



Hydrological signatures of flood magnification in German rivers

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River systems and flooding can change over time in response to climate shifts, land-use change, or engineering modifications of the river. The past 10-15 years has seen severe repeated flooding on several European rivers. Flooding on the Oder River in 1997 nearly doubled some previous flow records, and flooding on the Elbe River in 2002 broke stage records dating back to the 13th century. For this study, hydrologic data for 84 stations on 29 German rivers were collected. These data include long-term records of daily stage and daily discharge updated to 2005-2006. Stage data are less commonly used in hydrology and require special processing. All stage and discharge records were evaluated for completeness and quality. Each stage record was corrected for changes in gauge location and datum, using published hydrologic yearbooks as well as characteristic discontinuities identified within each time series. Other discontinuities represented updates to the rating curves and discrete river modifications near individual gages. A series of rapid analytical techniques was applied to the data to test for significant changes in the frequency and magnitude of flood events over time and distinguish among potential causal mechanisms. Statistically significant trends in annual maximum discharges suggest climate and/or land-use impacts on runoff, whereas significant trends in peak stages without corresponding discharge trends suggest change in flow conveyance for example due to river engineering. Overlapping stage and discharge records allow specific-gage analysis, which can distinguish the effects of different causal mechanisms. On the German Rivers, no statistically significant trends were present at many stations, at others climate and/or land-use changes

dominated, and at a few channel modifications have driven hydrologic change. Many of the latter experienced large increases in flood levels. At Dresden on the Elbe River, for example, increases of at least 1.2 m are documented for floods such as the 2002 event. This increase is concentrated in time post-1960 and is manifested for overbank flow, suggesting levees as a likely mechanism. The goal for these tools is to serve as “indices of flood magnification” - for hydrologic reconnaissance and generation of hypotheses to be tested by detailed local analysis.