

## Report for the year 2021 and future activities

### SOLAS FINLAND

**compiled by: Lauri Laakso / Finnish meteorological institute,**

**reporting for**

- **Finnish Meteorological Institute (FMI)**
- **Finnish Environment Institute (SYKE)**
- **University of Helsinki (UH)**
- **University of Turku (UT): nothing to report**
- **Åbo Akademi University (ÅA): nothing to report**
- **Geological Survey of Finland (GTK)**
- **Natural Resources Institute Finland (LUKE): nothing to report**

*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. ?**

In general, lobby for suitable themes to EU- and national funding programs.

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

### **1. Scientific highlight**

*Describe one scientific highlight with a title, text (max. 300 words), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in results of international collaborations. (If you wish to include more than one highlight, feel free to do so).*

FMI

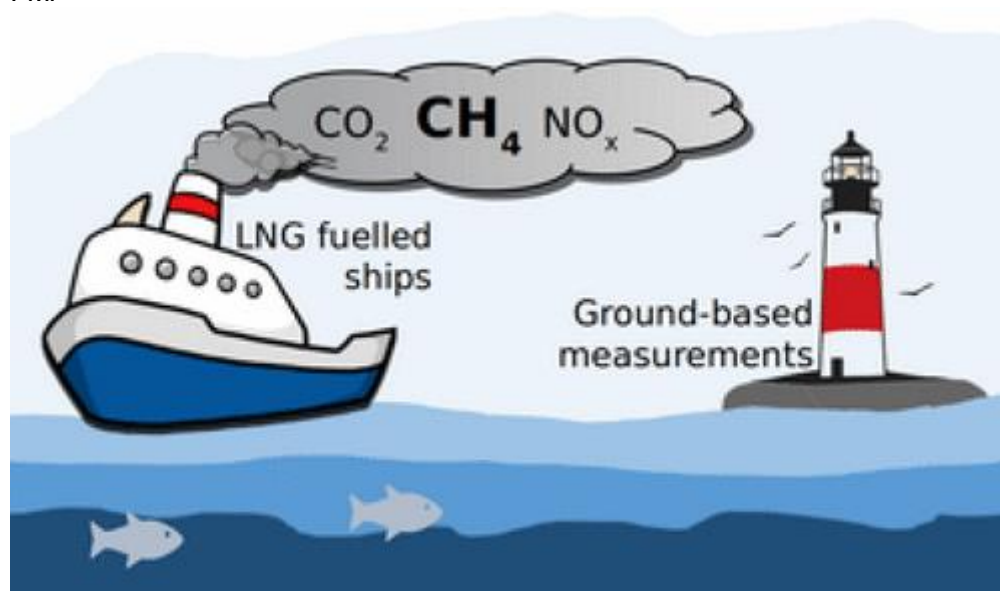


Figure 1: Remote marine air-quality measurements show significant climate relevant methane emissions (methane slip) from ships using liquefied natural gas as a fuel.

Citation: Grönholm, T., Mäkelä, T., Hatakka, J., Jalkanen, J.-P., Kuula, J., Laurila, T., Laakso, L., Kukkonen, J.: Evaluation of Methane Emissions Originating from LNG Ships Based on the Measurements at a Remote Marine Station, <https://doi.org/10.1021/acs.est.1c03293>, Environmental Science & Technology, 2021.

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**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).**

*FMI*

- *Completion of European Maritime Transport Environmental Report in cooperation with EMSA and EEA*
- *Joined the ICES WGSHP group*
- *Participation in IMO MEPC, ISWG GHG meetings*
- *HELCOM reporting of Baltic Sea ship air emissions, discharges and underwater noise*
- *Traficom report of winter navigation impact on shipping GHG emissions in the Baltic Sea area.*
- *Presented the FMI work of underwater noise from shipping to TG NOISE*

