Global Variability of Mesoscale Convective System Anvil Structure

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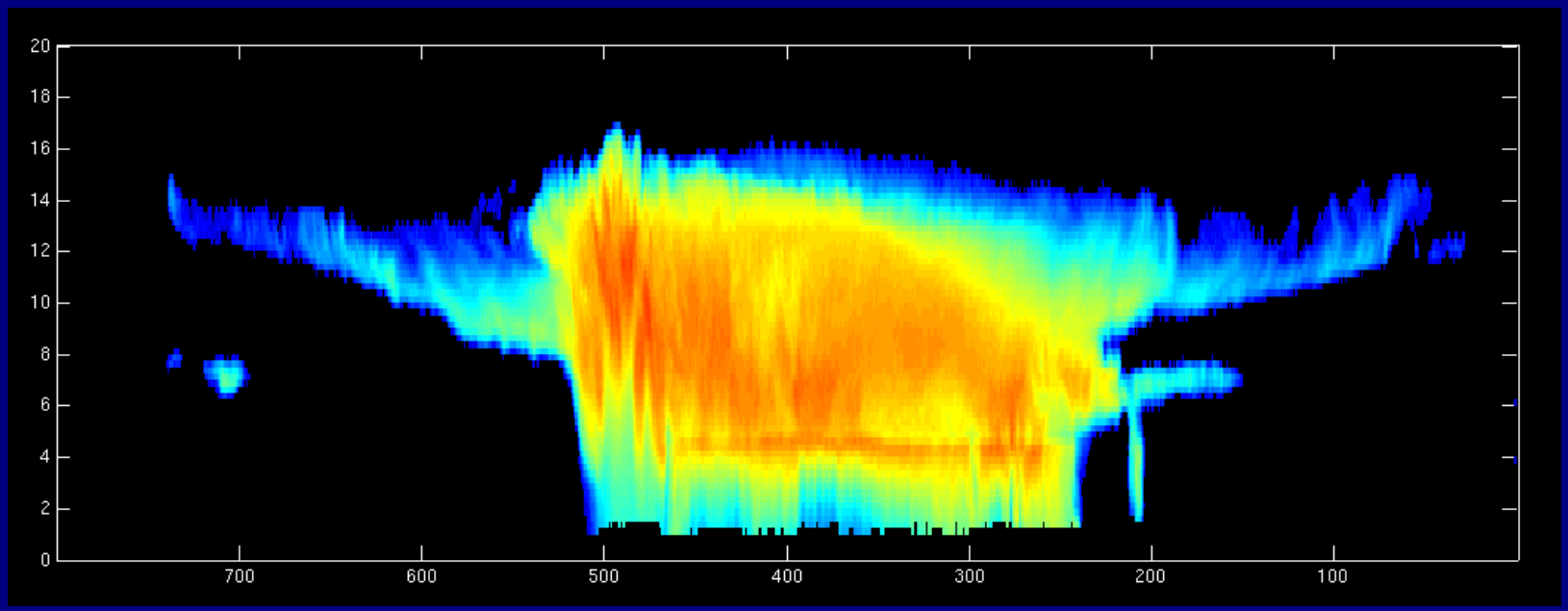
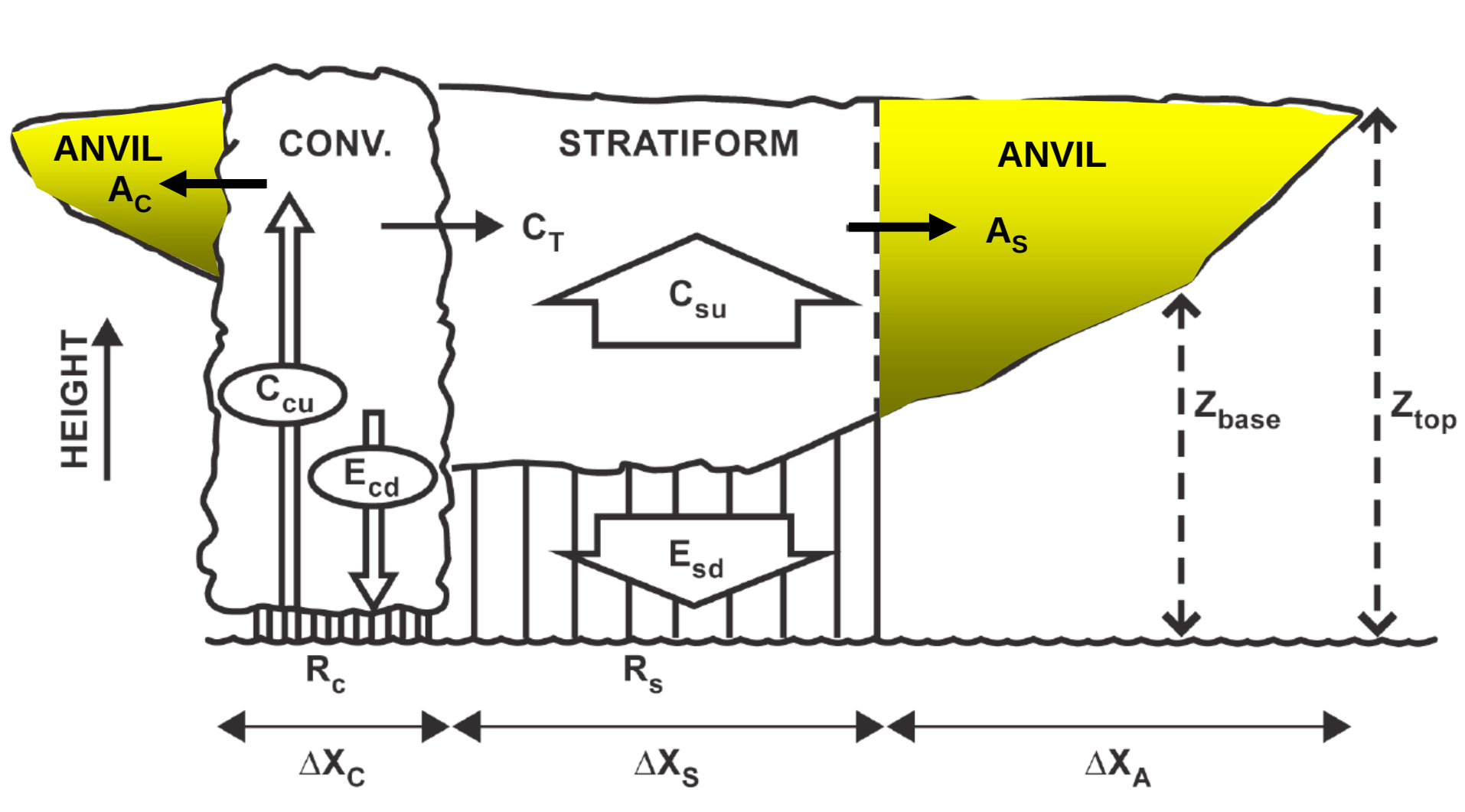


