

Report for the year 2020 and future activities

SOLAS FRANCE

compiled by: Rémi Losno with the help of the French SOLAS community.

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. ?

Bring more help for scientific animation

PART 1 - Activities from January 2019 to Jan/Feb 2021

This period was deeply impacted by the CoVid disease that canceled many planned field experiments.

1. Scientific highlight

2. Activities/main accomplishments in 2019 and 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).

A new team lead by Prof. Weidong CHEN (chen@univ-littoral.fr) joined SOLAS community, Research is focused on topics 1 and 5: Development of spectroscopic instruments for the optical metrology of gas traces and aerosols. Measurement of greenhouse gases (ANR NexLAS, ANR MULTIPAS), radicals (ANR ICAR-HO₂), optical properties of aerosols (ANR MABCaM) and PM_{2.5} particles (PIA SEAM). For 4 years a new horizon is proposed to broaden expertise in instrumentation applied to study: (1) the interaction between ocean and atmosphere, (2) the impact of marine aerosols on the atmospheric oxidation capacity and (3) the measurement of pollution from maritime transport.

Homepage : <http://lpca.univ-littoral.fr/>

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Eva Bucciarelli*, Valérie Stiger-Pouvreau, and Solène Connan, *Journal of Phycology*, 57, 689–693 (2021)

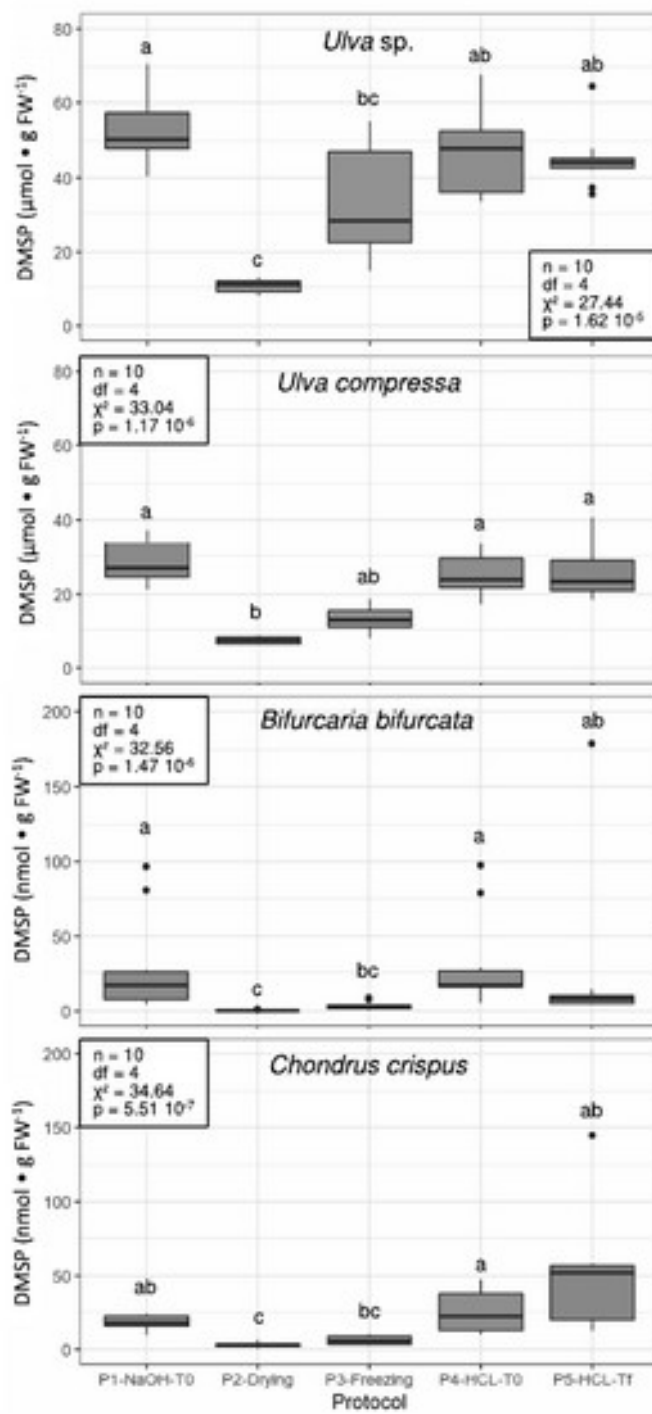
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A NEW PROTOCOL USING ACIDIFICATION FOR PRESERVING DMSP IN MACROALGAE AND COMPARISON WITH EXISTING PROTOCOLS

