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Low level winds in a coastal site in the northeast of Brazil

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The surface and lower level winds is a key parameter for several meteorological applications like weather forecast, air quality dispersion models and also to support space launching. The winds inside the boundary layer (up to 1 km) at the Brazilian Space Launching Center (CLA) in Alcântara, MA, Brazil, is influenced by the intense trade winds (higher than 5 m s-1) and a sea breeze circulation. The CLA is located near the equator (2˙ 19’ 10” S) right at the coastal line. Previous measurements made by remote sensing (microwave radiometer) and in situ (rawinsoundings) indicated that the Convective Boundary Layer (CBL) is typically around 600 m height, very similar from the Marine BL (MBL) obtained from literature. Also, the winds inside the surface boundary layer were investigated using a long time series (1995-2010) data from a 70 m tall tower with 6 levels of windspeed and direction. During the dry season the windspeed ranges between 6.0 -7.0 m/s close to the surface (10 m), reducing these values (from 5.0 up to 6.0 m/s) for the wet season. Due to the strong winds, the atmospheric stability is near-neutral most of the time without the daily cycle dependence. The wind profile follows a logarithmic profile and some micromet parameters were derived: friction velocity values ranged from 0.32 (wet) up to 0.46 (dry) and roughness length from 0.19 (wet) up to 0.24 (dry), showing a seasonal dependence with the rainfall regime. Recently, a minisodar was installed at this site to extend the windprofile up to 200 m and the preliminary results showed that the logarithmic profile is valid up to 150 m. The power law coefficient was also determined from the wind tower data and it ranged from 0.2 up to 0.3 which is higher than the observed values over free water. The topography of this place is quite complex with a step cliff (40 m height) at the coastal line. Numeric simulations and wind tunnel tests made previously suggested that an Internal Boundary Layer (IBL) is able to developed with a typical height of 20 m at 150 m from the edge of the cliff. The advection of the MBL inland guarantees a quasi-steady inversion height for the CBL, as far as7 km inland (the site of rawinsounding launchings). The winds within the boundary layer (BL) and just above it show a diurnal relationship. From midnight to noon, the BL wind seems to increase and rotate clockwise, while in afternoon to late evening it seems to decrease and rotate counterclockwise. Above the boundary layer between 1000 m and 1500m, the wind shows almost an opposite behavior but with a smaller rotation. The entire rotations, for BL and above it, are about 45 degrees or less around NE, showing no reversal in the flow direction. It is likely that any horizontal pressure gradient resulting from the thermal contrast between land and sea is not strong enough or do not have component anti-parallel strong enough to cancel or overcome the trade winds.