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Flood mechanisms and flood extremes in a changing climate

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River flooding can have severe societal, economic and environmental consequences. However, limited understanding of the regional differences in flood-generating mechanisms results in poorly understood historical flood trends and uncertain predictions of future flood conditions. To address this issue, we use a simple observation-based approach to decipher the dominant drivers of floods across large geographic regions. The generated process knowledge provides helpful context of the mechanisms that are of main interest when studying the (non)stationarity of flood response. Such assessments of floods trends across large regions always focus on frequently occurring events (e.g. annual peaks), whereas changes in very extreme but rare floods are only studied for a small number of locations that have exceptionally long observational records. Understanding changes in these extreme and rare floods is especially relevant as these events are often most damaging. Utilizing aggregate regional flood information, we show that during recent decades there is a strong decadal variability and an overall increase in both the frequency and magnitude of extreme floods across multiple continents. This observation-based assessment of extreme floods is broadly consistent with model predictions, but also highlights strong decadal variability. Because we mapped regional differences in flood generating mechanisms of more commonly occurring floods, there remains a need to identify the regional and hemispheric drivers that control changes in extreme floods.