Morphological Control on Overwashing Hazard at an Energy Generation Asset

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Adaptation and Resilience of Coastal Energy Supply
ARCoES
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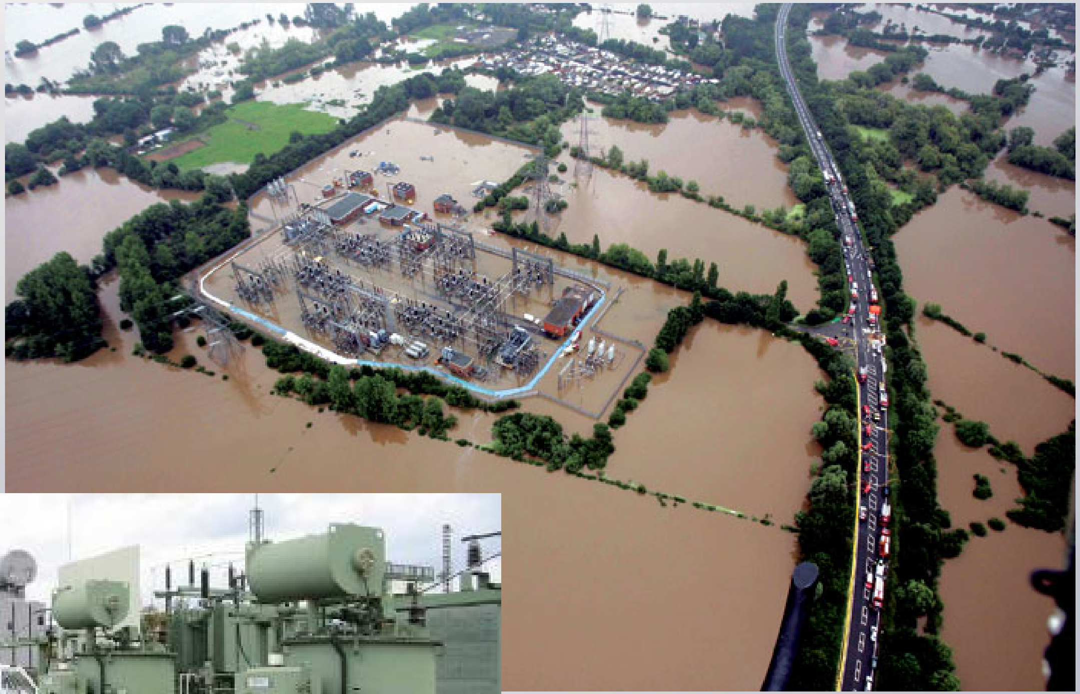
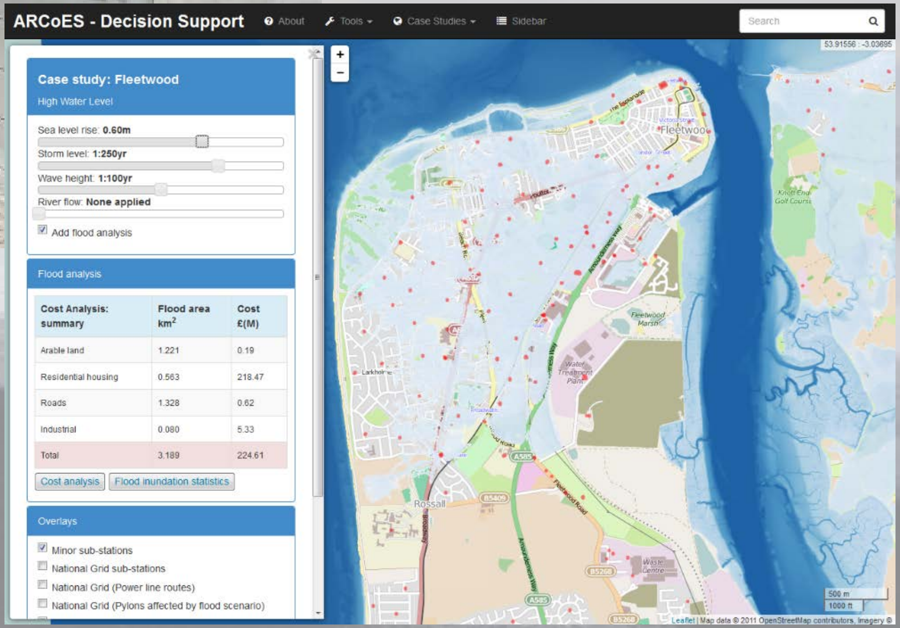
NATURAL ENVIRONMENT RESEARCH COUNCIL





Adaptation and Resilience of Coastal Energy Supply

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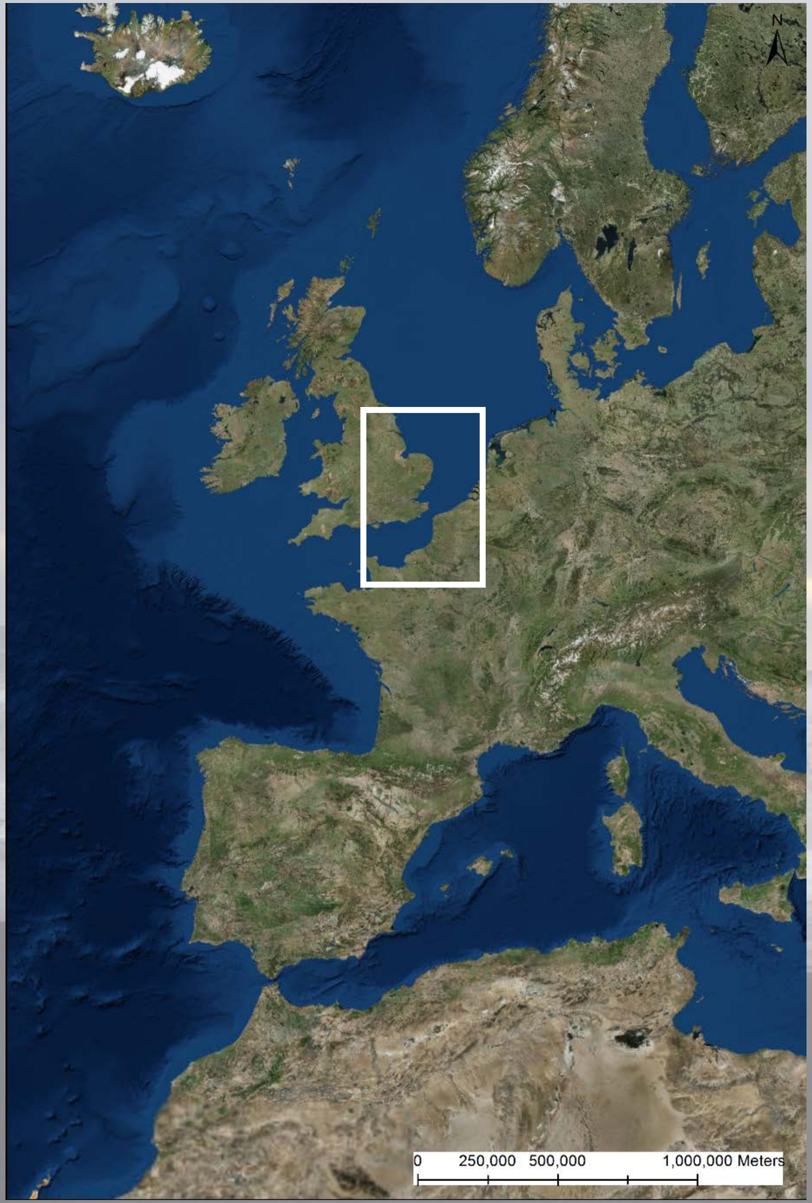
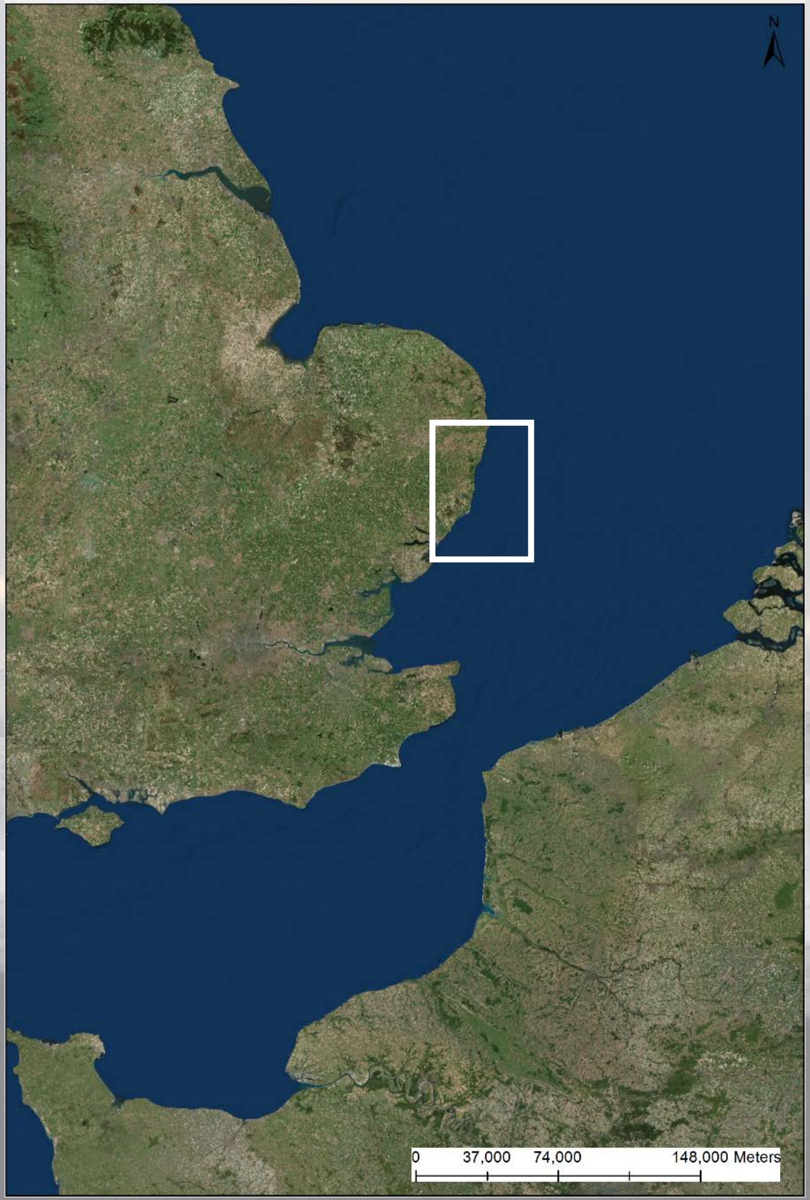
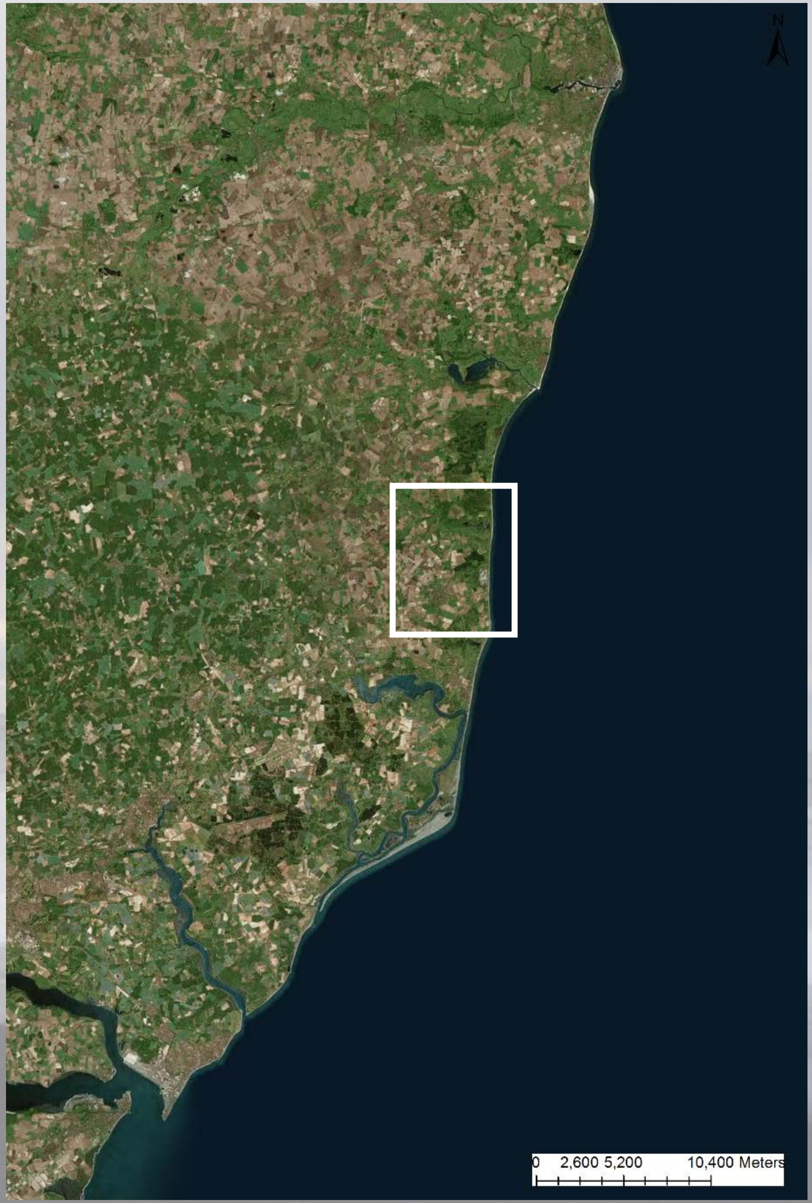
Impacts of 2013/2014 Winter Storms on UK North Sea Coastline

