SYNOPTIC AND MESOSCALE ASPECTS OF TWO FLASH FLOOD EVENTS IN EASTERN SPAIN PRODUCED BY LONG-LIVED QUASISTATIONARY MCSs: ROLE OF ATLAS MOUNTAINS AND LATENT HEAT RELEASE

R. Romero, C. A. Doswell III and C. Ramis*

National Severe Storms Laboratory, NOAA/ERL,
Norman, Oklahoma

*Meteorology Group, Departament de Fisica,
Universitat de les Illes Balears, Palma de Mallorca, Spain

Devastating flash floods are relatively frequent in coastal areas of Mediterranean Spain. These events are typically produced by quasistationary mesoscale convective systems (MCSs), which tend to be most frequent and intense during the autumn season because the Mediterranean sea is quite warm after the summer's insolation, thereby ensuring considerable moisture supply and low static stability in the overlying air. In this work, we investigate the synoptic and mesoscale settings in which two MCSs that attained extraordinary stationarity and longevity developed. Both systems (3-4 November 1987, and 20 October 1982) affected the Valencia region (eastern Spain), lasted more than 30 and 12 h and produced rainfalls in excess of 800 and 400 mm in 24 h respectively.

The analysis evidences the large-scale similarities of the events (both fulfill the climatological essence of these phenomena: cold-core troughs or cutoff lows aloft about southern Spain and a long fetch of flow over the Mediterranean interacting with the terrain features of eastern Spain), but at the same time stresses the unique characteristics of each event. One of the events (3-4 November 1987) developed within a quite stationary and dynamically weak synoptic context. The other MCS did not occur within such static conditions, but under strong dynamic forcing at middle and upper levels and appreciable baroclinicity of the flow. In the first case, the stationary character of the convective system seems to be linked to the stagnancy of the large-scale pattern itself; in the second case, uninterruption of the easterly moist flow and upward forcing owing to the peculiar behaviour of the disturbance –mobile, but along a cyclonic path about the south Mediterranean- seems to have been an important factor.

A set of mesoscale numerical simulations using The Pennsylvania State University-National Center for Atmospheric Research model are conducted. In both cases, the used mesoscale model is able to provide accurate spatial details of the precipitation field as well as capture its long stationarity, but as expected the quantitative forecast is worse. Also, model output fields suggest the development of a surface meso-low by condensational latent heat release, and lee cyclogenesis over the Mediterranean by the action of the north-African Atlas mountains. It is hypothesized that these mesoscale pressure patterns could have played an important role in both events by providing low level convergence and enhanced upslope winds. Thus, the effects of latent heat and Atlas factors are isolated using a numerical separation technique. For the event of 3-4 November, the latent heat factor was decisive for the focalization of the precipitation maximum over central Valencia, and the Atlas topography induced rainfall enhancement over the same zone. For the event of 20 October, however, the first factor was identically important, whereas the Atlas factor imposed a general rainfall suppression. This negative effect is contrary to the general assumption, already demonstrated for particular case studies, that the Atlas-induced modulation of the surface pressure field is essential for the genesis of heavy precipitations over eastern Spain. Such anomaly could be attributed to a negative interaction between the Atlas and the uncommonly observed great influence that the upper levels dynamics and frontal forcing exert on this case.

Acknowledgements. This work was performed while the first author held a National Research Council-National Severe Storms Laboratory Research Associateship. Also, computer support provided by NCAR/Scientific Computer Division for meteorological data preprocessing is acknowledged. Precipitation data and Meteosat satellite pictures were provided by the Spanish Instituto Nacional de Meteorologia (INM).