Convective Characteristics of the MJO Observed by Shipborne Radar during DYNAMO

Weixin Xu and Steven Rutledge

Colorado State University, FC, Colorado

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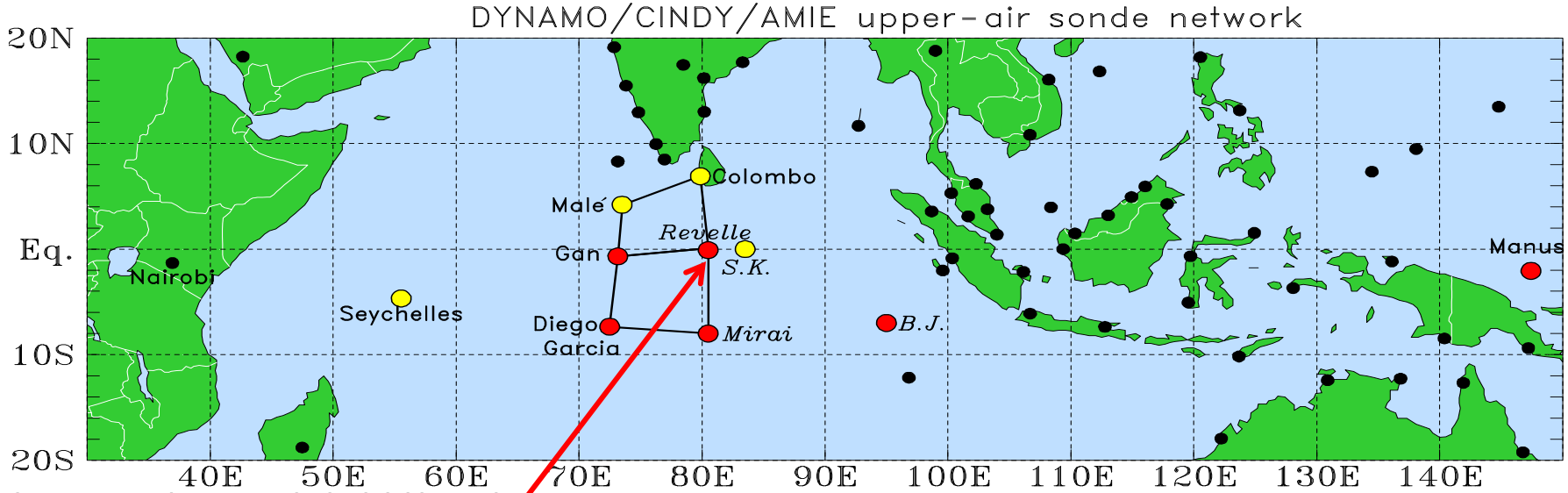
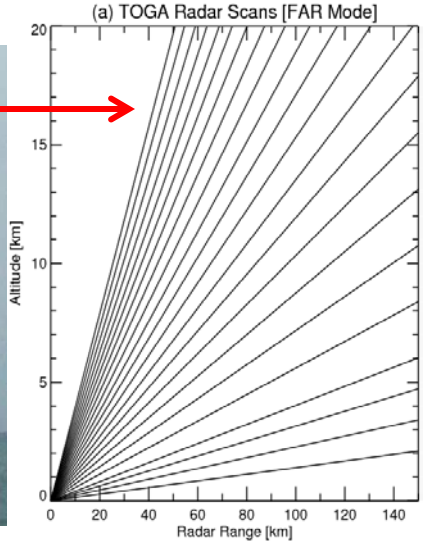
DYNAMICS of the MJO (DYNAMO, 2011-2012)

Our goal: MJO convective evolution and environmental transitions.



(Courtesy Johnson and Ciesielski 2013)

Photo courtesy Timothy Lang



360°, 22 angles

Data (at/near *Revelle*):

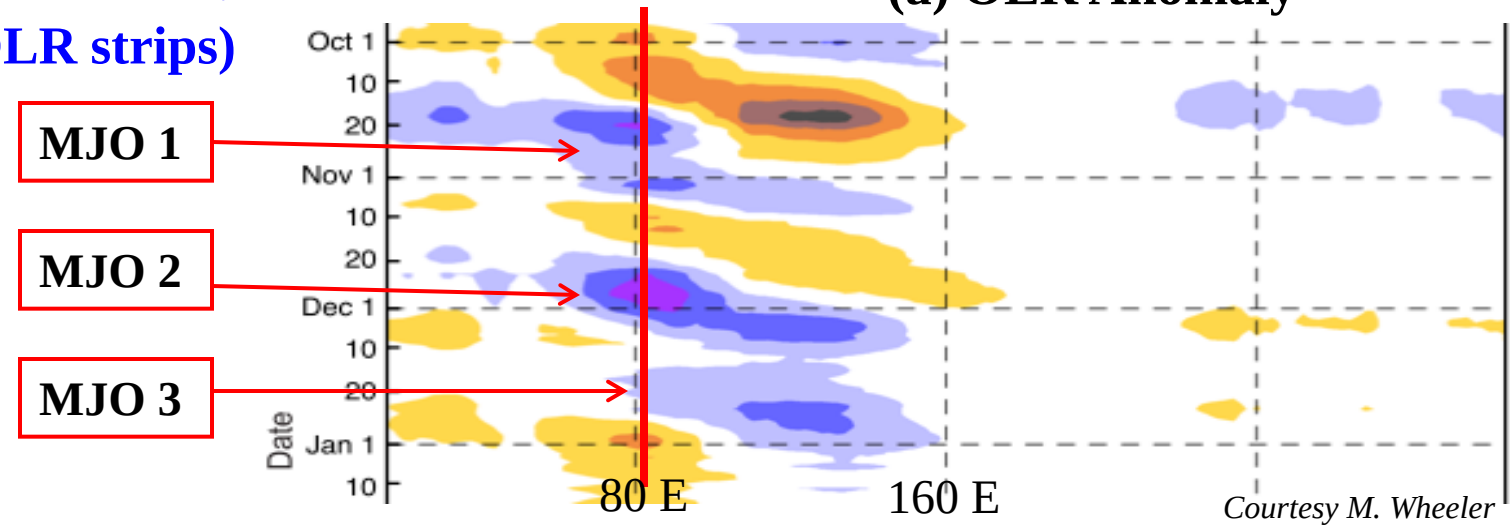
* C-band radar data;
* 3 hourly soundings;
* RAMA SSTs;
* GLD360 lightning;

