CLIMATOLOGY OF MEDITERRANEAN FLASH-FLOOD PRODUCING STORMS
(Course A2 of the Summer School on Mediterranean Storms Driven Flash Floods)

R. Romero
(1) Departament de Física, Universitat de les Illes Balears, Palma de Mallorca, Spain
Romu.Romero@uib.es

Flash-flood producing precipitation systems in the Mediterranean are frequently associated with the near presence of a cyclonic disturbance. These Mediterranean lows, not necessarily deep or strong, provide the lifting mechanism necessary to release the convective instability and/or stimulate continuous stratiform rain, often in combination with a coastal mountain barrier, and help to organize the feeding current of warm and moist air towards the area of sustained heavy rain. Cyclones can range from synoptic to mesoscale in size, from pure baroclinic systems to orographically or diabatically modulated disturbances in type, and its role for creating the flash-flood environment can be direct (e.g. by local cyclogenesis) or indirect (e.g. by remotely providing a moist low-level jet impinging over the coastal orography). Since the specific synoptic and mesoscale ingredients conductive to flash-floods will be explained in **course A3**, this lecture will be more centred on the climatology of the large-scale circulation agents (i.e. cyclones) that promote and sustain those ingredients and in which the flash-flood producing precipitation systems are usually embedded.

Many national and international research efforts (e.g. MEDEX, a WWRP WMO project) have been directed towards the design of physically-based climatologies of cyclones and the description of their links with heavy rain and flooding. The main results of the MEDEX data base of cyclones will be illustrated in this lecture, emphasizing the main cyclogenetic areas, cyclone tracks and other attributes (lifetime, size, vertical structure, etc), typical depth and origin of the cylones depending on the geographical zone, seasonal differences, and the distinction between western Mediterranean and eastern Mediterranean cyclones and between Mediterranean and Atlantic systems. The analysis will be extended by crossing the above data base with a data base of heavy precipitation events in the western Mediterranean in order to illustrate the strong link between cyclones and the occurrence of extreme daily rainfall: a near cyclonic centre is found in more than 70% of the heavy rain cases, usually located in a position favourable for bringing moist Mediterranean air towards the coastal areas. The crucial role of specific airflows relative to the coastal orography and the importance of upper-level dynamical forcing are better established from a climatologic perspective by attempting to classify the atmospheric circulation connected with historical events of heavy rain at regional scale. The use of multivariate statistical techniques (e.g. Principal Components Analysis and Cluster Analysis) will be emphasized in the course, showing examples of regional classifications performed by the lecturer and other authors for eastern Spain, north Italy and Greece.

Finally, prototype flash-flood events for Catalonia, Cévennes and Piémont regions will be presented, and the role of relevant synoptic and mesoscale signatures of the flow already emphasized in the previous climatologies will be pointed out. In particular, the roles of the upper-level precursor disturbance, local Mediterranean cyclogenesis and moist low-level jet will be analysed in detail, and predictability issues concerning the 24-48 h forecasts of these synoptic and mesoscale structures, and therefore of the flash floods, will be inferred using a mesoscale numerical model and the adjoint model tool that will be described in the **course** "Meteorological and hydrological predictability issues" of this same summer school.