Shallow-to-Deep Convective Transition during GOAmazon

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We also acknowledge:
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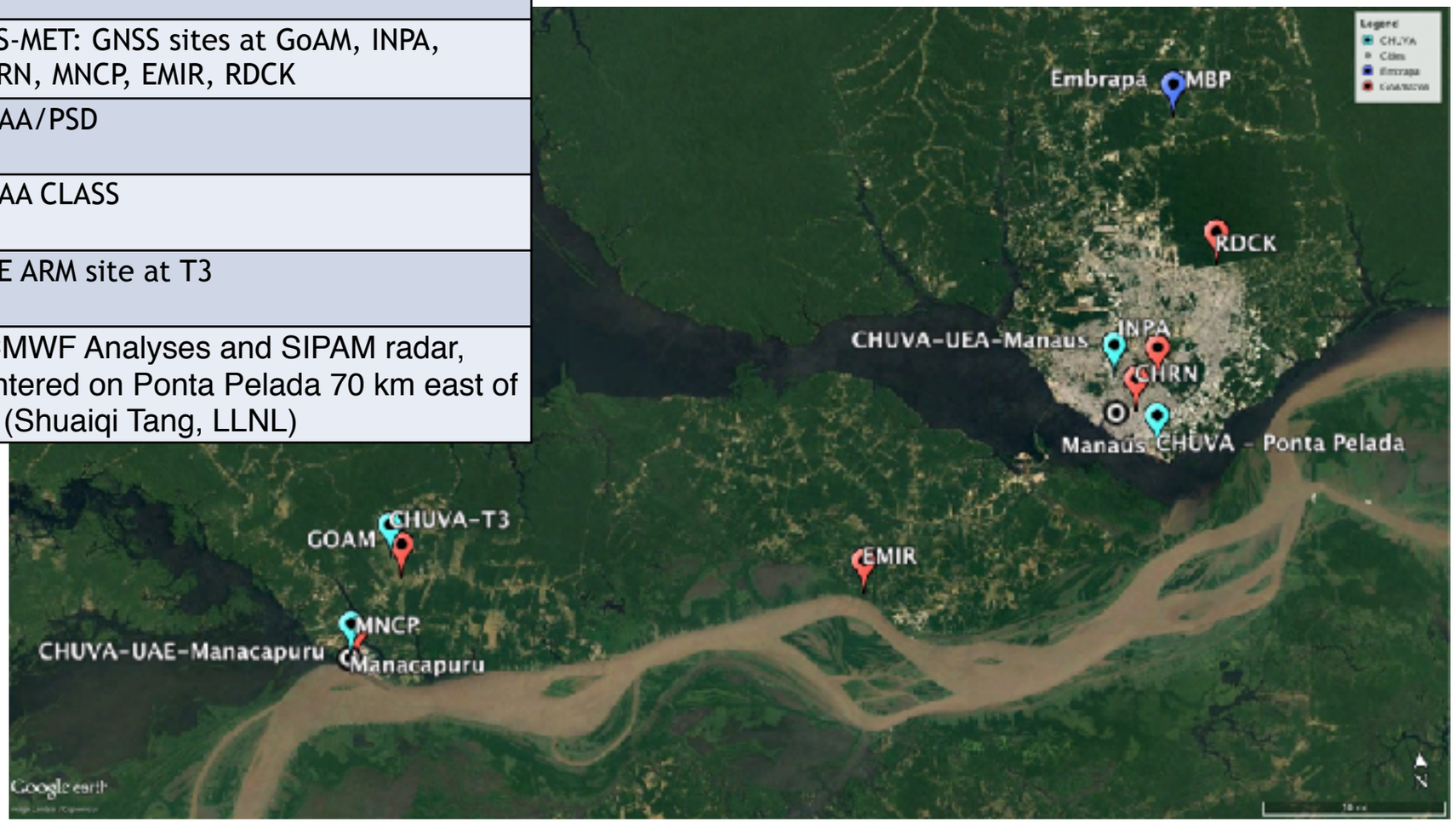
Objectives

- To understand the shallow-to-deep convective transition over the Amazon
- Examine how convection develops with respect to different phases of large-scale waves (e.g., Kelvin, WIG) during GOAmazon
- Identify **important factors** contributing to periods of enhanced convection related to the waves.

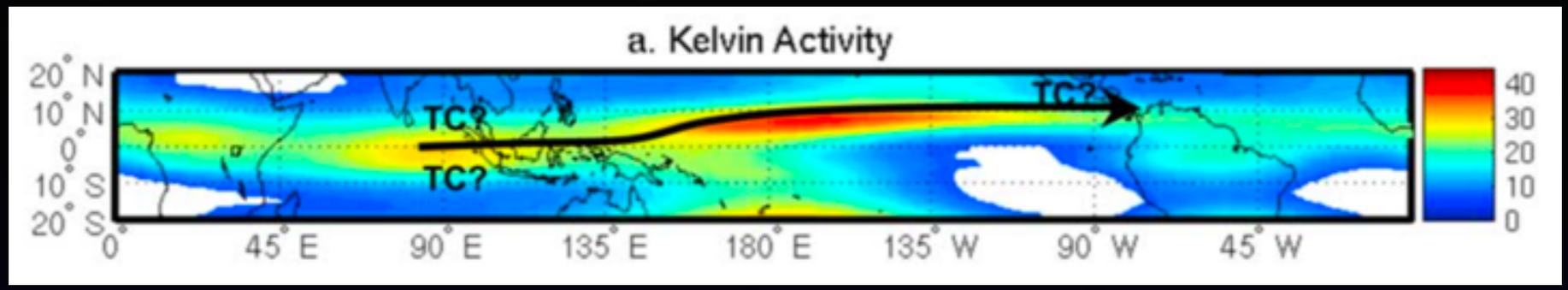
Data

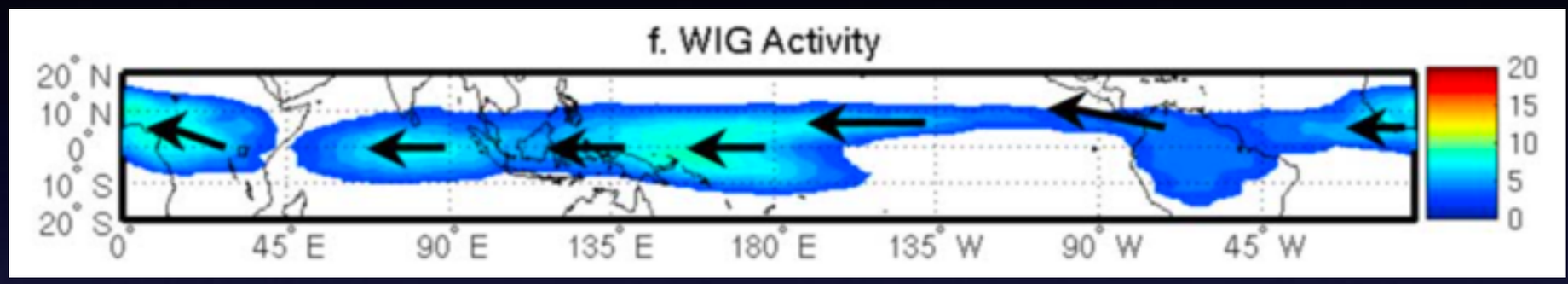
MEASUREMENT	INSTRUMENTS
Surface precipitation	Optical rain gauge (AOSMET) – T3 Tipping bucket – T3 (TB), ~T3 (TIWA) Disdrometer (PARS2) – T3
Cloud fraction (by type)	W-band Radar (WACR) – T3 Radar Wind Profiler (RWP) – T3 Ceilometer – T3 Micropulse Lidar (MPL) – T3
Rain area and MCS identification	S-band Doppler Radar (SIPAM) – Manaus
Column precipitable water vapor (PWV)	GPS-MET: GNSS sites at GoAM, INPA, CHRN, MNCP, EMIR, RDCK
Outgoing Longwave Radiation (OLR)	NOAA/PSD
GOES IR (4km)	NOAA CLASS
Radiosondes u, v, q, T	DOE ARM site at T3
Variational Analyses (70 km east of T3)	ECMWF Analyses and SIPAM radar, centered on Ponta Pelada 70 km east of T3 (Shuaiqi Tang, LLNL)

