

SOLAS annual report to SCOR

Reporting period: May 2021 - July 2022

Version of 29 July 2022 by Jessica Gier

I. Short summary

The Surface Ocean-Lower Atmosphere Study (SOLAS) is dedicated to achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and atmosphere, and how this coupled system affects and is affected by climate and environmental changes.

During this reporting period, SOLAS and its community completed a thorough report of SOLAS's major achievements since 2016, and its plans for the next phase. This report was reviewed by an Ad Hoc Review Panel representing SCOR and Future Earth. The Review Panel highly regarded SOLAS's achievements during the past 5 years and the panel also made some valuable recommendations which has been adopting in SOLAS implementation strategy.

In addition to its excellent contribution to conventional science breakthrough, SOLAS has recently been devoting to ensure the effective transformations of science into policy and decision-making on climate and environmental health via engaging for example, COP26 and other activities of the UUNFCCC. In order to co-design and co-implement relevant activities of societal impacts, SOLAS is collaborating with three UN Ocean Decade programmes and co-organised four Ocean Decade events.

In addition, SOLAS is committed to capacity building and organised its first virtual summer school in June 2022, which hosted 62 students and involved 31 lecturers. An in-person school will be held in June 2023 on Cape Verde. With its first hybrid Open Science Conference on 25-29 September 2022 in Cape Town, South Africa, SOLAS offers the ideal programme for scientists who wish to learn and exchange about innovative research in the field, present their own findings, and connect with colleagues from all over the world. A dedicated Early Career Scientist Day is being organised by an ECS committee for the day before the OSC. Moreover, SOLAS and the National University of Ireland (NUI) Galway, launched a new structured Research Master of Science (MSc) programme on Ocean, Atmosphere and Climate. The MSc bridges the boundaries between ocean and atmosphere and provides graduates with a broad understanding of how this coupled system works, affects and is affected by climate and human activities. The first students will start in September 2022.

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II. SOLAS Mission and Organisation

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

The 2015-2025: Science Plan and Organisation organised this mission around five core themes:

Core Theme 1: Greenhouse gases and the oceans

Core Theme 2: Air-sea interface 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

In addition, the study of these themes are integrated in efforts to understand key environments, e.g. upwelling systems, polar oceans, and the Indian Ocean, as well as to evaluate the environmental efficacy and impacts of climate intervention proposals, policy decisions, and societal developments.

The SOLAS 2015-2025: Science Plan and Organisation (SPO) is available to download from the SOLAS website (<https://www.solas-int.org/science/science-plan.html>), and hardcopies are available upon request from the IPO.

With the launch of the new science plan in 2015, SOLAS chose to use a pragmatic approach to the implementation strategy with a continually-evolving live document developing plans at least 2 years into the future. This approach means that the document is a moving target that is regularly updated. The implementation strategy is intended to be a live web-based document only and a new version will be available for download from the SOLAS website soon at: <https://www.solas-int.org/science/implementation-strategy.html>

The Implementation Strategy update will be released online in Oct./Nov. 2022.

Upcoming SOLAS and SOLAS co-sponsored activities include:

- The SOLAS Seminar series will continue and be organised as a quarterly event, which is structured around SOLAS relevant topics covered by the SOLAS 2015-2025 Science Plan and beyond, with the aims of fostering discussions on innovative scientific questions, providing researchers at all career stages with the opportunity to interact and building SOLAS community across the globe.
- SOLAS Southeast Asia workshop, online, 23 Aug. 2022
- Conference on Eastern Boundary Upwelling Systems (EBUS): Past, Present and Future & 2nd International Conference on the Humboldt Current System, Lima, Perú, 19-23 Sep. 2022
- SOLAS Open Science Conference, online and in Cape Town, South Africa, 25-29 Sep. 2022
- SOLAS SSC meeting, online and in Cape Town, South Africa, 30 Sep.-1 Oct. 2022
- GESAMP WG 38 - SOLAS workshop on Atmospheric Input of Chemicals to the Ocean - Management Implications, Gqeberha, South Africa, Oct. 2022
- COP27 side event on the impact of increasing fire activity on the Earth System and society, in-person/hybrid, Sharm El-Sheikh, 7-18 Nov. 2022
- SOLAS session at the co-sponsored Sixth Xiamen Symposium on Marine Environmental Sciences (XMAS-VI), hybrid in Xiamen, China, 9-12 Jan. 2023
- ESA-SOLAS workshop on Eddy covariance measurements, Galway, Ireland, Mar. 2023
- 9th SOLAS Summer School, Mindelo, Cape Verde, Jun./Jul. 2023
- GOOD-OARS Summer School, Coquimbo-La Serena, Chile, 6-12 Nov. 2023

III. Progress on implementation of project science

III.a. Integrated activities

SOLAS Programme Review

SCOR and Future Earth conducted a review of SOLAS to evaluate its major achievements over the last five years, and assist SOLAS in planning its major activities in the next five years. The Ad Hoc SOLAS Review Panel completed the review. In April 2022, the SCOR Executive Committee found that SOLAS has satisfactorily addressed all requests and recommendations, and provided clear actions for the years to come to follow SCOR's guidelines and policy.

SOLAS Summer School

The first SOLAS summer school took place in July 2003 in Cargèse, France. The success of this first school was such that the SOLAS summer school became a regular and productive event (for both science and networking). SOLAS is proud to have offered 7 schools between 2003 and 2018, involving 477 international students and produced a textbook (Le Quéré and Saltzman 2009). Typically, four applications are received for every available place. SOLAS is contributing to SDG 5 (Gender equality), with a gender balance of 55% females to 45% males in SOLAS Summer School participants.