Current Defences are mostly resilient, but aging and increasing mean sea levels will deteriorate their resilience to extreme events

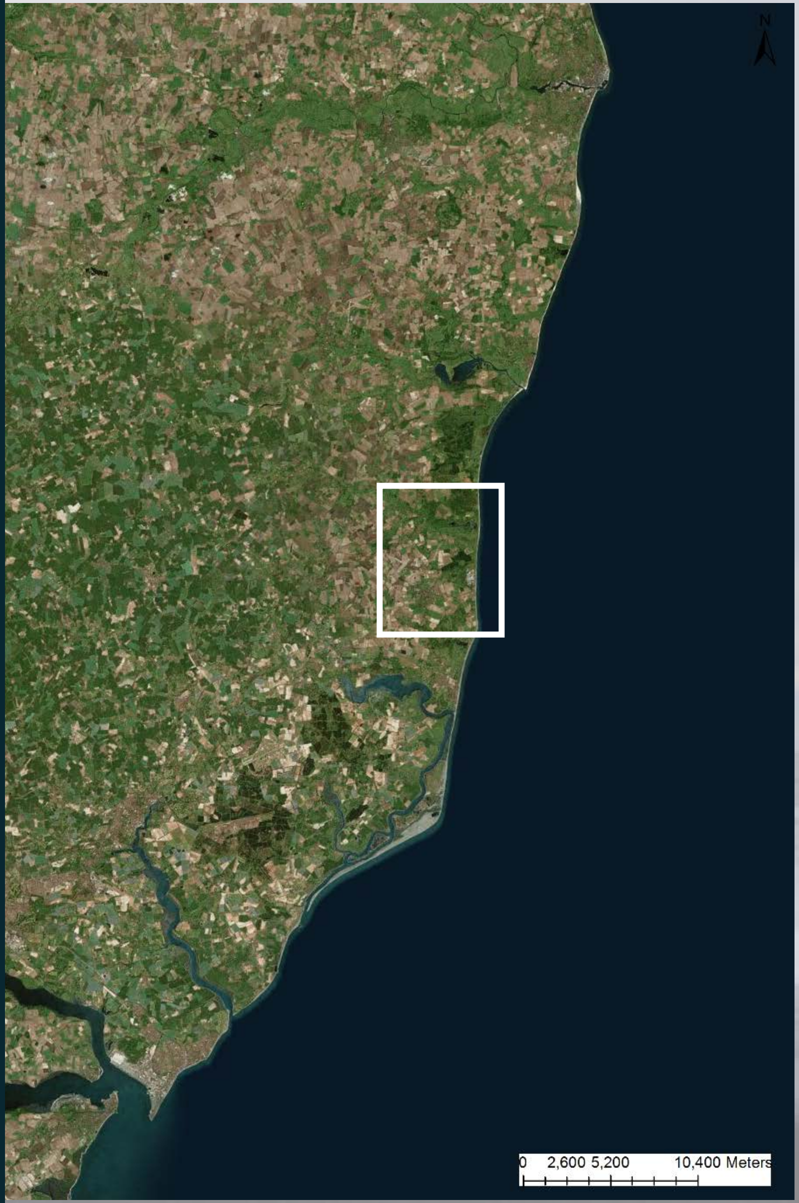
Study Area: Sizewell Power Station and Minsmere Nature Reserve