Dimethylsulfide (DMS, (CH₃)₂S) is a volatile organic sulfur compound that contributes to 18% (Northern Hemisphere) and up to 45% (Southern Hemisphere) of the total atmospheric sulfur burden (Mahajan et al. 2015). Its oxidation products in the atmosphere are cloud condensation nuclei (CCN) that are supposed to participate in cloud droplet formation and the planetary albedo (Charlson et al. 1987). The ocean contributes to up to 98% of the DMS fluxes to the atmosphere (Gondwe et al. 2003). The oceanic precursor of DMS, dimethylsulfoniopropionate (DMSP), is intracellularly produced mainly by micro- and macroalgae (Malin and Kirst 1997, Bullock et al. 2017). Within macroalgae, high DMSP concentrations are generally found in green macroalgae and a few red algal species, while brown macroalgae only contain small amounts (Reed 1983, Van Alstyne and Puglisi 2007). Protocols to preserve DMSP in samples of macroalgae and plants have been proposed, including drying or freezing (Karsten et al. 1994, Russell and Howard 1996, McFarlin and Alber 2013, Borges and Champenois 2017). These methods, however, can strongly affect DMSP contents, compared to analyses on fresh samples (Bischoff et al. 1994, Karsten et al. 1994, Russell and Howard 1996). In this study, we investigated if acidification can be a suitable method to preserve DMSP over 3 months in samples of macroalgae, compared to drying and freezing at -20°C. There was no significant difference between DMSP measurements on freshly collected material (P1-NaOH-T0) and after acidification of the samples, whether 24h later (P4-HCl-T0) or after 3 months of storage (P5-HCl-Tf). This was in contrast to 3-month storage protocols involving overnight drying at 60°C (75-98% DMSP loss, P2-Drying), and freezing at -20°C (37-80% DMSP loss, P3-Freezing).

We thus advise to use acidification (0.2 mol L⁻¹ HCl, pH < 2) for preservation of macroalgal samples over long periods of time rather than drying or freezing at -20°C, when assaying DMSP content (Bucciarelli et al. 2021).

Figure 1: DMSP concentrations in the four macroalgal species according to the five different protocols (in μmol or nmol g^{-1} algal fresh weight depending on the algal species). Significant differences among protocols for each macroalgal species are marked with different letters (n = 10; Friedman rank test for data in repeated measurement designs with post-hoc Nemenyi-Wilcoxon tests; p-value < 0.05).



Elvira Pulido-Villena*, Karine Desboeufs, Kahina Djaoudi, France Van Wambeke, Stéphanie Barrillon, Andrea Doglioli, Anne Petrenko, Vincent Taillandier, Franck Fu, Tiphonie Gaillard, Sophie Guasco, Sandra Nunige, Sylvain Triquet, Cécile Guieu. Biogeosciences Discuss. [preprint], <https://doi.org/10.5194/bg-2021-94>, 2021.

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PHOSPHORUS CYCLING IN THE UPPER WATERS OF THE MEDITERRANEAN SEA (PEACETIME CRUISE): RELATIVE CONTRIBUTION OF EXTERNAL AND INTERNAL SOURCES

The study of phosphorus cycling in P-depleted oceanic regions, such as the Mediterranean Sea, has long suffered from methodological limitations leading to a simplistic view of a homogeneous surface phosphate pool with concentrations theoretically set to zero above the pycnocline. During the PEACETIME cruise, carried out from 10 May to 11 June 2017, we conducted collocated measurements of phosphate pools at the nanomolar level, alkaline phosphatase activities and atmospheric deposition of phosphorus, across a longitudinal gradient from the west to central Mediterranean Sea (Fig. 1).

In the phosphate depleted layer (PDL), between the surface and the pycnocline, nanomolar phosphate was low and showed little variability across the transect spanning from $6 \pm 1 \text{ nmol L}^{-1}$ in the Ionian basin to $15 \pm 4 \text{ nmol L}^{-1}$ in the westernmost station. The low variability in phosphate concentration contrasted with that of alkaline phosphatase activity which varied over one order of magnitude across the transect. Nanomolar phosphate data revealed density gradients of phosphate concentration inside the PDL ranging between $10.6 \pm 2.2 \text{ } \mu\text{mol kg}^{-1}$ in the westernmost station to values close to zero towards the east. Using the density gradients, we estimated diapycnal fluxes of phosphate to the PDL and compared them to atmospheric deposition, another external source of phosphate to the PDL (Fig. 1). Phosphate supply to the PDL from dry deposition and diapycnal fluxes was comparable in the western part of the transect. The contribution of atmospheric deposition to external P supply increased towards the East as well as under the occurrence of rain and Saharan dust. Although this finding must be taken cautiously given the uncertainties in the estimation of diapycnal fluxes, it opens exciting questions on the biogeochemical response of the Mediterranean Sea, and more generally of marine oligotrophic regions, to expected changes in atmospheric inputs and stratification regimes.

