

## ***Interactive comment on “The added value of system robustness analysis for flood risk management” by M. J. P. Mens and F. Klijn***

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The comments of the referees

Referee #3 formulates a judgement on the paper, which we acknowledge with thanks, but this referee has no comments requiring us, as authors, to respond to or act upon. Referee #4 has one major comment and three smaller comments. This referee's main concern is that the added value of system robustness as decision criterion is not sufficiently discussed in Section 5. The referee suggests to additionally compare decision making based on a cost-benefit analysis with decision making based on both cost-benefit analysis as well as robustness analysis. The minor comments of this referee are: 1) It should be mentioned in the title that this analysis is done for one case study

C2994

2) Population growth is less relevant for increasing flood risk in the Netherlands 3) The paper is structured in a non-standard way. Suggestion to change section titles to make the structure more clear.

Author's response

As for the minor comments, our response can be brief: 1) A fair request, we shall follow the suggestion 2) We agree that population growth is much less important in the Netherlands than economic growth, but this may be different for other countries where the approach could also be applied. The text may need clarification on this. 3) This structure worked best for this paper; for readability, we wanted to keep the method and results of the flood risk analysis together as well as the method and results of robustness analysis. We, however, agree that the section titles can be improved in such a way as to better show this internal structure.

As for the major comment (#4), we agree with the reviewer that it is interesting to analyse how decisions would differ when system robustness is taken into account in addition to, for example, cost benefit analysis. In fact, we recently performed such an analysis and report on it in a paper which we submitted to another journal (Journal of Mitigation and Adaptation Strategies for Global Change). As it involves new research, done after the submission of our paper to NHESS and requiring lots of explaining and further complicating the text, we prefer not to fully include it in this paper. A brief preview in our discussion (addressing the research question) can, however, be included. In the current paper, we discuss the added value of robustness analysis not only in relation to decision making, but rather in terms of the different insights that can be obtained in comparison to straightforward flood risk analysis. This was the main focus of the paper. Through our case study, we have demonstrated that robustness analysis provides additional insights into how a river flood risk system deals with extreme discharges, compared to flood risk analysis only, because: - It shows which range of flood events can be resisted without damage regardless of the discharge variability, whereas flood risk needs assumptions on discharge return periods. - It additionally shows the

C2995

sensitivity of flood damage to changes in discharge. This is relevant in view of dealing with uncertainty about the magnitude and frequency of occurrence of extreme events, which is seldomly well-covered by the common flood risk metrics. - It supports a reflection on the acceptability of flood damage We feel that these insights are a sufficient demonstration of the added value of robustness analysis already. How it may influence decision making asks for extensive explanation and thorough treaty, which we consider justifying a separate paper.

Author's changes in manuscript

1) We changed the title (now: 'The added value of system robustness analysis for flood risk management illustrated by a case on the IJssel River') 2) We added a footnote to clarify this 3) We adapted the section titles according to referee's suggestion 4) We extended the discussion to better explain what we consider added value and we included a brief preview to further investigations into how the preference ordering of alternative strategies may be influenced by taking into account robustness as additional decision criterion.

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