

Report for the year 2024 and future activities

SOLAS JAPAN

compiled by: Yuzo Miyazaki

This report has two parts:

- **Part 1:** reporting of activities in the period of January 2024 - Feb/Mar 2025
- **Part 2:** reporting on planned activities for 2025 and 2026.

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 Core Themes or Cross-Cutting Themes.

Core Theme 1: Greenhouse gases and the oceans;

Core Theme 2: Air-sea interfaces and fluxes of mass and energy;

Core Theme 3: Atmospheric deposition and ocean biogeochemistry;

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

Core Theme 5: Ocean biogeochemical control on atmospheric chemistry;

Cross-Cutting Theme: Integrated studies of high sensitivity systems (upwelling systems, Indian Ocean, polar oceans and sea ice);

Cross-Cutting Theme: Climate intervention;

Cross-Cutting Theme: Science and society.

IMPORTANT: *This report should reflect the efforts of the SOLAS community in the entire country or region 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 2024 to Feb/Mar 2025

1. Scientific highlight

1) Observed APO Seasonal Cycle in the Pacific: Estimation of O₂ Oceanic Emissions in Autumn

Seasonal variations of air-sea molecular oxygen (O₂) exchanges are mainly driven by spring/summer emission and autumn/winter absorption. Emission results mainly from O₂ production

by phytoplankton at the ocean surface; absorption is related to O₂ uptake in deep oxygen-depleted water layers caused by oceanic ventilation. A phytoplankton bloom in autumn and outgassing from water rich in dissolved O₂ just below the mixed layer, known as the shallow oxygen maximum, have been suggested as possible mechanisms contributing to the O₂ seasonal cycles. Unfortunately, these oceanic autumn O₂ emissions are not well characterized.

Tohjima et al. (2024) analysed air samples collected in the western and northern Pacific to evaluate the oceanic component of the O₂ seasonal cycle, known as “atmospheric potential oxygen” and calculated as the sum of atmospheric O₂ and carbon dioxide. By comparing these observations with model simulations that used previous air-sea O₂ flux estimates as input, they identified marked enhancements in autumn at latitudes between 20°N and 60°N in the Pacific. This corresponds to the geographic area where the autumn phytoplankton bloom and the shallow oxygen maximum occur. This result is a strong indication of additional autumn O₂ emissions in the extratropical North Pacific.

