## SOLAS Canada

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It has been a busy year for Canadian SOLAS scientists with several accomplishments completed in the main research goals:

The ARCTIC-ICE program: The third ice camp took place during May-June 2012 in the Resolute Passage. The results highlighted higher DMS concentrations (up to 770nmol $l^{-1}$) at the bottom of the ice and very short (min) turnover time of the dissolved DMSP reservoir. This suggests the presence of a high microbial activity in the brines.

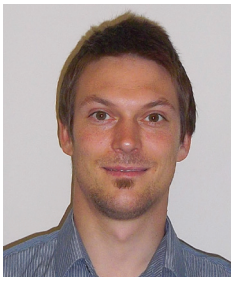
The BaySys2012 is a continuing project investigating air-sea $CO_2$ exchange dynamics as high-$pCO_2$ river plumes mix with low-$pCO_2$ sea-ice melt-influenced marine water in Hudson Bay. The measurements were carried out to quantify the inorganic carbon system parameters in the surface waters at thigh vertical resolution.

A SABINA (Study of Air-Sea Biogeochemical Interactions in the North-western Atlantic) workshop was held in order to summarize the collected data during three cruises conducted in the North-western Atlantic. The workshop took place in Quebec, Canada and was sponsored by the Canadian Foundation for Climate and Atmospheric Sciences. Additionally, microcosms experiments were conducted in July 2012 to test the effect of pH on dimethylsufide production by natural estuarine communities; these experiments showed that the local diatom community is resistant to pH changes.

Scientific highlight: Biological cycling of dimethylsulfoniopropionate (DMSP) and dimethylsulfide (DMS) in the Northwest Atlantic -Macroscale patterns and dynamics

The influence of the seasonal development of microplankton communities on the cycling of DMS and its precursor DMSP was investigated along a South-North gradient in the Northwest Atlantic. The South-North progression of the diatom bloom did not influence the production of DMS whereas conditions in the North Atlantic drift lead to a persistent bloom of DMSP-rich flagellate-dominated phytoplankton community and high net DMS production rates.

Lizotte M, Levasseur M, Michaud S, Scarratt MG, Merzouk A, Gosselin M, Pommier J, Rivkin RB, Kiene RP (2012). Biological cycling of dimethylsulfoniopropionate (DMSP) and dimethylsulfide (DMS) in the Northwest Atlantic -Macroscale patterns and dynamics. Biogeochemistry. doi: 10.1007/s10533-011-9698-4.



Since January 2011 Peter Landschützer is studying for a PhD degree at the University of East Anglia in Norwich, UK, funded by the European Union Marie Curie Greencycles II program. His research focuses on the seasonal to inter-annual variability of air-sea fluxes of carbon dioxide ($CO_2$) in the Atlantic Ocean.

# The changing carbon sink in the Atlantic Ocean

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The North Atlantic is playing a key role in the uptake of carbon dioxide ($CO_2$) from the atmosphere. A recent estimate of the average basin-wide uptake of $CO_2$ was 0.49±0.11 PgC $yr^{-1}$ over the last two decades (Schuster et al., 2013), which accounts for 20-25% of the estimated global $CO_2$ uptake by the ocean based on model studies (Le Quéré et al., 2009), yet major uncertainties remain regarding long term basin-wide trends and the inter-annual variability of the basin's carbon sink. Therefore, since 2002, the University of East Anglia is measuring sea surface $pCO_2$ in the North Atlantic on-board commercial vessels between the UK and the Caribbean. These underway measurements are part of a collection of observations within the recently released SOCAT v1.5 database (Pfeil et al., 2013) which was made possible due to the data collection and synthesis effort of the marine carbon community. Basin-wide estimates of the sea surface $pCO_2$ based on observations, however, remain a key challenge, due to the highly heterogeneous distribution of the observations in time and space.

Here, we use a combination of two neural network methods to overcome this challenge (Figure 1): firstly, a self-organizing

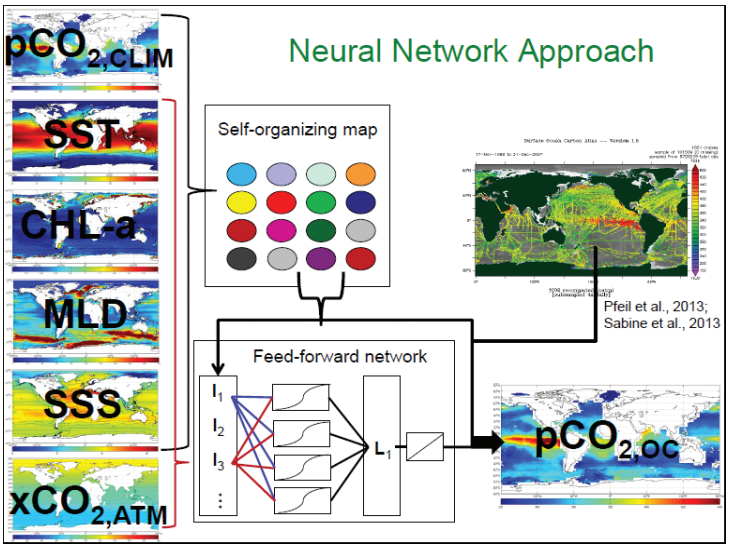


Figure 1: Schematic of the two neural network steps. We firstly use a set of input parameters to identify 16 oceanic provinces, and secondly reconstruct the non-linear relationship between a second set of inputs and available gridded observations from the SOCAT V1.5 database (Pfeil et al., 2013; Sabine et al. 2013).

