TTL Variability associated with the Madden-Julian Oscillation during DYNAMO

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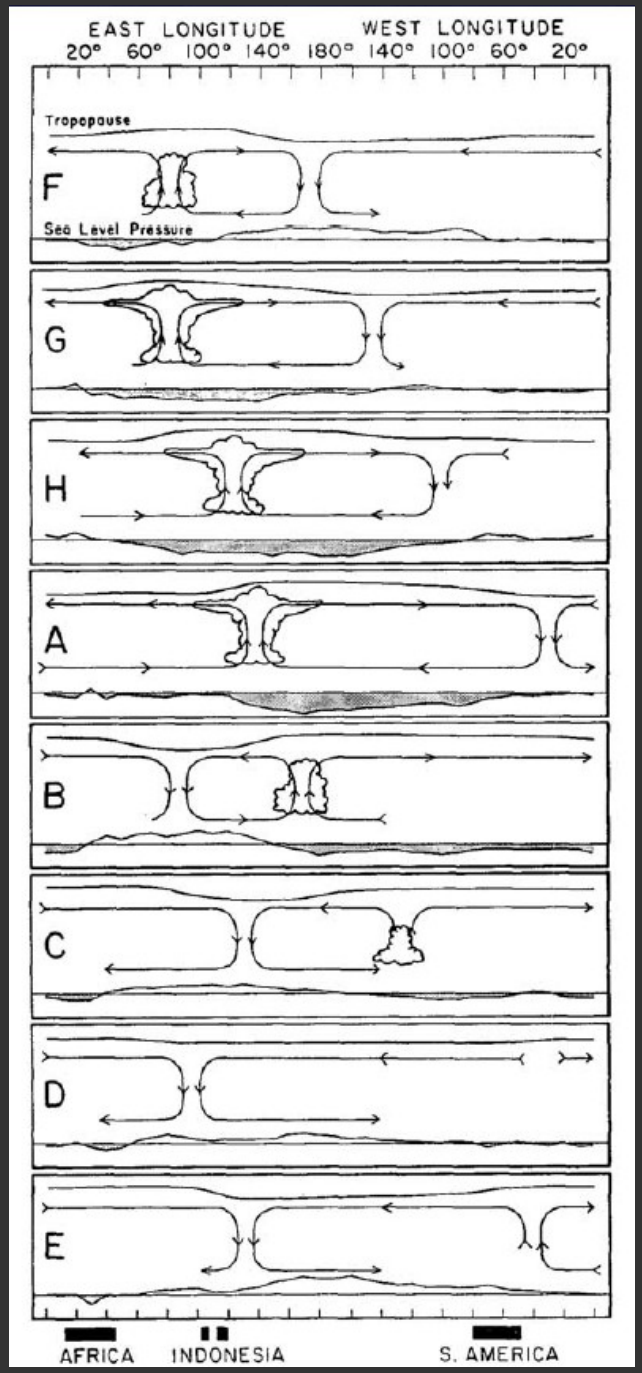
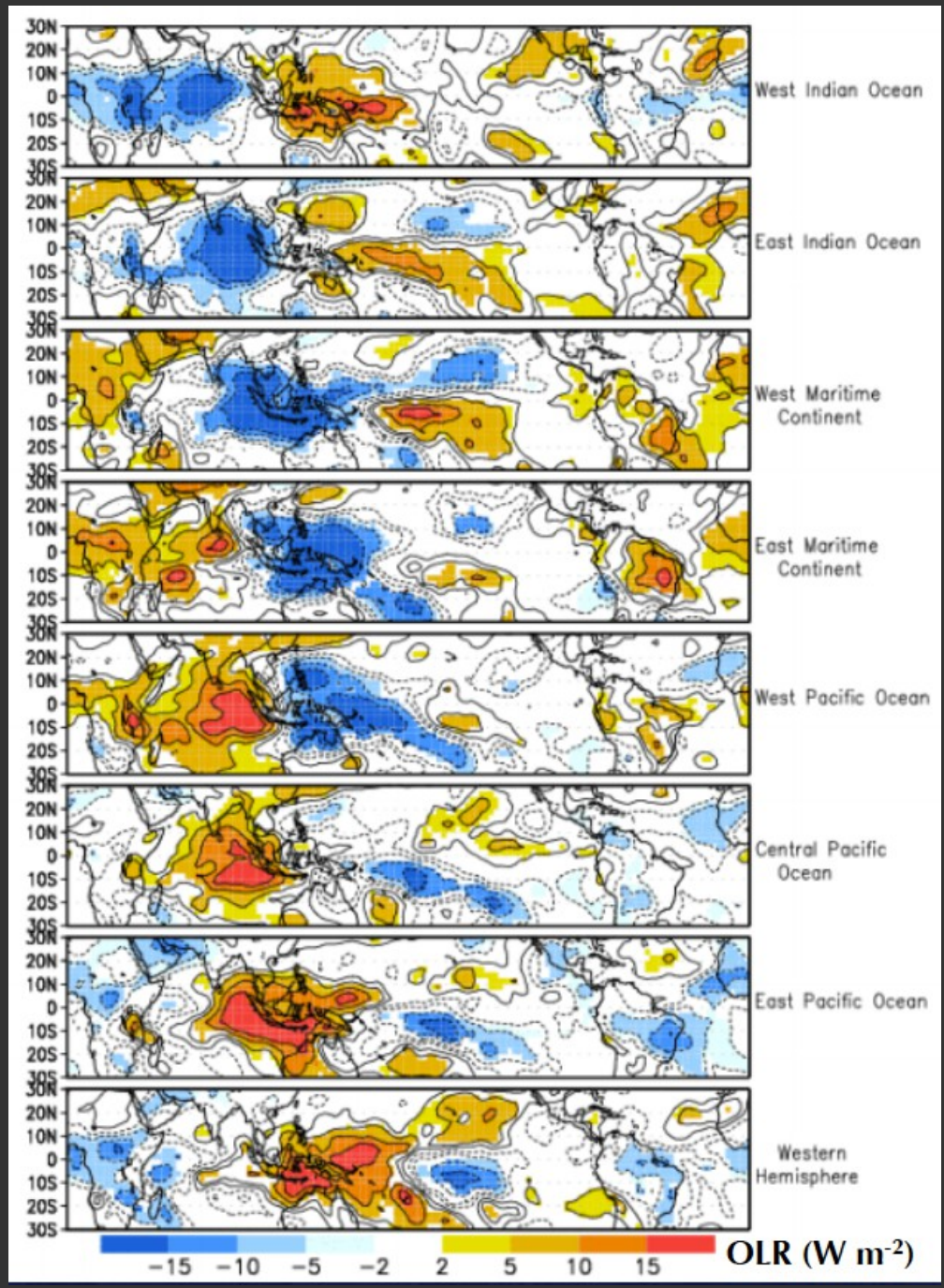
Outline

Madden–Julian Oscillation (MJO)



Madden & Julian (1972)



