

The role of Mediterranean cyclones for producing large-scale wind and precipitation extremes

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Extreme wind and precipitation events are associated with the passage of cyclones and their attendant fronts in the Mediterranean region. Particularly, large scale high-impact extremes are of societal importance for their association with a high risk for extended flooding and severe damage. Yet, the majority of current studies analyze local extremes as observed at single stations, or at a grid point, over a short time duration. Thus, key aspects regarding large-scale extremes remain unresolved: 1) what fraction of extreme events are related to cyclones in the different regions of the Mediterranean? 2) what are the special features of cyclones that produce extremes compared to average cyclones? 3) how often do large-scale extremes in wind and precipitation co-occur?

We study these questions by statistical analysis of large-scale extreme precipitation and gust events that are identified objectively using ERA-Interim data for 1979-2012, and with investigation of dynamical processes that occur during the evolution of a few selected cyclones associated with extremes, using both ERA-Interim data and mesoscale model (COSMO) simulations.

We find that Mediterranean cyclones associated with extremes are characterized uniquely by at least one of the following: 1) stationary position, allowing accumulation of precipitation; 2) rapid deepening, creating strong pressure gradients and winds; 3) strong surface fluxes, adding contributions of intense diabatic processes to increase cyclone intensity and precipitation; 4) their location near topography enhances precipitation.

Here we present the statistical analysis results of large-scale extreme precipitation and surface wind gusts and a detailed representative case study.