surface ocean solas lower atmosphere study

Report for the year 2021 and future activities

SOLAS CANADA
Compiled by: Martine Lizotte

First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?
We simply wish to thank the IPO for their continued support of SOLAS-related activities in Canada.

PART 1 - Activities from January 2021 to Jan/Feb 2022

1. Scientific highlight

*Describe one scientific highlight with a title, text (**max. 300 words**), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in results of international collaborations. (If you wish to include more than one highlight, feel free to do so).*

1. **Synthesis of the sea-ice ecosystem and associated ecosystem services**

A key science highlight was produced under Canadian leadership and several Canadian authors within the BEPSII research community and synthesises sea-ice ecosystems and associated ecosystem services.

The 2021 **synthesis of the sea-ice ecosystem and associated ecosystem services** highlights that: 1. The sea-ice ecosystem supports all four ecosystem service categories; 2. sea-ice ecosystems meet the criteria for ecologically or biologically significant marine areas (EBSAs); 3. global emissions driving climate change are directly linked to the demise of sea-ice ecosystems and its ecosystem services; and 4. the sea-ice ecosystem deserves specific attention in the evaluation of marine protected area planning. The ongoing changes in the polar regions have extreme impacts on sea-ice ecosystems and associated ecosystem services. While the response of sea-ice associated primary production to environmental change is regionally variable, the effect on ice-associated mammals and birds are predominantly negative, subsequently impacting human harvesting and cultural services in both polar regions. Conservation can help protect some species and functions. However, the key mitigation measure that can slow the transition to a strictly seasonal ice cover with climate change, reduce the overall loss of sea-ice habitats from the ocean, and thus preserve the unique ecosystem services provided by sea ice and their contributions to human-well being is a reduction in carbon emissions.

