

**SOLAS Open Science Conference 2009**  
**Discussion Session Report:**  
**Sea-ice biogeochemistry and exchange with the atmosphere**  
Wednesday 18<sup>th</sup> November 2009

Jacqueline Stefels<sup>1</sup> (Convener), Dave Kieber<sup>2</sup> (Co-convener) & Claire Hughes<sup>3</sup> (Rapporteur)

<sup>1</sup> University of Groningen, the Netherlands

<sup>2</sup> State University of New York, USA

<sup>3</sup> School of Environmental Sciences, University of East Anglia, UK

Near-future climate change is predicted to have its strongest impact in polar regions due to direct changes in surface area of polar oceans and ice sheets and to subsequent feedback processes. Observed reductions in sea ice cover appear to be occurring faster than predicted by current model forecasts. Currently, global models include the seasonal wax and wane of sea ice, but restrict associated properties to only a few physical features. Emerging views indicate, however, that sea ice itself plays an important role in the biogeochemical cycling and exchange of climate relevant compounds. Relevant examples of such processes are:

- The impact of biology on climate-relevant gases such as CO<sub>2</sub>, DMS, N<sub>2</sub>O, halocarbons, etc.
- The impact of biology on ice structure: porosity, energy absorption
- Strong precipitation and dissolution processes of CO<sub>2</sub> in brines
- Optical properties of sea ice and associated photochemical processes
- The release of macro and trace nutrients (N, P, Fe) for surrounding waters during ice melt

Apart from the need for a better understanding of the biogeochemical cycles in sea ice for future climate models, this is also important for unraveling palaeoclimatology. Sea-ice extent is an important indicator for past climate. Proxies in Antarctic ice cores, such as methane sulfonic acid and ikaite crystals, are used to reconstruct regional sea-ice extent. Combining knowledge on sea-ice related processes involved in the formation of both compounds with data analyses from firn, will improve our understanding of palaeoclimate.

After a short introduction based on the SOLAS White Paper (see: midterm strategy on SOLAS website) by Jacqueline Stefels, three topical presentations were given and discussed:

- Tessa Vance: Exposure of sub-ice phytoplankton to spring sunlight and subsequent DMS(P) production.
- Kevin Randall: Arctic sea ice: source or sink for nitrous oxide?
- Claire Hughes: Ecosystem variability and sea-to-air bromocarbon fluxes from the western Antarctic Peninsula.

During the discussion several additional climate relevant processes were discussed:

- What impact does carbon deposition have on ice albedo? (*Laurens Ganzeveld, Wageningen University and Research Centre, Netherlands*)
- What is the light field in the ice? What are the implications for photochemistry and photobiology? How does snowfall influence light field? (*Dave Kieber, State University of New York, USA*)
- How are the Polar Regions and sea ice included in CO<sub>2</sub> models? More CO<sub>2</sub> will move into the oceans as sea-ice retreats. What will be the consequence of ocean acidification in Polar Regions? Will ice reductions and/or acidification result in shifts in community structure with impact on carbon budgets?
- Can satellite observations be used for biomass estimations in ice and open-leads? This could lead to possible collaboration with the European Space Agency (ESA) (*Jacqueline Stefels, University of Groningen, Netherlands*)

- How to quantify gas movement through sea-ice? Potential for ice-tank experiments studying gas exchange and ice (*Wade McGillis, Lamont Doherty Earth Observatory*)

The way SOLAS could proceed with this theme is to link with or build on several ongoing studies and initiatives. As part of the International Polar Year legacy, several initiatives were mentioned:

Circumpolar Flaw Lead System Study (Arctic, Canada, CCGS Amundsen <http://www.ipy-cfl.ca/index.html>), the IPY Science Conference 2010 in Oslo (8-12 June, <http://www.ipy-osc.no/>) and PolarCat (<http://www.polarcat.no/>). Other interesting initiatives are: ArcticNet (<http://www.arcticnet.ulaval.ca/>), a newly planned Chinese expedition (three in the Arctic so far, another in 2010), several relevant ILeaps-recognised projects (<http://ileaps.org/>), follow-up of EU project DAMOCLES (Developing Arctic Modeling and Observing Capabilities for Long-term Environmental Studies).

For future activities on sea-ice research within SOLAS, you are requested to visit the SOLAS website, mid-term strategy page, regularly.