# Sea ice $pCO_2$ dynamics and related air-ice $CO_2$ fluxes during a flood-freeze cycle (Bellingshausen Sea, Antarctica).

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Sea ice covers about 7% of the Earth surface at its maximum seasonal extent. For decades sea ice was assumed to be an impermeable and inert barrier for air – sea exchange of $CO_2$ so that global climate models do not include $CO_2$ exchange between the oceans and the atmosphere in the polar region. However, uptake of atmospheric $CO_2$ over sea ice cover has been recently reported raising the need to further investigate $pCO_2$ dynamics in the marine cryosphere realm and related air-ice $CO_2$ fluxes.

We carried out direct measurements of $pCO_2$ within brines and related air-ice $CO_2$ fluxes (chamber method) of Antarctic first year pack ice during the “Sea Ice Mass Balance in Antarctica –SIMBA” drifting station experiment. This experiment was carried out on board the N.B. Palmer in September and October 2008 in the Bellingshausen Sea (Antarctica, 69 – 71°S; 90 – 95°E). In this area, significant snow loading promotes flooding of sea ice floes. In the course of the experiment we experienced a full cycle of cooling and warming of the air temperature with large changes in the snow cover thickness. Temperature and snow cover changes affected brine salinities, drastically increasing the instability of the brine column in the initial isothermal and porous sea ice. Cooling of the surface layer has significantly increased the surface layer brine salinity, triggering a downwards transfer of brines into the underlying porous ice. This downward transfer was likely counterbalanced by upwards (or lateral) transfer of sea water into the ice, a flooding-like process. While the sea-ice cover was undersaturated in $CO_2$ with respect to the atmosphere, convective processes significantly affected the partial pressure of $CO_2$ ($pCO_2$) of the brines, promoting the increase of $pCO_2$ and reducing the magnitude of related air-ice $CO_2$ transfer.