surface ocean solas lower atmosphere study

Report for the year 2016 and future activities

SOLAS *'Germany'*
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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

Future emissions of marine halogenated very-short lived substances under climate change
Ziska et al., 2016

Halogenated Very Short-lived Substances (VSLS, e.g. bromoform, dibromomethane, methyl iodide) are naturally produced in the oceans and are involved in tropospheric and stratospheric ozone depletion. The effect of climate change on the oceanic emissions of these compounds is not well quantified. Based on present-day observed global oceanic and atmospheric concentrations and future data from three CMIP5 models, future sea-to-air fluxes of these VSLS are calculated. The simulations are used to infer possible effects of projected changes of physical forcing on emissions in different oceanic regimes. The RCP scenarios 2.6 and 8.5 are used as input data for the emission calculations. Of the parameters that have the main influence on the sea-to-air fluxes, the global sea surface temperatures show a steady increase during the twenty-first century, while the projected changes of sea surface wind speed is very small. The future sea-to-air fluxes of VSLS generally increase during the twenty-first century under the assumption of constant concentration fields in the ocean and atmosphere. The multi-model mean global emissions of bromoform increase by 9.0% between 2081–2100 under RCP 8.5 (2.6) and dibromomethane and methyl iodide emissions increase by 23.3% (6.4%) and 5.5% (1.5%),respectively.

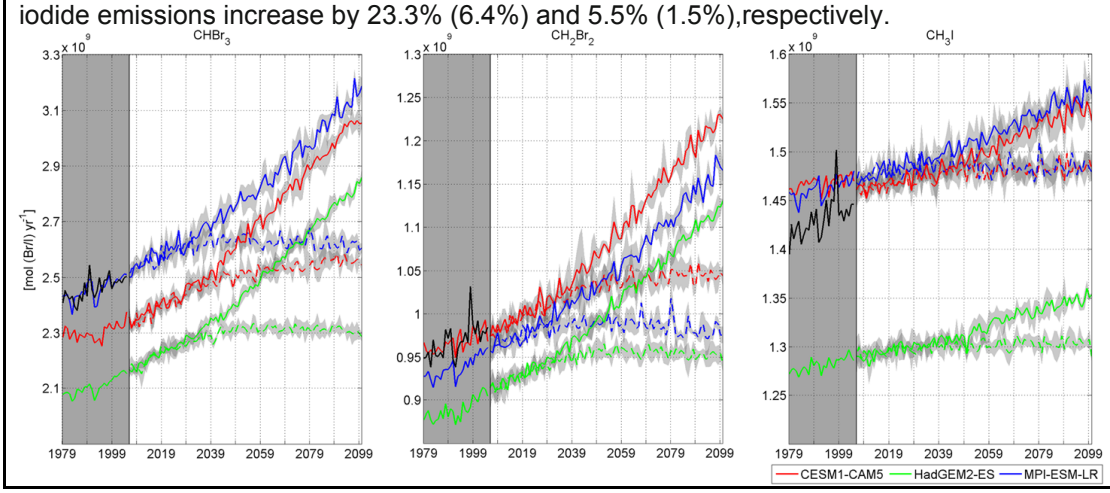

Fig. 5 from paper. Modeled global sea-to-air fluxes time series of $CHBr_3$ (left), CH_2Br_2 (middle) and CH_3I (right) in pmol m^{-2} h^{-1} calculated with the CMIP5 model output fields of CESM1-CAM5 (red), HadGEM2-ES (green) and MPI-ESM-LR (blue), using the mean of the historical ensemble runs from 1979 to 2005 (grey shading) and RCP 2.6 scenario (dashed lines) and RCP 8.5 scenario (solid lines) for the time period 2006–2100. Additionally, the standard deviation of the ensemble means (shaded area) and the ERA-Interim dataset from 1979 to 2005 (black line) are included.

Latitudinal and Seasonal Distribution of Particulate MSA over the Atlantic using a Validated Quantification Method with HR-ToF-AMS

Huang, S et al.

