

## Report for the year 2019 and future activities

### **SOLAS Finland**

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*with contributions from the Finnish Marine Research Infrastructure FINMARI partners*

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*This report has two parts:*

- **Part 1:** reporting of activities in the period of January 2019 - Jan/Feb 2020
- **Part 2:** reporting on planned activities for 2020 and 2021.

*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. ?**

- Lobby for funding in suitable international organizations including EU.
- Provide feedback on work plan of relevant funding instruments, like Horizon, BANOS, CEF etc.
- Promote the uptake of results and data in e.g. Copernicus marine and atmospheric services

**PART 1 - Activities from January 2019 to Jan/Feb 2020**

**1. Scientific highlight**

**Highlight 1 (Theme #5)**

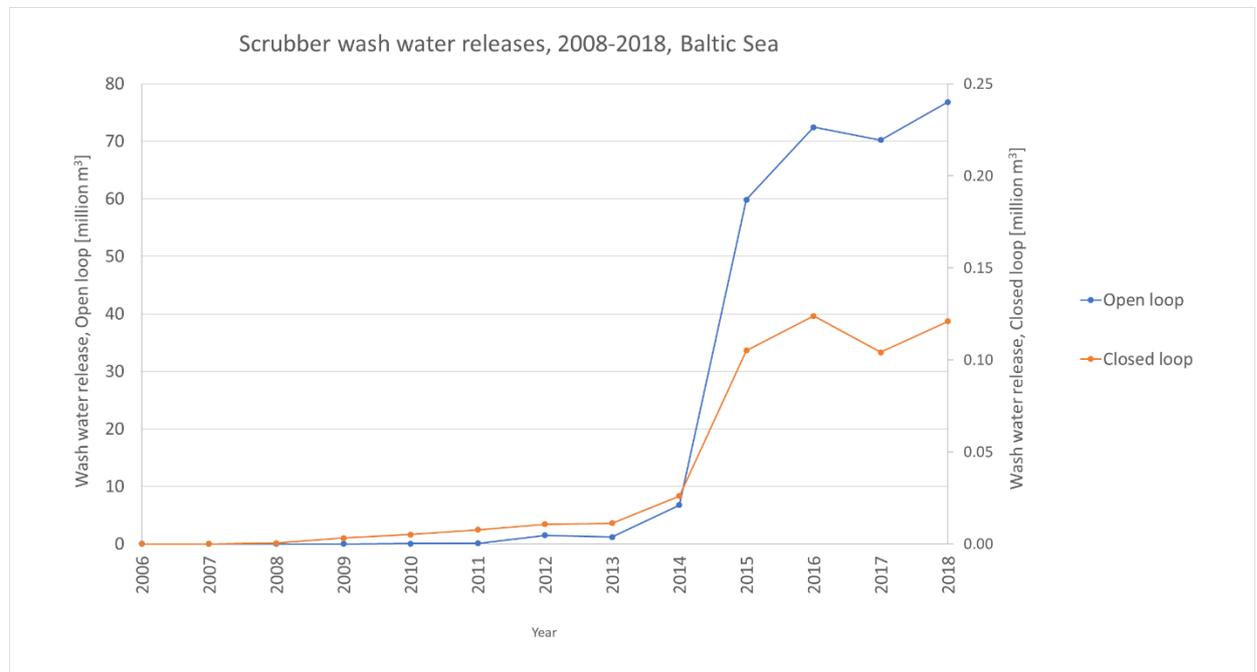


Figure 1 Discharges of wash water from SOx scrubbing ships in the Baltic Sea region during the time period 2006-2018. Contribution from open loop and closed loop scrubber were estimated at 77 and 0.1 million tonnes, respectively. The number of vessels using SOx scrubbing equipment was 99, whereas the rest, about 7850 vessels, have chosen to switch to low sulphur fuel instead

