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Ecosystem effects of future upscaling offshore wind

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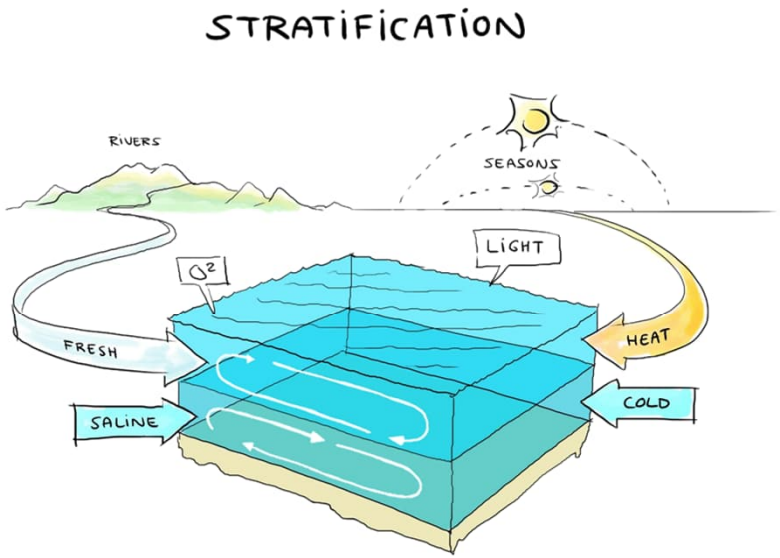
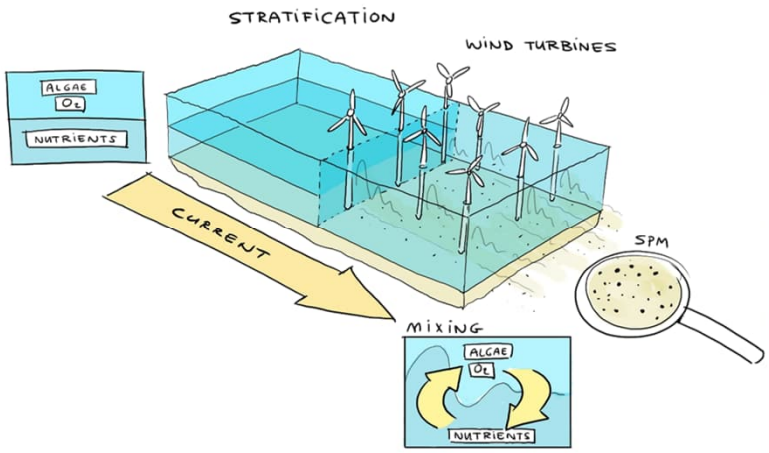
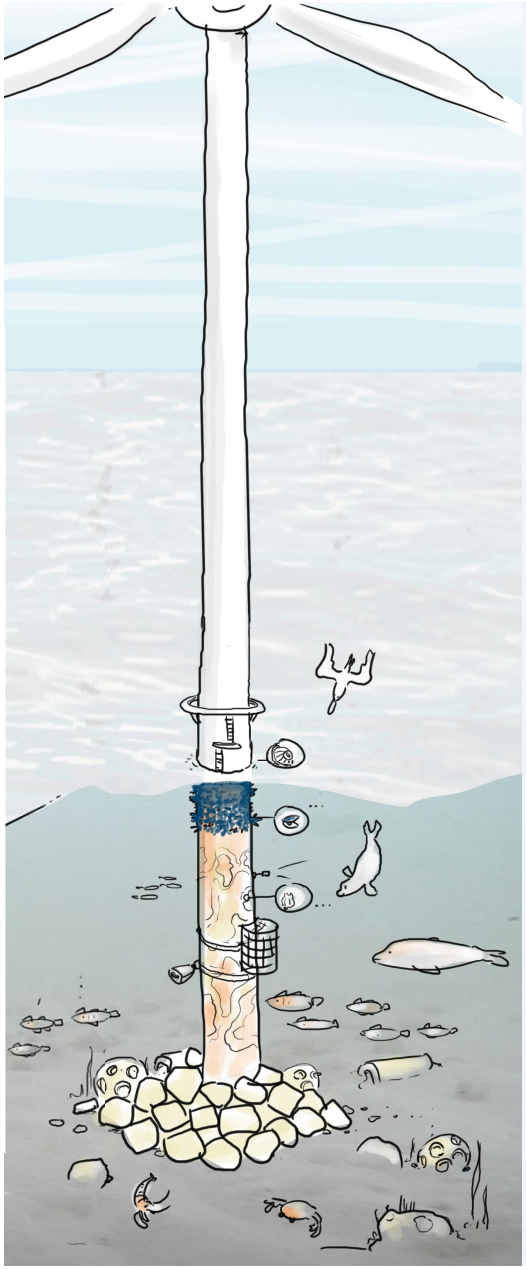
14 februari 2023

Ecosystem effects; from currents to kittiwakes







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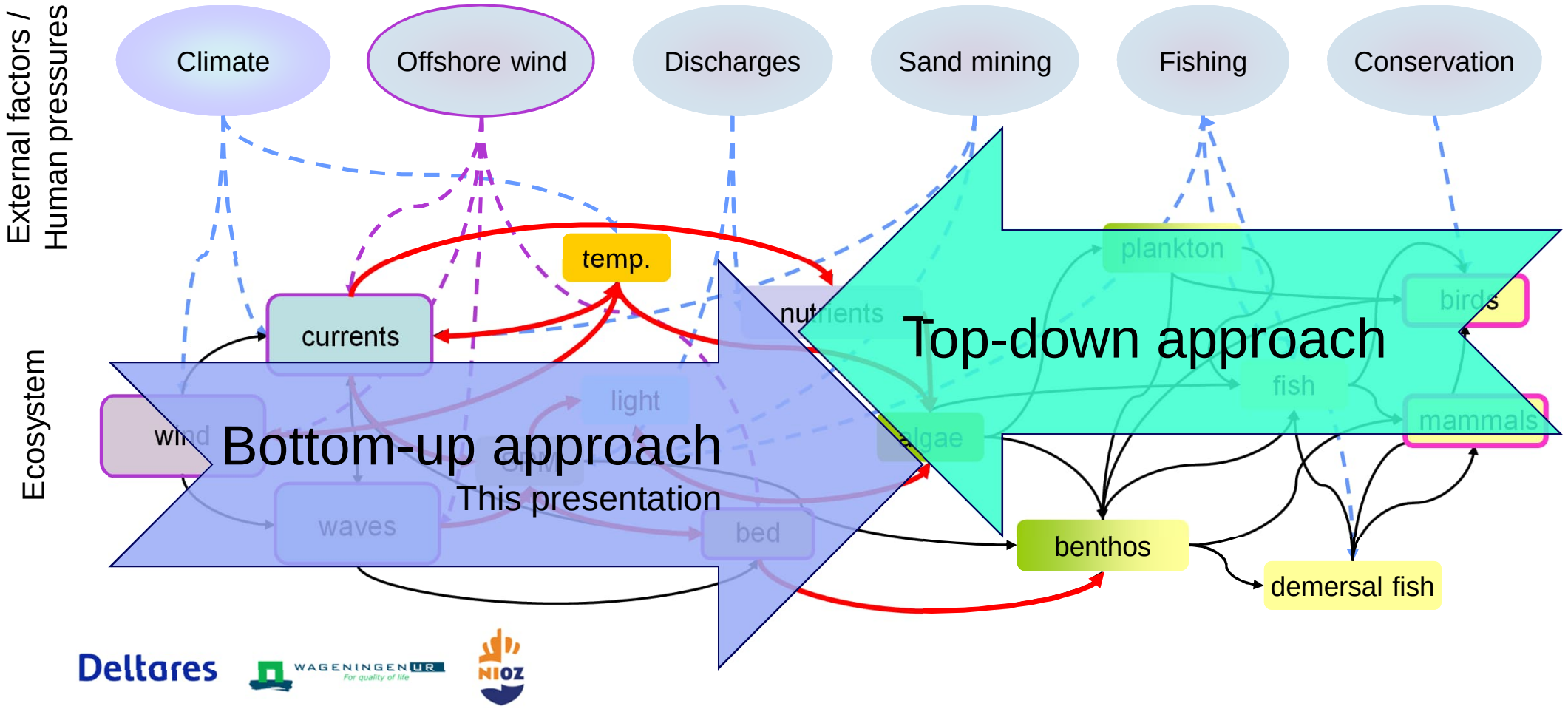
Effect chain



