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An assessment of sea-air CO_2 flux in the Arctic Ocean from 1985 to 2018

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As a contribution to the Regional Carbon Cycle Assessment and Processes phase 2 (RECCAP2) project, we present synthesized estimates of the Arctic Ocean CO_2 uptake and their uncertainties from state-of-the-art surface ocean pCO_2-observation products, global and regional ocean biogeochemical models and atmospheric inversions. For the period of 1985−2018, the Arctic Ocean represents a net sink of CO_2 of 103 ± 19 TgC yr^{-1} in the pCO_2 products and 92 ± 30 TgC yr^{-1} in the ocean biogeochemical models. While the long-term mean CO_2 uptake in the Arctic Ocean is primarily caused by steady-state fluxes of natural carbon, it is enhanced 28% by the atmospheric CO_2 increase and 15% by climate change. Moreover, the climate effect in the Arctic Ocean has become more important in recent years. The CO_2 uptake peaks in late summer and early autumn, and is low in winter because the sea ice cover inhibits sea-air fluxes. The annual mean of CO_2 uptake increased due to the decreasing sea ice concentration both in the pCO_2 products and the ocean biogeochemical models. Both, the mean CO_2 uptake and the trend, is substantially weaker in the atmospheric inversions. Uncertainty across all estimates is large especially in the estimated surface ocean pCO_2 values in the East Siberian Sea and the Laptev Sea, due to scarcity of observations and missing processes in models, such as land-sea fluxes and sediment dynamics.