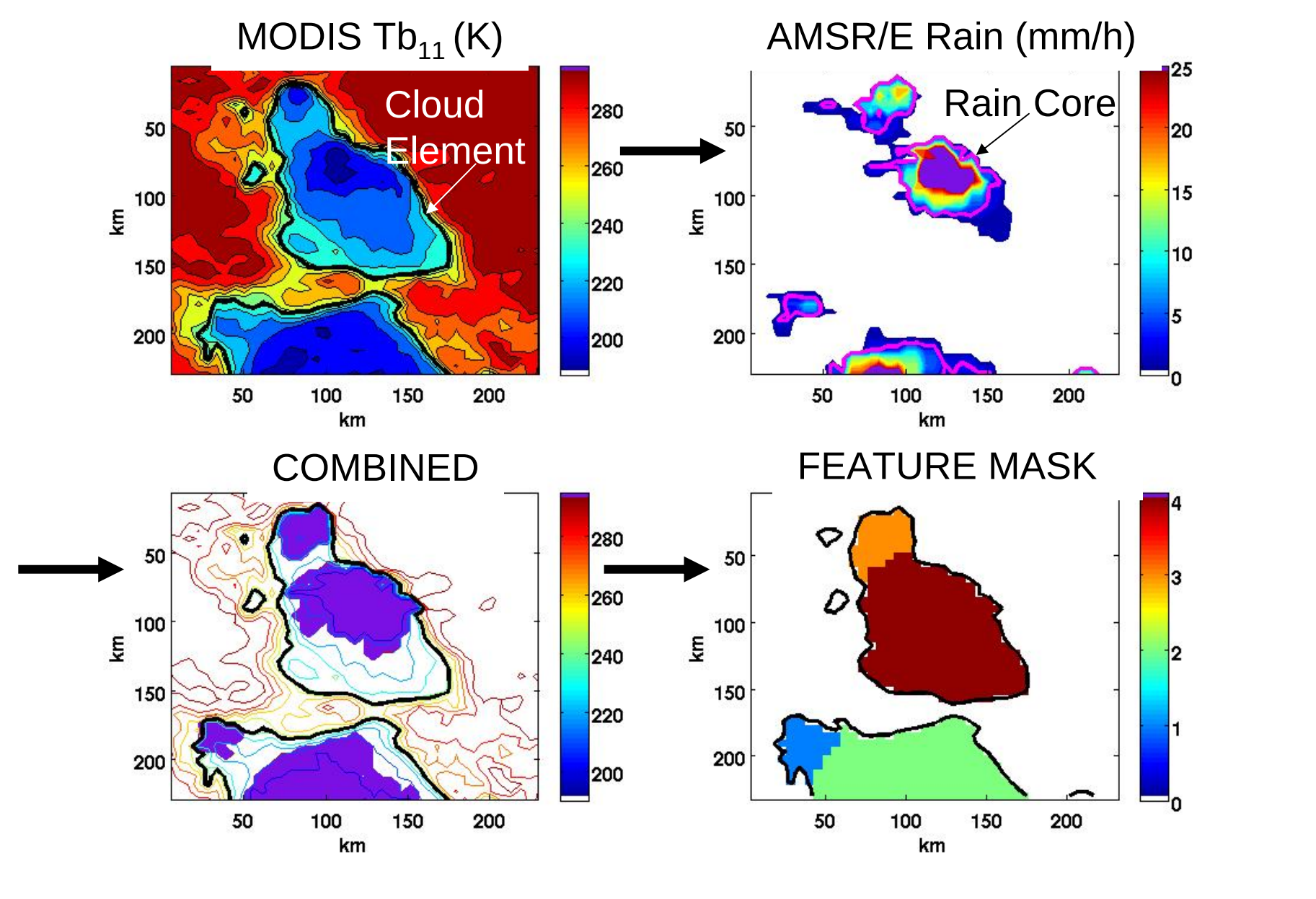
Goal: Global variation of the structure and composition of MCS anvils



