

## Report for the year 2022 and future activities

### SOLAS South Africa

**compiled by: Brett Kuyper**

*This report has two parts:*

- **Part 1:** reporting of activities in the period of January 2022 - Jan/Feb 2023
- **Part 2:** reporting on planned activities for 2023 and 2024.

*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 ongoing support.

### **PART 1 - Activities from January 2022 to Jan/Feb 2023**

#### **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).*

Relatively little is known about the temporal and spatial variability of the photosynthetic efficiency (Fv/Fm) and its biogeochemical controls in the higher latitudes (Deppeler and Davidson, 2017). This *in situ* study spans the full latitudinal extent of the Atlantic Southern Ocean (SO) during five summer voyages (2008 – 2016) to assess zonal, inter-annual and intra-seasonal variability in phytoplankton Fv/Fm. Zonal variability showed that the Polar Frontal Zone (PFZ) had the highest Fv/Fm, whilst the Southern Antarctic Circumpolar Current Zone (SACCZ) had the lowest. This implies efficient photosynthesis in the PFZ that was the least constrained by environmental conditions and the most likely to generate higher rates of production positively impacting the biological carbon pump (BCP). Strong inter-annual variability in Fv/Fm was observed in the SACCZ and PFZ, with most years being significantly different, while the Antarctic Zone (AZ) exhibited very low inter-annual variability in Fv/Fm. This zonal investigation of inter-annual variability provides a dynamic understanding of phytoplankton regionalization in response to the characteristics of the underlying drivers, which are either strongly seasonal (expressed as low inter-annual variability) or highly variable i.e., more likely influenced by sub-seasonal forcing of the nutrient and light supply (expressed as high inter-annual variability). Intra-seasonal differences in Fv/Fm between early and late summer reflected seasonal nutrient limitation following biological utilization when averaged across all zones and cruises. However, this response was not consistent when considered per zone or per cruise highlighting the likelihood of a dynamic interplay of sub-seasonal variability of environmental drivers. The characteristics of variability were investigated in the context of five biogeochemical ancillary data sets. Although variability appeared to be linked to SST, nutrient ratios and community structure depending on whether the data were grouped per zone or per cruise, no consistent patterns were evident in any single driver-response relationship. These results highlight the complex interplay between eco-physiological drivers and their photophysiological responses, which act simultaneously and oftentimes antagonistically making it difficult to detect a single driver influence from the net effect. This study alludes to how climate change may alter the impact of various environmental factors on phytoplankton photophysiology and, by extent, primary production and the BCP. More *in situ* studies on the drivers of photophysiology, including further potential key drivers such as iron, will provide a broader understanding of the factors limiting phytoplankton primary production in the SO, as well as assist in predicting how phytoplankton will respond to future conditions that are associated with climate change. Such information is vital for accurately predicting the future role of the SO in the global uptake and regulation of atmospheric CO<sub>2</sub>.

Citation: Singh A, Thomalla SJ, Fietz S and Ryan-Keogh TJ (2022) Spatial and temporal variability of phytoplankton photophysiology in the Atlantic Southern Ocean. *Front. Mar. Sci.* 9:912856. doi: 10.3389/fmars.2022.912856

**2. Activities/main accomplishments in 2022 (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)**

There has been movement on several fronts under the SAPRI purview. These include:

- The Data, Products and Society (DPS) node is being housed at Stellenbosch University. The team is being led by Dr Anne Treasure, with Ms Anche Louw as the digital marketing and communications manager. The node is going from strength to strength.
- Planning for the Marion cruise 2023 is well underway.
- The South African National Antarctic Program (SANAP) project call will be out soon.
- The User fora are still very active and there was a recent meeting between the members and SAPRI, the Department of Science and Innovation (DSI), the Department of Forestry, Fisheries and the Environment (DFFE) and SANAP/ National Research Foundation (NRF) to discuss concerns and opportunities.
- Ongoing discussions between DFFE, DSI, NRF and SAPRI have been really positive in trying to resolve concerns and create a cohesive longer-term plan for cruises and sustainability of long-term observations. The plan is for more detailed community engagement in May.
- There have been some key initial infrastructure purchases and staff appointments.

### **Southern African Marine Science Symposium (SAMSS)**

The 17th South African Marine Science Symposium was held in Durban in June 2022. Marine Science is at a crossroads. Recent technological advances are driving new fields of biological endeavour with the aim of addressing current environmental and societal needs. Funding models are promoting transdisciplinary research and multi-institutional programmes that not only tackle ongoing global change issues, but have tangible societal benefits as well.

