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# Detrained moisture from ITCZ facilitate transition of shallow-to-deep convection in MJO

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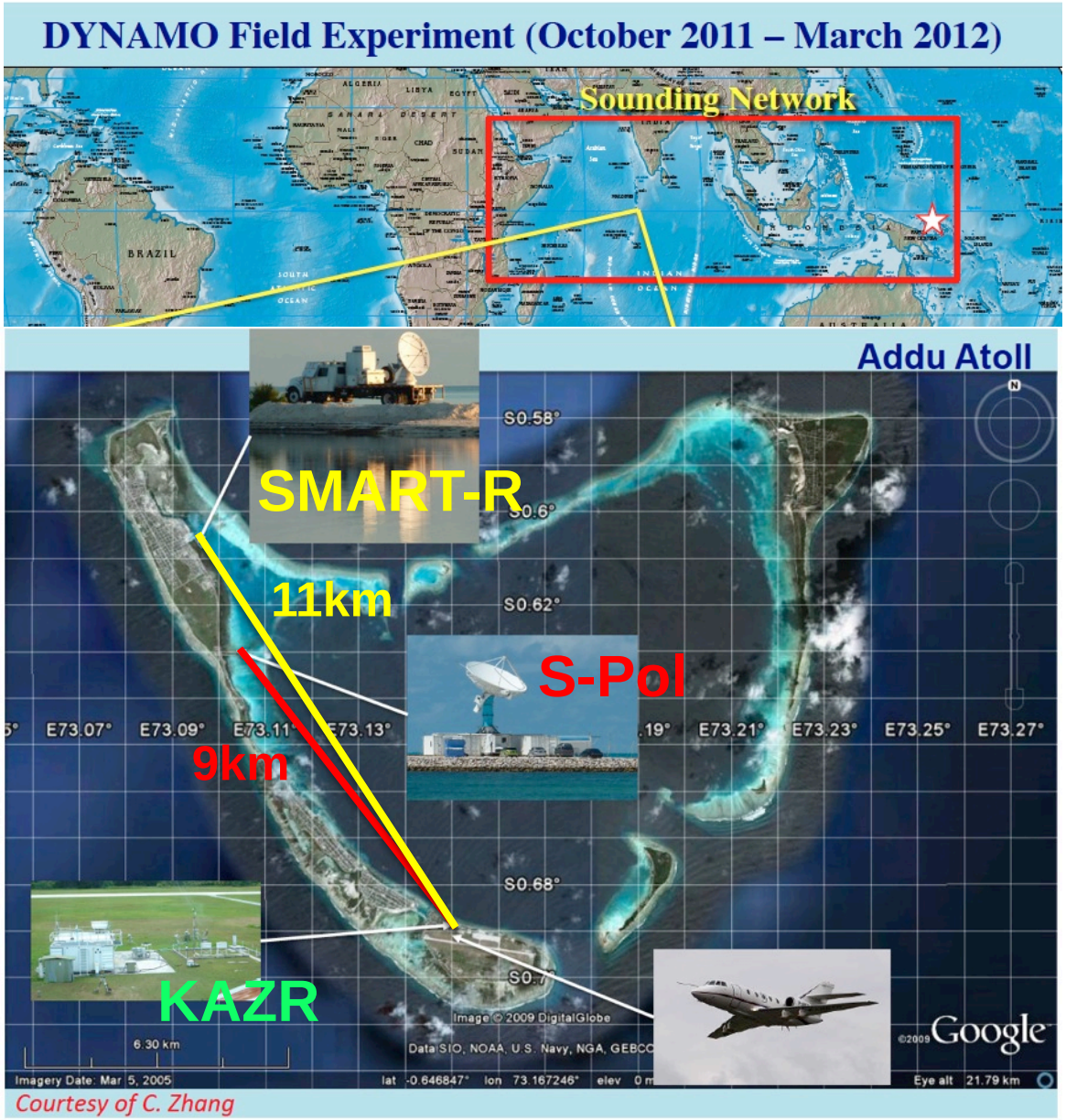
**2013 ASR Fall Working Group Meeting – AMIE/MJO/S2D Breakout**

