SPATIAL MODELLING OF MUSSEL FARM PRODUCTION AND NUTRIENT MITIGATION POTENTIAL IN THE W BALTIC SEA

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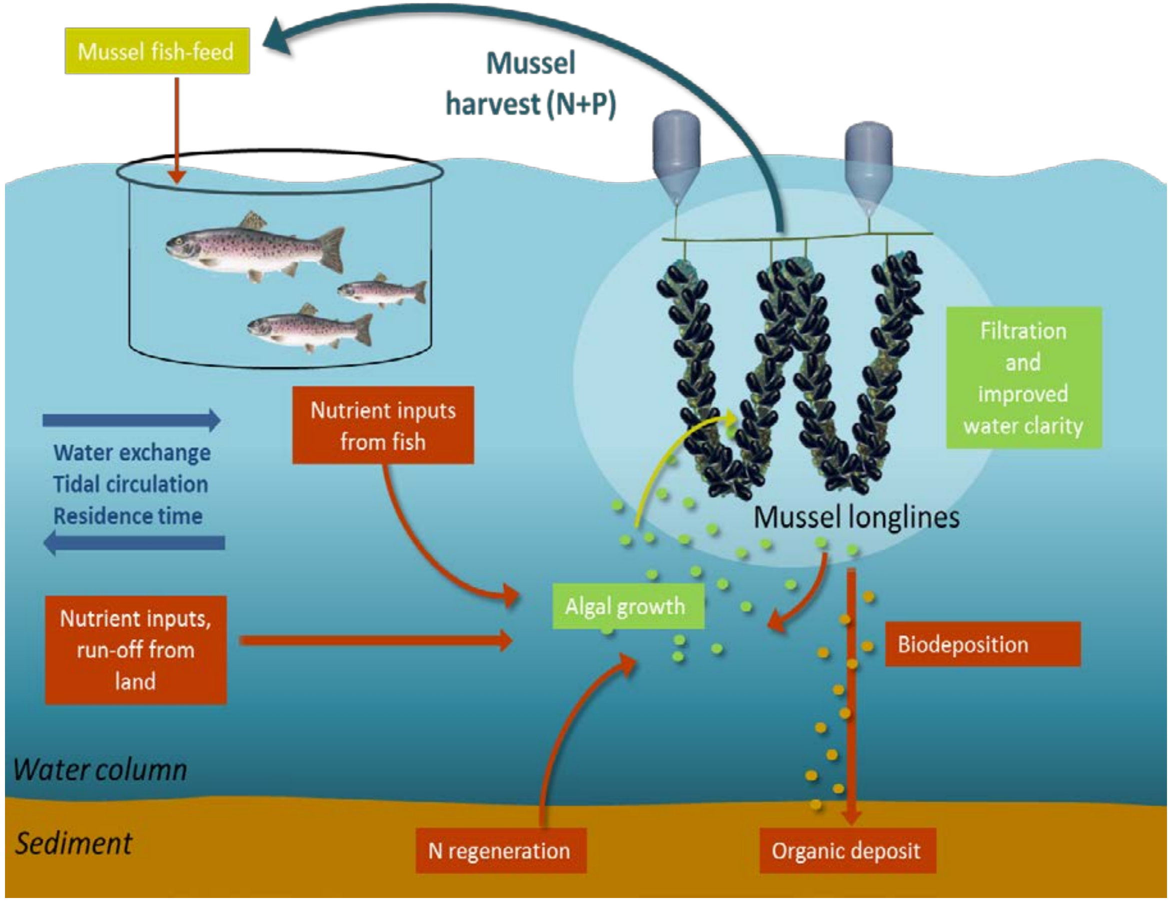
BONUS OPTIMUS

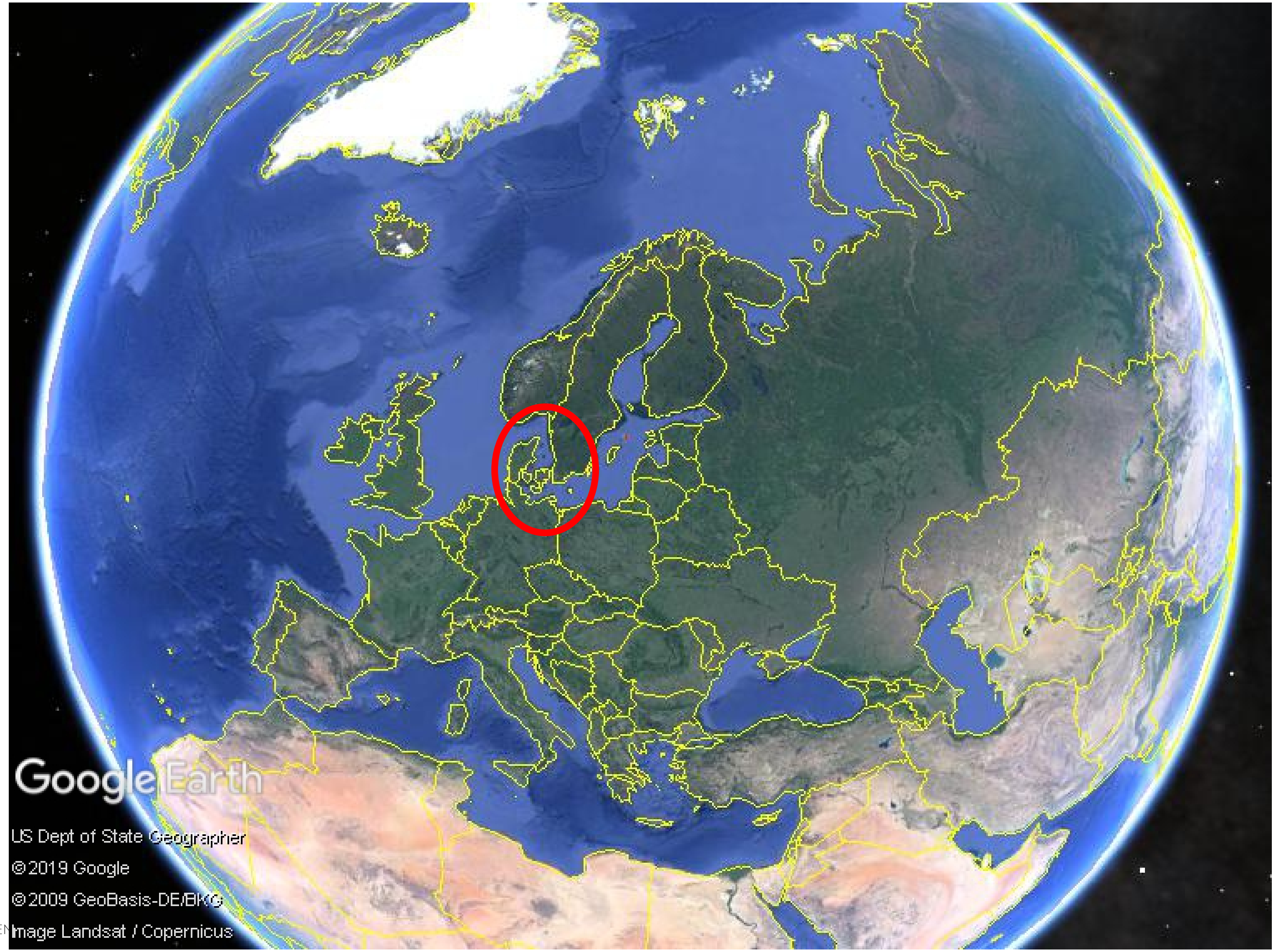
CONCEPT OF MUSSEL MITIGATION CULTURES

- **Eutrophication** of coastal waters is a worldwide problem
- Mussel **mitigation cultures** have been suggested as a tool to remove nutrients
- **Site selection** for mitigation cultures is an important part of sustainable marine spatial planning (MSP)

