SCIENCE-BASED TOOLS FOR COASTAL ADAPTATION TO RISING SEA LEVEL

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Adaptation and Resilience of Coastal Energy Supply

ARCoES

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Supporting decision making

Adaptation and Resilience of Coastal Energy Supply

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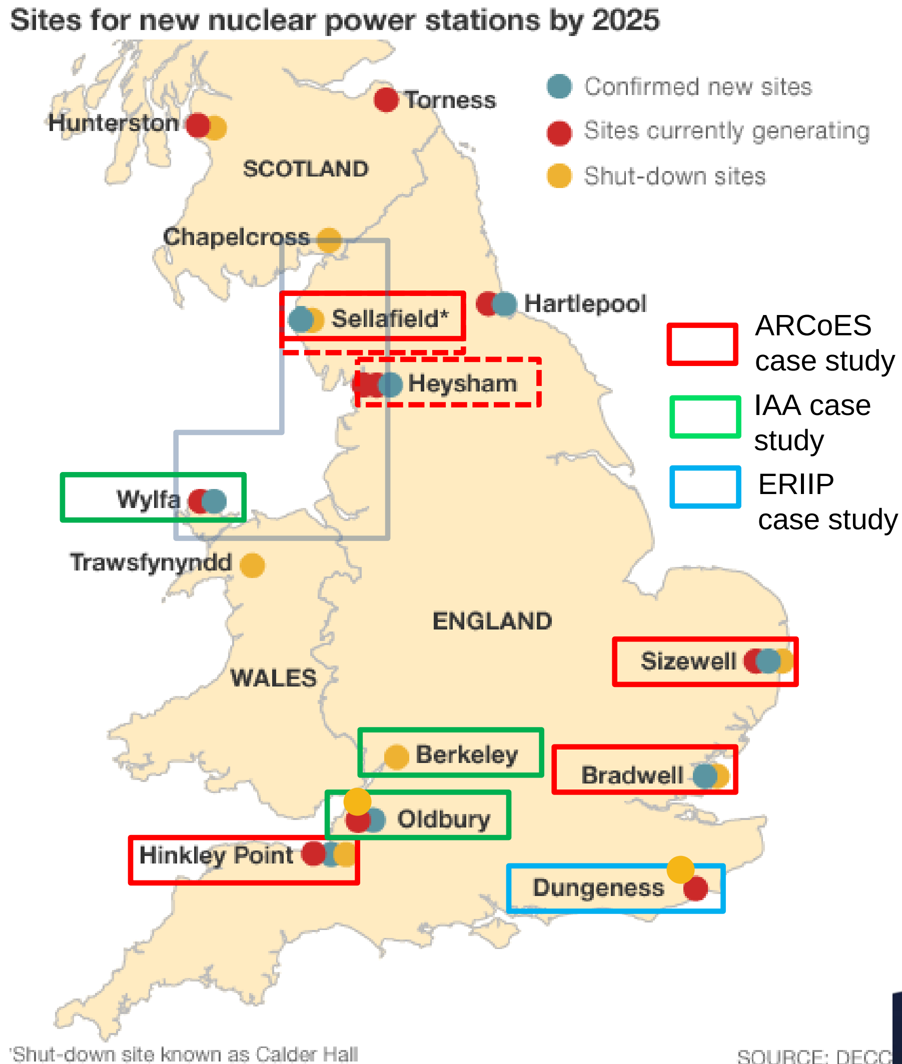
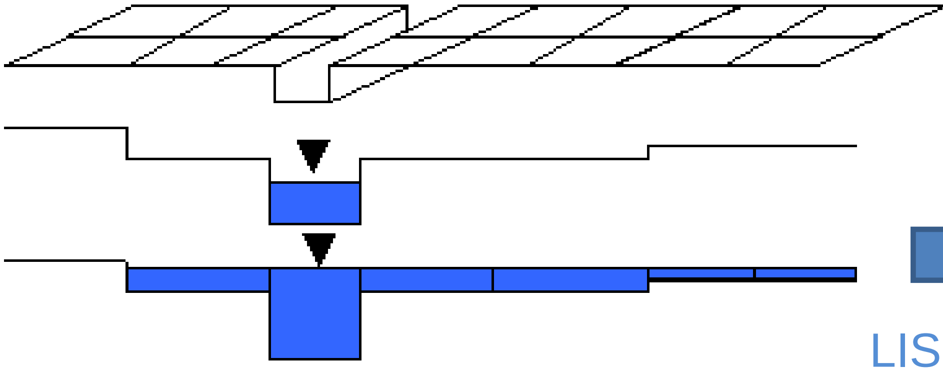
Online map viewer for exploring plausible flood hazard to **2500 AD**.

Developed on NW region and selected nuclear case studies.

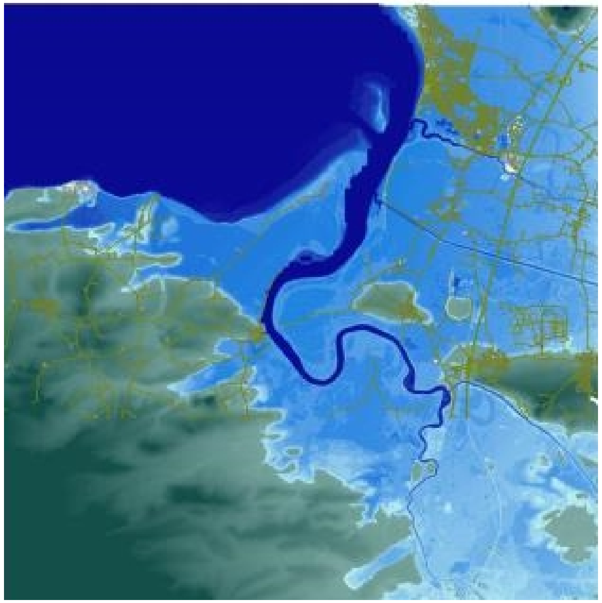
* Sizewell (mixed beach)
* Hinkley Point (rocky shore & cliff)
* Bradwell (estuary)
* Sellafield (sand beach/dune)



