Evaluating impacts in system behaviour analysis: a framework for sensitivity, uncertainty and scenario assessments

A. Curran*[1,2], K.M. De Bruijn[2], M. Kok[1]

*a.n.curran@tudelft.nl

[1]TU Delft, [2]Deltares,

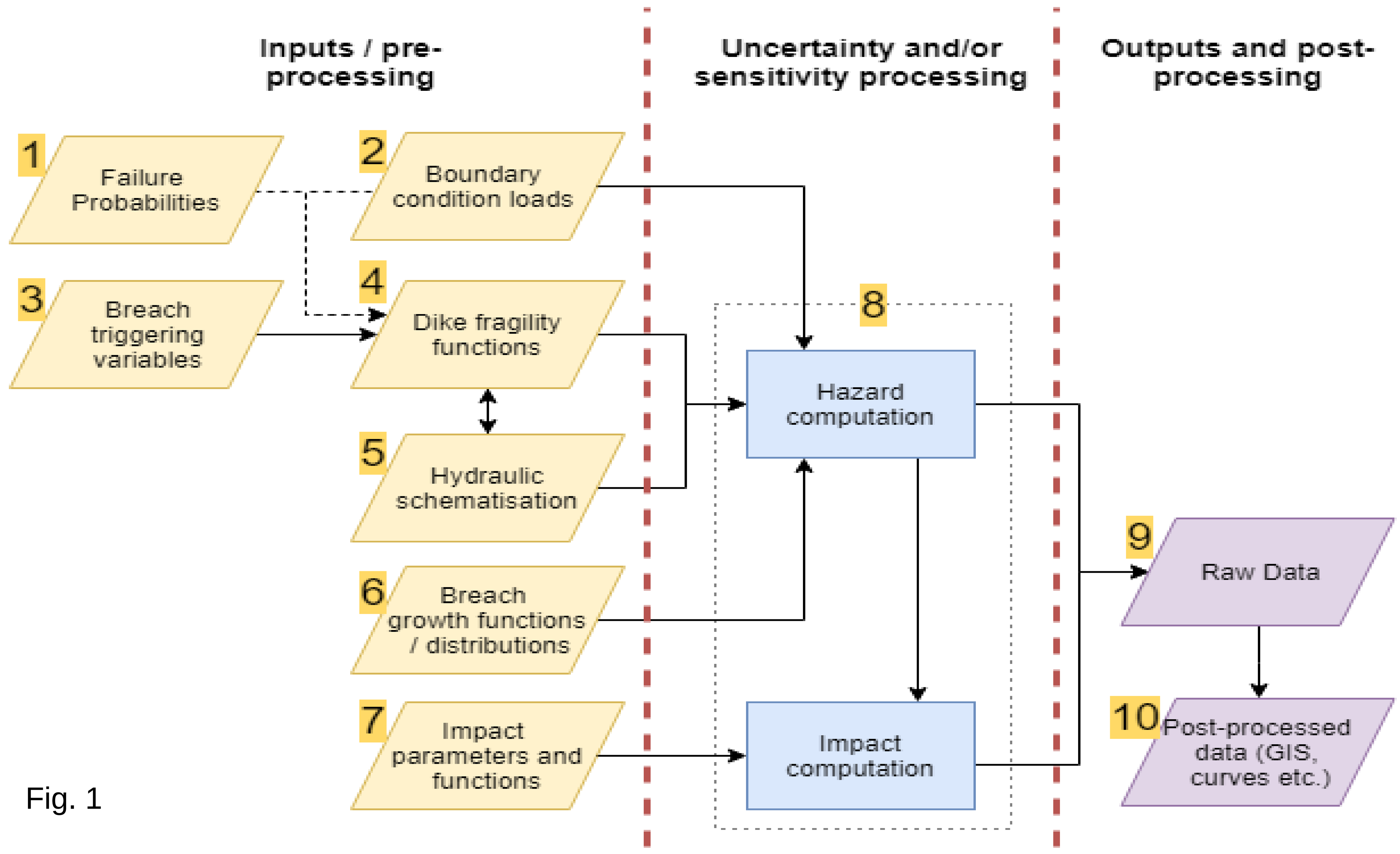
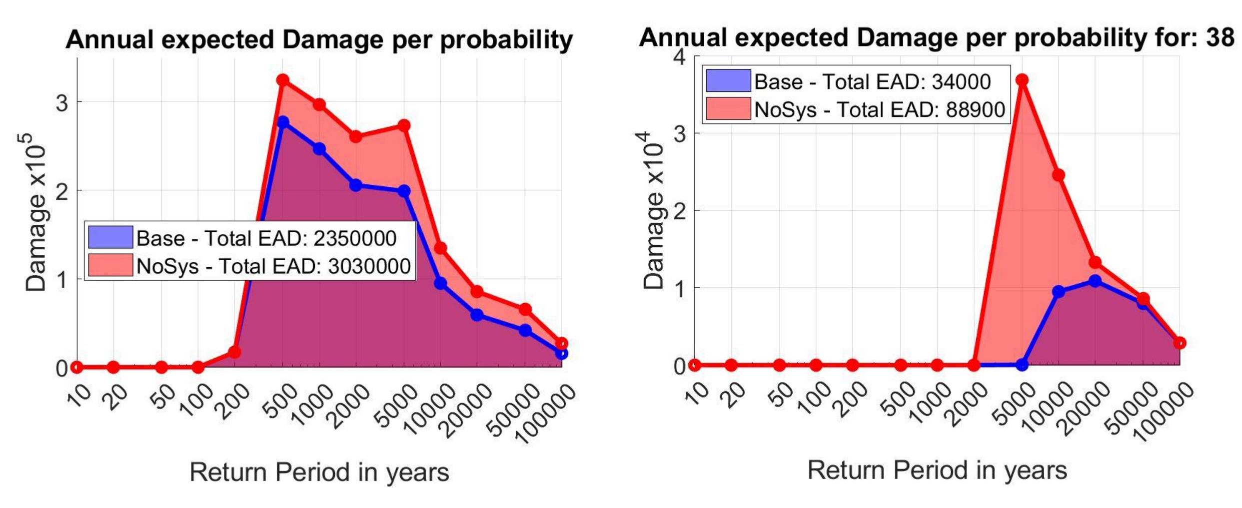