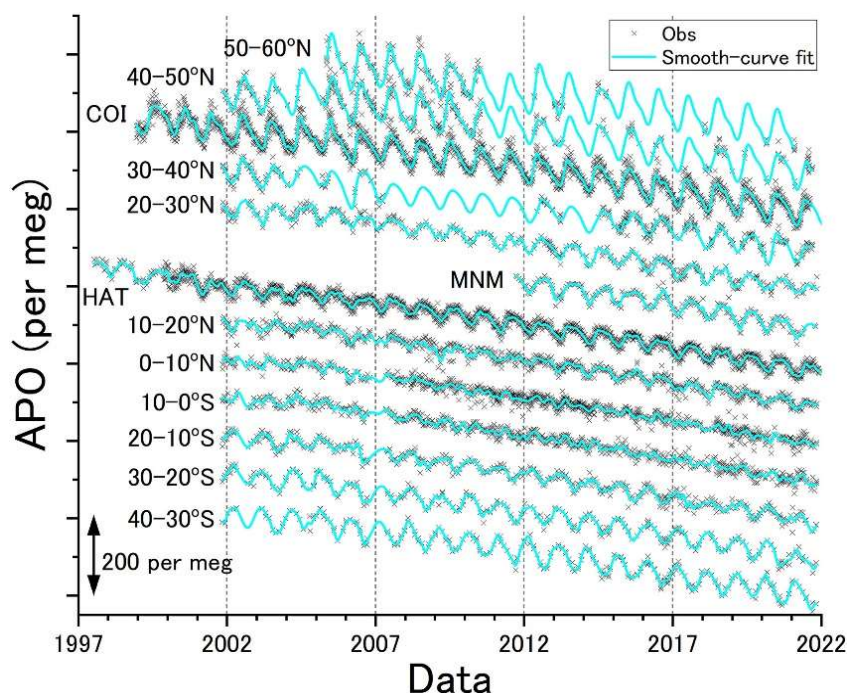


Figure: Time series of atmospheric potential oxygen (APO) data (crosses, in per meg) for all air samples collected at ground stations (Cape Ochiishi (COI; 43.16°N, 145.50°E), Hateruma Island (HAT; 24.06°N, 123.81°E), and Minamitorishima Island (MNM; 24.28°N, 153.98°E)) and onboard cargo ships, shifted vertically for visibility, and the associated smooth-curve fits (light blue curves). The ship sampling data points are binned into 10° latitude bands and displayed by decreasing latitude from top to bottom (50°N–60°N to 40°S–30°S).

Citation: Tohjima, Y., Shirai, T., Ishizawa, M., Mukai, H., Machida, T., Sasakawa, M., Terao, Y., Tsuboi, K., Takao, S., and Nakaoka, S. (2024), Observed APO seasonal cycle in the Pacific: Estimation of autumn O₂ oceanic emissions, *Global Biogeochemical Cycles*, 38, e2024GB008230. <https://doi.org/10.1029/2024GB008230>.

2) Quantitative Assessment of Factors Contributing to Variations in Sea Surface pCO₂ in the Pacific Sector of the Arctic Ocean

Assessment of the factors that cause ocean carbon dioxide (CO₂) to vary is important in the Arctic Ocean, which acts as an atmospheric CO₂ sink that will change significantly because of global warming. Tozawa et al. (2024) collected seawater and sea ice samples in the Pacific sector of the Arctic Ocean to quantitatively assess seasonal variations in the partial pressure of CO₂ (pCO₂) in the Pacific sector of the Arctic Ocean (Canada Basin and Chukchi Sea) in 2021. The pCO₂ was lower on the sea surface than in the atmosphere during summer, and the ocean absorbed

atmospheric CO₂. The decreases in $p\text{CO}_2$ from winter to summer were driven primarily by biological activity in the Chukchi Sea (partially offset by temperature increases) and by freshwater additions in the Canada Basin. Sea ice meltwater, snow meltwater, and river water had different effects on $p\text{CO}_2$, even though all of them diluted the carbonate concentrations of surface water. This is due to differences in the alkalinity and carbonate chemistry among these freshwater sources. They emphasize the importance of freshwater type and proportion, as well as freshwater supply, for prediction of future $p\text{CO}_2$ changes.

