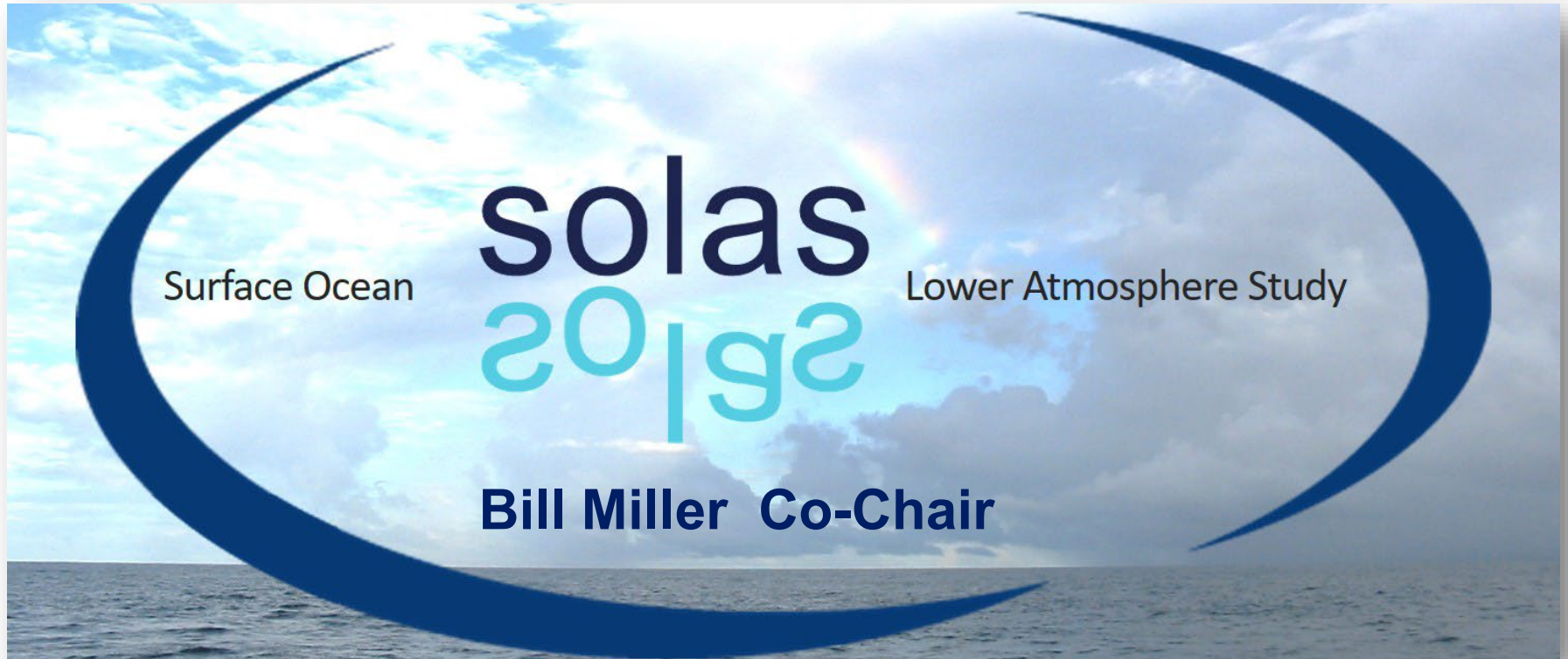


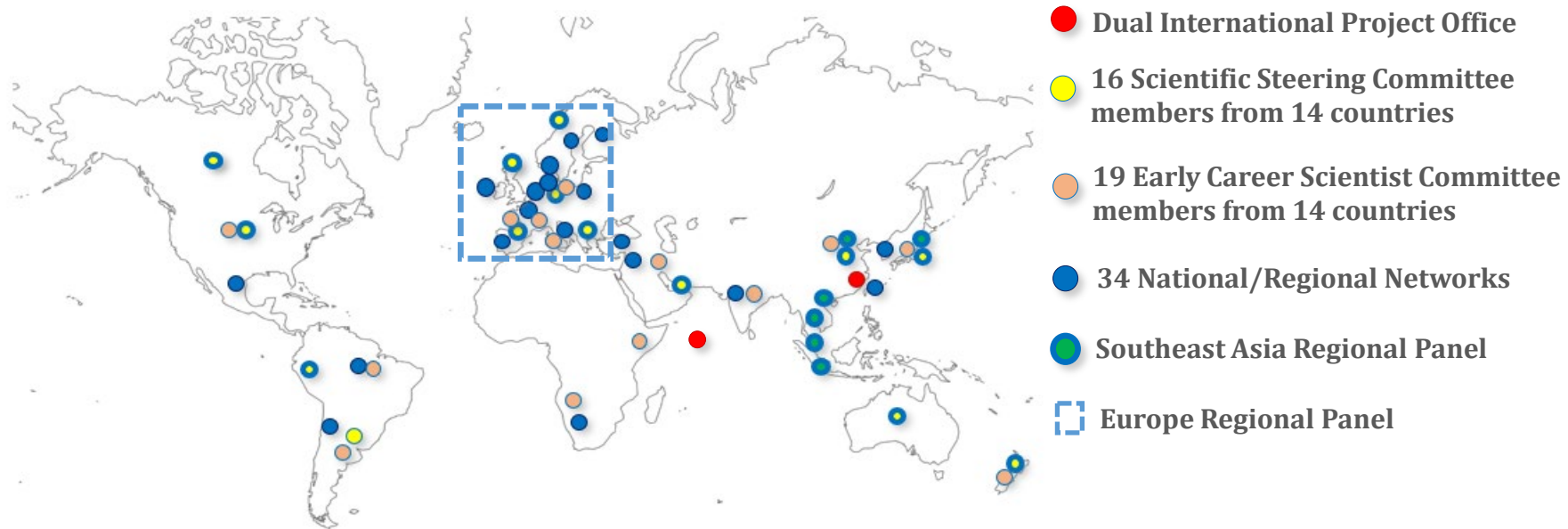
SOLAS International Project Office
State Key Laboratory of Marine Environmental Science
Xiamen University, China. www.solas-int.org. solas@xmu.edu.cn



SOLAS Mission

"to achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and atmosphere, and of how this coupled system affects and is affected by climate and global change."

