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Hydrology and Earth System Sciences Discussions

Interactive comment on "What drives flood trends along the Rhine River: climate or river training?" *by* S. Vorogushyn and B. Merz

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First of all, I would like to apologize for the late upload of this review.

Overall, this is a paper with relevant results for the river Rhine and potential to be extrapolated to many large rivers around the world (especially European ones), in terms of quantitative effects of river training on peak flow trend and flood wave acceleration. The title itself is quite ambitious. It refers to a science question not directly addressed in the paper, but only partially answered, in the sense that after quantifying and removing the effect of river training there are still remaining significant trends. These need to be attributed to other causes, as is accurately stated in the Conclusions (Page 13555, lines 8-11), and not exclusively to climate change. The title could remain, but

some comments on the fact that only the part of the question concerning river training is answered could be included in the Conclusions.

- (abstract) Page 13538, lines 20-21 There is a strong language bias if under "large-scale driver", only the example of climate is included, especially in the abstract. The formulation of the last sentence of the abstract ("... by factors other than river training...") or more explicitly the one of Page 13555, lines 8-11 is more rigorous.

- (section 2.2) Page 13543, line 22 "By simulating a number of historical floods...". The step of the hydraulic reconstruction and flood flow homogenisation is crucial for the implications in the rest of the analysis. The statements could be more quantitative answering questions like: how many historical events were used for calibrating the the hydraulic models in each period (an why, maybe data issues...)?, was the entire Rhine basin calibrated and simulated, or gauge per gauge?, why do the numbers of events in Table 1 differ for the same periods? where the historical events for calibration selected or discarded after some criteria?

- (section 2.2) Page 13543, line 24 "..., the relationships between the observed and reconstructed..." There is no explicit mention on the text that linear regressions (one can extract this information only looking at the table, not at the description of the method) were performed. In Page 13544, line 1, only "regressions" is mentioned, these could refer also to analytical relationships different to linear. Another technical question related to the linear regression, are the coefficients of determination shown in Table 1 in validation (e.g. leave-one-out jackknifing) or in calibration (then it is equal to the linear correlation coefficient between $y \sim x$)? If one analyses the values of estimated slopes in the linear regression formulas, they are all very similar to the unity, with a couple of exceptions, meaning that the relationship consists basically in a shift. This could indicate that perhaps linear regression is not the best choice; have other alternatives been tested? Why not simulate hydraulically all the new events with the past conditions? Is it a matter of computational time?

- (section 2.2) Page 13544, line 6 “... typically showed very high coefficients of determination.” The statement could be quantitative, e.g. “showing values between 0.89 and 0.99”.

- (section 2.3) Page 13545, line 25 and Page 13546, equation (1) “... between the years 1952 and 2009 given by...” Do the differences always refer to the control period 1952-2009 of observed data, or for all different 30-yr combinations between 1952-2009. Should the equation then be, more generally, “Q*last – Q*first”?

- (section 2.3) Page 13546, line 20 What is a “10-yr running mean of the coefficient of variation”? Does it refer to the calculated sample coefficient of variation over a moving window of 10 years of data (i.e., sample size of 10)?

- (section 3.1.1) Page 13548, lines 9-10 (and Page 13554, lines 12-13) Being not familiar with the method, I could be completely wrong, but couldn’t be the significant chnage-points in the 50s and the 2000s due to an artifact, being at the beginning and the end of the sample?

- (section 3.1.2) Page 13548, lines 7-11 (and Figure 5b) In order to assess the stationarity of flood wave travel times in the Neckar River, the difference in arrival times of flood peaks between Rockenau (Neckar) and Basel (Rhine) was calculated. By looking at Figure 1, one can see that these two gauges are located more than 200 km away. This could imply that the flood peaks in the two stations could be originated in different points in time during the same rainfall event, due to spatial and temporal heterogeneity of rainfall, particularly during large-scale storms, such as the ones affecting the entire Rhine river basin. A closer gauge in the river Rhine should be used in order to investigate the stationarity of celerities in the Neckar River, possibly Maxau or Worms.

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