- T3, GNSS network (PWV), SIPAM, NOAA OLR, GOES, Variational Analyses

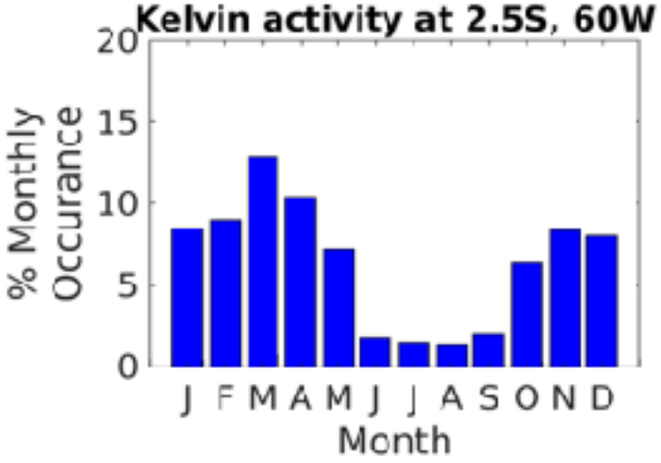


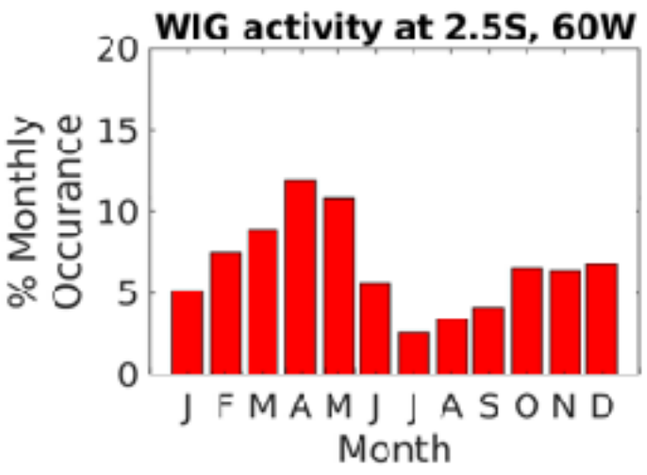
Kiladis et al. 2009



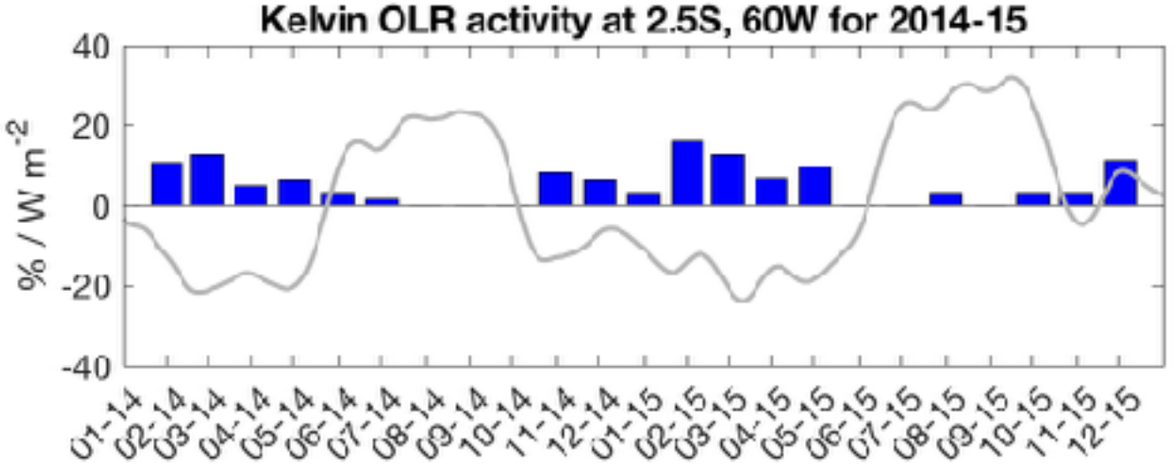


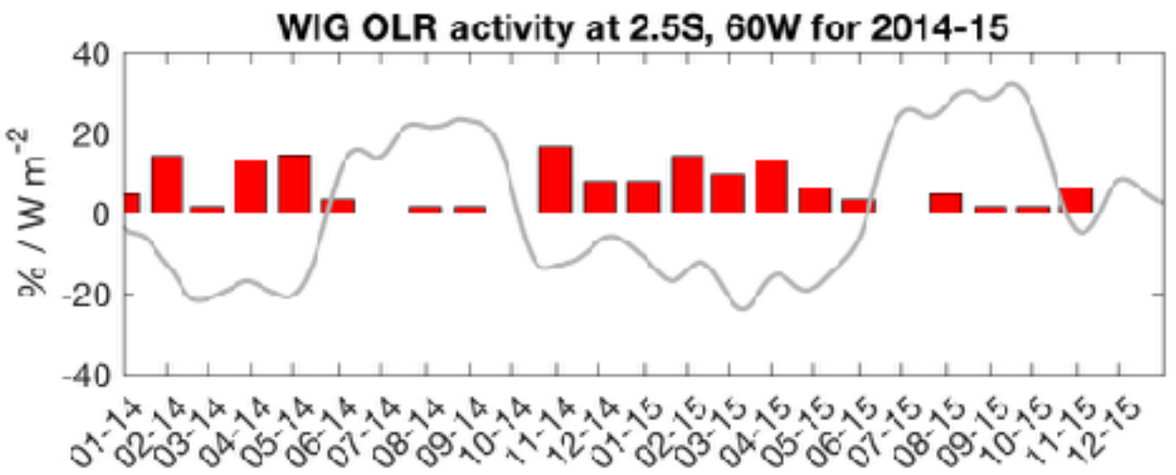
Wave Activity 1980-2010



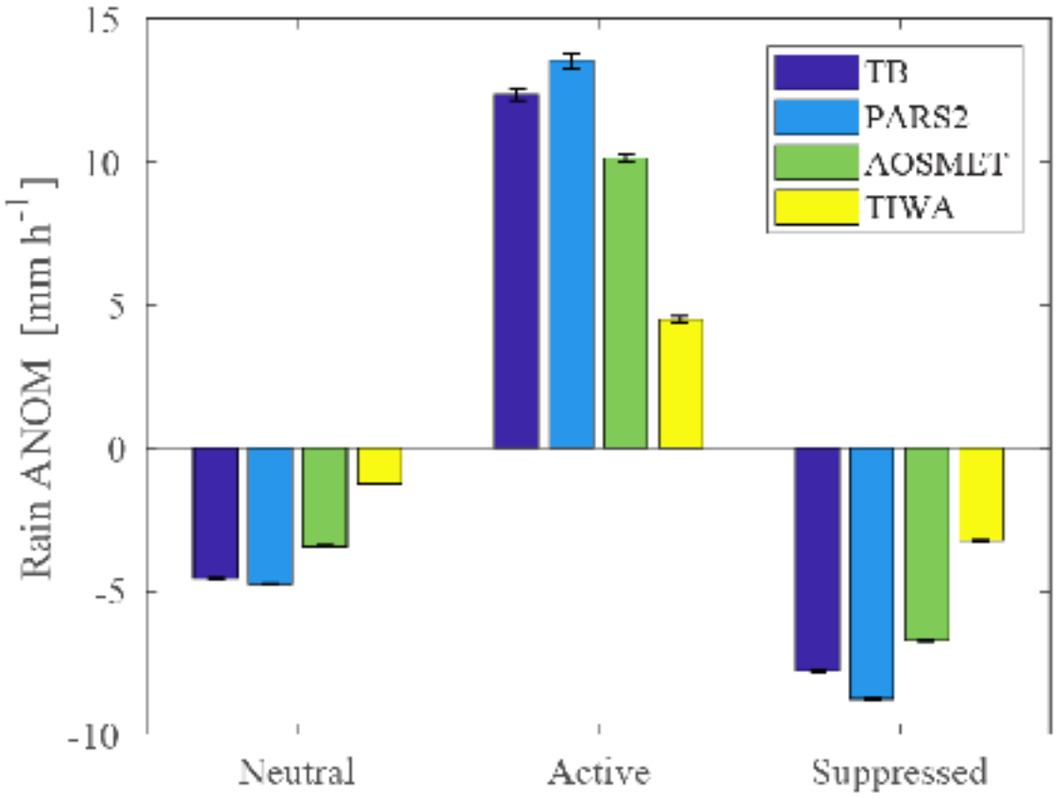


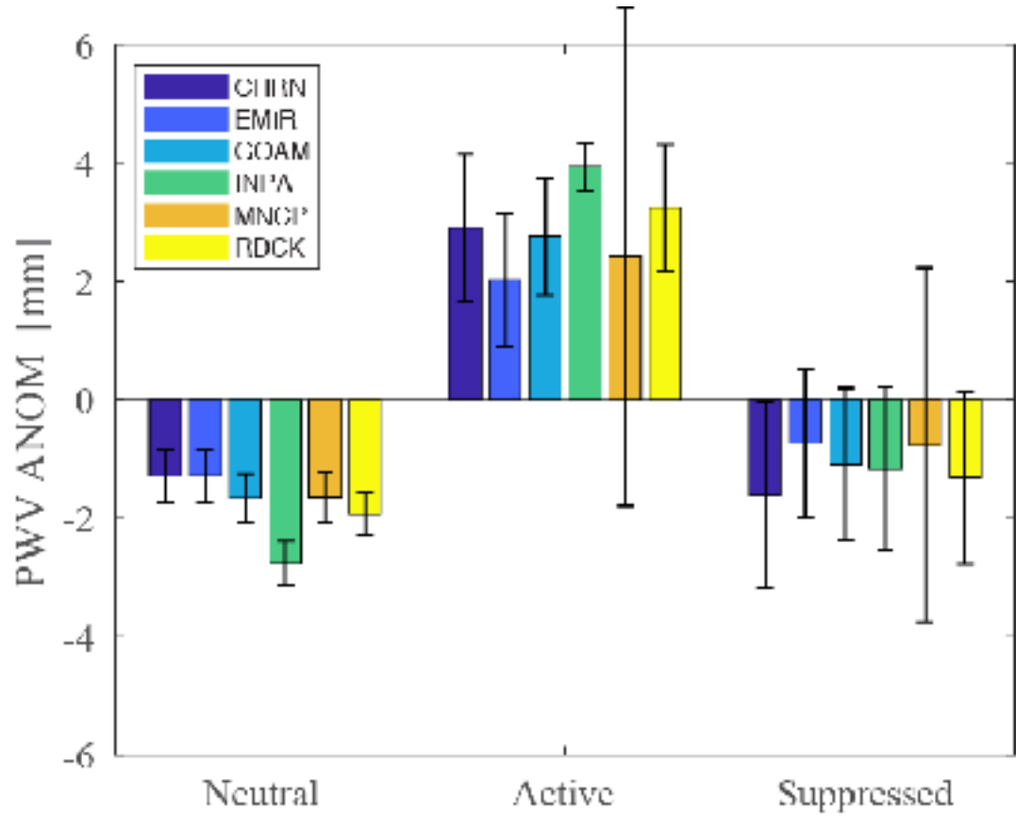
