

Report for the year 2022 and future activities

SOLAS Sweden

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This report has two parts:

- **Part 1:** reporting of activities in the period of January 2022 - Jan/Feb 2023
- **Part 2:** reporting on planned activities for 2023 and 2024.

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. ?

All fine, thanks!

PART 1 - Activities from January 2022 to Jan/Feb 2023

1. Scientific highlight

One scientific highlight explored the potential for sea spray aerosols to act as a source of perfluoroalkyl acids (PFAAs) in the atmosphere (Sha et al., 2022). By analyzing aerosol samples collected from Norwegian coastal locations, a significant correlation between PFAAs and tracer ions in sea spray aerosols, such as Na⁺ and Mg⁺ was identified (see figure below). This discovery represents the first field evidence of this transport pathway of PFAAs and highlights the importance of sea spray aerosols as a source of these pollutants in coastal areas.

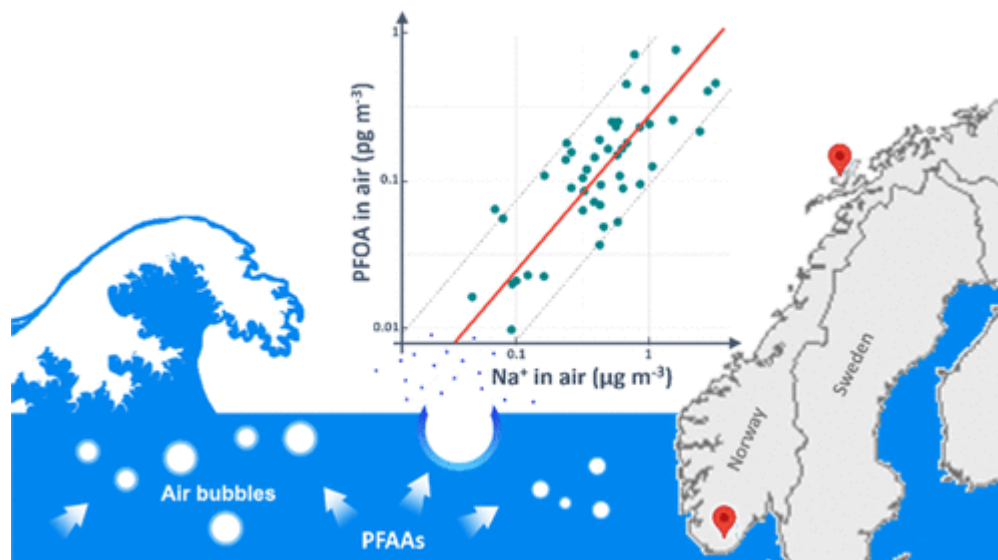


Figure: Graphical abstract by Sha et al. showing the positive correlation between perfluorooctanoic acid and sodium concentration in air, as well as the two sampling locations at the coast of Norway.

Citation: Sha, B., Johansson, J. H., Tunved, P., Bohlin-Nizzetto, P., Cousins, I. T., & Salter, M. E. (2021). Sea spray aerosol (SSA) as a source of perfluoroalkyl acids (PFAAs) to the atmosphere: field evidence from long-term air monitoring. *Environmental Science & Technology*, 56(1), 228-238.

<https://pubs.acs.org/doi/full/10.1021/acs.est.1c04277>

2. Activities/main accomplishments in 2022 (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).

- Intensive planning for the ARTofMELT commenced in real with a workshop in October that marked the start of the practical planning for the May-June icebreaker expedition to the central Arctic (Michael Tjernström and Paul Zieger, Stockholm University)
- Gas Transfer on Water Surfaces Conference in Plymouth; field campaign in Jade Bay (Leonie Esters, Uppsala University)
- Funding of marine ACTRIS station at the Östergarnsholm site (Anna Rutgeron, Uppsala University).
- Large campaign in collaboration with Chalmers using their combustion laboratory (Erik Thomson, University of Gothenburg).
- Stockholm University (ACES): Field work at Graciosa island (Azores) to study the effect of atmospheric aging on sea spray particles (in collaboration with US partners, see <https://www.aces.su.se/research/projects/closing-the-gap-between-properties-of-fresh-sea-spray-aerosol-and-aerosol-observed-in-the-marine-boundary-layer/>)
- Conference contributions: Talk and poster at ISME18 – 18th International Symposium on Microbial Ecology (ISME) 14th to 19th August 2022, Lausanne, Switzerland; Poster at Viruses of Microbes 2022, 18th to 22nd July 2022, Guimarães, Portugal; Invited talks at 8th Annual NORBIS conference, Rosendal, Norway; University of Hamburg seminar series and ECR Viromics Webinar; Interview with Susanne Wedlich for MARE magazine; Press release on Synoptic Arctic Survey: <https://www.polar.se/en/news/2022/viruses-that-hitchhike-or-kill/> (Janina Rahlff, Linnaeus University)

