

PML

Plymouth Marine
Laboratory



**National
Oceanography Centre**
NATURAL ENVIRONMENT RESEARCH COUNCIL

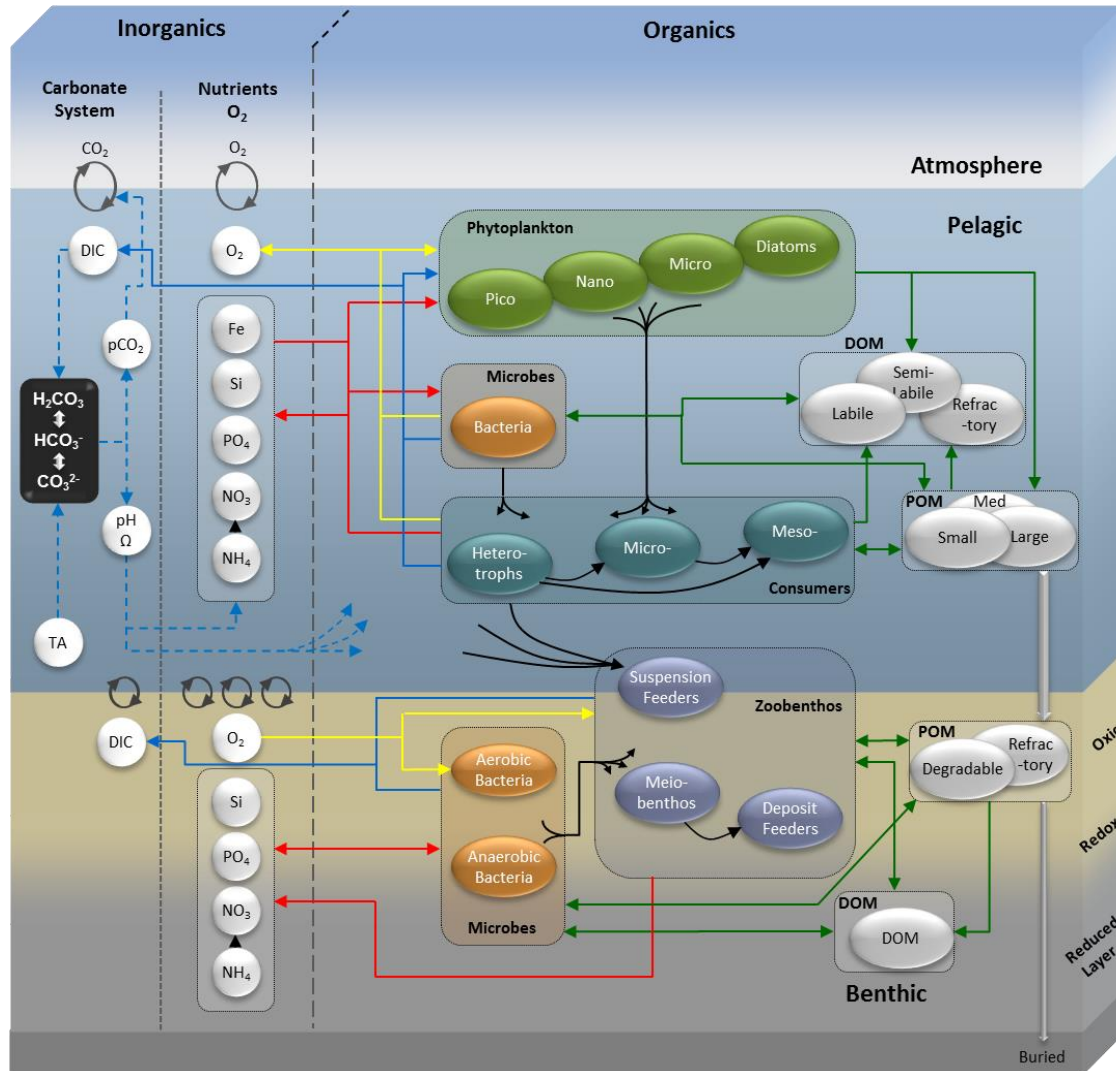
Listen to the ocean



AMM7 hindcast: validation and major biogeochemical dynamics

Y. Artioli, M. Butenschön, S. Wakelin, J. Aldridge, L. Amoudry, J. Blackford, J. Bruggeman, J. Clark, J. Holt, G. Lessin, M. Luneva, R. McEwan, L. Polimene, T. Silva, J. Tinker, S. Van Leeuwen, J. Van Der Molen, R. Wood, I. Allen