Taken together, external sources of phosphate to the PDL contributed little to total phosphate requirements which were mainly sustained by in situ hydrolysis of DOP (Fig. 1). The results obtained in this study show a highly dynamic phosphorus pool in the upper layer of the euphotic zone, above the pycnocline, and highlight the convenience of combining highly sensitive measurements and high-resolution sampling to precisely quantify P fluxes supplying this crucial layer for biogeochemical cycles.

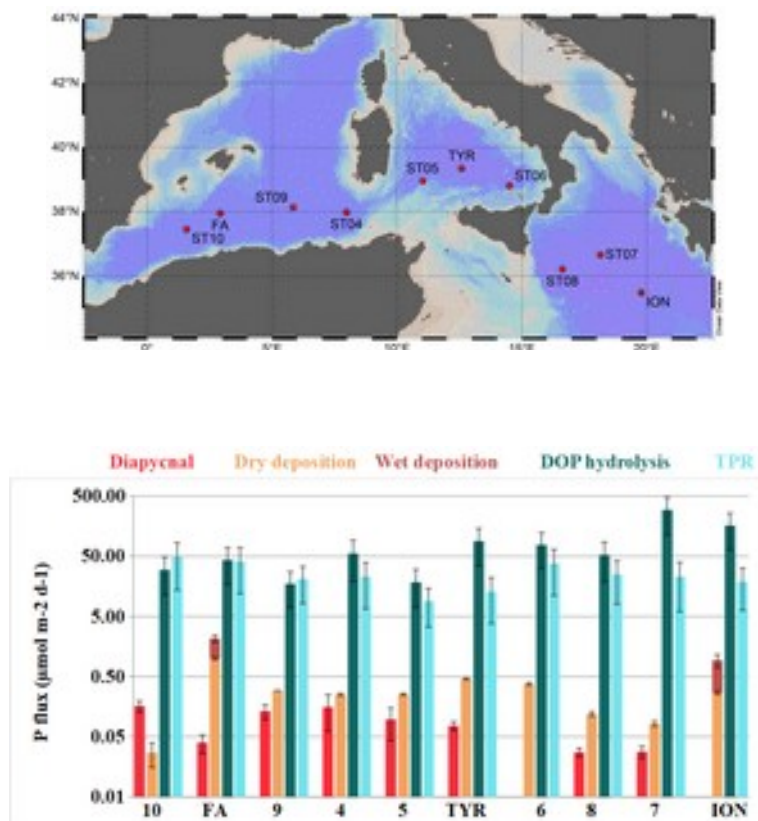


Figure 1. Station location map and Phosphate fluxes ($\mu\text{mol m}^{-2} \text{d}^{-1}$, logarithmic scale) supplying the mixed layer across the study stations arranged longitudinally: diapycnal fluxes inside the PDL, total (dry plus wet) atmospheric deposition and DOP in situ hydrolysis. Estimated total phosphate requirements (TPR) are depicted for comparison

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IN SITU CHARACTERIZATION OF DMSP AND PSTs IN FRENCH COASTAL SEAWATER IN 2019 AND 2020 (PROJECT ALEXVISIT- FUNDING IFREMER)

Sampling of seawater along the French coasts of Brittany (summer) and on the Mediterranean side of the Thau Lagoon (autumn) were performed in 2019 and 2020 to characterize the DMSP and PSTs concentrations. Samplings were planned on periods favorable for potential blooms of the toxic dinoflagellate *Alexandrium* known as a genus able to produce DMSP, however it did not happen. On the Atlantic coast in summer 2019, DMSP concentrations tended to lower with the summer season with values that ranged from 116 to 12 nM for total DMSP (DMSPt) and from 69 to 2 nM DMSPP (Fig1A). DMSP concentrations did not follow the chlorophyll concentration or the cell density of *Alexandrium* (Fig. 1B). However, the presence of *Alexandrium* did occur in periods of high DMSP concentration but cannot explain the whole DMSP input (Fig. 1C).

