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Numerical study of a non-forecasted sea breeze thunderstorm in the Eastern Iberian Peninsula. Part II. The role of strong low-level sea breeze convergence in initiating severe weather

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In the second part of this numerical study of a non-forecasted sea breeze thunderstorm occurred in the eastern complex area of the Iberian Peninsula (Spain) on 7 August 2008, the overall goal is to get better knowledge of the bounday layer convection associated with sea breezes in the apparent absence of synoptic scale forcing. As it is described in the first part of this numerical study two grid-spacing setups (5.0-km and 2.5-km) of the operational High Resolution Limited Area Model (HIRLAM) and also the non-hydrostatic spectral HARMONIE model (2.5-km) are used to simulate convection associated with sea breezes. The convective inhibition (CIN), the convective available potential energy (CAPE) and the vertical velocity (OMEGA) are examined here in order to analyse the role of strong low-level sea breeze convergence in initiating severe weather under non-well defined synoptic disturbances. The spatio-temporal horizontal structure of the wind vectors (W) along with precipitation (PREC), CIN and CAPE fields simulated with the higher resolution (2.5-km) are analysed in order to reveal the areas where strong low-level sea breeze convergence and PREC occurred, and to show how CIN and CAPE layers are modulated by surface winds. The HIRLAM and HARMONIE models are capable of resolving sea breeze circulation at 5 and 2.5-km grid resolution. Horizontal cross-sections of low level W field revealed a well-defined discontinuity (leading edge of sea breezes were distinctly visible) under offshore moderate westerly-southwesterly winds over the lower plateau of the Iberian Peninsula, which interact with well-developed onshore easterly-southeasterly sea breezes penetrating few km inland from the Mediterranean Sea. Consequently, a strong horizontal sea breeze convergence intensification was observed over the Iberian System mountains. Frictional effects produced by terrain and anabatic winds also caused sea breeze front intensification. A very small and isolated PREC area developed, occurring most of the accumulated precipitation late in the afternoon. The low-level convergence caused sufficient vertical displacement of parcels to overcome the CIN, and the convection deepened rapidly to the tropopause. In addition, some positive availability of potential energy (CAPE) was observed for this significant severe weather event. Vertical cross-sections also showed the structure of the sea breeze boundary with strong updrafts vertical motion at the leading edge (reinforced by mechanical orographic lift and valley-slope winds) and downdrafts on their flanks. We can conclude that location of thunderstorms along the eastcoast of the Iberian Peninsula is mainly controlled by the location and movement of sea breezes, and the spatial-temporal evolution of CIN, CAPE and OMEGA. Evolution of the sea breeze is also important when forecasting severe weather events.