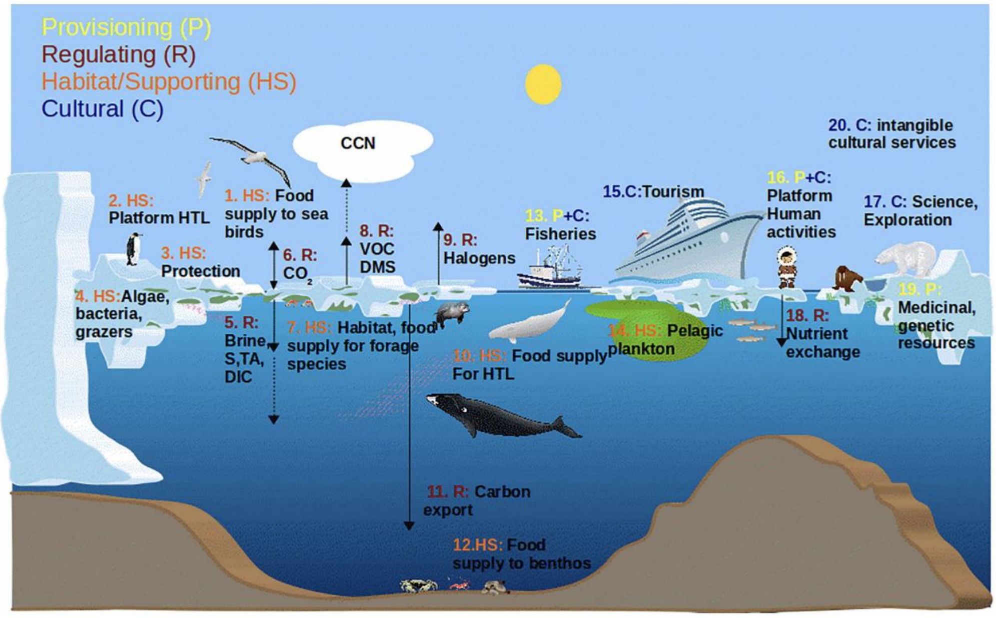

Figure 1.1 Key examples of sea-ice ecosystem services. Examples for provisioning (P, yellow), regulating (R, red) habitat/supporting (H, orange), and cultural (C, blue) ecosystem services provided by polar sea-ice ecosystems: (1) Food supply to higher trophic level species and sea birds; (2) Platform for birthing and neonatal care of higher trophic species; (3) Protection from predators for ice-adapted species; (4) Habitat for sympagic algae, bacteria, grazers (ice, melt pond, slush communities); (5) Brine drainage that exports salt (S), total alkalinity (TA), dissolved inorganic carbon (DIC); (6) CO2 exchange; (7) Habitat and food supply for key foraging species (amphipods, Antarctic krill, Arctic cod); (8) Emission of aerosol precursors for cloud condensation nuclei (CCN), including volatile organic compounds (VOC) and dimethylsulfide (DMS); (9) Halogen oxidation via frost flowers and snow; (10) Food supply for higher trophic level species (fish, seals, whales); (11) Carbon export into the (deep) ocean; (12) Food supply to benthic species; (13) Fisheries and harvesting; (14) Nutrient supply to pelagic phytoplankton; (15) Tourism; (16) Platform for human transport and subsistence harvesting; (17) Spiritual connection and inspiration, science and exploration; (18) Nutrient exchange; (19) Medicinal and genetic resources; and (20) all of the intangible, cultural, services that connect coastal communities to the sea ice, such as spiritual experience and Indigenous and local knowledge. From Steiner, NS, et al. 2021. Climate change impacts on sea-ice ecosystems and associated ecosystem services. Elem Sci Anth, 9: 1. DOI: https://doi.org/10.1525/elementa.2021.00007

2. Observational evidence of changes in albedo due to aerosol concentrations

As part of a fog study in June – July 2016 on the coast of Nova Scotia near Halifax, we measured aerosol concentrations, liquid fog droplet concentrations and extinction, which can be used to calculate visibility and cloud reflectivity. The study site was primarily influenced by advection fog that formed offshore and was blown to the coast, suggesting that our observations were reflective of fog formed over the ocean. We found that the maximum droplet number concentration (N_D) during a fog correlated with the total number concentration in the pre-fog air with a slope of 0.011, suggesting that 1% of all particles end up as a cloud droplet. We also found that the calculated reflectivity in the fog also correlated with the N_D (Figure 1). The slopes calculated in Figure 1 represent the susceptibility of a fog (or an equivalent cloud) to a change in N_D for a range of liquid water contents (LWC). By combining these two results, we calculated that an increase in 1 particle / cm^3 would result in an increase in albedo of

$3.8x10^{-4}$ in the observed range of LWC. This is the first observational study to quantify changes in aerosol concentrations to albedo at any level of the atmosphere and demonstrates the potential effect of changes in marine aerosol concentrations on albedo, a strategy often discussed in geoengineering approaches.

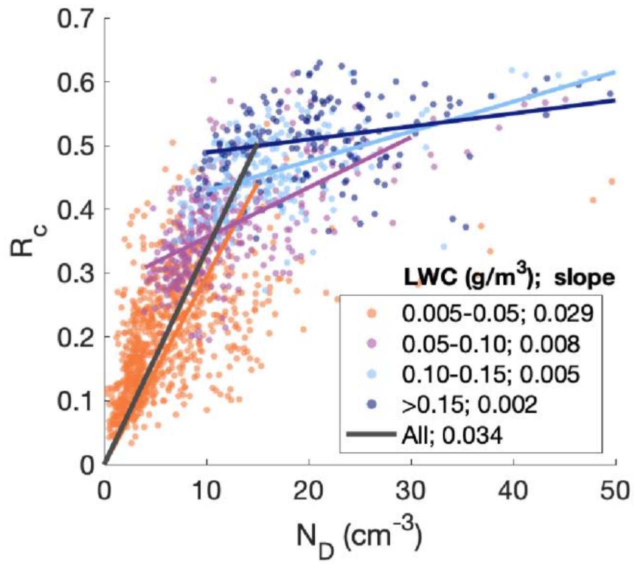

Figure 2.1 Calculated albedo (R_c) based on measured visibility as a function of fog droplet number concentration (N_D), color-coded by liquid water content (LWC). Slopes of linear fits for LWC ranges and all LWC with 0<ND<15 cm^{-3} are included in the legend and represents the fog susceptibility. From Duplessis, P., Bhatia, S., Hartery, S., Wheeler, M. J., & Chang, R. Y.-W. (2021). Microphysics of aerosol, fog and droplet residuals on the Canadian Atlantic coast. *Atmospheric Research*, 264, 105859. https://doi.org/10.1016/j.atmosres.2021.105859

3. Factors controlling marine aerosol size distributions and their climate effects over the northwest Atlantic Ocean region

