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SOLAS-France

https://solas-france.org

India | SOLAS Open Science Conference 2024

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The **SOLAS-France** community brings together a community of scientists from more than 12 laboratories with expertise in the study of the surface ocean and the lower atmosphere, as well as the feedbacks that operate between these two environments.
The SOLAS-France activities are supported by the national program **LEFE** (Les Enveloppes Fluides et l'Environnement) managed by the **INSU** (Institut National des Sciences de l'Univers) of **CNRS**.
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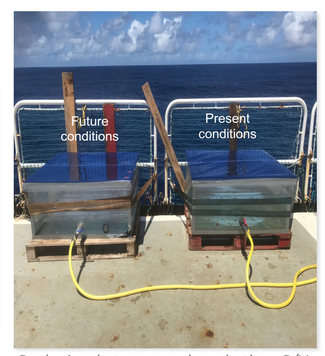
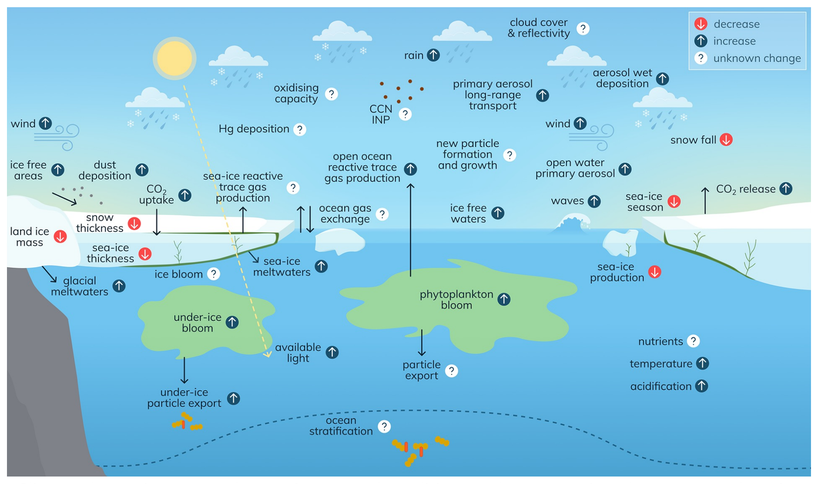


Deck incubators on board the *R/V Marion Dufresne* in Feb.-March 2022. Demasy et al. (subm. to Earth's Future)

Responses of phytoplankton to Patagonian dust input and anthropogenic changes in the future Southern Ocean

C. Demasy and M. Boye (boye@ipgp.fr), IPGP

On board incubations show that future changes in Patagonian Fe-dust input, temperature and pH trigger a dissimilar phytoplankton response in different regions of the Southern Ocean, principally due to effect on diatoms. Future conditions benefit mainly smaller species (haptophytes and picophytoplankton) while phytoplankton assemblage is not modified overall. The primary production does not change under future conditions, but the increase in long-chain diatoms in the future HNLC waters can suggest intensification of carbon export.



Climate change impacts on key environmental conditions and processes in polar oceans and sea ice Willis et al. (2023) Elementa: Science of the Anthropocene 11(1).

Polar oceans and sea ice in a changing climate

J.L. Thomas (jennie.thomas@univ-grenoble-alpes.fr) and H. Angot (helene.angot@univ-grenoble-alpes.fr), IGE, University of Grenoble Alpes

Polar oceans and sea ice cover 15% of the Earth's ocean surface, and the environment is changing rapidly at both poles. Improving knowledge on the interactions between the atmospheric and oceanic realms in the polar regions, a SOLAS project key focus, is essential to understanding the Earth system in the context of climate change. However, our ability to monitor the pace and magnitude of changes in the polar regions and evaluate their impacts for the rest of the globe is limited by both remoteness and sea-ice coverage. Sea ice not only supports biological activity and mediates gas and aerosol exchange but can also hinder some in-situ and remote sensing observations. While satellite remote sensing provides the baseline climate record for sea-ice properties and extent, these techniques cannot provide key variables within and below sea ice. Recent robotics, modeling, and *in-situ* measurement advances have opened new possibilities for understanding the ocean–sea ice–atmosphere system, but critical knowledge gaps remain. Seasonal and long-term observations are clearly lacking across all variables and phases. Observational and modeling efforts across the sea-ice, ocean, and atmospheric domains must be better linked to achieve a system-level understanding of polar ocean and sea-ice environments. As polar oceans are warming and sea ice is becoming thinner and more ephemeral than before, dramatic changes over a suite of physicochemical and biogeochemical processes are expected, if not already underway. These changes in sea-ice and ocean conditions will affect atmospheric processes by modifying the production of aerosols, aerosol precursors, reactive halogens and oxidants, and the exchange of greenhouse gases. Quantifying which processes will be enhanced or reduced by climate change calls for tailored monitoring programs for high-latitude ocean environments. Open questions in this coupled system will be best resolved by leveraging ongoing international and multidisciplinary programs, such as efforts led by SOLAS, to link research across the ocean-sea ice-atmosphere interface.

