

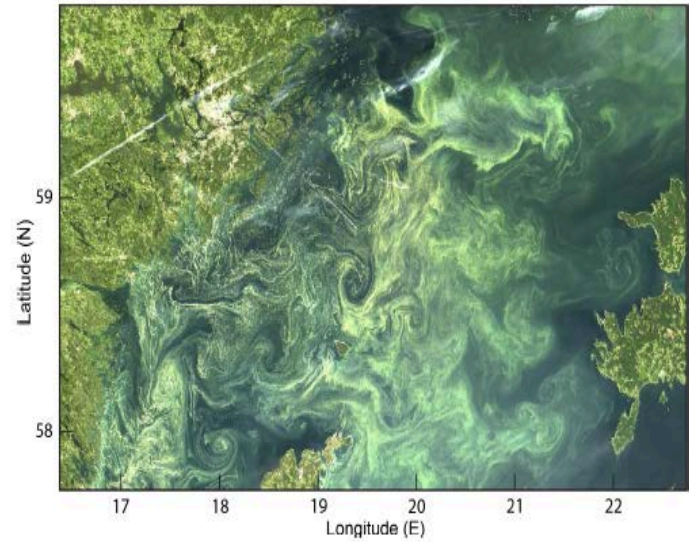
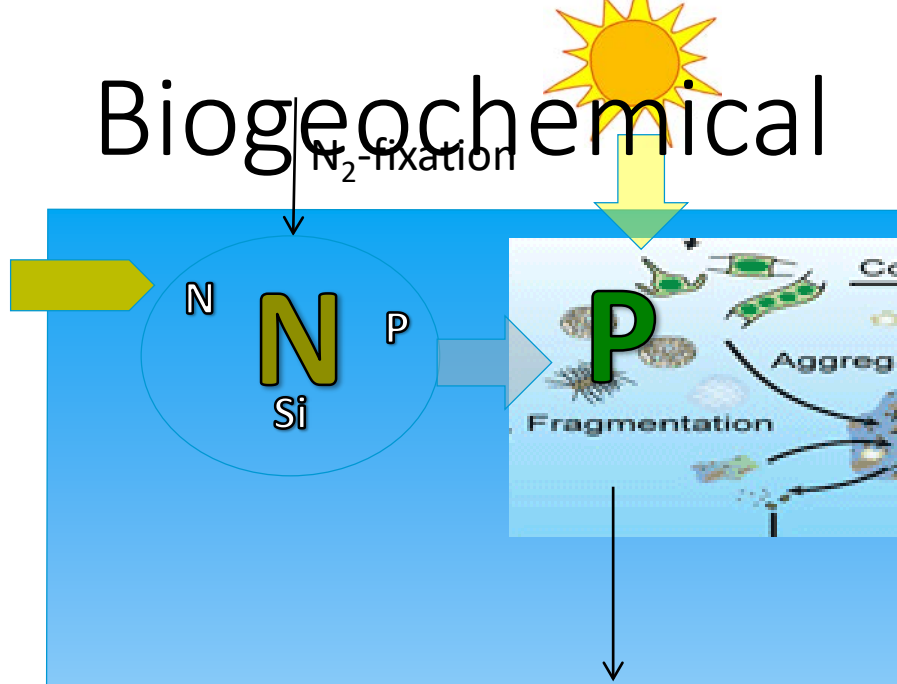
THE CRITICAL ROLE OF ATMOSPHERIC FORCING FOR SIMULATING THE DYNAMICS OF THE BALTIC SEA ECOSYSTEM



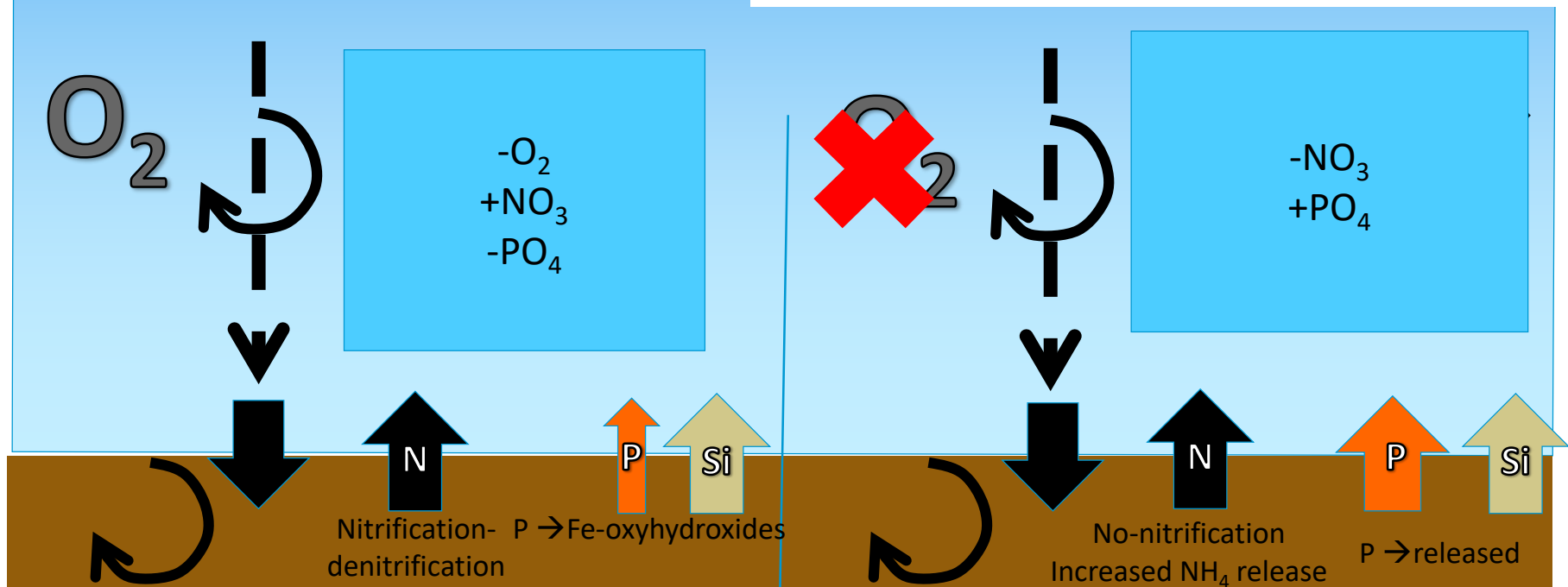
Ute Daewel, Corinna Schrum, Beate Geyer

Institute for Coastal Research

Biogeochemical

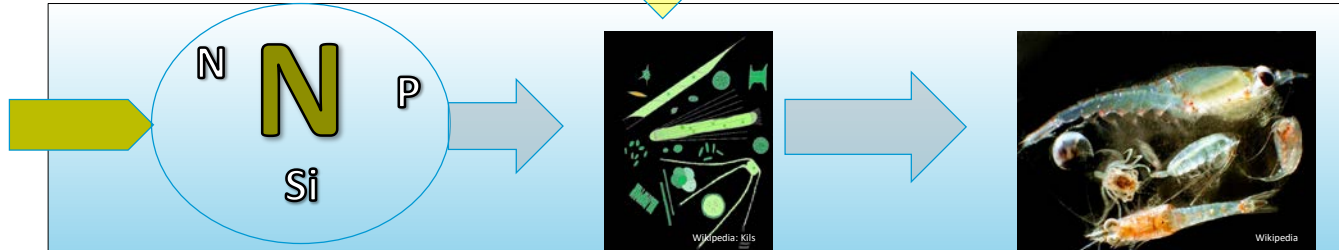


Kahru & Elmgren, Biogeosciences 2014





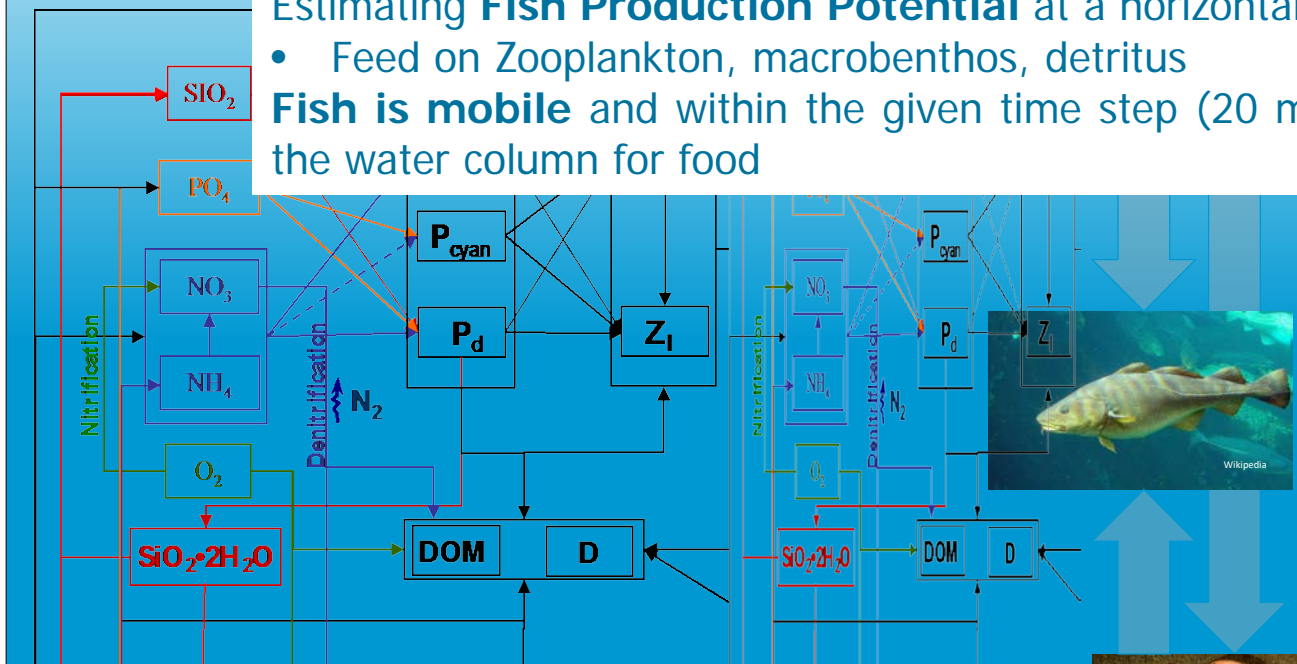
A consistent NPZD-FISH approach



Estimating **Fish Production Potential** at a horizontal location

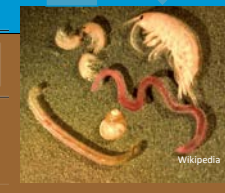
- Feed on Zooplankton, macrobenthos, detritus

