

Report for the year 2025 and future activities

SOLAS FRANCE

compiled by: **Marie Boye, Karine Sellegri**

This report has two parts:

- **Part 1:** reporting of activities in the period of January 2025 - Feb/Mar 2026
- **Part 2:** reporting on planned activities for 2026 and 2027.

Specific SOLAS 2015-2025 Science Plan Themes:

- Core Theme 1:** Greenhouse gases and the oceans;
- Core Theme 2:** Air-sea interfaces and fluxes of mass and energy;
- Core Theme 3:** Atmospheric deposition and ocean biogeochemistry;
- Core Theme 4:** Interconnections between aerosols, clouds, and marine ecosystems;
- Core Theme 5:** Ocean biogeochemical control on atmospheric chemistry;
- Cross-Cutting Theme:** Integrated studies of high sensitivity systems (upwelling systems, Indian Ocean, polar oceans and sea ice);
- Cross-Cutting Theme:** Climate intervention;
- Cross-Cutting Theme:** Science and society.

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 2025 to Feb/Mar 2026

1. Scientific highlight

Highlight 1 (Core Theme 3 and polar ocean): Responses of the natural phytoplankton assemblage to Patagonian dust input and anthropogenic changes in the Southern Ocean.

The cumulative effects of multi-faceted changes on the phytoplankton community of the Southern Ocean (SO) are not yet known, which is a major limitation to predicting the future direction of the biological carbon pump. Thus, our study aimed to estimate the effects of intensified Patagonian dust inputs, warming and acidification on the growth, composition and production of phytoplankton assemblages in the Polar Frontal Zone (PFZ) and the High-Nutrient Low-Chlorophyll (HNLC) region of the Indian sector of the SO during the austral summer 2022. Natural phytoplankton communities were incubated for 5-day under 4 scenarios (present and future conditions, and 2 intermediate scenarios). In the PFZ, +3°C and acidification stimulated the growth of phytoplankton, mainly cyanobacteria, while intensified dust inputs alone did not have notable impact. Conversely, in HNLC waters, the addition of Fe-dust alone increased the total chlorophyll a of diatoms (mainly *F. kerguelensis*), whereas the negative effect of acidification and +3°C counteracted the positive impact of dust input on the diatoms. In these waters, future conditions benefited smaller species (haptophytes and cyanobacteria). The net particulate organic carbon production (POC) was also unaltered by future conditions, suggesting that primary production may not change in the future SO. However, the increase in the length and number of long-chain diatoms under future HNLC conditions may indicate that POC export could intensify in the future. These findings highlighted the complexity of phytoplankton responses, which vary across regions and are influenced by interactive

environmental factors. Understanding the impact of these environmental factors on phytoplankton is critical to predicting how future changes will shape the role of the SO in the global carbon cycle.

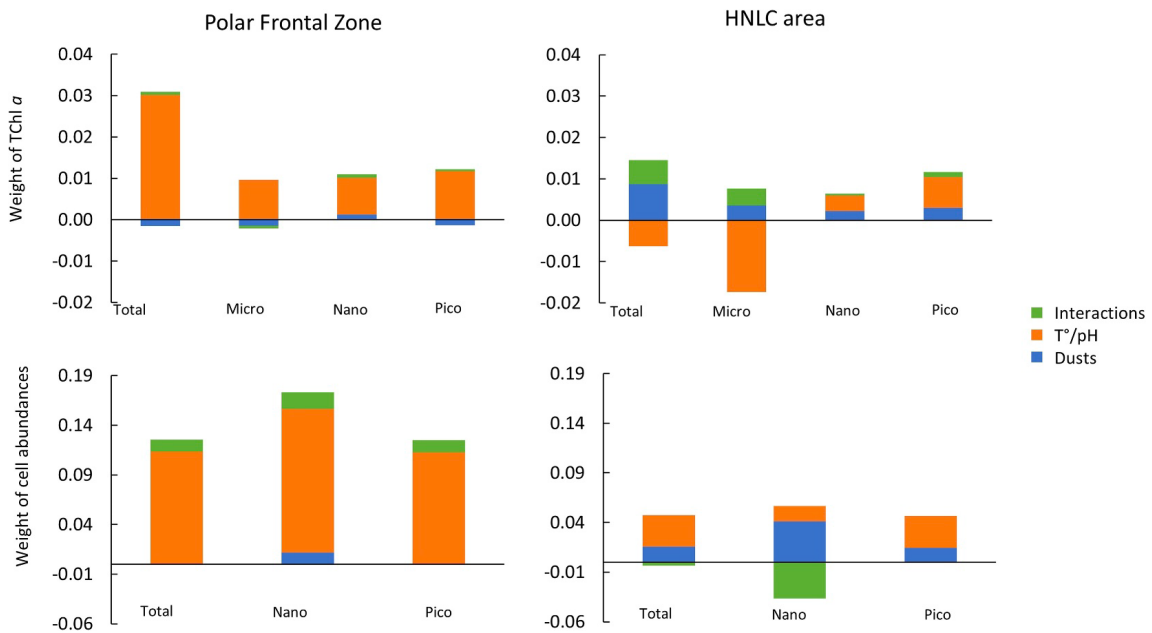


Figure: Individual versus interactive effects of dust input and other factors (warming and acidification) on the cell densities and biomasses. Total biomass was associated with TChl a, diatom biomass (microphytoplankton) with fucoxanthin, cyanobacteria (picophytoplankton) with zeaxanthin and total chlorophyll b, and haptophytes, like coccolithophorids (nanophytoplankton) with 19'-hexanoyloxyfucoxanthin. Total cell density was associated with growth rate of each size-cell abundance, cyanobacteria with OraPicoProk and RedPico, and nanophytoplankton with HsNano. The changes in biomass and cell density between day 5 and day 0 were used in the statistical model (Goupy, 1993).

Citation: Demasy, C., Boye, M., Delisée, A., Maguer, J.-F., Thyssen, M., Gest, L. (2025) Responses of the natural phytoplankton assemblage to Patagonian dust input and anthropogenic changes in the Southern Ocean. *Earth's Future*, 13, e2024EF005762, doi.org/10.1029/2024EF005762

Highlight 2 (Core Theme 5): Biological activity in hydrothermal sources influences ice nuclei particles in seawater and nascent sea spray of the Subtropical Pacific Ocean.

Particles of marine origin may act as ice nuclei when clouds form and therefore influence cloud properties and lifetime. Here we investigate the abundance of Ice Nuclei Particles in bulk seawater (INPSW) collected in natural seawater of the Western Tropical South Pacific and in sea spray aerosol (INPSSA) artificially generated from the surface seawater. The study area was separated into two oligotrophic zones (the Melanesian Basin and the Western South Pacific Gyre), and a mesotrophic one (the Lau basin), characterized by high plankton biomass due iron fertilization by underwater hydrothermal activity of the Tonga volcanic arc. Our results show that INPSW were on average 80% heat labile, suggesting a biological origin. INPSW concentrations were two-fold higher in the Lau basin as compared to both oligotrophic areas at all freezing temperatures. This trend is consistent with a higher abundance of planktonic microorganisms, pigments and particulate organic carbon (POC) concentrations in the Lau basin. Over the whole cruise transect, medium to strong correlations were found between INPSW concentrations and pigments (notably with bacteriochlorophyll-a and carotene), bacterial abundance and POC. The heat stable fraction of INPSW exhibited correlations with Dissolved Organic Carbon (DOC) concentrations and were not as variable as the heat labile INPSW. In the nascent sea spray, INPSSA were also mostly heat labile in line with the INPSW. INPSSA were predominantly (60 %), submicron in size (presumed originating from film drops), but the supermicron INPSSA constituted 40% of the INPSSA and were all heat labile (presumably originating from jet drops). Supermicron INPSSA were between 60 to 80% heat stable with a high variability between samples, indicating different nature of the two fractions of INPs. Supermicron INPSSA were generally more abundant in the Lau basin, while submicron INPSSA did not exhibit any significant difference between the three regions. We report a transfer function, in the form of the ratio of SSA INPs to seawater INPs of 1.70 m⁻².LSW for total INPs and 3.3 m⁻².LSW for heat INPs. The difference in the two transfer functions would indicate that heat stable INPs were more efficiently transferred to the SSA compared to heat labile INPs. Our results suggest that biological activity in hydrothermal sources enhances the INP concentration of surface waters, which

results in increases of the ice forming ability of supermicron sea spray particle. These results could be evaluated regarding their impact in future ocean-atmosphere interaction studies.