NOAA

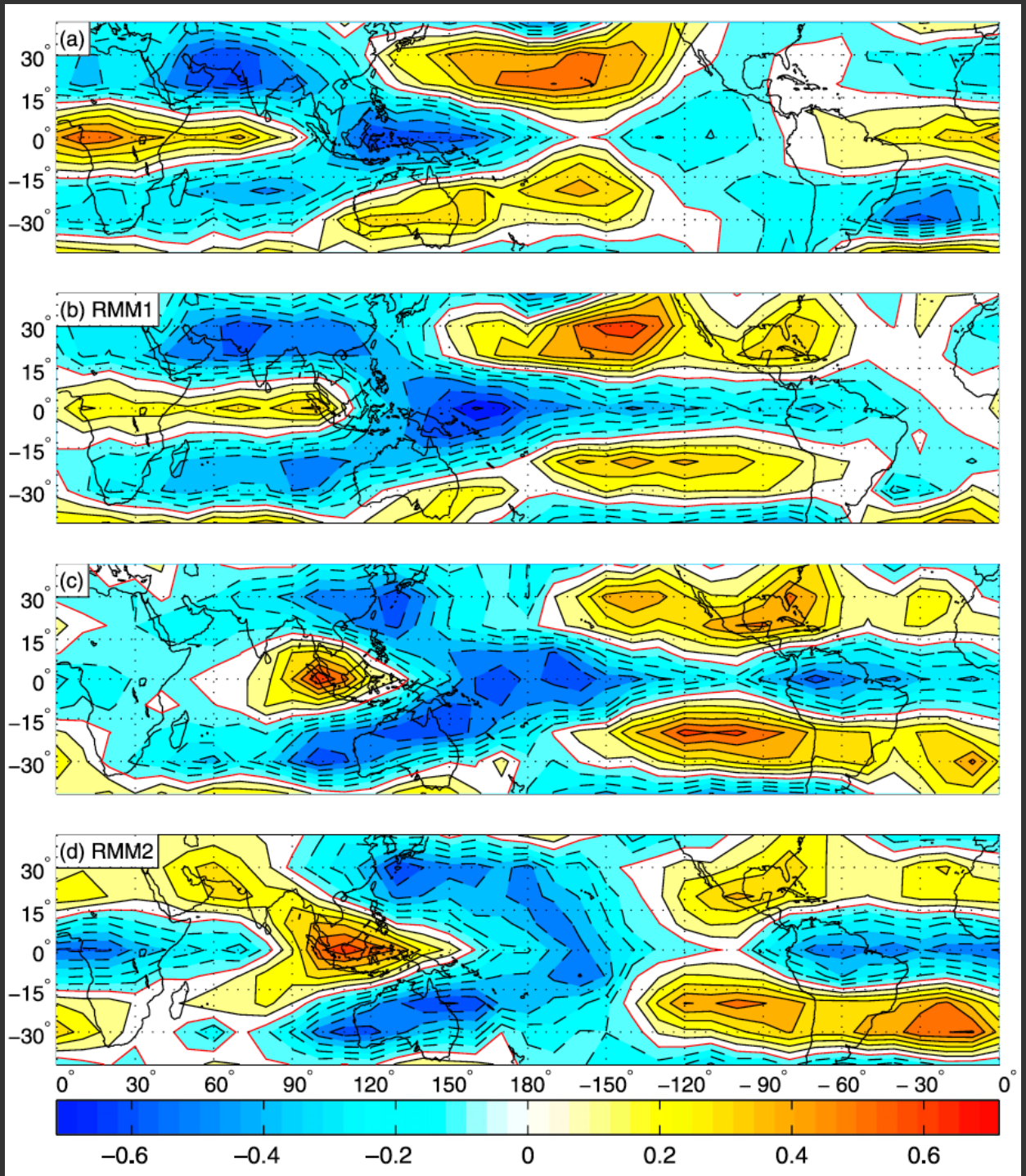
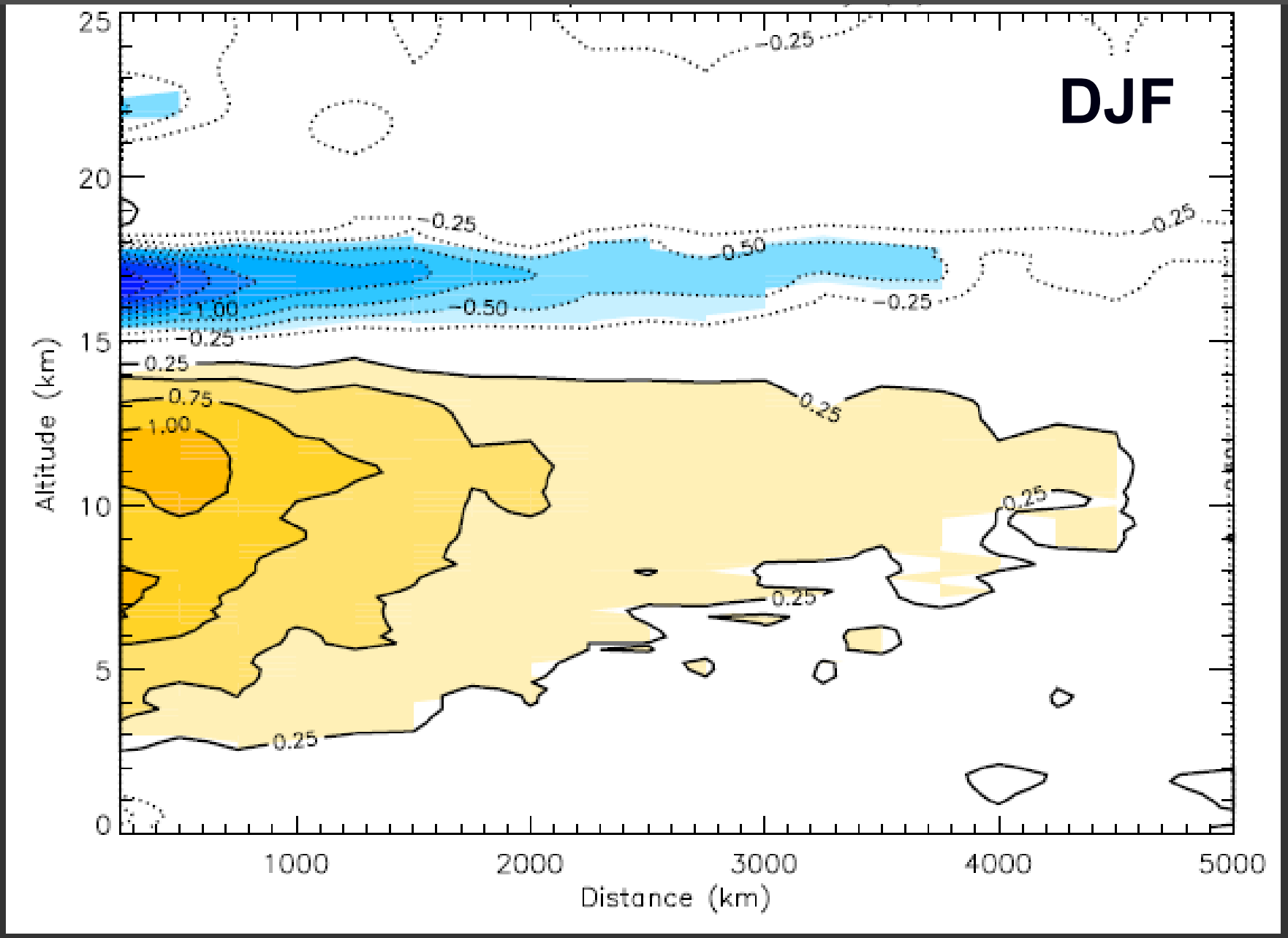


FIG. 3. Filtered COSMIC 100-hPa temperature regressed onto (a) RMM1 − RMM2, (b) RMM1, (c) RMM1 + RMM2, and (d) RMM2. CI = 0.1 K; 0 K contour is red.

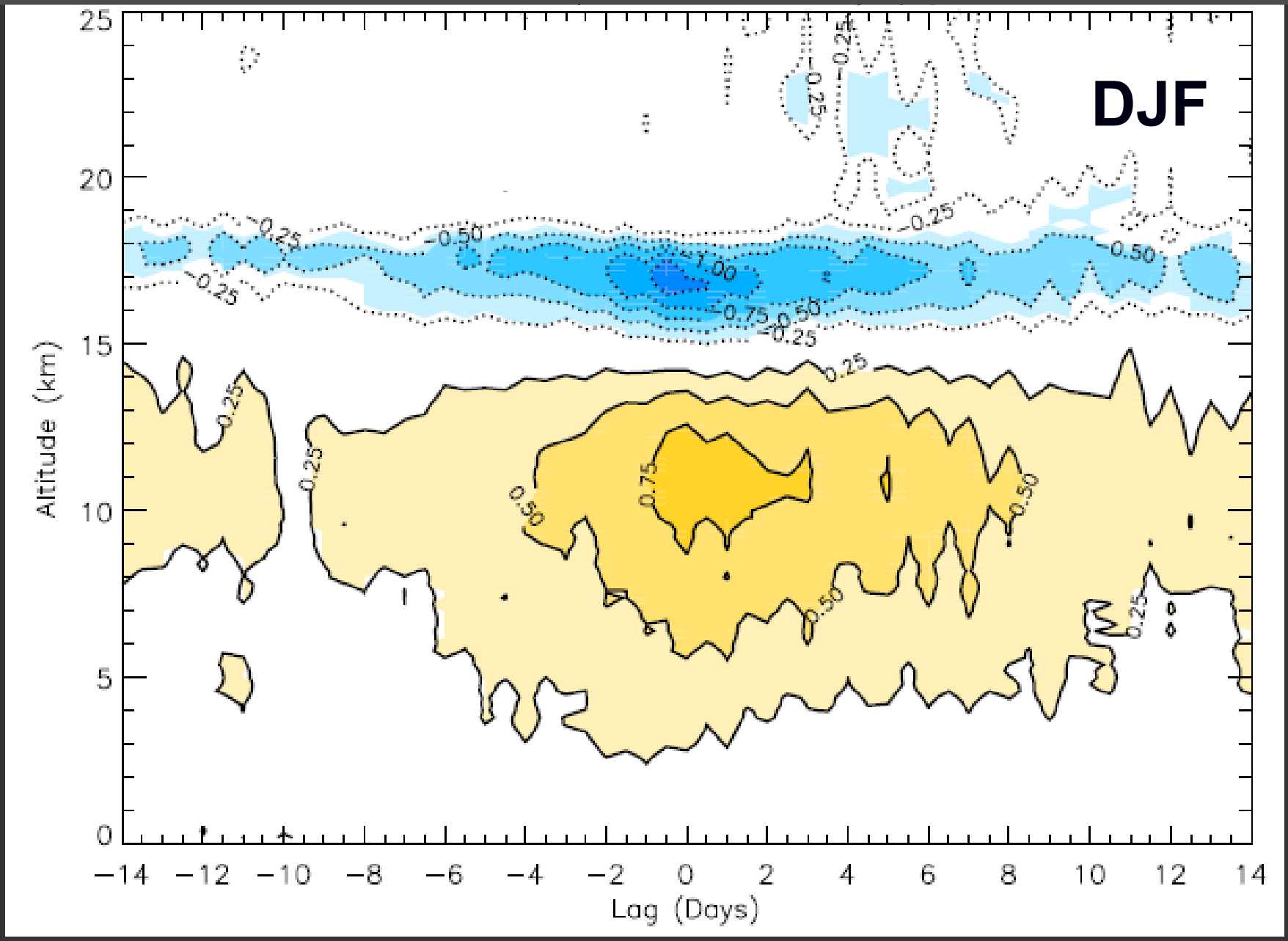
Virts & Wallace (2014): ~cold point temperature structure associated with the MJO

