

Report for the year 2016 and future activities

SOLAS New Zealand

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This report has two parts:

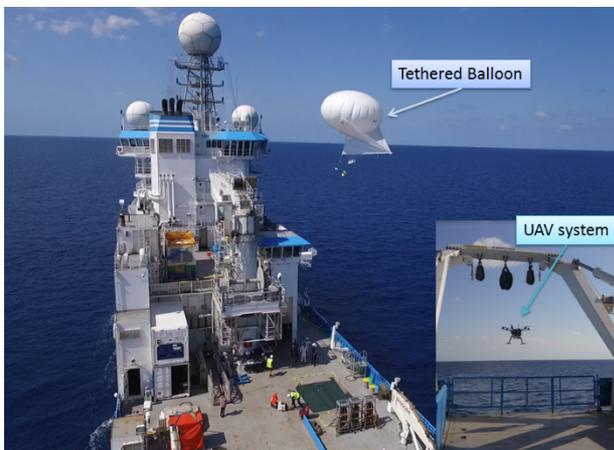
- **Part 1:** reporting of activities in the period of January 2016 – Jan-Feb 2017
- **Part 2:** reporting on planned activities for 2017/2018 and 2019.

PART 1 - Activities from January 2016 to Jan/Feb 2017

1. Scientific highlight

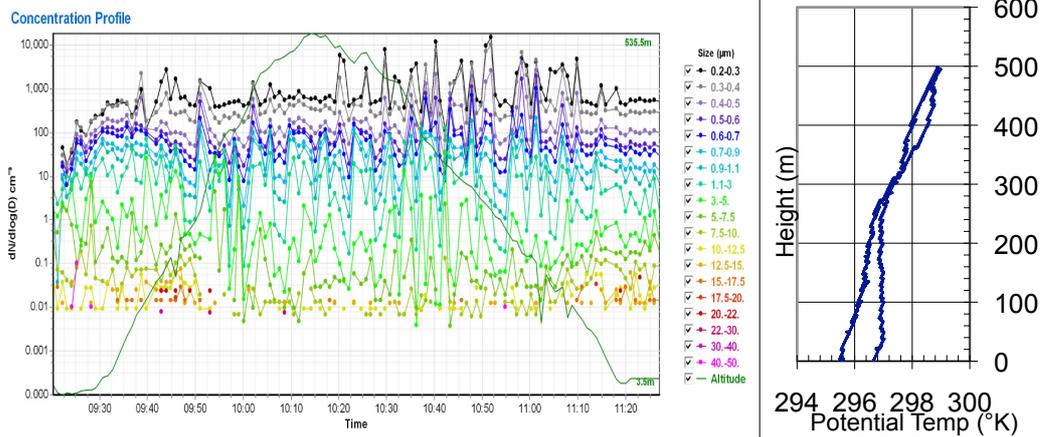
Vertical profiling of atmospheric aerosol by tethered helikyte - Reef to Rainforest (R2R) Spt-Oct 2016 voyage

The R2R voyage took place on RV Investigator, with measurement stations up- and down-wind of the Great Barrier Reef to address: *Is the GBR a significant source of climatically relevant aerosol particles & do emissions from coral symbiotic algae influence cloud properties and rainfall?* The project investigated the influence of aerosol particles on cloud properties and hence implications for climate and the hydrological cycle. Determining the magnitude and drivers of biogenic aerosol production in different ecosystems will ultimately input to the development of earth system models.



Part of the New Zealand focus was to develop ship-based methodologies to collect in situ vertical profiles of aerosol properties. This complemented atmospheric lidar/radar soundings and surface in situ measurements on the ship. We examined vertical mixing of aerosol in the boundary-layer by use of a tethered helikyte (allsopp.co.uk), enabling profile measurement over several hours. The example profile below shows a relatively stable background aerosol spectra (0.2 – 10 μm) between the surface and 500 amsl, altitude (green LH up-down trace), with aerosol size measured by light-weight optical aerosol counter. Analyses are underway, and

a post-voyage workshop is planned for later in 2017. *The Reef-to-Rainforest voyage was led by Prof Zoran Ristovski, QUT, Brisbane, with airborne in situ measurements were made in collaboration between the International Laboratory for Air Quality and Health (ILAQH, QUT), Australian Research Centre for Aerospace Automation (ARCAA, QUT), School of Earth Sciences (University Melbourne) & NIWA Wellington*

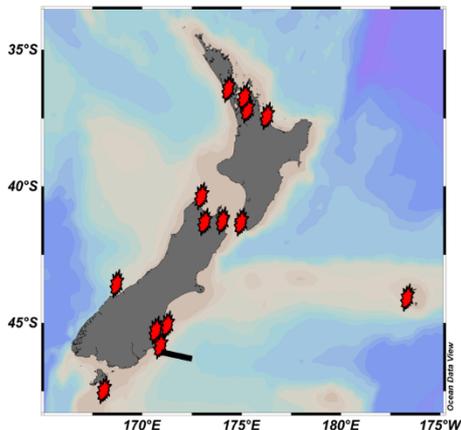


2. Activities/main accomplishments in 2016 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

The New Zealand Ocean Acidification Observing Network (NZOA-ON)