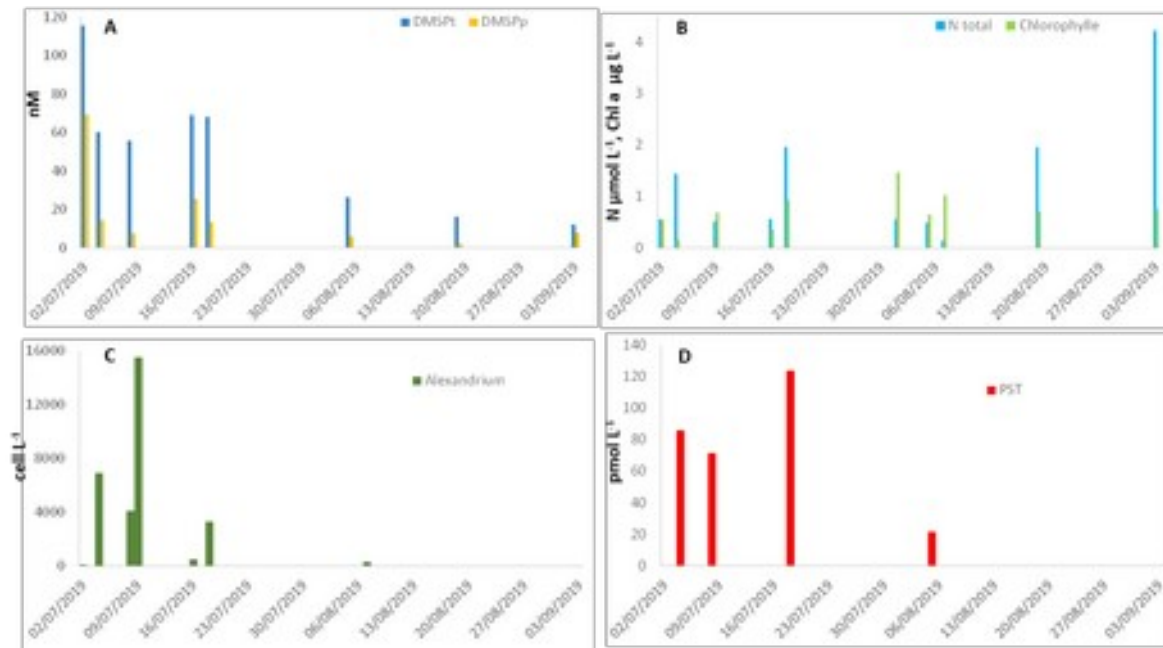


Figure 1 Concentrations in (A) DMSP (t+p), (B) total N and Chl a, (C) cell density of *Alexandrium minutum* and (D) PSTs in seawater Atlantic coast of Brittany (Concarneau, Daoulas, Pointe du château) in summer 2019.

Toxins (PSTs- paralytic shellfish toxins) were detected in a range between 0-124 pmol L^{-1} (Fig. 1D). Their presence was associated with the presence of *A. minutum* and the toxic profile was typical of *A. minutum* from this area. In spring-summer 2020, samplings on the Atlantic coast supply DMSP data ranging from 301 to 35 nM. These elevated concentrations are comparable to those observed in high DMSP production zone such as summer production of the Southern Ocean.

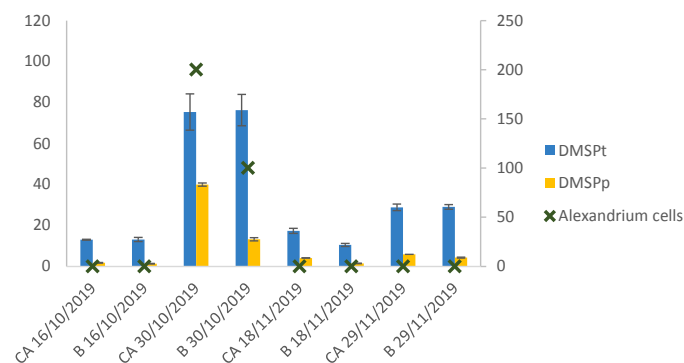


Figure 2 Concentrations in DMSP (t+p) and cell density of *Alexandrium minutum* in autumn 2019 at 2 sampling stations of the Thau Lagoon (CA : Crique de l'Angle and B : Bouzigues).

On the Thau Lagoon (Autumn 2019), DMSPt concentrations were slightly lower than on the Atlantic coast, ranging between 10 and 76 nM and for DMSPp, between 1 and 40 nM (Fig. 2). Concentrations were similar between the 2 sampling stations of the Lagoon. Maximal DMSP concentrations were associated with the occurrence of *Alexandrium* cells and with maximal chlorophyll concentrations. No PSTs were detected. Due to substantial DMSP concentrations measured in coastal French waters, we expect to carry on further samplings during phytoplankton blooms to better characterize DMSP and DMS input.

Yangjunjie Xu* achieved his PhD work on Saharan Dust deposition over the lesser Antilles (20/07/2020)

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"ÉTUDE DE LA VARIABILITÉ TEMPORELLE DU DÉPÔT ATMOSPHÉRIQUE EN GUADELOUPE"

translated into

"ATMOSPHERIC DEPOSITION AT LA GUADELOUPE: A TIME SERIES STUDY"

