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Phytoplankton stoichiometry: the (missing) link between grazing and recalcitrant DOM production

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SHELF SEA BIOGEOCHEMISTRY

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Background

In the first par of the project

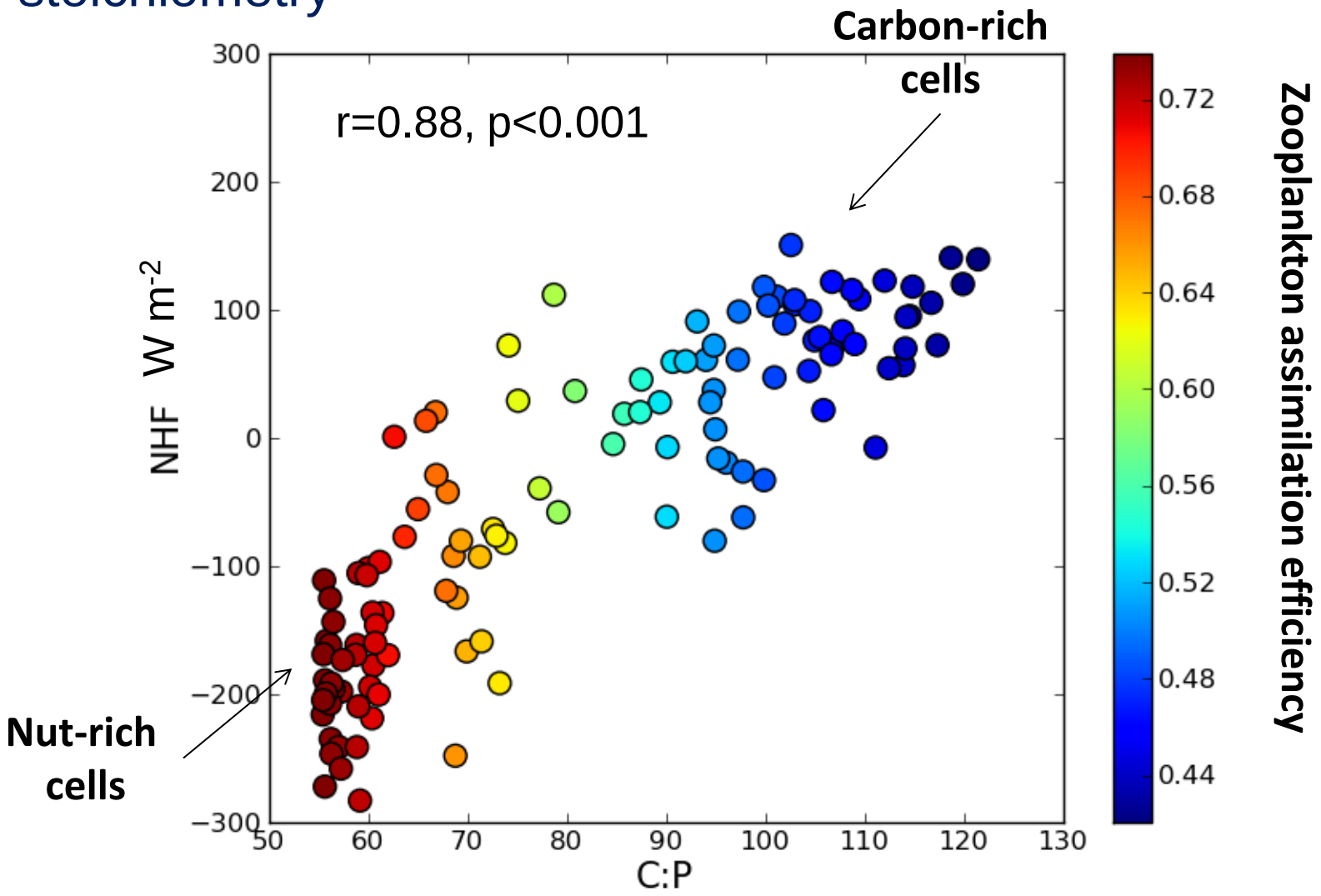
we investigated the role of phytoplankton nutritional status in the formation of the spring bloom regularly observed at the station L4 in the Western English Channel (*Polimene et al., 2015*)

In that work we proposed that:

the increase in light from winter to spring induces a decrease in diatom nutritional status thereby reducing their palatability and allowing them to bloom.

