The potential for Wind farms to affect Primary production

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ECOWind Supergen Offshore Renewable Energy

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UNIVERSITY OF ABERDEEN

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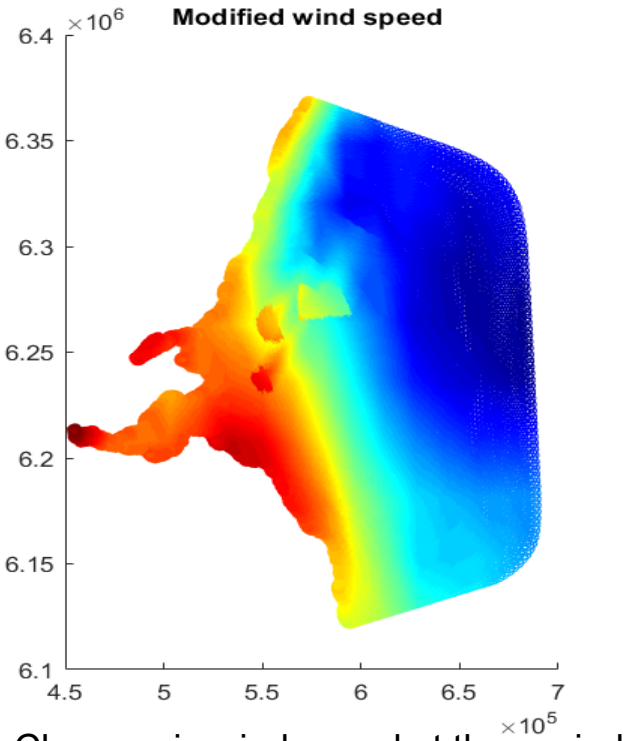
Physics-to-Ecosystem Level Assessment of Impacts of Offshore Windfarms
Lead Principal Investigator: **Professor Beth Scott, University of Aberdeen**

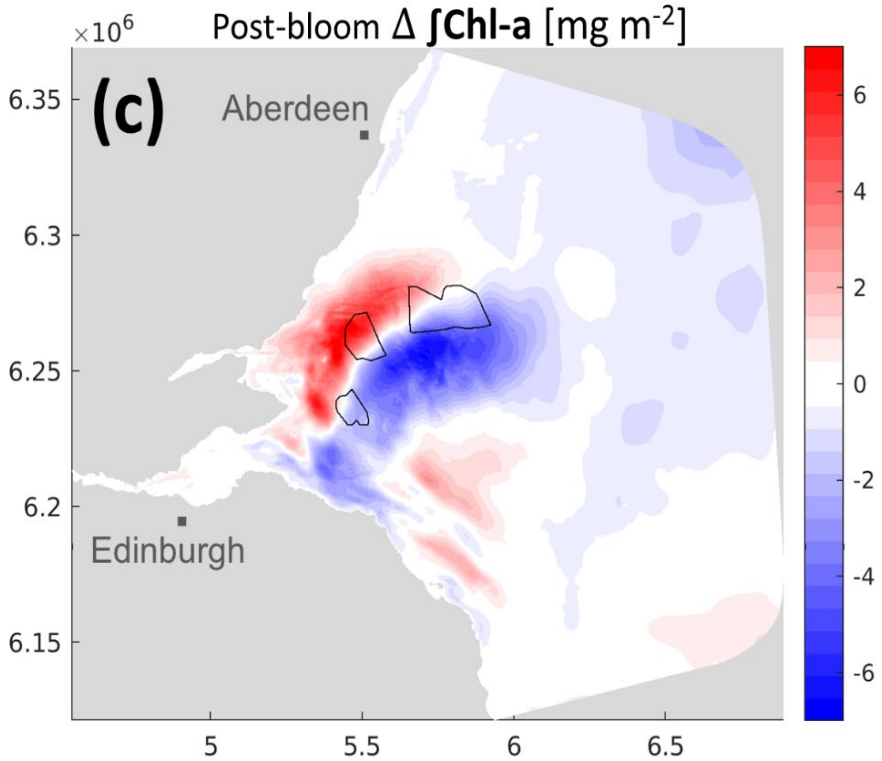
Scottish Government
Riaghaltas na h-Alba

