surface ocean solas lower atmosphere study

Report for the year 2020 and future activities

SOLAS *'Spain'*
compiled by: 'Alfonso Saiz-Lopez'

This report has two parts:

***- Part 1:** reporting of activities in the period of January 2020 - Jan/Feb 2021*
***- Part 2:** reporting on planned activities for 2021 and 2022.*

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 of high sensitivity systems;
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).*

First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

PART 1 - Activities from January 2020 to Jan/Feb 2021

1. Scientific highlight

*Describe one scientific highlight with a title, text (**max. 300 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).*

Contaminants of emerging concern enter the environment every day due to our modern lifestyle. Some of them are semivolatile or are transported by sea-spray aerosols, allowing them to reach pristine environments like Antarctica by atmospheric transport and deposition. One family of special concern is composed by the

perfluoroalkyl substances (PFAS), a group of man-made chemicals that have been extensively produced and are very persistent in the environment and bioaccumulative, causing threat to human and environmental health. So far, no biodegradation of any compound of the PFAS family has been described in nature, and removal in the environment occurs partly by sorption to soils in land, or to a minor extend by settling particles in the ocean. Perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) acids are ubiquitous in the oceans, including polar environments, and are toxic to fish and mammals. We challenged natural bacterial communities inhabiting Antarctic coastal waters (Deception Island) with environmental concentrations of PFOS and PFOA and observed a significant removal of PFOS (more than 50%) after 48 hours. Gene expression profiles of the degrading microorganisms revealed a significant enrichment of sulfur metabolism-related transcripts in the treatments suggesting desulfurization of PFOS. Conversely, no significant differences were found between initial and final PFOA concentrations. Transformation products of PFOS desulfurization were most probably volatile, indicating for first time, the capacity of a marine bacterial taxa, mostly within Gammaproteobacteria and Roseobacter groups, to remove PFOS from seawater. These results show a direct effect of PFOS and PFOA exposure on the composition and functionality of natural Antarctic marine microbial communities and a direct link of PFOS desulfurization to the sulfur biogeochemistry of the ocean.