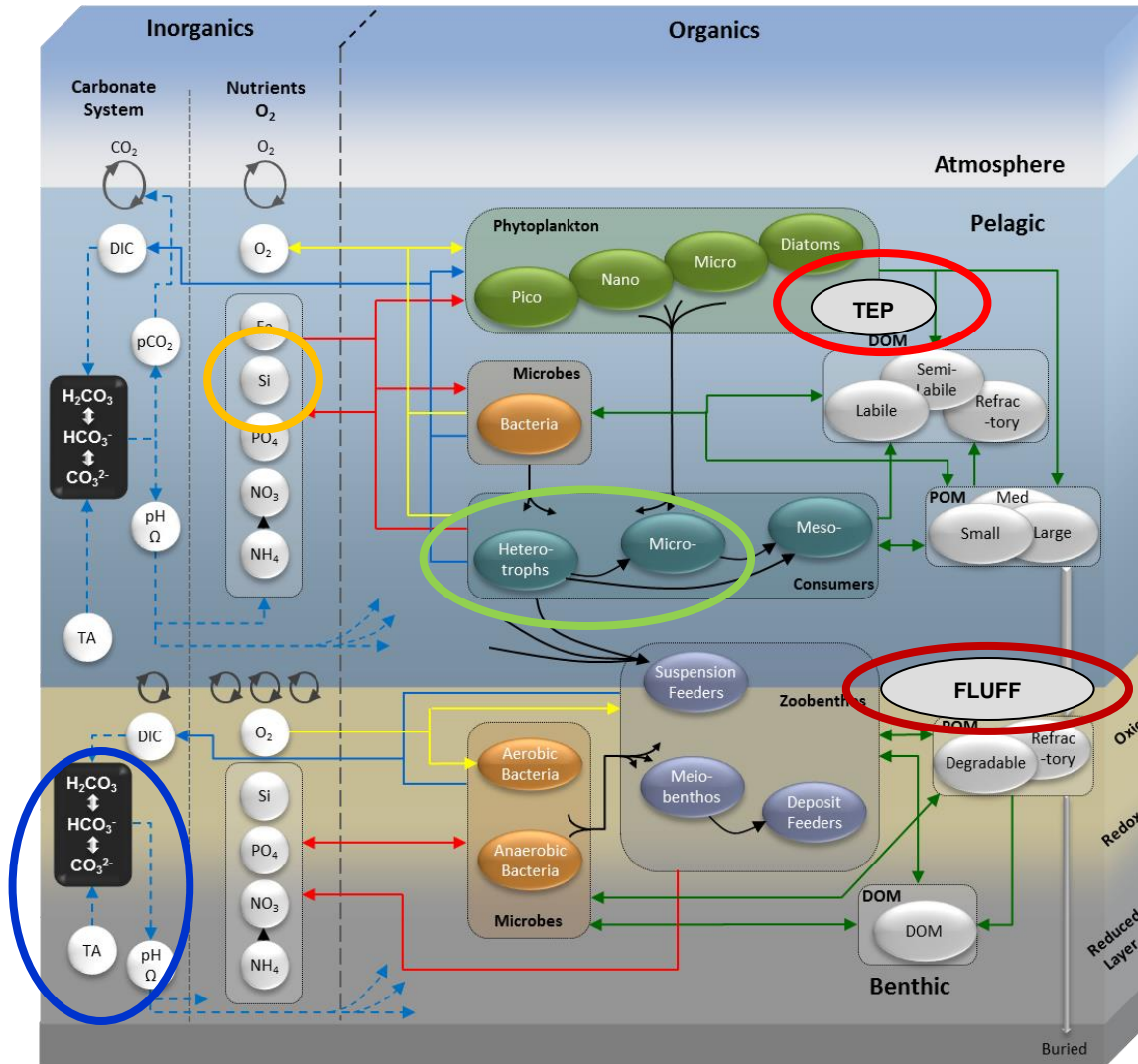
ERSEM: SSB-v0



ERSEM v16.06

Equivalent to ERSEM v15.06 but in FABM
Allows for flexible configuration
Used in the 2 SSB modelling workshops

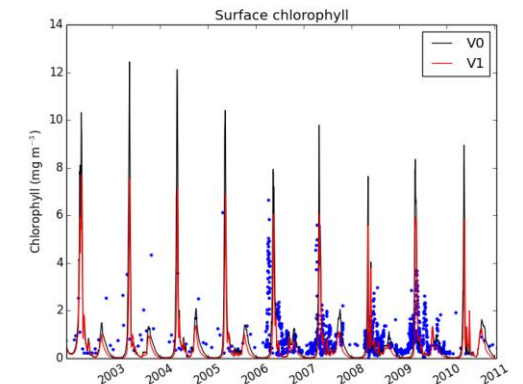
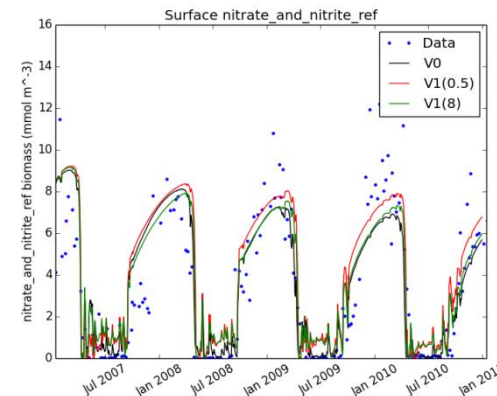
ERSEM: SSB-v1



Major updates:

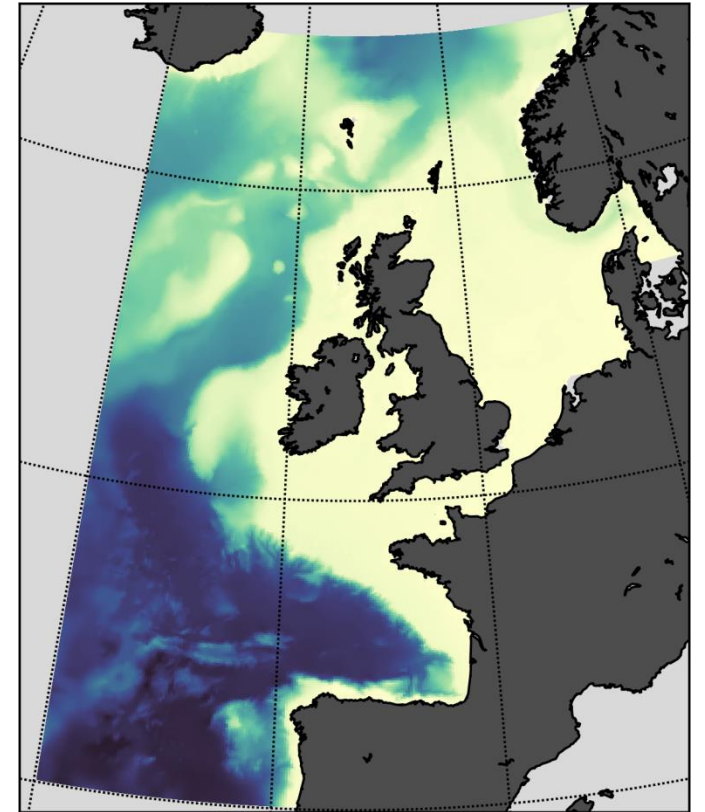
- TEP
- Stoichiometric Modulation Predation
- Pelagic Si remineralisation
- Fluff layer
- Benthic carbonate