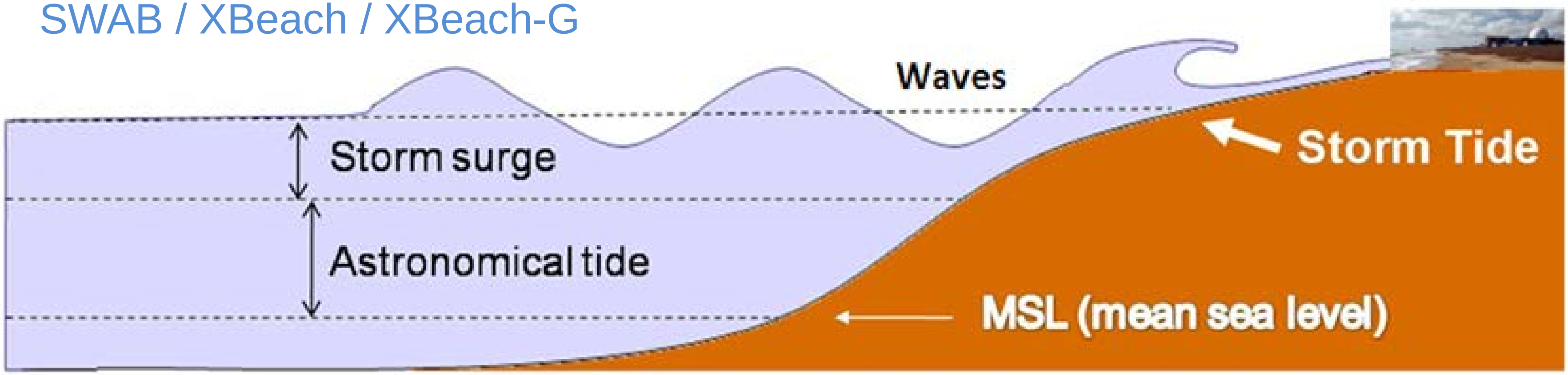
Numerical approach to flood modelling



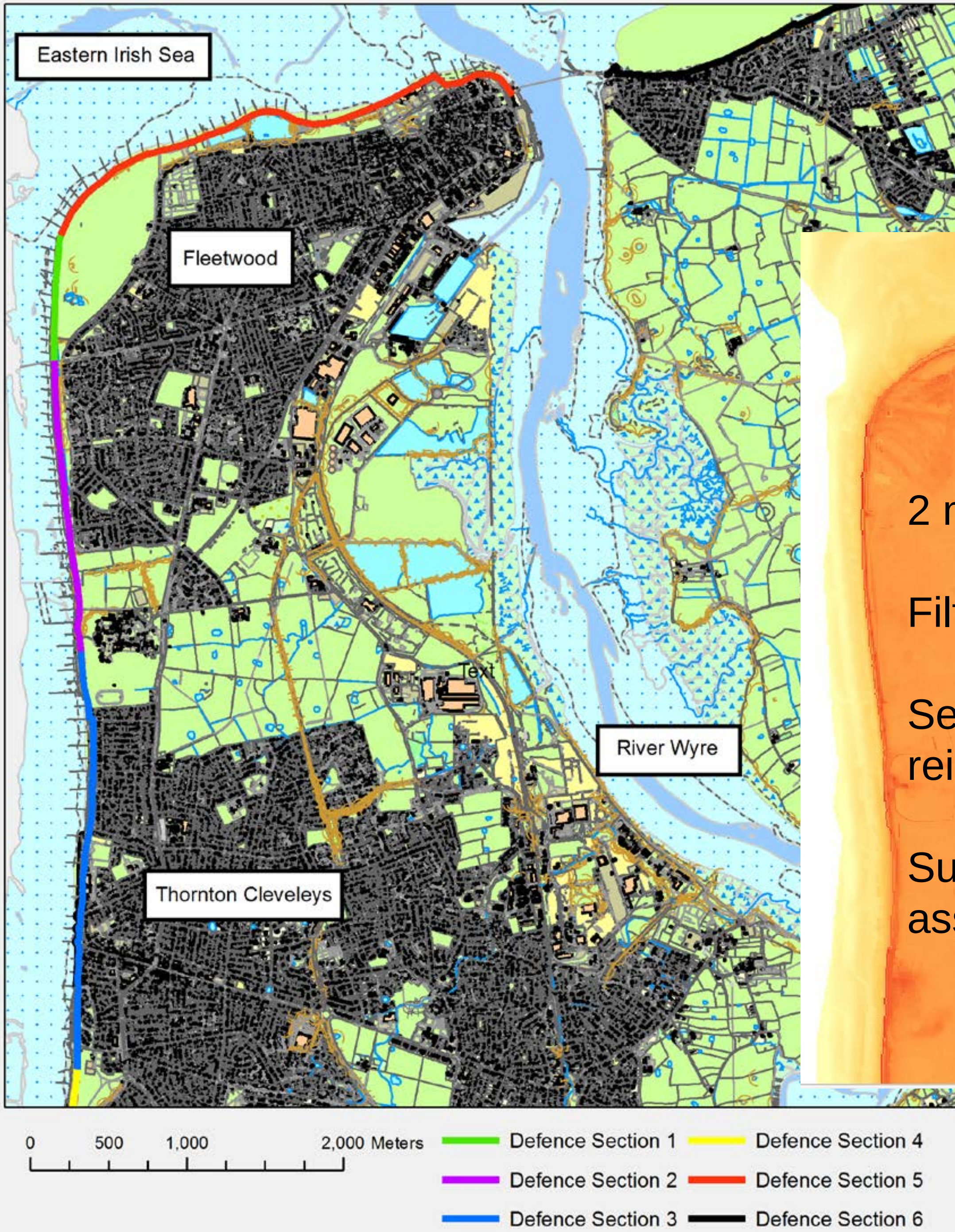
LISFLOOD-FP

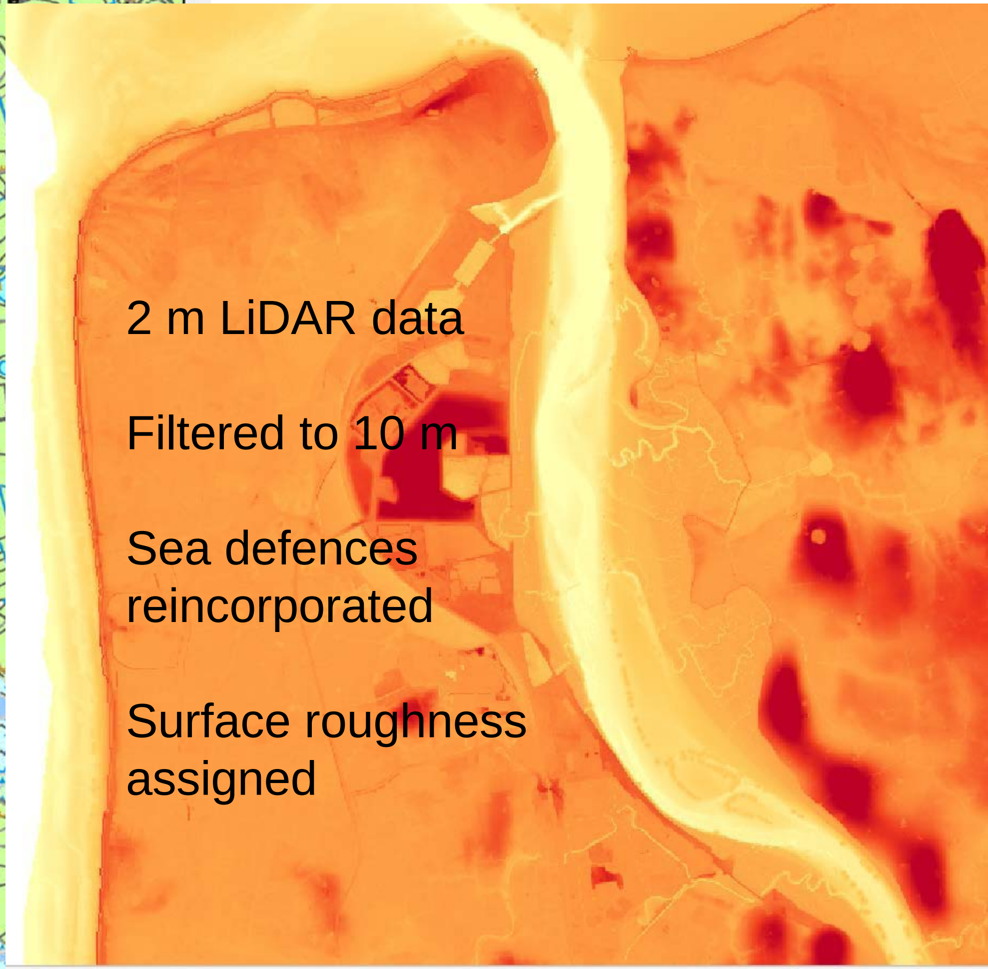


SWAB / XBeach / XBeach-G



Model setup, Fleetwood example





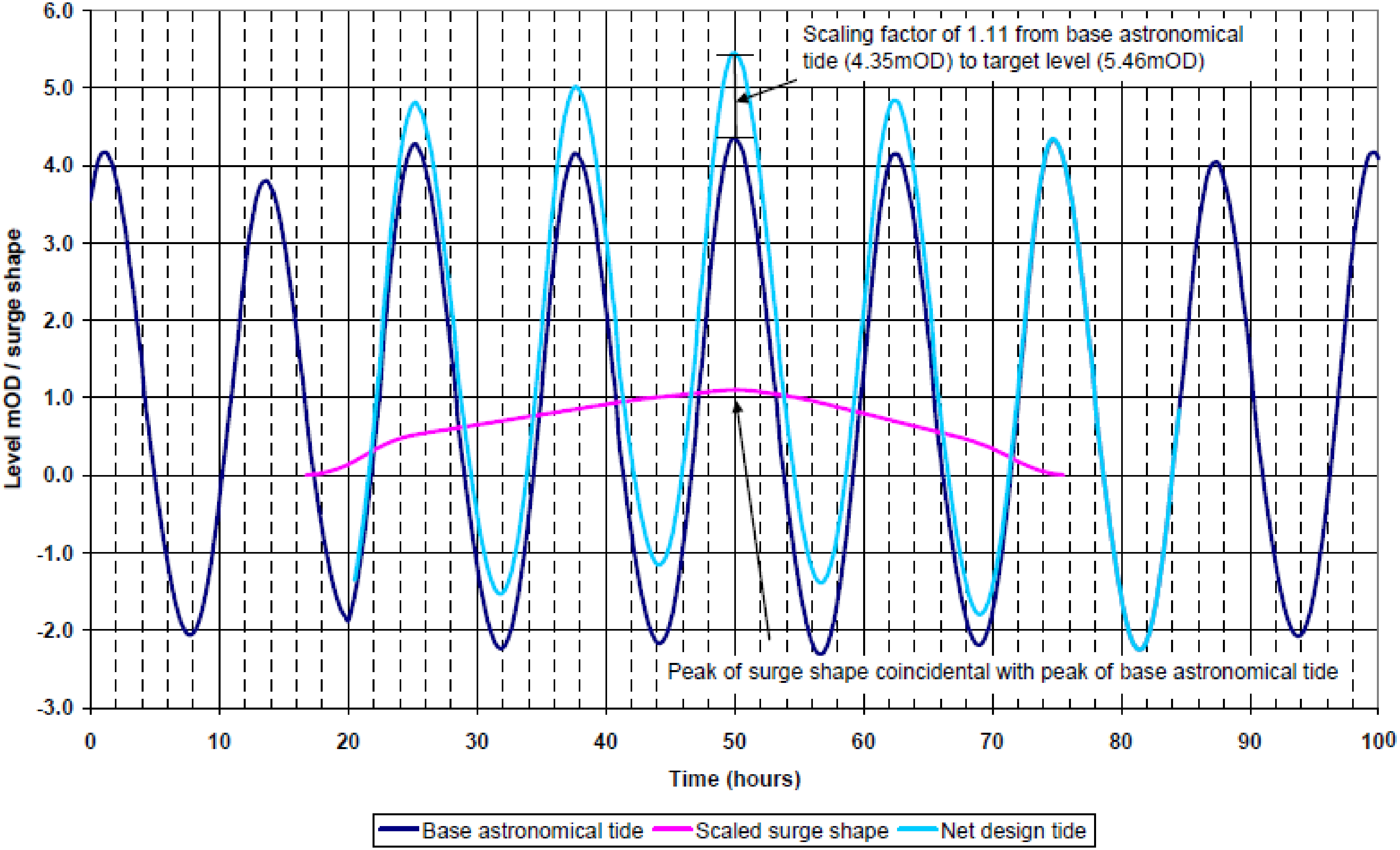
2 m LiDAR data

Filtered to 10 m