A global chemical transport model (GEOS-Chem) with an aerosol microphysics algorithm (TOMAS) was used to interpret measurements collected from ship and aircraft during the four seasonal campaigns of the North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) conducted between 2015 and 2018. Observations from the NAAMES campaigns show enhancements in the campaign-median number of aerosols with diameters larger than 3 nm in the lower troposphere (below 6 km), most pronounced during the phytoplankton bloom maxima (May/June) below 2 km in the free troposphere. Our simulations, combined with NAAMES ship and aircraft measurements, suggest several key factors that contribute to aerosol number and size in the northwest Atlantic lower troposphere, with significant regional-mean (40-60◦ N and 20-50◦ W) cloud-albedo aerosol indirect effect (AIE) and direct radiative effect (DRE) processes during the phytoplankton bloom. These key factors and their associated simulated radiative effects in the region in decreasing order of importance include the following: (1) particle formation near and above the marine boundary layer (MBL) top (AIE: −3.37 W m^{-2}, DRE: −0.62 W m^{-2}); (2) particle growth due to marine secondary organic aerosol (MSOA) as the nascent particles subside into the MBL, enabling them to become cloud-condensation-nuclei-sized particles (AIE: −2.27 W m^{-2}, DRE: −0.10 W m^{-2}); (3) particle formation and growth due to the products of dimethyl sulfide, above and within the MBL (−1.29 W m^{-2}, DRE: −0.06 W m^{-2}); (4) ship emissions (AIE: −0.62 W m^{-2}, DRE: −0.05 W m^{-2}); and (5) primary sea spray emissions (AIE:

+0.04 W m^{-2}, DRE: −0.79 W m^{-2}). Our results suggest that a synergy of particle formation in the lower troposphere (particularly near and above the MBL top) and growth by MSOA contributes strongly to cloud-condensation-nuclei-sized particles with significant regional radiative effects in the northwest Atlantic.