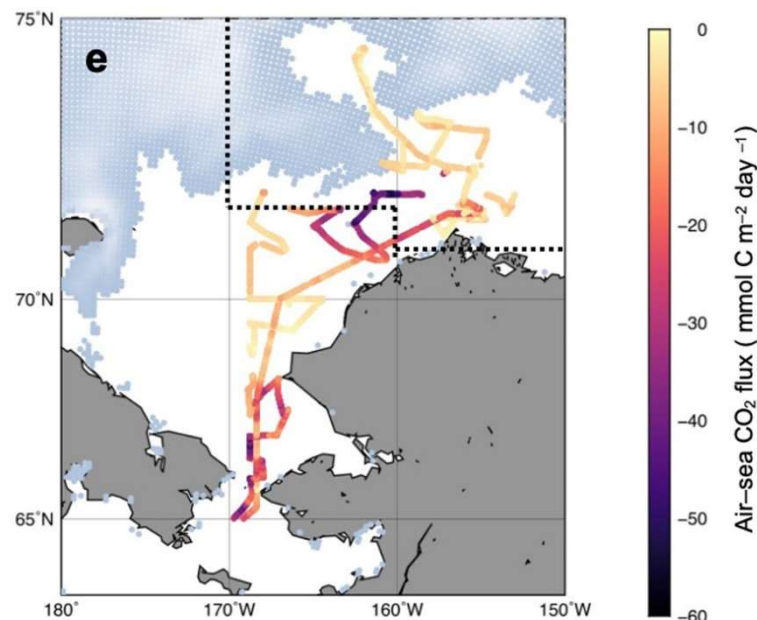


Figure: Horizontal distributions of air-sea CO₂ flux based on ocean surface observations. The dotted line indicates the boundary between the Chukchi Sea and the Canadian Basin in Tozawa et al. (2024).

Citation: Tozawa, M., Nomura, D., Matsuura, M., Hatta, M., Fujiwara, A., Yasunaka, S., and Murata, A. (2024), Quantitative assessment of factors contributing to variations in sea surface $p\text{CO}_2$ in the pacific sector of the Arctic Ocean, *Journal of Geophysical Research: Oceans*, 129, e2024JC021012. <https://doi.org/10.1029/2024JC021012>.

2. Activities/main accomplishments in 2024 (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).

(No specific order)

- Atmospheric GHG and oceanic CO₂ monitoring in the Pacific Ocean using two cargo ships.
- MR24-04 "Observation of air-sea interaction over the Tropical Northwestern Pacific", R/V Mirai cruise in the tropical Northwestern Pacific, 21 Jun. - 30 Jul. 2024 (PI: S. Yokoi)
- MR24-06C "Observation cruise of ArCS-II." R/V Mirai cruise in the North Pacific, Bering Sea, Arctic Ocean, 26 Aug.-30 Sep. 2024 (PI: M. Ito)
- MR24-07 "Interdisciplinary study of atmosphere-ocean-ecosystem variability in the western North Pacific" Oct.-Nov. 2024 (PIs: K. Kimoto and M. C. Honda)
- MR25-01 "Studies on air-sea interaction in the western and central equatorial Pacific", R/V Mirai cruise in the western and central equatorial Pacific, 12 Jan.-25 Feb. 2025 (PI: A. Nagano)

- SOLAS related R/T/V Toyoshio Maru cruise in the Seto Inland Sea, Biogeochemical Cycles and Photochemical Processes at the Atmosphere-Ocean Boundary, 29 June-3 July 2024 (PI: K. Takeda and Y. Iwamoto)
- SOLAS related R/V Shinsei Maru cruise off Boso Peninsula, "Atmospheric and Oceanic Impact Survey of Shallow Bottom Methane Venting Zone off Kujukurihama, Boso Peninsula," 10-14 July 2024 (PI: Y. Iwamoto)
- SOLAS related research projects during R/V Hakuho Maru cruise in the Southern Indian Ocean, 25 Aug - 22 Sep 2024 (PI: H. Saito)
- Joint Usage research meeting at Kashiwa, AORI, Univ. of Tokyo, "Integrated Process Study of Atmosphere-Ocean Boundary in the western North Pacific" 4-5 Mar 2025 (Convener: Y. Iwamoto and K. Hamasaki)
- SOLAS related R/T/V Toyoshio Maru cruise in the Seto Inland Sea, "Biogeochemical Cycles and Photochemical Processes at the Atmosphere-Ocean Boundary," 10-14 Mar 2025 (PI: K. Takeda and Y. Iwamoto)
- Field campaigns in Can Gio bay, Vietnam, "Estimates of annual methane flux to the atmosphere from the western South China Sea coastal area", 17-20 Aug., 2024, Jan. 11-14, 2025, collaboration with Dr. O. T. N. Bui (HCMUS-VNU, Vietnam), Grant for Environmental Research Projects, The Sumitomo Foundation (No. 2330089)
- Ground-based continuous aerosol sampling at a coastal site in the Sea of Okhotsk, Japan: since August 2023 (PI: Y. Miyazaki)
- Grand-based observation at Ogasawara Island in the western North Pacific, Sep. 2024 (PI: F. Taketani (JAMSTEC))