Sea defences reincorporated

Surface roughness assigned

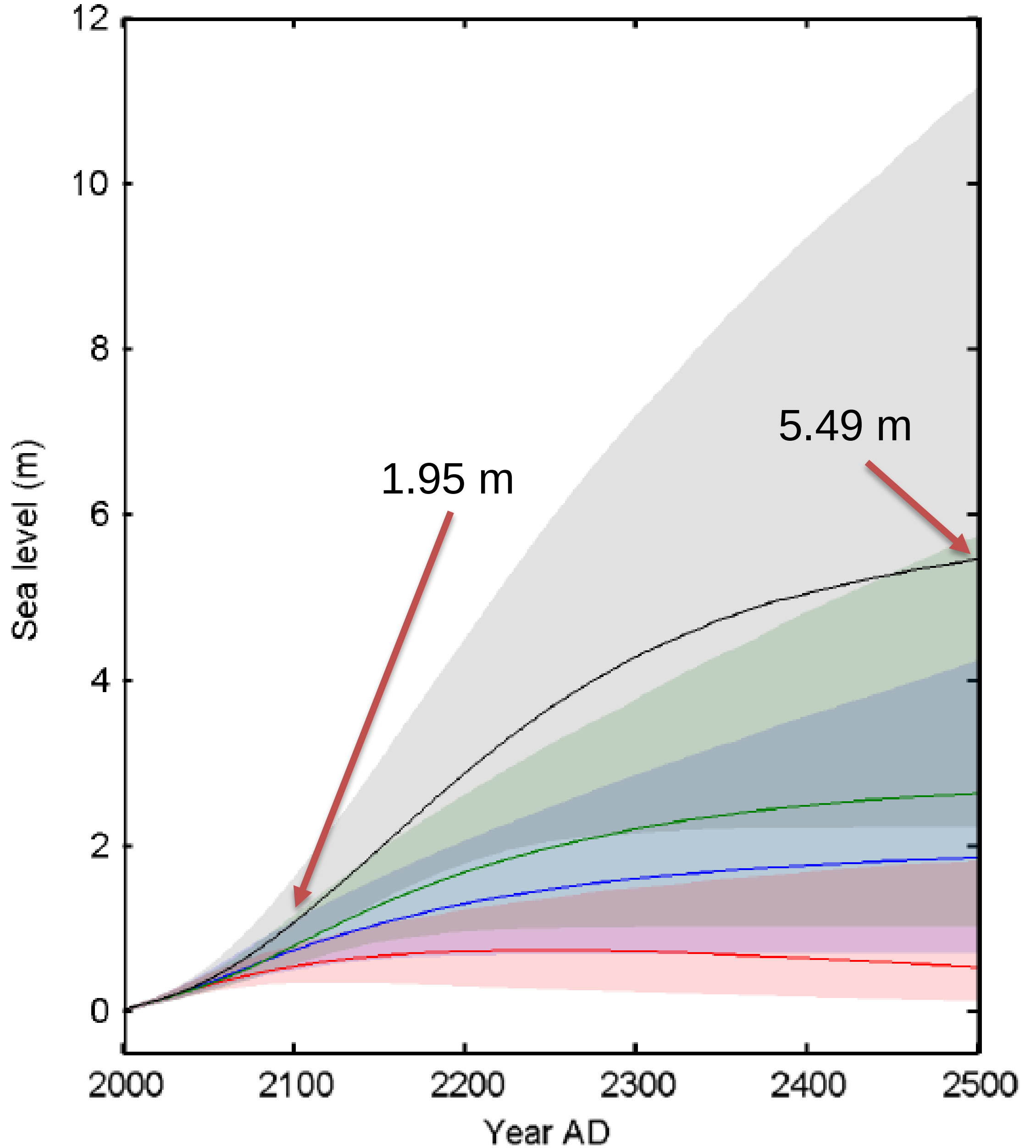
Extreme water level hazard



Source: EA, Flood boundary conditions for UK mainland and islands Project: SC060064/TR2: Design sea level (Macmillan et al., 2011)

Sea level rise: plausible high-end projections to 2500 AD

(Jevrejeva et al., 2012)