At the same time, the skills and lessons of the past remain pertinent. Studies of biodiversity and evolved traits inform of species resilience and probable trajectories in an age of global change, emphasizing the lasting truth of Dobzhansky's famous dictum – that nothing in biology makes sense, except in the light of evolution. Ancient coastlines and climate records can shed light on past conditions and changing biological assemblages. Studies in basic marine ecology, chemistry, oceanography and organismal biology build our understanding of the important drivers of marine systems and inform our decisions and actions. And while funding for pure or basic science is under pressure, it may be the foundation for the next scientific revolution, and helps us retain the sense of wonder that ensures continued engagement with the marine world.

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.

### **SOLAS Open Science Conference**

The SOLAS Open Science conference was held in Cape Town, South Africa in September 2022. A virtual broadcast of the conference was sent out in real time. This inclusion resulted in comprehensive engagement across the community. A good turnout of in-person attendees were treated to some wonderful Cape Town weather to go along with the excellent science and community building. The post conference reports indicate that there was a good mix of early career scientist presentations along with established researchers. It great to have these platforms to propel the science forward.

### **International Conference on Mercury as a Global Pollutant (ICMGP)**

The 15<sup>th</sup> 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.

### **3. Top 5 publications in 2022 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.**

Nicholson, S.A., Whitt, D.B., Fer, I. et al. Storms drive outgassing of CO<sub>2</sub> in the subpolar Southern Ocean. *Nature Communications* 13, 158 (2022). <https://doi.org/10.1038/s41467-021-27780-w>

du Plessis, M. D., Swart, S., Biddle, L. C., Giddy, I. S., Monteiro, P. M. S., Reason, C. J. C. Nicholson, S.-A., et al. (2022). The daily-resolved Southern Ocean mixed layer: Regional contrasts assessed using glider observations. *Journal of Geophysical Research: Oceans*, 127, e2021JC017760. <https://doi.org/10.1029/2021JC017760>

Edholm, J. M., Swart, S., Plessis, M. D., & Nicholson, S.-A. (2022). Atmospheric rivers contribute to summer surface buoyancy forcing in the Atlantic sector of the Southern Ocean. *Geophysical Research Letters*, 49, e2022GL100149. <https://doi.org/10.1029/2022GL100149>

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- Awo FM, Rouault M, Ostrowski M, Tomety FS, Da-Allada CY and Jouanno, J. (2022). Seasonal cycle of sea surface salinity in the Angola upwelling system. *Journal of Geophysical Research: Oceans*, 127, e2022JC018518.
- Braby L, Deshayes J, Beal L, Morris T, Novelli G, Maitland J, Ansorge I, and Hermes J. (2022). First observations of seasonal variability in water mass properties across the Agulhas Current. *Journal of Geophysical Research: Oceans*, 127(9), e2021JC018107.
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- Cunningham EM, Rico Seijo N, Altieri KE, Audh RR, Burger JM, Bornman TG, Fawcett S, Gwinnett CMB, Osborne AO and Woodall LC. 2022. The transport and fate of microplastic fibres in the Antarctic: The role of multiple global processes. *Frontiers in Marine Science*, 9:1056081. doi: 10.3389/fmars.2022.1056081
- De Jager W and Vichi M. (2022). Rotational drift in Antarctic sea ice: pronounced cyclonic features and differences between data products, *The Cryosphere*, 16(3): 925–940.
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- Djeutchouang LM, Chang N, Gregor L, Vichi M, and Monteiro PMS. (2022). The sensitivity of *p*CO<sub>2</sub> reconstructions to sampling scales across a Southern Ocean sub-domain: a semi-idealized ocean sampling simulation approach, *Biogeosciences*, 19: 4171–4195,
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- Mashifane T, Bourbonnais A, Fawcett SE. (2022). Nitrous oxide dynamics in the southern Benguela upwelling system. *Journal of Geophysical Research: Oceans*, 127(11): 1-17
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Rouault M, Tomety FS. (2022). Impact of El Niño–Southern Oscillation on the Benguela Upwelling. *Journal of Physical Oceanography*, 52(10):2573-87.

Daniels T, Fearon G, Vilaplana A, Hewitson B, Rautenbach C. (2022). On the importance of wind generated waves in embayments with complex orographic features—A South African case study. *Applied Ocean Research*, 128:103355.

#### **4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2022? 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 2023 and 2024**

### **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. The programme will continue into 2023. This annual programme offers postgraduate students from South Africa a hands-on learning opportunity aboard the R/V 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 bias in the knowledge in physical and chemical oceanography. Couple with this is a 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'. Some samples are taken during the cruise and analysed at home in the laboratory, allow for isotope analysis and different sea ice information.

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

### **SOLAS Local Conference**

Plans are in development to establish a biennial local SOLAS conference. The primary aim of the conference would be to communicate ongoing research within the local community. It is hoped that this will improve relationships and collaboration, resulting in further research and open opportunities for multi-disciplinary efforts.

### **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. Dr Roger Diamond was recently appointed as the Director of the BIOGRIP Platform.

### **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, O<sub>3</sub>, NO<sub>x</sub> 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**