Global network



> 1200 core member scientists

TRAINING
9 Summer Schools
with ~ 600 early
career researchers

NETWORKING
9 Open Science Conferences
~1900 participants

**KNOWLEDGE
EXCHANGE**
>100 sponsored
workshops

PROJECTS
> 40 sponsored/affiliated/
endorsed projects globally

COMMUNICATION
>100 e-bulleting,
newsletters, and reports

OUTPUTS
> 200 publications and policy
advisories annually

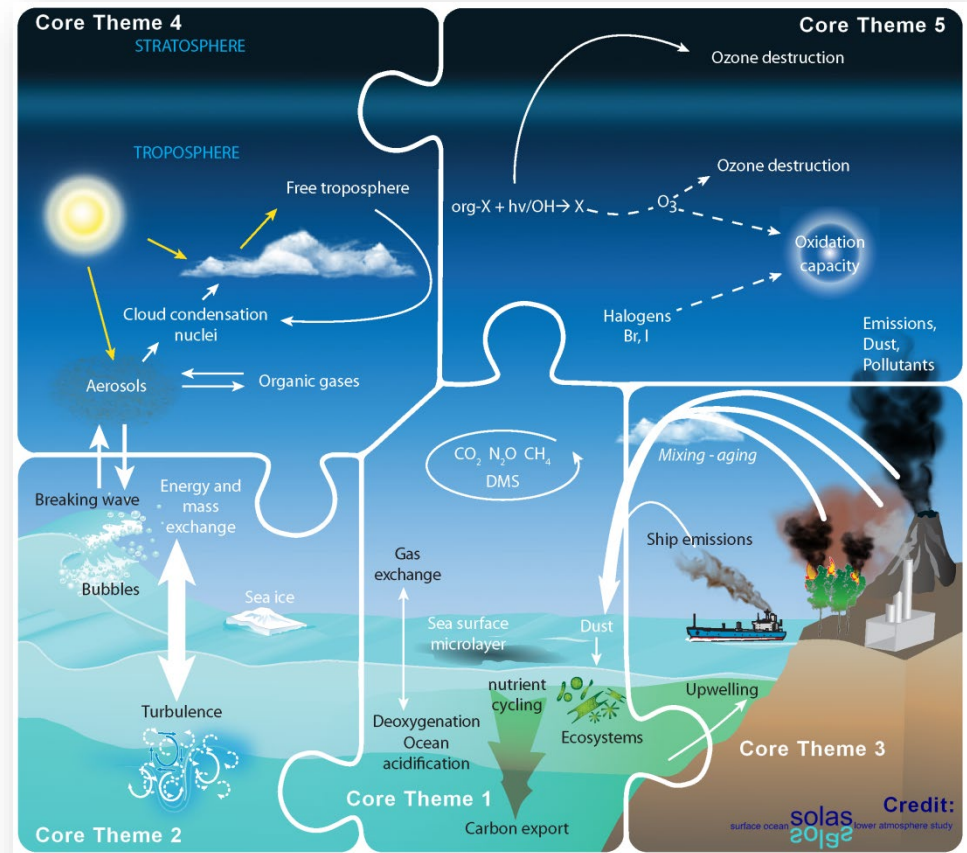
Science Plan 2015-2025

Core Themes:

1. Greenhouse gases and the oceans
2. Air-sea interface and fluxes of mass and energy
3. Atmospheric deposition and ocean biogeochemistry
4. Interconnections between aerosols, clouds, and marine ecosystems
5. Ocean biogeochemical controls on atmospheric chemistry

Cross-Cutting Themes:

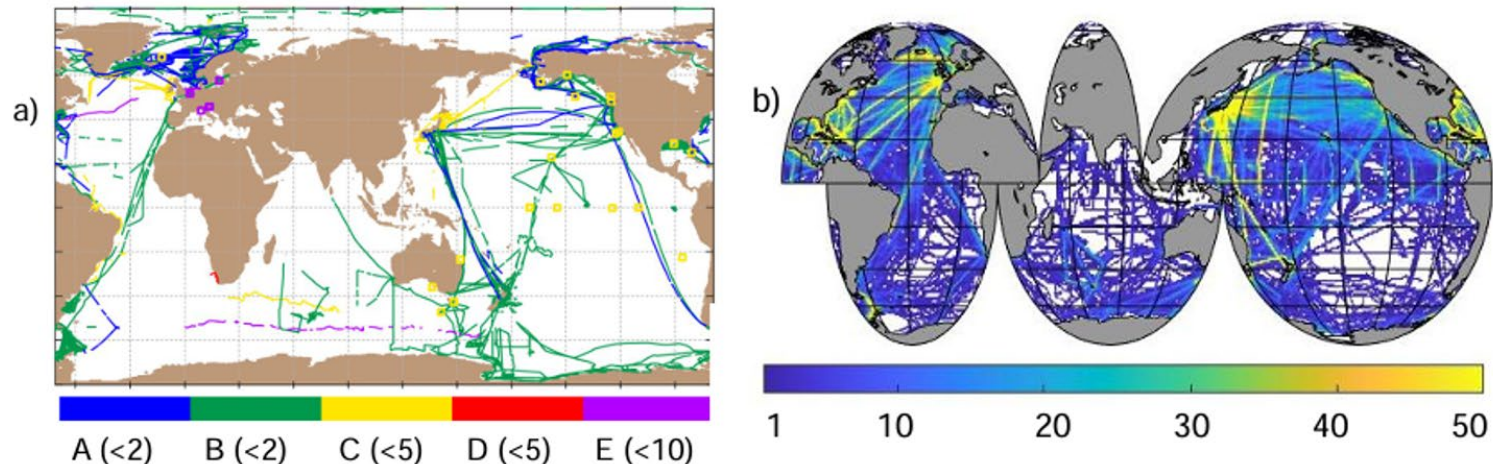
1. Integrated topics (e.g., upwelling systems, Polar & Indian Oceans)
2. Climate Intervention
3. Science and Society



Theme 1: Greenhouse gases and the oceans

Surface Ocean CO₂ Atlas (SOCAT)

- An annual synthesis activity since 2007 for quality-controlled, surface ocean $f\text{CO}_2$ observations by the international marine carbon research community.
- SOCAT Version 2025 contains 41.4 million $f\text{CO}_2$ measurements collected between 1957 and 2024 with an estimated accuracy of better than $5 \mu\text{atm}$.



a) Newly available fugacity of carbon dioxide ($f\text{CO}_2$) in v2025, colour coded by data set Quality Control (QC) flag with the uncertainty in μatm in brackets. Squares indicate moorings. b) Number of individual months with $1^\circ \times 1^\circ$ gridded $f\text{CO}_2$ from 1970 to 2024.

