Press Release

GEOMAR
Helmholtz Centre for Ocean Research Kiel

48/2013

CO_2-hungry microbes might short-circuit the marine foodweb
Results of the EPOCA experiment on ocean acidification in Svalbard

***13 September 2013/Ny-Ålesund, Kiel*. Do the smallest plankton organisms determine the future of the ocean? A five-week long field experiment of the European Project on Ocean Acidification (EPOCA) shows that pico- and nanophytoplankton benefit from higher carbon dioxide concentrations in the water, causing an imbalance in the food web. In addition, the carbon export to the deep ocean and the production of the climate-cooling gas dimethyl sulfide are diminished – two important functions for the global climate. A special issue of the European Geosciences Union's journal *Biogeosciences* compiles the results of the study which took place in Kongsfjorden, Svalbard, in 2010. It is the first of four long-term studies using the Kiel KOSMOS mesocosms under the direction of the GEOMAR Helmholtz Centre for Ocean Research Kiel.**

The smallest of the small seem to be among the winners in the ocean of the future. In a five-week long experiment, an international team of scientists showed that particularly tiny plankton, so-called pico- and nanophytoplankton, grows more strongly under elevated carbon dioxide levels and produces more organic carbon. "If the tiny plankton booms, it consumes the nutrients that are normally also available to larger plankton species", explains Prof. Ulf Riebesell from GEOMAR, head of the KOSMOS mesocosm experiments. "We could clearly see that the boom at the base of the food web happened at the expense of diatoms which are part of the larger micro-phytoplankton. Our experiment was too short to determine whether zooplankton runs short in food as a consequence of this. This seems a reasonable assumption though."

In a system dominated by pico- and nanophytoplankton, less carbon is transported to the deep ocean. "This may cause the oceans to absorb less CO_2 in the future", concludes the GEOMAR biogeochemist. And one more climate-related function may be weakened: the production of dimethyl sulfide (DMS). This gas supports cloud formation over the oceans. Less DMS therefore means that more sunlight reaches the Earth's surface, contributing to the greenhouse effect "These important services of the ocean may thus be significantly affected by acidification."

For the experiment, the Greenpeace vessel ESPERANZA brought nine mesocosms to Svalbard in May 2010 and deployed them in Kongsfjorden off Ny-Ålesund together with the international scientific team. The mesocosms' eight-meter long flotation frames carry plastic bags with a capacity of 50 cubic meters. Like giant test tubes, they enclose the entire plankton community present in the water column. In seven of the bags, carbon dioxide was gradually added to the water so that it reached acidity levels which are expected in 20, 40, 60, 80 and 100 years. Two of the bags represented the actual fjord environment as controls. About 50 different physical, chemical and biological parameters were measured daily, and samples were collected for further processing in the home laboratories.

"Because we can only work in the ice-free fjord with our mesocosms, we could not start the experiment before the end of May", says Riebesell. "The spring bloom was then completed and the plankton community was characterized by distinct bacterial production and a large number of different phytoplankton species. The grazing by medium-sized meso-zooplankton was comparatively low." The scientists used nutrients to bring productivity to the level of a natural

bloom. “The different responses we observed made it clear that the communities’ sensitivity to acidification depends strongly on whether or not nutrients are available."

With 35 participants from 13 European institutions, the mesocosm experiment was the largest project of the European Project on Ocean Acidification EPOCA which ran from 2008 to 2012. It was made possible with the support of the French-German Arctic Research Base (AWIPEV) at Ny-Ålesund. "EPOCA decided to go to the Arctic because the ocean in this region absorbs more carbon dioxide, due to the low water temperatures. Acidification is faster there than in temperate or tropical regions", says Jean-Pierre Gattuso. The Centre National de la Recherche Scientifique (CNRS-INSU) scientist from the Laboratory of Oceanography of Villefranche-sur-mer, France coordinated EPOCA. “In addition, it was the aim of the project to investigate the response of organisms within their natural communities and to verify the results from laboratory studies.”

Trends from this first study with the Kiel KOSMOS mesocosms were complemented by subsequent experiments in Norway (2011), Finland (2012) and Sweden (2013): "Time and again the tiniest plankton benefits from the surplus of CO_2, they produce more biomass and more organic carbon, and DMS production and carbon export are decreasing", Riebesell summarizes. “This year, our long-term experiment off the west coast of Sweden gave us a chance to see for the first time what this development means for the higher trophic levels, and whether the system can adapt to higher acidity. We await the results with great anticipation."

Original publication:
Riebesell, Ulf; Gattuso, Jean-Pierre; Thingstad, T. Frede; Middelburg, Jack J. (Eds.): Arctic ocean acidification: pelagic ecosystem and biogeochemical responses during a mesocosm study. *Biogeosciences* Special Issue Volume 10/2013. www.biogeosciences.net/special_issue120.html

Links:
EPOCA www.epoca-project.eu
Basic information about ocean acidification: www.bioacid.de/front_content.php?idcat=576&idlang=22

Images:
High resolution images are available at www.geomar.de/n1460. Video footage on request.

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