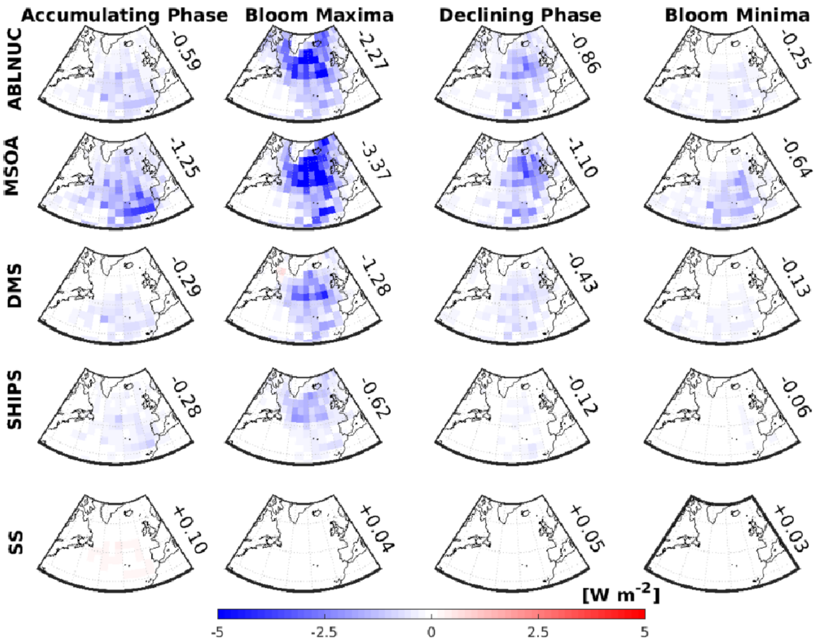

Figure 3.1 GEOS-Chem-TOMAS simulated 2-month-mean cloud-albedo aerosol indirect effect (AIE) attributed to five key factors. Top row: above-boundary-layer particle nucleation (ABLNUC); second row: particle growth by marine secondary organic aerosol (MSOA); third row: particle formation and growth due to DMS-oxidation products (DMS); fourth row: shipping emissions contribution to particles (SHIPS); and bottom row: sea spray (SS). AIEs are in columns for the following time periods, March/April 2018 (Accumulating Phase), May/June 2016 (Climax Transition, Bloom Maxima), August/September 2017 (Declining Phase), and October/November 2015 (Winter Transition, Bloom Minima). AIEs for ABLNUC, MSOA, DMS, SHIPS, and SS are calculated using the differences in the top-of-the-atmosphere solar flux between simulation BASE and respective sensitivity simulations (noABLNUC, noMSOA, noDMS, noSHIPS, noSS). Values shown are area-weighted-mean AIEs over the region bounded by 40–60N and 20–50W. The figure shows that the greatest AIE occurs during the Bloom Maximum through the processes of ABLNUC and MSOA. From Croft, B., Martin, R. V., Moore, R. H., Ziemba, L. D., Crosbie, E. C., Liu, H., Russell, L. M., Saliba, G., Wisthaler, A., Müller, M., Schiller, A., Galí, M., Chang, R. Y.-W., McDuffie, E. E., Bilsback, K. R., & Pierce, J. R. (2021). Factors controlling marine aerosol size distributions and their climate effects over the northwest Atlantic Ocean region. *Atmospheric Chemistry and Physics*, 21(3), 1889–1916. https://doi.org/10.5194/acp-21-1889-2021

2. Activities/main accomplishments in 2021 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

1. New SCOR WG approved/funded with Canadian leadership and participating members: Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds) (N. Steiner co-chair)

2. Contribution to the IPBES-IPCC report on Climate Change and Biodiversity (N. Steiner)

3. A Canadian NSERC project is investigating Canada's carbon sink through a combination of model evaluations and observational synthesis. Canada's Marine Carbon Sink project aims to develop methods of quantifying and predicting the absorption of anthropogenic carbon by the three ocean regions adjacent to Canada. The project networks graduate students, postdoctoral fellows, and academic and government scientists, combining both observation and modelling focused scientists. In 2021, we met monthly over Zoom to hear an update from one of our groups and engage in a lively discussion about the science presented. Our graduate students and postdocs have formed their own peer-to-peer discussion group, also meeting monthly, with a central aim of producing a perspective paper on marine carbon sink issues within Canada from the viewpoint of early career scientists (R. Hamme).

4. Canadian participation in the H2020 CRIceS project is aiming at improving our understanding and model parameterisations of ocean-ice-snow-atmosphere exchange processes in polar regions. Work and publications are in progress.

5. Analysis from the Halifax Fog and Air Quality Study showed that atomic chlorine originating from sea salt aerosols can contribute an important part of the radical budget in marine atmospheres influenced by anthropogenic emissions such as port cities (R. Chang).

6. Aerosol samples were collected as part of the Surface Tracer Release Experiment (TReX) where a surface water tracer, rhodamine-WT, was released in the St. Lawrence Estuary off the coast of Rimouski, QC on September 5 – 9, 2021. Bulk aerosol was sampled every 12 hours and the mean size-resolved aerosol composition was measured for the entire five days of the experiment. The goal of this work is to determine the atmospheric impact of a possible contamination in the river spill as well as to constrain sea salt aerosol flux (R. Chang).

7. Laboratory experiments were conducted with the Dalhousie Artificial Wave Tank to determine the effect of surfactants on the sea spray aerosol size, number concentration, chemical composition and ability to activate as cloud condensation nuclei. Results show the addition of a surfactant reduces the size, concentration and CCN-activity of the model primary marine aerosols (R. Chang).

3. List SOLAS-related publications published in 2021 (only PUBLISHED articles). If any, please also list weblinks to models, datasets, products, etc.

L. A. Miller, F. Domine, M. M. Frey, and D. Trombotto Liaudat, 2021. In: P.B. Shepson and F. Domine, eds., *Advances in Atmospheric Chemistry*, Volume 3: *Chemistry in the Cryosphere, Part 2*, World Scientific, New Jersey, pp. 831-65, doi: 10.1142/9789811230134_0017. The Future? Big Questions about Feedbacks between Anthropogenic Change in the Cryosphere and Atmospheric Chemistry. *Invited Review.*

N. S. Steiner, J. Bowman, K. Campbell, M. Chierici, E. Eronen-Rasimus, M. Falardeau, H. Flores, A. Fransson, H. Herr, S. J. Insley, H. M. Kauko, D. Lannuzel, L. Loseto, A. Lynnes, A. Majewski, K. M. Meiners, L. A. Miller, L. N. Michel, S. Moreau, M. Nacke, D. Nomura, L. Tedesco, J. A. van Franeker, M. A. van Leeuwe, P. Wongpan, 2021. *Elem. Sci. Anth.* 9(1): 00007, doi: 10.1525/elementa.2021.00007. Climate change impacts on sea-ice ecosystems and associated ecosystem services.

