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INSTITUTE OF MARINE SCIENCES

IMS METU contribution to EURO BASIN WP2 and WP6

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22 October 2013

EURO-BASIN Annual meeting,
Istanbul 22-24 October 2013

IMS contribute:

WP2 (task: 2.4)
Development and implementation of a new algorithm for particle flux

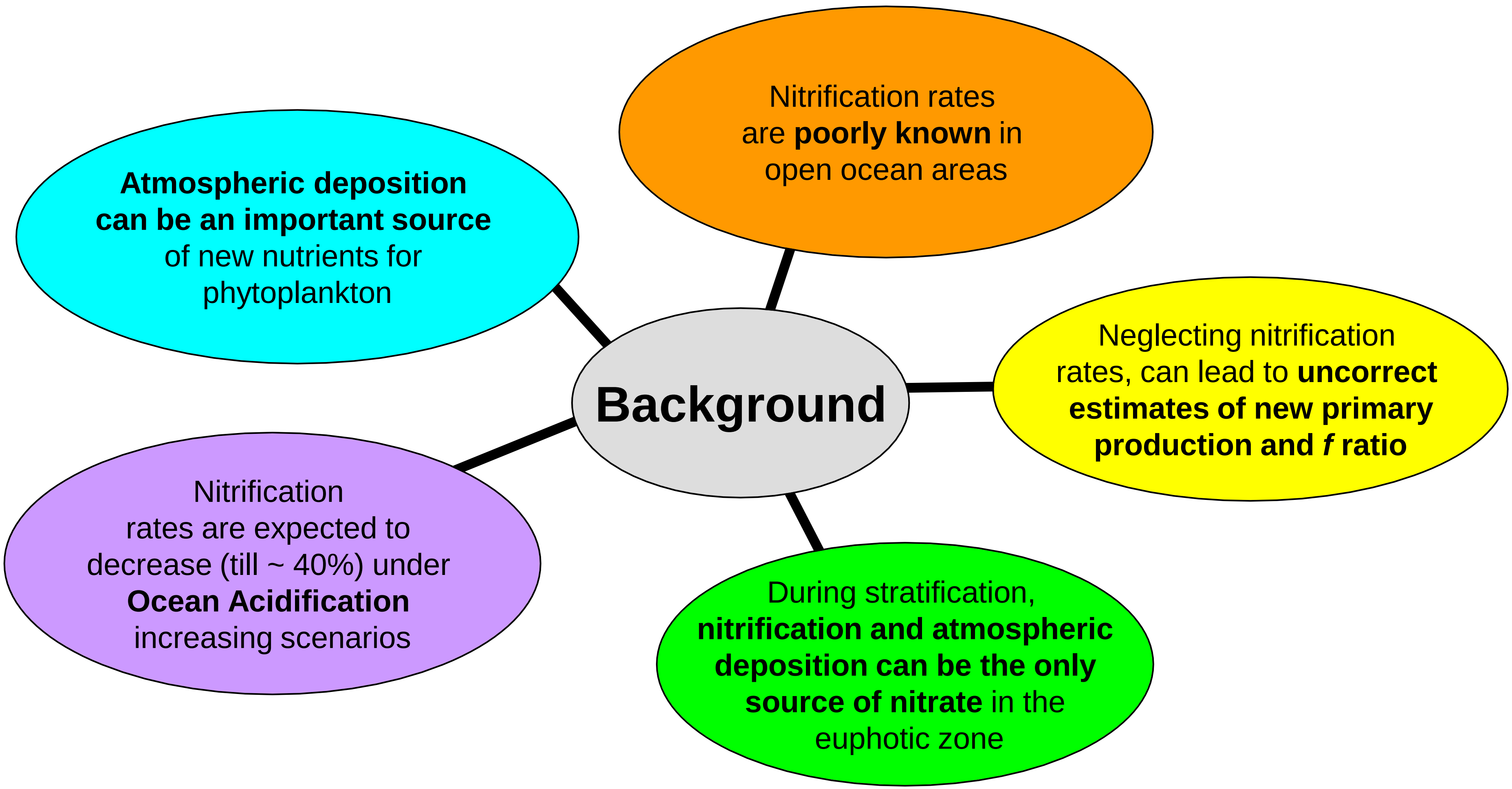
WP6 (task: 6.2)
original plan: NEMO-SHELF-ERSEM high resolution simulation (1/12) for 1980-2005

in addition

Participation to PAP site cruise (30 May-18 June)