Temperature Anomalies (from GPS) as a Function of Distance from Deep Convective Cloud (from CloudSat) > 17km (within +/- 6h)



Paulik & Birner (2012)

Temperature Anomalies (from GPS) as a Function of Time Lag from Deep Convective Cloud (from CloudSat) > 17km (within +/- 1000 km)



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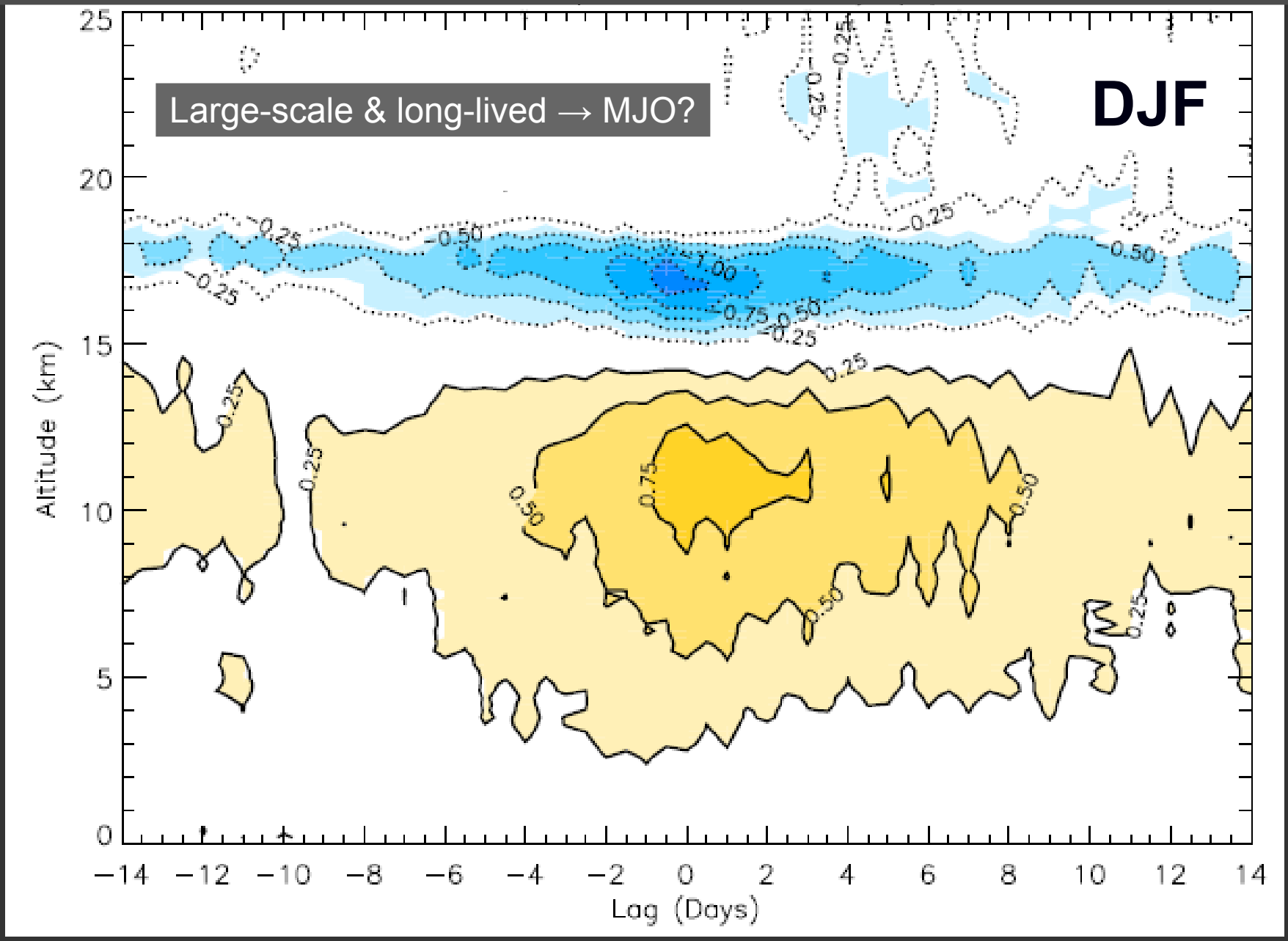
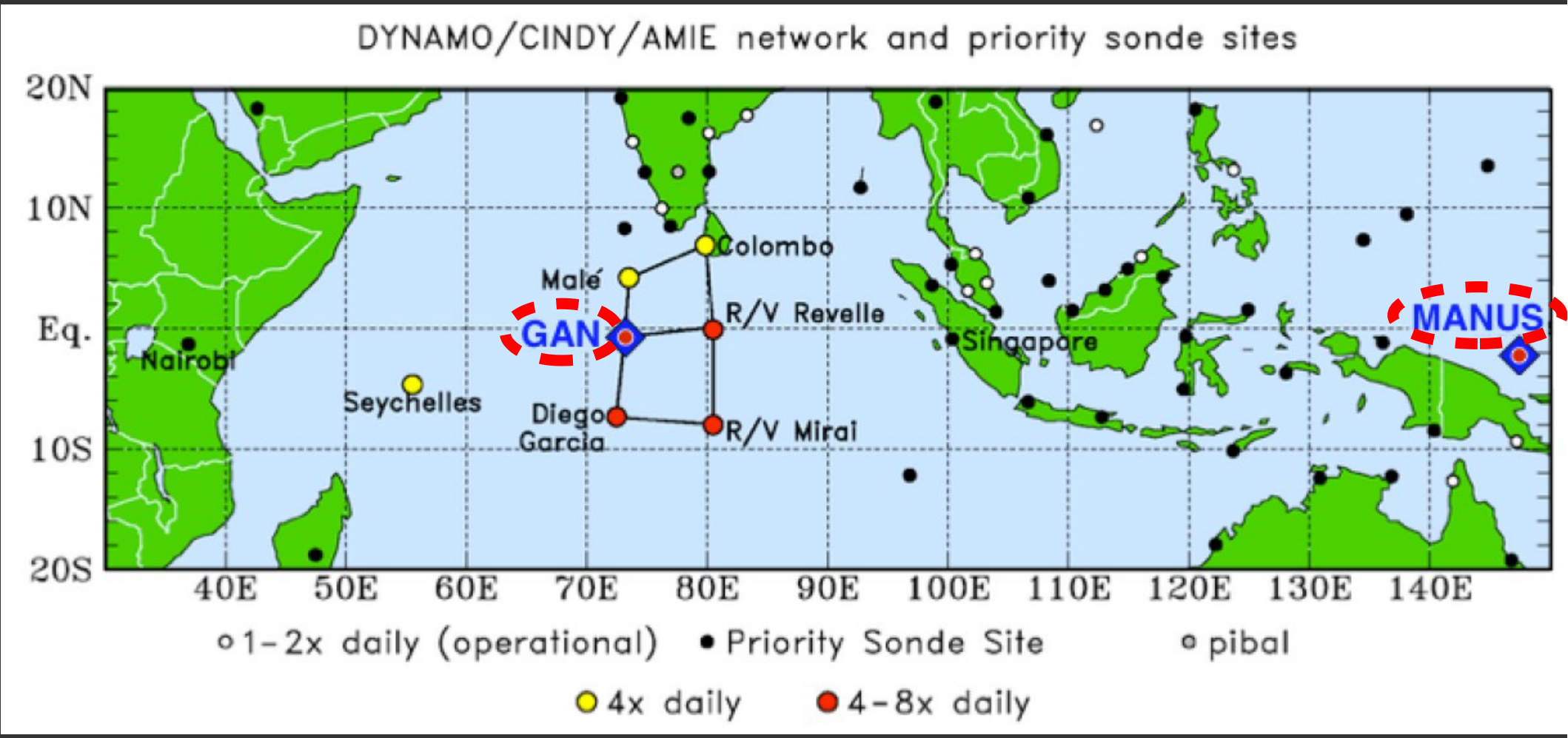