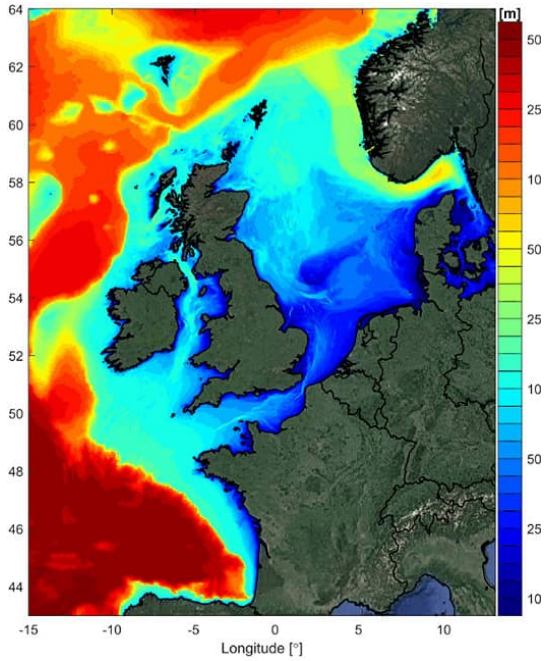
Story so far – bottom-up modelling

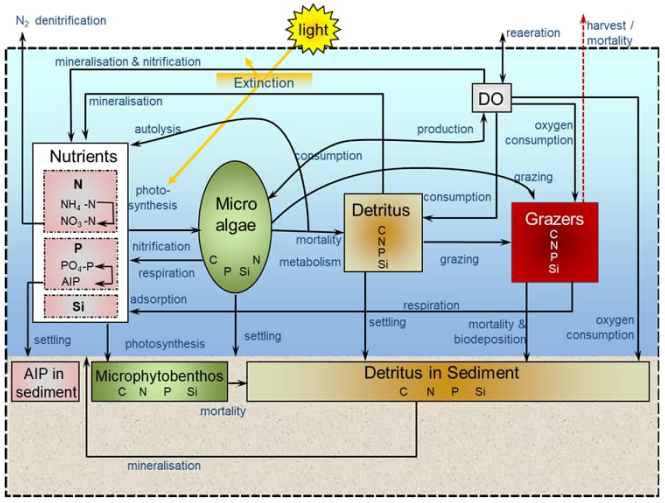
- Bottom-up: completely new modelling suite Delft 3D-FM
- Coupled to SPM and ecological processes
- First exercise: SPM and ecology not yet fully coupled
- 3 scenarios analysed:
  - reference
  - 2020
  - hypothetical upscaling

➢ Aim:

? Are ecosystem effects relevant?

? Which parts of the North Sea are susceptible?





2021 – 2022 work

- Results in 2021
  - Good results, effects important; model had still teething problems
    - Fine sediment bias
    - Mussels “died” on pillars
  - Link between top-down and bottom-up approach not easy
- Hypothetical scenario – designed to learn from, not for direct policy support
- Focus of work last year
  - model improvement
  - further investigation fine sediment transports
  - more realistic scenarios

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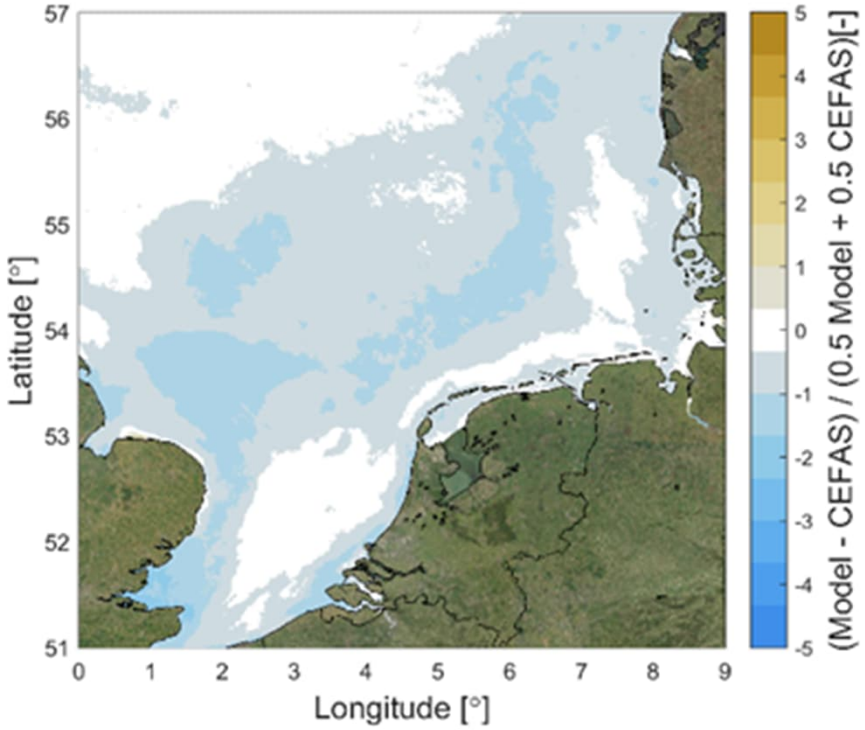
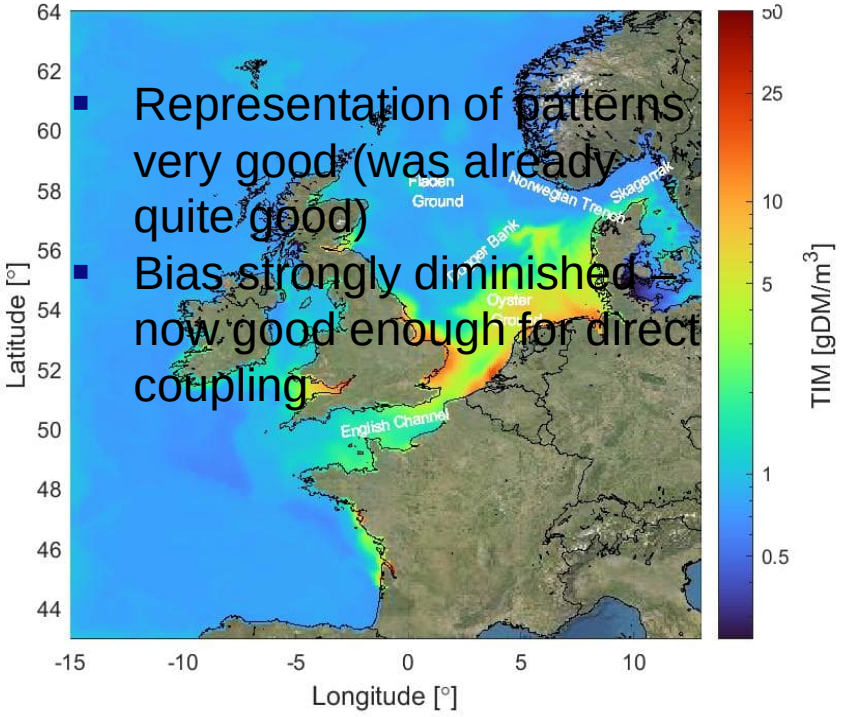
Model improvement fine sediment

Validation with remote sensing



Mud summer surface concentration new



- Representation of patterns very good (was already quite good)
- Bias strongly diminished – now good enough for direct coupling

