

Report for the year 2019 and future activities

SOLAS Australia

compiled by: Andrew Bowie and Ruhi Humphries

This report has two parts:

- **Part 1:** reporting of activities in the period of January 2019 - Jan/Feb 2020
- **Part 2:** reporting on planned activities for 2020 and 2021.

*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. ?

PART 1 - Activities from January 2019 to Jan/Feb 2020

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).*

Origin, transport and deposition of aerosol iron to Australian coastal waters

Highlights:

- New aerosol trace metal data for coastal waters around Australia
- High heterogeneity in aerosol Fe sources and solubilities across Australia
- Biomass burning plays a key role in determining aerosol Fe solubility in Australia
- New aerosol Fe observations will improve modelling studies of southern oceans

Australia is a major source of Fe-laden dust to the anemic marine phytoplankton in the Southern Ocean and to Southern Hemisphere (SH) low latitudes diazotrophic bacteria. However, the paucity of observations and laboratory experiments on SH aerosols biases model predictions of atmospheric Fe deposition to the southern oceans and the subsequent response of ocean productivity. As a result of an extensive shipboard aerosol sampling effort, this study presents laboratory measurements of aerosol Fe concentrations, solubilities and fluxes and analysis of chemical tracers, highlighting the large heterogeneity between aerosol Fe sources in 5 coastal regions around Australia. While dust-sourced high Fe loadings and low Fe solubilities (5%) dominated aerosols from the western coasts of Australia, much lower Fe concentrations but greater Fe solubilities (10.5% and 13%) measured in aerosols along the east coast were attributed to solubility-enhancing atmospheric reactions with anthropogenic pollutants. Finally, surprisingly high aerosol Fe solubilities (>20%) in northern Australia aerosols were associated with direct emissions or atmospheric reactions with bushfire emissions at tropical latitudes, which accounted for 49% of the total soluble Fe flux from the continent to surrounding seawaters. Such data will greatly help constraining biogeochemical model representation of aerosol deposition to the SH.

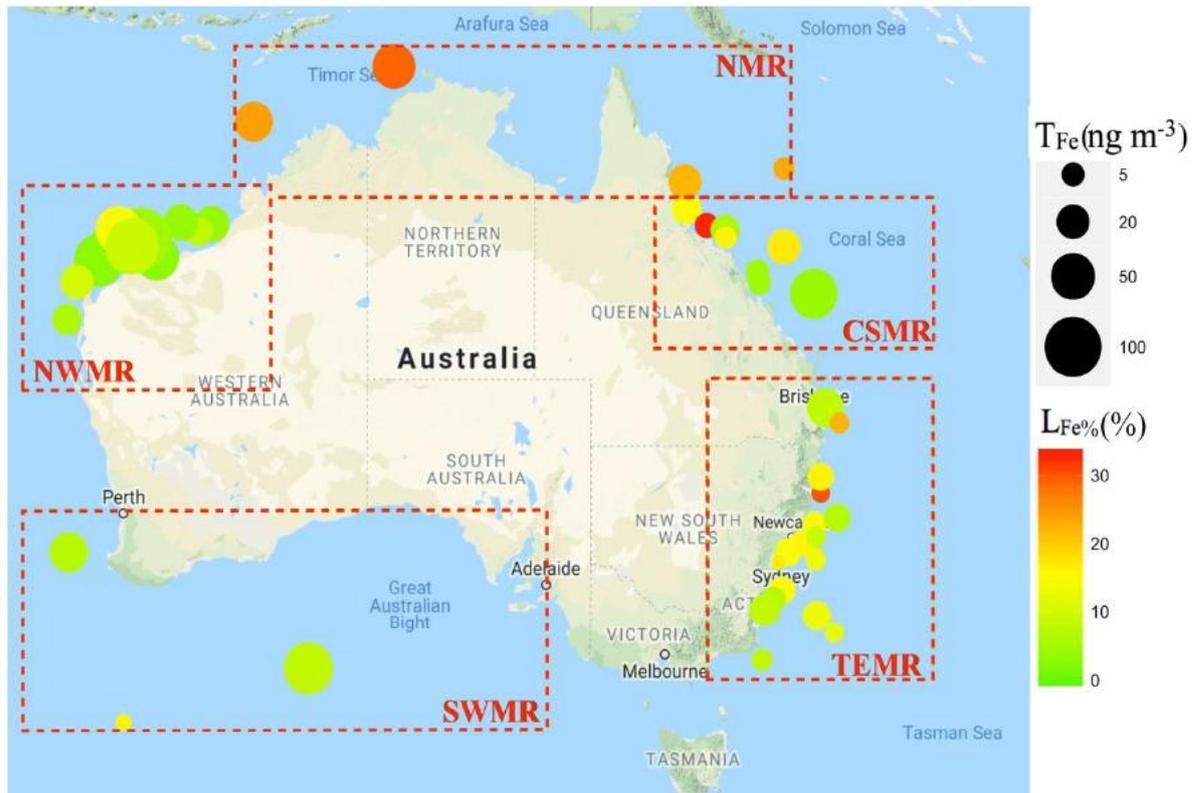


Figure: Labile Fe fraction (color scale, L_{Fe} , %) and total Fe concentration (point size, T_{Fe} , $ng\ m^{-3}$) in aerosols for each marine region delimited by the red dashed rectangles.