Theme 1: Greenhouse gases and the oceans

Integrated Ocean Carbon Research (IOC-R)

- Succeeds and expands on the SOLAS-IMBeR Ocean Carbon Research mandate of 2006.
- Launched in 2018 in collaboration with IOC/UNESCO, IOCCP, IMBeR, GCP and **CLIVAR**.
- 1st report published in 2021 to synthesize the state of knowledge about the oceans' role in the carbon cycle and point to the way ahead.
- 2nd report “Integrated Ocean Carbon Research: a vision primed for implementation” launched at UNOC3.



SOLAS-IMBeR Ocean Acidification (SIOA) working group

- Launched in 2009 to coordinate international research efforts and synthesis activities in ocean acidification.
- Serves as an advisory panel for the Ocean Acidification International Co-ordination Centre (OAICC) of International Atomic Energy Agency (IAEA).
- Training workshops, data compilation and management.

Theme 2: Air-sea interface and fluxes of mass and energy

Remote sensing for air-sea interface study

Project

- ESA's support through Science Element (STSE) initiative. Two OceanFlux Greenhouse Gas projects funded.

Workshops and seminars

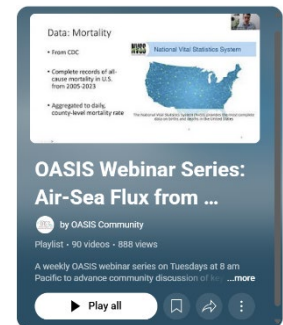
- 2016: SOLAS-ESA workshop, Frascati, Italy.
- 2018: SOLAS-ESA-NASA workshop, Washington, D.C., USA.
- 2019: SOLAS session at ESA Living Planet Symposium
- 2021: EUMETSAT-Copernicus-SOLAS workshop, online
- Since 2023: OASIS Webinar Series "Air-Sea Flux from Space"

Special issues and publication

- <https://www.solas-int.org/publications/publications.html>

Eddy Covariance Initiative

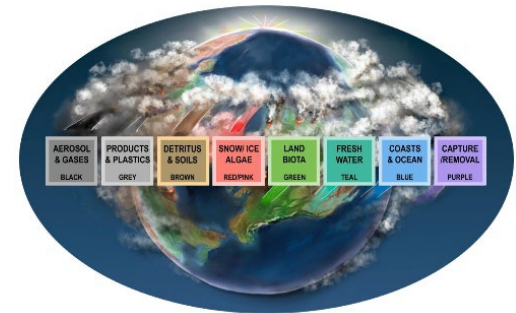
- Eddy Covariance (EC) air/sea gas flux best practice workshop, 28-30 March 2023, London, UK
- Best practice for EC CO₂ flux system setup; results assessment of a data analysis intercomparison exercise; best practice for EC data analysis and uncertainty estimation; plan for an EC CO₂ flux intercomparison experiment in the field



Theme 3: Atmospheric deposition and ocean biogeochemistry

Fire Initiative

- COP27 UN Climate Change Conference Side Event: Fire risk increase, a challenge for Earth system and societies, 6-18 Nov 2022
- Fire science Learning Across the Earth system (FLARE) Workshop, 18-21 Sep 2023, Bermuda.
- White paper published on The Fire science Learning Across the Earth System (FLARE) Working Group (2024). Igniting progress: Results from the FLARE workshop and 3 challenges for the future of transdisciplinary fire science.
- Three ESA/NSF-funded ECSC-led projects on wildfires presented at ESA Living Planet Symposium 2025.