Due to worldwide travel restrictions, SOLAS launched a virtual version of the school, 13-17 June 2022, which hosted 62 students and involved 31 lecturers. An alumni-dominated organising committee carried the success of the SOLAS Summer School forward, with Christa Marandino from

GEOMAR, Kiel, Germany as the director of the summer school. During the virtual School, students participated in lectures, practicals and networking events led by international experts. To design and realise this innovative virtual format, the team of Mindfully Wired Communications supported the organising committee. Programme: <https://www.solas-int.org/events/summer-school-22-23/virtual-school-22-program.html>

The in-person school will take place at the Ocean Science Centre Mindelo, Mindelo, Cape Verde (<https://www.oscm.cv/>) in Jun./Jul. 2023 (see more details [here](#)). The school will host about 70 students and 20 lecturers who give both lectures and practicals and make significant efforts to promote sustainability and diversity in science. The aim is to integrate these important topics more permanently in the school's mission in the long-term.

SOLAS Open Science Conference

SOLAS has organised a series of highly successful Open Science Conferences (OSCs). During the OSCs, SOLAS scientists debate pressing science questions during discussion sessions and brainstorm about new initiatives during targeted workshops.

The 8th SOLAS OSC will be held on 25-29 September 2022 in Cape Town, South Africa. With its first hybrid Open Science Conference, SOLAS offers the ideal programme for scientists who wish to learn and exchange about innovative research in the field, present their own findings, and connect with colleagues from all over the world. <https://uctcmc.eventsair.com/solas-osc2022/>
[Early Career Scientist Day, 25 September 2022](#)

Taking place the day before the OSC, the SOLAS Early Career Scientist Day (ECS) is an international hybrid event that brings together 30 in-person and more online ECSs with world-leading scientists for a day of skill development, awareness workshops, and a tour to the Cape Point Nature Reserve. <https://uctcmc.eventsair.com/solas-osc2022/early-career-scientist-day>

Collaboration with the Ocean Carbon & Biogeochemistry (OCB)

- Ocean-Atmosphere Interaction Subcommittee (OAIC), <https://www.us-ocb.org/about/ocb-subcommittees/subcommittee-on-ocean-atmosphere-interactions/>
The OAIC was formed by OCB to coordinate research on ocean-atmosphere interactions and their role in marine biogeochemical cycles. In December 2021, OAIC published the US SOLAS Science Plan, which aids in coalescing the air-sea interaction research community around a common set of science goals and research priorities and foster a more cohesive US contribution to international SOLAS.
 - US SOLAS Science Plan: <https://darchive.mblwhoilibrary.org/handle/1912/27821>
- OCB is a co-sponsor of the 2023 in-person SOLAS Summer School on Cape Verde.

III.b. Progress on Core Themes

Core Theme 1: Greenhouse gases and the oceans

SOLAS-IMBER Ocean Acidification Working Group (SIOA)
<https://www.solas-int.org/science/sponsored-science.html>

The SOLAS-IMBER Ocean Acidification (SIOA) group is a SOLAS-sponsored activity that provides a key advisory role to the Ocean Acidification International Coordination Centre (OA-ICC) based at

the International Atomic Energy Agency Environment Laboratories in Monaco. SIOA facilitates OA-ICC activities, which include support for the Global Ocean Acidification Observing Network (GOA-ON), updating and improving best practices for making ocean acidification measurements and building global capacity. The largest OA community meeting, the [5th International Symposium on the Ocean in a High CO₂ World](#) will be held on 13-16 September 2022. The annual SIOA meeting/OA-ICC expert group meeting is planned as a hybrid 1-day side event on 12 Sep. 2022 in Lima, Peru. SOLAS will join the meeting online.

[Integrated Ocean Carbon Research \(IOC-R\)](#)

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

The Working Group on Integrated Ocean Carbon Research (IOC-R) is a SOLAS sponsored activity, is coordinated by the Intergovernmental Oceanographic Commission (IOC). It brought together five international research and coordination programmes (SOLAS, the International Ocean Carbon Coordination Project, IOCCP, the Integrated Marine Biosphere Research Project, IMBeR, the Climate and Ocean Variability, Predictability and Change, CLIVAR, and the Global Carbon Project, GCP). SOLAS will further contribute to on-going discussion related to the implementation plans of IOC-R's science and policy objectives.

[13th Meeting of the Subsidiary Body for Scientific and Technological Advice \(SBSTA\)](#)

The 13th Meeting of the SBSTA Research Dialogue was held on 1-2 June 2021, focusing on 'Climate system dynamics: New knowledge and its implications for decision making' and 'Resilience for and by nature: Building knowledge and understanding to weave the protection and restoration of nature into decision making on mitigation and adaptation'. SOLAS and IOC-R were represented by SOLAS co-chair Minhan Dai.

[The Surface Ocean CO₂ Atlas \(SOCAT\)](#)

<https://www.socat.info/>

The Surface Ocean CO₂ Atlas (SOCAT) documents the increase in surface ocean CO₂ (carbon dioxide), a critical measure as the oceans are taking up one quarter of the global CO₂ emissions from human activity. SOCAT has had annual public releases in 2021 and in June 2022. SOCAT was co-initiated and co-endorsed by SOLAS. Each succeeding version contains new data sets as well as updates of older ones. The latest SOCAT version (version 2021) contains 30.6 million *in situ* surface ocean $f\text{CO}_2$ measurements with an estimated accuracy of $< 5 \mu\text{atm}$. A further 2.1 million $f\text{CO}_2$ values with an accuracy of $< 10 \mu\text{atm}$ are also available.

[Core Theme 2: Air-sea interface and fluxes of mass and energy](#)

[Collaboration with the European Space Agency \(ESA\), National Aeronautics and Space Administration \(NASA\), and the European Organisation for the Exploitation of Meteorological Satellites EUMETSAT \(EUMETSAT\)](#)

The long-standing and fruitful collaboration between SOLAS and EUMETSAT, ESA, and NASA, is continuing on a number of fronts.

