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Analysis of spatial and temporal complexity of rainfall in the Brue catchment, UK

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Rainfall is the main driver of streamflow variability. Different rainfall events may have different degrees of complexity, which may be matched by different hydrological models of varied complexities. Moreover, different resolution of rainfall input will bring different degrees of uncertainty. In this study we explore the spatial and temporal complexity of rainfall in the Brue catchment located in Southwest England. We use observations from 49 rain gauges and one flow gauging station. Data in 1994 are chosen for the case study, which have been separated into 197 rainfall-runoff events. Several methods, such as semi-variograms, auto-correlation, spectral analysis using FFT, spatial correlation, etc., are chosen to analyse and characterise spatial and temporal characteristics of these rainfall events. Different methods provide different insights into these rainfall dynamics and how they vary between and during storms. Results so far show that spatial correlation varies with direction, that larger events exhibits greater spatial correlation and that winter events have more uniform spatial distribution than summer events. Analyzing the temporal complexity of both rainfall and streamflow shows that the catchment is able to filter out the high-frequency part of rainfall to produce flow, only allowing the low frequency part to pass. Also, rainfall in summer is more temporally fluctuant than in winter due to the dominating convective weather system. Based on those rainfall complexity indicators, we develop a decision tree to classify the rainfall events into different categories, which are then used by a hydrological model with a varied degree of spatial complexity. The same methodology is further explored in other catchments with different land use/land cover, topography and soil types so that catchment complexity could be explored alongside the rainfall complexity and hydrological model complexity. Our aim is to eventually explore what hydrological model complexity (spatial and temporal dynamics) is required to match different types of rainfall complexity.