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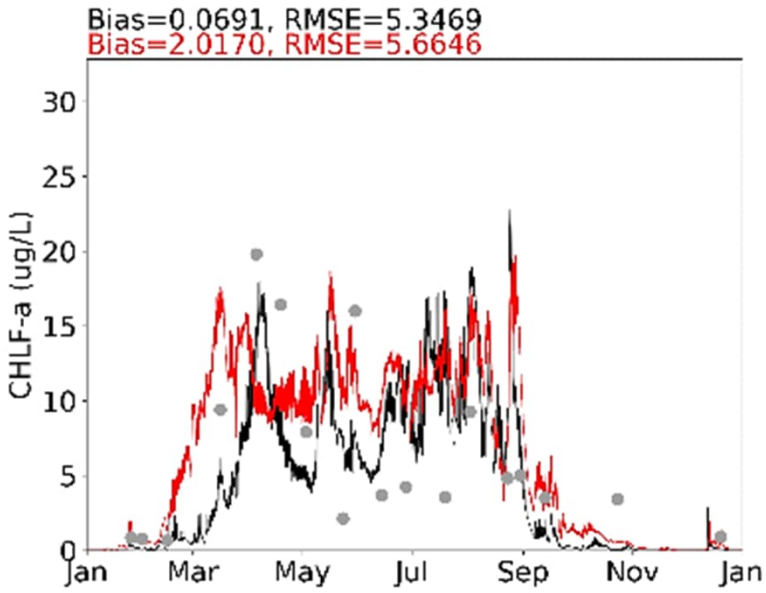
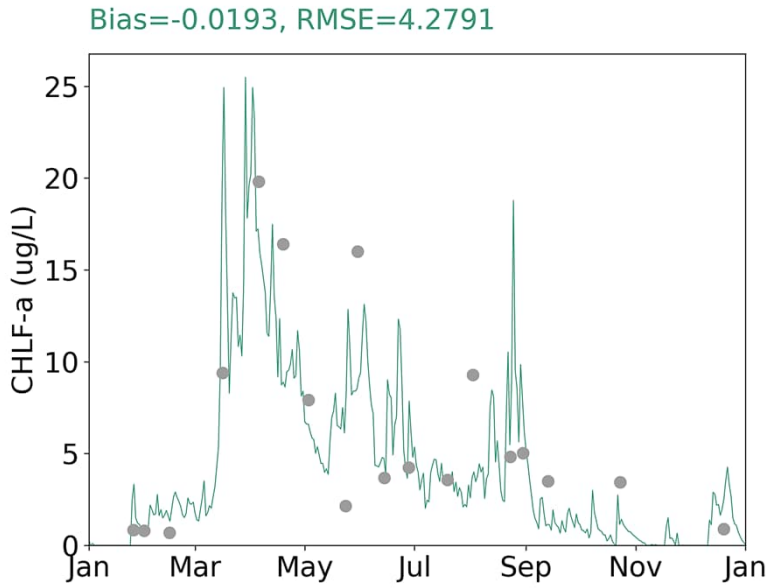
Model improvements ecology

Noordwijk 20 km

2007 intial uncoupled run
2007 initial coupled run
2007 calibrated coupled run
2007 measurements

Chlorophyll a





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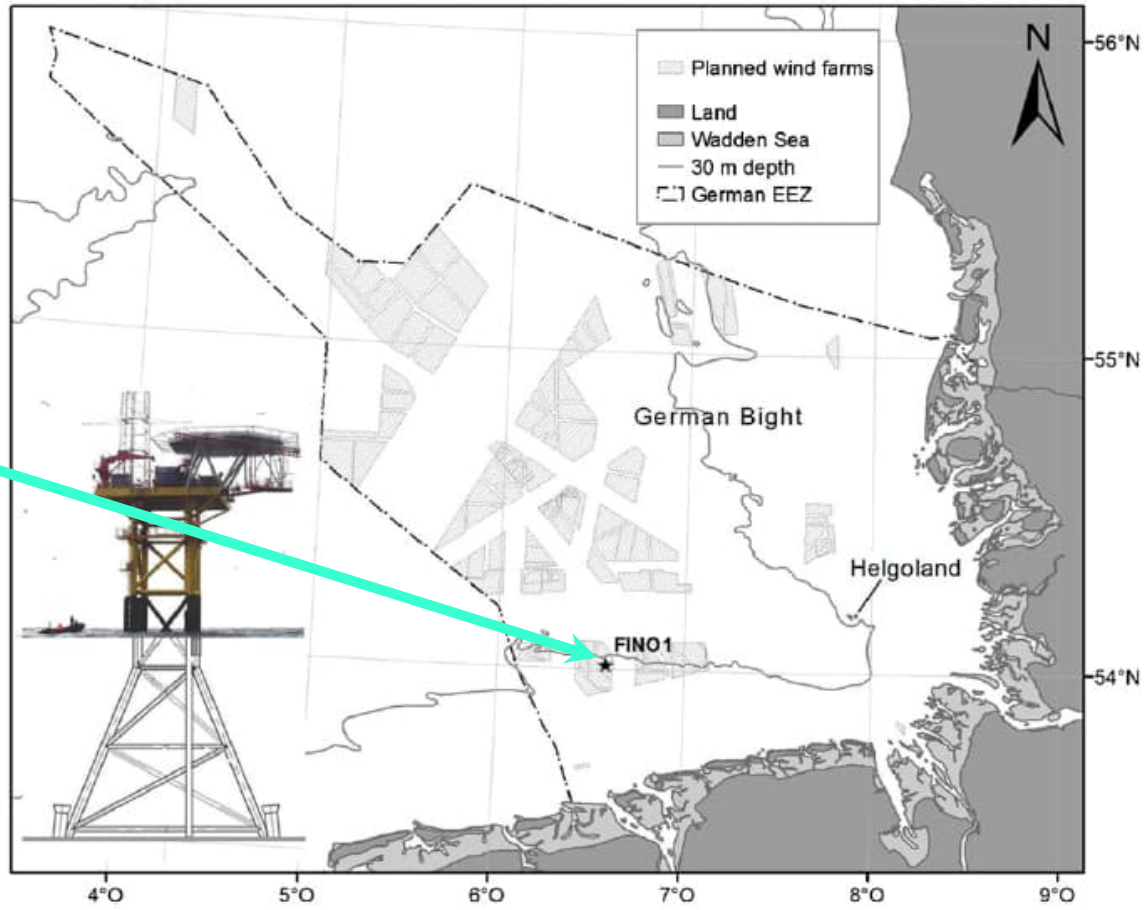
Growth of mussels on pillars

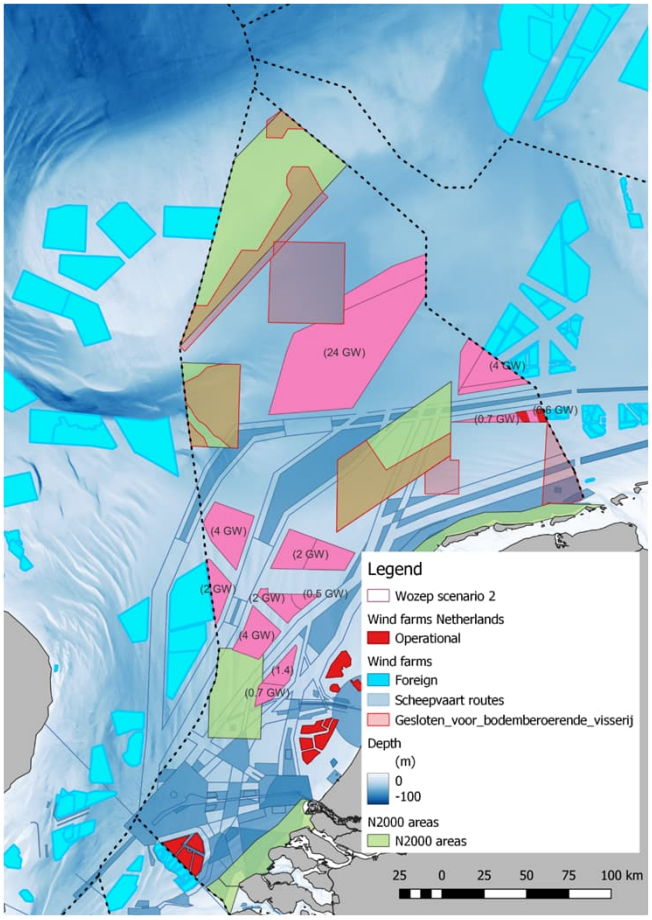
- No suitable data available from Dutch wind farms
- Model tests to reproduce mussel biomasses observed by Krone et al. (2013) at the FINO1 windfarm