Aims

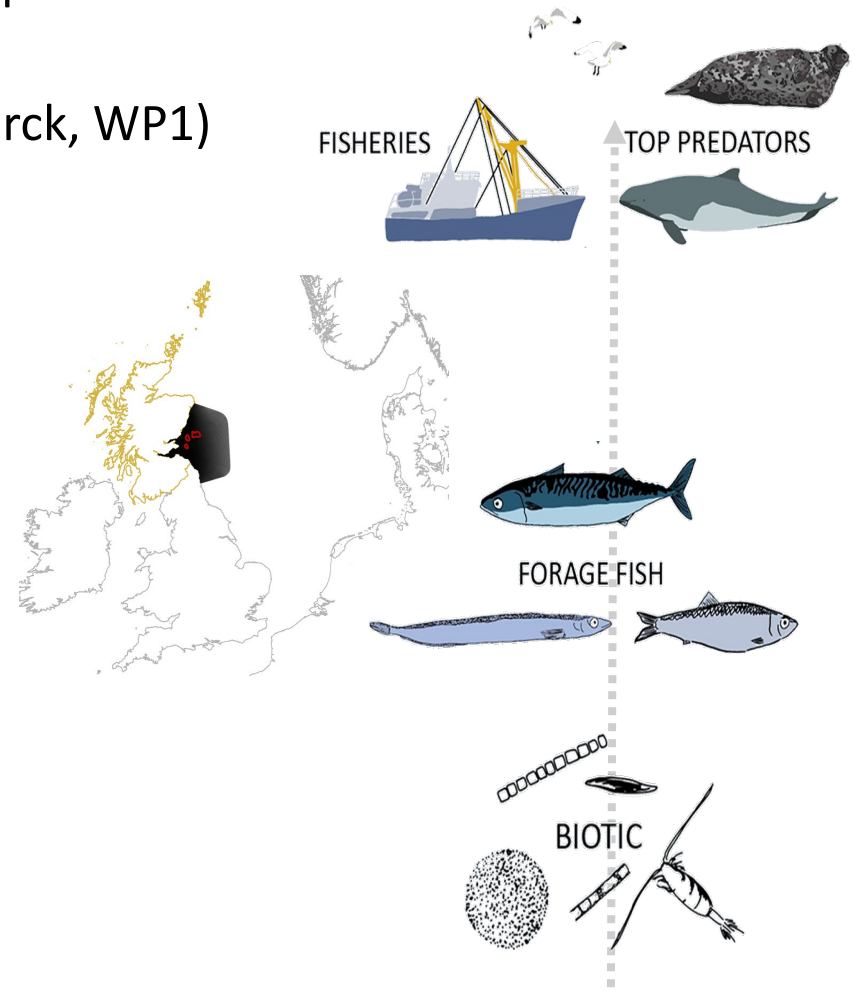
- Including wind wakes into oceanographic and biogeochemical models by changing atmospheric variables to reflect observed wind wakes (from SAR, lidar, CFD)
- Understand the impacts on the fundamental processes regulating primary production in the North Sea
- Evaluating the ecological effects of wind energy extraction (Morgane Declerck, WP1)



Changes in wind speed at three wind wakes in the Firth of Forth (Scotland)

