Report for the year 2017 and future activities

SOLAS United Kingdom
compiled by: Tom Bell

This report has two parts:

- **Part 1:** reporting of activities in the period of January 2017 – Jan-Feb 2018
- **Part 2:** reporting on planned activities for 2018/2019 and 2020.

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;
6. Integrated studies;
7. Environmental impacts of geoengineering;

**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).

<table>
<thead>
<tr>
<th>PART 1 - Activities from January 2017 to Jan/Feb 2018</th>
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<tbody>
<tr>
<td><strong>1. Scientific highlight</strong></td>
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<td>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 results of international collaborations. (If you wish to include more than one highlight, feel free to do so).</td>
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Sabbaghzadeh et al. present the first measurement of surfactant activity in the surface microlayer (SML) and sub-surface water at an Ocean Basin scale. Measurements from two Atlantic Meridional Transect cruises (50°N to 50°S) show that the SML is ubiquitously enriched in surfactants relative to underlying water (i.e. Enrichment Factor > 1). Interestingly SML enrichments appear to persist at intermediate-high wind speeds (>7 m/s). These results have important implications for air/sea gas transfer and for the production and composition of primary marine aerosol.

I know I'm not supposed to put more than one highlight, but I didn't feel comfortable selecting myself. With the obvious bias, I think Bell et al. (2017) is important. The paper presents the first field-based estimates of bubble-mediated gas exchange. The air/sea gas transfer velocities of gases with different solubility (DMS and CO\textsubscript{2}) were measured concurrently. The difference between the gas transfer velocities is very likely to be due to enhanced bubble-mediated exchange of the less soluble gas (CO\textsubscript{2}). The difference between the transfer velocities (∆k) shows strong relationships with wind speed and whitecap fraction. ∆k was also used to estimate the bubble component of CO\textsubscript{2} transfer at high wind speeds and compare with existing models of bubble mediated exchange. The data suggest that the models overpredict the bubble component of gas exchange at intermediate wind speeds.
Reference:

2. Activities/main accomplishments in 2017 (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).

Meetings
- GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) WG 38 held two workshops (hosted at the University of East Anglia):
  1. Changing Atmospheric Acidity and the Oceanic Solubility of Nutrients
     25 people came to the meeting from around the world. It was co-sponsored by SOLAS, SCOR, GESAMP, NSF and UEA.
  2. Impact of Ocean Acidification on Fluxes of non-CO2 Climate-Active Species
     Participants left Norwich full of enthusiasm for the new scientific insights the groups had developed. The aim now is to write a series of papers synthesising these conclusions. At least one review paper is in preparation:
     FE Hopkins, P Suntaralingham, M Gehlen, et al. Changing ocean acidity as a modulator of atmospheric biogeochemistry and climate.
     Bob Duce & Tim Jickells (co-chairs of GESAMP WG38)
     Alex Baker, Cécile Guieu and M.M. Sarin (Co-chairs of Workshop 1)
     Parv Suntharalingam, Marion Gehlen and Frankie Hopkins (Co-chairs for Workshop 2)
- West Antarctic Peninsula Royal Society meeting on biogeochemical cycling. Kavli International Centre, Chicheley Hall, 17-18/05/2017.
ICDC10, the 10th International Carbon Dioxide Conference, Interlaken, Switzerland, 20-27/08/2017.


Projects

Rob Upstill-Goddard’s (Newcastle University) and Lucy Carpenter’s (University of York) research groups participated in the MILAN project (Sea-surface MicroLayer functioning during the Night) during March/April 2017 in the Southern N. Sea: [http://www.ncl.ac.uk/nes/research/marine/projects/completemilan.html](http://www.ncl.ac.uk/nes/research/marine/projects/completemilan.html). This was an international collaboration hosted by ICBM (Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg). The Newcastle contribution was funded by the School of Marine Science and Technology, Newcastle University.

Surface Ocean CO\textsubscript{2} Atlas (SOCAT) news:

- The Surface Ocean CO\textsubscript{2} Atlas (SOCAT) released version 5 on 19 June 2017.
- SOCAT updated its website on the occasion of its 10\textsuperscript{th} anniversary ([www.socat.info](http://www.socat.info)).
- The Surface Ocean CO\textsubscript{2} Atlas (SOCAT) celebrated its 10th anniversary at ICDC10, the Tenth International Carbon Dioxide Conference, with a festive dinner on 24/08/2017 in Interlaken, Switzerland.
- The SOCAT Scientific Community, 09/06/2017. Voluntary Commitment to the 2017 UN Conference for ‘Annual, public SOCAT releases’ #OceanAction20464 for the UN Ocean Conference. [https://oceanconference.un.org/commitments/?id=20464](https://oceanconference.un.org/commitments/?id=20464)

3. Top 5 publications in 2017 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

For journal articles please follow the format:
Author list (surname and initials, one space but no full stops between initials), year of publication, article title, full title of journal (italics), volume, page numbers, DOI.

