Effects of Arctic sea-ice and biogeochemical drivers and storms on under-ice water fCO_2

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The ice cover in the Arctic Ocean has decreased during the last decades, manifested in particular as an extensive transition from thicker multiyear ice to thinner first-year ice. As the summer sea-ice cover is decreasing, larger areas with open water will be exposed to the atmosphere. This will have implications for the carbonate chemistry and sea-air carbon dioxide (CO_2) exchange. We present measurements of CO_2 fugacity (fCO_2) and estimates of the effects biogeochemical processes in under-ice water, driving the sea-air CO_2 fluxes. The data was obtained from January to June 2015 during the Norwegian young sea ICE (N-ICE2015) expedition, where the ship drifted with four different ice floes and covered the deep Nansen Basin, the slopes north of Svalbard, and the Yermak Plateau. This unique winter-to-spring data set includes the first winter-time under-ice water fCO_2 observations in this region. The observed under-ice fCO_2 was undersaturated relative to the atmospheric fCO_2. Although the sea ice partly prevented direct CO_2 exchange between ocean and atmosphere, frequently occurring leads and breakup of the ice sheet promoted sea-air CO_2 fluxes. The maximum sea-air CO_2 fluxes occurred during storm events in February and June. In winter, the main drivers of the change in under-ice water fCO_2 were dissolution of $CaCO_3$ (ikaite) and vertical mixing. In June, in addition to these processes, primary production and sea-air CO_2 fluxes were important.