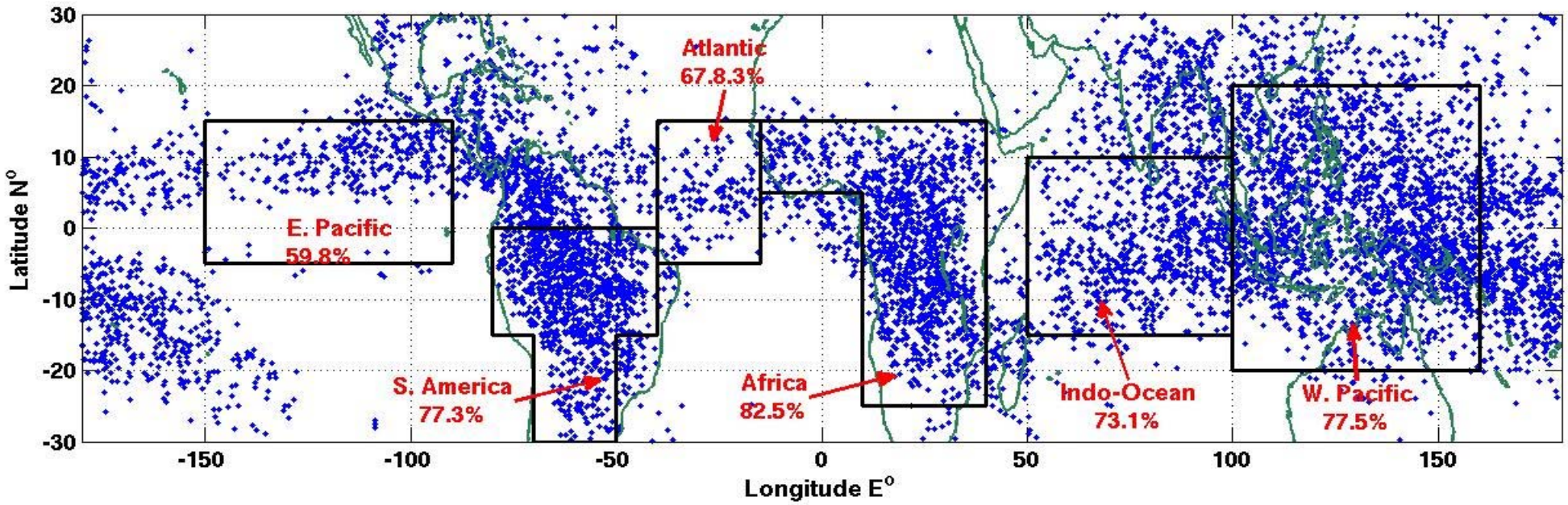
Objective Identification of MCSs

- Rain Rate: **AMSR-E**
  - Aqua L2B Global Swath Rain Rate (AE_Rain).
- Horizontal Cloud Structure: **MODIS**
  - MODIS/Aqua Clouds 1km and 5km 5-Min L2 Wide Swath Subset along CloudSat V2 at GES DISC(GES_DISC_MAC06S1_v2)
- Vertical Cloud Structure: **CloudSat**
  - Products 2B-GEOPROF; 2B-CWC-RO; 2B-FLXHR; …

Identification of High Cloud Features

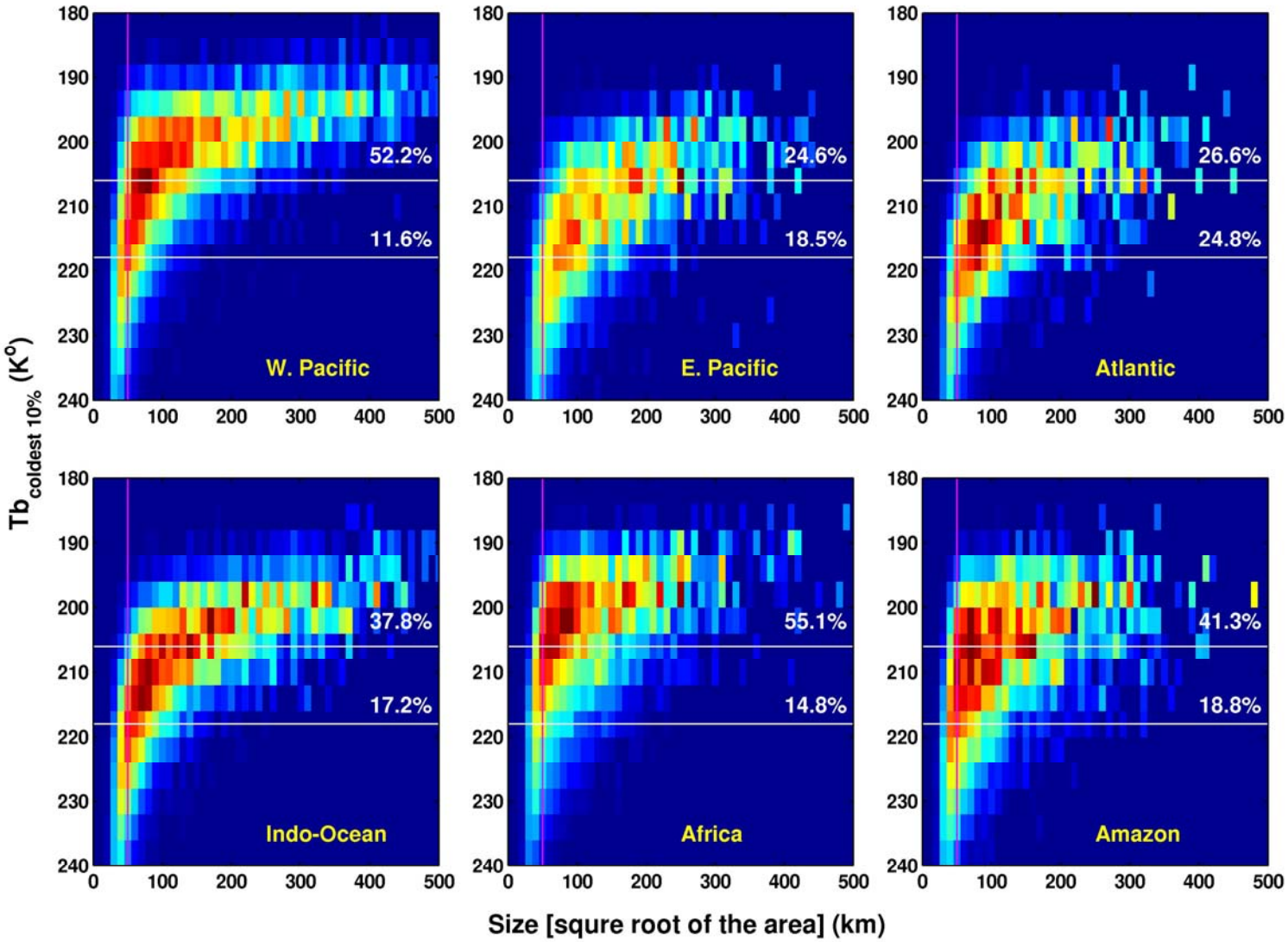


Precipitation from deep cloud systems



Percentages are contributions of total rainfall from all high cloud systems within each region for the whole 12 months of 2007.

