BASIN Meeting
Rutgers June 3rd-4th 2010

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Oceans 2025

Basin-scale Analysis BASIN Synthesis, and INtegration

National Oceanography Centre, Southampton
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

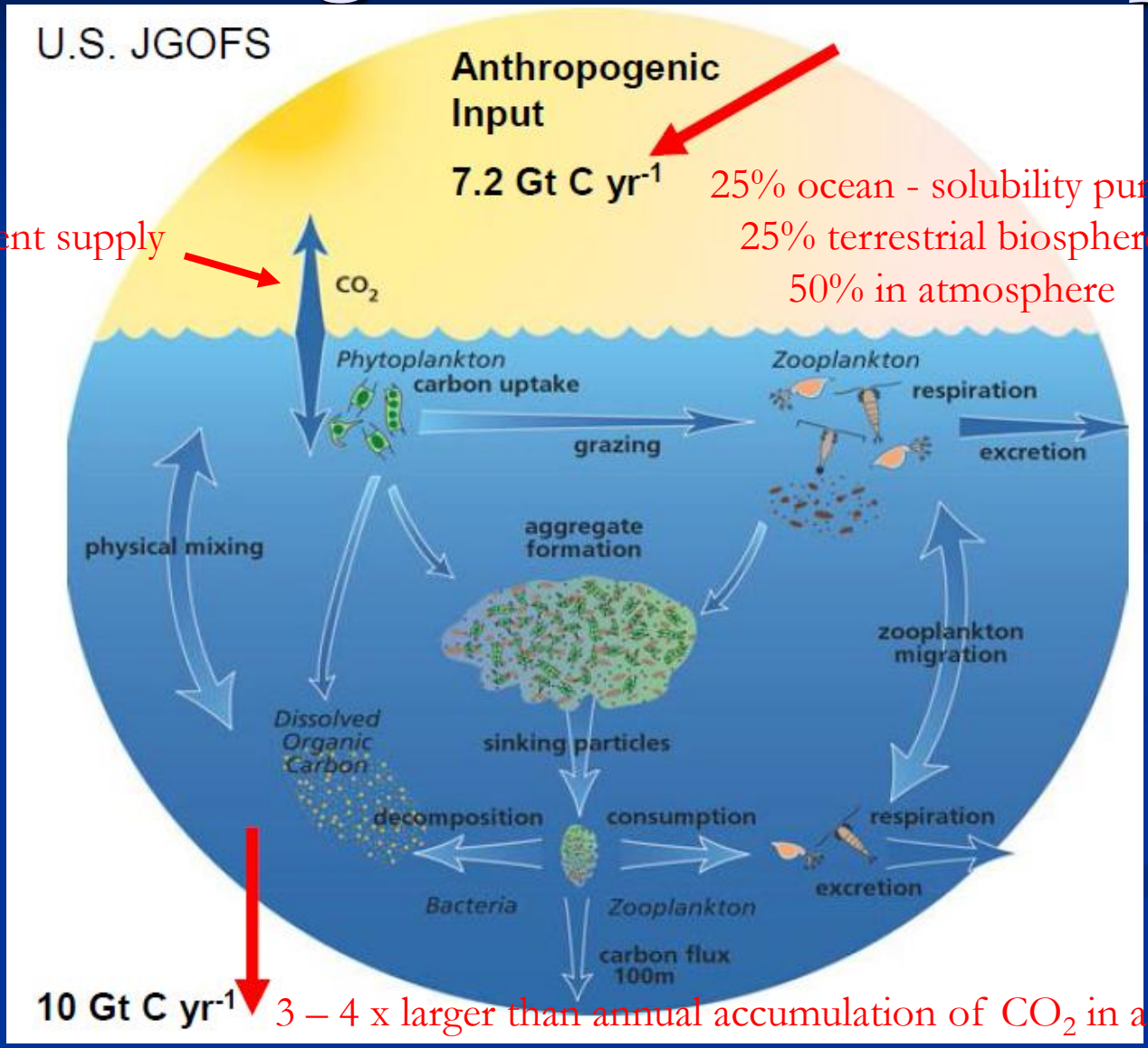
BASIN Objectives

- - to understand and simulate the population structure and dynamics of broadly distributed, and trophically and biogeochemically important plankton and fish species in the North Atlantic ocean
- - to resolve the impacts of climate variability on marine ecosystems and the feedbacks to the climate system
- - to develop understanding and models that will advance ocean management

EU BASIN programme

- Ca 8 Million Euros
- Multiple partners
- Submitted end 2009, now in negotiations to start October 2010 for 4 years
- 7 Work Packages
- WP2 is the Biological Carbon Pump