# AMIE/DYNAMO Field Campaign

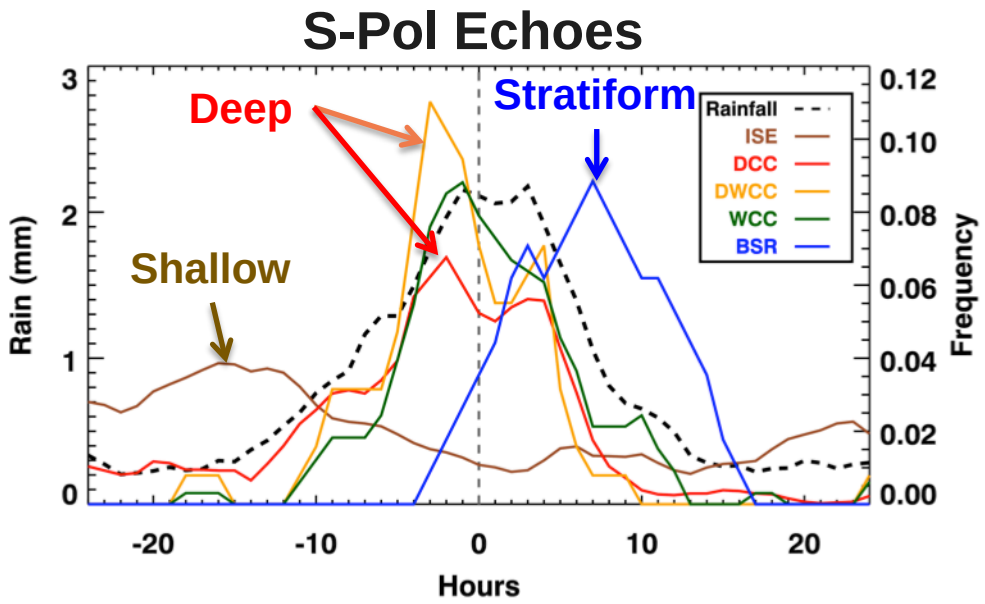


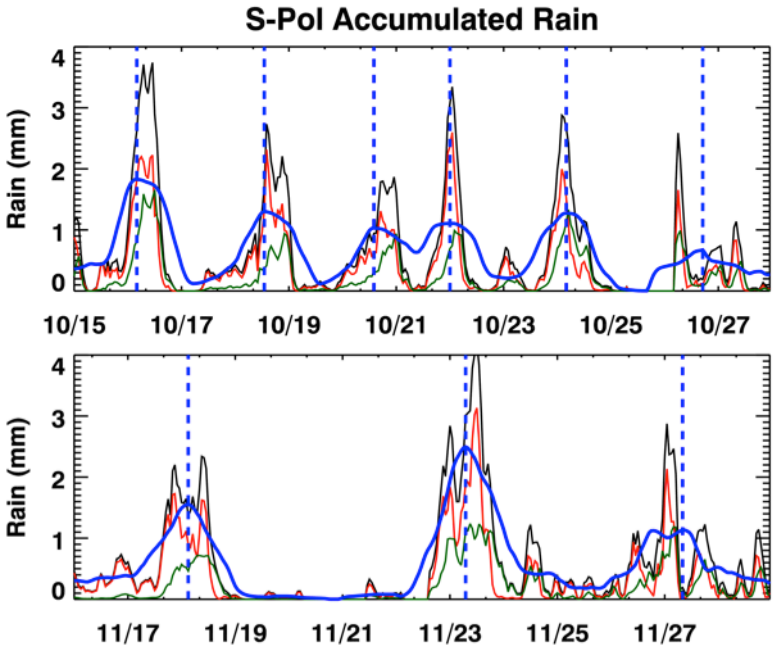
- Multi-frequency radars, sounding arrays, surface observations in Indian Ocean
- Captured entire spectrum of cloud populations in the passage of 3 MJO episodes