Meetings/international conferences/workshop/siminar contributions to int. assessments

- SOLAS related session in JpGU Meeting 2024, 28 May 2024 (Convener: S. Kameyama, Y. Iwamoto, M. N. Aita, N. Kosugi)
- The Oceanographic Society of Japan, 2024 Fall Meeting, Tokyo, Japan, Multidisciplinary Study of Biogeochemistry in the Northwestern Pacific (24F-11), Sep 17, 2024, (Conveners: Aita Noguchi M., Iwamoto Y., Sukigara C., Sato K., Nishikawa H.)
- SOLAS OSC side event: Reducing Uncertainty on Soluble Trace Element Deposition to the ocean: Early Career Researcher Workshop (Morgane M. G. Perron, Douglas S. Hamilton, Akinori Ito, Ashwini Kumar)
- Discussion Session: Reducing uncertainties in soluble aerosol trace element deposition: a SCOR working group call to the community (Morgane M. G. Perron, Douglas S. Hamilton, Akinori Ito) in SOLAS Open Science Conference 2024, Goa, India, Nov. 2024.
- Discussion Session: The coupling of ocean, sea-ice and atmospheric chemistry and biogeochemistry: A cross-disciplinary research challenge in SOLAS Open Science Conference 2024, Goa, India, Nov. 2024.
- Goldschmidt 2024: Air Pollutants, Sources and Processes, Climate Change, and Human Health (N. Rastogi, V. Verma, A. Ito, M. Kurisu, S. Takano, Y. Takahashi)
- M. Kurisu, A member of SOLAS Early Career Scientist Committee.
- Developing resources for the study of Methylated Sulfur compound cycling PROcesses in the ocean (DMS-PRO), SCOR Working Group No 166, Sohiko Kameyama (associate member)

3. Publications in 2024 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

(No specific order)

Core Theme 1: Greenhouse gases and the oceans;

Tozawa, M., Nomura, D., Matsuura, M., Hatta, M., Fujiwara, A., Yasunaka, S., Murata, A. (2024). Quantitative assessment of factors contributing to variations in sea surface pCO₂ in the Pacific Sector of the Arctic Ocean. *Journal of Geophysical Research-Oceans*. 129, 6. <https://doi.org/10.1029/2024JC021012>.

Noshiro, T., Nomura, D., Kondo, F., Ono, K., Else, B., Ikawa, H. (2024). Comparisons of different sample air drying systems for carbon dioxide flux measurements based on eddy covariance in cold environments. *Journal of Agricultural Meteorology*. 80(1), 22–28, 10.2480/agrmet.D-23-00014.

Tohjima, Y., Shirai, T., Ishizawa, M., Mukai, H., Machida, T., Sasakawa, M., Terao, Y., Tsuboi, K., Takao, S., and Nakaoka, S. (2024). Observed APO seasonal cycle in the Pacific: Estimation of autumn O₂ oceanic emissions. *Global Biogeochemical Cycles*, 38, e2024GB008230. <https://doi.org/10.1029/2024GB008230>

