Geophysical Research Abstracts
Vol. 19, EGU2017-7525, 2017
EGU General Assembly 2017

Attribution of regional flood changes based on scaling fingerprints

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Changes in the river flood regime may be due to atmospheric processes (e.g., increasing precipitation), catchment processes (e.g., soil compaction associated with land use change), and river system processes (e.g., loss of retention volume in the floodplains). We propose a framework for attributing flood changes to these drivers based on a regional analysis. We exploit the scaling characteristics (i.e. fingerprints) with catchment area of the effects of the drivers on flood changes. The estimation of their relative contributions is framed in Bayesian terms. Analysis of a synthetic, controlled case suggests that the accuracy of the regional attribution increases with increasing number of sites and record lengths, decreases with increasing regional heterogeneity, increases with increasing difference of the scaling fingerprints, and decreases with an increase of their prior uncertainty. The applicability of the framework is illustrated for a case study set in Austria, where positive flood trends have been observed at many sites in the past decades. The individual scaling fingerprints related to the atmospheric, catchment, and river system processes are estimated from rainfall data and simple hydrological modeling. Although the distributions of the contributions are rather wide, the attribution identifies precipitation change as the main driver of flood change in the study region.