The following alphabetical list of SOLAS-relevant, peer-reviewed 2017 publications (n = 46) with UK authors/co-authors is based on researchers’ input and Web of Knowledge searches. There has been no attempt to formally rank the “top 5” in terms of scientific quality or importance.


4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2017? If yes, who? How did you engage?


PART 2 - Planned activities for 2018/2019 and 2020

1. Planned major field studies and collaborative laboratory and modelling studies, national and international (incl. all information possible, dates, locations, teams, work, etc.).
Multi-million £ NERC-funded field programs will be taking place in the Southern Ocean during the S. Hemisphere summer season in the next 4 years.

For more details see:
Ocean Regulation of Climate by Heat and Carbon Sequestration and Transports (ORCHESTRA)
https://www.bas.ac.uk/project/orchestra/

Role of the Southern Ocean in the Earth System (RoSES)
http://www.nerc.ac.uk/research/funded/programmes/roses/

2. Events like conferences, workshops, meetings, schools, capacity building etc. (incl. all information possible).
Helen Czerski and Ian Brooks have fieldwork planned next summer (August/September 2018) as part of the Microbiology-Ocean-Cloud Coupling in the High Arctic (MOCCHA) study, which is funded by the Swedish Polar Research Secretariat and the NSF. It is an international study led by Caroline Leck at Stockholm University, with participants from the UK, USA, and Germany.

MOCCHA will study the links between marine microbiology, biochemistry, and aerosols produced at the water surface in open leads, and their interaction with ubiquitous Arctic stratiform clouds within the boundary layer: http://www.aces.su.se/research/projects/microbiology-ocean-cloud-coupling-in-the-high-arctic-moccha/ A 2 month cruise on icebreaker Oden will more to a stable ice floe close to the pole and drift for 5 weeks. An extensive set of instrumentation will be deployed on the sea ice. The Leeds group will measure surface fluxes, atmospheric boundary layer structure, cloud properties via a suite of remote sensing instruments, and ice nucleating particles. Some sampling will be conducted from a tethered balloon.

Helen is waiting to hear whether an additional component to the work on that ship will be funded by NERC.

3. Funded national and international projects / activities underway.

2017 projects
Ongoing (no specific order)
- Radiatively Active Gases from the North Atlantic Region and Climate Change (RAGNARoCC) – Lead PI: A. Watson (www.greenhouse-gases.org.uk/ragnarocc)
- NERC/Defra Shelf Sea Biogeochemistry programme – Science Coordinator: P. Williamson (http://www.uk-ssb.org/)
- Atlantic BiogeoChemical fluxes (ABC) – PI: E. McDonagh (http://www.rapid.ac.uk/abc/)
- Surface Mixed Layer Evolution at Submesoscales (SMILES) – Lead PI: P. Hosegood (http://www.smiles-project.org/) Aims to identify the influence of submesoscales upon the structure and properties of the upper ocean, and thereby the transformation of surface water masses, within the Southern Ocean.
- A novel pathway for the production of the climate cooling gas dimethyl sulfide - how important is the mddA gene to global DMS emissions? (NERC) – Lead PI: Jonathan Todd
- Importance of marine gases and particles for tropospheric chemistry (NERC). PI: Claire Reeves
- Determining the Impact of Seawater Chemistry on the Solubility of Atmospheric Trace metals: DISCOSAT (Marie Curie) – Lead PI: Simon Ussher
- Oceanic Reactive Carbon: Chemistry-Climate impacts: ORC3 (NERC) – Lead PI: Steve Arnold
- Biogeochemical cycling of N-osmolytes in the surface ocean (NERC) – Lead PI: Y. Chen.
- Trace gases at the Rothera Time-series Site (BAS Collaborative Gearing Scheme, CGS) – Lead PI: C. Hughes
- Marine particles as sources of ice nucleating particles (Marinelce, ERC consolidator grant) – Lead PI: Ben Murray
- The Global Methane Budget (NERC Highlight Topic) – Lead PI: Euan Nisbet
- Eco-interactomics: From microbial interactions to the fate of dissolved organic matter in the oceans (NERC Fellowship for J. Christie-Oleza).
- Ocean Regulation of Climate through Heat and Carbon Sequestration and Transports (ORCHESTRA) – Lead PI: Mike Meredith (https://www.bas.ac.uk/project/orchestra/)
- Bacteria make DMSP - how significant is this process? (NERC) – Lead PI: Jonathan Todd
- Iodide in the ocean: Distribution and impact on iodine flux and ozone loss (NERC) – Lead PI: L. J. Carpenter.
- How do eukaryotic CO₂ fixers co-exist with faster growing prokaryotic CO₂ fixers in the oligotrophic ocean covering 40% of Earth? (NERC) – Lead PI: Mike Zubkov
- A multidisciplinary study of DMSP production and lysis – from enzymes to organisms to process modelling (NERC) – Lead PI: Jonathan Todd
- Does Ozonolysis Chemistry affect Atmospheric Marine Boundary Layer Sulphur Cycling? (NERC) – Lead PI: William Bloss
- Climate and Air Quality Impact of Airborne Halogens (NERC Fellowship for Ryan Hossaini).
- Zinc, iron and phosphorus co-limitation in the Ocean (ZIPLOc). (NERC) – Lead PI: Claire Mahaffey

