Plinius Conference Abstracts,
Vol. 11, Plinius11-88, 2009
11th Plinius Conference on Mediterranean Storms

Study of the impact of cyclogenesis at the Mediterranean Sea

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The Mediterranean Basin is usually affected by high impact weather events, generating high impacts in all Mediterranean countries and causing important damages. This basin is surrounded by mountains and arid regions, and the interaction of the air flow with the orography barriers produces many effects, the most important is the formation of low pressure centers. This is one of the reasons why the Mediterranean Sea is considered to be the most cyclogenetic area in the world (Jansà, 1997). Floods are also one of the most important natural hazards in the Mediterranean Basin. Flood events occur when soil absorption, runoff or drainage cannot adequately disperse intense rainfall from quasi-stationary or stationary weather systems in short time periods. In some occasions these floods produce high social impact in the affected areas.
Our work presents the study of the relationship between the flood episodes and the presence of cyclones in the Mediterranean Basin during those episodes, between 1990 and 2004. Information about social impact of each event has also been considered. To do these analyses the MEDEX database (MEDiterranean EXperiment on cyclones that produce high impact weather in the Mediterranean) has been improved in the frame work of the European FLASH project, and information about cyclones and rainfall has been extracted from the MEDEX cyclones database. A total of 217 flood events had been identified. Once the presence of one or more cyclones during each flood episode has been identified, temporal and regional analyses were made to determine the distribution of the cyclonic centers and to study the evolution of the events. Mediterranean cyclogenesis is leaded by influence of external systems (along the African coast, from the Atlantic Ocean, and from the west of Europe), although the majority of the cyclones (87% of the studied cases) are generated in the Mediterranean Basin, under influence of preexistent systems. There are different Mediterranean cyclones, from weak mesoscale depressions to strong, intense and more extensive depressions, and are classified using different criteria. In our study each cyclone identified was characterized using two dynamic criteria: vertical structure and geostrophic circulation. The first characterization is based on the vertical profiles of the laplacian of temperature, depending on which atmospheric level is reached by the cyclone. The second characterization is based on the geostrophic circulation, defined with the geostrophic vorticity in the cyclone domain. From these two characterizations, we have classified the cyclonic centers into six different types: deep, medium and shallow; strong, moderate and weak cyclones.
Results show that between 1990 and 2004, 25% of the days in this time period have recorded a flood event in the Mediterranean Basin, and 90.7% of these flood events were related to a cyclonic center. 57% of these events had been located at the western Mediterranean part, although some flood prone areas can be identified in all the Mediterranean Basin; Eastern Spain and Balearic Islands, northern of Italy (gulf of Genève), north of Africa (Sahara) and Cyprus and Turkey. Cyclones related with floods in the western part are mainly superficial cyclones. An important nucleus of deep cyclones related with floods can be found near Cyprus. The spatial distribution of cyclones related with floods, for the period from 1990 to 2004, is coherent with the general distribution of cyclones showed by Gil et al. 2002. There is a general tendency of increase of detected flood events with cyclonic center in the vicinity in the time period analyzed. A total of 4724 victims where counted during flood episodes. Results of the relationship between flood episodes and cyclonic centers show that 40% of the flood episodes with higher damages were related to weak cyclones.