



What is the role of flood wave superposition for the severity of extreme floods?

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The severity of floods is shaped not only by event and catchment specific characteristics but also depends on the configuration of the river network. At the confluence of relevant tributaries to the main river, flood event characteristics may change depending on magnitude and temporal matching of flood waves. However, up to now, the impact of flood wave superposition on the severity of flood peaks was not analysed for a large data set.

To fill this gap, the role of flood wave superposition was investigated for 45 triple points from the four large river basins in Germany and Austria (Elbe, Danube, Rhine and Weser). A triple point consists of the three gauges at the tributary and upstream and downstream of the confluence at the main river. At the triple points, differences and similarities in flood peaks were jointly analysed in terms of their temporal matching and their peak magnitudes.

For all triple points, we demonstrate how strong a low/high flood peak in the tributary impact the flood peak in the main river. Our analysis shows that flood wave superposition is a relevant factor for flood peak severity, but not the most important one. In the majority of the cases, the largest floods at the downstream gauge do not occur because of a perfect temporal matching of tributary and main river. In particular, flood peaks in the large tributaries (Mulde, Inn) occur some days earlier than in the main river. Hereby, no significant differences in temporal matching were detected for medium and extreme floods. In terms of spatial variability, the impact of flood wave superposition is site-specific. At a very few locations, only a few high flood events seem to coincide with the wave superposition, e.g. at the Neckar/Rhine confluence. Characteristic patterns of flood wave superposition were detected for the flood peaks in the Danube where discharge largely increases due to inflow from the alpine tributaries.