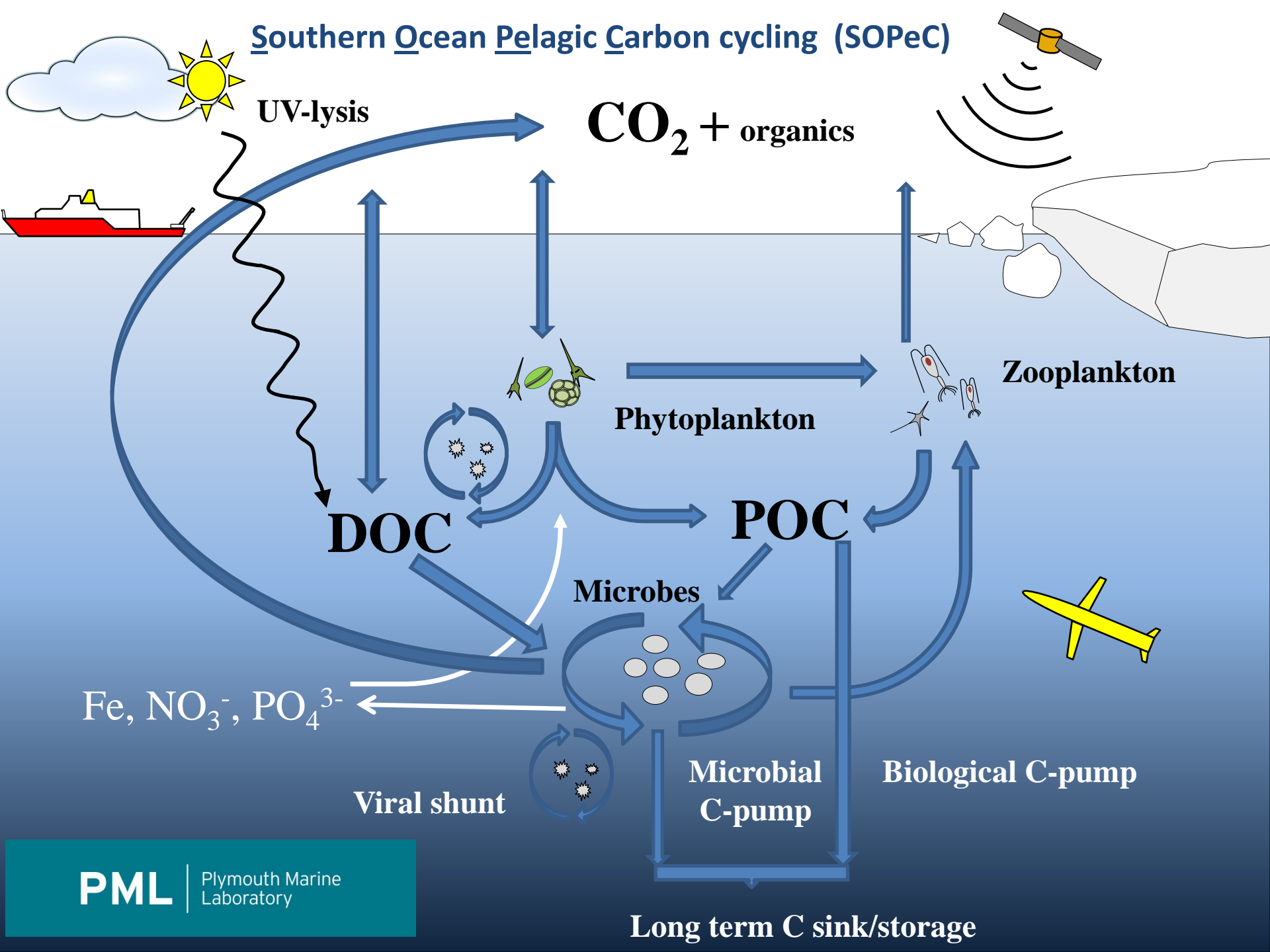
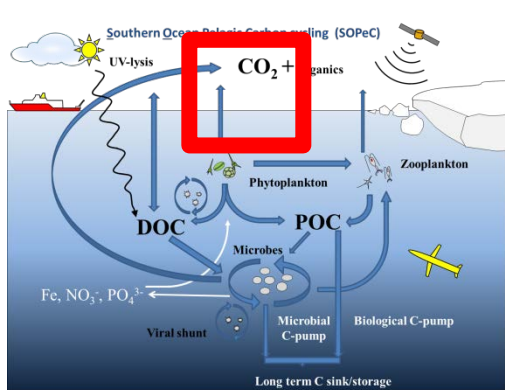


