

## Report for the year 2017 and future activities

### SOLAS 'Spain'

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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;
- 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 2017 to Jan/Feb 2018

##### 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 results of international collaborations. (If you wish to include more than one highlight, feel free to do so).

The atmosphere plays a fundamental role in the transport of microbes across the planet but it is often neglected as a microbial habitat. Although the ocean represents two thirds of the Earth's surface, there is little information on the atmospheric microbial load over the open ocean. This study provides a global estimate of microbial loads and air-sea exchanges over the tropical and subtropical oceans based on the data collected along the Malaspina 2010 Circumnavigation Expedition. Total loads of airborne prokaryotes and eukaryotes were estimated at  $2.2 \times 10^{21}$  and  $2.1 \times 10^{21}$  cells, respectively. Overall 33–68% of these microorganisms could be traced to a marine origin, being transported thousands of kilometres before re-entering the ocean. Moreover, these results show a substantial load of terrestrial microbes transported over the oceans, with abundances declining exponentially with distance from land and indicate that islands may act as stepping stones facilitating the transoceanic transport of terrestrial microbes.

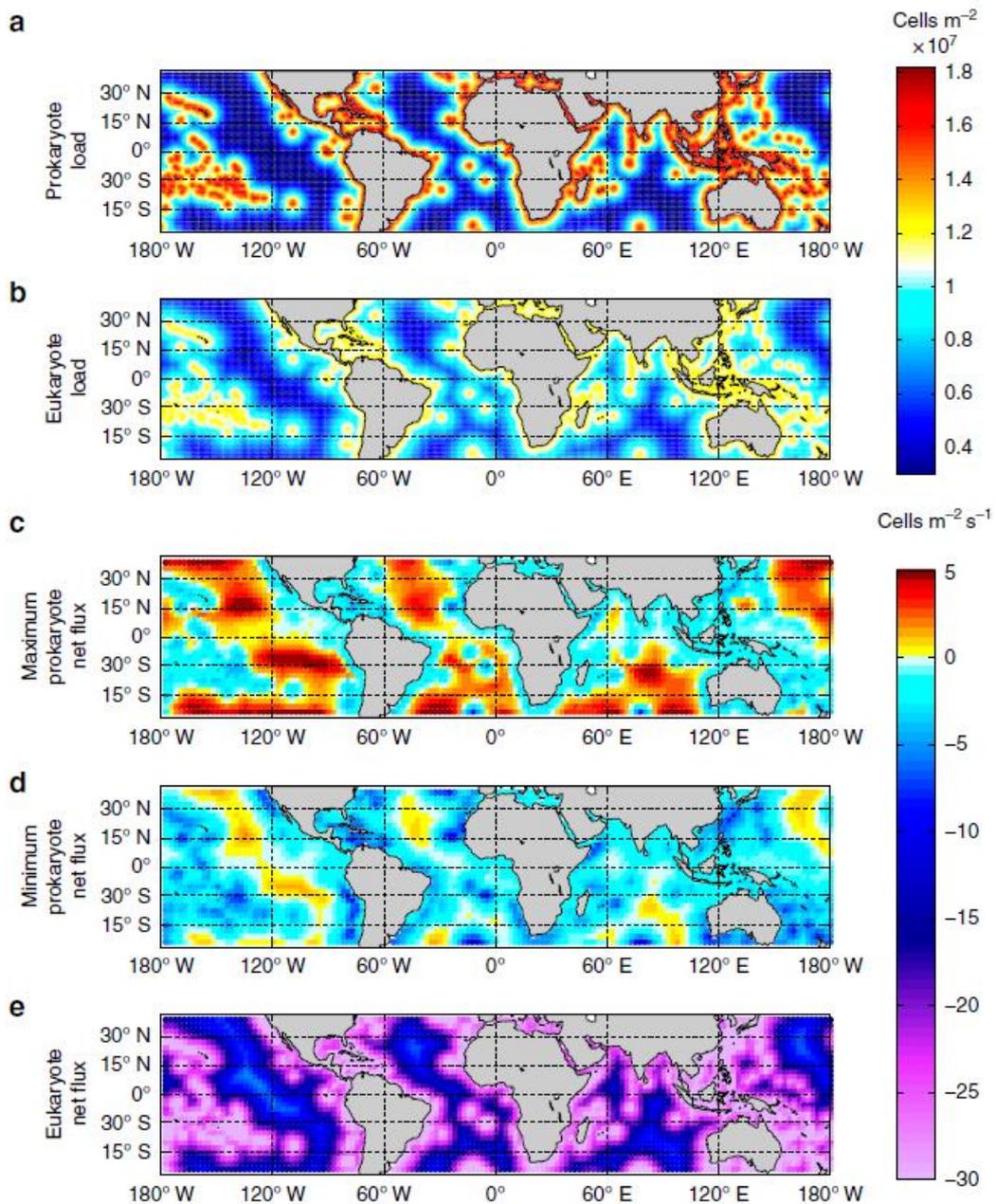


Figure: Microbial loads and air-sea exchange fluxes over the global tropical and subtropical ocean. Prokaryotic load a and eukaryotic load b over the ocean extension compressed between 40° S and 40° N with resolution of  $1^\circ \times 1^\circ$ ; maximum net fluxes of prokaryotes considering high spray fluxes c and low spray fluxes d; and net fluxes of eukaryotes e considering high spray fluxes (the differences between net fluxes of eukaryotes using high or low spray fluxes were negligible) with resolution of  $2.5^\circ \times 2.5^\circ$ . Negative values indicate net deposition fluxes.

Citation: Mayol et al., Long-range transport of airborne microbes over the global tropical and subtropical ocean. *Nature Communications*, 8 (1), 2017.

