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Coastal diurnal cycle of summer clouds of Western Iberia

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During the summer, anticyclonic conditions are frequent off the coast of Iberia, causing prevailing northerly winds, large-scale subsidence, coastal upwelling and colder SSTs. These conditions allow the maintenance of extensive stratocumulus decks off the coast. In coastal regions and during nighttime, these decks frequently penetrate inland together with the marine boundary layer, leading to overcast and often foggy conditions which are dissipated during the morning. The aim of this study is to further explore and characterize this process, since little climatological information about it exists so far.

The EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) has recently released the so-called cloud property dataset using SEVIRI (CLAAS), which is a Climate Data Record (CDR) of cloud, surface albedo and radiation properties covering 9 years (2004-2013) of SEVIRI measurements. Their monthly mean diurnal cycle of cloud properties products are used here to explore the coastal diurnal cycle, in terms of cloud fractions and heights. These observations show the alternation between two different convection regimes over Iberian coastal regions: on one hand, diurnal deep convection development over land, with the growth of a well developed boundary layer due to strong surface heating followed by the formation of shallow cumulus that eventually become deeper over the afternoon; on the other the penetration of the stratocumulus decks over land during the night, with lower boundary layers and higher cloud fraction.

The results are compared to regional climate simulations performed with the Weather Research and Forecast model (WRF) over Iberia, forced by ERA-Interim reanalysis and two resolutions; a 50km Euro-Cordex and high 9km resolution. The model reproduces the observed diurnal cycle of clouds in the summer remarkably well, especially regarding the evolution of the spatial patterns of cloudiness during the diurnal cycle. The model is then used to explain the observations: it is shown that the clouds disappear during daytime due to the sea and mountain breeze circulations and associated heating/cooling patterns; mountain ranges play a critical role in the separation between the aforementioned convection regimes as they enhance convection locally, limiting the extent of which the stable stratocumulus decks are able to penetrate inland.