The Biological Carbon Pump



Control via nutrient supply

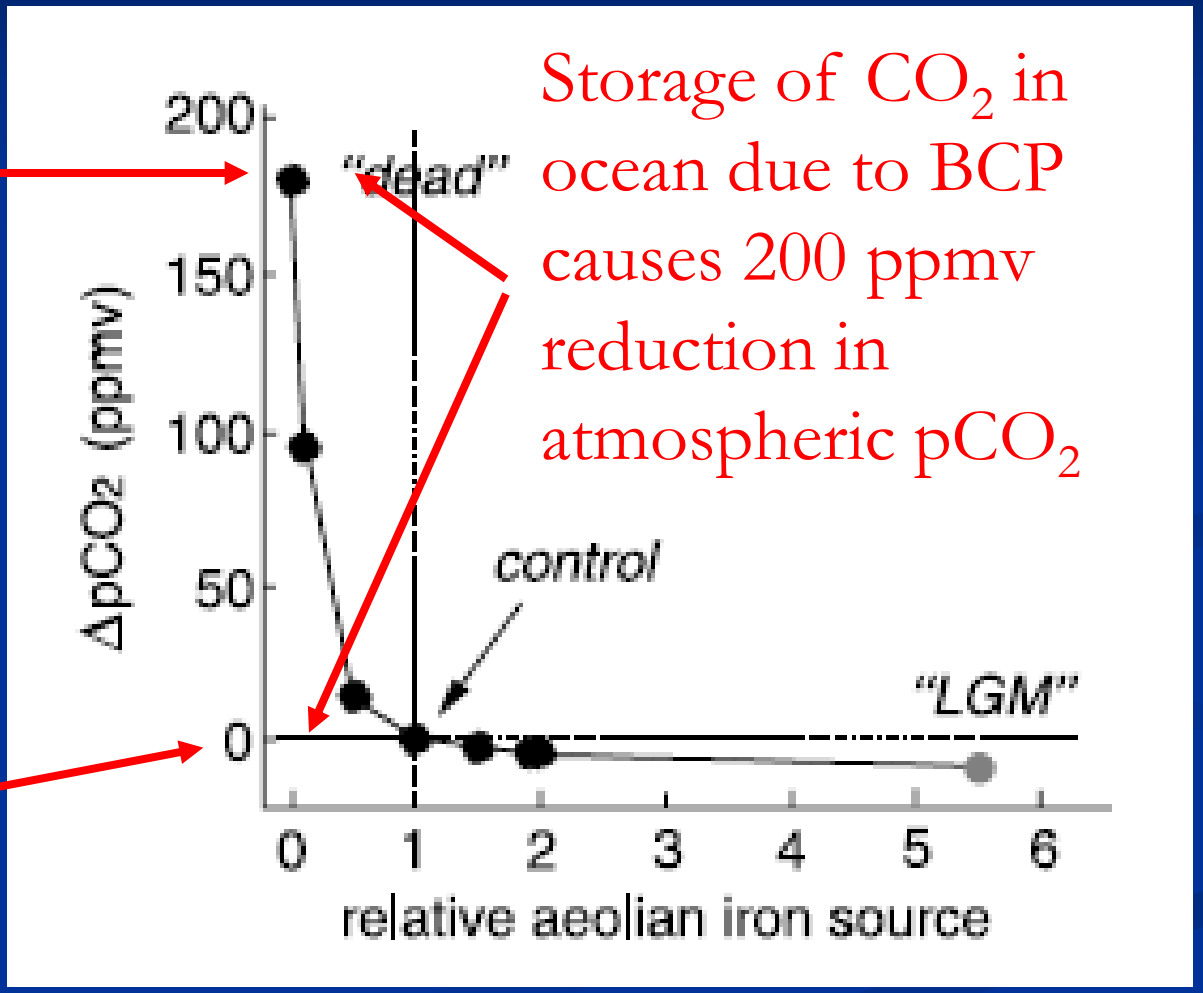
25% ocean - solubility pump
25% terrestrial biosphere
50% in atmosphere