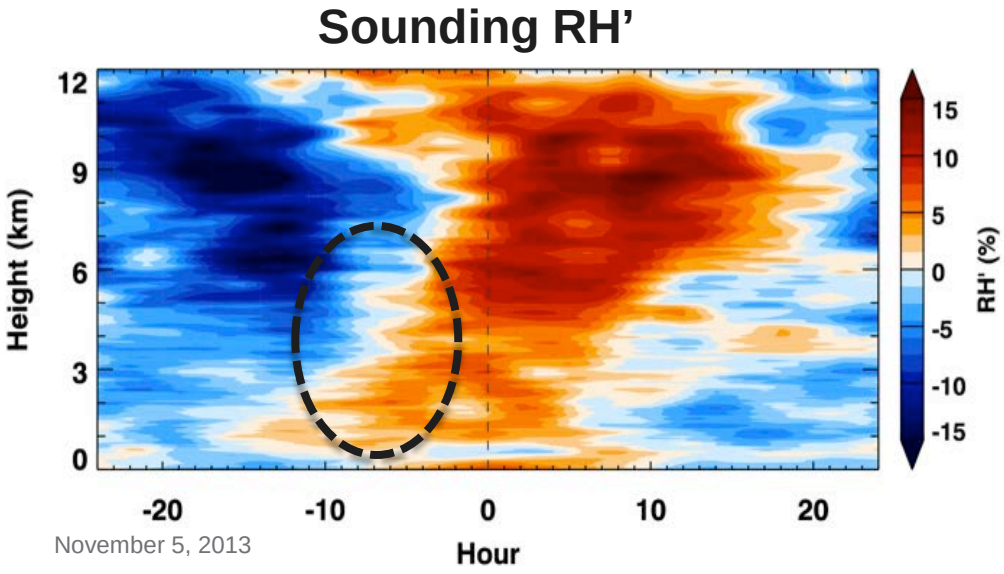


# Observed Transition of Precipitating Clouds





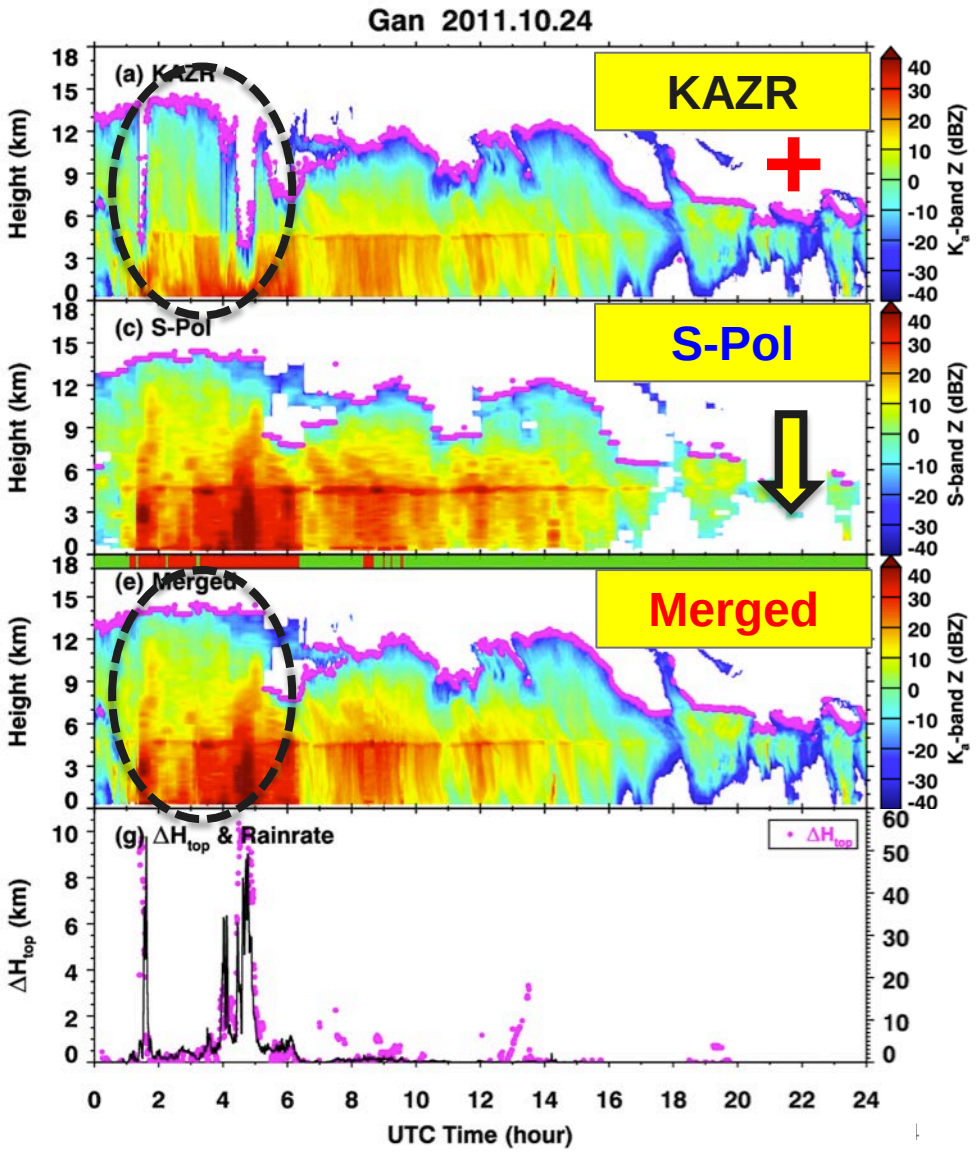




- Analyses similar to Zuluaga and Houze (2013)
- 2-4 day wave modulate AMIE/DYNAMO precipitation episodes
- Transition from shallow to deep convection much shorter than MJO, but longer than individual convective systems

