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Investigating recent trends in the rainfall structure: an overview across Portugal

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The spatial and temporal structure of rain, which typically exhibits extreme variability, is a core issue in studies that span a number of research areas, e.g. hydrology, hydraulics, environment, energy, economics, society. The interest in this process demands its comprehensive study and characterization at a variety of space- and time-scales. Local studies of the rainfall climate can play an important role as they may contribute to characterizing rainfall. In this work the study area is mainland Portugal.

Mainland Portugal is located in the transitional region between the sub-tropical anticyclone and the sub-polar depression zones. The characteristics of global circulation (specifically the Atlantic origin of many synoptic disturbances such as seasonal movements of the Azores high pressure system) in the context of regional geography (e.g. latitude, orography, oceanic and continental influences) greatly influence the spatial distribution of precipitation over the territory. The climatic variables exhibit strong north-south and west-east gradients, and precipitation also exhibits strong seasonal variability. The dominant climate in mainland Portugal is mild Mediterranean with a warm, dry summer period. These characteristics are more pronounced in the south, where the climate is sometimes classified as semi-arid. These regions are also well known for their vulnerability to climate variability.

Several studies have reported increased rainfall variability in recent years, largely on the basis of annual and monthly point rainfall data, and for different geographical locations across the Iberian Peninsula, including Portugal. The main aim of this work, which complements those trend studies, is to contribute to identifying and clarifying recent changes in rain variability in Portugal by analysing trends in the small-scale temporal behaviour and statistics of this process.

Thus the analyses reported here concentrate on the statistics of short-term rainfall events. The time span of the point rainfall records is about 65 years for the daily data and 25 years for the hourly and sub-hourly data (30, 15, 10 and 5 minutes resolutions). These analyses focus on rainfall intensities for different time intervals and on some of the many indices and parameters proposed in the literature. The seasonality of rainfall is also accounted for by investigating the changes in its distribution and structure within a year.

Over the time span of the data records changes are observed in the distribution of rain within a year and over the territory, a finding which further strengthens the well-known strong seasonal and regional character of precipitation in Portugal. In addition, not all the rainfall trends are monotonic; partial trends were identified too. Overall, the results suggest an increase of variability in the structure of rainfall, manifested across scales. Intense rainfall events play a role in this behavior which is expected to have social, environmental and economic impacts.