Session: C4 Poster: TH195B

CLIVAR-SPAIN contributions: Peaks-over-thresholds study of trends in extreme rainfall over the Iberian Peninsula

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A peaks-over-threshold (POT) approach is used to study trends in extreme rainfall over the Iberian Peninsula (IP) at a daily scale. Records from 52 observatories regularly distributed over Iberia with no missing data were available for the common period from 1958 to 2004. The POT approach was used because it is particularly effective at extracting information concerning true extreme events. A generalized Pareto distribution fit was made to the data involving time-dependent parameters to account for possible temporal changes in the frequency distribution. These parameters were analyzed for trends in the return level period, of importance for engineering purposes. A time-varying threshold was defined, and an automatic declustering scheme was used to select independent extreme events exceeding the threshold. The results indicate a high variability of extreme events over the coastline of the IP, greater over the Mediterranean coast than over the Atlantic coast. The calculation of the trends for the 2-year return level yielded a large proportion of negative trends for all three seasons considered: 58% for winter, 63% for spring, and 69% for autumn. The parametric approach also revealed an increase in the area with positive trend of the 20-yr return level relative to the 2-yr return period, especially in autumn in the east of the IP. The time-varying threshold was defined using the mean rainfall per rain event for each season. The linear regression of this variable basically reflected a declining trend over the IP for all three seasons. Winter in particular showed a predominance of negative trends over a major part of the IP. The negative trends in the southwest of the IP could be related to the prevailing positive phase of the North Atlantic Oscillation (NAO) during the last 30 years. Since this oscillation influences rainfall over the southwest of the IP, this could be the cause of the decreasing winter rainfall for this region. Small regions in the southeastern IP showed positive trends of the mean rainfall in spring and winter, but few were significant -- only one for spring and two for winter. Only autumn for the western IP presented increasing behaviour of the mean rainfall per rain event, with 4 significant positive trends. The results obtained for the trend of the mean rainfall per rain event indicate the usefulness of considering this parameter in defining the time-varying threshold in order to reflect temporal changes in rainfall. Despite the difficulty in selecting a time-varying threshold for such a complex meteorological variable as daily rainfall, the generalized Pareto distribution proved to be a useful tool with which to study extreme events in these series. The results for the 2-yr return level were largely indicative of a decreasing trend in the values of extreme rainfall for all three seasons considered: 58% for winter, 63% for spring, and 69% for autumn. When the return period considered was increased, there was a concomitant increase in the trend of the return level, especially in autumn in the east of the IP. So, although the mean rainfall per rain event is decreasing with time, rare extreme events corresponding to long return periods are increasing, especially in autumn over the southern and east-central IP.