MJO Events (Oct – Dec 2011)

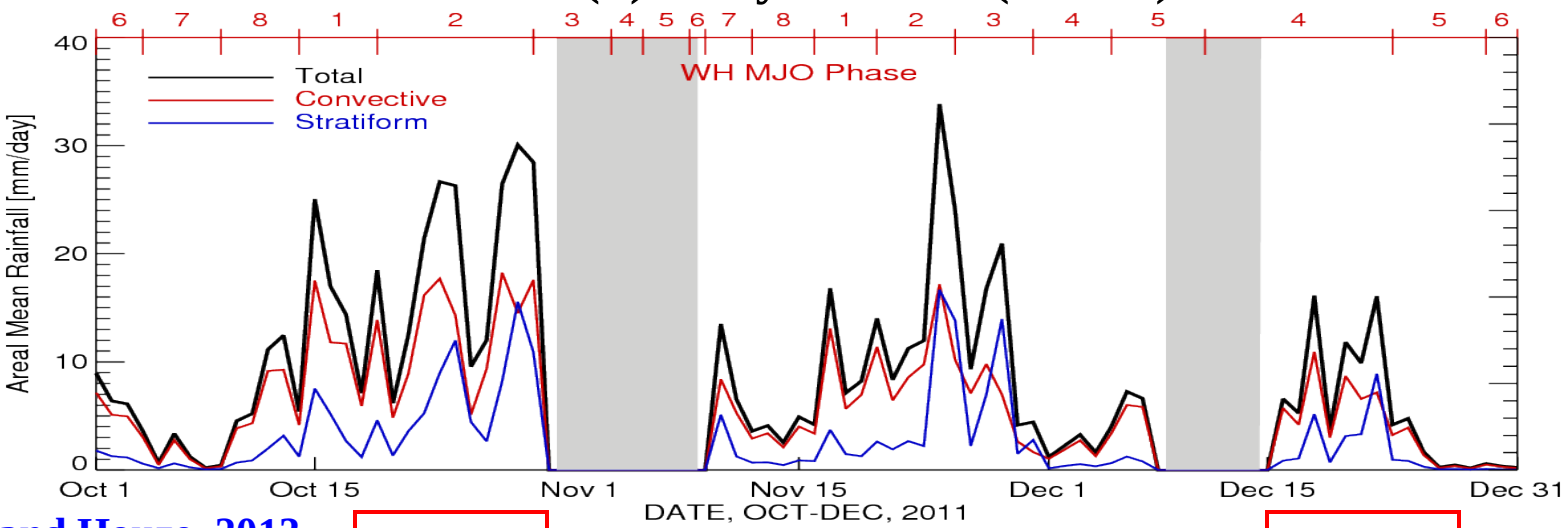
MJO convection:
(cold OLR strips)

R/V Revelle

(a) OLR Anomaly



(b) Daily Rainfall (Radar)



"Zuluaga and Houze, 2013
(2-4 day rain events, Gan)"