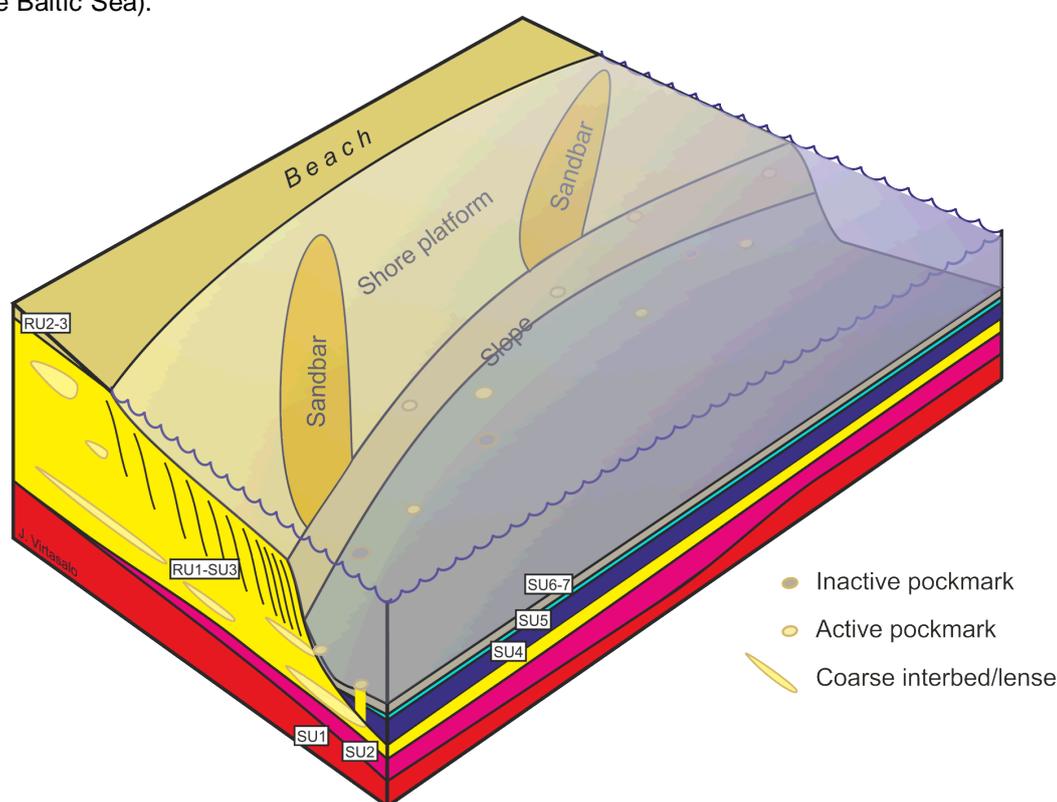
Three kinds of scrubbers (open, closed, hybrid loop) were included in the wash water modeling, which was based on used engine power as a function of time. This allowed modeling of wash water release based on engine kWh, on top of which additional power requirement (three percent for open loop, 0.5% for closed loop) of pumps was included. Hybrid scrubbers were run in open loop mode whenever possible considering the alkalinity of seawater and regional restrictions.

During 2018, 99 (2017: 85) vessels were installed with scrubbers in the Baltic Sea area. These vessels released about 77 million cubic meters (2017: 70 million m<sup>3</sup>) of wash water into the sea. Over 99.9% of this release came from vessels using open loop scrubbers. Most of the 99 vessels using a scrubber are RoRo or passenger vessels, but only 14 vessels were identified which have no possibility to operate the scrubber in closed loop mode. These 14 vessels were responsible for three percent of the open loop scrubber wash water discharge

Citation: J.-P. Jalkanen, L. Johansson, with additional contributions from work of M. Wilewska-Bien, L. Granhag, E. Ytreberg, K. M. Eriksson, D. Yngsell, I.-M. Hassellöv, K. Magnusson, U. Raudsepp, I. Maljutenko, L. Styhre, J. Moldanova and H. Winnes, Discharges to the sea from Baltic Sea shipping in 2006-2018, HELCOM Maritime19/13-4-INF, 2019

## Highlight 2 (Theme #2)

Description of the geological structure of the first submarine groundwater discharge site in Finland (third in the Baltic Sea).



