

Thermodynamics of the MJO in the suppressed phase

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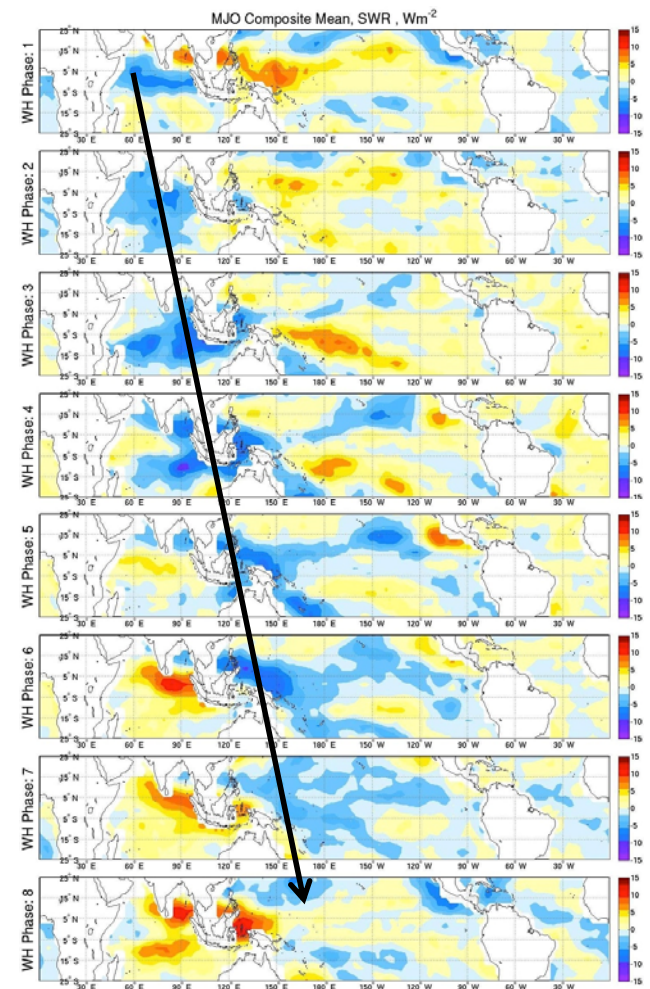
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Outline

- Motivating questions
- Datasets & Domain
- Validation of satellites
- Identification of MJO Types
 - Matthews (2008) OLR Index
- Comparisons of different events
 - OLR and Clouds vs.
 - AIRS/AMSU Temperature and Humidity

MJO Initiation, Propagation, and Failures

- Observational perspective
 - MJOs initiate over the IO and the propagate eastward
 - Some MJOs are considered primary while others follow a previous MJO event.
- Focus here on:
 - What are the thermodynamic precursors for MJO initiation
 - What are the differences between primary, succeeding, and non-MJO convection



Datasets

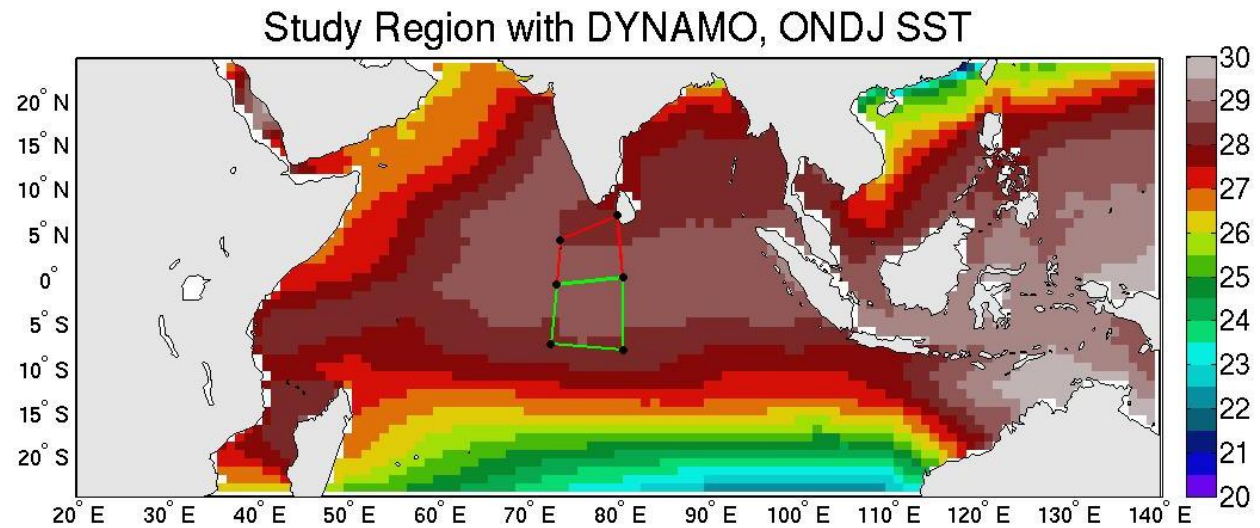
Satellite (2002 – 2013)