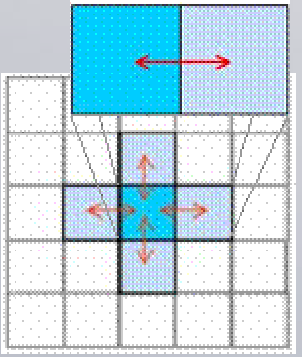


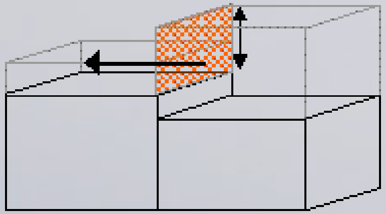


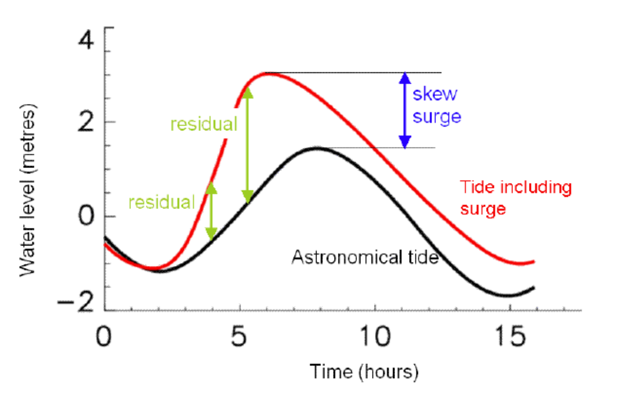
Study Area: Size Nature Reserve

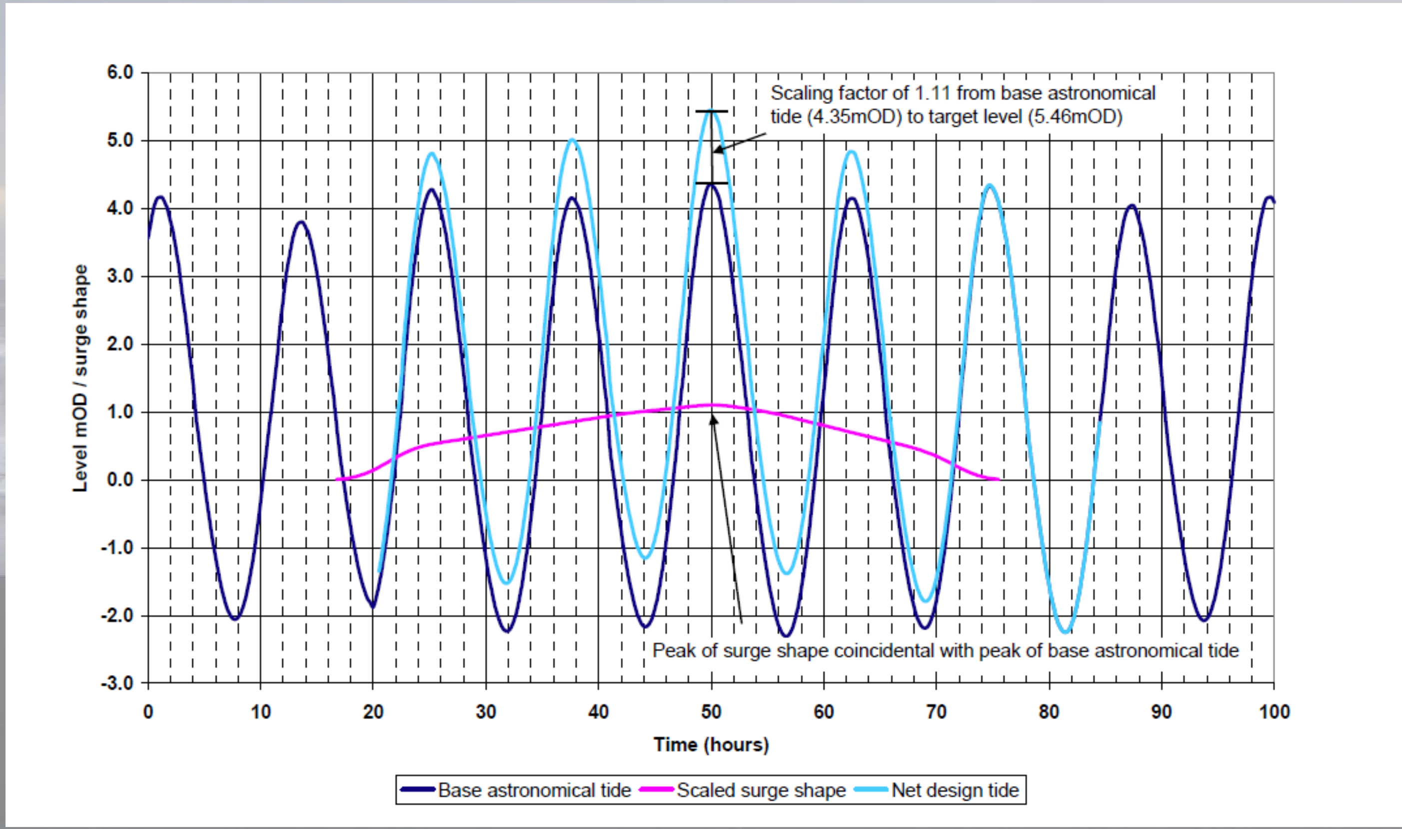


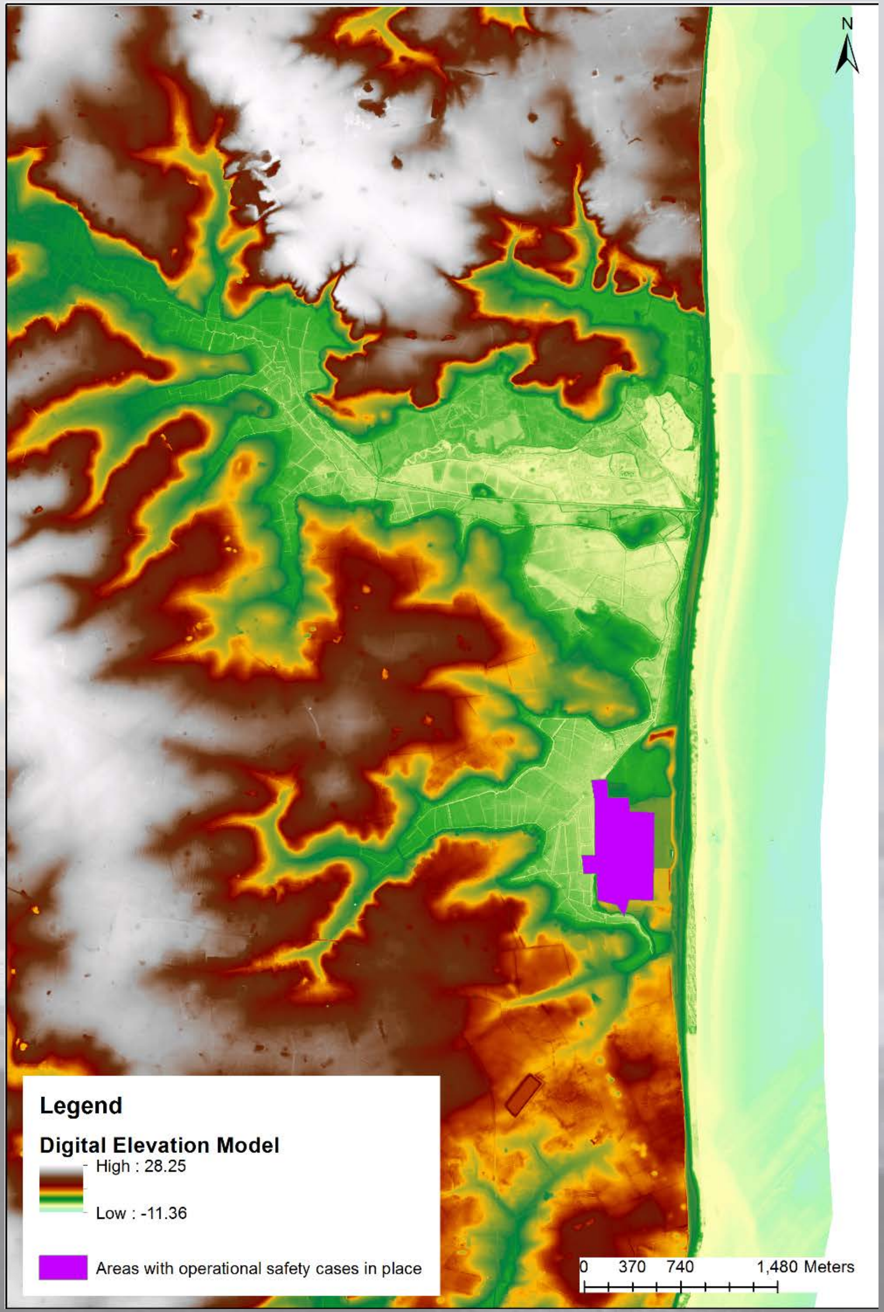
LISFLOOD-FP 2D Hydrodynamic Flood Inundation Model











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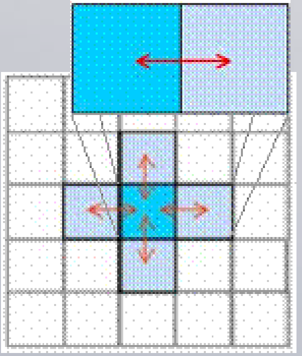
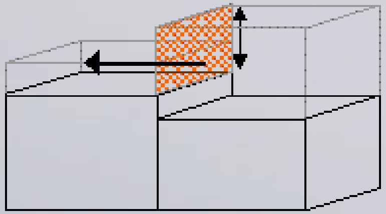
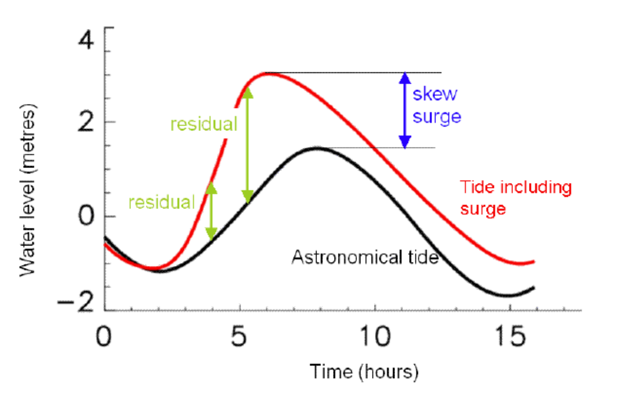
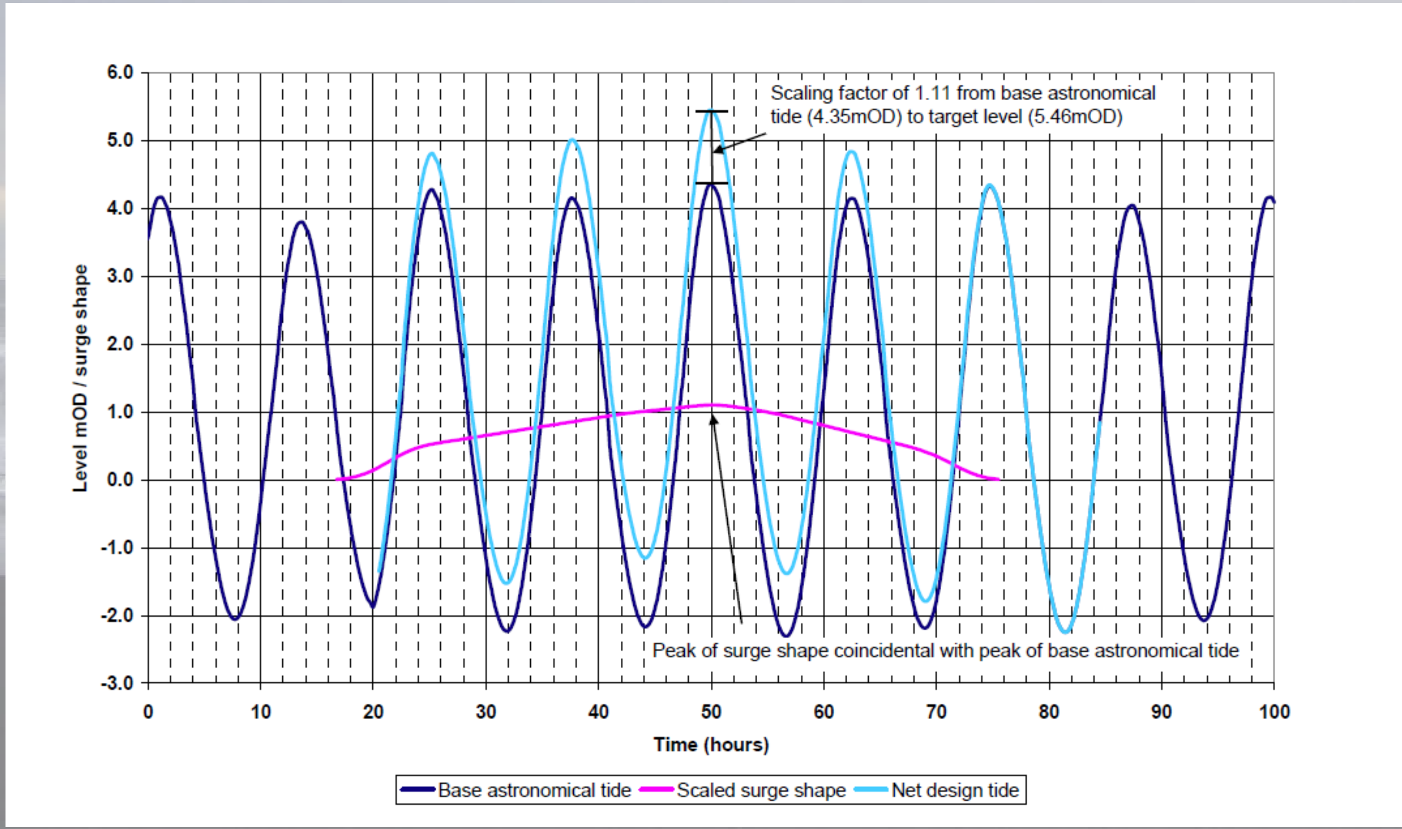
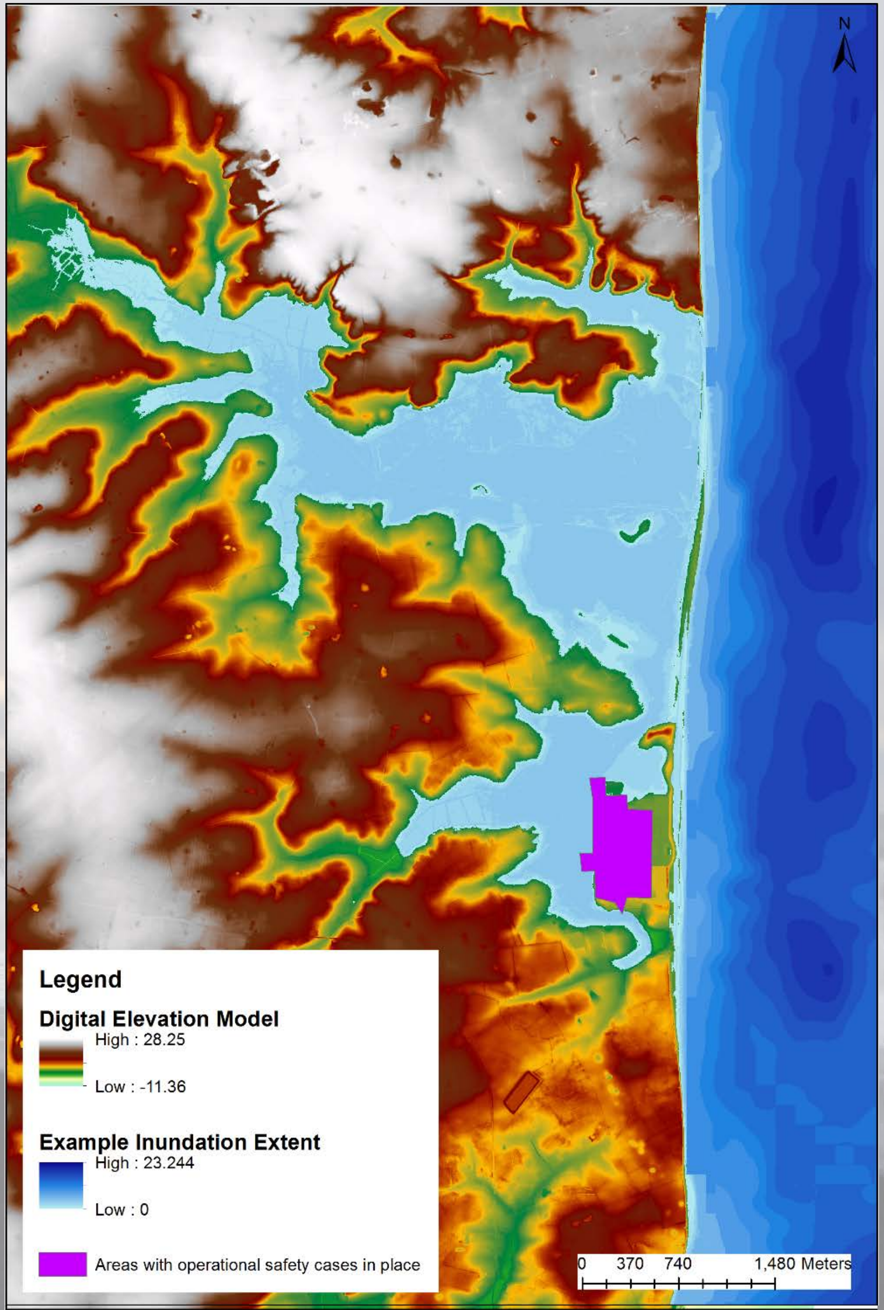