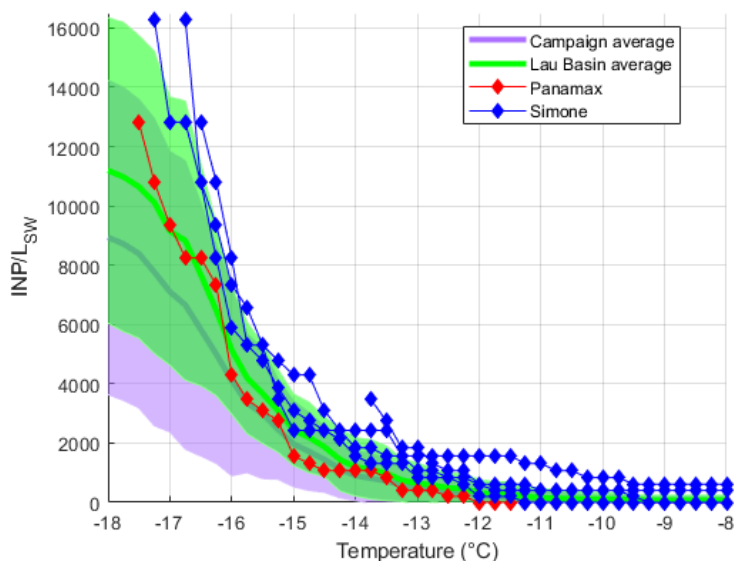


Figure: Comparison of seawater INPs near the Panamax and Simone volcanoes. The campaign and Lau basin averages (influenced by hydrothermal activity) are represented as purple and green shaded areas (solid line : mean, shaded area : standard deviation of the dataset). Panamax and Simone data are represented as single days INP spectra, corresponding to days where seawater was sampled in the immediate vicinity of the volcano (<20 km distance). This represents one sample for Panamax and four samples for Simone.

Citation: Bras Y., Sellegri K., Freney E., Benavides M., Bigeard E., Dulaquais G., Dimier C., Bouvier L., Ribeiro M., Guieu C., Bonnet S. Biological activity in hydrothermal sources influences ice nuclei particles in seawater and nascent sea spray of the Subtropical Pacific Ocean, *submitted to Biogeosciences*

Highlight 3 (Core Theme 2, including Indian ocean): Constraining elemental mercury air-sea exchange using long-term ground-based observations.

Mercury is a global pollutant of major environmental concern due to its persistence, long atmospheric lifetime, and ability to undergo long-range transport before deposition to ecosystems. In its elemental form (Hg^0), mercury can remain in the atmosphere for several months to a year, enabling intercontinental transport and exchange between the atmosphere and the ocean. Air-sea exchange of Hg^0 is a central, yet still poorly constrained, component of the global mercury cycle. The ocean acts both as a sink through deposition and as a secondary source through re-emission, with oceanic emissions estimated to contribute a substantial fraction of atmospheric Hg globally. A major outcome of the reporting period is the publication by Molepo et al. (2025), which demonstrates that long-term ground-based atmospheric observations can be used to constrain Hg^0 air-sea exchange. Using multi-site datasets, including Amsterdam Island in the Indian Ocean, the study shows that atmospheric Hg^0 concentrations increase with the recent residence time of air masses within the marine boundary layer, before reaching a steady state. This provides direct observational evidence that oceanic emissions control background Hg^0 levels in remote marine atmospheres. The study further derives quantitative estimates of dissolved Hg^0 in surface waters and associated emission fluxes, illustrating the potential of long-term monitoring sites to constrain key parameters of the global mercury cycle.

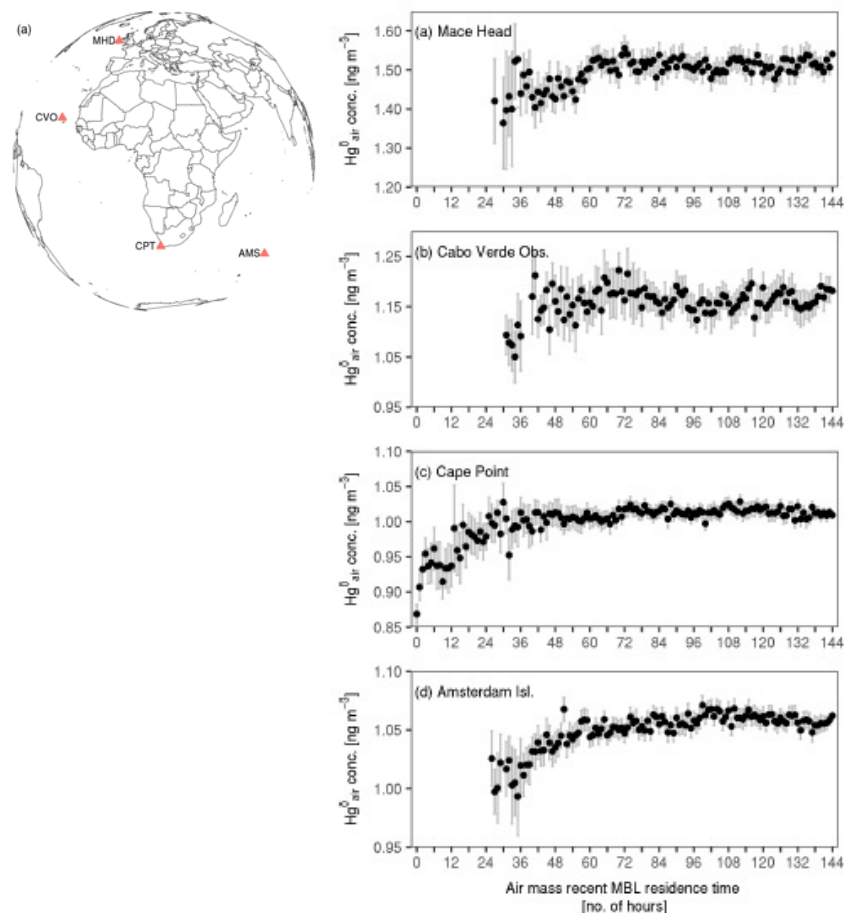


Figure: Relationship between atmospheric Hg^0 concentrations and recent air mass residence time in the marine boundary layer at the different monitoring sites (Cape Point: CPT, Amsterdam Island: AMS, Mace Head: MHD and Cabo Verde Observatory: CVO). Hg^0 concentrations increase with residence time before reaching a steady state, consistent with ocean-driven emissions and air-sea equilibrium.