3 – 4 x larger than annual accumulation of CO_2 in atmosphere

How important is the BCP

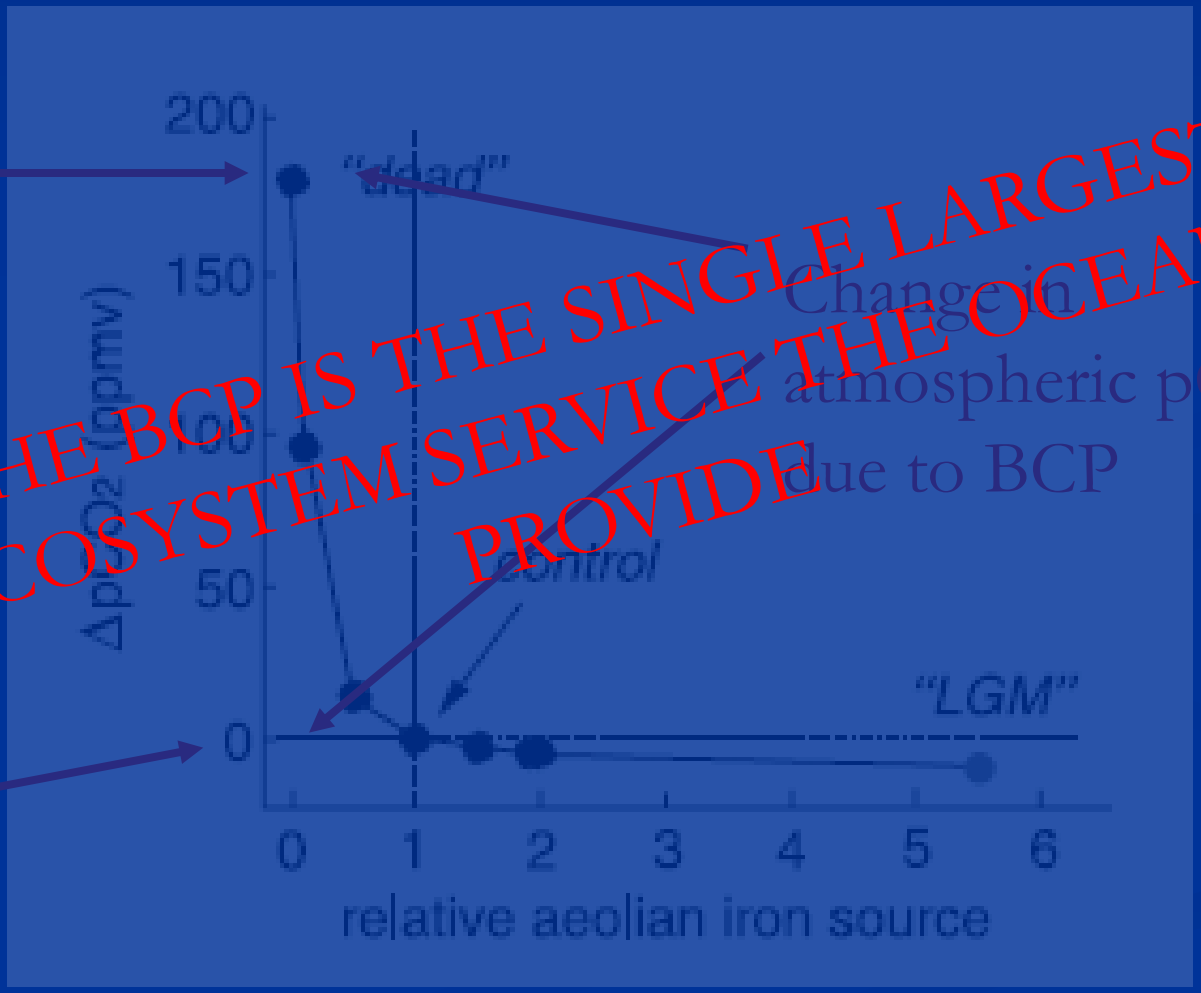
No BCP

Modern BCP



Parekh et al., 2006, GRL

How important is the BCP



No BCP

Modern BCP

Change in atmospheric pCO2 due to BCP

THE BCP IS THE SINGLE LARGEST ECOSYSTEM SERVICE THE OCEANS PROVIDE

Parekh et al., 2006, GRL

Current topics in BCP Research

- How big is the BCP, what is its spatial distribution?
- How does the BCP function?
  - How do nutrients get into photic zone?

    Sets upper limit on BCP (mixing, turbulence, mesoscale)
  - What prevents complete nutrient utilisation?

    Iron in high latitudes, nitrogen fixation in low latitudes
  - How does material flux down through ocean?

    Ballast effect (OA), particle morphology, observed mismatch between interior respiration and reduction in downward C flux
- How will the BCP change?
  - Small fractional change change could affect partitioning of CO_2 between ocean and atmosphere

Cannot do everything – need to focus!

- Models only real way to predict response to change
- But Models have imperfections and need new information to improve their skill
- Focus observations on those parts of the BCP whish we understand least well
- Develop new parameterisations to take account of these, trial them in models,

What do we understand least well

- Supply of nutrients to photic zone – submesoscale – the next big climate challenge
- Controls over nutrient utilisation – iron vs grazing
- Linkages between ecosystem structure and penetration of POC into ocean

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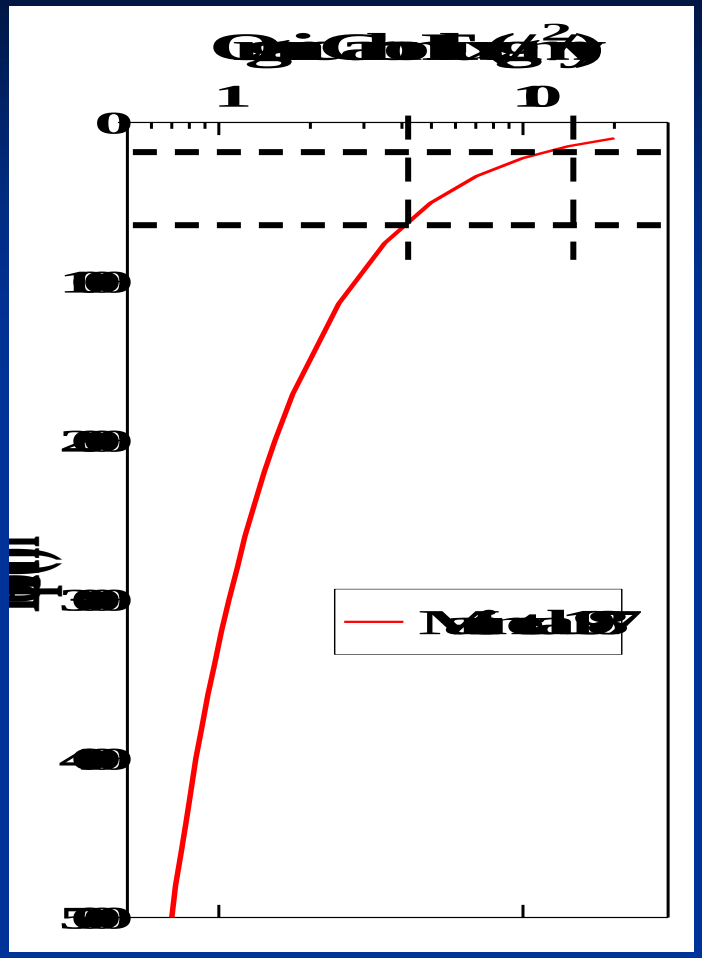
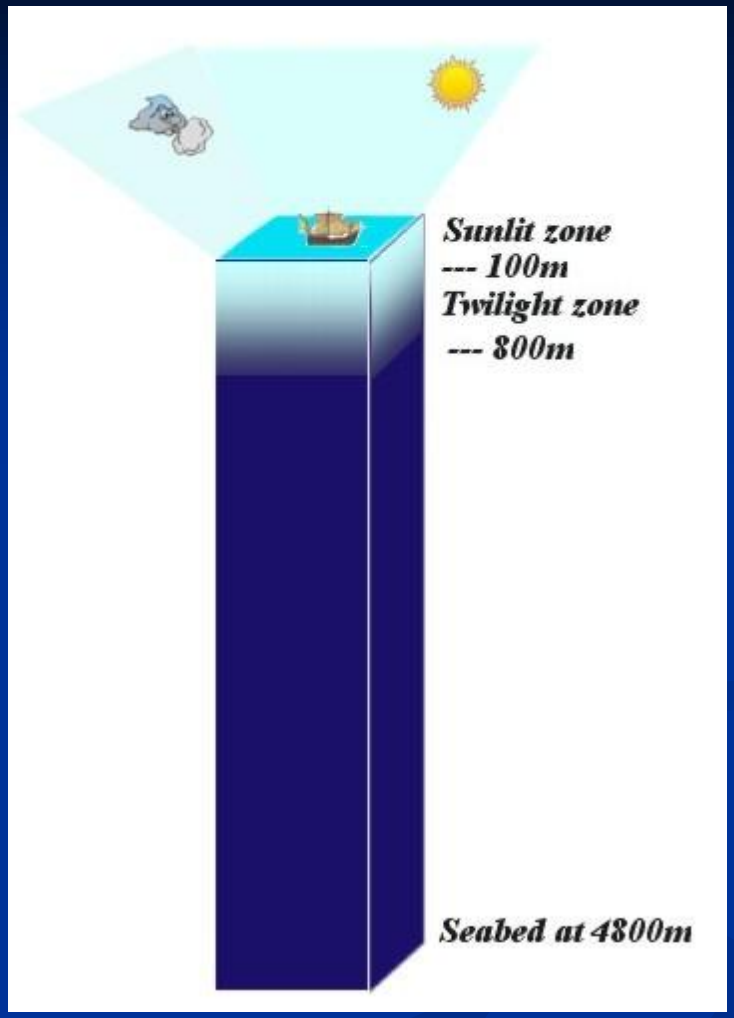




