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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Review article: Natural hazard risk assessments at the global scale" *by* Philip J. Ward et al.

Philip J. Ward et al.

philip.ward@ivm.vu.nl

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This review paper provides a valuable and comprehensive overview of the state of the art of global risk models for natural hazards. I much agree on the objective of comparing modelling approaches across sectors, and I believe such comparison may offer a contribution towards the improvement of global models. The paper is generally well structured. The sections addressing the different hazards are balanced and informative, including the supplementary material. Before recommending the paper for publication, I'd like to suggest some minor changes. We thank the reviewer for the time taken to review our manuscript and for his useful comments. We are pleased that the reviewer finds the manuscript to be a useful contribution, well-balanced, and informative. In preparing a revised manuscript, we will take care to address the minor

comments of the reviewer. We respond each of the individual review comments below.

(1) Section 2.1.1, River floods: several modelling frameworks only cover large river basins (e.g. 5000km2 in Alfieri et al., 2017) while minor river network is not considered (even though there are exceptions). I think it would be important to mention this as a general limitation. Indeed, this is an important point to add. We propose to add the following statement to section 2.1.1. "It should be noted that each of the models described here has its own minimum catchment size (ranging from ∼500 to ∼5000km2), under which hazard (and therefore risk) are not calculated"

(2) Section 2.1.3, Pluvial floods: it would be good to shortly discuss the issue of modelling flash floods at global scale (i.e. fast-developing flood events occurring in the minor river network). Maybe it's worth mentioning here the global flood model by Sampson et al. (2015), because it is the only global flood model including a pluvial flooding component (to my best knowledge). Thanks for the very valuable suggestion. We propose to add the following text to section 2.1.3: "Sampson et al. (2015) do include floods in small river channels (with catchment less than 50km2) driven by intense local precipitation. To do this, they use a 'rain-on-grid' method in which flow is generated by simulating rainfall directly on the DEM at a high resolution (3" x 3"), using Intensity-Duration-Frequency relationships of extreme rainfall from ∼200 locations around the world. However, they state that it is not known whether this method provides robust estimates of return period rainfall globally, and also indicate the importance of tackling the aforementioned difficulties. Wing et al. (2018) use this method to assess flood hazard and risk in the conterminous USA."

(3) Section 2.2 I would mention the multi-hazard nature of tropical cyclones (i.e. the fact that impacts are caused by strong winds and the combination of pluvial, coastal, river flooding). Thank you for the suggestion. We propose to emphasise this with the following sentence in section 2.2: "A defining aspect of a TC hazard is that it is composed of wind, precipitation, and storm surge, and the impacts result from a combination of these. However, the current studies to date do not explicitly model all of these aspects.".

This is also further elaborated on in section 4.1 as part of the discussion.

(4) Line 297 typo: "Commonly, drought hazard is defined as..." Thank you. We have amended the sentence as suggested.

(5) Line 301 typo: "Hence, a universal definition of drought seems impracticable..." Thank you. We have amended the sentence as suggested

(6) Line 693-694: It's worth mentioning that the study by Wing et al. (2018) also evaluated risk from pluvial flooding. We propose to add the following statement to section 2.1.3: "Wing et al. (2018) use this method to assess current flood hazard and risk in the conterminous USA." (see also response to reviewer's comment (2)).

(7) Section 4.3, Vulnerability: another important challenge here is the reliability of existing global loss datasets, which have known limitations in data coverage, accessibility, completeness and accuracy (e.g. see UNISDR-CRED (2018) related to EM-DAT database). These limitations hamper the validation of any large-scale modelling framework and I think they should be mentioned, either in section 4.3 or in a dedicated section. This is a very important issue. We agree that it is prudent to note this, although a long description is not possible due to space constraints. We propose to add the following to the start of section 4 (just before 4.1): "An overall challenge for global risk modellers is the lack of high-quality impact data for model validation. Efforts are constantly ongoing to improve the collection of impact data used in databases such as EM-DAT (CRED, 2020), NatCatService (Munich Re, 2020), DesInventar (UNDRR, 2020), and CATDAT (Daniell, 2020), but issues relating to incompleteness, fragmentation, bias, and differences in reporting conventions remain a challenge (e.g. Kron et al., 2012; CRED & UNISDR, 2018)."

(8) Table 1: please consider the idea of separating each hazard in a dedicated table. Thank you for the suggestion. We also considered this option in the original manuscript. However, we believe that providing the information for all hazards next to each other in one table provides a more simple reference point for comparing the different elements

across hazards. Therefore, we believe that changing this would weaken this valuable aspect of our current manuscript, and hence we would prefer to leave the table in its current format.

(9) Also, please define the meaning of IDF in the caption. Thank you for pointing out this omission. We have added this to the caption (IDF= intensity-damage function)

References cited by the reviewer or in our response to the reviewer âĂć CRED, 2020. EM-DAT. The Emergency Events Database. Université catholique de Louvain (UCL) - CRED, Brussels, www.emdat.be âĂć Daniell, J.E. 2020. CATDAT. The CATDAT Integrated Natural Catastrophes Database, Karlsruhe, http://www.risklayer.com/en/service/catdat/ âĂć Kron, W., Steuer, M., Löw, P., Wirtz, A., 2012. How to deal properly with a natural catastrophe database – analysis of flood losses. Nat. Hazard. Earth Sys., 12, 535-550, doi:10.5194/nhess-12-535-2012 âĂć Munich Re, 2020. NatCatSERVICE. Munich Re, Munich, https://natcatservice.munichre.com/ âĂć Sampson, C.C., Smith, A.M., Bates, P.D., Neal, J.C., Alfieri, A., Freer, J.E., 2015. A highâĂŘresolution global flood hazard model. Water Resour. Res., 51, 7358-7381, doi:10.1002/2015WR016954 âĂć UNDRR, 2020. DesInventar database. UNDRR, Geneva, https://www.desinventar.net/ âĂć UNISDR-CRED (2018). Economic Losses, Poverty and Disasters 1998-2017, https://www.unisdr.org/2016/iddr/IDDR2018_Economic%20Losses.pdf âĂć Wing, O.E.J., Bates, P.D., Smith, A.M., Sampson, C.C., Johnson, K.A., Fargione, J., Morefield, P., 2018. Estimates of present and future flood risk in the conterminous United States. Environ. Res. Lett., 13, 034023, doi:10.1088/1748-9326/aaac65

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