Fish. E.g. Trout: *Oncorhynchus mykiss*
Mussel: *Mytilus edulis*



WESTERN BALTIC SEA



- Denmark
- Sweden
- Germany

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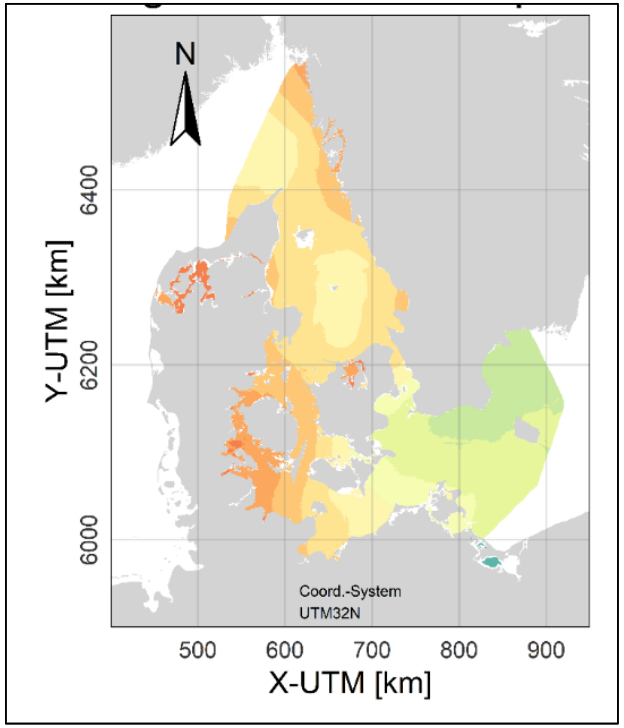
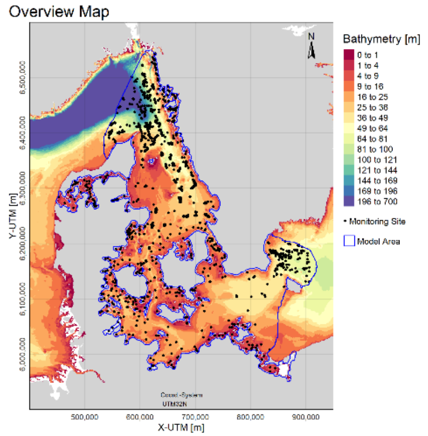
APPROACH

