surface ocean solas lower atmosphere study

Report for the year 2018 and future activities

SOLAS *Finland*

compiled by: Lauri Laakso / FMI, with contributions from University of Helsinki, Åbo Academy University, Geological Survey of Finland.

Themes or Cross-Cutting Themes.

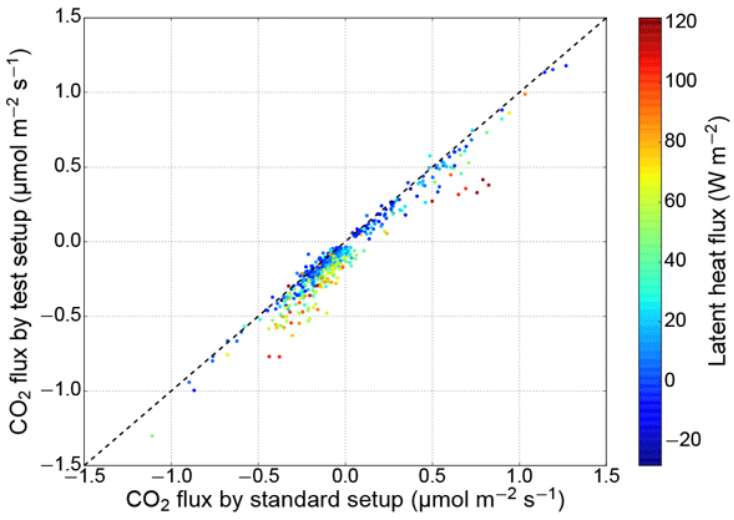
1 Greenhouse gases and the oceans;
2 Air-sea interfaces and fluxes of mass and energy;
3 Atmospheric deposition and ocean biogeochemistry;
4 Interconnections between aerosols, clouds, and marine ecosystems;
5 Ocean biogeochemical control on atmospheric chemistry;
Integrated studies;
Environmental impacts 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).*

PART 1 - Activities from January 2018 to Jan/Feb 2019

1. Scientific highlight

CO_2 infrared gas analyzers are known to be prone to water vapor interference. Honkanen et al. (2018) tested two closed-path infrared gas analyzers, one of which was equipped with a drier and a virtual impactor, for measuring the CO_2 exchange between the sea and the atmosphere. The undried setup showed a positive bias that increased with increasing water vapor flux.



Reference: Honkanen, M., Tuovinen, J.-P., Laurila, T., Mäkelä, T., Hatakka, J., Kielosto, S., and Laakso, L.: Measuring turbulent CO2 fluxes with a closed-path gas analyzer in a marine environment, Atmos. Meas. Tech., 11, 5335-5350, https://doi.org/10.5194/amt-11-5335-2018, 2018

2. Activities/main accomplishments in 2018 (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, social sciences, and media).

The first submarine groundwater discharge site described in Finland, in the Hanko Peninsula. This is the third such site described in the Baltic Sea (there is one in Eckernförde Bay in Germany, and one in Puck Bay in Poland). The direct discharge of groundwater causes an as yet unquantified flux of methane from the seafloor.

Completion of BONUS SHEBA and KAMON projects

Participation in IMO MEPC73 meeting (International Maritime Organisation Marine Environment Protection Committee), London, Oct 2018

Participation in TFEIP meeting (Task Force for Emission Inventories and Projections), Sofia, May 2018

Three submissions to HELCOM Maritime18 meeting (4.3/INF Air emissions from ships; 12.4/INF Discharges from ships to sea; 12.5/INF Underwater noise from ships). Annual reporting of these quantities from 2018 onwards.

FMI holds a seat at the European Sustainable Shipping Forum as a science advisor.

Onboard measurements of SOx scrubber efficiency within EnviSum project

Delivery of global and regional ship emissions inventories for EU Commission (Copernicus Atmospheric Monitoring Services)

Networking with Baltic Earth group

A Profiling cabled observatory installed (in April 2018) 2 km south of Utö Atmospheric and Marine Research Station

3. Top 5 publications in 2018 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Five top publications in each theme indicated with (*)

Theme 1:

* Fransner, F., Gustafsson, E., Tedesco, L., Vichi, M., Hordoir, R., Roquet, F., ... Nycander, J. (2018). Non-Redfieldian Dynamics Explain Seasonal pCO(2) Drawdown in the Gulf of Bothnia. Journal of Geophysical Research : Oceans, 123(1), 166-188. https://doi.org/10.1002/2017JC013019

* Glippa, O., Engström-Öst, J., Kanerva, M., Rein, A., & Vuori, K. (2018). Oxidative stress and antioxidant defense responses in Acartia copepods in relation to environmental factors. PLoS One, 13(4), [0195981]. https://doi.org/10.1371/journal.pone.0195981