Study of specific prosesses of nitrogen cycle:
- → nitrification
- → nitrogen uptake
- → atmospheric deposition
- → impact of ocean acidification on nitrification

Experimental work at PAP-cruise 2013: Nitrification Rates, Nitrogen Uptake, Atmospheric Deposition *(contribution to WP2)*

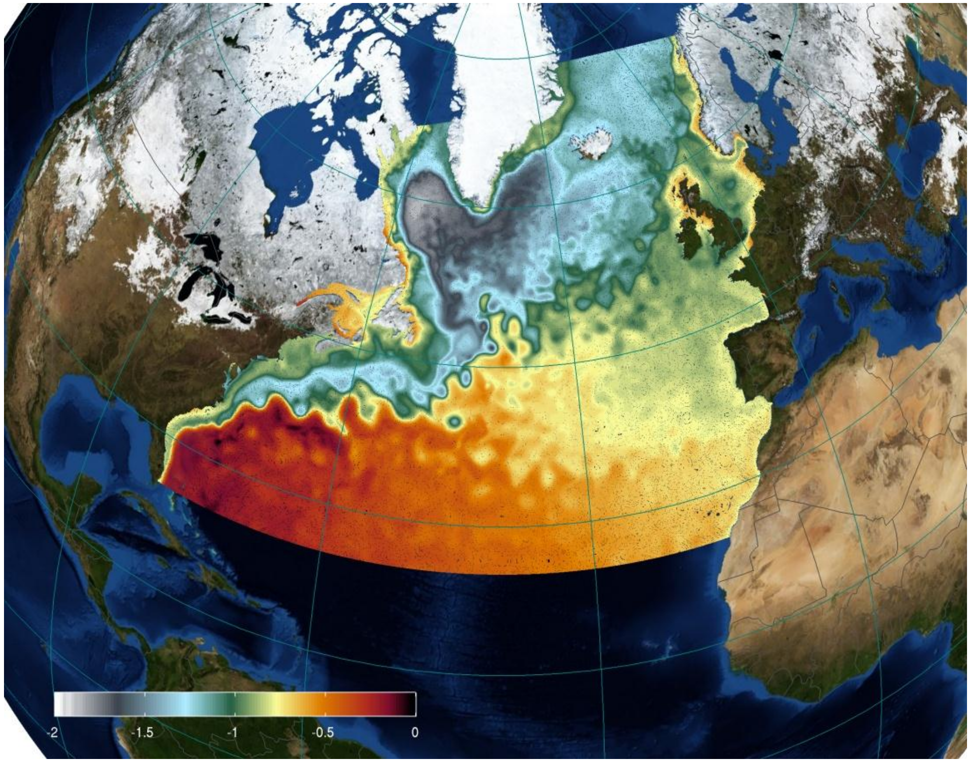


How do experiments on nitrogen cycle (PAP-cruise 2013) contribute/link WP2 and WP6?

1. New data of new production, regenerated production, and *f-ratio* (for model validation). Implications on new production estimates based on nitrate.

2. Very new data on nitrification rates in North Atlantic to update parameterization in ERSEM

WP6: 1/12 hindcast NEMO shelf-ERSEM



- Strong collaboration with NOC-Liverpool
- Testing new parameterization for ERSEM specific for North Atlantic

Deliverables 6.3, 6.4, 6.5, 6.6

Need of remodulation of simulation outputs to be compliant with deadlines (Dec. 2013)

Quantifying parameter uncertainty in WP6

Set up of 1D-GOTM-ERSEM in 3 timeseries-sites of North Atlantic (BATS, PAP, ESTOC) characterized by different biogechemical dynamics

↓

Testing a new COMMON parameterization:

- → optical and photosynthesis –irradiance curve parameters
- → microbial loop parameters
- → trophic structure parameters

