Carbon fluxes within a natural plankton community at elevated atmospheric CO_2

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The predicted doubling of current atmospheric CO_2 by the year 2100 will lead to a redistribution of oceanic dissolved inorganic carbon (DIC), increasing CO_2 and HCO_3^- at the expense of CO_3^{2-} concentrations. While laboratory studies have shown that DIC acquisition by marine phytoplankton is sensitive to changes in carbonate chemistry, the effect of increasing atmospheric CO_2 on marine ecosystems as a whole is virtually unkown. During the PeECE III CO_2 enrichment study the bloom development of a natural plankton community was investigated at today‘s (380 ppmv), predicted year 2100 (750 ppmv) and year 2150 (1150 ppmv) CO_2 concentrations.

Following nutrient addition (N,P) at day 0 particulate organic carbon (POC) concentrations started to increase in all CO_2 treatments. This build-up of POC during the bloom phase was reflected in a concomitant drawdown of dissolved inorganic carbon. Measured POC concentrations, however, can only account for about half of the DIC removal observed. Furthermore, while maximum POC concentrations are about the same in all three CO_2 treatments, the maximum drawdown in DIC appears to increase with increasing CO_2. The DIC drawdown represents the community net inorganic carbon uptake, balancing processes of carbon fixation with those of respiration. To separate these processes and to follow the carbon exchange between the major carbon pools (DIC, phytoplankton, bacteria, zooplankton and detritus), the seawater DIC pool was enriched in ^{13}C on day 1. Measurements of the carbon isotopic composition ($\delta^{13}C$) of several group-specific biomarkers (polar-lipid-derived fatty acids), representative for phytoplankton and bacteria, together with the $\delta^{13}C$ signal of zooplankton allows to evaluate the carbon fluxes within the natural plankton communities. This data together with a simple conceptual carbon flux model will be presented, revealing the processes responsible for the apparent differences in dissolved inorganic carbon drawdown.