Paulik & Birner (2012)

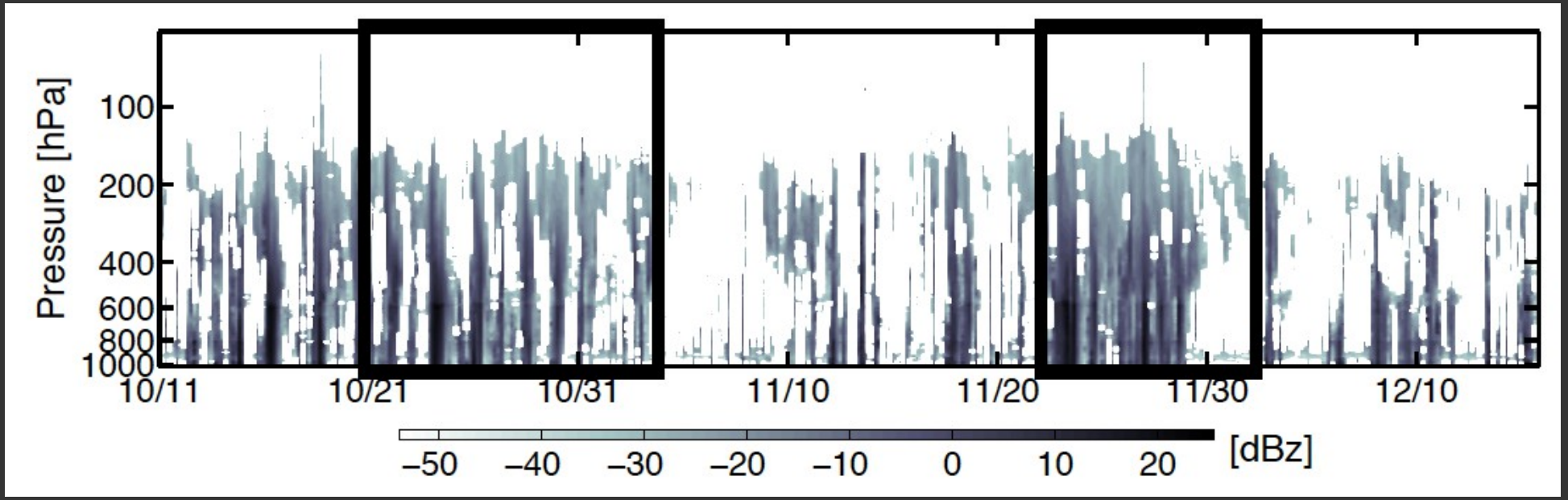
Madden-Julian Oscillation modulation of TTL dynamics (results from DYNAMO)



DYNAmics of the Madden-Julian Oscillation: intensive observing period during Oct-Dec 2011

TTL temperature & convection

Temperature anomaly & PNNL radar reflectivity (Gan Island)



- Higher cloud tops during MJO active phases
- Tropopause-level cirrus not detectable

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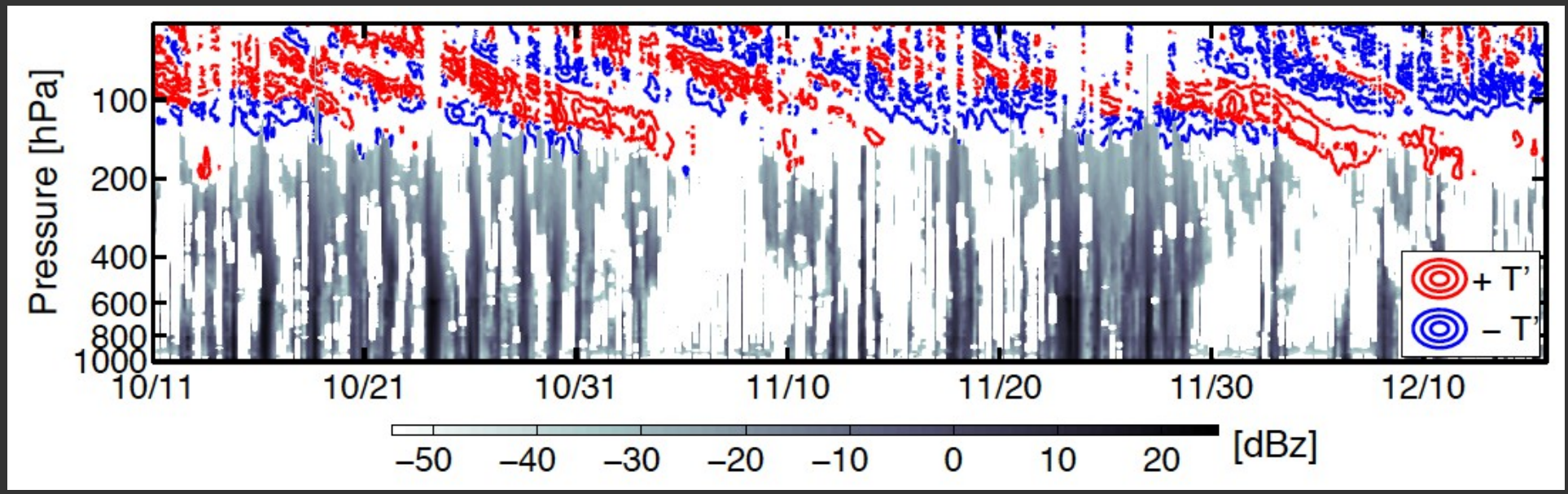
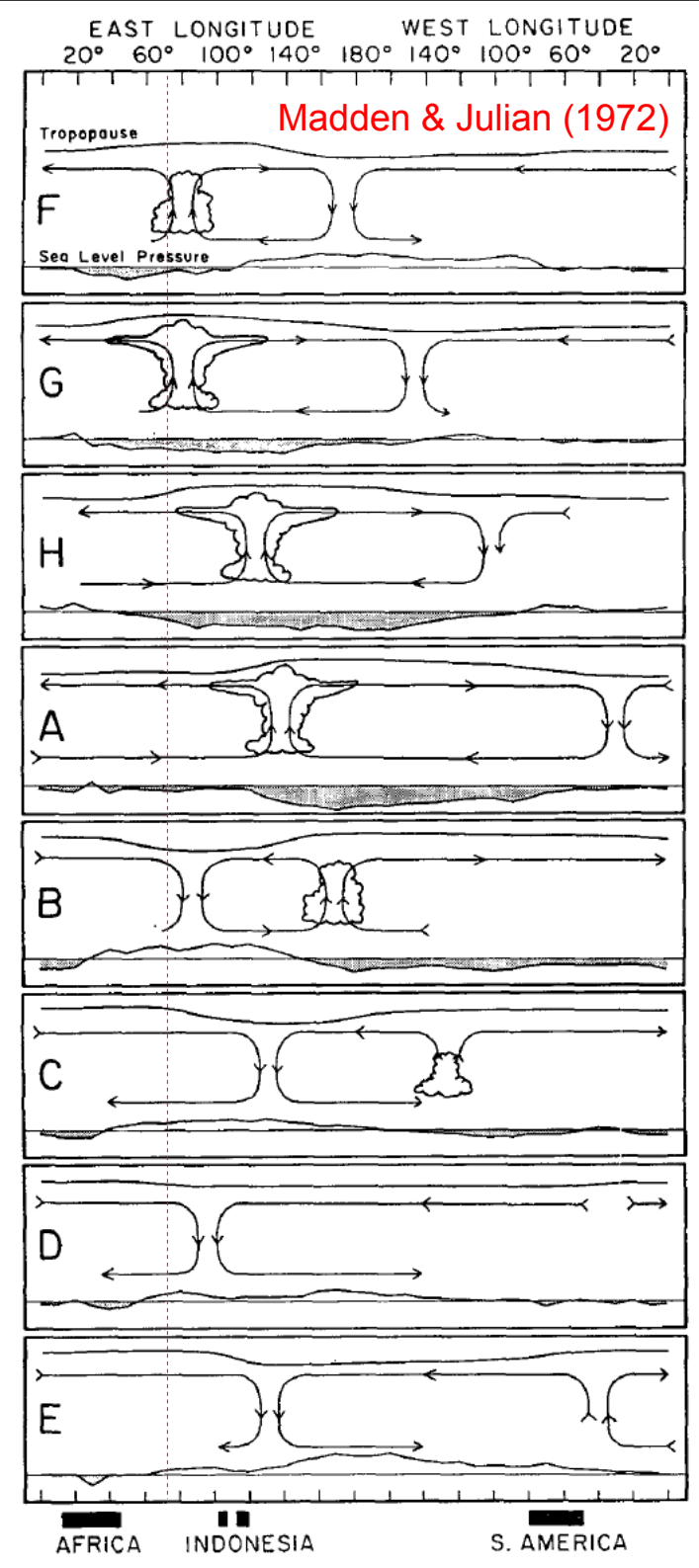
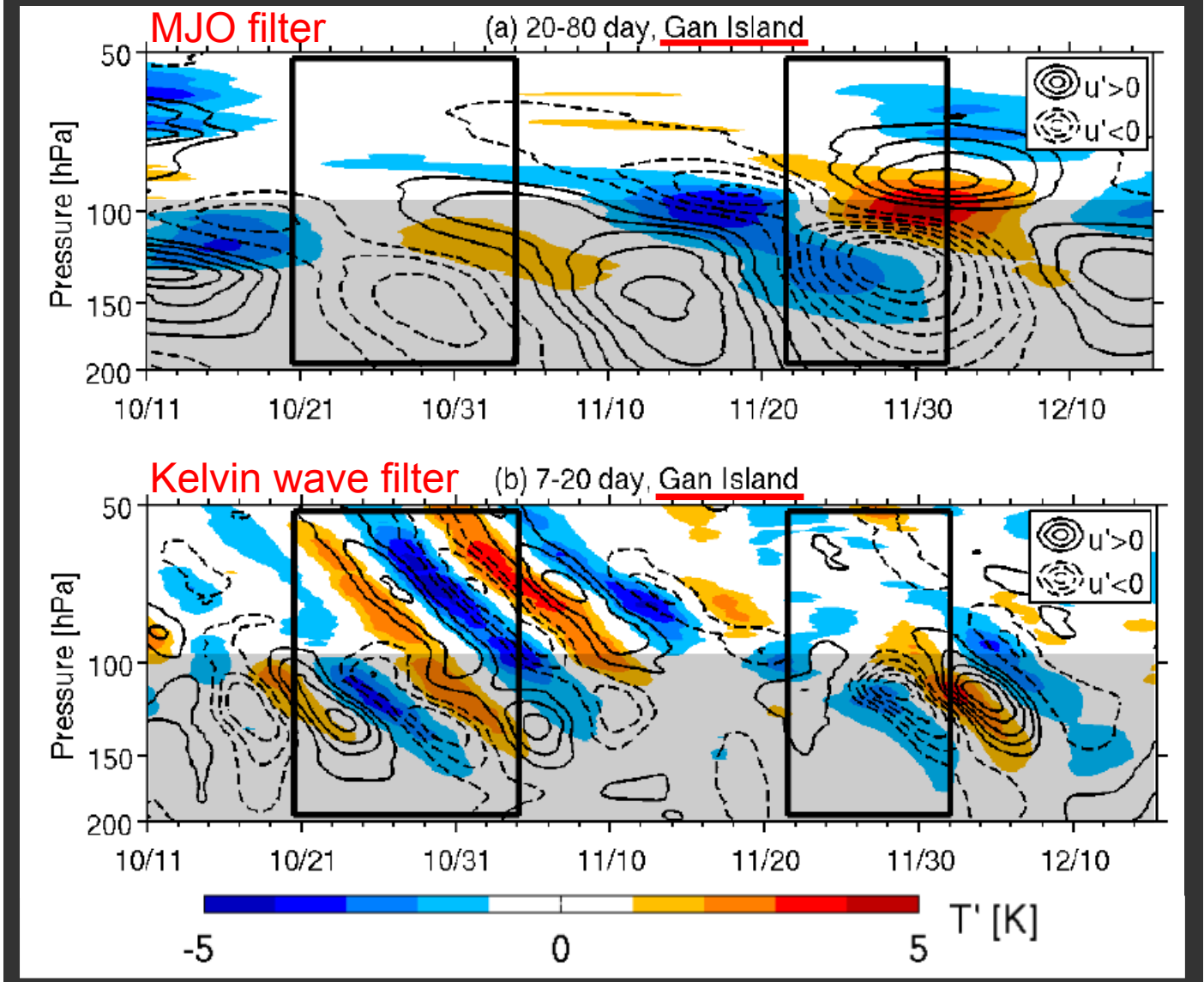