Fish is mobile and within the given time step (20 min) able to search the water column for food



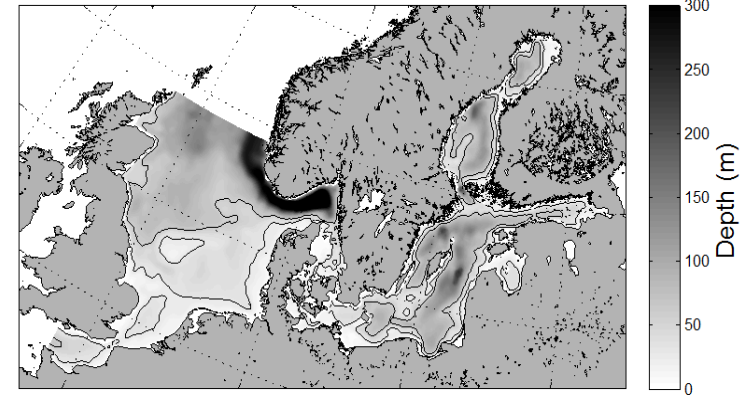
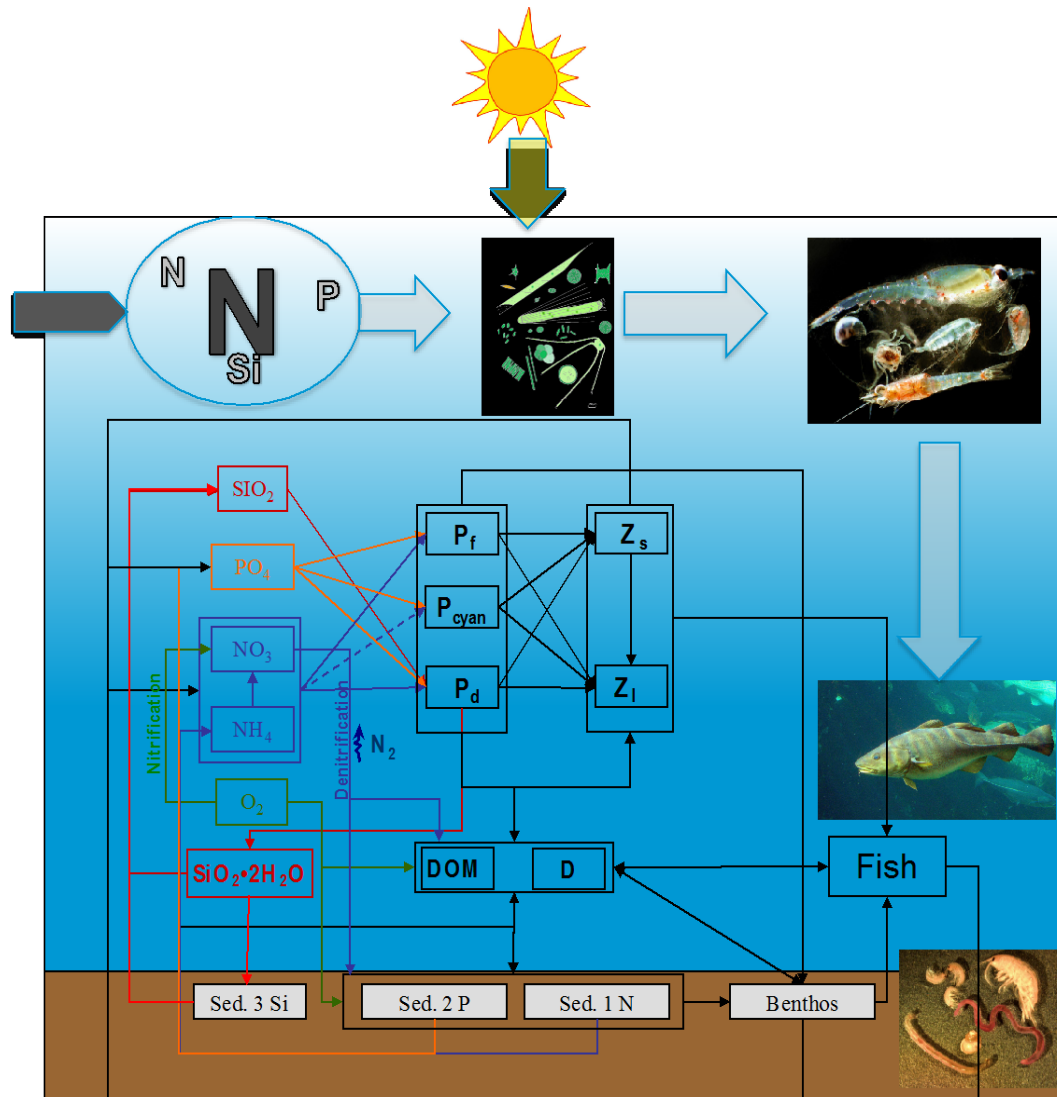
Macrobenthos is stationary at the bottom

- Feeds on Sediment POC, detritus, phytoplankton, zooplankton



FULLY COUPLED MODEL ECOSMO E2E

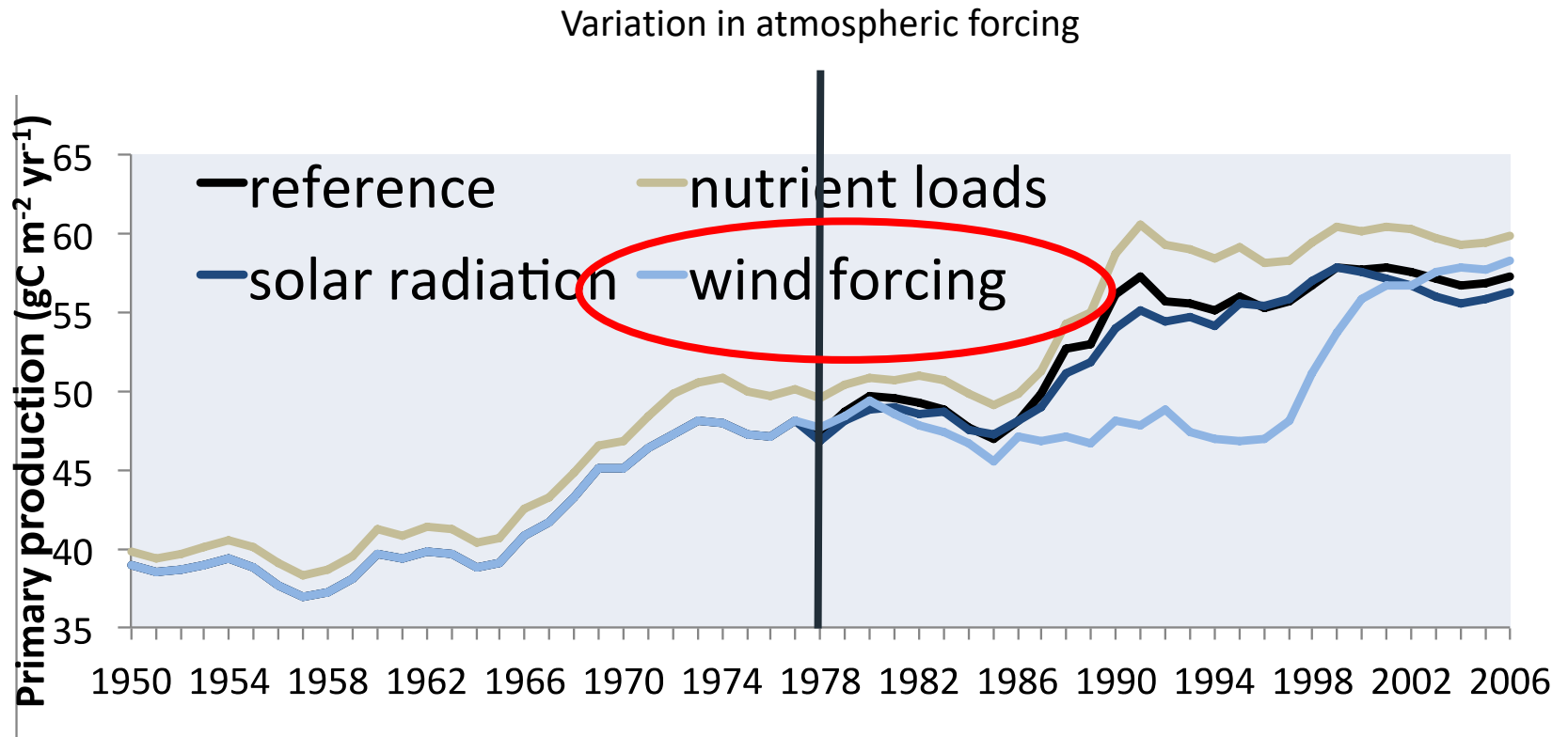
(Daewel & Schrum, 2013 JMS; Daewel & Schrum, under review PiO)



