# Modelling the impact of tidal farms on flood risk in the Solway Firth estuary

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The available tidal energy resource within estuaries is quite significant in the UK but these areas are usually prone to flooding. The objective of this study is the assessment of flood risk due to tidal farms in estuaries through its application to a real case, the Solway Firth.

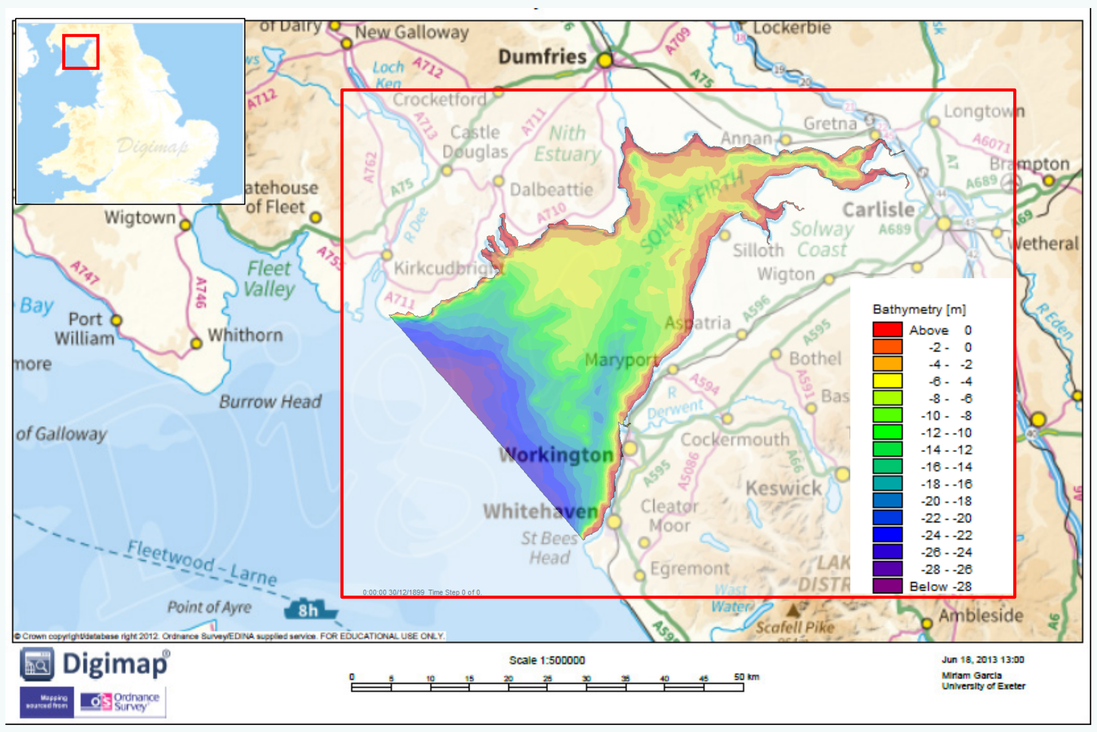
A numerical model has been developed to represent the hydrodynamic conditions of the estuary during an extreme event. The results from this model for the maximum velocities indicate the suitable locations for the tidal farms. Two different cases with parallel and staggered configurations of tidal farms have been introduced. The comparison of the results for the maximum water levels between the situations with and without the farms allow us to draw conclusions about changes of flood risk due to the farm and contrast the impact of two different arrangements of turbines. The values of the energy extracted in both configurations will also be investigated.

## Solway Firth Model

### *Numerical model*

Mike 21 Flow Model FM has been used to simulate the hydrodynamic behaviour of the estuary. A cell-centred finite volume method is applied for the spatial discretization of the 2D depth-averaged Shallow Water equations.

### *Domain - Bathymetry*

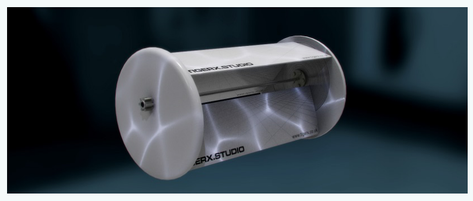



### *Model Parameters*

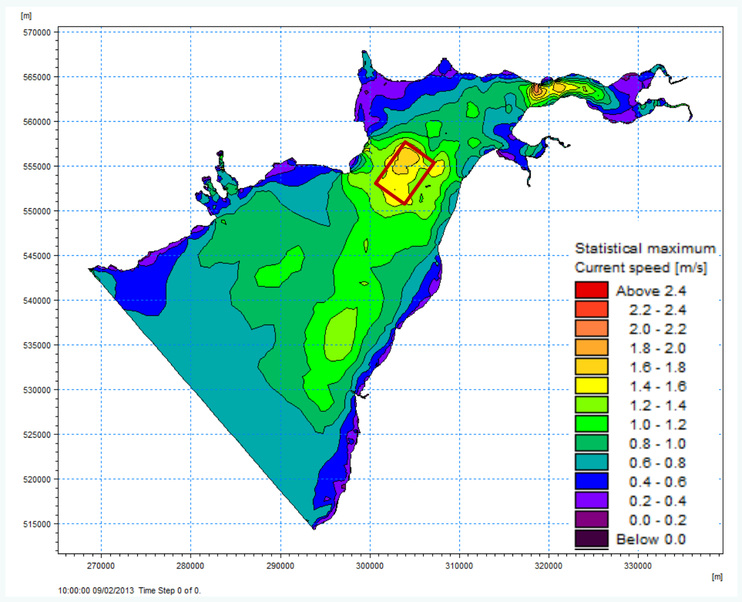
| | |
|---|---|
| Simulation period | 4 days |
| Time step | 900 sec |
| Elements (approx.) | 13500 |
| Max. mesh size | 1 km$^2$ |
| Bed roughness (1/n) | 22 m$^{1/3}$/s |
| Smagorinsky's Coeff. | 0.28 |

