

Report for the year 2015 and future activities

SOLAS Australia
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compiled by: Sarah Lawson and

Please note that this report has two parts!

Part 1: reporting of activities in the period of January 2015 – December 2015

Part 2: reporting on planned activities for 2016 to 2018/19.

*The information provided will be used for reporting, fundraising, networking and strategic development. In particular, **in 2016 SOLAS will develop its Implementation Plan, which will be largely based on the information from part 2 of the national reports, as well as input from international SOLAS initiatives and activities.** This info will be crucial in order to draft a realistic Implementation Plan representative of SOLAS, internationally.*

IMPORTANT: *May we remind you that this report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups)!*

PART 1 - Activities from January 2015 to December 2015

1. Scientific highlight

Describe one scientific highlight with a title, text (max. 200 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 international collaboration.

Marine nitrogen fixation is co-limited by the supply of iron and phosphorus in large areas of the global ocean. Up to 75 % of marine nitrogen fixation may be limited by iron supply due to the relatively high iron requirements of planktonic diazotrophs. The deposition of soluble aerosol iron can initiate nitrogen fixation and trigger toxic algal blooms in nitrate-poor tropical waters. There is a large variability in estimates of soluble iron, related to the mixing of aerosol iron sources. Most studies assume that mineral dust represents the primary source of soluble iron in the atmosphere. However, seasonal biomass burning in tropical regions is a potential source of aerosol iron that could explain the large variability in soluble iron.

To investigate aerosol iron sources to the adjacent tropical waters of Australia, the fractional solubility of aerosol iron was determined during the Savannah Fires in the Early Dry Season (SAFIRED) campaign at Gunn Point, Northern Territory, Australia during the dry season in 2014. The source of PM10 aerosol iron was a mixture of mineral dust, fresh biomass burning aerosol, sea spray and anthropogenic pollution. The mean soluble and total aerosol iron concentrations were 30 and 500 ng m⁻³ respectively. Fractional Fe solubility was relatively high for the majority of the campaign and averaged 8 % but dropped to 3 % during the largest and most proximal fire event. Fractional Fe solubility and proxies for biomass burning (elemental carbon, levoglucosan, oxalate and carbon monoxide) were unrelated throughout the campaign. An explanation to explain the lack of correlation between fractional Fe solubility and elemental carbon at the biomass burning source is due to the physical properties of elemental carbon, i.e., fresh elemental carbon aerosols are initially hydrophobic, however they can disperse in water after aging in the atmosphere. Combustion aerosols are thought to have a high fractional Fe solubility, which can increase during atmospheric transport from the source. Although, elemental carbon may not be a direct source of soluble iron, it can act indirectly as a surface for aerosols iron to bind during atmospheric transport and subsequently be released to the ocean upon deposition. In addition, biomass burning derived aerosols can indirectly impact the fractional solubility of mineral dust. Fractional Fe solubility was

highest during dust events at Gunn Point, and could have been enhanced by the mixing of biomass burning derived species. Iron in dust may be more soluble in the tropics compared to higher latitudes due to the presence higher concentrations of biomass burning derived reactive organic species in the atmosphere, such as oxalate, and their potential to enhance the fractional Fe solubility of mineral dust. As the aerosol loading is dominated by biomass burning emissions over the tropical waters in the dry season, additions of biomass burning derived soluble iron could have harmful consequences for initiating nitrogen fixing toxic algal blooms. Future research is required to quantify elemental carbon sources of soluble iron over tropical waters.

