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Robust characterization of rainfall intermittency in Sardinia and identification of physical controls

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The study of rainfall statistical variability is important for a wide range of water-related disciplines. Rainfall intermittency is often referred to two different aspects of variability: (i) the sudden variations of intensity, and (ii) the alternation of dry and wet periods, which can be analyzed through the construction of the binary series (BS). In this study, we characterize rainfall intermittency in time using a dataset collected by more than 200 tipping-bucket rain gages, covering the entire territory of Sardinia, Italy. For each gage, we sampled the rainfall signal at a resolution of 1 min and selected time sequences of $\sim$45 days, thus focusing on a range of scales interesting for hydrological applications. On each sequence, we applied several techniques to investigate intermittency, including spectral and scale invariance analysis, and computation of clustering and intermittency exponents. The spectral analysis reveals the existence of two scaling regimes, typical of stratiform (from 3 days to 2.5 h) and convective (from 2.5 h to 2 min) systems, consistent with other studies. Investigation of scale invariance for higher moments shows the existence of an additional breaking point at 15-30 min. The change of statistical properties of the rainfall signals at these scales is also confirmed by the clustering and intermittency exponents. These metrics indicate that (i) the BS shows a behavior similar to the white noise at scales lower than 15-30 min, and (ii) rainfall intensity fluctuations tend to attenuate (amplify) the intermittency of the BS at scales smaller (larger) than 15-30 min. Finally, thanks to the availability of a large dataset, we show the presence of spatial patterns for the metrics characterizing rainfall intermittency, which can be explained by the geographical location and the topographic features of the gages, and by the interaction of these characteristics with the dominant weather conditions.