Friedlingstein, P., O'Sullivan, M., Jones, M. W., Andrew, R. M., Hauck, J., Landschützer, P., Le Quéré, C., Li, H., Luijkx, I. T., Olsen, A., Peters, G. P., Peters, W., Pongratz, J., Schwingshackl, C., Sitch, S., Canadell, J. G., Ciais, P., Jackson, R. B., Alin, S. R., Arneeth, A., Arora, V., Bates, N. R., Becker, M., Bellouin, N., Berghoff, C. F., Bittig, H. C., Bopp, L., Cadule, P., Campbell, K., Chamberlain, M. A., Chandra, N., Chevallier, F., Chini, L. P., Colligan, T., Decayeux, J., Djeutchouang, L. M., Dou, X., Duran Rojas, C., Enyo, K., Evans, W., Fay, A. R., Feely, R. A., Ford, D. J., Foster, A., Gasser, T., Gehlen, M., Gkritzalis, T., Grassi, G., Gregor, L., Gruber, N., Gürses, Ö., Harris, I., Hefner, M., Heinke, J., Hurtt, G. C., Iida, Y., Ilyina, T., Jacobson, A. R., Jain, A. K., Jarníková, T., Jersild, A., Jiang, F., Jin, Z., Kato, E., Keeling, R. F., Klein Goldewijk, K., Knauer, J., Korsbakken, J. I., Lan, X., Lauvset, S. K., Lefèvre, N., Liu, Z., Liu, J., Ma, L., Maksyutov, S., Marland, G., Mayot, N., McGuire, P. C., Metzl, N., Monacci, N. M., Morgan, E. J., Nakaoka, S.-I., Neill, C., Niwa, Y., Nützel, T., Olivier, L., Ono, T., Palmer, P. I., Pierrot, D., Qin, Z., Resplandy, L., Roobaert, A., Rosan, T. M., Rödenbeck, C., Schwinger, J., Smallman, T. L., Smith, S. M., Sospedra-Alfonso, R., Steinhoff, T., Sun, Q., Sutton, A. J., Séférian, R., Takao, S., Tatebe, H., Tian, H., Tilbrook, B., Torres, O., Tourigny, E., Tsujino, H., Tubiello, F., van der Werf, G., Wanninkhof, R., Wang, X., Yang, D., Yang, X., Yu, Z., Yuan, W., Yue, X., Zaehle, S., Zeng, N., and Zeng, J. (2025), *Global Carbon Budget 2024*, *Earth Syst. Sci. Data*, 17, 965–1039, <https://doi.org/10.5194/essd-17-965-2025>.

Core Theme 3: Atmospheric deposition and ocean biogeochemistry;

Ito, A. (2024), Aerosol Iron Deposition to Marine Ecosystems in the Anthropocene-From the Perspective of Global Modeling Studies, *Journal of Aerosol Research*, 39 (2), 98-110, doi:10.11203/jar.39.98.

Kurisu M, Sakata K, Nishioka J, Obata H, Conway TM, Hunt HR, Sieber M, Suzuki K, Kashiwabara T, Kubo S, Takada M, Takahashi Y (2024) Source and fate of atmospheric iron supplied to the subarctic North Pacific traced by stable iron isotope ratios. *Geochim Cosmochim Acta*, 378:168–185. <https://doi.org/10.1016/j.gca.2024.06.009>.

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

Yahara, K., K. Yamaji, F. Taketani, M. Takigawa, Y. Kanaya, S. Ohata, Y. Kondo, M. Koike (2024), Controlling factors of spatiotemporal variations in black carbon concentrations over the Arctic

region by using a WRF/CMAQ simulation on the Northern Hemisphere scale, Polar Sci., 41, 101093.

Kondo, F., T. Fujita, and H. Aiki (2024), Direct measurements of sea spray particle fluxes using a high temporal resolution optical particle counter over the coastal ocean. Coastal Engineering Journal, 66, 467–478, doi:10.1080/21664250.2024.2359160

Core Theme 5: Ocean biogeochemical control on atmospheric chemistry;

Kameyama, S. (2024), Progress in research on production/consumption processes of dimethylsulfide in the ocean surface, Chikyukagaku (Geochemistry), 58, 102-117. (in Japanese with English abstract).

Miyazaki, Y. (2024), Emissions of atmospheric reactive nitrogen from the ocean surface in the framework of biogeochemistry, Chikyukagaku (Geochemistry), 58, 125-134. (in Japanese with English abstract).