Abstract : Atmospheric deposition provides many nutrients to tropical rain-forests and thus contributes to soil preservation. Its importance is particular in the Caribbean area with high rainfall rate. This work carried out a continuous temporal study of three and a half years on the deposit flux in Guadeloupe of 45 elements (Al, As, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, S, Sc, Sb, Se, Sr, Ti, Tl, U, V, Zn and REEs) and one year on their concentration in air. Detailed isotopic analysis of strontium ($^{87}\text{Sr}/^{86}\text{Sr}$), neodymium ($^{143}\text{Nd}/^{144}\text{Nd}$) and lead (^{206}Pb , ^{207}Pb , ^{208}Pb) was performed on all samples where possible. The compositional analysis using the methods developed by Aitchison and his collaborators was of great help in the interpretation of the results. We have been able to show that the two main sources of atmospheric deposition in Guadeloupe are trans-Atlantic Saharan dust for elements considered to be crustal such as iron, aluminium, manganese, REEs, and sea salts for the other elements such as magnesium, sodium, sulfur, and part of molybdenum, potassium and zinc. We note a very strong seasonal variability for the Saharan inflows with a peak of deposition between April and September. Analyses of REEs and isotopes indicate a regional variability of the sources of Saharan dust without being able today to identify them precisely because of the lack of quantitative data in the emission zones. There is a compositional split between the deposit and the aerosol measured at ground level with some anthropogenic enrichment for aerosol.

Keywords : Tropical North Atlantic, Guadeloupe, atmospheric deposition, Saharan dust, atmospheric aerosol, compositional analysis, rare earth elements, trace elements, isotopes.

Karine Sellegri (k.sellegri@opgc.univ-bpclermont.fr) **Sea2Cloud**

Highlight 1. Biogenic-driven seawater processes impact sea spray derived CCN fluxes to the atmosphere

The emission of sea spray plays a major role in the Earth climate system via influencing cloud properties. Yet, the role of marine biology on sea spray fluxes is poorly understood. Although the biogenic origin of organic matter in sea spray has been extensively studied, empirical evidence that marine biota modifies the sea spray number concentration flux to the atmosphere is scarce and yet to be formalized. This lack of knowledge is likely due to the difficulty in measuring quantitative number fluxes both in the laboratory and in the field, with a concomitant characterization of natural seawaters at the origin of these fluxes.

Within **Sea2Cloud**, the use of a consistent methodology for sea spray generation from biologically characterized natural seawaters of various geographic locations (Arctic, Mediterranean, coastal NW Pacific), showed a significant relationship between seawater nanophytoplankton cell abundances and sea-spray derived Cloud Condensation Nuclei (CCN) number fluxes (Fig 1; [Sellegri et al. 2021](#)). The proposed underlying mechanism for nanophytoplankton to influence sea spray number fluxes is the presence of an marine organic class identified in sea spray, that is linked to nanophytoplankton, contains signatures of fatty acid and amino acids ([Freney et al. 2021](#)), and would modify the bubble bursting

films surface tension and life time. The sensitivity of sea spray and CCN number fluxes to ocean biology is currently unaccounted for in climate models yet the results indicate that it influences fluxes by more than one order of magnitude over the range of phytoplankton investigated.

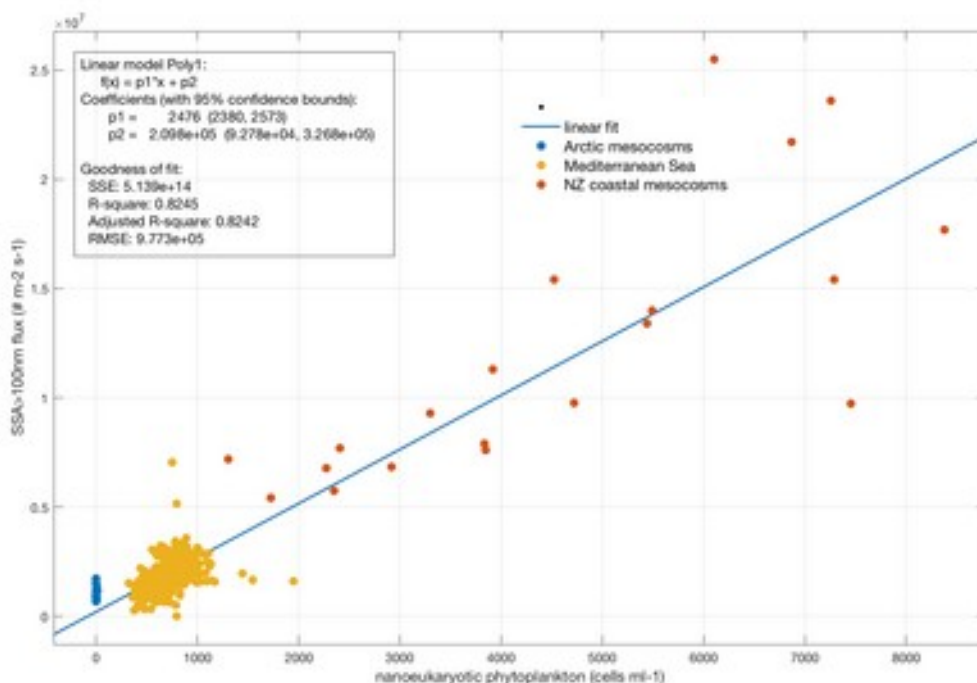


Fig 1: Sea spray aerosol larger than 100 nm flux number F_{SSA100} ($\# m^{-2} s^{-1}$) calculated for a wind speed of $9 m s^{-1}$ and $15^{\circ}C$ sea temperature as a function of the NanoPhyto ($cells ml^{-1}$) in the seawater of different regions. The solid line indicates the linear fit to the data set.