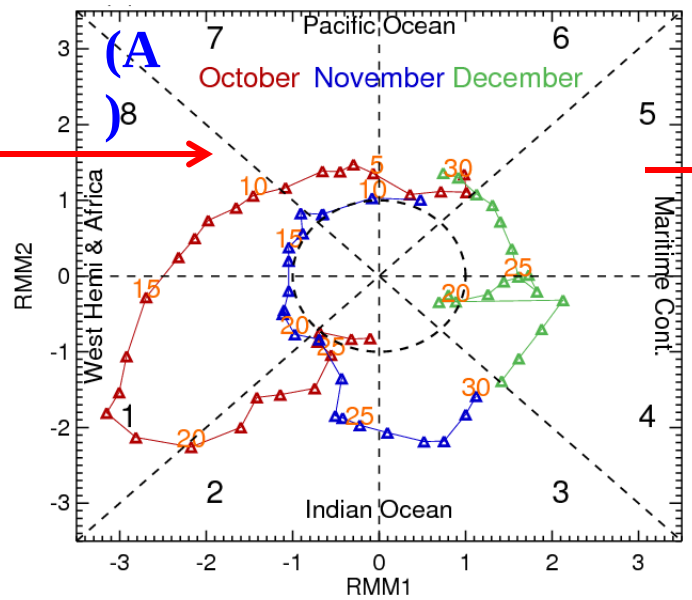
MJO 1 **MJO 2** **MJO 3**

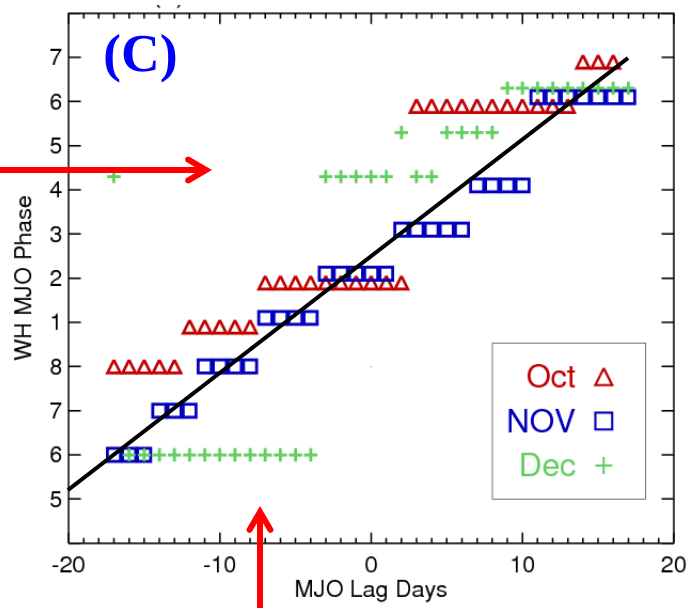
MJO Definitions (WH Index)

"Use times when R/V Revelle was on station during Oct 1-Dec 31"