Wave Activity GoAmazon





Kelvin wave influence on rain and PWV

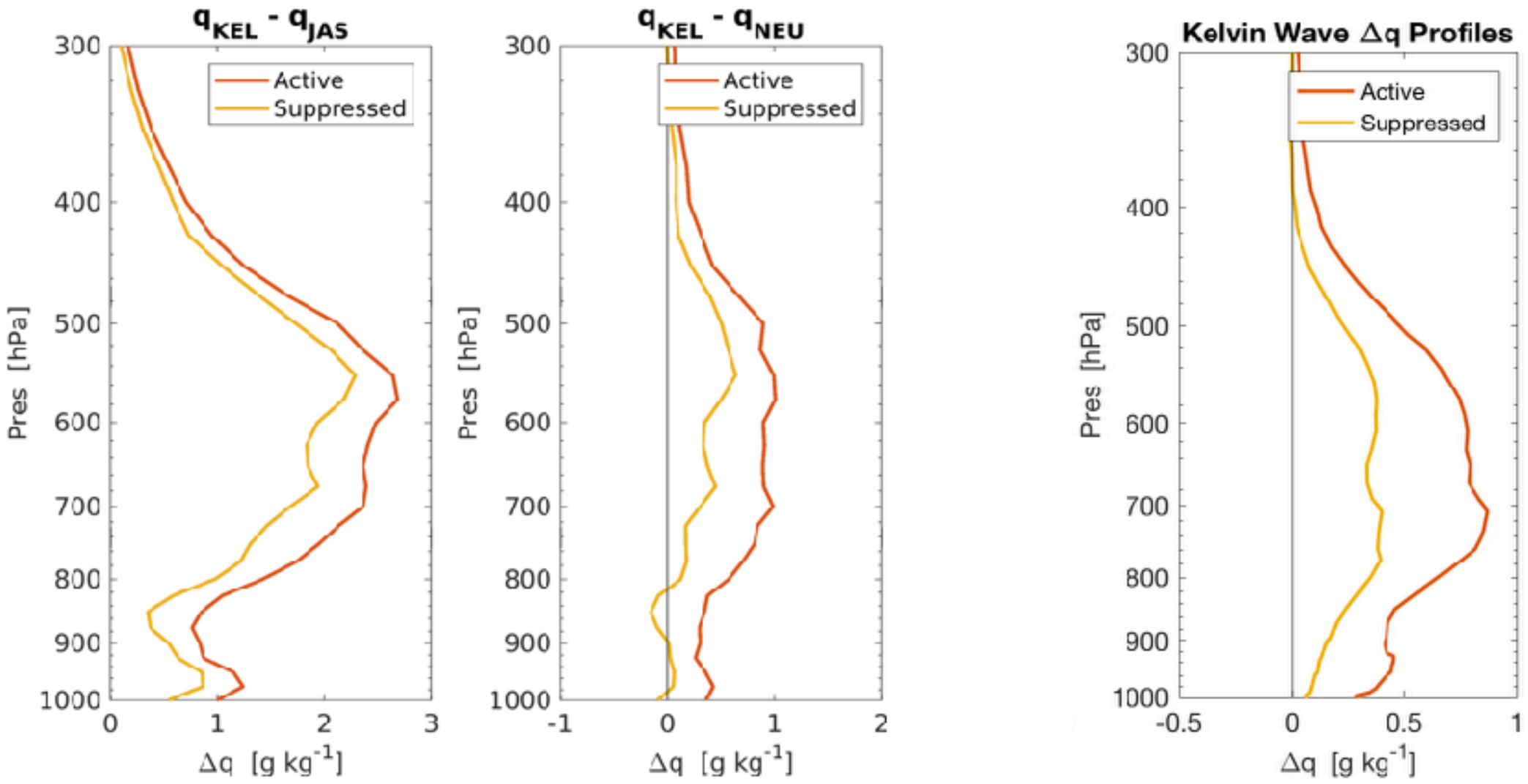




- Enhanced rainfall during Kelvin active phase over neutral and suppressed phases.
- Widespread impact on column moisture throughout the region evidenced in simultaneous PWV measurements across the GNSS network composited on Kelvin activity at T3.