RCP3PD
RCP4.5
RCP6
RCP8.5

upper 95% and low 5% confidence level

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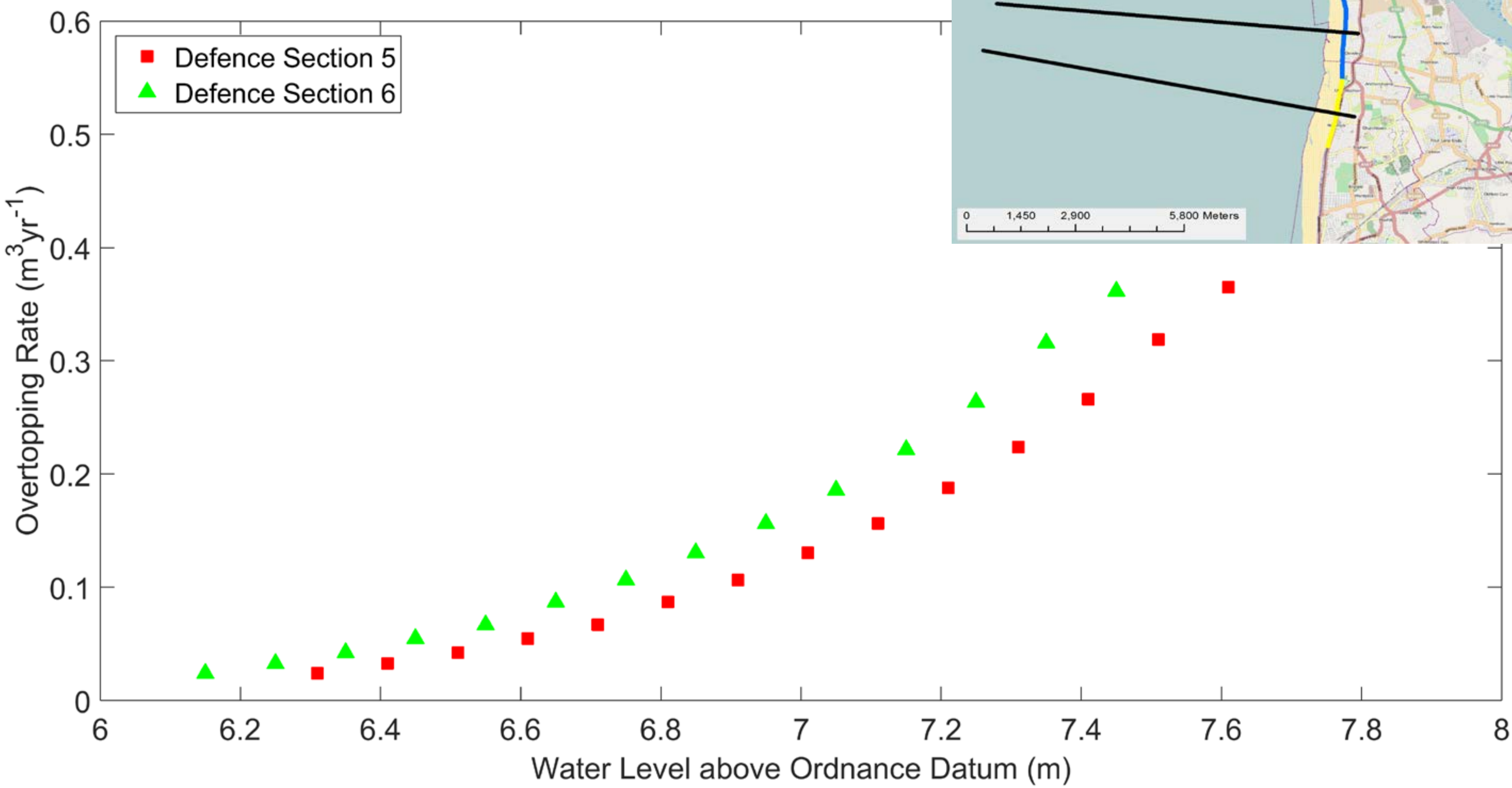
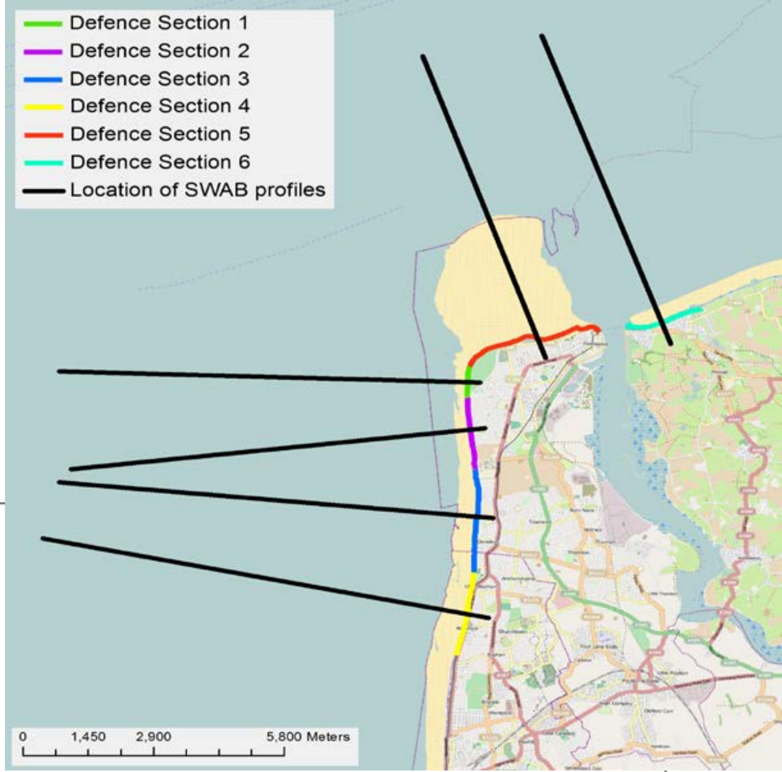
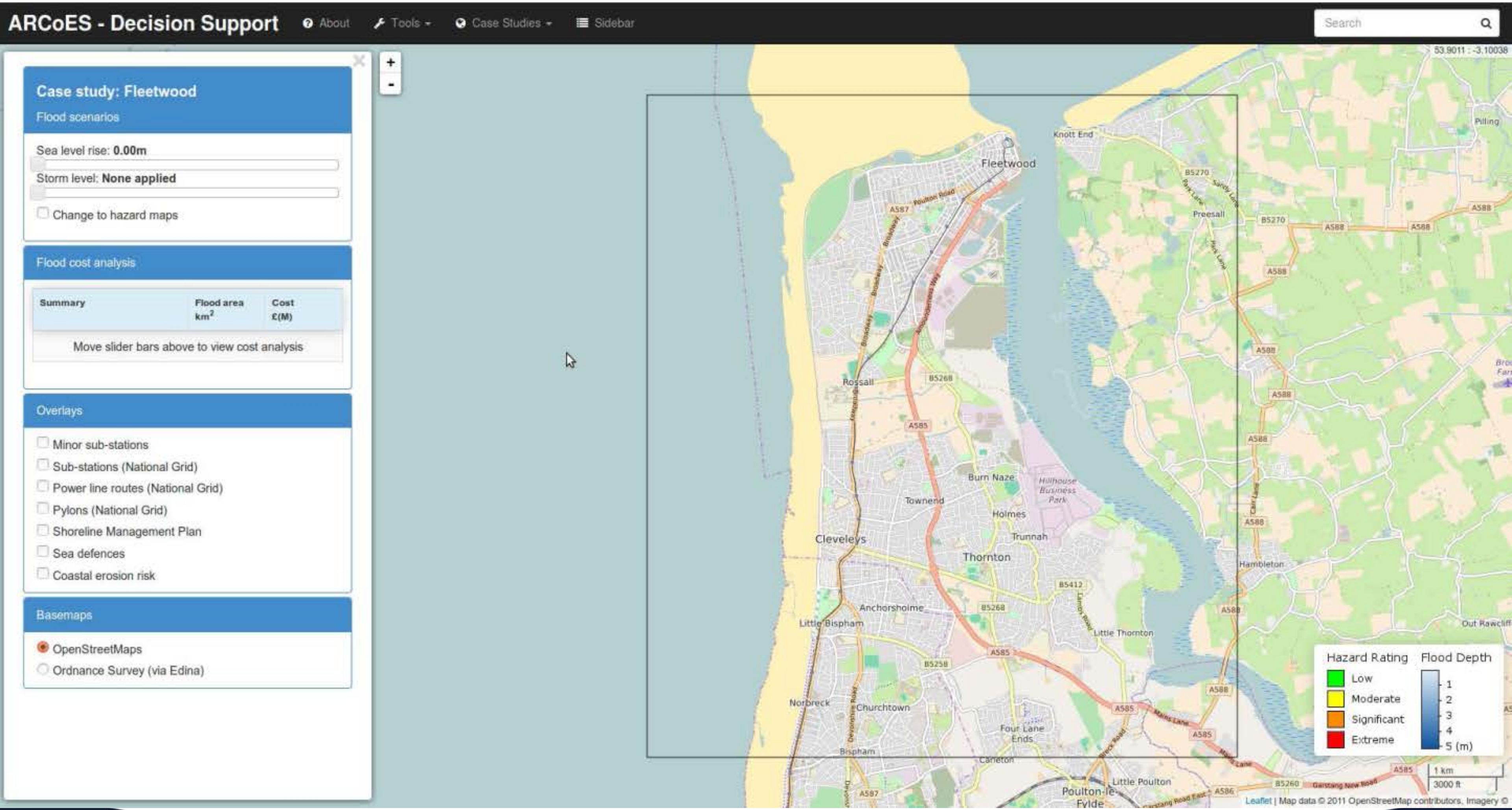
Wave overtopping hazard

