

Report for the year 2015 and future activities

SOLAS Belgium

compiled by: **Nathalie Gypens**

Please note that this report has two parts!

Part 1: reporting of activities in the period of January 2015 – December 2015

Part 2: reporting on planned activities for 2016 to 2018/19.

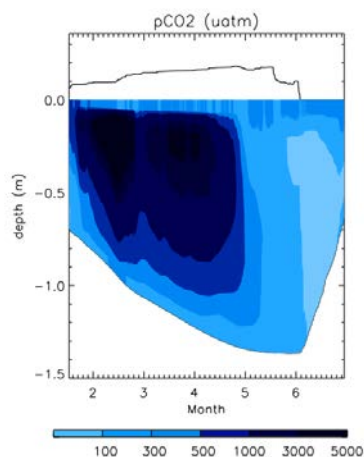
The information provided will be used for reporting, fundraising, networking and strategic development. In particular, **in 2016 SOLAS will develop its Implementation Plan, which will be largely based on the information from part 2 of the national reports, as well as input from international SOLAS initiatives and activities.** This info will be crucial in order to draft a realistic Implementation Plan representative of SOLAS, internationally.

IMPORTANT: May we remind you that this report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups)!

PART 1 - Activities from January 2015 to December 2015

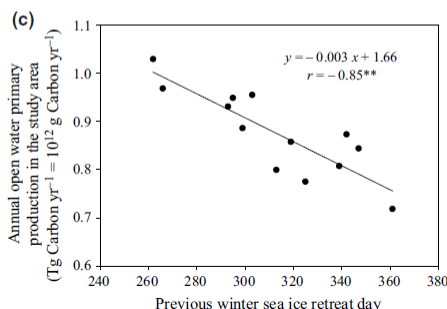
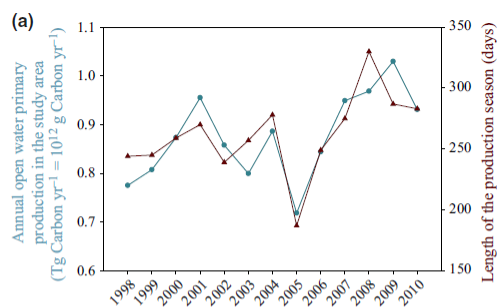
1. Scientific highlight

Moreau et al. 2015. Drivers of inorganic carbon dynamics in first-year sea ice: A model study. *Journal of Geophysical Research: Oceans*, 120(1):471-495



We analyzed CO₂ dynamics within sea ice using a one-dimensional halo-thermodynamic sea ice model including gas physics and carbon biogeochemistry. The results show that the DIC budget is mainly driven by physical processes,

whereas brine-air CO₂ fluxes, ikaite formation, and net primary production, are secondary factors. In terms of ice-atmosphere CO₂ exchanges, sea ice is a net CO₂ source and sink in winter and summer, respectively.



Moreau et al. 2015. Climate change enhances primary production in the western Antarctic Peninsula. *Global Change Biology* 21(6):2191-205

We observed the effects of climate change on primary production in the waters west of the Antarctic Peninsula over the last three decades. Since 1978, sea ice retreat has been occurring earlier in the season (in March in 1978 and in late October during the 2000s) while the ozone hole is present in early spring since the early 1990s, increasing the intensity of UVB radiation. The annual open water primary production (retrieved from satellite observations) increased from 1997 to 2010 (from 0.73 to 1.03 Tg C yr⁻¹) concomitantly with the increase in the production season length. The coincidence between the earlier sea ice retreat and the presence of the ozone hole increased photoinhibition during austral spring (from 0.014 to 0.025 Tg C yr⁻¹). This increase in photoinhibition was minor compared to the overall increase in production, however. Climate change hence had an overall positive impact on primary production in the WAP waters.