- 3-D hydrodynamic Model (*Schrum and Backhaus, 1999*)
- ca 10 km horizontal res.
- 20 vertical layer
- Dynamical Sea-Ice model
- Multidecadal hindcast-1948-2015
- NCEP atmospheric forcing
- daily runoffs
- Open boundary conditions North Sea, anomalies in T,S are considered

SENSITIVITY OF PRIMARY PRODUCTION TO EXTERNAL FORCING

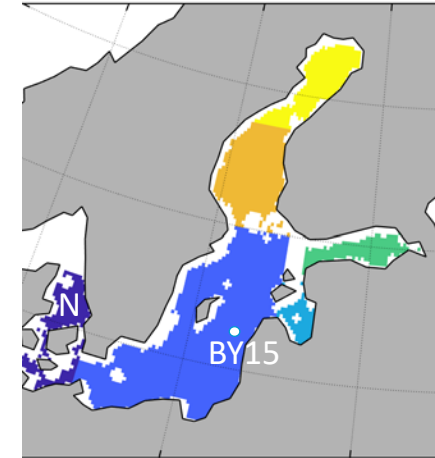
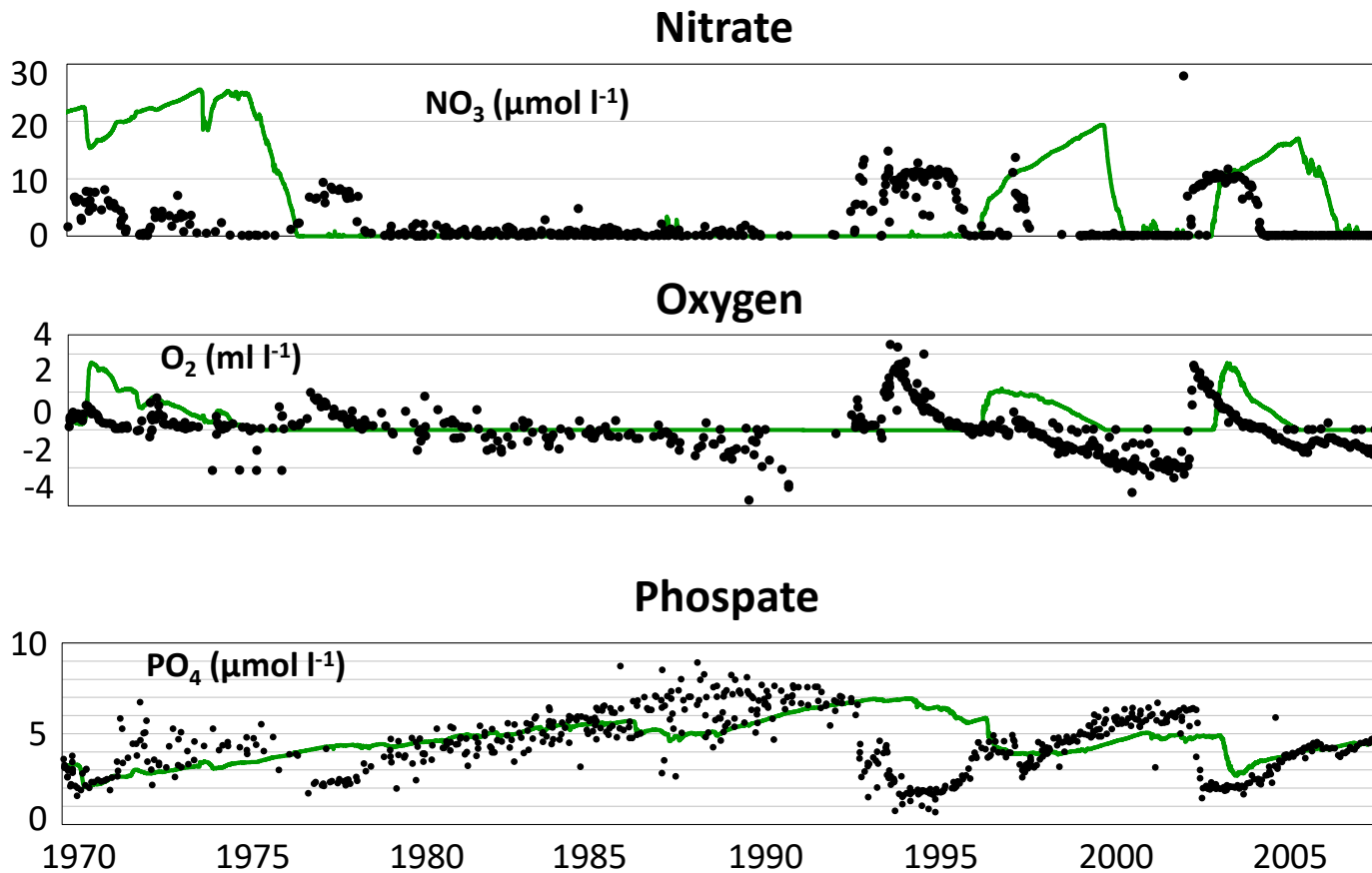
Daewel and Schrum 2017



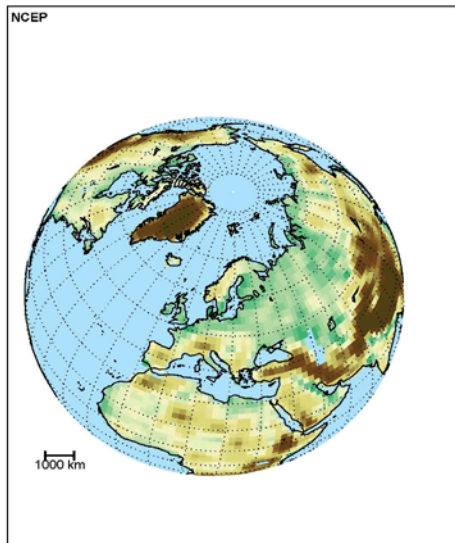
SIMULATED LONG TERM CHANGES IN BOTTOM WATER NUTRIENT

Daewel and Schrum 2013

Model simulation ECOSMO vs observations (from HELCOM) at BY15



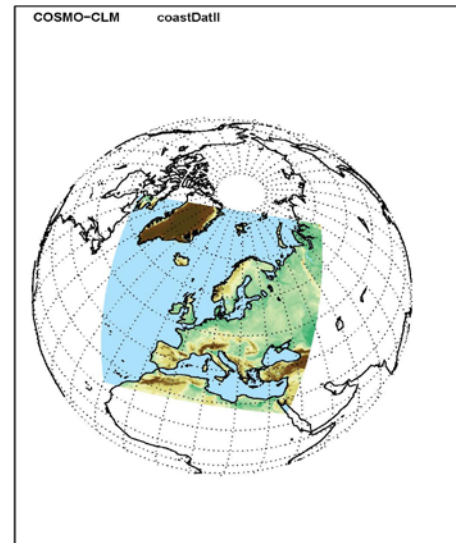
NCEP/NCAR global reanalysis
Kalnay et al. 1996