Improving global flux estimates of atmospheric deposition to the ocean

- Collaboration with GESAMP WG38 and Global Atmosphere Watch Programme (GAW)/WMO.
- Kick off workshop to identify research priorities: Heraklion, Greece, 7-10 Apr, 2025
Synthesis paper is under construction

Theme 4: Interconnections between aerosols, clouds, and marine ecosystems

Theme 5: Ocean biogeochemical controls on atmospheric chemistry

Research highlight

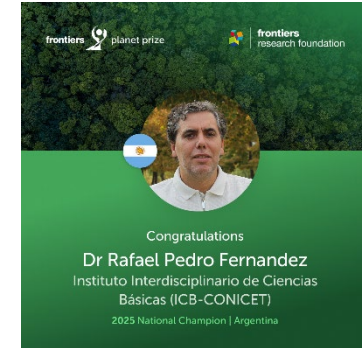
[nature](#) > [articles](#) > [article](#)

Article | [Open access](#) | Published: 28 June 2023

Natural short-lived halogens exert an indirect cooling effect on climate

Alfonso Saiz-Lopez , Rafael P. Fernandez, Qinyi Li, Carlos A. Cuevas, Xiao Fu, Douglas E. Kinnison, Simone Tilmes, Anoop S. Mahajan, Juan Carlos Gómez Martín, Fernando Iglesias-Suarez, Ryan Hossaini, John M. C. Plane, Gunnar Myhre & Jean-François Lamarque

Nature **618**, 967–973 (2023) | [Cite this article](#)



Possible foci for joint working groups identified with IGAC (**APARK?**)

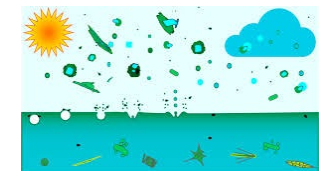
Coastal Regions

- the peculiarities of atmospheric chemistry and air quality in coastal regions, with an emphasis on radical/halogen chemistry and on the oxidative properties of the coastal atmosphere



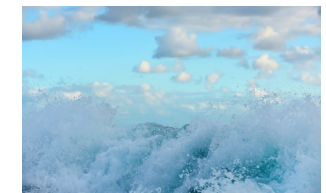
Sea-spray as a vehicle

- the role of sea-spray as a vehicle for transferring a variety of seawater components (biogenic organic matter, pollutants, bacteria, viruses and toxins) from the sea surface to the atmosphere



Fluxes and chemistry of reactive compounds

- the ocean is a major source of sea-salt that can rapidly interact with pollutants (e.g. shipping emissions) changing the atmospheric oxidation capacity on both local and regional scales



Cross-cutting Themes:

Polar oceans/Indian Ocean

Biogeochemical Exchange Processes at Sea-Ice Interfaces (BEPSII)

- Co-sponsored by SOLAS, SCAR and **CLiC**
- Regular winter school, 28 Feb - 9 Mar 2026, Saroma-ko Lagoon, Hokkaido, Japan
- ECR Exchange Program
- Opinion papers, position papers, policy briefs



Cryosphere and Atmospheric Chemistry (CATCH)

- Co-sponsored by SOLAS and IGAC
- Regular Open Science Workshops, Seminar Series
- Partnerships for Investigations of Clouds and the biogeoChemistry of the Atmosphere in Antarctica and the Southern Ocean (PICCAASO)
- Joint event with BEPSII, e.g., winter school, IPY32/33 events



SCOR WG proposal on Indian Ocean observation to improve climate forecast

- Led by **CLIVAR** with SOLAS' involvement

Cross-cutting Themes: Climate Intervention/Science and Society

Climate Intervention

- **Global network of SOLAS marine Carbon Dioxide Removal (mCDR) Nodes**
 - Established to develop standards for mCDR initiatives especially concerning Monitoring, Reporting, and Verification (MRV).
 - Paper being drafted
- **Postdoc programme:**
 - “Constraining the additionality problem for Ocean Alkalinity Enhancement”
 - “Investigating the additionality effect of Ocean Alkalinity Enhancement on air-sea fluxes in Halifax Harbour and the Scotian Shelf”
- **Ocean Alkalinity Enhancement Project (OAEPIP)**
 - Standardised OAE microcosm experiment with plankton communities to be conducted worldwide.