1. N. S. Steiner, D.L. VanderZwaag, Chapter 12, Ocean Acidification and the Arctic: Regional Scientific and Governance Responses, in , Ocean Acidification Handbook: Research Handbook on Ocean Acidification Law and Policy, 2021. ISBN: 978-1-78990-013-2, Edward Elgar Publishing, 320 pp.

A. C. Franco, D. Ianson, T. Ross, R. C. Hamme, A.H. Monahan, J.R. Christian, M. Davelaar, W.K. Johnson, L.A. Miller, M. Robert, P.D. Tortell, 2021. *Global Biogeochemical Cycles 35*, e2020GB006829, doi: 10.1029/2020GB006829. Anthropogenic and climatic contributions to observed carbon system trends in the Northeast Pacific.

M. M. M. Ahmed, B. G. T. Else, B. Butterworth, D. W. Capelle, C. Guéguen, L. A. Miller, C. Meilleur, T. Papakyriakou, 2021. *Elem. Sci. Anth.* 9(1): 00130. doi: 10.1525/elementa.2020.00130. Widespread surface water pCO_2 undersaturation during ice-melt season in an Arctic continental shelf sea (Hudson Bay, Canada).

P. J. Duke, B. G. T. Else, S. F. Jones, S. Marriot, M. M. M. Ahmed, V. Nandan, B. Butterworth, S. F. Gonski, R. Dewey, A. Sastri, L. A. Miller, K. G. Simpson, H. Thomas, 2021. *Elem. Sci. Anth.* 9(1): 00103. doi: 10.1525/elementa.2021.00103. Seasonal marine carbon system processes in an Arctic coastal landfast sea ice environment observed with an innovative underwater sensor platform.

R. W. Izett, P. D. Tortell, 2021. ΔO2/N2′ as a tracer of mixed layer net community production: Theoretical considerations and proof-of-concept. Limnology and Oceanography: Methods, 19(8), 497–509. https://doi.org/10.1002/lom3.10440

R. W. Izett, R. C. Hamme, C. McNeil, C. C. M. Manning, A. Bourbonnais, P. D. Tortell, 2021. ΔO2/N2′ as a New Tracer of Marine Net Community Production: Application and Evaluation in the Subarctic Northeast Pacific and Canadian Arctic Ocean. Frontiers in Marine Science, 8, 1–19.https://doi.org/10.3389/fmars.2021.718625

C. C. M. Manning, Z. Zheng, L. Fenwick, R. D. McCulloch, E. Damm, R. W. Izett, W. J. Williams, S. Zimmermann, S. Vagle, P. D. Tortell, 2022. Interannual variability in methane and nitrous oxide concentrations and sea-air fluxes across the North American Arctic Ocean (2015–2019). Global Biogeochemical Cycles, DOI: 10.1029/2021GB007185

C. Pennelly, P. G. Myers, 2021. Impact of different atmospheric forcing sets on modeling Labrador Sea Water production. Journal of Geophysical Research: Oceans, 126, e2020JC016452. https://doi.org/10.1029/2020JC016452

K. Rutherford, K. Fennel, D. Atamanchuk, D. Wallace, H. Thomas, 2021. A modeling study of temporal and spatial pCO2 variability on the biologically active and temperature-dominated Scotian Shelf, Biogeosciences, 18, 6271-6286 https://doi.org/10.5194/bg-18-6271-2021

N. Schuback, P. D. Tortell, I. Berman-Frank, D. A. Campbell, A. M. Ciotti, E. Courtecuisse, Z. K. Erickson, T. Fujiki, K. Halsey, A. Hickman, D. Hughes, Y. Huot, M. Gorbunov, Z. Kolber, M. Moore, K. Oxborough, O. Prasil, C. M. Robinson, T. J. Ryan-Keogh, G. Silsbe, S. Simis, D. Suggett, S. Thomalla, D.R. Varkey, 2021. Single-turnover variable chlorophyll fluorescence as a tool for assessing phytoplankton photosynthesis and primary productivity: Opportunities, caveats and recommendations. Frontiers in Marine Science, https://doi.org/10.3389/fmars.2021.690607