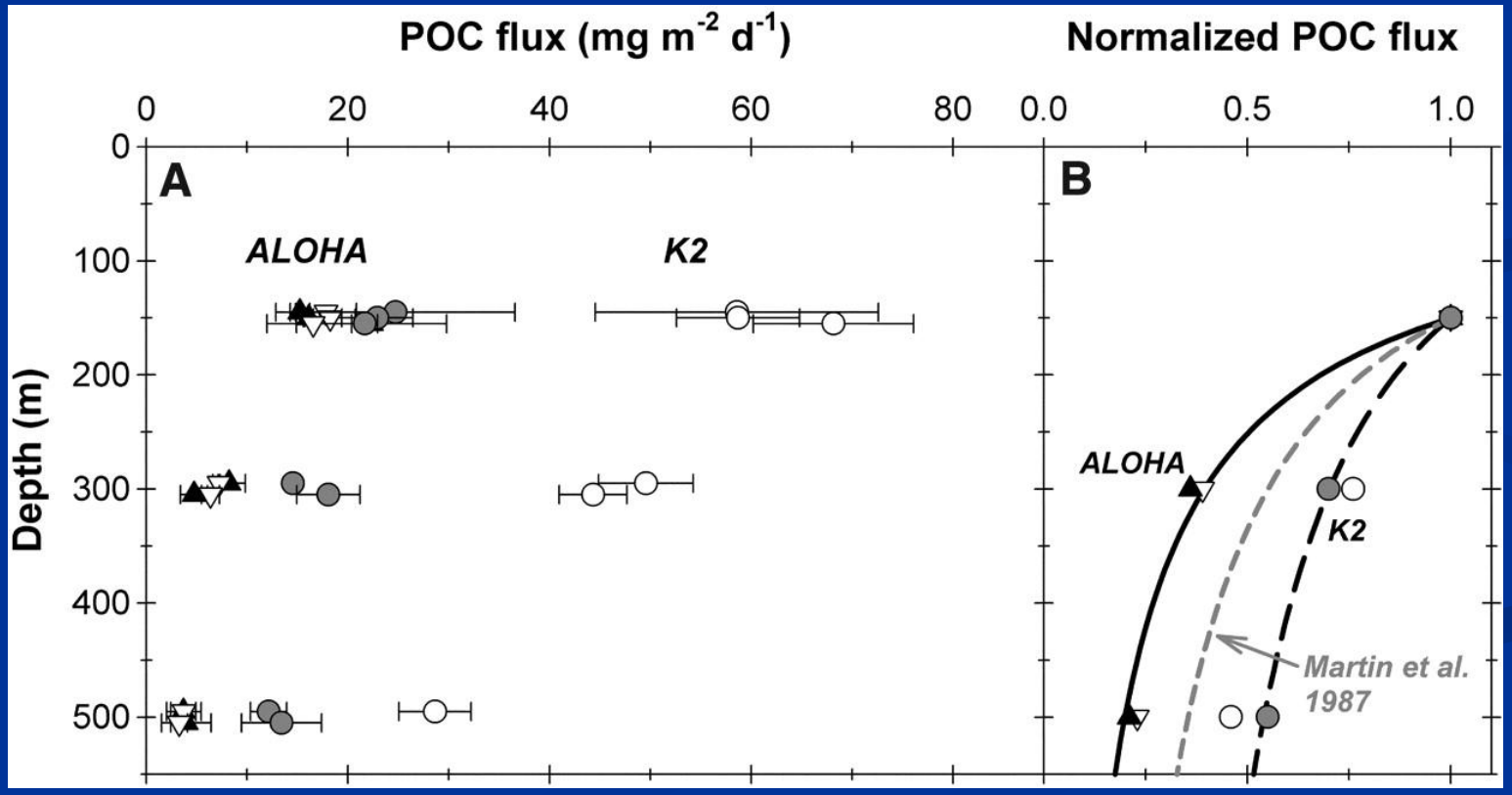
- Rapid reduction in downward flux of OC – b value
- Implications for lifetime of sequestered CO_2 in Ocean
- How does b vary, what controls it?