# Combined Cloud Remote Sensing Data



- Combined collocated S-Pol/KAZR/Lidar data to detect all cloud types
- COMBRET retrieves cloud microphysics & radiative heating rates (PI product submitted)
- Use improved multi-platform cloud remote sensing dataset along with sounding to investigate source of moistening



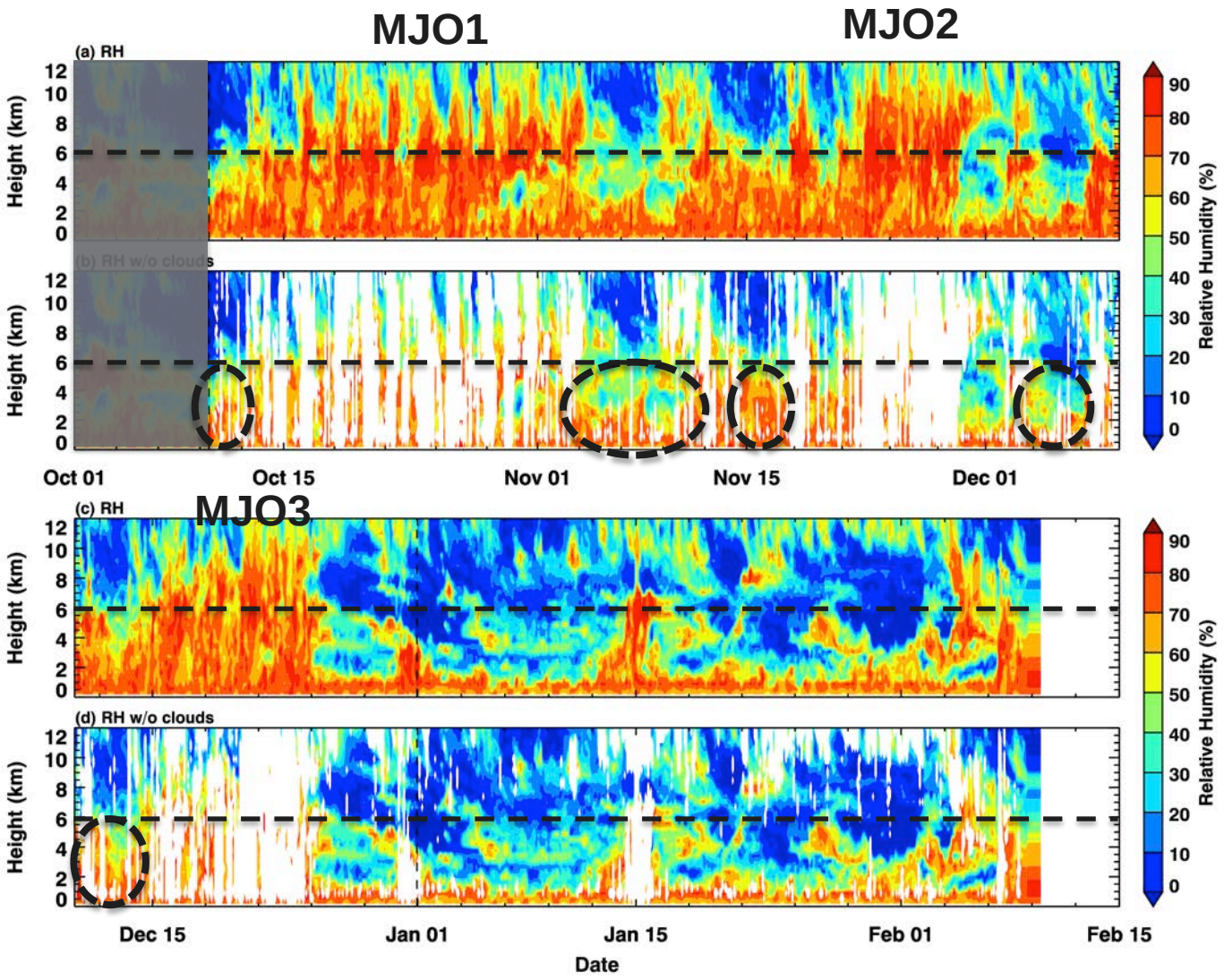

Feng et al. (2013), *in revision*

Z. Feng & J. Comstock:
http://www.arm.gov/data/pi/71

# Sounding and Cloud



- High RH naturally coexist with clouds
