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# Low-level Jets, Turbulence and Waves in the Tyrrhenian Coastal Zone as Shown by Sodar

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The low-level jet (LLJ) in the atmospheric boundary layer is a fast increase of the wind speed with height up to a certain maximum magnitude (5-20 m s-1) at some altitude (50-1000 m), and a further decrease above this level. Different remote sensing devices as radars, lidars and sodars allowed not only to measure the vertical profiles of wind velocity, but also to visualize the spatial and temporal structure of turbulence within the LLJ. However, till now, some aspects of this phenomenon (especially, the behaviour of the turbulence structure within it) need to be deepened.

A long-term monitoring of the planetary boundary layer using a sodar and micrometeorlogical sensors was carried out in proximity to the coast of the Tyrrhenian Sea (Tarquinia, Italy). Some results concerning the behaviour of the coastal boundary layer are presented. This zone is under the strong influence of local circulation producing rather regular daily variations in the wind field and different atmospheric boundary-layer turbulence regimes. The seasonal statistics of the diurnal cycle of meteorological and turbulence parameters for a two-year period has been done. Sodar observations showed some interesting features of the structure of lower troposphere not observed earlier. During the nighttime and early morning hours, LLJs are often observed together with two separated turbulent layers below and above the wind-speed maximum. The LLJ peak magnitude reaches 8-12 m s-1 at heights between 200-250 m. The upper layer extends up to 400-500 m. The wind shears below and above the maximum are respectively 0.035-0.040 s-1 and 0.025-0.030 s-1. A high-resolution visual inspection of sodar echograms allowed us to reveal and expose Kelvin-Helmholtz billows (KHBs) exhibiting the braid (or, herringbone) structure with different tilts within these layers. Such a wave pattern is in line with some earlier hypothesized assumptions on the possible structure of LLJ flows. The angle of braid tilts seems to be connected with the height dependence of the mean flow speed within a wavy layer. As shown in some recent papers, the vorticity of the wind disturbance within KHBs may be either clockwise or counterclockwise, depending on the wind gradient profile. If the wind speed increases with height, then the upper part of the braid structure appears over a sodar first, and, on the echogram, the tilt will be shown directed from the point on top left side to the right bottom. If the wind speed decreases with height, then the lower part of a braid appears first, and the tilt direction will be from the point on the left bottom side to the up right point on the sodar echogram. Previous observations showed mostly the first case or the second one, but never the two patterns simultaneously.