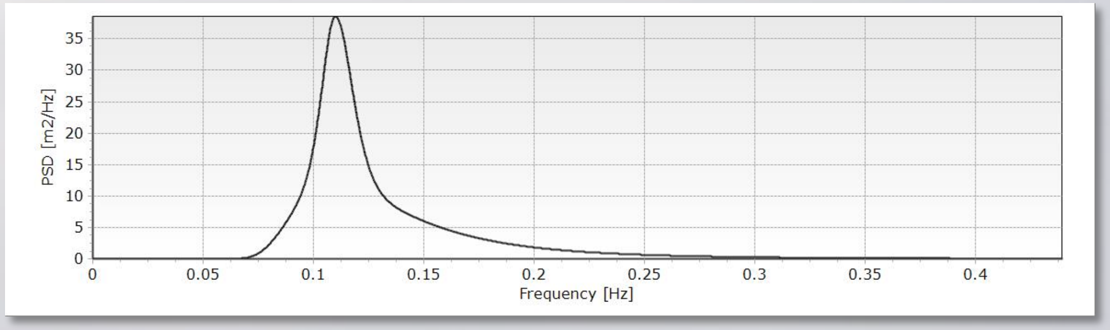


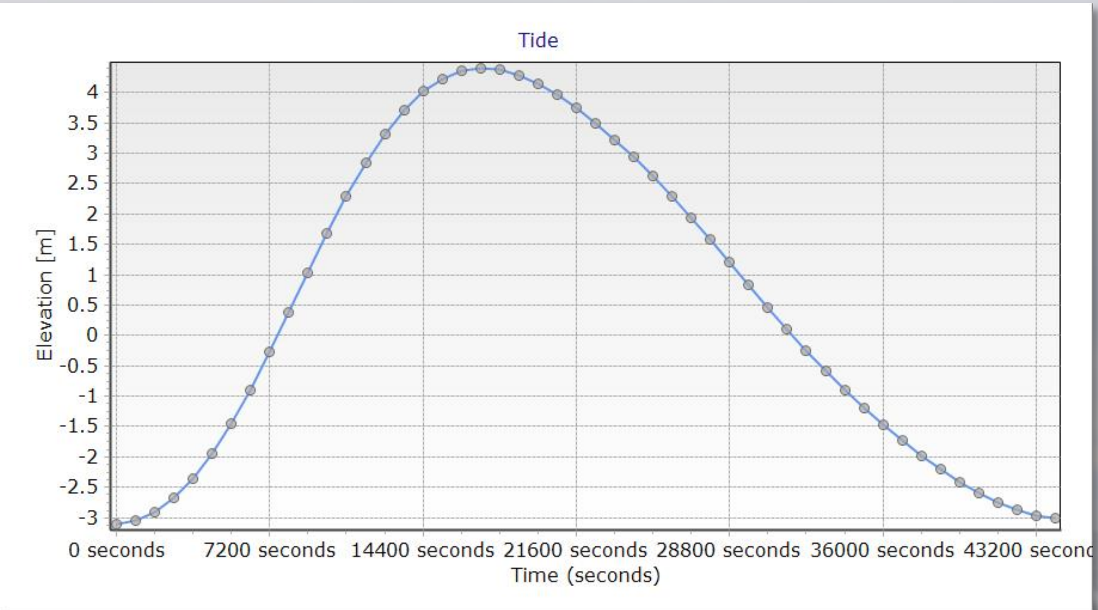


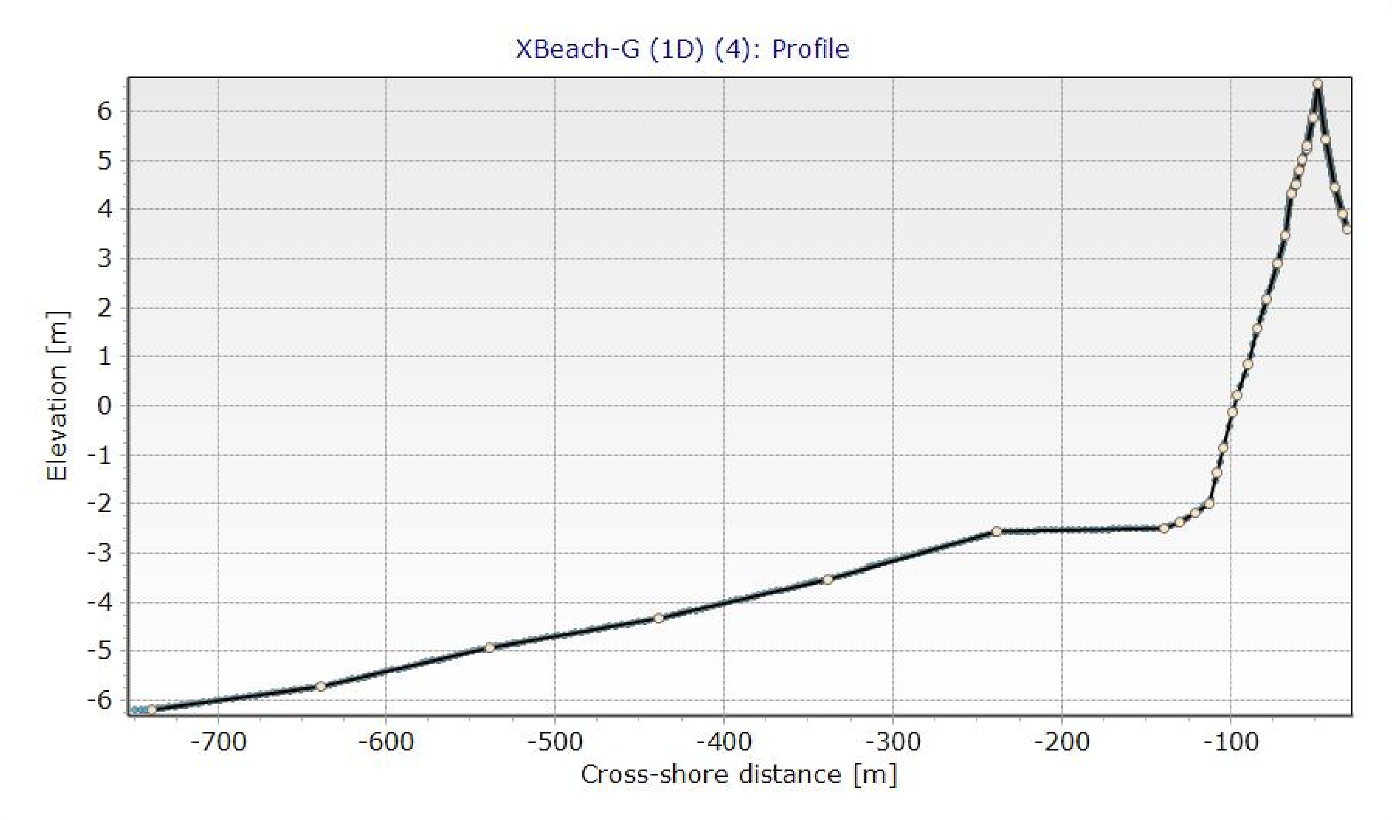


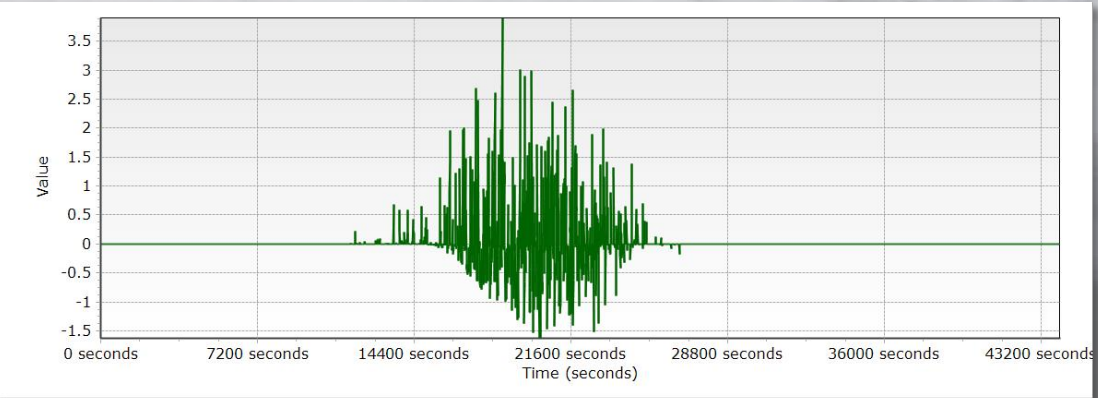
Xbeach-G: Storm Impact Model for Gravel Beaches

XBeach-G is a branch of the main XBeach development that is being developed to simulate storm impacts on gravel beaches.









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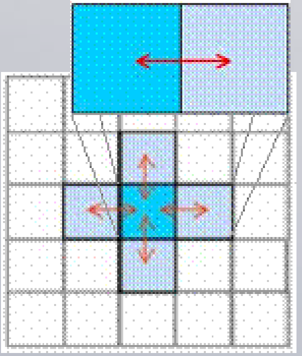