Biogeochemistry of greenhouse gases in coastal upwelling systems: processes and sensitivity to global change

V. Garçon (garcon@ipgp.fr) and co-workers, IPGP & LEGOS

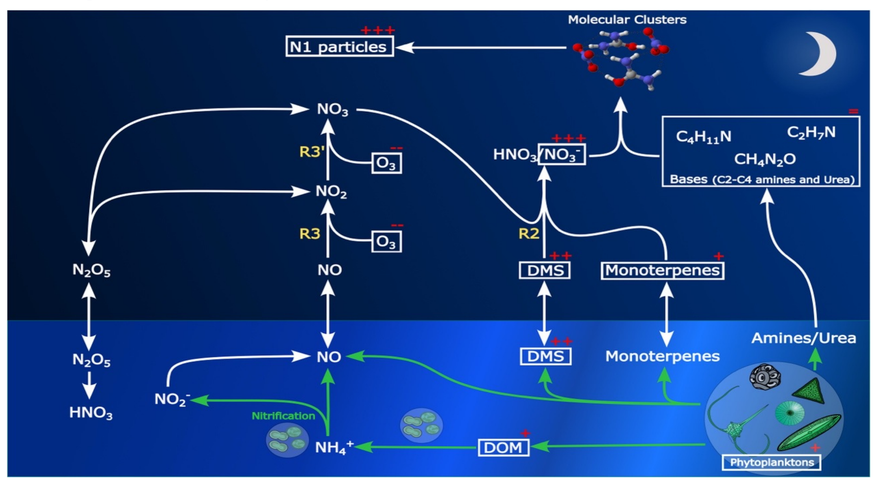
We provide a short synthesis of the current knowledge of the contributions of major coastal upwelling systems to the cycling of greenhouse gases (GHG) such as CO_2, N_2O, and CH_4. Despite variations within and among different systems, low-latitude coastal upwelling systems typically act as a net carbon source to the atmosphere, while those at higher latitudes function as weak sinks or remain neutral regarding atmospheric CO_2. These systems also significantly contribute to oceanic N_2O and CH_4 emissions, although the extent of their contribution to the latter remains poorly constrained. We also overview recent and future changes to upwelling systems in the context of a warmer climate and discuss uncertainties and implications for GHG production. Although rapid coastal warming is anticipated in all major coastal upwelling systems, the future changes in upwelling-favorable winds and their implications within the context of increased stratification are uncertain. Finally, we examine the major challenges that impede our ability to accurately predict how major coastal upwelling systems will respond to future climate change, and present recommendations for future research to better capture ongoing changes and disentangle natural and forced variability.

Overview of physical and biogeochemical processes in major coastal upwelling systems Zouhair et al. (2024) Elementa: Science of the Anthropocene, 12 (1).

Nitrate-based nighttime atmospheric nucleation driven by marine microorganisms

G. Chamba and K. Sellegri (K.Sellegri@opgc.univ-pbclermont.fr), LaMP

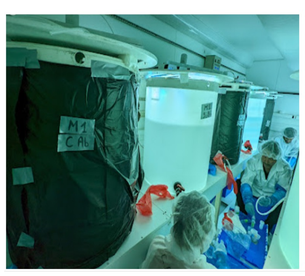
Using measurements collected in ship-borne air-sea interface tanks deployed in the Southwestern Pacific Ocean, new particle formation was identified during nighttime that was related to plankton community composition. They show that nitrate ions are the only species for which abundance could support new particle formation rates in the semi-controlled experiments. Nitrate ions also prevailed in the natural pristine marine atmosphere and were elevated under higher sub-10 nm particle concentrations. Hypotheses on nitrate-based emissions are complex short-term biogeochemical cycles involving the microbial loop.



Chamba et al. (2023) PNAS, 120 (48).

How biomass combustion aerosols affect the chemical composition of seawater and what is its impact on marine micro-organisms?