↓

Transferring the new parameterization in 3D NEMO-ERSEM simulation (1980-2005, 1/12°)

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Carbon export algorithm advancement in models PAP, BATS and ESTOC test case

EUROBASIN

T2.4 - Development and Implementation of Novel Algorithms for Particle Flux

V. Çağlar Yumruktepe, Barış Salihoğlu, Adrian Martin

22 October 2013

AIMS OF THIS WORK

EURO-BASIN
BASIN SCALE ANALYSIS, SYNTHESIS AND INTEGRATION

•Partners of EUROBASIN are conducting cruises, mesocosm experiments and laboratory work focused on the fate of carbon in the water column, and data collected will be utilized for generation of new algorithms and parameterizations.

•**The main aim of my research is to incorporate these improved algoritms of the downward flux of particulate organic carbon in 1D ecosystem models, compare and test their effectiveness and success with respect to existing algorithms.**

•**Second goal of this work will be to transfer the set of successful algorithms into 3D models that are run globally with the aim of improving our understanding of the global carbon budget.**

Links between tasks and WPs

The 1D model is at the stage of implementing information from WP1 and WP2 Tasks 1, 2 & 3

Task 2.1 – Laboratory and Mesocosm Exp.

- Formation
- Sinking velocities
- Effects of minerals
- Decomposition and remineralization of aggregates
- Effects of dominant phytoplankton (diatom vs coccoliths), mesozooplankton on aggregates

Task 2.2 – Cruises

- Linkages between nutrients, phytoplankton community composition, grazing, aggregation and carbon flux

Task 2.3 & WP1

- Literature and historical data input

Task 2.4 – Development & implementation of novel algorithms

- Test the information taken from other WP2 Tasks, implement them in the 1D model, evaluate the results with the historical datasets

WP6

Successful set of algorithms & parameterizations will be transferred to WP6 to be included in 3D models

Evaluation of existing model algorithms

Investigation of existing models, algorithms and parameterizations from the literature

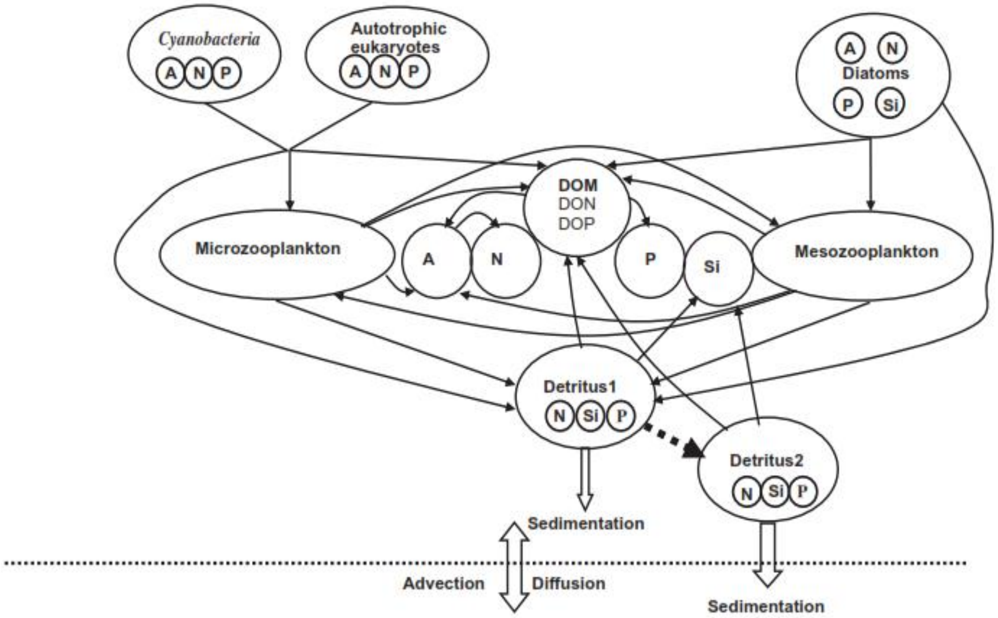
Preperation of a generic 1D model for testing the algorithms