- But after removing local clouds, periods of prolong high RH still observed below 6km, particularly during suppressed MJO phase
- **Hypothesis**: moisture advected by large-scale wind



# Evolution of Cloud and Moisture

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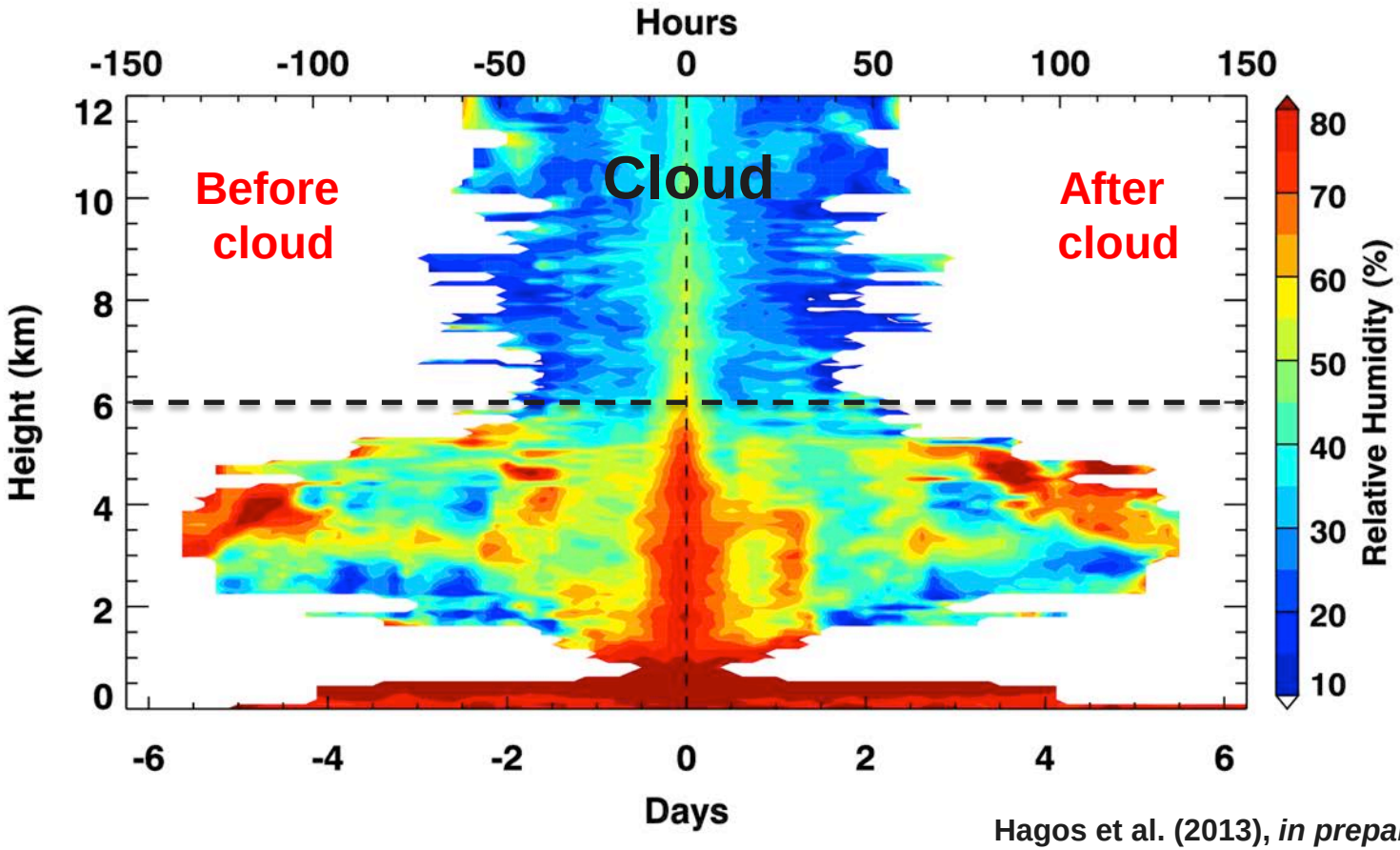
- Composite RH with respect to timing of local clouds
- Moisture detrained from previous deep convection can stay aloft long enough to be advected by prevailing winds, create favorable condition for transition to deep convection further downstream

