Conclusions and perspectives

In autumn and winter, temperature decrease and salinity increase in sea ice brines lead to calcium carbonate precipitation. This latter process, and possible bacterial activity, are responsible of a strong increase in pCO₂ within sea ice. When these processes occur, sea ice temperature is too low (below -5°C) to allow brines exchange with the underlying water and gases exchange with the atmosphere (station 9).

In spring as the sea ice temperature increases, brines and gases can be exchanged with respectively underlying water and the atmosphere. Brine release in the underlying water lead to a small increase of the pCO₂ of the water column, while oversaturation of pCO₂ at the air-ice interface (station 7) drives CO₂ release to the atmosphere (under favourable temperature and snow conditions). However, at the same time, brine circulation initiates the onset of high primary production that is responsible of a dramatic decrease of pCO₂ and a large undersaturation. Consequently, sea ice begins to act as a CO₂ sink. Firstly in the underlying water since generally phytoplankton starts to bloom at the ice-water interface, then for the atmosphere as the bloom reaches the sea ice upper layer.

Thereafter, it appears that spring Antarctic pack ice can either act as a source or as a sink of CO₂ for both the atmosphere and the underlying water, in close connection with its thermal and biogeochemical seasonal history. For decades, sea ice was seen as a simple inert stopper for air-sea exchange of CO₂: this long-lived paradigm should be revisited in some part.