- The ESA-SOLAS special issue on Remote Sensing of Air-Sea Fluxes in the journal Remote Sensing attracted eight publications. So far, the papers have 13859 views and 32 citations. https://www.mdpi.com/journal/remotesensing/special_issues/Air_Sea_Fluxes

- ESA, PML, and NASA organised a workshop on Ocean Carbon From Space that took place online, 14-18 February 2022. The goal of the event was to formulate the science agenda in the field for the next decade. SOLAS was an associated partner, member of the scientific organising committee, and presented on SOLAS carbon activities - challenges and future opportunities. <https://oceancarbonfromspace2022.esa.int/>.
- The European Organisation for the Exploitation of Meteorological Satellites ([EUMETSAT](#)), with the support of [SOLAS](#) and [Copernicus](#), organised an online workshop on Remote Sensing for Ocean-Atmosphere interaction studies and applications, 1-3 December 2021. (see SOLAS Event Report, [Issue 22](#))

Core Theme 3: Atmospheric deposition and ocean biogeochemistry

Collaborations with GEOTRACES

- Following a joint session at the SOLAS OSC in April 2019 in Sapporo, Japan, a GEOTRACES - SOLAS workshop was organised for 26-30 July 2021 on Iron at the Air-Sea Interface, online and in Ashville, North Carolina, USA. The aim of the workshop was to improve the understanding on how atmospheric bioaccessible iron moves across the atmosphere-ocean interface and becomes bioavailable for ocean ecosystems and at scales important for the carbon cycle. Overall, 74 scientists from 23 countries registered to participate and to present their experimental, modeling, and remote sensing studies related to atmospheric supply and speciation of aerosol Fe, its contribution to the dissolved Fe inventory of the ocean, and its potential impacts on primary production and CO₂ uptake. The workshop brought together established scientists and early career researchers to provide opportunities for professional interactions (see SOLAS Event Report, [Issue 20](#)).

Collaboration with PICES

- The PICES Section on Carbon and Climate includes SOLAS members at its annual meeting, to maintain two-way communication between PICES and SOLAS.
- A SOLAS session on 'Atmospheric nutrient deposition and microbial community responses, and predictions for the future in the North Pacific Ocean' has been organised as part of the PICES 2021 virtual annual meeting on 26 October 2021.
- PICES is a sponsor of the SOLAS OSC 2022, supporting the early career scientist day and the attendance of early career scientists from PICES countries.

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

Core Theme 5: Ocean biogeochemical control on atmospheric chemistry

New Initiatives in Atmospheric Chemistry

- In collaboration with the International Global Atmospheric Chemistry (IGAC) program, SOLAS has launched a scoping exercise to identify critical science on which our two organisations should collaborate. Ideas include organising side meetings at the OSCs and planning a jointly supported networking event around atmosphere-ocean interactions. Topics for future collaborations include the interplay between ocean and the urban environment in coastal cities that affect the environment and human health, studies over the remote oceans, and the impact of ship plumes, nitrogen deposition, and background atmospheric chemistry.

- SOLAS and IGAC co-organised two sessions at the Sustainability Research & Innovation Congress 2021 (SRI2021) on “The Atmosphere - the “forgotten” domain in the SDGs?” and the session on “Air Quality and Human Health”.

III.c. Progress on Integrated Topics

Polar

Biogeochemical Exchange Processes at Sea Ice Interfaces (BEPSII)

<http://www.bepsii.org>

Biogeochemical Exchange Processes at Sea-Ice Interfaces (BEPSII) started in 2011 with a focus on sea-ice biogeochemistry, was a SCOR working group from 2012 until September 2016, and has since been endorsed as a SOLAS-CLIC Activity (from 2016) and as a SCAR Action Group (from 2017).

- The BEPSII 2021 annual meeting was held online in August 2021, with an ECS meeting on the preceding day. Plenary sessions and 3 round-the world sessions were organised according to different BEPSII themes. In total, more than 80 people subscribed to the meeting and each session was visited by up to 50 people.
- In October 2021, BEPSII published its Arctic Policy Brief ‘Effective Arctic climate change mitigation and adaptation strategies require consideration of biogeochemical and ecological impacts of sea-ice decline’. The policy brief and related research were highlighted at COP26 within sessions of the Cryosphere pavilion.
- The joint BEPSII-CATCH SCOR working group 163 (Clce2Clouds) was granted in November 2021, aiming at better linking the communities and help improve our understanding and model parameterisation of biogeochemical processes in sea-ice regions.
- The new Horizon 2020 project on Climate relevant interactions and feedbacks: the key role of sea ice and snow in the polar and global climate system (CRiceS) is linking BEPSII with the atmosphere and was endorsed by SOLAS. CRiceS brings together researchers from the [CATCH](#) and [BEPSII](#) communities. The group is organising its 1st hybrid annual meeting back-to-back with the SOLAS OSC on 23-24 September 2022 in Cape Town, South Africa.
- In 2021, BEPSII launched its first exchange program award to support early-career scientists in research collaborations. The program supported short visits between institutions to learn new techniques, develop joint experiments, and exchange knowledge. Funding from SOLAS was awarded to four scholars.
- The BEPSII Sea Ice School 2022 took place at the Canadian High Arctic Research Station (CHARS) in Cambridge Bay, Canada from 14-23 May 2022. Lectures, field and lab work addressed basic sea-ice and snow physics, sea ice optics, primary production, carbon cycle, biogeochemistry together with, sea-ice biogeochemical modelling, gases fluxes at the interfaces and life in the North.

