

Report for the year 2016 and future activities

SOLAS Finland

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This report has two parts:

- **Part 1:** reporting of activities in the period of January 2016 – Jan-Feb 2017
- **Part 2:** reporting on planned activities for 2017/2018 and 2019.

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan.

IMPORTANT: May we remind you that this report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities)!

PART 1 - Activities from January 2016 to Jan/Feb 2017

1. Scientific highlight

Describe one scientific highlight with a title, text (max. 200 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 international collaboration. (If you wish to put more than one, feel free to do so).

Partanen et al. (2016) used an intermediate complexity University of Victoria Earth System Climate Model to study how solar radiation management by sea spray injections into marine clouds would affect ocean biogeochemistry. The study is the first global assessment of marine ecosystem impacts of sea spray geoengineering. In general, ecosystem impacts of geoengineering are highly important and largely unexplored field of research. The major scientific advance of the study was to show that sea spray geoengineering can significantly alter regional primary production of oceans when change in temperature is considered in addition to the reduced light availability. A novel result was also that solar radiation management resulted in decrease of the carbon uptake of oceans in a context of low CO₂ emission scenario.

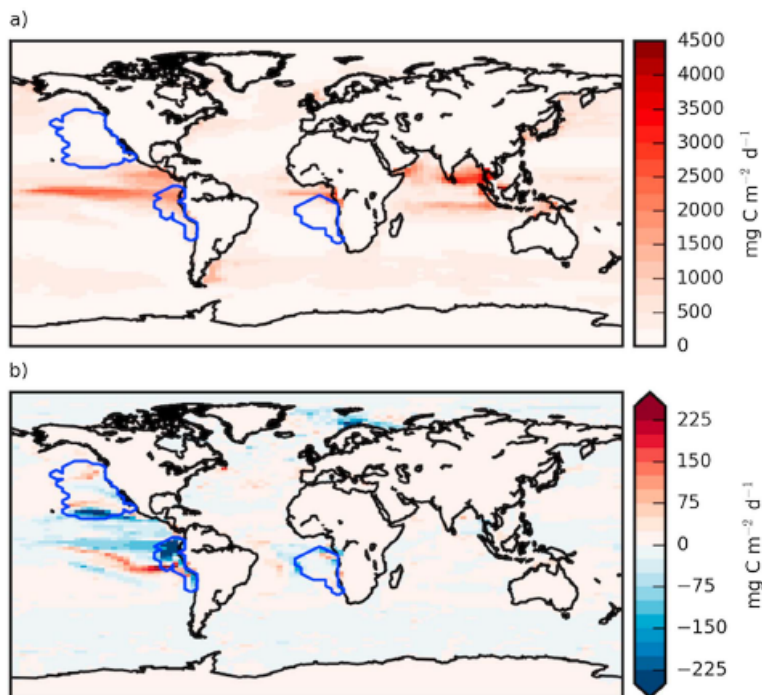


Figure 1: Vertically integrated mean ocean net primary productivity at year 2030 in (a) Control simulation based on RCP4.5 scenario (CTRL) and (b) difference from the CTRL when Solar Radiation Management (SRM) is started in 2020. SRM is a geoengineering method, where sea spray particles are injected into marine clouds to enhance their reflectivity. The blue lines in the figure encircle the SRM regions.

2. Activities/main accomplishments in 2016 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

Most of marine research in Finland is coordinated by Finnish Marine Research infrastructure FINMARI. FINMARI partners are Arctia Shipping Ltd, Finnish Environment Institute SYKE, Finnish Meteorological Institute FMI, Geological Survey of Finland GTK, University of Helsinki UHEL, University of Turku UTU, Åbo Akademi University ÅAU and Natural Resources Institute Finland LUKE

FINMARI combines all major components of the Finnish marine research community. It is an infrastructure network of field stations, research vessels and multi-purpose icebreakers, laboratory facilities, ferry boxes, fixed measurement platforms and buoys. In addition to experimental research, FINMARI facilitates modelling research through observations and communication.