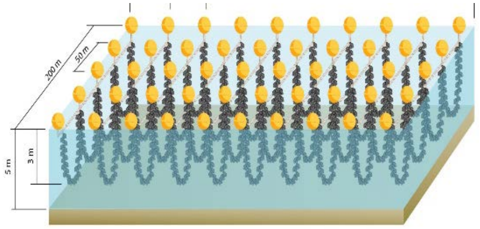
Spatial model of farm production



Spatial model of T, S and Chl a data



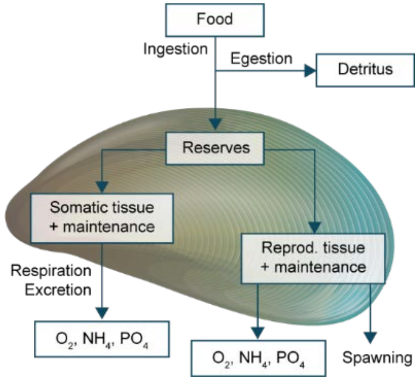
Statistical farm production model



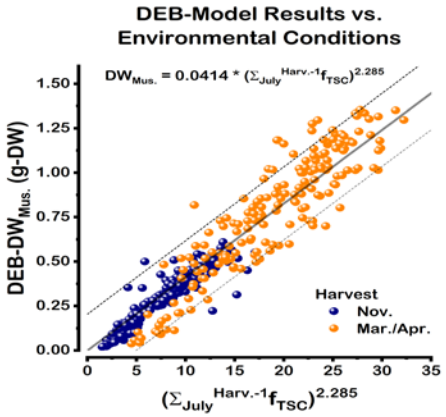
Statistical growth model

Growth data

T, S, Chl a data



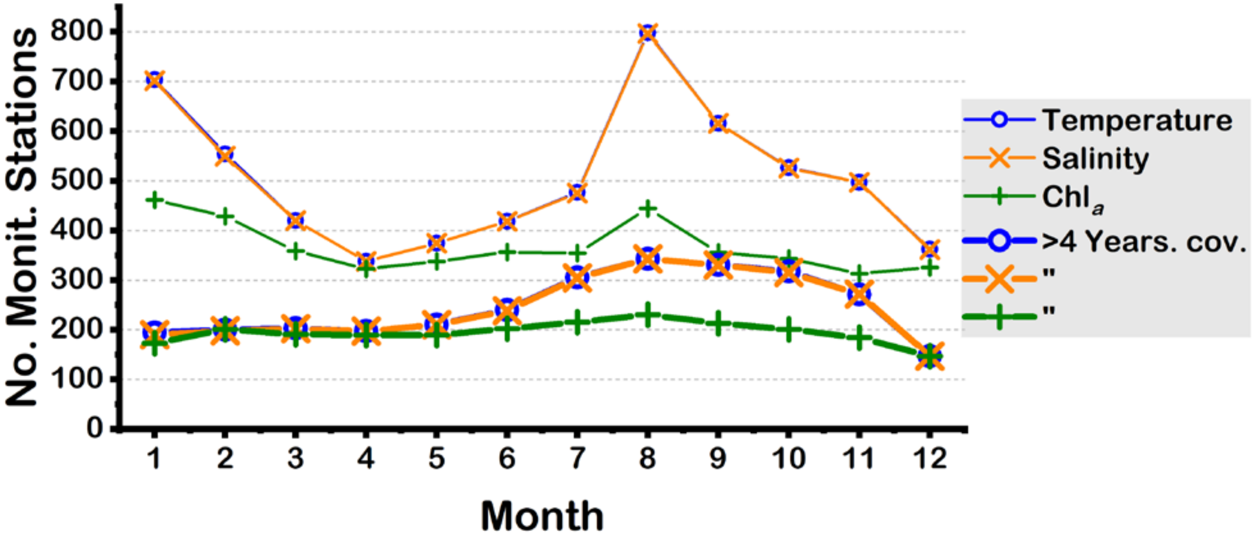
DEB growth model

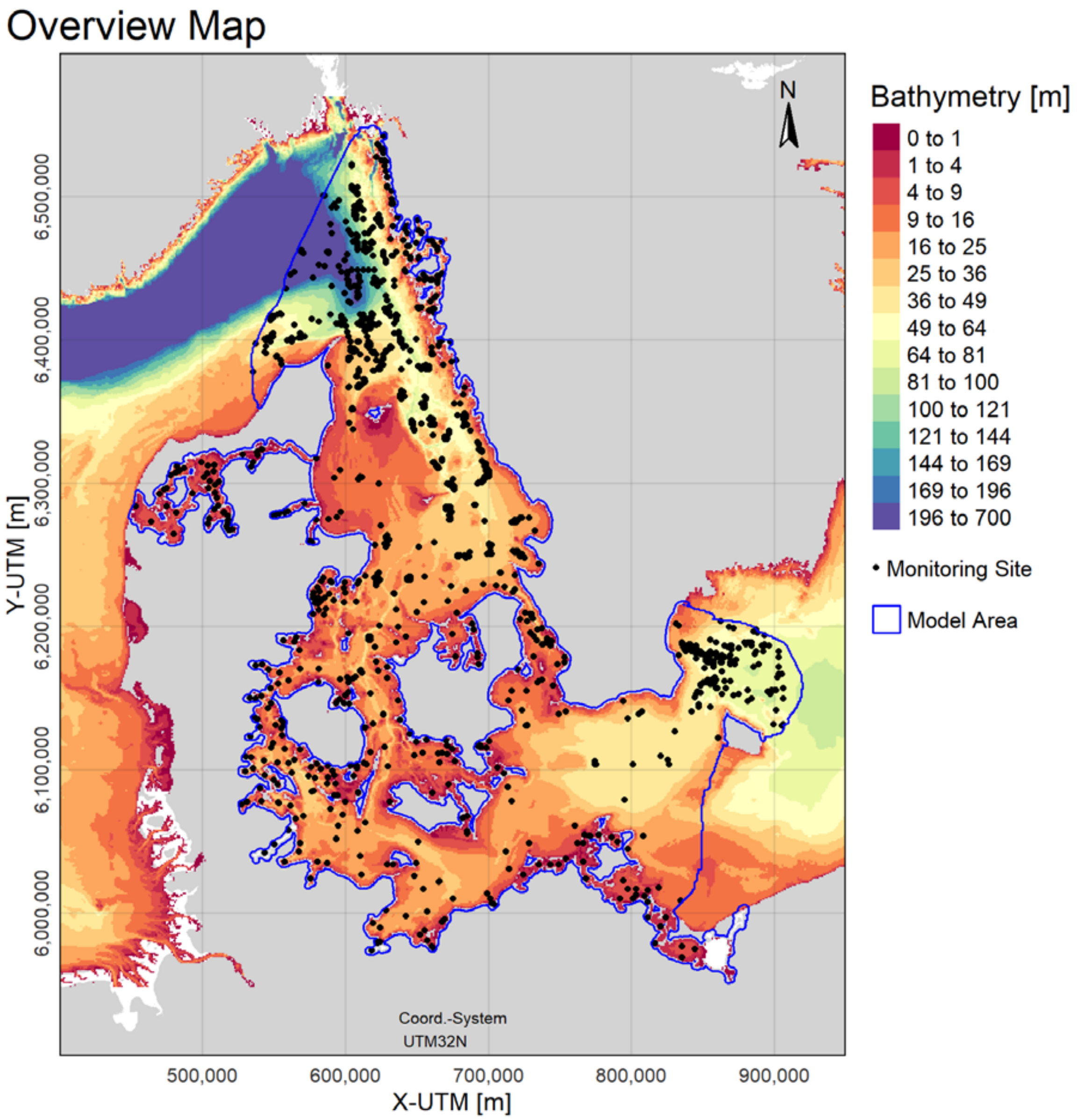


MONITORING DATA

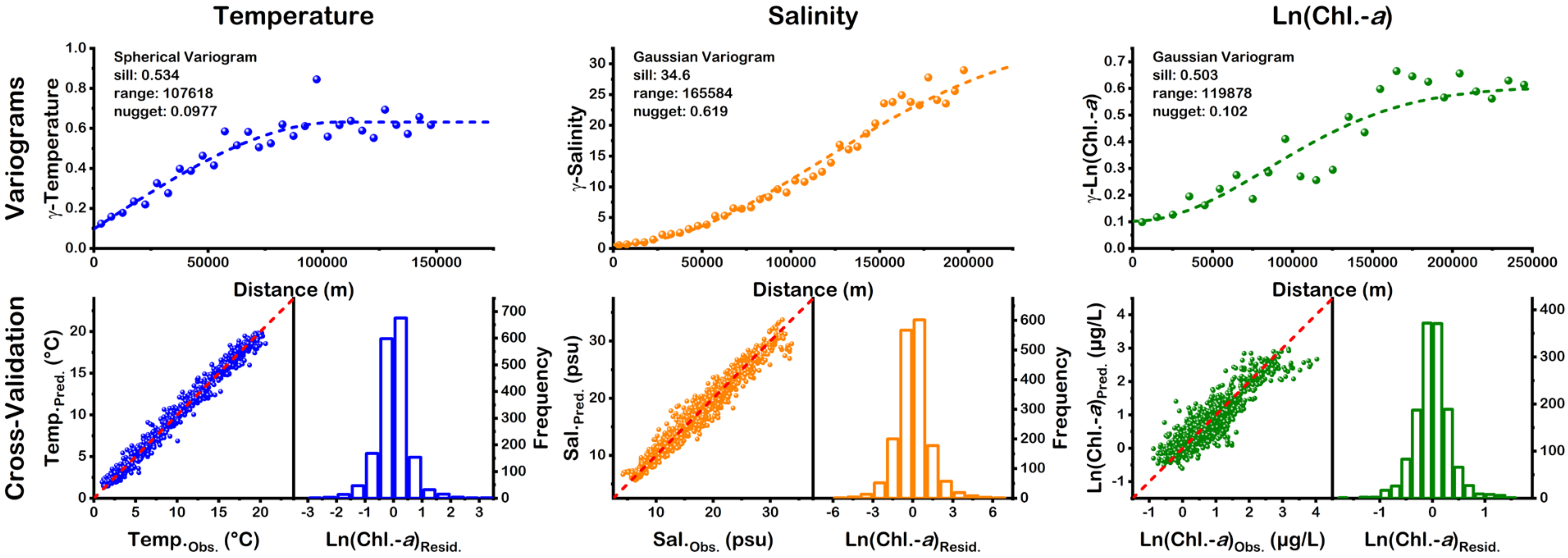
2007 - 2017

- ODA Database (Danish NOVANA program)
- LLUR / LUNG (German monitoring program)
- SHARKweb (Swedish monitoring program)

