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

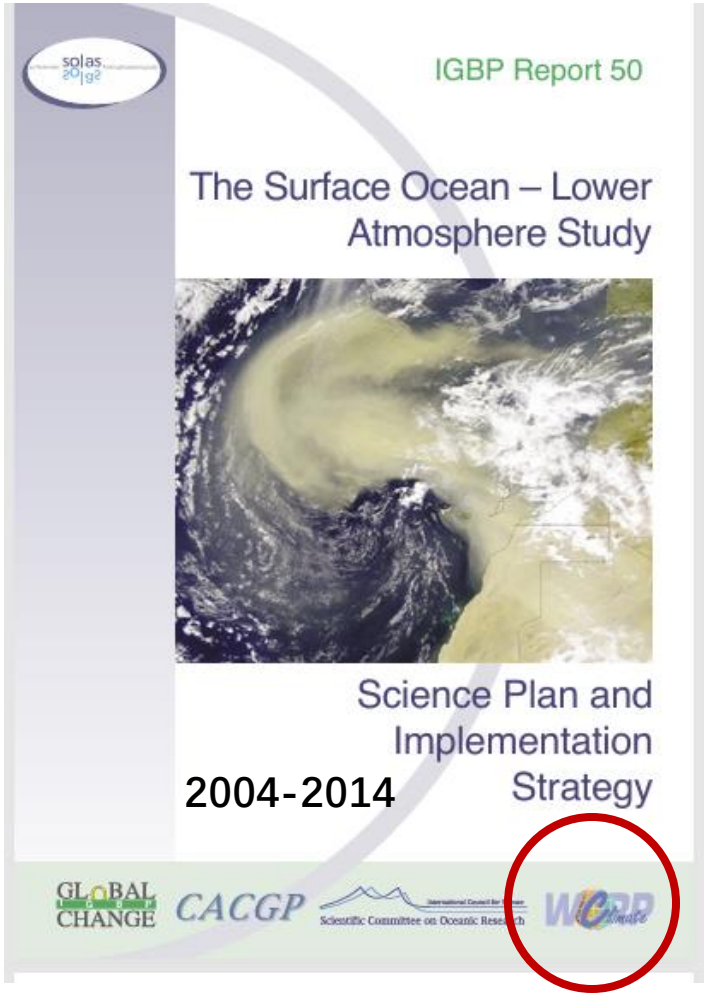

futureearth
Research. Innovation. Sustainability.