Kelvin wave modulation of column water vapor

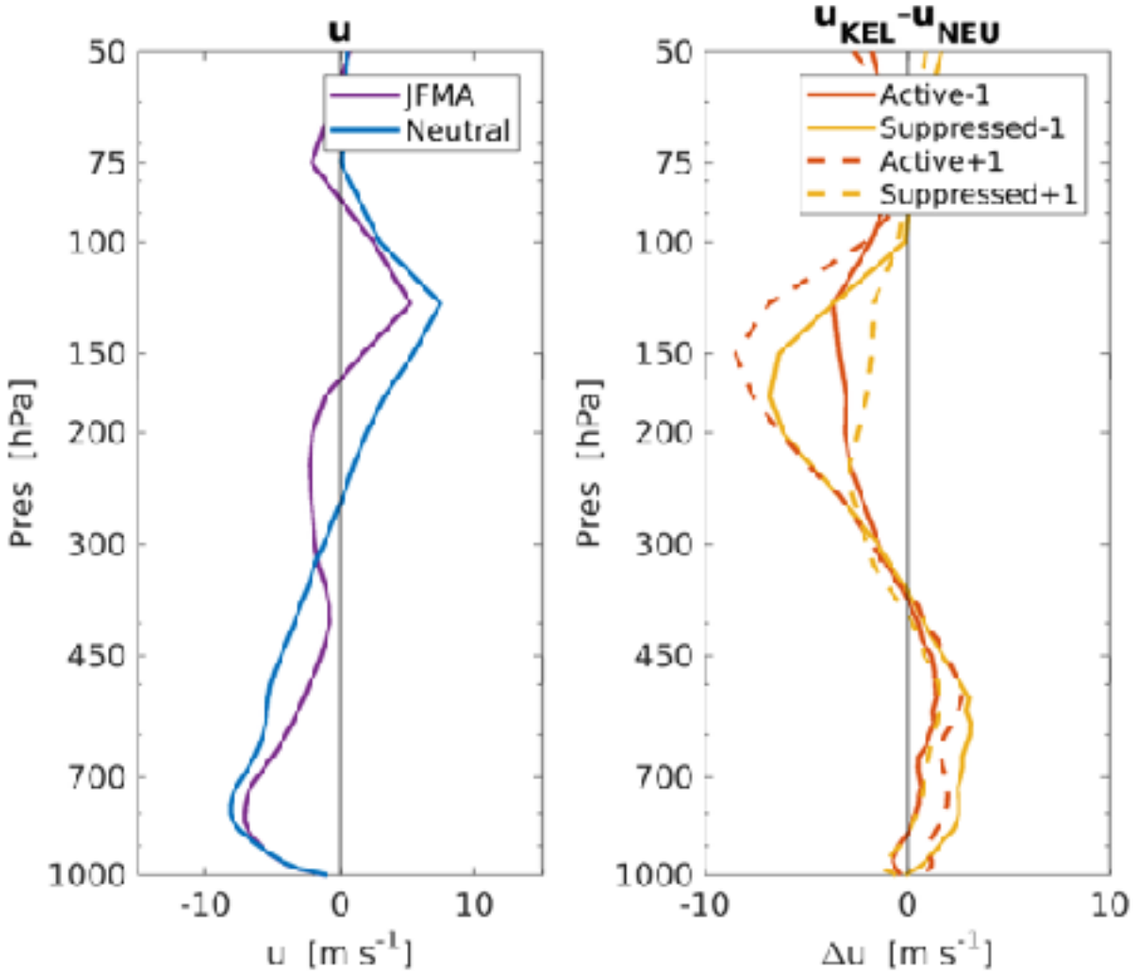
Radiosonde **MWRP**



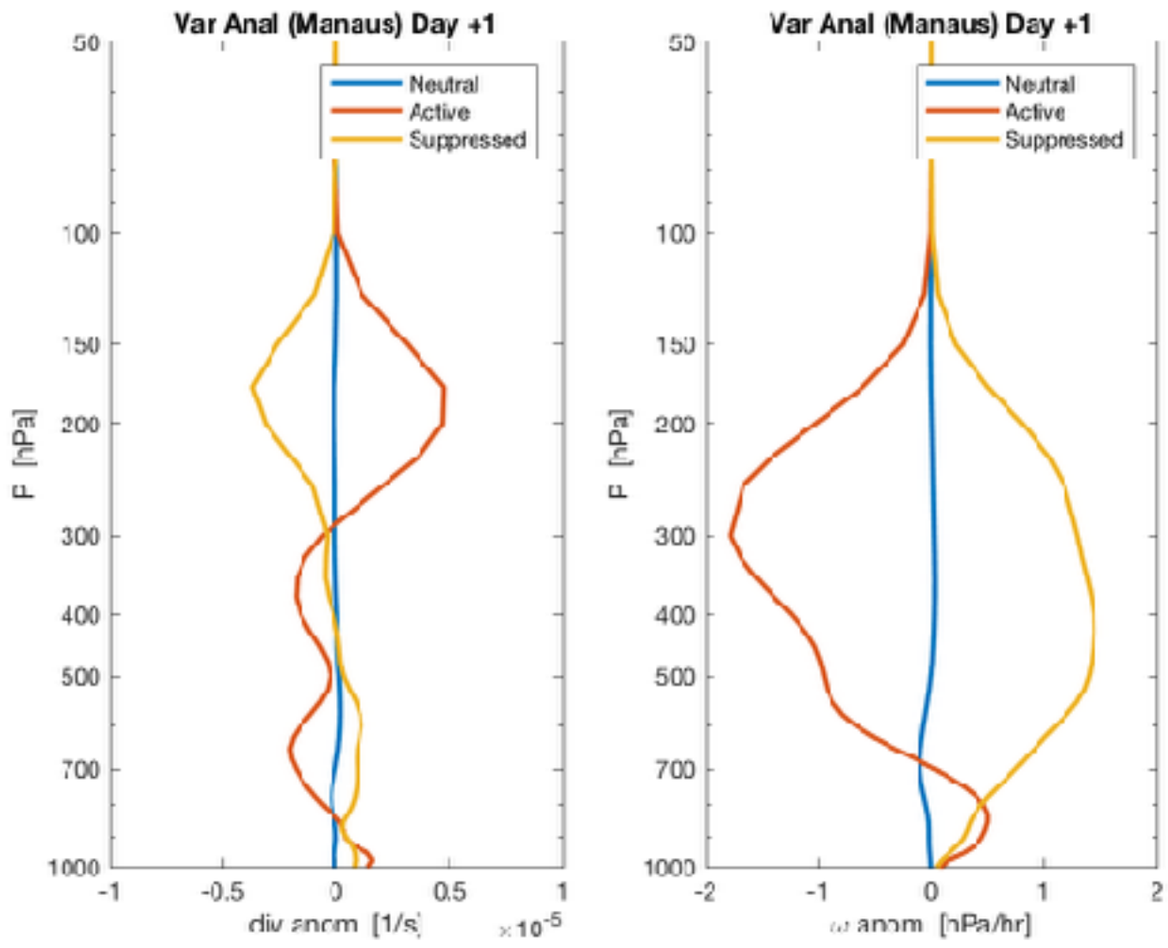
- Wave signal similar in magnitude to seasonal cycle
- Radiosonde and MWRP show similar composite results
- Kelvin wave shows deep moistening of troposphere within and above the boundary layer

Kelvin wave modulation of wind fields

Radiosonde at T3



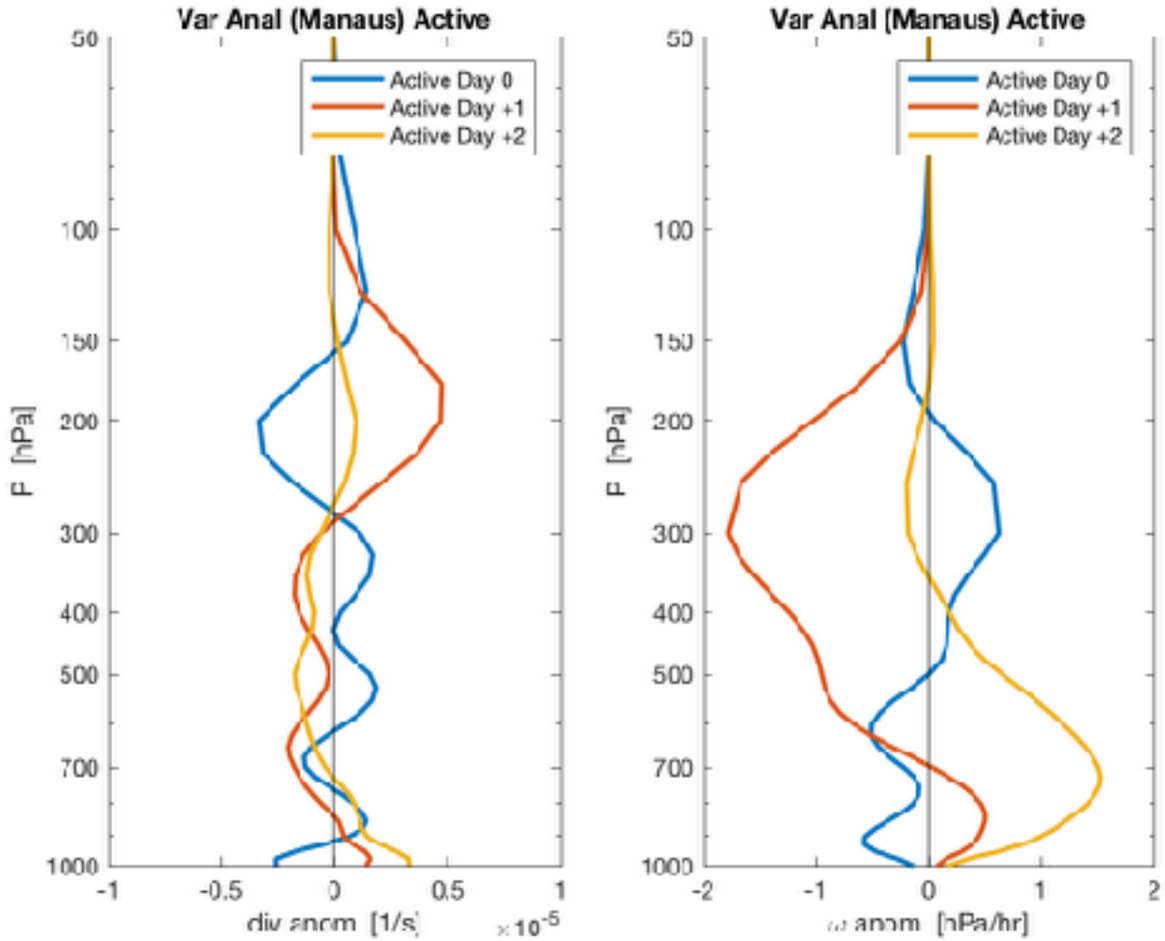
Variational Analysis at Manaus



- Anomalies with respect to 20-day mean with diurnal cycle removed, Kelvin activity at T3
- Upper level divergence is enhanced on Day 0 of a Kelvin wave activity (Day +1 at Manaus)
- Lower level convergence is also enhanced mainly above the boundary layer.

