

The role of mathematics in the explanation of the dynamics of meteorological situations that produce heavy rain over the spanish mediterranean zone

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Heavy rains are the natural hazards that annually produce the greater number of mortal victims as well as numerous economic losses. Mainly in autumn, the Spanish Mediterranean zone, in particular the Valencian area, is affected by these meteorological phenomena of remarkable form. The more frequent meteorological situation that produces such episodes can be characterized at surface by an European anticyclone and a weak cyclone located on the Algerian coast that produce humid winds from the East impinging on the Spanish Mediterranean coast. In the middle and high troposphere a cold closed low or trough usually is located on the gulf of Cadiz, producing Southwest flux over the western Mediterranean. The conceptual model that can be designed from the synoptic situation attributes an important paper to the orography, that it is the factor that produces enough lifting to the humid currents to trigger the convection. The evaporation from the sea is the responsible for the amount of water vapor that drags the flow associated with the Algerian low. The validity of this conceptual model has been studied (Romero et al. 2000) through the numerical simulation of several cases of torrential rain by means of the application of the factors separation technique developed by Stein and Alpert (1991). In order to analyze the role that plays the disturbance of high levels we apply techniques of numerical diagnosis for the determination of the ingredients that are favorable to the development of convection and intense rain. In particular we discuss the role of the Potential Vorticity nucleus, associated with the cold upper levels low, trough numerical simulations. Initial conditions in the model have been modified weakening the Potential Vorticity field and using the invertability methodology (Davis and Emanuel, 1991). The results show that the high level Potential Vorticity is the responsible for the development of an easterly low level jet. The interaction of such circulation and the orography determines the focalization of the heavy rain (Homar et al. 2002, Romero et al. 2005).

References

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