surface ocean solas lower atmosphere study

Report for the year 2015 and future activities

SOLAS Denmark *compiled by: Lise Lotte Sørensen*

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

Estimate of the CO_2 uptake of the coastal Grennlandic ocean

It is critical to accurately estimate CO_2 uptake by the Greenlandic coastal area because the marine region is sensitive to climate change and it takes up relative more CO_2 than other marine areas. Thus we aim to obtain a reliable assessment of the CO_2 uptake by the Greenlandic coastal area and air – water CO_2 fluxes were estimated for the coastal area of Greenland based on measurements at two Greenlandic estuaries at two different latitudes; Godthåbs fjord in Nuuk, and Young Sound, Daneborg.
Both estuaries appear as CO_2 sinks and therefore the total coastal area is estimated to be a sink. The estimated uptake is depending on ice cover, temperature, and wind velocities. The coastal marine surface of Greenland is 0.08% of the total global ocean surface and 1.1% of the coastal area. However the estimated uptake of CO_2 is around 0.5% of the global ocean uptake and 6.1% of the global coastal uptake. The uptake is estimated from the parameterization of Clarck et al. (1995) and Ho et al., 2006 which showed similar results. The uptake is shown in Table 1.
The estimated uptake is based on a very limited dataset and it is clear from new measurements that more knowledge of the spatial and temporal distribution of air sea CO_2 fluxes around Greenland is needed.

	Clarck et al. (1995)	*Reduced sea ice (30%)*	*Changed wind climate*
Exchange velocity *g-C m^{-2} hr^{-1}*	1 - 7 x 10^{-3}		
Total uptake *Tg C y^{-1}*	11.65	16.65	11.28

Table 1: CO_2 uptake by the coastal marine area of Greenland estimated using three different scenarios (present climate, reduced sea ice, reduced sea ice but including increased water temperature and changed wind climate) (http://dx.doi.org/10.6027/TN2015-538).

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.)

Coastal measurements of CO2 and CH4 fluxes at Station Nord (LAT: 81°36'09. LONG:16°40'12)

A mobile flux tower was installed on the sea ice at Station Nord in mid- April with two Licor instruments (one enclosed sampler 7200 and one open path sampler 7500A) and two sonics to measure fluxes of CO2 and heat over the snow covered sea ice in spring and summer 2015 (a gap in July due to difficulties in access to the station with batteries). In May a CH4 instrument was added to the instrument package to also measure CH4 fluxes. In end of May the tower was moved from the ice to the shore and measurements over the open water surface was continued.
The instruments have been measuring most of the summer until December 2015, where the tower was taken down and instruments calibrated. We have just started the data analyzes, where the first task is to compare data from the two different CO2 sampler.
The project is collaboration between Aarhus University, Denmark and University of Manitoba, Canada.

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

Sievers J., Sørensen, L. L., Papakyriakou, T., Sejr, M., Søgaard, D. H., Barber, D. and Rysgaard, S., 2015, Winter observations of CO2 exchange between sea ice and the atmosphere in a coastal fjord environment. *The Cryosphere*, 9, 1701-1713, DOI:10.5194/tc-9-1701-2015.

Lansø, A. S., Bendtsen, J., Christensen, J. H., Sørensen, L. L., Chen, H., Meijer H. A. J. and Geels, C., 2015. Sensitivity of the air-sea CO2 exchange in the Baltic and Danish waters to atmospheric short term variability. *Biogeosciences*. 12, 2753-2772, DOI: 10.5194/bg-12-2753-2015.

Sievers, J., Papakyriakou, T., Larsen, S. E., Jammet, M. M., Rysgaard, S., Sejr, M. K. and Sørensen, L. L., 2015, Estimating surface fluxes using eddy covariance and numerical ogive optimization. *Atmospheric Chemistry and Physics* 15, 2081–2103, DOI:10.5194/acp-15-2081-2015.

Miller L. A., Fripiat, F., Else, B. G. T, Bowman, J. S., Brown, K. A., Collins, R. E., Ewert, M., Fransson, A., Gosselin, M., Lannuzel, D., Meiners, K., Michel, C., Nishioka, J., Nomura, D., Papadimitriou, S., Russell, L. M., Sørensen, L. L., Thomas, D. N., Tison, J.-L., van Leeuwe, M. A., Vancoppenolle, M., Wolff, E. W., Zhou, J., 2015,. Methods for Biogeochemical studies of sea ice: The state of the art, caveats, and recommendations. *Elementa: Science of the Anthropocene*, 3:000038, DOI:10.12952/journal.elementa.000038.

Meire L., Søgaard, D.H., Mortensen, J., Meysman, F. J. R, Soetaert, K., Arendt, K. E., Juul-Pedersen, T., Blicher, M. E. and Rysgaard, S., 2015, Glacial meltwater and primary production are drivers of strong CO2 uptake in fjord and coastal waters adjacent to the Greenland Ice Sheet, *Biogeosciences*, 12, 2347-2363, DOI:10.5194/bg-12-2347-2015

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.)

This spring Aarhus University is planning on field work in Nuuk fjord where we will measure adjacent fluxes of CO2 and sea spray.

Furthermore a multidisciplinary study of Greenland ice sheet-ocean interactions in Greenland fjords will be conducted. Based on oceanographic surveys along ~5 transects from the shelf towards main outlet glaciers in NW Greenland we will: 1) Identify near shore water mass characteristics and bathymetry to assess potential marine heat sources and circulation processes important for glacial melt. 2) Identify impacts of glacial melt water on vertical mixing, light and nutrient conditions and subsequent rates of phytoplankton production. 3) Determine surface pCO2 values and carbonate system dynamics including pH and aragonite saturation states to confirm if glacial fjords are sites of high uptake of atmospheric CO2. 4) Determine the importance of glacial derived carbon for pelagic and benthic carbon cycling

A coastal Danish ICOS atmospheric station measuring CO2 and CH4 will be established At Station Nord in 2016 and 2017.

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

We are planning a SOLAS-DK national workshop

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')

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.

Comments