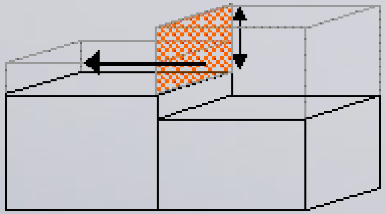

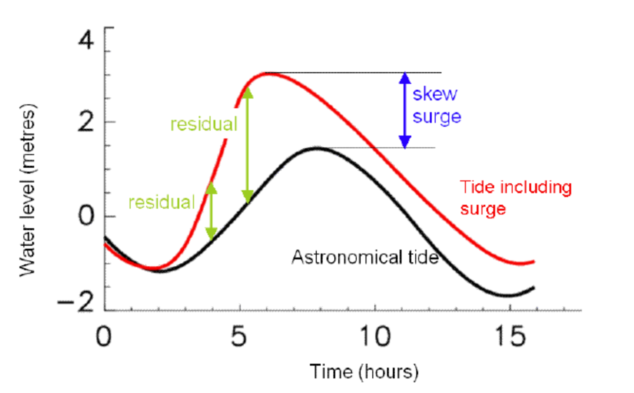

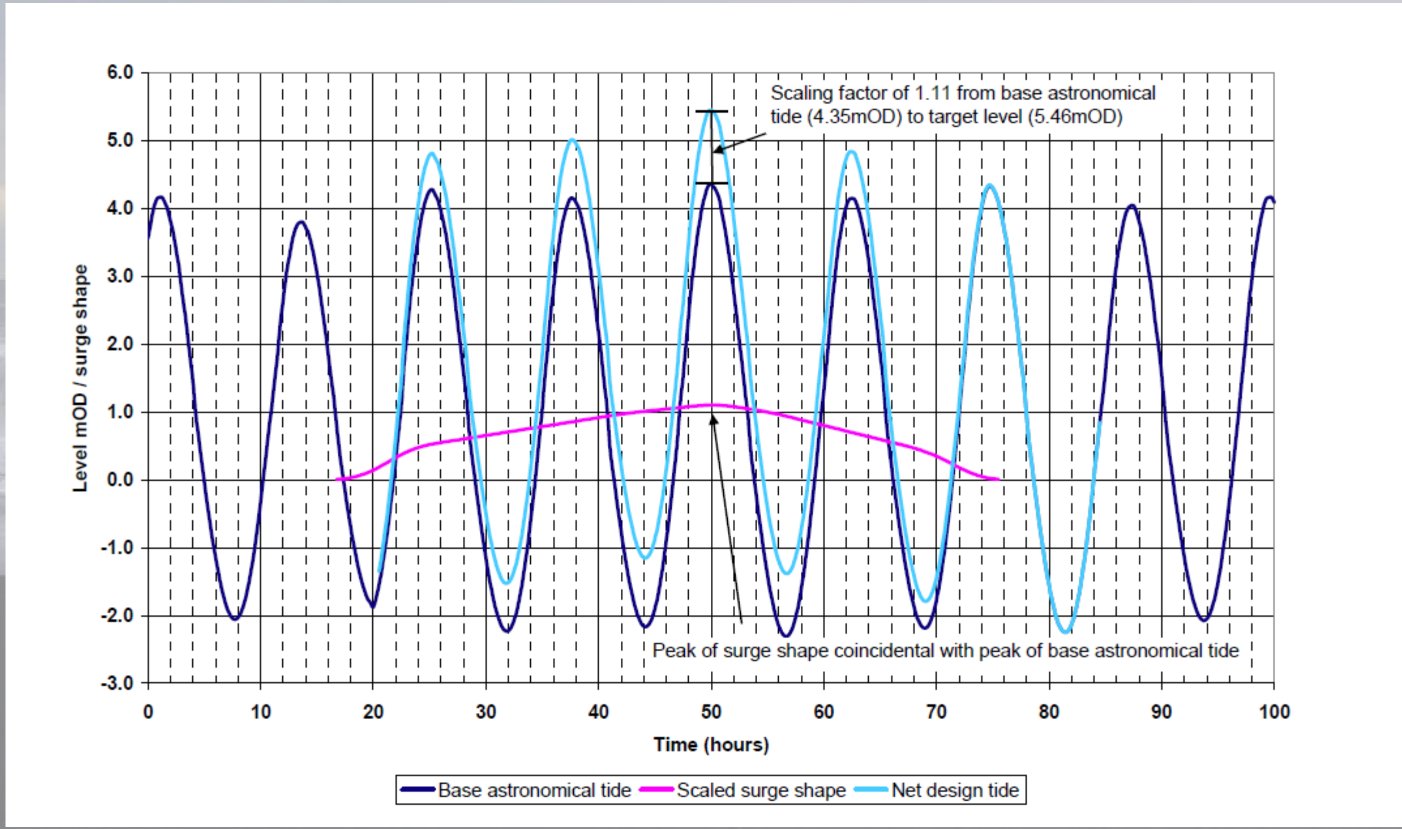

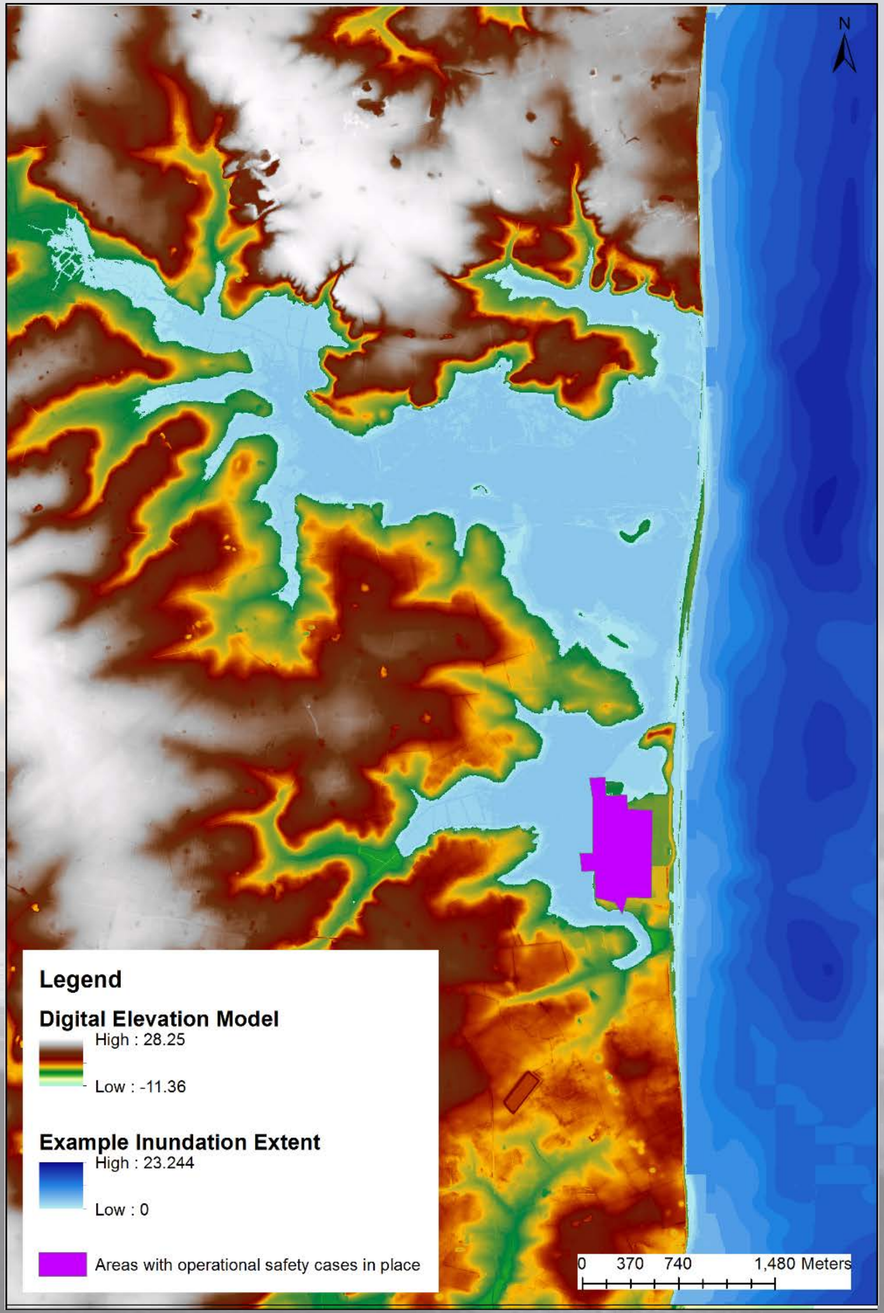

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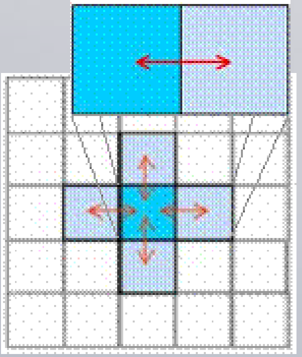
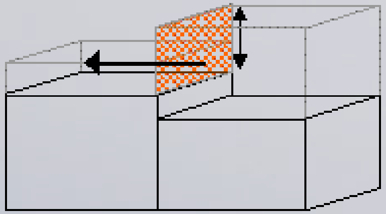
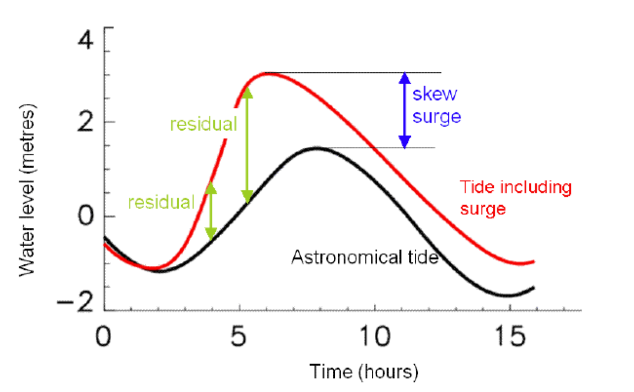
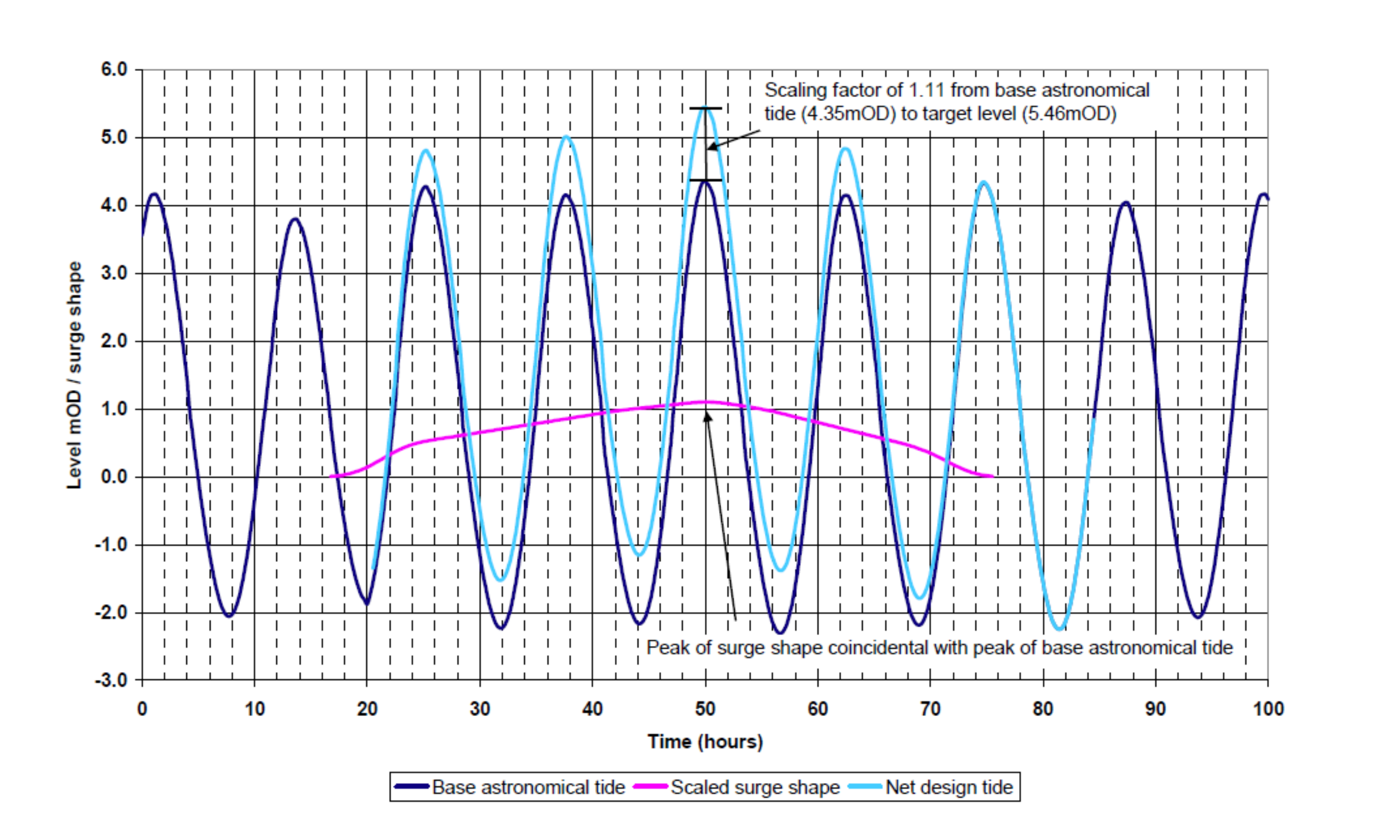
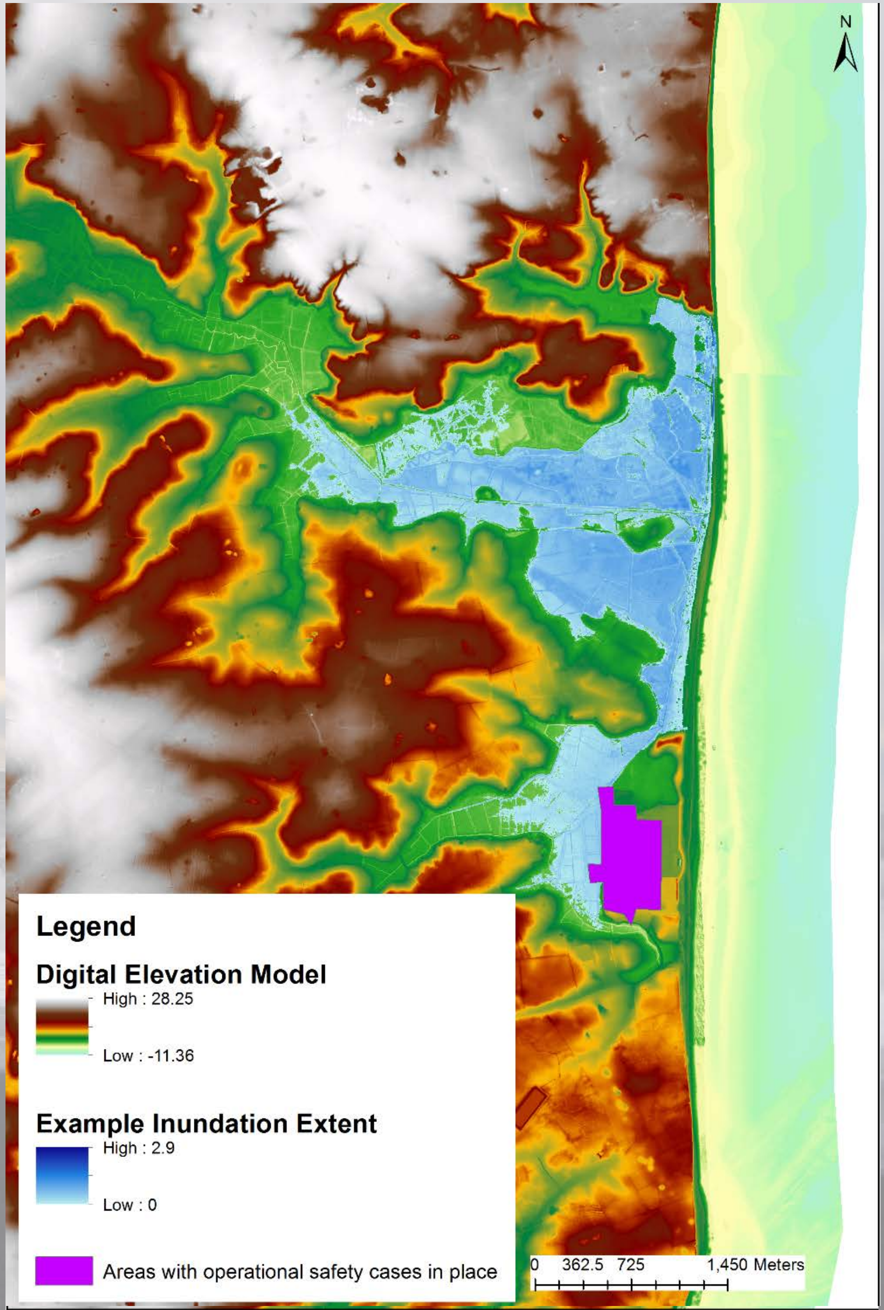