Highlight 2. Sea spray Ice nuclei properties parameterized from the SML biogeochemistry

Ice nucleating particles (INP) have a large impact on clouds over the oceans. Studies have shown that sea spray aerosols (SSA), produced upon bursting of bubbles at the ocean surface, can be an important source of INP, particularly during periods of enhanced biological productivity. However, existing parameterizations for marine INP abundance are based solely on single variables such as SSA organic carbon (OC) or SSA surface area, which may mask specific trends in the separate classes of INP. In [Trueblood et al. \(2021\)](#), INP concentrations in the surface microlayer (INP_{SML}) and in SSA (INP_{SSA}) produced using a plunging aquarium apparatus were continuously monitored while surface seawater (SSW) and SML biological properties were measured in parallel during a cruise in the Mediterranean Sea. A dust wet deposition event increased the INP concentrations measured in the SML by an order of magnitude, in line with increases of iron in the SML and bacterial abundances. Increases of INP_{SSA} were not observed until after a delay of three days compared to increases in the SML, and are likely a result of a strong influence of bulk SSW INP for the temperatures investigated ($T = -18^{\circ}C$ for SSA, $T = -15^{\circ}C$ for SSW). Outside this dust event, INP_{SSA} are divided into two classes depending on their associated organic matter. Warm ($T \geq -22^{\circ}C$) INP_{SSA} concentrations are correlated with water soluble organic matter (WSOC) in the SSA, but also to particulate organic carbon in the SSW (POC_{SSW})

while cold INPSSA ($T < -22^{\circ}\text{C}$) are correlated with SSA water-insoluble organic carbon (WIOC), SML dissolved organic carbon (DOC) concentrations and SSW nano- and micro-phytoplankton cell abundances. These relationships could be translated into a single component model based on POC_{SSW} and a two-component model based on SSA WIOC and OC. We also altered a previous model based on OC_{SSA} content to account for oligotrophy of the Mediterranean Sea. We then compared this formulation with the previous models. This new parameterization should improve attempts to incorporate marine INP emissions into numerical models.

