A study of the scaling properties of rainfall and its application to obtain Intensity-Duration-Frequency relationships in Catalunya

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Rainfall generation, as other atmospheric processes, acts in a wide temporal range giving rise to phenomena that look the same regardless of the temporal scale where they are observed (self-similarity), with properties that can often be described using statistical scale relationships (Schertzer and Lovejoy, 2011; Burlando and Rosso, 1996; Menabde et al. 1999). In the simple scaling case, the scaling behavior of rainfall intensity can be expressed using a single parameter β, which seems to be related to some of the climate characteristics of the place of study, like its rainfall pattern (Menabde et al., 1999; Rodríguez-Solà et al., 2017; Casas-Castillo et al., 2018). Llabrés-Brustenga et al. (2017) found a spatial distribution of β over Catalunya consistent with the main features of the rainfall pattern in this territory, for instance, the NW mountainous area with some Atlantic climate influence at its most northwestern end where large rainfall accumulations are most often caused by episodes of continuous rain, as well as the driest areas of the territory at the west. In the present work, values of the scaling parameter β have been applied to obtain intensity-duration-frequency relationships at different scales from the intensity-frequency relationships for durations of 1 day at the same location. Indeed, the scaling parameter can be used to perform a temporal downscaling to infer rainfall intensities for sub-daily durations from daily values (Menabde et al., 1999; Yu et al. 1994; Bara et al., 2010; Rodríguez-Solà et al., 2017). Rainfall spatial distribution maps over Catalunya for several sub-daily durations and return periods are presented.

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