

Interactive comment on “An advanced method for flood risk analysis in river deltas, applied to societal flood fatality risks in the Netherlands” by K. M. de Bruijn et al.

Anonymous Referee #1

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General comments

This paper represents an advanced method for analysing flood risks in river delta areas. The methodology presented in this paper consists of a Monte Carlo-based framework, combined with a 1D hydrodynamic model, to provide outcomes that can be later represented in FN curves.

The main findings are:

- (1) the impact of including hydrodynamic interaction effects (reduction of water levels in downstream locations due to upstream dike breaches) on flood risk calculations,

C372

and,

- (2) the consideration of tidal and non-tidal zones and the combination of the corresponding loads, including storm surges and extreme river discharges.

I read the paper from two perspectives: someone who is familiar with the terms and concepts that the authors are using, and someone who is not familiar with flood risk analysis techniques. Suggestions are offered from both points of view.

In summary, the following general comments are provided:

- a) The objective of this paper is of high interest and societal flood risk outcomes from applying this method may be used to inform flood risk mitigation strategies.
- b) The methodology is, in general, clearly explained, though more detail on some sections might be needed (see specific comments).
- c) The authors are clear about how this method has been applied to a large area in the Netherlands, however societal risk results for different scenarios or flood risk management strategies are not provided to support the applicability of the method for the third requirement presented in the Introduction.
- d) Discussion on the application of the method to other systems (e.g. flood risk analysis from failure of other flood protection systems) would benefit this paper.
- e) Due to data requirements (loss-of-life database, fragility curves, hydrodynamic model, breach locations, etc.) and pre-/post-processing, reproduction of results by others or application of the method to other areas might be complicated.

Therefore, in general, I recommend including some additional discussion on the applicability and limitations of this method and some additional results on a new scenario to show the potential impact of flood risk mitigation strategies.

Specific comments

C373

Suggestions and other specific comments are here included:

1. [Section 2.1] “Various methods have been developed to analyse flood risk in deltas...” References to deterministic and probabilistic approaches are focused on river delta or coastal areas and, more specifically, previous work in the Netherlands, which is related to the context of the paper, but it would be of interest to include more references to other loss-of-life estimation and flood risk analysis approaches (and their corresponding tools), maybe applied to case studies or regions other than the Netherlands or UK.
2. [Page 1645, l.22] “The water levels in the reservoirs are not used to assess flood impacts. Instead, for locations where breaches occur, existing 2-D model results are taken from a database with pre-simulated flood scenarios” Please describe the loss-of-life estimation method used for the database.
3. [Page 1645, l.24] “The flood patterns were translated to fatality figures with the adapted version of the 25 mortality functions of Jonkman” For clarification, a more detailed explanation would be necessary to describe this stage.
4. [Page 1647, l.2]; and [Section 4, Page 1654-1657] “...failure probabilities of each dike section correspond with the user-defined safety level”. Please explain in more detail the fragility curves used in this method and how are shifted to the user-defined safety levels. Add figures as an example to support explanation.
5. [Page 1653, l. 19-21] Please include further information on the hypothesis and data used for the consequences database, the fatality figures and design conditions for which loss-of-life was estimated.
6. [Section 4, Page 1654-1657] I suggest the analysis of other scenarios (flood risk management measures/strategies) to show the impact on societal flood risk and to support the applicability of the method for policy making. [General comment]
7. [Page 1657, l.13] “The method is not computationally demanding...” Please de-

C374

scribe the impact of the hydrodynamic model on simulation time. Is this also valid if other hydrodynamic model was used (e.g. more complex model, 2D)?

8. [Section 6, Page 1658] Please include discussion on the applicability/limitations of the method for analyzing flood risk from failure of other flood protection systems. [General comment]
9. [Section 6, Page 1658] Discuss the applicability of FN curves for other analyses, e.g. at local level, and possible limitations (include references).
10. [Fig.1] Describe data requirements in more detail and the need for detailed information (hydrological models, database, fragility curves, fatalities, etc.) for applying the method.

Other comments:

Page Line Comment

1649 6 Add NAP stands for Normal Amsterdam Level

1650 10 Z<0), f(x)

1653 21 Replace “1-D2-D” by “1-D/2-D” if refers to a coupled/linked model

1655 3 Delete is

1667 Fig. 2 L1th

1668 Fig. 3 Check figure caption: 5000 and fatalities

1668 Fig. 3 Check text vertical axis (right figure) #casulaties

1670 Fig. 5 Negative values x axis

1670 Fig. 5 m3/s