ENVIRONMENTAL SCIENCE & TECHNOLOGY 51 (1), 418-426, 10.1021/acs.est.6b03186,

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Methanesulfonic acid (MSA) has been widely used as a proxy for marine biogenic sources, but it is still a challenge to provide an accurate MSA mass concentration with high time resolution. This study offers an improved MSA quantification method using high resolution time of-flight aerosol mass spectrometer (HR-ToF-AMS). Particularly, the method was validated based on an excellent agreement with parallel offline measurements (slope = 0.88, R-2 = 0.89). This comparison is much better than those using previously reported methods, resulting in underestimations of 31-54% of MSA concentration. With this new method, MSA mass concentrations were obtained during 4 North/South Atlantic cruises in spring and autumn of 2011 and 2012. The seasonal and spatial variation of the particulate MSA mass concentration as well as the MSA to non-sea-salt sulfate ratio (MSA:nssSO(4)) over the North/South Atlantic Ocean were determined for the first time. Seasonal variation of the MSA mass concentration was observed, with higher values in spring (0.03 mu g m(-3)) than in autumn (0.01 mu g m(-3)). The investigation of MSA:nssSO(4) suggests a ubiquitous and significant influence of anthropogenic sources on aerosols in the marine boundary layer.

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.)

SOLAS SCIENCE AND SOCIETY WORKSHOP - organized by Kiel scientists, took place in Brussels, discussed topics: Valuing carbon and the ocean's role, policy across the air-sea interface, and biogeochemistry and the shipping industry

GEOMAR PLYMOUTH COLLABORATION – between Anja Engel and the Marine Biological Association, Plymouth, UK (Dr. Michael Cunliffe) on microbial community composition in SML and ULW off the Peruvian coast

IRON MODEL INTERCOMPARISON - resulted in a paper in GBC, 2016 (see below)

BIOACID GOES COP22 -The German research network on ocean acidification and its partners speak up for the ocean at the climate change negotiations. Together with Plymouth Marine Laboratory, Labex MER, Scripps Institution of Oceanography, the Ocean and Climate Platform and the Ocean Acidification International Coordination Centre, the German research network on ocean acidification, BIOACID (Biological Impacts of Ocean Acidification) draws negotiators' attention to ocean change at the Marrakech *Climate Change* Conference COP22.

PHOTO EXHIBITION ABOUT OCEAN ACIDIFICATION PREMIERED AT GEOMAR - In a photo exhibition by the German research network on ocean acidification BIOACID, the two nature photographers Solvin Zankl and Nick Cobbing present BIOACID members at their work and introduce organisms that current ocean acidification research focuses on. The exhibition is a contribution to the Science Year 2016*17 – Seas and Oceans and is presented at GEOMAR Helmholtz Centre for Ocean Research Kiel, east shore campus, until 21 October. A website and a

web app with further information complement the exhibition (more information here).

3. Top 5 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

1) Ziska, F., Quack, B., Tegtmeier, S., Stemmler, I. and Krüger, K., 2016, Future emissions of marine halogenated very-short lived substances under climate change, *Journal of Atmospheric Chemistry*, pp.1-16, DOI 10.1007/s10874-016-9355-3.
2) Wurl, O., Stolle, C., Van Thuoc, C., Thu, P. T., Mari, X., 2016, Biofilm-like properties of the sea surface and predicted effects on air-sea CO_2 exchange, *Progress in Oceanography*, 144, pp. 15-24, DOI: 10.1016/j.pocean.2016.03.002.
3) Tagliabue, A., Aumont, O., DeAth, R., Dunne, J.P.,Dutkiewicz, S., Galbraith, E.,Misumi, K., Moore, J.K., Ridgwell, A., Sherman, E., Stock, C., Vichi, M., Völker, C., Yool, A., 2016, How well do global ocean biogeochemistry models simulate dissolved iron distributions?, *Global Biogeochemical Cycles*, 30, pp. 149–174, doi:10.1002/2015GB005289.
4) Hauck, J. , Köhler, P. , Wolf-Gladrow, D. and Völker, C., 2016, Iron fertilisation and century-scale effects of open ocean dissolution of olivine in a simulated CO_2 removal experiment, *Environmental Research Letters*, 11 (2), 024007, doi:10.1088/1748-9326/11/2/024007.
5) Engel, A. and Galgani, L., 2016, The organic sea-surface microlayer in the upwelling region off the coast of Peru and potential implications for air–sea exchange processes *Biogeosciences*, 13 (4). pp. 989-1007. DOI 10.5194/bg-13-989-2016.