- |                                  |                                 |                                 |
|----------------------------------|---------------------------------|---------------------------------|
| RU1: Distal ice-contact fan      | RU2: Shoreface lag deposit      | RU3: Beach ridges               |
| SU5: Postglacial lacustrine clay | SU6: Brackish-water mud (lower) | SU7: Brackish-water mud (upper) |
| SU1: Bedrock                     | SU2: Till                       | SU3: Ice-contact fan            |
|                                  |                                 | SU4: Glaciolacustrine rhythmite |

The submarine groundwater discharge site is located in the front of Lappohjan beach in Hanko, Finland. Groundwater is discharged through crater-like depressions (pockmarks) on the seafloor at water depths between 10 and 17 meters and approximately 200 m from the shoreline. Altogether there are more than twenty pockmarks up to 25 m wide and 2 m deep. Groundwater and pockmarks are hosted in the distal part of a subaqueous ice-contact fan, which is part of the First Salpausselkä ice-marginal formation. The distal part of the fan is predominantly composed of fine sand with moderate hydraulic conductivity.

Coarse sand interbeds and lenses in the fan deposits provide conduits for localized groundwater flow to the pockmarks. This study is funded by the BONUS SEAMOUNT project.

Citation: Virtasalo, J. J., Schröder, J. F., Luoma, S., Majaniemi, J., Mursu, J., and Scholten, J. 2019: Submarine groundwater discharge site in the First Salpausselkä ice-marginal formation, south Finland. *Solid Earth* 10, 405-423, <https://doi.org/10.5194/se-10-405-2019>.

## 2. Activities/main accomplishments in 2019 (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:

- Bonus-Integral winter cruise took place in March 2019. During the cruise, different greenhouse gases and relevant biogeochemical variables were measured on Northern Baltic Sea and especially on ice-covered areas. Cruise was part of international Bonus-Integral project (**Themes #1, 3**)
- FMI has been an active partner in developing coastal observations within the framework of JERICO-RI. (**Themes 1, 2, 3, 5**)
- FMI decided to include VOS line between Helsinki and Stockholm to ICOS-OTC network (**Theme #1**)

### SYKE

- SYKE has been an active partner in developing coastal observations within the framework of JERICO-RI. (**Themes #1, 2, 3, 5**)
- SYKE participated in project "Operational Marine Acidification Indicators OMAI " funded by the Nordic Council of Ministers ( Grant #1900009)

### UH

- A new research vessel (R/V Augusta, 18 m catamaran) was delivered to Tvärminne Zoological Station in October 2019 and it will significantly improve the Finnish national capacity for near-shore coastal research.
- A profiling buoy was installed near Tvärminne Zoological Station in May 2019, continuing the water column monitoring that has been ongoing at the site since 1926.

### GTK

- BONUS SEAMOUNT cruise took place in October 2019 onboard r/v Geomari. The aim of the cruise was to sample and measure the structure of groundwater plume discharged from seafloor at the newly discovered submarine groundwater discharge site in Hanko, Finland. (Theme #1)
- GTK participated in the Aranda FINMARI cruise, 28 Aug to 6 Sep 2019, to the western Gulf of Finland. The aim of the cruise was to characterize hydrodynamics and sedimentation dynamics of a large submarine channel.

## 3. Top 5 publications in 2019 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

- 1) Björkqvist, J.-V., Pettersson, H., and Kahma, K. K., 2019: The wave spectrum in archipelagos, *Ocean Sci.*, 15, 1469–1487, DOI: 10.5194/os-15-1469-2019. (**Theme #2**)
- 2) Björkqvist, J.-V., Pettersson, H., Drennan, W. M., and Kahma, K. K., 2019: A new inverse phase speed spectrum of nonlinear gravity wind waves, *Journal of Geophysical Research: Oceans*, 124, 6097– 6119, DOI: 10.1029/2018JC014904 (**Theme #2**)