Cryosphere and Atmospheric Chemistry (CATCH)

<https://sites.google.com/view/catchscience/home>

Cryosphere and Atmospheric Chemistry (CATCH), co-sponsored by SOLAS and the International Global Atmospheric Chemistry (IGAC) program, facilitates atmospheric chemistry research within the international community, with a focus on natural processes specific to cold regions of the Earth.

- The CATCH-BEPSII initiative that grew out of a joint discussion session at the 2019 SOLAS OSC in Sapporo, Japan has resulted in the Coupling of ocean-ice-atmosphere processes: from sea-ice biogeochemistry to aerosols and Clouds (Clcea2Clouds) SCOR WG (<https://www.cice2clouds.org/home>), which is co-chaired by an early career researcher.
- The CATCH science meeting, a virtual side meeting, and SSC meeting was held during the IGAC virtual science conference in September 2021.
- The monthly virtual [CATCH seminar series](#) host talks on CATCH related topics with the aim of fostering engaging scientific discussions between researchers on outstanding questions.
- The CATCH Open Science Workshop 2022 was held online on 9-13 May 2022, with a focus on natural processes specific to cold regions of the Earth.

Climate Intervention

Following our successful workshop in Sapporo, Japan, in spring, 2019, SOLAS is building a coalition of global research programmes to form a scientific oversight community on climate intervention. A COP26 side event on Carbon conservation and sequestration in ocean: Nature-based and technology solutions, co-organised by Future Earth, was held on 6 November 2021. The role of marine nature-based solutions to mitigate climate change, their benefits and trade-offs and Present options for carbon removal from the technological to the industrial levels were discussed. Minhan Dai, Erik van Doorn and Lisa Miller joined the event on behalf of SOLAS/Future Earth.

Science and Society

A forum session on “The apparent mismatch between science and policy at the air-sea interface” was held at the Sustainability Research & Innovation Congress 2021, which builds on topics included in the launch of the SOLAS Science and Society Integrated Topic. The SOLAS session took place virtually and included four introductory talks and a panel discussion (see SOLAS Event Report [Issue 21](#)). The session aimed to consider whether the interaction between the lower atmosphere and the upper layer of the ocean is sufficiently addressed in policy and regulations. Regulations need not target the air-sea interface directly but should regulate the source of pollution or designated areas in need of a higher protection.

At COP27 a side event on “The impact of increasing fire activity on the Earth System and society” is being planned in collaboration with Future Earth Global Research Networks (IGAC, iLEAPS, and PAGES) and the [BRIDGES](#) Coalition.

Upwelling

SOLAS will support the hybrid Open Science Conference on Eastern Boundary Upwelling Systems (EBUS): Past, Present and Future and the Second International Conference on the Humboldt Current System, planned for September 19 - 23 in Lima, Peru. <https://www.ebus-lima2022.com>.

Indian Ocean

- The SOLAS community developed a new integrated topic on the Indian Ocean region, with an implementation plan aimed at evaluating SOLAS-related processes and perturbations within field campaigns and long-term observations in collaboration with the International Global Atmospheric Chemistry (IGAC) project, the Second International Indian Ocean Expedition (IIOE-2) project and CLIVAR’s Indian Ocean Regional Panel (IORP).

- A SOLAS side meeting at the Integrated Meetings of the Indian Ocean Global Ocean Observing System (IOGOOS) and its allied programmes meetings, following the International Indian Ocean Science Conference (IIOOSC-2022), took place on 24 March 2022. The SOLAS meeting had the following topics: a) overview of recent SOLAS activities from India, b) IIOE-2 and SOLAS, and c) Increasing SOLAS collaborations within ongoing programmes in India and future of SOLAS India.

IV. Summary of 2021-2022 SOLAS activities

Global Sustainability Scholars (GSS) fellow

SOLAS hosted a Global Sustainability Scholars (GSS) fellow for 20 weeks in the IPO. The GSS programme was newly created by the Institute for the Sustainable Earth (ISE) and supported by Future Earth and the Belmont Forum. The GSS fellow Kim Magalona worked on the impacts of the SOLAS Summer School on alumni careers and research.

Contributions to the UN Ocean Decade

SOLAS is involved in the following UN Ocean Decade activities:

- Partner of the Coastal Zones Under Intensifying Human Activities and Changing Climate: A Regional Programme Integrating Science, Management and Society to Support Ocean Sustainability ([Coastal-SOS](#)),
- Co-sponsor of the [53rd International Liège colloquium on Ocean Dynamics](#), which is a contribution to the Ocean Decade programme Global Ocean Oxygen Decade (GOOD).
- Co-organiser of the Satellite Activity of the Ocean Decade Laboratory on [An Observing Air Sea Interactions Strategy \(OASIS\) for a Clean Ocean](#), with [OASIS](#) (SCOR WG 162 and endorsed by the Decade).
- Partner of the Ocean to Climate Seamless Forecasting system ([OSF](#))
- Partner of the Global Ocean Negative Carbon Emission ([Global ONCE](#))
- SOLAS co-organised a side event at the UN Ocean Conference on Future Earth's marine networks: a trans- and interdisciplinary scientific community working toward the achievement of the SDGs, hybrid in Lisbon, Portugal, 30 Jun. 2022
- Discussion session on UN Decade of Ocean Science Proposal: Aerosol Exchange with Marine Ecosystems with partner programmes such as GEOTRACES, IMBER to prepare a proposal for endorsement by the UN Ocean Decade, SOLAS OSC, 25-29 Sep 2022.