FINMARI organized national science conference in Helsinki and Tvärminne Zoological Station 1 - 3 November 2016. More than 60 scientists and the Scientific Advisor Board of FINMARI participated in the meeting. Presentations covered full range research topics from automatic glider observations at the Bothnian Sea to sediment biogeochemistry, bio-optical and automated imaging tools, and survival of white fish roe in a changing climate.

According to the international Scientific Advisor Board, the atmosphere within the Finnish marine research community is enthusiastic, collaborative spirits high, and the overall coordination of scientific resources and research is ahead of many other countries.

FINMARI www-pages: <https://www.finmari-infrastructure.fi/>

FINMARI partner reports for SOLAS-relevant activities:

Arctia Shipping Ltd: nothing to report

Finnish Environment Institute (SYKE):

Finnish Environment Institute, together with Finnish Meteorological Institute carried out several field campaigns at Utö Atmospheric and Marine Research Station focusing on biological carbon cycle. These field campaigns were part of preparations for an intensive carbon observing period (04/2017 – 04/2018) within the H2020 INFRAIA project "Joint European Research Infrastructure network for Coastal Observatory – Novel European expertise for coastal observatories" (JERICO-NEXT).

<http://www.jerico-ri.eu/>

Finnish Meteorological Institute (FMI):

The SOLAS-relevant research at FMI includes both atmospheric and marine research.

The main focus of marine research has been in the development of Utö Atmospheric and Marine Research Station (<http://en.ilmatieteenlaitos.fi/uto>) and especially in testing and validating different marine carbon cycle and emission observations. One of the main focus areas has been the development of sea spray removal system on a coastal eddy covariance flux tower. This research is part of a H2020 infrastructure project Jerico-next (2015-19).

Important part of experimental SOLAS studies has been carried out based on more than 15 research cruises during the 21st century on board RV Aranda. The focus of these studies is on sea surface gas exchange, waves and sea surface turbulence. Currently, data gathered is analysed and published (see e.g. Kahma et al., 2016).

On atmospheric research side, one of the research topics has been the influence of geoengineering on marine ecosystems (please see highlights of the research).

The fourth important research topic has been the emissions by ship traffic (Jalkanen et al., 2016)

Geological Survey of Finland: nothing to report

University of Helsinki, Tvärminne Zoological Station:

In 2016, nine articles on the effects of ocean acidification on the plankton community and pelagic biogeochemistry in the northern Baltic Sea were published in a special issue of Biogeosciences (http://www.biogeosciences.net/special_issue204.html). All of these articles are based on the KOSMOS 2012 campaign that Prof. Ulf Riebesell (GEOMAR) and his team, including Finnish colleagues, conducted at Tvärminne Zoological Station (University of Helsinki, Finland) in June-July 2012.

University of Helsinki, Viikki Campus

2016 work (relates to core themes 1 and 5) of research group Nutrient cycles in aquatic ecosystems (Susanna Hietanen, University of Helsinki)

1) In 2016 N₂O and CH₄ concentration samples were collected in April, June, August and October at two coastal stations in Hango archipelago. Samples were collected from water column and sediments and accompanied by CTD casts for temperature, salinity and oxygen and sampling of water column and sediment porewater for dissolved nutrients and H₂S. In addition a spatial transect from river mouth at Pojo bay to outer archipelago was analysed for same parameters in June. This project is part of an ongoing spatial and temporal study of N₂O and CH₄ dynamics in coastal ecosystem, started in 2015.

2) In 2016 the N₂O and CH₄ concentration data collected from Gotland Basin 2015 following the Major Baltic Inflow was analysed and summarized in a scientific manuscript that is currently in review in Earth System Dynamics. Another paper is in prep.

