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## Comment on nhess-2021-385

Stefano Barontini (Referee)

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Referee comment on "Mapping Transboundary Climate Change Risk: the case study of the Trinationl Metropolitan Area Upper Rhine Area" by Nils Riach et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-385-RC2>, 2022

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The article addresses a methodology to draw climate change related risk maps in a transboundary hydrological basin, taking as a case study the Upper Rhyne. The methodology is interesting and the article is well written, but despite this I think that the Authors should clarify three key aspects, before that the article might be recommended for publication:

1. The definition of risk and of its components. The Authors correctly report that many approaches are available in the literature to define risk (R) and its components. What remains unclear is the approach followed by the Authors and how the terms of hazard (H), exposure (E) and vulnerability (V) are defined and combined. As the focus is on natural risks, I would suggest to adopt the classical form  $R = H E V$  and to evidence, on the basis of the literature, why and how other authors' definitions differ from this form;

2. Climate homogeneities and risk unhomogeneities. The Authors states that in transboundary areas mapping faces the problem of harmonizing different regional data. Yet differences of regional data rather being considered a problem should in my opinion regarded to a source of information. They can be a consequence of different theoretical approaches, data collection methods, purposes of the procedure, historical risk perception. Moreover unhomogenities in risk mapping might arise also from different geological contexts (e.g. different slopes might differently react to precipitations and be differently prone to landslides, or the extradoxal area of river bends is generally more hazardous with respect to the intradoxal one) or by different population distribution (maps reported in the Supplementary material from page 20 to page 28 shade some insights on this aspect and require to be discussed with more detail in a geographical perspective). I therefore recommend (1) to deeper investigate the origin of the unhomogeneities they found in the regional risk mapping, and (2) to clearer state whether their approach homogeneizes these differences by working on the original data, or it goes beyond these differences by working on different, transboundary, datasets.

3. The crucial problem of arbitrariness in risk mapping. Risk mapping is a quantitative description of the potential damages or losses consequent to an adverse event. It passes through quantitative assessment and often also through classification, normalization and weighting of much different elements. In many cases these elements share the only property that they can be in some way quantified – as far as, e.g., ecosystem services are mostly not quantifiable. These procedures often introduce margins of arbitrariness which has effects on the final maps. On the other hand it is often difficult to have an estimate of the goodness of the introduced arbitrary choice. This can be done in case collected data sets of previous similar events are available. In case such data are not available the comparison of different procedure can guide the assessment of the validity of the procedure. In the lack of previous data or in the absence of the comparison with different mapping procedures, it is difficult to assess the goodness of the proposed mapping technique. The area investigated by the Authors has been urbanized for long time and it is reported that previous maps are available. At least a comparison with previous maps is recommended also to support this point.

Other minor comments:

I.6 "risk can be approximated" not clear what does it mean;  
I.35 and followings: here it is important to detail some expectations (and uncertainties) of the considered climate change scenarios for the area;  
I.55 Introduce here a definition of risk and of its components;  
I.67 "vulnerability of the function of exposure..." it is not clear, all these statement should be better detailed in a framework of a reference risk definition which should be introduced before;  
I.145 "vulnerability = risk": see above  
I.199 RCP4.5 and RCP8.5: introduce a small description of the scenarios  
I.205 At which time scenario are these data referred?  
I.215 and around: how was the reliability for the scenarios assessed? I recommend firstly to make a comparison between measured data and the simulation of present time, to identify the biases and the proper downscaling (of simulations) / upscaling (of measurements) procedures and then apply the same biasing and, if necessary, downscaling, to future scenarios;  
I.222  $rr > 20$  mm: what does  $rr$  stand for?  
II.254---255 see point 2.  
II.338---364 it seems being more a state of the art than a discussion. Many references are presented in an introductory way: in this section they should be more detailed commented point by point in comparison with the presented approach.