SHELF SEA BIOGEOCHEMISTRY

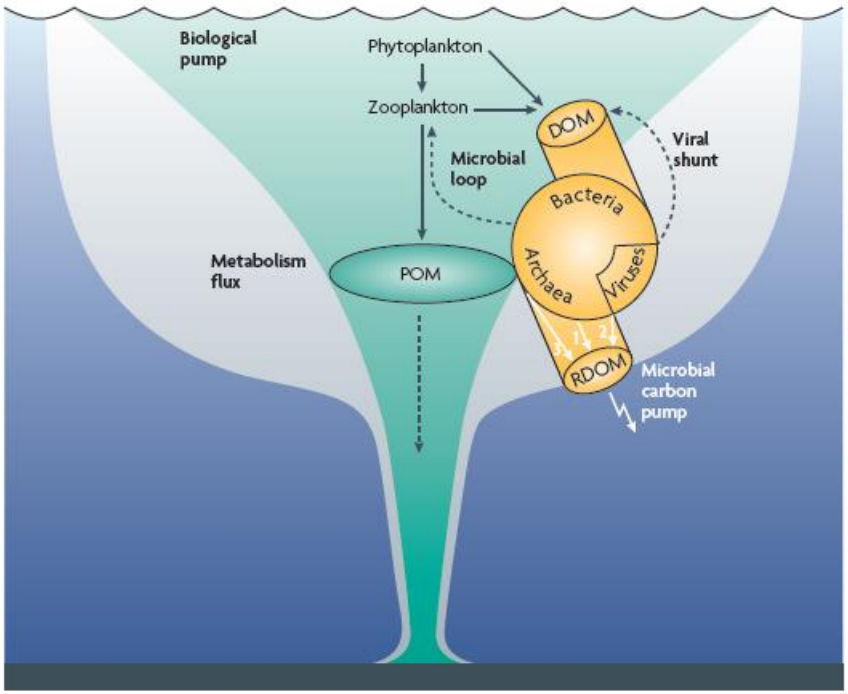
Emerging correlation between modelled NHF and diatom stoichiometry



(Polimene et al., 2015)

Background 2.

Here we go further, investigating the role of phytoplankton stoichiometry on recalcitrant DOM production



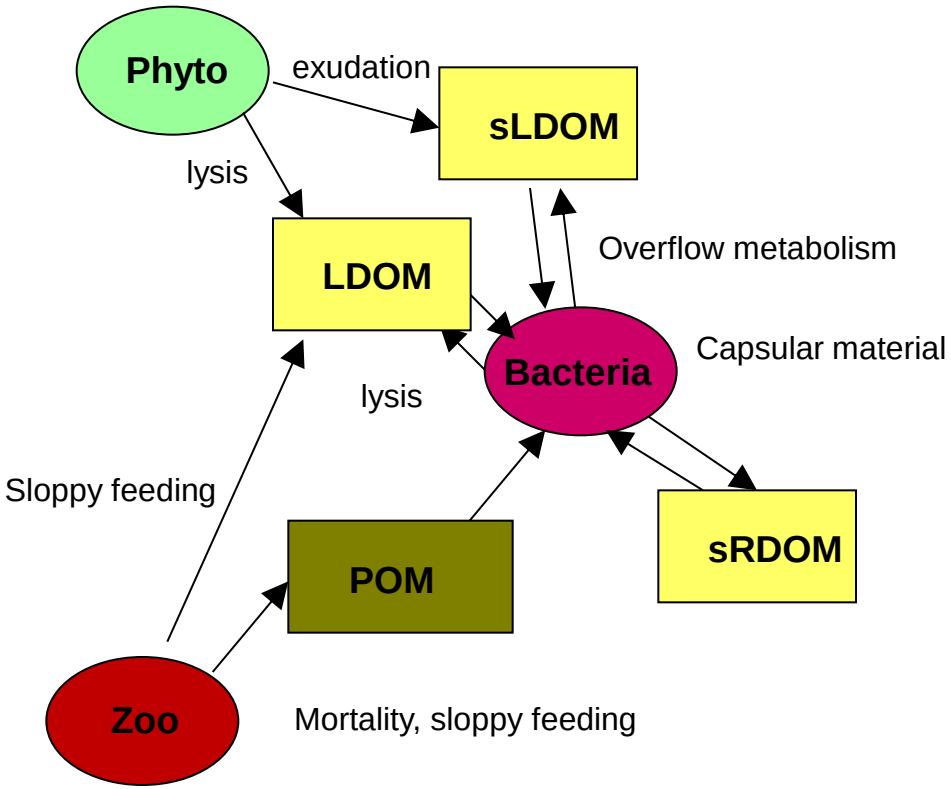
- RDOM accumulates in the ocean at different time scales
- Bacterial production of RDOM could be an important mechanism for carbon storage
- Up to 4.5 % of annual netPP could be processed through the MCP (Benner and Herndl, 2011)
- MCP:BCP could vary depending on nutrients