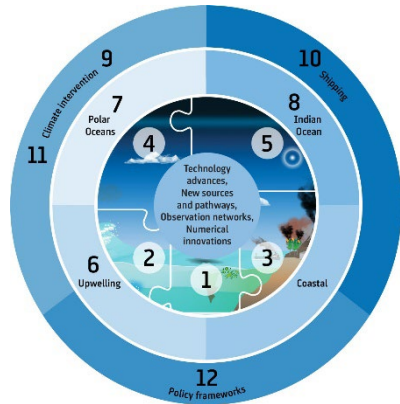
Science and Society

- **Phase 1 since 2016: workshop series and publications on**
 - Ocean carbon
 - Ship emissions
 - Air-sea interaction, policy, and stewardship
- **Phase 2 since 2024: 2-day workshop alongside the OSC 2024**
 - Nature-based marine solutions to climate change
 - Harmful algae blooms
 - Marine plastic



Cross-cutting activities

Special Feature “Boundary Shift: The Air-Sea Interface in a Changing Climate” in “Elementa: Science of the Anthropocene”



<p>Surface ocean-lower atmospheric processes in the Indian Ocean: Current understanding, knowledge gaps, and future directions</p>	<p>Can coastal and marine carbon dioxide removal help to close the emissions gap? Scientific, legal, economic, and governance considerations</p>	<p>Influence of open ocean biogeochemistry on aerosol and clouds: Recent findings and perspectives</p>	<p>Three critical problems to consider for marine carbon dioxide removal</p>	<p>Biogeochemistry of greenhouse gases in coastal upwelling systems: Processes and sensitivity to global change</p>	<p>Science, international law, and policy across the air-sea interface</p>
<p>Advances in understanding of air-sea exchange and cycling of greenhouse gases in the upper ocean</p>	<p>An aerosol odyssey: Navigating nutrient flux changes to marine ecosystems</p>	<p>Perspectives on shipping emissions and their impacts on the surface ocean and lower atmosphere: an environmental-social-economic dimension</p>	<p>Polar oceans and sea ice in a changing climate</p>	<p>Impacts of ocean biogeochemistry on atmospheric chemistry</p>	

Modelling Initiative

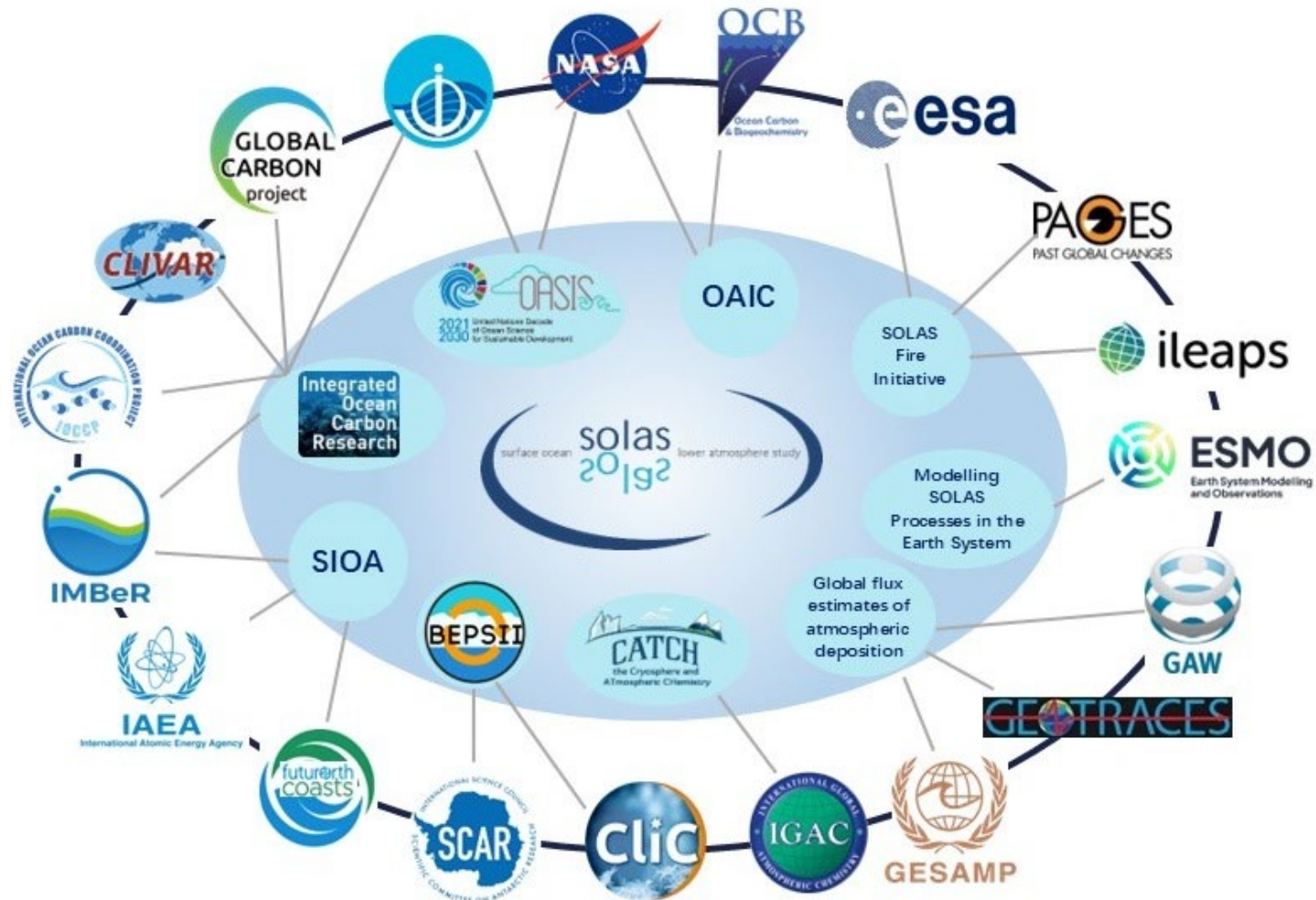
- Recommendation of the SOLAS mid-term review conducted by SCOR and Future Earth
- Online workshop on Modelling surface ocean and lower atmosphere interactions in the Earth system, 24 July 2023
- Discussion session with EMSO at SOLAS Open Science Conference 2024

