北極海 CO_2 フラックスの推定：広域分布と季節・経年変化

Mapping of the air–sea CO_2 flux in the Arctic Ocean and its surrounding seas: Basin-wide distribution and seasonal to interannual variability

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We produced 204 monthly maps of the air–sea CO_2 flux in the Arctic Ocean and its adjacent seas (north of 60°N) from January 1997 to December 2013, using the partial pressure of CO_2 in surface water (pCO_{2w}) estimates by a self-organizing map technique. The pCO_{2w} data were measured by shipboard underway measurements and calculated from alkalinity and total inorganic carbon of surface water samples. Subsequently, we investigated the basin-wide distribution and seasonal to interannual variability of the CO2 fluxes. The pCO_{2w} undersaturation combined with less ice-cover and strong winds drives a flux of CO_2 into the Greenland/Norwegian, Barents and Chukchi seas, averaging 11 ± 3 mmol m^{-2}, 10 ± 4 mmol m^{-2} day^{-1}, and 4 ± 4 mmol m^{-2} day^{-1}, respectively, over the 17 year period. Annual CO_2 uptake of the Arctic Ocean was estimated to be 152 ± 173 TgC yr^{-1}. The seasonal variability of the CO_2 flux depends mainly on wind variability, and partly on sea-ice coverage. In winter, the CO_2 influx was large in the Greenland/Norwegian Sea because of strong winds, but small in the Chukchi Sea because of sea ice. In contrast, interannual variability was mostly related to the air–sea pCO_2 differences and partly to wind speed and sea-ice changes. In recent years, the CO_2 uptake in the Greenland/Norwegian Sea has increased and that in the southern part of the Barents Sea decreased due to increased and decreased air–sea pCO_2 differences, respectively.

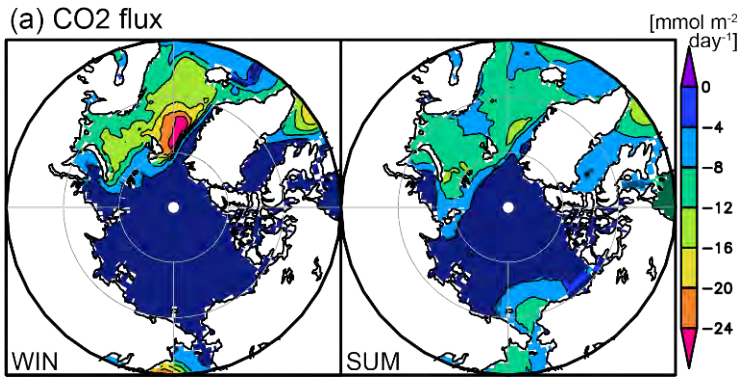

Figure 1. CO2 flux [mmol m–2 day–1] from December to May (left) and from June to November (right.). Darker shades show values in grids where values were smaller than the uncertainty.