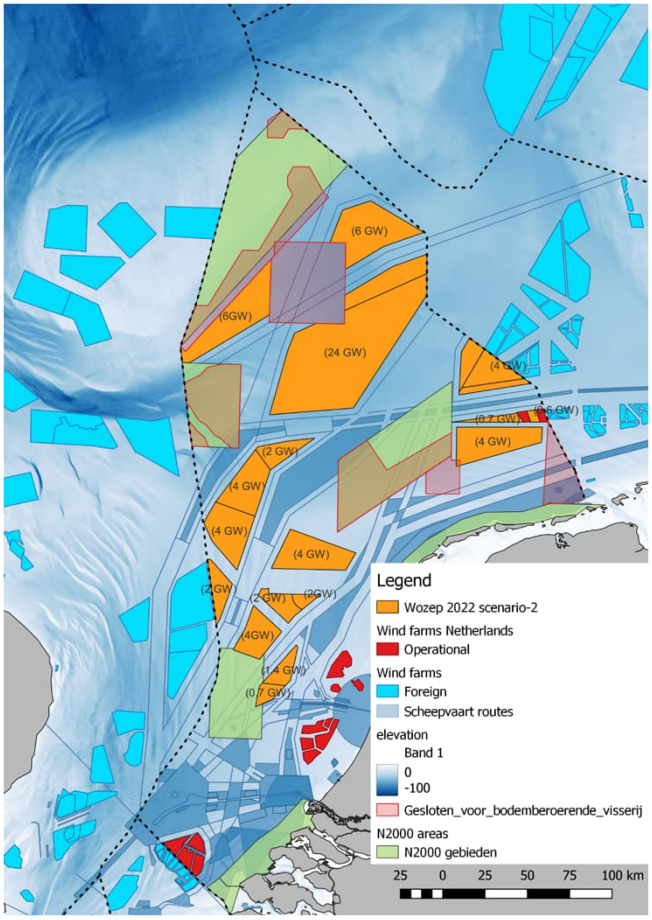


Reproduced from Krone et al. (2013)

New two-tiered way of working

- Model not perfect, but ‘good enough’
- Model development vs. model application
- 2022 scenario report still slightly hybrid (new calibration work and application)
- 2 scenarios
  - Expected developments ±2040
  - Extreme upscaling – likely not realistic!
- This presentation concentrates on scenario 1





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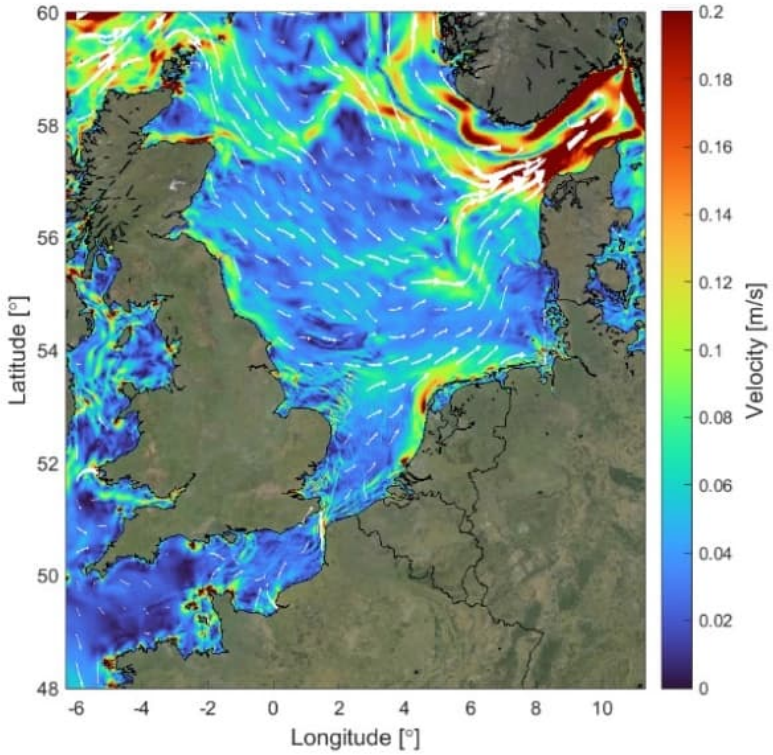
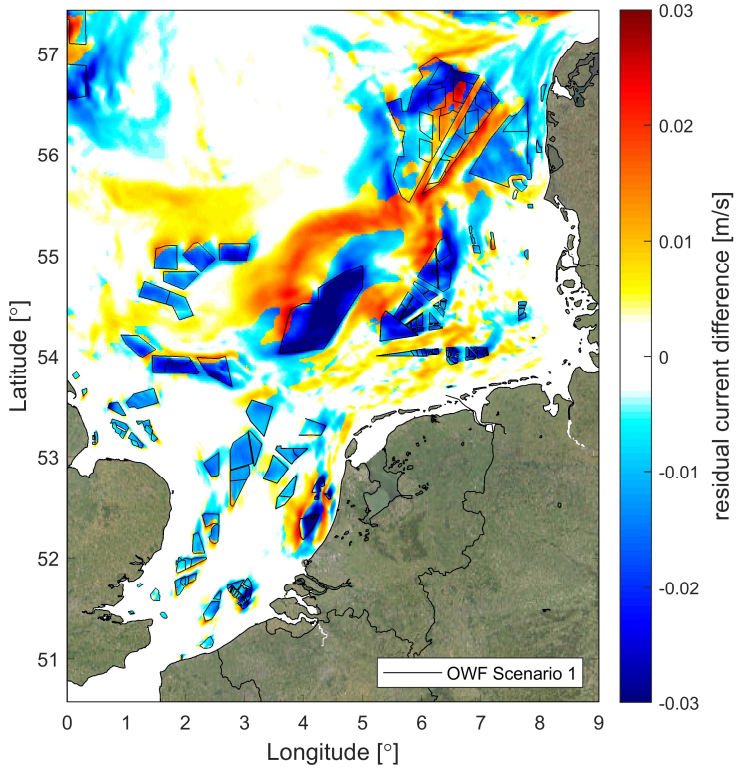
Hydrodynamics - currents

Residual current surface (reference)



Impact of scenario 1 on *surface residual currents* (scenario 1 – reference)



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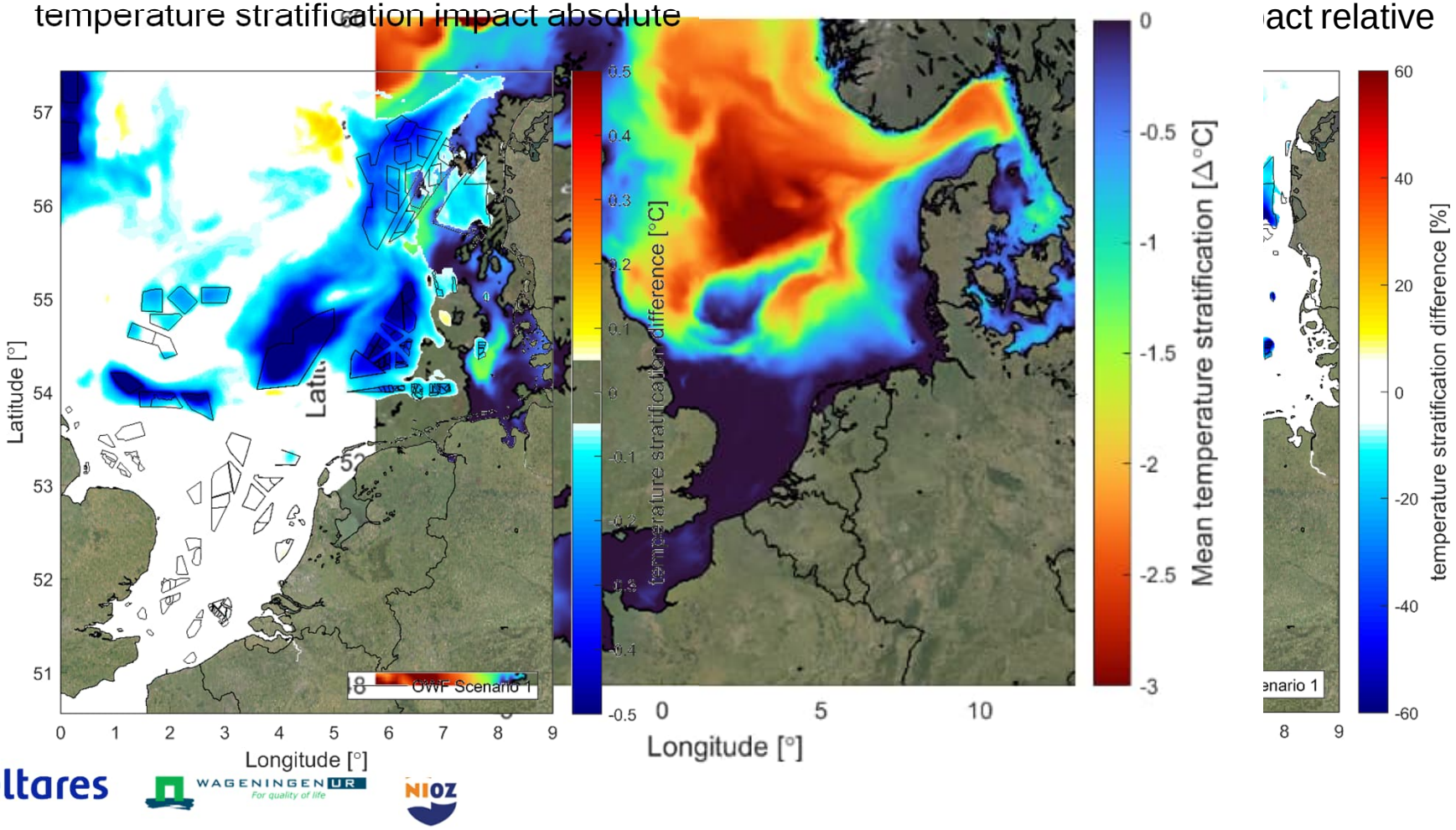
Hydrodynamics - temperature stratification

