Report for the year 2022 and future activities

SOLAS Aotearoa New Zealand
compiled by: Holly Winton

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;
6. Integrated studies of high sensitivity systems;
7. Environmental impacts of geoengineering;

**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? 

The SOLAS Seminars and Newsletters provide highly useful and accessible updates on the latest science and activities.

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

#### 1. Scientific highlight

Clouds over the Southern Ocean are a large source of error in the current generation of climate models. To help address this the goSouth project characterised climate relevant aerosol processes in the turbulent boundary layer over the Southern Ocean as part of an international collaboration between the Leibniz Institute for Tropospheric Research (TROPOS), the Institute for Meteorology and Climatology (IMUK) at the Leibniz University of Hannover, the University of Auckland, the University of Canterbury and NIWA. A measurement campaign was carried out in November 2022 at a site overlooking Te Waewae Bay near Pahia (46.31°S, 167.71°W, 10 m a.s.l.), about 50 km west of Invercargill (Figure 1). Five researchers from TROPOS and one researcher from IMUK joined the NZ contingent for three weeks of aerosol and turbulence measurements.
measurements from ground level to 1 km. Measurements were made of aerosol physicochemical properties and concentrations in conjunction with a LOSTECCA remote-sensing campaign (Hofer et al., 2022) at the same site.

Despite severe logistical difficulties, due mainly to international shipping and local power problems, a potentially interesting ground-based and vertically resolved in-situ aerosol, meteorological and turbulence dataset, was acquired. First indications are that particle formation events were observed but due to the circulation patterns in the bay, it is possible that formation came from gaseous precursors emitted from New Zealand terrestrial sources. The project successfully demonstrated the feasibility of joint field campaigns in NZ and that due to the complex terrain and flow conditions, Te Waewae Bay is not the best place for investigating undisturbed Southern Ocean air-masses. First results were presented at a special session of the NZ Metsoc conference in Dunedin on December 6th 2022. Plans are now being made to seek funding for a larger campaign in 2025 to align with potential air and ship born campaigns planned for then.

Figure 1: The sampling site at Te Waewae Bay.

Acknowledgement: Go South is funded by BMBF (German Federal Ministry for Education and Research, project 01LK2003A), TROPOS, the Deep South Challenge and NIWA through SSIF.

measurements from Ships of Opportunity crossing the Southern Ocean between New Zealand and Antarctica, and historic atmospheric radiocarbon measurements reconstructed from tree rings collected in New Zealand and it’s subantarctic islands and Chile. This research is led by GNS and NIWA.

The Munida Time Series
- Now in its 24 year, the Munida Time Series continuing to collect carbon chemistry data, in subantarctic and frontal waters of the SW Pacific. An empirical multivariate linear regression (MLR) model was developed to estimate the concentration of dissolved inorganic carbon (DIC) in the surface ocean, capable of utilizing remotely sensed and modelled data to fill data gaps. This MLR was evaluated with seven other imputation models using data from seven long-term monitoring sites, including the Munida Time Series in a comparative assessment of gap-filling performance and the impacts on variability in the reconstructed time series.

RV Tangaroa (TAN2302) voyage, New Zealand to Ross Sea, 10 January-23
- Methane sources in coastal waters (NZ Antarctic Science Platform), PIs Sarah Seabrook, Cliff Law.

UNESCO

RV Ikatere (IKA2205) voyage, Bay of Plenty, 6 Oct 2022
- Sampling to track the fate of gases in the Bay of Plenty from the Calypso vent field.


Pacific Island Ocean Acidification Centre (PIOAC), a Fiji-based partnership between Otago, SPC, University of the Pacific, and NIWA. Founding members Kim Currie and Christina McGraw.

Pacific Island Ocean Acidification
- Pacific Island Ocean Acidification Centre (PIOAC), a Fiji-based partnership between Otago, SPC, University of the Pacific, and NIWA. Founding members Kim Currie and Christina McGraw.