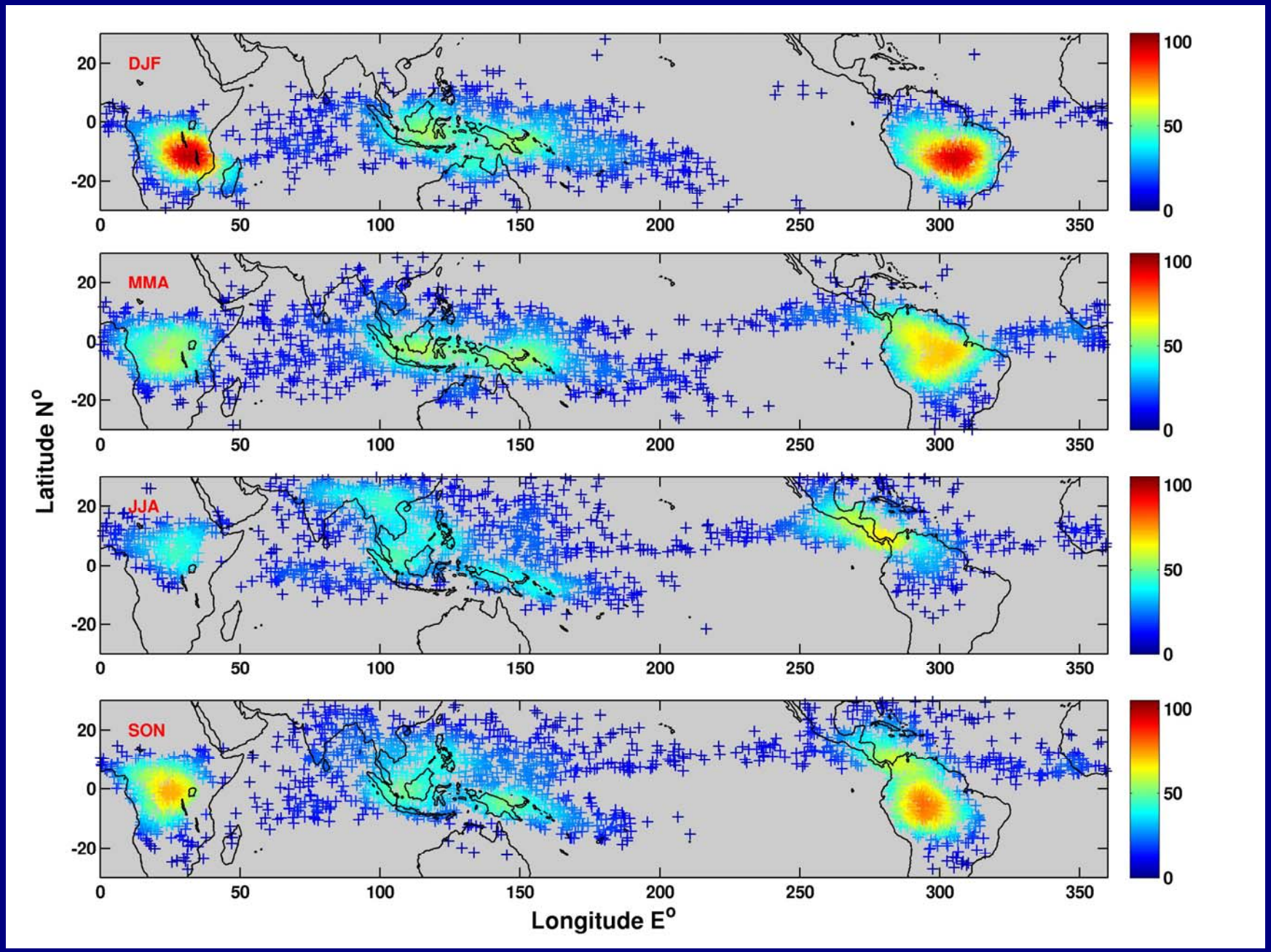
Rain-weighted frequency of cloud systems by size and coldness of cloud top of rain area



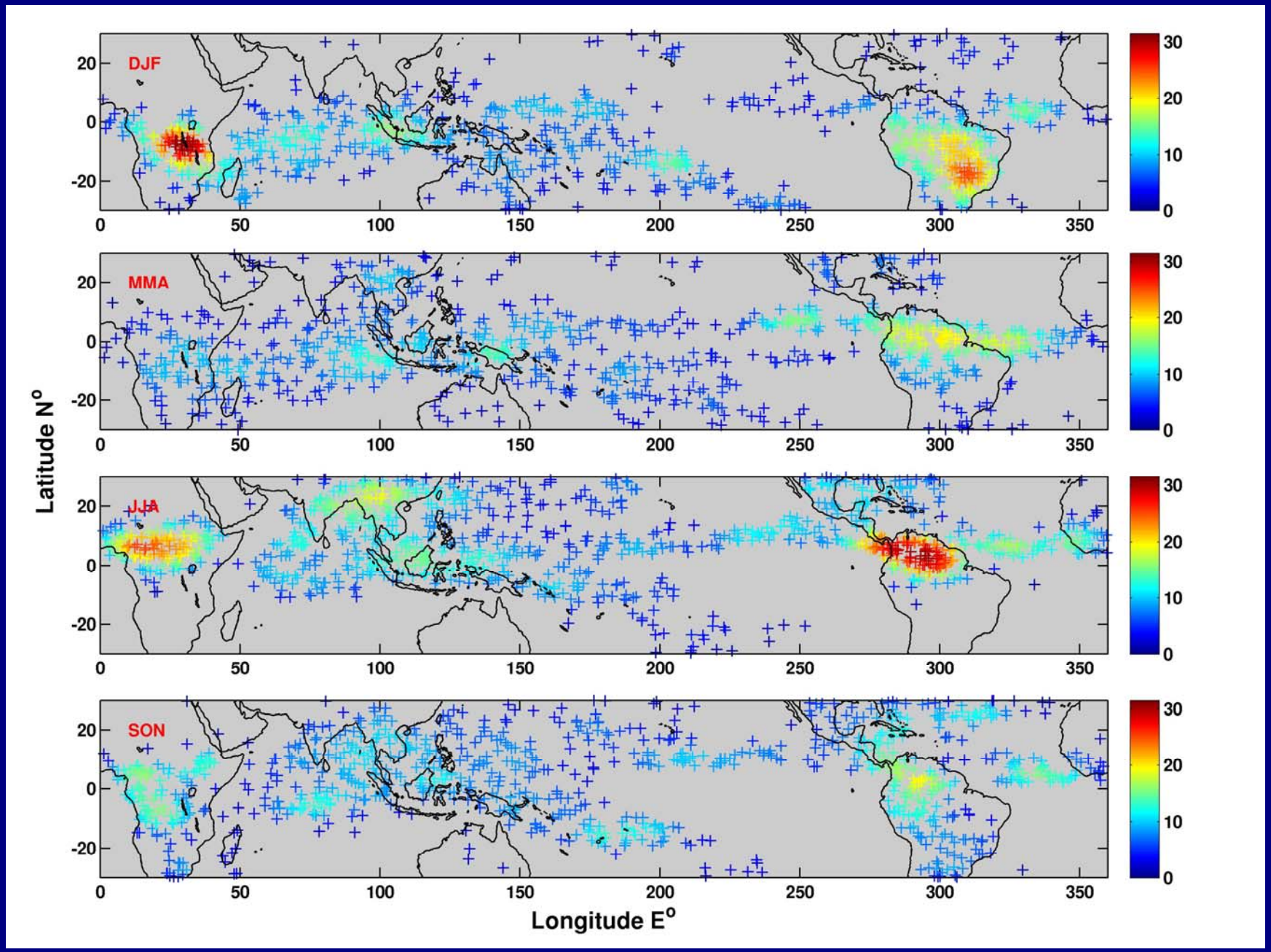
Selection of Mesoscale Convective Systems