(A) WH Index (RMM1, RMM2)

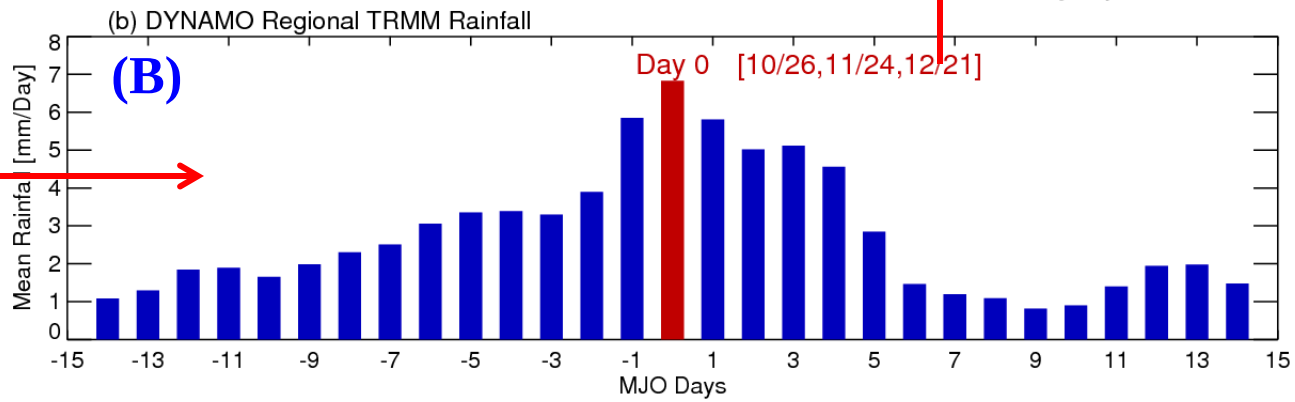
Phase 2-3: active periods in Indian Ocean





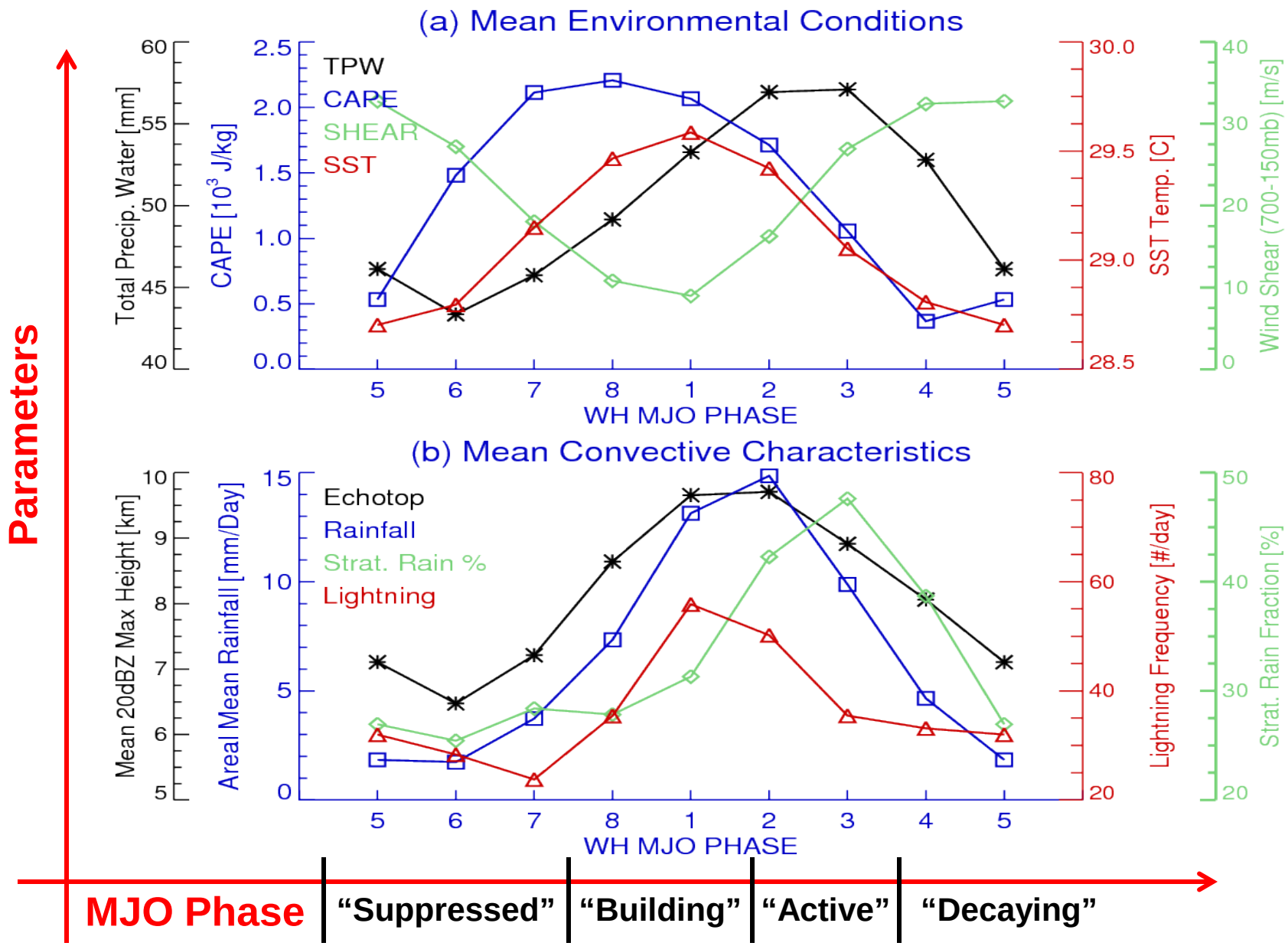
(B) RAIN Index (Local Rainfall)