### *Tidal Farm*

32x32 devices – MRL turbine

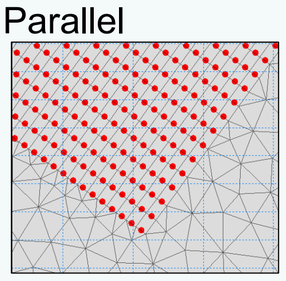


### *Farm location*

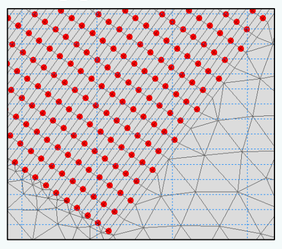



### *Configurations*

Parallel



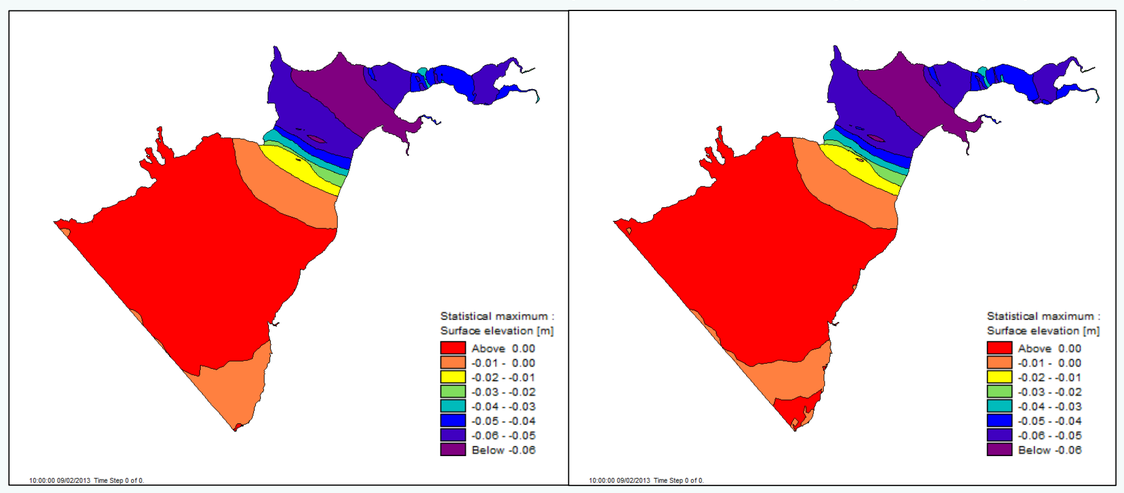
Staggered



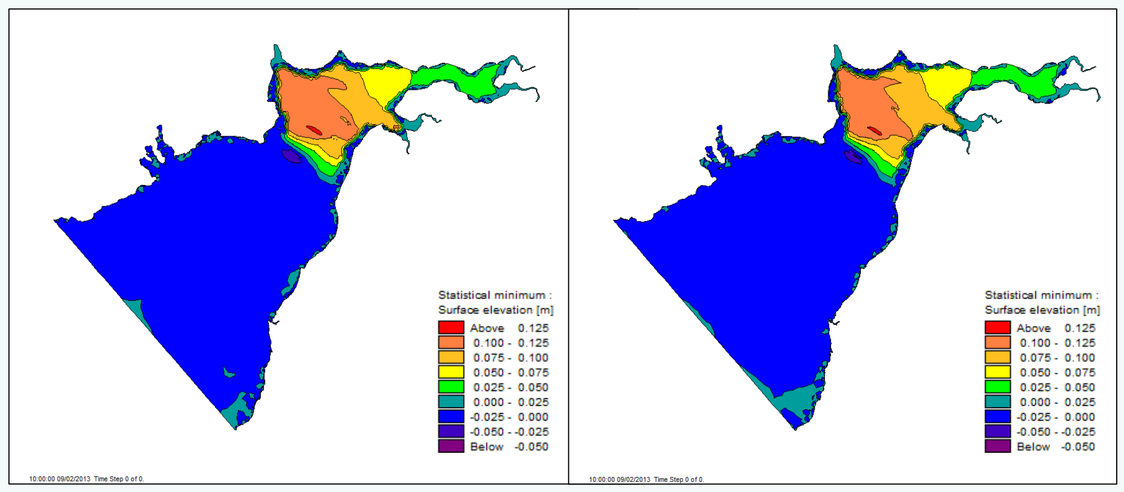
## Results

Positive values indicate increased water levels due to the farm effect , and vice-versa.

### *Influence on maximum water levels (parallel-left, staggered-right)*




### *Influence on minimum water levels (parallel-left, staggered-right)*




## Conclusions

The effects on the maximum water levels are not significant. Nevertheless, low tide levels are affected in a higher degree in the inner part of the estuary next to the farms. These changes could imply that intertidal areas and their associated habitats would be covered by water for longer periods in the presence of tidal farms.

## References

- M.G. Gebreslassie, G.R. Tabor and M.R. Belmont, CFD simulations for investigating the wake states of a new class of tidal turbine, *Journal of Renewable Energy and Power Quality*, 10(241), 2012.
- M. Garcia-Oliva , G. Tabor, S. Djordjevic, Computational modelling of an estuary in the frame of the optimisation of tidal farms, *Proceedings of the 22nd UK Conference of the Association for Computational Mechanics in Engineering*, Exeter.

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