Y. Sezginer, D. Suggett, R. W. Izett, P.D. Tortell, 2021. Irradiance and nutrient-dependent effects on photosynthetic electron transport in Arctic phytoplankton: A comparison of two Chlorophyll fluorescence-based approaches to derive primary photochemistry. PLoS ONE 16(12): e0256410. https://doi.org/10.1371/journal.pone.0256410

R. Bénard, Lizotte M., Levasseur M., Scarratt M., Michaud S., Starr M., Tremblay J.-É., Kiene R. P., Kameyama S., 2021. Impact of anthropogenic pH perturbation on dimethyl sulfide cycling: a peek into the microbial black box. *Elementa: Science of the Anthropocene* 9(1): 00043. doi: 10.1525/elementa.2021.00043.

R. Bénard, Lizotte, M. Levasseur, M., Scarratt, M. G., Michaud, S., Starr, M., Tremblay, J.-É., Kiene, R. P., Kameyama, S., 2021. Brackish water carbonate chemistry and concentrations of dimethyl sulfide (DMS) and dimethylsulfoniopropionate (DMSP). *PANGAEA*, https://doi.org/10.1594/PANGAEA.939831Chen, C., Zhang, M., Perrie, W., Chang, R., Gultepe, I., Fernando, H. J. S., & Chen, X. (2021). A Case Study Evaluation of PAFOG One- D Model With Advection in Simulations of Fog/Stratus From C-FOG Experiment. *Journal of Geophysical Research: Atmospheres*, 126, e2021JD034812. https://doi.org/10.1029/2021JD034812

N. Chisholm, Nagare, B., Wainwright, C., Creegan, E., Salehpoor, L., VandenBoer, T. C., Bullock, T., Croft, B., Lesins, G., Osthoff, H., Fernando, H. J. S., & Chang, R. Y.-W. (2021). Characterizing Atmospheric Aerosols off the Atlantic Canadian Coast During C-FOG. *Boundary-Layer Meteorology*. https://doi.org/10.1007/s10546-021-00673-7

B. Croft, Martin, R. V., Moore, R. H., Ziemba, L. D., Crosbie, E. C., Liu, H., Russell, L. M., Saliba, G., Wisthaler, A., Müller, M., Schiller, A., Galí, M., Chang, R. Y.-W., McDuffie, E. E., Bilsback, K. R., & Pierce, J. R. (2021). Factors controlling marine aerosol size distributions and their climate effects over the northwest Atlantic Ocean region. *Atmospheric Chemistry and Physics*, 21(3), 1889–1916. https://doi.org/10.5194/acp-21-1889-2021

P. Duplessis, Bhatia, S., Hartery, S., Wheeler, M. J., & Chang, R. Y.-W. (2021). Microphysics of aerosol, fog and droplet residuals on the Canadian Atlantic coast. *Atmospheric Research*, 264, 105859. https://doi.org/10.1016/j.atmosres.2021.105859

H. J. S. Fernando, Richter, D., Krishnamurthy, R., Wainwright, C., Lozovatsky, I., Grachev, A., Wagh, S., Wang, S., Dimitrova, R., Sharma, A., Bardoel, S., Gonzales, E., Hyde; O., Creegan, E., Hocut, C., Chang, R., Nagare, B., Chisholm, N., Gultepe, I., Pardyjak, ; E., Hoch, S., Gunawardena, N., Olson, A., Perelet, A., Morrison, T., Wang, Q., Alapattu, D., Yamaguchi, R., Ortiz-Suslow, D., Wauer, B., Dorman, C., Gaberšek, S., Flagg, D., Bullock, T., Wroblewski, M., Perrie, W., (2021) C-Fog Experiment - Towards Improving Coastal Fog Prediction. *Bulletin of American Meteorological Society*, 102 (2), E244–E272 doi.org/10.1175/BAMS-D-19-0070.1

I. Gultepe, Heymsfield, A. J., Fernando, H. J. S., Pardyjak, E., Dorman, C. E., Wang, Q., Creegan, E., Hoch, S. W., Flagg, D. D., Yamaguchi, R., Krishnamurthy, R., Gaberšek, S., Perrie, W., Perelet, A., Singh, D. K., Chang, R., Nagare, B., Wagh, S., & Wang, S. (2021). A Review of Coastal Fog Microphysics During C-FOG. *Boundary-Layer Meteorology*. https://doi.org/10.1007/s10546-021-00659-5

J. MacInnis, Chaubey, J. P., Weagle, C., Atkinson, D., Chang, R. Y.-W. Measurement report: The chemical composition of and temporal variability in aerosol particles at Tuktoyaktuk, Canada, during the Year of Polar Prediction Second Special Observing Period. *Atmospheric Chemistry and Physics*, 21(18), 14199–14213. https://doi.org/10.5194/acp-21-14199-2021, 2021.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2021? If yes, who? How did you engage?