3) Research group Nutrient cycles in aquatic ecosystems (Susanna Hietanen, University

of Helsinki) participated in N₂O and CH₄ concentration analysis intercalibration organized by Hermann Bange (Geomar) and Gregor Rehder (IOW); we have not yet received any intercomparison results but have submitted our own data to organizers.

University of Turku: nothing to report

Åbo Akademi University:

A vertical profiling buoy was deployed in the NW Åland measuring basic oceanographic parameters such as temperature, salinity and oxygen content from 4 to 40 metres. The profiling is to be continued early spring 2017.

Natural Resources Institute Finland LUKE: nothing to report

3. Top 7 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

University of Helsinki, Tvärminne zoological station:

- 1) Webb AL, Leedham-Elvidge E, Hughes C, Hopkins FE, Malin G, Bach LT, Schulz K, Crawford K, Brussaard CPD, Stühr A, Riebesell U, Liss PS., Effect of ocean acidification and elevated f CO₂ on trace gas production by a Baltic Sea summer phytoplankton community. *Biogeosciences* 13:4595-4613, 2016.

Finnish Environment Institute:

- 2) Spilling K, Paul AJ, Virkkala N, Hastings T, Lischka S, Stühr A, Bermudez R, Czerny J, Boxhammer T, Schulz KG, Ludwig A, Riebesell U., Ocean acidification decreases plankton respiration. *Biogeosciences* 13:4707-4719, 2016

FMI:

- 3) Partanen, A.-I., D. P. Keller, H. Korhonen, and H. D. Matthews, Impacts of sea spray geoengineering on ocean biogeochemistry, *Geophys. Res. Lett.*, 43, doi:10.1002/2016GL070111., 2016
- 4) JP Jalkanen, L Johansson, J Kukkonen, A comprehensive inventory of ship traffic exhaust emissions in the European sea areas in 2011, *Atmospheric Chemistry and Physics* 16 (1), 71-84, 2016
- 5) Kahma, K.K., Donelan, M.A., Drennan, W. M., Terray, E. A. Evidence of energy and momentum flux from swell to wind, *Journal of Physical Oceanography*, DOI: <http://dx.doi.org/10.1175/JPO-D-15-0213.1>, 2016
- 6) Albert, M. F. M. A., Anguelova, M. D., Manders, A. M. M., Schaap, M., and de Leeuw, G.: Parameterization of oceanic whitecap fraction based on satellite observations, *Atmos. Chem. Phys.*, 16, 13725-13751, doi:10.5194/acp-16-13725-2016, 2016.
- 7) Sipilä et al. "Molecular-scale evidence of aerosol particle formation via sequential addition of HIO₃", *Nature* 537, 532-534, 2016.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2016? If yes, who? How did you engage?

- 1) Most of the involvement of stake holders has been carried out through FINMARI board, and advisory board: <https://www.finmari-infrastructure.fi/management/> .
- 2) Very strong interaction with stakeholders has been organized through a national "SmartSea"-project (<http://smartsea.fmi.fi/what-is-smartsea-project/>). The objective of the SmartSea project (2015 - 2021) is to provide science-based guidance and new innovations for the sustainable use of the Finland's marine resources. SmartSea is part of Finnish Strategic Research framework <http://www.aka.fi/en/strategic-research-funding/>

PART 2 - Planned activities from 2017/2018 and 2019

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

Some of the planned activities for 2017:

- 1) Jerico-next intensive observing period (2017/04 – 2018/04) focusing on biological carbon cycle (FMI and SYKE)
- 2) Beginning of Baltic Sea carbon observing project "Integral - Integrated Carbon and Trace Gas Monitoring for the Baltic Sea" coordinated by IOW, Germany and funded by Bonus. (FMI)
- 3) Deployment and set-up of new instruments obtained through FINMARI funding scheme:

Major new investments of the FINMARI consortium during 2017-2018 will extend the current profiling buoy network to the Western Gulf of Finland (UHEL/Tvärminne), create a fleet of 6 Bio-Argo floats and a bottom-landing Argo (FMI), build a new flume aquaria system for experimentation (ÅAU/Husö), upgrade zooplankton sampling systems (UTU/Seili), enhance seabed studies with a multibeam sonar and a free-fall cone penetrometer (GTK) and fish stock studies with a horizontal sonar (Luke), as well as develop a cutting-edge indoor mesocosm facility with advanced control and real-time flow-through measurement instrumentation (SYKE/MRC).