SOLAS Master Programme

<https://www.solas-int.org/events/solas-masters-programme.html>

SOLAS, in collaboration with the National University of Ireland (NUI) Galway, launched a new structured Research Master of Science (MSc) programme on Ocean, Atmosphere and Climate. The MSc bridges the boundaries between ocean and atmosphere and provides graduates with a broad understanding of how this coupled system works, affects and is affected by climate and human activities. The course combines taught and research elements and includes a seven-month research placement in a world-leading partner organisation under SOLAS, to work with renowned scientists in the respective areas. Applications are open for the academic term starting in September 2022.

SOLAS Seminar

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

SOLAS launched a seminar series, which is a quarterly event, structured around SOLAS relevant topics covered by the SOLAS 2015-2025 Science Plan and beyond, with the aims of fostering discussions on innovative scientific questions, providing researchers of all career stages with the opportunity to interact and building SOLAS community across the globe.

- Apr. 2022, hybrid in Xiamen, China on Interconnections between aerosols, clouds and marine ecosystems,
- Jul. 2022, hybrid at Laboratoire d'Océanographie de Villefranche, France on Atmospheric deposition and ocean biogeochemistry: in situ observation, processes studies and modeling approach
- Oct. 2022: Next Seminar

The recordings are available on the [SOLAS YouTube Channel](#).

Surface Ocean Lower Atmosphere Study in Southeast Asia

SOLAS together with the [Centre for IDEA](#) and the Marine Ecosystem Research Centre ([EKOMAR](#)), Universiti Kebangsaan Malaysia, the Institute of Ocean and Earth Sciences (IOES), University of Malaya, and Sun Yat-sen University is organising an online workshop on Surface Ocean Lower Atmosphere Study in Southeast Asia. The workshop is a key event on the SOLAS calendar, aiming to promote SOLAS science and build SOLAS network in Southeast Asia. The workshop will take place on 23 Aug 2022.

IV.a. Participation in events

- "Bite-size" Gas Transfer at Water Surfaces Symposium 2021, online, 19 May 2021
- 13th Meeting of Subsidiary Body for Scientific & Technological Advice (SBSTA), online, 2 Jun. 2021
- OCB2021 summer workshop, networking event, online, Jun. 2022
- China Forum on The United Nations Decade of Ocean Science for Sustainable Development, Qingdao, China, 8 Jun. 2021
- Sustainability Research and Innovation Congress sessions on 1) SOLAS Science & Society: The apparent mismatch between science and policy at the air-sea interface, 2) The Atmosphere - the "forgotten" domain in the SDGs? and 3) Air Quality and Human Health, online, 12-15 Jun. 2021
- 42nd Session of the World Climate Research Programme (WCRP) Joint Scientific Committee (JSC-42), online, 28 Jun. – 2 Jul. 2021
- Aerosol emissions from POLAR CHANGing Environments (POLAR CHANGE) Workshop, including BEPSII and CATCH communities, online, 7 Jul. 2021
- GEOTRACES-SOLAS workshop on Iron at the Air-Sea Interface, online, Ashville, North Carolina, USA, 26-30 Jul. 2021
- BEPSII & ECVice 2021 annual meeting and early-career researcher day, online, 20-27 Aug. 2021
- 16th IGAC Science Conference, CATCH session, online, 12-16 Sep. 2021
- SOLAS-supported Ocean Best Practices Workshop on eddy covariance air-sea flux, online, 21 Sep. 2021

- Young Scientist Forum, First Institute of Oceanography, Ministry of Natural Resources of China, online, 28 Sep. 2021
- PICES annual meeting, Physical Oceanography and Climate Committee meeting, online, 30 Sep 2021; Biological Oceanography Committee meeting, online, 4 Oct 2021; session on Atmospheric nutrient deposition and microbial community responses, and predictions for the future in the North Pacific Ocean, online, 26 Oct. 2021
- COP26 side event on Carbon conservation and sequestration in ocean - Nature based and technology solution, online, Glasgow, UK, 6 Nov. 2021
- UN Ocean Decade Laboratory Satellite event, An Observing Air-Sea Interaction Strategy (OASIS) for a Clean Ocean, online, 18-19 Nov. 2021
- COASTAL-SOS Launch Session, UN Ocean Decade Kick-off Conference for the Western Pacific and its Adjacent Areas, online, 26 Nov 2021.
- EUMETSAT-SOLAS workshop, Remote sensing for ocean-atmosphere interactions studies & applications, online, 1-3 Dec. 2021
- SCOR China Annual Meeting, online, Qingdao, China, 21-22 Dec. 2021
- ESA/PML/NASA workshop on Ocean Carbon From Space, online, 14-18 Feb. 2022
- EGU 2022, session on Air-sea Chemical Fluxes: Impacts on Biogeochemistry and Climate, Vienna, Austria, 3-8 Apr. 2022
- Future Earth China National Committee Annual Meeting, online, 7 May 2022
- BEPSII Sea Ice School 2022, Cambridge Bay, Canada, 14-23 May 2022
- 53rd International Liège colloquium on Ocean Dynamics and GO₂NE oxygen conference, Liège, Belgium, 16-20 May 2022
- 8th Int. Symposium on Gas Transfer at Water Surfaces (GTWS), Plymouth, UK, 17-20 May 2022
- Measuring Essential Climate Variables in Sea Ice (ECV-Ice) intercalibration experiment and BEPSII winter school, Cambridge Bay, Canada, 17-20 May 2022
- 8th SOLAS Summer School, online, 13-17 Jun. 2022
- Sustainability Research Innovation 2022, hybrid, Pretoria, South Africa, 20-24 Jun. 2022
- Virtual Training Programme for Sustainable Oceans 2022, online, 28 Jun. – 1 Jul. 2022
- Side event at the UN Ocean Conference on Future Earth's marine networks: a trans- and interdisciplinary scientific community working toward the achievement of the SDGs, hybrid in Lisbon, Portugal, 30 Jun. 2022

IV.b. Communications

Website: <http://www.solas-int.org/>

Newsletter: 12 SOLAS newsletters have been sent to over 1000 SOLAS scientists since the last SCOR report. The monthly newsletter releases compile scientific highlights, news from SOLAS, opportunities for meetings, abstract submission deadlines, recent publications, vacancies, and news from relevant partner projects and collaborators. Past issues can be viewed on the SOLAS website: <https://www.solas-int.org/news/newsletter-archive.html>

Community survey: In June 2022, a community survey on the SOLAS Newsletter was launched to find out whether the newsletter's format and content still meets the needs of its readers.