A cross-basin modelling study will be done at three sites in the NA with different characteristics. This will give us the chance to evaluate the algorithms at different locations and environments

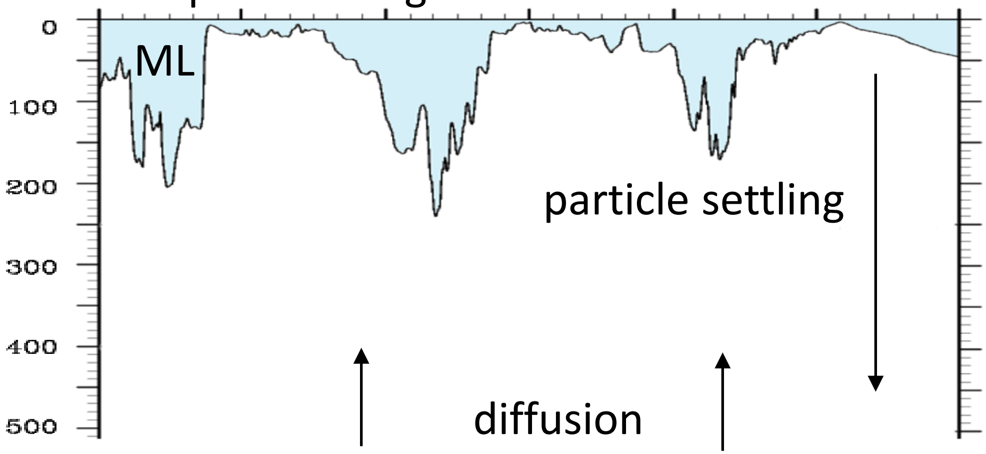
BATS, PAP and ESTOC

Test the algorithms and the 1D model and its generic capabilities

Different existing and new algorithms that are developed by latest measurements will be tested by the 1D modelling framework, and will be used to investigate the structure and magnitude of the biological carbon pump



Salihoglu etal, 2008, DSR



Nutrient forcing at bottom boundary

Schematic of the lower trophic ecosystem model used for testing purposes:

- Decoupled C/N/P/Si/Chl dynamics
- 3 PFT's (cyanobacteria, autotrophic eukaryotes, diatoms)
- 2 zooplankton
- POM & DOM

Improvements:

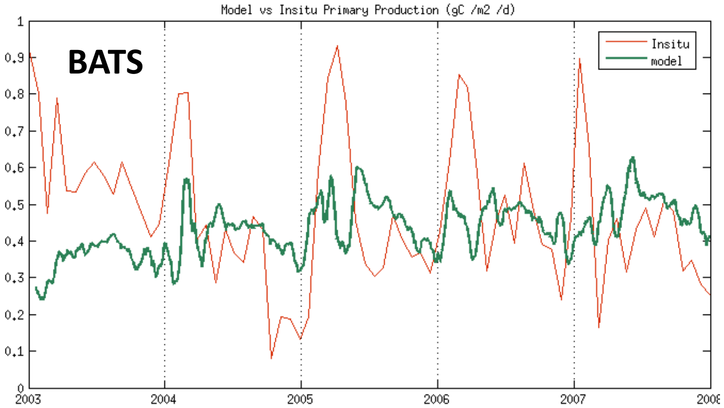
- The model was recoded in F90, the code was improved for easier algorithm implementation and post-processing
- Vertical structure extended down to 3000 m
- Phyto growth & uptake rates, stoichiometry and grazing were revised wrt recent literature

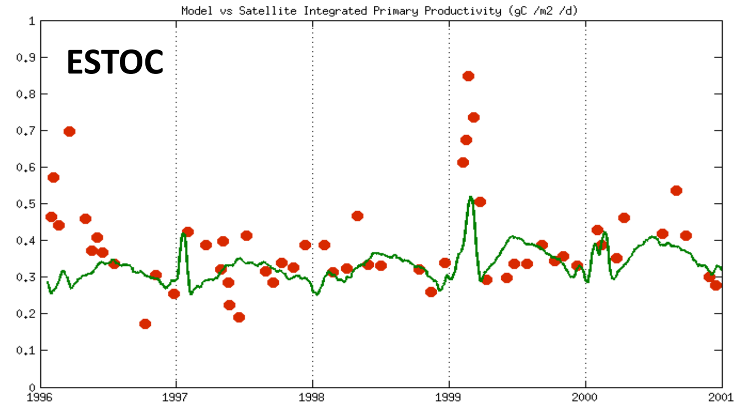
Physical setting used for 3 of the sites:

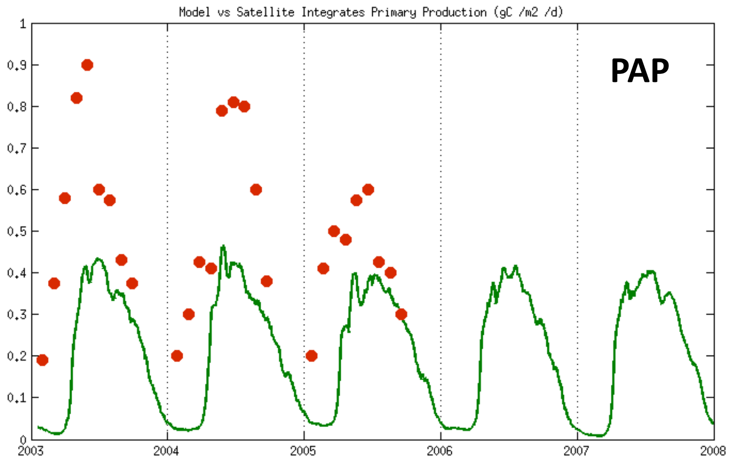
- Mixed Layer is calculated from the observations, and homogenous mixing is forced within the ML.
- Diffusion is the main force below the ML
- Particles have the tendency to settle
- 1 m vertical resolution down to 3000 m

Comparison of model results in 3 of the timeseries stations

Primary Productivity:





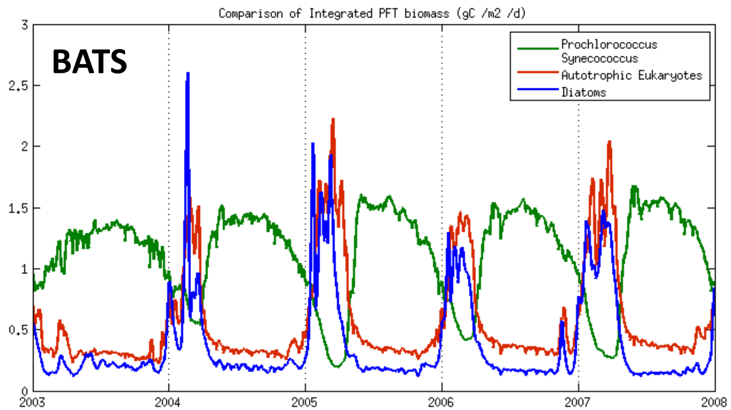


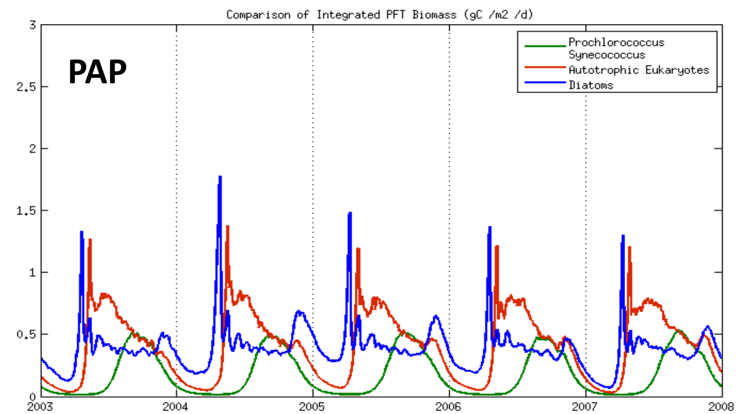
- PP levels are in good agreement with the overall magnitude of PP at BATS and ESTOC, however miss the peaks in production at PAP.
- The pronounced pulse of productivity at BATS is more towards winter/spring, whereas at PAP, this pulse is more towards end of spring/summer.
- Further improvements are in need, such as light vs chlorophyll vs growth algorithms.

