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Sea breeze convergence and convective cloud frequencies from AVHRR data over Mallorca Island

C. Azorin-Molina (1,2), J. A. Guijarro (3), R., Baena-Calatrava (4), A. Jansà (3)

(1) Laboratory of Climatology, University Institute of Geography, University of Alicante, Spain, (2) Group of Climatology, University of Barcelona, Catalonia, Spain, (3) Instituto Nacional de Meteorología, Palma de Mallorca, Spain, (4) High Technical College of the University of Jaen, Spain, (cesar.azorin@ua.es / Fax: +34 96-5909485 / Phone: +34 96-5909455 Ext. 9455)

The short-term forecast of the timing, location and intensity of the sea breeze convection is currently one of the most difficult atmospheric phenomena since forecasting tools available are not enough. The line of Cu clouds associated with the low level convergence and the sea breeze complex interactions with the features of the coastline, the small-scale terrain and the large-scale synoptic flows is the main feature of this β-mesoscale circulation. The boundary layer convergence zones developed by the sea breeze can generate scattered local heavy showers and thunderstorms under a slightly unstable atmosphere, which can be extraordinarily severe when they produce hailstone and gusty winds. AVHRR data from the NOAA-17 (0900-1200 UTC) and NOAA16 (1200-1500 UTC) satellites were collected during 1-year period (March-October 2004) over the Mallorca Island (Spain) for computing high-resolution (1.1 km) convective cloud composites. Ten-minutes wind direction and speed surface observations from 3 meteorological stations located on the SW (Palma), the NE (Pollensa) and the SE (Portocolom) coast were used in order to calculate overall wind convergence values over the island. First results show most prominent areas for convective development under different sea breeze convergence categories: (1) Non-sea breeze convergence, $<$5 (10-5 s-1); (2) Light to moderate sea breeze convergence, 5-10, and (3) Strong sea breeze convergence, $>$10. It is found that strong convergence values enhance sea breeze cloud convection and the sea breeze front is well-organized over the centre of the island, especially during the morning orbits. Light to moderate sea breeze convergence also produces a clear but weaker line of Cu clouds.

Non-sea breeze convergence weakens the boundary layer discontinuity and develops widespread clouds either over the island and the Western Mediterranean sea. A non-eulerian numerical model is used in order to simulate the diurnal evolution of the mesoscale sea breeze field and to support satellite observations. The high-resolution convective cloud composites are a powerful tool on diagnosing the convection associated with the sea breeze.