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Characterization of the lower boundary layer based on Sodar observations (2010-2013) in Bauru, São Paulo, Brazil

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Continuous Sodar observations from Bauru, located in the central State of São Paulo, are presented in this paper for a 4-year period (January 2010 – December 2013). The data were collected at the Meteorological Research Institute (IPMet) of the Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP), Campus Bauru, which is situated at the southeastern outskirts of the town, in a pristine environment with mostly indigenous vegetation. The medium-sized Sodar was programmed to record 60-minute averages of the vertical wind profiles (u, v, w) between 30 and 800 m above ground level (AGL, station height 624 m above mean sea level) at 30-minute intervals with a vertical resolution of 10 m. The data recovery was almost 100% in the first 160 m, subsequently diminishing gradually to 50% at 370 m, 20% at 500 m and then tailing off to only 1% at 800 m AGL. Since the Sodar is an acoustic sensor, the reception of the backscattered signals is strongly dependent on meteorological conditions. The maximum height of 800 m was maintained, despite the low recovery rate, because it is important for individual case studies. However, mean wind roses will only be presented up to 500 m AGL, to avoid a possible bias in sampling wind directions.

In this paper wind roses at selected heights are presented to document the variation of the wind direction and speed with height, as well as their seasonal variation. Besides the standard primary data of the 3 wind components, the scalar hourly mean wind speed and the mean vector direction, the Sodar also generates their standard deviations. Furthermore, a variety of derived parameters, such as shear, shear direction, sigma speed, sigma Phi, sigma Theta, turbulence intensity, Pasquill-Gifford (PG) stability class, turbulent kinetic energy and eddy dissipation rate are generated as hourly means at each height level and recorded as sliding means every 30 min. The Software also offers the facility to generate a separate daily file with so called Non-Profile Variables, providing a single value for every vertical profile of the following variables: PG stability, surface heat flux, Monin Obukov Length and friction velocity. These are important input data for dispersion modeling, but only being calculated under convective conditions (mostly mid-day & early afternoon). Furthermore, the maximum range of the backscatter signal, as well as estimates of the lowest inversion height and the mixing height, if detected, are also being recorded for every profile. However, the last two variables mentioned are only estimated from the backscatter profile and thus not very reliable. Nevertheless, since there is no RASS attached to this Sodar, the statistics of all these parameters do provide a good record of the diurnal variation of the nocturnal stable Planetary Boundary Layer and daytime instability.

Finally, the seasonal variation and characteristics of the nocturnal Low-Level-Jets (LLJs), developing on top of the surface radiation inversion, will be presented. These LLJs generally form during late evening at altitudes ranging from 200–500 m AGL, with maximum speeds of 12–25 m/s from east-south-east. They usually last until 08:00–09:00 LT (Local Time), when the inversion has been eroded by the solar radiation. LLJs could be identified on about 30-70 % of the days per month throughout the year. The practical importance of the LLJ lies in the rapid transport of moisture and pollutants in a narrow vertical band above the radiation inversion.