Fig. 1

Case study results - method



System behavior analysis:

The graphs show the expected damage for different events in the overall system (left) and at a specific dikering (right). Analysis not accounting for system behaviour shows a ~30% increase in cost, but locally these differences can be more extreme, such as in dikering 38 (right).

Overall, no damage is observed to occur for events smaller than 1/100 years.

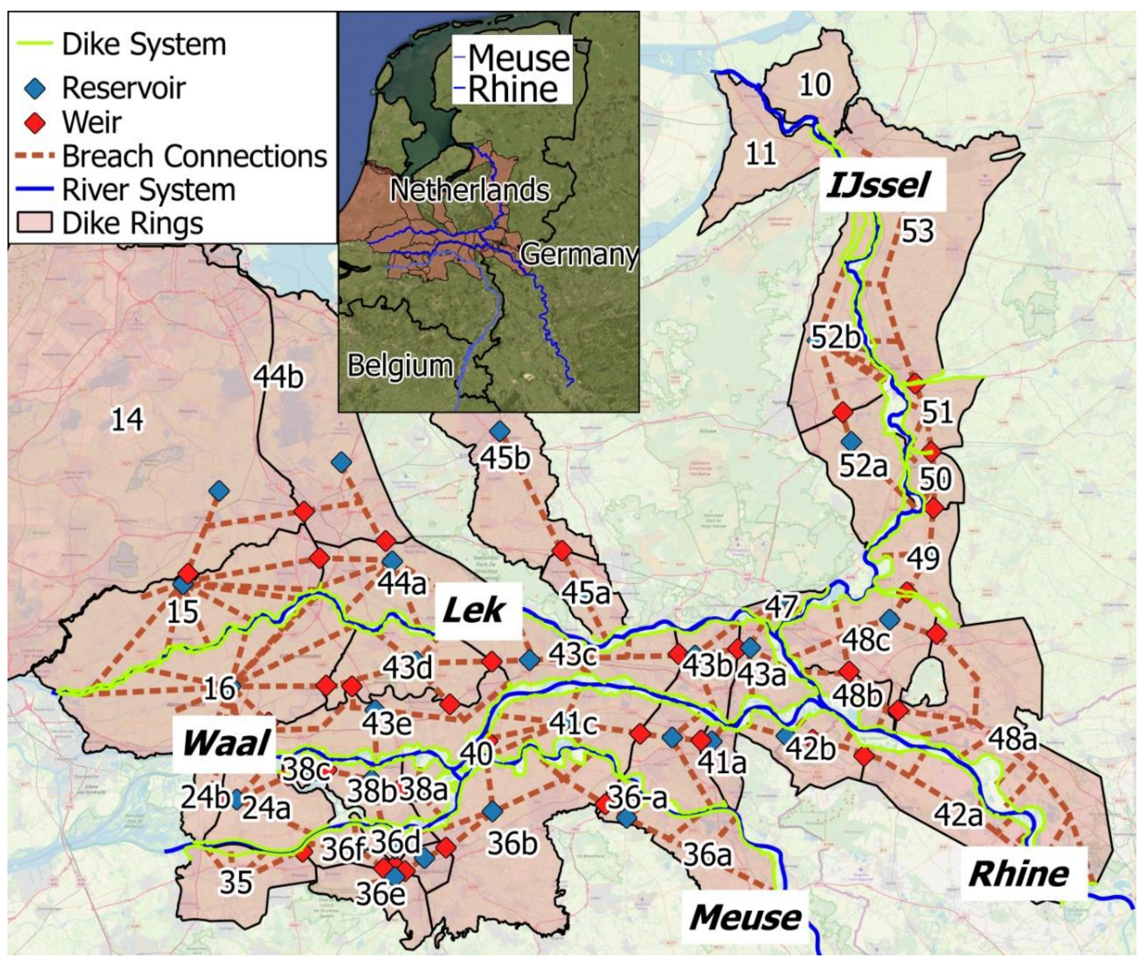
Introduction

'System behavior' analyses include the possibility of breaching in large-scale flood risk assessments. They are often highly complex, involving many components and assumptions, so assessing the sensitivity of these components is important if the results drive future decision-making.

A framework for how to conduct sensitivity, uncertainty and scenario analyses to quantify impacts such as economic and flood fatality risk has been developed, based on the components given in Fig. 1.