Citation: Molepo, K. M., Bieser, J., Koenig, A. M., Hedgecock, I. M., Ebinghaus, R., Dommergue, A., Magand, O., Angot, H., Travnikov, O., Martin, L., Labuschagne, C., Read, K., and Bertrand, Y. (2025) Constraining elemental mercury air-sea exchange using long-term ground-based observations, *Atmospheric Chemistry and Physics*, 25, 9645-9668, <https://doi.org/10.5194/acp-25-9645-2025>

Highlight 4 (Core Theme 1): Development of an optical sensing platform for real-time *in situ* measurements of seawater pCO_2 and air-sea CO_2 flux.

In the context of growing efforts to better quantify ocean-atmosphere carbon exchanges, we developed a compact optical sensing platform enabling real-time, *in situ* measurements of dissolved CO_2 partial pressure (pCO_2) and associated air-sea CO_2 fluxes with high temporal and spatial resolution. The system relies on tunable diode laser absorption spectroscopy (TDLAS), using a distributed feedback laser operating at 2008.8 nm to target the CO_2 absorption line at 4980.13 cm^{-1} . Sensitivity is enhanced through a miniaturized multi-pass cell, providing an effective optical path length of 30 m. Continuous gas-liquid equilibration is achieved via a membrane contactor-based equilibrator, specifically designed for efficient and stable extraction of dissolved CO_2 from seawater. Laboratory characterization demonstrates robust analytical performance, with a limit of detection of 0.59 ppm (3σ), a precision of 2.12 ppm at 0.4 s averaging time improving to 0.15 ppm at 186 s, and a response time of 17-18 s. These metrics highlight the capability of the system to resolve rapid fluctuations in CO_2 concentrations in dynamic marine environments. Funded by a program coordinated by the Direction of the Oceanographic Fleet (DFO) for the Research Infrastructure of French Oceanographic Fleet operated by IFREMER and its subsidiary Genavir, the platform was deployed during two coastal shipborne campaigns in the English Channel (summer and winter 2025), under real environmental conditions. The measurements reveal pronounced nearshore-offshore gradients in temperature, salinity, and pCO_2 , as well as a clear seasonal contrast, with elevated pCO_2 levels observed during winter. Importantly, the observed seasonal and spatial variability is consistent with historical datasets from the Surface Ocean CO_2 Atlas (SOCAT), supporting both the

accuracy and reliability of the developed system. This agreement validates the platform's ability to capture meaningful biogeochemical signals in coastal water. The high spatiotemporal resolution of the measurements further enables the estimation of air-sea CO₂ fluxes, revealing marked spatial heterogeneity in exchange dynamics. During the winter campaign, the study area acted as a net CO₂ source, with fluxes ranging from 0.21 to 1.12 mmol m⁻² day⁻¹. These values fall within the lower range reported for coastal environments and reflect the combined influence of wind forcing and ΔpCO₂ gradients. Overall, this work demonstrates that the developed optical platform provides a powerful tool for resolving fine-scale variability in coastal carbon dynamics, thereby contributing to improved quantification of air-sea CO₂ exchanges. This is particularly important in coastal regions, which are among the most dynamic components of the global carbon cycle, yet remain insufficiently constrained. Such capabilities are essential for advancing our understanding of coastal carbon budgets and their role in the global climate system.

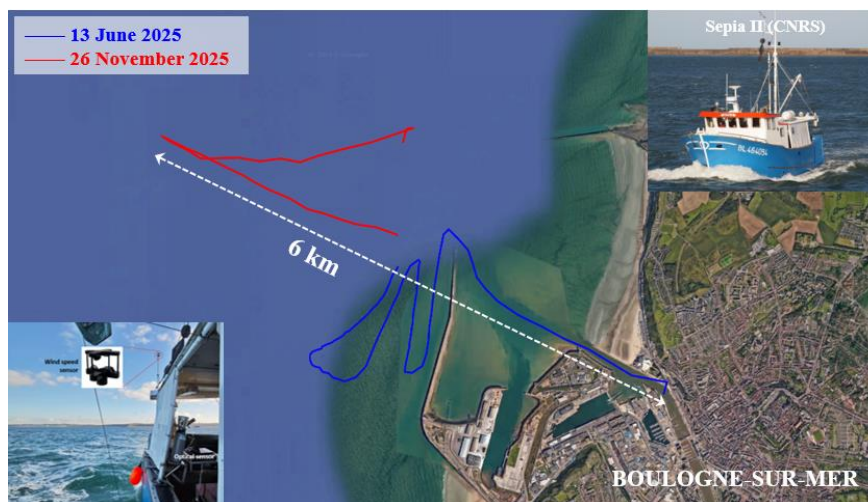


Figure: The navigation routes for shipborne measurements in 13 June 2025 and 26 November 2025, respectively.

Citation: Hu, Y., J. Wang, K. Liu, R. Cui, Y. Wang, C. Routtier, P. Augustin, M. Fourmentin, H. Wu, L. Dong, T. Nguyen Ba, and W. Chen. Development of an optical sensing platform for real-time *in situ* measurements of seawater pCO₂ and air-sea CO₂ flux, in submission.

Highlight 5 (Cross-Cutting Theme: Science and society): Expanding the Planetary Boundaries framework to account for the ocean interior and all its domains from physics to biogeochemistry and biodiversity framework

Rockström et al. (2009) introduced the PB concept to estimate a safe operating space for humanity with respect to Earth system functioning. They identified nine key Earth system processes that regulate planetary stability, resilience, and life-support functions and attempted to quantify boundary levels for each process that should not be transgressed to avoid unacceptable global environmental change. Transgressing these boundaries increases the risk of destabilising Earth system processes and reducing nature's capacity to absorb disturbances and maintain essential ecosystem functions. While ocean acidification (OA) is well established within the PB framework, not all ocean processes relevant for Earth-system stability are currently captured. Over the coming decades and centuries, ocean health will increasingly be affected by the combined influence of at least three interacting stressors: rising temperature, OA, and ocean deoxygenation. These processes have been repeatedly identified as key drivers of large-scale changes in marine ecosystems and species habitats and proposals have recently been made to expand the PB framework to better account for these interacting stressors within the ocean interior under an Ocean Change PB (Mathesius et al., 2026, submitted). A side event was organised during UNOC3 in June 2025 to unlock a deeper vision for the Earth's future (<https://www.digitaloceanpavilion.eu/content/the-eu-the-marine-observing-infrastructure>).