**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).**

The **Antarctic Circumnavigation Expedition (ACE)** was a project funded by the Swiss Polar Institute with sponsorship by Ferring Pharmaceuticals. It consisted of a 3 months cruise across the Southern Ocean around Antarctica, visiting the Subantarctic islands and touching twice the Antarctic coasts. Scientists from 30 countries are involved through 22 projects covering island ecology, glaciology, plankton and benthic biodiversity, plankton productivity, whale distribution, air-sea interactions, the water cycle, winds and waves. The ICM-CSIC team (R. Simó) led the subproject **SORPASSO (ACE#8)**, aimed at measuring the distribution and drivers of trace gases and organic particles in the surface Southern Ocean.

During the period 2015-2017 (extended to 2018), INTA conducted routine tropospheric measurements of BrO, IO and aerosol extinction from the sites of Belgrano and Marambio within the HELADO project (Halogens in the Antarctic atmosphere and its role in the Ozone distribution, CTM2013-41311-P, Spanish Ministry of Economy and Competitiveness).

SENTINEL project sampling campaigns: February 2017-Deception Island (South Shetland islands). December 2017-March 2018- Livingston Island (South Shetland islands). Objective: Atmospheric deposition and cycling of organic pollutants in the coastal Antarctica.

An oceanographic cruise was conducted on board Victor Angelescu (Argentina) from Vigo (Spain) to Buenos Aires (Argentina) in November 2017 providing underway CO<sub>2</sub> measurements apart from advising about its installation and supervising its working during the cruise.

Project ANIMA (ongoing). ANIMA is a research project funded by the Spanish Ministry of Economy and Competitiveness (CTM2015-65720-R), running from 2016 to 2018. <http://anima.icm.csic.es>

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

Mayol E, Arrieta JM, Jiménez MA, Martínez-Asensio A, Garcias-Bonet N, Dachs J, González-Gaya B, Royer S-J, Benítez-Barrios VM, Fraile-Nuez E, Duarte CM, 2017 Long-range transport of airborne microbes over the global tropical and subtropical ocean. *Nature Communications*, 8 (1), art. no. 201, DOI: 10.1038/s41467-017-00110-9.

Dall'Osto M., J. Ovadnevaite, M. Paglione, D.C.S. Beddows, D. Ceburnis, C. Cree, P. Cortés, M. Zamanillo, S.O. Nunes, G.L. Pérez, E. Ortega-Retuerta, M. Emelianov, D. Vaqué, C. Marrasé, M. Estrada, M.M. Sala, M. Vidal, M.F. Fitzsimons, R. Beale, R. Airs, M. Rinaldi, S. Decesari, M.C. Facchini, R.M. Harrison, C.D. O'Dowd, R. Simó (2017). Antarctic sea ice region as a source of biogenic organic nitrogen in aerosols. *Scientific Reports* 7: 6047, doi:10.1038/s41598-017-06188-x.