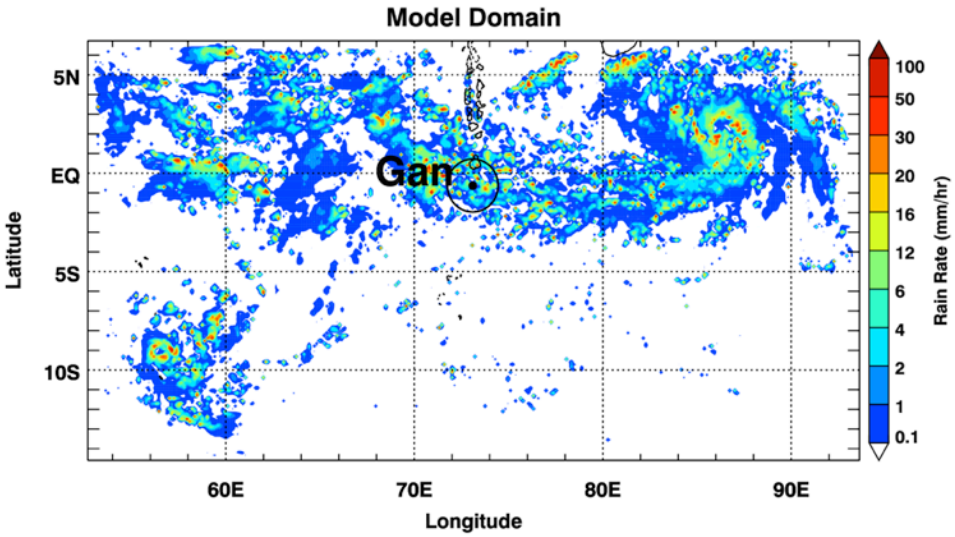


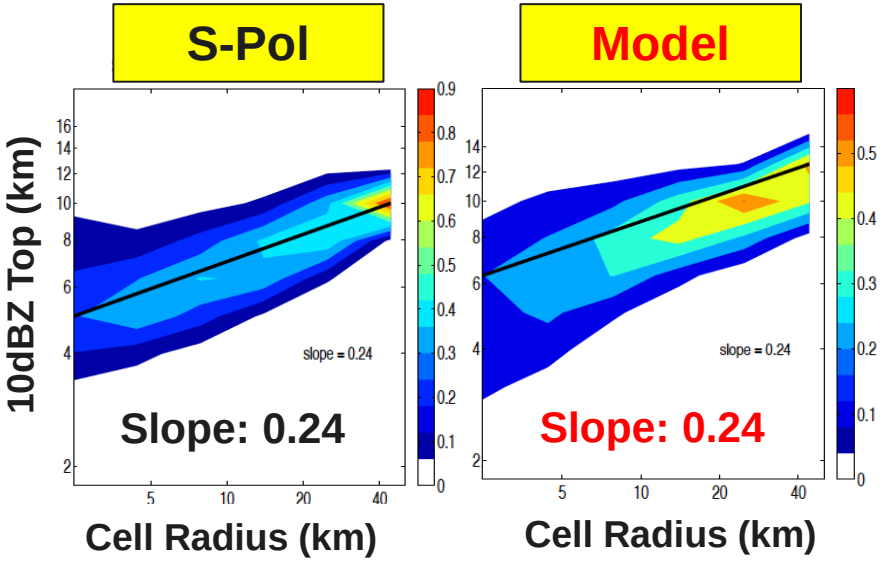

Hagos et al. (2013), *in preparation*

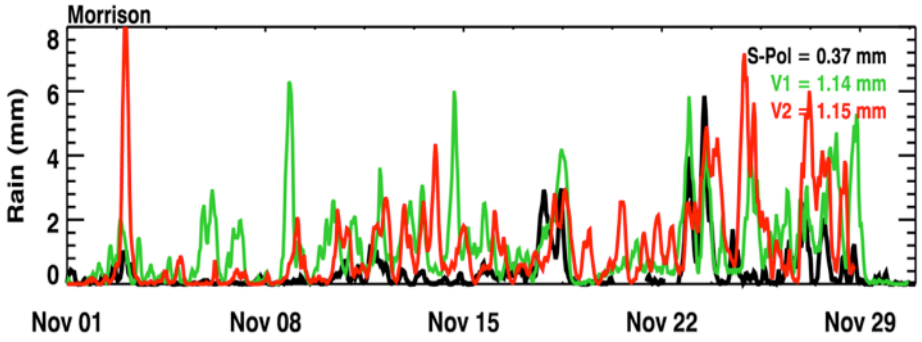
# High-res WRF Simulation



- Simulate two MJO events (2 months) using WRF (3-km resolution) with modified Morrison scheme (reduce raindrop DSD)



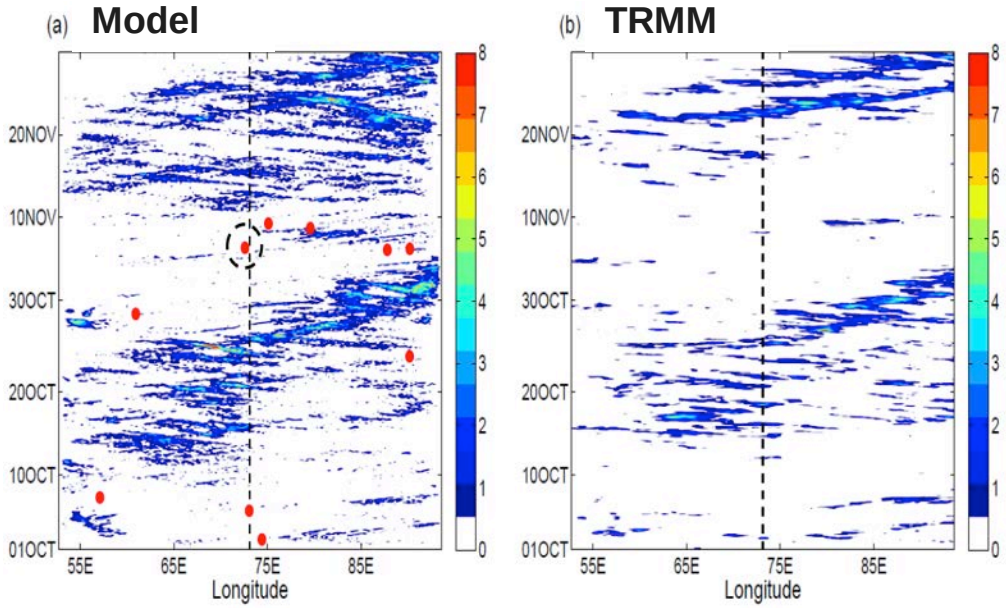