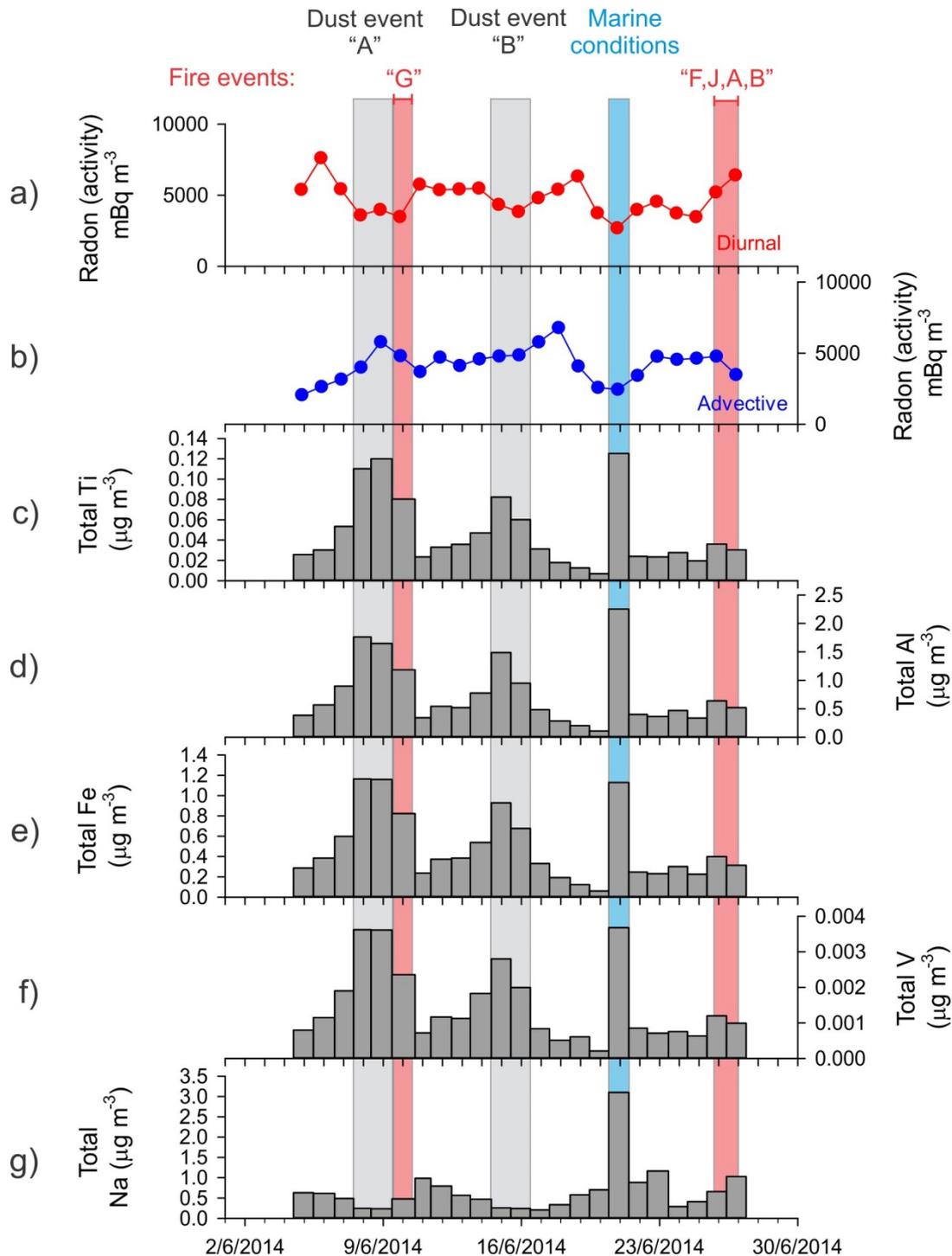


Figure: Time series of a) diurnal radon, b) advective radon, and total PM10 trace element concentrations c) Ti, d) Al, e) Fe, and f) Na during the (SAFIRED) campaign at Gunn Point, Northern Territory, Australia.

Citation: V.H.L. Winton et al. Dry season aerosol iron solubility in tropical northern Australia. In preparation.

2. Activities/main accomplishments in 2015 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

The first Cold Water trial and the Maiden Scientific Voyage of Australia's new Research Vessel the RV Investigator were made in January and March 2015 respectively in the Southern Ocean. The RV Investigator travelled to the ice edge of Antarctica (65°S) on the Cold Water Trial. A wide variety of atmospheric measurements were made on both voyages, including organic trace gases, greenhouse gases, aerosol chemical composition, aerosol size distribution, and aerosol microphysical and optical properties. Preliminary results of aerosol chemical composition were presented at SOLAS OSC.

Atmospheric monitoring and sampling campaigns have been included in both of the first two voyages of RV Investigator in 2016 (see Part 2, section 1 below).

RV Investigator blog:

<https://blog.csiro.au/investigator>

An aerosol trace metal sampling program was established on the 'leading tower at the Gravity Discovery Centre in Gingin (Western Australia)' in March 2015. This complements existing monitoring at Cape Grim (Tasmania) (since 2013), and plans for new stations to be established on Lord Howe Island and Mt Wellington (southern Tasmania) in 2016.

3. Top 5 publications in 2015 (only PUBLISHED articles) and if any weblinks to models, datasets, products, etc.

Cravigan, L. T., Ristovski, Z., Modini, R. L., Keywood, M. D., and Gras, J. L. (2015) : Observation of sea salt fraction in sub-100 nm diameter particles at Cape Grim, *Journal of Geophysical Research: Atmospheres*, 2014JD022601, 10.1002/2014JD022601, 2015.

Lawson, S. J., Keywood, M. D., Galbally, I. E., Gras, J. L., Cainey, J. M., Cope, M. E., Krummel, P. B., Fraser, P. J., Steele, L. P., Bentley, S. T., Meyer, C. P., Ristovski, Z., and Goldstein, A. H. (2015) Biomass burning emissions of trace gases and particles in marine air at Cape Grim, Tasmania, *Atmos. Chem. Phys.*, 15, 13393-13411, 10.5194/acp-15-13393-2015, 2015a.

