surface ocean solas lower atmosphere study

Report for the year 2020 and future activities

SOLAS *Japan*
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This report has two parts:

***- Part 1:** reporting of activities in the period of January 2020 - Jan/Feb 2021*
***- Part 2:** reporting on planned activities for 2021 and 2022.*

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan. As much as possible, please indicate the specific SOLAS 2015-2025 Science Plan Themes addressed by each activity **or specify an overlap between Themes or Cross-Cutting Themes.**

1 Greenhouse gases and the oceans;
2 Air-sea interfaces and fluxes of mass and energy;
3 Atmospheric deposition and ocean biogeochemistry;
4 Interconnections between aerosols, clouds, and marine ecosystems;
5 Ocean biogeochemical control on atmospheric chemistry;
Integrated studies of high sensitivity systems;
Environmental impacts of geoengineering;
Science and society**.**

***IMPORTANT**: This report should reflect the efforts of the SOLAS community in the **entire country** you are representing (all universities, institutes, lab, units, groups, cities).*

First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

PART 1 - Activities from January 2020 to Jan/Feb 2021

1. Scientific highlight

Linking the amount of organic matter (OM) in sea spray aerosols (SSAs) to biological processes in ocean surface is essential for understanding marine aerosol formation and their potential to affect cloud formation. To date, chlorophyll (Chl) *a* concentration has been widely used as a surrogate for surface phytoplankton biomass or productivity to predict the relative abundance of OM in SSAs (OM_{SSA}). Miyazaki et al. (2020) proposed a new index to present OM_{SSA} using concentrations of Chl *a* and chlorophyllide (Chllide) *a*, which is a breakdown product of Chl *a* and has been used as a

biomarker of senescent algal cells. The index was compared with submicrometer OM_{SSA}, based on surface seawater and aerosol samples obtained during the pre-bloom in the western subarctic Pacific (March 2015). Their results showed that the OM_{SSA} was highly correlated with this unique index, suggesting that the OM_{SSA} was closely linked with senescent algal cells and/or cell lysis. Furthermore, the hygroscopicity parameters κ derived from water-extracted SSA samples implied a reduction in the SSA hygroscopicity with increasing senescent status of phytoplankton. The index can represent OM_{SSA} on a timescale of a day during the pre-bloom period, which should be further examined over different oceanic regions.

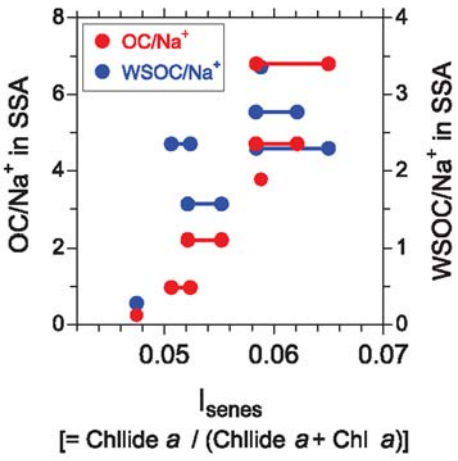

Figure: The organic carbon (OC)/Na^+ and water-soluble OC (WSOC)/Na^+ ratios in the SSA samples as functions of (a) Chl *a* concentration and (b) I_{senes} in surface seawater (SSW). I_{senes} is defined as [Chllide *a*]/([Chllide *a*] + [Chl *a*]), where [Chl *a*] and [Chllide *a*] represent the concentrations of Chl *a* and Chllide *a* in SSW, respectively. For each one SSA sample, one or two corresponding measurement data of Chl *a* and Chllide *a* in SSW were obtained, so that the number of the data point in the panels is more than six of the SSA samples. The individual SSW data points corresponding to the identical aerosol sampling data are connected with a straight line. Adopted from Miyazaki et al. (2020).

Citation: Miyazaki, Y., K. Suzuki, E. Tachibana, Y. Yamashita, A. Müller, K. Kawana, and J. Nishioka (2020), New index of organic mass enrichment in sea spray aerosols linked with senescent status in marine phytoplankton, *Scientific Reports*, 10, 17042, doi: 10.1038/s41598-020-73718-5.