Annual mean stratification

temperature stratification impact absolute



act relative

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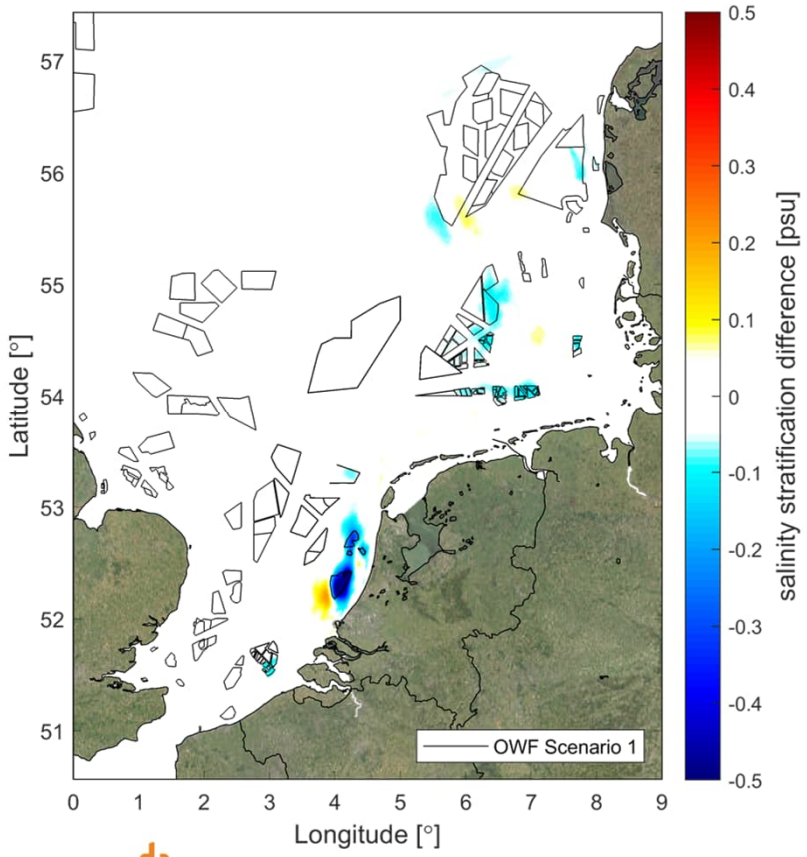
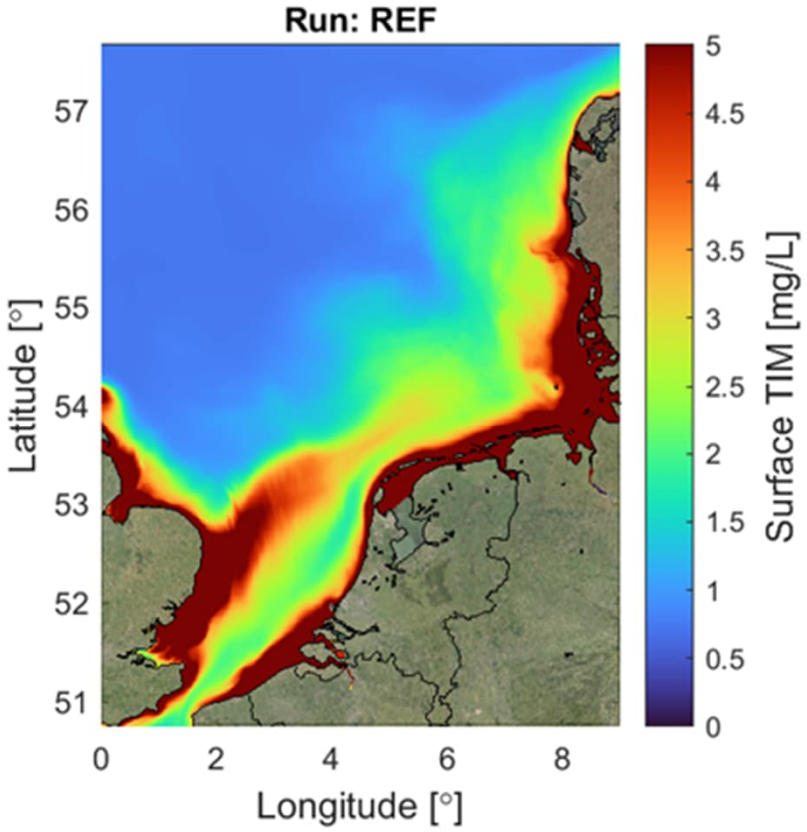
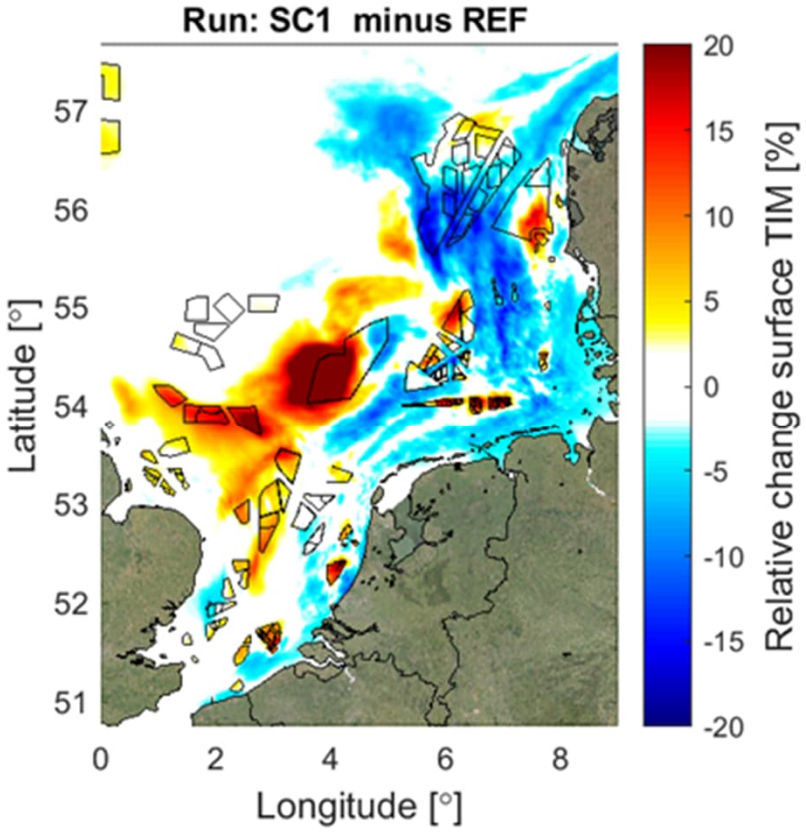
Hydrodynamics salinity stratification

