surface ocean solas lower atmosphere study

# Report for the year 2021 and future activities

## SOLAS *Japan*
## *compiled by: Yuzo Miyazaki*

*This report has two parts:*

***- Part 1:** reporting of activities in the period of January 2021 - Jan/Feb 2022*
***- Part 2:** reporting on planned activities for 2022 and 2023.*

*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. ?** |
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## PART 1 - Activities from January 2021 to Jan/Feb 2022

### 1. Scientific highlight

The source apportionment of aerosol iron (Fe) is important because aerosol Fe can enhance oceanic primary production in the surface ocean. This study aimed to estimate the relative contribution of anthropogenic combustion Fe and natural Fe to marine aerosols and to investigate the factors that control fractional Fe solubility in the northwestern Pacific. Air masses from the direction of East Asia included fine particles that yielded $\delta^{56}$Fe values 0.5 ‰ to 2 ‰ lower than those of the coarse particles because of the presence of combustion Fe. The $\delta^{56}$Fe values of

coarse and fine particles in air masses from the eastern, central, or northern Pacific were close to the crustal value. It was also found that in air masses from the direction of East Asia, fractional Fe solubilities are mainly controlled by the presence of combustion Fe. The proportion of combustion Fe in the total Fe in marine aerosols was up to 51 % and 20 % in fine and bulk particles, respectively. In addition, the contribution of combustion Fe was greater in the soluble component, suggesting the importance of combustion Fe as a source of Fe in the surface ocean. However, the influence of combustion Fe was limited in the vicinity of East Asia, and natural Fe was the main source of aerosol Fe in air masses from the eastern, central, or northern Pacific. The comparison with the IMPACT model output suggested that $\delta^{56}$Fe values of size-fractionated aerosol are important to make this comparison due to the different characteristics of "combustion Fe" included in the different approaches, in which combustion Fe estimated using Fe isotope ratios is limited to particles emitted by evaporation mainly contained in fine particles. Considering that the $\delta^{56}$Fe values were correlated with fractional Fe solubilities, isotope-based estimation is important when discussing the contribution of combustion Fe with high fractional Fe solubility. The contribution may be much larger when air masses are transported to the open ocean from East Asia. This study showed the applicability of Fe isotope data to further understanding atmospheric Fe sources and their fractional Fe solubilities. The result also suggests the possible contribution of combustion Fe to the surface seawater, where iron isotope data will be helpful. It is anticipated that this will lead to a more quantitative understanding of Fe cycling in the atmosphere–surface ocean system.

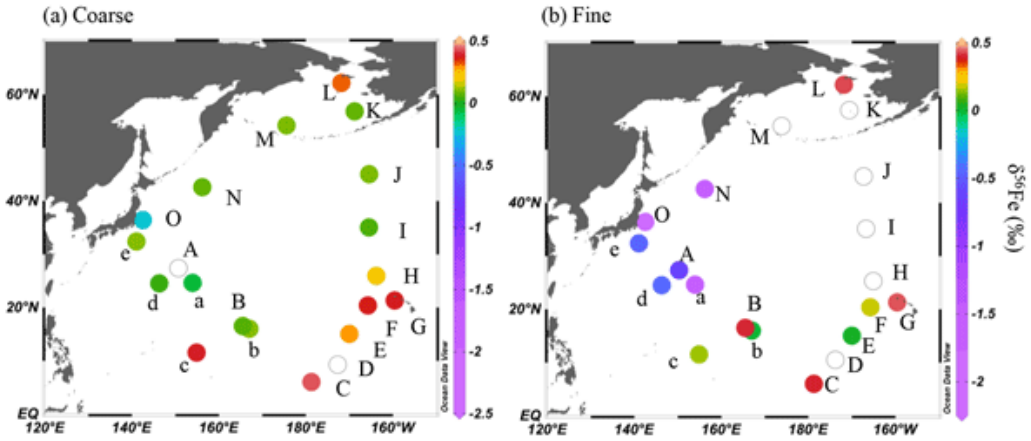


Figure: The contribution of combustion Fe to (a) coarse and (b) fine Fe in marine aerosols. Data with open circles were not determined. (Kurisu et al., 2021)

Citation: M. Kurisu et al. Contribution of combustion Fe in marine aerosols over the northwestern Pacific estimated by Fe stable isotope ratios, *Atmos. Chem. Phys.*, 21, 16027–16050, 2021, https://doi.org/10.5194/acp-21-16027-2021.