2. Activities/main accomplishments in 2015 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

Field campaigns and projects

During 12-26 May 2015, an oceanographic campaign was jointly conducted by VUB and ULB on board the R/V Belgica. It aims at assessing the different biogeochemical processes controlling the nitrogen cycle in oligotrophic N.E. Atlantic waters. During this BG2015/14 cruise we concentrated most of the work on the Iberian Margin to verify the regional extent and intensity of diazotrophy there. Incubation experiments enriched with ¹³C and ¹⁵N using natural phytoplankton assemblages were conducted on board to measure the primary production, nitrification and N₂ fixation in the euphotic layer. Special efforts were devoted to study the influence of dissolved Fe on N₂ fixation. The 2014 results show that N₂ fixation rates in oligotrophic waters have been tremendously stimulated through the addition of dissolved Fe compared to the control, demonstrating the limitation of N₂ fixation by Fe.

In addition, laboratory perturbation experiments were conducted to assess the impact of iron speciation and availability on the phytoplankton and the diazotroph communities. The individual and combined effects of pCO₂ (ocean acidification), temperature (seawater warming) and dust deposition were investigated. The results show that dust particles could provide a readily utilizable source of Fe and other macronutrients (dissolved phosphate and silicate) for phytoplankton growth. Elevated pCO₂ concentrations may have adverse impact on the diatom growth; warming may cause diatom poleward shifts in biogeographic distribution.

Optimist 2015 sea ice survey in Storefjord in March 2015. This survey was carried out in the frame of the project OPTIMIST-bio (Observing Processes impacting The sea Ice Mass balance from In Situ Measurements: from physics to its impacts on biology) funded by the CNRS (France) and led by F. Vivier from LOCEAN - UPMC. We measured greenhouse gases (CO₂, CH₄, N₂O) concentration and related physical and biogeochemical parameters in sea ice.

N-ICE 2015 survey. The Norwegian Young sea ICE cruise (N-ICE2015) was a drifting ice station that took place from January to June 2015 north west of Svalbard. N-ICE 2015 was investigating ocean, sea ice and atmosphere processes. We measured N₂O in the water column and sea ice and are collaborating with the groups involved in CH₄ and CO₂ measurements. N-ICE 2015 was funded by the Norwegian Polar Institute (among others) and led by H. Steen and M. Granskog. <http://www.npolar.no/en/projects/n-ice2015.html>

Conferences

There is strong Belgian community involved in sea ice chemistry that was involved in the session "Towards Joint SOLAS- Clic Activities on Sea -Ice Biogeochemistry" at the SOLAS 2015 open conference, 07-11 Septembre 2015, Kiel, Germany

47th International Liège Colloquium “Marine Environmental Monitoring, Modelling and Prediction”, 4th - 8th May 2015, Liège, Belgium

Session on “Biogeochemistry of coastal seas and continental shelves and impacts of anthropogenic pressures on coastal ecosystem functioning and services”, European Geosciences Union, General Assembly, Vienna, Austria, 12-17 April 2015

Participation to the Goldschmidt 2015 conference: Li X., D. Fonseca, H. Ingber, N. Roevros, F. Dehairs and L. Chou (2015) Iron biogeochemistry under a changing climate: impact on the phytoplankton growth and the diazotrophic nitrogen fixation. Goldschmidt 2015 conference, 16-21 August 2015, Prague, Czech Republic. Oral presentation.

3. Top 5 publications in 2015 (only PUBLISHED articles) and if any weblinks to models, datasets, products, etc.

Borges A.V. and W. Champenois (2015) Seasonal and spatial variability of dimethylsulfoniopropionate (DMSP) in the Mediterranean seagrass *Posidonia oceanica*, *Aquatic Botany*, 125, 72-79

De Jong JTM, Stammerjohn SE, Ackley SF, Tison J-L, Mattielli N, Schoemann V (2015) Sources and fluxes of dissolved iron in the Bellingshausen Sea (West Antarctica): The importance of sea ice, icebergs and the continental margin, *Marine Chemistry*, 177, 518–535.

