

Report for the year 2022 and future activities

SOLAS Poland

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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. ?

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

1. Scientific highlight

In their work, Zbizika et al. described the new approach to Aerosol Optical Depth studies. Aerosol Optical Depth (AOD) is a measure of the extinction of solar radiation by aerosols in the atmosphere. Understanding the variations of global AOD is necessary for precisely determining the role of aerosols. Arctic warming is partially caused by aerosols transported from vast distances, including those released during biomass burning events (BBEs). However, measuring AODs is challenging, typically requiring active LIDAR systems or passive sun photometers. Both are limited to cloud-free conditions; sun photometers provide only point measurements, thus requiring more spatial coverage. A more viable method to obtain accurate AOD may be found through machine

learning. This study uses DNNs to estimate Svalbard's AODs using a minimal set of meteorological parameters (temperature, air mass, water vapor, wind speed, latitude, longitude, and time of year). The mean absolute error (MAE) between predicted and true data was 0.00401 for the entire set and 0.0079 for the validation set. It was then shown that the inclusion of BBE data improves predictions by 42.167%. It was demonstrated that AODs may be accurately estimated without the use of expensive instrumentation, using machine learning and minimal data. Similar models may be developed for other regions, allowing immediate improvement of current meteorological models.

Citation: Zbizika, R.; Pakszys, P.; Zielinski, T. Deep Neural Networks for Aerosol Optical Depth Retrieval. *Atmosphere* 2022, 13, 101. <https://doi.org/10.3390/atmos13010101>

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).

Editors in the following Special Issues: *Frontiers in Marine Science: Marine Observations and Society: Pathways to Improve Public Engagement and the Science-Policy Nexus*; *Atmosphere: Unusual Aerosol Conditions in the Arctic*; *Sustainability: Sustainable Environment through Sustainability Science — Environmental Studies in the Era of the UN Decade of Ocean Science for Sustainable Development (2021–2030)*.

Funding programs SESS: projects - LOAD-RiS, Harmonising Environmental Research and Monitoring of Priority Pollutants in the Svalbard Atmosphere (HERMOSA).

Numerous capacity building workshops and events for various stakeholders.

Active participation in the UN Ocean Conference 2022.

3. Top 5 publications in 2022 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

1. Adriana Bailey, Franziska Aemisegger, Leonie Villiger, Sebastian A. Los, Gilles Reverdin, Estefanía Quiñones Meléndez, Claudia Acquistapace, Dariusz B. Baranowski, Tobias Böck, Sandrine Bony, Tobias Bordsdorff, Derek Coffman, Simon P. de Szoeki, Christopher J. Diekmann, Marina Dütsch, Benjamin Ertl, Joseph Galewsky, Dean Henze, Przemysław Makuch, David Noone, Patricia K. Quinn, Michael Rösch, Andreas Schneider, Matthias Schneider, Sabrina Speich, Bjorn Stevens, Elizabeth Thompson, 2022, Isotopic measurements in water vapor, precipitation, and seawater during EUREC4A. *Earth Syst. Sci. Data Discuss.* <https://doi.org/10.5194/essd-15-465-2023>
2. Luca Ferrero, Lorenzo Scibetta, Piotr Markuszewski, Mikolaj Mazurkiewicz, Violetta Drozdowska, Przemysław Makuch, Patrycja Jutrzenka-Trzebiatowska, Adriana Zaleska-Medynska, Sergio Ando, Francesco Saliu, Douglas E. Nilsson, E. Bolzacchini, Airborne and marine microplastics from an oceanographic survey at the Baltic Sea: An emerging role of air-sea interaction? *Science of The Total Environment*, 2022, 153709, <https://doi.org/10.1016/j.scitotenv.2022.153709>
3. Otremba Z., Piskozub J., 2022, Monte Carlo Radiative Transfer Simulation to Analyze the Spectral Index for Remote Detection of Oil Dispersed in the Southern Baltic Sea Seawater Column: The Role of Water Surface State, *Remote Sensing*, 14(2), art. no. 247, <https://doi.org/10.3390/rs14020247>
4. Iwona Wróbel-Niedźwiecka, Małgorzata Kitowska, Przemysław Makuch and Piotr Markuszewski, The Distribution of pCO₂w and Air-Sea CO₂ Fluxes Using FFNN at the Continental Shelf Areas of the Arctic Ocean. *Remote Sens.* 2022, 14, 312. <https://doi.org/10.3390/rs14020312>
5. R. Zbizika, P. Pakszys, T. Zieliński. Deep Neural Networks for Aerosol Optical Depth Retrieval. *Atmosphere* 2022, 13, 101, <https://doi.org/10.3390/atmos13010101>. 2022.

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?

We run numerous workshops, some dedicated to ecosystem services, also with respect to climate change ocean related issues. The results are analysed and will be published soon. We also run a number of events for general public and youth as well as science fairs and various types of conferences, from scientific to popular science ones.

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.).

As below.

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

Sea cruises of r/v Oceania in the Baltic and the Arctic. Interdisciplinary marine and atmospheric studies.

Participation in the Maritime Aerosol Network

(https://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html) activities.

Works within the Re-evaluation and Homogenization of Aerosol Optical Depth Observations in Svalbard (ReHearsol) - RCN project no. 311250.

Works within the LOAD-RiS and HERMOSA Svalbard Science Forum projects.

INES- International School on INTe grated Environmental Studies in the Arctic

(<http://www.iopan.pl/Ines/index.html>) with respect to climate changes summer school. Five days of lectures and activities for international students.

Participation in the works of the Scientific Committee of the European Marine Board Communication Panel.

Expertizes for the Polish Ecological Club.

Numerous popular interviews in various media.

3. Funded national and international projects/activities underway.

A number of actions are planned for 2023.

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

Continued research activities, with use of the r/v Oceania, whenever possible. We plan both the Baltic and the Arctic cruises.

Organization and co-organization of many scientific and outreach events, such as:

- INES summer school 2023,
- Open Science Days 2023,
- European Maritime Day 2023.

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

There are a number of projects being run. Some include:

1. Marine Knowledge Sharing Platform for Federating Responsible Research and Innovation Communities - MARINA.
2. AERONET.
3. International Ocean Carbon Coordination Project (IOCCP; www.ioccp.org).
4. MARBEFES.
5. LOAD-RIS.
6. SURETY.
7. Land2Sea.

Comments