Several partners (UHEL/Tvärminne, ÅAU/Husö, UTU/Seili, Luke) will acquire side-scan sonar equipment to pursue a national effort for seafloor habitat mapping (coordinated by GTK), and the Utö station (FMI, SYKE/MRC) flow-through system and cabled observatory will be upgraded, with e.g. purchases of an on-line laser diffraction particle analyzer and a holographic particle imaging system (SYKE/MRC).

- 4) Verification of Wave model WAM against wave buoy observations as a part of Copernicus activities. (FMI)
- 5) 2017 plans (relates to core themes 1 and 5) of research group Nutrient cycles in aquatic ecosystems (University of Helsinki):
 - there will be two field campaigns (early summer and late summer) to study the sources and sinks of N₂O in Pojo Bay, a coastal embayment in Hanko archipelago; the results will be presented in PPNW workshop in autumn 2017
 - A method to study anaerobic oxidation of methane will be established in the group and tested and subsequently used in Pojo Bay, a coastal embayment in Hanko archipelago this summer

Campaigns in which University of Helsinki / Dept. of Physics, together with FMI, participates:

- 6) Ny Ålesund, Svalbard February-March 2017, "Marine aerosol impact on clouds in the arctic (MACA)" RIS (Research in Svalbard <http://www.researchinsvalbard.no>) ID: 10713
- 7) We participate the mesocosms experiment which is part of MACA. Performed in collaboration with CNRS, France.
- 8) Ny Ålesund, Svalbard: March-August 2017 "Molecular steps of new particle formation in the arctic atmosphere (NPFARCTIC)" RIS ID: 10732 Our own project, performed in collaboration with CNR, Italy and Stockholm University
- 9) November/December 2017 February 2018: Marambio Base, Antarctic Peninsula in collaboration with Eija Asmi / FMI and Servicio Meteorológico Nacional Argentina. Campaign has no official project status yet.

During these (# 6-9) campaigns (funded by Finnish academy researcher project: 296628 and ERC-StG project: Grant agreement No 714621.), we'll sample the air chemical composition and particle and cluster distributions and cluster chemical composition aiming to understand the role of DMS derived Sulphuric acid and the iodine vapours from sea ice emissions and the potential of iodine containing vapours to form new particles

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

- 1) Jerico-next General Assembly in Helsinki (13-16 March 2016)
- 2) A summer school: "Environmental impacts of catchment from headwaters to the sea", 8.-24.8.2017. Location: Lammi Biological Station, Finland; Tvärminne Zoological Station, Finland, Askö Laboratory, Stockholm, Sweden.

3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 Science Plan and Organisation (downloadable from the SOLAS website) the activity topics relate – including the core themes and the cross cutting ones)

FINMARI obtained 2 M€ national infrastructure funding for the years 2017-18 from Finnish Academy. In addition, FMI received 260k€ SOLAS-relevant funding from BONUS for a three-year project for the period 2017/07-2020/07. All individual FINMARI partners have received significant amount of national and international funding together with a large number of national and international partners.

Funding obtained will cover the Core Themes 1, 2, 3 and 4 together with all three cross-cutting themes.

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)

There are several national and international applications to EU, Nordforsk, BONUS, national funding agencies and private foundations by individual FINMARI partners, and different combinations of the FINMARI partners, and together with international parties. There are too many to be listed and also some plans by partners may also be confidential.

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

There are too many to be listed: EMBRC, EURO-ARGO, ICOS, ACTRIS, COPERNICUS etc.

Comments