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Wind profile at tropical coastal boundary layer based on wind tower and SODAR measurements

Diogo Ramos and Gilberto Fisch
Instituto de Aeronáutica e Espaço, Departamento de Ciência e Tecnologia Aeroespacial, Brazil (diogonsramos@gmail.com)

The near-neutral stability condition is common in oceanic and coastal regions during fair weather. The aerodynamic roughness above ocean surface favors more intense winds and dynamically less turbulent. However, some changes in the planetary boundary layer (PBL) thermodynamic structure during the occurrence of synoptic events are complicated and very difficult to predict numerically especially the wind intermittency and the thermal stratification. This work evaluates the wind profile in the Northern coast of Brazil during the wet season transition using data collected in April 2012 by a Sonic Detection And Ranging (SoDAR), and in April 2017 by an 100 m anemometer tower were analyzed. The synoptic conditions in both periods had negative precipitation anomaly close to 30%, resulting in more intense surface winds than the local climatology. Although the data were obtained for different years, the easterly winds were predominant, and the surface characteristics certainly favor the maintenance of microscale patterns over the studied area. The SoDAR wind data (from surface up to 180 m) indicate a stratification with two distinct layers delimited at 50 m height. Below this level the wind profile tends to logarithmic adjustment. However, above it, the wind distribution curvature suggests a dynamically stable environment. The information collected in the tower also reproduces the locally neutral pattern throughout the daily cycle. The peak wind speed was observed between late afternoon and early evening, probably due to the influence of sea breeze. The winds registered up to 50 m were slightly more intense between 6 and 12 hours local time than between 18 and 0 hours, mainly in April 2012. This signal is an indicative of the land breeze component, which is weaker during the wet-dry regime. The wind gradient oscilate less than 2 m/s in the higher levels (> 70 m) and less than 1 m/s in the lower levels (< 30 m) during all the diurnal cycle. The averaged wind profiles shows a tendency to the neutrality adjustment, in more than 80% of the period analyzed. This result was unexpected because this period has been defined by a rainy month, where a major frequency of the stable conditions is more common. Future work may be directed at investigating the thermal stability wind profile during the transition season, seeking to identify which type of turbulent regime dominates the local near-neutral stability on the PBL structure.