P6.11 TROPICAL-LIKE HEAVY CONVECTIVE RAINS OVER THE SPANISH MEDITERRANEAN REGIONS: A RADAR-BASED PERSPECTIVE

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1. INTRODUCTION

Heavy rain is an important meteorological characteristic of the western Mediterranean regions during autumn. Convection usually organizes into Mesoscale Convective Systems (MCS) (Riosalido *et al*., 1988; Ramis *et al*., 1994; Tuduri and Ramis, 1997; Doswell *et al.*, 1998). In general, MCS features, as seen by remote sensing data, are those associated with deep convection: cold cloud top temperatures in IR channel, high, elevated and persistent reflectivity cores in radar data and high lightning rates (Martin et al., 1994). But sometimes, heavy rain producing MCS does not show the aforementioned features but those typically associated with oceanic-tropical convective clouds: relatively low reflectivity centroide heights, non intense reflectivity values (large hail is not reported), low lightning flash rates and cold, or even warm, cloud top temperatures in IR data.

Throughout 21 to 24 October 2000, a well-defined cut-off low was located over Morocco. A continuous, persistent and moist easterly wind was established in low levels over the Spanish Mediterranean shores. Sounding data of the Spanish network closed to the zone showed some similarities: high values of precipitable water (PW), weak-moderate vertical wind shear, "benign" CAPE (Convective Available Potential Energy), low cloud bases, etc.., so that the environmental precipitation efficiency was quite remarkable. More than 400 mm fell in many places located over the east of Spain. Some MCS were the major contributors to the heavy rain episodes. This paper focused on the radar-based features of some MCSs resembling oceanic-tropical ones. The radar data was complemented by lighting information and IR METEOSAT images.

2. DATA AND METHODOLOGY

The Spanish radar network is composed of 13 identical C band Ericsson Doppler weather radar. The full volume scan is available every 10 minutes and is composed of a series of 20 plan position indicators (PPI). The polar volume is transformed to Cartesian volume forming 12 CAPPIs (more technical details about the Spanish radar network may found in Aguado *et al*., 1995). The episode was studied using the 12 CAPPIs from one of these radar, located in Murcia (SE of Spanish Peninsula). Each cell is objectively identified using a 3 dimensional (3D) technique based on the NEXRAD algorithm (Johnson *et al*., 1998) running in a McIDAS-X workstation (Man-computer Interactive Data Access System. Suomi, 1983).

Cloud-to-ground (CG) lightning observations are available in real time, from the Spanish Lightning Detection Network, and IR METEOSAT satellite data are received in the INM at full resolution every 30 minutes.

3. RESULTS

The study focalised on the period from 10:00 to 11:30 UTC, 23th October. For that time, a MCS showed a well-defined development, as depicted by IR data. The radar images for that period were compared with the corresponding IR images. The 3D-radar cells, locating in areas with cold brightness temperature, were analysed. The following mean characteristics were obtained at the cell level:

- VIL (Kg/m^{-2}): Vertically Integrated Liquid is a measure of the liquid water in a vertical column within a storm (Greene and Clark, 1972).
- Echotop (Km): The highest altitude at which the value of radar reflectivity is 12 dBZ.
- Hcen (Km): The 3D-cell centroide height.
- Zmax (dBZ): The highest value of radar reflectivity.

A total of 611 CG lightning was detected from 10:00 to 11:30 UTC associated with the convective zones over east of Spain and north of Africa. Less than 300 flashes could be associated to de MCS located in the Murcia radar area. No hail and damaging winds were reported.

The results were quite surprising. The mean values for all the parameters were lower than those obtained for some MCS and convective clusters, in the same regions, one month earlier. These last ones showed many similarities to the American Great Plains severe thunderstorms: high VILs (50-64 Kgm^{-2}), high Echotops (14-16 Km, or more), intense Zmax (60 dBZ), lightning, large hail and, occasionally, severe winds were reported.

4.- CONCLUSIONS

This case shows that some radar-based convective cells developing in the western Mediterranean in autumn resamble the tropical-

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oceanic. Nor the mean values of VIL, Echotop, Hcen and Zmax, neither the number of lightning correspond to the typically associated to deep, severe convection. By contrary, IR images may be related with deep convection.

The aforemetioned features are similar to some monsoon/oceanic rainfall regimes associated with deep cumulonimbus cloud systems in the tropics. It is not strange that Mediterranean basin resembles as a "tropical and warm sea", mainly in autumn, when appropiated synoptic and mesoscale perturbations move on this area.

Many authors suggest the vertical velocities in oceanic convective clouds tend to be low compared with continental convective clouds. Most oceanic storms have updrafts to maintain high concentration of liquid water but these upward velocities are not intense enough to support and transport supercooled liquid water, large ice particles and soft hail at middle - upper levels. The ice-ice collisions decrease in comparison with the continental convection so that electrification processes are insufficient to lead to lightning may generated (Zipser, 1994).

Other atmospheric situations have caused severe rains and flooding in the same area with similar remote-sensing data features. Apparently, radar data have not good enough "skill" to detect this kind of convective systems, mainly when they move around the limit of the good radar coverage, let us say, 120 Km. Far away, the radar limitations for detecting these shallow structures are evident.

From nowcasting point of view, operational forecasters must analyse the environmental variables close to the storms using sounding (real o forecast by numerical models) data. When synoptic and mesoscale settings favour high precipitation efficiency environments, then low centroids convective storms may develop.

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