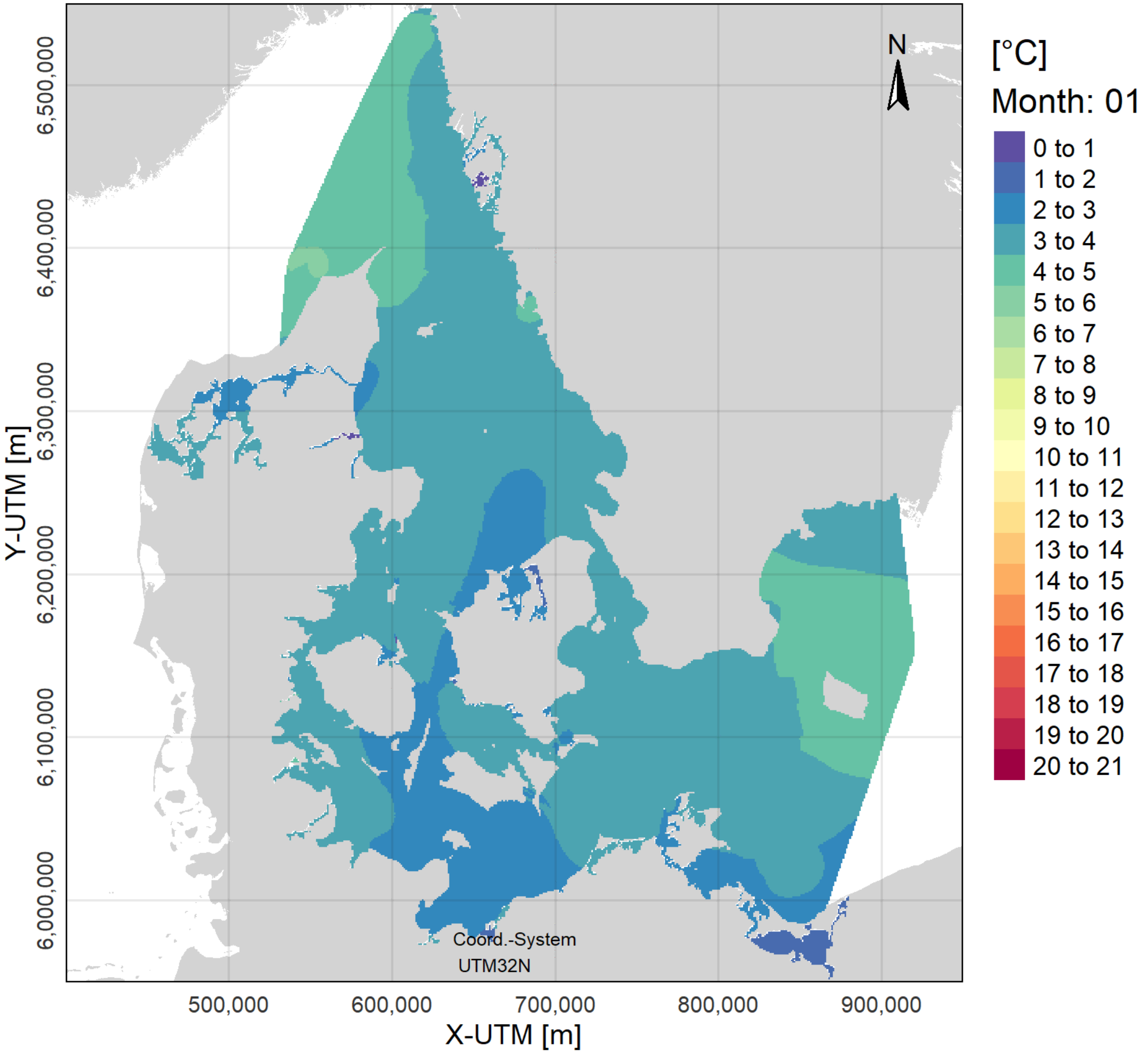


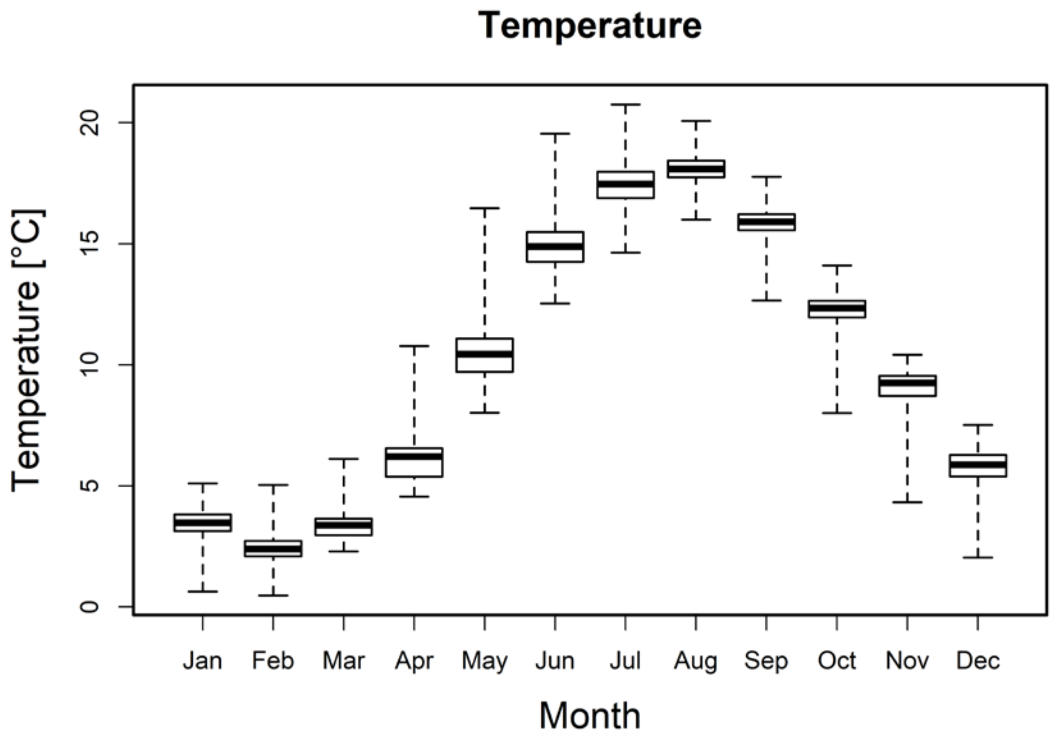


SPATIAL MODELLING AND VALIDATION

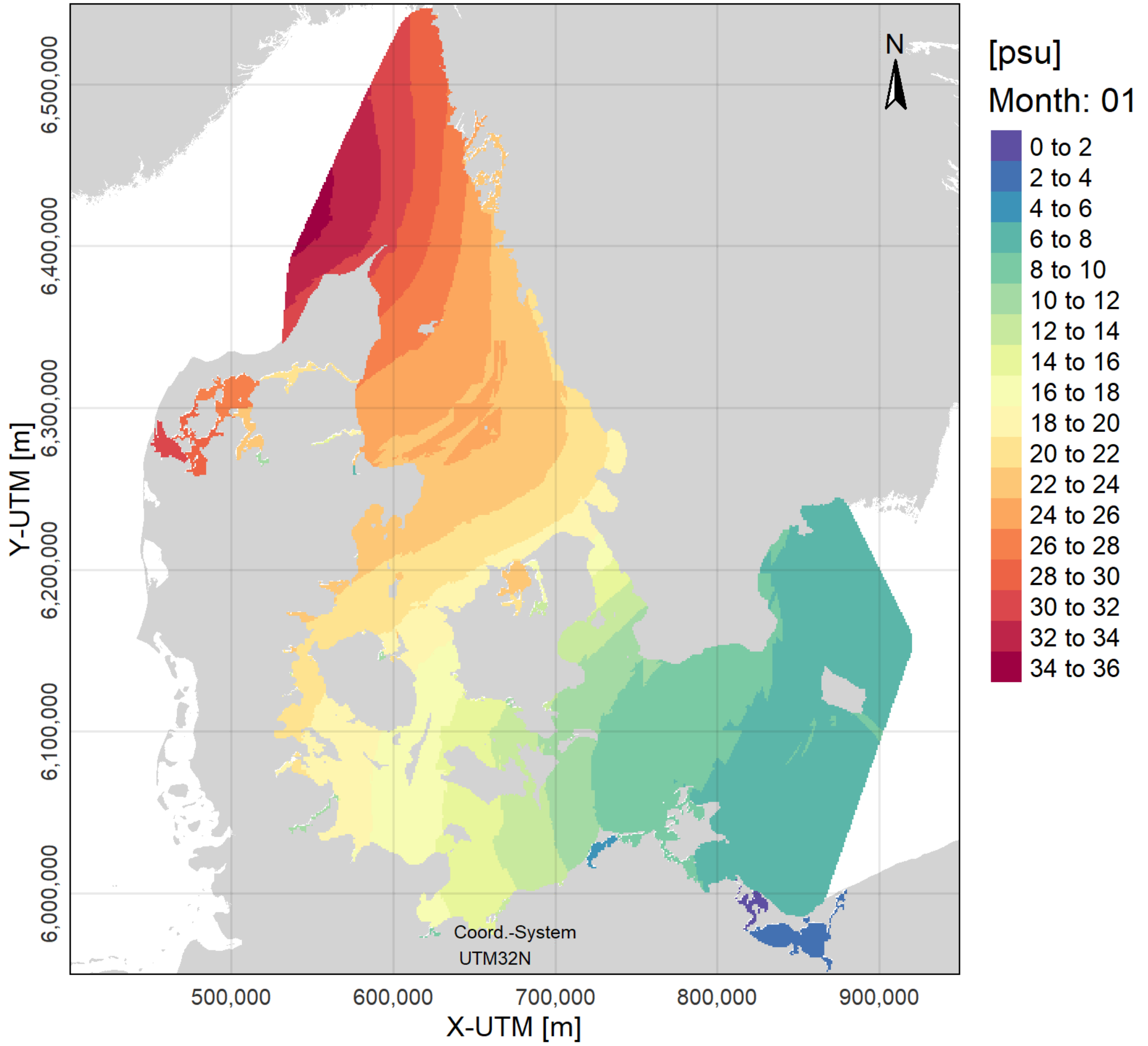


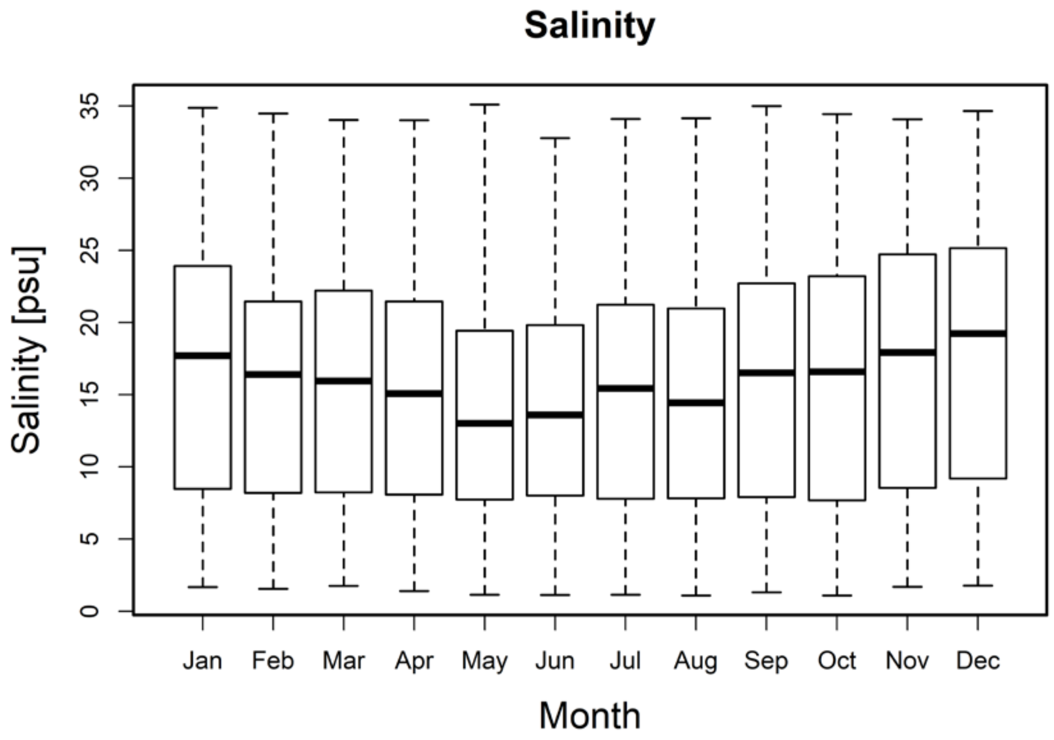
Mean Temperature



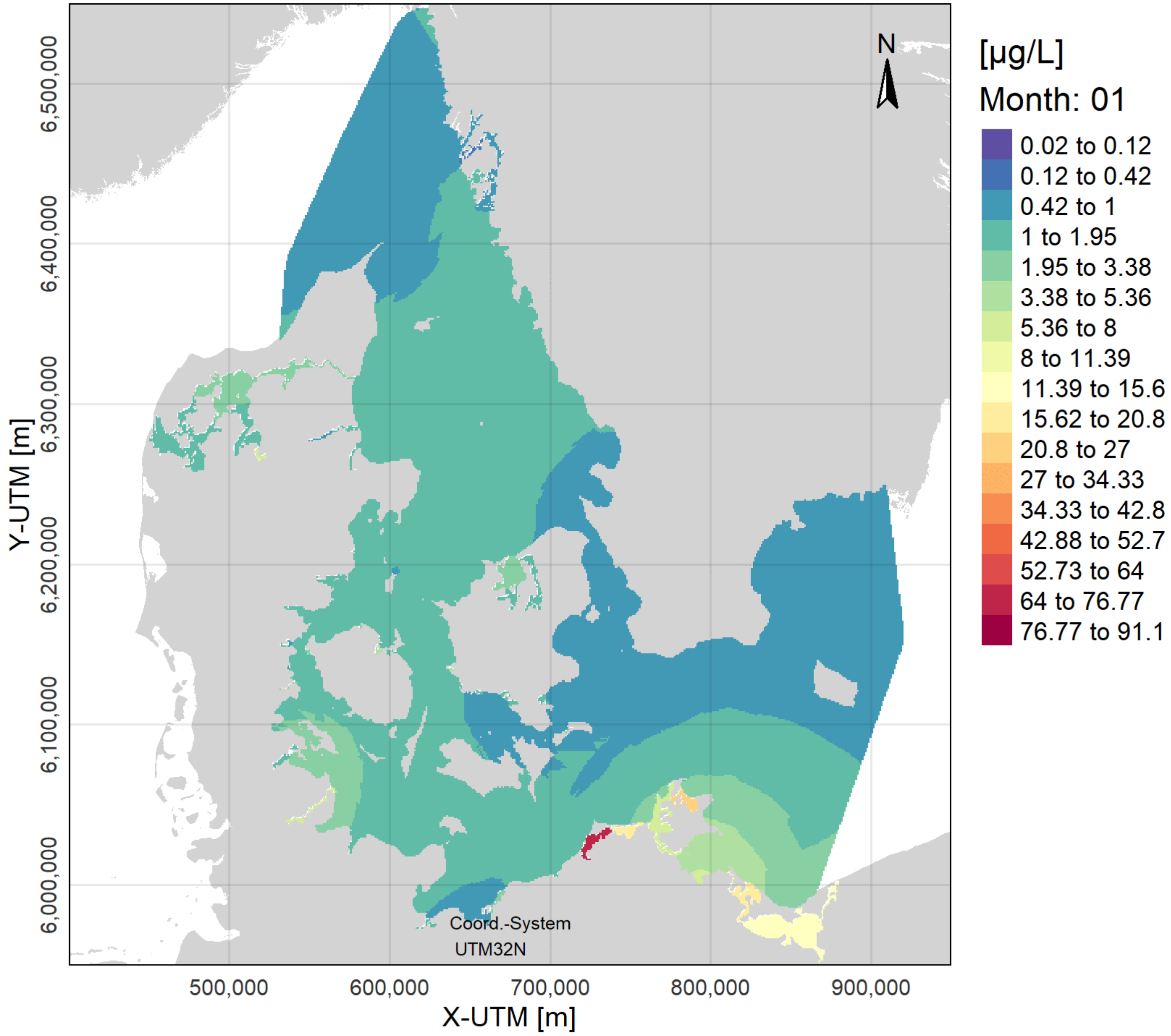