Hagens H., C. P. Slomp, F. J. R. Meysman, D. Seitaj, J. Harlay, A. V. Borges, J. J. Middelburg (2015) Biogeochemical processes and buffering capacity concurrently affect acidification in a seasonally hypoxic coastal marine basin, *Biogeosciences*, 12(5):1561-1583

Moreau S., H. Kaartokallio, M. Vancoppenolle, J. Zhou, M. Kotovitch, G. Dieckmann, D. N. Thomas, J.-L. Tison, B. Delille. (2015) Assessing the O₂ budget under sea ice: An experimental and modelling approach. *Elementa*, 3, 000080, doi: 10.12952/journal.elementa.000080

Moreau S., Vancoppenolle M., Delille B., Tison J.-L., Zhou J., Kotovitch M., Thomas D., Geilfus N.-X. and Goosse H. (2015). Drivers of inorganic carbon dynamics in first-year sea ice: A model study. *Journal of Geophysical Research: Oceans*, 120 (1) : 471-495

PART 2 - Planned activities from 2016 to 2018/19

1. Planned major field studies and collaborative laboratory and modelling studies, national and international (incl. all information possible, dates, locations, teams, work, etc.)

Field campaigns and projects

Optimist 2015 sea ice survey in Storefjord in April 2016. This survey was carried out in the frame of the project OPTIMIST-bio (Observing Processes impacting The sea Ice Mass balance from In Situ Measurements: from physics to its impacts on biology) funded by the CNRS (France). We will measure greenhouse gases (CO₂, CH₄, N₂O) concentration and air-ice fluxes. We will also collect sea ice for measurement of related physical and biogeochemical parameters.

We are involved in the project Polynyas, Ice production and seasonal evolution in the Ross Sea (PIPERS) funded by the NSF and led by S. Ackley. The principle objective of PIPERS is to quantify the full 3-D Suite of Atmosphere-Ocean-Ice (AOI) interactions within the Ross sea polynya. This includes transfer of heat, momentum, and CO₂ together with sea ice formation rate. This project has a strong multiple platforms approach (including AUV, UAV, buoys, mooring and cruise on the NB Palmer. We will take part of the NB Palmer where we will deal with sea ice biogeochemistry. This cruise is scheduled in April-June 2017

Laboratory experiments

Laboratory incubation experiments using *Trichodesmium* are planned to study the influence of pCO₂ and temperature on the nitrogen fixation of this filamentous cyanobacterium. Nutrient and dust addition bioassays are also planned to investigate the effect of phosphate and dissolved Fe on N₂ fixation. Special attention will be given to studying the effects of mineral dust deposition which is believed to promote N₂ fixation through increasing Fe availability.

2. Events like conferences, workshops, meetings, schools, capacity building etc. (incl. all information possible)

Conferences

Colloquium "Submesoscale Processes: Mechanisms, Implications and new Frontiers" 48th International Liège Colloquium on ocean dynamics, University of Liège, 23rd - 27th May 2016

Session on "Biogeochemistry of coastal seas and continental shelves, with a special focus on Sedimentary Carbon in the Coastal Ocean", European Geosciences Union, General Assembly, Vienna, Austria, 17-22 April 2016

Li X., D. Fonseca-Batista, J. Brouwers, N. Roevros, F. Dehairs and L. Chou (2016) The marine diatom and diazotroph under future climate: Role of Iron. EGU General Assembly 2016, 17-22 April 2016, Vienna, Austria. Oral or poster presentation to be decided by the convenor.

3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 science plan the activity topics relate – including the themes on 'SOLAS science and society' and 'Geoengineering')

ISOtopic Investigation of Greenhouse Gases in Polar regions: An Ocean Ice-Atmosphere Continuum (ISOGGAP) funded by the FRS-FNRS (2016-2019, 432 kEur). This project covers the theme 8 "High Sensitivity Systems- HS2" but will focus on arctic systems. ISOGGAP will address: 1) Gas exchange monitoring and process studies; 2) Regional dynamics of stressors and their effect in sea ice systems; 3) Improvement of the representation of biogeochemistry in regional models of sea ice 4) Identification of the elements of HS² that are key parameters to global change and incorporate them into Earth System Models.

**4. Plans / ideas for future projects, programmes, proposals national or international etc.
(please precise to which funding agencies and a timing for submission is any)**

5. Engagements with other international projects, organisations, programmes etc.

Belgium is strongly involved in the BEPSII (Biogeochemical exchange processes at Sea Ice Interfaces) community and activities. 2016 will be a transitional year for the BEPSII community, since the first phase and its financial support from SCOR will come to an end. As a result, in 2015 BEPSII community reviewed its progress and proposed new objectives. In addition BEPSII turned towards CLIC and SOLAS to fund its activities (mainly meetings)

Comments