C. Guieu (cecile.guieu@imev-mer.fr), LOV, and E. Ortega-Retuerta (eva.ortega-retuerta@obs-banyuls.fr), LOMIC




A ground-breaking experiment was conducted in July 2022 using ash collected after a real forest fire to gain a detailed mechanical understanding of how biomass combustion aerosols (BBa) disrupt the chemical composition of seawater and their impact on marine micro-organisms. To do this, we used our cleanroom container in "sedentary" mode in the laboratory, pumping *in situ* oligotrophic water. The adsorption/desorption kinetics of nutrients and metals (with a strong focus on Fe) provided by BBa in seawater, the pattern of dissolved organic matter, as well as their impact on biota (bacteria and phytoplankton) were quantified.

The experiment lasted 14 days in 9 tanks to represent wet deposition with a rotating device that correctly imitated the rain droplets containing the BBa particles deposited on the surface of tank. Gueiu et al. (2023) XMAS-VI invited talk.

SOPHYAC-Light project

K. Sellegri (K.Sellegri@opgc.univ-pbclermont.fr), LaMP, and M. Boye (boye@ipgp.fr), IPGP

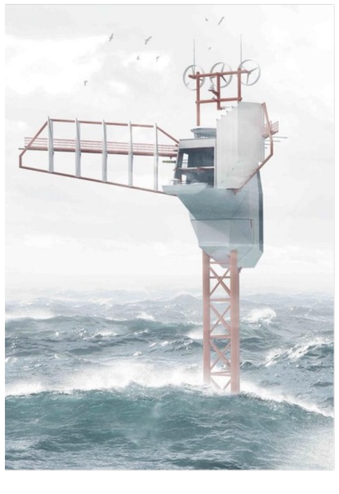
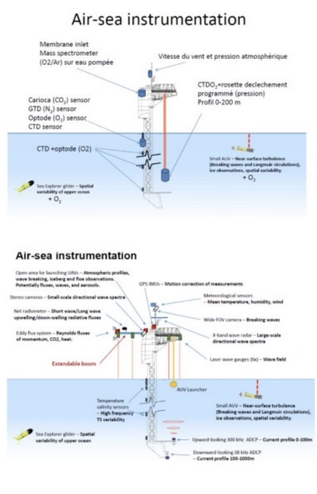
The main objective of the SOPHYAC-Light project (2024-2025) is to investigate the impact of UV light on marine microorganisms of the Southern Ocean and the subsequent release of precursor gases to nucleation in the atmosphere. This will be investigated using incubation experiments that will be carried out during a cruise aboard the *R/V Marion Dufresne* scheduled for December 2024-February 2025.

Polar POD project

David Antoine (david.antoine@curtin.edu.au), Peter Sutherland, Karine Leblanc, Cédric Cotte, Rémi Losno

Polar-Pod program really starts after a decade of preparation. More than 100 researchers of 43 worldwide research institutions are involved in the Polar POD scientific program. It will be an essential contribution to the program of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). All data will be available to the entire scientific community as well as the general public.

https://www.polarpod.fr

Model intercomparison in atmospheric chemistry

J.L. Thomas (jennie.thomas@univ-grenoble-alpes.fr), IGE

Model intercomparison between LATMOS and IGE laboratories, which is a CATCH effort (SOLAS and IGAC).

https://github.com/jenniethomas/arctic-bromine-model-intercomp

REFUGE-ARCTIC campaign

H. Angot (helene.angot@univ-grenoble-alpes.fr), IGE, L.-E. Heimburger (lars-eric.heimburger@mio.osupytheas.fr), MIO

A cruise aboard the Amundsen was conducted in early August to early October 2024 in order to study the Nares Strait and the Lincoln Sea. Mercury (Hg) concentrations were measured in the atmosphere and the water-column, and they will serve to estimate exchange fluxes at the ocean-sea ice-atmosphere interfaces in different types of ice (multi-year or first-year sea ice).

Amsterdam Island: Installation of a new station for aerosol measurements

K. Sellegri (K.Sellegri@opgc.univ-pbclermont.fr), LaMP, and A. Dommergue (aurelien.dommergue@univ-grenoble-alpes.fr), IGE

Researchers from LaMP and IGE initiated aerosol measurements (number size distribution 2 nm-10 microns; submicron aerosol chemical composition, fluorescence, scattering properties) at Amsterdam Island since April 2024.

MAP-IO (Marion Dufresne Atmospheric Program Indian Ocean)

P. Tulet (pierre.tulet@aero.obs-mip.fr), LACy

The *R/V Marion Dufresne* has been equipped with atmospheric and oceanic sensors that operate on a continuous basis since 2022, and will continue to be tested as a mobile measurement station for 2024. Atmospheric sensors relevant for SOLAS comprise SMPS, CPC, CCNC, OPC, ozone and NOx analysers, picaro for GHG, sunphotometer and miniSAOZ, while oceanic sensors comprise an on-line flow cytometer.

http://www.mapio.re