N_2O production and cycling within Antarctic sea ice

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Nitrous oxide (N2O) is a potent greenhouse gas that has a lifetime of 114 years in the atmosphere and a global warming potential 300 time higher than that of CO2. However there are still large uncertainties and gaps in the understanding of the N2O cycle in polar oceans and particularly associated to sea ice. Sources and sinks of N2O are therefore poorly quantified. To date, only one study by Randall et al. 2012 present N2O measurements in sea ice. They pointed out that sea ice formation and melt has the potential to generate sea-air or air-sea fluxes of N2O, respectively. The main processes (except the transport processes) involved in the N2O cycle within the aquatic environment are nitrification and denitrification. Recent observations of significant nitrification in Antarctic sea ice shed a new light on nitrogen cycle within sea ice. It has been suggested that nitrification supplies up to 70% of nitrate assimilated within Antarctic spring sea ice. Corollary, production of N2O, a by-product of nitrification, can potentially be significant. Our recent studies in Antarctic land fast ice in McMurdo Sound, confirmed this suggestion, where N2O release to the atmosphere was estimated to reach 4µmol.m-2.yr-1. But this assessment is probably an underestimation since it only accounts for dissolved N2O while a significant amount of N2O is likely to occur in the gaseous form like N2, O2 and Ar. We will then address the new tools to measure the bulk concentration of N2O (dissolved and gaseous) in sea ice, and the production of N2O by sympagic microorganisms - what process is dominant and how much N2O is produced - based on the first time series of N2O measurement in sea ice. The determination of the isotopic composition of N2O using cavity enhanced laser absorption spectroscopy technique (Off-axis ICOS) will allow us to determine the origin of these processes.

Reference

- Randall, K. et al. 2012. First measurements of nitrous oxide in Arctic sea ice. Journal of Geophysical Research: Oceans 117:1978–2012.