Kelvin wave modulation of wind fields

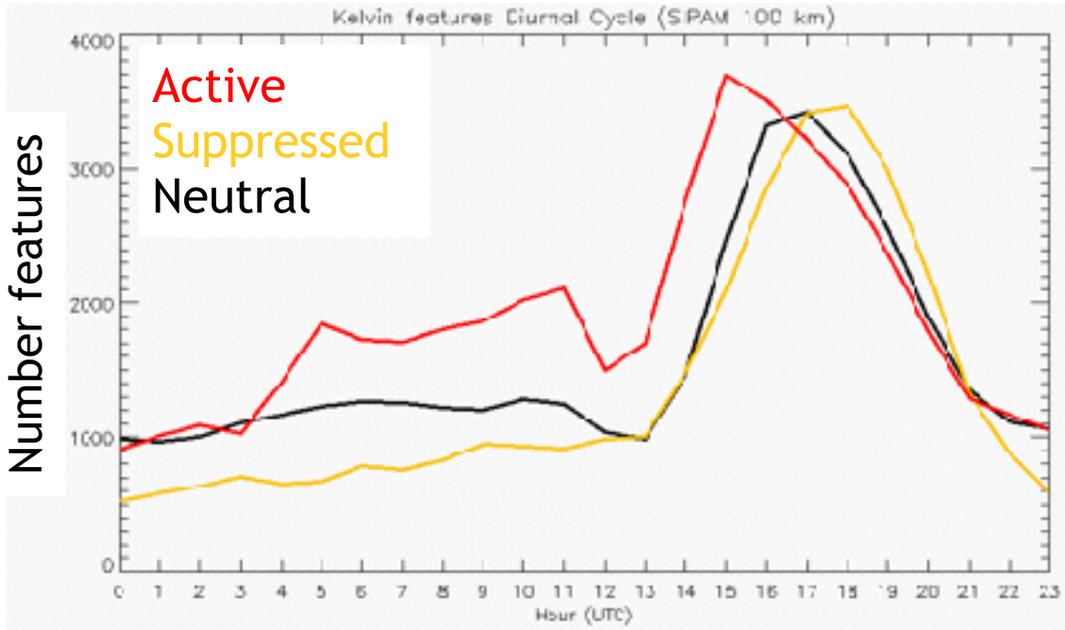
Variational Analysis at Manaus

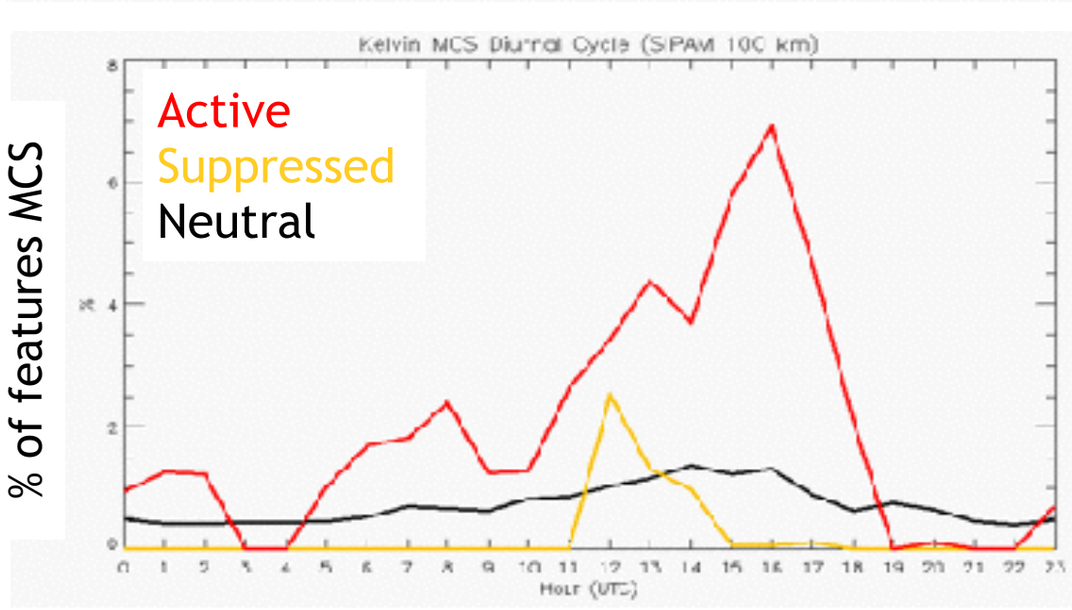


- Anomalies with respect to 20-day mean with diurnal cycle removed, Kelvin activity at T3
- Upper level divergence is enhanced on Day +1 at Manaus, similar to Day 0 at T3. Prior to this, convergence is seen to initiate at lower levels with upward motion and weak divergence is seen at mid levels.
- Following the peak in Kelvin active phase, convergence transitions to divergence at the lowest and upper levels, while mid levels remain convergent. Vertical velocities suggest upward motion has transitioned to strong downward motion, particularly at lower levels.