**Newly-funded (no specific order)**
- Functional biology and ecology of planktonic marine fungi – Revealing the mechanistic basis of the roles of mycoplankton in the marine carbon cycle (MYCO-CARB) (European Research Council, Consolidator Grant) – Lead PI: Michael Cunliffe
- EU RINGO https://www.icos-ri.eu/vingo – Lead UK PI: Richard Sanders
- EU BONUS Integral, led by Gregor Rehder https://www.io-warnemuende.de/integral-home.html – UK PI: Jamie Shutler
- Is bacterial DMS consumption dependent on methylamines in marine waters? (NERC) Lead PI: Jo Dixon
- MOCCHA Analysis of Dynamic, Cloud, and Aerosol Processes – Lead PI: Ian Brooks
- Seasonal inorganic carbon dynamics at the land-ocean interface – Lead PI: Dorothee Bakker
- The sources, processing and activity of dust as ice nucleating particles in the high latitudes – Lead PI: Ben Murray
- The Impact of Short-Lived Halocarbons on Ozone and Climate (ISHOC): An International Multi-Model Intercomparison – Lead PI: Ryan Hossaini
- CAMPUS (Combining Autonomous observations and Models for Predicting and Understanding Shelf seas) – Lead PI: Icarus Allen
- A War of Tiny Giants - Do viruses impact Pelagibacterales genotype dynamics in the Western English Channel – Lead PI: Ben Temperton
- An ocean habitat trap? Impacts of global oxygen-minimum zone expansions on threatened apex predator ecology – Lead PI: David Sims
- How do eukaryotic CO\textsubscript{2} fixers co-exist with faster growing prokaryotic CO\textsubscript{2} fixers in the oligotrophic ocean covering 40% of Earth? – Lead PI: Mike Zubkov
- NSFGE0-NERC: A Thermodynamic Chemical Speciation Model for the Oceans, Seas, and Estuaries – Lead PI: Simon Clegg
- Marine bacterioplankton respiration: a critical unknown in global carbon budgets (The Leverhulme Trust) - Lead PI: Carol Robinson
- REMineralisation of organic carbon by marine bActerIoplanktoN (REMAIN) (NERC) – Lead PI: Carol Robinson
- NERC Fellowship: Beyond Iron in the Ocean: Trace metal micronutrients and the carbon cycle (BIO-Trace) – PI: Susan Little

**PhD Studentships:**
- CASE award: OMG The Southern Ocean Bias: Observing and Modelling trace Gases to explore the Southern Ocean temperature Bias – Lead PI: Paul Halloran
- CASE award: The impact of atmosphere-wave-ocean coupling on extreme surface wind forecasts – Lead PI: Suzanne Gray
- CASE award: Quantification and characterisation of dissolved organic matter in the North Sea – Lead PI: Martin Johnson
- CASE award: Understanding controls on oxygen deficits in UK waters using a community ecosystem model and isotopic tools – Lead PI: James Clark

**4. Plans / ideas for future projects, programmes, proposals national or international etc.**

(please indicate the funding agencies and potential submission dates).

Links between UK S. Ocean projects and US SOCCOM program (see 1. Above)

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

**Comments**