NEW VIDEO ON OCEAN ACIDIFICATION RESEARCH

BIOACID - Exploring Ocean Change

A new video shows how oceanographers, marine biologists and chemists, economists and social scientists of the BIOACID project investigate impacts of ocean acidification.

From the Arctic to the tropics, ocean acidification changes life in the sea. By absorbing carbon dioxide (CO_2) from the atmosphere, the ocean slows down global climate change. But in seawater, the greenhouse gas causes a chemical reaction with far-reaching consequences: carbonic acid is formed, and the pH drops.

A new video reveals how members of the German research network BIOACID examine the effects of acidification on the life and biogeochemical cycles in the ocean - and on all those who depend on it.

The international version with subtitles in English, German and French is available on YouTube at https://youtu.be/pnp8uQh6VAI

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?

BIOACID - scientists from Bremen develop ecosystem model in cooperation with stakeholders in Norway

HOW OCEAN ACIDIFICATION AFFECTS SOCIETY

In cooperation with potentially affected stakeholders, Scientists from the University of Bremen have developed an ecosystem model that integrates the relevant environmental processes and examines ecological changes and their socio-economic implications.

Climate change does not only lead to global warming and an increase in weather extremes: The ocean is also affected by the uptake of carbon dioxide from the atmosphere: Chemical reactions reduce the pH of the sea water. While the process of ocean acidification is taking place already, possible consequences for marine ecosystems and human societies are not fully understood yet.

Scientists at the University of Bremen have now published first findings about the expected environmental changes and their impact in Norway. In cooperation with potentially affected stakeholders, they have developed an ecosystem model that integrates the relevant environmental processes and examines ecological changes and their socio-economic implications. The

researchers describe their participatory method in their article "Stakeholder-Informed Ecosystem Modeling of Ocean Warming and Acidification Impacts in the Barents Sea region" in the open access journal "Frontiers in Marine Science" (DOI: 10.3389/fmars.2016.00093), more information here.

Integrated Carbon Observing System (ICOS)

Underway CO_2 measurements onboard a container ship crossing the North Atlantic, representing one oceanic component of ICOS, were presented during the annual meeting of German ICOS (April 2016, meeting was in Kiel). Delegates from the German ministry for research and education (BMBF) and the ministry for traffic and infrastructure (BMVI), important ICOS stakeholders, were also present during this meeting. Data usage and planning for the next years of ICOS is an outcome from this (and similar) meetings.

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.)

Baltic GasEx 2018 project (GEOMAR, Uni Kiel) with USA partners (University of Hawaii, Manoa and Columbia University); Jun and Sep R/V Alkor cruises to Boknis Eck to investigate surfactant influence on gas exchange

Eddy covariance measurements of CO_2 on the N. Atlantic VOS line operational 2017 (GEOMAR)

MarParCloud campaign at the CVAO; Investigation of organic matter in the marine environment, characterization of the processes of organic matter from the (biological) formation in seawater, enrichment in the sea surface microlayer, transfer to aerosol particles and function as INP, Activities: sampling of bulk water, sea surface microlayer, aerosol particles, ice nucleating particles, cloud water, Dates: 28.09.2017-13.10.2018 at the CVAO and OSCM in Mindelo, Team: TROPOS, ICMB Wilhelmshaven, IOW, ZMT

MILAN experiment in Wilhelmshaven initiated by Dr. Mariana Ribas-Ribas and Dr. Christian Stolle from ICBM with national (GEOMAR) and international collaborations, 01. April - 13. April 2017 - sea surface microlayer functioning during the night

PEACETIME cruise from La Seyne-sur-mer to La Seyne-sur-mer with cruise leaders Dr. Cécile Guieu and Dr. Karine Desboeufs (GEOMAR participation), 10. May - 11. June 2017 - analysing the impact of dust input events on the sea surface microlayer

