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Hydrology and Earth System Sciences Discussions

Interactive comment on "A consistent set of trans-basin floods in Germany between 1952–2002" *by* S. Uhlemann et al.

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First of all we want to thank the reviewer for his/her valuable and thoughtful comments. Following, we will reply to each of the comments made.

General Comment: One interesting point I have missed in the paper is the relevance of the trans-basin floods compared to the whole set of floods regarding the total risk accumulated over space and time. Or in other words to which degree contribute trans-basin floods and too which degree the floods with smaller extent regarding mean expected damage. The severity indicator or another criterion could be used to assess an accumulated risk for all trans-basin floods and for all events with smaller extent building each the sum of the index over all events. At least a discussion of this issue should be

included in the text.

Reply: This is indeed a very interesting point and certainly, i.e. for insurances, it is crucial to not only assess the accumulated risk due to trans-basin floods but also due to an accumulation of damages caused by local floods over a period of time. However, this paper aims to provide the methodology to identify trans-basin floods and to provide a consistent set of these floods in the 51year period. To assess to which degree trans-basin floods and too which degree floods of smaller spatial extent contribute to mean expected damage on e.g. the national scale, an equally consistent approach to collect all relevant flood events of small spatial extent would need to be developed. This is a challenging task and to our knowledge no such assessment has yet been performed. To derive such a set, the pool of gauging stations used in this study would need to be extended by adding stations of smaller catchment sizes resulting in a denser network of stations. So far we have used only stations in catchments that exceed at least 500km2. With the methodology developed in this study we are able to reliably detect large scale flooding. For small floods the uncertainty of the completeness of the event set increases, since a number of local flood events that occurred in ungauged basins will be missed out on. These are issues that will need to be carefully addressed before conclusions on accumulated risk are drawn. Therefore, we cannot yet provide an answer on this point that would be based on solid evidence. However, extending our studies to the full assessment of risk accumulation taking into account both small and large floods is an interesting if not compulsory task. And, as the reviewer suggests, we will add a paragraph in the discussion chapter of the paper.

Detailed Comment 1: The ranking of multivariate events according to their magnitude is not straightforward. Here a severity indicator is used. This indicator is not easily interpreted. An obvious alternative would be the application of a mean return period calculated over all floods at different gauges, may be weighted by the affected length of the river network. A brief discussion why this latter criterion has not been considered would be useful for the reader.

Reply:Even though the concept of a mean return period is much easier to understand it also bears some short comings. First, during many events peak discharges of very high magnitude had occurred. The estimation of the return period at any site is based on the annual maximum series, here based on 51 years. Estimating return periods beyond the 50 year flood are associated with high uncertainties due to an extrapolation beyond the range of the data. We have chosen to assess the magnitude of an event at any site by normalising the maximum discharge during an event to the median annual flood at this particular site. In this way, the level of flooding amongst all sites becomes comparable and the uncertainties are limited to the uncertainty of the discharge measurement during peak flood. Second, an event return period based on the mean over all return periods from the affected gauges would too easily be interpreted as the true return period of the entire event. This is certainly not the case. The estimation of the return period of a trans-basin flood must be based on a frequency analysis over the entire event set and even more - moving away from an empirical estimate - must be based on an assessment of many (a thousand or more) synthetically generated flood scenarios that take into account the spatial dependencies amongst the flood peaks within the events. We acknowledge the reviewers hint and will include these arguments in the paper to improve the understanding of the composition of the indicator.

Detailed Comment 2: The exclusion of catchments with drainage areas smaller than 500 km2 is certainly ok for the analysis of trans-basin floods at the country scale. However, for total risk assessment the floods in smaller catchments might contribute significantly to the accumulated risk considering e.g. events resulting from convective storms. This should be mentioned in the text.

Reply: See reply to the general comment above.

Detailed Comment 3: Eq. (1) becomes not quite clear. E seems to denote the set of events. In that case E = {...} would be the correct notation. Reply: We rechecked the notation and found that there was some confusion in the notation of Eq 1 and that of Eq 8 + following paragraph. E actually denotes the number of events identified. What we

want to express in Eq 1 though is, that each flood event Fe (with e=1,...,E) can be fully described by the timing and the magnitude of the significant discharge peaks during this event.So in Eq (1) the former notation E will be replaced by F with subscript e. We thank the reviewer for his/her careful reading!

Detailed Comment 4: The need to apply Eq. (2)-(4) for the flood peak identification becomes not clear. For AMS simply the largest daily discharge in each year could be chosen and for POT the n-largest values or the n values above a threshold considering a minimum lag time could be selected?

Reply: The reviewer is right. We did generate the AMS from the daily time series by extracting the maximum discharge per water year but denoted this process wrongly in the writing of the paper. We will correct that. The application of Eq. (2)-(4) rather refers to the procedure of peak identification in series of daily mean discharge. Since POTs are supposed to be peaks above a threshold and since we are looking for the particular day of the peak, which in case of slow response could stretch over 2 or 3 days, we also use the Peak-notation. In this way we can give a clear indication of which peaks (days respectively) were chosen in the series. This point is often not mentioned in studies that make use of POTs. Essentially POTs are a subset of all peaks that can be identified in any daily series i. Therefore we can make use of the same notation for POT-identification as well as for the peak identification in general, which later forms the basis for the pooling of mutually dependent peaks.

Detailed Comment 5: Fig. 5: The label for the x-axis is not completely visible.

Reply: this will be corrected

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 1485, 2010.