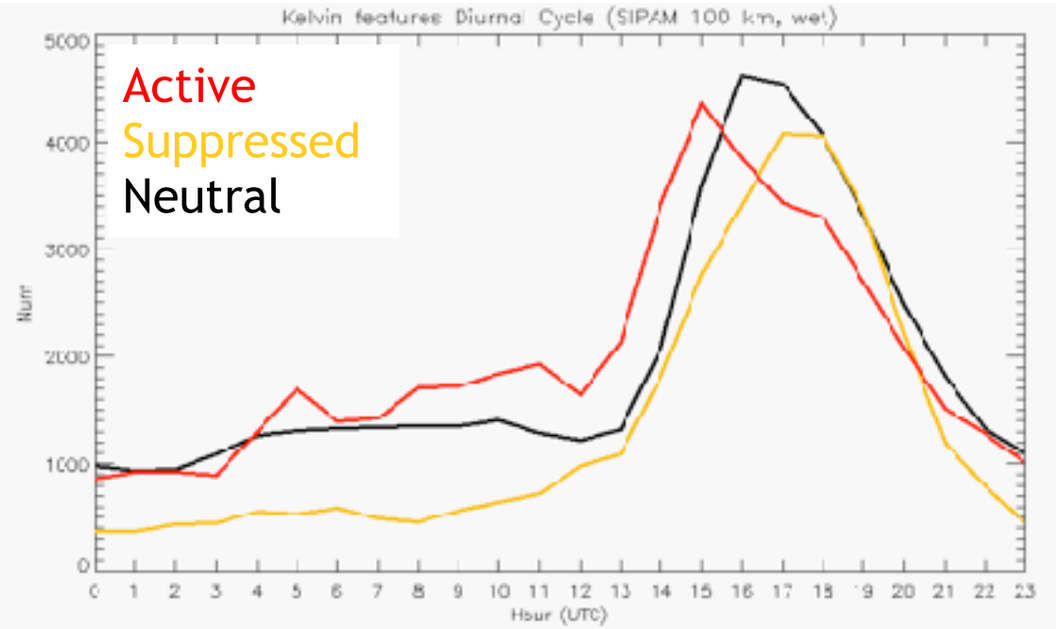
MCS Composite Diurnal Cycle

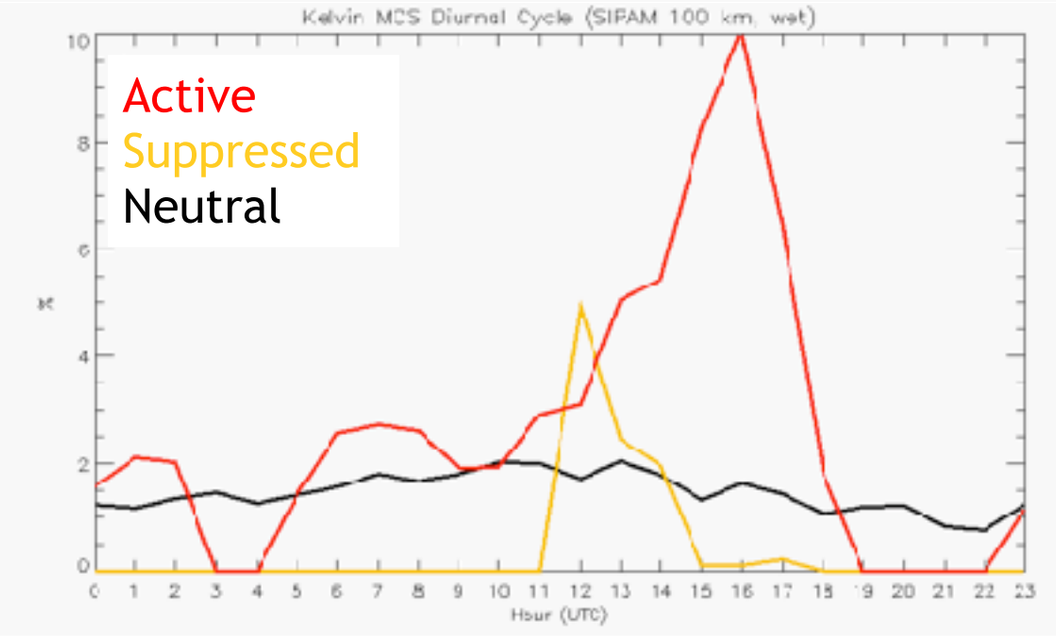
ALL





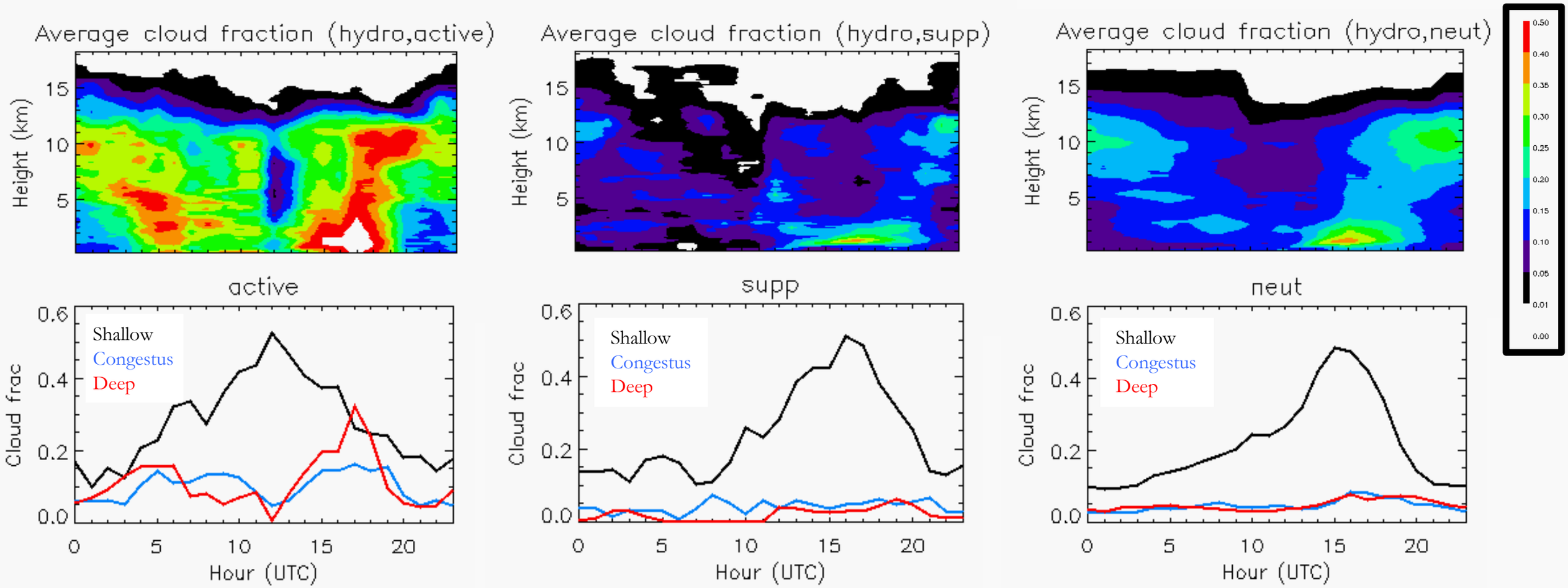
Wet Season (Jan-Apr)





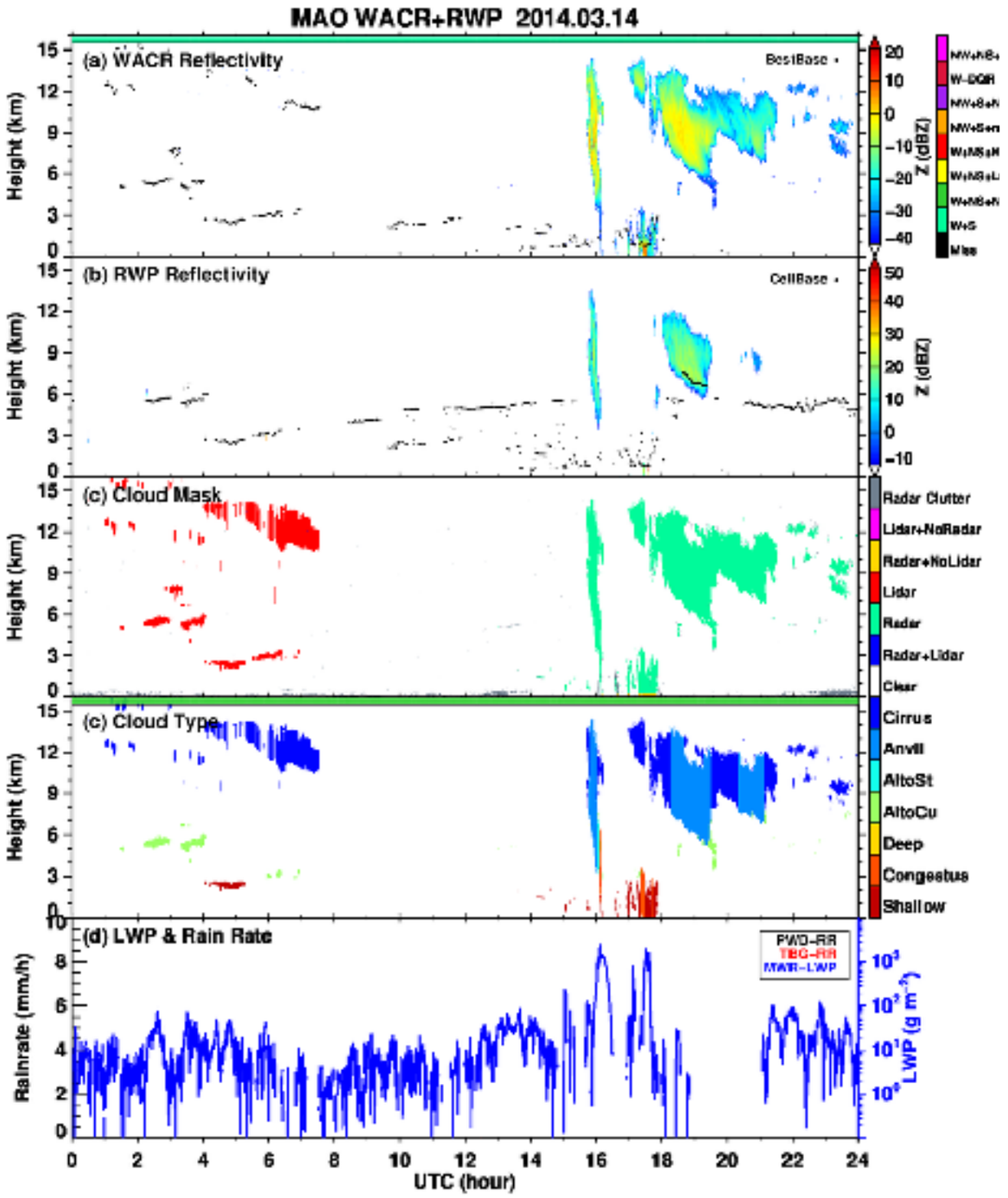
- Features defined over 100 km SIPAM domain centered on Manaus
- Local noon is UTC - 4 (16 UTC)

