Mesoscale Convective Systems (MCSs) in the Intra-Americas Seas (IAS): Evidence from TRMM (for Session 1)

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The TRMM Precipitation Feature Database is accessible to all at:
http://trmm.chpc.utah.edu/ AND/OR http://atmos.tamucc.edu/trmm/

Questions or assistance? Contact the author, or
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How do we define a “precipitation feature” (PF)?

**Contiguous** rain area at least 4 pixels in size (75 km²) …

This database was updated to its 4th version in *Liu et al., JAMC 2008*, updated to TRMM V7, and generalized so that the PFs can be defined from any of the TRMM instruments (radar, passive microwave, lightning, IR)

How do we define a “mesoscale convective system” (MCS?) By size of the PF, generally > 100 km linear dimension or > 2000 km² in area
Some early uses of the PF database

• Where in the world does most rain come from large systems (like MCSs)?

• Where does most rain come from light rain rates? Heavy rain rates?

• What fraction of rainfall over land and ocean is from thunderstorms?

• Where are the strongest convective storms on earth?

To answer such questions, we went beyond the radar structure, so valuable from the PR algorithms, to add information from TMI, LIS, and VIRS
Global Annual Rainfall from TRMM Radar Retrieval

Description: TRMM 3A25 mean monthly rain
Mean: 2.68653
Standard deviation: 2.17340
Download the DATA

(Rectangle shows IAS domain for later detailed figures)
Rain contribution by PFs reaching 12, 15 km, and (bottom panel) with at least one LIS flash.
IAS Region: Rainfall from TRMM Radar Retrieval – 4 Seasons

Maps showing rainfall data for different seasons:
- **JJA (June, July, August)**
- **SON (September, October, November)**
- **DJF (December, January, February)**
- **MAM (March, April, May)**

The maps display rainfall patterns across the region, with color coding indicating the intensity of rainfall.
IAS Region: Rainfall from TRMM Radar Retrieval – Sept-Oct-Nov
All deep convective systems (MCSs) are not alike!

NEXT: Where are the rainiest, tallest, most intense MCSs in the IAS?

Fig. 3. Spatial distribution of the probability of a location being under (a) a deep convective core, (b) a wide convective core, and (c) a broad stratiform region during the months JJA of 1998–2012. The contour inside the continent represents the 1000-m terrain elevation.

(Zuluaga and Houze, MWR 2015)
Where are the individual precipitation features (PFs) with the MOST volumetric rain? 

[> 300,000 mm km^2 per hour], e.g., 5 mm/h X 60,000 km^2

1131 MCSs were found

From PF Database, 1998-2013
1415 MCSs were found

From PF Database, 1998-2013

Where are the individual precipitation features (PFs) with the HIGHEST NEAR-SURFACE RADAR REFLECTIVITY?

[> 52 dBZ, or ~ ~ 50-100 mm/hour at TRMM pixel scale of ~ 20 km^2]
Where are the individual precipitation features (PFs) with the HIGHEST LIS-observed lightning flash rates? > ~ 100 flashes per minute

From PF Database, 1998-2013
Where are the individual precipitation features (PFs) with the HIGHEST 20 dBZ radar echo?

[> 16.5 km …IR tops are higher]
Where are the individual precipitation features (PFs) with the 40 dBZ echo top > 10 km? [equivalent to Zuluaga & Houze’s Deep Convective Cores – DCCs]
THANK YOU!

Comments and questions welcome!
Extra slides
Where are the **most** “intense” storms? Orange, purple, black: very strong (0.1%) Even stronger (0.01%) TOP 0.001% (Zipser et al., BAMS 2006)

- **Lightning flash rate**
  - Purple is >125/min
  - Black is >310/min

- **Max height of 40 dBZ echo**
  - (a very strong echo for the ice region – large graupel likely)

- **Minimum 85 GHz PCT**
  - (related to ice water path)