Run at L4 and Oyster ground

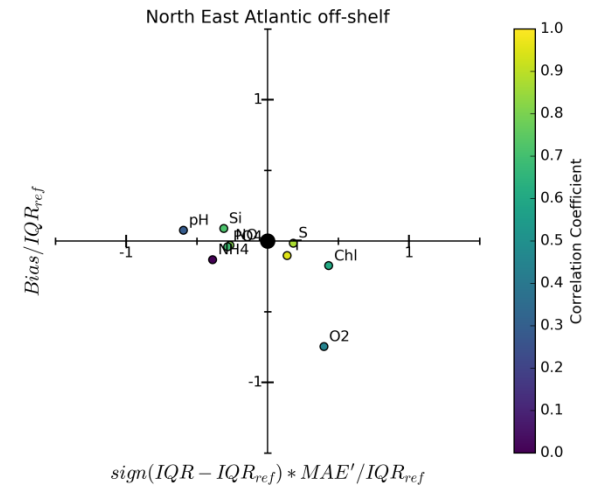
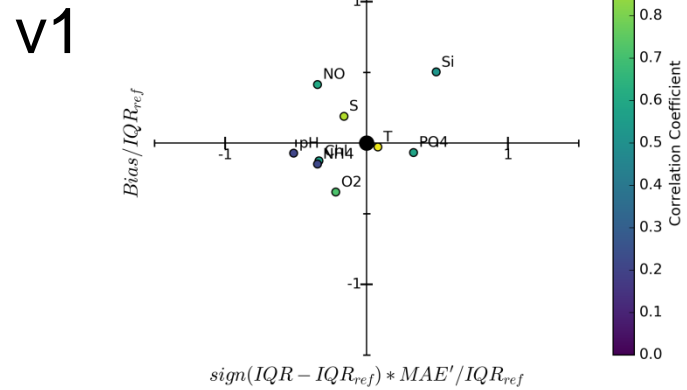
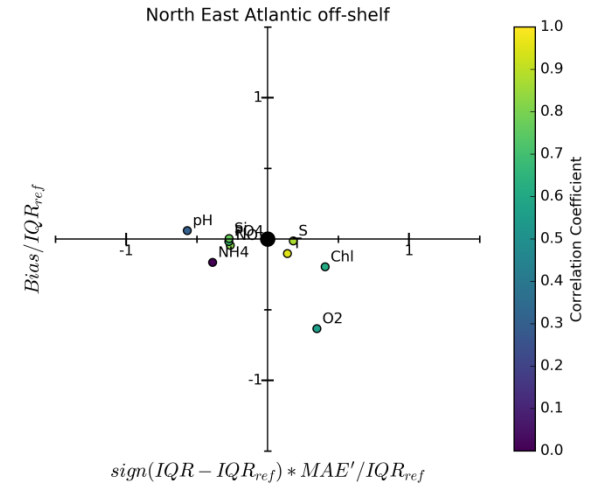
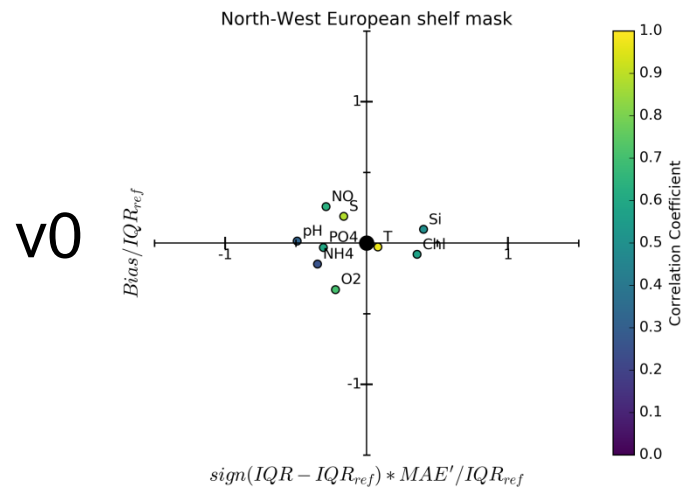
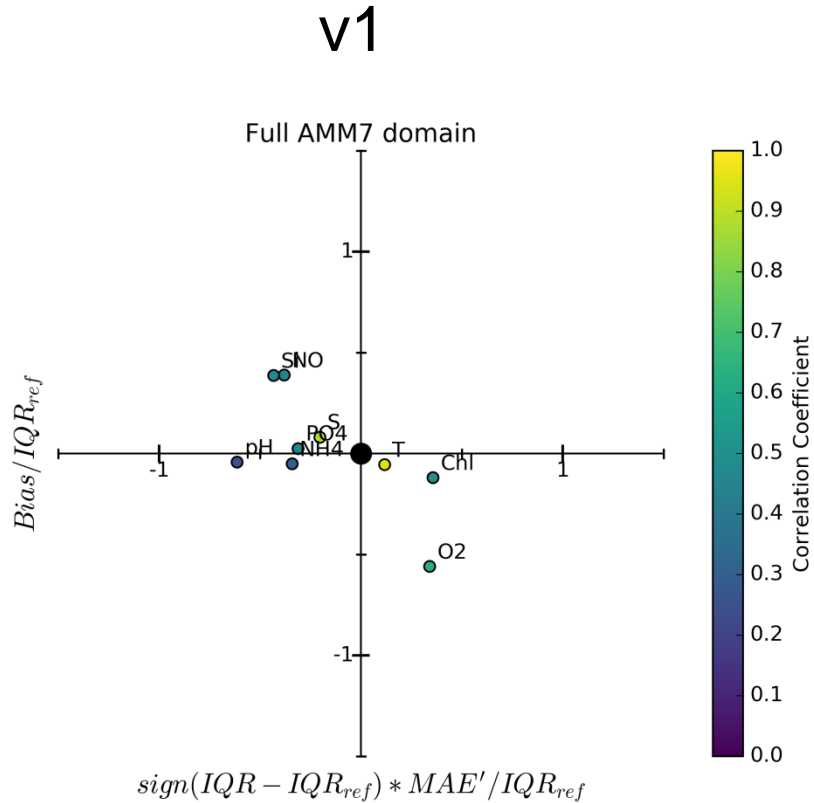


Model set-up: physics and configuration

- Based on NEMO 3.6, svn rev. 6232
- AMM at ~7km resolution (AMM7), 50 s-layers
- Code additions for open ocean boundaries of tracers
- Forced by reanalysis product
- Atmospheric deposition of nitrogen
- Attenuation using gelbstoff absorption from satellite
- Fully runtime configurable number of tracers, atmospheric and riverine inputs
- Run from 1980 to 2015, large list of variables at daily and monthly resolution (18TB)