(10 S-10N; 70-80E)



Day 0: heaviest rainfall in CIO

Overall Environ. and Conv. Transitions



Transitions on Tropospheric Humidity

1. Driest phase:

Phase 5-6

2. Lower-level Moistening:

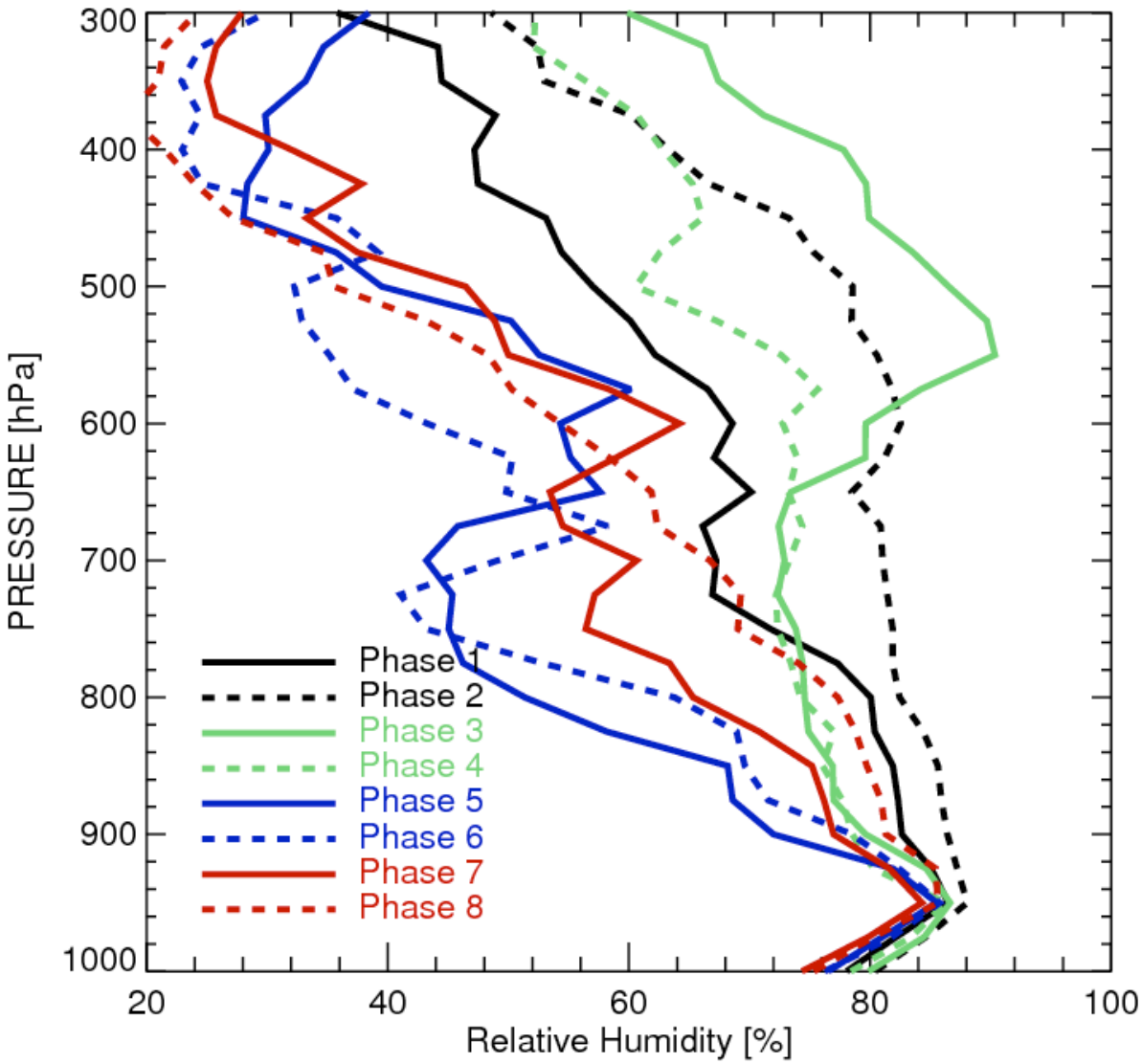
Phase 7-8

3. Upper-level Moistening:

Phase 1-2

4. Upper Drying:

Phase 4-5



Precipitating Cloud Population

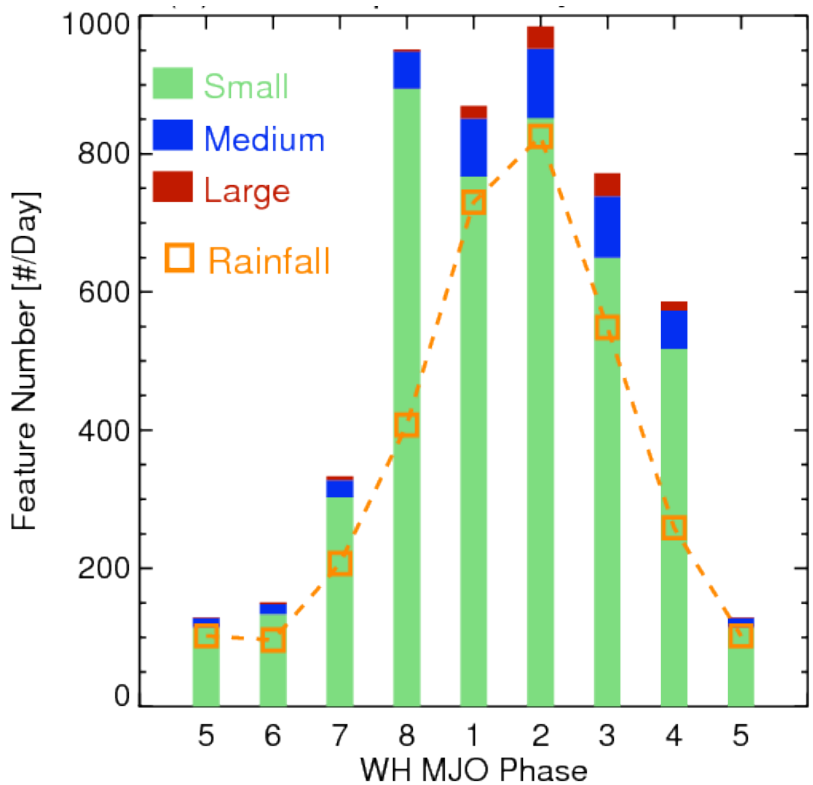
"Precipitating Clouds: echo (> 20-dBZ) objects"

Specific Feature Types

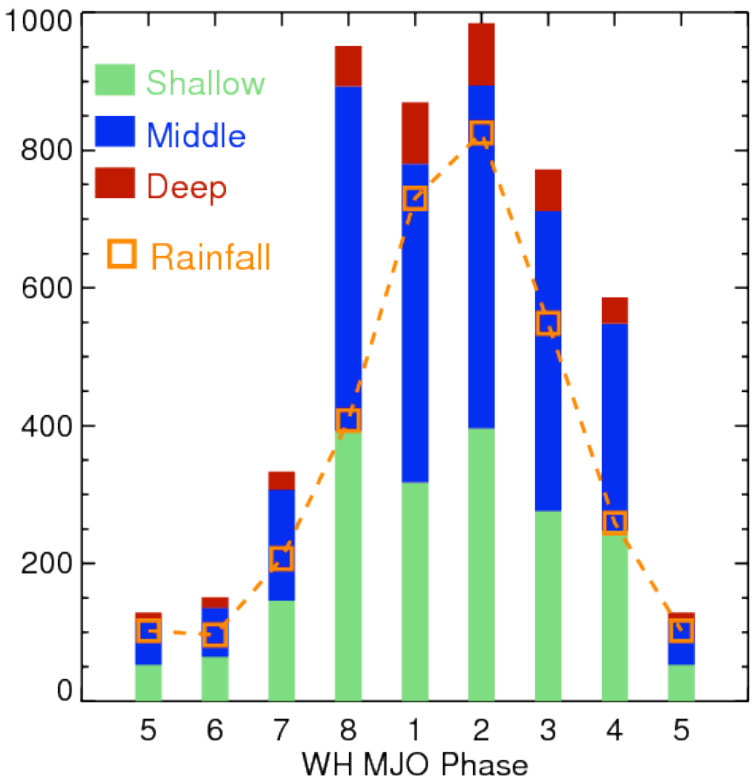
Size: Small (< 200), Medium (200-1000), Large (> 1000 km^2)

Echo top: Shallow (< 5 km), Middle (5-8 km), Deep (> 8 km)