Spatial Resolution: $2^{\circ} \times 1.8^{\circ}$
Temporal Resolution: 6h

Used with correction on 2M
Temp. and SWR

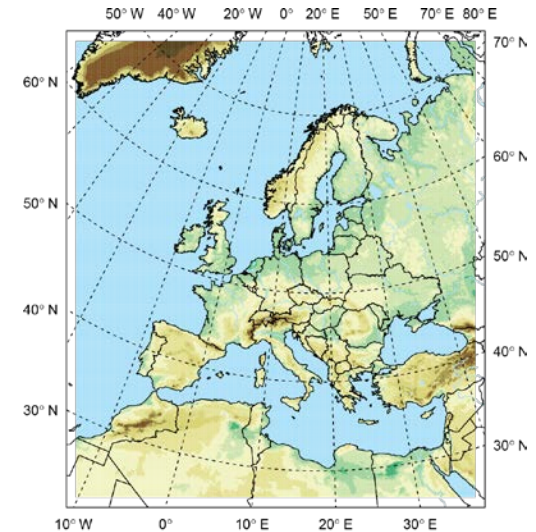
COSMO-CLM CoastDat II
Geyer 2014



Based on NCEP/NCAR
Spatial Resolution: 0.22°
Temporal Resolution: 1h

Used with corrected adapted
windstress parameterisation

COSMO CLM coastDat3

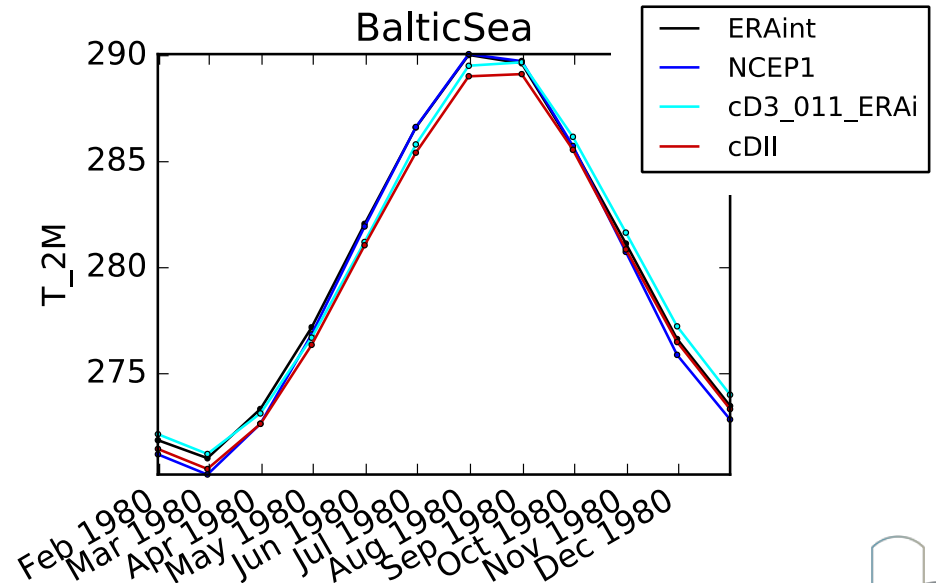
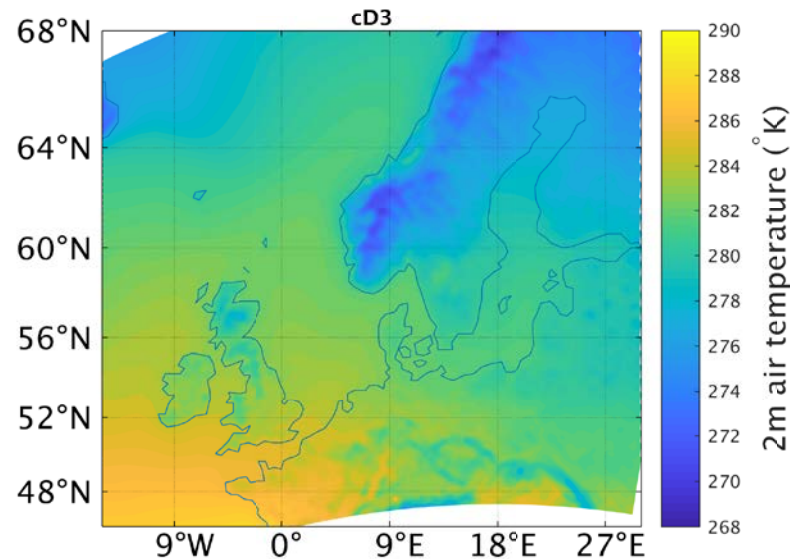
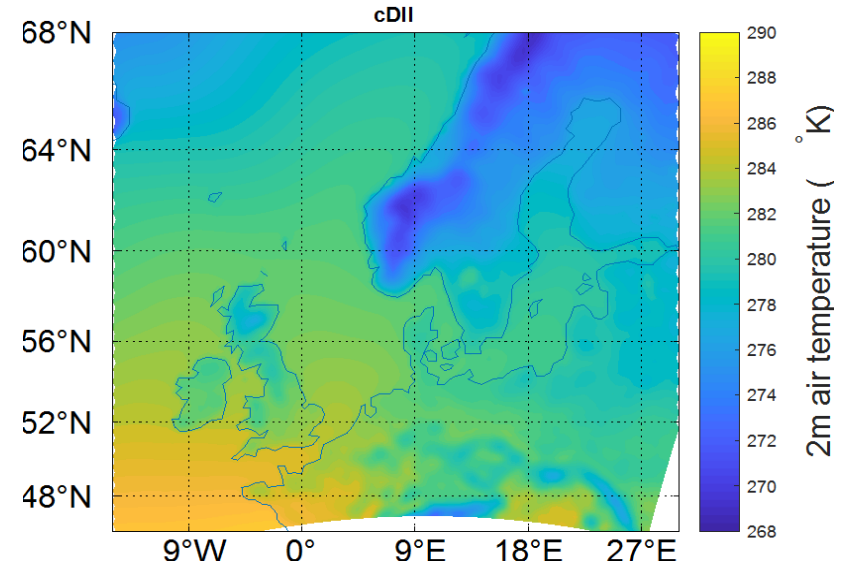
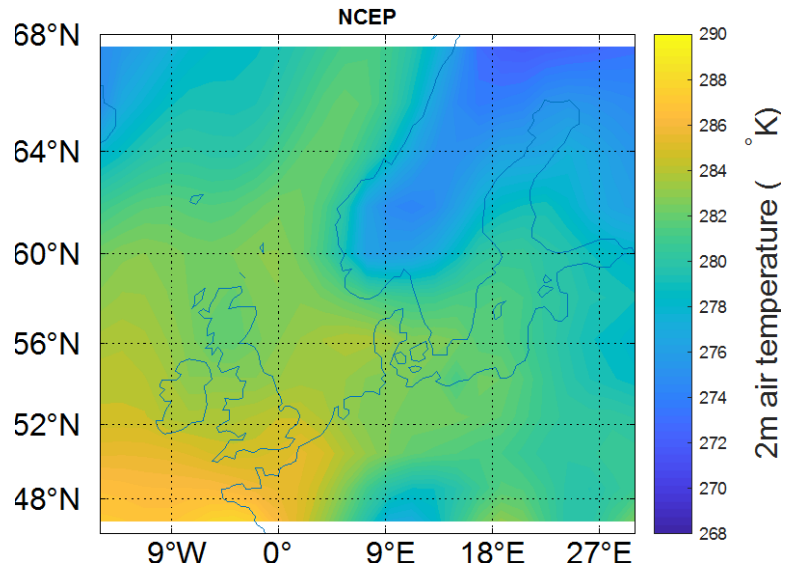


