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Metabolic balance of the plankton community in Arctic coastal water in relation to increased pCO_2 levels

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The effect of ocean acidification on the balance between gross community production (GCP) and community respiration (CR) (i.e. net community production, NCP) of Arctic plankton communities was investigated as part of the 2010 EPOCA experiment at Ny-Ålesund, Spitsbergen. Coastal surface water was enclosed in 9 mesocosms and subject to 8 pCO_2 levels (2 replicated controls and 7 enhanced pCO_2 treatments), and the response of the plankton community was monitored for one month. Waters from the mesocosms were incubated in BOD bottles in quadruplicate and incubated for 24 h for NCP and for 48 h for CR at in situ temperature. Dissolved oxygen (DO) concentration was determined with automated Winkler titration method using a potentiometric end-point detection. Changing rate of DO (NCP, CR) was determined by linear regression of DO against time. GCP was calculated as the difference between NCP and CR.
The enclosed waters were characterized by low concentrations of nutrients and chlorophyll until inorganic nutrients (N, P, Si) were added on Day 13. After the nutrient addition, chlorophyll increased in all the mesocosms. NCP, CR, and GCP were in a range of -4.4 to 5.0, -5.6 to 0, and -0.5 to 6.9 $\mu\mathrm{mol\,O_2\,l^{-1}\,d^{-1}}$, respectively, before the nutrient addition. NCP slightly increased after the nutrient addition (range: -2.9 to 7.9 $\mu\mathrm{mol\,O_2\,l^{-1}\,d^{-1}}$), while CR changed little (range: -4.5 to -0.7 $\mu\mathrm{mol\,O_2\,l^{-1}\,d^{-1}}$). Hence, GCP tended to increase (range: 0 to 11.2 $\mu\mathrm{mol\,O_2\,l^{-1}\,d^{-1}}$) after the nutrient addition. However, these parameters did not show a consistent response to the increase of pCO_2 based on the data comparison at a given day of the measurement. When changing rates of DO were integrated for two periods (before and after the nutrient addition), NCP and GCP were unaffected by enhanced pCO_2 before the nutrient addition, while both significantly decreased with increase of pCO_2 after the nutrient addition. No significant change of CR was detected. These data suggest that ocean acidification may reduce NCP and GCP in Arctic coastal waters.