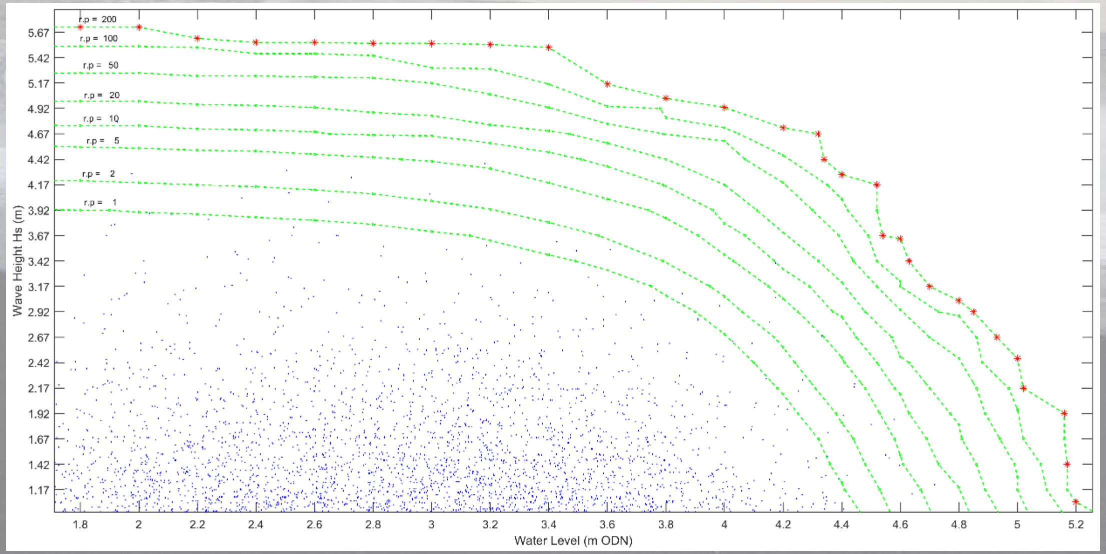


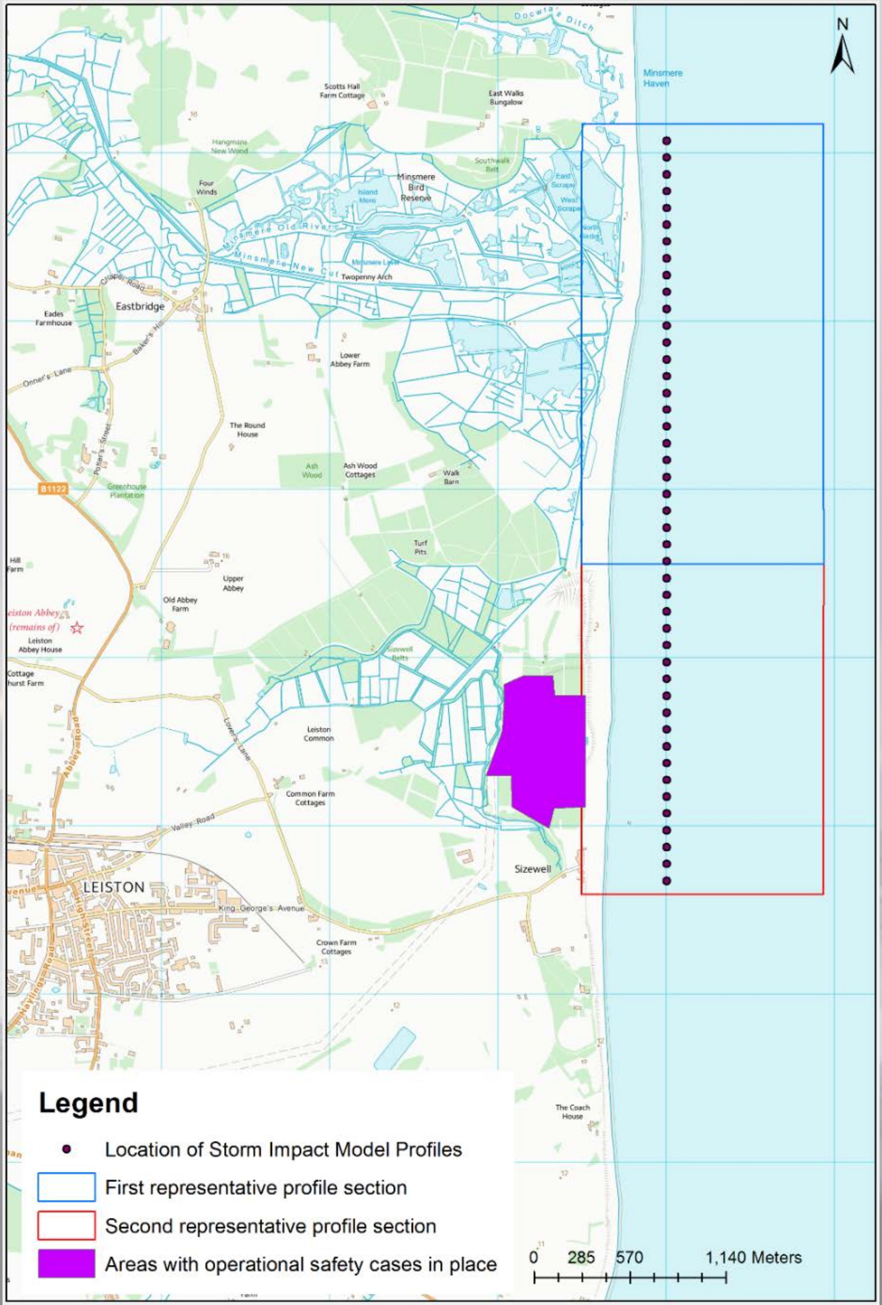
Simulating an ensemble of scenarios

Reasons an ensemble of scenarios would be required, these include:

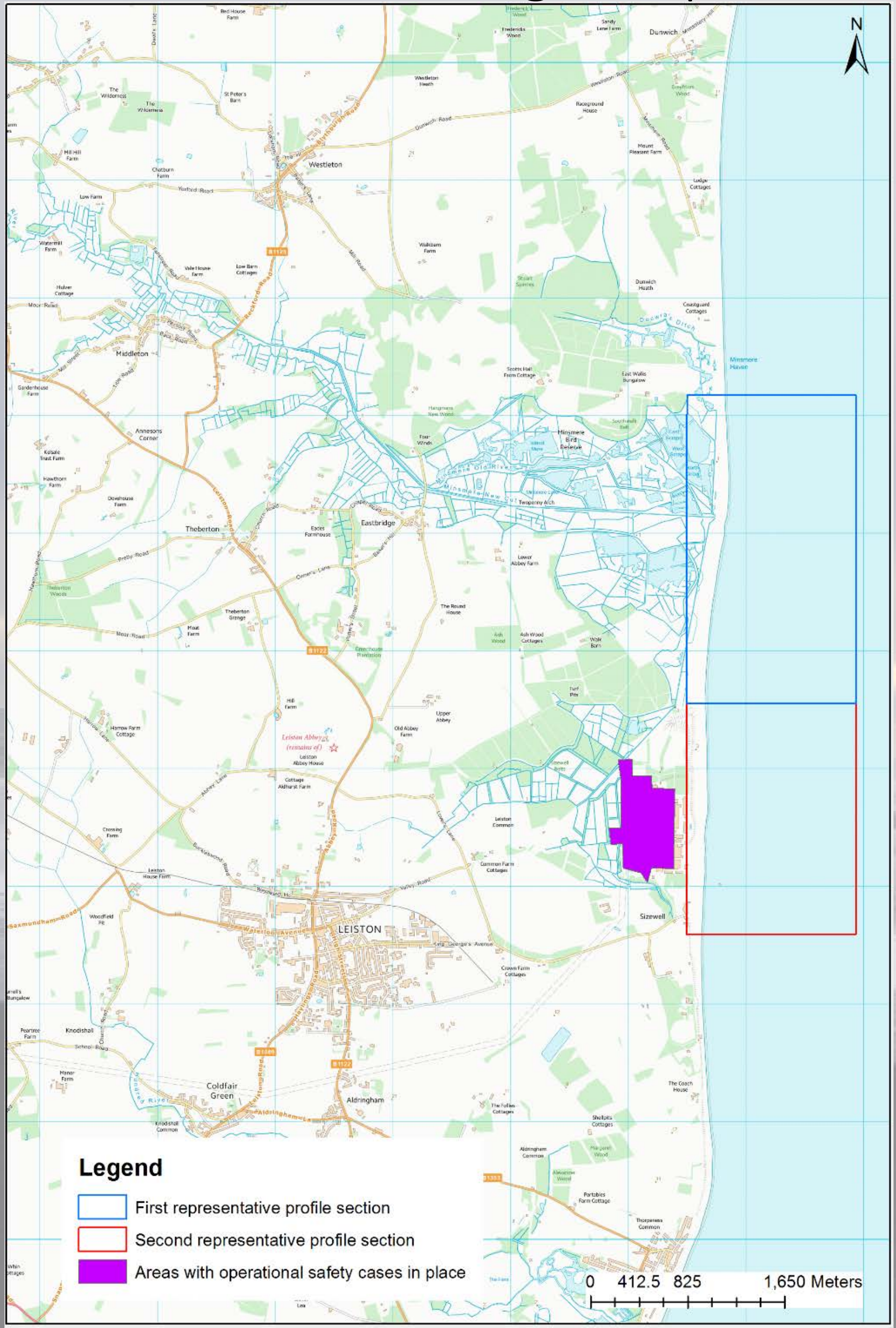
- being able to modify beach profiles to simulate the benefit and any negative impacts of beach nourishment
- Increasing the defence crest height to reduce overwashing risk
- Running many different joint probability combinations to understand the uncertainty in these joint probabilities
- Able to run lots of probabilities of occurrence at different projected SLR

