SOLAS CANADA

compiled by Maurice Levasseur

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1. Scientific highlights

1. Publication of The first intercomparison of oceanic DMS models

Le Clainche Y, Vézina AF, Levasseur M, Cropp R, Gunson J, Vallina S, Vogt M, Lancelot C, Allen I, Archer S, Bopp L, Deal C, Elliott S, Jin M, Malin G, Schoemann V, Simó R, Six K, Stefels J (2010). A first appraisal of prognostic ocean DMS models and prospects for their use in climate models, *Global Biogeochem. Cycles*, doi:10.1029/2009GB003721

This community paper represents the first attempt to compare and evaluate the existing Oceanic DMS models (1D and 3D). This is the main deliverable of the SOLAS-funded CODiM international workhop held in Brussels in 2007. The exercise was highly informative and highlighted the similarities and divergences between the models. Most models failed to reproduce the summer DMS peak measured at low latitudes, which underlines the importance of identifying and parameterizing physiological functions (ex. light stress) stimulating DMS production.

2. Seguin, A.M., Norman, A.L., Eaton, S., Wadleigh, M.A., Sharma, S. (2010) Elevated biogenic sulfur dioxide concentrations over the North Atlantic. *Atmospheric Environment,* 44, 1139-1144.

Sulfur dioxide from dimethylsulfide oxidation, or biogenic SO_2, was found at very high concentrations over the North Atlantic in summer, reaching 82 nmol m^{-3}, the highest reported in the literature. Biogenic SO_2 was higher in polluted than in clean marine air suggesting anthropogenic pollutants influence its prevalence and potentially enhance CCN formation.

2. Main accomplishments

1. Arctic SOLAS - The Canadian International Polar Year (IPY) Arctic SOLAS program is reaching its end (March 2011). Hence, most SOLAS researchers have been busy finalizing the analysis of the samples collected in the High Canadian Arctic during the 2008 and 2009 cruises. These field observations were complemented by other SOLAS-related studies carried out as part of the IPY Circumpolar Flaw Lead (CFL) study in 2008-2008, during a year-round deployment of the Canadian icebreaker CCGS Amundsen. A subset of papers from these closely related cruises will be submitted to a special *IPY Circumpolar Flaw Lead and Arctic SOLAS* section in the Journal of

Geophysical Research (Oceans or Atmospheres) in the next few months.

2. **Biogeochemical Impacts of Asian Dust on the North Pacific Ecosystem and Climate -** Two cruises were also conducted in the North-East Pacific during the summer to investigate the impact of dust and ash depositions on plankton ecosystems and dimethylsulfide production as well as to explore how changes in pH could affect these responses. These cruises were conducted in partnership with several researchers from the Institute of Ocean Sciences (Dept. of Fisheries and Oceans) and under the umbrella of a joint Quebec-Shandong Provinces research initiative.

3. Arctic research - As part of the Arctic-ICE project, we conducted an interdisciplinary study of carbon dioxide and DMS biogeochemistry and fluxes in sea ice at the Allen Bay ice camp near Resolute. As part of the ArcticNet summer cruise on the Amundsen, we conducted a detailed study, including marine organic photochemistry, of air-sea CO_2 exchange in Hudson Bay, looking at how the fluxes vary across the salinity gradient from fresh to sea waters.

3. Top 10 publications in 2010

1. Le Clainche Y, Vézina AF, Levasseur M, Cropp R, Gunson J, Vallina S, Vogt M, Lancelot C, Allen I, Archer S, Bopp L, Deal C, Elliott S, Jin M, Malin G, Schoemann V, Simó R, Six K, Stefels J (2010). *A first appraisal of prognostic ocean DMS models and prospects for their use in climate models, Global Biogeochem. Cycles*, doi:10.1029/2009GB003721

2. Shadwick, E. H., Thomas, H., Comeau, A., Craig, S. E., Hunt, C. W., and Salisbury, J. E.: *Air-Sea CO_2 fluxes on the Scotian Shelf: seasonal to multi-annual variability*, Biogeosciences, 7, 3851-3867, doi:10.5194/bg-7-3851-2010, 2010.

3. Miller LA, Papakyriakou TN, Collins RE, Deming JW, Ehn JK, Macdonald RW, Mucci A, Owens O, Raudsepp M, Sutherland N. Carbon dynamics in Sea Ice: A Winter Flux Time Series. (in press JGR), doi: 10.1029/2009JC006058.

4. Royer S-J, Levasseur M, Lizotte M, Arychuk M, Scarratt MG, Wong CS, Lovejoy C, Robert M, Johnson K, Peña A, Michaud S, Kiene RP (2010). *Microbial dimethylsulfoniopropionate (DMSP) dynamics along a natural iron gradient in the northeast subarctic Pacific*. Limnol. Oceanogr. 55(4), 2010, 1614–1626

5. Papakyriakou T, Miller L. *Springtime CO_2 exchange over seasonal sea ice in the Canadian Arctic Archipelago.* (in press *Ann. Glaciol.*)

6. Wurl O, E. Wurl, L. Miller, K. Johnson, S. Vagle. 2011. *Formation and global distribution of sea-surface microlayers.* Biogeosci. **8**: 121-35.