- Identify MCSs:
  - Rain area 2,000-250,000 km^2
  - Mean Tb11 <235 K
  - Rain area with R>10 mm/hr > 200km^2
- Stratify MCSs
  - Cold: Tb11_min<208 K
  - Warm: 208 K^0<Tb11_min<220 K
  - Subdivide Cold and Warm by size

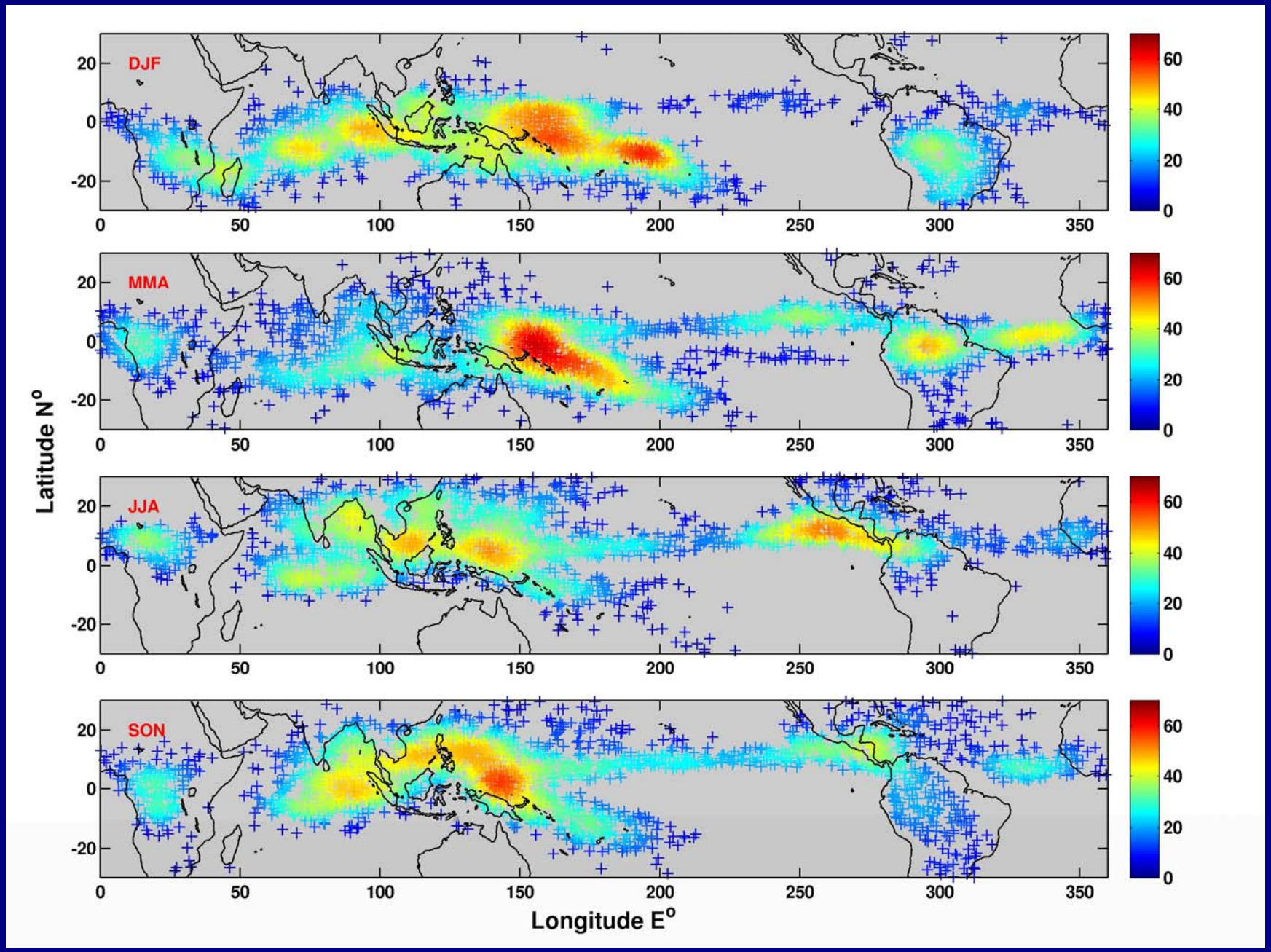
Cold MCS (Smallest 30%)



