Supplement of Atmos. Chem. Phys., 20, 15–27, 2020
https://doi.org/10.5194/acp-20-15-2020-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

Planetary boundary layer evolution over the Amazon rainforest in episodes of deep moist convection at the Amazon Tall Tower Observatory

Maurício I. Oliveira et al.

Correspondence to: Maurício I. Oliveira (mauricio.meteorologia@gmail.com)

In the main manuscript, high-frequency, multi-level measurements performed at a 80-m tall tower of the Amazon Tall Tower Observatory (ATTO) are analyzed during the passage of outflows generated by deep moist convection. In order to give the readers confidence in the results, we included in this supplementary material figures of precipitation evolution for all events (Fig. S1), and of raw wind velocity and temperature data for events 1 and 2 (Figs S2 and S5 at all levels). Only events 1 and 2 have been chosen because we could easily identify four different parts in these events from the analysis of sensible heat fluxes: before the gust front (I); the period of upward heat flux that marks the gust front arrival (II); the period of large downward heat flux that corresponds to enhanced storm-generated turbulence (III) and the wake period after the event (IV). Besides, following the suggestion of reviewer #1, a spectral analysis has also been done. For each different portion (I, II, III and IV) of events 1 and 2, we analyzed multiresolution TKE spectra (Figs. S3 and S6) and heat flux cospectra (Figs. S4 and S7) at all levels. Further information regarding multiresolution decomposition can be found at Howell and Mahrt (1997), Vickers and Mahrt (2003) and Voronovich and Kiely (2007).

The main remarks are:

- Precipitation was never large. Total precipitation along the entire duration of the events was 2.3, 1.0, 5.3 and 1.5 for events 1 to 4 respectively;
- Reviewer #1 pointed that "*there may be an issue with vibrations of sensor mounts and tower that affects measurements during storms*". However, TKE spectra and heat flux cospectra are, in all cases, well-organized, tending to zero in the high-frequency limit, indicating that there is reduced levels of noise. Besides, the upward or downward fluxes happen over the entire range of turbulence scales, being well organized vertically as well. They also show that the 1-min time window captures the majority of the turbulent fluctuations. It gives us a high degree of confidence in our dataset.
- The raw velocity and temperature turbulent data from events 1 and 2 indicate the absence of spikes and random fluctuations.

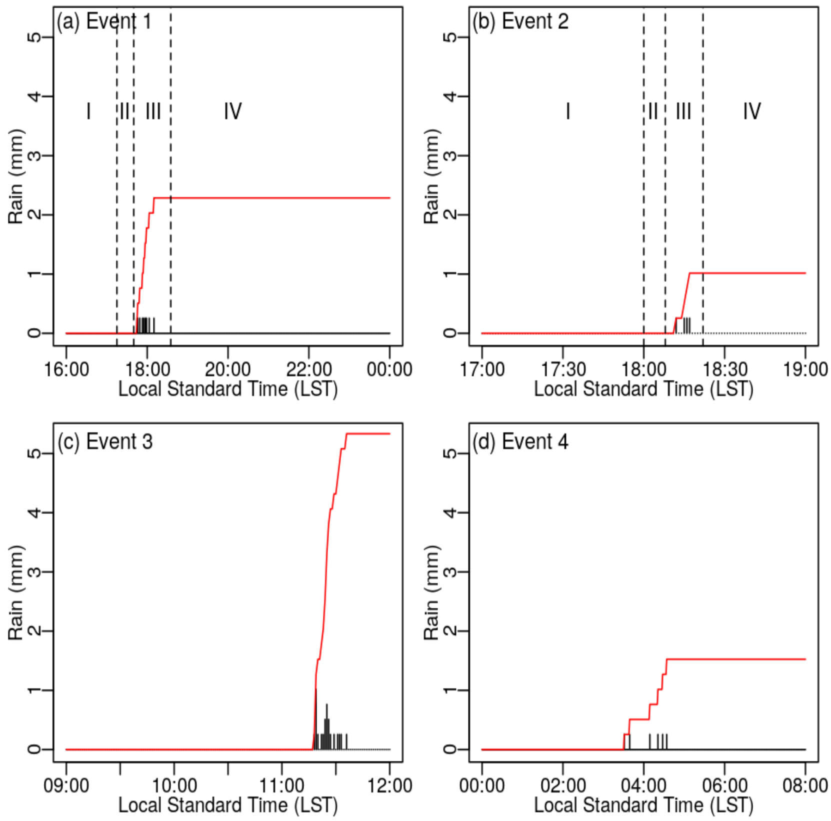

Fig. S1. 1-minute and total precipitation for each event.

