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Modelling the sea-land breeze patterns by using the WRF-ARW model in South-western Iberian Peninsula

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There are several sites in which the relationship between the atmospheric dynamics and behaviour of pollutants is difficult to understand, generally places with complex orography such as coastal areas or valleys. Inside the set of atmospheric circulations, sea-land breezes are a phenomenon widely studied in many regions around the world due to their interest in atmospheric dynamics and their impact on the local air pollution. Nowadays, to study with sufficient accuracy different aspects related to its structure and dynamics, such as inland penetration of the sea breeze front, the compensating return flow aloft or the features of the thermal internal boundary layer (TIBL) formation, is needed a Weather Prediction System (WPS). There is a lack of these studies in South-western Iberian Peninsula. Due to the orography characteristics, Guadalquivir valley, and emission levels, with industrial, urban or biogenic origin, this region is suitable to present air pollution problems. Therefore, the accurate understanding of the sea-land breeze characteristics will allow a reliable analysis of the air pollution. Thanks to observations, in previous works have been identified two different sea-land breeze patterns in this area, called as pure and non-pure. The aim is to increase the understanding of the meso-meteorological processes, analysing its structure, behaviour and evolution along the Guadalquivir valley, applying the mesoscale meteorological model of high resolution, Weather Research and Forecasting (WRF-ARW). Five meteorological stations, located in both coastal area and inland Guadalquivir valley, have been used to compare simulations and observations (wind speed and direction, potential temperature and specific humidity). The differences between them are in a wide agreement with the results presented in similar works. The model is able to reproduce the wind behaviour along the valley with better results for the non-pure type, while the wind speed are overestimated in both patterns. The potential temperature is underestimated, while the specific humidity presents a slight underestimation at the coast and an overestimation inland. Surface winds simulated show a short spatial development along the Guadalquivir valley for both sea-land breeze patterns, reaching a maximum horizontal extension of approximately 30-40 Km inland. The arrival of Mediterranean flows through transversal valleys over the Guadalquivir valley and the predominance of south westerly flows along the valley during the day limit the horizontal extension of pure and non-pure sea-land breeze. The wind field at different heights and the cross-section of the u and w wind components and specific humidity along the valley axis, reveals the low vertical development of the pure and non-pure sea-breeze pattern, less than 500 m. In addition, the modelling of the mixing height shows the valley division in case of the pure breeze in contrast with the more homogeneity observed for the non pure case. In both patterns, the maximum mixing layer height simulated is close to 1600 m, being also identified the formation of thermal internal boundary layer (TIBL) at the coastal area.