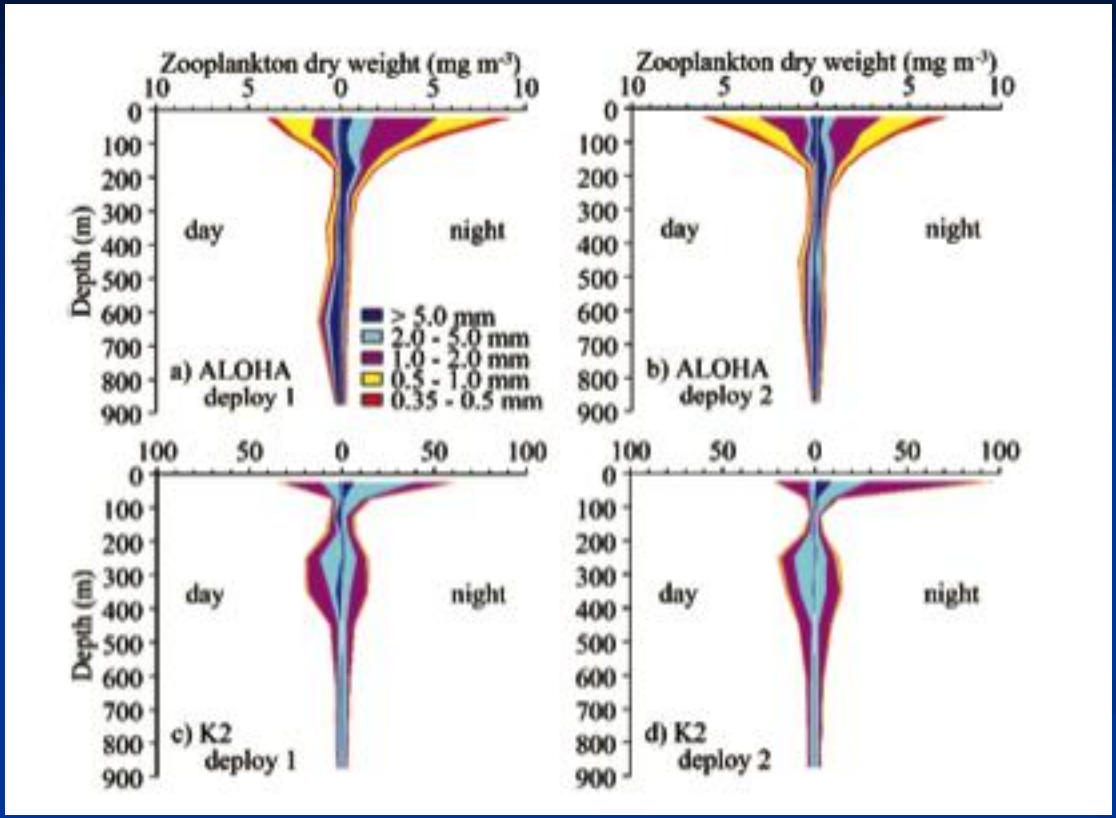
Vertigo

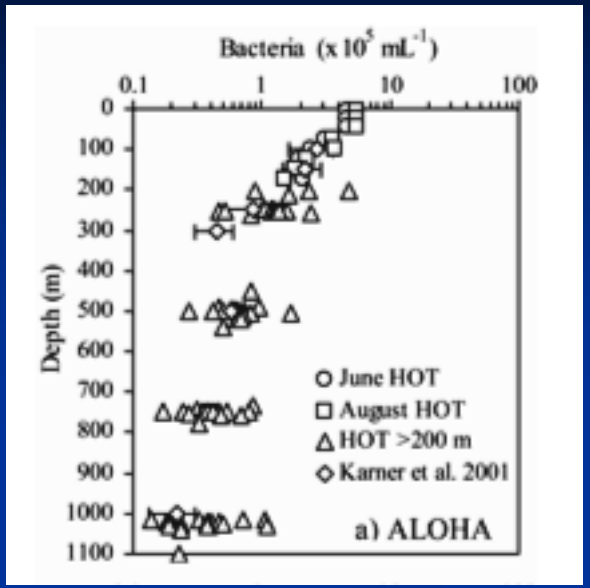
- Vertigo measured the change in downward POC flux at two sites (K2, ALOHA)
- Also estimated consumption of POC by bacterioplankton and mesozooplankton