Impact of scenario 1 on *salinity stratification* (scenario 1 – reference)



SPM effects surface





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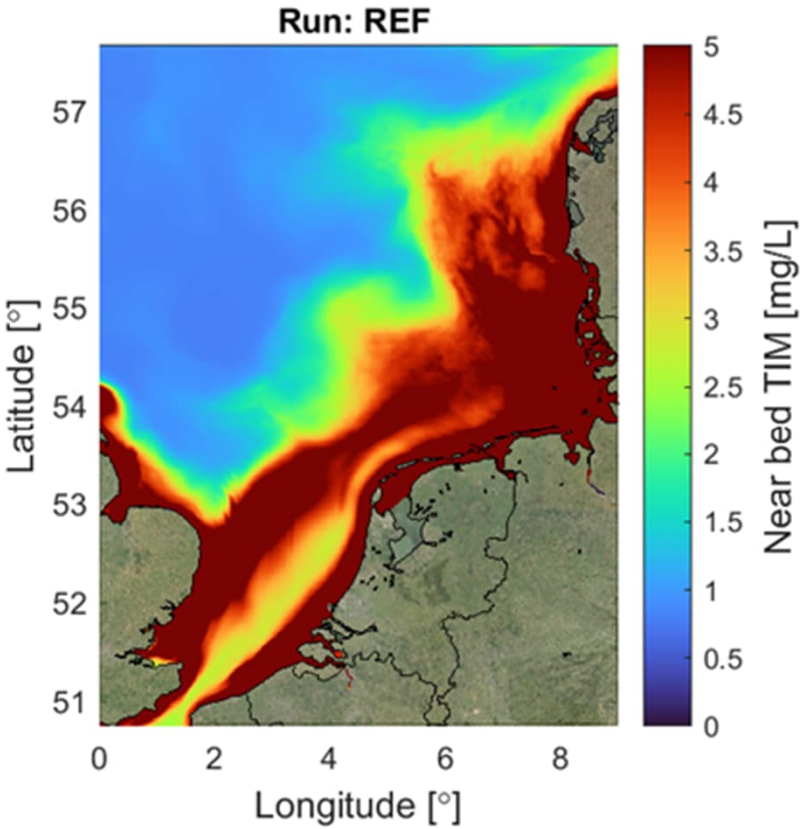
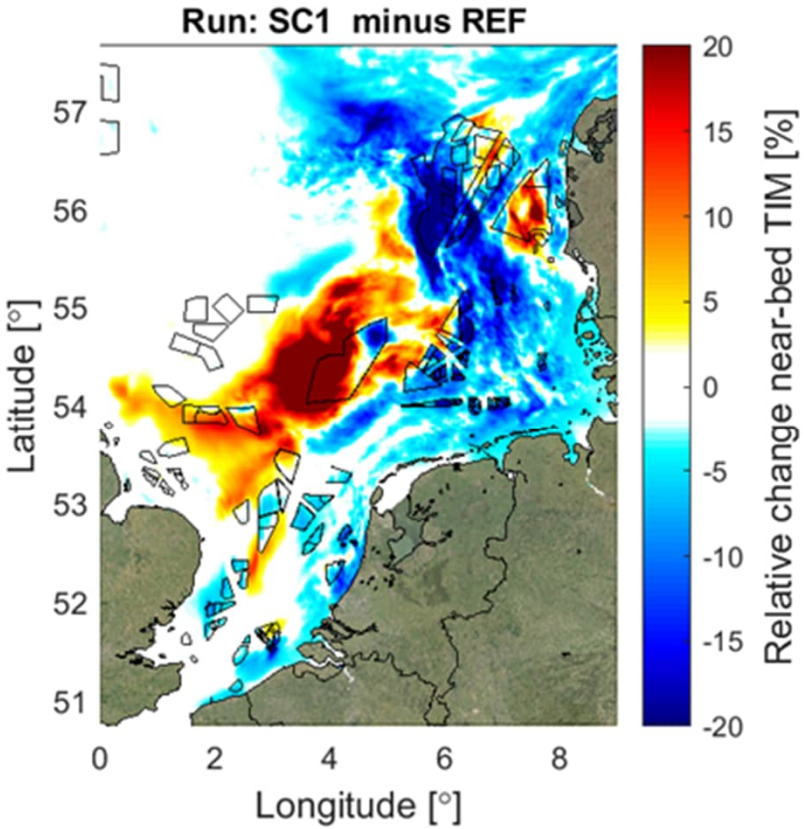
SPM effects near bed





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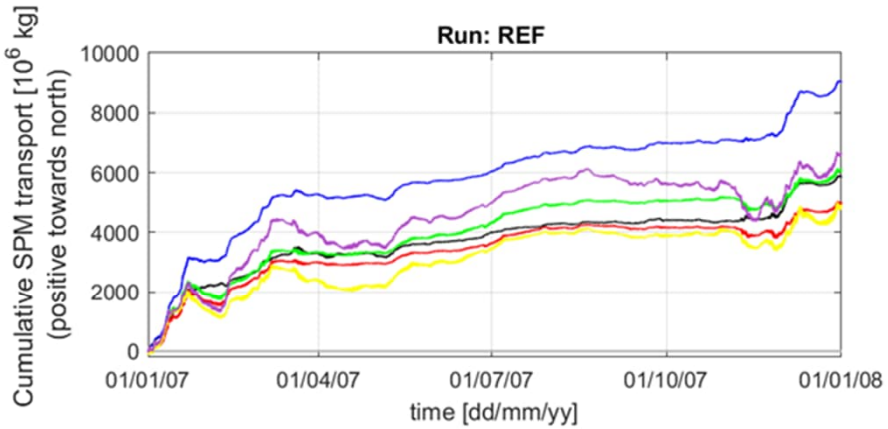
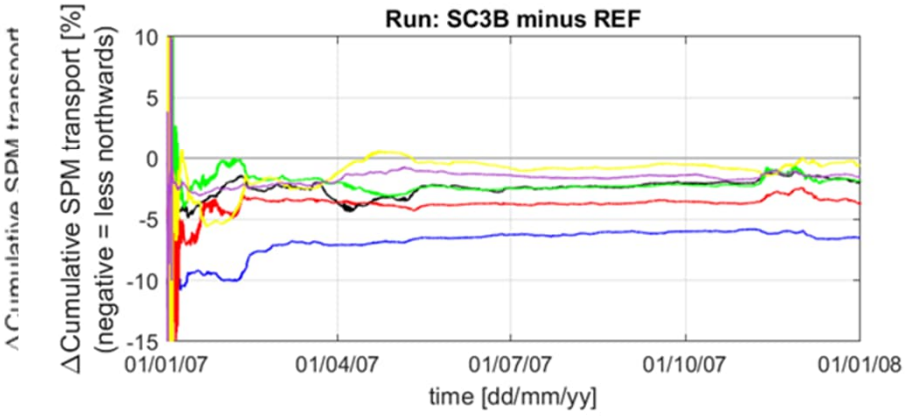
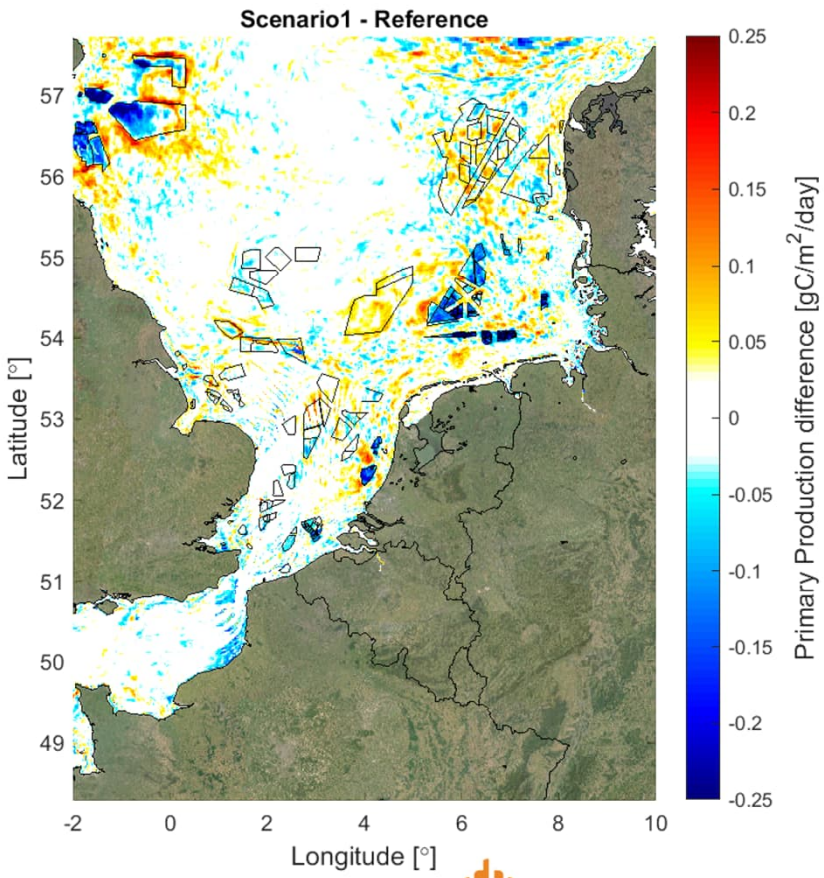
Fine sediment transport along the Dutch coast



