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Analyzing features and impacts of mountain breezes at three different mountainous sites

Carlos Román-Cascón (1,2), Carlos Yagüe (1), Jon. A. Arrillaga (1), Marie Lothon (2), Fabienne Lohou (2), Eric Pardyjak (3), Mariano Sastre (1), Gregorio Maqueda (1), and Rosa M. Inclán (4)

(1) Departamento de Física de la Tierra y Astrofísica. Universidad Complutense de Madrid, Spain., (2) Laboratoire d'Aérologie, Université Toulouse Paul Sabatier, CNRS, France., (3) Department of Mechanical Engineering, University of Utah. Salt Lake City, United States., (4) Department of Environment, CIEMAT, Madrid, Spain

Near-surface observational data from three different sites have been analysed with the objective of analysing mountain breezes (thermal circulations). These sites are located in the foothills of the Guadarrama mountains range (San Lorenzo de El Escorial, Spain, ATMOUNT project), on a plateau close to The Pyrenees (Lannemezan, France, Centre de Recherches Atmosphériques site) and within the Salt Lake Valley (Utah, US, MATERHORN project). High-quality data during relatively long periods are available at these sites; therefore, a systematic and objective algorithm has been used to automatically detect the katabatic and anabatic events at each site. The detection algorithm is based on different criteria regarding local (tower) meteorological conditions complemented with synoptic conditions (temperature, wind and humidity data) obtained from the NCEP FNL Operational Model Global Tropospheric Analyses. A wide number of downslope and upslope wind events have been detected and studied with the aim of performing robust statistics about their features and influences. Special attention has been paid to their effects on the surface turbulence, stability conditions and variations in carbon dioxide and water vapour concentration and fluxes, thanks to the availability of data from high-frequency and gas analyser instruments. The statistical description has been complemented with the detailed analysis of specific and representative case studies, in order to better illustrate how these wind systems are influencing the local conditions at the three sites. The multi-site analysis allows determining similarities and differences between the three analysed areas and, therefore, to establish more robust conclusions about the mountain breezes features and impacts.