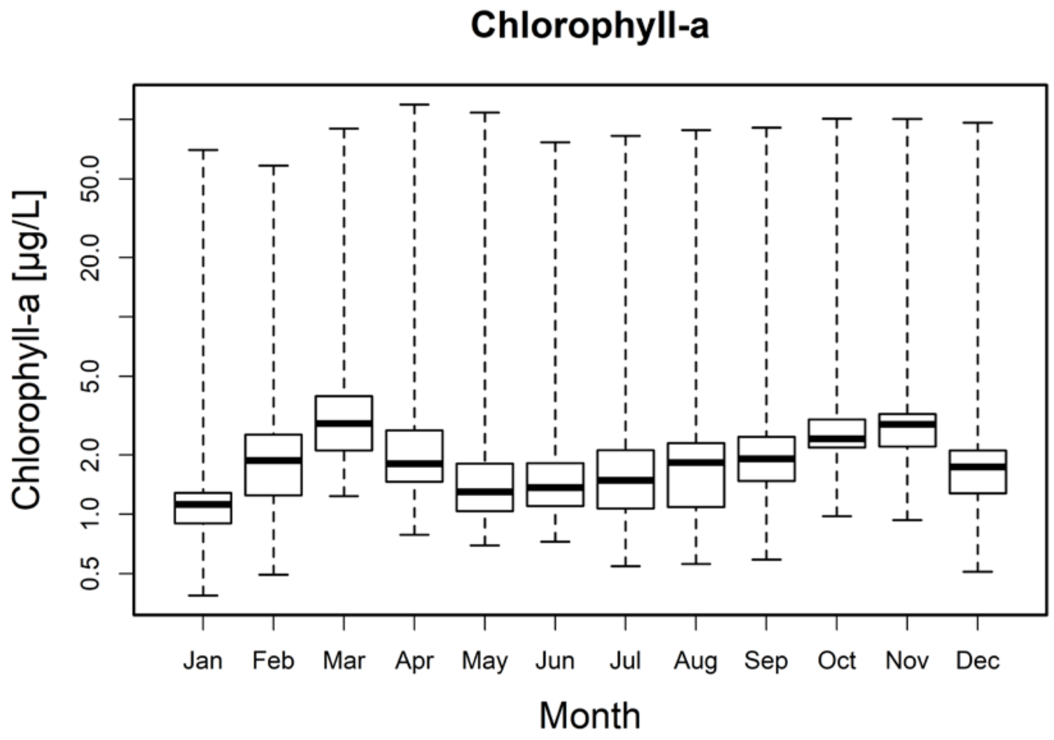
Mean Salinity





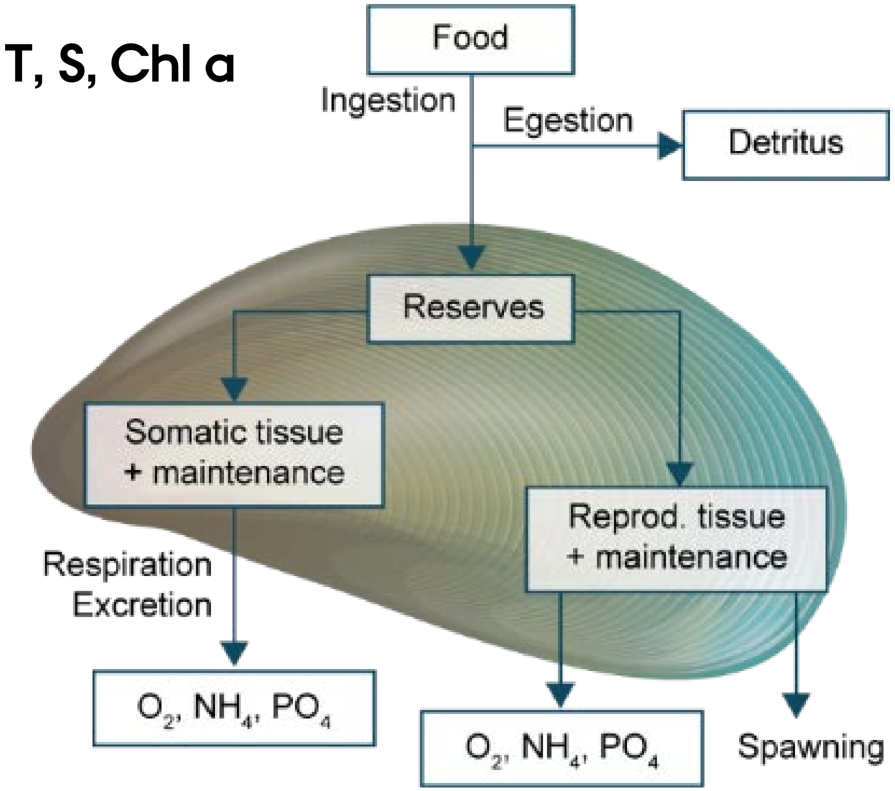
Mean Chlorophyll-a

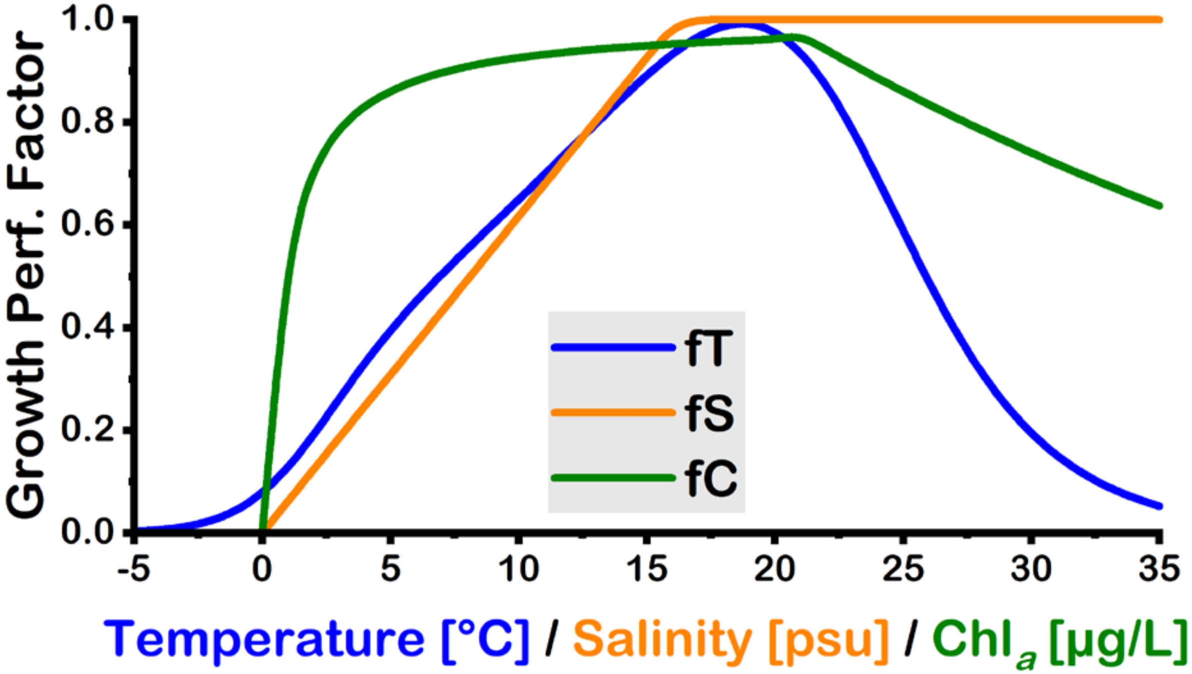




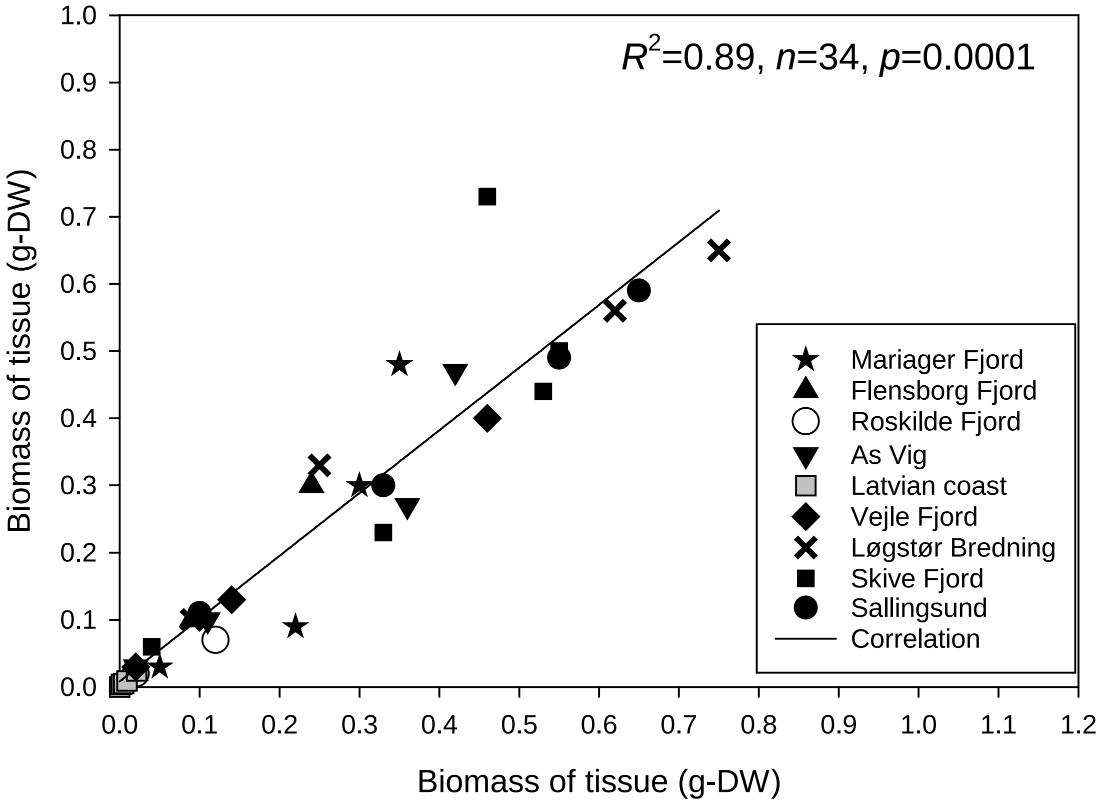
DYNAMIC ENERGY BUDGET MODEL