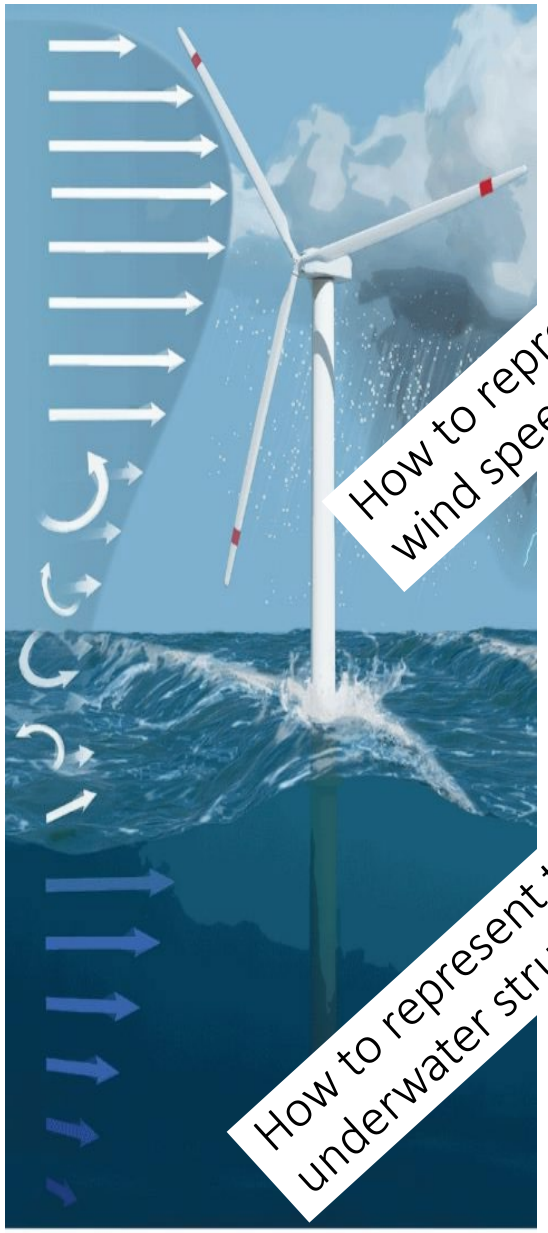


Changes in integrated Chl-a caused by three wind wakes in the Firth of Forth (Scotland)



Isaksson et al. 2023, ICES JMS

Modelling wind turbines at regional and shelf-wide scales



frontiers in Marine Science

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Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes

Nils Christiansen[1*], Ute Daewel[1], Bughsin Djath[1] and Corinna Schrum[1,2]

More effects?

Contents lists available at SciVerse ScienceDirect

Coastal Engineering

journal homepage: www.elsevier.com/locate/coastaleng

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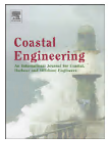

On the effect of structure-induced resistance and mixing on inflows into the Baltic Sea: A numerical model study

Hannes Rennau [a,1], Stefan Schimmels [b], Hans Burchard [a,*]

[a] Leibniz Institute for Baltic Sea Research Warnemünde, Seestraße 15, D-18119 Rostock, Germany
[b] Forschungszentrum Küste, Merkurstaße 11, D-30419 Hannover, Germany

1) Changes to turbulence can increase vertical mixing. This is now represented in the turbulence model.

scientific reports

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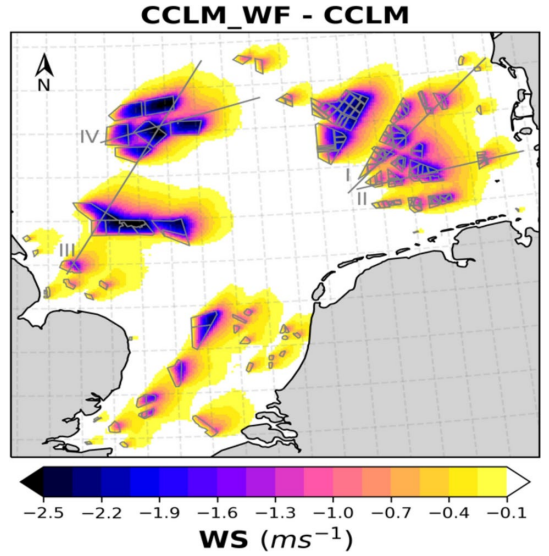
Accelerating deployment of offshore wind energy alter wind climate and reduce future power generation potentials