Humphries, R. S., Klekociuk, A. R., Schofield, R., Keywood, M., Ward, J., and Wilson, S. R.: Unexpectedly high ultrafine aerosol concentrations above East Antarctic sea ice, *Atmos. Chem. Phys.*, 16, 2185-2206, doi:10.5194/acp-16-2185-2016, 2016.

Humphries, R. S., Schofield, R., Keywood, M. D., Ward, J., Pierce, J. R., Gionfriddo, C. M., Tate, M. T., Krabbenhoft, D. P., Galbally, I. E., Molloy, S. B., Klekociuk, A. R., Johnston, P. V., Kreher, K., Thomas, A. J., Robinson, A. D., Harris, N. R. P., Johnson, R., and Wilson, S. R.: Boundary layer new particle formation over East Antarctic sea ice – possible Hg-driven nucleation?, *Atmos. Chem. Phys.*, 15, 13339-13364, doi:10.5194/acp-15-13339-2015, 2015

Winton, V. H. L., R. Edwards, B. Delmonte, A. Ellis, P. S. Andersson, A. Bowie, N. A. N. Bertler, P. Neff, and A. Tuohy (2016), Multiple sources of soluble atmospheric iron to Antarctic waters, *Global Biogeochem. Cycles*, 30, doi:10.1002/2015GB005265.

V.H.L. Winton, A.R. Bowie, R. Edwards, M. Keywood, A.T. Townsend, P. van der Merwe, A. Bollhöfer, 2015. Fractional iron solubility of atmospheric iron inputs to the Southern Ocean. *Marine Chemistry* 177 (2015) 20–32, doi:10.1016/j.marchem.2015.06.006

For journal articles please follow the proposed format:

Author list (surname and initials, one space but no full stops between initials), year of publication, article title, full title of journal (italics), volume, page numbers, DOI.

PART 2 - Planned activities from 2016 to 2018/19

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

1. CAPRICORN (Clouds, Aerosols, Precipitation and atmospheric Composition Over the southern ocean) on voyage IN2016_V02 of RV Investigator in March-April 2016 as part of International SOCRATES (Southern Ocean Clouds Radiation Aerosol Transport Experimental Study). Follow up CAPRICORN voyages scheduled for July – Sep 2017 and Jan –Mar 2018.

2. Cloud radar and lidar observations being made at Macquarie Island in 2016 also as part of SOCRATES

3. The Great Barrier Reef as a significant source of climatically relevant aerosol particles, August 2016. Includes researchers from Queensland University of Technology, CSIRO Oceans and Atmosphere, Southern Cross University, University of Melbourne, University of Eastern Finland, Swiss Federal Institute of Technology, Lausanne, National Institute of Water and Atmospheric Research, New Zealand, University of Helsinki, Finland, NIES Japan.

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

The Cape Grim Baseline Air Pollution Station will celebrate its 40th year Anniversary in April 2016. The WMO GAW Reactive Gases Scientific Advisory Group will hold its annual Scientific Advisory Group meeting in Tasmania in November 2016.

3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 science plan the activity topics relate – including the themes on ‘SOLAS science and society’ and ‘Geoengineering’)

Voyages on RV Investigator as listed above under 1) funded by the Marine National Facility

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)

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

In February 2016 the inaugural Australian Meteorological and Oceanographic Society expert group on Atmospheric and Oceanic Composition was formed. This Expert Group will focus on the sub-discipline of Atmospheric and Oceanic Composition, defined as both natural and anthropogenically influenced composition from the stratosphere to the deep ocean. Strong linkages exist between the scientific focus of this expert group and the SOLAS strategic focus.

Sarah Lawson (an Australian SOLAS representative) is a member of the new Expert group.

Comments

In February 2016 the Federally funded Commonwealth Scientific and Industrial Research Organisation (CSIRO) announced that it would be halving the number of positions working in the areas of climate science modelling and monitoring in the Oceans and Atmosphere Business Unit. This loss of positions is in line with a new CSIRO strategy to reduce public good research and focus on increased commercialisation of science. Despite international protest, including two articles in the New York Times and signing of a petition of protest by 3000 scientists from 60 countries, the cuts are going ahead with impacted people scheduled to be informed in early April 2016. CSIRO has a major and central role in atmospheric and oceanic research in Australia; these cuts will have a major impact on the ability of Australia to both monitor and predict future changes in climate. Cape Grim Baseline Station and atmospheric measurements on the RV Investigator will be severely impacted by these cuts.

http://www.nytimes.com/2016/03/04/opinion/australia-turns-its-back-on-climate-science.html?_r=0

<http://www.nytimes.com/2016/02/28/world/australia/cape-grim-climate-change-research.html>