2. Activities/main accomplishments in 2020 (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).

Theme 1: Greenhouse gases and the oceans

Cruise/Field campaigns

- Sep.-Nov. 2020, R/V Mirai, underway pCO_2 observation in the Arctic and the North Pacific Ocean (P.I. Murata)
- Participation in the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) Expedition(Participant: D. Nomura)

Model and data intercomparisons

- Mar. 2019- RECCAP2 (Regional Carbon Cycle Assessment and Processes phase 2; Co-char Patra)

Theme 3: Atmospheric deposition and ocean biogeochemistry

Cruise/Field campaigns

- 13 Feb-24 Mar, 2021: IMPACT-SEA (Influence on Marine ecosystem at western North Pacific by Atmospheric Chemical Trace Species from East Asia) project during R/V Mirai (PI: F. Taketani)

Theme 4: Interconnections between aerosols, clouds, and marine ecosystems

Cruise/Field campaigns

- Baseline atmospheric composition observations (BC, O_3, CO, fluorescent aerosols etc) on R/V Mirai during MR19-04 Leg3 (Jan-Feb 2020) over Indian Ocean, MR20-01 (Feb-Mar 2020), MR20-E01 (Aug-Sep 2020), MR20-E02 (Nov-Dec 2020) and MR21-01 (Feb-Mar 2021) over the western Pacific, and MR20-05C (Sep-Nov 2020) over the Northern Pacific/Arctic Ocean.

General SOLAS

Meetings/international workshop

- "Biogeochemical linkages between the surface ocean and atmosphere" session at Japan Geoscience Union (JpGU) -AGU Joint Meeting 2020, 13 July 2020 (Conveners: S. Kameyama, Y. Iwamoto, M. N. Aita, D. Sasano)

- Session of "Ozone over the Oceans" by working group (WG) under Tropospheric Ozone Assessment Report (TOAR)-II kick-off online workshop on 27 and 28 Jan 2021. (basically under IGAC but SOLAS related). The WG has been led by Roberto Sommariva and Alfonso SaizRoberto Sommariva with Yugo Kanaya as SC Liaison, and Takashi Sekiya, Hisahiro Takashima, and Yuzo Miyazaki as WG members from Japan.

3. Top 5 publications in 2020 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

(In alphabetical order)

Ito, A., M. M. G. Perron, B. C. Proemse, M. Strzelec, M. Gault-Ringold, P. W. Boyd, and A. R. Bowie, Evaluation of aerosol iron solubility over Australian coastal regions based on inverse modeling: Implications of bushfires on bioaccessible iron concentrations in the Southern Hemisphere, *Progress in Earth and Planetary Science*, 7, 42. https://doi.org/10.1186/s40645-020-00357-9, 2020.

Murakami K, Nomura D, Hashida G, Nakaoka S, Kitade Y, Hirano D, Hirawake, T, Ohshima K.I. Strong biological carbon uptake and carbonate chemistry associated with dense shelf water outflows in the Cape Darnley polynya, East Antarctica, *Marine Chemistry*, 225, 103842, https://doi.org/10.1016/j.marchem.2020.103842, 2020.

Tohjima, Y., Zeng, J., Shirai, T., Niwa, Y., Ishidoya, S., Taketani, F., Sasano, D., Kosugi, N., Kameyama, S., Takashima, H., Nara, H., and Morimoto, S., Estimation of CH_4 emissions from the East Siberian Arctic Shelf based on atmospheric observations aboard the R/V Mirai during fall cruises from 2012 to 2017, *Polar Science*, 100571, https://doi.org/10.1016/j.polar.2020.100571, 2020.

Tsunogai, U., Y. Miyoshi, T. Matsushita, D.D. Komatsu, M. Ito, C. Sukigara, F. Nakagawa, M. Maruo, Dual stable isotope characterization of excess methane in oxic waters of a mesotrophic lake, *Limnology and Oceanograhy*, 65, Issue 12, 2937–2952, doi:10.1002/lno.11566, 2020.

Yoshizue, M., Taketani, F., Adachi, K., Iwamoto, Y., Tohjima, Y., Mori, T., and Miura, K., Detection of Aerosol Particles from Siberian Biomass Burning over the Western North Pacific, *Atmosphere*, 11, 1175, pp.1-8, 2020 DOI:10.3390/atmos11111175, 2020. (Selected as the Editor's choice paper)

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2020? If yes, who? How did you engage?