- Storm tide: 1 in 250 yr R.P.
- Waves: 1 in 100 yr R.P.
- SLR: 0.65 m

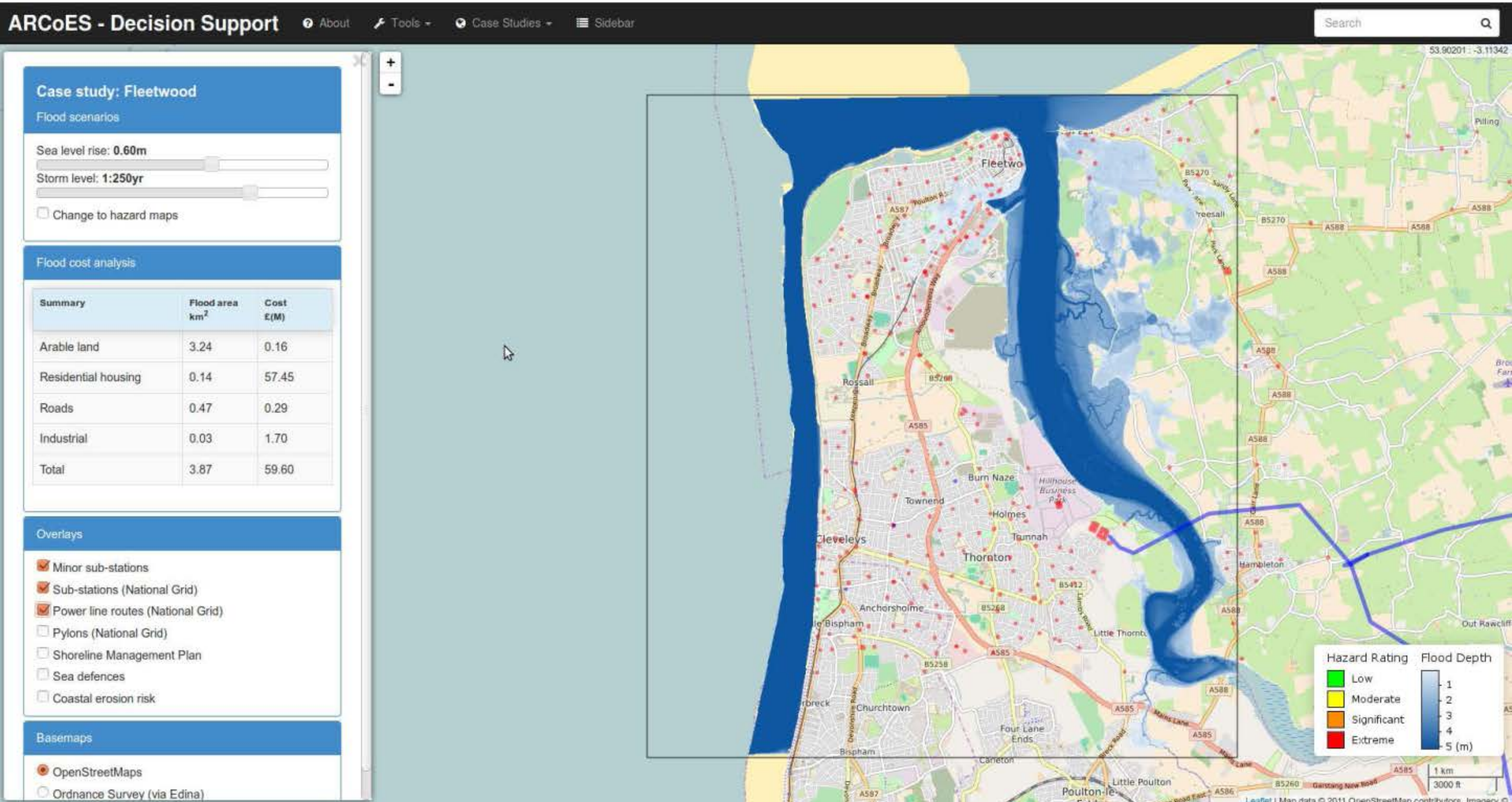




https://arcoes-dst.liverpool.ac.uk/

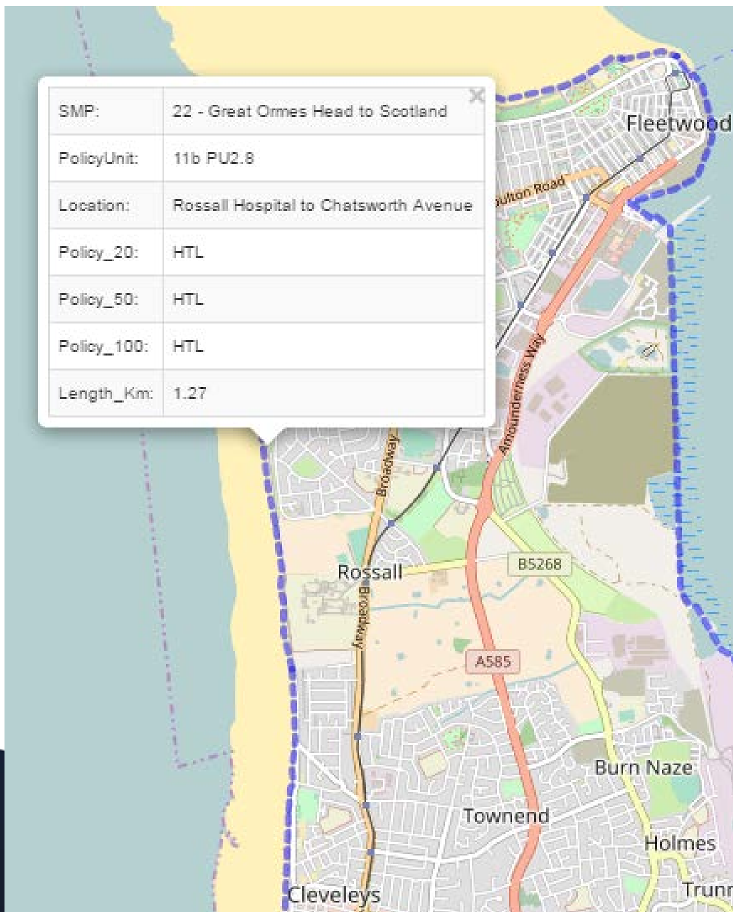


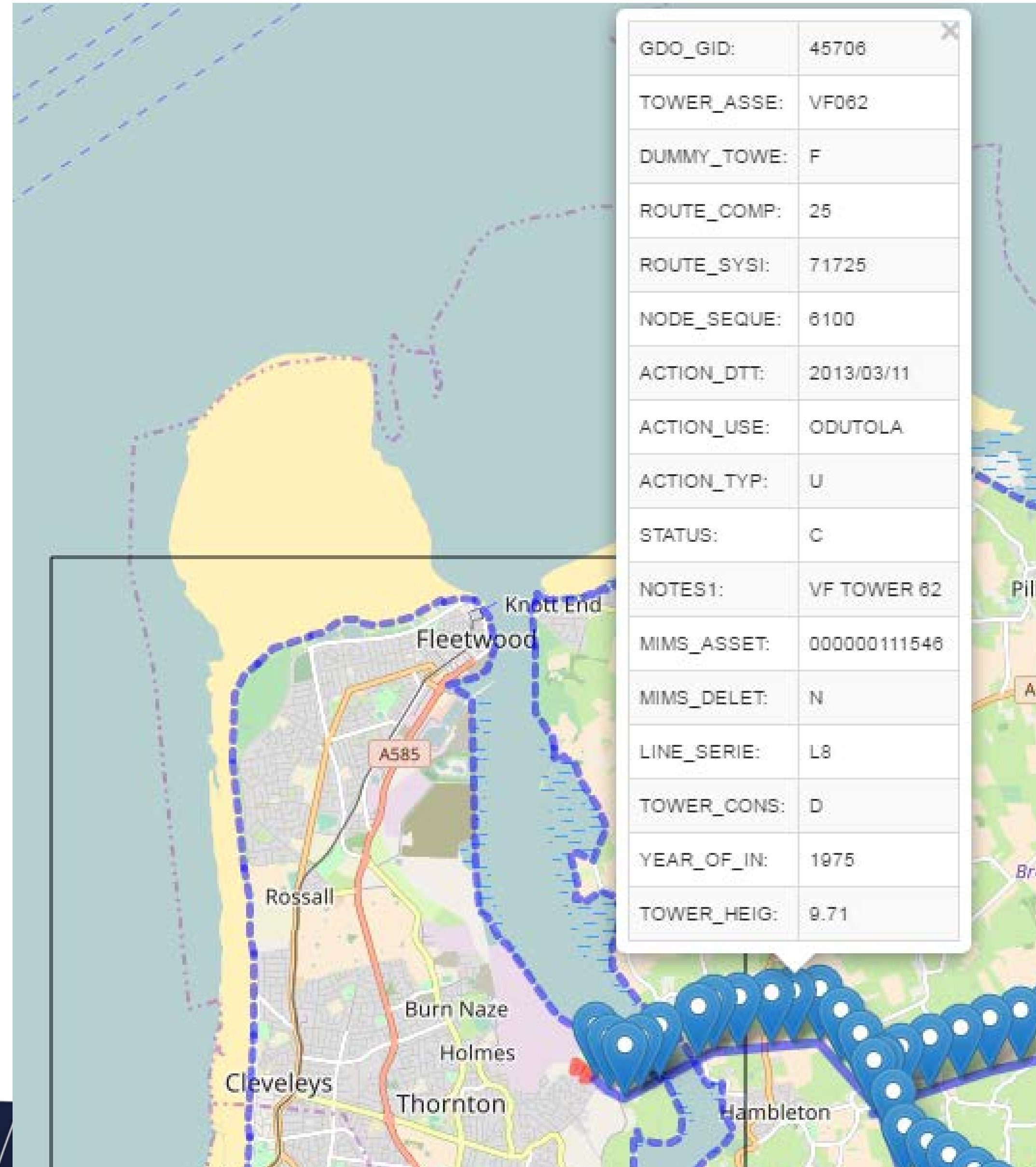
Flood depth



Summary	Flood area km^2	Cost £(M)
Arable land	3.24	0.16
Residential housing	0.14	57.45
Roads	0.47	0.29
Industrial	0.03	1.70
Total	3.87	59.60

Present day management information

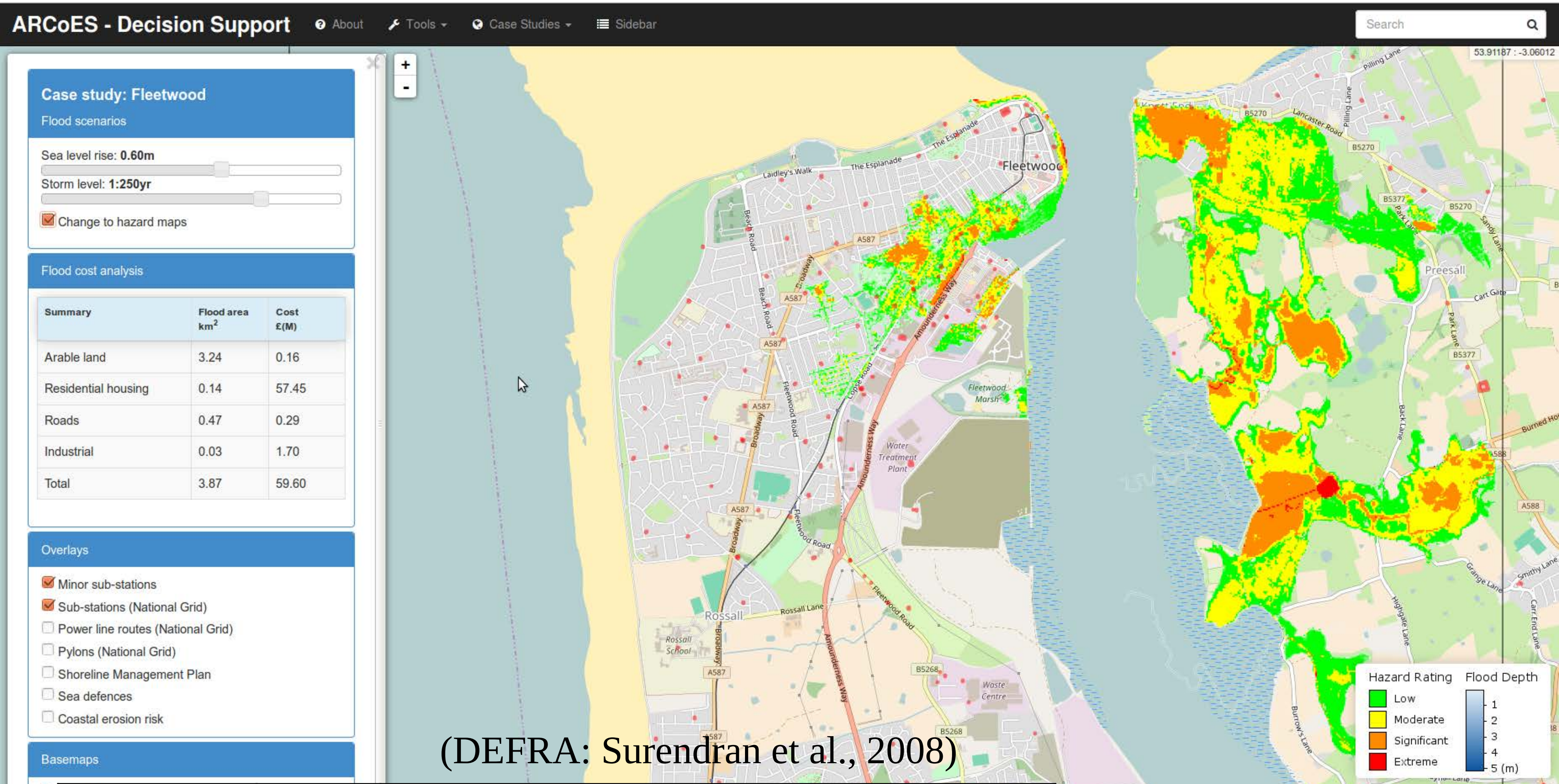




Hazard ratings

$$\text{Depth} \times (\text{Velocity} + 0.5) + \text{Debris Factor}$$

[land use: pastoral/arable, woodland, urban]



(DEFRA: Surendran et al., 2008)

Hazard threshold (H)	Degree	Description
< 0.75	Low	**Caution**: Flood zone with shallow water or deep standing water
0.75 - 1.25	Moderate	**Dangerous for some** (i.e., children): Flood zone with deep or faster flowing water
1.25 - 2.0	Significant	**Dangerous for most people**: Flood zone with deep or fast flowing water
> 2.0	Extreme	**Dangerous for all**: Flood zone with deep or fast flowing water