Jiao et al., 2010 (*Nature Reviews Microbiology*)

Jiao et al., 2014 (*Biogeosciences*)

The ERSEM Bacteria-DOM submodel

(Polimene et al., 2006 and 2007)

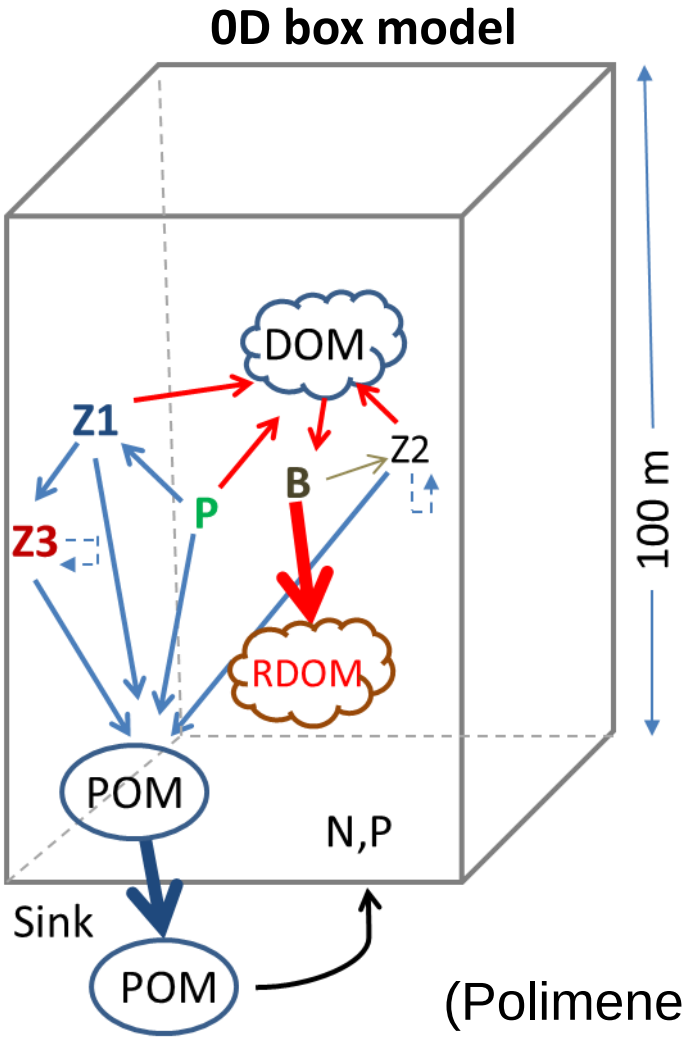


