



## **Radiative forcing effect on the generation of submeso motions in a low-wind boundary layer**

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This work investigates the characteristics of submeso motions and their influence on the dynamics of the atmospheric boundary layer in different stability conditions. Submeso motions generally refer to a complex mix of non-stationary stochastic processes of different nature on scales that separate the main turbulent eddies (few meters in stable conditions) and the smallest mesoscale motions (few kilometres). Submeso motions can take a variety of forms including gravity waves, density currents or drainage flows. During low-speed conditions submeso activities manifest themselves as horizontal meandering of the wind velocity vector. Meandering generally refers to large non-turbulent oscillations of the horizontal wind velocity components, associated to the oscillation of the wind direction and temperature. Although horizontal meandering is typically associated to stable stratifications of the boundary layer, wavelike oscillations associated to low turbulent activity have also been observed in diurnal conditions. Some insight in the understanding of the meandering dynamic has been achieved, but the causes of the meandering phenomenon and its complex interactions with turbulence are still poorly understood. While these modes may have a strong impact on the horizontal transport of pollutants in the presence of weak and intermittent turbulent mixing, their accurate parameterisation within weather and climate models remains an open question. In this work we study the role of radiative forcing on the generation of horizontal meandering in different stability conditions. To this purpose, measurements of wind velocity components, temperature, radiation, CO<sub>2</sub> and water vapour concentrations carried out at two distinct sites (Santa Maria, Brazil; Ny-Ålesund, Svalbard, Arctic) were analysed. To detect meandering occurrences and their characteristic time-scales Eulerian autocorrelation functions and spectral analysis of the wind components and temperature are employed. Horizontal meandering is identified by a clear negative lobe in the Eulerian autocorrelation functions corresponding to a peak located at low-frequency in the spectra of wind components and temperature. The performed analysis confirmed that horizontal modes represents a distinctive feature of the very stable boundary layer, characterised by a strong radiative cooling, low wind conditions and a weak and intermittent mechanical turbulent production. Horizontal meandering has been observed also during daytime in presence of low positive radiative forcing, often related to cloudy conditions and weak large scale flows. In all atmospheric conditions meandering appears strongly correlated to scalar oscillations, confirming its important role in the horizontal transport of pollutant in low-wind conditions.