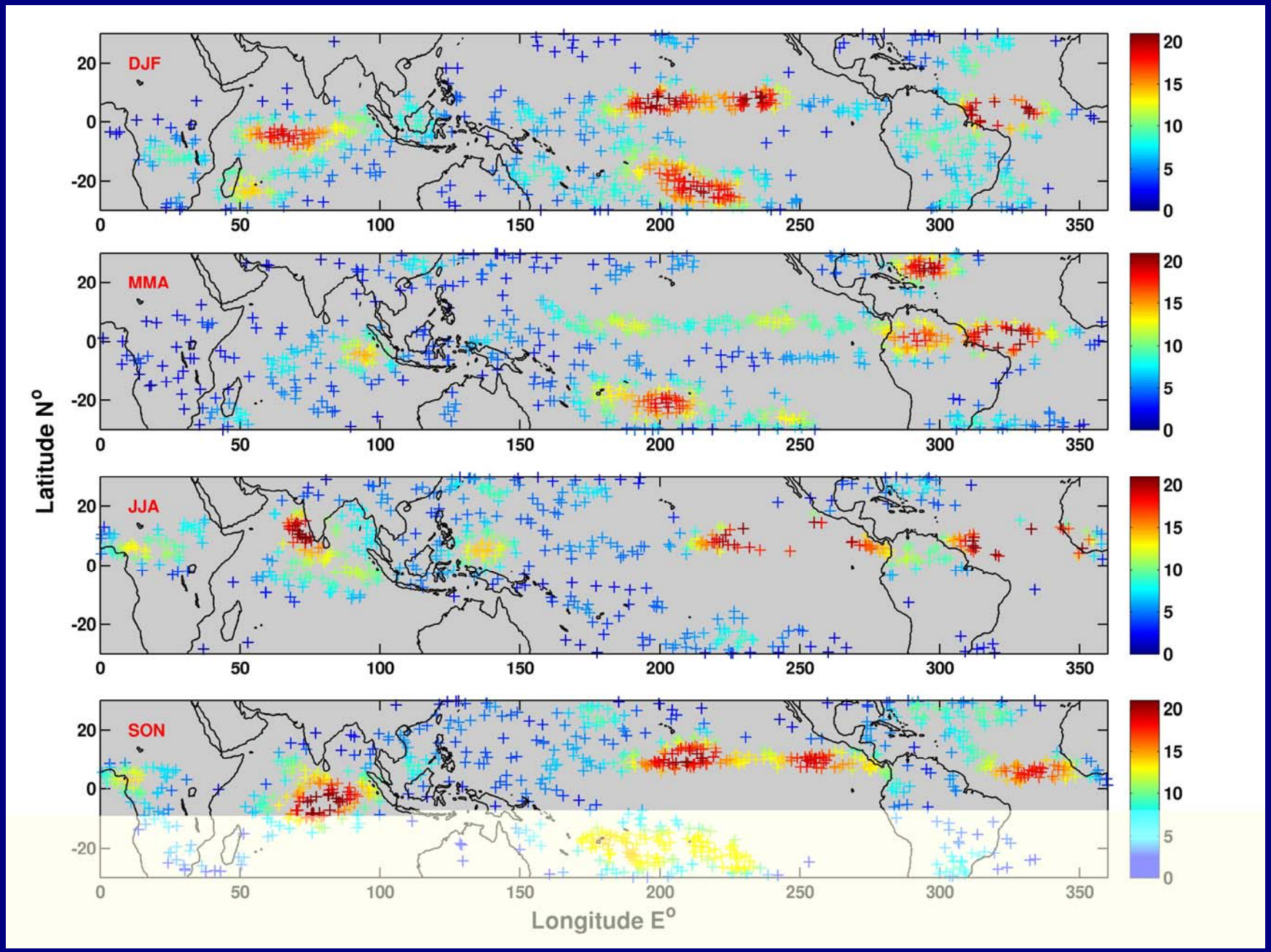
Warm MCS (Smallest 30%)



Cold MCSs (Biggest 30%)



Warm MCS (Biggest 30%)