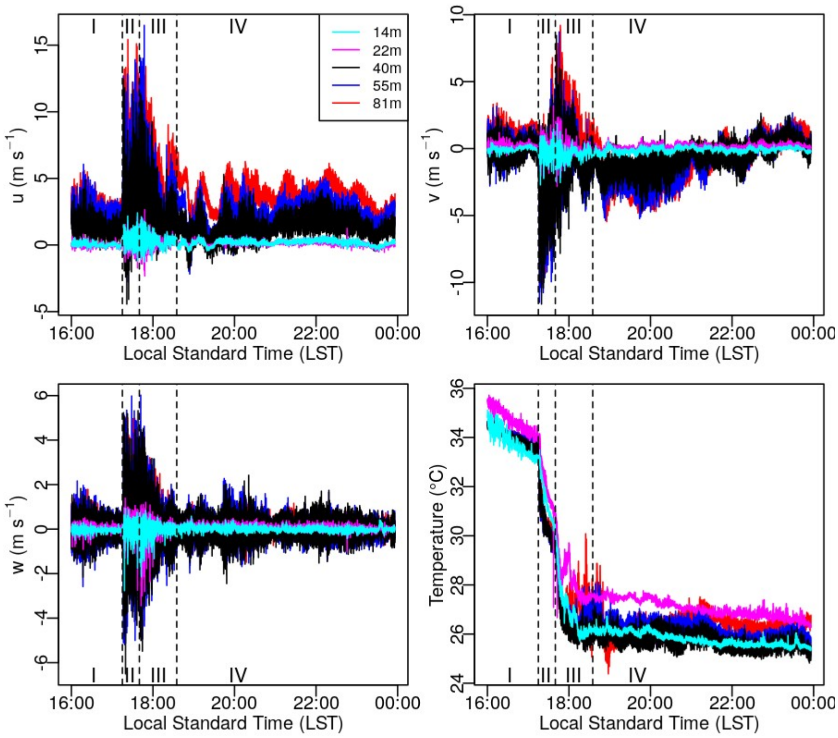

Fig. S2. Time series of the velocity components and temperature along event 1.

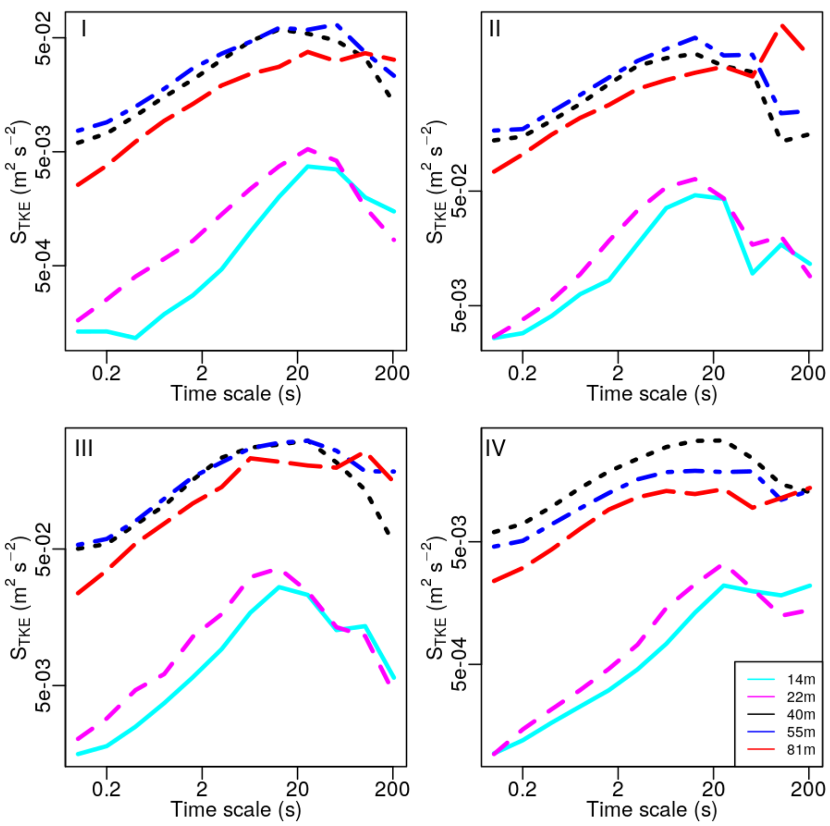

Fig. S3. Multiresolution TKE spectra for the 4 periods of event 1.