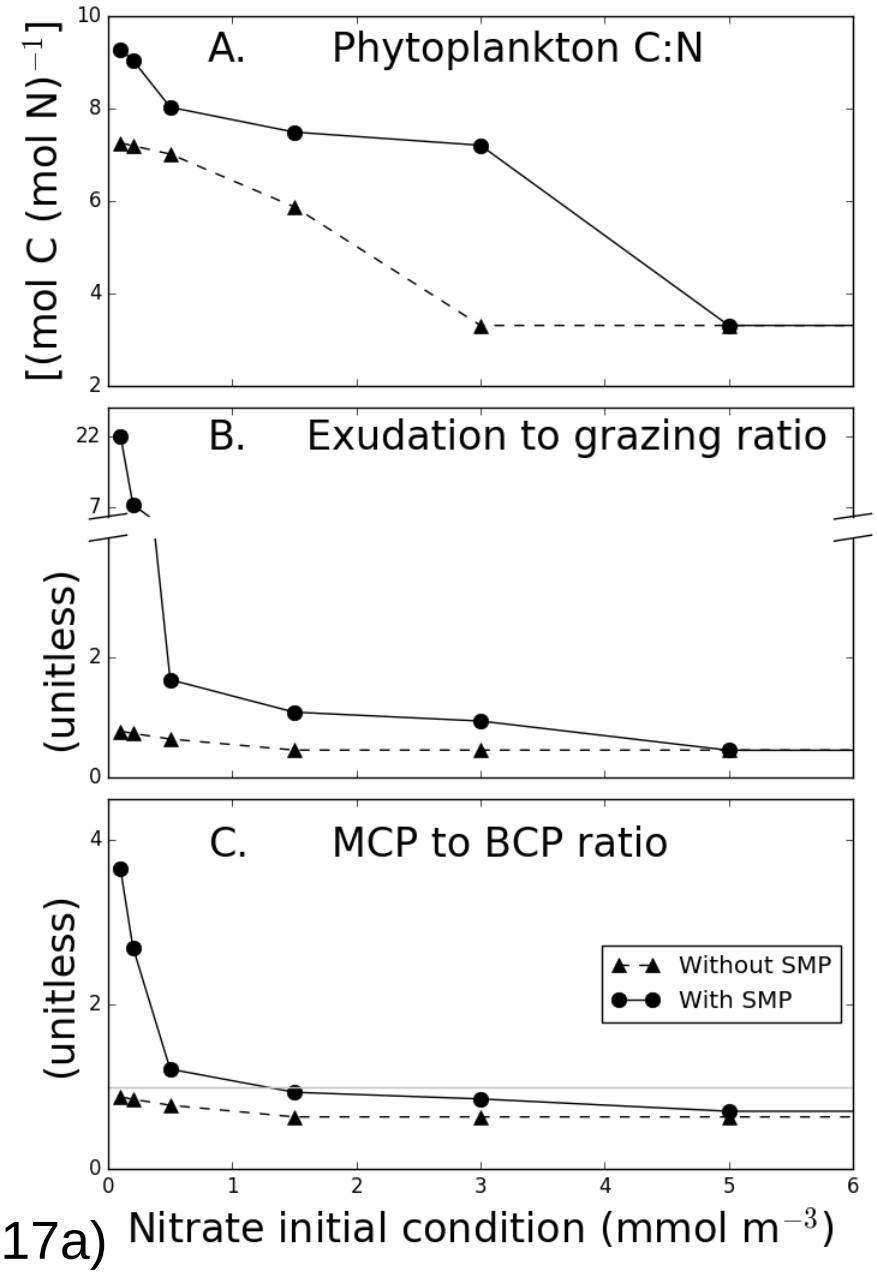
Model characteristics:

- Variable stoichiometry (in bacteria and DOM)
- Labile, semilabile and semi-refractory DOM
- *Bacteria RDOM production* and variable BGE (depending on nutritional status)