7. Shadwick EH, H. Thomas, M. Chierici, B. Else, A. Fransson, C. Michel, L.A. Miller, A. Mucci, A. Niemi, T.N. Papakyriakou, and J.-É. Tremblay. 2011. *Seasonal variability of the inorganic carbon system in the Amundsen Gulf region of the southeastern Beaufort Sea*. *Limnol. Ocea*nogr. **56**(1): 303–22.

8. Mucci A, B. Lansard, L.A. Miller, and T.N. Papakyriakou, 2010. *J. Geophys. Res.* 115, C04003, doi: 10.1029/2009JC005330. CO_2 fluxes across the air-sea interface in the southeastern Beaufort Sea: Ice-free period.

9. Arctic SOLAS data management. Martine Lizotte (U Laval) is working on the incorporation of the metadata and data from the Canadian IPY Arctic SOLAS program into the Polar Data Catalogue.

4. International interactions and collaborations

1. A Quebec-Shandong workshop examining the impacts of ocean acidification on marine resources and biogeochemical cycles was held in Qingdao, China, in December 6-8, 2010. The workshop was funded by the Government of Québec, and has been conducted under the umbrella of SOLAS.

5. Goals and plans for future activities

1. Arctic-ICE-Resolute 2011 project- An ice camp will be conducted for the second year in May-July 2011 near Resolute in the High Canadian Arctic. The sampling will focus on the impact of ice on the light field and the response of the ice algae and phytoplankton. Production/fluxes of CO_2, DMS and N_2O will be determined. Main investigators are CJ Mundy, M Gosselin, D Barber, T Papakyriakou, L Miller, and M Levasseur.

2. Biogeochemical Impacts of Asian Dust on the North Pacific Ecosystem and Climate - Onboard incubation experiment will be conducted on the combined effect of dust and pH on the plankton community and its capacity to produce DMS during the August 2011 Line P cruise in the Northeast subarctic Pacific. Main investigators are M Levasseur, L Miller, P Tortell, N Steiner, M Scarratt and JE Tremblay.

6. Other comments

Results from the Canadian IPY Arctic SOLAS program will be submitted to JGR-Ocean and JGR-Atmosphere to be part of the special section 'IPY Circumpolar Flaw Lead and Arctic SOLAS Experiments: Oceanography, Geophysics and Biogeochemistry of the Southern Beaufort, Amundsen Gulf, and NW Passage during a year of unprecedented sea ice minima'. The following papers are either submitted of in an advanced stage of writing:

Song G, Xie H, Aubry C, Zhang Y, Gosselin M, Mundy CJ, Philippe B, Papakyriakou TN. *Spatiotemporal variations of dissolved organic carbon and carbon monoxide in first-year sea ice in the western Canadian Arctic*. JGR-Ocean (submitted)

Luce M, Levasseur M, Scarratt MG, Michaud S, Kiene R, Lovejoy C, Gosselin M, Poulin M, Gratton Y. *Distribution and microbial metabolism of dimethylsulfoniopropionate and dimethylsulfide*

during the 2007 Arctic ice minimum. JGR-Ocean (submitted)

Motard-Côté J, Levasseur M, Scarratt MG, Michaud S, Lovejoy C, Rivkin R, Keats K, Gosselin M, Tremblay J-E, Kiene RP, Gratton Y. *Distribution and phylogenetic affiliation of dimethylsulfoniopropionate (DMSP)-degrading bacteria in Northern Baffin Bay*. JGR-Ocean (in prep)

Rempillo O, Seguin M, Norman A-L, Scarratt M, Michaud S, Levasseur M, Sjostedt S, Chang R, Abbatt J, Else B, Papakyriakou T, Sharma S. *DMS fluxes and the growth of the biogenic sulphur aerosol component: a study aboard an icebreaker in the Arctic in the fall of 2007 and 2008*. JGR-Atmosphere (in prep)

Randall K, Scarratt MG, Levasseur M, Xie H, Gosselin M, Michaud S. *Arctic sea ice: source or sink for nitrous oxide?* JGR-Ocean (in prep)

Chang R, Sjostedt SJ, Pierce JR, Papakyriakou TN, Scarratt MG, Michaud S, Levasseur M, Leaitch WR, Abbatt JPD. *Relating atmospheric and oceanic DMS levels to particle nucleation events during the Canadian Arctic summer*. JGR-Atmosphere (in prep).

Else BGT, Papakyriakou TN, Galley RJ, Drennan WM, Miller LA, Thomas H. *Eddy covariance measurements of wintertime CO_2 fluxes in an arctic polynya: Evidence for enhanced gas transfer during ice formation* (submitted JGR).