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- Kotilainen, A.T., Kotilainen, M.M., Vartti, V.-P., Hutri, K.-L. & Virtasalo, J.J. 2021: Chernobyl still with us: <sup>137</sup>Caesium activity contents in seabed sediments from the Gulf of Bothnia, northern Baltic Sea. *Marine Pollution Bulletin* 172, 112924. **THEME 5**
- Ojala, A.E.K., Virtasalo, J.J., Lindsberg, E. & Markovaara-Koivisto, M. 2021: Basin-scale 3D sedimentary modelling: an approach to subdivide Baltic Sea onshore sediments for land use and construction. *Geotechnical and Geological Engineering* 39, 4855–4876. **THEME 5**
- Karpin, V., Heinsalu, A. & Virtasalo, J.J. 2021: Late Pleistocene iceberg scouring in the north-eastern Baltic Sea, west of Estonia. *Marine Geology* 438, 106537. **THEME 5**
- Palmu, J.-P., Ojala, A.E.K., Virtasalo, J., Putkinen, N., Kohonen, J. & Sarala, P. 2021: Classification system of superficial (Quaternary) geological units in Finland. *Geological Survey of Finland, Bulletin* 412, 115–169. **THEME 5**
- Luoma, S., Majaniemi, J., Pullinen, A., Mursu, J. & Virtasalo, J.J. 2021: Geological and groundwater flow model of a submarine groundwater discharge site in Hanko, northern Baltic Sea. *Hydrogeology Journal* 29, 1279–1297. **THEME 5**

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

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- Kuittinen, N., Jalkanen, J.-P., Alanen, J., Ntziachristos, L., Hannuniemi, H., Johansson, L., Karjalainen, P., Saukko, E., Isotalo, M., Aakko-Saksa, P., Lehtoranta, K., Keskinen, J., Simonen, P., Saarikoski, S., Asmi, E., Laurila, T., Hillamo, R., Mylläri, F., Lihavainen, H., Timonen, H., Rönkkö, T., "Global particle number emissions from shipping equal all continental anthropogenic sources", *Environ. Sci. Technol.* 2021, 55, 1, 129–138, <https://doi.org/10.1021/acs.est.0c03627>
- Michael Gauss, Jerzy Bartnicki, Jukka-Pekka Jalkanen, Agnes Nyiri, Heiko Klein, Hilde Fagerli, Zbigniew Klimont, Airborne nitrogen deposition to the Baltic Sea: past trends, source allocation, and future projections, *Atmos. Env.*, 253 (2021) 118377, <https://doi.org/10.1016/j.atmosenv.2021.118377>
- Jalkanen, J.-P., Johansson, L., Wilewska-Bien, M., Granhag, L., Ytreberg, E., Eriksson, K. M., Yngsell, D., Hassellöv, I.-M., Magnusson, K., Raudsepp, U., Maljutenko, I., Styhre, L., Winnes, H. and Moldanova J., "Modeling of discharges from Baltic Sea shipping", *Ocean Science*, 17, 699–728, 2021, <https://doi.org/10.5194/os-17-699-2021>
- Moldanová, J., Hassellöv, I.-M., Matthias, V., Fridell, E., Jalkanen, J.-P., Ytreberg, E., Maljutenko, I., Tröltz, J. and Quante, M., "Framework for the environmental impact assessment of operational shipping", *AMBIO*, <https://doi.org/10.1007/s13280-021-01597-9>
- Geels, C., Andersson, C, Winter, M, Jalkanen, J-P, Brandt, J, Frohn, LM, "Projections of shipping emissions and the related impact on air pollution and human health in the Nordic region", *Atmos. Chem. Phys.*, 21, 12495–12519, 2021, <https://doi.org/10.5194/acp-21-12495-2021>
- Ilja Maljutenko, Ida-Maja Hassellöv, K. Martin Eriksson, Erik Ytreberg, Daniel Yngsell, Lasse Johansson, Jukka-Pekka Jalkanen, Mariliis Kõuts, Mari-Liis Kasemets, Jana Moldanova, Kerstin Magnusson, Urmas Raudsepp, Modelling spatial dispersion of contaminants from shipping lanes in the Baltic Sea, *Environmental Pollution, Volume 173, Part A, December 2021*, 112985, <https://doi.org/10.1016/j.marpolbul.2021.112985>
- Jari Walden, Liisa Pirjola, Tuomas Laurila, Juha Hatakka, Heidi Pettersson, Tuomas Walden, Jukka-Pekka Jalkanen, Harri Nordlund, Toivo Truuts, Miika Meretoja, and Kimmo K. Kahma, "Measurement report: Characterization of uncertainties in fluxes and fuel sulfur content from ship emissions in the Baltic Sea", *Atmos. Chem. Phys.*, 21, 18175–18194, <https://doi.org/10.5194/acp-21-18175-2021>, 2021
- Marcus Reckermanm, Juris Aigars, Naveed Akhtar, Jacek Beldowski, Cris Pons-Seres de Brauer, Tom Cronin, Michał Czub, Michael Dähne, Margit Eero, Kari Hyttiäinen, Jukka-Pekka Jalkanen, Anders Kiessling, Erik Kjellström, Xiaoli Guo Larsén, Michelle McCrackin, Markus Meier, Sonja Oberbeckmann, Anders Omstedt, Kevin Parnell, Anneli Poska, Jarkko Saarinen, Tarmo Soomere, Beata Szymczycha, Emma Undeman, Anders Wörman, Eduardo Zorita, Multiple drivers of environmental changes and their interactions in the Baltic Sea region, *Earth Syst. Dynam.*, 13, 1–80, 2022, <https://doi.org/10.5194/esd-13-1-2022>
- Honkanen, M., Müller, J. D., Seppälä, J., Rehder, G., Kielosto, S., Ylöstalo, P., Mäkelä, T., Hatakka, J., and Laakso, L.: The diurnal cycle of pCO<sub>2</sub> in the coastal region of the Baltic Sea, *Ocean Sci.*, 17, 1657-1675, <https://doi.org/10.5194/os-17-1657-2021>, 2021.

