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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Uncertainty in flood damage estimates and its potential effect on investment decisions" *by* D. J. Wagenaar et al.

D. J. Wagenaar et al.

dennis.wagenaar@deltares.nl

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We thank this referee for the useful and constructive feedback. We really appreciate the effort and time this referee has put into this review. Below a summary of what we intend to do with it:

1. We will clarify table 1 and make clear which uncertainties are included later in the paper and which uncertainties are neglected. This will be done in table form and by adding an extra paragraph (on page 613, after line 18). This will also cover the suggestion to make a stronger link between the first and the second part.

2. The referee had some questions about choices made in this paper. Below our argumentation for these choices. We will include this argumentation in the paper.

a. For the model selection we used all models from developed countries that were available to us at the time of this research (we will add this on page 619 to the paragraph about the damage function library).

b. The focus on residential buildings and companies was chosen for several reasons: These two categories are available in almost all models and therefore make comparisons possible, they cover the majority of the direct damage according to most models and restricting the model to two categories keeps it simple and keeps the calculation time acceptable. (we will add this to page 618 around line 18)

c. Only two models included just one sector, both models are from the same area, are created in similar ways and one covers residential buildings and the other companies. Therefore the two models were merged into a new one for the purpose of this research. (we will add this to page 619 around line 11)

3. The referee commented that coefficient of variation is a biased estimator of variation for non-normal distributions such as used in this paper. The coefficient of variation is based on the standard deviation and this is not an exact measure outside the normal distribution. Some information will therefore be lost when the entire distribution is summarized in this single number. However, other indicators such as the IQR/median are also no exact descriptions of variations and therefore have similar imperfections. We will also calculate the IQR/median indicator and see if this parameter gives a similar picture as the coefficient of variation. If they give similar views about the variation we will report both parameters, if they give different views we will either explain the difference or only show the IQR/median indicator.

4. The referee asked for some extra clarification about Dutch literature about finding the optimal protection level of a dike. We will add these clarifications especially for the parts that are only described in Dutch literature. (We will elaborate on some of the explanations in in the end of page 623 and the beginning of page 624). Supplement document

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The referee provided a supplement document with comments directly made in the text of the paper. Most key points in this supplement document are repeated in the general comments and are addressed above. The minor questions not yet addressed above will be answered below, typos or very basic correct clarifications given by the referee will be processed in the final manuscript without mention below:

-Page 609 (1): This reference will be added to the paper.

-Page 609(2): The paper lead to several focus points for the improvement of flood damage models as noted in the discussion and conclusion.

-Page 612: More differentiation will lead to an improved description of the natural variability and therefore less model uncertainty. (will be clarified in the text)

-Page 614: The first part of this section is about the location only the second part is also about the number of objects per location (this will be clarified by adding the word location).

-Page 615: This reference will be added to the paper.

-Page 616: This is correct; this is just a theoretical description. It will be clarified in the text.

-Page 617: With “event” we mean recorded flood events that caused flood damage. We will clarify this.

-Page 619: This is the method we used to represent the water depth. This explanation will be moved to the next chapter where it will make more sense.

-Page 620: The number of jobs will be introduced as indicator for company size (see response to William Lehman for more detail).

-Page 621(1): These values have no background and are rough estimates. The results of the model are however not sensitive to this estimation.

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-Page 621(2): It is difficult to estimate how skewed this distribution is or what it would look like. We didn't go deeper into this because the model is not sensitive to this distribution. We will clarify this in the text.

-Page 621(3): The paper results are also not sensitive for this estimate. This estimate was done based on experience with different flood damage models. In the flood damage model HAZUS this assumption comes back and many other flood damage models have assumptions that are close to 50-50. We will reference to HAZUS.

-Page 622(1+2): The definition of large and small event as was used in this paper is shown in figure 3. There is however not an exact border between small and large events.

-Page 622(3+4): Yes this is correct, will be added between brackets.

-Page 622(5): This is a very complex topic and it is very difficult to estimate this local correlation. More research is necessary to do this. We will change the word calibration into more research.

-Page 623: There are indeed fewer peaks than models because two models have been merged into one because they had only one sector (see major comments). Furthermore, two other peaks are so close together that they make one wider peak together. That leaves 5 peaks for 7 models. Some extra clarification will be added in the figure description.

-Page 624: Optimal is defined as dike height with the lowest expected costs in the future including both expected damage and investment costs. This will be clarified in the method description.

-Page 626(1): We only used one flood simulation for this assessment. Common practice in the Netherlands is to use multiple flood simulations with different water levels and dike breach conditions and then apply weights to these different flood simulations. We will clarify this further and refer to some of the Dutch literature about this issue.

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-Page 626(2): We will make clear that there are different viewpoints about this and reference to the papers provided by the referee.

-Page 628: There is not an exact difference between a small and large flood but rather a transition between the two. However, the definitions used to get to this conclusion are shown in figure 3.

The referee also asked to compare the approach of this paper to other recent probabilistic flood damage modeling approaches. This is an interesting discussion that we would like to add to the paper. Especially the work of Vogel et al., 2012 and Schröter et al, 2014 is interesting to mention. The obvious difference is that this paper is using a Monte Carlo approach while they use fundamentally different methods. However, the more interesting difference is that this paper assumes a situation where no good local data is available and that little is known about the expected conditions during the potential flood (apart from the maximum water depth). Therefore, this paper used relatively simple data from many different countries and flood types as input for the uncertainty analysis, while these other papers used relatively complex data from only Germany. The strength of this approach therefore is that it has a wider coverage of the spectrum of possible flood damage. The disadvantage of this approach is that it is not applicable when a good local flood damage model is available based on a lot of data. The other mentioned papers typically focused on uncertainty in flood risk management as a whole with much less attention to uncertainty in the flood damage aspect.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 607, 2015.