3. List SOLAS-related publications published in 2022 (only PUBLISHED articles) and if any, web links to models, datasets, products, etc.

Voskuhl, L. and J. Rahlff, Natural and oil surface slicks as microbial habitats in marine systems: A mini review, *Front Mar Sci*, 2022. 9: DOI: 10.3389/fmars.2022.1020843

Zhang, S., L. Wu, J. Arnqvist, C. Hallgren and A. Rutgersson. Mapping coastal upwelling in the Baltic Sea from 2002 to 2020 using remote sensing data. *Int. J. of Appl. Earth Observation and Geoinformatics*, Volume 114, 2022, 103061.

Gutiérrez-Loza, L., E. Nilsson, M. B. Wallin, E. Sahlée, and A. Rutgersson. On physical mechanisms enhancing air-sea CO₂ exchange. *Biogeosciences*, 19, 5645–5665, 2022.

You, C., M. Tjernström, A. Devasthale, 2022: Eulerian and Lagrangian views of warm and moist air intrusions into winter Arctic, *Atmospheric Chemistry and Physics*, 22, 8037–8057.

You, C., M. Tjernström, A. Devasthale, and D. Steinfeld, 2022: The role of atmospheric blockings in regulating Arctic warming, *Geophysical Research Letters*, 49, e2022GL097899.

Karlsson, L., Baccarini, A., Duplessis, P., Baumgardner, D., Brooks, I. M., Chang, R. Y., et al. (2022). Physical and chemical properties of cloud droplet residuals and aerosol particles during the Arctic Ocean 2018 expedition. *Journal of Geophysical Research: Atmospheres*, 127, e2021JD036383.

Radoman, N., Christiansen, S., Johansson, J. H., Hawkes, J. A., Bilde, M., Cousins, I. T., & Salter, M. E. (2022). Probing the impact of a phytoplankton bloom on the chemistry of nascent sea spray aerosol using high-resolution mass spectrometry. *Environmental Science: Atmospheres*, 2(5), 1152-1169.

Gomez, J., Allen, R. J., Turnock, S. T., Horowitz, L. W., Tsigaridis, K., Bauer, S. E., ... & Ginoux, P. (2023). The projected future degradation in air quality is caused by more abundant natural aerosols in a warmer world. *Communications Earth & Environment*, 4(1), 22.

d Santos, L. F., Salo, K., Kong, X., Noda, J., Kristensen, T. B., Ohigashi, T., & Thomson, E. S. (2023). Changes in CCN activity of ship exhaust particles induced by fuel sulfur content reduction and wet scrubbing. *Environmental Science: Atmospheres*, 3(1), 182-195.

d Santos, L. F., Salo, K., & Thomson, E. S. (2022). Quantification and physical analysis of nanoparticle emissions from a marine engine using different fuels and a laboratory wet scrubber. *Environmental Science: Processes & Impacts*, 24(10), 1769-1781.

Freitas, G. P., Stolle, C., Kaye, P. H., Stanley, W., Herlemann, D. P., Salter, M. E., & Zieger, P. (2022). Emission of primary bioaerosol particles from Baltic seawater. *Environmental Science: Atmospheres*, 2(5), 1170-1182.

Zinke, J., Nilsson, E. D., Zieger, P., & Salter, M. E. (2022). The Effect of Seawater Salinity and Seawater Temperature on Sea Salt Aerosol Production. *Journal of Geophysical Research: Atmospheres*, 127(16), e2021JD036005.