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- Kraft, K., Seppälä, J., Hällfors, H., Suikkanen, S., Ylöstalo, P., Anglès, S., Kielosto, S., Kuosa, H., Laakso, L., Honkanen, M., Lehtinen, S., Oja, J., Tamminen, T.: Application of IFCB High-Frequency Imaging-in-Flow Cytometry to Investigate Bloom-Forming Filamentous Cyanobacteria in the Baltic Sea, <https://www.frontiersin.org/article/10.3389/fmars.2021.594144>, *Frontiers in Marine Science*, 2021.

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- Jilbert, T., Cowie, G., Lintumäki, L., Jokinen, S., Asmala, E., Sun, X., Morth, C-M., Norkko, A., & Humborg, C. (2021). Anthropogenic Inputs of Terrestrial Organic

Matter Influence Carbon Loading and Methanogenesis in Coastal Baltic Sea Sediments. *Frontiers in Earth Science*, 9, [716416].

<https://doi.org/10.3389/feart.2021.716416> **THEME #1**

- Aalto, S. L., Asmala, E., Jilbert, T., & Hietanen, S. (2021). Autochthonous organic matter promotes DNRA and suppresses N<sub>2</sub>O production in sediments of the coastal Baltic Sea. *Estuarine, Coastal and Shelf Science*, 255, [107369].

<https://doi.org/10.1016/j.ecss.2021.107369> **THEME #1**

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#### 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?

*FMI*

- National management plan for the EU marine strategy (Merenhoidon TPO), expert group meeting participation
- SWAM, study to assess the quantities of exhaust gas cleaning system discharges in the OSPAR regions, report finalized and submitted to HASEC and EIHA (Apr 2022)
- ICES WGSHP, regular meetings of the WGSHP group
- Science support for Portuguese, British national research projects of ship emissions

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- Project funding by the Academy of Finland: GEOMEASURE - Foundations for green offshore energy production in Finland: from marine investigations to the numerical estimation of undrained shear strength of the seabed deposit layers under cycling loading. **THEME 5**
- Project funding by the Foundation for Research of Natural Resources in Finland: FeCoVERY - Recovery and sustainable use of Baltic Sea ferromanganese concretions as a resource of hi-tech metals. **THEME 5**

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## 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.).

