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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Flood loss modelling with FLF-IT: A new Flood Loss Function for Italian residential structures" *by* Roozbeh Hasanzadeh Nafari et al.

Anonymous Referee #1

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Summary

In this study a flood loss function was derived from a flood event in the Emilia-Romagna region in Northern Italy in January 2014. The flood loss function used in this study was developed by the first author of this manuscript using a case study from Australia and was calibrated to the case study area in Italy using empirical data. The data used for calibration comprises official damage records of three affected municipalities in Emilia-Romagna and the water depth that was modelled by a combination of 1-D and 2-D hydrological models. For the calibration of the function, bootstrap samples were used to find the best fitting values for two different parameters (root function and the maximum relative damage) based on a chi-square test of goodness of fit. The average of all

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Discussion paper

bootstrap rounds for the two parameters was used to calibrate the “most likely” function. In addition, the parameter sets that maximizes and minimizes the depth damage curve were used as minimum and maximum damage scenarios. A three-fold cross-validation was applied to validate the function with the same data set. For that, the model was calibrated in three iterations with leaving out a different third of the data for testing each time. The model performance for predicting the relative damage was evaluated using the MBE, MAE and RMSE. The MBE showed an overestimation for the first and an underestimation for the second and third iteration, leaving the average mean bias error at zero. The values for MAE and RMSE were ranging between 9 and 10% and 12 and 16% respectively. In a second step, the model was validated using absolute damage values. Therefore, the 95% confidence interval of the absolute damage was calculated by resampling the empiric damage values using bootstrapping. The performance of the loss function was accepted, when the predicted absolute damage was within the 95% confidence interval. This was the case for all three validation iterations as well as the sum of all iterations. The absolute damage was predicted by using the loss function to predict the relative damage and multiply it with the building value.

General comments

Although the application of depth-damage functions for economic flood loss estimation is quite frequently addressed in literature (see Penning-Rowsell et al. 2005 , Merz et al. 2010 and Hammond et al. 2015) the study at hand presents a new approach to calibrate a synthetic flood loss function with empiric damage data. The language of the manuscript is clear and understandable. However, major weaknesses in the documentation of the data as well as in the presentation of the calibration of the loss function, have a considerable effect on the replicability of the study. In addition, the presented results are not discussed or framed in the context of existing studies, which makes it difficult to see the advantage of the presented method in comparison to similar approaches. Therefore, I recommend accepting the manuscript only after major revisions.

Specific comments

Data description

In the documentation of the data used in the manuscript, several information are missing or not accurately described, which makes it difficult to fully understand each step of the analysis. An overview table of the empiric data used for the model calibration could help to get a better understanding of the data set in terms of distribution and sample size. It remains also unclear what building values were used to calculate the relative damage. In L8 on p.5 the author states to use “mean depreciated value” while in L13 p.5 it says “average market values”. Values that represent the actual cost of the building based on material and labor can differ considerably from market values depending on the demand for housing in a certain area. In addition, the spatial matching of the damage values and building properties (L13-L17 on p. 5) should be outlined more clearly including Figure 2. This includes a description on how the damage records were aggregated on building level and which assumptions have been made in case damage records were not available for all units in a building. In Figure 2 the authors should explain what the points and building shapes mean and what we can learn from that.

Calibration and validation of FLF-IT

To avoid confusion, I would suggest moving the part that explains the cross-validation procedure (L12-14 on p.6) in front of the bootstrapping and calibration part (L24 on p. 5 to L6 on p.6) so it is in chronological order. It should also be stated how many samples were pulled out of the data set for each bootstrapping iteration. This is closely linked to the Data description section, where the overall size of the original dataset, the size of each subsample for cross-validation and the size of resampled dataset after bootstrapping should be stated. This can also help to explain the Number of samples in Table 1, which is unclear in the current version of the manuscript. Regarding the RMSE and MAE it should be stated if the percentage values are the original unit coming from the relative damage or if the RMSE and MAE were normalized. In case the values were not normalized it is not possible to assess the predictive performance of the model without knowing the distribution of relative damage in the original dataset. Therefore, either the distribution of relative damage records in the original dataset should be provided or the RMSE and MAE should be normalized. In addition, I would recommend to slightly restructure Table 3 by showing the 95% confidence interval with the lower and upper boundaries in the second column instead of spreading it over column two and three.

Discussion

Given the fact that the application of depth-damage functions is a quite frequently addressed topic in flood research (see Merz et al. 2010 and Hammond et al. 2015), I would highly recommend to discuss the results of this manuscript in the framework of existing flood loss functions to highlight the unique and novel character of this study. This discussion should also include a critical evaluation of the study and the limitation of the study design. For example in L1 f. on p.8 the authors state that “Results of these validation tests illustrate the importance of model calibration, especially when the water depth is the only hydraulic parameter taken into account [...].” However, without the comparison with an uncalibrated function it is not possible to proof that predictions of calibrated loss functions are significantly better that uncalibrated ones. Since the loss function was calibrated on a single event in Italy using a single building type, the limitations in terms of a temporal and spatial transfer should be addressed as well.

Literature

P.2 L14: Jonkman (2007) provides a very detailed definition of (in)tangible and (in)direct flood damage and should be added here.

P.8 L4: Merz et al. (2013) and Schröter et al. (2014) showed that additional damage influencing factors considerably improve the damage predictions and therefore should be added here.

Technical corrections

P.1 L1: “Floods and storms”: Damage caused by storms is actually not covered in this study. Therefore, I would recommend to include numbers for flood damage only.

P.2 L1 & P.3 L11f: “medium flood probability”, “high flood probability”. These are rather soft terms to describe flood probability. If available, I would recommend using numeric flood probabilities (e.g. “1% change to get flooded in any given year”)

P.2 L17: “I-O models”: write full name the first time a new term is mentioned

P.4 L10: “10 thousand”: 10,000 or 10ˆ4

P.4 L17: “125 mm of rain”. Please provide timespan “e.g. 125 mm of rain in 48 hours”

P.4 L21 & L27f: “6.5 thousand hectares”: convert into mˆ2 or kmˆ2 to improve comparability with other values provided in this section.

P.4 L30: “bi-dimensional”: 2-D

P.5 L1: “one-meter resolution”: a one-meter resolution

Table 3: “(in EUR m)”: Million? 10ˆ6 EUR

P8. L21: “takes empirical data of damage and depth”: According to the Data description section, the water depth was modelled and not empirically measured.

References

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