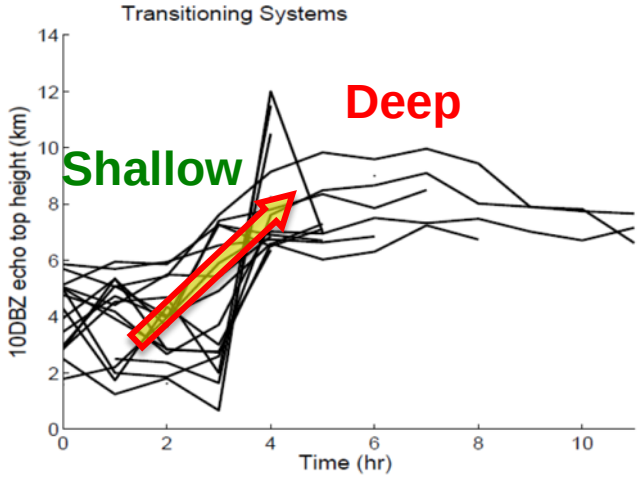

- Model produced similar distribution of convective cell size vs. echo-top height relationship, but overestimated rainfall

# Identify Transitions in Model






- Simulated two MJO events (Oct - Nov)
- Use simulated $T_b$ (< 250K) to track individual convective clusters throughout their lifetime

