

Journal:

NHESS

Title: **Results comparison and model validation for flood loss functions in Australian geographical conditions**

Author(s): R. Hasanzadeh Nafari, T. Ngo, and W. Lehman

MS No.: nhe-2015-156 MS Type: Research Article

Iteration: First review

The objective of the paper is “to assess the applicability and transferability of overseas flood damage models to Australian geographical conditions by using historic data (..) In addition, the accuracy of the results obtained from a newly derived model and a local methodology were compared and evaluated using historic data”.

To this aim the authors compare observed damages with damage estimations supplied by two existing models, and with those of a new synthetic model calibrated with historical data.

Despite the objective of the study is interesting, the paper suffers of major shortcomings which prevent its publication. In what follows, major criticisms are first discussed and then specific comments on the text are supplied. I suggest major revision of the paper. However, given the amount of required work, authors may chose a new submission.

Major criticisms

With respect to the two existing models, neither the applicability nor transferability of the model are analysed. To this aim, I expected authors to analyse whether the hazard and vulnerability features considered in the development of the models fit with Australian conditions; whether vulnerability parameters of the models are significant or not in the study area, etc.

The authors simply evaluate the accuracy of damage estimates (supplied by the two models) by a comparison with empirical data.

As regards the new model, I understand that it was calibrated and validated with the same dataset which of course implies good performances. The comparison of the performance of the three models by using a different set of damage data, would be more reasonable . In general, the description of the new model requires some clarifications (see below)

Also the performance evaluation (section 6) suffers of several problems. See below.

The present organisation of contents creates confusion in the reader. Sometimes linked concepts are discussed in distinct sections; some concepts are instead not in the right section.

I would suggest to change the objective of the paper that should be “presenting a new model for Australia and comparing it with existing methodologies (one local and one from US)”. To this aim I would suggest to change the organisation of contents in this way:

- remove section 3 and replace it with a section describing in detail the new model. The description of the GA method and USACE method can be directly included in section on results.
- Section 5 should focus on the derivation of the model, including the statistical analysis.
- Section 6 should focus only on models comparison.

Specific (minor and major) comments

Section 1

Pg 2 line 24 “*in recent decades, the probability of flood and the values of exposed properties have increased exponentially* ” → This is not totally correct and is not supported by the articles cited. An increase in flood damages has been observed (as suggested by the authors quoted). However, a debate is ongoing about

whether such a trend is due to an increase in hazard frequency and intensity or to a better damage recording. I agree that exposed properties increased significantly.

Pg 3 line 1 *“damage assessment in terms of mitigating the probability of expected losses”* → Why “in terms of”? Do authors mean “damage assessment as the base for/ in order to mitigate the probability of expected losses”?

Pg 3 line 27 *“On the other hand, flood actions on buildings could be related to a variety of hydraulic factors such as lateral pressure, velocity, duration, debris, erosion, and the chemical effects of water. But most of the models for direct impact estimation consider only the depth of water as the main characteristic of flood”*. → The concept is not “concluded”. Which is the consequence of this? I guess model uncertainty. If this is the case, the role of vulnerability factors should be discussed as well, because they can be even more influencing.

Pg 4 line 14 *“Although the simplicity of stage damage functions is the main reason for their common usage, neglecting some influencing aspects due to a lack of real damage data will raise the level of uncertainty”*. → this is actually the conclusion of the above concept. But it appears some lines below. Suggestion: the role of influencing factors (or explicative variable I would say) on model uncertainty is not in the scope of the paper. There are not analyses/evaluations on the role of considered and neglected factors on model accuracy. In order to avoid confusion in the reader, I would delete this discussion from the paper or, at least, I would specify that the point is not handled in the following.

Section 2

Pg 4 line 19 *“In addition to the Rapid Appraisal Method (RAM), which is an averaging methodology for damage estimation, there are a lot of depth–damage curves for flood loss assessment in Australia. The RAM is a simplified method for flood damage estimation in the absence of data required for using depth–damage curves. This method considers mean unit values of damage for all buildings in the inundated area. Although RAM is useful for early assessment of the magnitude of damage, the results are considerably inaccurate (Barton et al., 2003)”*. → I do not understand why the RAM method is explained as it is not subsequently used. Ok in the introduction, not in the background section.

Pg. 5 line 2. *“Gathering data from one actual flood event and using it as a guide for future events in a new area of study, or even in the area of origin, requires a complicated process of extrapolation (Gissing and Blong, 2004; Smith, 1994)”*. → quite general, please explain

Pg. 5 line 6 *“Valuation surveys refer to the value and elevation of all assembly items and contents that are located above the basement”* → Not clear, please specify more

Pg. 5 line 27 *“ANUFLOOD”* → Not all readers know such a model. Please introduce it or, at least, supply references.

Pg. 6 line 6. *“... will raise the level of uncertainty in the results”* → In this case, I would say the reliability/ accuracy of results more than uncertainty.

Pg. 6 line 11 *“...such as the ANUFLOOD methodology, the Geoscience Australia model, and NSW government curves”* → I understand that no specific literature on models derivation is available but I guess that at least they are cited in some documents, please supply references.

Pg. 6 line 16 *“Although the detailed valuation survey proposed by Smith seems a little complicated and time-consuming even for data gathered from one type of building (Merz et al., 2010), the new model for evaluating the assembly items and tracking the vertical parameters by considering more general categories, has attempted to simplify the process as much as possible”* → repetition, see pg. 5 line 11

Section 3

I think that this section must be changed. See above.

Pg. 6 line 23 → comprehensive or generic???