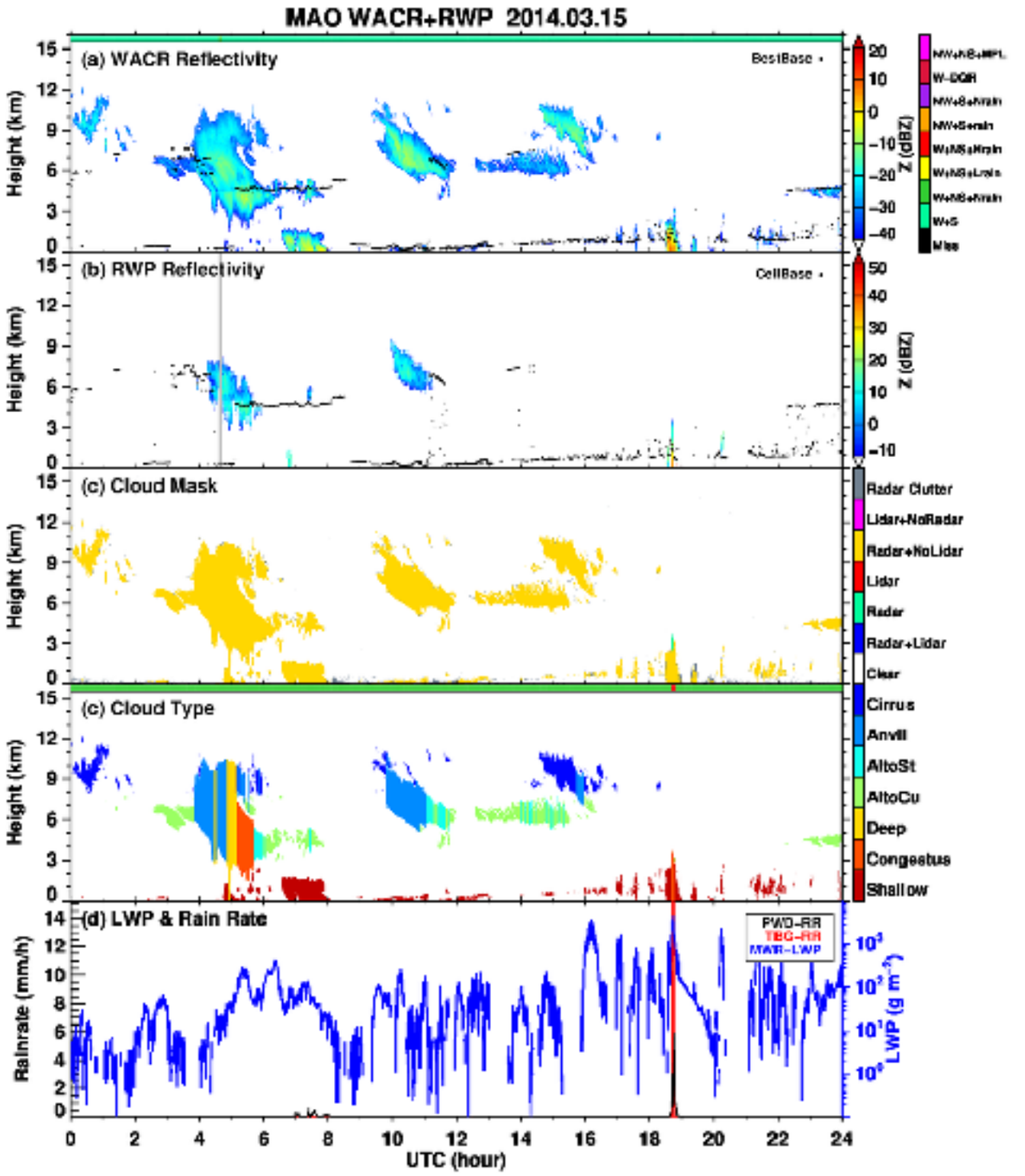
Cloud Type Diurnal Cycle



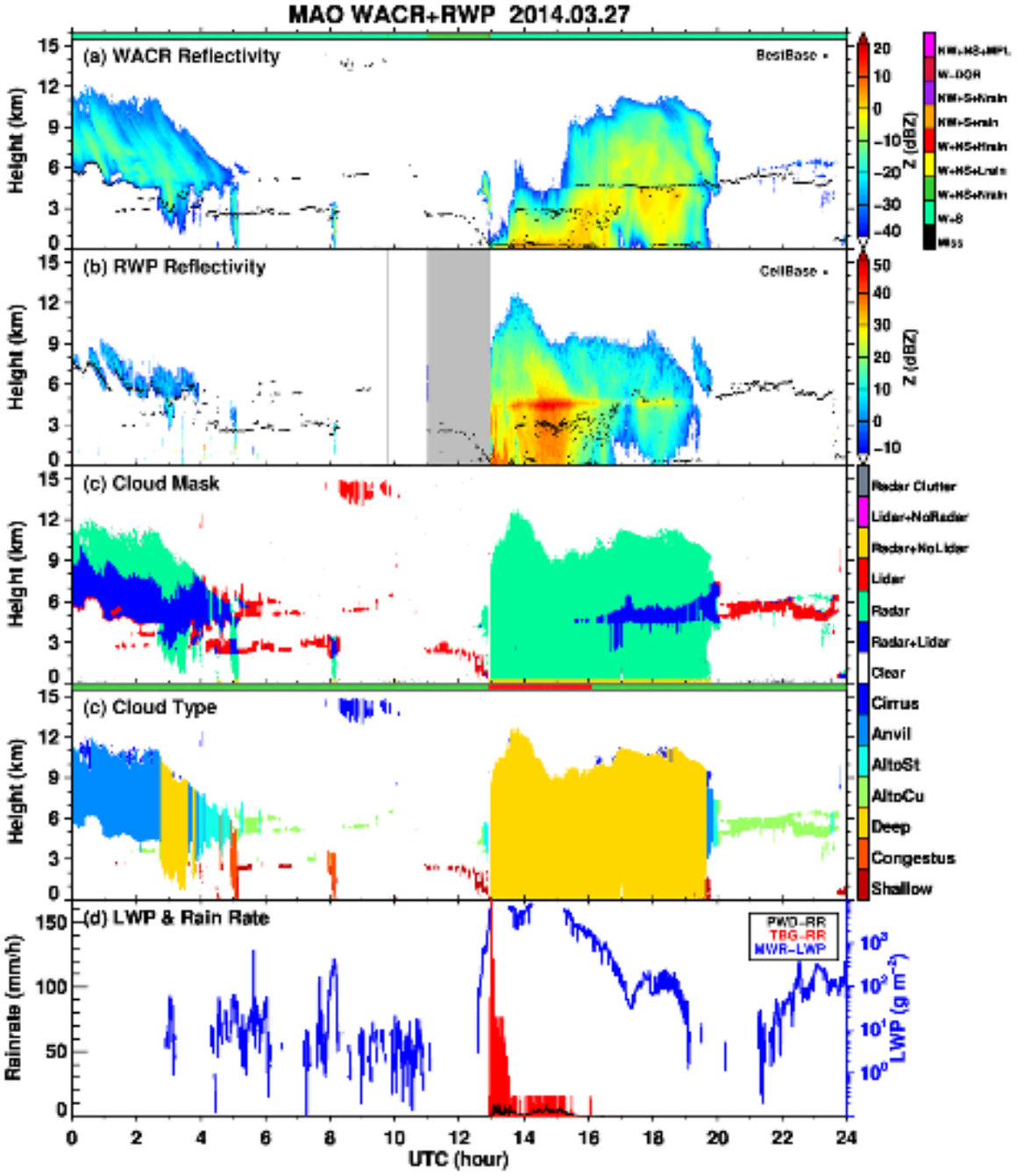
- Cloud fraction by type product from Zhe Feng and Scott Giangrande defined over T3
- Local noon is UTC - 4 (16 UTC)