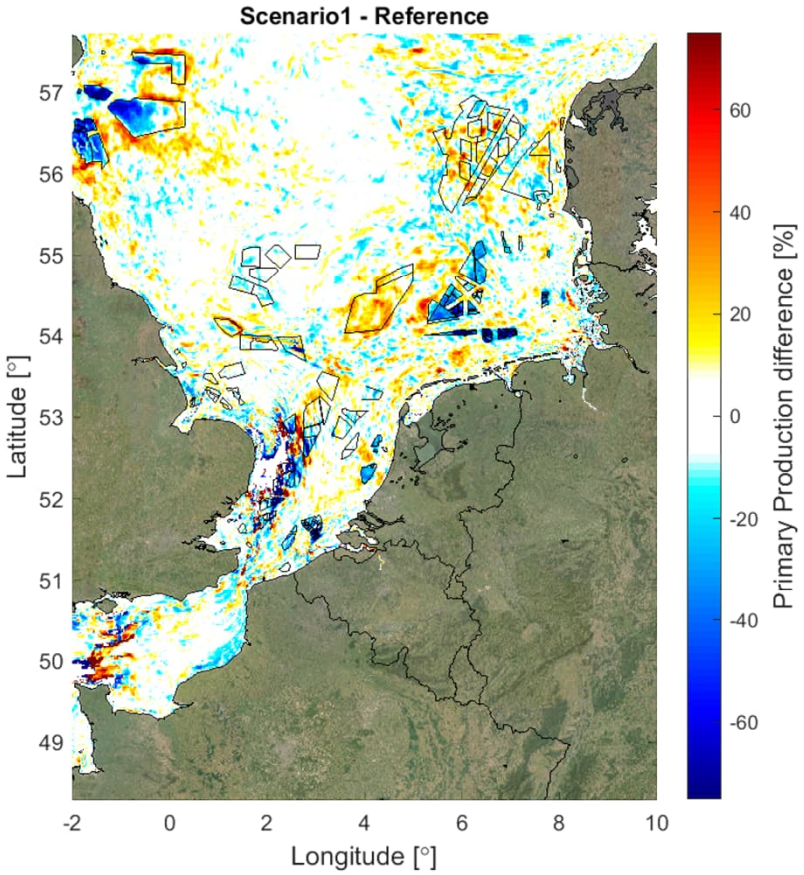


Effects on primary production (no mussels)

Absolute



Relative



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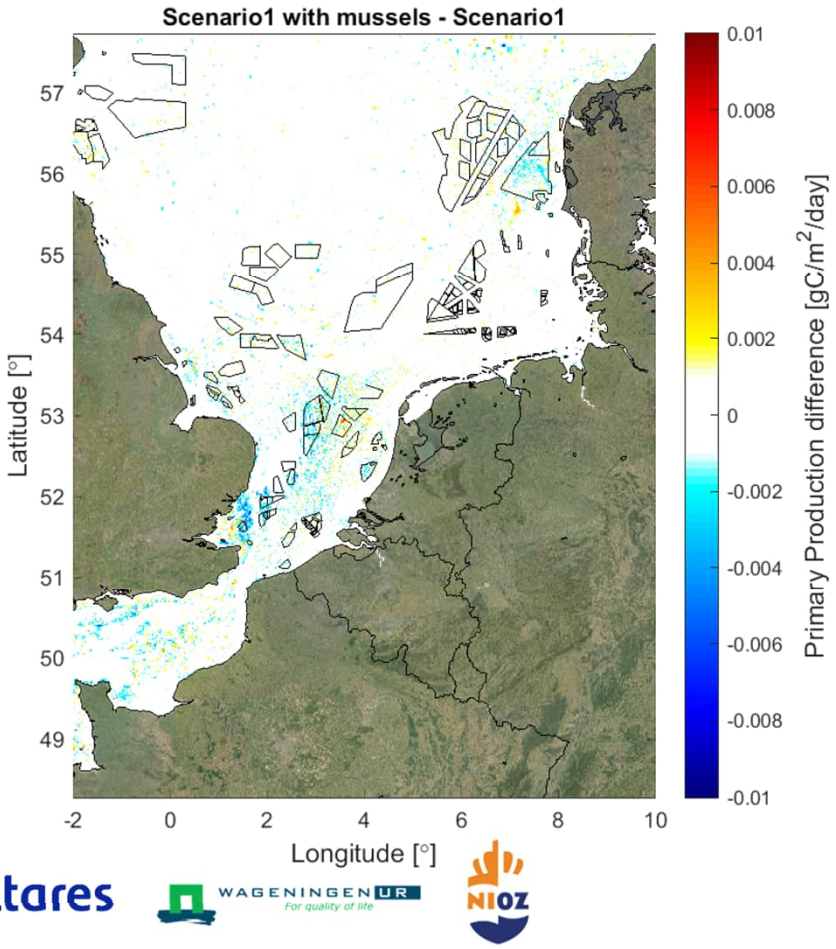
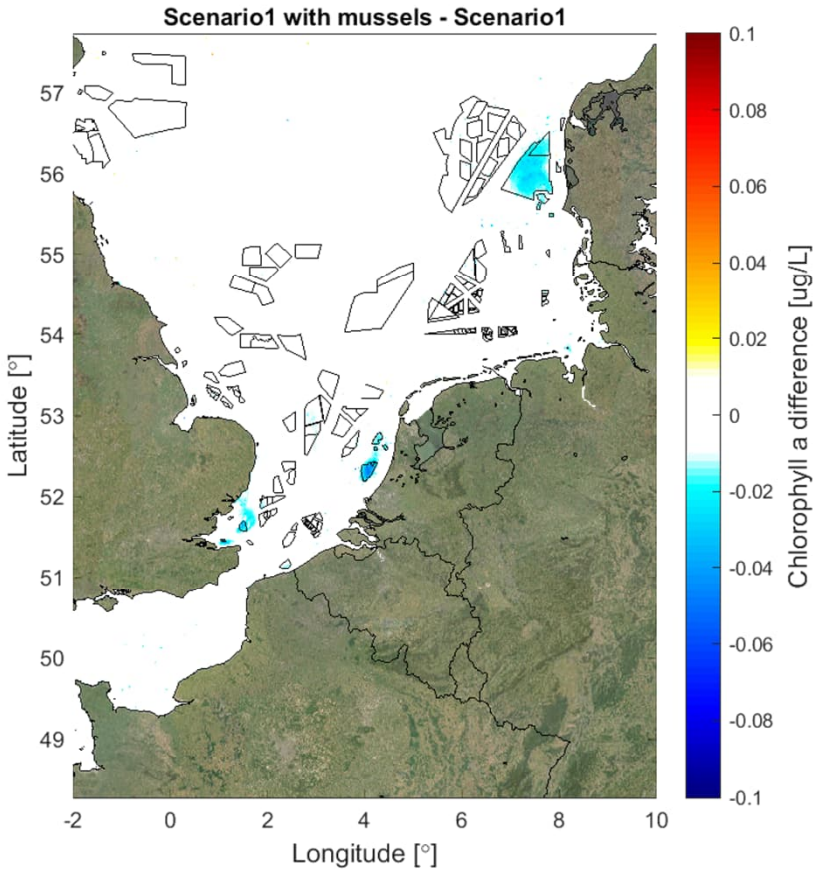
Effect of mussel growth on pillars