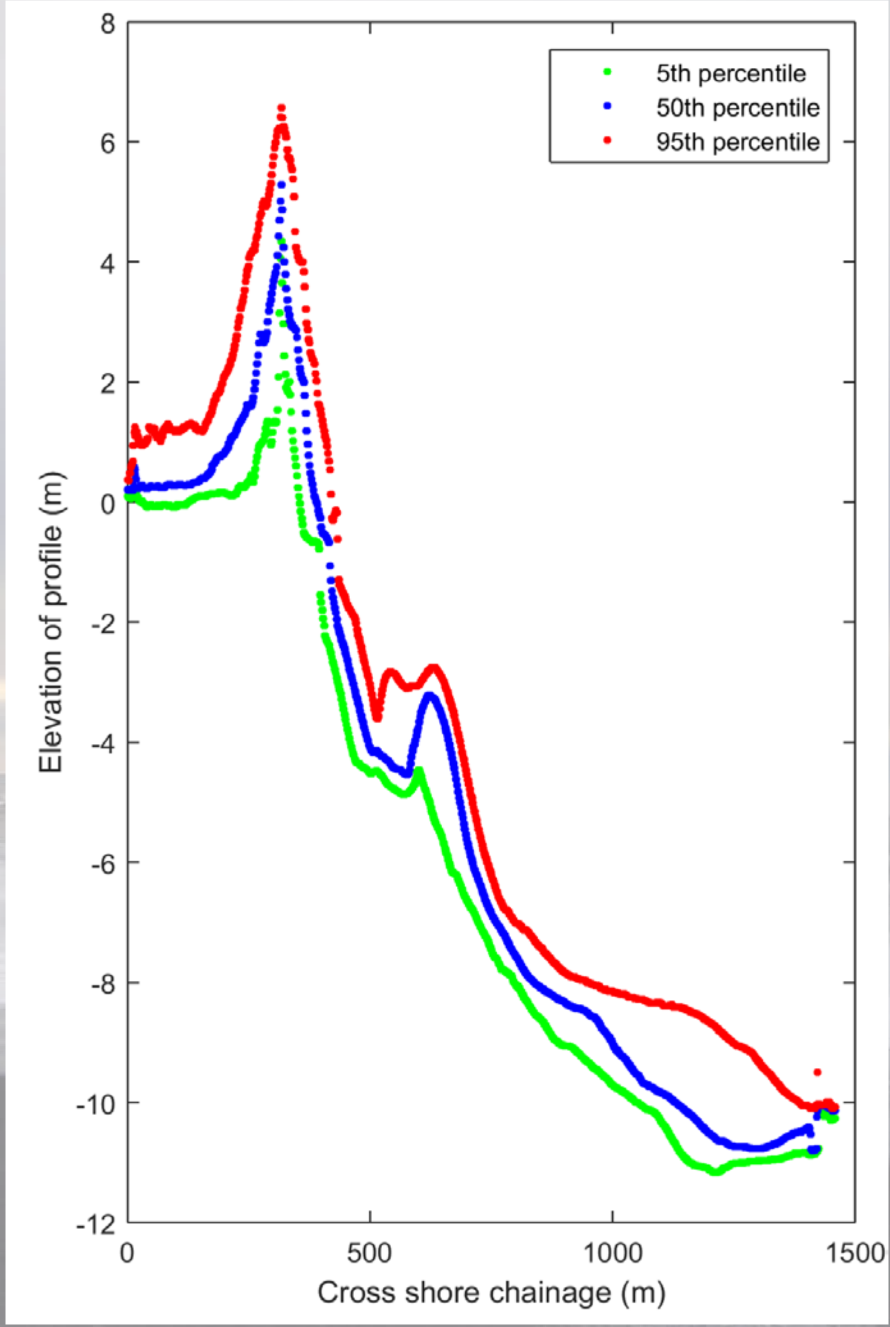
Reducing computational cost is important as it allows all these benefits while not having a detrimental impact on the result.





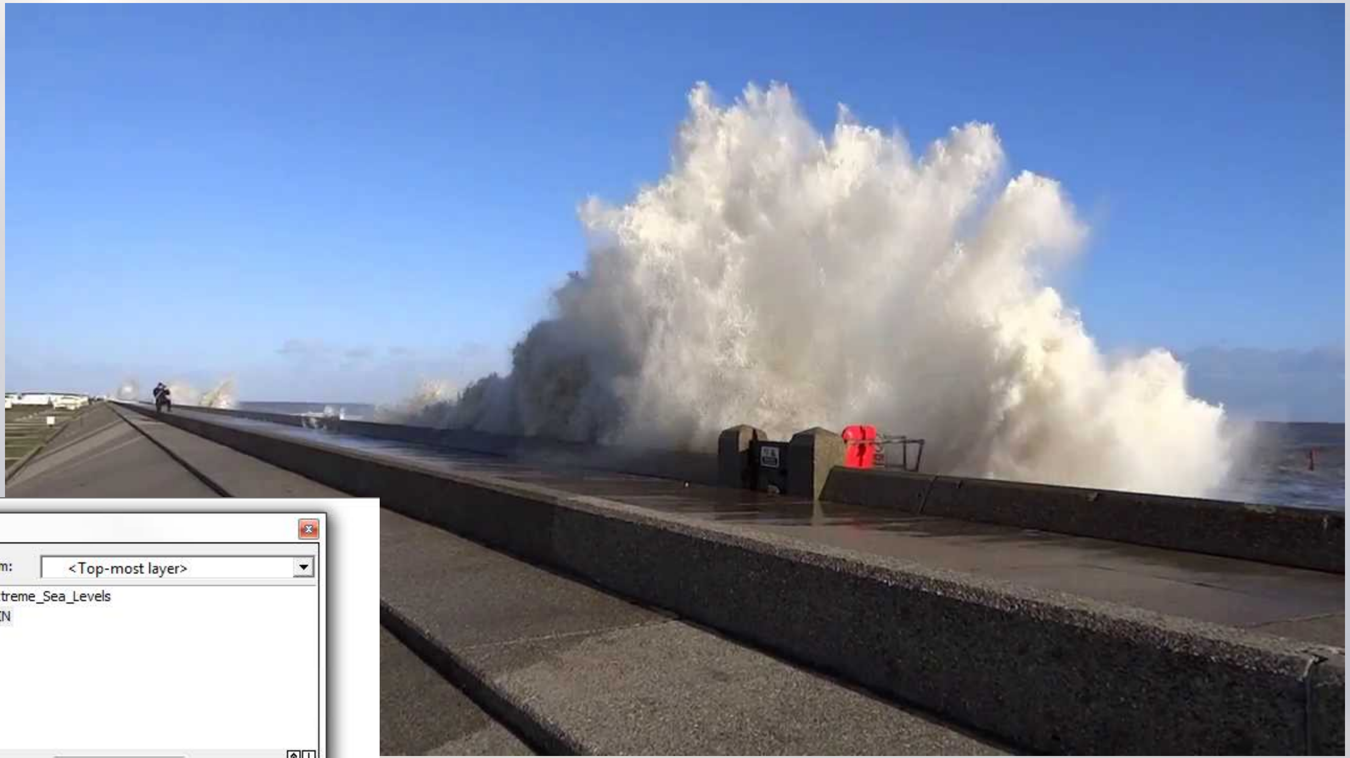
Reducing Computational Cost of Running Multiple Scenarios