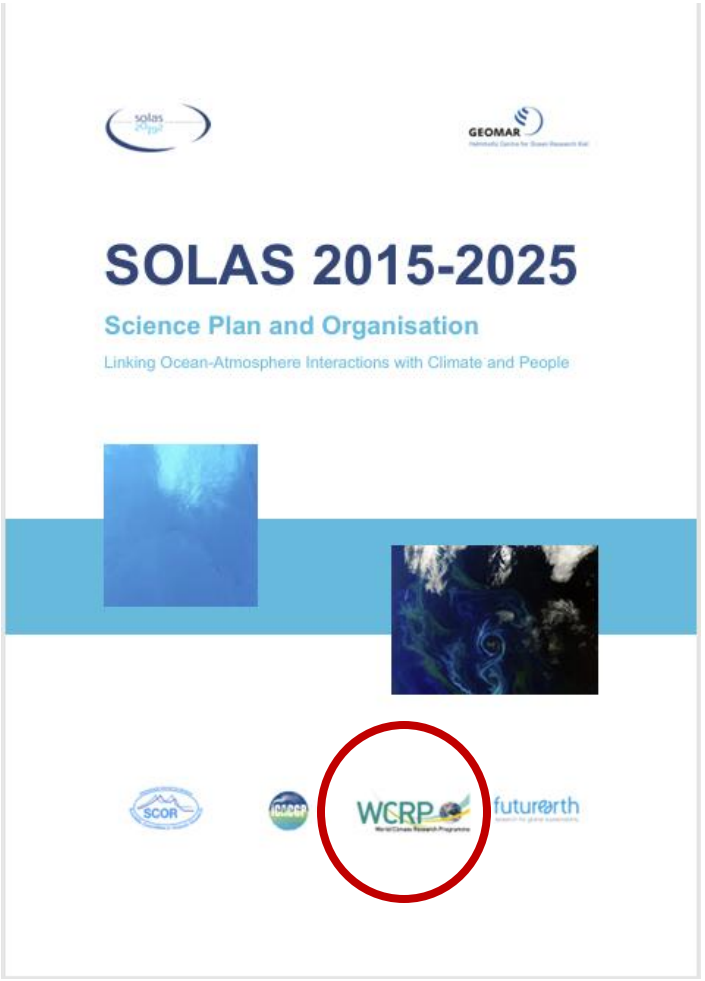
iCACGP

International Council for Science
SCOR
Scientific Committee on Oceanic Research

WCRP
World Climate Research Programme

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



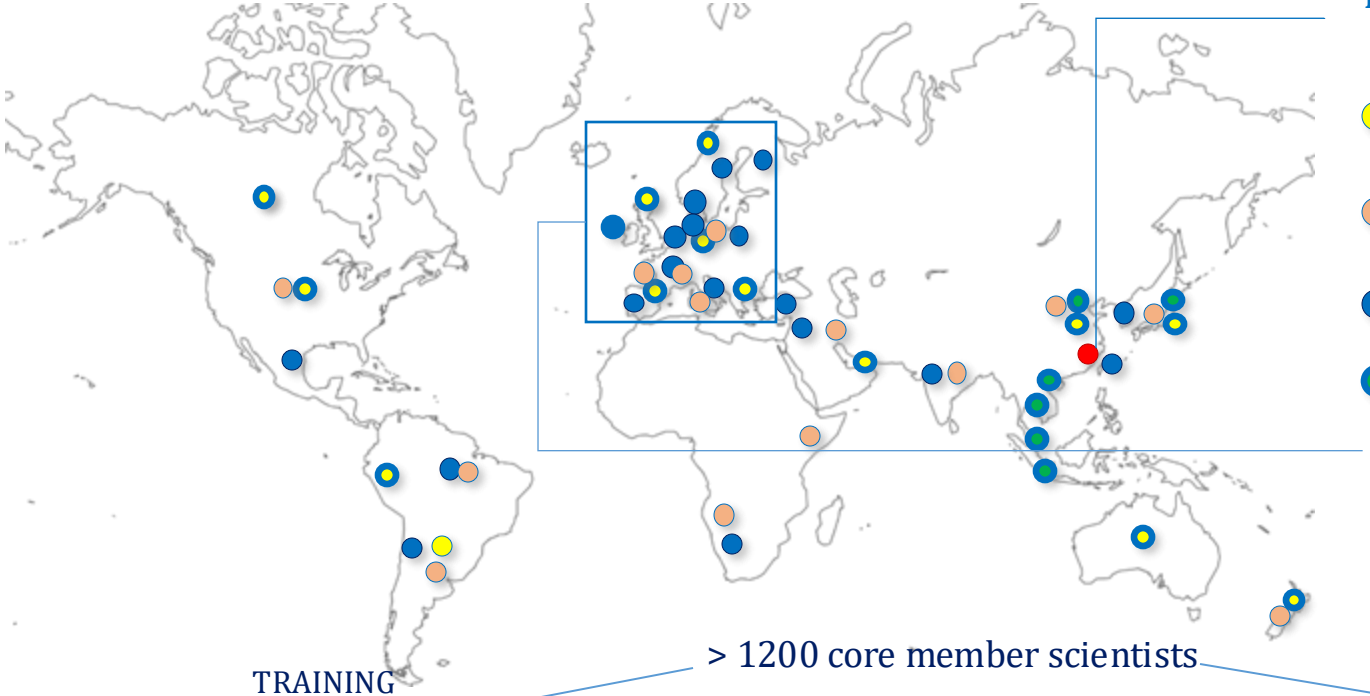
surface ocean solas lower atmosphere study

# 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."*

surface ocean solas lower atmosphere study

# Global network



**International Project Office**
**Xiamen, China**

- 16 Scientific Steering Committee members from 14 countries
- 19 Early Career Scientist Committee members from 14 countries
- 34 National/Regional Networks
- Southeast Asia Regional Panel

