Climate Change - the importance of the Marine Food Web

Phytoplankton (tiny organisms that behave like plants) living in the ocean are responsible for regulating the amount of carbon uptake by the surface ocean. This in turn affects Earth's climate by moderating concentrations of CO_2 (a greenhouse gas) in the atmosphere.

Phytoplankton absorb CO_2, use it to produce organic carbon and this is then passed along the food chain. Whenever creatures die, most of the organic carbon they have in their bodies is decomposed to CO_2 and returned to the atmosphere, but a little bit of that carbon eventually sinks to the bottom of the ocean. This process of removing CO_2 from the atmosphere and transferring it to deep ocean sediments is called the biological carbon pump.

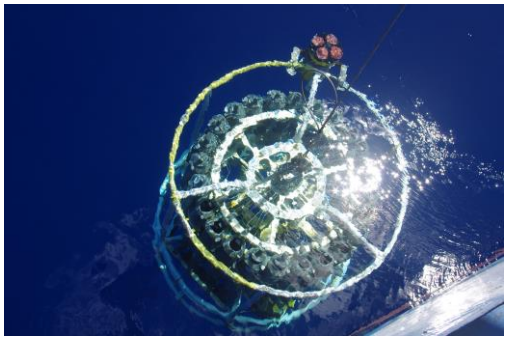
The food web in the ocean therefore plays a key role in regulating climate. Many factors affect the efficiency of the biological carbon pump. As part of the multidisciplinary project Ocean Certain, Geomar is finding out how climate change may affect micronutrient concentrations in the surface ocean. Together with colleagues from 10 other partner institutions we will investigate how changes to the chemistry of the surface ocean affect the biological carbon pump.

Geomar's Work

The Ocean Certain WP2 project which Geomar is part of aims to not only look at what is happening in the oceans now, but to use this information to make accurate predictions about what further changes will happen in coming decades.

Climate change affects the physics and chemistry of the surface ocean where phytoplankton live (Achterberg 2014). One way of investigating how these phytoplankton may respond to future changes is by conducting mesocosm experiments where a large volume of water is held in a tank and then manipulated to make it resemble the surface ocean in a future climate scenario.

Geomar has participated in three Ocean Certain mesocosms in Patagonia (2014), Svalbard (2015) and Crete (2016) plus a west Mediterranean research cruise (2015).



Ocean Certain researchers will use the results of these experiments to address three questions:

1. How will climate change in the coastal ocean change micronutrient (eg iron) biogeochemistry?
2. What effect(s) will this have on biological productivity?
3. How will these changes affect ecosystem services such as the biological carbon pump, fisheries and leisure industries?

Field Sites

The three field sites were chosen because of their sensitivities to recent climate change.

The Svalbard and Patagonian fieldsites are both fjords. Freshwater input into fjords creates strong changes in the physical and chemical properties of the water column. Organisms living within fjordic environments are well adapted to these local conditions. Changes to the freshwater cycle, such as increasing glacial melt or rainfall, have direct implications for both nutrient delivery and ecosystem structure in these environments (Hopwood et al. 2016).

Field Sites

The Mediterranean Sea is recognized as a hotspot for anthropogenic driven change because of its enclosed nature. Only limited mixing occurs between the Mediterranean and water from other seas, so the effects of pollution and climate change are more evident.

What also makes the Mediterranean Sea very useful for climate change research is that the time scale for deep water mixing is much shorter than for the global ocean, with deep water having a turnover of around 60 years. Changes can therefore happen fast, thus findings from research conducted in the Mediterranean Sea can allow us to predict similar changes in the global ocean in the future.

Collaboration

Through the Ocean Certain WP2 project we are providing data on trace metal micronutrient cycling to our modelling colleagues at CEFAS (UK) and the University of Gothenburg (Sweden). This will be one component used to construct their model of the biological carbon pump. We are also working with colleagues at the Austral University of Chile and CNR-ISMAR (Italy) to investigate the biogeochemistry of our 3 fieldsites.

**Photos kindly provided by Ocean Certain colleagues for dissemination.*

Further Reading

Achterberg EP (2014) Grand challenges in marine biogeochemistry. Front Mar Sci. doi: 10.3389/fmars.2014.00007

Hopwood MJ et al. (2016) Seasonal changes in Fe along a glaciated Greenlandic fjord. Front. Earth Sci. doi:10.3389/feart.2016.00015:

Updates

For up-to-date information on our project follow @Markinthelab, @OceanCertain or visit our website http://oceancertain.eu/ or facebook page https://facebook.com/oceancertain

Contact

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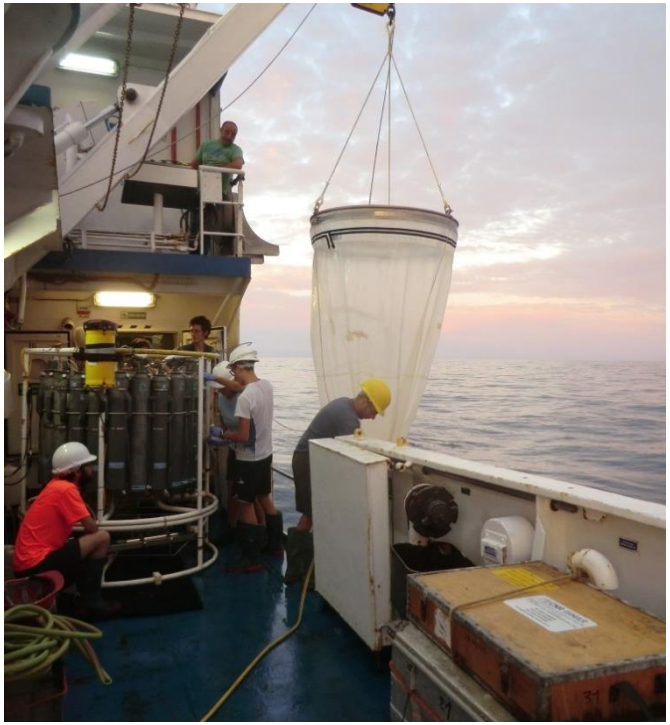
Climate Change in the Coastal Ocean



Geomar's contributions to Ocean Certain WP2: Mesocosms and cruises