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Study of the evening transition to the nocturnal atmospheric boundary layer: statistical analysis and case studies

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Turbulence is probably the most important feature dealing with the diffusion of contaminants in the planetary boundary layer. The main characteristics of turbulence are governed, apart from synoptic conditions, by the daily cycle of the Earth surface heating and cooling, so that, simplifying, two configurations are often found: convective and stable. The transition from a diurnal convective boundary layer to a typically stable nocturnal one is not still well understood (Edwards, 2009). Different micrometeorological conditions at sunset or a few hours previously may be critical for the establishment of a strong surface-based stability or a weak one, even for similar synoptic conditions.

This work focuses on the characterization of the evening transition which takes place at the atmospheric boundary layer, considering the temporal interval 17.00-23.00 GMT. The methodology includes looking for some relations between meteorological variables, turbulent parameters and particulate matter (PM10, PM2.5 and PM1) concentrations measured by a GRIMM particle monitor (MODEL 365). Observational data (Summer 2009) is provided from permanent instrumentation at the Research Centre for the Lower Atmosphere (CIBA) in Valladolid (Spain), which is on a quite flat terrain (Cuxart et al., 2000). A 10m height mast equipped with temperature, wind speed and direction, and moisture sensors at several levels are available. Also two sonic anemometers (20 Hz sampling rate) at 1.5 and 10m were deployed in the mast. The database is complemented by a triangle of microbarometers installed next to the surface, and another three microbarometers placed in a 100m meteorological tower at 20, 50 and 100m respectively, which are ideal to study coherent structures present in the boundary layer.

Statistical parameters of meteorological variables have been calculated and studied in order to find out connections with the most relevant physical processes. Moreover different cases studies will be analyzed, where multiscale methods are applied in the analysis of field data, namely the wavelet transform and the multiresolution decomposition (Vickers and Mahrt, 2003; Viana et al., 2009), in order to evaluate the contribution of different scales to the total kinetic energy and heat fluxes during the evening transition.

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