SOLAS and Planetary Boundary Framework

- Side event at UNOC3 on “The Ocean and Planetary Boundaries: Unlocking a Deeper Vision for the Earth’s Future” (European Pavilion, 12 Jun 2025) in collaboration with IOC/UNESCO, GOOS, GOOD, OARS, OASIS
- Perspective paper in National Science Review (in prep)



Collaborations



New Scientific Plan (2026-2035) – SOLAS 3.0

Discovery science (long term trends and extreme events)

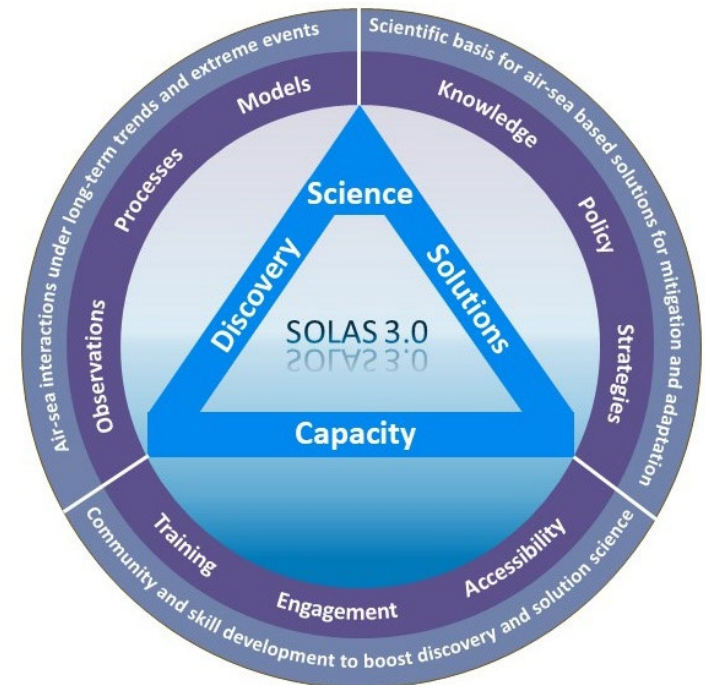
1. Air-sea exchange and cycling of greenhouse gases (Ocean Extremes in Heat, Hypoxia, and Acidification)
2. Aerosols source-to-sink dynamics and impacts on the marine environment (Heat Waves, Dust Storms and Fires)
3. Impacts of ocean biogeochemistry on atmospheric chemistry and clouds (Harmful Algal Blooms)
4. Ocean–sea ice–snow–atmosphere interactions (Sea Ice Loss)
5. Weather and climate (Storms and Cyclones)