Validation/1: ICES dataset

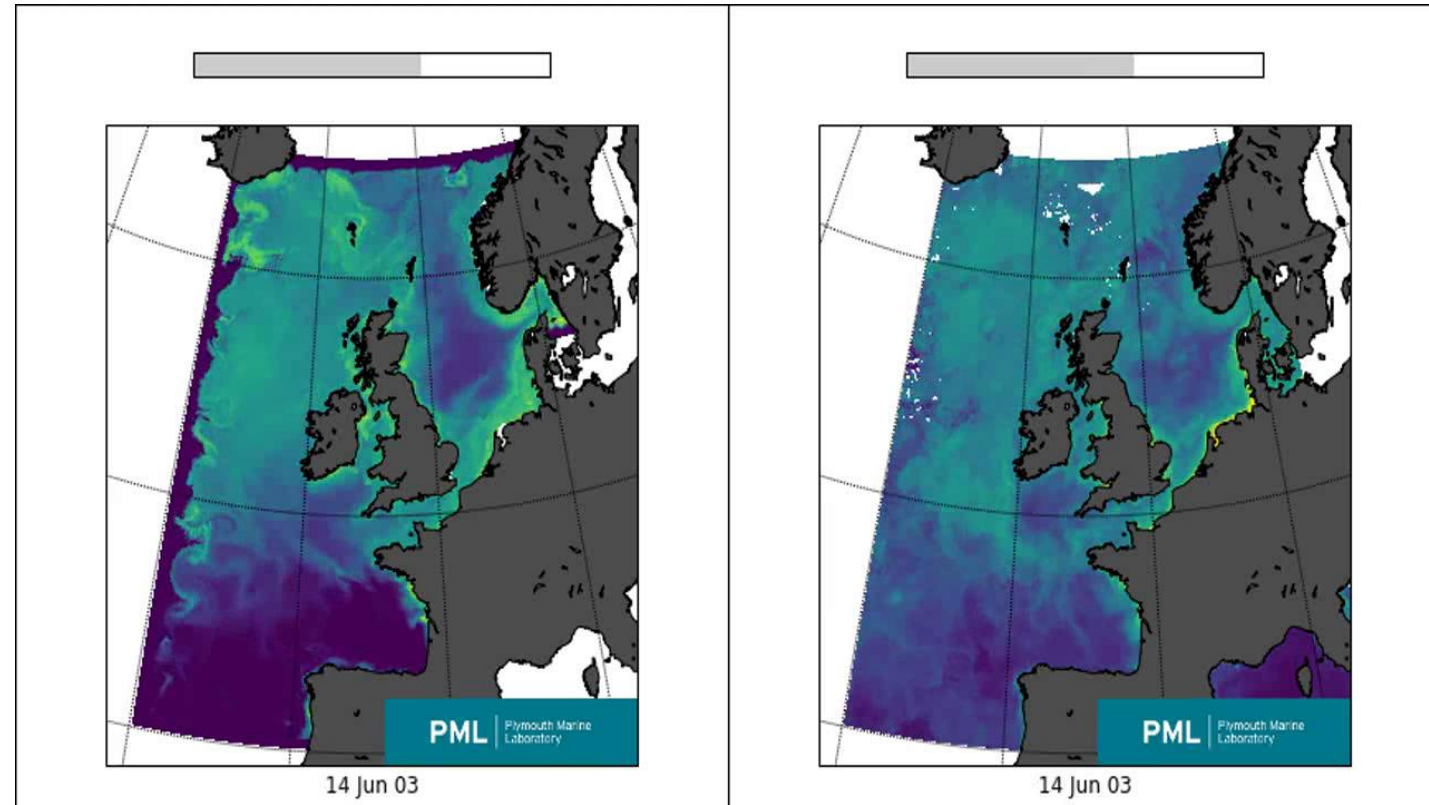
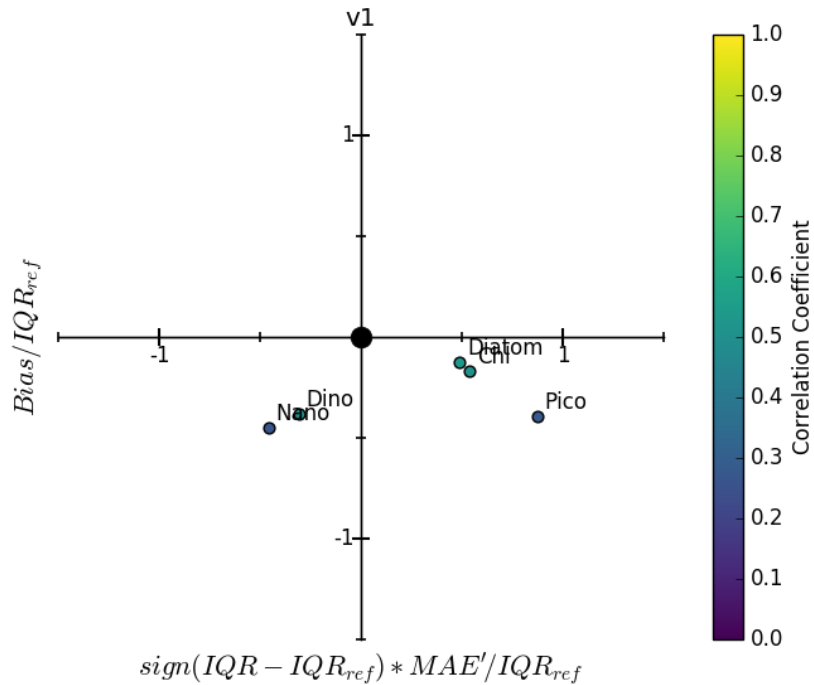


Validation/2: Satellite Chlorophyll

Chlorophyll

model

CCI



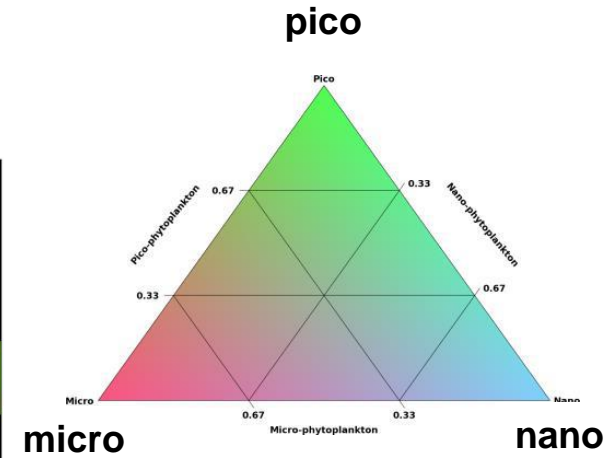
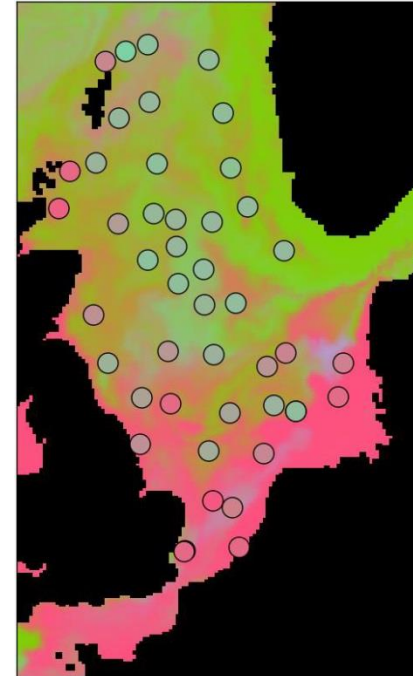
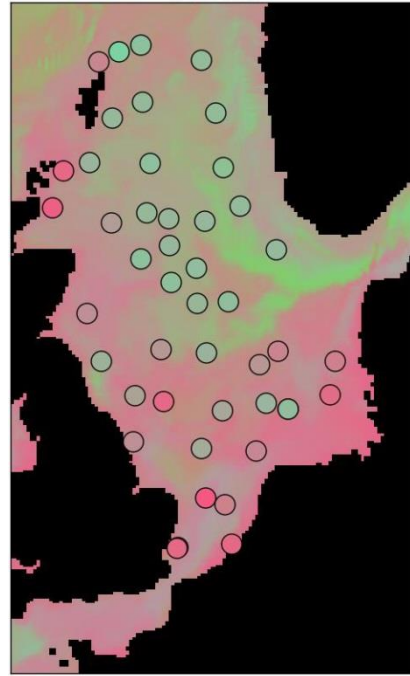
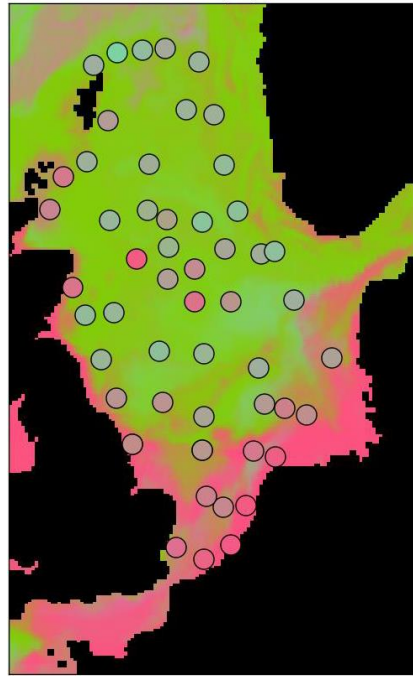
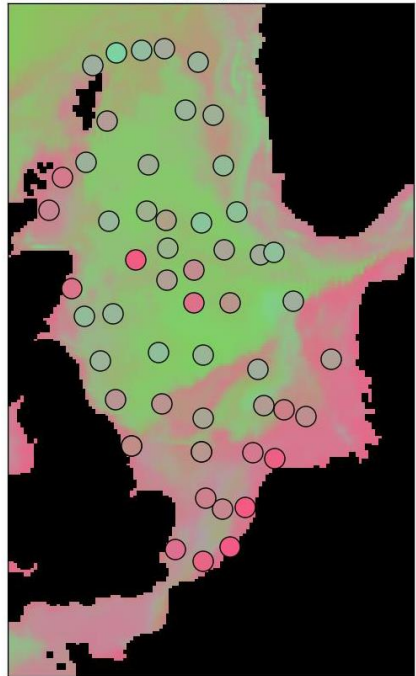
Validation/3: in situ community composition

