

Report for the year 2021 and future activities

SOLAS South Africa

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This report has two parts:

- **Part 1:** reporting of activities in the period of January 2021 - Jan/Feb 2022
- **Part 2:** reporting on planned activities for 2022 and 2023.

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan. As much as possible, please indicate the specific SOLAS 2015-2025 Science Plan Themes addressed by each activity or specify an overlap between Themes or Cross-Cutting Themes.

- 1 Greenhouse gases and the oceans;
 - 2 Air-sea interfaces and fluxes of mass and energy;
 - 3 Atmospheric deposition and ocean biogeochemistry;
 - 4 Interconnections between aerosols, clouds, and marine ecosystems;
 - 5 Ocean biogeochemical control on atmospheric chemistry;
- Integrated studies of high sensitivity systems;
Environmental impacts of geoengineering;
Science and society.

IMPORTANT: *This report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities).*

First things first...Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

Thank you for the great work and on-going support.

PART 1 - Activities from January 2021 to Jan/Feb 2022

1. Scientific highlight

Describe one scientific highlight with a title, text (max. 300 words), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in results of international collaborations. (If you wish to include more than one highlight, feel free to do so).

The surface ocean is supplied with nutrients through ocean circulation. These nutrients fuel global ocean productivity. The rates and mechanisms of nutrient and water transport are poorly known.

Using nitrate isotope measurements and a box model, we show that Southern Ocean nutrients support >60% of lower latitude productivity. The nutrients are transported north predominantly through mixing (Fripiat et al. 2021; Nature Geoscience).

2. Activities/main accomplishments in 2021 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

South African Polar Research Infrastructure (SAPRI)

The South African Polar Research Infrastructure is a consortium and was established in 2021. The ultimate goal of SAPRI is enable broadscale research growth across the polar disciplines and further expand the world class datasets already established. The Implementation Phase is being finalised between the Department of Science and Innovation (DSI) and the National Research Foundation (NRF) of South Africa. SAPRI is currently hosted by the South African Earth Observing Network (SAEON) under Dr Juliette Hermes. SAPRI aims to close the gap between existing infrastructure (logistics) and ongoing and upcoming research in the South Africa marine and polar regions.

Part of the SAPRI umbrella includes facilitating research cruises on the R/V SA Agulhas II. These include SEAmester and the Winter Cruise. SAPRI is also heavily involved in establishing a Polar Laboratory, which will be hosted at UCT. One of the Polar Laboratory's missions is to make research in the polar regions accessible for universities and students who would otherwise not have the opportunity.

Southern African Marine Science Symposium (SAMSS)

The conference is formally hosted by the University of KwaZulu Natal and the KZN Sharks Board, on behalf of SANCOR (South African Network for Coastal and Oceanic Research). SAMSS 2022 saw the annual conference recommence after a COVID hiatus. This conference therefore aims to explore the links, continuity and changes in marine science of the past and present, with emphasis on how the science being done today will determine the 'future pasts' of our marine ecosystems and the people who depend on them.

3. List SOLAS-related publications published in 2021 (only PUBLISHED articles). If any, please also list weblinks to models, datasets, products, etc.

[* indicates student-led]

*Flynn, R.F., Bornman, T.G., Burger, J.M., Smith, S., Spence, K.A.M., Fawcett, S.E. Summertime productivity and carbon export potential in the Weddell Sea, with a focus on the waters adjacent to Larsen C Ice Shelf. *Biogeosciences* 18: 6031-6059, 10.5194/bg-18-6031-2021 (2021).

*Stirnimann, L., Bornman, T.G., Verheye, H.M., Bachèlery, M.-L., van der Poel, J., Fawcett, S.E. Plankton community composition and productivity in the vicinity of the Subantarctic Prince Edward Island archipelago in autumn. *Limnology and Oceanography* 66:4140-4158, 10.1002/lno.11949 (2021).

Landwehr, S., Volpi, M., Haumann, F.A., Robinson, C.M., Thurnherr, I., Ferracci, V., Baccarini, A., Thomas, J., Gorodetskaya, I., Tatzelt, C., Henning, S., Modini, R.L., Forrer, H.J., Lin, Y., Cassar, N., Simó, R., Hassler, C., Moallemi, A., Fawcett, S.E., et al. Exploring the ocean and atmosphere coupled system with a data science approach applied to observations from the Antarctic

Circumnavigation Expedition, Earth System Dynamics 12: 1295-1369, 10.5194/esd-12-1295-2021 (2021).

Fripiat, F., Martínez-García, A., Marconi, D., Fawcett, S.E., Kopf, S.H., Luu, V.H., Rafter, P.A., Zhang, R., Sigman, D.M., Haug, G.H. Nitrogen isotopic constraints on nutrient transport to the upper ocean. Nature Geoscience 14: 855-861, 10.1038/s41561-021-00836-8 (2021).

*Puccinelli, E., Sardenne, F., Pecquerie, L., Fawcett, S.E., Machu, E., Soudant, P. Omega-3 pathways in upwelling systems: the link to nitrogen supply. Frontiers in Marine Science 8: 664601, 10.3389/fmars.2021.664601 (2021).