- MODIS
- AIRS/AMSU
- TMPA 3hr
- CERES SYN 3hr
- OAFLUX

In situ (2011)

- DYNAMO Ship & CSU Sounding Products 3b
 - Use to examine capture of signals in satellite products

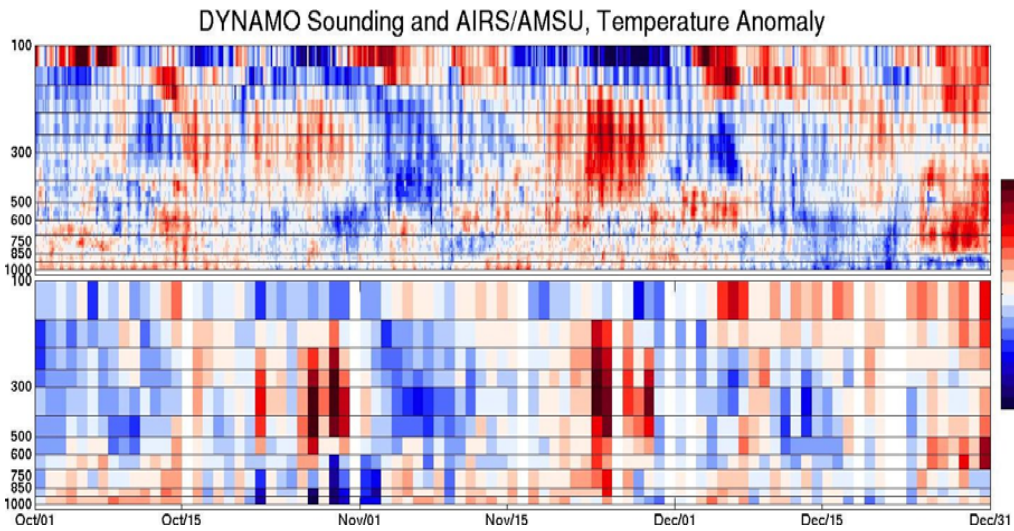
20N/S , 20E-140E



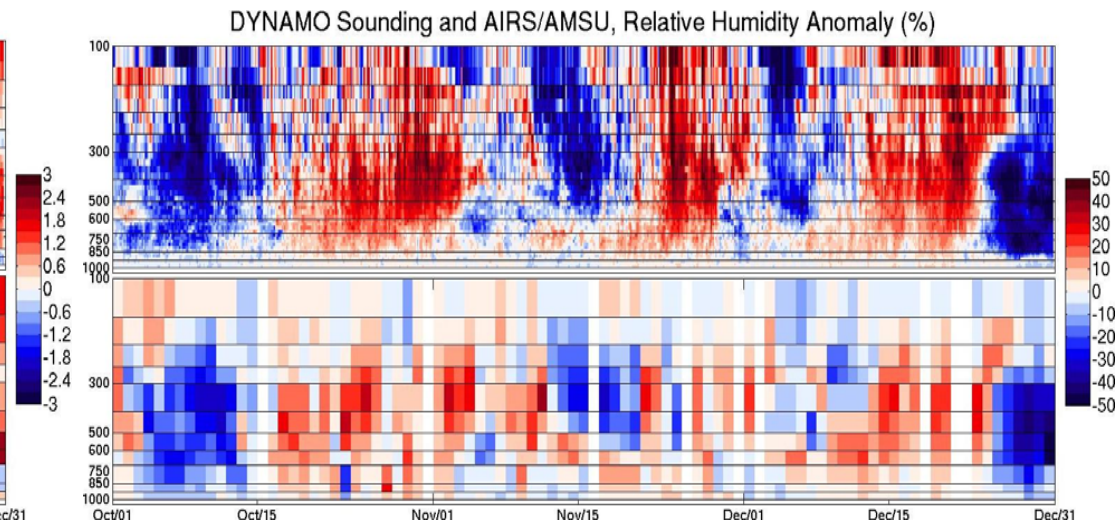
- The general area of focus is for MJO events that initiation over the central (60E-90E) Indian Ocean