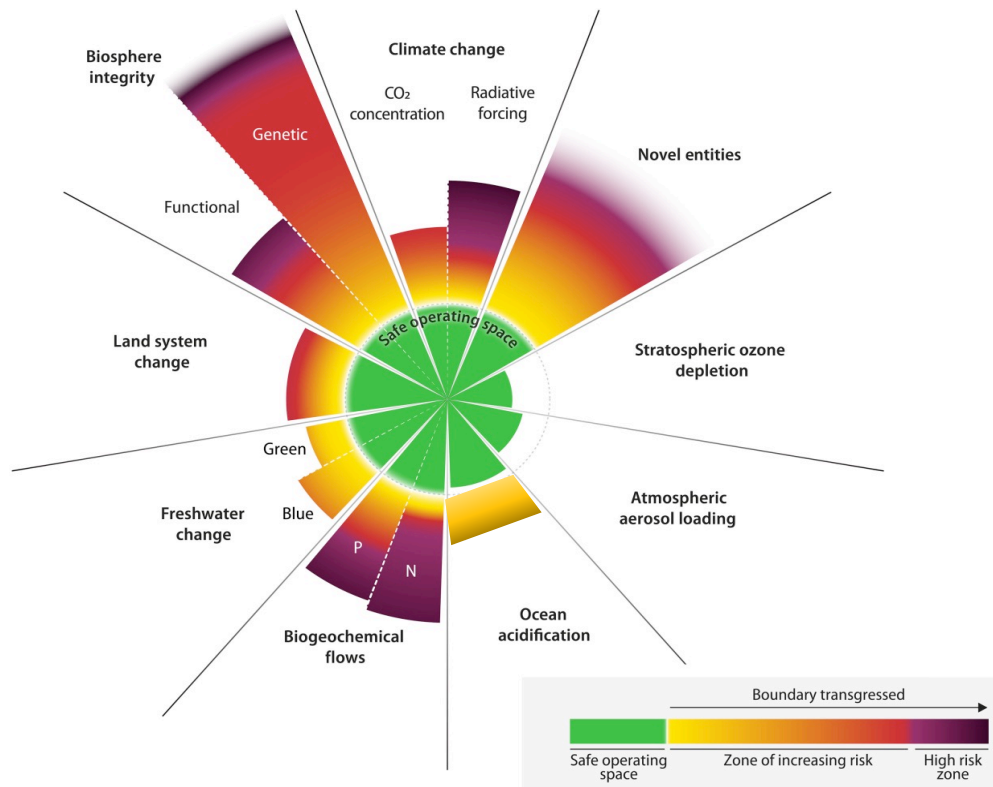


Figure: Earth beyond seven of nine planetary boundaries (Richardson et al., 2023; Mathesius et al., 2026)

Citation: Mathesius et al., 2026, submitted.

Highlight 6 (Core Theme 2): Late autumn aerosol trace element composition and source tracking over the southern Mozambique Channel.

The Mozambique Channel receives a range of atmospheric emissions from both Madagascar and southeastern Africa. Our study addresses the lack of observation in this study region by characterizing the trace element composition of aerosols collected in the southern part of the channel (20-30° S) in April-May 2022. Small dust deposition fluxes ($40\text{-}263 \text{ mg m}^{-2} \text{ yr}^{-1}$) calculated confirmed the absence of major dust or fire events during the study. Such low natural emission signal enabled to highlight surprisingly high levels of anthropogenic chromium ($4 \pm 2 \text{ ng m}^{-3}$) and cadmium ($0.02 \pm 0.01 \text{ ng m}^{-3}$) in the atmosphere over the southern Mozambique Channel. These emissions were, at least in part, attributed to mining (chromite and gold, respectively) and smelting activities (copper, zinc and cadmium co-emission) on both neighbouring landmasses. Our results emphasise the need to better track overlooked atmospheric sources by finding representative atmospheric tracers. This goal can be achieved by studying a wide range of trace elements in the atmosphere. We also show that a holistic understanding of the variety of air-masses affecting our samples is necessary to prevent misinterpretation on the trace elements origin in our sample. We encourage the use of cluster air-mass transport model analysis in regions dominated by the long-range atmospheric transport as minor (sporadic) inputs from terrestrial air-masses may have disproportionate impact on the atmospheric composition.

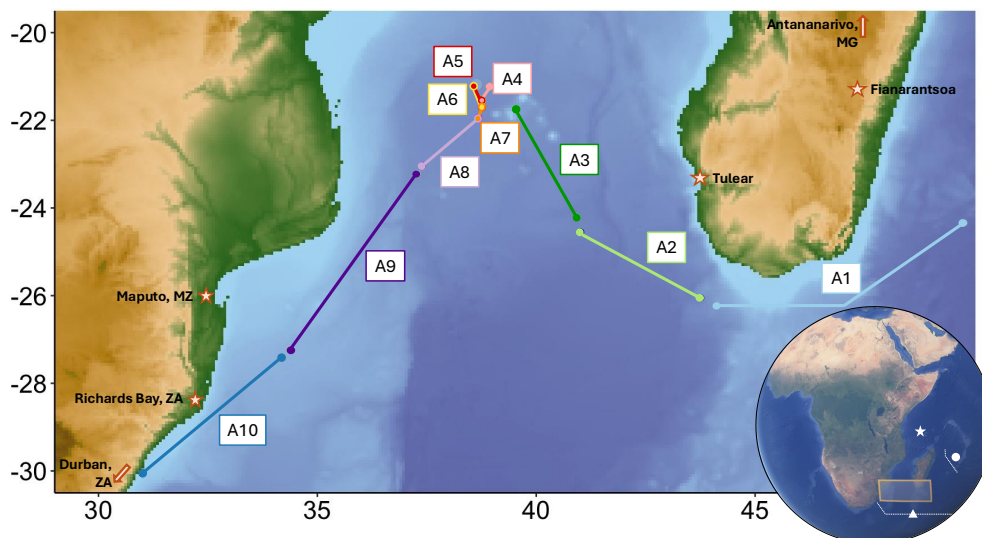


Figure: Location of the 10 aerosol samples collected during the RESILIENCE campaign in the Southern Mozambique Channel. The inset world map indicates the location of this study (yellow rectangle) together with the location of previous field studies (symbols) reporting atmospheric trace element concentrations in the direct vicinity of our study region (triangle: Witt et al. (2006), circle: Witt et al. (2010), star: Chester et al. (1991)).

Citation: Perron, M.M.G., Bucciarelli, E., Planquette, H., Holmes, T., Samanta, S., Germain, Y., Roychoudhury, A., and Sarthou, G. (2025) Late autumn aerosol trace element composition and source tracking over the southern Mozambique Channel. *EGUsphere* [preprint], <http://doi.org/10.5194/egusphere-2025-4962>

Highlight 7 (Core Theme 2): Linking composition and solubility of metals in Namibian dust aerosols and fog.

The western coast of southern Africa is a region of particular climatic interest, marked by complex aerosol sources, active ocean-atmosphere exchanges, and frequent fog formation. During the field campaign of the AEROSOLS, RadiatiON ad CLOUDS in southern Africa (AEROCLO-sA) project in August-September 2017, three weeks of aerosol and fog-water sampling were conducted at Henties Bay, Namibia, to investigate the composition, solubility, and transformation of trace metals under contrasting synoptic regimes. Aerosol measurements revealed a transition from predominantly natural, windblown mineral dust in August-consistent with local Namibian sources-to anthropogenic, mining-related dust in September, potentially influenced by smelting emissions in northern Namibia or the Copper Belt region. Chemical analyses showed that anthropogenic dust contained enhanced concentrations of heavy metals (e.g., As, Cu, Cd, Pb, Zn) and coarser particles but exhibited lower metal solubility, including Fe, compared with natural dust. Conversely, high fluoride levels originating from marine emissions correlated with increased solubility of several metals in both dust types, underscoring the importance of coastal ocean-atmosphere interactions in the Benguela region. Furthermore, paired total suspended particulate (TSP) and fog-water samples demonstrated that dissolved concentrations of several trace metals (Al, Fe, Ni, Cu, Cr) were markedly higher in fog droplets than in the aerosol phase. Thermodynamic modeling indicated that Cu, Cr, and Ni form soluble inorganic and organic complexes in fog, whereas Al and Fe should precipitate at the near-neutral fog pH. However, X-ray absorption near-edge structure analysis revealed Fe-oxalate complexes that likely stabilize dissolved Fe in fog, while transmission electron microscopy and dynamic light scattering detected nano-sized colloidal particles of Fe and Al that appear soluble in ICP-MS measurements. We hypothesize that these dissolved and colloidal species form during early droplet activation, when water content and acidity are higher, and persist in fog as kinetically stable complexes. Together, these results highlight the strong coupling between aerosol source variability, fog processing, and marine emissions in shaping trace-metal chemistry along the Namibian coast, with implications for atmospheric composition and regional marine biogeochemistry.