# Southern Ocean Pelagic Carbon cycling (SOPeC)





$$\text{Air/sea Flux} = k \cdot \Delta p \text{CO}_2$$

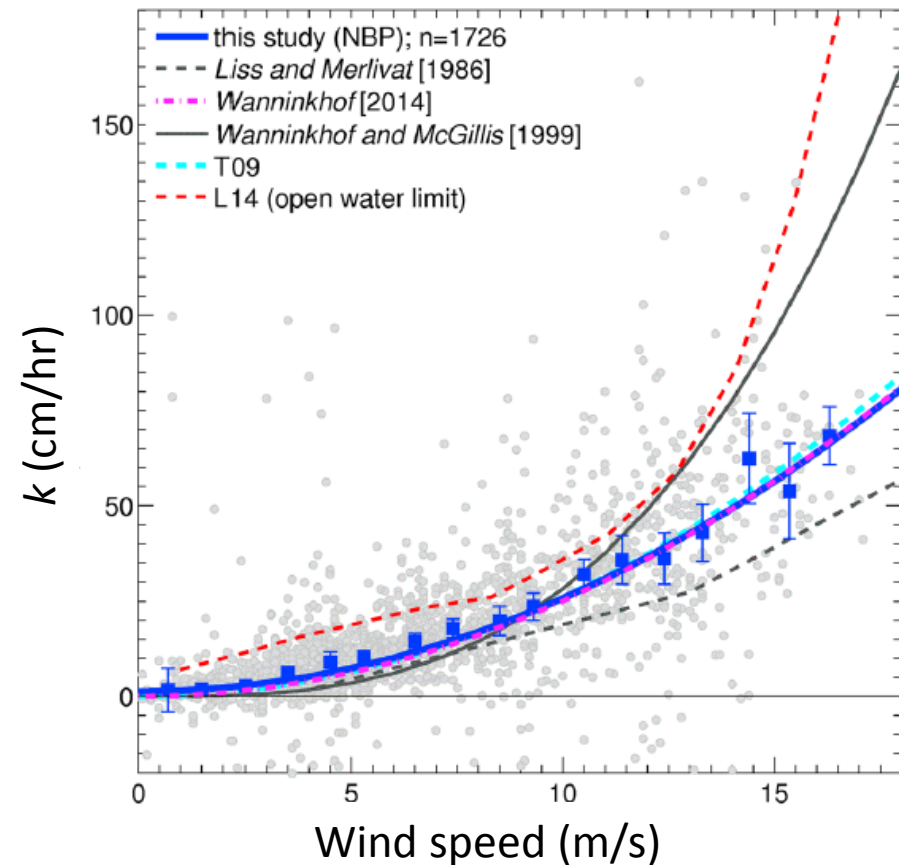
ORCHESTRA = Autonomous CO<sub>2</sub> flux + pCO<sub>2</sub>

Choice of k parameterisation:  
>50% uncertainty in air/sea  
CO<sub>2</sub> flux estimates

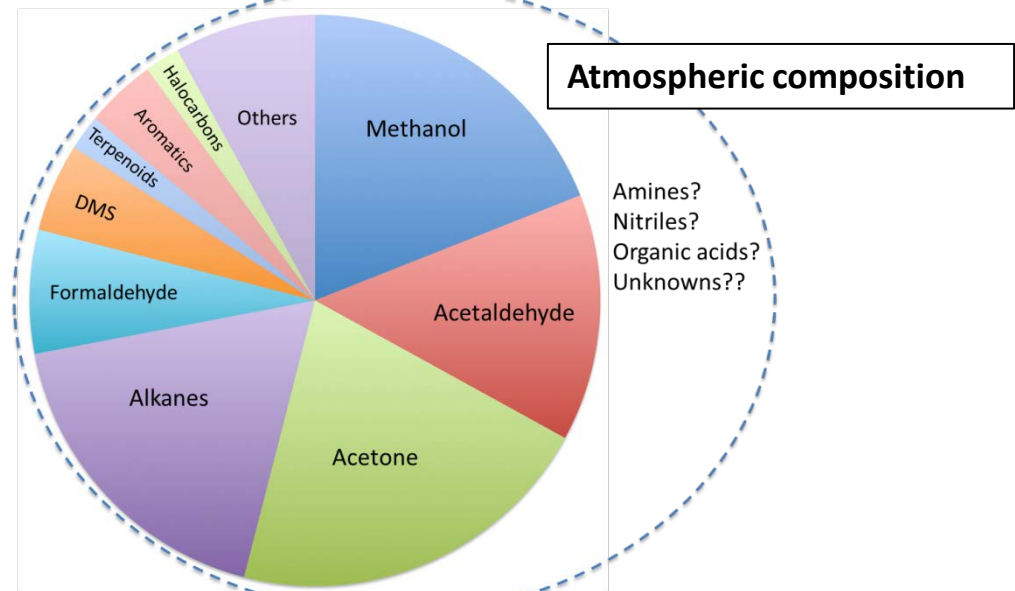
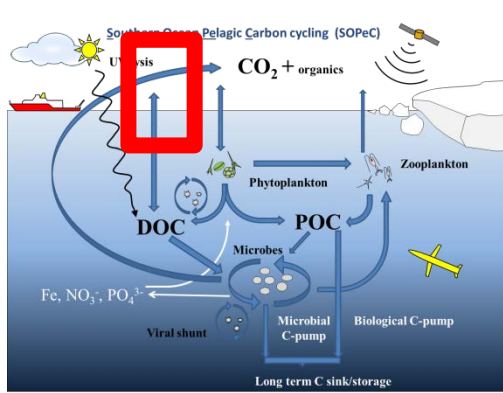
Questions:

What processes determine the variability  
in k? (e.g. wind, waves, bubbles,  
surfactants)

Can we parameterise the contribution of  
bubbles to gas transfer?



# Air/sea exchange of Organic Carbon



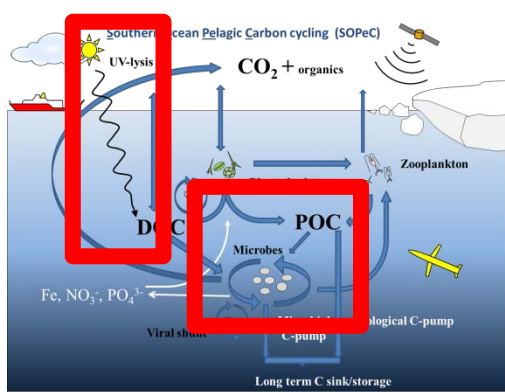
- Volatile organics poorly-quantified and large (~65% of Antarctic Peninsula DOC)
- Flux direction and magnitude uncertain

*Questions:*

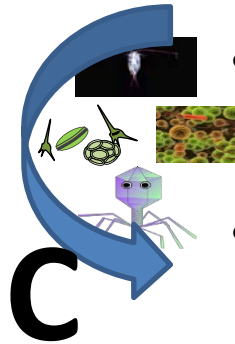
*Abundance, composition, controls of volatile organic C in seawater and marine air?*

*Magnitude and direction of air/sea volatile organic C flux?*

| Compound                  | Global Air/Sea Flux (Pg C/yr) |
|---------------------------|-------------------------------|
| CO <sub>2</sub>           | -2.0                          |
| DMS                       | +0.015                        |
| Methanol                  | -0.016                        |
| Acetaldehyde              | +0.010                        |
| Acetone                   | +0.004                        |
| Other organics            | ???                           |
| <i>volatile organic C</i> | ±10-100                       |



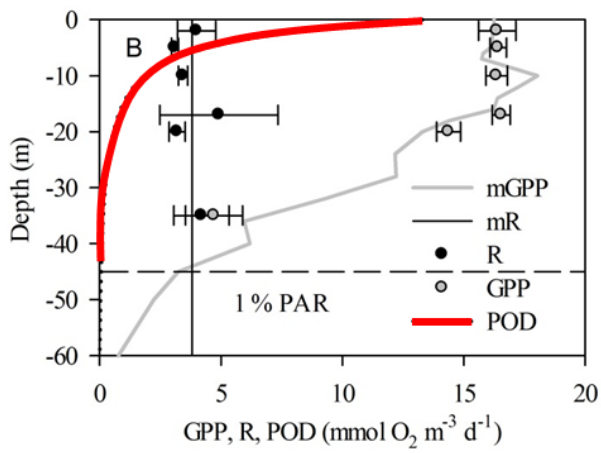
## Microbial C-fluxes?



- Viral influence on microbial processes & carbon flow
- Controls of magnitude/interactions between the microbial/biological carbon pump ?