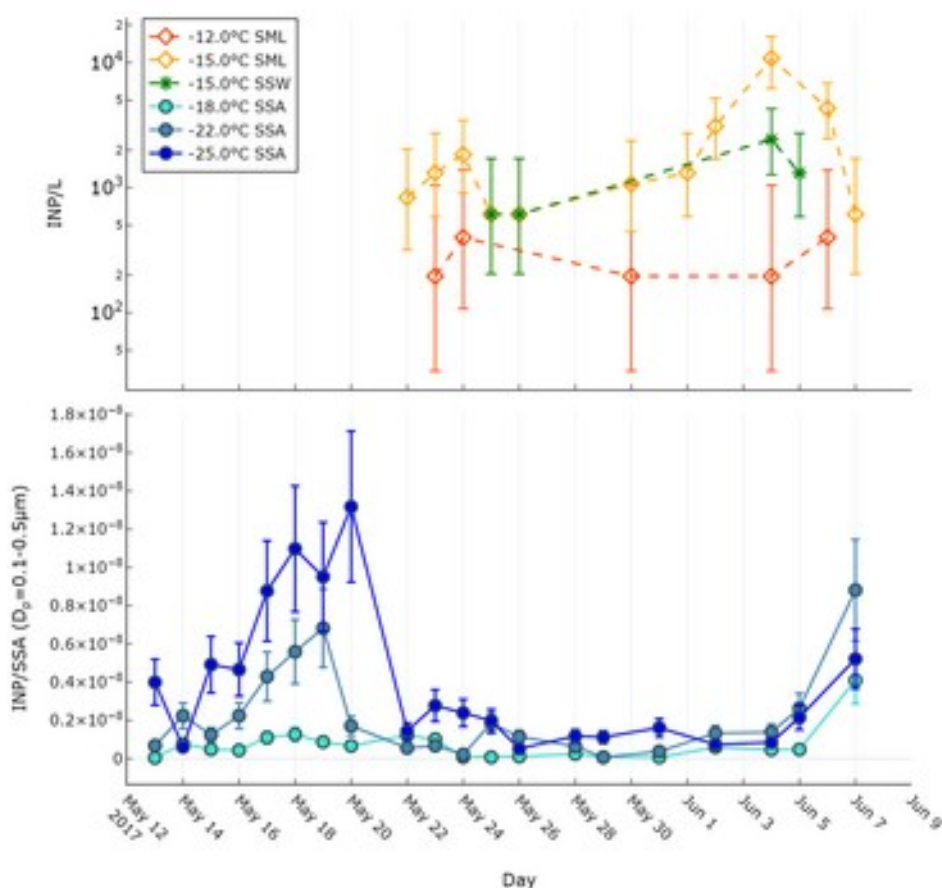


Fig 2: Ice nuclei particles in surface seawater (SSW), surface microlayer (SML) and sea spray aerosol (SSA) measured during the Peacetime Cruise

Protat, A., Schulz, E., Rikus, L., Sun, Z., Xiao, Y., and M. Keywood : Shipborne Observations of the Radiative Effect of Southern Ocean Clouds. *J. Geophys. Res.* 122, D026061, 2017.
 S  ferian, R., Nabat, P., Michou, M., Saint-Martin, D., Voldoire, A., Colin, J., Decharme, B., Delire, C., Berthet, S., Chevallier, M., S  n  si, S., Franchisteguy, L., Vial, J., Mallet, M., Joetzjer, E., Geoffroy, O., Gu  r  my, J.-F., Moine, M.-P., Msadek, R., Ribes, A., Rocher, M., Roehrig, R., Salas-y-M  lia, D., Sanchez, E., Terray, L., Valcke, S., Waldman, R., Aumont, O., Bopp, L., Deshayes, J.,   th  , C. and Madec, G., Evaluation of CNRM Earth-System model CNRM-ESM2-1 : role of Earth system processes in present-day and future climate, *James*, 11, 4182-4227, 2019.

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

In the frame of the PEACETIME project, the BIOGEOSCIENCES/Atmospheric Chemistry and Physics inter-journal Special Issue) is almost completed. Please check the so far 22 articles published/in revision or just submitted. Among those, please note the seven recent articles very related to SOLAS:

1- Theme3 group (*Atmospheric deposition and ocean biogeochemistry*):

Gazeau, F., Ridame, C., Van Wambeke, F., Alliouane, S., Stolpe, C., Irisson, J.-O., Marro, S., Grisoni, J.-M., De Liège, G., Nunige, S., Djaoudi, K., Pulido-Villena, E., Dinasquet, J., Obernosterer, I., Catala, P., and Guieu, C.: Impact of dust enrichment on Mediterranean plankton communities under present and future conditions of pH and temperature: an experimental overview, *Biogeosciences Discuss.* [preprint], <https://doi.org/10.5194/bg-2020-202>, accepted, 2020.

Roy-Barman, M., Foliot, L., Douville, E., Leblond, N., Gazeau, F., Bressac, M., Wagener, T., Ridame, C., Desboeufs, K., and Guieu, C.: Contrasted release of insoluble elements (Fe, Al, rare earth elements, Th, Pa) after dust deposition in seawater: a tank experiment approach, *Biogeosciences*, 18, 2663–2678, <https://doi.org/10.5194/bg-18-2663-2021>, 2021.

2- Theme Interconnections between aerosols, clouds, and marine ecosystems

Trueblood, J. V., Nicosia, A., Engel, A., Zäncker, B., Rinaldi, M., Freney, E., Thyssen, M., Obernosterer, I., Dinasquet, J., Belosi, F., Tovar-Sánchez, A., Rodriguez-Romero, A., Santachiara, G., Guieu, C., and Sellegri, K.: A two-component parameterization of marine ice-nucleating particles based on seawater biology and sea spray aerosol measurements in the Mediterranean Sea, *Atmos. Chem. Phys.*, 21, 4659–4676, <https://doi.org/10.5194/acp-21-4659-2021>, 2021.

Freney, E., Sellegri, K., Nicosia, A., Williams, L. R., Rinaldi, M., Trueblood, J. T., Prévôt, A. S. H., Thyssen, M., Grégori, G., Haëntjens, N., Dinasquet, J., Obernosterer, I., Van Wambeke, F., Engel, A., Zäncker, B., Desboeufs, K., Asmi, E., Timonen, H., and Guieu, C.: Mediterranean nascent sea spray organic aerosol and relationships with seawater biogeochemistry, *Atmos. Chem. Phys.*, 21, 10625–10641, <https://doi.org/10.5194/acp-21-10625-2021>, 2021.

