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A probabilistic assessment of future flood and drought hydro-hazard hot spots

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Hydro-hazards, floods and droughts, cause significant economic damages and pose risks to lives worldwide, including in Great Britain where the Environment Agency identified the critical need to understand these hazards and their impact on people. In an increasing hydro-climatic risk context as a result of climate change, this work aims to identify future hydro-hazard hot spots across Great Britain. This approach was applied to a spatially-coherent statistical database of daily river flows (Future Flows Hydrology) across Great Britain to assess changes between the baseline (1961-1990) and the 2080s (2069-2098). First, both flood and drought hazards were defined and selected in a consistent and parallel approach with a threshold method. For floods, peak-over-threshold series were extracted while for droughts, its equivalent, the inter-event time and volume criterion method, was applied. High- and low-flow thresholds were defined to obtain on average three independent events per year on the baseline period, and the same threshold applied for the 2080s period. Then, a nation-wide systematic and robust statistical framework was developed to quantify changes in frequency, magnitude, and duration, and assess time of year for both hazards. The uncertainty associated with climate model projections was also assessed by investigating the 10th, 50th, and 90th quantiles across the ensemble-members. Hot spots were identified in catchments presenting an increase in frequency and magnitude and duration of both hazards at the same time. The results showed that based on the Future flows Hydrology database, hydro-hazard hot spots are likely to develop along the west coast of England and Wales and across northeast Scotland, mainly during the winter (floods) and autumn (droughts) seasons, with a higher increase in drought hazard in terms of magnitude and duration and in flood hazard in terms of frequency. These results suggest a need for adapting water management policies in light of climate change impact, not only on the magnitude, but also on the timing of hydro-hazard events, and future policy should account for both extremes together, alongside their potential future evolution.