EGU21-12838, updated on 03 Aug 2021
https://doi.org/10.5194/egusphere-egu21-12838
EGU General Assembly 2021

Detecting flood drivers through large-sample geomorphology

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Many fluvial processes have long been treated as stationary, fluctuating within an unchanging envelope of variability. However, a large body of evidence has revealed that shifts in climate, land cover and river basin management may manifest locally along river networks through hydrological and geomorphic change. Measuring the effect of these changes on the local flood risk requires a large sample approach. Large sample geomorphology has existed for many decades but is currently undergoing a step-change characterised by computational techniques, scalability, and growing interdisciplinarity. This step-change has been assisted by the availability of remotely sensed datasets describing the land surface (including satellite, airborne and ground-based acquisitions), alongside other datasets more conventionally employed in hydro-climatology (including weather and climate observations, reanalysis, and projections). Within this context, data science and AI approaches facilitate pattern detection and the testing of both long-standing and emerging theories, to derive insights about processes and mechanisms at play. Here, we will discuss the value of large-sample geomorphology for understanding nonstationary landscapes and the associated flood risk. We will provide insights into the promise and pitfalls of large-sample approaches within an evolving discipline, and discuss ways forward, with more systematic hypothesis testing and developing projections of future change.