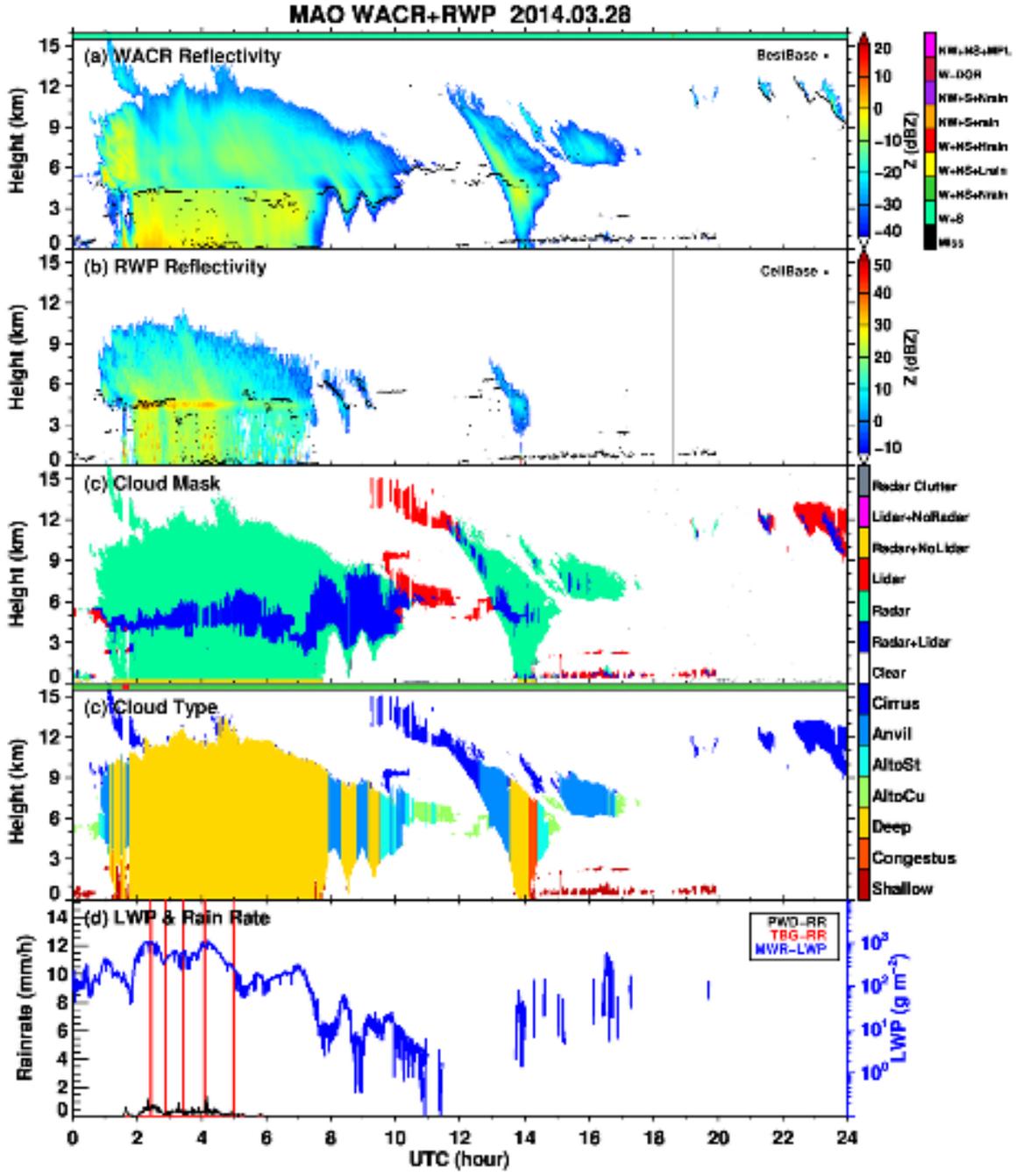
14-15 March 2014



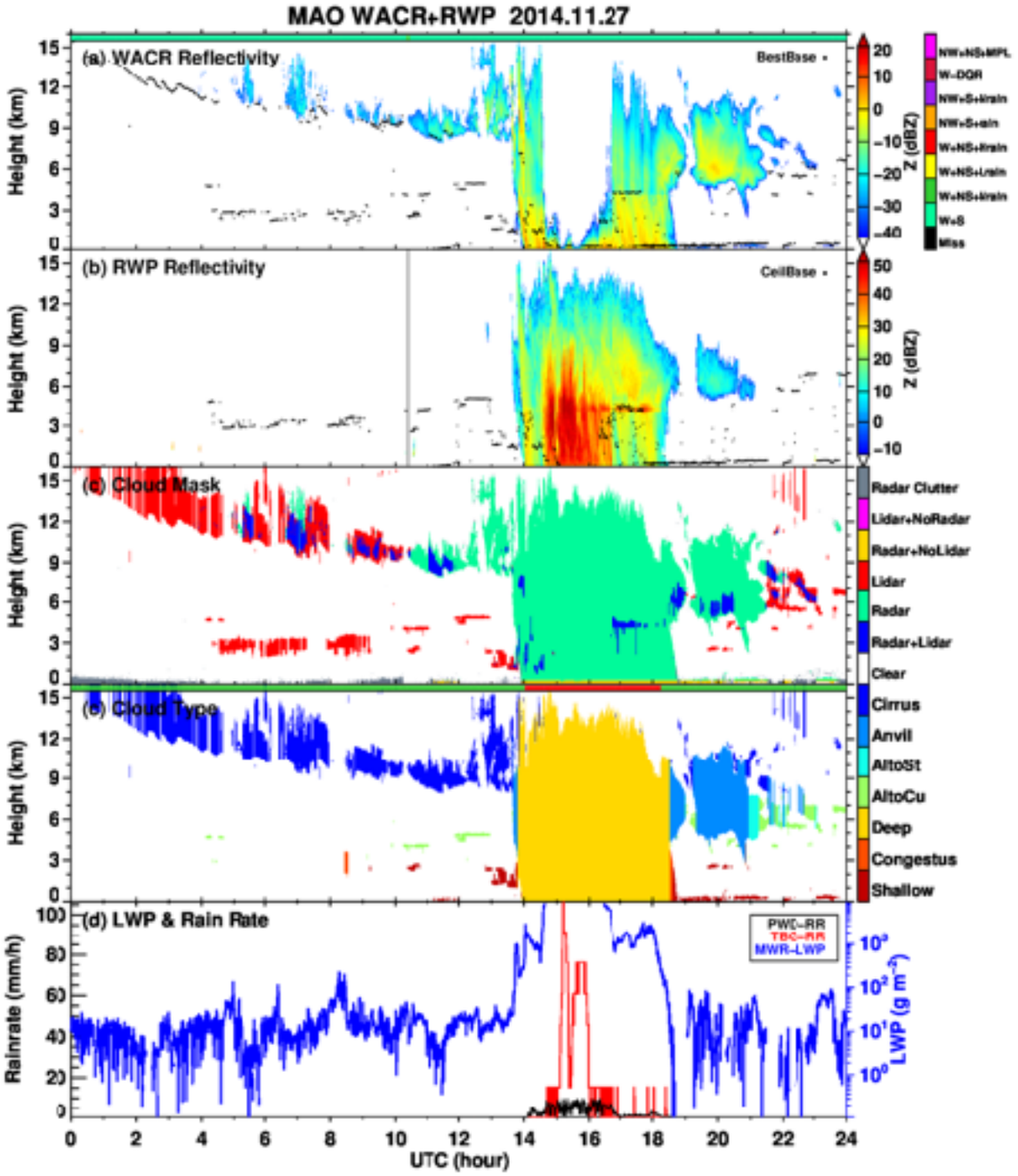


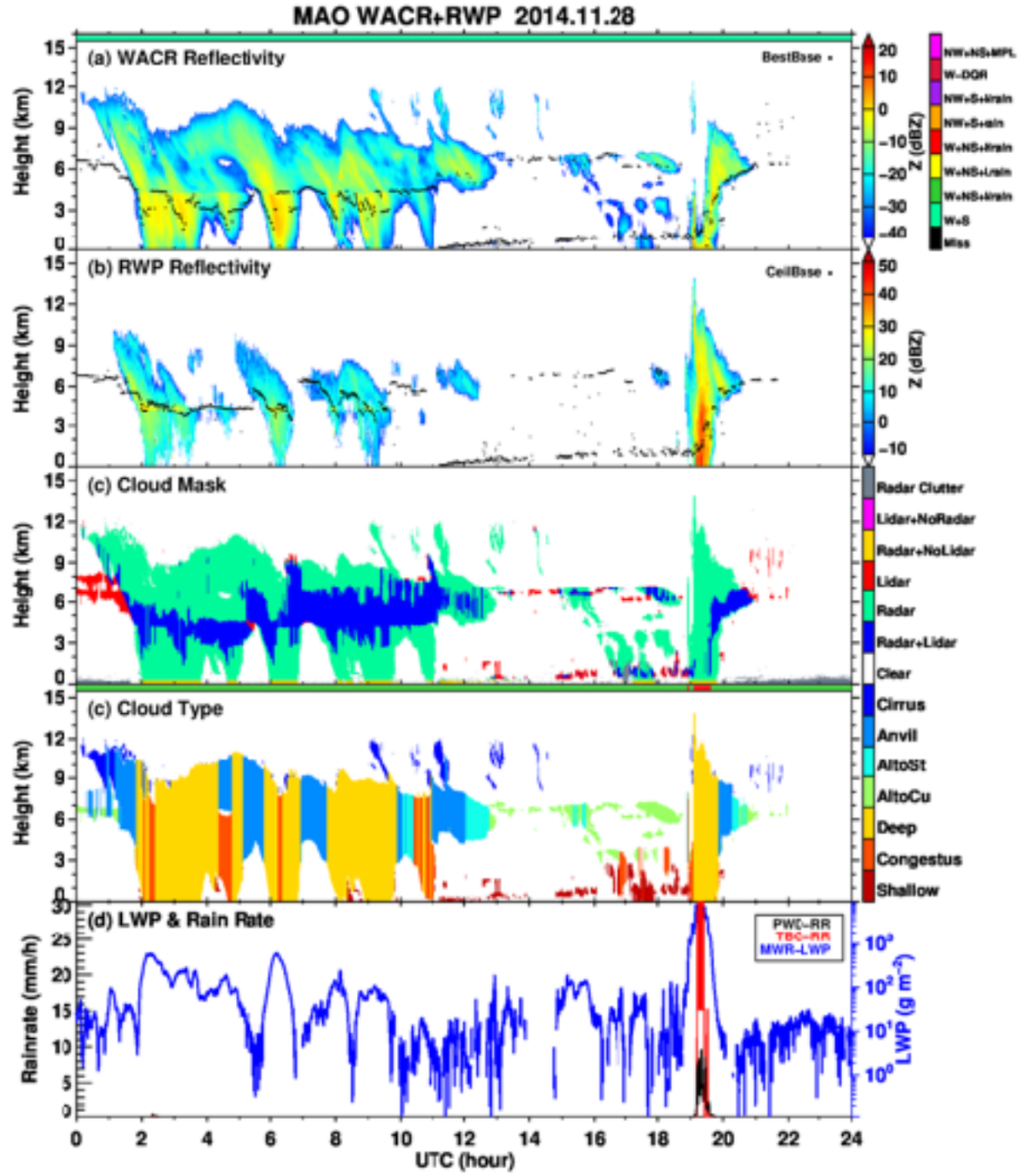
27-28 March 2014





27-28 November 2014





Summary

- Kelvin and WIG waves are documented in the literature as occurring over the Amazon region.
- Kelvin (and WIG) waves are most active during the wet season.
- Kelvin waves enhance tropospheric moisture during the wet season by a similar magnitude as the magnitude of the seasonal cycle.
- Moisture anomalies are widespread over the GoAmazon region.
- Kelvin dynamic signature is observed in radiosonde profiles at T3 as well as in Variational Analyses centered over Manaus. These modulations would also favor large-scale convection through enhanced upper level divergence and low to mid level convergence.
- Kelvin waves alter the diurnal cycle in total feature counts throughout the region, as well as the diurnal cycle in the area covered by MCSs. Cloud fractions for various cloud types also modulated by phase of the wave.
- We are interested to better understand the reasons for the modulation of the diurnal cycle by the waves and if high resolution models like WRF are able to capture these changes.