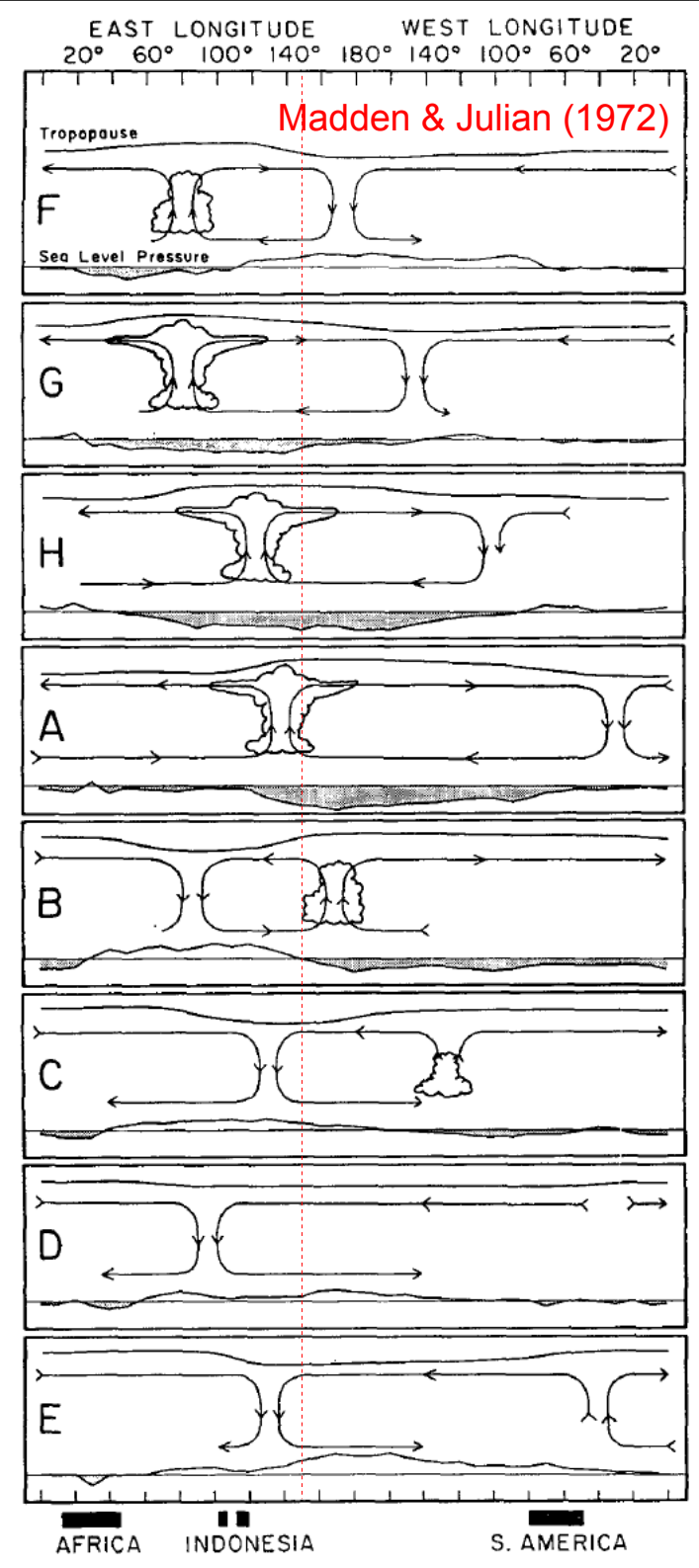
- Higher cloud tops during MJO active phases
- Tropopause-level cirrus not detectable
- Wave structures in temperature anomalies