Vertigo

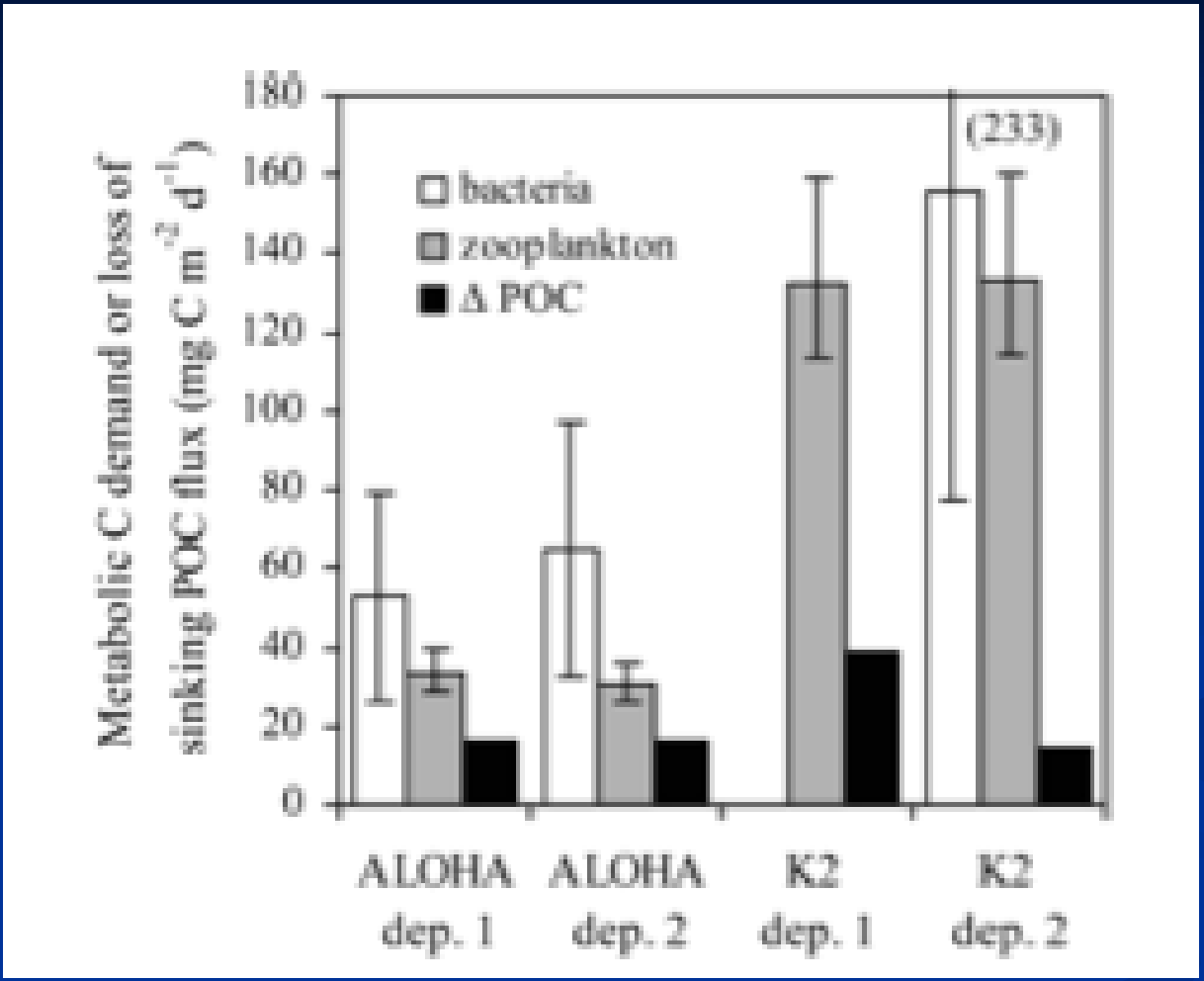
- Transfer efficiency of sinking particulate organic carbon between 150 and 500 meters of 20 and 50% at two contrasting sites (Buesseler et al., 2007).







- Convert biomass to respiration via Gut fluorescence and growth efficiency (Zooplankton) or leucine uptake + conversion factor + growth efficiency (Bacteria)



- Sinking POC was inadequate to meet metabolic demands at either site.
- *Steinberg et al., 2008 L+O*

Activities

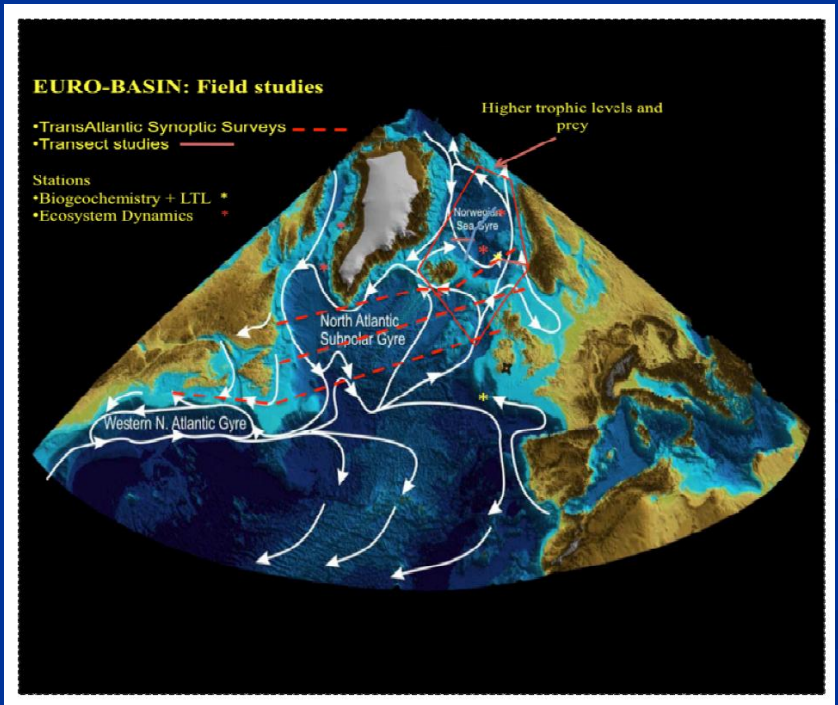
- Literature survey to define state of art in parameterisations of downward POC flux
- Refine parameterisations based on fieldwork
- Pass refined parameterisations to one dimensional modelling group for testing
- Implement best parameterisations in 3 d model

Fieldwork

- 2011 Mesocosm experiment to examine role of ecosystem structure (diatoms vs coccolithophorids, grazing pressure) on particle production and characteristics
- Co-ordinator Christina de la Rocha (Brest) ***christina.delarocha***@univ-***brest***.fr