Cross-Cutting Theme:

Akino, R., Nomura, D., Sahashi, R., Tozawa, M., Hatta, M., Matsuno, K., Endo, W., Shiozaki, T., Kawakami, T., Ito, M., Murata, A., Fujiwara, A. (2024). Characteristics of late summer Arctic brash sea ice and its melting effect on the surface-water biogeochemistry in the Chukchi Shelf and Canada Basin. Elementa, Science of the Anthropocene. 12(1), <https://doi.org/10.1525/elementa.2023.00094>.

Tozawa, M., Nomura, D., Yamazaki, K., Kiuchi, M., Hirano, D., Aoki, S., Sasaki, H., Murase, H. (2024). Oceanographic factors determining the distribution of nutrients and primary production in the subpolar Southern Ocean. Progress in Oceanography. 225, <https://doi.org/10.1016/j.pocean.2024.103266>.

Nomura, D., Akino, R., Corkill, M., Hirano, K., Kasai, A., Katakura, S., Kawaguchi, Y., Kawakami, T., Kimura, R., Lannuzel, D., Makabe, R., Matsuura, M., Matsuno, K., Meiners, K., Nagasaki, K., Nosaka, Y., Samori, N., Sakaya, S., Son, E. Y., Suga, R., Sunakawa, Y., Takahashi, K. D., Takahashi, M., Takeda, Y., Toyota, T., Tozawa, M., Wongpan, P., Yoshida, H., Yoshida, K., Yoshimura, M. (2024). Multidisciplinary research for sea ice in Saroma-ko Lagoon, Hokkaido, Japan 2023. Bulletin of Glaciological Research, doi: 10.5331/bgr.24R01.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2024? If yes, who? How did you engage?

PART 2 - Planned activities for 2025 and 2026

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)

- NIES VOS program and Global Environmental Research Coordination System from Ministry of the Environment of Japan support the atmospheric GHG and oceanic CO₂ monitoring in the Pacific Ocean from FY2021 to FY2025.
- R/V Mirai cruise in the central Pacific: Apr. 2025 (PI: S. Koketsu)
- R/V Mirai cruise in the Arctic Ocean: May. 2025
- R/V Mirai cruise, "Interdisciplinary Biogeochemical Studies in the Subarctic North Pacific," July–August, 2025 (PI: Fujiki T.)
- Cruises of R/V Mirai in the North Pacific, the Bering Sea and the Arctic Ocean, Sep., 2025 (PI: A. Fujiwara)
- SOLAS-related IGAC activity: Oceans WG of TOAR-II (Tropospheric Ozone Assessment Report Phase II)
- R/V Shinsei Maru cruise targeting ocean-atmosphere interaction over the Kuroshio Extension, 20 June - 4 July 2025 (PI: R. Yamaguchi)
- SOLAS related R/T/V Toyoshio Maru cruise in the Seto Inland Sea, "Biogeochemical Cycles and Photochemical Processes at the Atmosphere-Ocean Boundary," 7-11 July 2025 (PI: K. Takeda and Y. Iwamoto)
- SOLAS related R/V Hakuho Maru cruise in the western North Pacific, 26 Feb to 25 Mar 2026 (PI: K. Hamasaki)
- Field work/School: International Sea Ice School in Saroma-ko Lagoon, Hokkaido, Japan, 28 February - 9 March 2026, BEPSII/CATCH/CIce2Clouds community.
- Workshop: BEPSII/CATCH/CIce2Clouds joint meeting, Shiretoko, Hokkaido, Japan, 9-10 March 2026, BEPSII/CATCH/CIce2Clouds community.
- "Surface Ocean and Lower Atmosphere Study (SOLAS) Japan integrated process study in the western North Pacific (SOLAS-JIPS) Part II"

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

(No specific order)

- SOLAS related session in JpGU Meeting 2025 (Convener: S. Kameyama, Y. Iwamoto, M. N. Aita, N. Kosugi), Chiba, Japan, May 2025.
- BACO2025, IAMAS-IACS-IAPSO Joint Assembly, the SOLAS co-sponsored session Biogeochemical interactions across the atmosphere-ice-ocean interface (Conveners: Y. Miyazaki, J. Jung, M. Kurisu, M. Mochida), Busan, South Korea, July 2025.
- International Workshop "Mid-latitude Atmosphere-Ocean-Ecosystem Interactions: Processes, Predictability, and Habitability" in Kyushu Univ., July 2025.