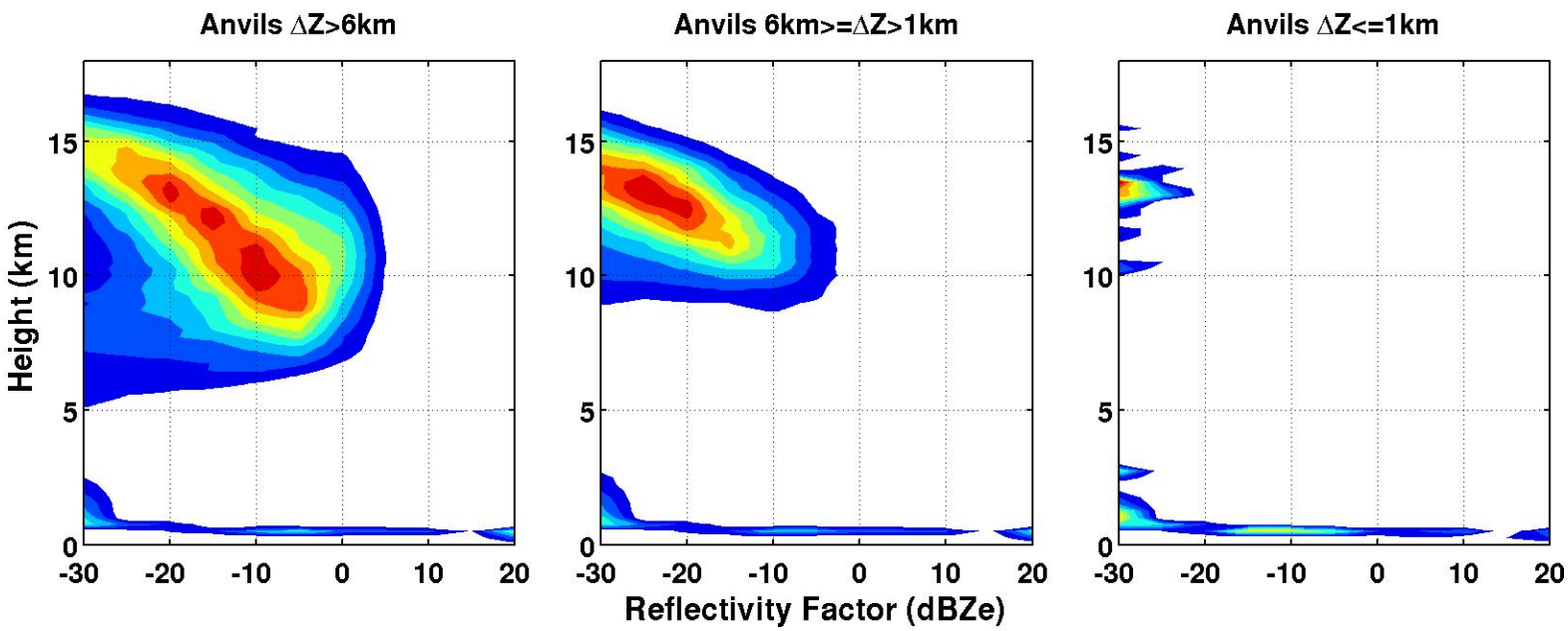
Vertical Structure of Anvils

West Pacific (20S°-20N°,100E°-160E°) over open water.

Sampled from the Cold MCS category:

T_{min}<208K°. 2000km^2<Rain area<250000km^2.

All anvil bases are above 4.5km.



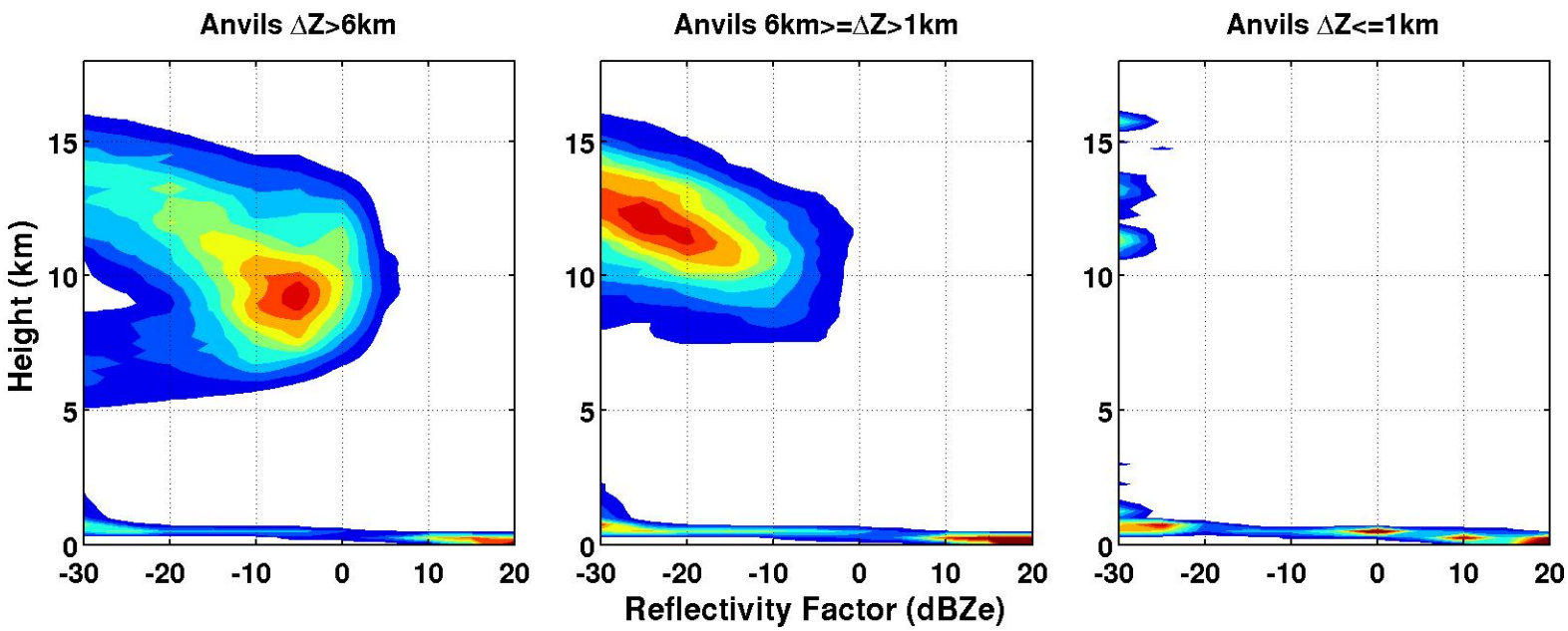
Vertical Structure of Anvils

Africa (25S°-25N°, 10W°-50E°) over land.

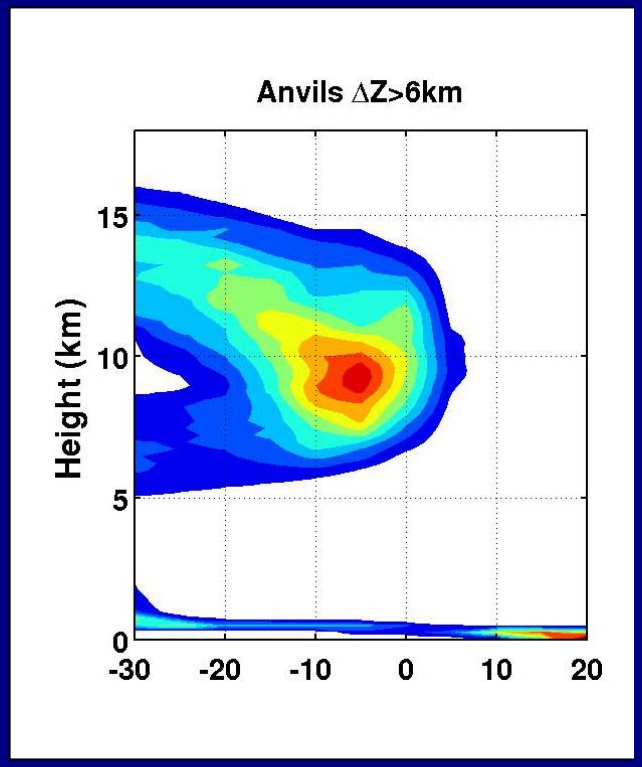
Sampled from the Cold MCS category:

