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Observed and simulated features of the phases of the sea-breeze in the island of Mallorca

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In order to better understand the diurnal cycle of the Sea-Breeze (SB) in the island of Mallorca, during September 2013 and June 2014 two experimental field campaigns have been conducted in the Campos basin (at the south side). A total of 6 IOPs (clear skies and weak pressure gradient conditions) are analysed using observations taken close to the coastline (about 900 m inland) that consist on a surface portable station (equipped with a temperature and humidity probe, and one 2-D and 3-D sonic anemometers), a captive balloon (temperature and humidity) and a multicopter (temperature and humidity). Besides, observations from automatic weather stations of the AEMET network are taken as well as satellite-derived surface temperatures that together with the model outputs from high-resolution mesoscale simulations are used to better understand the organization of the flow at lower levels.

With the combined inspection of observations and model results it is found that during the previous phase (after sunrise) land-breeze conditions were present and the sensible heat flux turned to positive meanwhile the turbulence started. In the preparatory phase (about 3 hours after sunrise) the wind close to the coast started to veer progressively towards the SB direction. As soon as the SB was initiated (about 5 hours after sunrise), the SB front progressed to the inland direction reaching a mature phase starting at noon. Afterwards, the SB decaying starts and close to sunset the wind speed was close to zero and veered towards the land to sea direction. During the campaign all phases were measured with special emphasis to the morning transition (from LB to SB) and the evening transition (from SB to LB) because of the strong wind shear (turbulence) reported during the mature phase.

It is found that for all the different phases the model is able to capture the organization of the flow at lower levels although it experiences some difficulties in reproducing the thermal profile during the preparatory phase, when the model energy budget usually differs a lot from the observed one. Nevertheless, at the end of this phase the model agrees with the observations, showing that the general energetics of the morning transition are well captured.