**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).**

**Theme 1: Greenhouse gases and the oceans**

**Cruise/Field campaigns**

- Atmosphere–sea ice–ocean interaction study in Saroma-ko Lagoon, Hokkaido, Japan (February to March, 2021)
- Gas exchange process in the Arctic Ocean, Mirai cruise, MR21-05C (August to October, 2021)
- Continuous measurements of atmospheric and surface seawater $CO_2$ along the P01 line at 47°N in the North Pacific from July to August, 2021 under the framework of GO-SHIP (JAMSTEC)
- Continuous measurements of atmospheric and surface seawater $CO_2$ and $CH_4$ in the North Pacific, the Bering Sea, and the western Arctic Ocean during 31 August – 22 October, 2021, as

a field campaign of the Arctic Challenge for Sustainability II (ArCS II) program (JAMSTEC)

- Regional Carbon Cycle Assessment and Processes (RECCAP2) 2 -ocean (JAMSTEC, MRI)

**Theme 3: Atmospheric deposition and ocean biogeochemistry**

**Cruise/Field campaigns**

- MR21-01 (R/V Mirai), Impact assessment of Asian atmospheric trace species on the marine biogeochemistry in the western North Pacific, PI: F. Taketani, Feb-Mar 2021,

- MR21-03, Impact of iodine species of ocean origins on atmospheric ozone over the Western Tropical Pacific Warm Pool, F. Taketani, May-Jul 2021

- MR21-06, Distribution and ecological/biogeochemical impact of anthropogenic materials derived from the Asian countries in the western subtropical Pacific, Nov 2021 - Jan 2022, PI: M. Kitamura

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

**Cruise/Field campaigns**

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

- MR21-05C, ArCS II: Arctic Challenge for Sustainability II, Aug-Oct 2021.

**General SOLAS**

**Meetings/international workshop/ contributions to int. assessments**

- SOLAS-related IGAC activity: Oceans WG of TOAR-II (Tropospheric Ozone Assessment Report Phase II) 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.

- IPCC AR6 WG1 Chapter 6. Short-lived Climate Forcers, Review Editor (Y. Kanaya)

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

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

(In alphabetical order)

Baker, A. R., Kanakidou, M., Nenes, A., Myriokefalitakis, S., Croot, P. L., Duce, R. A., Gao, Y., Guieu, C., Ito, A., Jickells, T. D., Mahowald, N. M., Middag, R., Perron, M. M. G., Sarin, M. M., Shelley, R., and Turner, D. R. (2021) Changing atmospheric acidity as a modulator of nutrient deposition and ocean biogeochemistry, *Sci. Adv.*, 7, 1–9, https://doi.org/10.1126/sciadv.abd8800.

Inoue, J., Tobo, Y., Taketani, F., and Sato, K. (2021) Oceanic supply of ice-nucleating particles and its effect on ice cloud formation: A case study in the Arctic Ocean during a cold-air outbreak in early winter,, *Geophys. Res. Lett.* 48, https://doi.org/10.1029/2021gl094646

Ito, A., Ye, Y., Baldo, C. and Shi Z., Ocean fertilization by pyrogenic aerosol iron. *npj Clim Atmos Sci,* 4, 30 (2021). https://doi.org/10.1038/s41612-021-00185-8

Kiuchi, M., Nomura, D., Hirano, D., Tamura, T., Hashida, G., Ushio, S., Simizu, D., Ono, K., Aoki, S. (2021). The effect of basal melting of the Shirase Glacier Tongue on the CO2 system in Lützow-Holm Bay, East Antarctica. *Journal of Geophysical Research-Biogeosciences*, 126, e2020JG005762. http://doi.org/10.1029/2020JG005762.

Kawana, K., Matsumoto, K., Taketani, F., Miyakawa, T., and Kanaya, Y.: Fluorescent biological aerosol particles over the central Pacific Ocean: covariation with ocean surface biological activity indicators, *Atmos. Chem. Phys*., 21, 15969–15983, https://doi.org/10.5194/acp-21-15969-2021, 2021.

Kurisu, M., Sakata, K., Uematsu, M., Ito, A., and Takahashi, Y. (2021), Contribution of combustion Fe in marine aerosols over the northwestern Pacific estimated by Fe stable isotope ratios, *Atmos. Chem. Phys.*, 21, 16027–16050, https://doi.org/10.5194/acp-21-16027-2021.

Nishioka, J., H. Obata, T. Hirawake, Y. Kondo, Y. Yamashita, K. Misumi, I. Yasuda (2021), A review: iron and nutrient supply in the subarctic Pacific and its impact on phytoplankton production, *J. Oceanogr*., doi:10.1007/s10872-021-00606-5.

Simu, S. A., Miyazaki, Y., Tachibana, E., Finkenzeller, H., Brioude, J., Colomb, A., Magand, O., Verreyken, B., Evan, S., Volkamer, R., and Stavrakou. T. (2021), Origin of water-soluble organic aerosols at the Maïdo high-altitude observatory, Réunion Island in the tropical Indian Ocean, *Atmos. Chem. Phys.*, 21, 17017–17029, https://doi.org/10.5194/acp-21-17017-2021.