AIRS-AMSU Temperature and Humidity Retrievals

Temperature Anomaly (w.r.t DYNAMO time-mean)



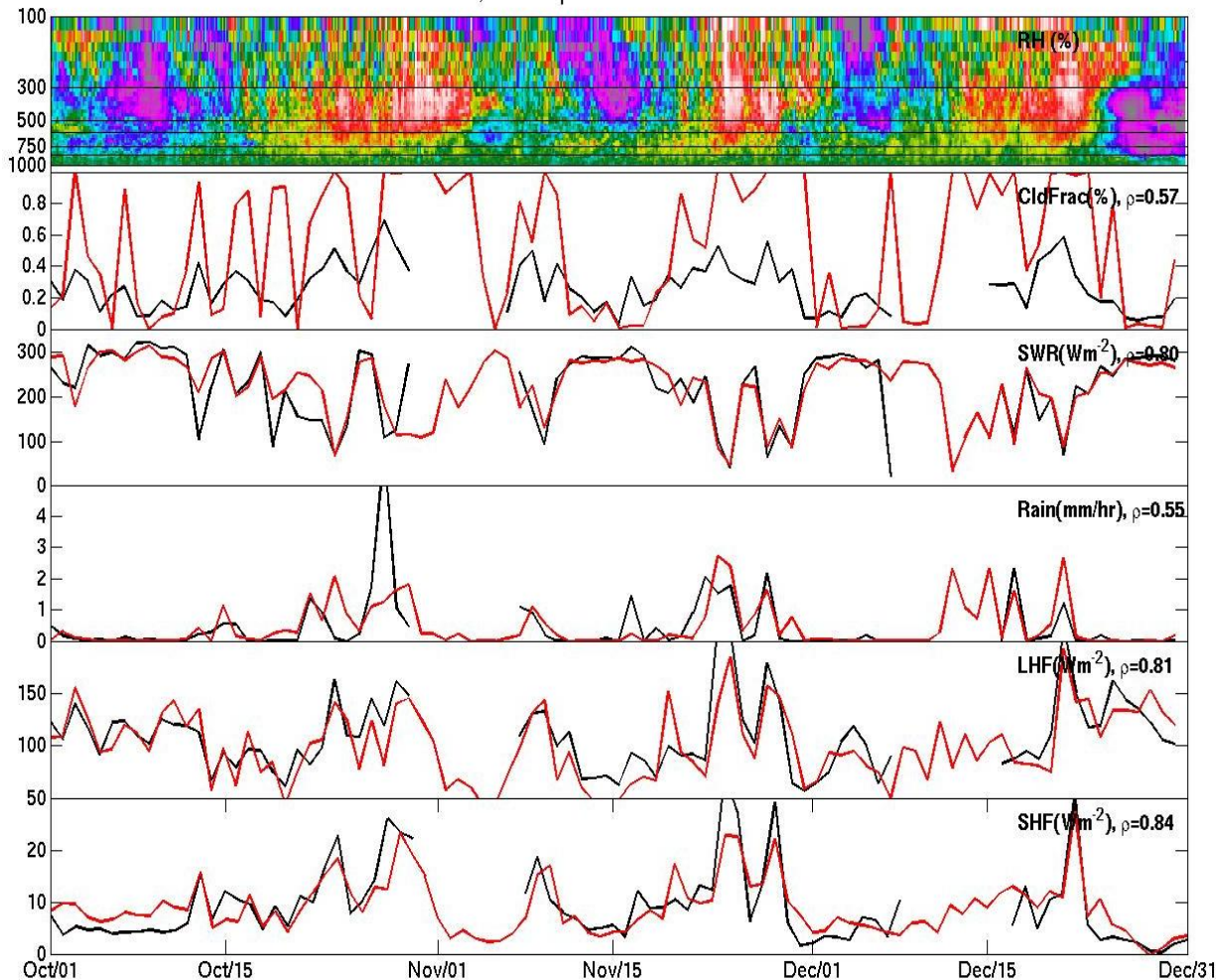
Relative Humidity Anomaly



- DYNAMO soundings and AIRS/AMSU both show 3 pulses of mid-level warming and moistening during Oct-Dec 2011 with about the same timing
- The amplitude of the RH anomalies are about (10%) smaller than those from soundings.
- RH moistening anomalies persist a little longer while dry anomalies are somewhat shorter in duration for AIRS/AMSU

