

The study of air-ice CO₂ exchange emphasize the importance of gas bubble transport during sea ice growth

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We report air-ice CO₂ fluxes measured continuously using automated chambers over artificial sea ice from freezing to decay. We observed an uptake of CO₂ as seawater was cooling down prior to sea ice formation. As soon as the first ice crystals started to form, we observed a shift from a sink to a source. Sea ice released CO₂ until we initiated the ice decay by warming the atmosphere. Sea ice then returned to be a CO₂ sink. Direct measurements of the fluxes were consistent with the depletion of dissolved inorganic carbon in sea ice. Measurements of bulk partial pressure of CO₂ in sea ice and of atmospheric CO₂ allowed us to assess a gas exchange coefficient for CO₂ at the air-sea ice interface during the grow stage. We compared these observations with a 1D biogeochemical model. Discrepancies between the model and the observations lead us to emphasize the role of gas bubbles in CO₂ transport through sea ice.