Altieri, K.E., Fawcett, S.E., Hastings, M.G. The surface ocean-lower atmosphere reactive nitrogen cycle. Annual Review of Earth and Planetary Sciences 49: 513-540, 10.1146/annurev-earth-083120-052147 (2021).

*Kravitz, J., Matthews, M., Lain, L., Fawcett, S.E., Bernard, S. Potential for high fidelity global mapping of common inland water quality products at high spatial and temporal resolutions based on a synthetic data and machine learning approach. Frontiers in Environmental Science 9: 587660, 10.3389/fenvs.2021.587660 (2021).

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2021? If yes, who? How did you engage?

International:

National (non university)

Collaborations included shared field work (specifically):

Research cruises – Relief Voyage of the R/V SA Agulhas II along the ‘Goodhope Transect’ between Cape Town and Antarctica.

Ongoing collaboration between the South African Weather Service and University of Cape Town. Resulting in research at the Cape Point Global Atmospheric Watch Tower.

South African Polar Research Infrastructure (SAPRI) – See above.

PART 2 - Planned activities for 2022 and 2023

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

SAPRI –

SEAmester

The SEAmester recommenced in 2022. This programme offers postgraduate students from South Africa a hands-on learning opportunity aboard the SA Agulhas II. The cruise lasts around 10 days and is comprised of lectures and practical demonstration and activities. Introducing students to various facets of ocean and atmospheric dynamics. This includes physical, chemical and biological oceanography, atmospheric chemistry and meteorology, data analysis and measurement techniques. cruise involves running a transect across the core of the Agulhas Current off Port St Johns, known as the ASCA line

Winter Cruise

The R/V SA Agulhas II embarks on a cruise each year departing from Cape Town to the marginal ice zone. This cruise closes a seasonal gap / bias in the knowledge in physical oceanography and in better understanding the processes affecting the sea ice formation and the Southern Ocean during winter months. The cruise follows the same transect as in summer, known as the 'Goodhope Transect'.

Polar Change –

Aerosol emissions from polar changing environments. The aim of this project is to link aerosol emission processes with the polar marine biosphere and cryosphere interactions. Part of this study includes a research cruise to the Antarctic in 2023 to examine about the sources of aerosols and the vertical distribution and transformation. The UCT Marine Biogeochemical Laboratory will likely be taking part in the cruise. The cruise and the project are being run and facilitated by the Institut de Ciències del Mar under Rafael Simo and Manuel Dall'Osto.

International Conference on Mercury as a Global Pollutant (ICMGP)

The 15th ICMGP was held virtually in 2022. This meeting will seek to assess implementation of solutions to reduce the emissions and exposure to mercury as a global environmental pollutant and test the efficiency of implementation of the Minamata Convention in various parts of the world. The conference will bring together representatives from industry, government, research institutions, non-governmental organizations (NGOs) and academia to discuss, inter alia, options for low-mercury energy and industrial technologies and the concept of low-mercury society. The event will also showcase new equipment to measure mercury in various environmental samples, and technology to reduce mercury emissions and exposure.

Southern African Marine Science Symposium (SAMSS)

See above.

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

SOLAS OSC CPT September 2022

The SOLAS Open Science Conference is taking place in Cape Town in September 2022.

UN/GESAMP Working group 38

A number of South African scientists including members of the UCT Marine Biogeochemistry Laboratory, North-West University, Nelson Mandela University, and Rhodes University (perhaps others) will be taking part in the UN/GESAMP WG38 project taking place in Gqeberha, South Africa and focused on atmospheric deposition to the South Indian Ocean.

SEAmester

SEAmester is an ongoing training platform for young students. The SEAmester cruise aims to provide a learning opportunity for postgraduate students, who might not have otherwise had such a

chance. There is also the opportunity for the training of early career scientists, by becoming involved in the teaching aspects of the course.

3. Funded national and international projects/activities underway.

BIOGRIP –

The Biogeochemistry Research Infrastructure Platform (BIOGRIP) is a South African research initiative. The multidisciplinary initiative aims to broaden research capacity and discovery biological, geological, chemical and physical process. To explore how these processes interact and shape natural environments over time and space.

South African National Antarctic Programme (SANAP) –

The South African National Antarctic Programme is funded by the Department of Forestry, Fisheries and the Environment (DFFE) and the National Research Foundation (NRF). The DFFE remain responsible for logistics and infrastructure with the SANAP programme. The NRF is the agency responsible for grant allocation for the scientific community to continue research in the polar regions, utilising SANAP infrastructure. Large infrastructure includes the manned station on Antarctica as well as on Marion and Gough Islands, the SA Agulhas II and a number of smaller research vessels.

South African Polar Research Institute (SAPRI) –

Part of the goal of SAPRI is to bridge this disconnect between research being funded in the polar regions and access to the infrastructure.

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

Joint venture

A joint measurement campaign between the Department of Oceanography and Mayis Universitesi Department of Physics Turkey / Samsun is being examined. The venture aims to place underway atmospheric instrumentation onboard the SA Agulhas II. Proposed measurements include CO, O₃, NO_x and FTIR. Dates for the start of the project are still being determined.

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

The Marine Biogeochemical Group at the University of Cape Town will be taking part in the Polar Change and PICCASSO programmes, both supported by SOLAS and involving SOLAS scientists from other countries.

Comments