V0 - 2010

V1 - 2010

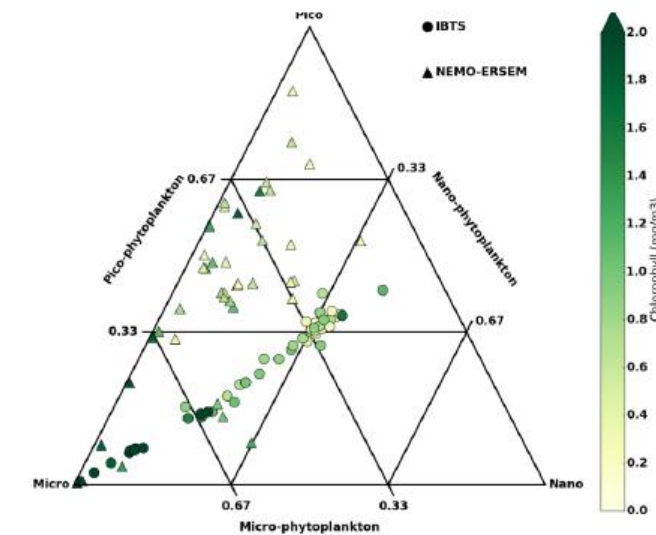
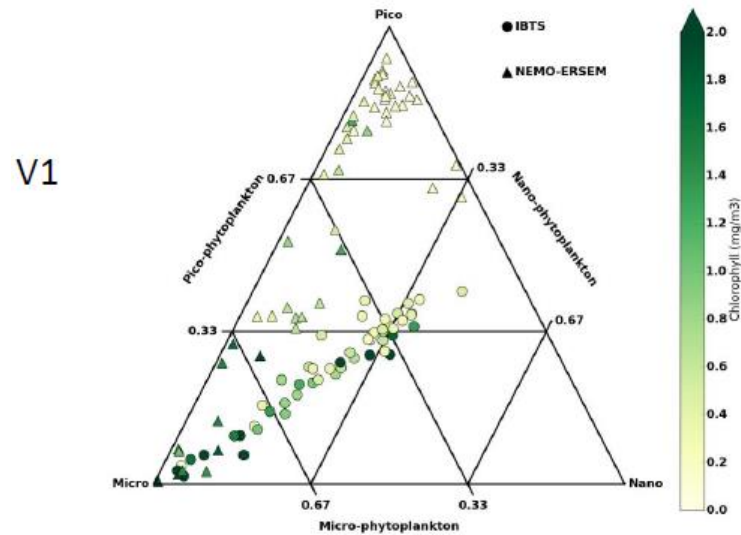
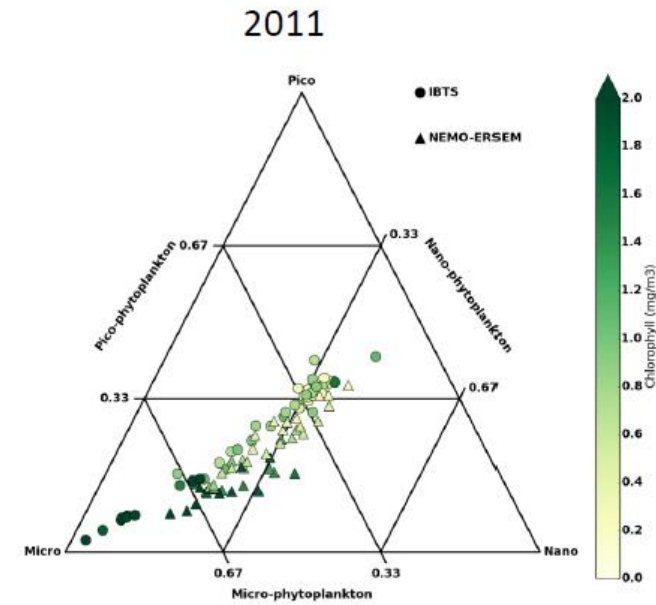
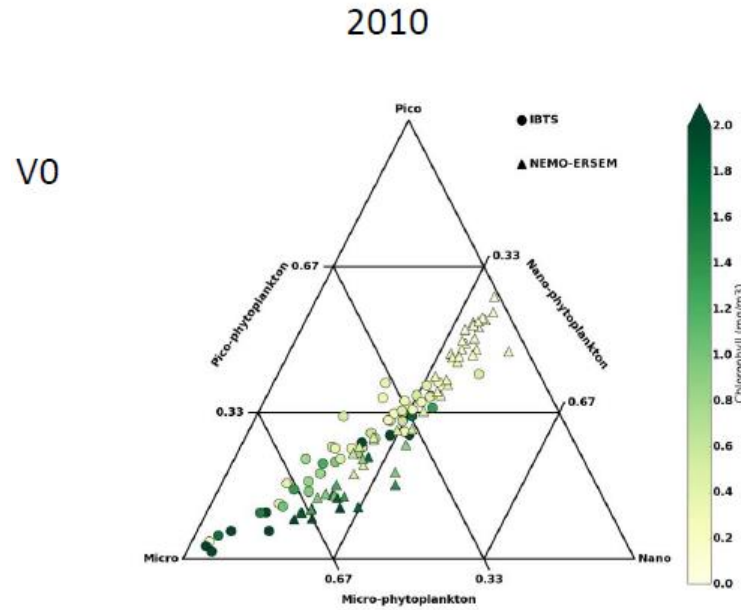
V0 - 2011