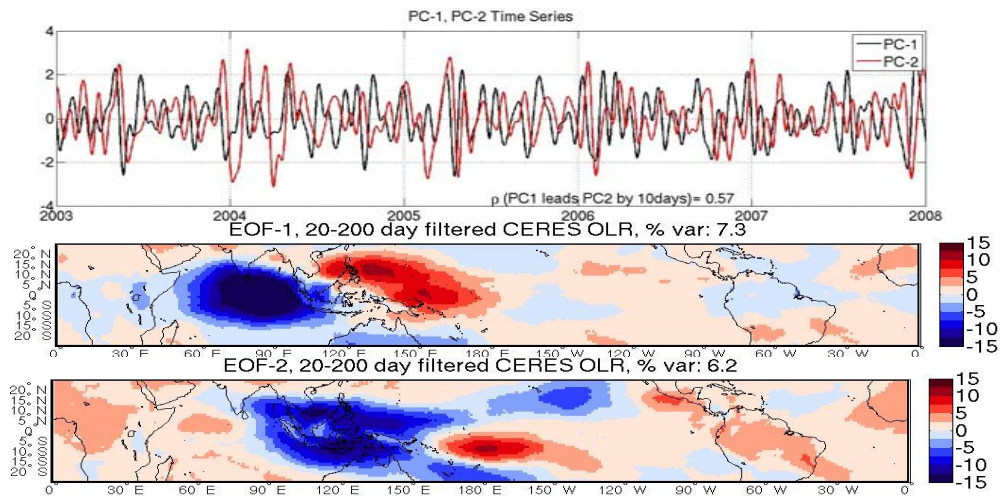
RV/Revelle vs. MODIS/CERES/TRMM/OAFLUX

DYNAMO, Atmosphere and Surface Evolution

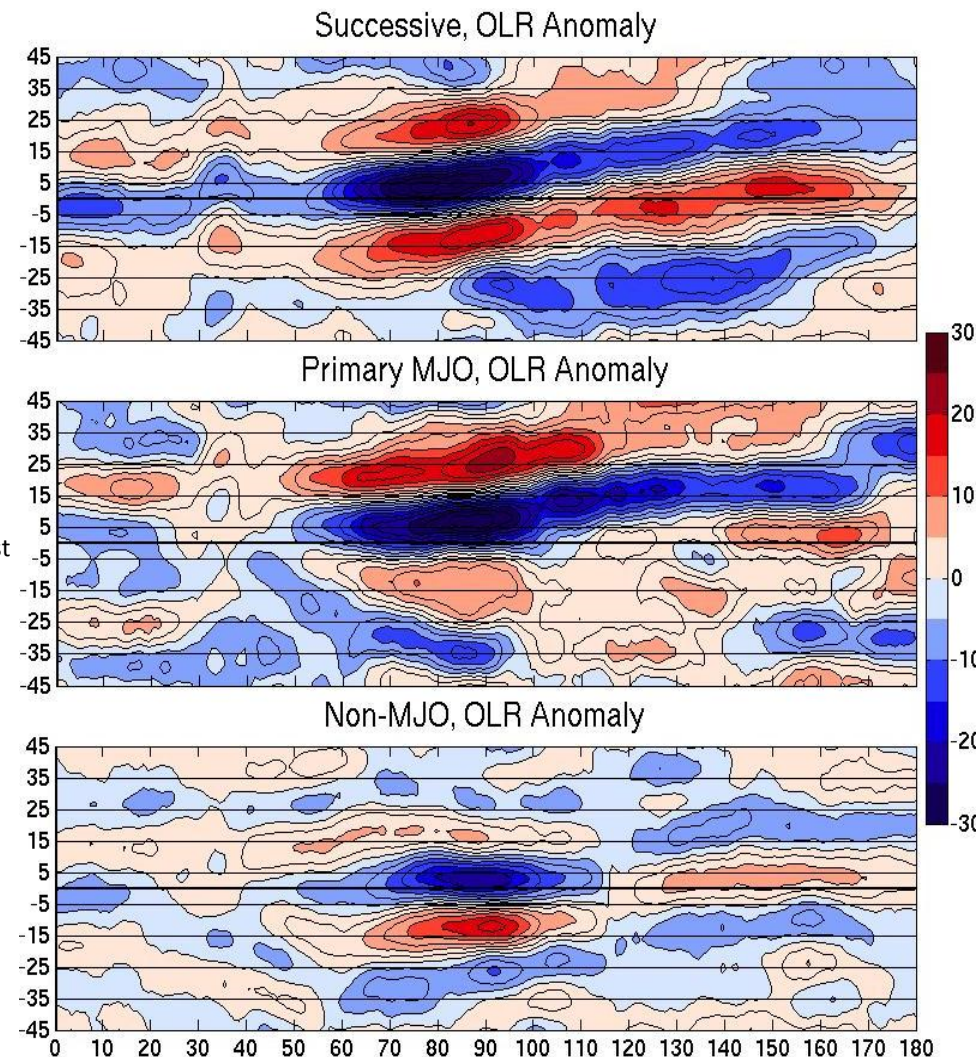


- The cloud fraction from MODIS show “OK” agreement with DYNAMO ceilometer
 - At least 3 reasons:
 - i) Point vs. 1-degree spatial observations
 - ii) MODIS CTP-COT Fraction is based only on daytime, successful retrievals