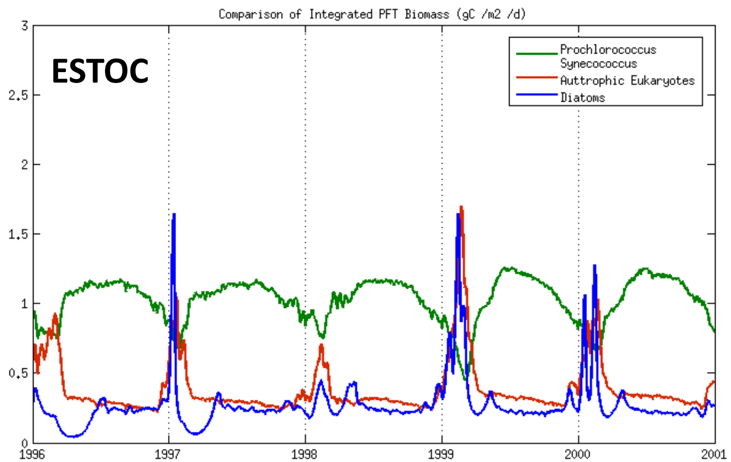
REF: Hartman etal, 2010, DSR II
Neuer etal, 2007, Prog. Ocean.

Comparison of model results in 3 of the timeseries stations

Phytoplankton Functional Types:



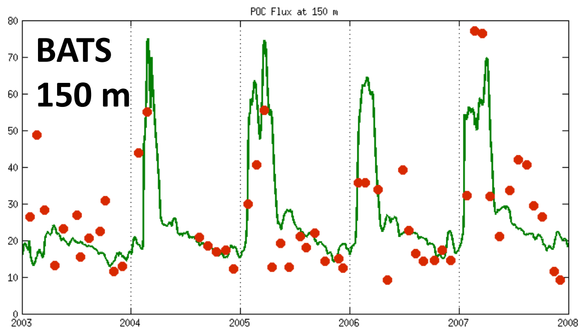


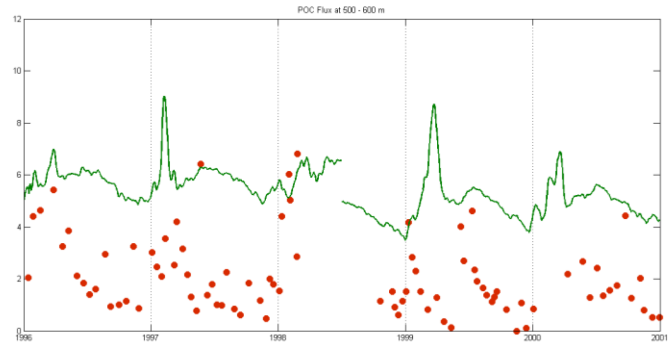


- There is a clear evidence of shifting dominance of phytoplankton within different seasons. At BATS and ESTOC, in summer months, prokaryotes dominate the PFT abundance.
- Due to the availability in nutrients and light, the clear spring bloom in all of the stations are due to the presence of larger cells, mostly diatoms.
- Pronounced eukaryotic blooms continue towards summer time at the PAP station, suggesting that nutrients are still abundant to support larger cell growth.

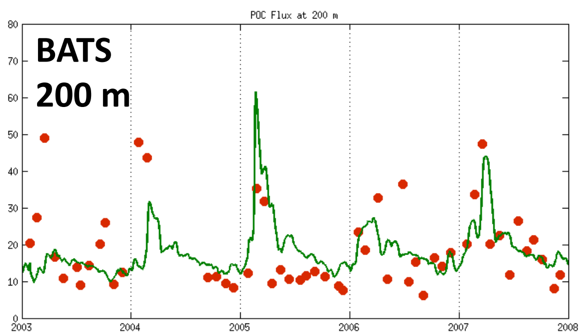
Comparison of model results in 3 of the timeseries stations