T, S, Chl a





DEB MODEL VALIDATION 2018-2019



STATISTICAL MODEL OF MUSSEL GROWTH

Linear fit: $\Sigma(fTSC)^x$ vs. biomass dry-weight for two harvest times

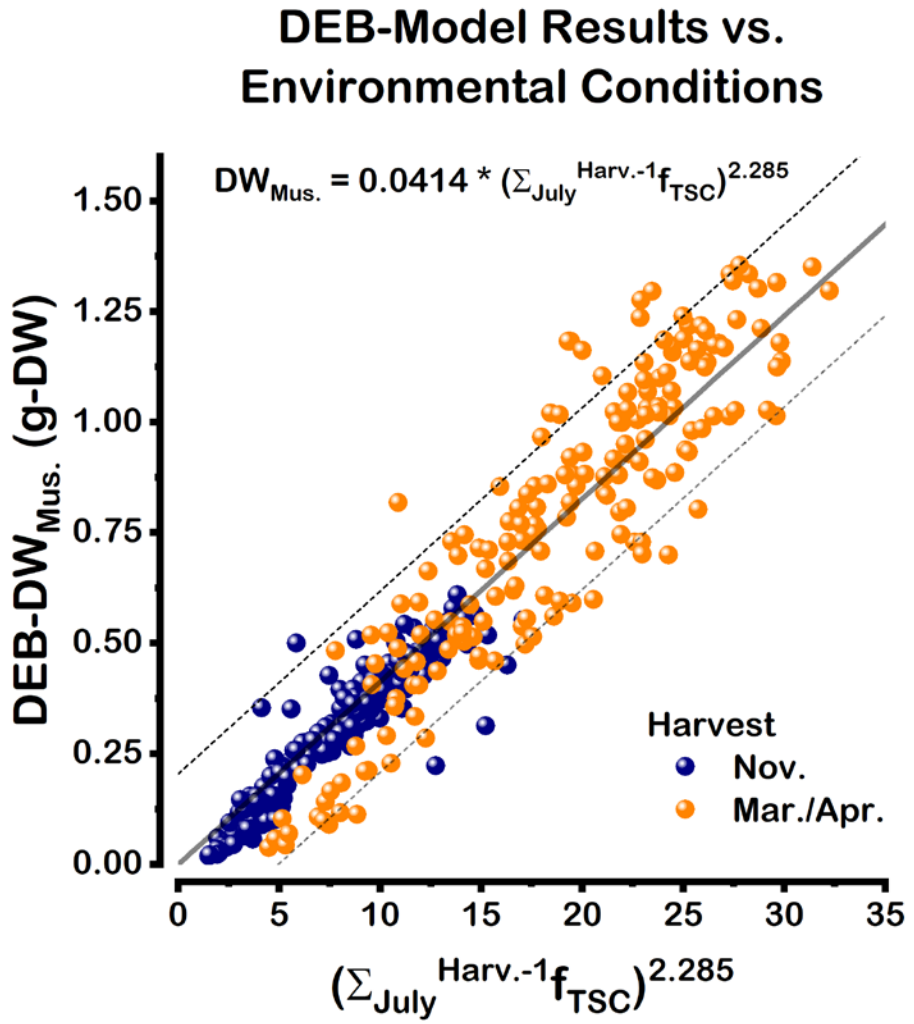
- November
- March / April

Fit-function forced through 0