Tokoro T., Nakaoka S., Takao S., Nojiri Y., Kuwae T., Kubo A., Endo T. (2021) Contribution of Biological Effects to Carbonate-System Variations and the Air -Water $CO_2$ Flux in Urbanized Bays in Japan. *Journal of Geophysical Research-Oceans*, 126 (6)

Toyoda, S., T. Kakimoto, K. Kudo, N. Yoshida, D. Sasano, N. Kosugi, M. Ishii, S. Kameyama, M. Inagawa, H. Yoshikawa-Inoue, S. Nishino, A. Murata, S. Ishidoya, and S. Morimoto (2021), Distribution and Production Mechanisms of $N_2O$ in the Western Arctic Ocean, *Global Biogeochemical Cycles*, 35, doi: 10.1029/2020GB006881.

**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?**

## 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.).**

(No specific order)

**Cruise/Field campaigns**:

- MR22-03, Distribution and impact of lithogenic materials from east Asia on the western Pacific ecosystem in spring, Apr-May 2022, PI: K. Sugie

- MR22-06C, ArCS Ⅱ: Arctic Challenge for Sustainability Ⅱ, Aug-Oct 2022.

- KS-22-6, Elucidating tidal mixing and biogeochemical processes during the post-bloom period in the southwestern Sea of Okhotsk (led by T. Nakamura). April – May 2022.

- KS-22-10, Impact of aerosols on the clouds over the Western Pacific coincident with aircraft observations, Jul-Aug 2022 (Y. Kawai, T. Miyakawa, Y. Miyazaki)

- Regional Carbon Cycle Assessment and Processes (RECCAP2) 2 -ocean (JAMSTEC, MRI)

- SOLAS-related IGAC activity: Oceans WG of TOAR-II (Tropospheric Ozone Assessment Report Phase II) planned to continue to 2024

- Inter-comparison experiment for gas exchange process over the sea ice in Cambridge Bay, Canada (April-June, 2022)

- 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), July 2022.

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

(No specific order)

**Meetings/international workshop**

- A session in JpGU Meeting 2022 (May 22-May 27, 2022) A-CG-46 "Biogeochemical linkages between the surface ocean and atmosphere" Conveners: Sohiko Kameyama, Yoko Iwamoto, Maki Noguchi Aita and Naohiro Kosugi

- Ocean Decade Laboratories: A Productive Ocean, satellite activity: Prosperous Ecosystems in the Western North Pacific, (Led by Maki Noguchi Aita), 1 June 2022, online

**3. Funded national and international projects/activities underway.**

(No specific order)

- Grant-in-Aid for Scientific Research (A), granted by the Japan Society for the Promotion of Science (JSPS), 21H04933, PI: Yugo Kanaya, FY2021-2024, Tropospheric ozone hole and iodine chemistry over the ocean: Focus analysis in the western Pacific low-latitude region and global assessment.

- Grant-in-Aid for Scientific Research (A), granted by the Japan Society for the Promotion of Science (JSPS), PI: Koji Hamasaki, FY2022-2026, Microbiology of the atmosphere-ocean boundary: its linkage with enrichment in ocean bubbles and cloud nuclei.

- Grant-in-Aid for Scientific Research (B), granted by the Japan Society for the Promotion of Science (JSPS), 20H04350, PI: Maki Noguchi Aita, FY2020-2022, Evaluation of the influence of anthropogenic aerosols on primary production in the western North Pacific.

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

- Grant-in-Aid for Scientific Research (C), granted by the Japan Society for the Promotion of Science (JSPS), 21K12230, PI: Fumikazu Taketani, FY2021-2023, Assessment of Influence of the wet deposition to oligotrophic sea area on surface primary productivity by in-situ observations.

- Grant-in-Aid for Challenging Research (Exploratory) granted by the Japan Society for the Promotion of Science (JSPS), PI: Chuya Shinzato (co-Investigator: Sohiko Kameyama), FY 2020-2022, Are corals creating clouds and changing the climate? Verification using genetic analysis technology.

- Grant-in-Aid for Challenging Research (Exploratory) granted by the Japan Society for the Promotion of Science (JSPS), 21K19835, PI: Yuzo Miyazaki, FY 2021-2022, “Exploratory research on new source of atmospheric reactive nitrogen focusing on marine nitrogen-fixing organisms”.

- Grant-in-Aid for Scientific Research (C) granted by the Japan Society for the Promotion of Science (JSPS), FY 2018-2022" Sulfur Circulation in the Arctic Sea Ice Area based on Precise Sampling Techniques" PI: Sohiko Kameyama

- Global Environmental Research Coordination System from Ministry of the Environment of Japan is planned to support a part of NIES VOS program to investigate the role of biological activity to ocean carbon cycle since 2022 for 5 years.

- Arctic Challenge for Sustainability II (ArCS II) (FYs 2020-2025)

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

-Cruises of R/V Mirai in spring 2023 (PI: K. Nagashima)

-Decadal Vison in Oceanography 2022: Air-Sea boundary (in JAPANESE), Iwamoto, Y., Aiki, H., Isoguchi, O., Obayashi, Y., Kondo, F., Kondo, Y. and Nishioka J. https://www.jstage.jst.go.jp/article/kaiyou/30/5/30_199/_article/-char/en

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

-International program: CATCH, BEPSII, CIce2Clouds. (D. Nomura)

**Comments**