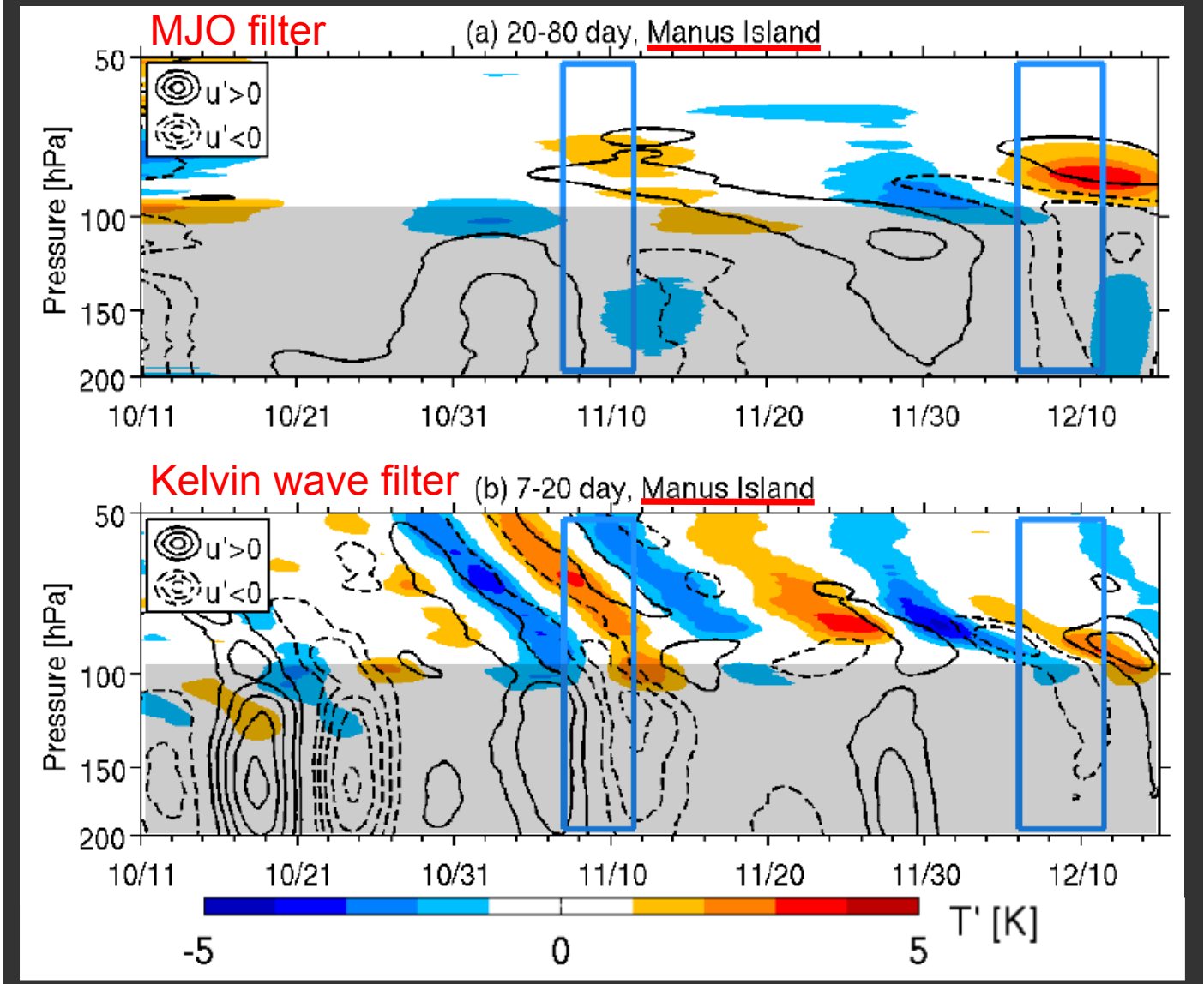
MJO modulation of TTL dynamics (results from DYNAMO): Gan Island