Citation: Morgane M. G. Perron, Bernadette C. Proemse, Michal Strzelec, Melanie Gault-Ringold, Philip W. Boyd, Estrella Sanz Rodriguez, Brett Paull, Andrew R. Bowie, 2020. Origin, transport and deposition of aerosol iron to Australian coastal waters. Submitted

2. Activities/main accomplishments in 2019 (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 I

sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

- Ongoing atmospheric measurements of the RV Investigator
<https://research.csiro.au/acc/capabilities/rv-investigator/>
- RV Investigator March 2019 voyage (IN2019_V03 – SOTS: automated moorings for climate and carbon cycle studies in the Southern Ocean) investigated trace metal aerosol supply to the subantarctic Southern Ocean
- RV Investigator Oct-Dec 2019 voyage (IN2019_V06: Maritime Continent observations of atmospheric convection, biogenic emissions, ocean vertical mixing, and the Indonesian Throughflow.)
- RSV Aurora Australis 'CAMMPCAN' research voyages — parallel projects, measuring aerosol and cloud properties in the Antarctic sea-ice region in the 2018/19 summer season.
<http://www.antarctica.gov.au/news/2018/seedling-southern-clouds>
<https://www.abc.net.au/news/2018-12-16/cloud-researchers-using-new-technology-in-antarctica/10623752>
- Voyages highlighted on Airbox page <https://airbox.earthsci.unimelb.edu.au/#tab19>
- Southern Ocean Atmospheric Research (SOAR) Workshop, 19 – 21 November 2019, IMAS Hobart
- Atmospheric Composition & Chemistry Observations and Modelling Conference & Cape Grim Annual Science Meeting, November 2019, CSIRO Aspendale
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3. Top 5 publications in 2019 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Morgane M.G. Perron, Michal Strzelec, Melanie Gault-Ringold, Bernadette C. Proemse, Philip W. Boyd, Andrew R. Bowie, 2020. Assessment of leaching protocols to determine the solubility of trace metals in aerosols. *Talanta* Volume 208, 1 February 2020, 120377

Humphries, R. S., McRobert, I., Ponsonby, W., Ward, J., Keywood, M., Loh, Z., Krummel, P. B. and Harnwell, J.: Identification of platform exhaust on the RV Investigator, *Atmospheric Measurement Techniques*, doi:<https://doi.org/10.5194/amt-12-3019-2019>, 2019.

Alroe, J., Cravigan, L. T., Miljevic, B., Johnson, G. R., Selleck, P., Humphries, R. S., Keywood, M. D., Chambers, S. D., Williams, A. G. and Ristovski, Z. D.: Marine productivity and synoptic meteorology drive summer-time variability in Southern Ocean aerosols, *Atmospheric Chemistry and Physics Discussions*, 1–27, doi:<https://doi.org/10.5194/acp-2019-1081>, 2019.

Dominick, D., Wilson, S. R., Paton-Walsh, C., Humphries, R., Guérette, É.-A., Keywood, M., Selleck, P., Kubistin, D. and Marwick, B.: Particle Formation in a Complex Environment, *Atmosphere*, 10(5), 275, doi:[10.3390/atmos10050275](https://doi.org/10.3390/atmos10050275), 2019.

Guérette, É.-A., Paton-Walsh, C., Galbally, I., Molloy, S., Lawson, S., Kubistin, D., Buchholz, R., Griffith, D. W. T., Langenfelds, R. L., Krummel, P. B., Loh, Z., Chambers, S., Griffiths, A., Keywood, M., Selleck, P., Dominick, D., Humphries, R. and Wilson, S. R.: Composition of Clean Marine Air and Biogenic Influences on VOCs during the MUMBA Campaign, *Atmosphere*, 10(7), 383, doi:[10.3390/atmos10070383](https://doi.org/10.3390/atmos10070383), 2019.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2019? If yes, who? How did you engage?

PART 2 - Planned activities for 2019/2020 and 2021

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

Future RV Investigator voyages

- Integrated Marine Observing System Southern Ocean Time Series climate and carbon cycle moorings (IN2020_V03) (April/May 2020), including project “Dust to the ocean: Does it really increase productivity?”
- Measuring the world’s cleanest air –validating atmospheric measurements above the Southern Ocean (IN2020_V05) (August/September 2020) will provide a first-ever comparison of two Global Atmospheric Watch stations (Cape Grim and the RV Investigator). This will allow validation of Investigator aerosol instrumentation against a world-class benchmark which will improve confidence in both stations.

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

- Atmospheric Composition & Chemistry Observations and Modelling Conference & Cape Grim Annual Science Meeting, November 2020, Murrumurang Resort, NSW

3. Funded national and international projects/activities underway.

Australian Antarctic Program Partnership (AAPP), 2019-2029

ARC Discovery funding, 2019-22, “Dust to the ocean: Does it really increase productivity?” Zanna Chase, Andrew Bowie, Peter Strutton

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

Australian Research Council Special Research Initiative for Excellence in Antarctic Science
(submitted for funding to start in 2020)

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

International GEOTRACES program – www.geotraces.org

World Meteorological Organisation's Global Atmosphere Watch Programme

SOCRATES - <https://www.eol.ucar.edu/content/socrates-project-overview>

US Atmospheric Radiation Measurement facility

IGAC

Comments

Andrew Lenton (CSIRO Oceans and Atmospheres, Hobart, Tasmania) joined the SOLAS SSC