**Europe Regional Panel**
**Newly Launched**

> 1200 core member scientists

TRAINING
9 Summer Schools with ~ 600 early career researchers

NETWORKING
9 Open Science Conferences
~1900 participants

KNOWLEDGE EXCHANGE
>100 sponsored events and 1 quarterly Seminar Series

PROJECTS
> 40 sponsored/ endorsed projects globally

OUTPUTS
> 200 publications and policy advisories annually

COMMUNICATION
>100 e-bulleting, newsletters, and reports

surface ocean solas lower atmosphere study

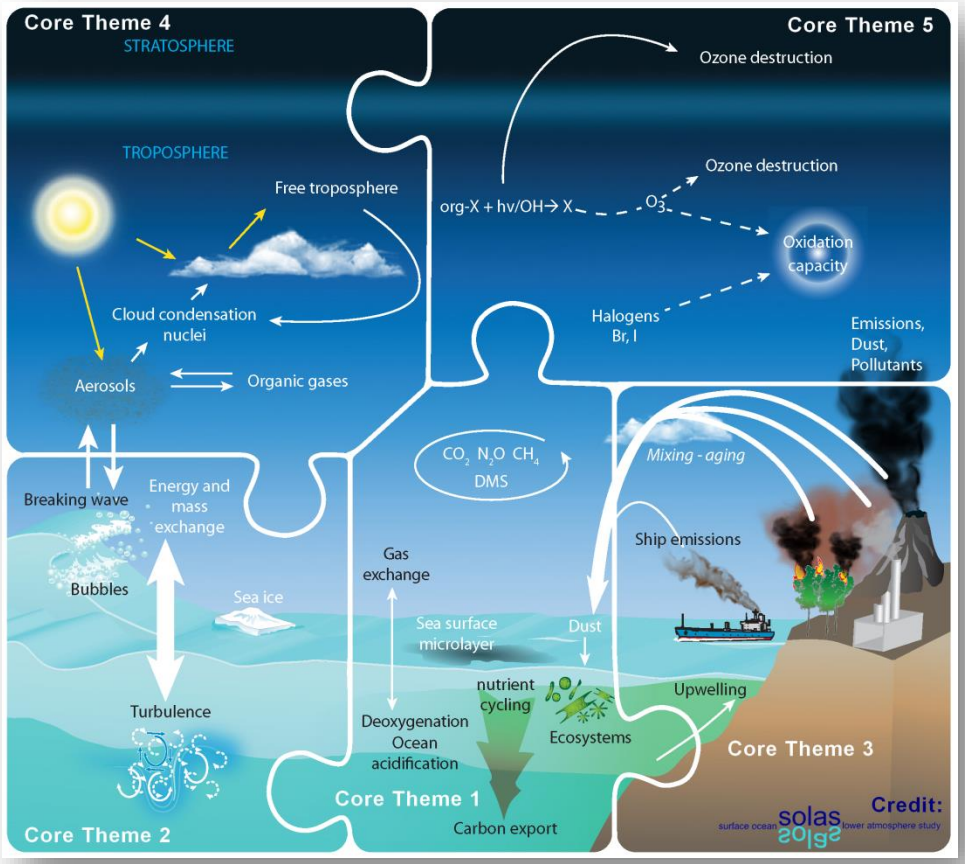
# Scientific structure 2015-2025

## 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



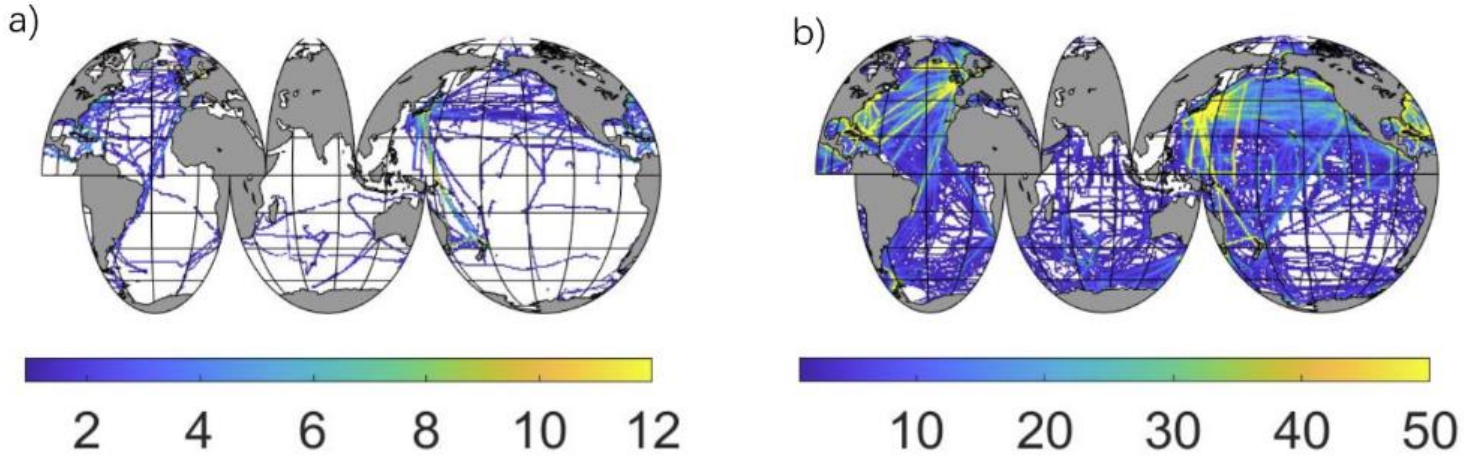
# Theme 1: Greenhouse gases and the oceans

surface ocean solas lower atmosphere study

## Surface Ocean CO2 Atlas (SOCAT)

- An annual synthesis activity since 2007 for quality-controlled, surface ocean $fCO_2$ observations by the international marine carbon research community.
- SOCAT Version 2024 contains 38.6 million $fCO_2$ measurements collected between 1957 and 2023 with an estimated accuracy of better than 5 µatm.

SOCAT · SURFACE OCEAN $CO_2$ ATLAS ·




a) The number of year months with 1° x 1° gridded surface ocean fugacity of carbon dioxide (fCO2) in 2022 and 2023 in v2024. b) The number of individual months with 1° x 1° gridded surface ocean fCO2 between 1970 and 2023

# Theme 1: Greenhouse gases and the oceans

surface ocean solas lower atmosphere study

