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Impact of Climate Change on extreme flows across Great Britain: a comparison of extreme value distributions and uncertainty assessment.

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Floods are the most common and widely distributed natural risk to life and property worldwide, causing over £B worth of damage to the UK since 2000. Climate projections are predicted to result in the increase of UK properties at risk from flooding. It thus becomes urgent to assess the possible impact of these changes on extreme high flows in particular, and evaluate the uncertainties related to these projections.
This paper aims to assess the changes in extreme runoff for the 1:100 year return period event across Great Britain as a result of climate change. It is based on the Future Flow database and analyses daily runoff over 1961-2098 for 281 gauging stations. The Generalized Extreme Value (GEV) and Generalized Pareto (GP) distribution functions are automatically fitted for 11 climate-change ensembles over the baseline (1961-1990) and the 2080s (2069-2098) for each gauging station. The analysis evaluates the uncertainty related to the Extreme Value (EV) distributions, and the uncertainty related to the climate model parameterization. Then it assesses return levels with combined uncertainties across Great Britain for both EV distributions. Ultimately, this work gives a national picture of extreme flows assessed by the two methods and allows a direct comparison between them.
Results show that the GP distribution computes higher runoff estimates than the GEV distribution. Generally, the uncertainties associated with both distributions are similar, but the GP computes significantly higher uncertainties for stations in the south and southeast of England. From the baseline to the 2080s horizon, the GEV distribution shows variable runoff trends across Great Britain, while the GP distribution shows an increasing trend of return level estimate and uncertainties, especially in the northeast and southeast of England. The lowest climate model and extreme value uncertainty is generally seen across the west coast of Great Britain. In terms of uncertainty, with the GEV distribution the climate model parameterisation provides the greater uncertainty (on average 58% and 59% on the baseline and the 2080s respectively across the country), while the probabilistic distribution provides higher uncertainties (on average 56% and 51% on the baseline and the 2080s respectively across the country) than the climate model with the GP distribution. This shows that (i) the GEV distribution is globally robust for the 100-year return period estimation and more sensitive to the input data used; and (ii) the GP distribution seems less robust in its parameterisation.