Paper Name: "Direct flood risk assessment of the European road network: an object-based approach"
Journal: Natural Hazards and Earth System Sciences

Summary: This paper presents many useful insights into more detailed modeling of large geographic scale transportation network (road) damages resulting from flooding in the current climate. Specific advancements include the creation of new depth-damage curves and more granular assessment of infrastructure locations and asset types using available OpenStreet Map data. Overall, the manuscript is well written, although it appears disorganized (perhaps reorganized) in the Methods and SI sections. It is clear the authors have done a lot of detailed work to create this assessment and there is very useful information presented for application in many instances. The manuscript would benefit significantly from clarifications, especially in the Methods sections, to help readers better understand exactly what assumptions and actions are taken at different steps. Some text should be moved to a 'Background' section to clarify what information informed, but did not directly contribute, to the results presented. Particularly, as noted by the authors, this kind of information (particularly the damage curves and costs) are often cited for years to come, so clarification on the specific applications and limitations of the methods will be most useful. Some specific areas for clarification are detailed below for reference.

Comments:
Section 1: It would be helpful to clarify the specific meaning of "object-based" in this study – it can vary across disciplines and be helpful as a reference

Section 2.1: This study builds on previous work by some of the authors, referencing several different publications (notably Alfieri et al. 2014/2015). While full details can be referenced and found in that work, adding greater detail in this work is needed.

- Specifically, is this geospatial data? If not, how is it integrated into the study?
- The consideration that 'no flood protection is in place' (line 130) also could benefit from a short iteration on how this likely affects the results (it seems like potentially overestimating the damages/flooding to the most important regions of infrastructure, as those would be protected as part of the design).
- Additionally, from the end of line 131 to the end, it seems that this is a description of the Dottori et al (2020) dataset? Being very clear here that no new work was done to augment/change these data by the authors would be helpful

Figure 2 mentions that the road network is "simplified" but this isn't explained in the text, unless this is referring to either the classification of the data (Table S3) or the 1498 regions it is broken into (line 179). If the latter, this seems more like a geographic binning than simplification. This is an important detail be clear about exactly what inputs were analyzed.

Section 2.3.3, specifically regarding Table 1, Table S8 and S11 and the writeup for costs and damage curves used:

- Creating new (ground-truthed) damage curves and costs is a major contribution to the literature. But, it is really hard to distill what was *actually* applied in this study from the large amount of data collected. For example, Table 1 states that "Motorway, Max Damage (high flow)" has a relative cost for A/B type road of 22%. In Figure S3, this seems to reach 90%. It may be that a cutoff value is considered (100 cm), but this also does not appear to correspond to FigureS3. It's also stated earlier that expert judgment was used. This is a valid method, but needs to be clearly explained if that is what was done, and some explanation of the discrepancies between the tables and figures should be noted. This is a key contribution of the paper, and merits more room in the manuscript to be clear for readers
- It appears (though is not stated in the manuscript) that Table S11 is the data actually applied to obtain the study results. Table S8, while a great collection of background data, is too disparate to provide any insight into how these results were obtained.
- Lines 216-231 are useful background information, but seem to be more background than Methodology. Moving this to earlier in the manuscript might improve the clarity of what costs and assumptions are actually used in this study
- Line 243 states that "Therefore, we assume that the predicted floods have relatively low flow velocities"… but high flow results are later considered. This merits clarification
- Lines 247-260 are good explanation of a key contribution to this study. It might (if space permits) even be worth putting Figures S3 and S4 into the main body of the manuscript, after Figure 3. However, adding another paragraph to identify how the curves created (C1-C6) can be attributed to the costs presented in Tables S8, S11 and resulting in Table S13 would be really helpful to readers
- Lines 263-272 are really good background information. Moving this information to the background improve clarity of the Methods applied in the study.
- Table S13 seems very useful to the study results. Considering a summarized version of this applicable to the Methods used to obtain the results in the body of the manuscript would be useful

Section 2.3.5: Clarification on the type of sampling used is helpful (Was random sampling used for each road segment/flood? Or was a Monte Carlo simulation used?). Additionally, a small example here could be very useful

Line 298-299: Add a citation for the assumption of a normal distribution for the flow, or state that this assumption was made because of a lack of available reference data

Section 2.4/Table S17 – this is a clever way to get good data on a test section. What types of roads were 'assumed' via the OSM data for this region? Does it appear accurate? Adding a short but pointed validation of the input data agreement would improve the strength of this section as a verification

Section 3:

- Lines 390-396 and Figure 5: The explanation here doesn't seem to exactly correlate to the Figures. Figure 5B is the "share of regional GDP" whereas the explanatory text talks about National GDP per capita. It also seems that the explanation might be backwards – it appears that the GDP-scaled data (5B) reveals countries such as Croatia as being high-risk, where as the text states "without this GDP correction…" (line 391)

Supplementary Information: the Supplementary Information seems out of order with what is presented in the manuscript, and some seemingly important tables are not mentioned in the main manuscript at all. I think it would benefit from a thorough organizational read.