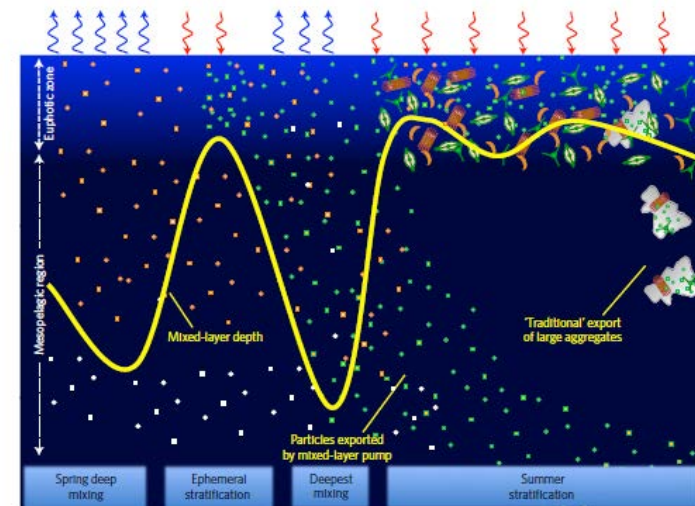
## Photochemical C-fluxes?

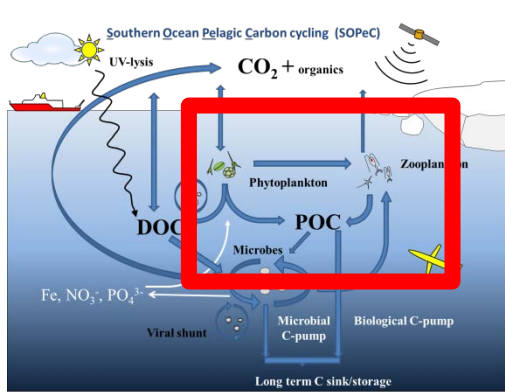
- Does photochemical DOC removal compete with the microbial C pump ?



## Autonomous vehicles – Bio-Argo; gliders

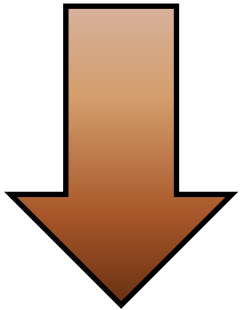
- What is the role of the mixed layer pump in C export ?





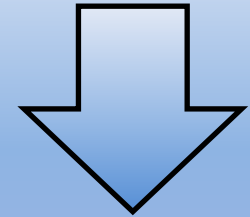
# How does foodweb structure modulate the Biological Carbon Pump?

Increased Iron supply

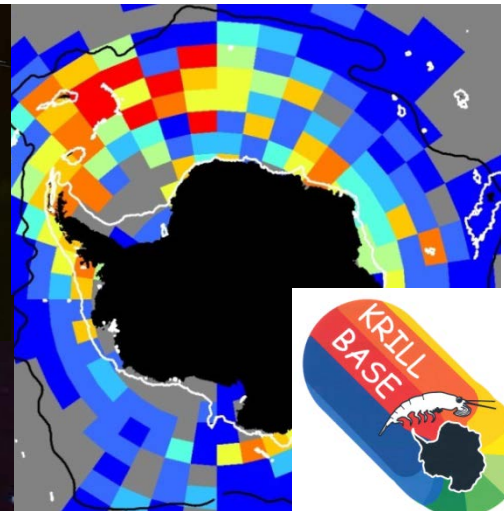
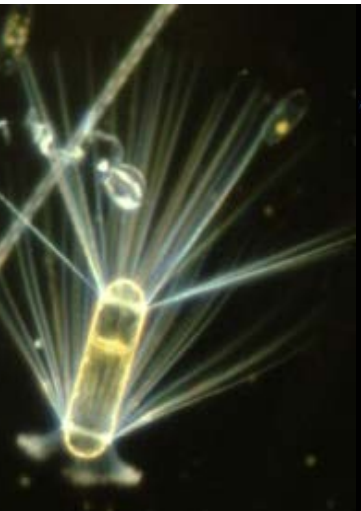


Primary Production increases ?  
 Escape from grazing control?  
 Higher Plankton biomass ?  
 Larger size of sinking detritus?  
 Aggregation/Vertical migration?

