Geophysical Research Abstracts
Vol. 17, EGU2015-11307, 2015
EGU General Assembly 2015
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On the dynamics of synoptic scale cyclones associated with flood events in Crete

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Flood events in the Mediterranean are frequently linked to synoptic scale cyclones, although topographical or anthropogenic factors can play important role. The knowledge of the vertical profile and dynamics of these cyclones can serve as a reliable early flood warning system that can further help in hazard mitigation and risk management planning.

Crete is the second largest island in the eastern Mediterranean region, being characterized by high precipitation amounts during winter, frequently causing flood events. The objective of this study is to examine the dynamic and thermodynamic mechanisms at the upper and lower levels responsible for the generation of these events, according to their origin domain.

The flooding events were recorded for a period of almost 20 years. The surface cyclones are identified with the aid of MS scheme that was appropriately modified and extensively employed in the Mediterranean region in previous studies. Then, the software VTS, specially developed for the Mediterranean cyclones, was employed to investigate the vertical extension, slope and dynamic/kinematic characteristics of the surface cyclones. Composite maps of dynamic/thermodynamic parameters, such as potential vorticity, temperature advection, divergence, surface fluxes were then constructed before and during the time of the flood. The dataset includes 6-hourly surface and isobaric analyses on a 0.5° x 0.5° regular latitude-longitude grid, as derived from the ERA-INTERIM Reanalysis of the ECMWF.

It was found that cyclones associated with flood events in Crete mainly generate over northern Africa or southern eastern Mediterranean region and experience their minimum pressure over Crete or southwestern Greece. About 84% of the cyclones extend up to 500hPa, demonstrating that they are well vertically well-organized systems. The vast majority (almost 84%) of the surface cyclones attains their minimum pressure when their 500 hpa counterparts are located in the NW or SW, confirming that baroclinicity is one of the most important driving mechanisms for the cyclonic deepening over the examined region. The upper level dynamics acting well before the event and the low level diabatic processes over the Aegean or the Levantine sea contribute to the large amounts of precipitation.

The research reported in this paper was fully supported by the “ARISTEIA II” Action (“REINFORCE” program) of the “Operational Education and Life Long Learning programme” and is co-funded by the European Social Fund (ESF) and National Resources.