A theoretical approach

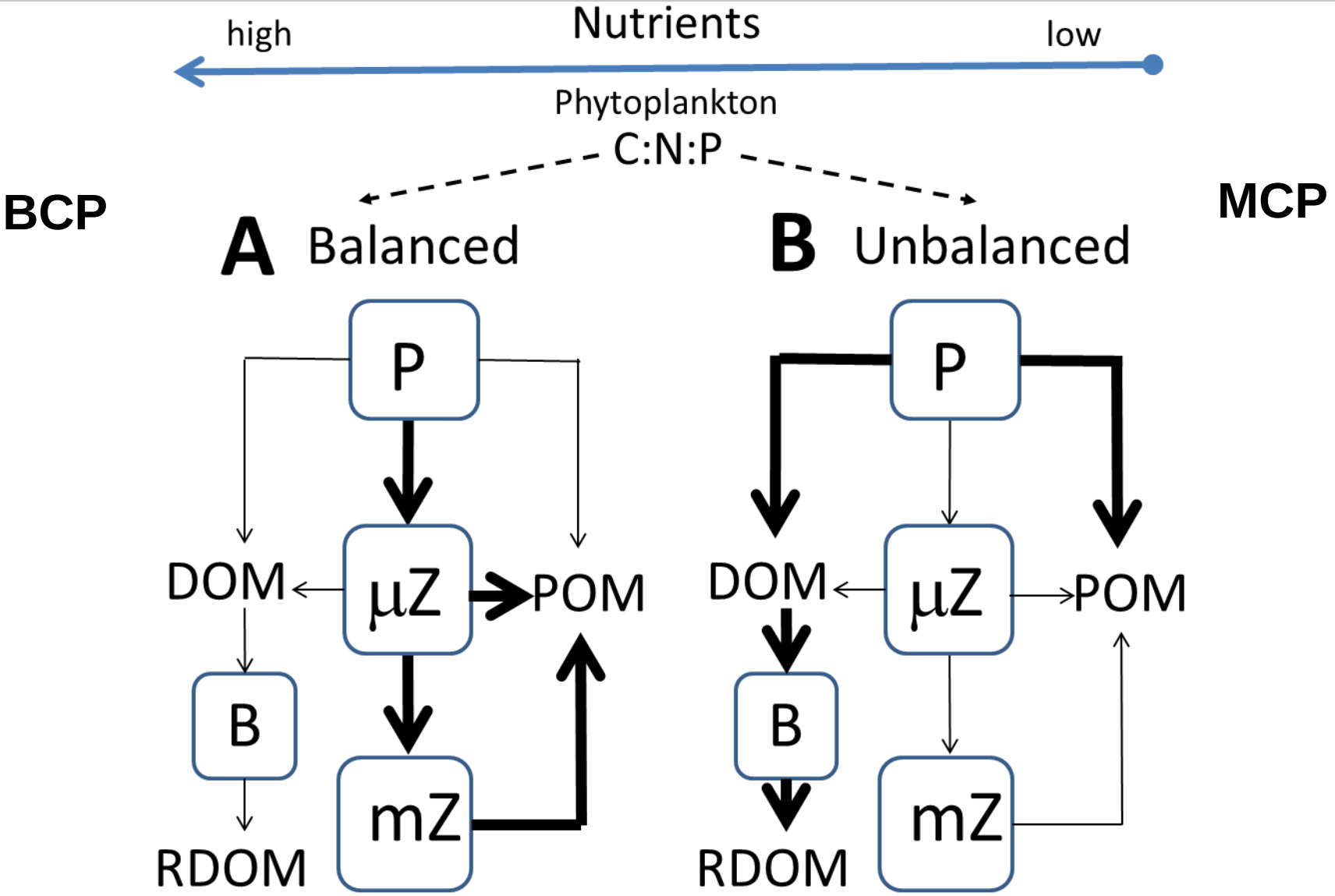
A first attempt to simulate MCP dynamic in relation to BCP





(Polimene *et al*., 2017a)