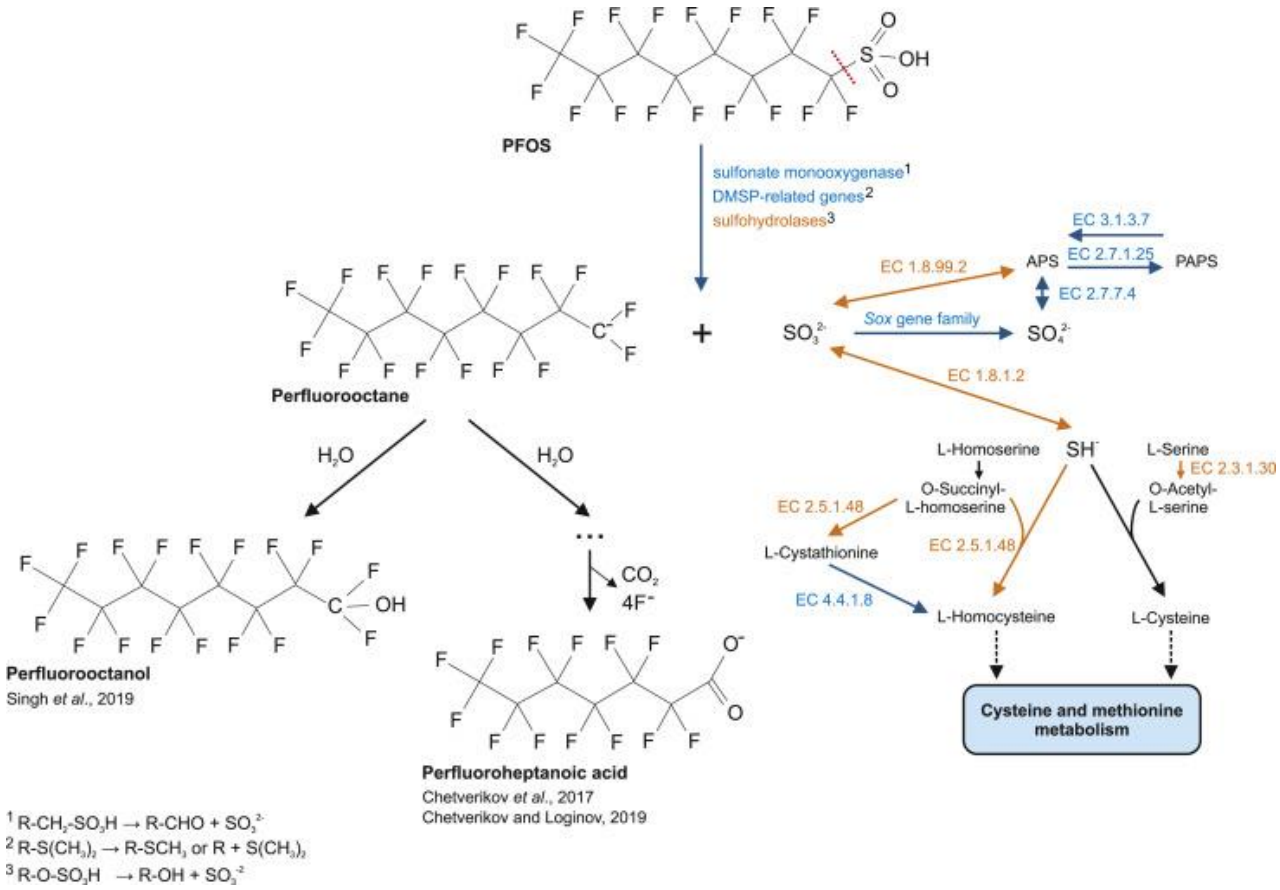

Figure: Suggested pathways of bacterial PFOS desulfurization based on enriched transcripts in metatranscriptomes supplemented with chemical pathways suggested in the literature.

Citation: Cerro-Gálvez, E., Roscales, J. L., Jiménez, B., Sala, M. M., Dachs, J., & Vila-Costa, M. (2020). Microbial responses to perfluoroalkyl substances and perfluorooctanesulfonate (PFOS) desulfurization in the Antarctic marine environment. *Water research*, *171*, 115434.

2. Activities/main accomplishments in 2020 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities,

medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

3. Top 5 publications in 2020 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Hopwood, M.J., Santana-González, C., Gallego-Urrea, J., Sánchez, N., Achterberg, E.P., Ardelan, M.V., Gledhill, M., González-Dávila, M., Hoffmann, L., Leiknes, Ø., Santana-Casiano, J.M., Tsagaraki, T.M., Turner, D., 2020. Fe(II) stability in coastal seawater during experiments in Patagonia, Svalbard, and Gran Canaria. *Biogeosciences*, 17(5),1327–1342. https://doi.org/10.5194/bg-17-1327-2020

González-Vega, A., Fraile-Nuez, E., Santana-Casiano, J.M., González-Dávila, M., Escáner-Pérez, J., Gómez-Ballesteros, M., Tello, O., Arrieta, J.M., 2020. Significant release of dissolved inorganic nutrients from the shallow submarine volcano Tagoro (Canary Islands) based on seven-year monitoring. *Frontiers in Marine Science*, vol. 6, Art. 829. https:/doi.org/10.3389/fmars.2019.00829

Iglesias-Suarez, F., Badia, A., Fernandez, R.P. *et al.* Natural halogens buffer tropospheric ozone in a changing climate. *Nature Climate Change* **10,** 147–154 (2020). https://doi.org/10.1038/s41558-019-0675-6

Gómez Martín, J.C., Lewis, T.R., Blitz, M.A. et al. A gas-to-particle conversion mechanism helps to explain atmospheric particle formation through clustering of iodine oxides. *Nature Communications* **11,** 4521 (2020). https://doi.org/10.1038/s41467-020-18252-8

Rodríguez-Ros, P., Galí, M., Cortés, P., Robinson, C. M., Antoine, D., Wohl, C., et al. (2020). Remote sensing retrieval of isoprene concentrations in the Southern Ocean. *Geophysical Research Letters*, 47, e2020GL087888. https://doi.org/10.1029/2020GL087888

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2020? 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 2021 and 2022

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

CSIC has planned modelling studies in collaboration with Shanghai Key Laboratory of Atmospheric Particle Pollution and Prevention: Studying coastal atmospheric chemistry using the WRF-Chem model.

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

Several Spanish groups have been and will be presenting research at the EGU and AGU 2020-2021.

3. Funded national and international projects/activities underway.

1. **COMFORT,** Our common future ocean –quantifying coupled cycles of carbon, oxygen, and nutrients for determining and achieving safe operating spaces with respect to tipping points. Funding agency: European Commission (H2020), Call H2020-LC-CLA-2018-2019-2020. Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement. International consortium formed by 32 partners. (2019-2023)

2. **Effects of ocean acidification, temperature and organic matter on Fe(II) persistence in the Atlantic Ocean (ATOPFe).** Funding agency: Ministerio de Economía y Competitividad. CTM2017-83476-P. (2018-2021)

3. **Ocean Acidification in the Canary Region (CanOA).** Funding agency: Fundación Loro Parque and Canary Goverment. (2019-2021)

4. **ANTOM, Transporte y biogeoquímica de contaminantes emergentes y materia orgánica antropogénica en el océano austral.** Funding agency: Ministerio de Ciencia, Innovación y Universidades. Ref. PGC2018-096612-B-I00. (2019-2021).

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

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

From ICMAN-CSIC:
1. Data provider for the Intergovernmental Oceanographic Commission (IOC) of UNESCO for indicator 14.3. 1. of the Sustainable Development Goals (SDG).
2. Contribution to the Global Ocean Acidification Observing Network (GOA-ON) through the monitoring program at the Strait of Gibraltar.
(http://portal.goaon.org/Explorer?action=oiw:mobile_platform:STS_235:details)

Several Spanish groups have been involved in fieldwork during the MOSAiC project, and are actively involved in the data analysis and interpretation.

Comments