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EPOCA 2010 mesocosm CO_2 enrichment experiment in Arctic waters

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Due to its naturally low carbonate saturation states the Arctic Ocean is considered particularly vulnerable to ocean acidification. If CO_2 emissions continue to rise at current rates, half of the Arctic Ocean will be undersaturated with respect to calcium carbonate and, therefore, corrosive for calcareous organisms within the next three to four decades. While recent studies have demonstrated sensitivities of some Arctic species to ocean acidification, no information is presently available on community- and ecosystem-level responses. As a first attempt to closing this gap, an off-shore mesocosm system (KOSMOS) developed at IFM-GEOMAR was deployed in the Kongsfjord off Spitsbergen - about 1000 nautical miles south of the North Pole - in June/July 2010 and was used to conduct a pelagic CO_2 enrichment experiment. IFM-GEOMAR, which provided the logistics for this experiment, received support from the Greenpeace vessel M/S ESPERANZA, transporting the mesocosms and assisting during deployment and recovery.

In nine 15 m long mesocosms, each enclosing about 50 m^3 of seawater, stepwise addition of CO_2 saturated seawater was applied to achieve CO_2 concentrations ranging from ca. 180 to 1400 μatm. Half way through the experiment inorganic nutrients (5, 2.5, and 0.32 μmol L^{-1} nitrate, silicate, and phosphate, respectively) were added to the enclosed, nutrient-poor waters. In the framework of the EU integrated project EPOCA a team of 35 scientists from 12 institutes monitored the mesocosms over a period of 35 days. In total 45 parameters were measured daily and over 15000 samples analysed to cover aspects ranging from viral, bacterial, phytoplankton and zooplankton abundances, compositions, biomasses, and productivities, carbon and nutrient dynamics and stoichiometry, vertical particle fluxes, to the production of climate relevant gases and air/sea gas exchange. In bringing together a wide range of scientific expertise this study provides a comprehensive data set on pelagic ecosystem and biogeochemical responses to ocean acidification in Arctic waters.