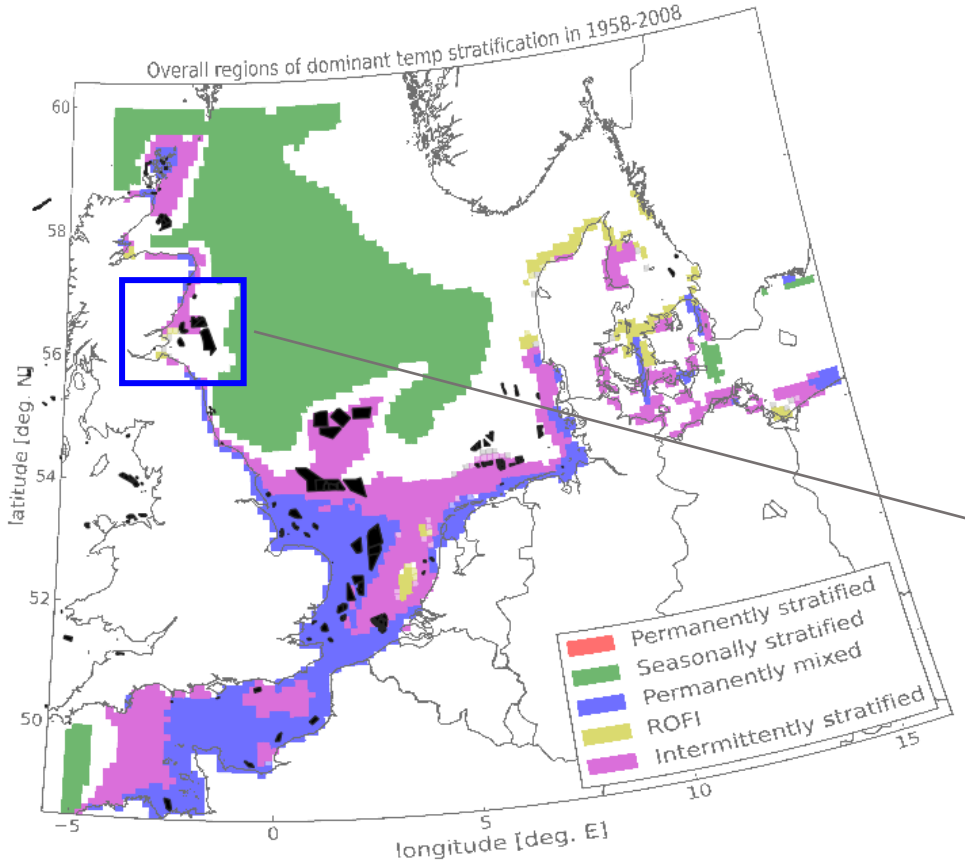
Naveed Akhtar✉, Beate Geyer, Burkhardt Rockel, Philipp S. Sommer & Corinna Schrum



2) The underwater structure causes **horizontal drag** which can be represented as a retarding forcing in the momentum equations

The potential impact of offshore wind farms on primary production

https://supergen-ore.net/events/webinar-3



Van Leeuwen et al. 2015, JGR Oceans

■ Wind farms
@EMODnet

FVCOM+ERSEM

- Unstructured grid ~ 69 m – 4 km * 10 sigma layers
- Salinity, temperature, horizontal currents, atmospheric forcing (wind, precipitation and solar radiation), river inputs
- 3 wind farms in waters at depths 41-58 m: **Parameterization of the wake effect** on atmospheric forcing

Wind wake and next steps

https://supergen-ore.net/events/webinar-3

Length of the wind wake is 30 km and maximum relative deficit is 10%

- ✗ Atmospheric stability
- ✗ Number of turbines
- ✗ Deep array effect among turbines