* Honkanen, M., Tuovinen, J.-P., Laurila, T., Mäkelä, T., Hatakka, J., Kielosto, S., and Laakso, L.: Measuring turbulent CO2 fluxes with a closed-path gas analyzer in a marine environment, Atmos. Meas. Tech., 11, 5335-5350, https://doi.org/10.5194/amt-11-5335-2018, 2018

* Jilbert, T, Asmala, E, Schröder, C, Tiihonen, R, Myllykangas, J P, Virtasalo, J J, Kotilainen, A, Peltola, P, Ekholm, P, Hietanen, S, 2018, Impacts of flocculation on the distribution and diagenesis of iron in boreal estuarine sediments, Biogeosciences, 15, 1243–1271, doi: 10.5194/bg-15-1243-2018.

* Jokinen, S A, Virtasalo, J J, Jilbert T, Kaiser, J, Dellwig, O, Arz, H W, Hänninen, J, Arppe, L, Collander, M, Saarinen, T, 2018, A 1500-year multiproxy record of coastal hypoxia from the northern Baltic Sea indicates unprecedented deoxygenation over the 20th century, Biogeosciences, 15, 3975–4001, doi: 10.5194/bg-15-3975-2018.

Theme 2:

* Druzhinin O., Troitskaya Y., Zilitinkevich S., 2018: The study of momentum, mass and heat transfer in a droplet-laden turbulent air-flow over a waved water surface by direct numerical simulation. Journal of Geophysical Research (JGR) – Oceans, 123, 11, 8346-8365, DOI10.1029/2018JC014346

Henriksson, S. V., Interannual oscillations and sudden shifts in observed and modeled climate, Atmos. Sci. Lett. 19, e850, doi:/10.1002/asl.850, 2018. (interaction between ocean and atmosphere)

* Högström, U., Sahlée, E., Smedman, A.-S. Rutgersson, A., Nilsson, E., Kahma, K., Drennan, W.M.: The Transition from Downward to Upward Air–Sea Momentum Flux in Swell-Dominated Light Wind Conditions, Journal of the Atmospheric Sciences, Vol 75, pp. 2579-2588, https://doi.org/10.1175/JAS-D-17-0334.1 ,2018

* Mengis, N., Partanen, A.-I., Jalbert, J., Matthews, H. D.: 1.5 °C carbon budget dependent on carbon cycle uncertainty and future non-CO2 forcing, Sci. Rep., 8, 5381, doi:10.1038/s41598-018-24241-1, 2018. (related to uncertainty in ocean carbon uptake)

Myslenkov S., Medvedeva A., Arkhipkin V., Markina M., Surkova G., Krylov A., DobrolyubovS., Zilitinkevich S., Koltermann P., 2018: Long-term Statistics of Storms in the Baltic, Barents and White Seas and Their Future Climate Projections. Geography, Environment and Sustainability, 11(1):93-112, DOI 10.24057/2071-9388-2018-11-1-93-112

* Troitskaya Y., Kandaurov A., Ermakova O., Kozlov D., Sergeev D., and Zilitinkevich S., 2018: The “bag breakup” spume droplet generation mechanism at high winds. Part I. Spray generation function.. J. Phys. Oceanogr., 48, 2167–2188, DOI 10.1175/JPO-D-17-0104.1

* Troitskaya Y., Druzhinin O., Kozlov D., Zilitinkevich S., 2018: Bag-breakup spume droplet generation mechanism at high winds. Part II: The impact on momentum and enthalpy transfer. J. Phys. Oceanogr., 48, 2189–2207, DOI 10.1175/JPO-D-17-0105.1

Theme 5

* Alvarez-Fernandez, S., Bach, L. T., Taucher, J., Riebesell, U., Sommer, U., Aberle, N., Brussaard, C.P.D., Boersma, M. (2018). Plankton responses to ocean acidification: The role of nutrient limitation. Progress in Oceanography, 165, 11-18. https://doi.org/10.1016/j.pocean.2018.04.006

* Boxhammer, T., Taucher, J., Bach, L. T., Achterberg, E. P., Alguero-Muniz, M., Bellworthy, J., ... Anderson, L. G. (2018). Enhanced transfer of organic matter to higher trophic levels caused by ocean acidification and its implications for export production: A mass balance approach. PLoS One, 13(5), [0197502]. https://doi.org/10.1371/journal.pone.0197502

* Ding J et al, 2018, Maritime NOx emissions over Chinese seas derived from satellite observations, Geophysical Research Letters, 45, 2031-2037, https://doi.org/10.1002/2017GL076788

Jalkanen J-P et al, 2018, Modeling of ships as a source of underwater noise, Ocean Science, 14, 1373-1383, https://doi.org/10.5194/os-14-1373-2018

* Sofiev M et al, 2018, Cleaner fuels for ships provide public health benefits with climate tradeoffs, Nature Communications, 406, 1-12, DOI: 10.1038/s41467-017-02774-9

* Wilewska-Bien M et al, 2018, Phosphorus flows on ships: Case study from the Baltic Sea, Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, May, 1-12, DOI: 10.1177/1475090218761761

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2018? If yes, who? How did you engage?