FMI

- Supporting EMSA through CAMS2-61 for ship emission reporting. Annual reporting of global and regional ship emissions to produce data for CAMS user groups, to be made available through ECMWF atmospheric data store.
- Annual HELCOM reporting of ship emissions to air, discharges to the sea and underwater noise emissions
- Scenario development for ship emissions, both Business As Usual and various policy scenarios to reduce air and water pollution from ships

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- Joonas Virtasalo will participate in the IODP Expedition 386 “Japan Trench Paleoseismology” in October-November 2022. **THEME 5**
- Joonas Virtasalo will participate in the cruise onboard r/v Electra of the Stockholm University in September 2022 to the southern Gulf of Finland. **THEME 5**

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

FMI

- *Air Pollution 2021 Wessex; Nunes, R. A. O., Alvim-Ferraz, M. C. M., Martins, F. G., Calderay-Cayetano, F., Durán-Grados, V., Moreno-Gutiérrez, J., Jalkanen, J.-P., Majamäki, E. and Sousa, S. I. V: HEALTH IMPACTS OF PM 2.5 AND NO 2 SHIP-RELATED AIR POLLUTION IN MATOSINHOS MUNICIPALITY, PORTUGAL; 2021; Wessex, UK Oral, co-author*
- *EGU21; Sundström, A.-M., Majamäki, E., Jalkanen, J.-P., Ialongo, I., and Tamminen, J.: Detecting single ship plumes from TROPOMI NO2 data, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-14623, <https://doi.org/10.5194/egusphere-egu21-14623>, 2021. 2021 Online Oral, co-author*
- *EGU2021; Fink, L., Matthias, V., Karl, M., Petrik, R., Majamäki, E., Jalkanen, J.-P., Oppo, S., Kranenburg, R., The contribution of shipping to air pollution in the Mediterranean region*

– a model evaluation study , <https://doi.org/10.5194/egusphere-egu21-8344>; 2021; Vienna, Austria Online, co-author

- AGU2021; Soulie et al, *Greenhouse Gases and Atmospheric Pollutants: a Global Emissions Dataset for the 2000-2021 Period*; 2021; New Orleans, USA; Online, co-author

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- Hosted the IODP Magellan Plus workshop “Mechanisms of rifting of large continental blocks – a case study at the Baltic Sea”, 1-3 December 2021, Espoo, Finland. **THEME 5**

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

*FMI*

- *H2020/EMERGE*
- *H2020/SCIPPER*
- *H2020/AIRCOAT*
- *ShipNOEm*
- *Biodiv-Support*
- *CAMS81*
- *Horizon EU/GREEN RAY*

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- Academy of Finland Project: FERMAID - Ferromanganese Concretion-Archives of Ecosystem Variability, Climate Forcing and Anthropogenic Impact on the Baltic Sea. **THEME 5**
- Academy of Finland Project: GEOMEASURE - Foundations for green offshore energy production in Finland: from marine investigations to the numerical estimation of undrained shear strength of the seabed deposit layers under cycling loading. **THEME 5**
- Foundation for Research of Natural Resources in Finland Project: FeCoVERY - Recovery and sustainable use of Baltic Sea ferromanganese concretions as a resource of hi-tech metals. **THEME 5**

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

FMI

- GREEN RIVER, Horizon EU (in evaluation)
- SUSTAINABLUES, Swedish MISTRA call (in evaluation)
- SHIPMONITOR, BSR Interreg (in evaluation)

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

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- Cooperation with Portuguese EMISSHIP project
- Cooperation with British ACRUISE project
- Cooperation with ECMWF project CHE

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**Comments**



*Most activities listed here have happened without active connection to SOLAS*

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