Event Report series: Reports on SOLAS sponsored or co-sponsored events are published after each SOLAS-sponsored event. These reports are sent to the SOLAS sponsors and other interested parties and are released in combination with the monthly Newsletters.

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

The following reports were published since the last reporting:

- [Issue 20](#). GEOTRACES-SOLAS Workshop on Iron at the Air-Sea Interface Workshop, which took place online and onsite in Asheville, North Carolina, USA, 26-30 July 2021.
- [Issue 21](#). SOLAS session at Sustainability Research & Innovation Congress 2021 (SRI2021) on 'SOLAS Science & Society: The apparent mismatch between science and policy at the air-sea interface', online and in Brisbane, Australia, 12-15 June 2021.
- [Issue 22](#). EUMETSAT-SOLAS Workshop on Remote Sensing for Ocean-Atmosphere Interactions Studies and Applications, online, 1-3 December 2021.

Twitter: Regular posts (currently 1656) are being sent out and the number of followers is steadily increasing (currently 1358). [@SOLAS_IPO](#)

ResearchGate: Connects the SOLAS research network and includes nearly 700 SOLAS-related publications with 225 followers and 1988 reads.

<https://www.researchgate.net/project/Surface-Ocean-Lower-Atmosphere-Study-SOLAS-2>

Flickr: SOLAS public photo stream shows pictures (currently 68) of the most recent SOLAS events and SOLAS related research. In addition, SOLAS distributes event pictures (currently 344) among participants via private links. <https://www.flickr.com/photos/182357030@N02>

Call for Photos: In April 2022, a call to share research stories and photos with the IPO was sent to the SOLAS community, to publish on the SOLAS Flickr and Twitter accounts as well as to use to produce a SOLAS image film in the future.

Summer School alumni survey: The GSS fellow Kim Magalona, who worked in the IPO for 20 weeks, conducted as part of her project a survey on the impacts of the SOLAS Summer School on alumni careers and research. In addition, she did two interviews with two of the alumni. The first results were published in the SOLAS Review Report and the IPO is now working on the final publication of the results.

Outreach: SOLAS figures, conceptual diagrams, 3-fold SOLAS flyer, and logos are available for download from the SOLAS website. <https://www.solas-int.org/publications/downloads.html>

Presentation: A SOLAS presentation is available upon request from the IPO.

IV.c. Publications

Please see the SOLAS project on ResearchGate for an extensive list of recent relevant publications from the community: <https://www.researchgate.net/project/Surface-Ocean-Lower-Atmosphere-Study-SOLAS-2>

Key integrative SOLAS publications from 2021 and 2022 are summarised on the SOLAS website: <https://www.solas-int.org/publications/publications.html>

IV.d. National and regional networks

In September 2021, the IPO redesigned the SOLAS Networks website. With the redesigned website, SOLAS would like to give the National and Regional Representatives a larger platform to increase their role, their visibility and to thank them for their voluntary and extremely valuable commitment to the SOLAS community. The representatives are listed on a separate website at <https://www.solas-int.org/index/networks.html>, which now includes their profile pictures, affiliations, website links, and information on expertise. The annual reports are now under “Publications” at <https://www.solas-int.org/publications/national-regional-reports.html>.

SOLAS has national/regional representatives in 31 countries and/or regions around the globe. The representatives report annually on SOLAS-related activities in their countries.. As a new initiative, national reports are being posted on the SOLAS website. The information contained in the reports is a valuable source of information for the IPO to report to sponsors but also to facilitate coordination and dissemination of results and progress from national projects to the rest of the SOLAS community. Information provided through the reports is also used by the Scientific Steering Committee to develop the implementation strategy.

Since the last annual report, SOLAS established new national networks in Greece and the United Arab Emirates. SOLAS is also working on the establishment of regional networks in Southeast Asia and Africa. We wish to get the Representatives more engaged in SOLAS, e.g., recruiting them to the Implementation Teams and soliciting them to organise the SOLAS seminars.

Current national networks:

- Australia: Andrew Bowie and Ruhi Humphries *
- Belgium: Nathalie Gypens *
- Brazil: Leticia Cotrim Da Cunha
- Canada: Martine Lizotte *
- Chile: Laura Farias
- China (Beijing): Huiwang Gao *
- China (Taipei): Chonlin Lee *
- Denmark: Lise Lotte Soerensen and Mikael Sejr
- Finland: Lauri Laakso
- France: Rémi Losno #
- Germany: Christa Marandino and Hartmut Herrmann #
- Greece: Alexandra Gogou
- India: Sheryl Oliveira Fernandes *
- Israel: Yoav Lehahn *
- Ireland: Peter Croot *
- Italy: Chiara Santinelli
- Japan: Yuzo Miyazaki *
- Korea: Kitack Lee *
- Mexico: Jose Martin Hernandez Ayon *
- Netherlands: Jan-Berend Stuut
- New Zealand: Holly Winton *
- Norway: Siv Lauvset *

- Peru: Michelle Graco
- Poland: Timo Zielinski
- South Africa: Brett Kuyper
- Spain: Alfonso Saiz-Lopez *
- Sweden: Paul Zieger *
- Turkey: Baris Saglihoglu, Mustafa Koçak, Nazli Olgun
- United Arab Emirates: Diana Francis #
- UK: Philippa Rickard *
- USA: Rachel Stanley #