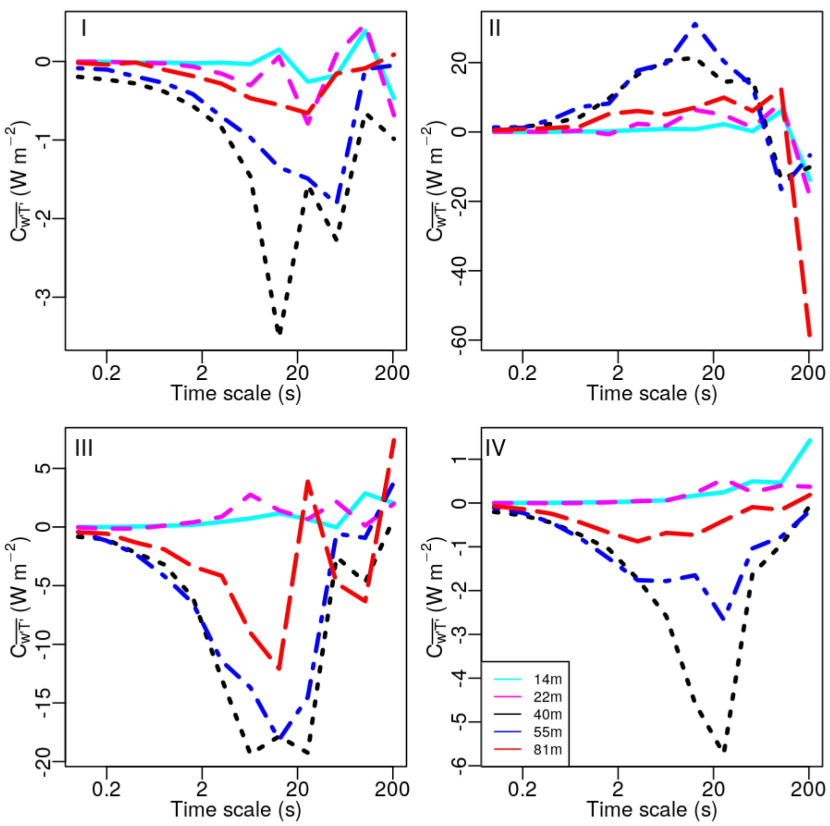

Fig. S4. Multiresolution heat flux cospectra for the 4 periods of event 1.

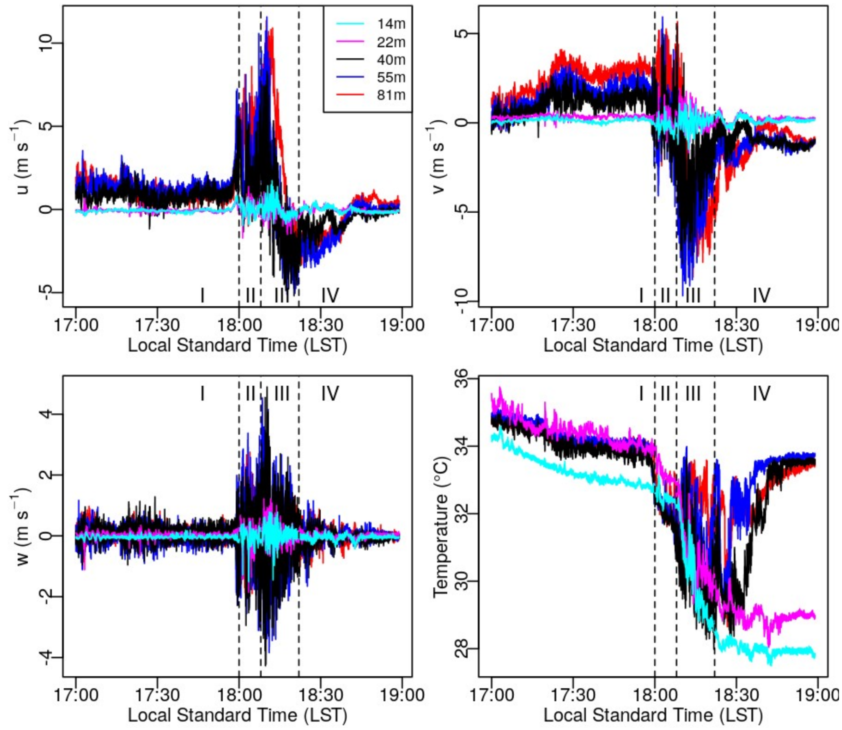

Fig. S5. Time series of the velocity components and temperature along event 2.

