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Projections of droughts, extreme rainfalls, heat waves and cold spells in Europe using a combination of dynamical and statistical approaches

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Climate change is one of the greatest environmental concerns for modern societies. European countries are particularly vulnerable to future changes in the frequency and intensity of extreme weather events such as heat waves, heavy precipitations, persistent droughts, severe convective storms and violent cyclonic windstorms. As evidenced in recent years, most of the nature-related economic costs and human losses in many regions of Europe, including the Mediterranean zone, are due to extreme phenomenology. It is likely that by the end of the century extreme precipitation events -and concomitant floods or flash floods- might become more intense over the continent while droughts might last longer. In dry regions as southern Europe, soils are predicted to dry out as temperatures rise and rain-bearing atmospheric circulations become less frequent.

Perspectives on the future of these extreme events are here derived by using observed and model projected daily meteorological data. Specifically, E-OBS high resolution gridded data sets of daily observed precipitation and surface minimum and maximum temperatures have been used as the regional observed baseline. For projections, the same meteorological variables have been obtained from a set of regional climate models (RCMs) integrated in the EURO-CORDEX European project, considering the rcp4.5 and rcp8.5 future emissions scenarios. To properly project the RCM data at local scale, a quantile–quantile adjustment has been applied to the simulated regional scenarios. The method is based on detecting changes in the cumulative distribution functions (CDFs) between the recent past and successive time slices of the simulated climate and applying these changes, once calibrated, to the observed series of maximum, minimum temperature and precipitation. However, for our specific purposes dealing with the extreme phenomenology, the general method has been first adapted to explicitly focus on the tails of the distributions, instead of deriving the calibration parameters from the general spectrum of the CDFs.

Results about the future incidence of heavy precipitation episodes, heat waves, cold spells and droughts at annual and seasonal scale will be presented for each emission scenario, scaling down the results from the whole European continent throughout Southern Europe and the Mediterranean lands. The most vulnerable geographical areas in terms of heavy precipitation, drought, heat waves and cold spells incidence as the century progresses will be identified.