How well do flood defence models match reality?

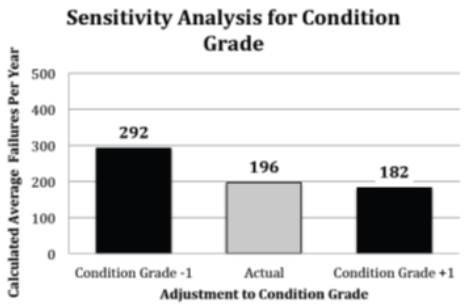
Sometimes flood defence embankments can fail, or breach, when river levels rise. These are rare but potentially damaging events. They are included in the Environment Agency's national flood risk assessment (NaFRA) models using fragility curves to estimate failure probabilities for increasing water levels, including extreme flood conditions.

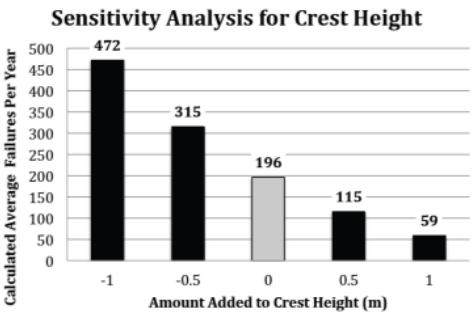
Fragility curves and extreme river level probabilities are estimated using data that can never be perfect, so we are interested to know how the models compare with what has happened in real floods

What evidence do we have about flood defence failures?

Flood defence failures are rare and evidence is hard to find; past studies have documented few embankments failing in any given year. Data about failures has not been collected consistently in the past.

Environment Agency records suggest 10 embankments failed in the floods of summer 2012, and fewer than 10 in the 2007 floods





What do the flood defence models say?

We looked at Environment Agency data on flood defences (AIMS), river water levels (NFLD) and fragility curves for 5,143 embankments with the best data, using the same models as the Environment Agency's existing NaFRA analysis

The models suggested, on average, about 200 failures per year in the sample set we analysed (which would mean about 500 over England and Wales, if the sample set is representative)

The models suggested that we should have been seeing, on average, about an order of magnitude more failures then actually seem to have been observed

Left: Our analysis explored sensitivity to bias in defence condition and crest levels

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Conclusions

Fluvial flood defences seem to be performing better than models have previously suggested.

Sensitivity analysis suggests that substantially more flood defence failures would be expected if these assets were in poorer condition.

Recommendations

These findings support on-going Environment Agency initiatives to collect better, more consistent records on flood defences, including breaches, and to update its fragility curves and risk models.

We should repeat this study using the new curves, and also include more detailed information about extreme river levels, where available.

A focus on embankment failure probabilities in the NaFRA models has required other aspects of the modelling to be highly simplified. This balance should be kept under review as part of on-going work to improve the models.

We should look in detail at specific events (e.g. 2007) to see if the failures expected from fragility models match observations, using more detailed models to capture the consequences of flooding and quantifying uncertainties.

We should continue to investigate the role of breaching in risk assessments, and the implications for investment. Breaches could still cause damaging losses, depending on where they happen.

More monitoring and research like this needed to ensure models are as realistic as possible.

Janie Haven completed her dissertation *"A Comparison of Actual Fluvial Embankment Flood Defence Performance to RASP Estimated Performance"* for the MSc in Water and Environmental Management at the University of Bristol, in August 2013.

The research described here is based on Janie's work, supported by the Environment Agency (who provided key data), JBA Trust and Horritt Consulting.

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