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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Anatomy of simultaneous flood peaks at a lowland confluence" *by* Tjitske J. Geertsema et al.

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This paper looks at the probability of simultaneous flood peaks occurring at river confluences in lowland systems. This is a relatively under-studied topic, yet the impact of network topology and hydrology on the generation of flood extremes is potentially significant and this paper represents an important contribution. Its subject matter is therefore appropriate for HESS. The work is also well executed and well written, and with minor modification to respond to the points detailed below I think the paper can be published.

1. P1, Line 10. The point being made here is that discharge peaks are very likely to coincide at these confluences because of the long duration of flood events in the

Meuse, Dommel and Aa basins. This is a key finding of the paper, but I wonder if this is perhaps as surprising as the paper implies? It is well understood that large river basins (say >100,000 km2) typically have a single annual flood pulse, and this is precisely because flood waves from joining tributaries coincide along the main stem to create a single large wave. In these large basins flood wave duration is typically always long enough that tributary waves can join with the main stem flood pulse. Even the Congo's bi-modal annual flood peak, which is an obvious exception to the 'large basin annual flood pulse' rule, is a product of these effects. My question here is 'at what basin scale does it become surprising that this effect occurs'? Clearly, whether flood waves coincide at tributaries is a product of rainfall patterns over the basin, geology and the network topology, but, from the empirical evidence, at some scale flood wave duration and travel time become sufficiently large that the combination of tributary and main stem flood waves into a larger synchronous pulse becomes almost certain. Should we therefore be surprised to observe coincident waves in a 33,000 km2 lowland catchment? It would be great if the authors could somewhere in the paper add a more nuanced discussion of these effects.

2. P1, Line 20. The point about the highway is repeated here from line 18. It would read better if the repetition was removed.

3. P2, line 12. Same point as (1) above. Does not the empirical evidence from large basins suggest that the counter-hypothesis, namely that superimposition of flood waves is actually to be expected in basins of the scale of the Meuse, is more appropriate?

4. P3, line 2. Isn't the likely response of water levels to simultaneous occurrence of flood peaks already well understood based on standard hydraulic theory? Higher main stem water levels will create significant backwater effects as your analysis shows, but this is well known from other large rivers (see for example Bob Meade's classic paper on backwater effects on the Amazon: Meade, R.H., Rayol, J.M., Da Conceicão, S.C. et al. Environ. Geol. Water Sci (1991) 18: 105. https://doi.org/10.1007/BF01704664).

5. P9, line 13. But the empirical evidence suggests that flood waves quite commonly superimpose in large basins, so whilst other basins may have different climatology the end result seems to be much the same.

6. P9, lines 18 and 19. There are some typos here which make the text on these two lines difficult to follow. Can you edit please?

7. P9, line 22. Should be ‘introduces’.

8. P9, line 22. Perhaps should note that this is not the only cause of spatial variation in flood risk.

I hope these comments are useful.

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