Population, by Size



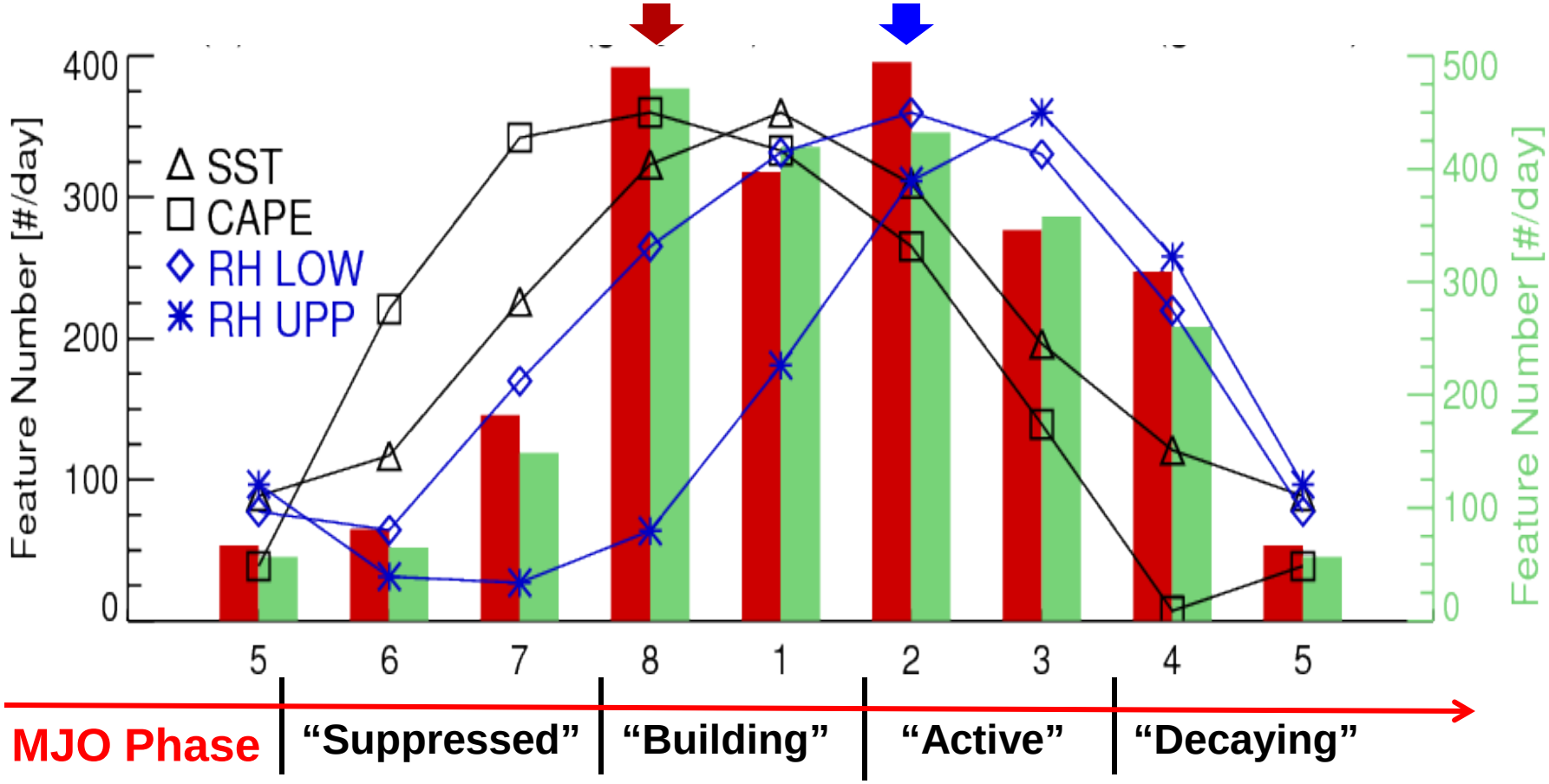
Population, by Echo Top



Shallow Isolated Convection

Shallow isolated (*20 dBZ echo-top < 5 km, size < 200 km²***)**

Middle isolated (*20 echo-top at 5-8 km, size < 200 km²***)**



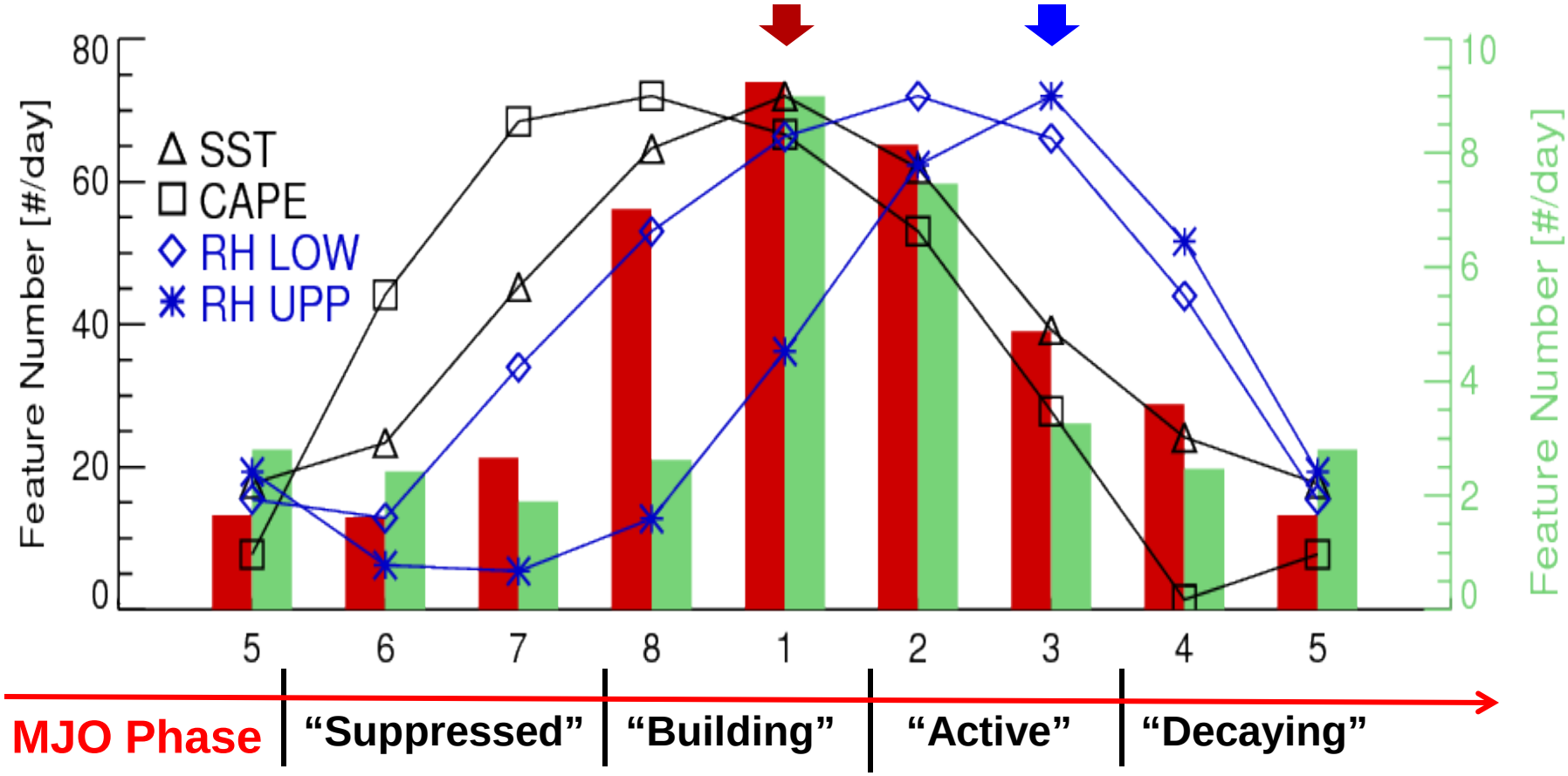