## Integrated Ocean Carbon Research (IOC-R)

- Succeeds and expands on the mandate of the previous SOLAS-IMBeR ocean carbon research (2006).
- Launched in 2018 in collaboration with IOC/UNESCO, IOCCP, IMBeR, GCP and CLIVAR.
- 1st report published in 2021 to synthesize of the state of knowledge about the oceans' role in the carbon cycle and point to the way ahead.
- 2nd report to be released at UNOC3.


## SOLAS-IMBeR Ocean Acidification (SIOA) working group

- Launched in 2009 to coordinate international research efforts and synthesis activities in ocean acidification.
- Being 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

surface ocean solas lower atmosphere study

## 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 $CO_2$ flux system setup; results assessment of a data analysis intercomparison exercise; best practice for EC data analysis and uncertainty estimation; plan for an EC $CO_2$ flux intercomparison experiment in the field

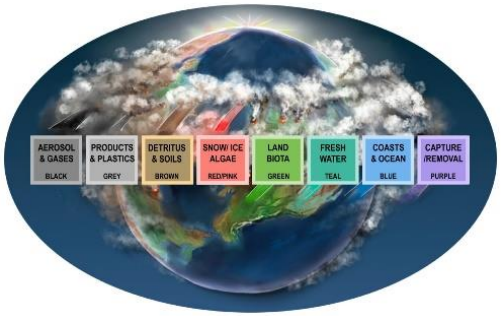
# Theme 3: Atmospheric deposition and ocean biogeochemistry

surface ocean solas lower atmosphere study

## 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.

COP27 SHARM EL-SHEIKH EGYPT 2022




## 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

# Theme 4: Interconnections between aerosols, clouds, and marine ecosystems
# Theme 5: Ocean biogeochemical controls on atmospheric chemistry

