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Detection of spatio-temporal changes in extreme precipitation on the Island of Ireland

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Climate change is expected to intensify the hydrological cycle leading to increased frequency and severity of precipitation extremes, and hence increasing flood risk. In Ireland, there has been an apparent increase in floods in the past decade that has identified society's vulnerability to such extreme events. However, the majority of research on changes in observed and future precipitation discuss changes in the mean rather than extremes. This has limited relevance when translating to floods given flood dynamics are concerned with antecedent conditions and intensity of rainfall, as well as the magnitude of events. Therefore, there is a scientific need to better understand the changing nature of observed precipitation extremes at the spatial (regional and local) and temporal (daily, multi-day) scales relevant for impacts such as flooding. This study uses a spatially dense network of daily station-based precipitation observations across the Island of Ireland over 1941-2012 to extract 12 annual and seasonal indices of extreme precipitation characteristics such as magnitude, frequency, duration, and intensity, using ETCCDI definitions. Three tasks were undertaken using the extracted extreme precipitation indices: i.) Trend analysis using fixed periods; ii.) Assessment of temporal representativeness of fixed periods in light of the known influence of Decadal Climate Variability (DCV); and iii.) Investigation of dependency of trends on period of record for the full available time-series. The Mann-Kendall test for monotonic trend was applied for exploring signatures of change in indices relating to the magnitude, duration, and intensity of extremes. Logistic regression was employed for assessment of changes in frequency indices. The magnitude of trends was estimated using the robust Theil-Sen approach. Results show evidence of robust increasing trends in the majority of extreme precipitation indices at the annual scale across the Island, particularly for maximum 5-day precipitation and precipitation intensity, which are flood relevant indicators. However, substantial differences are apparent in both the strength and direction of trends at seasonal scales, highlighting important sub-region heterogeneity. Additionally, records across the Island are strongly affected by DCV given Ireland's sentinel position on the Atlantic fringe of Europe - a final word on drivers of this variability will be offered.