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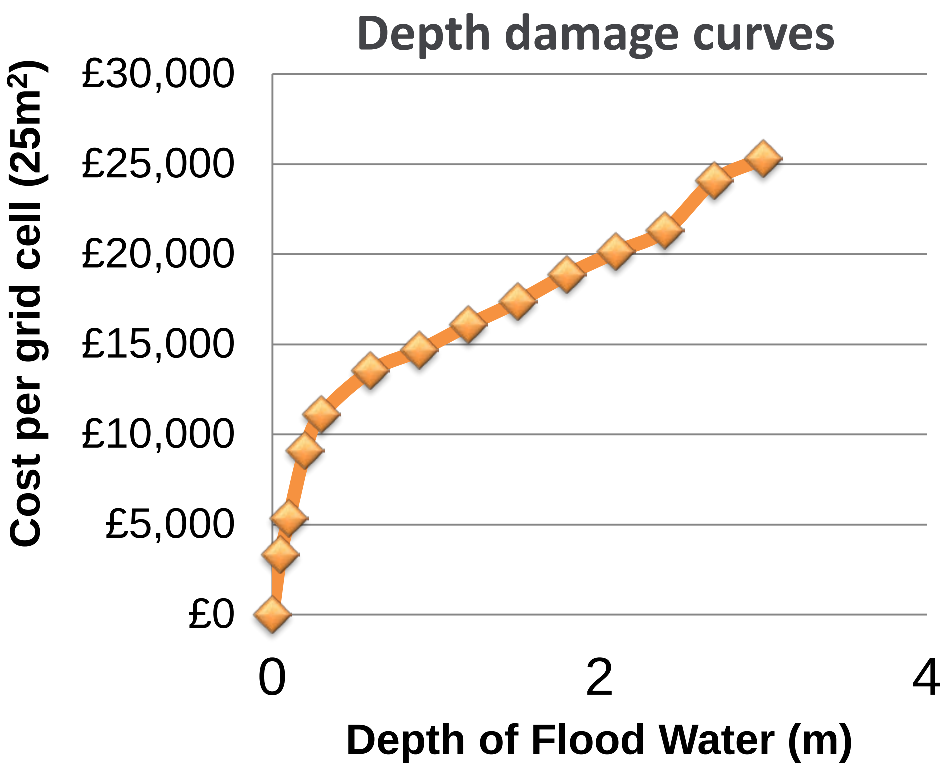
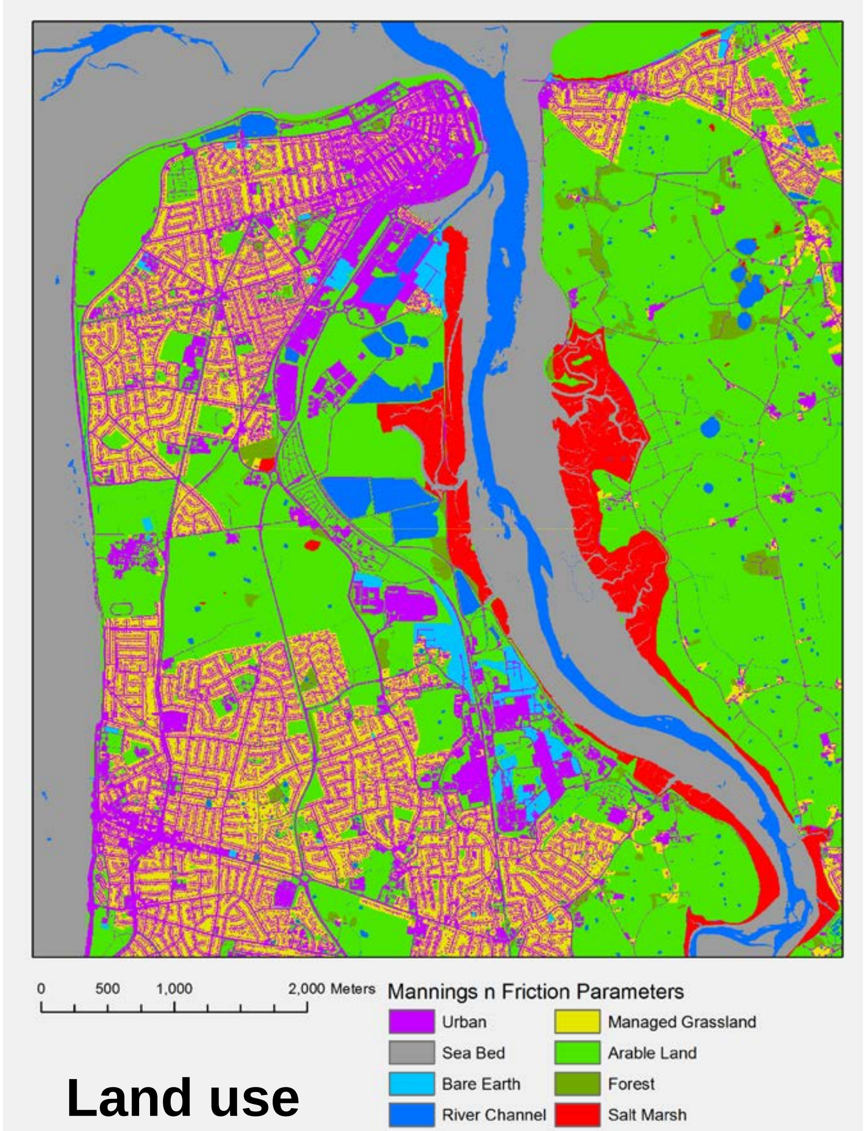
Cost of flooding for use in cost-benefit analysis



Housing - short duration saltwater events



Land use

Costs for each land use and the total area inundated

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Case study: Fleetwood

Flood scenarios

Sea level rise: **0.60m**

Storm level: **1:250yr**

- [x] Change to hazard maps

Flood cost analysis

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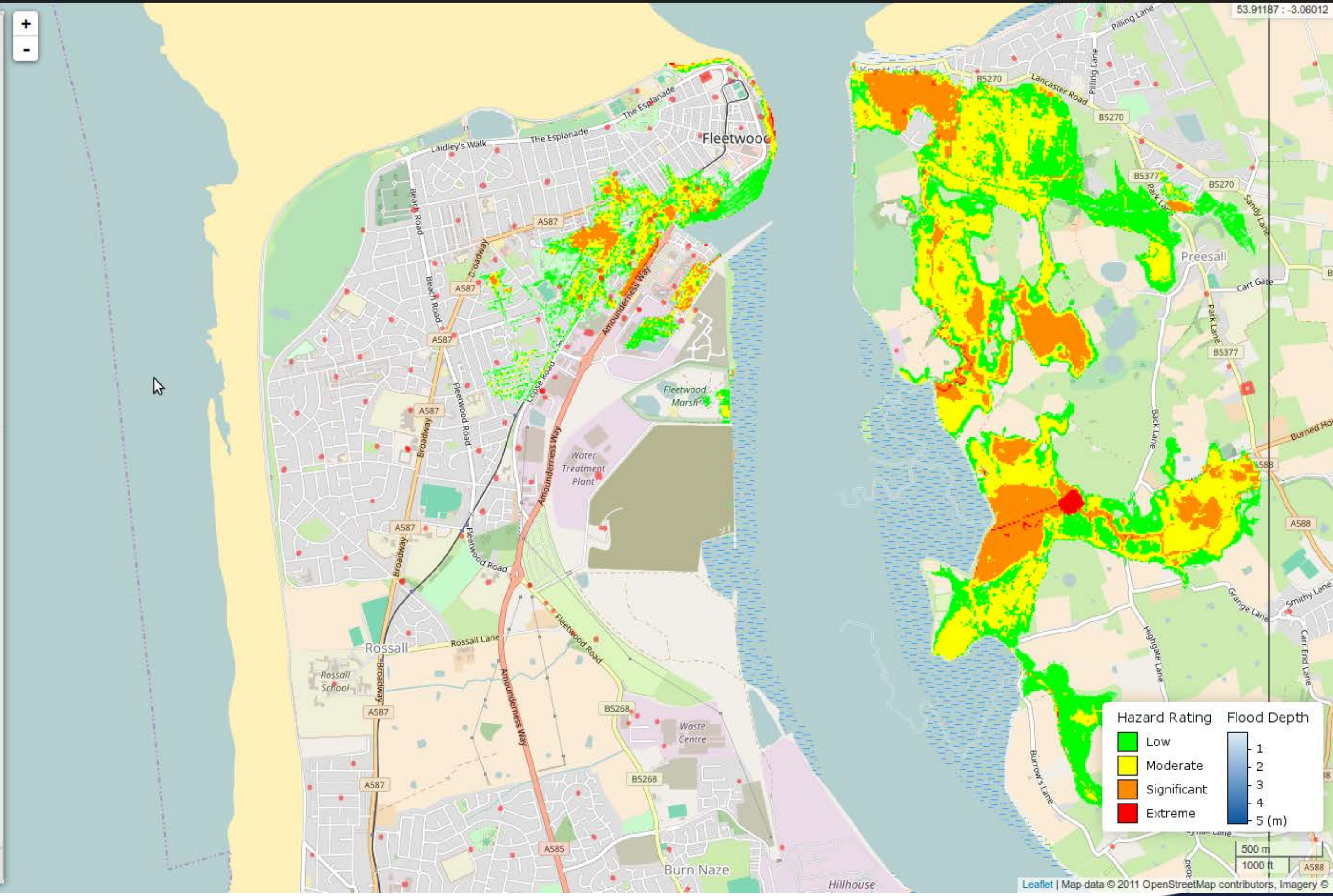
Overlays