V1 - 2011

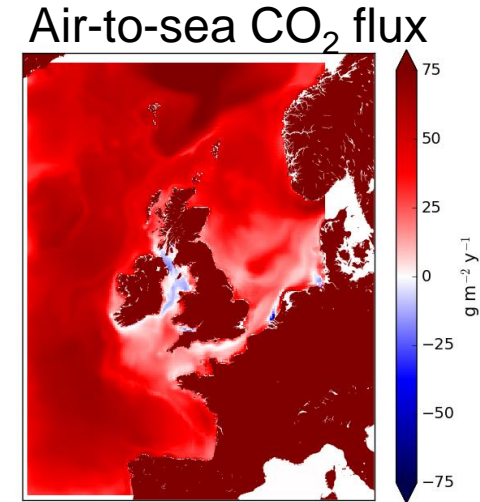
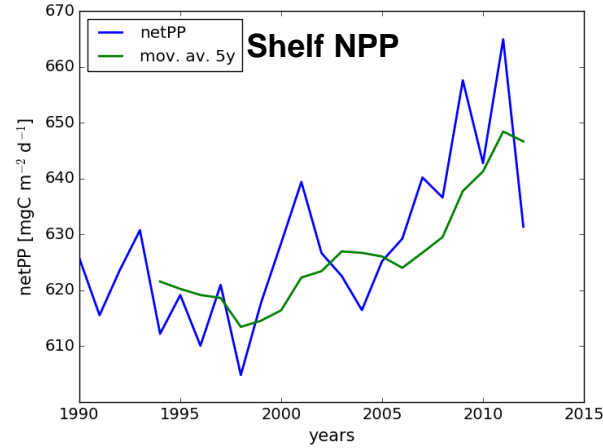
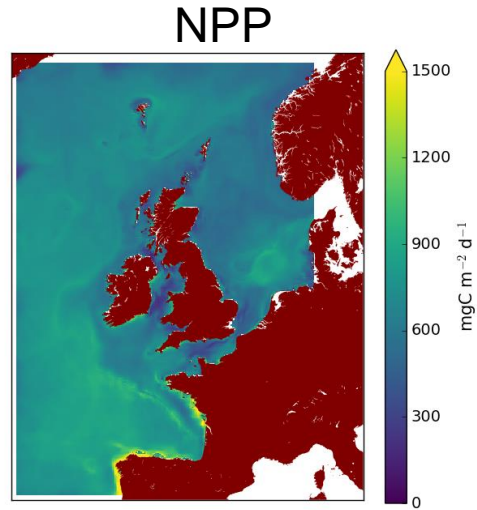


● data from IBTS

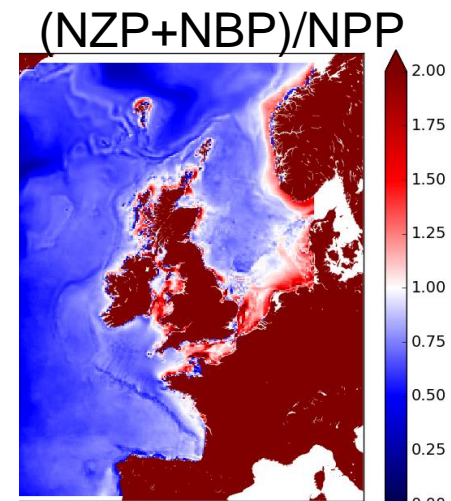
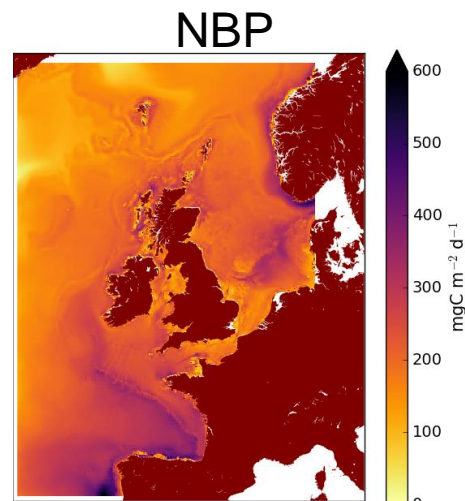
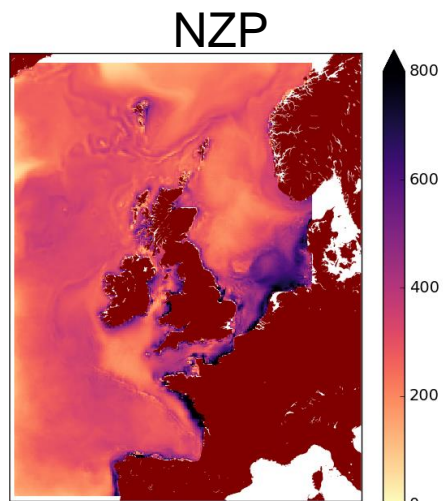
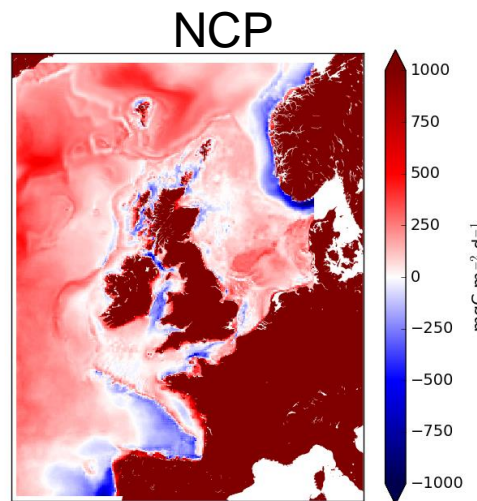
Validation/3: in situ community composition