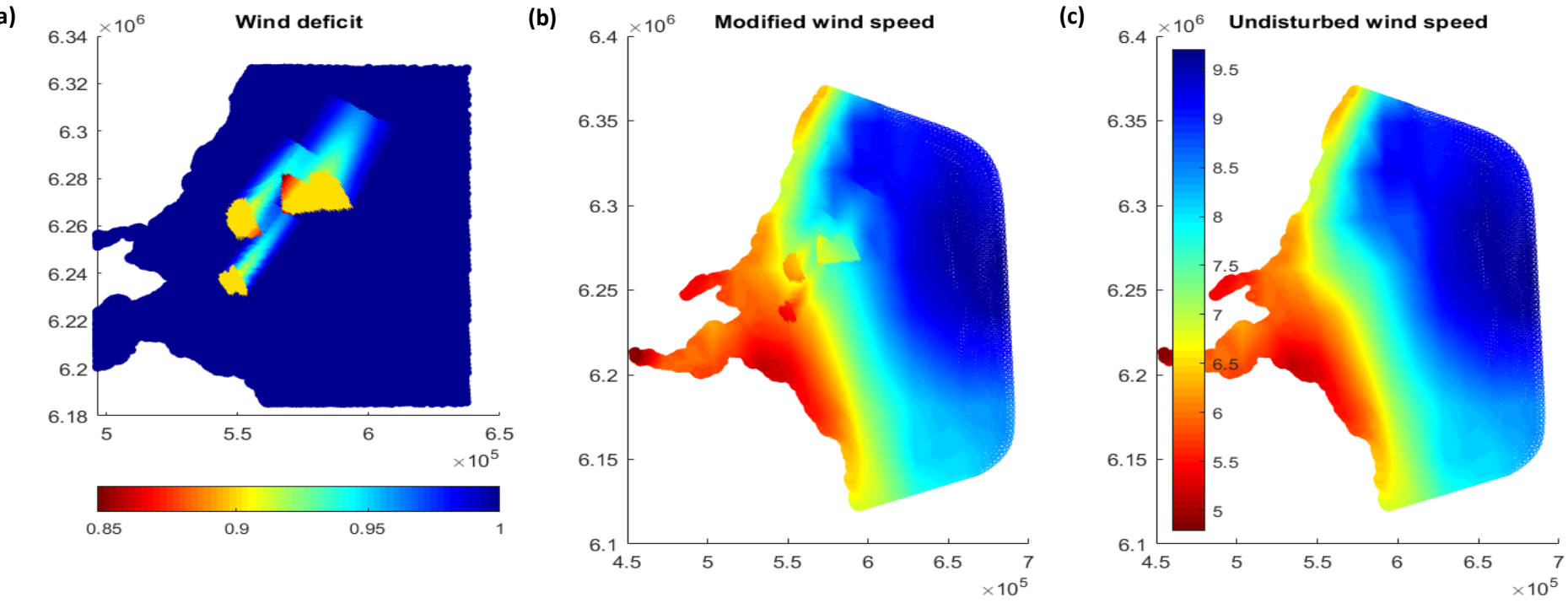
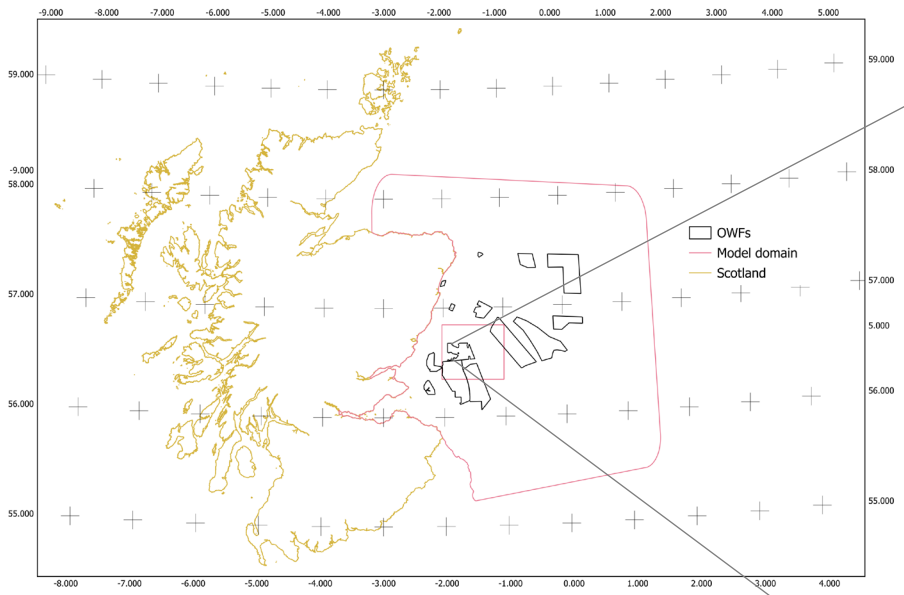
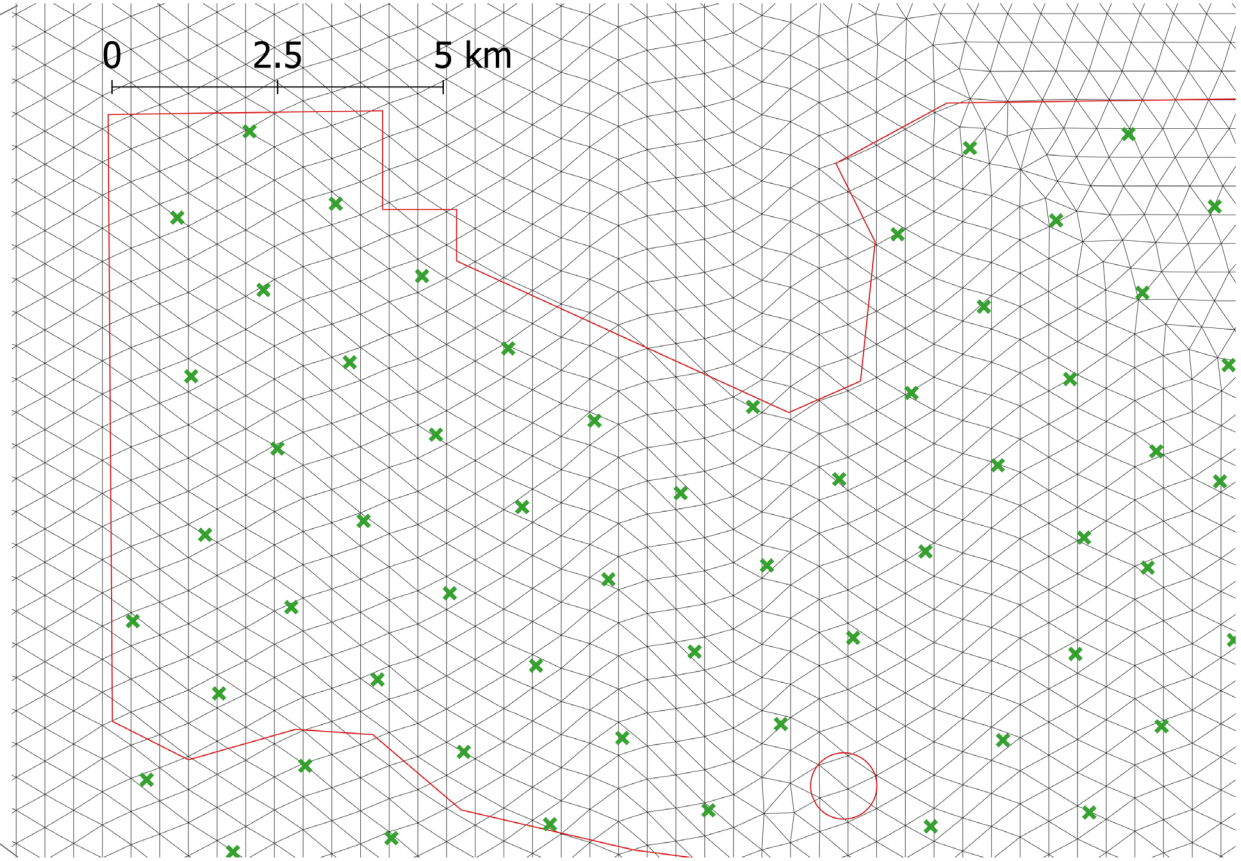


Figure: (a) maps showing the wind deficit (0 to 1, where 1 is no effect and 0 is 100% of wind reduction). (b) map of the wind field in M_{WF} and (c) in M_B.

Wind wake and next steps





- Interaction between wakes *
- Wake length/recovery *
- Energy extraction *
- Candidate deployment sites
- scale: 100 – 500 m up to 1 – 3 km,
  1 h time steps

(*under different atmospheric conditions)

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