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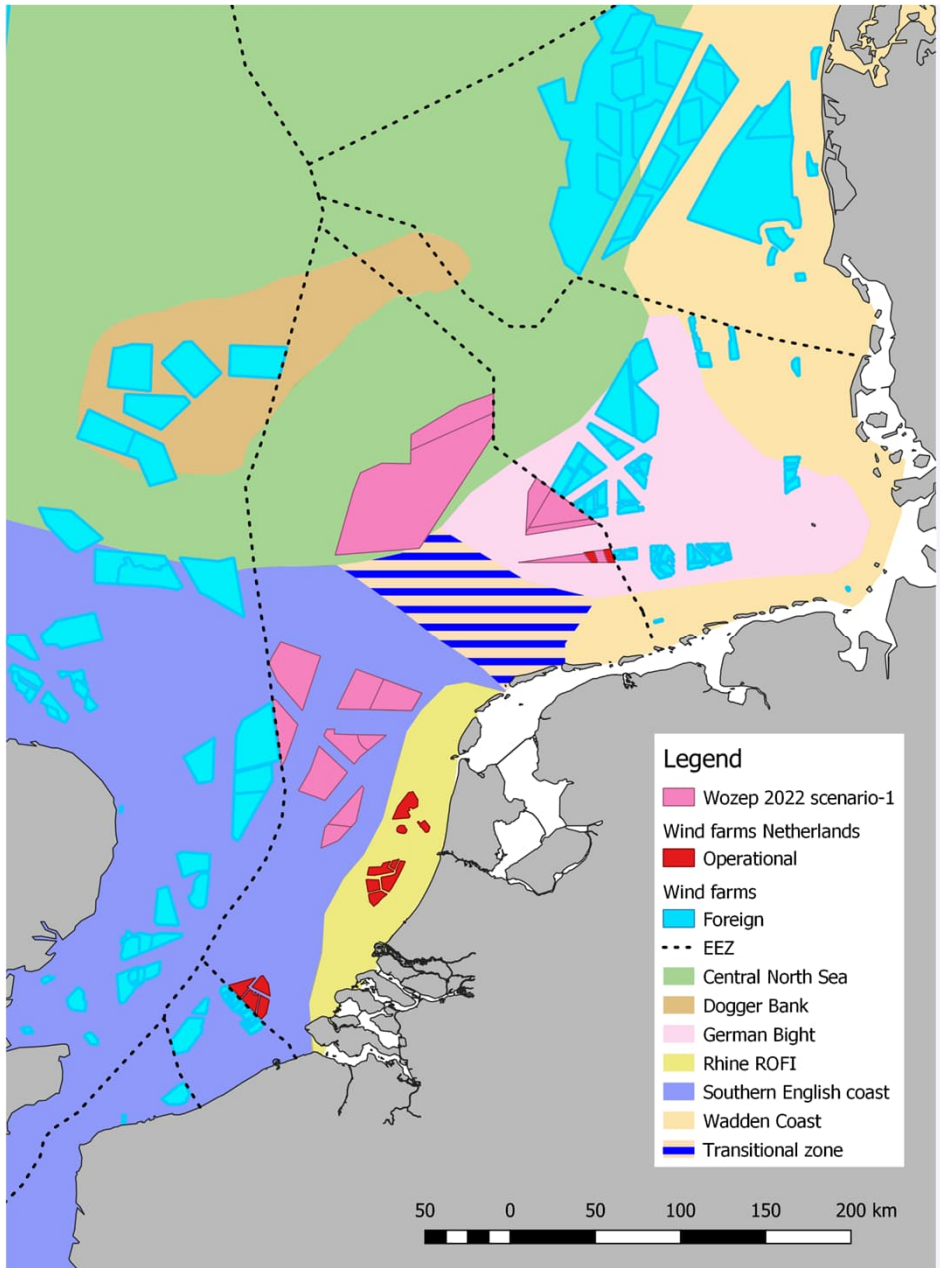
Conclusions

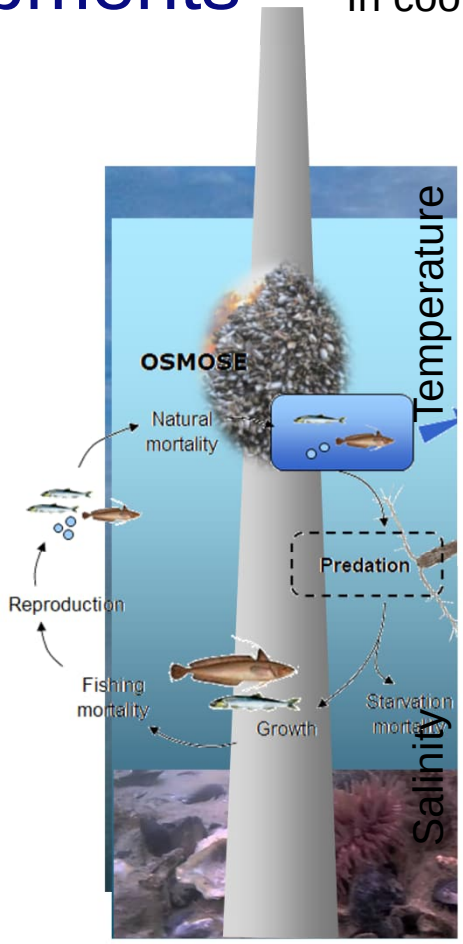
- Model significantly improved, now fit for purpose
- Impact of fine sediment appears relatively more important
- Conclusions of first report on impacts in different regions still hold – delineation does not really change
  - Central North Sea – destratification dominant
  - German Bight – complex, SPM dominant
  - English coast and Wadden coast – effects minor – some negative effects SPM
  - Rhine ROFI – impact on SPM transport
  - Dogger bank – impact minor

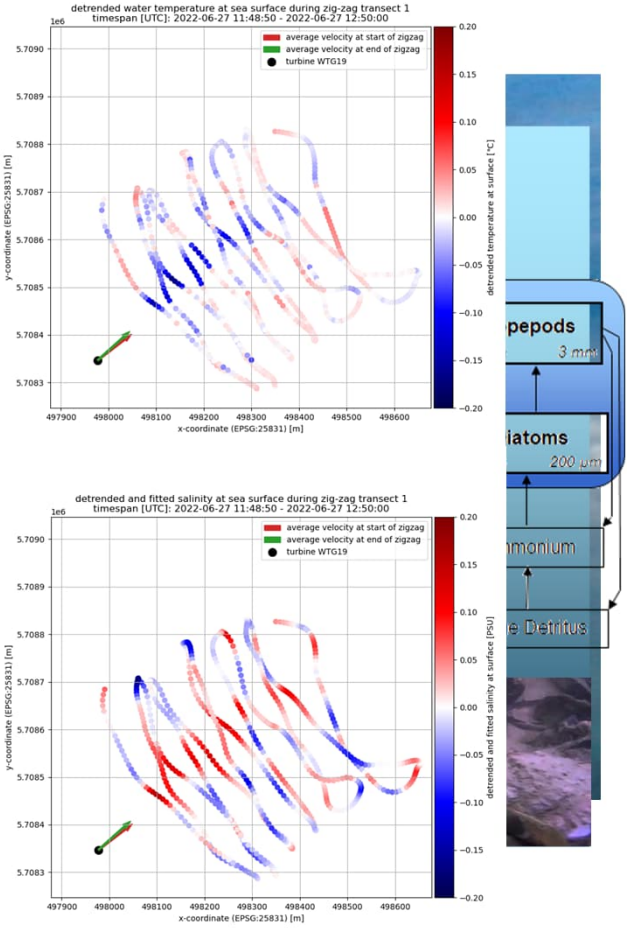


Further work, new developments

Measurement campaign Erik Hendriks
In cooperation with NIOZ and UGent

- Link hydrodynamic model to HARMONIE (KNMI) to assess effects wind wakes of farms
- Validation of effect of wind farms still important
- Improve mussel DEB model
- Incorporate zooplankton DEB model
- Reduce the gap between bottom up and top down by linking to FISH IBM models (OSMOSE)
- Link up to international developments





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