Our conceptual framework



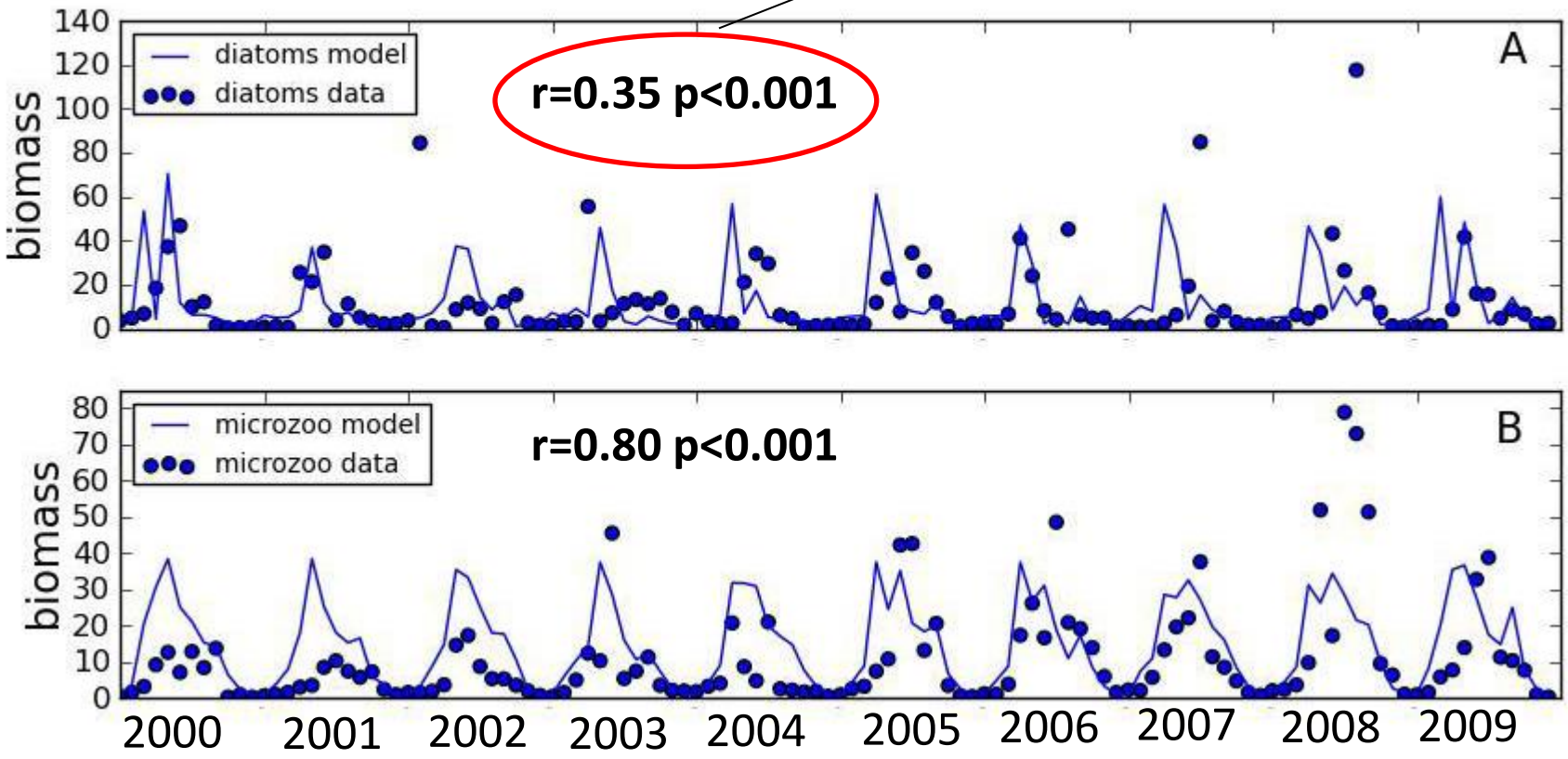
(Polimene *et al*., 2017a Journal of Plankton Research)