PART 2 - Planned activities for 2021 and 2022

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

(No specific order)

Cruise/Field campaigns:

- 11 April – 1 May 2021, Elucidating impact of sea-ice melting in the offing of Shiretoko on physical oceanography, marine ecosystem, and biogeochemical processes, R/V Shinsei Maru cruise (KS-21-6 led by J. Nishioka) over the Sea of Okhotsk.

- Seisui-maru (Mie University) cruise at Ise Bay and coastal area of western North Pacific (chief scientist: Urumu Tsunogai) (7-9 July 7, 2021).

- Sinsei-maru (Mie University) cruise at western North Pacific (chief scientist: Urumu Tsunogai) (28 Oct. – 5 Nov. 2021).

- Seisui-maru (JAMSTEC) cruise at Ise Bay and coastal area of western North Pacific (chief scientist: Urumu Tsunogai) (from Nov. 10 to 12, 2021).

- Continued atmospheric composition observations (BC, O_3, CO, fluorescent aerosols etc) on R/V Mirai during MR21-03 etc (May-Jul, Dec 2021) over the western Pacific and an arctic cruise (Sep-Oct 2021).

- 5-9 July 2021: Sampling of aerosol and reactive oxygen spices in seawater during R/V Toyoshio Maru cruise in Seto Inland Sea, Japan (PI: Y. Iwamoto and K. Takeda)

- Inter-comparison experiment for the gas flux over the sea ice at Cambridge Bay, Canada, May 2022. (Participant: D. Nomura)

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

(No specific order)

Meetings/international workshop

-Institute of Low Temperature Science (ILTS) Workshop on Biogeochemical Interactions between Ocean and Atmosphere, Hokkaido University, Sapporo, in March 2021 (Organizers: A. Ito, Y. Miyazaki)

-3 June 2021: "Biogeochemical linkages between the surface ocean and atmosphere" session at Japan Geoscience Union (JpGU) Meeting 2021 (Convener: S. Kameyama, Y. Iwamoto, M. N. Aita, D. Sasano)

- Oxygenated Compounds in the Tropical Atmosphere– Variability and Exchanges (OCTAVE) Intensive Field Campaign Online Workshop, October 2021 (Organizer: T. Stavrakou, Presentation: Y. Miyazaki)

3. Funded national and international projects/activities underway.

(No specific order)

National projects:

- Quantifying nitrate dynamics in hydrosphere using triple oxygen isotopes as tracers, A Grant-in-Aid for Scientific Research (A) granted by the MEXT/JSPS, PI: Urumu Tsunogai, FY2017-2020.

- Organic nitrogen aerosols in the marine atmosphere: What is a key factor of marine microbial activity controlling the formation?, A Grant-in-Aid for Scientific Research (B) granted by the MEXT/JSPS, 19H04233, PI: Yuzo Miyazaki, FY2019-2021.

- Pyrogenic iron: Source attribution of atmospheric bioaccessible iron supplied to the Pacific Ocean, A Grant-in-Aid for Scientific Research (B) granted by the MEXT/JSPS, 20H04329, PI: Akinori Ito, FY2020-2022.

- Study for volatile organic compound at the top of sea ice and chamber experiment, A Grant-in-Aid for Scientific Research (B) granted by the MEXT/JSPS, 20H04345, PI: Daiki Nomura, FY2020-2022.

- Arctic Challenge for Sustainability (ArCS) Project 2, 2020-2025 (Many of SOLAS-relevant scientists have been involved)

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

(No specific order)

- The above-mentioned "Ozone over the Oceans" WG under TOAR-II will continue to produce assessment publications in 2023/2024. The WG has been led by Roberto Sommariva and Alfonso SaizRoberto Sommariva with Yugo Kanaya as SC Liaison, and Takashi Sekiya, Hisahiro Takashima, and Yuzo Miyazaki as WG members from Japan.

- The SOLAS-Japan National Committee has been discussing the linkage with and possible contribution to Future Earth in collaboration with the National Committees of IGAC, iLEAPS, etc.

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

Comments