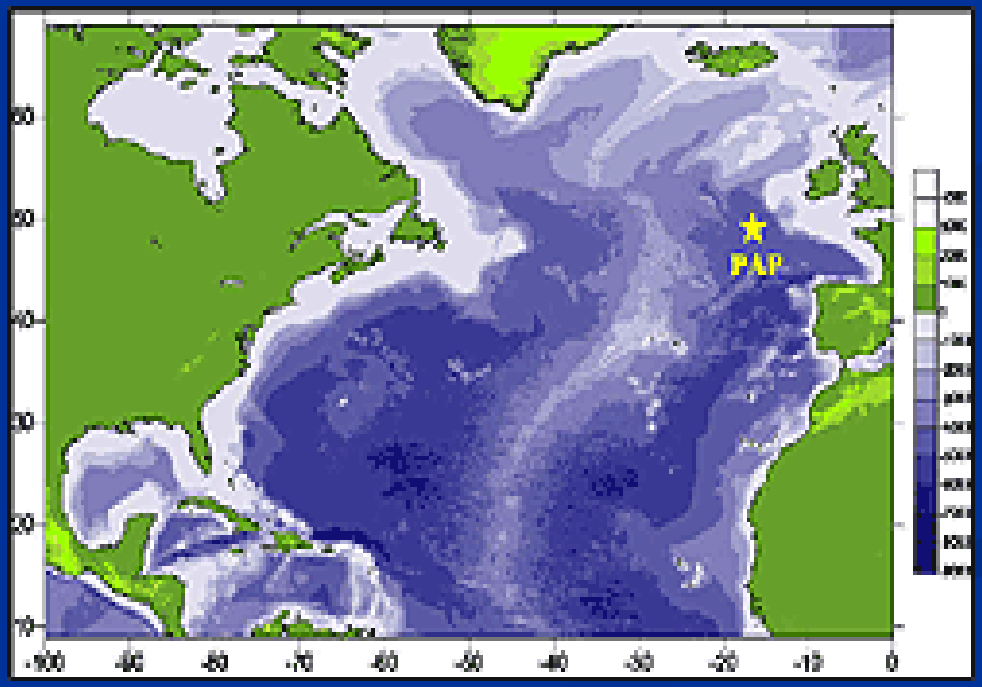
Fieldwork 2012

- ***German Cruise at high latitudes – Comparative ecosystem analysis – contact Mike St John***