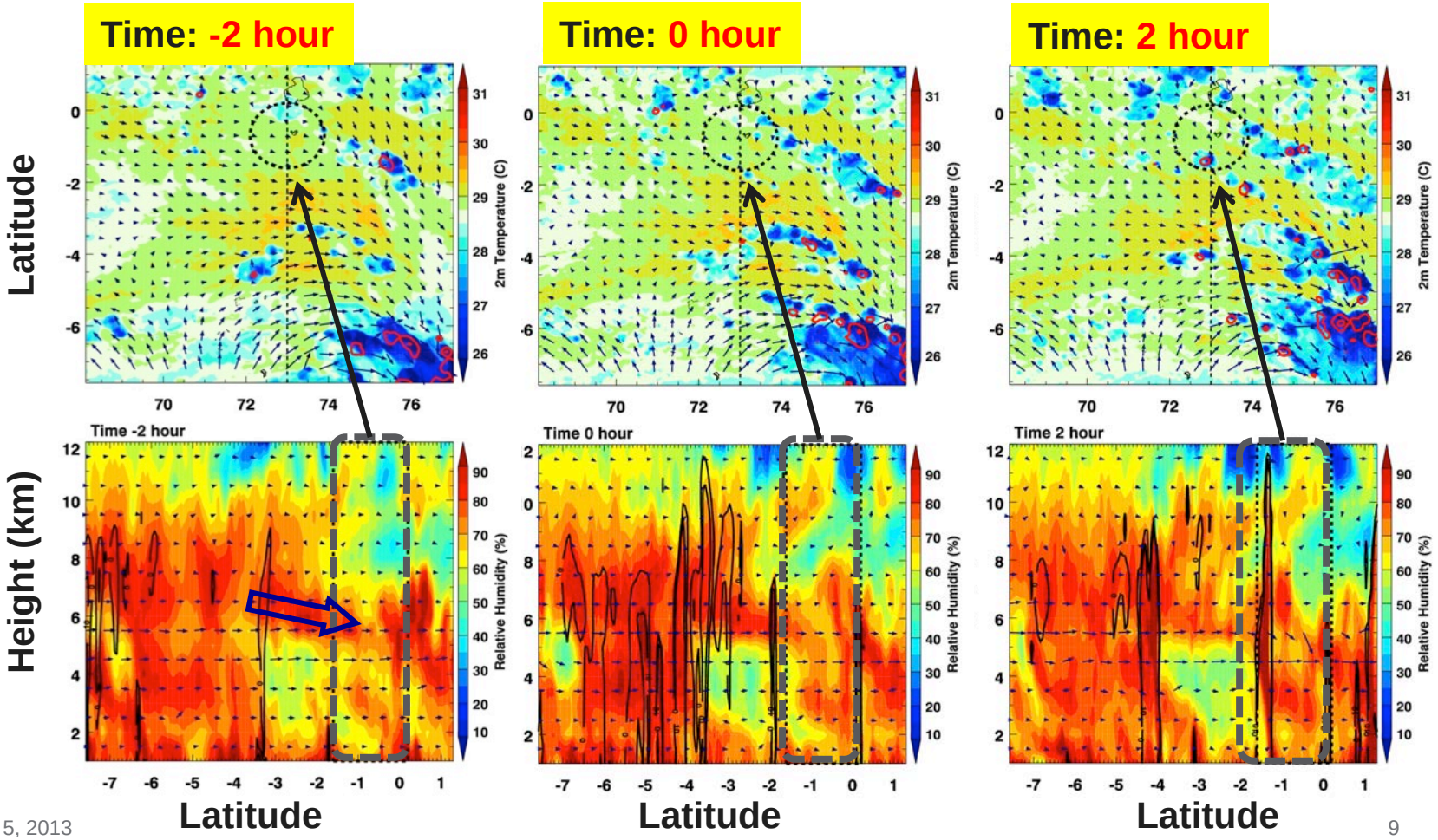



- Identified shallow-to-deep transitions using simulated radar echo-top heights (red dots)
- Most transition cases occur near suppressed MJO phase

# Moistening by Advection



- The **mid-tropospheric moisture** responsible for transition to deep convection may be **supplied by detrained moisture from earlier deep convection in the ITCZ.** Similarity in 9/10 cases analyzed.



# Summary & Future Work



- **Summary**
  - Observed high mid-tropospheric humidity exists both before/after local convective clouds
  - High-resolution WRF simulation suggests moisture may be advected from previous deep convective events, links MJO with deep convection in ITCZ

- **Future Work**
  - Improve tracking using simulated reflectivity instead of $T_b$, perform composite analysis of more tracked convective clusters
  - Compare environment between non-transition vs. transition clusters, during suppressed vs. active phase of MJO
  - Trace back sources of moisture when transitioning clusters are detected