 - iii) More sensitive to upper-level clouds
- Despite sampling differences, MODIS cloud fraction do capture the times of enhanced cloudiness with MJO convection
- CERES SWR, OAFLUX turbulent, and TRMM rainfall all show very good agreement on of timing and amplitude of signals on synoptic and intraseasonal time scales.

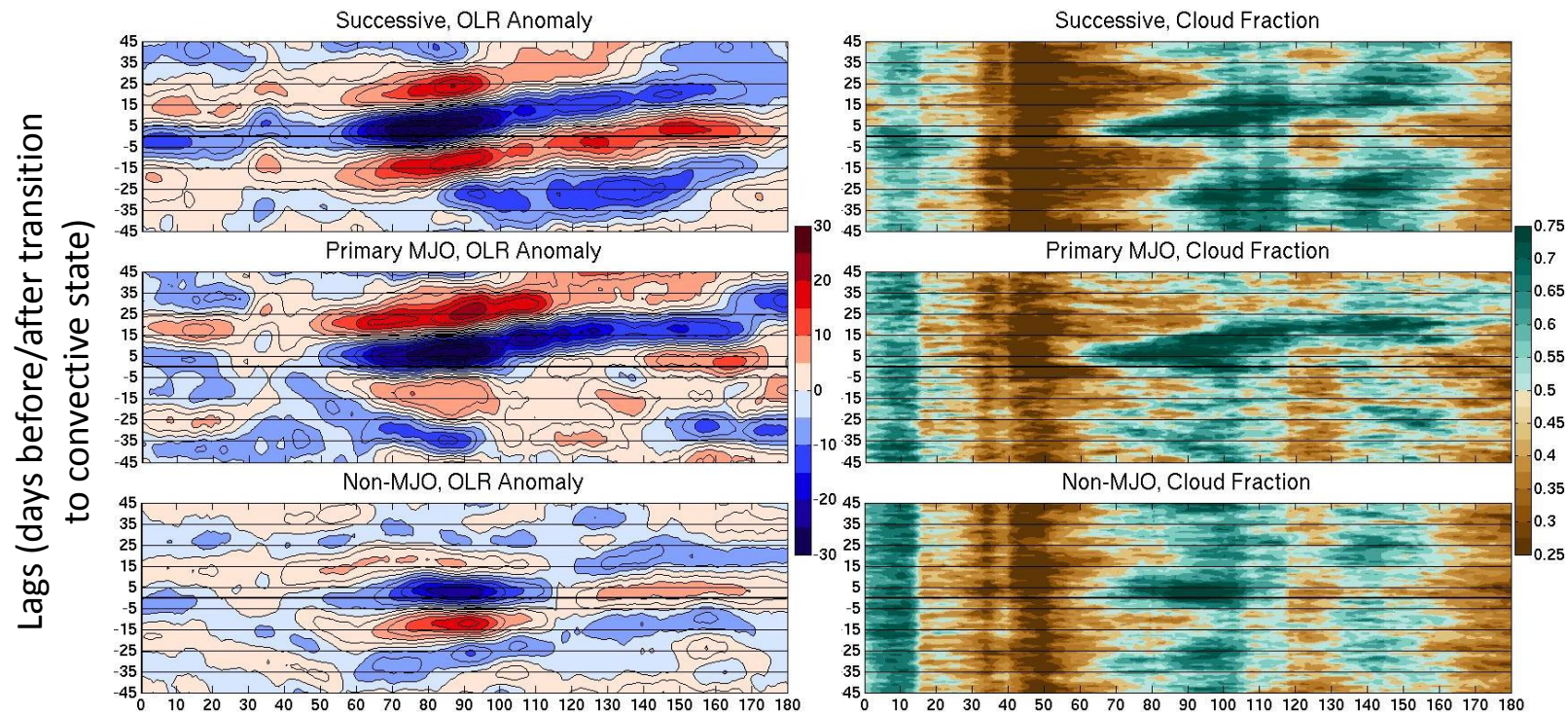
MJO – What’s in a name ?