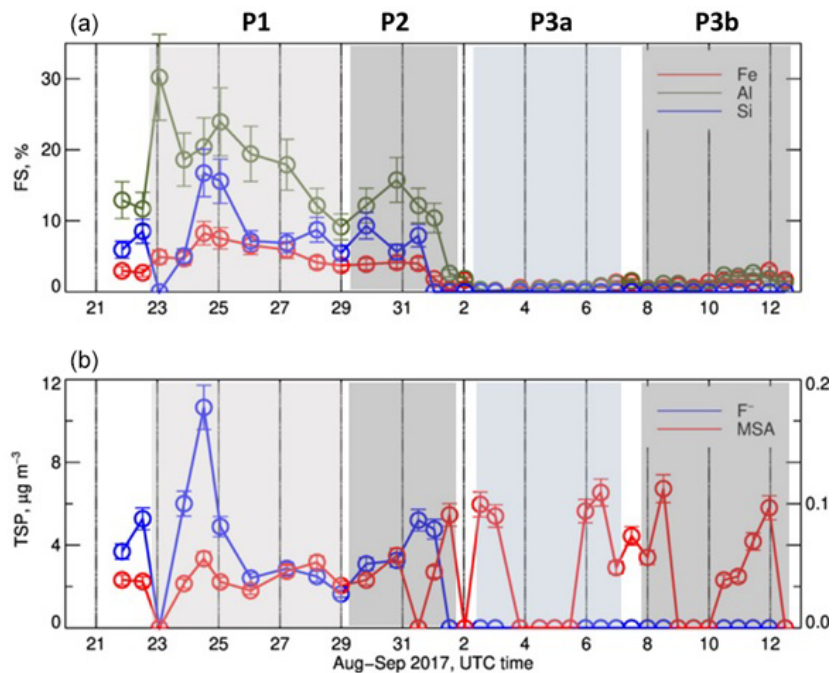


Figure: Top panel: Time series of the fractional solubility Al, Si and Fe in the TSP fraction. Bottom panel: Time series of concentrations of F⁻ (blue) and MSA (red) in the TSP fraction. The MSA concentrations are reported on the right axis of lower panel. Missing data correspond to periods when the measured concentrations were below the detection limit. Error bars on concentrations represent the analytical errors. Error bars on ratios represent the sum of percent analytical errors on measured concentrations.

Citation:

Giorio, C., et al. (2025) Contrasting solubility and speciation of metal ions in total suspended particulate matter and fog from the coast of Namibia - Part 1, *Atmos. Chem. Phys.*, 25, 16107-16125, <https://doi.org/10.5194/acp-25-16107-2025>

Formenti, P., et al. (2025) Elemental composition, iron mineralogy, and solubility of anthropogenic and natural mineral dust aerosols in Namibia: a case study analysis from the AEROCLO-sA campaign - Part 2, *Atmos. Chem. Phys.*, 25, 16127-16145, <https://doi.org/10.5194/acp-25-16127-2025>

Highlight 8 (Core Theme 3): Saharan dust deposition mechanism over Caribbean region: deposition models have to be improved for an accurate description of aerosol deposition processes.

Based on 14 months of measurements in the Guadeloupe Islands (Lesser Antilles), we describe the relationship between the aerosols suspended in the air and their deposition, both dry and wet. The models describing the behavior of atmospheric aerosols predict high concentrations in the air and a fairly slow total deposition rate, especially in the form of dry deposition. The results of our study demonstrate the opposite: in the case of the tropical island of Guadeloupe, the total atmospheric deposition fluxes are predominantly governed by wet deposition, leaving a very short residence time for atmospheric aerosols traveling close to the ground before they are brought down. We therefore measure low aerosol concentrations remaining in the air close to ground level. We highlight little-known phenomena of atmospheric aerosol scavenging close to the ground.

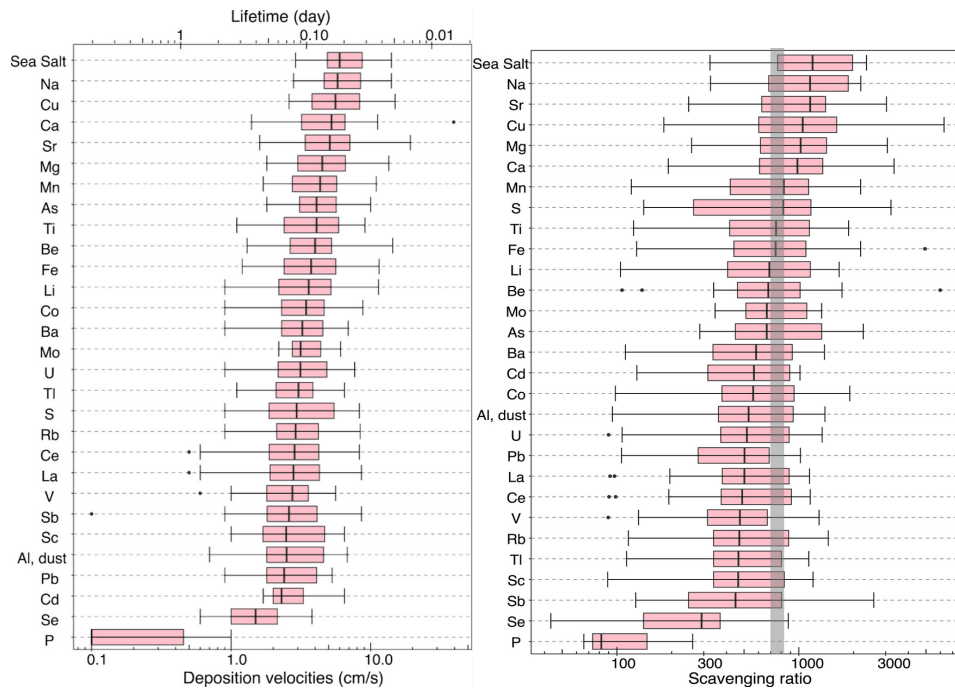


Figure: Measured deposition velocity (cm s^{-1}), lifetime (day), with a 66 m atmospheric layer thickness, and scavenging ratios for elements, dust (identical to Al), and sea salt (identical to sea-salt sodium).