Finnish Transport Safety Agency, HELCOM secretariat, EU flag state representatives, European Community Shipowners' Association, European Sea Port Organisation, Hapag-Lloyd, MAN Diesel & Turbo, Wartsila, Transport & Environment (NGO), Shell, Finnish Communication Authority, Finnish Transport Agency. Regular dialogue with our national IMO delegates, joint research efforts with HELCOM secretariat, communication of research result summaries at the European Sustainable Shipping Forum, cooperation with Finnish Communication Authority and Finnish Transport Agency concerning ship navigational systems. Several University rectors and chancellors, National Broadcasting company (YLE) director, and stake holders from ministries visited Utö Atmospheric and Marine Research Station in August 2018.

PART 2 - Planned activities for 2019/2020 and 2021

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

GTK will participate in the Aranda FINMARI cruise, 28 Aug to 7 Sep 2019 to the western Gulf of Finland.

Bonus-Integral winter cruise for observing the pCO2, pCH4 and pN2O concentrations on ice-covered sea areas in the Northern Baltic Sea. Joint effort of FMI (Finland), IOW (Germany) and IOPAN (Poland)

The implementation of a new wave-dependent CO2-flux parameterization into the WAM wave model in the Baltic Sea. The work is done within the Bonus INTEGRAL project during 2019.

Continuation of Copernicus work, work within H2020/SCIPPER project to understand Black Carbon emissions and scrubber efficiency better. Validation of ship emission inventories with on-board and remote sensing measurements. Continued development of vessel discharge and underwater noise modelling capabilities. Continue working on nine shipping related projects (5 current, 4 new).

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

Organizing:

FINMARI (Finnish marine Research Infrastructure) Researcher Days 26 February 2019, Helsinki, Finland

Participation in e.g. the following conferences:

Transport & Air Pollution 2019 Conference, Thessaloniki, May 2019

International Technical Meeting (ITM2019) of Air Pollution and Applications, Hamburg, Sep 2019

Shipping & Environment 2 conference, Gothenburg, Sep 2019

Underwater noise workshop at IMO, London, 29.1-1.2.2019

Intersessional working group meeting of Greenhouse Gas emissions from ships (ISWG), IMO, London, March 2019

Pollution Prevention and Readiness meeting, IMO, London, May 2019

Marine Environment Protection Committee 75th meeting, IMO, London, Oct 2019

AGU, USA

Global Emissions Initiative (GEIA19), Santiago, Chile, Nov 2019

3. Funded national and international projects / activities underway.

H2020, Jerico-Next (2015-19), project coordinated by IFREMER/France. Joint European Research Infrastructure Network for Coastal Observatory – Novel European expertise for coastal observatories.

Bonus-Integral (2018-20), project coordinated by IOW/Germany: Integrated carbon and trace gas monitoring for the Baltic Sea.

Academy of Finland, SEASINK (2018-22), project coordinated by SYKE and FMI/Finland: Project "Evolving carbon sinks and sources in coastal seas – will ecosystem response temper or aggravate climate change?"

H2020/Aircoat, ShipNOEm(national funding)

GLORIA(Academy of Finland)

CAMS-81 (ECMWF)

CSHIPP (Interreg)

EnviSum(Interreg)

EPITOME(Nordic Council of Ministries)

BioDiv Support (Belmont Forum; 2019-)

H2020/SCIPPER (2019-)

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

A.-I. Partanen, R. Makkonen, and A. Perrels are part of Ocean NETs consortium for a H2020 application. The proposal is focused on ocean based negative emission technologies. The submission of first stage proposal is in February 2019.

Detection of small boats using coastal radars

Antifouling paint leeching from vessel hulls

Extension of ship underwater noise studies

The profiling buoy (as reported in an earlier SOLAS report) will be installed near TZS in spring 2019.

- The MONCOAST coastal observatory network of loggers is being developed; now we have purchased a total of five YSI Exo 2 loggers (T, S, O2, pH, Turb) and they will eventually all send data to a public online portal:

https://www.helsinki.fi/en/research-stations/tvarminne-zoological-station/research/monicoast

- a new research vessel (18 m catamaran) will be delivered to TZS in September 2019.

- a H2020n application for Continuation of infra project Jerico-Next submitted in spring 2019.

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

Transport Canada, several universities in USA, China, Europe. Cooperation with Baltic Earth network, DG Environment, European Maritime Safety Agency. Co-operation and projects especially wrt data with EMODNET, CMEMS, HELCOM, BOOS, SeaDataCloud etc

Comments