Sha, B., Johansson, J. H., Tunved, P., Bohlin-Nizzetto, P., Cousins, I. T., & Salter, M. E. (2021). Sea spray aerosol (SSA) as a source of perfluoroalkyl acids (PFAAs) to the atmosphere: field evidence from long-term air monitoring. *Environmental Science & Technology*, 56(1), 228-238.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2022? If yes, who? How did you engage?

- Engagement with fuel companies providing low aromatic bio-fuels (Erik Thomson, University of Gothenburg)
- Stakeholder discussions in the ShipTRASE project to develop scenarios for future shipping (Anna Rutgersson, Uppsala University)

PART 2 - Planned activities for 2023 and 2024

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

- Development of ACTRIS site at the Baltic Sea (Östergarnsholm, more info can be found here: https://www.icos-sweden.se/station_ostergarnsholm.html and <https://www.actris.se/node/12>).



- CoastClim project, which brings together experts in marine ecology, biogeochemistry, marine physics, and atmospheric research. The goal is to quantify the biodiversity and feedbacks of the coastal zone of the Baltic Sea, including the origin and type of habitat-specific greenhouse gas fluxes and aerosols and their precursors. To achieve this goal, funding was secured from the Swedish Research Council (VR) to build a state-of-the-art laboratory that focuses on air-sea interaction in the coastal zone of the Baltic Sea. This unique floating laboratory will be located up to several kilometers from the shore, within the Stockholm Archipelago, and will be powered by a hydrogen fuel cell, making it independent of shore power while not emitting substances that may interfere with our measurements. The laboratory will be equipped with cutting-edge instrumentation to accurately quantify the fluxes of greenhouse gases, aerosols, and aerosol precursors such as volatile organic compounds. Construction of the laboratory will begin in 2023, and it is planned for it to be fully operational by 2024. This facility will help us gain valuable insights into the coastal zone of the Baltic Sea and its impact on the environment. More info can be found here: <https://www.coastclim.org/>



- The ARTofMELT is an international icebreaker-based field campaign into the central Arctic from early May to mid-June, 2023. This timing is unusual since it is the most difficult time to navigate in the Arctic sea ice, and the expedition is also novel in the sense that it targets atmospheric rivers, and hence has no fixed route. Instead we will use extended ensemble forecasts to identify times and location and move the ice breaker to optimal positions. The observations cover the upper ocean, the sea ice and the atmosphere and is targeting the effects of atmospheric rivers on the surface exchange in the spring, especially the processes that are central for the initiation of the surface melt. More info can be found here: www.su.se/artofmelt and <https://www.polar.se/en/expeditions/artofmelt-2023/>



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

- 10th FEMS Congress of European Microbiologists in Hamburg, Germany from July 9 -13th, 2023
- Symposium of Aquatic Microbial Ecology – SAME, 17 August 20 -25, 2023, In Tartu, Estonia
- ARTofMELT science workshop spring 2024
- MOCCHA-ACAS-ICE-AO2018 4th workshop in Stockholm September 4-6 2023.
- MILAF, Oct 2023 (<https://bioice.wordpress.com/2022/12/06/milaf-international-early-career-workshop-oct-2023-denmark/>)
- Towards a Molecular Understanding of Atmospheric Aerosols (MUOAA 2024) will take place from April 1st to 5th, 2024 at the institute for scientific studies of Cargèse
- Open workshop on intercoupled system behavior, 23-25 October 2023, Stockholm, Sweden (part of <https://www.crices-h2020.eu/>)

3. Funded national and international projects/activities underway.

- FORMAS Mobility grant on turbulence-driven air-sea gas exchange study
- FORMAS and VR grants for work on viruses and microbes in sea slicks and rainwater to be submitted
- VR, 2020 Molecular Level Drivers of Clouds and Climate

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

- Planned FORMAS follow up to further investigate implications of marine fuel regulations

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

- ARTofMELT is a collaboration between many partners, including Swedish, German, Swiss, Danish, Finnish, UK and US universities, the ECMWF, the Norwegian weather service and WMO/WWRP.

Comments