Biogeochemical dynamics: Carbon



Shelf flux
27 ÷ 36 TgC y⁻¹

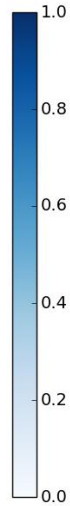
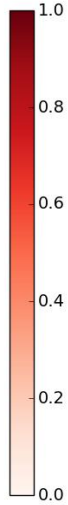
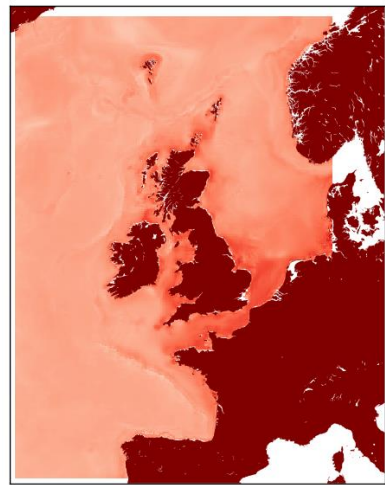


NPP=photosynth.- Phy. resp
NCP=photosynth.- Comm. resp
NZP=Zoo uptake - Zoopl. resp
NBP=bact. uptake. - bact. resp

Biogeochemical dynamics: Inorganic nitrogen (remineralisation)

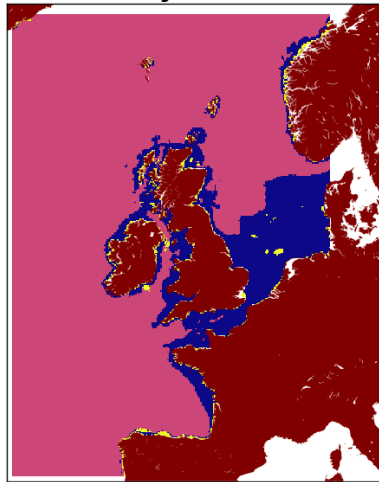
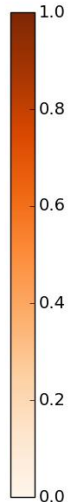
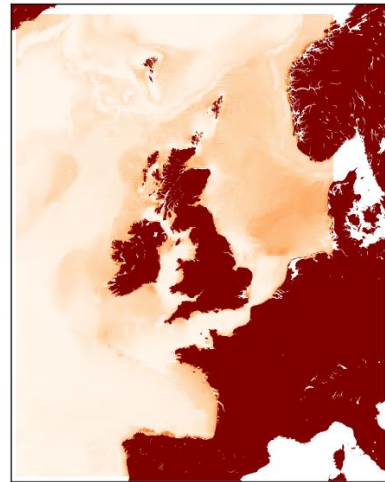
zoopl

bacteria

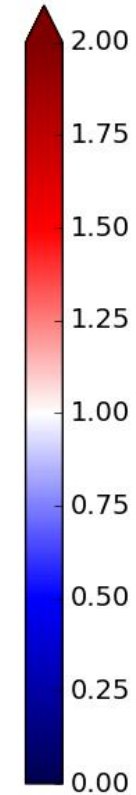
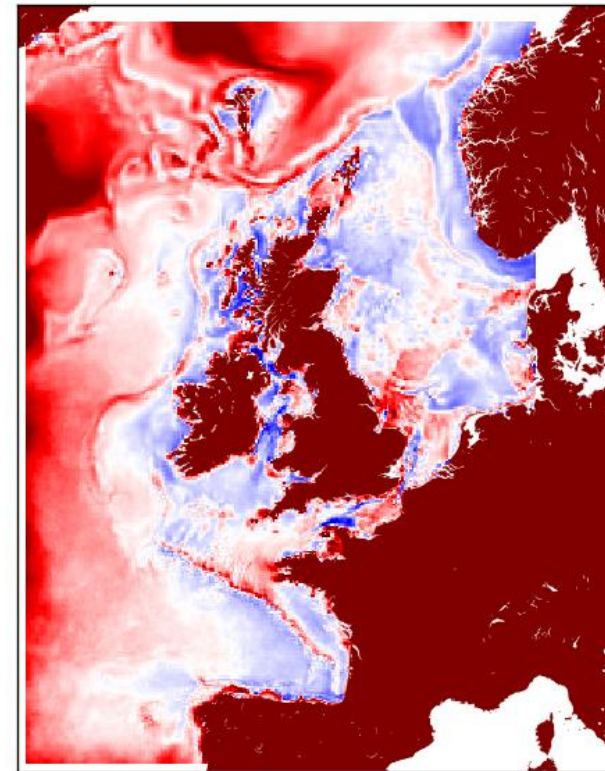