* SOLAS has received the 2021 report

report to be submitted shortly

IV.e. Current endorsed projects and time series – ongoing

- July 2022: (Biogeochemical processes and Air–sea exchange in the Sea-Surface microlayer (BASS), <https://uol.de/en/bass>)
- April 2022: Carbon Storage in German Coastal Seas - Stability, Vulnerability and Perspectives for Manageability (CARBOSTORE), <https://www.carbostore.de/index.php.en>
- January 2022: Carbon-FE - Carbon Fixation and Export in oligotrophic ocean, <https://carbon-fe.xmu.edu.cn/index.asp>
- September 2021: Marine Carbon Sink - Quantifying and Predicting Canada's Marine Carbon Sink , <https://www.nserc-crsng.gc.ca/NSERC-CRSNG/FundingDecisions>
- June 2021: Climate Relevant interactions and feedbacks: the key role of sea ice and Snow in the polar and global climate system (CRiceS), <https://en.ilmatieteenlaitos.fi/press-release/7Hl5wqSzMeJvUizgtMZgTb>
- April 2021: Breathing Oceans: understanding the organic skin that modulates the exchange of greenhouse gases between the atmosphere and the ocean (BOOGIE), <https://carbonwaterdynamics.wordpress.com/projects/boogie/>
- November 2020: Global shipping: Linking policy and economics to biogeochemical cycling and air-sea interaction (ShipTRASE), YouTube information: <https://www.youtube.com/watch?v=2bygnQYK7fc>
- July 2020: Penlee Point Atmospheric Observatory, <https://www.westernchannelobservatory.org.uk/penlee/>
- July 2020: Boknis Eck Time-Series Station, <http://www.bokniseck.de>
- April 2020: Shipping Emissions in the Arctic and North Atlantic Atmosphere (SEANA), www.birmingham.ac.uk/seana
- December 2019: Are marine microorganisms influencing clouds? (Sea2Cloud), <https://www.europeandissemination.eu/sea2cloud-by-karine-sellegr-2/2704>
- November 2019: Atmospheric Composition and Radiative forcing changes due to UN International Ship Emissions regulations (ACRUISE), <https://www.pml.ac.uk/Research/Projects/ACRUISE>
- October 2019: Atlantic Meridional Transect Ocean Flux from Satellite Campaign (AMT4oceanSatFlux), <https://amt4oceansatflux.org/>

- September 2019: Role of Eddies in the Carbon Pump of Eastern Boundary Upwelling Systems (REEBUS), <https://www.ebus-climate-change.de/reebus>
- March 2019: Impact of atmospheric multi-stressors to coastal marine systems in a changing climate scenario (AMBIEnCE), <https://projectambience.wordpress.com/>
- October 2017: Processes Influencing Carbon Cycling: Observations of the Lower limb of the Antarctic Overturning (PICCOLO), <https://roses.ac.uk/piccolo/>
- June 2016: Tudor Hill Marine-Atmospheric Observatory, <http://www.bios.edu/research/projects/tudor-hill-marine-atmospheric-observatory/>

Information on all endorsements (also completed ones) and the formal application processes is available on the SOLAS website: <http://www.solas-int.org/activities/project-endorsement.html>.

IV.f. Metadata portal

The SOLAS metadata portal was set up by the SOLAS project integration initiative (2007-2013) with the intention to help SOLAS scientists identify what data exist, where they are stored, and the data originators. The portal is hosted by the BODC, and the metadata files are stored on the international standard Global Change Master Directory (GCMD). The resource is freely available at https://www.bodc.ac.uk/solas_integration/research_objectives/metadata_portal/

The SOLAS metadata portal is an ongoing effort. Scientists can help expanding the SOLAS metadata base by completing a simple template available at

https://www.bodc.ac.uk/solas_integration/implementation_products/data_submission/

IV.g. Income and expenses for the past year and budget for the coming year Including funding from all sources (not only SCOR funding)

- Executive director salary, office space and in kind provided by GEOMAR until August 2021.
- Executive director salary, office space and in kind provided by NUIG from January 2022 until December 2026.
- Deputy executive director salary, office space and in kind provided by MEL from January 2021 until December 2026.
- Project officer salary of 120kUSD provided by US-NSF via SCOR and office space/in kind by GEOMAR until January 2024.
- Project officer salary, office space and in kind provided by MEL, June 2021 until May 2024.
- US-NSF via SCOR annual grant of 32-35kUSD to use for activities until September 2021.
- New US-NSF via SCOR annual grant of 33kUSD to use for activities until September 2024.
- Future Earth annual block grant of 10kEUR in 2021 and 5kEUR without strings attached.

Income, expenses and budget for 2021-2022:

INCOMES		Credit (EUR)	Debit (EUR)
	Funds from GEOMAR Helmholtz Center for Ocean Research Kiel for salary	48.000	
	Funds from National University of Ireland Galway for salary	77.000	
	Funds from NSF via SCOR for salary	51.000	
	Funds from MEL for salary	71.000	
	NSF fund 2021-2022, year 1: Participant support	24.660	
	NSF fund 2021-2022, year 1: Publications	2.570	
	NSF fund 2021-2022, year 1: Other	2.100	
	Gordon and Betty Moore Foundation - for summer school	17.000	
	POGO fund for summer school	7.000	
	IUGG fund via iCACGP	2.600	
	CRNS fund 2022	8.000	
	Future Earth block grant 2021	5.000	
	Future Earth block grant 2022	10000	
Total Income		325.930	
EXPENSES		Credit (EUR)	Debit (EUR)
IPO	Salaries		247.000
	Consumables		150
Representational travel			6.700
Events	Ocean Liège Colloquium		3.000
	GTWS		3.000
	SOLAS virtual summer school		24.000
	BEPSII support for winter school		5.000
	CATCH online meeting support		500
Publications	SOLAS puzzle figure		160
	Ocean KAN support for online platfor		1.000
	SOLAS Website update		1.200
	SOLAS Website subscription 2021 and 2022		300
Total Expenses			292.010
Balance			33.920
Note:			
This does not include the following items:			
In kind from GEOMAR and MEL with office space/computer/printing/administration etc.			