RH LOW: Relative Humidity at 850-700 hPa

RH UPP: Relative Humidity at 500-300 hPa

Deep Isolated and Intense Convection

Isolated deep (*20 dBZ echo-top > 8 km, size < 1000 km²***)**

Intense convection (*30 dBZ echo-top > 8 km***)**



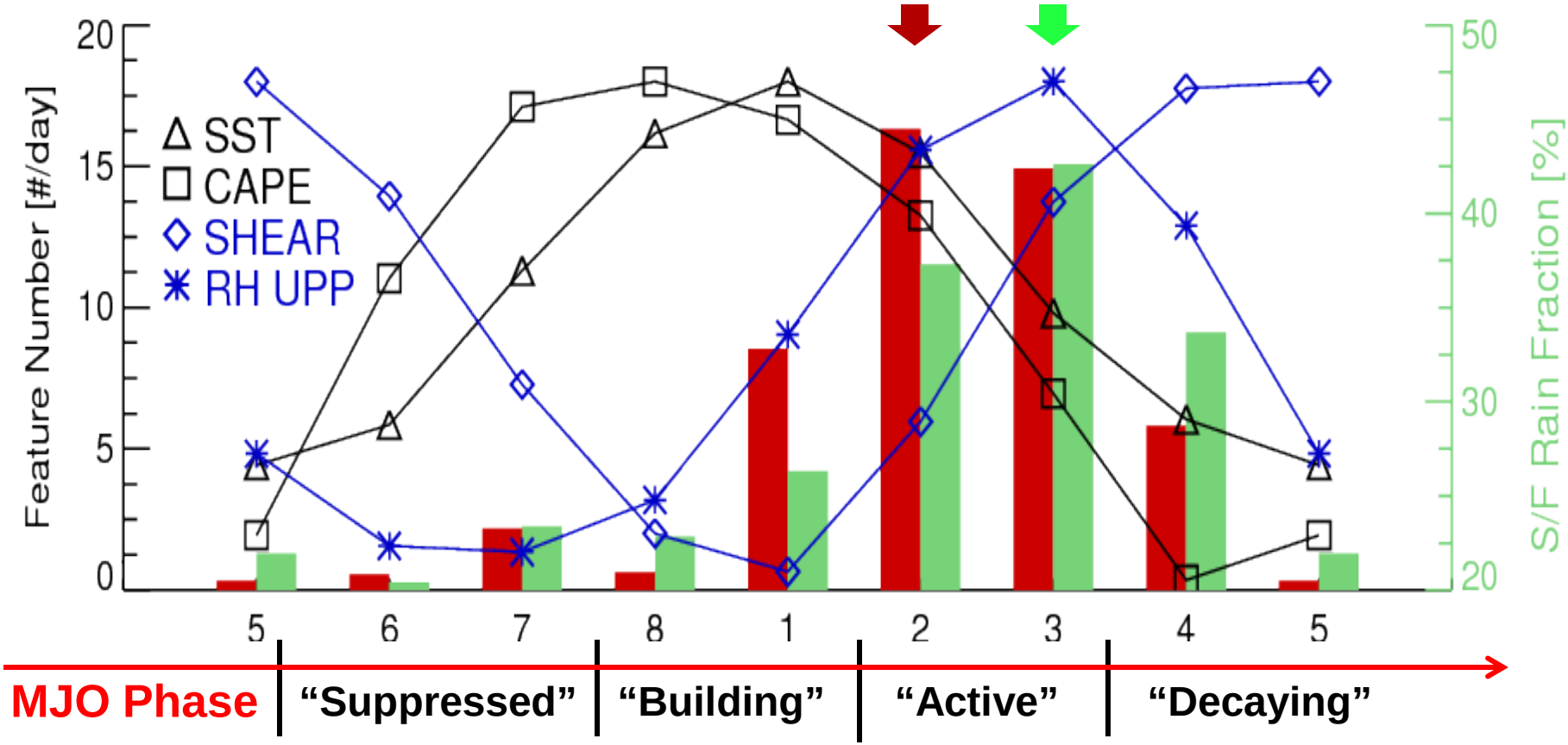
RH LOW: Relative Humidity at 850-700 hPa