benthos

Major source



PhyNuptake/Nremin

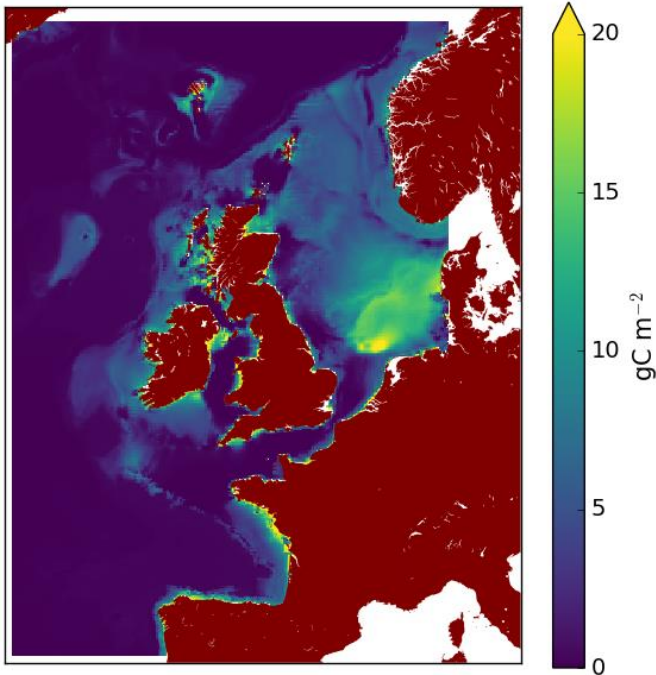


Extra sources needed

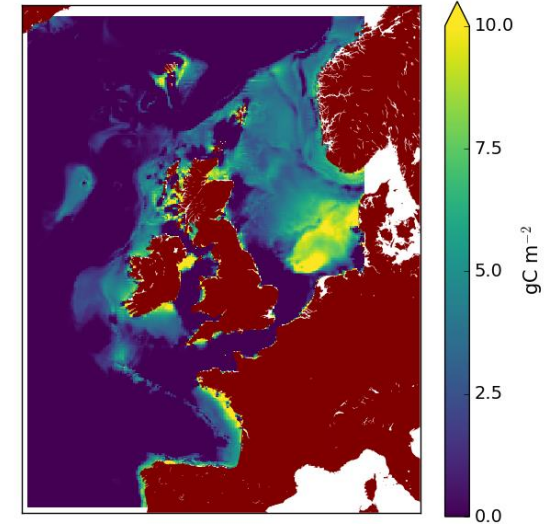
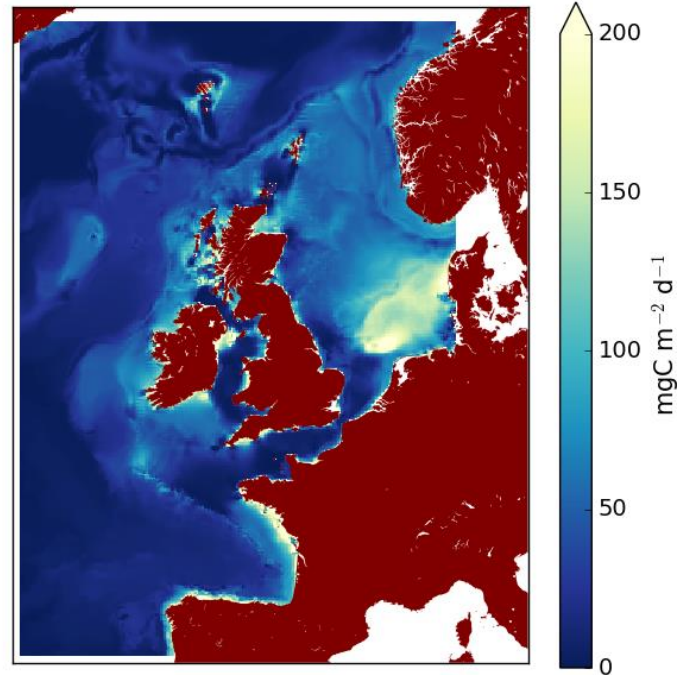
Local sources sufficient

Biogeochemical dynamics: benthic-pelagic coupling

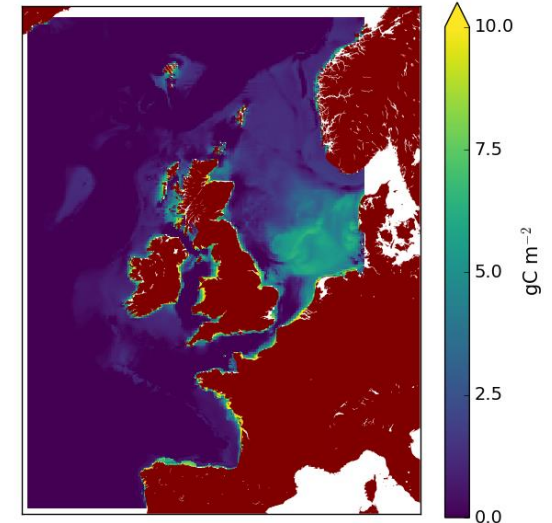
Total fauna



Export C



Deposit feeders



Suspension feeders

Scenarios

Based on v0

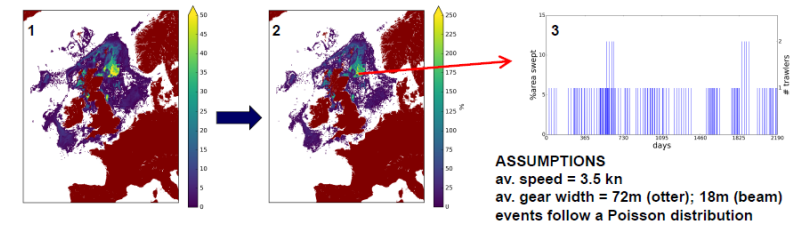
- Climate run (up to 2050, RCP 8.5)
- Trawling → see poster
- Marine Protected Area
- (de-)Eutrophication
- Climate + trawling + MPA + Eutrophication

Modelling impact of bottom trawling on carbon cycling

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¹ Plymouth Marine Laboratory (*yuti@pml.ac.uk) – ² Centre for Environment, Fisheries and Aquaculture Science¹

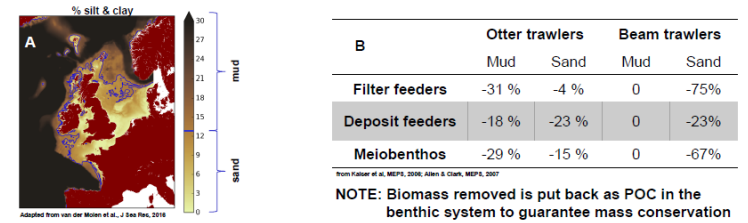
Trawling effort

VMS data for the three major trawling fleets (otter trawlers (1), beam trawlers and nephrops trawlers) have been converted in average trawling coverage (expressed as % of the grid cell area swept every year (2)) and then the daily timeseries of active trawlers has been generated (3)



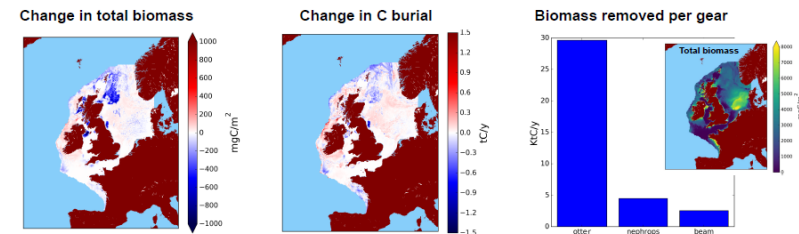
Single trawler impact

The impact of a trawler on benthic fauna depends on the sediment type (A) and gear type (B) and it has been scaled by the %area swept by the trawler in that day



Shelf wide impact

Pictures show outputs from year 2010 (model ran with trawling since year 2000)



Summary and limitation

Total faunal biomass decreases locally up to 1000mgC/m² (and up to 33%). Decrease in biomass leads to a decrease in activity and a consequent small reduction in C burial (-100t/y, <1%). Model underestimates impact of beam and nephrops trawlers because it underestimates total biomass in shallow high energy areas where beam trawling is focussed.

Conclusions

- ERSEM 16.06 (v0) slightly more reliable
- Model developments has proven to give important scientific insight, however they need more robust 3D parameterisation and data
- Shelf CO₂ sink $\sim 30\text{TgC y}^{-1}$
- Shelf N mineralisation equals N uptake, high variability
- Physical drivers crucial to shape benthic community
- Tonnes of data to analyse (18TB) collaborations welcomed