- 3) Humborg C, Geibel MC, Sun X, McCrackin M, Mörth C-M, Stranne C, Jakobsson M, Gustafsson B, Sokolov A, Norkko A, Norkko J (2019) High emissions of carbon dioxide and methane from the coastal Baltic Sea at the end of a summer heat wave. *Frontiers in Marine Science* 6: 493  
**(Theme #1)**
- 4) Karl, M., Bieser, J., Geyer, B., Matthias, V., Jalkanen, J. P., Johansson, L., & Fridell, E. (2019). Impact of a nitrogen emission control area (NECA) on the future air quality and nitrogen deposition to seawater in the Baltic Sea region. *Atmospheric Chemistry and Physics*.  
<https://doi.org/10.5194/acp-19-1721-2019> **(Theme #3, 5)**
- 5) Uotila, P., H. Goosse, K. Haines, M. Chevallier, A. Barthélemy, C. Bricaud, J. Carton, N. Fučkar, G. Garric, D. Iovino, F. Kauker, M. Korhonen, V. S. Lien, M. Marnela, F. Massonnet, D. Mignac, K. A. Peterson, R. Sadikni, L. Shi, S. Tietsche, T. Toyoda, J. Xie, Z. Zhang, An assessment of ten ocean reanalyses in the polar regions, *Clim. Dyn.*, doi:10.1007/s00382-018-4242-z, 2019.  
**(Theme #2)**

#### 4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2019? If yes, who? How did you engage?

##### FMI stake holder events

- Finnish Marine Research Infrastructure FINMARI research days, presentation on summer 2018 observations, Helsinki 26.2.2019; Stakeholders and Academia, 70 people.
- Lauri Laakso presented the research at Utö Atmospheric and Marine Research Station to President of Finland, Mr. Sauli Niinistö, Helsinki, 3.5.2019; Policy makers, 1 person.
- World oceans day exhibition on RV Aranda, 8.6.2019, General Public, 600 visitors
- Jerico-Next General Assembly, User meeting, Brest, France, 2019/07
- Shipping & Environment II conference, 4.-6.9.2010, Gothenburg, Sweden, 100 visitors. Scientific conference on environmental research made in the maritime sector.
- Science to Policy workshop, 3.9.2019, Gothenburg, Sweden. Identification of priorities for environmental stressors from ships. 25 participants.
- IMO Marine Environment Protection Committee, 74<sup>th</sup> meeting, 13.-17.5.2019, London, UK. Developing guidelines for the next IMO GHG study, energy efficiency, Black Carbon, discharges from ships.
- IMO Greenhouse Gas Emissions - Expert meeting, 11.-15.3.2019, London, UK. Head of delegation, representing Finland
- European Sustainable Shipping Forum, Air Emissions subgroup meeting, 11.2.2019, Brussels. Presentation of new relevant projects concerning air emissions from ships.
- European Sustainable Shipping Forum, Air Emissions subgroup meeting, 13.9.2019, Brussels. Emission factor update for the group
- International Workshop on underwater noise, 30.1.-1.2.2019, IMO, London, UK. This workshop identified the status of knowledge and consecutive steps in introducing a new work item for the IMO MEPC.
- Nordic Council of Ministers, Atmosphere and Climate Group meeting, 19.-20.11.2019, Oslo, Norway. Presentation of synergies between EMEP, TFEIP and Copernicus reporting and possibilities for cooperation.

##### SYKE

- World oceans day exhibition on RV Aranda, 8.6.2019, General Public, 600 visitors
- Jerico-Next General Assembly, User meeting, Brest, France 2019/07

##### GTK

- Finnish Marine Research Infrastructure FINMARI research days, presentation on summer 2018 observations, Helsinki 26.2.2019; Stakeholders and Academia, 70 people.

- Joonas Virtasalo presented results from the Hanko submarine groundwater discharge site studies at the monthly meeting of the Geological Society of Finland, Helsinki, 7.11.2019, Stakeholders and Academia, 30 people.
- World oceans day exhibition on RV Aranda, 8.6.2019, General Public, 600 visitors