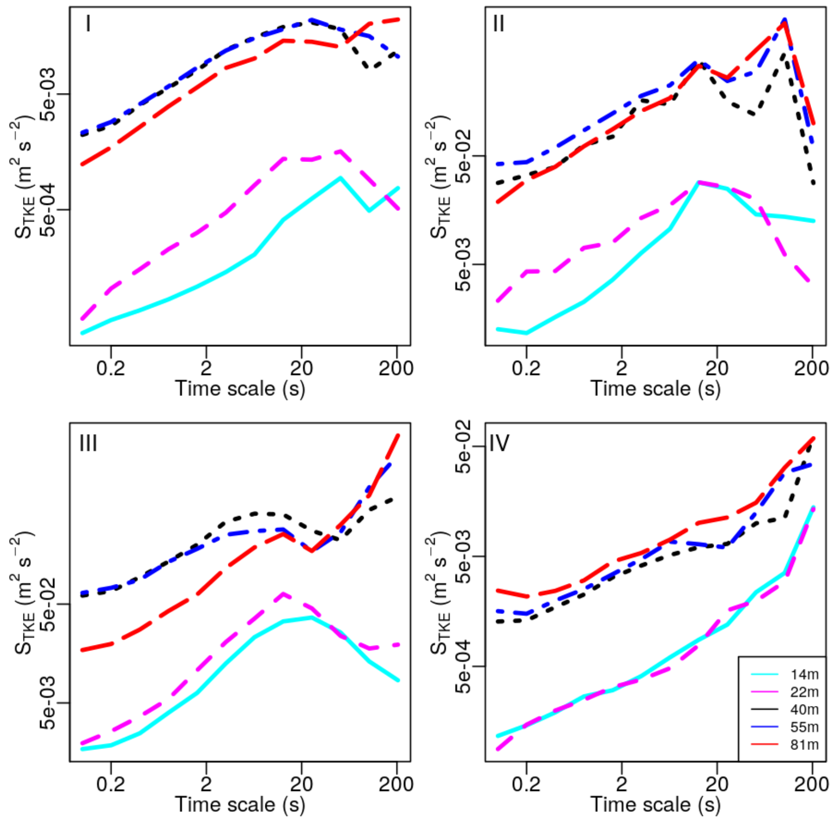

Fig. S6. Multiresolution TKE spectra for the 4 periods of event 2.

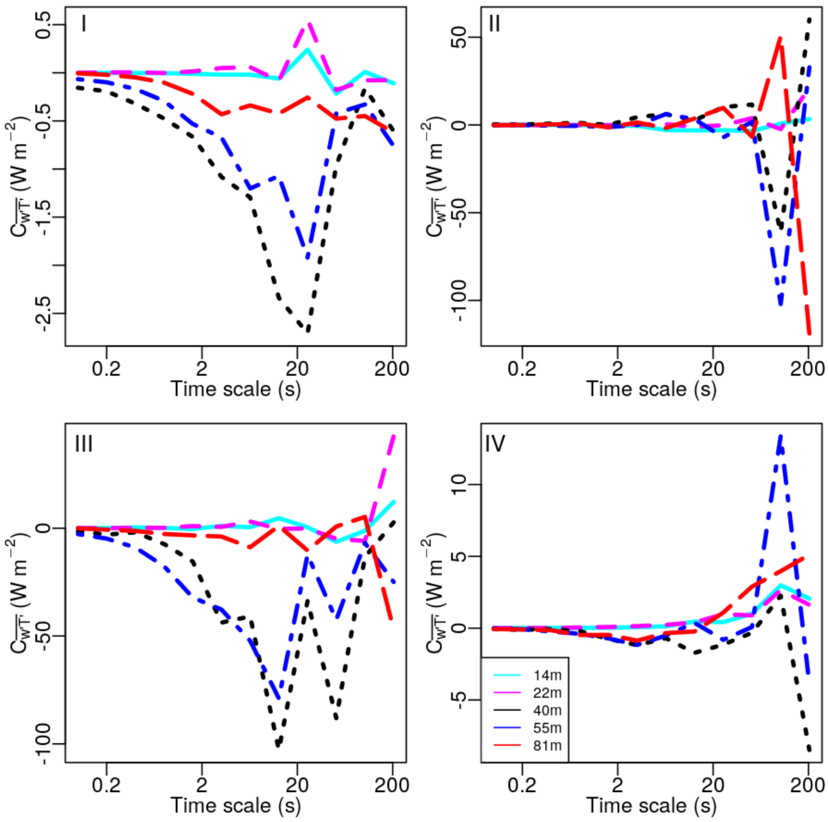

Fig. S7. Multiresolution heat flux cospectra for the 4 periods of event 2.

REFERENCES:

HOWELL, J. F.; MAHRT, L. Multiresolution flux decomposition. Boundary-Layer Meteorology, v. 83, n. 1, p. 117–137, 1997. ISSN 1573-1472.

VICKERS, D.; MAHRT, L. The cospectral gap and turbulent flux calculations. Journal of atmospheric and oceanic technology, v. 20, n. 5, p. 660–672, 2003.

VORONOVICH, V.; KIELY, G. On the gap in the spectra of surface-layer atmospheric turbulence. Boundary-Layer Meteorology, v. 122, p. 67–83, 2007.