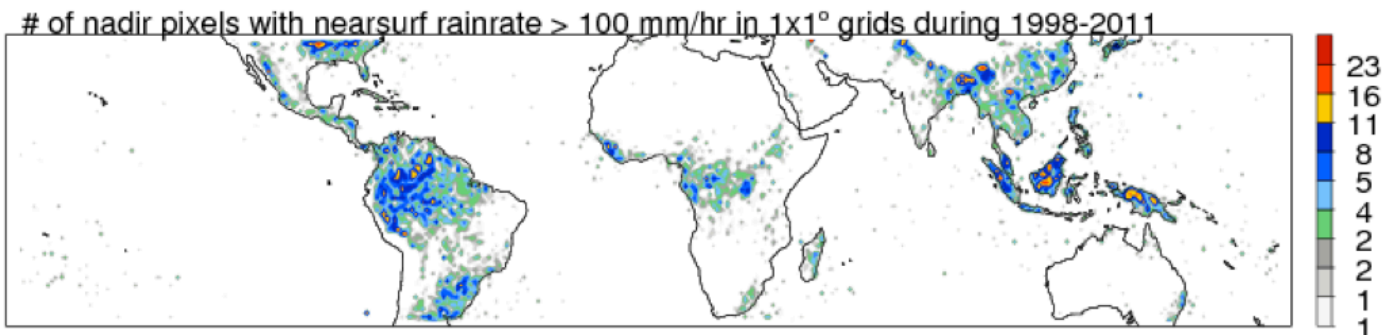
Collaborate with Takayabu and Hamada

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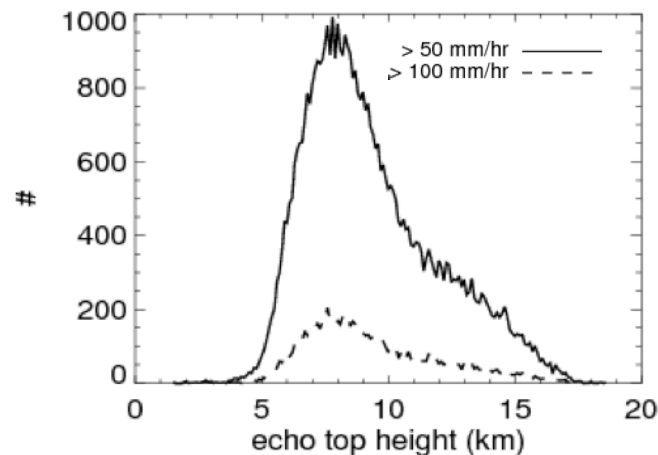
> 50 mm/hr



> 100 mm/hr



dBZ increases toward surface



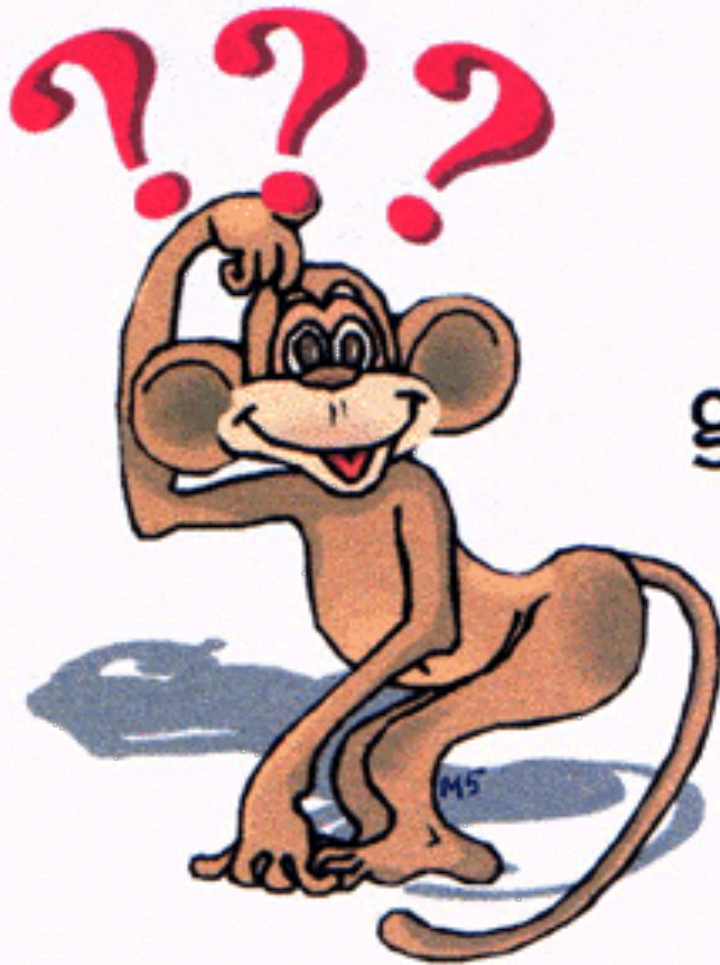
Shallow profiles



# Future research directions

Collaborations needed!!!

- Precipitation validation  
How do we use differences of precipitation estimates in different types of precipitation systems to improve retrieval algorithms?
- Precipitation contribution from different types of systems  
Extend the study to mid and high latitudes during GPM era
- Organization of convection  
How do we use the precipitation feature database to improve the description of sub-grid and organized convection in climate models?
- Lightning and properties of convection  
With more microphysics information from dual frequency radar on GPM, we should be able to improve understanding of the relationship between lightning and convection.
- Extreme precipitation rates  
Are they real, or artifacts? What kind of precipitation systems have them? DPR on GPM should be able to help us understand more on the extreme rain rates.



Questions  
are  
guaranteed in  
life;  
Answers  
aren't.