Waiti Waita, The NZMS5 & NZFSS Joint Conference 2022, Auckland

Oceans in a High CO2 World, Lima, Peru

Goldschmidt Conference, Honolulu, Hawaii

Media
Theme 2: Air-sea interface and fluxes of mass and energy
Gas Transfer at Water Surfaces (Plymouth, UK)

Theme 3: Atmospheric deposition and ocean biogeochemistry
RV Tangaroa (TAN2302) voyage, New Zealand to Ross Sea, 10 January - 23 February
- Influence of dust and ash deposition in NZ surface waters (PI Cliff Law)

Theme 4 Interconnections between aerosols, clouds, and marine ecosystems
Guest Editor for Sea2Cloud Special Issue in Atmospheric Chemistry & Physics/Ocean Sciences
- 6 papers published and submitted.

SOLAS OSC, Cape Town, S. Africa.

RV Tangaroa (TANG2302) voyage, New Zealand to Ross Sea, 10 January - 23 February:
- Ocean derived aerosol-cloud-climate interactions in the Ross Sea region (PI Holly Winton)
  Collection of aerosol samples and seawater particulates to understand air-sea transfer of biogenic and marine aerosol as fatty acids, trace elements and major ions. Real time measurement of aerosol concentration and size.
- Measuring microplastics over the Southern Ocean (PI Laura Revell)
  Daily seawater and air samples were collected to analyse for the presence of microplastics on the 2023 RV Tangaroa voyage on the Southern Ocean. This data set is complementary to a similar data set collected in 2021.
- Monitoring Clouds and Aerosol in the Southern Ocean (PI Adrian McDonald)
  Climatological measurements of near surface properties and low-level cloud and identifying Super-cooled liquid cloud.

RV Investigator (IN2022_V01) voyage Hobart to Southern Ocean, January-February 2022:
- Organic aerosol characterisation in the Southern Ocean (PI Holly Winton; piggyback project on the SOTS voyage)
  Collection of aerosol samples to understand biogenic emissions such as fatty acids.

Present-day spatial distribution of lipid biomarkers of marine microbes in the Ross Sea region, Antarctica (PI Holly Winton)
- Phytoplankton biomarker (fatty acid and highly branched isoprenoids) analysis of surface snow and marine sediment to understand ocean-atmosphere transfer processes and sources.
- de Jong E., winner of Creative Poster Prize at SOLAS 2022 summer school for presentation “The Unknown Future of Ross Sea, Antarctic Phytoplankton: A multi-archive biomarker approach to the recent past”.

Oceanic and atmospheric microplastics
- Kvale , K, Lou Del Bello, China Dialogue (19/05/2022)
- Kvale K., interviewed for In the ocean, its snowing microplastics, Sabrina Imbler, New York Times, (03/04/2022)
- Winton H., Radio New Zealand Afternoon Show, interviewed By Jesse Mulligan on “First microplastics found in Antarctic snow” 8 June 2022.
- Winton H., Science Media Centre expert reaction on “First microplastics found in Antarctic snow”

Modelling marine aerosol and ice nucleating particles
- Two postdocs, Abhi Venugopal and Nick Edkins, were appointed at the University of Canterbury and NIWA to work on modelling marine aerosol and ice nucleating particles over the Southern Ocean using the New Zealand Earth System Model.
Theme 5: Ocean biogeochemical control on atmospheric chemistry
3th International Conference on Southern Hemisphere Meteorology and Oceanography


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


Kvale K and Oschlies A. (2022) Recovery from microplastic-induced marine deoxygenation may take centuries. Nature Geosciences. 10.1038/s41561-022-01096-w (1,5)


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?


Kim Currie:
- The Ocean Foundation
- Sampling Partners:
  - Te Papa Atawhai Department of Conservation
  - Waikato Regional Council
  - Bay of Plenty Regional Council
  - Te Runanga o Nga Tahu
  - Paua Industry Council
  - Marlborough Shellfish Monitoring Programme

New Zealand Regional and Local Councils Coastal Special Interest Group (C-SIG) Invited expert presentation on Coastal and Marine ecosystem impacts of climate change by Cliff Law.

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.).