Model validation: in situ

Correlation (Spearman) between observed and simulated variables

PO4, r=0.61
NO3, r=0.80 } P<0.001
Si, r=0.67

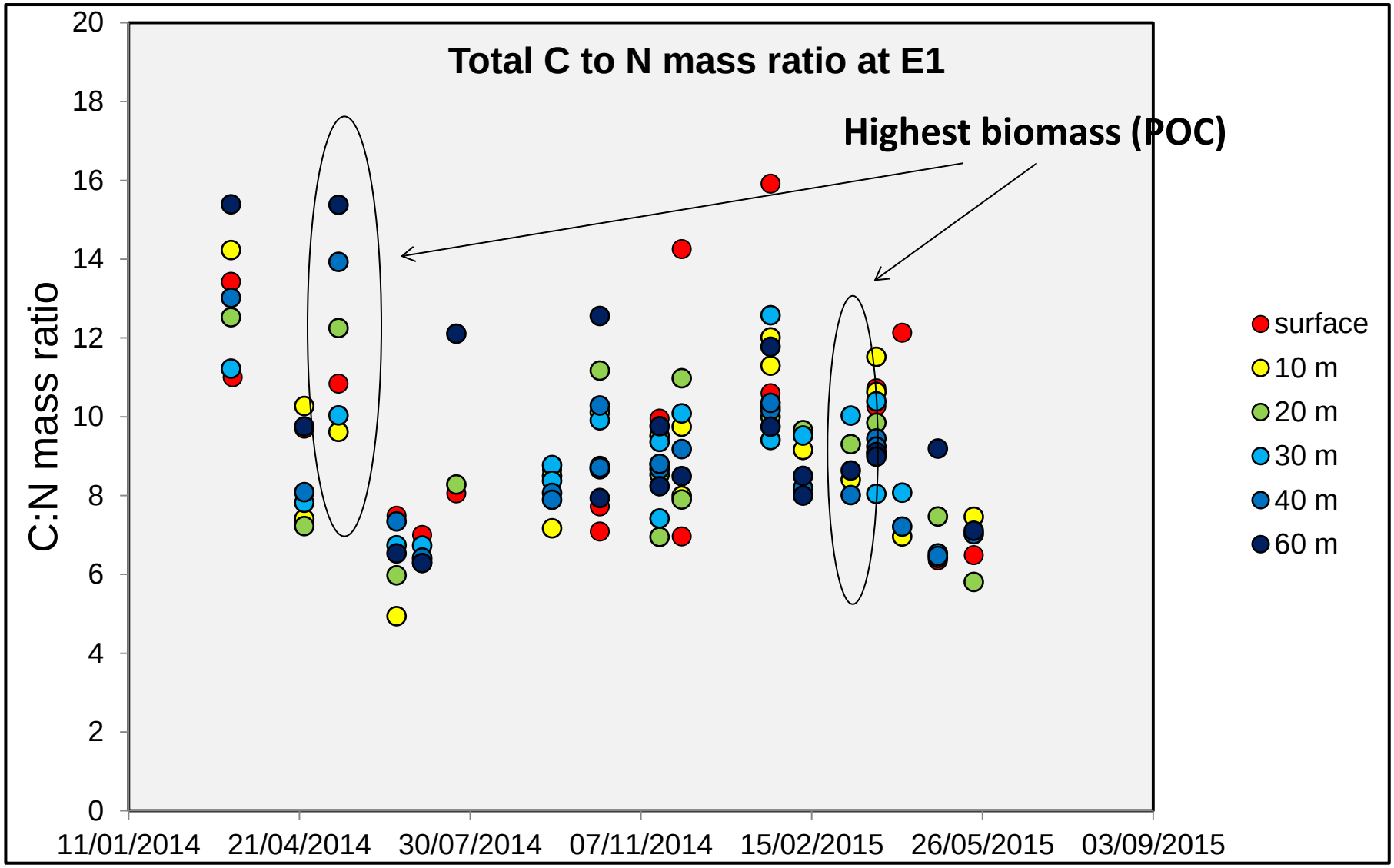
Improved with respect to the model without SMP (r=-0.16!)



(Polimene et al., 2015)

Model validation: in situ

C:N ratio in particles!



Model validation: in vitro (Polimene et al., 2017b)

Degradation and transformation of phytoplankton-derived DOM by the marine bacterium *Alteromonas sp*

Diatom culture
(Chaetoceros calcitrans)

phytoplankton cells were lysed to generate a DOM-rich medium (DOM “soup”)

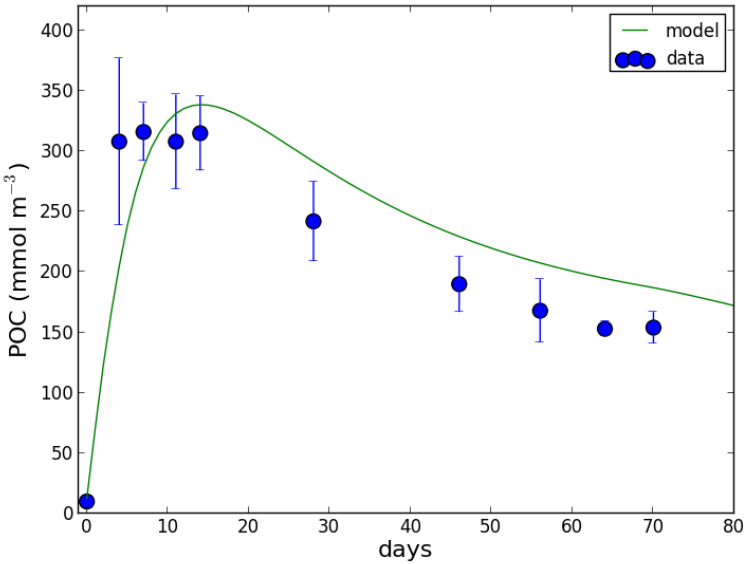
DOM “soup”

Bacterial culture (3 replicates)