BIOACID Integrated assessment of the elapsed 8-year investigation period , modelling of the results and information for policy makers (GEOMAR and partners)

Several research cruises and mesocosm experiments in the upwelling system off Peru (GEOMAR and partners)

Wave pump deployment and several research cruises in the oligotrophic waters off Gran Canaria (GEOMAR and partners)

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

SOLAS Summer School Cargese 2018 (German scientists on organizing committee)

SESAC III in 11/2017: Sino-European Summer School on Atmospheric Chemistry (German scientists on organizing committee)

Final Meeting of BIOACID with combined Integrated Assessment Workshop in Kiel (May 29 – 31 2017)

COP 23: The Bonn 2017 UN climate change conference (6 - 17 November 2017), more information here

Ocean deoxygenation: drivers and consequences, past, present, future:
https://www.sfb754.de/o2conference2018

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)

Project Title	**Funding Source**	**Period**	**Other information**
WG 151 – Iron Model Intercomparison Project (FEMIP)	SCOR	Granted in 2016	http://www.scor-int.org/SCOR_WGs_WG151.htm
German-Peruvian bilateral collaboration	BMBF	2015 - 2017	Coordinator (GEOMAR)
BIOACID III (**B**iological **I**mpacts of **O**cean **Acid**ification)	BMBF	2015 - 2017	coordinator, subproject leader (GEOMAR)
SFB754 – Climate-Biogeochemistry Interactions in the Tropical Ocean	DFG	2015 - 2019	subproject leader (GEOMAR)
Ocean Artificial Upwelling, Ocean artUp	EU, ERC Advanced Grant	2016 - 2021	Coordinator (GEOMAR)
AQUACOSM (**AQUA**tic Meso**COSM** Facilities)	EU	2017 - 2021	subproject leader (GEOMAR)
Humboldt-Tipping (Tipping points of the Humboldt Current Upwelling System and Economic Repercussions, preparation phase)	BMBF	2017 - 2018	coordinator, subproject leader (GEOMAR)
Feasibility study of a deep water pump driven by wave energy	BMBF, WTSH	2017	Coordinator (GEOMAR)
Marine biological production, organic aerosol particles and marine clouds: a process chain (MarParCloud)	Leibniz Association SAW funding	05/2016 - 10/2019	partners: TROPOS, ICBM Wilhelmshaven, IOW, ZMT
Phytoplanton Community Composition in the water and on Transparent Exopolymer Particles of the Sea Surface Microlayer in the	FO/DFG	April – December 2017	GEOMAR

Mediterranean Sea			
PhotoSOA	DFG-ANR	10/2017 – 09/2020	TROPOS Leipzig & IRCELYON, Lyon

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)

Project Title	**Funding Source**	**Note**	**Role of the PI**
CUSCO (**C**oastal **U**pwelling **S**ystem in a **C**hanging **O**cean)	BMBF	submitted	GEOMAR coordination, subproject leader
Humboldt-Tipping (Tipping points of the Humboldt Current Upwelling System and Economic Repercussions, preparation phase)	BMBF	Invitation for application in 2018	GEOMAR coordination, subproject leader
Upwelling systems and their influence on atmospheric reactive trace gases and aerosol particles (UPSTART)	BMBF	submitted	GEOMAR coordination, subproject leader, project partners: TROPOS, MPI Mainz, IOW

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

- Projects
  - BIOACID
  - InGOS
  - SCOR WGs #141, #142, and #143
  - Boknis Eck Time Series Station
  - CVOO/CVAO
  - SFB754
  - and many more

- Partner Institutions
  - INDP, Mindelo, Cape Verde
  - IMARPE, Callao, Peru
  - Ocean University China, Qingdao, China
  - PLOCAN
  - Universidad de Las Palmas de Gran Canaria
  - and many more

- International Organisations
  - IPCC
  - and many more

Comments

This is the first year that Christa Marandino and Hartmut Herrmann take over as the German SOLAS reps. It is also the first year after the German SOLAS project, SOPRAN, is finished. We hope to use the SOPRAN network to continue joint SOLAS activities in Germany and to stay updated, as well as update, the German SOLAS community.