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Impact of different types of gravity waves on the turbulent eddies, exchange coefficients and location of the spectral gap

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Wave-turbulence interaction is an unresolved point in atmospheric boundary layer studies. However, it is a key problem in the stable boundary layer which appears often during nights, where turbulence is inhibited by the stratification. When waves are present, the unsteadiness in the flow and the modified instantaneous fields of wind speed and temperature are the main cause for turbulence generation. The wave-modulated turbulence can extract or transfer energy to the wave; the turbulent fluxes usually show a periodic component, and appear sometimes accompanied by counter-gradient transfers produced by motions at the scale of the wave. A proper representation of these interactions can have important practical effects on the forecasting of minimum temperatures, formation and dissipation of fogs or diffusion of atmospheric pollutants, as these features are badly resolved by the usual atmospheric numerical models.

Several episodes of gravity waves of different nature where identified during SABLES2006 field campaign, which was carried out on a relatively flat and homogeneous terrain over an extensive high plain in the northern plateau of the Iberian Peninsula. Among the different events under study are: a strong mesoscale ducted gravity wave of high amplitude, waves on the top of a drainage flow and local evanescent gravity waves. In this work, we analyze some of these episodes focusing on the turbulent activity enhanced and/or modulated by these waves. MultiResolution Flux Decomposition (MRFD) is applied to sonic anemometer data at different levels of a 100-m tower. This is a valuable tool which can represent the timescale dependence of the momentum and heat fluxes. Several characteristics of the turbulence can be easily inferred from MRFD cospectra, namely: the mean size and timescale of the turbulent eddies, its size distribution, the timescale (if exists) of the spectral gap separating turbulence from wave and mesoscale motions, etc. The location of the spectral gap provides a way to reduce errors in the estimation of turbulent fluxes, allowing a more precise evaluation of other turbulent parameters, such as turbulent exchange coefficients. These and other related issues will be addressed for a better understanding of wave-turbulence interactions.