Citation: Xu-Yang, Y., Losno, R., Dessert, C., Monna, F., Mahowald, N.M., Tharaud, M. (2025). Atmospheric aerosols versus total atmospheric deposition in Guadeloupe (Lesser Antilles): Composition, concentration, and flux. *Journal of Geophysical Research: Atmospheres*, 130, e2024JD042682. <https://doi.org/10.1029/2024JD042682>

2. Activities/main accomplishments in 2025 (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).

- **SOLAS-France workshop** (5-6 November 2025, Institut de Physique du Globe de Paris, Paris), <https://solas-france.org/index.php/journees-solas-france-2025/>
- **Website of SOLAS-France** (<https://solas-france.org/>), webmaster Marie Boye (boye@ipgp.fr)
- **Workshop of SCOR 166 - DMS-PRO** (Developing resources for the study of Methylated Sulfur compound cycling PROCesses in the ocean (<https://scor-int.org/group/developing-resources-for-the-study-of-methylated-sulfur-compound-cycling-processes-in-the-ocean-dms-pro/>), April 2025, Barcelona, Spain. Contact: Eva Bucciarelli (Eva.Bucciarelli@univ-brest.fr)
- **Field campaign OBS-AUSTRAL 2026** (R/V *Marion Dufresne II*) including the project VACOA (VOC and Aerosol Chemistry at the Ocean-Atmosphere interface in the Indian and Southern oceans, funding LEFE-CHAT, CNRS INSU, PI: J. Kammer, LCE; O. Magand, OSU-R; and M. Rocco, MIO/LCE) in Indian and Austral Oceans: measurement of ambient VOC concentrations (PTR-QMS), aerosol composition (ACSM) and link to phytoplankton abundance and environmental parameters. Contact. M. Rocco (manon.rocco@univ-amu.fr)
- * Development of large-scale autonomous observations from **profiling floats** to constrain air-sea CO_2 exchanges and the oceanic carbon sink.
 - * Member of the Steering Committee of **SOCONET (Surface Ocean CO_2 Reference Observing Network)**, and coordination with international initiatives such as SOCAT, GOOS, IOCCP, OceanOPS, and WMO/G3W.
 - * Co-chair of special sessions at the **OSM26** meeting in Glasgow (Feb. 2026): The Southern Ocean Carbon Sink: processes, observations, and change, and SOCONET: Current Status and Future

Prospects; and oral presentation (Delaigue, L., Sauzède, R., Sulpis, O., Boyd, P. W., Claustre, H., Reichart, G.-J., and Humphreys, M. P.: Uncovering the spatial redistribution of the biological carbon pump).

Contact: Louise Delaigue (louise.delaigue@imev-mer.fr)

- **Field campaign in New-Caledonia** (IRD boats and vehicles) in May-June 2025 in the framework of the CaledoNia project (funding LEFE-EC2CO, PI M. Boye, IPGP, collaborations with IRD-center of Nouméa, F. Juillot) to study the island mass effect of New Caledonia on marine biogeochemistry and phytoplankton assemblages. Presentations at the **OSM26** meeting, Feb. 2026, Glasgow (Moreau et al.; Boye et al.). Contact: Marie Boye (boye@ipgp.fr)

- After four years of international collaboration, the **CRiceS project**, led by IGE (J. L. Thomas, H. Angot, R. Price), with contributions from LATMOS (L. Marelle, J-C Raut, R. Lapere), has officially come to an end in 2025. Funded by the European Union's Horizon 2020 programme, CRiceS has brought together scientists from across Europe and beyond to better understand how the polar regions, including sea ice and snow, interact with the atmosphere and ocean, and why this matters for polar and global climate. Through observations, modelling, and close collaborations, CRiceS has helped to: - Improve how climate models represent polar processes and feedbacks - Deepen our understanding of how Arctic change affects the rest of the planet - Explore the role of clouds and airborne particles (aerosols) in shaping polar climate - Strengthen connections between field measurements and climate modelling. These advances have aimed to help scientists make more accurate predictions about future polar and global climate change. More info: <https://www.crices-h2020.eu/>

- J. Thomas (IGE) participated, as a **panel speaker**, to the policy webinar "The importance of European scientific leadership in polar climate change" in November 2025. Contact: Jennie Thomas (jennie.thomas@univ-grenoble-alpes.fr)

- * Participation in the **2026 Saroma Sea-ice School** as a teacher/group supervisor (<https://sites.google.com/site/bepsiiwg140/news/bepsi-catch-sea-ice-school-2026>).

- *Organization of the **Interdisciplinary Polar Science Lectures** at IPSL (<https://www.ipsl.fr/article/ecole-thematique-polaire-16-18-mars-2026/>), a 3-day school for PhD and Masters students, covering all the components of the polar climate system, including the ocean-ice-atmosphere interactions.

- * Co-organization of the **Early Career Researcher Workshop for the Synoptic Arctic Survey II** at the 2026 Arctic Science Summit Week, fostering collaboration among ECRs to design an interdisciplinary training research cruise towards SAS II.

Contact: Rémy Lapere (remy.lapere@latmos.ipsl.fr)

- IGE organized the **2025 European Research Course on the Atmosphere** winter school, with contributions from LATMOS.

- Release of the **WRF-Chem-Polar code** (overview paper in preparation): <https://github.com/WRF-Chem-Polar/WRF-Chem-Polar>

- The **3rd edition of the Iron at the Air-Sea Interface** (<https://nicholasmeskhidze.com/iron-at-the-air-sea-interaction-workshop-joint-with-rusted-2025/>) organised by members of the **SCOR working group 167** (RUSTED), Drs Nicholas Meskhidze, Douglas Hamilton (North Carolina State University, USA), Morgane Perron (LEMAR, France) and Akinori Ito (JAMSTEC, Japan), Asheville, NC, 28-31 July 2025. It gathered 55 atmospheric scientists, oceanographers, and modelers from 13 countries to discuss fundamental gaps spanning laboratory measurements, field observations, mechanistic understanding, and model capabilities, that prevent better understanding how atmospheric deposition influences ocean productivity. A **white paper** was circulated to funding agencies and relevant scientific networks: <https://doi.org/10.5281/zenodo.19361638>. Contact: Morgane Perron (morgane.perron@univ-brest.fr)

- Participation in the **GESAMP WG38 workshop**, Heraklion, Crete, April 7-10, 2025, to better measure and model the wet and dry deposition fluxes of different gaseous and particulate substances between the atmosphere and the ocean, and in **Ocean Science Meeting**, Glasgow, UK, February 22-27, 2026 for an oral presentation at the Aerosol Deposition in the Ocean: Sources,

Drivers, and Biogeochemical Effects. Contact: Morgane Perron (morgane.perron@univ-brest.fr)

- **Field campaign on the Amsterdam island**, Nov-Dec 2025 (*R/V Marion Dufresne*) to resume all possible atmospheric measurements that had been interrupted due to a major fire in January 2025, which included CO₂, CH₄, N₂O, and CO, radon measurement, ozone, atmospheric particles (size, composition, and properties), atmospheric gaseous mercury, mercury in rainwater, and collection of emerging contaminants in air, rain and seawater, atmospheric particulate matter collection on filters, optical and microphysical properties of particles of atmospheric column, run by several research institutes in France (LSCE, LOA, LAMP, IGE). Although the fire did not directly damage the instruments, the long period of downtime and storage in a humid and corrosive environment caused by sea salt led to numerous problems and even the breakage of certain parts. Some instruments could not be restarted and will be repaired in the coming months. The coming months will be crucial for assessing the quality of the new observations, both because of potential damage to the instruments and due to the influence of the base itself. Contact: Aurélien Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr)

- **Development of an optical sensing platform for real-time *in situ* measurements of seawater pCO₂ and air-sea CO₂ flux** that exhibits strong potential for a wide range of scientific and operational applications, including: coastal carbon cycle studies; high-resolution process studies; climate and decarbonization-related applications, such as improving quantification of coastal CO₂ sources and sinks, contributions to global carbon budget assessments (e.g., IPCC frameworks), and monitoring the effectiveness of nature-based solutions such as blue carbon ecosystems; integration into autonomous and distributed observing systems (like drones, commercial ships, and fixed buoys). This optical sensor works with calibration-free or low-calibration measurement capability, inherent to absorption spectroscopy techniques, unlike conventional chemical analyzers, enabling enhanced long-term stability, reduced maintenance, and improved suitability for autonomous deployments. Presentations at **EGU General Assembly 2025**, Vienna, Austria & Online, 27 April-2 May 2025 (Hu et al., Optical sensing platform based on tunable laser absorption spectroscopy for the measurement of carbon dioxide dissolved in seawater) and **Autumn PIERS 2025**, 5-9 November 2025, Chiba, Japan (Hu et al., Carbon observation from the ocean to the lower stratosphere with photons). Contact: Weidong Chen (weidong.chen@univ-littoral.fr)

- * Organization of the **SS2025 GOOD/OARS International Summer school** at CEMACS in Malaysia, Penang from 4 to 11 November 2025. Co-Directors of the School: Véronique Garçon, Aileen Tan Shau Hwai, Minhan Dai. The full program of the school can be found at: <https://penangsummerschool2025.usm.my/>). An event report summary can be found at: <https://www.solas-int.org/publications/publications-reader/issue-42-international-good-oars-summer-school-2025.html> (SOLAS was one of the co-sponsors).