This framework is applied to the Dutch river and dike system below. Various sensitivity analyses are conducted on the inputs and the results are shown on the right.

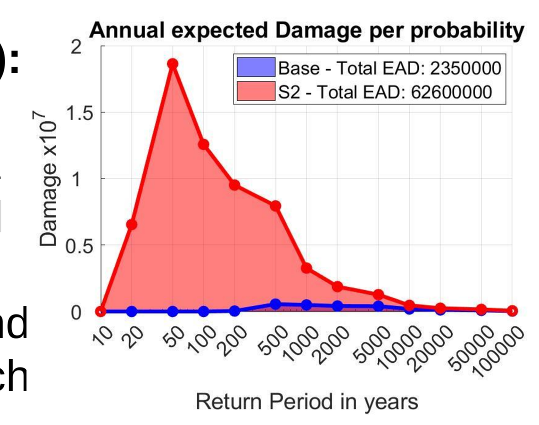
The results are based on the expected annual damage (EAD) for different scenarios and probabilities, with the total EAD also provided.



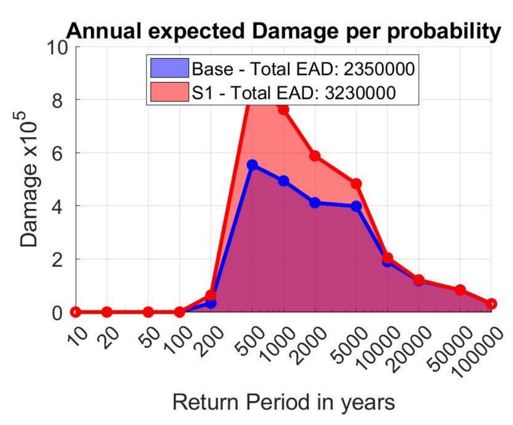
Case study results - inputs

Strengths

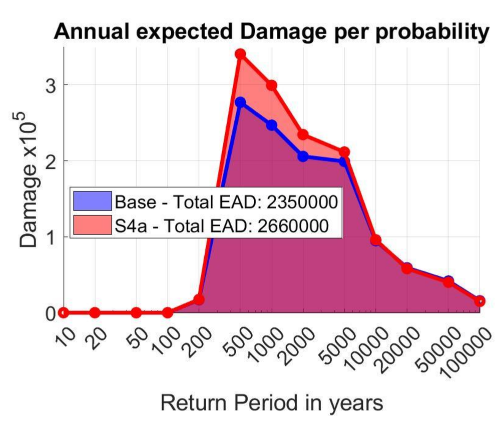
Failure probabilities (1): The new protection Standards (blue) show a large reduction in overall risk compared to current estimates (red), and damage occurs at much higher probabilities.



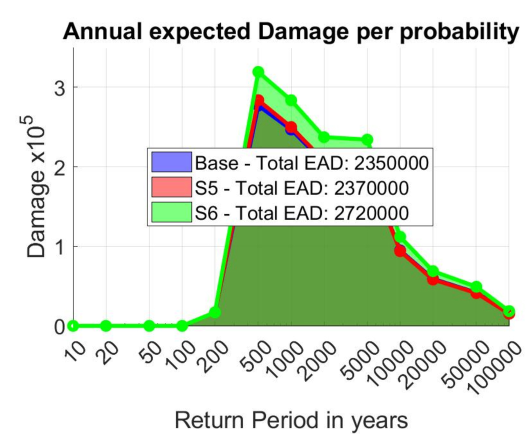
Breach triggers (3): Accounting for duration (blue) in breach triggering shows an increase in damage compared to breach triggers based on water level alone (red).