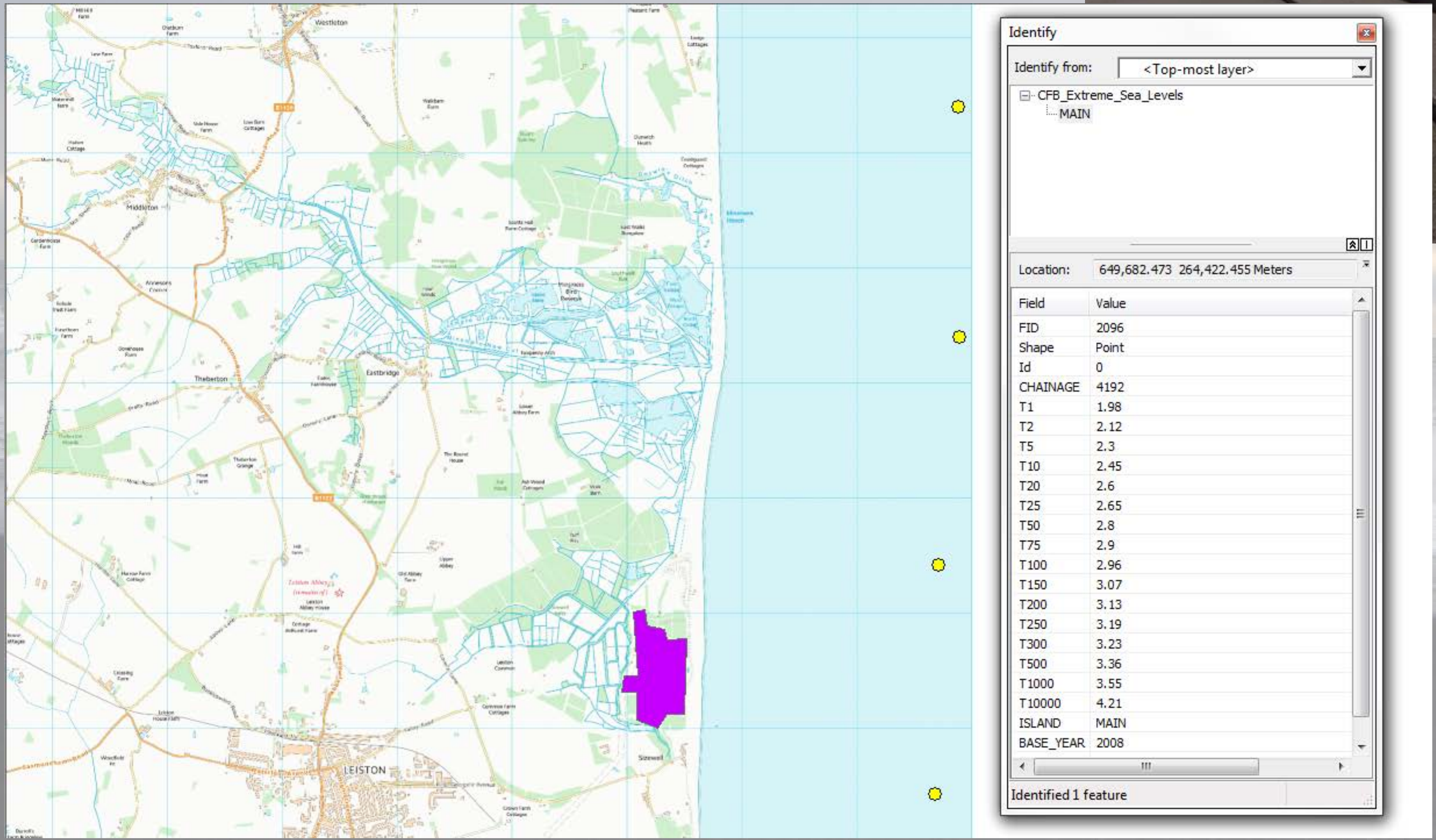




Extreme Event being simulated

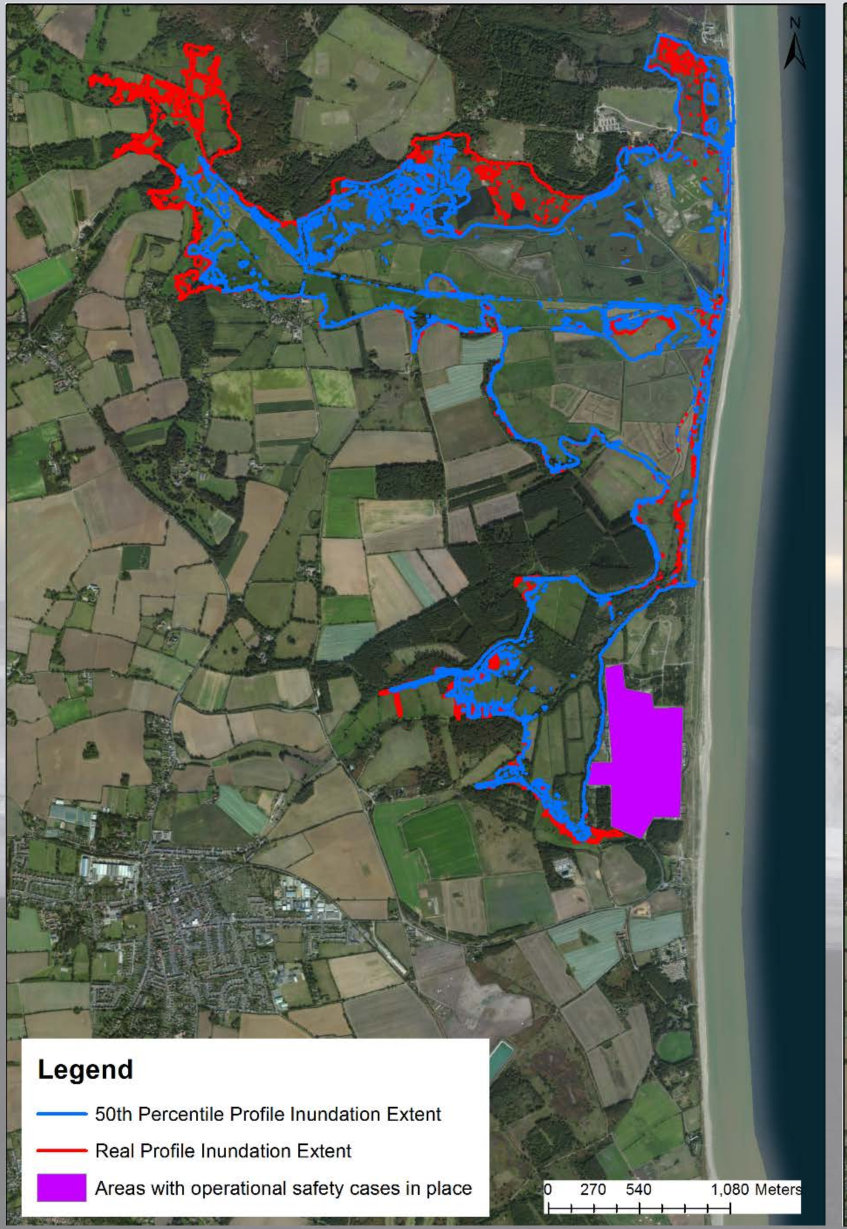
- 1 in 1000 year return period extreme water level (3.6 m OD)
- Wave conditions measured during 6th December 2013 extreme event from nearby wave buoy

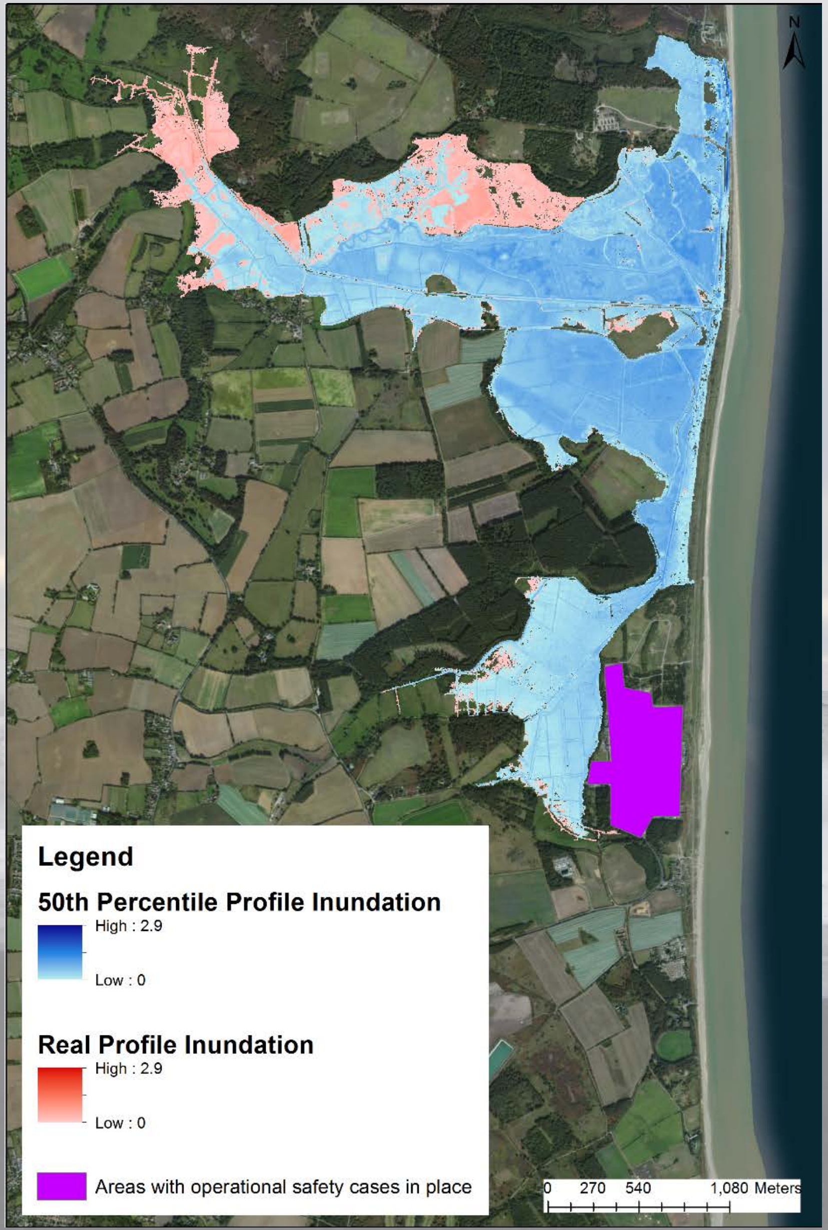


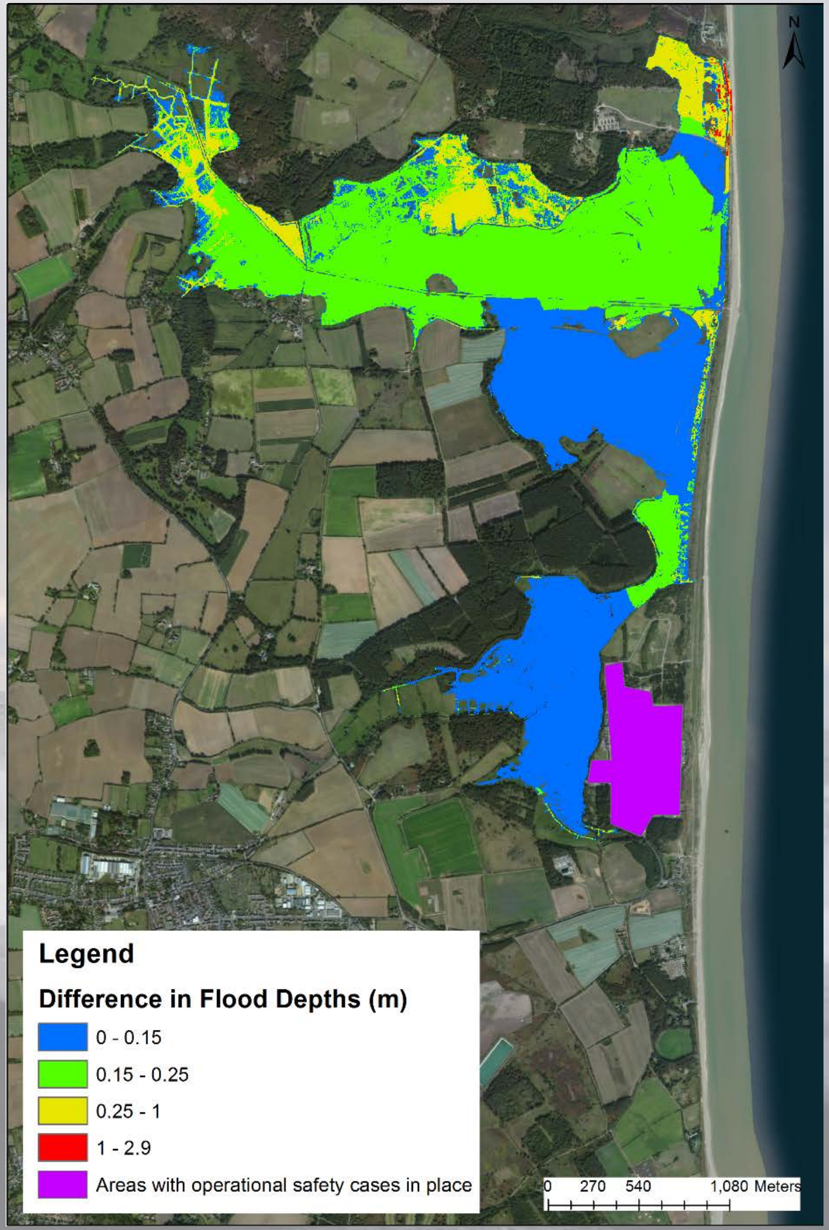


Joint Probability can be performed to provide a probability of occurrence for the extreme water level and wave height but the short data set (~8 years) means low probabilities difficult to calculate

Inundation Extent and Depth Difference of Real Profiles and 50th Percentile Representative Profile







Flood Depth Difference	Extent (m^2)	Percentage matched
≥1 m	10,250	0.2%
< 1 m & ≥ 0.25 m	487,675	10%
< 0.25 m & ≥ 0.15 m	2,141,025	47%
< 0.15 m	2,112,625	46%
Simulation	Extent (m^2)	Percentage matched
Multiple defence profile simulation	4,576,950	100%
50th Percentile profile simulation	3,930,450	86%

Conclusions

- Using 50th percentile representative profile is much less computationally expensive when for running ensemble model scenarios
- The results obtained by using two representative sections with a 50th percentile profile for each, is a good match to results obtained from 45 profiles
- 86% of the inundation matches between the two scenarios and 93% of flood depths are within 0.25 m of each other.

Further Work

- Calculate a joint probability analysis using data from a model of the North Sea rather than wave buoy data
- Apply an ensemble of scenarios to this study area to simulate different wave and water combinations making up the same probability of occurrence
- Modify representative profile to simulate effect of improving beach defence resilience by increasing defence width, height and offshore bank width and height.