## **PART 2 - Planned activities for 2019/2020 and 2021**

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

FMI

- Instrument validation and test cruise, RV Aranda, Northern Baltic, 24 March – 2 April 2020 (**Theme #3**)
- Participation on ICOS-OTC carbonate system instrument intercomparison exercise, August-September 2020, Belgium (**Theme #1**)
- H2020/SCIPPER project. Started 05/2019, comprehensive on-board monitoring of exhaust plumes from ships (04/2020). Contains on-shore campaigns in Sweden, Germany, Netherlands and Southern France (08/2019, 08/2020). This project is the science component of SO<sub>x</sub> compliance monitoring. 18 partners, Aristotle Univ. Thessaloniki as coordinator (**Themes #3, 5**).
- H2020/AIRCOAT project. Development of friction reducing surface for ship hulls. Measurements of water resistance of the newly developed surface foil at HSVA (Hamburg), coordinated by Fraunhofer CML (**Themes #3, 5**).
- Copernicus Atmospheric Monitoring Services (CAMS-81). FMI provides data services concerning global and regional ship emissions. Data covers period 2000-2018 and is freely available from ECMWF (**Themes #3, 5**).

SYKE

- Instrument validation and test cruise, RV Aranda, Northern Baltic, 24 March – 2 April 2020 (**Theme #3**)

GTK

- Participation on the IODP Expedition 386 Japan Trench Paleoseismology, 14 Oct – 13 Nov, Japan (**Theme #5**)

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

GTK

- BONUS SEAMOUNT (2017-2020) (**Themes #1, #5**)

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

All partners (FMI, SYKE, UH, UT, ÅA, GTK, LUKE):

- Finnish Marine Research Infrastructure (FINMARI) (**Themes #1, 2, 3, 4, 5**)

FMI

- H2020 JERICO-S3 (2020-24) (**Themes #1, 3, 5**)
- Bonus-Integral (2017-2020) (**Themes #1, 3**)
- H2020 SCIPPER (2019-2022) (**Themes #1, 3**) Science of SOx compliance monitoring
- H2020 AIRCOAT (2018-2021) (**Theme #1**) Development of friction reduction surface through air layering
- CAMS-81 (**Themes #1, 3**) Emission reporting for Copernicus Atmospheric MS
- ShipNOEm (**Themes #1, 3**) Air emissions, discharges, underwater noise reporting from Baltic Sea shipping. National funding source.
- GLORIA (**Theme #5**) Global health impacts of air quality and weather, especially shipping. Academy of Finland
- CSHIP (Project platform to disseminate results), EU/ERDF
- BioDiv Support (**Theme #4**) Biodiversity studies of climate/air quality changes. Belmont Forum/Academy of Finland.

SYKE

- H2020 JERICO-S3 (2020-24) (**Themes #1, 3, 5**)

UH

- Finnish Academy "the impact of Antarctic Ice Sheet - Southern Ocean interactions on marine ice sheet stability and ocean circulation" project (**Theme #2**)

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

FMI

- "BUFFER – Building a resilience for fast changing coastal risks", H2020, LC-CLA-13-2020, first stage submission date 13.2.2020 (**Theme #5**)
- New project, H2020/EMERGE starts 02/2020, 48 months. Environmental impacts of shipping SOx scrubbing. Emission measurements, water sampling, ecotoxicology testing. Integrated assessment of air/water pollution, cost/benefit analysis
- Submitted proposal, H2020/Decarbes: Decarbonising long-distance shipping
- Submitted proposal, Academy of Finland: Ship exhaust plume dispersion

LUKE

- Vesiviljelyn innovaatio-ohjelma (continuation for years 2020-2022), Funding agency: EMKR, submission date 29.2.2020 (**Theme #5**)

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

FMI

- ACRUISE/Plymouth Marine Lab. Climate impacts of global 0.5% Sulphur cap
- EMISSHIP/Univ Porto, Portugal. Impact of ships to air quality & health around the Iberian peninsula
- Air, water and noise reports in HELCOM Maritime19. Regular annual reporting of ship emitted pollutants in the Baltic Sea region.
- Jerico-S3 kick-off, San Sebastian, Spain, 2020/02

SYKE

- Jerico-S3 kick-off, San Sebastian, Spain, 2020/02

UH

- IUGG IAMAS, WCRP CLIVAR Southern Ocean Panel (**Theme #2**)

#### **Comments**

FMI

- 10 active shipping projects, addressing various environmental topics including air, water pollution as well as underwater noise