Trends and variability of precipitation: analyses of historical time series from Portugal

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The impact of climate change on precipitation is one of the major concerns in many scientific research studies. To predict changes in the other hydrological processes it is crucial to understand the recent changes in precipitation patterns as part of the long term behaviour of this process. Quite often the limiting factor is the short length of many existing precipitation records. The statistical analyses of historical time series, if they are available, can shed more light on our understanding of the dynamics of precipitation and, therefore, on the evaluation of recent changes in this process.

The purpose of this work is to investigate trends in the temporal and spatial variability of precipitation in Portugal by studying historical time series. The dataset comprises records of annual and monthly precipitation dating from the 19th century, from 13 meteorological stations scattered all over Mainland Portugal and in the Portuguese North Atlantic Islands of Madeira and Azores. The longest records date back from 1863. Different statistics methods were used in this study. As a preliminary step in the analyses, the data were statistically tested for serial correlation. Then, the homogeneity of the data was investigated; the methods used were: Standard Normal Homogeneity Test, Pettitt Test, von Neumann Ratio and Buishand Range Test. Finally, trends in the historical precipitation time series were examined using the Mann-Kendall nonparametric trend test and the Sen's nonparametric method. The non-monotonic character of the trends observed in the data, and to deal with partial trends, the method by Tomé and Miranda (2004) was applied to the data. This recently developed methodology is able to locate the times of significant change in the precipitation series.

This study complements previous investigations of precipitation trends in Portugal. It highlights the fact that the uncertainties of the trend projections came from the extreme variability in the precipitation process. On the one hand, when long records are available, the characterization of trends based on a monotonic (linear) model can be of intrinsic interest but, at the same time, can be meaningless for the evaluation of the behaviour of the process in the near future. In this case, the analysis of partial trends can assist us in identifying certain features of the behaviour of precipitation that are contributions towards a better understanding of its dynamics. On the other hand, the analyses of short precipitation records consisting of only a few decades, can be biased by the period studied. Conclusions on trends in precipitation should be tackled carefully, especially if only a reduced number of data sets are studied.