- Canadian scientists led the BEPSII policy brief, “Biogeochemical Exchange Processes at Sea-Ice Interfaces” (https://bit.ly/2ZfYDp2, doi: 10.5281/zenodo.5595254)
- SOLAS scientists contributed to Canada's application for Consultative Party status in the Antarctic Treaty. Collaborative sea-ice research done within the context of SOLAS-supported programs, including BEPSII, CATCH, and ECV-Ice, was highlighted as evidence of Canadian contributions to Antarctic research. These existing research networks were also tapped in the diplomatic outreach to generate support for Canada's application among current Antarctic Treaty member states.
- Presentations at COP26:
    - L. Miller, Side Event on Carbon Conservation and Sequestration in Ocean: Nature-Based And Technology Solutions. Invited speaker: Ocean Carbon: The potential for the oceanic carbon sink to mitigate climate change.
    - N. Steiner, Model projections of Arctic Ocean Acidification, Polar Acidification Session, Cryosphere Pavillion

PART 2 - Planned activities for 2022 and 2023

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

- ECV-Ice intercalibration experiment. Field testing, validation, and intercalibration of methods for measuring biological production and gases in sea ice. Collaborators from Japan, Belgium, and Norway to be hosted in Canada at the Canadian High Arctic Research Station (CHARS), Cambridge Bay, April – May 2022.
- Intensive 2-year study of carbon sequestration with deepwater formation in Foxe Basin, in the Canadian Arctic Archipelago, starting in 2023.
- Measurements at a coastal site (likely on the Gulf of St. Lawrence) to study seasonality of marine aerosols, June 2022 – May 2023.
- Participation in a research cruise in the North Atlantic as part of the Fog and Turbulence Interactions in the Marine Atmosphere led by Joe Fernando at University of Notre Dame, July 2022.
- Fog (cloud) measurements on Mt. Soledad as part of the Eastern Pacific Cloud Aerosol Precipitation Experiment led by Lynn Russell at University of California San Diego, Feb 2023 – Jan 2024.

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

- BEPSII winter school at the Canadian High Arctic Research Station (CHARS), Cambridge Bay, May 2022.
- Ocean Frontier 2022 Climate Action Conference in Halifax, May 2022 (run by the Ocean Frontier Institute)

3. Funded national and international projects/activities underway.

- Climate Relevant interactions and feedbacks: the key role of sea ice and Snow in the polar and global climate system (CRiceS). A European Union Horizon 2020 Framework Programme (J. Thomas, R. Makkonen, leads) with funded Canadian participation by B. Else, N. Steiner, and L. Miller. International collaborative project to integrate observational insights into climate and Earth system models. SOLAS Themes 4, 5, and Integrated topic on Polar Oceans
- Quantifying and Predicting Canada's Marine Carbon Sink, 2020-2022. Lead: R. Hamme. NSERC Advancing Climate Change Science in Canada Program. SOLAS Theme 1
- A co-operative, multi-platform effort to observe marine biogeochemical processes and address Arctic community research priorities, 2019-2022. Lead: B. Else. ArcticNET. SOLAS Integrated topics on Polar Oceans and Science & Society
- Fog and Turbulence Interactions in the Marine Atmosphere led by University of Notre Dame (May 2021 – April 2026) involves understanding fog in the North Atlantic and the Yellow Sea. Lead R. Chang. SOLAS Theme 4.

- Eastern Pacific Cloud Aerosol Precipitation Experiment led by University of California San Diego (Feb 2023 – Jan 2024) involves understanding aerosol-cloud-precipitation interactions via measurements using the Atmospheric Radiation Monitoring Mobile Laboratory facility on the Scripps Pier as well as complementary measurements on a nearby mountain to capture cloud formation and properties. Modelling and remote sensing activities will also take place. Lead R. Chang. SOLAS Theme 4.

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).
N.A.

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

Comments
N.A.