- * Organization of a **side event at UNOC 3 on the role of the Ocean in the Planetary Boundary Framework** in the EU Pavilion on June 12, 2025: <https://www.digitaloceanpavilion.eu/content/the-eu-the-marine-observing-infrastructure>

Contact: Véronique Garçon (garcon@ipgp.fr)

- **The cruises of the *Persévérance* with real-time measurements of atmospheric pollutants and trace gases**. The *Persévérance* is a sailboat belonging to the "Polar Ocean" association, headed by Jean-Louis and Elsa Etienne. This vessel carries several scientific instruments, including five atmospheric measurement systems, the **AtmoBox**, monitoring gaseous mercury, ozone, nitrogen oxides, radon, and a laser particle counter. Over the past 8 months, the ship departed Nice, France, in the Mediterranean Sea, crossed the Strait of Gibraltar and the North Atlantic to reach Nuuk, Greenland, then San Francisco, via the Northwest Passage and the Bering Strait, along the Mexican coast, to Clipperton Atoll, Papeete, Tahiti, Christchurch, New Zealand, the Antarctic coast and finally Hobart, Tasmania. Atmospheric quality was continuously monitored during this period. As expected, pollution is highest in ports and decreases during the passage from the Atlantic to the Pacific, with a further decrease upon entering the Southern Hemisphere. Despite issues encountered with NO_x measurements and the rapid wear of the gold trap included in the mercury analyzer system, the AtmoBox onboard system has the unique feature of transmitting its data in real time (<https://www.lge.ipgp.fr/Perseverance/>), thus allowing its operation to be monitored by a team of scientists on Earth when there are no qualified personnel on board. Upcoming presentation at **EGU General Assembly 2026**, 3-8 May 2026, Vienna, Austria (Losno et al., 2026, AtmoBox, a real

time device to measure atmospheric pollutants on board of *Persévérance*: transoceanic and polar cruises). Contact: Rémi Losno (losno@ipgp.fr)

3. Publications in 2025 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Aguilera et al. (2025) Characterization of copepod ingestion rates in the Humboldt Archipelago and implications for a biogeochemical model of the Coquimbo upwelling system, *Estuarine, Coastal and Shelf Science*, <https://doi.org/10.1016/j.ecss.2025.109195>

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Dinasquet, J., D.S. Hamilton, I.M. Leyba, J. Llorca, T. Marshall, R.R. de Oliveira, M.M.G. Perron, L. Tinel, V. Garçon, C. Marandino, N. Steiner, D. Wallace, L. Li (2025) Thriving through synergy: Fostering a SOLAS science community built on equity, international connections, and the integration of early career scientists. *Oceanography*. 38. doi.org/10.5670/oceanog.2025.140.

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Xu-Yang, Y., Losno, R., Dessert, C., Monna, F., Mahowald, N. M., & Tharaud, M. (2025). Atmospheric aerosols versus total atmospheric deposition in Guadeloupe (Lesser Antilles): Composition, concentration, and flux. *Journal of Geophysical Research: Atmospheres*, 130, e2024JD042682. <https://doi.org/10.1029/2024JD042682>

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2025? If yes, who? How did you engage?

- Launch of an **International Scientific Networks and Observing Infrastructures**, SOCONET (Surface Ocean CO₂ Reference Observing Network), for improving observations of surface ocean CO₂ and air-sea exchange. Communication on how ocean observations can reveal climate-relevant signals (https://www.youtube.com/watch?v=mPi08_HC6cg). Contact: Louise Delaigue (louise.delaigne@imev-mer.fr)
- The work of Molepo and co-workers on elemental mercury air-sea exchange (Molepo et al. 2025) contributes to the scientific basis underpinning the **Minamata Convention on Mercury**, for which atmospheric Hg monitoring is a key indicator of effectiveness. Long-term datasets from remote stations such as Amsterdam Island are particularly valuable for detecting changes in global background levels. The published data set is used for the first effectiveness evaluation of the Minamata Convention. Contact: Aurélien Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr)
- During the **GOOD-OARS Summer School**, we engage with local stakeholders along with all students explaining the threats brought up by warming, OA and deoxygenation on marine resources. Contact: Véronique Garçon (garcon@ipgp.fr)

PART 2 - Planned activities for 2026 and 2027

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

- **SARNEIO project** (collab. M. Rocco, MIO/LCE; J. Kammer, LCE and M. Thyssen, MIO): measure of BVOCs emissions from cultures of phytoplankton and *in-situ* from Mediterranean samplings. *Contact: M. Rocco (manon.rocco@univ-amu.fr)*
- LaMP-CNRS will participate to the **MISO2 cruise** planned Jan-Feb 2027 on board the R/V *Marion Dufresne*, joining international efforts to characterize marine aerosol-cloud interactions in the Southern and Antarctic Ocean. *Contact: Karine Sellegri (K.Sellegri@opgc.fr)*
- IGE and LATMOS are co-leading a **model intercomparison initiative on bromine in the Arctic**. The publication of the results is planned for late 2026-early 2027.
- **Completely relaunch the Atmospheric Observations Network at Amsterdam Island in the southern Indian Ocean**: within the framework of the ANR OBS4CLIM project (<https://www.obs4clim.fr/>), in coordination with several French institutes and with the support of the French Polar Institute, atmospheric observations will be maintained in the coming years on the Amsterdam Island. Although this requires significant human and financial resources, the atmospheric science community that is active at this site for many years strongly hopes that the Pointe Bénédicte site, unique due to its privileged location and minimal human influence, can be restored as quickly as possible in order to continue these unique observations. *Contact: Aurélien Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr)*
- Within the framework of the **EU funded SAFSEA project**, organization of **several stakeholders meetings** in Norway, Chile and France (in late 2026 and early 2027) to assess risk perception related to ocean acidification, building on the extensive work carried out with these communities on warming and deoxygenation (including both long-term trends and extreme events). We can also tap into ancestral knowledge to refine metrics, and gain insights into needs of the local communities. The idea would also be to start thinking on how to quantify multi-stressor effects from an observational and practical perspective. *Contact: Véronique Garçon (garcon@ipgp.fr)*