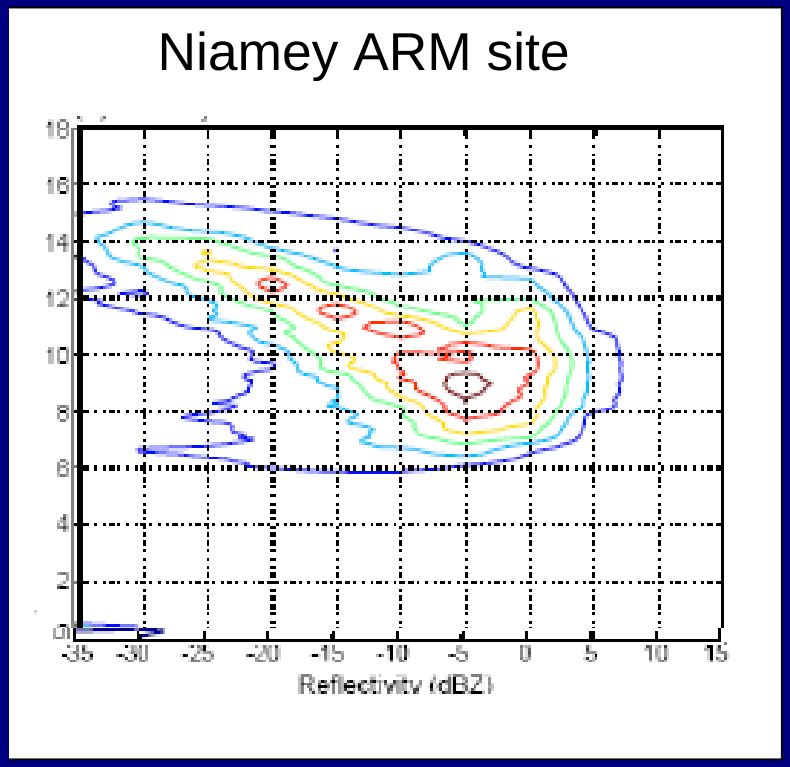
T_{min}<208K°. 2000km^2<Rain area<250000km^2.

All anvil bases are above 4.5km.



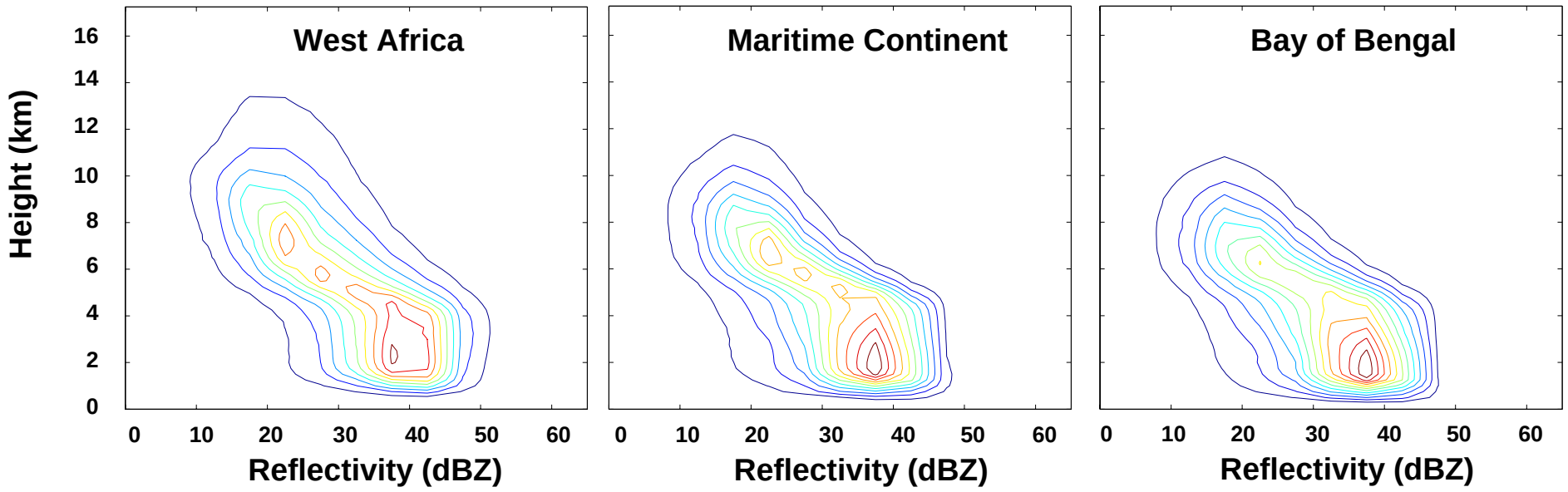
Compare to **ARM** Thick Anvil Results





Cetrone & Houze 2009

TRMM radar observations of convective echoes in MCSs



Cetrone & Houze 2009

Conclusions

- **OBJECTIVE MODIS/AMSR-E METHODOLOGY CAPTURES TROPICAL MCS CHARACTERISTICS**
  - Cloud tops of MCSs colder over Africa and West Pacific than over East Pacific and tropical Atlantic
  - Larger MCSs more frequent over ocean
  - Smaller MCSs more frequent over land
  - MJO AND South Asian monsoon favor larger, colder MCSs
  - Etc.
- **PRELIMINARY CLOUDSAT & ARM SITE RESULTS SHOW ANVIL STRUCTURE FOR OBJECTIVELY IDENTIFIED MCSs**
  - Africa: Stronger echo in deep raining cloud reaches higher altitude with max reflectivity concentrated at lower levels--suggests graupel
  - West Pacific: Narrow peaked distribution of reflectivity with values increasing downward--suggests diffusion, aggregation processes

Thank You