Based on ERA-interim
Spatial Resolution: 0.11°
Temporal Resolution: 1h

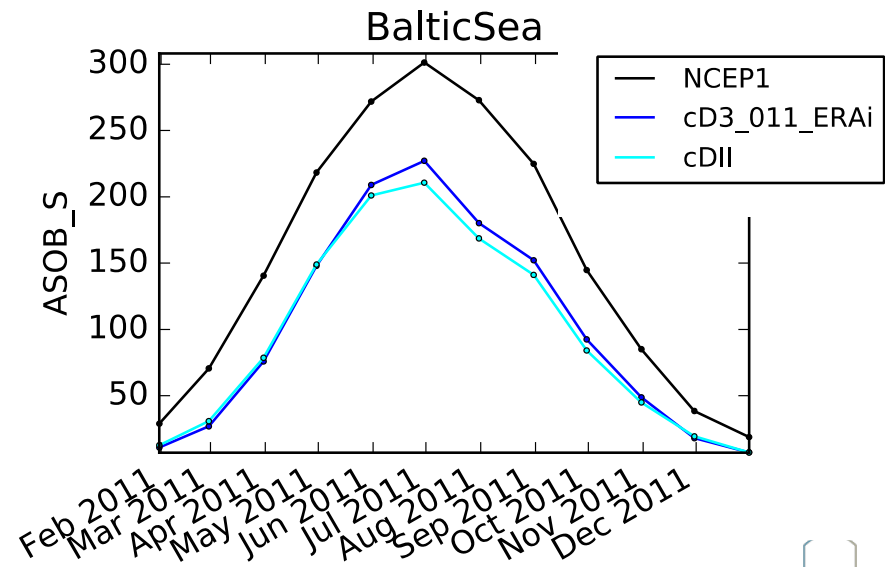
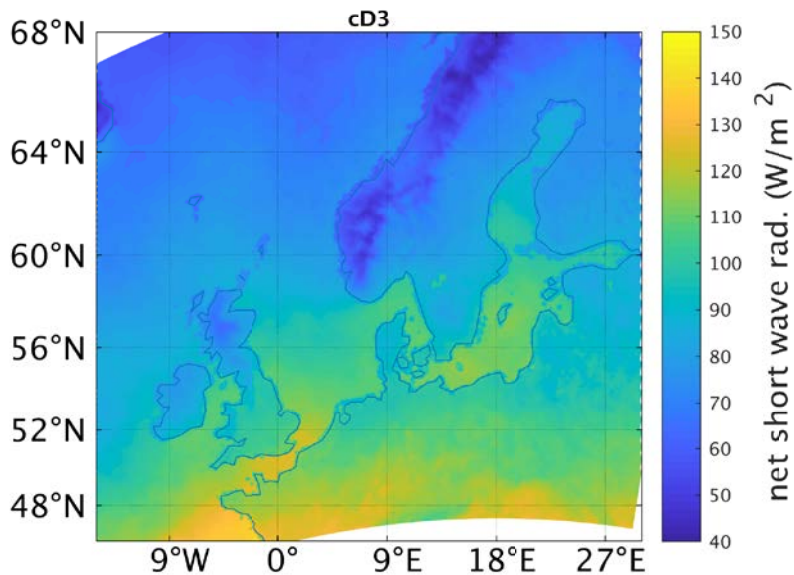
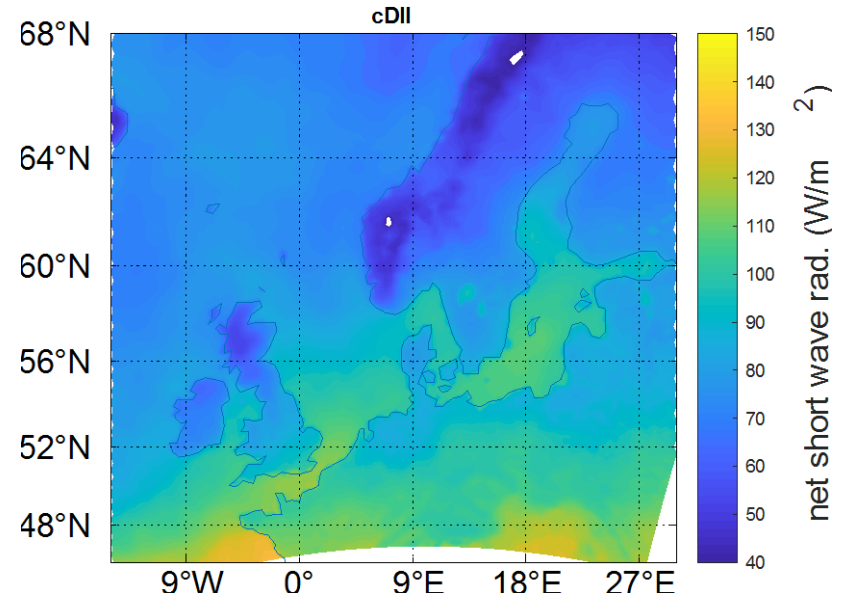
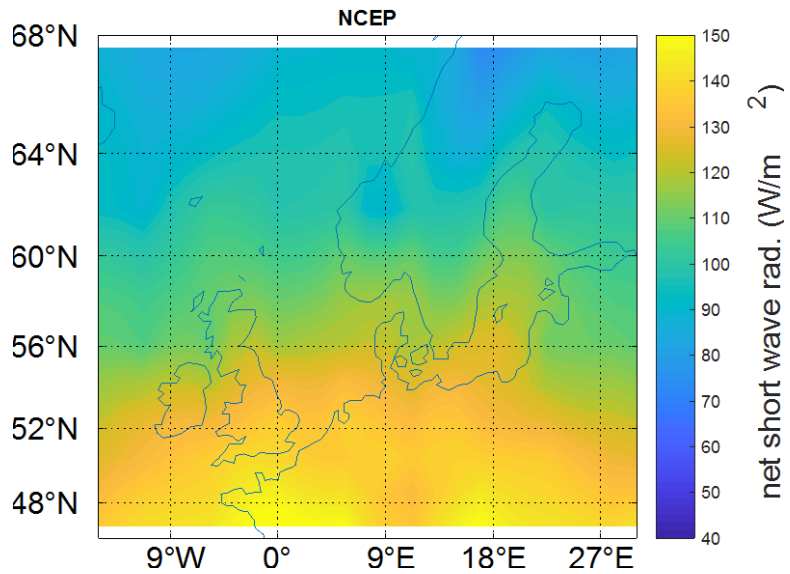
Used with corrected adapted
windstress parameterisation

Simulations from 1979-2014 – initiated with the NCEP reference simulation starting in 1948

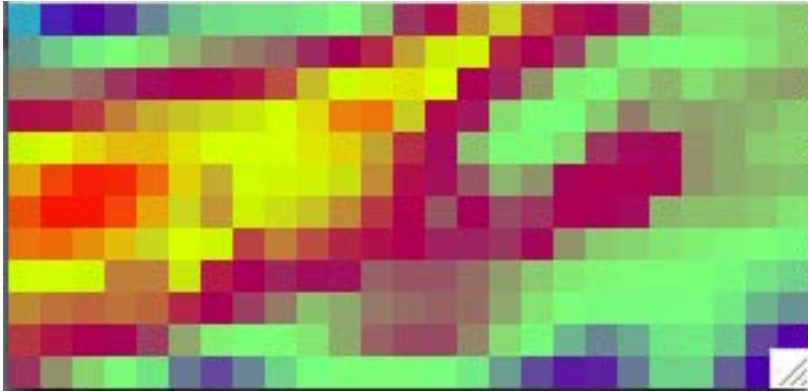
2 METER AIR TEMPERATURE (2011)



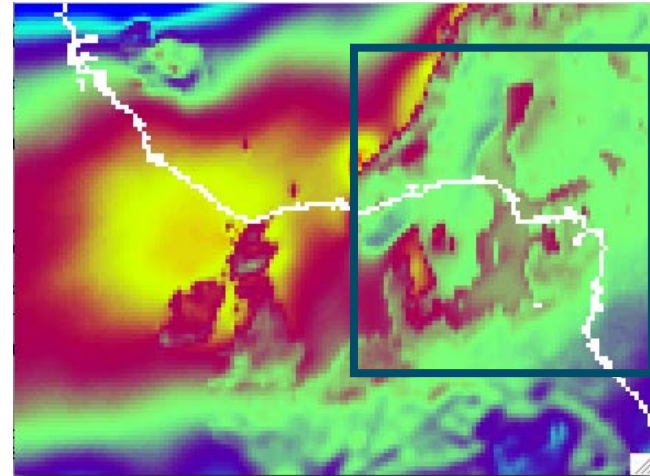
NET SHORT WAVE RADIATION



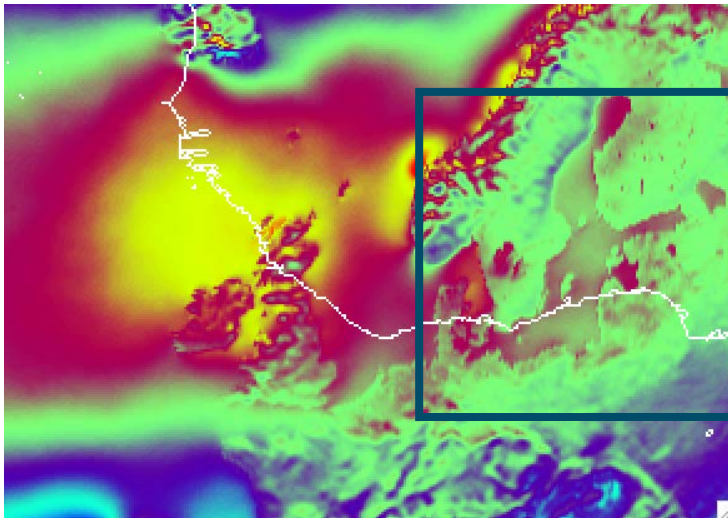
NCEP/NCAR



CCLM coastDatII



CCLM coastDat3 – erai



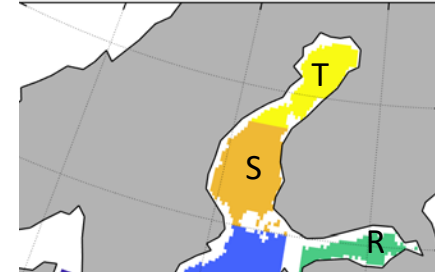
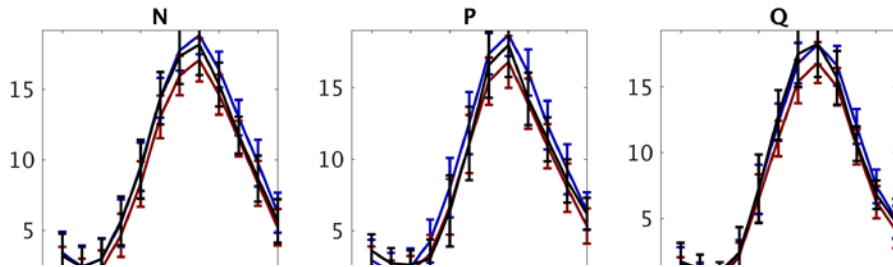
SEA SURFACE TEMPERATURE

Mean seasonal cycle (1980-2014)