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

- **DMSP Symposium** planned in Oct 2026 (Maine, USA). *Contact: Eva Bucciarelli (Eva.Bucciarelli@univ-brest.fr)*
- **VACOA team workshop** in June 2026 & Conferences - **ACTRIS Science Conference 2026** and **IGAC 2026** (posters): Rocco M., Guignard U., Kammer J., Magand, O., Metzger J.-M., Marquestaut N., Desprairies G., Gros V., Petit J.-E., Bergé A., Colomb A., Thyssen M., Kolasinski J., Tulet P., Pianezze J., Brioude J., Kammer J., First results of VACOA field campaign: VOC and Aerosol Chemistry at the Ocean-Atmosphere interface in the Indian and Southern Ocean. *Contact: M. Rocco (manon.rocco@univ-amu.fr)*
- **Optimal Ocean Carbon Observing Design Workshop**, Flanders Marine Institute, Ostend, Belgium, 10-11 June 2026. This workshop will focus on the design of an optimal surface ocean pCO₂ observing network, building on current intercomparison efforts and contributing to observing system design requested by WMO Global Greenhouse Gas Watch (G3W). *Contact: Louise Delaigue (louise.delaigne@imev-mer.fr)*
- **SOLAS-France meeting**, spring 2027. *Contact: Marie Boye (boye@ipgp.fr) and Karine Sellegri (K.Sellegri@opgc.fr)*
- IGE will organize the **2026 European Research Course** on the Atmosphere winter school, with contributions from LATMOS. *Contact: Rémy Lapere (remy.lapere@latmos.ipsl.fr)*
- Next **SS 2027 Summer School GOOD OARS** in Canada and upcoming SOLAS OSC in New Zealand. *Contact: Véronique Garçon (garcon@ipgp.fr)*

3. Funded national and international projects/activities underway.

- **SARNEIO project** (post-doctoral funding by the Ocean Institute): understand the VOC emitted from phytoplankton cultures. *Contact: M. Rocco (manon.rocco@univ-amu.fr)*
- **SOPHYAC-Light post cruise activities**: final workshop and presentations at the EGU 2025 (Quélever et al.) and the OSM26 (Dulaquais et al.).
- **Horizon Europe CERTAINTY project** (Cloud-aERosol inTeractions & their impActs IN The earth sYstem - <https://certainty-aci.eu/>, 2024–2027)- led by IGE with contribution of LATMOS
- **ANR ATOX** (Dec 2024–Dec 2028; <https://www.newarctictoxic.fr/>) on the Arctic mercury cycle and mercury exchange processes at the ocean-sea ice-atmosphere interface- led by IGE.
- **ANR BUBBLEPLAST** (Transfer through air bubble bursting of micro and nanoplastics from the ocean to the atmosphere) - led by IGE.
- **ANR MPC2**- led by LATMOS
- **French Polar Programs**: 416 - SNO-AMS / ICOS-France, 1274 MACA, 1028 GMOStral, 1177 CAPOXI, 1165 AERONET - *Contact: Aurélien Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr)*
- **ANR OBS4CLIM**, 2021-2029 (<https://www.obs4clim.fr/>)
- **EU funded BioGeoSea** (2025-2029)-GEOMAR lead (Germany) and **SAFESEA** (2026-2029)-PML Lead (UK). *Contact: Véronique Garçon (garcon@ipgp.fr)*

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

- **EU COST-SOLAS action**. A proposal led by Marie Boye will be submitted to the next call for projects (Autumn 2026). *Contact: Marie Boye (boye@ipgp.fr)*
- **ANR Proposal SAFE-PHY project** - Secondary Aerosol Formation rELated to PHYtoplankton VOC emissions. *Contact: M. Rocco (manon.rocco@univ-amu.fr)*
- **Field campaign planned in the Southern Ocean** in the framework of the Horizon Europe TRICUSO project (EUR 10 million). This campaign will involve the deployment of BGC-Argo floats equipped with temperature, salinity, oxygen, and passive acoustic sensors for wind, with the aim of better constraining air-sea exchanges through enhanced autonomous observations of the upper ocean. *Contact: Louise Delaigue (louise.delaigue@imev-mer.fr)*
- **ANR Proposal- SOrBEH** "SOuthern Ocean Biogeochemical Emissions: Impact of Heat Waves", phase 2 submitted Feb 2026- partners CNRS-LaMP (K. Sellegri), LEMAR (G. Dulaquais), LATMOS (J. Delanoë).
- Idea to create a **SCOR working group** on coupled modelling for polar regions, following the end of the Cice2Clouds working group. (submission planned April 2027 to SCOR). *Contact: Rémy Lapere (remy.lapere@latmos.ipsl.fr)*
- Strengthening constraints on **Hg⁰ air-sea exchange** through more *in situ* observations, particularly in the Southern Hemisphere. This will include the development of direct flux measurements and coupled atmospheric-oceanic observations - using research vessels for instance to better quantify oceanic Hg emissions and their variability. *Contact: Aurélien Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr)*

- **Go further and beyond with the optical sensing platform of CO₂ air-sea measurements**, by coupling the platform with drone-borne atmospheric CO₂ measurements to enable direct constraint of air-sea fluxes; improve gas-liquid equilibration efficiency and system response time to resolve rapid CO₂ dynamics, particularly in highly turbulent coastal environments; integration with complementary environmental observations-including temperature, salinity, wind speed, isotopic composition (e.g., ¹³CO₂), and biological activity to understand the processes controlling air-sea CO₂ exchange; pursue long-term measurements and sustained deployments to investigate seasonal to interannual variability and contribute to the development of continuous ocean carbon observing systems. Finally, assimilation of high-resolution measurements into regional climate models and emerging digital twin frameworks of coastal systems represents a promising direction for enhancing predictive capabilities. Beyond CO₂, the optical and modular nature of the platform offers strong potential for multi-species detection, paving the way toward a new generation of autonomous, low-maintenance, and calibration-light observing systems for ocean greenhouse gas monitoring at the ocean-atmosphere interface. Extending the platform to the measurement of other climatically relevant gases, such as methane (CH₄) and nitrous oxide (N₂O) dissolved in seawater, represents a highly promising direction. These gases play a critical role in the global greenhouse gas budget, yet their air-sea fluxes remain poorly constrained, particularly in coastal environments. The development of high-resolution, in situ optical measurements for CH₄ and N₂O would significantly enhance observational capabilities within the framework of programs such as SOLAS. *Contact: Weidong Chen (weidong.chen@univ-littoral.fr)*

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

- **SOLAS Europe Regional Panel**: The Regional Panel is established to structure and bring to life an interactive SOLAS network in Europe, identify possibilities and coordinated methods to foster research collaboration among SOLAS-related researchers in Europe, encourage early career scientists, and promote the mobility among SOLAS-related laboratories in Europe (<https://www.solas-int.org/index/networks/europe-regional-panel.html>) *Contact: Marie Boye (boye@ipgp.fr) and Manuela van Pinxteren (manuela@tropos.de)*
- **SCOR 166 - DMS-PRO (2023-2027)**: Developing resources for the study of Methylated Sulfur compound cycling PROCesses in the ocean (<https://scor-int.org/group/developing-resources-for-the-study-of-methylated-sulfur-compound-cycling-processes-in-the-ocean-dms-pro/>). *Contact: Eva Bucciarelli (Eva.Bucciarelli@univ-brest.fr)*
- **OASIS** (<https://airseaobs.org/>). *Contact: Marie Boye (boye@ipgp.fr)*
- Engagement/lead **Tara polar station** (LATMOS)
- **Antarctica InSync** (IGE and LATMOS)
- Engagement in **SAS II** (LATMOS)
- **Co-chair of IOCCP**, the GOOS Biogeochemistry panel. **OARS Outcome 3** on Observing strategies co-champion. Member of the **GO2NE IOC UNESCO working Group**. *Contact: Véronique Garçon (garcon@ipgp.fr)*

Comments