Nutrient biogeochemistry in Antarctic land-fast sea ice and exchange with the surface ocean

Sian F. Henley[1], Stefano Cozzi[2], François Fripiat[3], Klaus M. Meiners[4], Martin Vancoppenolle[5], Kevin Arrigo[6], Bruno Delille[7], Delphine Lannuzel[8], Daiki Nomura[9], Florian Deman[7,10], Jacqueline Stefels[11], Maria van Leeuwe[11], Elizabeth M. Jones[11,12], David N. Thomas[13], Agneta Fransson[14], Melissa Chierici[12]

[1]University of Edinburgh, UK

[2]CNR-ISMAR Marine Science Institute – Trieste, Italy

[3]Université Libre de Bruxelles, Belgium

[4]Australian Antarctic Division, Australia

[5]Laboratoire d'Océanographie et du Climat and Institut Pierre-Simon Laplace (LOCEAN-IPSL), France

[6]Stanford University, USA

[7]Université de Liège, Belgium

[8]University of Tasmania, Australia

[9]Hokkaido University, Japan

[10]Vrije Universiteit Brussel, Belgium

[11]University of Groningen, The Netherlands

[12]Institute of Marine Research, Norway

[13]Bangor University, UK

[14]Norwegian Polar Institute, Norway

Sea ice is an important component of the Antarctic marine system due to its strong coupling with upper ocean processes, its exchanges with underlying seawater and the overlying atmosphere, and its ability to support life. The biogeochemical cycling of nutrients in sea ice and exchange of dissolved and particulate constituents with the surface ocean are particularly important in regulating primary production by ice algae, organic matter remineralisation within the ice matrix, and potentially seeding of phytoplankton blooms. We have produced an international compilation of nutrient concentration data from land-fast sea ice around the Antarctic continent. We will present and discuss these data with a view to describing the overall trends observed at the circum-Antarctic scale, and the differences in these trends between regions and over seasonal and interannual timescales. Our results highlight the importance of exchange with surface waters in supplying nutrients to the sea-ice matrix, and of ice thickness in regulating the availability of light to ice-algal communities concentrated close to the ice-ocean interface and therefore the degree of nutrient uptake. Our data further show strong seasonality in the nutrient content of the ice column, as well as a decoupling of the biogeochemical cycles of nitrogen, phosphorous and silicon. This international circum-Antarctic dataset will be useful in informing modelling efforts focusing on the role of sea ice in modulating Southern Ocean biogeochemistry and its importance in the Earth System.