Fragility functions (4): Including spatial dependence in the generation of fragility curves (red) appears to have a small effect overall on risk compared to uncorrelated Curves (blue)

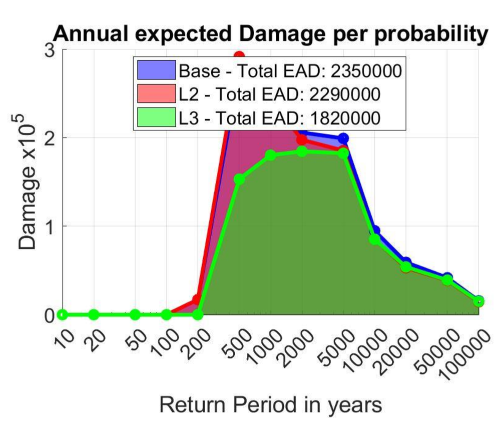


Breach growth Functions (6): Depending on breach Growth parameters, the overall risk does not change significantly with respect to breach growth parameters, but local differences are observed.

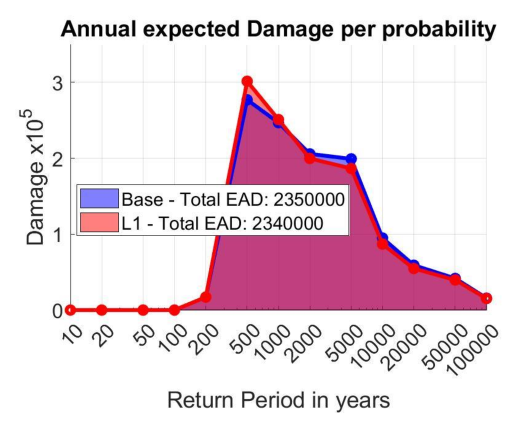


Loads

Correlation of river flows (2): The Rhine and Meuse are estimated to have a correlation in peak discharge of 0.9 (blue), but lower (0.5 - red) and higher (1 - green) estimates impact the risk.

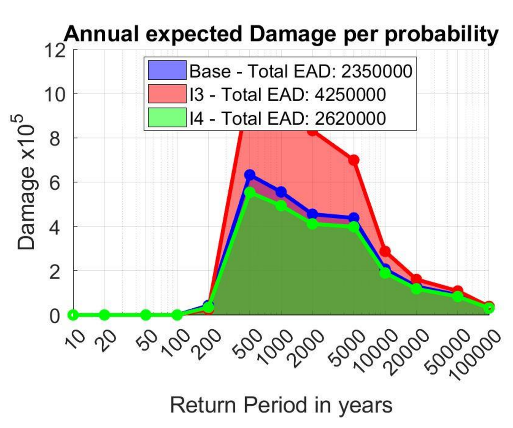


Boundary condition type (2): Using the actual flood waves generated by a weather generator (red), or distributions based on their characteristics (blue) has little impact on overall risk.

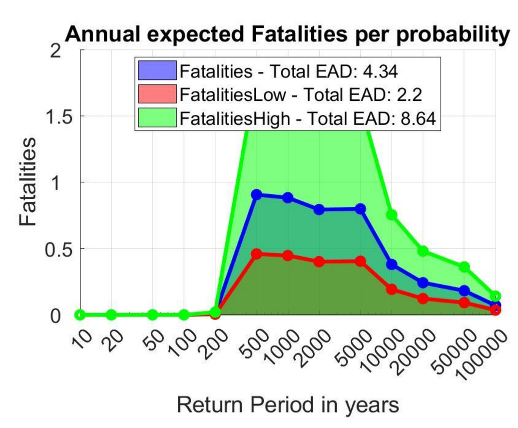


Impacts

Damage curves (7): Obviously, smaller (green) or larger (red) estimates of the damage curves can significantly Impact overall risk.



Fatality functions (7): As with the damage curves, the fatality functions used can have a significant impact on the expected yearly fatalities.



Conclusions

For the case study, although the assessments are computationally demanding, they provide useful information about the sensitivity of certain components that can be used for future studies.

The framework in general gives a clear indication of the relationships between system behaviour components, and allows for uncertainty, sensitivity and scenario analyses.