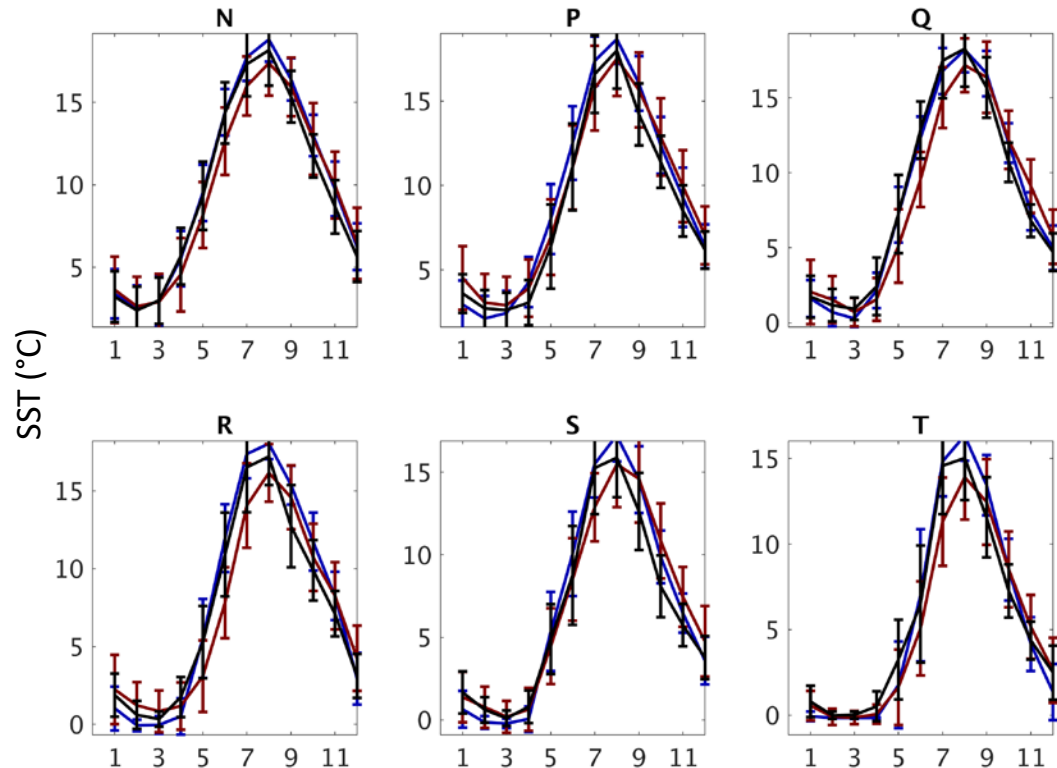
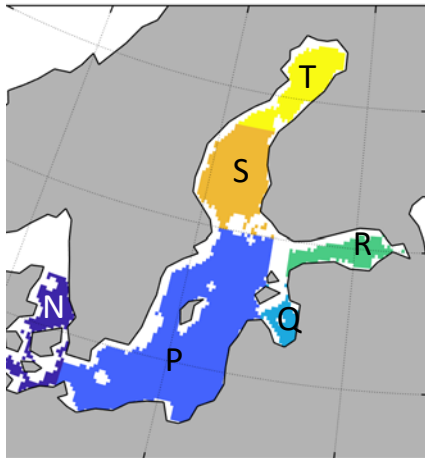
— ICES.dk surface data

— NCEP-run

— CDII-run



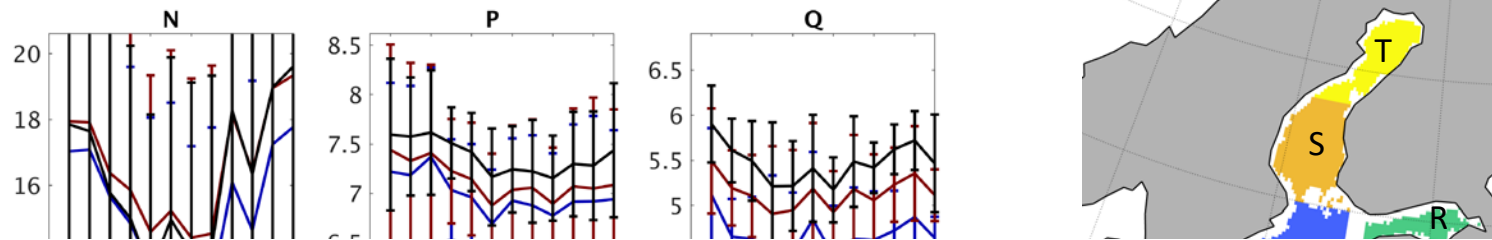
— CD3-run



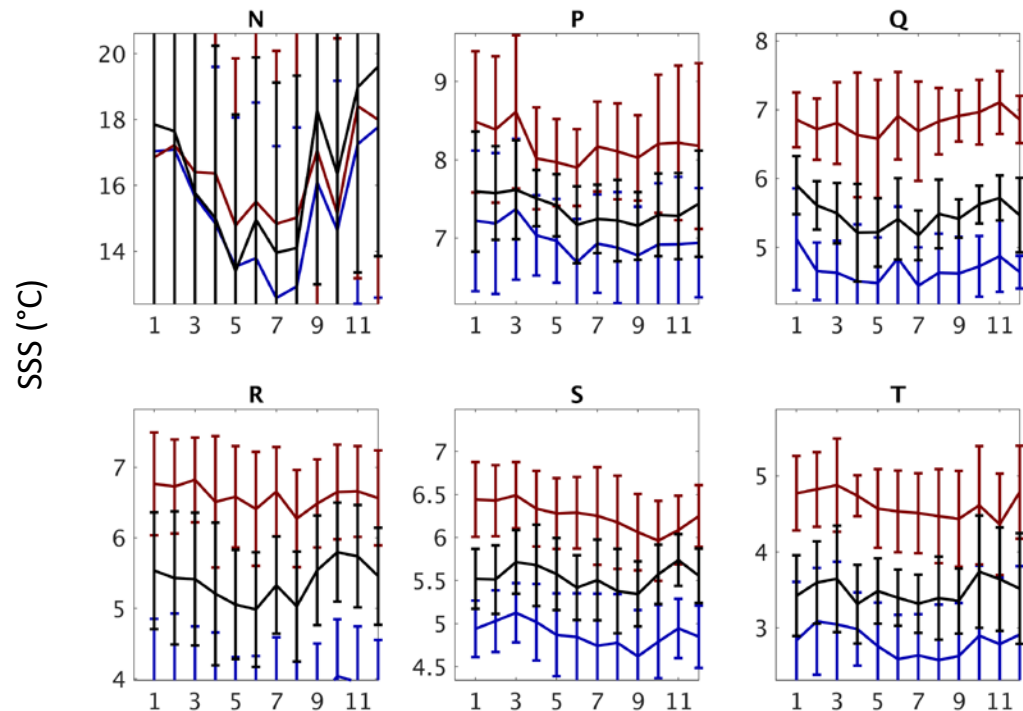
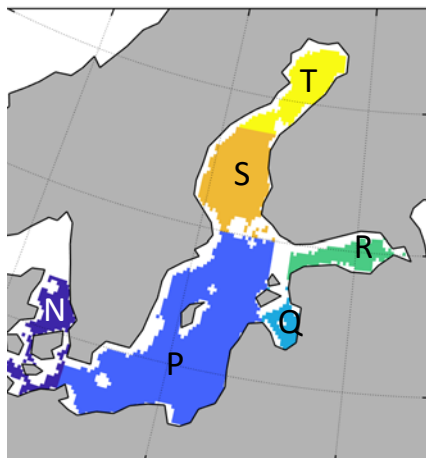
SEA SURFACE SALINITY

Mean seasonal cycle (1980-2014)