**Theme 1: Greenhouse gases and the Oceans**
6 Bimonthly transects on the Munida Time Series (Kim Currie)

**Theme 3: Atmospheric deposition and ocean biogeochemistry**
Laboratory studies of iron deposition from ice core records:
- Iron leaching experiments and biomarker analysis of ice core tephra from the 25,000 ka Oruanui supereruption, New Zealand (Holl Winton)

Laboratory studies of iron deposition
- Impact of dust/ash on phytoplankton in subantarctic water (Otago)

**Theme 4 Interconnections between aerosols, clouds, and marine ecosystems**
Hauraki Gulf, DMS distribution and influence on grazers, October 2023 (C. Law)

*BIO Hesperides* voyage, South America to the Antarctic Peninsula, Feb-March 2023 (PI Dall’Osto)
- Aerosol emissions from polar changing environments - Polar Change
  Collection of aerosol, seawater particulates and sea ice to understand air-sea transfer of fatty acids (Holly Winton)

*Le Ponant* voyage, New Zealand to Adélie Basin, Ross Sea, Amundsen and Bellingshausen Seas, the Antarctic Peninsula and Ushuaia, Feb-March 2023:
- Collection of snow and seawater for biomarker analysis.

*RV Investigator* (IN2023_V01) voyage Western Australia to coastal East Antarctica, January-February 2023:
- Organic aerosol characterisation in the Southern Ocean
  Collection of aerosol samples to understand biogenic emissions such as fatty acids.

Antarctic fieldwork, Terra Nova Bay, Victoria Land (Nov-Feb 2023) (PI Holly Winton)
- Ocean-air-snow transfer study of biogenic emissions and ice core drilling.

Laboratory studies of phytoplankton biomarkers in aerosol, seawater and ice cores:
- Fatty acid and biofluorescent analysis of samples collected from multiple voyages to the Southern Ocean (PI Holly Winton).

Biogeochemical modelling of phytoplankton sensitivity to changing sea ice conditions in the Ross Sea (PI Holly Winton).

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

HYDEE (Economic opportunities and environmental implications of energy extraction from gas hydrates)
Final workshop – Methane seep distribution and dispersion in the water column (Cliff Law)

3. Funded national and international projects/activities underway.

Theme 1: Greenhouse gases and the Oceans
Munida Time Series (continuing)

New Zealand Ocean Acidification Observing Network (Continuing)

Theme 3: Atmospheric deposition and ocean biogeochemistry
Royal Society of New Zealand Marsden Fund, Climatic and environmental impacts of the largest explosive volcanic eruptions on Earth, 2023-2026, PI Simon Barker

Royal Society of New Zealand Marsden Fund, Metal micronutrients: Major players in the Southern Ocean’s carbon sink, 2023-2026, PI: Claudine Stirling

University of Otago Research Grant, Fire and iron: The response of marine phytoplankton to the Australian bushfires, 2022-2024, Co-PIs: Cliff Law, Claudine Stirling and Linn Hoffmann

Theme 4 Interconnections between aerosols, clouds, and marine ecosystems
Royal Society of New Zealand Rutherford Discovery Fellowship, Southern Ocean phytoplankton and climate: understanding the ability of phytoplankton to modulate climate in a warmer world, 2023-2028, PI Holly Winton

Royal Society of New Zealand Marsden Fund, How did changing sea ice conditions impact primary production in the Ross Sea over the past 200 years? 2023-2026, PI: Holly Winton

Deep South National Science Challenge, Marine organic aerosol as freezing and cloud-condensation nuclei: Improving the realism of cloud-aerosol coupling, 2022-2024, PI: Laura Revell and Olaf Morgenstern

Royal Society of New Zealand Catalyst Seeding fund, Development of a standardized analytical method for measuring airborne microplastics, 2022-2024, PI: Laura Revell

Royal Society of New Zealand Marsden Fund, The longevity of airborne microplastic-climate forcing from legacy plastic pollution, 2023-2026, PI: Laura Revell

Royal Society of New Zealand Rutherford Discovery Fellowships, Airborne microplastics in a changing climate, 2023-2028, PI: Laura Revell

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

Scientists’ Network for an Effective Plastics Treaty (SNEPT) Scientific engagement with and support for the UNEP plastics treaty negotiations (2022-present).

Funding of new SCOR working group “Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED)” including associate member Holly Winton.

Ocean Acidification Research for Sustainability, an endorsed UN Decade of Ocean Science for Sustainable Development programme. Member of Working Group 7, whose aim is to “Develop strategies and solutions to enable countries and regions to include measures to reduce ocean acidification in their respective legislation” (2022 - present). Including working group member Christina McGraw.

Comments