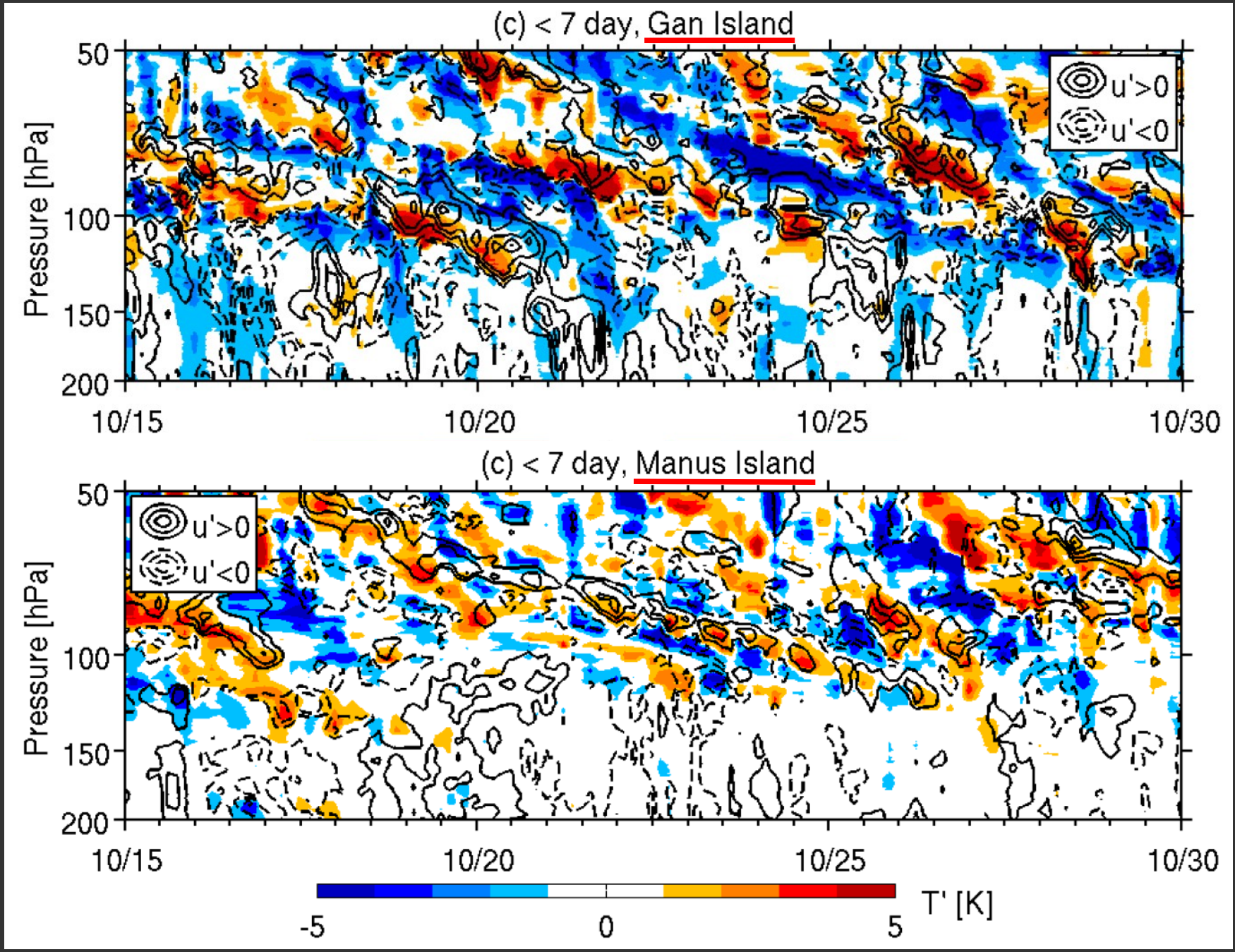


MJO modulation of TTL dynamics (results from DYNAMO): Manus Island



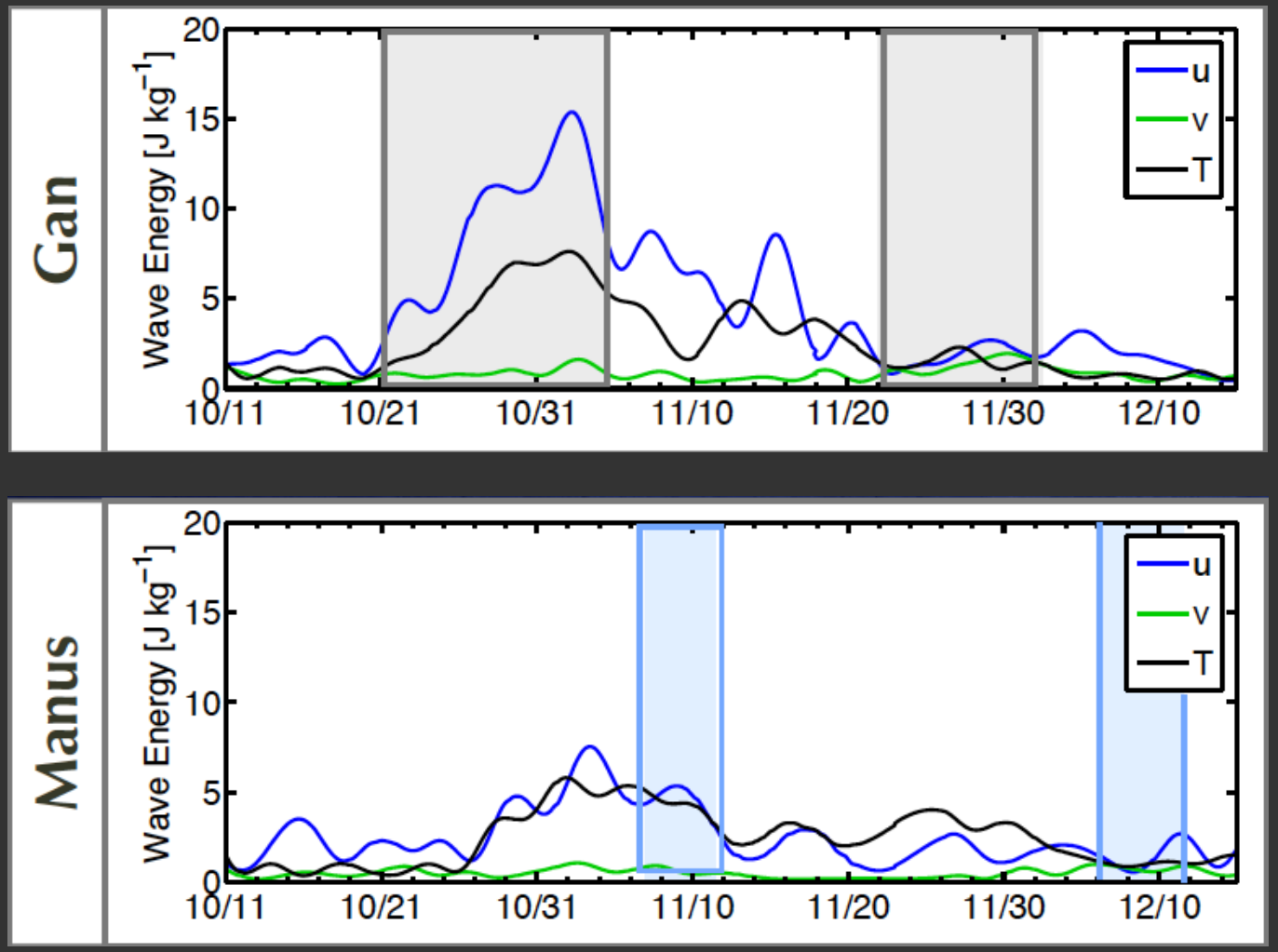


Higher-frequency waves during October 2011:



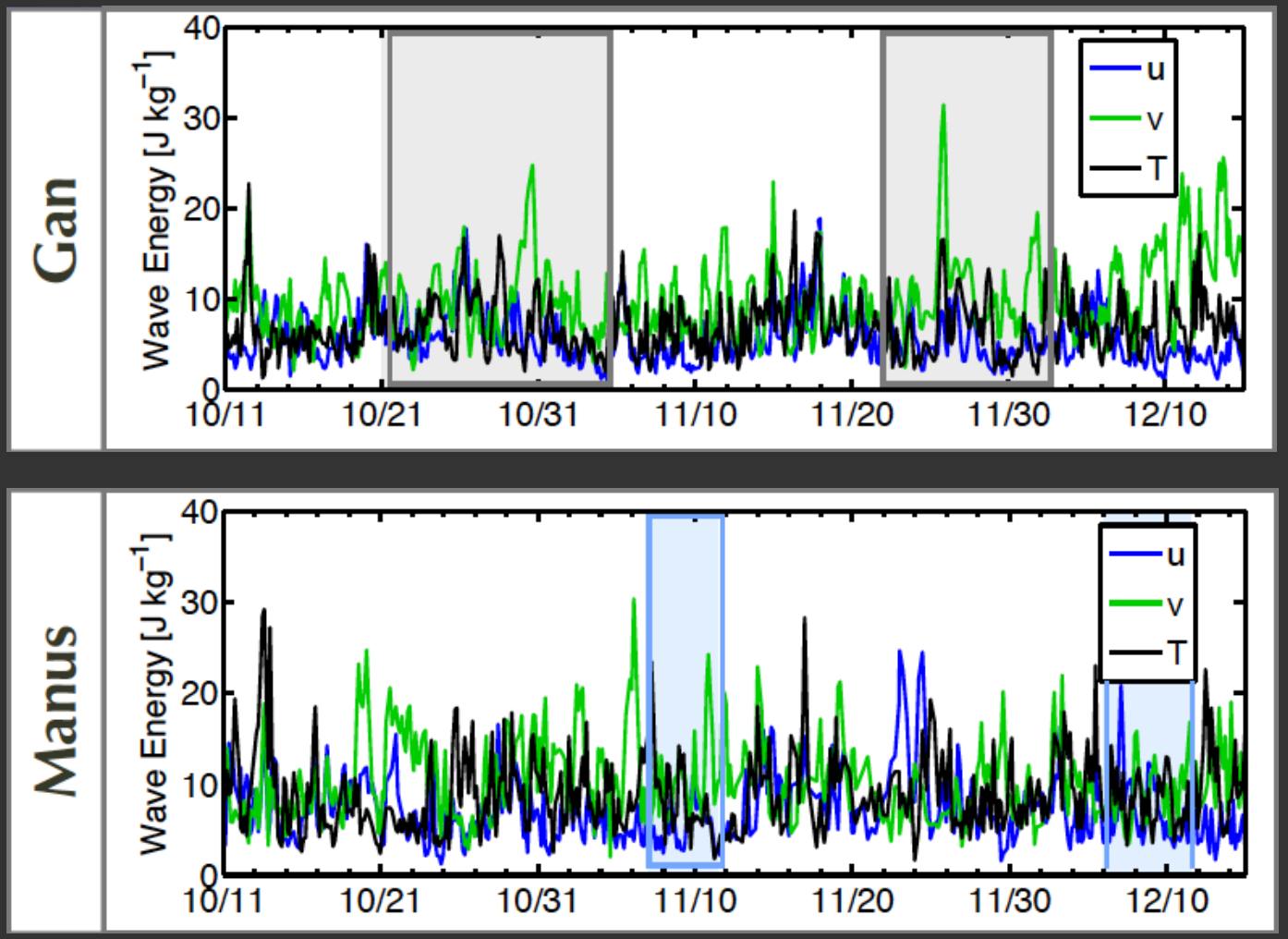
Lower stratospheric wave energy (30-85 hPa)

7-20 day bandpass filter



Lower stratospheric wave energy (30-85 hPa)

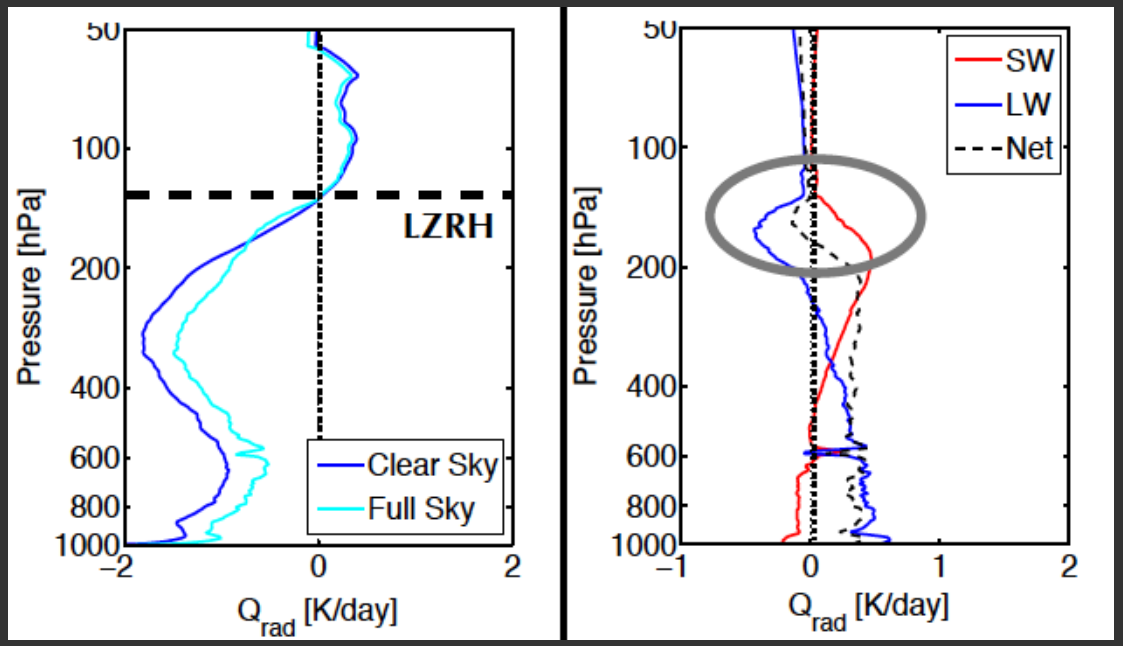
7 day highpass filter



Radiative heating rates (Gan Island)