— ICES.dk surface data
 — NCEP-run
 — CDII-run

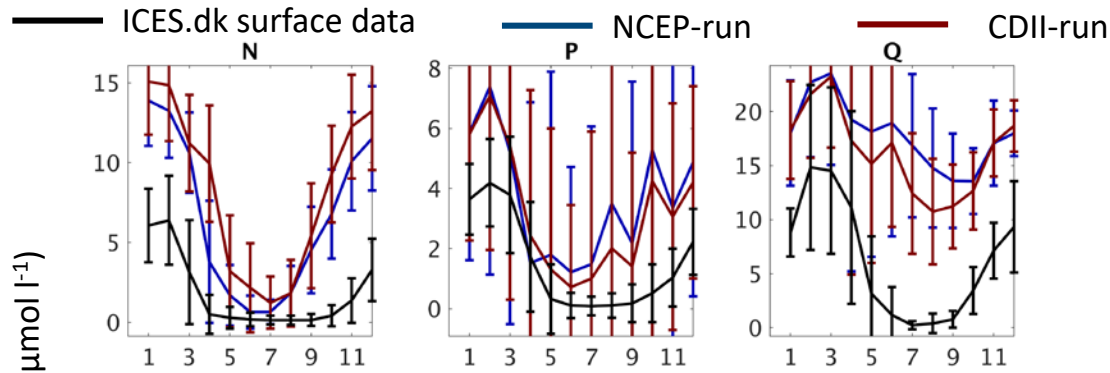


— CD3-run

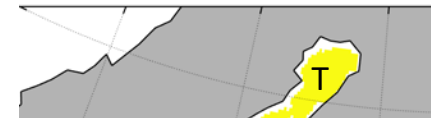


SURFACE NUTRIENTS NCEP-CDII

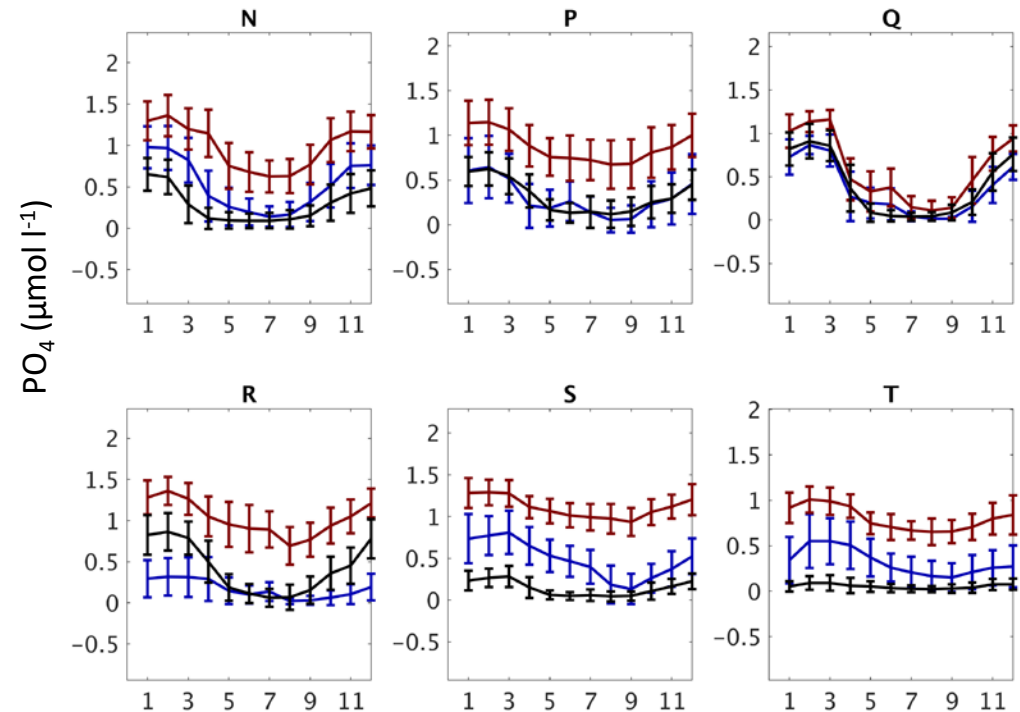
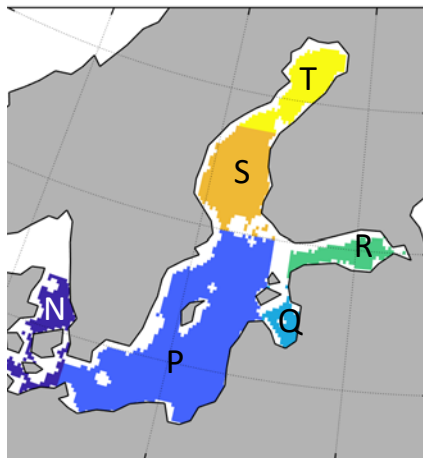
Mean seasonal cycle (1980-2014)



Nitrate



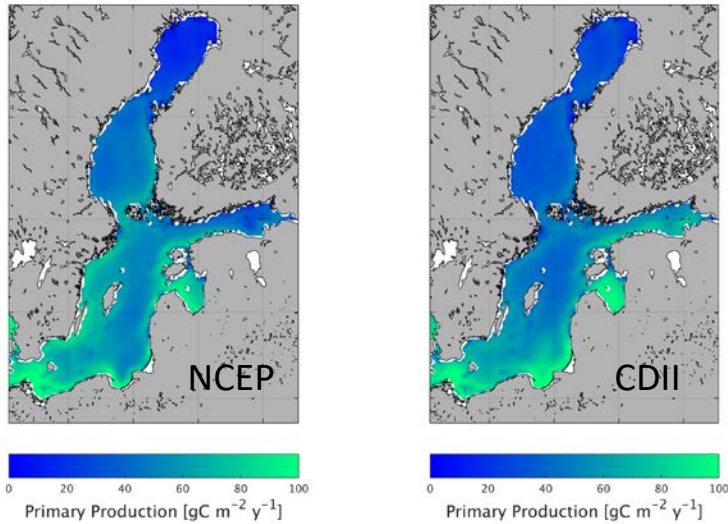
Phosphate



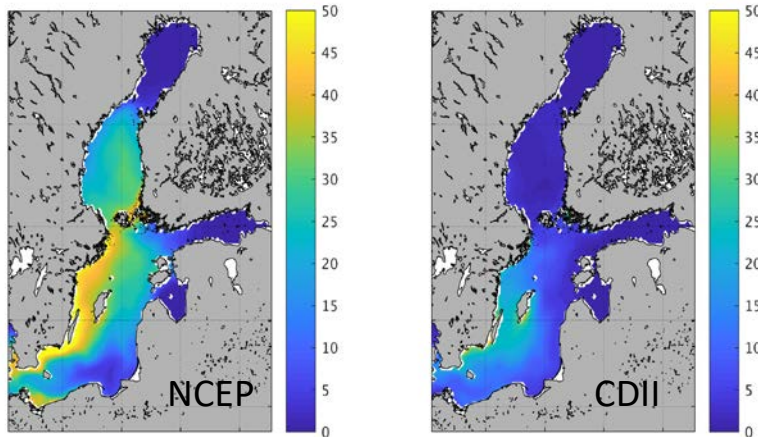
— ICES.dk surface data — NCEP-run — CDII-run

CONSEQUENCES ON BIOLOGY: PRIMARY PRODUCTION

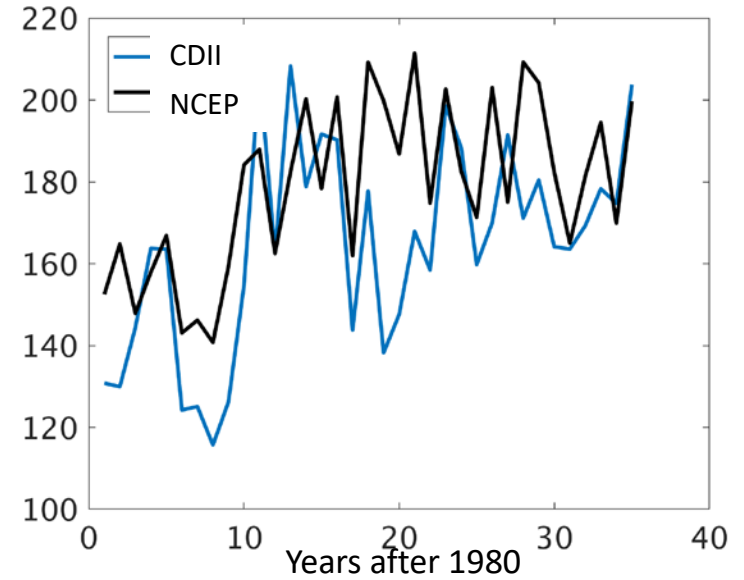
Mean Primary production (1980-2014) ($\text{gC}/\text{m}^2\text{yr}^1$)



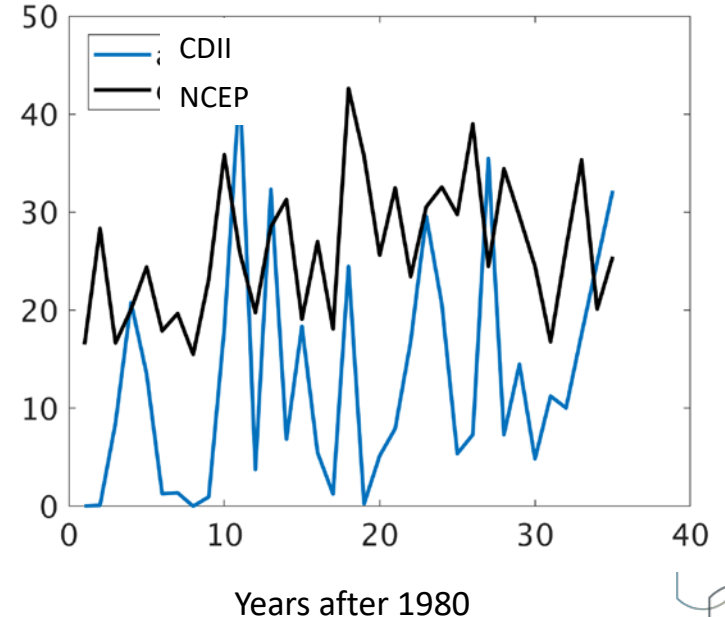
Cyanobacteria biomass at surface (mgC/m^3)



Cyanobacteria biomass ($\text{mgC}/\text{m}^2\text{d}^1$)



Cyanobacteria biomass (mgC/m^3)

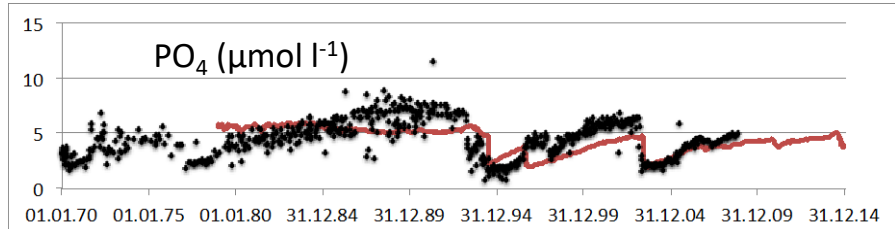
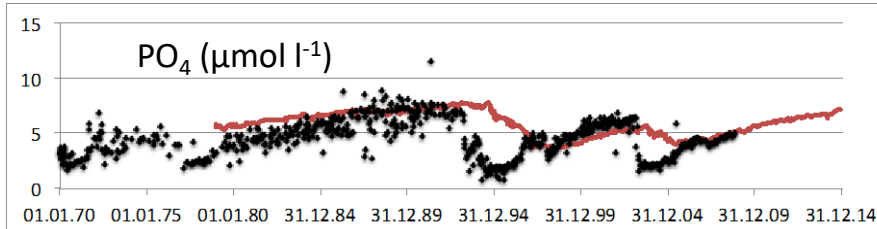


