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The interaction between a low-level jet and the boundary layer in complex topography

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A study investigating the effect of a low-level jet (LLJ) event on the boundary-layer (BL) turbulent structure is presented. During a radiosounding campaign aimed at investigating the atmospheric circulation in the area of Mount Carmel and Haifa Bay in Israel (35E - 33N), characterized by a complex terrain and a winding and jagged coastline, a couple of consecutive profiles showed a significant LLJ in the morning of January 7, 2010. Since there are no previous measurements or information about frequency or characteristics of the LLJ in this region, the scarcity of observed data does not allow addressing the nature and features of the LLJ. Therefore, its characteristics and development, and also its impact on tracer dispersion, have been explored through model simulations, using RAMS atmospheric model. RAMS was configured with four nested grids with resolution from 32 km to 500 m. A high vertical resolution in the inner grid was achieved with 15 levels below 400 m, using a vertical nesting with a rather novel approach not frequently adopted. RAMS simulated variables were verified against the available observations, providing a reliable reproduction of the LLJ pattern. An elevated inversion characterized the temperature profiles and the LLJ was located at the bottom of such inversion. An analysis of the turbulence kinetic energy (TKE) versus a jet-Richardson number showed that a strongly turbulent weakly-Stable-BL was characterizing the LLJ episode. At the hours of the peak of the LLJ event, 0700 and 0800 UTC (0900 and 1000 LT), two separate maxima, generated below and above the layer affected by the LLJ, appeared in the TKE vertical profiles due to the strong wind shear. Being a morning LLJ, when buoyancy-driven vertical motions started to develop they acted sustaining the turbulence below the LLJ, then decaying at higher elevation opposed also by the strong wind speed at the LLJ level. These and other results are presented and discussed, as a contribution to the understanding of LLJ dynamics and its impact on the boundary layer in complex topography.