

## ***Interactive comment on* “Direct flood risk assessment of the European road network: an object-based approach” by Kees C. H. van Ginkel et al.**

### **Anonymous Referee #2**

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The paper shows a methodology to calculate direct flood risk for roads on the basis of developed damage curves. This is a relevant topic and the methodology that is presented in the paper provides very useful information and contributes to advance risk knowledge particularly in the European context. My comments are as follows:

The paper indicates that a new object-based approach and new damage curves are proposed. However, I recommend to clarify what the novel contributions are, since object-based approaches have been used before (e.g. Hackl et al, 2017). In paragraph 65 it is mentioned that Koks et al. (2019) used OMS data for a global multihazard analysis but that several assumptions were made due to data scarce regions of the

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world, but in the European context data is more complete and a more detailed analysis can be carried out. Does this mean that the approach in the paper is the same as in Koks et al. (2019) but with more detail?. What are the differences with the approach in Koks et al. (2019)? What are the differences with the approach in Bubeck et al. (2019)?

The paper will gain clarity if a clear differentiation between direct and indirect damage is established. This will set the context to clarify the difference between an approach that analyses the physical damage to the road and one that provides a network analysis.

The main objective of the paper, as stated in line 65 is to compare the results and performance of an object-based approach to the more traditional grid-based approaches. It seems to me that such comparison is problematic. Results and performance of a grid-based approach depend on scale. If the grid is too coarse results will be coarse and then limited to, for example, strategic decisions in flood risk management. If the scale is detailed the performance should be better and the decisions informed by a more detailed flood risk assessment, therefore, will be more local. Object-based approaches are intended for detailed assessment, therefore they should provide a better level of information than e.g. mesoscale analysis. I recommend to clarify in the paper the differences in scale of the methods and how they can be compared. For example, what is the purpose of the continental-scale analysis (what decisions can be informed? It is for hotspot identification? are hotspots better identified by the object-based approach?) is this purpose better fulfilled by the object-based approach?. According to the explanation on section 2.2 and figure S2 it is clear that Corine 2012 and LUISA 2018 have a coarse resolution (100 m) then it is impossible that an object with only several meters of width can be appropriately represented by this information, besides Corine 2012 even lacks the representation of the roads in some cases. Then, I recommend to elaborate the discussion on the limitations of this data sets and their purpose.

Line 91 mentions the Huizinga infrastructure damage curves. However, no introduction of the Huizinga et al. (2017) reference is made. Since these curves are very important

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in the paper, consider including an introduction of these and why you chose those curves before they are mentioned in line 91.

Line 109 indicates that flood hazard is represented with a set of inundation maps taken from Alfieri et al. (2015), with a recent update by Dottori et al. (2020) which cover most of the European domain at a grid resolution of 100 m. The scale of the hazard maps could be considered coarse. Consider including in the paper a discussion about the impacts of the scale of the hazard maps particularly when using the object-based approach. Are the scales commensurated?

Paragraph starting at line 133. Please refer to the appropriate table at the beginning of the paragraph otherwise it is difficult to understand from where the percentage of 27% is obtained. How were these percentages obtained by Blending of Huizinga (2007)? and why damage was calculated to the percentage of infrastructure in each land use class? Could it be any type of infrastructure?

Line 148 implies that the approach in the paper was proposed by Koks et al. 2019 and that the difference with the method in the paper is the use of damage curves tailored to the European context and uses additional metadata. I recommend that this is clearly stated, particularly in the introduction and the conclusions.

Line 205 states that only flow depth will be used for the damage curves. However, velocity is indeed considered at least to develop two groups of curves. I recommend to review the way in which the parameters to be considered are presented, because it is confusing that velocity appears afterwards in the analysis. Furthermore, what consideration should be given to duration? Is this factor important in damage? Should it be considered somehow?

Line 217 mentions for the first time in the paper a Lisflood model. It is very unclear what was Lisflood used for. In the previous sections the source of the flood hazards is explained without any mention to Lisflood and in the methodology the use of Lisflood is not explained. I recommend to complement the methodology section explaining the

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use of Lisflood, what type of model was developed, what area was modeled and what information was used for the model.

Line 220 indicates that it was assumed that the predicted floods have relatively low flow velocities. Please elaborate your explanation here: Your study area does not cover any area where flash floods occur?, how did you carry out that identification?

Line 225 explains that an overview of the damage curves and supporting narratives can be seen in the supplemental document. In that document, there are figures of the damage curves with a description (narrative). However, it remains unclear how the curves were constructed. Commonly, damage curves are constructed from damage data, structural models or expert judgement. What method was used here? In case, the method is expert judgement, an explanation of procedure, experts, validation should be given.

Line 266 mentions the use of a model is it the Lisflood model?

Section 3.1 emphasizes the need of a more in depth discussion about the suitability of the comparison. Again, the question arises about what the percentage of infrastructure refers to in the CORINE and LUISA data.

Figure 4. The value of the LUISA flood risk is the upper limit of the interquartile range. I believe that this result should be discussed, considering the uncertainty is LUISA less useful? In terms of hotspots is LUISA providing significantly different results?

Line 328. From this line on, the results refer to the object-based approach? Please clarify.

Line 425 states that the Huizinga infrastructure function is a fair proxy for the average damage to road assets but is unsuitable for assessing damage at the individual road level. Is this to be expected? Are the Huizinga functions intended for damage at the individual road level? Here scale issues may have a role.

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