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Effects of surface heterogeneity on basin-scale circulations and associated turbulence

Daniel Martínez (1), Maria Antònia Jiménez (1), Joan Cuxart (1), Larry Mahrt (1,2)

(1) Universitat Illes Balears, Physics Dept., Palma (Illes Balears), Spain (dani.martinez@uib.cat), (2) College of Oceanic and Atmospheric Science, Oregon State University, Corvallis, OR

The turbulence in the nocturnal boundary layer is difficult to characterize. Under stable conditions, the nocturnal cooling within large basins depends strongly on the local topography and the land use. In order to analyze the temporal and spatial heterogeneity of the surface cooling, a large basin with relatively wide and flat floors is selected for a case study under very stable conditions. This basin surface temperature field represents the surface boundary conditions that affect the generation of turbulence. It is analyzed using satellite imagery, data from a meteorological network and from a tall tower located at the center of the basin.

A high-resolution mesoscale simulation is used to understand the organization of the within-basin flows when such surface heterogeneity is present. The inspection of mean profiles for each category shows that for the cases with jets, the stratification is weakly stable and the turbulence is the dominant cooling mechanism. For the strongly stratified cases near the surface, the turbulence flux convergence tends to warm partially the air and compensate for the radiative cooling.