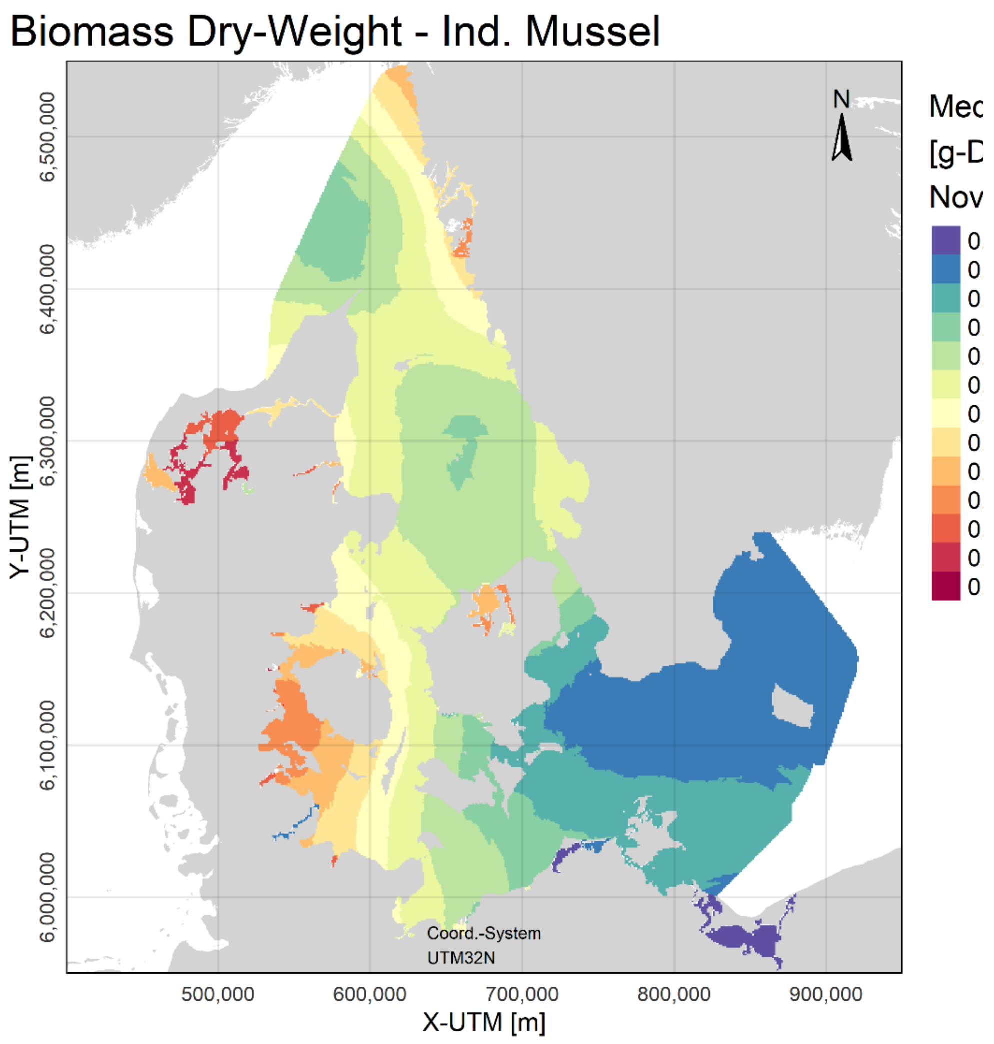
- No negative biomass is modelled

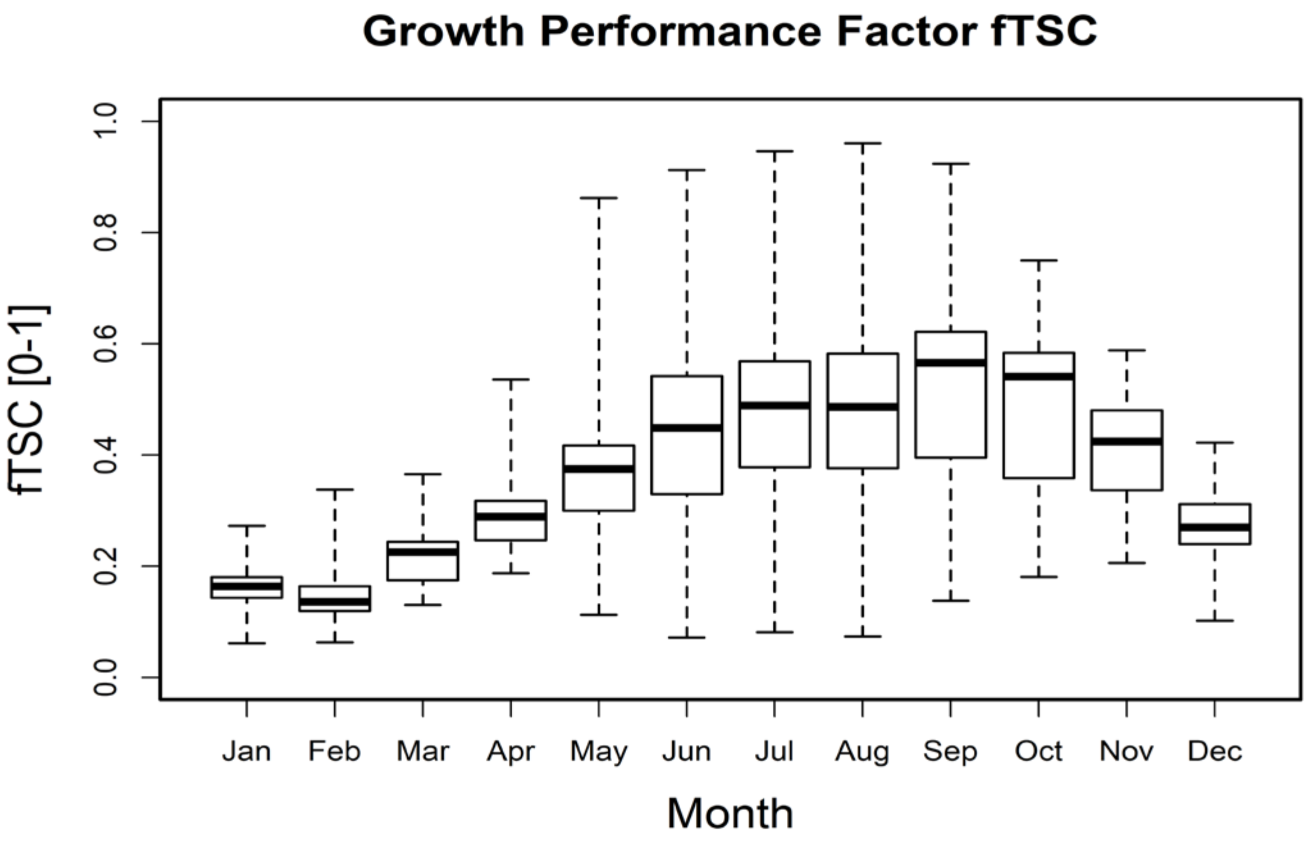
Monthly average conditions describe mussel growth in DEB-model well

- Uncertainty: ~± 0.2 g-DW (95% prediction interval)