3. Funded national and international projects/activities underway.

(No specific order)

- The Arctic Challenge for Sustainability III (ArCS III)
- NIES VOS Program (Atmosphere/Ocean Greenhouse Gas Observation: Japan-North America, Japan-Oceania)
- Global Environmental Research Coordination System from Ministry of the Environment of Japan, Comprehensive observations of marine ecosystem and carbonate system for accurate evaluation of oceanic CO₂ uptake

- JST CREST "Carbon cycle and Lower trophic level oceanic organisms Investigation for Future Environments (C-LIFE)" Grant number: JPMJCR24J1, PI: Maki Noguchi AITA, Oct. 2024 – Mar. 2030.
- Refined evaluation of dynamics of wave-associated aerosol particles and air-sea mass exchange, (PI: Y. Iwamoto, KAKENHI, 2024-2028, Grant-in-Aid for Transformative Research Areas, Habitable Japan: Sustainability of atmospheric and oceanic environment as a survival basis of island country Japan (PI: E. Oka)
- 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.
- Grant-in-Aid for Scientific Research (A), granted by the Japan Society for the Promotion of Science (JSPS), PI: Urumu Tsunogai, FY2022-2025, High-sensitivity tracer assay for oxygen consumption rate in seawater and freshwater.
- 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), PI: Yuzo Miyazaki, FY2023-2025, Elucidation of microbial factors that control the amount and physicochemical properties of atmospheric organic nitrogen aerosols in the subarctic ocean.
- Grant-in-Aid for Scientific Research (B), granted by the Japan Society for the Promotion of Science (JSPS), PI: Fumikazu Taketani, FY2024-2026, Impacts of atmospheric deposition on marine ecosystems: integration of observation, laboratory experiment and model analysis
- Grant-in-Aid for Scientific Research (C), granted by the Japan Society for the Promotion of Science (JSPS), PI: Yuko Omori, FY2024-2026, The impact of marine plastic as a source of volatile organic compounds emissions.
- Grant-in-Aid for Early-Career Scientists, granted by the Japan Society for the Promotion of Science (JSPS), PI: Minako Kurisu, FY2024-2026, Source identification of Fe supplied in the western subarctic North Pacific ~Quantitative evaluation using Fe stable isotope ratios.
- Grant-in-Aid for Transformative Research Areas, Dynamics of Atmospheric Aerosol Associated with Waves and Refined Evaluation of Mass Exchange Process between Atmosphere and Ocean, (PI: Y. Iwamoto, FY2024-2028)
- JST-CREST [Carbon-Blue X] Exploring the Potential of Ocean Blue Carbon Through Investigation of Ocean and Carbon Cycling Interactions. Changes in the dynamics of microalgae unravelled by wide-area, frequent, high-precision observations.

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

(No specific order)

- Perron, M. M. G., Fietz, S., Hamilton, D. S., Ito, A., Shelley, R. U., and Tang, M.: Preface to the inter-journal special issue "RUSTED: Reducing Uncertainty in Soluble aerosol Trace Element Deposition", Atmos. Meas. Tech., 17, 165–166, <https://doi.org/10.5194/amt-17-165-2024>, 2024.
- Biogeochemical Studies on Atmosphere, Ocean, and their Interaction in the western North Pacific region, SPecial call for Excellent Papers on hot topicS (SPEPS) in PEPS (Progress in Earth and Planetary Science), https://progearthplanetsci.org/speps_j/020.html.

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

- Research Announcement on the Earth Observations: EO-RA4, granted by JAXA, PI: Sayaka Yasunaka, FY2025-2027, Arctic Ocean CO2 mapping.

Comments