Pg. 6 line 23 *“Some comprehensive generic depth–damage curves for south-east Queensland have been presented in the report by Geoscience Australia”* → which report?

Pg. 7 line 7 *“they are adapted to our area of study”* → By who? What does it means?

Pg. 7 line 8 *“they are supported by the Australian government”* → And so what?

Section 3.2

It is not clear to me how the four classes were selected if you avoided the survey.

“As discussed further below, this categorisation is totally adaptable with the empirical flood loss data. In other words, the empirical datasets have expressed the percentage of damage and the condition of flooded buildings based on the damaged sub-assembly groups” → not clear, please specify

“In the above formula, the maximum value of damage for each class of building is extracted from the Geoscience Australia report (Geoscience Australia, 2012), which represents the value of damage corresponding to the maximum depth of water (maximum height of the building relative to the first floor)”
→ In order to be coherent with the damage estimation approach, D_{\max} should be equal to the total value of assembly items. Why this choice?

“ By following the notion that in uniform residential buildings with more than one storey, the first floor of the building contributes more damage than the other stories because most utilities are stored there, this formula enables the user to define how much damage would occur between the first floor elevation, and how much damage can be distributed among the other floors”

→ what are uniform buildings?

→ The concept is not clear. The possibility recalled in the paper is offered by the division of the total maximum damage in the maximum damage at each floor. Please clarify.

Section 4

Pg 13 line 6 → *“In addition to some issues regarding the standards of insurance companies that effect their methods of data gathering and collection”* → not clear, please comment on

Pg. 13 line 13 *“After discarding the unrelated cases”* → what do you mean with unrelated cases?

Pg, 13 line 17 *“It is to be noted that for selecting the most probable datasets, empirical samples with very rare population have been omitted from this group”* → not clear, what do you mean with “most probable datasets” and “empirical sample with very rare population”?

Pg. 14 line 10 *“ Table 1 summarises the contribution of sub-assembly replacement values as a percentage of the total building replacement value”* → I would expect that the contribution of sub-assembly items changes in the four vulnerability class . Did you consider this?

Pg. 14 line 11 *“Accordingly, based on the total value of affected items compared to the entire value of the building (Jonkman et al., 2008), each condition rate has been linked to one range of damage percentage and water depth (see Fig. 3)”* → this point must be clarify. I do not understand the figure. Maybe supplying some numerical examples can be useful.

Pg. 14 line 14 *“Finally, for every building, based on the magnitude of hazard and depth of water, the percentage of damage could be entracte”* → not clear. Please specify

Section 5

Pg. 15 line 6. *“As stated earlier, the first step of model derivation is choosing the maximum possible value of damage that can occur for each vulnerability class”* → where?

Pg. 15 line 10 *“Due to the fact that the utilities of buildings (including mechanical and electrical facilities) are mostly stored on the first floor of buildings, and based on the replacement value of this equipment compared to other fragile items (e.g. the superstructure, exteriors and interiors excluding utilities), the magnitude of first floor damage relative to second floor damage can be estimated to be approximately 1.8 times more”.* → I expect this to change according to the material. Did you consider this?

Section 6

I guess two different sets of data have been used to calibrate (i.e. defining the r values) and validate (i.e. comparing with empirical data) the model but this is not clear in the paper. Otherwise, it is evident that the new model better predict expected damage.

It can also be useful to know which is the dimension of the datasets used for calibration and validation, for each class.

“Due to the fact that potential damage is the maximum possible value of losses without considering any mitigation measures (Bureau of Transport Economics, 2001; Molinari, 2011; Molinari et al., 2013), underestimated values which represent the percentage of damages less than actual values should be omitted for the averaging part” → why? Not clear to me, this way you are not assessing the real performance of the model

“As can be seen from Table 3, the average values have been calculated from the ratios greater than one, and the standard deviation and coefficient of variation have also been estimated based on these ratios” → the table is not clear as all the ratios are reported. Moreover, results should be checked. For example, the average of positive ratios for model GA is 2.68 not 2.58

“Figs. 7 and 8, all approaches overestimate the magnitude of losses for the first few centimetres of flood (approximately the first 15 cm)” → this is true for Figure 8 but not for Figure 7 where the three models overestimate in the first 75 centimetres. A model that cannot be used in the first 15 cm may have sense where expected water levels are significant (as in the case of Australia). But neglecting the first 75 cm means that the model cannot be used in many circumstances. What is the authors intent in these cases?

“the newly derived model represents lower values for the average of the loss ratios and they are closer to one (i.e. the loss ratio is equal to one if the results of the functions and empirical datasets match each other)” → if you are not using different dataset for calibration and validation, of course it does. The other models were not calibrated with empirical data!!! See above

“we see that the newly derived model is also conservative, and marginally less than the results for the GA method and the USACE approach” → what do you mean with conservative?

“Other methodologies that represent unstable trends seem to be more uncertain and difficult for making decisions” → not clear, please specify

Conclusion

“This study aimed to investigate the applicability and adaptability of different flood damage models to Australian geographical conditions” → adaptability is not analysed in the paper (see above)

“The results of this study show that even the state methodologies will express the results of flood damage conservatively, either underestimating values or sometimes producing marginally high values” → what do you mean with conservative (see also above)? Always overestimating? Or always underestimating? The two features of the model described in the sentence are in conflict.

Bibliography

I did not check the bibliography at this stage of the review. I reserve to do this in a second time. However I noted that no reference is made for most of the discussed tools (i.e. damage models).

Figure 6

It is very strange to me to see empirical data which are so well aligned (i.e. without spread). Probably they have been filtered in some way but this is not clear in the paper.