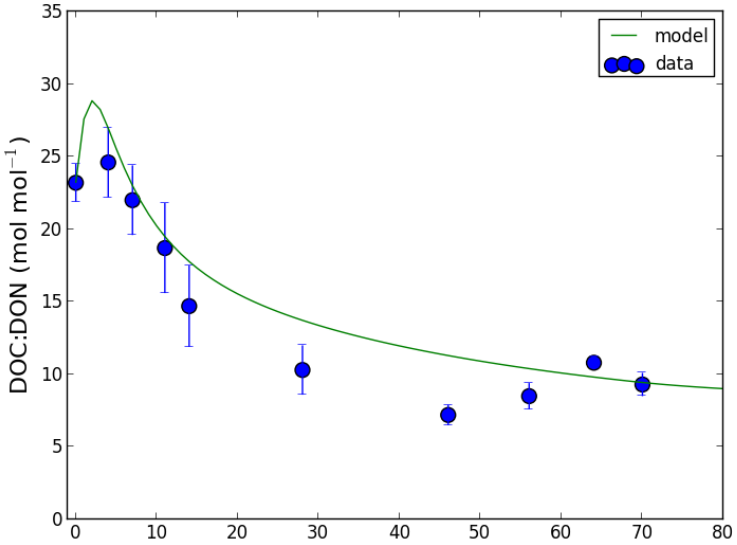
The cultures were placed at a temperature of 15 C and followed for 170 days

Model validation: in vitro (Polimene et al., 2017b)

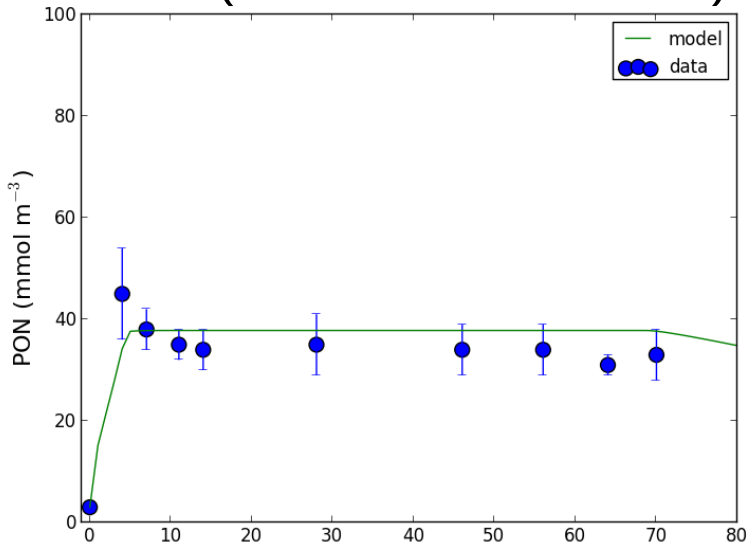
POC (bacterial C-biomass)



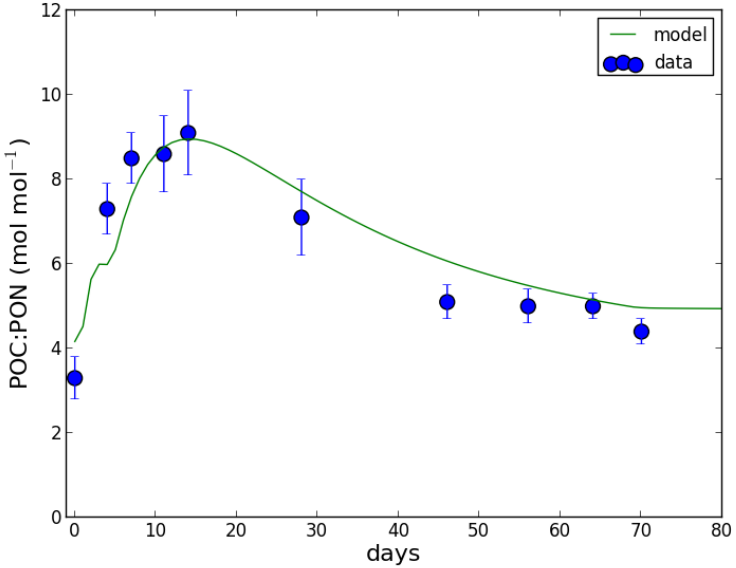
DOC:DON



PON (Bacterial N-biomass)



POC :PON



Summary

- Phytoplankton stoichiometry plays a key role in regulating ocean C fluxes
- ERSEM has the potential to simulate the MCP under changing nut.
- ERSEM bacterial sub-model corroborated by a fine scale process validation
- Truly refractory DOM needs to be considered

Future works:

RDOM production under different environmental conditions:
(Temperature, O2, pH, nutrients)