- Follow Matthews (2008) to define an index based only on the 1st two EOF/PC of 20-200 day filtered OLR
 - Form an (almost) quadrature pair of indices keyed only on the convective signal
- Using phase space progression, we can identify at least 3 types of events
 - Successive – A new MJO transitions from a preceding MJO
 - Primary – An MJO starts from a non-MJO state
 - Non-MJO – An organized convective pulse develops but does NOT propagate



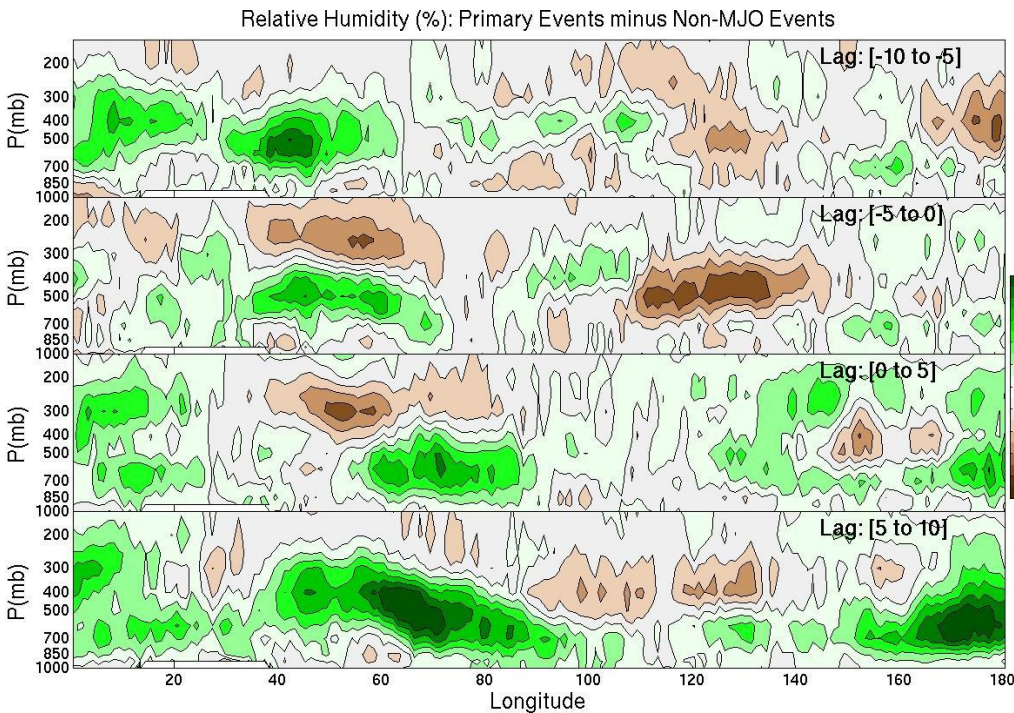
A bird's-eye view



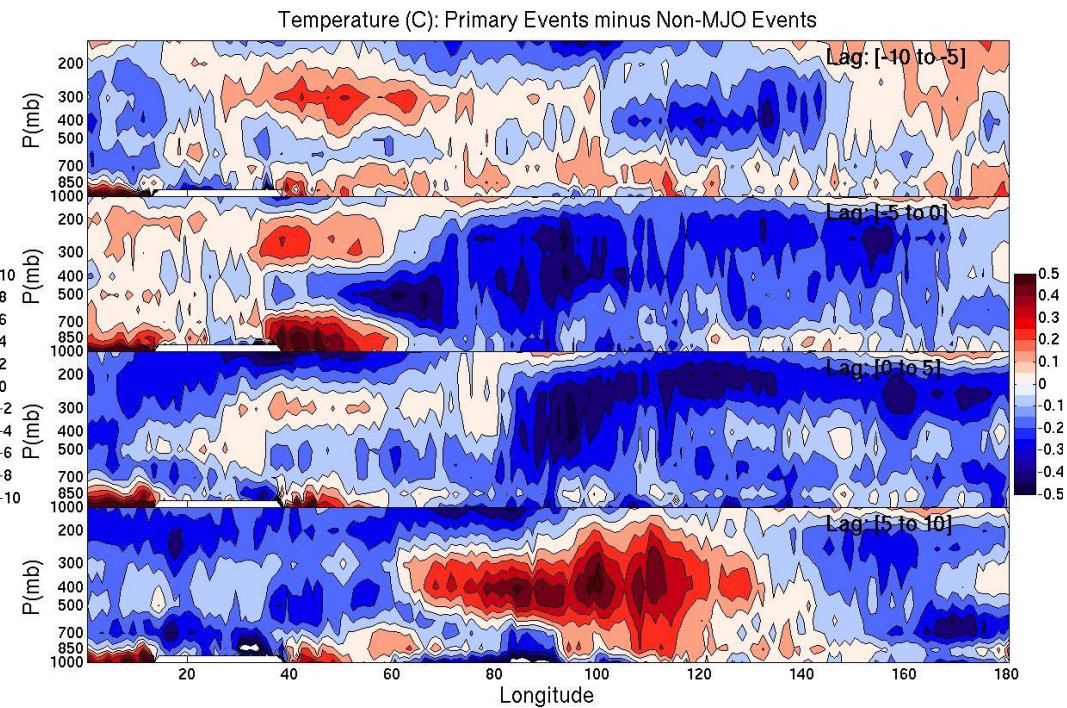