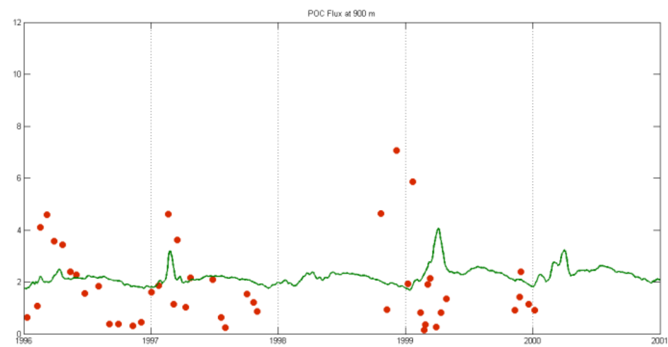
POC export:



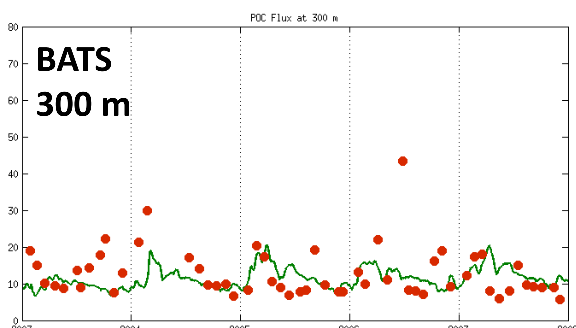


ESTOC
500 - 600 m





ESTOC
900 m

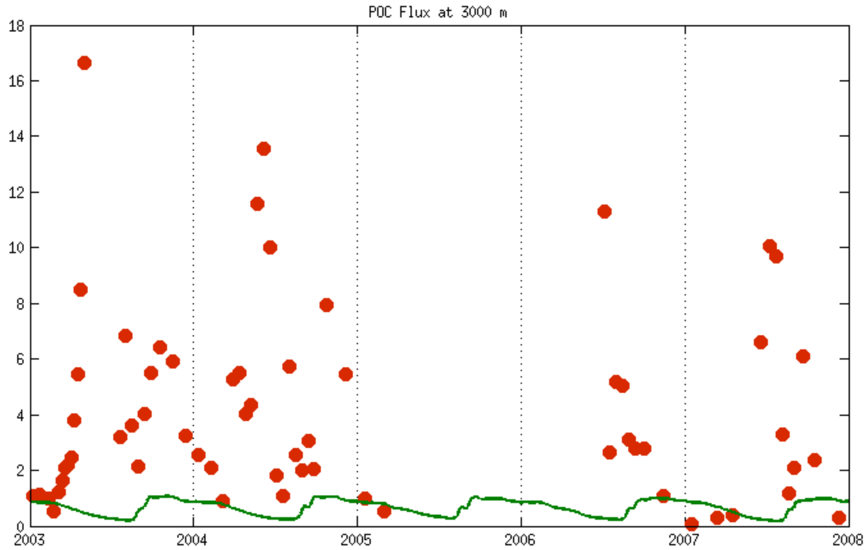


- Main purpose of this modelling study is to investigate the carbon flux to the ocean interior.
- Present setup of algorithms and parameterizations simulates the carbon flux with good agreement with the observations within the near surface regions of the ocean interior (0 – 1000 m).
- Peaks in export in spring months, especially at BATS station, are captured well (150 – 300 m).

Ref: WP2

Comparison of model results in 3 of the timeseries stations

POC export:



PAP 3000 m

- Flux at the PAP site, however, results with a different picture.
- The model uses constant aggregation and temperature dependent remineralization rates at the moment.
- Within the current setup, due to technical reasons, sinking rates of fast sinking detritus is rather slow compared to the observations
- Within the time for the fast sinking detritus to reach the deep ocean (3000 m), most of it is eroded with the current simple parameterization.

Main focus of algorithm development is (with feedback from WP1 & 2):

- PFT structure
- Organic matter dynamics(POM & DOM)
- Explicit bacterial interactions
- Grazing
- Vertical movement of zooplankton
- Aggregation
- Ballasting

Initial set of parameters that was used in the common modelling study of BATS, PAP and ESTOC will be provided to WP6

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