BOTTOM NUTRIENT TIMESERIES

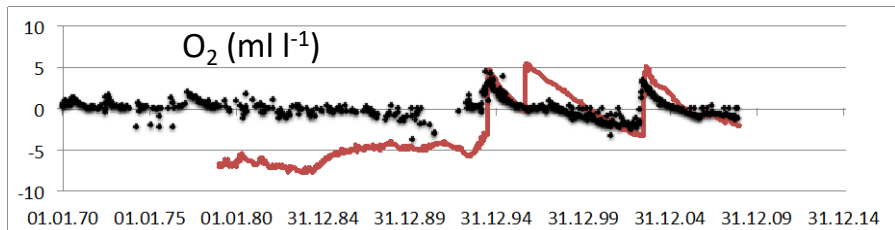
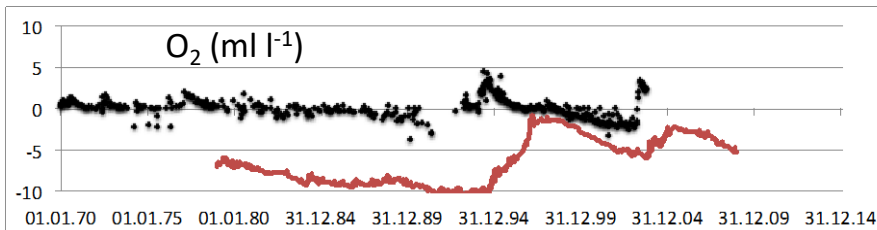
NCEP -simulation

Phosphate

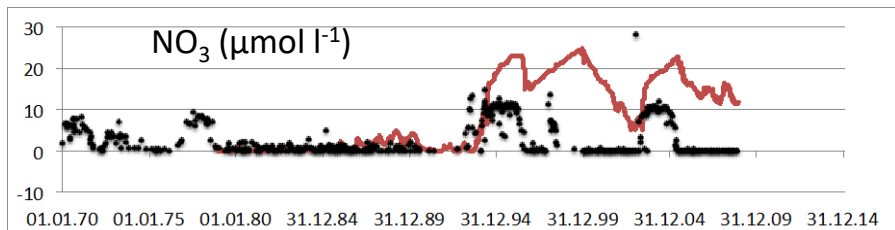
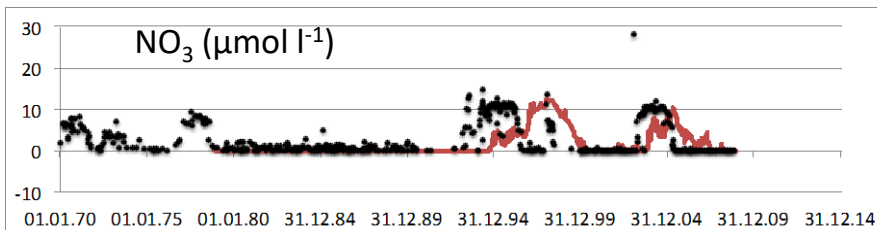
CD2 -simulation



Oxygen

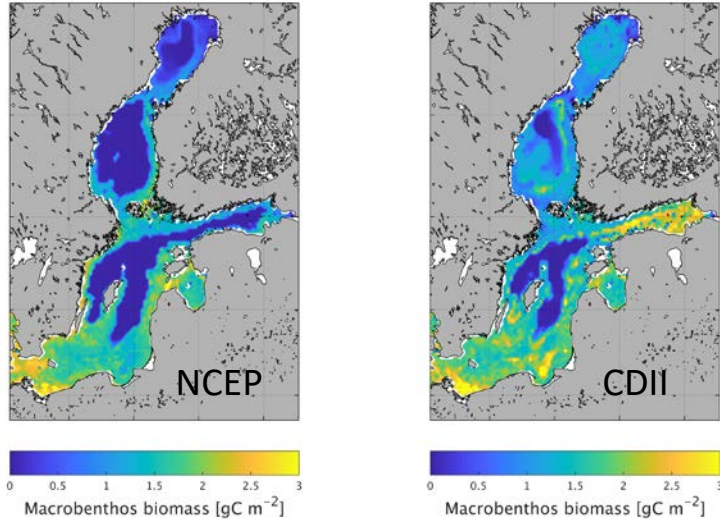


Nitrate

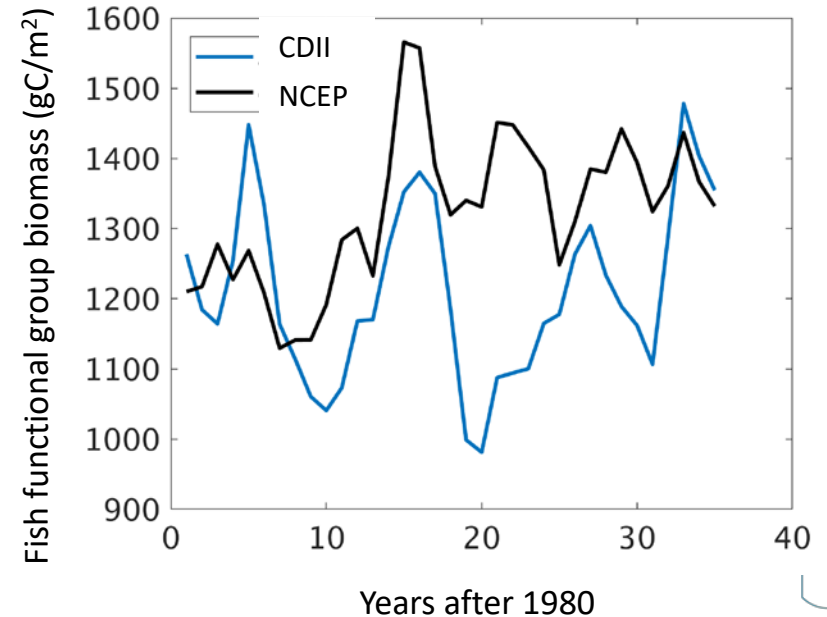
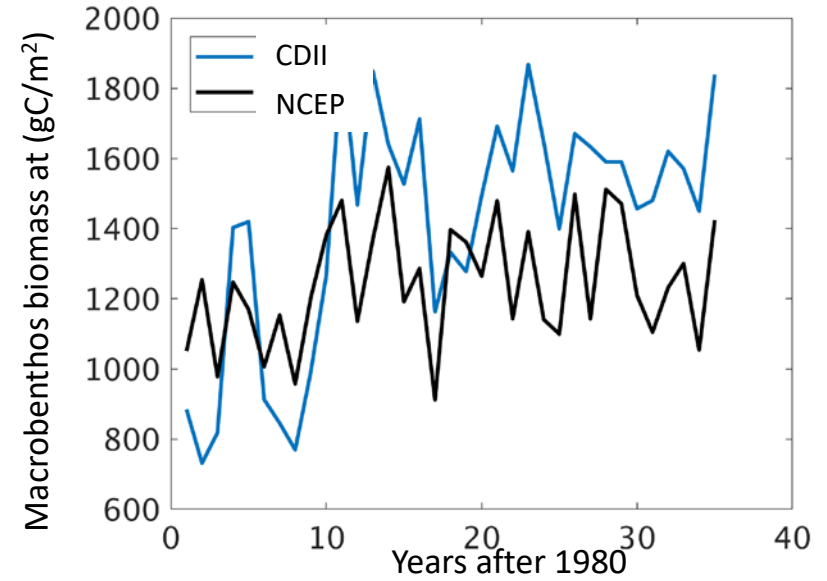
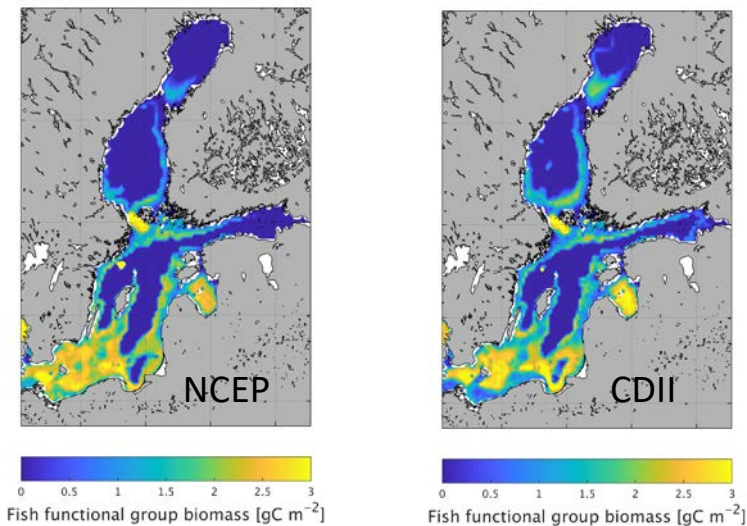


CONSEQUENCES ON BIOLOGY: BENTHOS AND FISH

Macrobenthos biomass at (gC/m^2)



Fish functional group biomass (gC/m^2)



1. The choice of the atmospheric forcing is critical for simulating both Baltic Sea physics and biology
2. The specifics of the atmospheric datasets need to be considered in the ecosystem model
 - Underestimation of short wave radiation for estimating primary production
 - Under/overestimation of wind speeds
 - Biases in temperature
3. The coarsely resolve global reanalysis doesn't allow for an accurate representation of Major Baltic Sea inflows