- You can clearly see the convective pulses in the OLR and Cloud Fraction (and Rainfall) product as you would expect
- However, looking at differences between MJO types results in some ambiguities
 - For example, from 120E-160E you might expect reduced cloud fraction for primary events than Non-MJO events;
 - Instead, the cloud fractions are fairly similar

Why? i) Cloud fraction is only one measure of a cloud ; ii) Clouds are only one influence on OLR

VS. Atmospheric Sounder's View

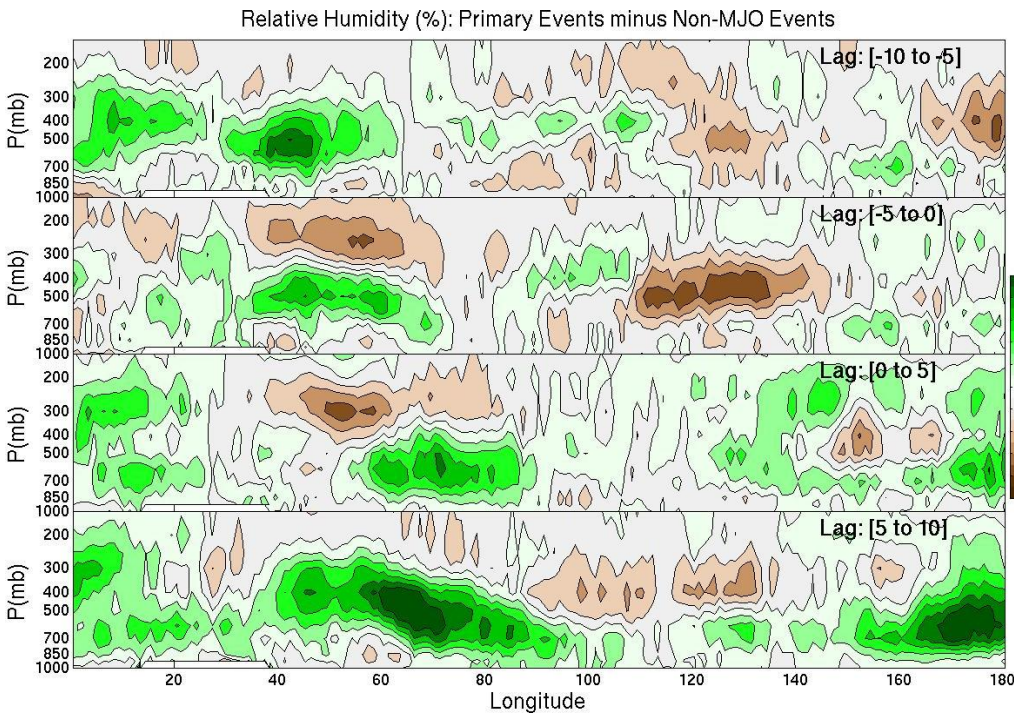


Composite Difference = (PRIMARY – NonMJO)