surface ocean solas lower atmosphere study

## 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

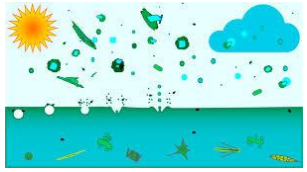

## Possible foci for joint working groups identfied with IGAC (APARK?)

### 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 Theme: Polar oceans/Indian Ocean

surface ocean solas lower atmosphere study

## 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

BEPSII
BIOGEOCHEMICAL EXCHANGE PROCESSES AT SEA ICE INTERFACES

## 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

CATCH
the Cryosphere and ATmospheric CHemistry

## SCOR WG proposal on Indian Ocean observation to improve climate forecast

- Led by CLIVAR with SOLAS' involvement

# Cross-cutting Theme: Climate Intervention/Science and Society

surface ocean solas lower atmosphere study

## Climate Intervention

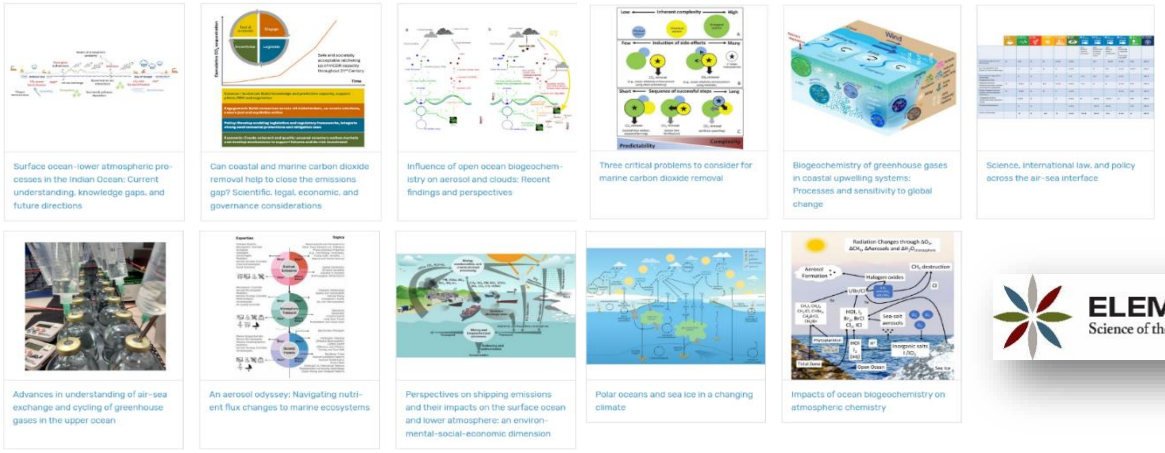
- **Global network of SOLAS marine Carbon Dioxide Removal (mCDR) Nodes**
  - Established to develop standards for mCDR initiatives especially concerning Monitoring, Reporting, and Verification (MRV).
  - Paper being drafted
- **Postdoc programme**:
  - "Constraining the additionality problem for Ocean 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*"




