Interactive comment on "Compound flood potential in Europe" *by* Dominik Paprotny et al.

Anonymous Referee #2

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The manuscript describes a multivariate analysis for characterizing compound events in Europe. The topic is surely interesting and the manuscript, although in some sections too rich of information, is pleasant to read. The proposed analysis is particularly challenging since multivariate analyses are effective with large sample dimension and usually compound events are lacking of information. I have some doubts concerning the copula application described in the manuscript, so I can not suggest the paper publication.

In my opinion, the main drawback is concerning the data selection. Copula inference requires that variables would be i.i.d. that is, in practice, marginals values should be independent. This condition is not addressed in the manuscript since authors decide (as also mentioned in the discussion) to use all the available data and not to select the maximum annual values (or peak over threshold values). This is an important issue that affects results and so it is important to solve.

The second point is related to the comparison among observations and model data and in general to the spatial characterization of dependence structures. Presently, it is addressed using dependence measure and copula functions (that is affected by the i.i.d. condition). In my opinion it could be more affective and representative the non parametric approach using the empirical copulas or the pseudo-observations. This allow to compare directly the shapes of the dependence structure without introducing the intrinsic error present in the parametric inference. An example of this approach is provided in Grimaldi, S., Petroselli, A., Salvadori, G., De Michele, C. (2016) Catchment compatibility via copulas: A non-parametric study of the dependence structures of hydrological responses. Advances in Water Resources, 90, pp. 116-133.

As minor point, compared to the other ones, is related to the joint return period, indeed is not clear which formulation was adopted in the paper (i.e. Gräler B., M. J. van den Berg, S. Vandenberghe, A. Petroselli, Grimaldi S, B. De Baets, and N. E. C. Verhoest (2013). Multivariate return periods in hydrology: a critical and practical review focusing on synthetic design hydrograph estimation. Hydrology and Earth System Sciences, vol. 17, p. 1281-1296, ISSN: 1027-5606.). I do not think that it would change the results however it is necessary to clarify it.