Publications of Sea2Cloud program:

Sellegri Karine, Alessia Nicosia, Evelyn Freney, Julia Uitz, Melilotus Thyssen, Gérald Grégori, Anja Engel, Birthe Zäncker, Nils Haëntjens, Sébastien Mas, David Picard, Alexia Saint-Macary, Maija Peltola, Clémence Rose, Jonathan Trueblood, Dominique Lefevre, Barbara D'Anna, Karine Desboeuf, Nicholas Meskhidze, Cécile Guieu and Cliff S. Law Surface ocean microbiota determine cloud precursors, *Sci Rep* 11, 281 <https://doi.org/10.1038/s41598-020-78097-5>, 2021

Jonathan V. Trueblood, Alesia Nicosia, Anja Engel, Birthe Zäncker, Matteo Rinaldi, Evelyn Freney, Melilotus Thyssen, Ingrid Obernosterer, Julie Dinasquet, Franco Belosi, Antonio Tovar-Sánchez, Araceli Rodriguez-Romero, Gianni Santachiara, Cécile Guieu, and Karine Sellegri, A Two-Component Parameterization of Marine Ice Nucleating Particles Based on Seawater Biology and Sea Spray Aerosol Measurements in the Mediterranean Sea, *Atmos. Chem. Phys.*, 21, 4659–4676, <https://doi.org/10.5194/acp-21-4659-2021>, 2021

Evelyn Freney, Karine Sellegri, Alessia Nicosia, Jonathan T. Trueblood, Matteo Rinaldi, Leah R. Williams, André S. H. Prévôt, Melilotus Thyssen, Gérald Grégori, Nils Haëntjens, Julie Dinasquet,

Ingrid Obernosterer, France Van-Wambeke, Anja Engel, Birthe Zäncker, Karine Desboeufs, Eija Asmi, Hilka Timmonen, and Cécile Guieu, Mediterranean nascent sea spray organic aerosol and relationships with seawater biogeochemistry, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-406>, accepted to ACP.

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?

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.).

The Polar Pod cruise (3 years around Antarctica over Southern Ocean) becomes real with the building of the vessel.



Par Jean Louis ETIENNE — Travail personnel, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=55534356>

This large buoy will derive in the circumpolar current at about 50°S and will support five people and scientific instrumentation for measurements in air and sea water. Like the U.S. FLIP, the POLAR.POD is a very steady platform: bank angle of 5° during strong weather and a vertical movement lower than 10% of the waves' height. Contrary to classic vessels, the movements of the POLAR.POD do not disturb the sea surface and it is very silent, making it a complementary platform to classic vessels, specially adapted to various research applications. This experiment will explore Ocean-Atmosphere exchanges of energy and matter, will monitor the Southern Ocean from remote observations, will observe the biodiversity, and will quantify the anthropogenic impacts over this very remote area.

Sea2Cloud

The investigation of the relationships between ocean biogeochemistry and cloud precursors is especially relevant for the oceans of the Southern Hemisphere. The Southern Hemisphere's atmosphere is especially sensitive to any change in marine sources emissions, due to low anthropogenic activities and a large impact of (white) clouds on the predominant dark ocean. Predictions of clouds over the Southern Ocean (SO) allow too much shortwave radiation to reach the ocean surface, inducing a large systematic bias that peaks during austral summer (Protat et al., 2017). This bias could be due to unaccounted-for biological impacts.

In this context, the goal of the Sea2Cloud ship campaign was to study the interplay between the ocean biogeochemical and physical properties, fluxes to the atmosphere and their impact on cloud formation under conditions free from direct anthropogenic influence. Sea2Cloud, which took place on board the R/V Tangaroa (March 2020), incorporated an interdisciplinary approach, combining atmospheric physics and chemistry with marine biogeochemistry with the objective to unravel oceanic influences on biogenic aerosol emission fluxes. In parallel to ambient measurements of atmospheric composition and seawater biogeochemical properties, the campaign incorporated experiments to characterize nascent sea spray properties and, using a novel experimental set-up of ship-borne Air-Sea Interface Tanks, new particles formed by nucleation from gas-phase biogenic emissions (including DMS, other BVOC and OVOC) and oxidation. Additional studies explored specific controls of ozone concentration on VOC fluxes and aerosol formation and the important role of the sea surface microlayer in driving sea-air fluxes. Emission studies will generate parameterizations of flux dependence on the seawater biogeochemistry (similar to the ones provided in Sellegri et al. 2021 and Trueblood et al. 2021, but adapted to a non-oligotrophic seawaters) for use in regional models (WRF-Chem and WRF-DESCAM), that will be tested against in situ gas, aerosol (including cloud condensation nuclei and ice nuclei) and cloud observations, as well as satellite retrievals. The new sea spray fluxes parameterization will also be tested in the Earth System Model CNRM-ESM2-1 (Séférian et al, 2019).

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

SOLAS-France visio meeting, March 21st (see <http://solas.ipgp.fr>)

3. Funded national and international projects/activities underway.

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.

Comments