Science toward solutions

1. Marine carbon dioxide removal
2. Marine solar radiation affects and management
3. Marine renewable energy (marine renewable wind, wave energy)
4. Solutions for specific environmental problems (ocean re-oxygenation, HAB management, management and assessment of shipping emissions)

Scientific community and skill development

1. Scientific synergy, collaboration and communication
2. Early career training and integration
3. Skill enhancement through tool and resource accessibility
4. Science advocacy, public engagement and policy outreach



Future collaborations with CLIVAR



SOLAS and OASIS Joint Statement of Collaboration

The Surface Ocean-Lower Atmosphere Study (SOLAS) and the Observing Air-Sea Interactions Strategy (OASIS) are formalising a collaborative partnership to advance and deepen scientific understanding of ocean-atmosphere interactions. This partnership merges SOLAS's long-standing expertise in biogeochemical and physical processes with OASIS's leadership in physical flux observations and operational oceanography, enabling a comprehensive, interdisciplinary approach to observing, modeling, and understanding the dynamic air-sea interface.

Through this affiliation, OASIS will become an officially recognised partner in the upcoming SOLAS 2026–2035 science plan, while SOLAS will designate liaisons to the OASIS Scientific Steering Committee. Together, the two programs will co-develop integrated strategies from small-scale process studies to Earth System Model improvements and capacity building in the Global South to joint participation in significant international efforts such as the UN Decade of Ocean Science for Sustainable Development.

Key areas of collaboration include:

- Air-sea transition zone physical-biogeochemical process studies
- Integration of physical and biogeochemical satellite and in situ observational datasets
- Parameterisation of ocean-atmosphere interactions in coupled climate models
- Advancing Earth System Modeling through constrained air-sea flux estimates
- Support for early career researchers via training, liaisons, and interdisciplinary capacity-building programs

The partnership also includes a shared commitment to public engagement, standardised methodologies, and developing educational resources and events such as workshops, town halls, and curriculum initiatives. Regular meetings and representation on each other's governance structures will ensure ongoing coordination, communication, and community alignment.

SOLAS and OASIS will work together to enhance the global impact of air-sea research by creating a more connected and solution-oriented scientific community.

Read the joint statement of collaboration [here](#).

We welcome feedback on the statement [here](#).

The goal being:

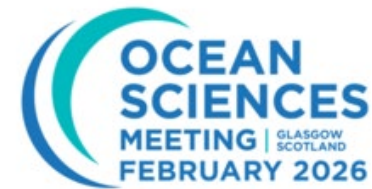
- Complement each other's science plans
- Develop joint activities, e.g., funding proposals (SCOR WG, EuroMarine) and workshops
- Issue joint calls for research foci / task groups

Upcoming and Recent Events

- **SOLAS Seminar XI “Air-Sea gas exchange in warming polar regions: impacts of the changing sea-ice scape”**
 - 15:00-16:00 UTC+2, Tuesday, 14 October 2025
 - Hosted by Aotearoa Blue Ocean Research & Leibniz Institute for Baltic Sea Research Warnemünde



- **SOLAS session and townhall at Ocean Science Meeting 2026**
 - 22-27 Feb 2025, Glasgow, Scotland.
 - Session AI005 - SOLAS and SOCOM: Understanding interactions and feedbacks between the ocean and atmosphere
 - Townhall - Surface Ocean-Lower Atmosphere Study (SOLAS) 3.0: From science to solutions
 - SOLAS/OASIS/CLIVAR workshop on 21 Feb in Edinburg. (tentative)



- **10th SOLAS Summer School: Call for applications open until 31 Aug 2025.**
 - 9-27 Mar, 2026, CEPENE, Tamandaré, Brazil.
 - Lectures, hands-on practicals, collaborative student-led projects - aligned with the SOLAS 3.0 framework "SOLAS Science Towards Solutions."
 - Website: <https://www.solas-int.org/events/solas-events/summer-school-2026.html>

