

Accepted Manuscript

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PII: S0169-8095(17)30772-X
DOI: <https://doi.org/10.1016/j.atmosres.2017.12.016>
Reference: ATMOS 4152
To appear in: *Atmospheric Research*
Received date: 23 July 2017
Revised date: 8 December 2017
Accepted date: 28 December 2017

Please cite this article as: Diogo Nunes da Silva Ramos, Julio Pablo Reyes Fernandez, Gilberto Fisch, Evolution of the Planetary Boundary Layer on the northern coast of Brazil during the CHUVA campaign. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Atmos(2017), <https://doi.org/10.1016/j.atmosres.2017.12.016>

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Evolution of the Planetary Boundary Layer on the northern coast of Brazil during the CHUVA campaign

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Abstract

This study aims to characterize the wind and thermodynamic structure of the Planetary Boundary Layer (PBL) on the northern coast of Brazil (NCB) via the CHUVA datasets. Three synoptic conditions were present in the NCB region between March 1 and 25, 2010: a dry period, the Upper Tropospheric Cyclonic Vortex (UTCV) and the Intertropical Convergence Zone (ITCZ). Nighttime precipitation accounted for 78% of the total precipitation observed in the month, mainly during the ITCZ. In general, the surface meteorological fields were few changed by intense weather events due to proximity to the ocean and the predominant contribution of the northeasterly trade winds. There was also a weak sea breeze signal that maintained the horizontal moisture flow in the studied area. On dry days, the PBL depth was higher, drier, and warmer, resulting in stronger winds below 500 m. Moreover, trends throughout the period suggest that PBLs are near-neutral below 500 m. However, the wind variability was intensified by up to 20% due to downdrafts and higher wind shears during the deep convection mechanisms derived by UTCV. Furthermore, ITCZ mixed rainfall cooled the PBL at approximately 2 K, making it very stable according to the Richardson number classification adopted. The observed temporal and spatial scale represent challenges to the physical parameterizations used to improve numerical weather prediction models over tropical coastal areas.

Keywords: Tropical Planetary Boundary Layer. Lapse rate. Wind profile. Atmospheric stability. Nighttime precipitation.

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