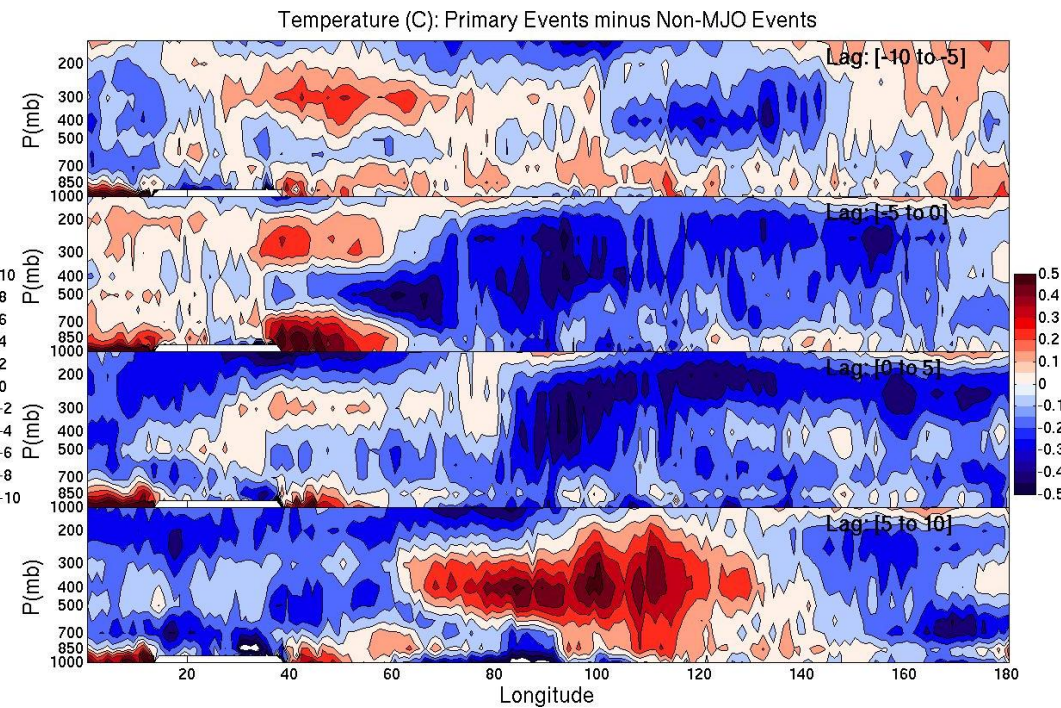


- Prior to a Primary MJO event, a moist mid-level (400-700mb) is present that propagates eastward towards the 60E-90E region where the convection becomes organized and amplified post- 0-day.
- For a Primary MJO event, there is a more moist mid-layer just east of 60E-90E, and significantly drier mid layer from 110E-140E.

VS. Atmospheric Sounder's View



Composite Difference = (PRIMARY – NonMJO)



- Primary MJO boundary layer temperatures are warmer just west of 60E-90E prior to deep convection
- Mid- to upper-level temperature are generally cooler (~20% of anomalous values) east of 60E prior to and just after transition to convective state
- The temperature response to diabatic heating is likewise much stronger for Primary MJO events

Summary

- AIRS/AMSU temperature and humidity retrievals are able to capture the atmospheric response to MJO events, albeit with somewhat reduced amplitude
- Together with other A-Train observations (e.g. CERES, MODIS), organized convective events were stratified into successive, primary, and, non-MJO events
- Those convective events that do not transition into a full-fledged propagating MJO have distinct large-scale environmental differences
 - *Primary MJO events occur under relatively cooler, wetter conditions over 60E-90E with a large mid-level dry anomaly over 110E-140E.*
- These differences, while marginally observable from cloud fraction and OLR, are readily apparent as differences in vertical sounder fields.

Extras