- [x] Minor sub-stations
- [x] Sub-stations (National Grid)
- [ ] Power line routes (National Grid)
- [ ] Pylons (National Grid)
- [ ] Shoreline Management Plan
- [ ] Sea defences
- [ ] Coastal erosion risk

Basemaps

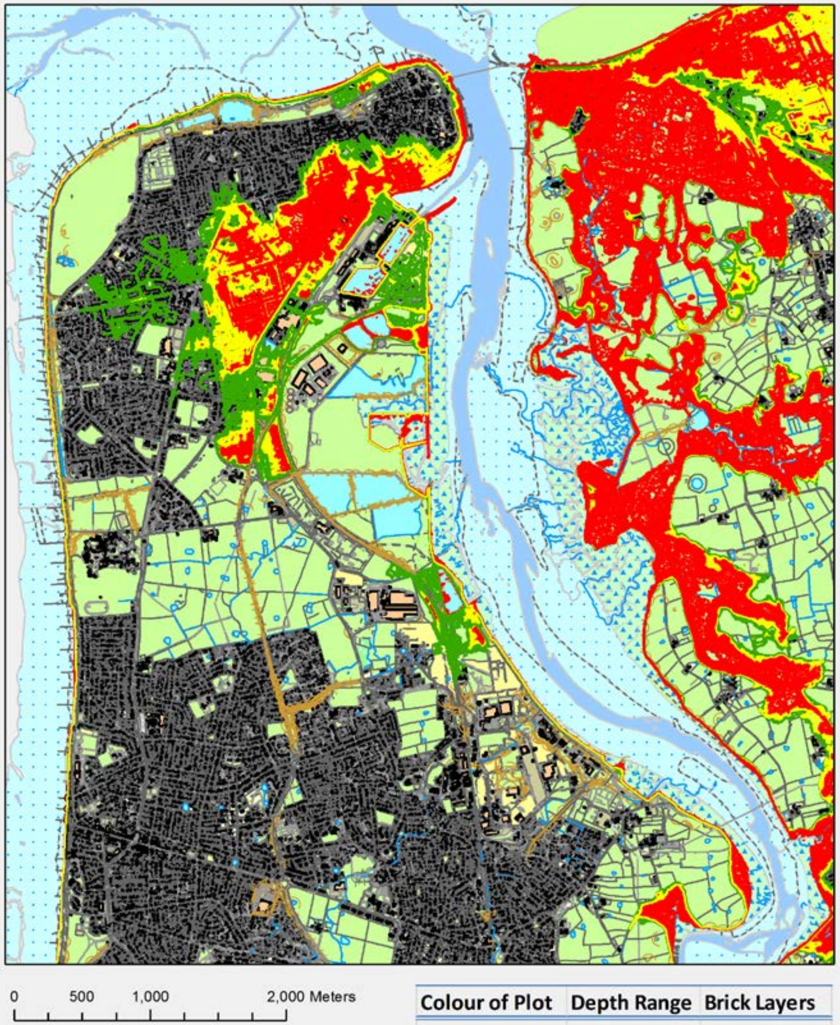
- (•) OpenStreetMaps
- ( ) Ordnance Survey (via Edina)



Fleetwood costs for each inundation scenarios for a 1 in 250 year storm tide + additional factors

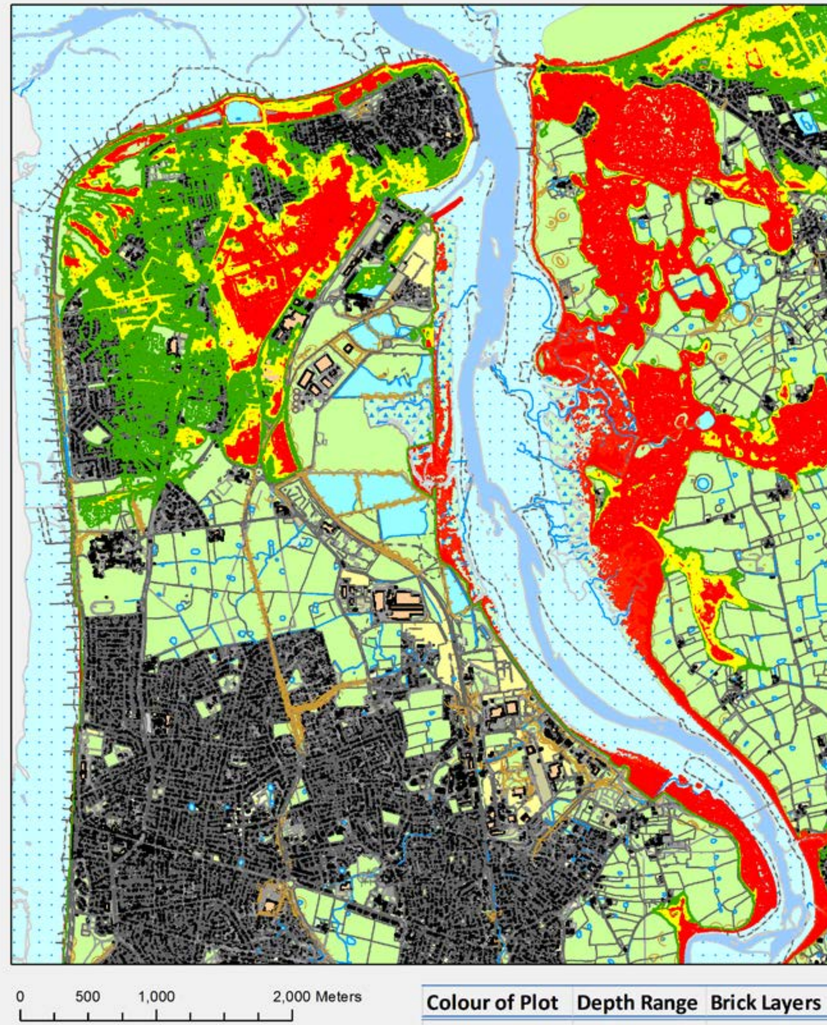
Additional Factor	Area of Land Inundated (Mm^2)	Volume of Flood Water (Mm^3)	Average Depth (m)	Standard Deviation of Depth	Total Cost(£M)
None	4.26	4.6	1.08	0.96	48.87
River forcing	9.68	12.2	1.26	1.01	247.32
Wave overtopping	8.33	6.99	0.84	0.82	224.61
Wave and River	12.75	14.04	1.10	0.97	377.11

Useful visualisation for the communication of results



Colour of Plot	Depth Range	Brick Layers
Red Areas	>0.6 m	8+
Yellow Areas	0.3-0.6 m	4 to 8
Green Areas	0.05-0.3 m	1 to 4

Storm tide & river



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Storm tide & waves

Acknowledgement of operational & pre-operational safety cases

Summary

- An open-source, web-based geospatial decision-support tool (DST) has been developed by ARCoES that allows the energy sector and the wider coastal stakeholder community to explore the plausible flood impacts of future climate scenarios.

- Even with efficient storm impact models there are still limitations in the DST due to the number of factors that can be represented within a feasible number of simulations.

- Even so, the DST offers the end-user the capability to undertake a tipping-point analysis, identifying when shifts in flood prone areas could occur making the present-day management policy unsustainable.

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Thanks for listening

More information available on YouTube, just search for ARCoES