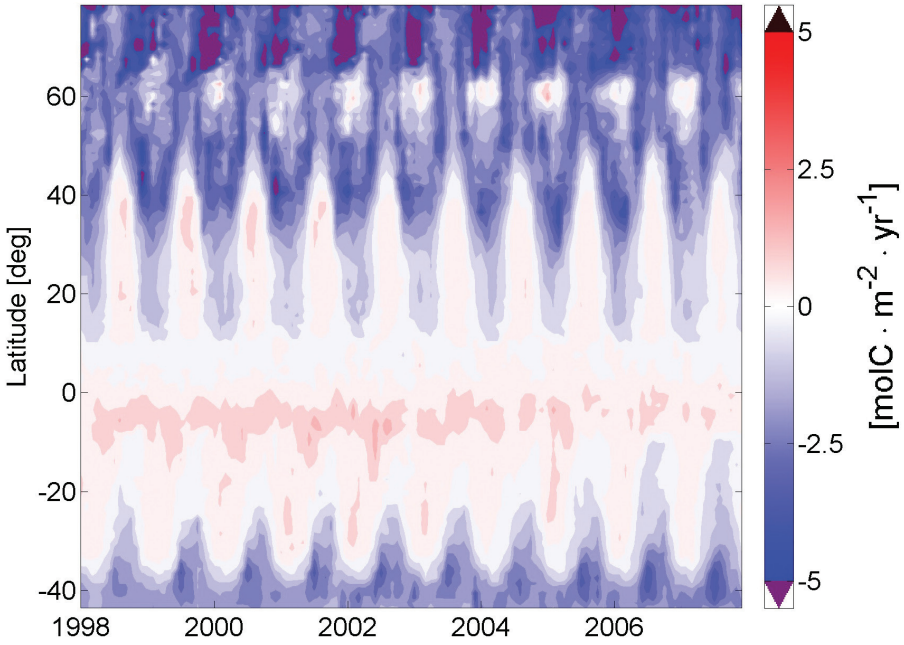


Figure 2: Hovmöller diagram of the long term mean seasonal cycle of the $CO_2$ flux density in the Atlantic Ocean from 1998 to 2007. Negative values indicate a sink.

map to identify oceanic biogeochemical regions of similar input relations and secondly a feed-forward neural network to retrieve a continuous number of $pCO_2$ outputs. The second step reconstructs the relationship between sea surface temperature, chlorophyll-*a* concentration, mixed layer depth, sea surface salinity and atmospheric $CO_2$ and the co-located gridded observations from the SOCAT database (Sabine et al., 2013). We estimate monthly sea surface $pCO_2$ on a 1°x1° degree grid from 1998 to 2007, and compute air-sea $CO_2$ flux densities using a standard gas exchange parameterization and high-resolution wind speeds.

On basin scale our results (Landschützer et al., in prep.) are in good accordance with recent findings from Schuster et al. (2013). We find the strongest seasonal variability of the sea surface $pCO_2$ and the air-sea fluxes within the subtropics in the northern and southern hemisphere, i.e. the zones where the seasonal cycle of the sea surface $pCO_2$ is thermally driven (Figure 2). Trends in the sea surface $pCO_2$ suggest that in large areas polewards of 40°N the sea surface $pCO_2$ increased faster than the atmospheric $pCO_2$. Basin-wide, however, the North Atlantic carbon sink was barely changing within the study period, whereas we find an increase in the South Atlantic carbon sink.

## References


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PICES

For more than 22 years, the North Pacific Marine Science Organization (PICES) has been providing an international forum for scientists from North America and Asia to tackle the complexities of natural and anthropogenic variability in the North Pacific Ocean. The PICES expert group on Carbon and Climate seized upon that opportunity to develop an integrated, intercalibrated, quality controlled database of carbonate system observations in the North Pacific. Public release of its major product, the PACIFICA database, is expected in May 2013.

PICES is anticipating an Open Science Meeting (OSM) for its integrative scientific program FUTURE (Forecasting and Understanding Trends, Uncertainty, and Responses of marine Ecosystems) from April 15-18, 2014 on the Kohala Coast, Hawaii. The overarching vision of the program is to understand and forecast responses of North Pacific marine ecosystems to climate change and human activities at basin and regional scales, and to broadly communicate this scientific information to members, governments, resource managers, stakeholders and the public. The OSM is an opportunity for a review of progress and to make necessary course corrections for the five years that remain of the program.

The PICES 2013 Summer School on Ocean Observing Systems and Ecosystem Monitoring (August 19-23, Newport, Oregon) is being organized in conjunction with Oregon State University. The school will provide hands-on at-sea training with new ocean monitoring technologies (e.g. gliders and profiling floats) and the remarkable data they are providing. It is proving to be a popular topic because the registrar received more than twice the number of applicants than could be accommodated.

Finally, at PICES 2013 annual meeting (October 16, Nanaimo, Canada) SOLAS and PICES are teaming up to offer a Topic Session on The changing carbon cycle of North Pacific continental shelves and marginal seas, co-convened by Minhan Dai (China), Sophia Johannessen (Canada), and Dong-Jin Kang (Korea), with Miguel Goni (Oregon State University, USA), and Kon-Kee Liu

(Institute of Hydrological and Oceanic Sciences, National Central University, China-Taipei) as invited speakers. Early registration and abstract submission deadlines are June 30, 2013 (http://www.pices.int/meetings/annual/PICES-2013/2013-background.aspx). PICES is the organization for international interdisciplinary research directed at understanding marine ecosystems of the North Pacific.


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