## Modelling Initiative

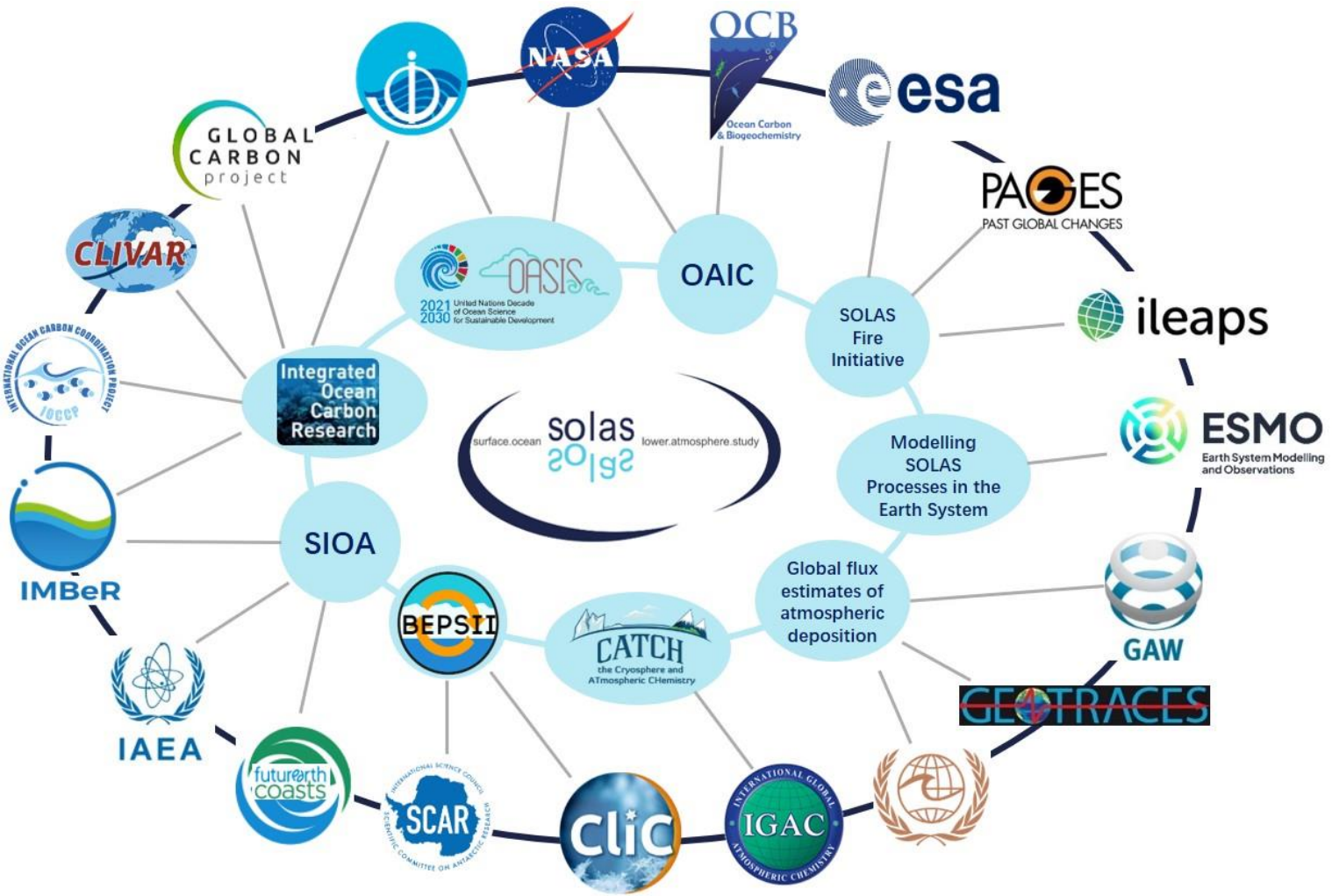
- Recommendation of the SOLAS mid-term review conducted by SCOR and Future Earth
- Online workshop on Modelling surface ocean and lower atmosphere interactions in the Earth system, 24 July 2023
- Discussion session with EMSO at SOLAS Open Science Conference 2024