RH UPP: Relative Humidity at 500-300 hPa

Organized MCSs

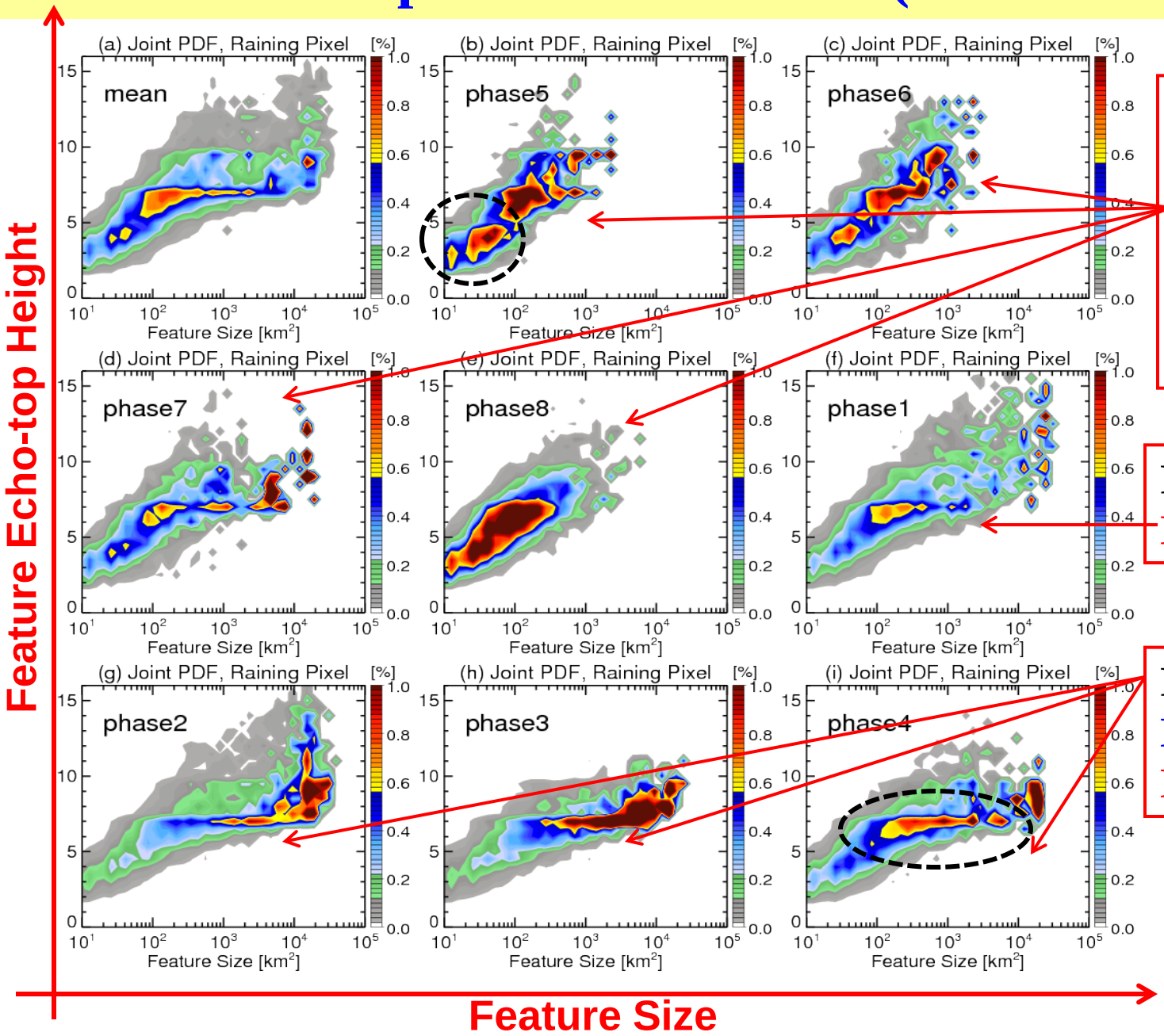
MCSs (*size > 2000 km², convective area > 100 km²*)

Stratiform rainfall fraction



Similar to "Zuluaga and Houze, 2013 (2-4 day rain events, Gan Island)"

Precipitation Structures (Joint PDFs)



Phases 5-8
Heavy "tails":
Shallow isolated

Narrow shapes:
Isolated cells

Phase 1
Deep but less S/F

Phases 2-4
Mid-level strips:
Large stratiform

Summary

- This study basically supports the “recharge”-“discharge” theory, based on composites of convective population and environmental conditions;
- Convective population across the MJO cycle changes from suppressed, to shallow isolated, to isolated deep, to organized MCSs, and to stratiform;
- Shallow isolated convective population leads low-level moistening by 2 phases;
- Deep isolated convection leads mid-to-upper level moistening by 1-2 phases;