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Comment on nhess-2022-187

Anonymous Referee #1

Referee comment on "Compound flood events: analysing the joint occurrence of extreme river discharge events and storm surges in northern and central Europe" by Philipp Heinrich et al., Nat. Hazards Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/nhess-2022-187-RC1>, 2022

General comments

The study gives an overview of past analyses of compound events in Europe, and proposes an empirical approach not relying on copulas to build a new climatology of compound discharge/surge peaks of NW European rivers. It concludes that westward facing coasts show more than random CEs, while eastward facing coasts are not shown to demonstrate an expected nr of events. For most areas Cyclonic Westerlies are held responsible. Large basins show fewer CEs.

The method is robust – as demonstrated by using different datasets and system parameters – and yields results that are physically understandable: the westerlies, certainly when their directional wind fields constrain the fetch over which surges can develop, generate both a surge and anomalous rainfall, which for smaller catchments comes to joint water level peaks. This expected physical interpretation is both a demonstration of skill of the method, but also a bit disappointing because it is not really a surprising result. Other studies have elaborated on the physical backgrounds of CEs in westerly storm track climates, and extended it further by also including explicit considerations of time lag (Kew et al 2013) and hydrological/meteorological memory (Khanal et al, 2019).

It is not really clear how the findings in this paper will contribute to practical applications, such as enhanced predictability, statistical underpinning of infrastructure design and others. This is not a requirement for a study like this to be published, but some extension of the implications of these findings for the better understanding or development of societal applications would be welcome.

Specific comments

- Other definitions of compound events than the SREX report are provided by Leonard et al (2014) and (already cited) Zscheischler et al (2018)
- Relevance to consider compound events in risk assessment are also clearly exposed by de Ruiter et al (2020)
- The color scale in Figure 1 is not very intuitively ranging between low to high values
- Line 290: a Western Cyclone GWL can not last for weeks, I would say. As shown by Kew, series of low pressure systems may well affect compound events in large river basins like the Rhine, provided a time lag is allowed

References

Kew et al (2013)

<https://nhess.copernicus.org/articles/13/2017/2013/nhess-13-2017-2013.pdf>

Khanal, S., A. Lutz, W. Immerzeel, H. Vries, N. Wanders and B. van den Hurk (2019): The impact of meteorological and hydrological memory on compound peak flows in the Rhine river basin; *Atmosphere* 2019, 10(4), 171; <https://doi.org/10.3390/atmos10040171>

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Ruiter, Marleen C. de, Anaïs Couasnon, Marc J.C. van den Homberg, James E. Daniell, Joel C. Gill, and Philip J. Ward. 2020. "Why We Can No Longer Ignore Consecutive Disasters." *Earth's Future*. John Wiley and Sons Inc. <https://doi.org/10.1029/2019EF001425>.