Burgos, M., Ortega, T., Forja, J.M. 2017. Temporal and spatial variation of N<sub>2</sub>O production from estuarine and marine shallow systems of Cadiz Bay (SW, Spain). *The Science of the Total Environment*, 607-608: 141-151. doi: 10.1016/j.scitotenv.2017.07.021.

González-Dávila, M., Casiano, J.M.S., Machín, F. (2017) Changes in the partial pressure of carbon dioxide in the Mauritanian-Cap Vert upwelling region between 2005 and 2012. *Biogeosciences*. 14, 389-3871. DOI: 10.1016/j.dsr2.2016.10.004.

Navarro G, Almaraz P, Caballero I, Vázquez A, Huertas IE (2017) Reproduction of Spatio Temporal Patterns of Major Mediterranean Phytoplankton Groups from Remote Sensing OC-CCI Data. *Frontiers in Marine Science* 4, 246,doi:10.3389/fmars.2017.00246

### 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?

The Antarctic Circumnavigation Expedition has been a major endeavour of a number of research institutions with a private foundation (Editions Paulsen and the ACE Foundation).

## **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.).**

OVIDE line cruise Jun-Jul 2018. pCO<sub>2</sub> underway measurements.

FICARAM-18 from Ushuaia-Cartagena: pCO<sub>2</sub> underway measurements.

The BIOGAPS Expedition to Moorea. An island-based intensive sampling study in the open ocean and coral reef waters of the tropical South Pacific. Accommodation, labs and sampling facilities are provided by the Richard B. Gump Station (UC Berkeley . April 4 to 27, 2018).

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

F. Peters (ICM-CSIC) convened a Session at the Ocean Sciences Meeting on Air-sea exchanges and Ocean Biogeochemistry. Portland OR, 16 February 2018.

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

#### **2016-2018 SENTINEL-The Antarctic as sentinel of global pollution. Funded by Spanish Government (PN).**

SORPASSO (Surveying organic reactive gases and particles in the surface Southern Ocean). A subproject of the Antarctic Circumnavigation Expedition. EPFL – Polar Swiss Institute. PI: R. Simó. 120.000 €. 2016-2019.

BIOGAPS (Biogenic trace gases and their cycling processes in the surface sea). CTM2016-81008-R (Spanish MINECO). PI: R. Simó. 258.940 €. Dec 2016- Dec 2019.

VIMS-Ehux (Viral Infection and Microbiome Succession during an *E. huxleyi* bloom and its implications for the biogeochemical S and C cycles), an AQUACOSM Transnational Access project funded by the EC through H2020-INFRAIA. PI: Assaf Vardi (Wassmann Inst, Israel); co-PI: R. Simó. 2018.

Response of Mediterranean jellyfish to the interacting effect of climate-related drivers of impacts: survival in a warmer and more acidic Mediterranean (CTM2016-75487-R). Funding agency: Spanish Ministry of Economy, Industry and Competitiveness. (2017-2019)

Effect of permeabilization of Doñana marshland on the biogeochemical status of its aquatic ecosystems (1539/2015). Funding agency: Spanish Ministry of Agriculture, Food and Environment. (2016-2018).

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

Proposal to the H2020 Programme: ACCENTO (Aerosol-Clouds interactions and their Climate Effects in Antarctica and the Southern Ocean). Partners: BAS (UK), TROPOS (G), ICM-CSIC (E), Univ. Aveiro (Por), Uni. Leeds (UK), AWI (G), CNRS (F), KU Leuven (B), UCO (G), TU Delft (NL), GAIA (I). To be submitted February 2018.

MOSAIC (Multidisciplinary drifting Observatory for the Study of Arctic Climate). An international project led by AWI, with participation of a number of international institutions. Subproject to be submitted to a special call of the Spanish MINECO on a hitherto unknown date. PI. R. Simó.

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

**Comments**