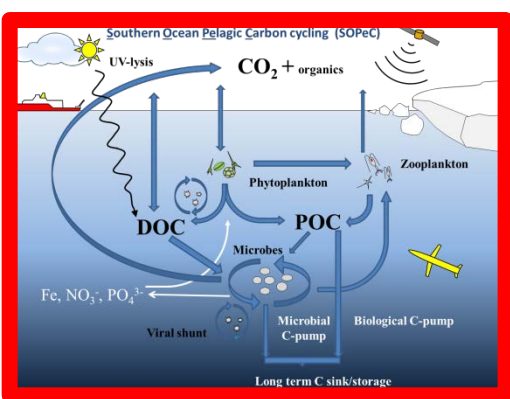
SMALL SIZE



LARGE SIZE

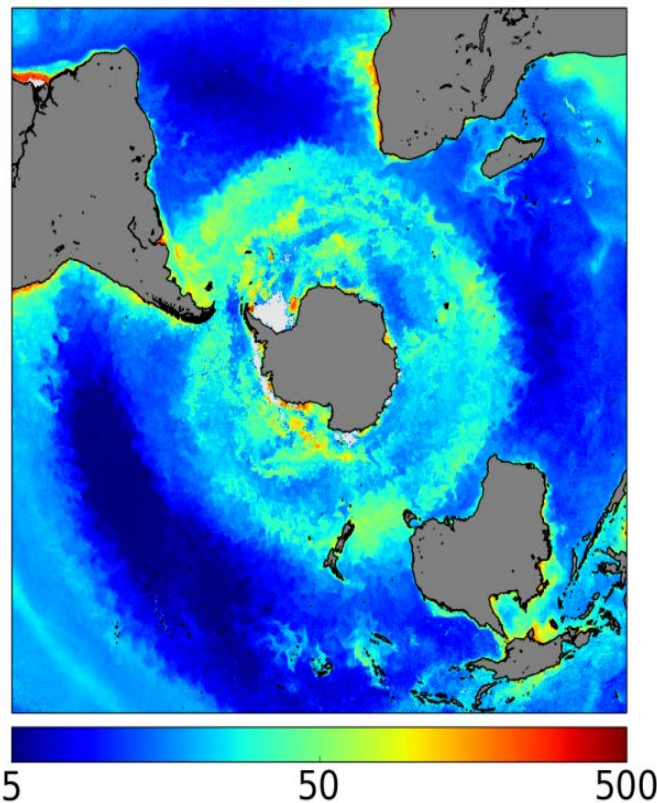
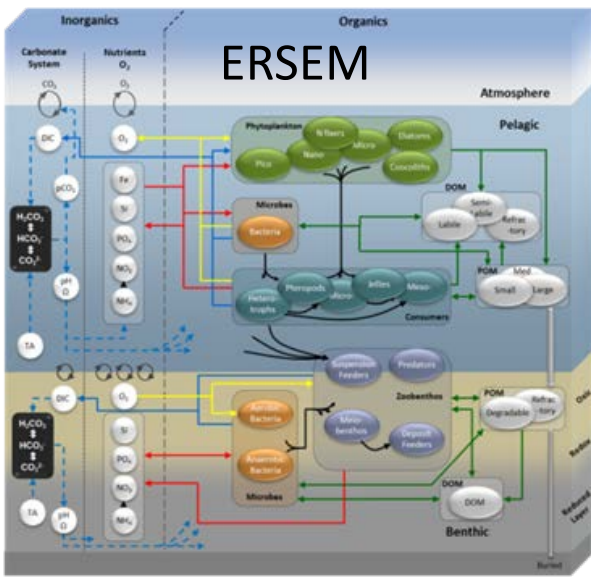
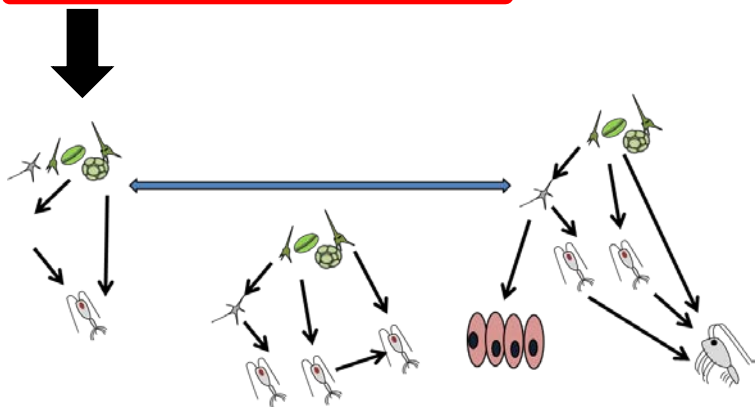






## Integrating tools: Earth Observation and Modelling

- scalable diversity and complexity
- In silico experiment / hypothesis testing
- Upscaling from local regional scale
- Identification of key processes



Sathyendranath, unpublished results