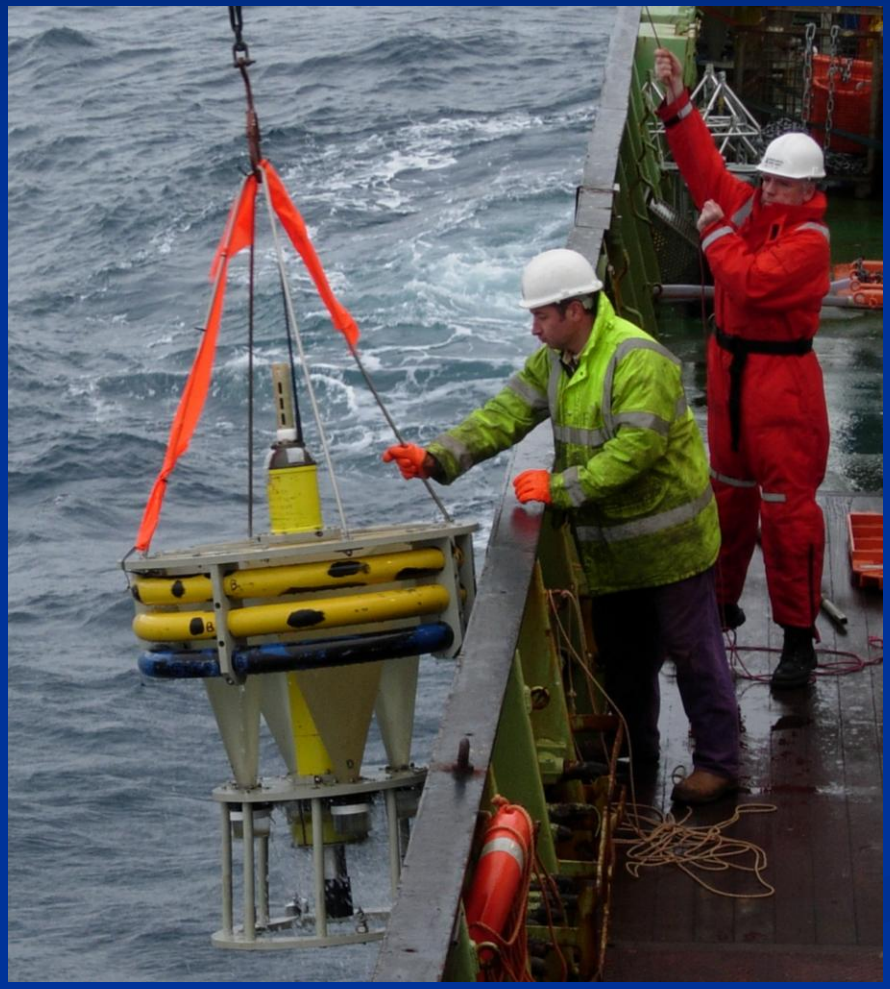


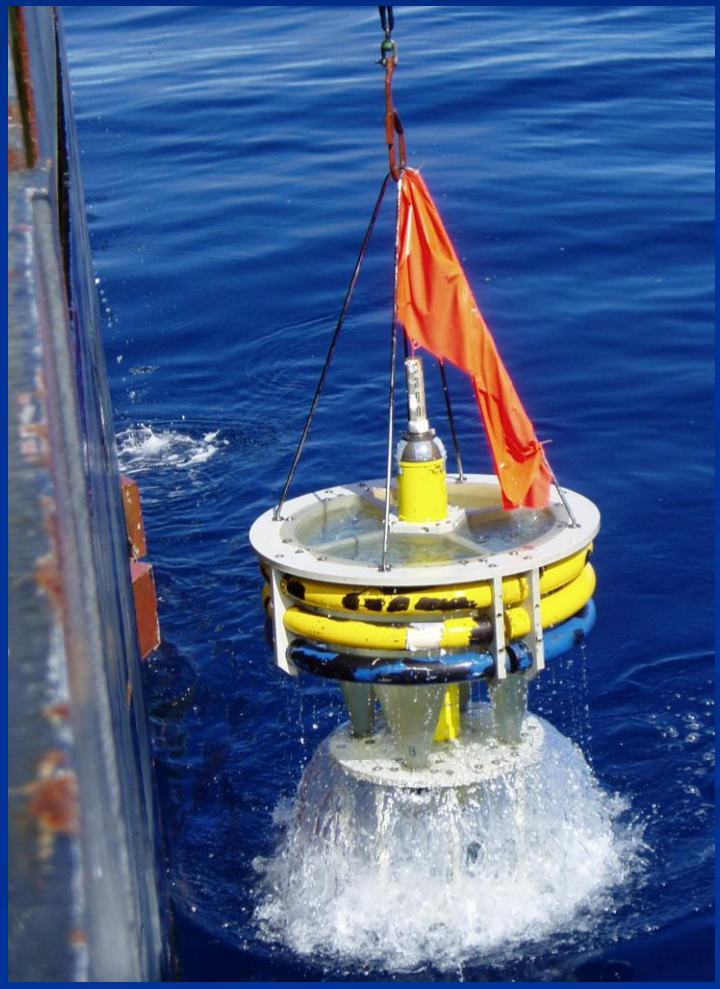
Fieldwork 2013

- UK Cruise to PAP site – process study with emphasis on attenuation of downward C flux
- rics@noc.soton.ac.uk

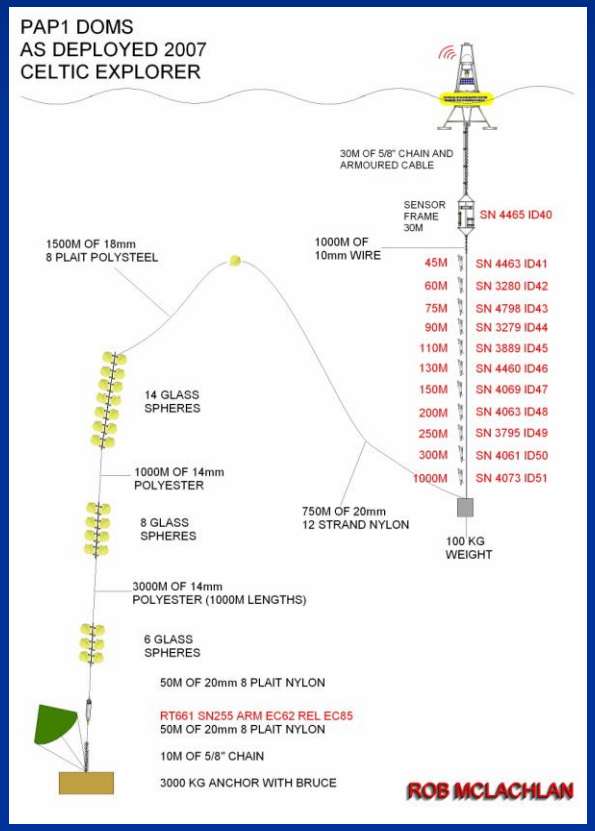


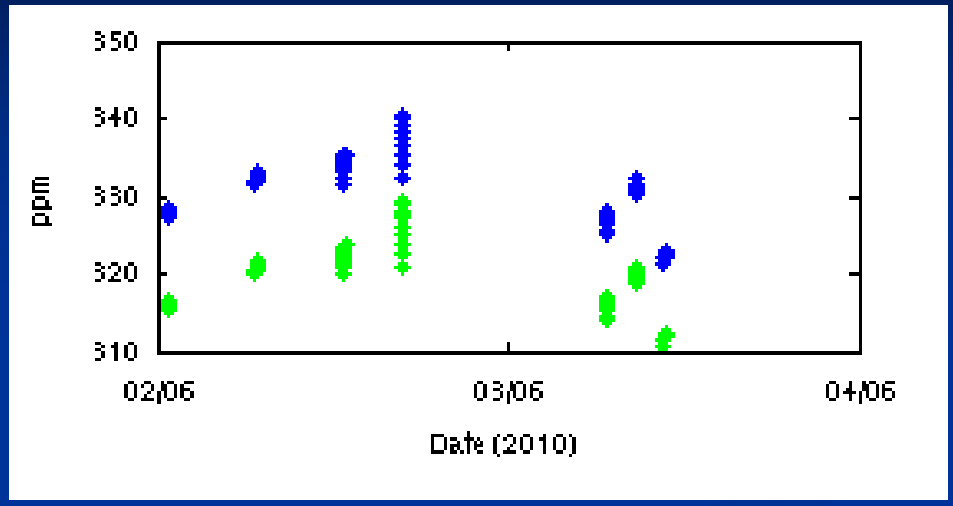
Upper ocean particle fluxes measured with Pelagra; the Pelagic lagrangian sediment trap





Mooring gives background context





Summary

- Rich and diverse programme planned
- In earliest stages of planning
- Significant opportunities for collaboration
- Joint cruise in 2013 to PAP site with Buesseler