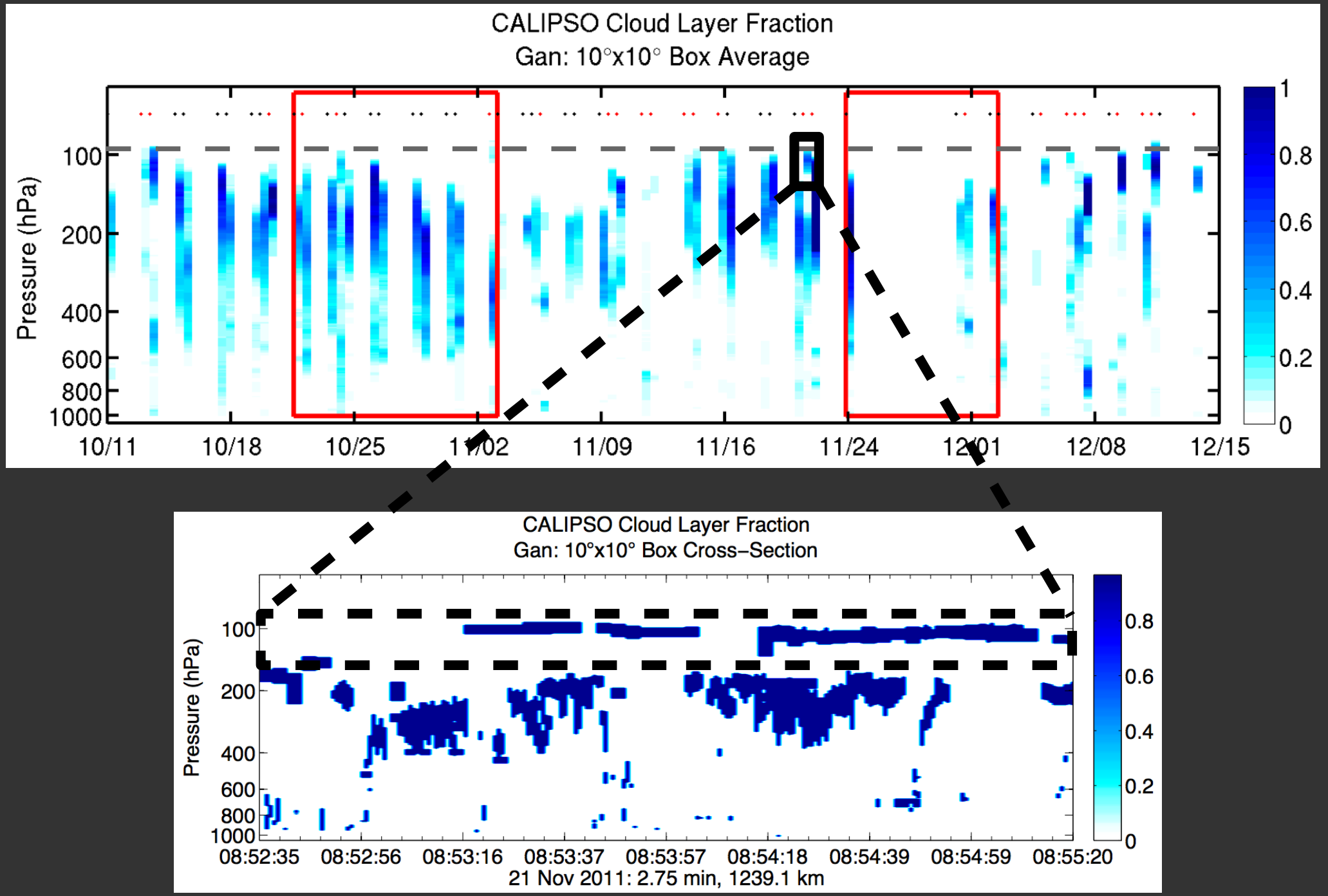
PNNL

Cloud radiative forcing



- cloud-radiative cooling in TTL, in conflict with previous studies (Corti et al. 2005; Yang et al. 2010)
- Missing tropopause-level cirrus radiative heating!

TTL Cirrus from CALIPSO



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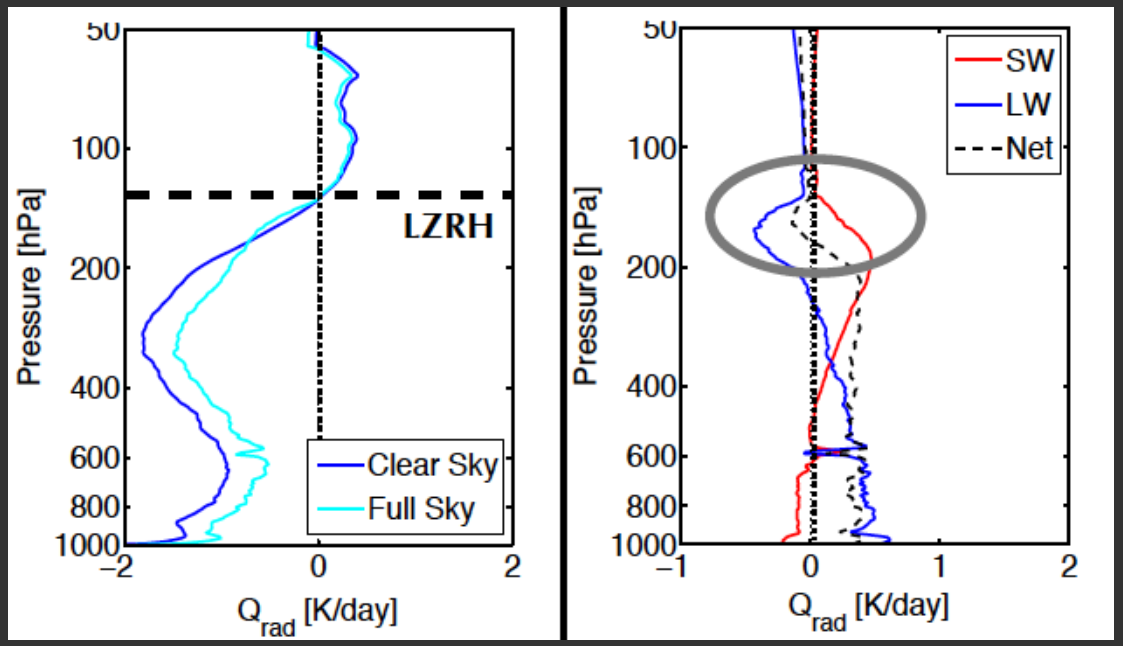
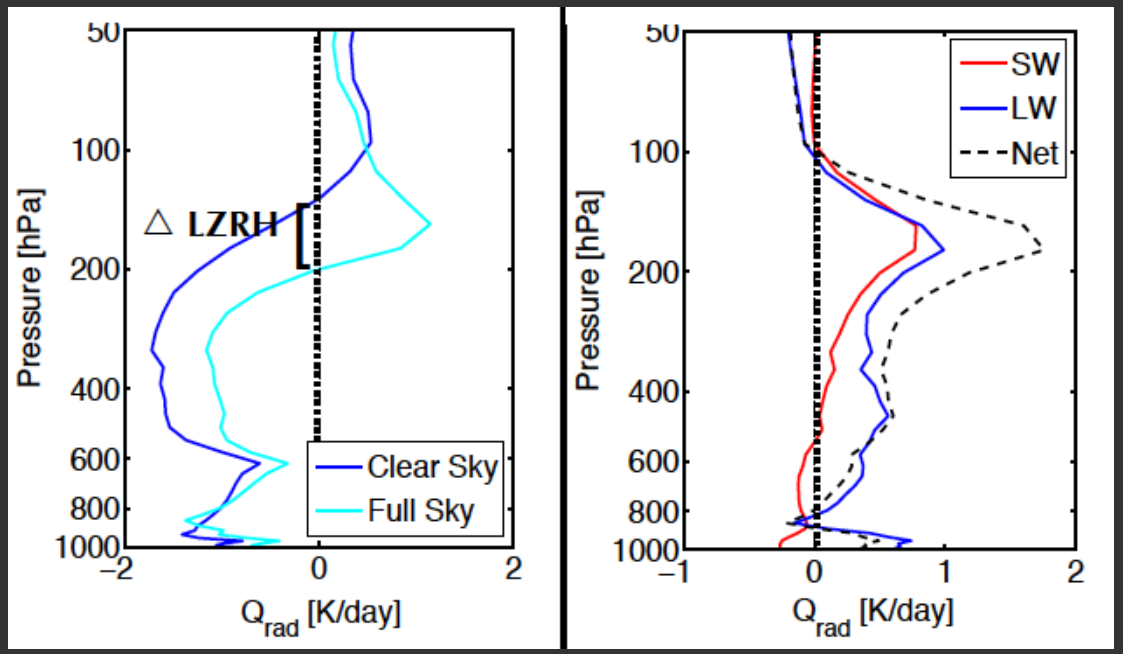


ERAi



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- Missing tropopause-level cirrus radiative heating!

- ERAi has too much cloud-radiative warming in the TTL

Conclusions

- higher cloud tops, shifts in tropopause, TTL Kelvin wave activity associated with the MJO
- Stratospheric Kelvin wave does not seem to be directly associated with the MJO
- No clear modulation of stratospheric gravity wave activity due to MJO
- TTL response at Manus much weaker than at Gan Island