MUSSEL INDIVIDUAL GROWTH

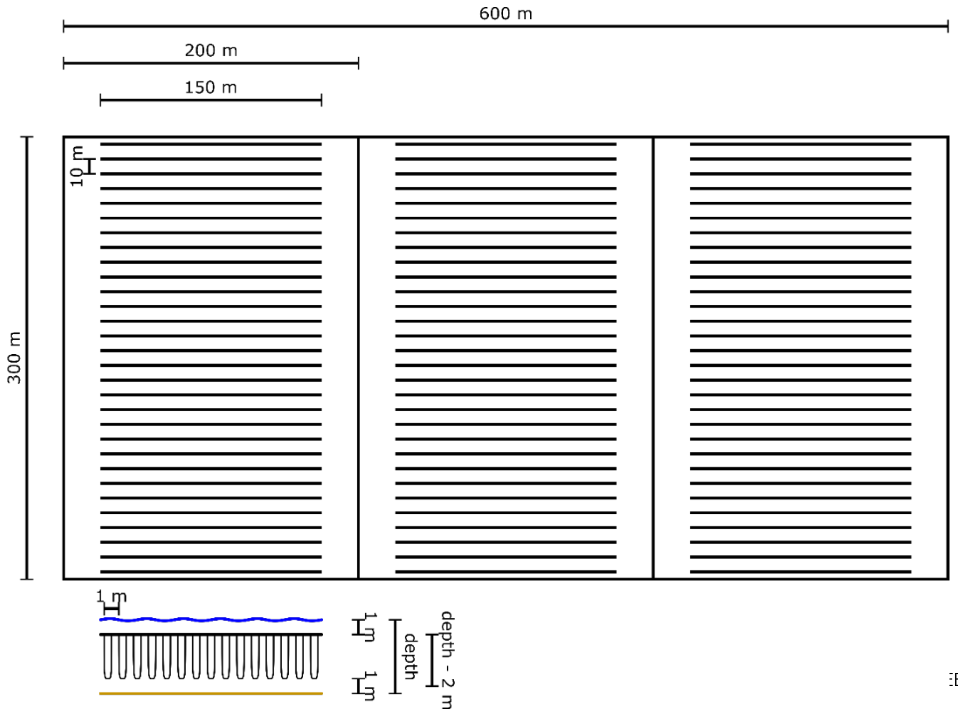


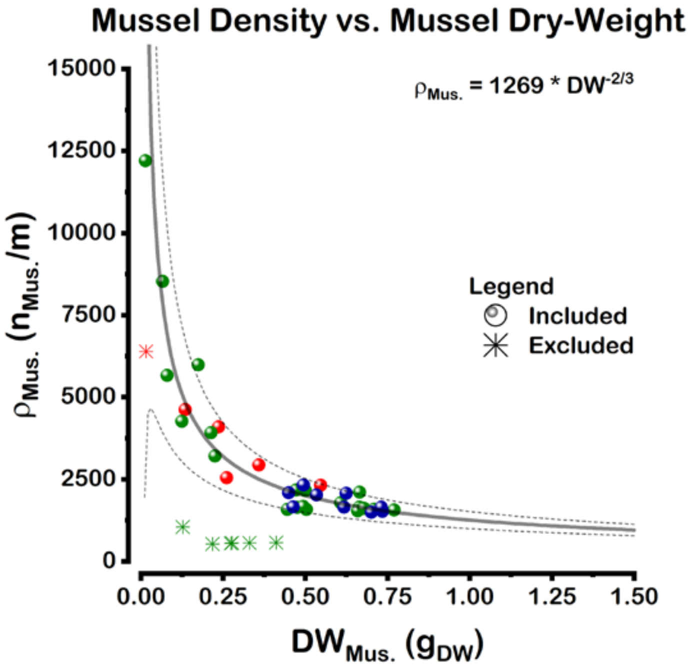


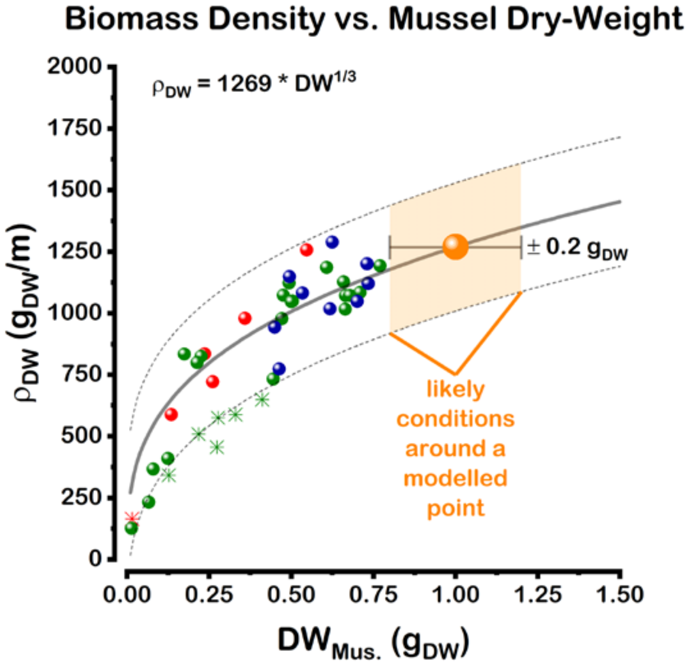
THE MODEL-FARM SETUP

Structure

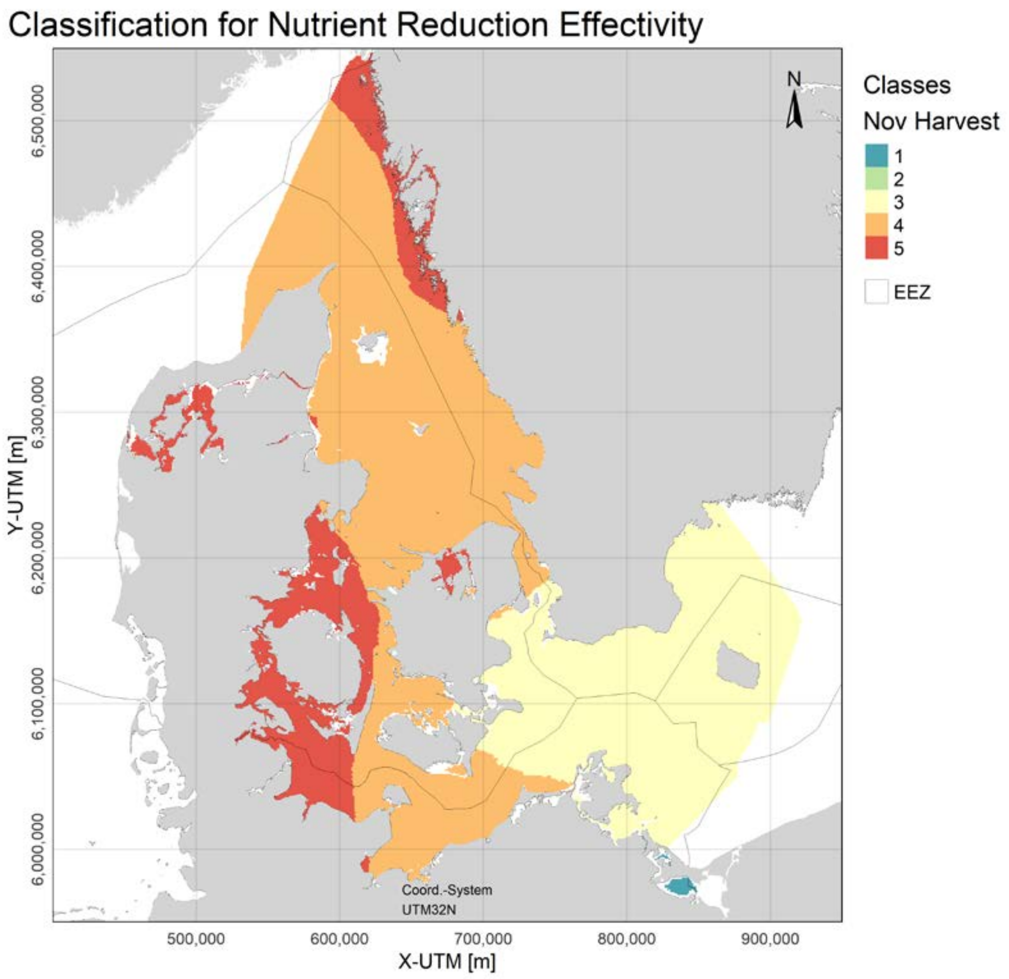
- ➢ 3 sections with 30 long-lines
- ➢ 150 m line-length
- ➢ 1 loop collector / 0.7 m long-line
- ➢ 18 ha







POTENTIAL NUTRIENT REMOVAL

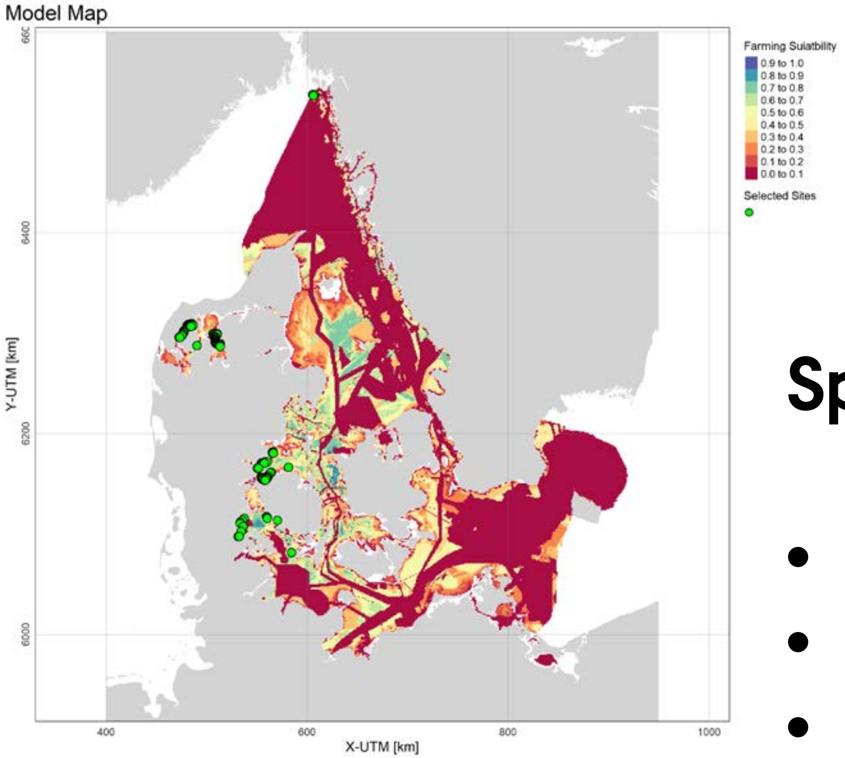


Red zone	Longlines:	Nets:
t-N/ha		
Model data	0.5-1.4	1.0-2.5
Measured	0.7-1.4	1.6-3.0
t-P/ha		
Model data	0.03-0.08	0.06-0.15
Measured	0.06-0.09	0.10-0.17

NEXT STEPS…

Risks:

- Natural variability
- Food depletion
- predation by eiders
- ice cover
- physical exposure
- Hypoxia
- Heat waves



Spatial planning:

- Environmental protection
- Recreational activities
- Other economic activites
- Farm costs
- Visual pollution
- Environmental impacts
- Socal acceptance

CONCLUSIONS

- Highest 20% farm production potential is in the Danish fjords and Belt Sea, NW coast of Sweden and Kiel Bay in Germany
- 1 farm can remove 13-54 t-N out of 20-2000 t-N loading per waterbody
- Salinity gradient important for production potential
- High Chl *a* values in fjords and coastal areas promotes high production
- Maps of N-removal can be used in multi-criteria site selections of mussel mitigation cultures