V. Update on the Scientific Steering Committee and International Project Office

V.a. SOLAS Scientific Steering Committee

Minhan Dai (M, China) and Cliff Law (M, New Zealand) were appointed as SOLAS SSC co-chairs in January 2021, acting for 3 years. After Cliff Law stepped down as co-chair, Cecile Guieu (F, France) was appointed in October 2021 as new co-chair. Both will act as co-chairs through December 2023.

SOLAS has an Executive Committee composed of the Co-chairs Minhan Dai (China) and Cecile Guieu (France), Katy Altieri (F, South Africa), Jun Nishioka (M, Japan), and Jurgita Ovadnevaite (F, Ireland).

The following SSC members rotated off at the end of 2021:

- Miller, Lisa (F, Canada) as ex officio
- Minnett, Peter (M, USA)
- Suntharalingam, Parvatha (F, UK)

In January 2022, two new SSC members were appointed:

- Bell, Thomas (M, UK)
- Singh, Arvind (M, India)

The following SSC members finished their 1st terms in 2021 and were renewed for a 2nd term:

- Mahajan, Anoop (M, India)
- Ovadnevaite, Jurgita (F, Ireland)

Last name	First name	Country of employment	Gender	Scientific expertise	SOLAS expertise	Term	End
Dai	Minhan	China	M	C and nutrient bgc, trace metals, ocean acidification	Co-chair, Theme 1, Coastal ocean	1	2023
Singh	Arvind	India	M	C, N, P bgc cycles, stable isotope tracers	Theme 1, Indian Ocean	1	2024
Körtzinger	Arne	Germany	M	C cycle, Ocean observation	Theme 1, Upwelling	2	2023
Cornejo	Marcela	Chile	F	Nutrient and greenhouse gases cycling, upwelling	Theme 1, Upwelling	1	2023
Zhang	Guiling	China	F	Bgc of trace gases	Theme 1, Coastal ocean	2	2022
Lenton	Andrew	Australia	M	Marine bgc, modelling, C cycle	Theme 1, Climate intervention SIOA liaison	1	2022
Bell	Thomas	UK	M	Air-sea chemistry & gas exchange; bgc cycles; modelling	Themes 2 and 3 ESA connection	1	2024
Rutgersson	Anna	Sweden	F	Air-sea physical interaction	Theme 2, Science & Society WCRP rep	2	2022
Latif	Mohd Talib	Malaysia	M	Microlayer, atmospheric aerosols	Themes 2 and 5	2	2023
Guieu	Cecile	France	F	Atmospheric chemistry, trace elements, C cycle	Themes 2 and 3	1	2023
Altieri	Katye	South Africa	F	Atmospheric molecules, climate policy	Themes 3 and 5, Polar oceans, Science & Society CATCH liaison	2	2023
Gassó	Santiago	USA	M	Remote sensing, aerosols, dust transport	Themes 3 and 4, NASA connection	2	2023

Ovadnevaite	Jurgita	Ireland	F	Aerosol chemistry, physics and cloud processes	Themes 4 and 5	1	2021
Kanakidou	Maria	Greece	F	Atmospheric modelling and pollutants	Themes 4 and 5, iCACGP connection	1	2023
Mahajan	Anoop	India	M	Atmospheric chemistry, halogens, climate modelling	Theme 5, Indian Ocean	1	2021
Nishioka	Jun	Japan	M	Trace metal bgc cycle, Polar oceanography and sea-ice bgc	Theme 3, Polar oceans PICES connection	2	2022
Van Doorn	Erik	Germany	M	Law of the Sea	Science and Society	2	2022

The current gender and country balance of the SSC for 2 co-chairs and 15 members:

- 7 female members and 10 male members
- 6 members from developing countries and 11 from developed countries

V.b. SOLAS International Project Office

IPO at GEOMAR in Kiel, Germany

The SOLAS IPO was hosted at the GEOMAR Helmholtz Centre for Ocean Research Kiel in Kiel, Germany until August 2021.

The new US-NSF via SCOR annual grant allows maintaining the project officer position at GEOMAR on a half-time basis until January 2024. Every three months, GEOMAR sends an invoice to SCOR, and a job description is being submitted to SCOR.

IPO at the National University of Ireland in Galway, Ireland

From January 2022, the National University of Ireland (NUIG), in Galway, Ireland, will host the IPO-Ireland and the executive director for 5 years with the possibility of an extension. The hosting agreement is connected to the development and administration of a 1-year international SOLAS research master's program with the first students joining in September 2022.

IPO at the State Key Laboratory for Marine Environmental Science (MEL) in Xiamen, China

Minhan Dai (co-chair) from the State Key Laboratory for Marine Environmental Science (MEL), Xiamen University supports the SOLAS IPO-China. The deputy executive director and the project officer positions are until December 2026 and May 2024, respectively.

Dual-IPO setup between Galway, Ireland and Xiamen, China

While both SOLAS IPOs (Ireland and China) will fulfill separate responsibilities, they will closely collaborate and provide mutual support on major SOLAS tasks. Each IPO will be staffed and funded by their respective host institutions and manage the funds required for their responsibilities, respective staff, travel, and activities