## SOLAS and Planatery 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)

UN OCEAN CONFERENCE NICE 2025 FRANCE

# Collaborations



surface ocean solas lower atmosphere study

# Scientific structure 2026-2035

## Discover science:

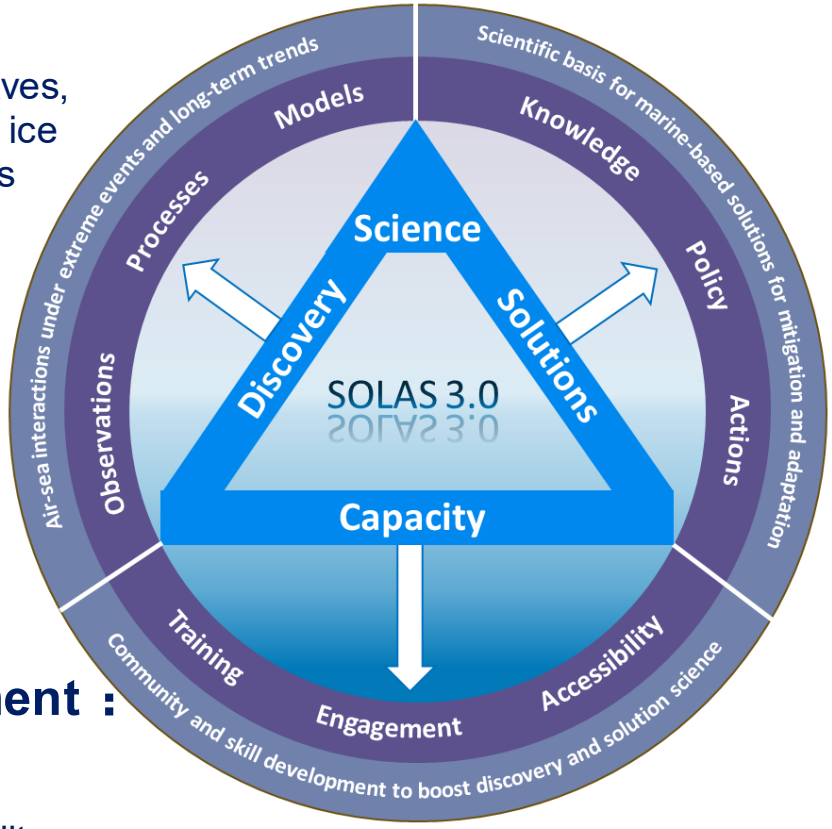
1. Core science in the SOLAS domain
2. Extreme events in the SOLAS domain (marine heatwaves, hypoxia, high acidification, extreme HAB, extreme sea ice loss, heatwaves, dust storms and fires, extreme storms and cyclones

## Science towards solution:

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



# Scientific structure 2026-2035

## Scientific community and skill development :

Oceanography THE OFFICIAL MAGAZINE OF THE OCEANOGRAPHY SOCIETY

HOME | ABOUT | VIEW ISSUES | SUBSCRIBE | ORDER ISSUES | AUTHOR GUIDELINES | PERMIS

OPEN ACCESS

Thriving Through Synergy: Fostering a SOLAS Science Community Built on Equity, International Connections, and the Integration of Early Career Scientists

By Julie Dinasquet, Douglas S. Hamilton, Inés M. Leyba, Joan Llort, Tanya Marshall, Raquel R. de Oliveira, Morgane M.G. Perron, Liselotte Tinel, Véronique Garçon, Christa Marandino, Nadja Steiner, Douglas Wallace, and Li Li

- Published Online: March 26, 2025
- https://doi.org/10.5670/oceanog.2025.140
- Export Article Citation: BibTeX | Reference Manager


FIGURE 3. Feedback from the mentorship program discussion during SOLAS Open Science Conference 2024. The word cloud describes the benefits of mentorship, and the pie chart describes expectations from the mentorship program. > High res figure

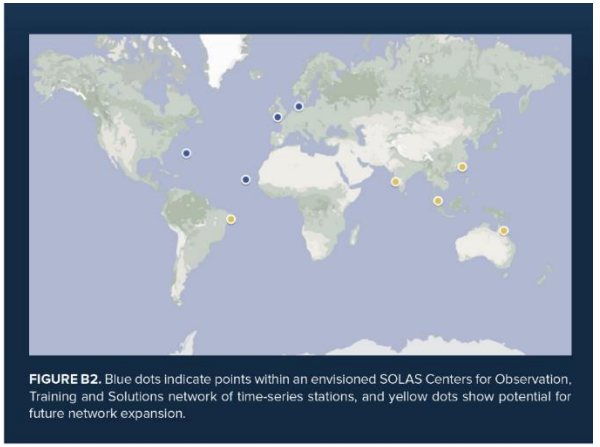


FIGURE B2. Blue dots indicate points within an envisioned SOLAS Centers for Observation, Training and Solutions network of time-series stations, and yellow dots show potential for future network expansion.

# Future with WCRP

**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.

**Align with WCRP's missions**

**Complement WCRP's projects**

**Be part of WCRP structure?**