<https://marinedata.niwa.co.nz/nzoa-on/>

Ocean acidification in coastal areas can be caused by processes such as terrestrial run-off, local eutrophication, upwelling of deep low pH waters as well as uptake of atmospheric carbon dioxide. These processes vary spatially, so the impact also will vary spatially. The habitat of most species vulnerable to changing carbonate chemistry, such as shellfish, is coastal, therefore establishing existing OA conditions, and monitoring for future changes is important. The New Zealand Ocean Acidification Observing Network (NZOA-ON) consists of 14 sites around the coast, including pristine and impacted sites, sites of importance to the aquaculture and shellfish industries, and sites of cultural importance (Figure 1). Sampling partners collect fortnightly bottle samples which are sent to a central laboratory for analysis of DIC and alkalinity, and subsequent calculation of pH and carbonate saturation states. Sampling partners include research institutes, local councils, aquaculture and fishing industry, and the Department of Conservation. Several of the sites also have



SeaFET pH sensors for determination of pH on a higher time frequency to capture diurnal and tidal signals. The NZOA-ON also links to the Munida Time Series Transect, along which the carbonate chemistry had been measured since 1998. The NZOA-ON is also aligned with, and is part of the Global Ocean Acidification Observing Network GOA-ON

Figure 1: Location of the 14 NZOA-ON sites, with the Munida Time Series Transect shown as a black bar.

Coastal Acidification: Rates, Impact & Management (CARIM)

<http://www.carim.nz/>

A four-year national project began at the end of 2015 to establish the variability of the carbonate system in New Zealand waters, and use this information to determine ecosystem impacts and develop mitigation solutions. The project was developed by interaction with regional councils, the NZ aquaculture industry and Maori partners, and focuses on three different coastal regions. CARIM includes a monitoring component for pH and the carbonate system at three sentinel sites; this information is being used to develop hydrodynamic models & budgets to identify the main drivers of acidification in the Firth of Thames, which will subsequently inform land and coastal management. The impacts of pH change by the end of the century are assessed for coastal

plankton and coralline algae, to determine how primary productivity, food quality and substrate availability. This information will be combined with physiological response data for all life-history stages of three species – Paua (NZ Abalone), Greenshell Mussel and Snapper – of social, cultural & economic importance. Investigations into the adaptive capacity of the two shellfish species, and development of regional models of the factors driving coastal acidification will inform potential mitigation approaches. CARIM is led by NIWA, with partners at the Cawthron Institute and Universities of Otago and Auckland.

Surface Ocean Aerosol Production (SOAP)

<https://www.niwa.co.nz/atmosphere/research-projects/soap>

4 papers have been published to date, in a joint Special Issue in *Ocean Science* and *Atmospheric Chemistry & Physics* at:

http://www.ocean-sci.net/special_issue10_333.html

Data analysis

Work in progress on 5 further SOAP papers. This includes examining the complex interplay of primary and secondary aerosol sources through a detailed model representation aimed at understanding the evolution of marine organic carbon (MOC) in the atmosphere and its role in the climate system. In work led by Dr Matthew Woodhouse, CSIRO the ACCESS-UKCA global composition-climate model (incorporating the aerosol microphysics module GLOMAP-mode) is being used to simulate the emissions and role of MOC, firstly with respect to observations on the local scale, comparing against aerosol data from biologically rich waters measured during the SOAP campaign. The chemistry climate model is being used to potential MOC impact on cloud and radiative mechanisms for assessing the role of aerosol in the climate system.

Woodhouse, M., Lawson, S., Luhar, A., Keywood, M., and Harvey, M.: Modelling and observation of organic carbon aerosol in the marine atmosphere AMOS/MSNZ Conference and ANZ Climate Forum 2017 Australasian oceans, weather and climate - past, present and future, Australian National University, Canberra, 7 - 10 Feb, 2017.

Climate Change Impacts on NZ EEZ - Marine Case Study

<http://ccii.org.nz/wp-content/uploads/2016/12/RA2-Marine-Case-Study-Synthesis-report.pdf>

The report commissioned by the NZ Ministry for Business, Industry & Employment validates existing Earth System Models for the ocean around New Zealand, and then applies the optimal suite of models to project conditions in the mid- and end of the 21st Century under two different scenarios (RCP 4.5 & 8.5) for a range of physical and biogeochemical parameters.

SCOR Working Group WG 143 Dissolved N₂O and CH₄ measurements: Working towards a global network of ocean time series measurements of N₂O and CH₄ : intercalibration of standards and samples

Multiple Stressor Workshop (Co-Chair), *Oceans in a High CO₂ World* Symposium, Hobart, Tasmania, May 2016.

New Zealand Marine Sciences Conference Session on Ocean Acidification. July 2016, Wellington.

3. Top 5 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Walker C F, Harvey M J, Smith M J, Bell T G, Saltzman E S, Marriner A S, McGregor J A., Law C S 2016. Assessing the potential for DMS enrichment at the sea-surface and its influence on air-sea flux. *Ocean Science* 12: 1033-1048, doi:10.5194/os-12-1033-2016.

Burrell T, Maas E W, Teesdale-Spittle P H, Law C S. 2016. Assessing approaches to determine the effect of ocean acidification on bacterial processes. *Biogeosciences* 13, 4379-4388, doi:10.5194/bg-13-4379-2016

Stevens C L, Smith M J. 2016. Turbulent mixing in a stratified estuarine tidal channel: Hikapu Reach, Pelorus Sound, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 50 (4): 485-505.

Bakker D C E, Pfeil B, Landa C S, Metzl N, O'Brien K M, Olsen A, Smith K, et al. 2016. A multi-decade record of high-quality fCO₂ data in version 3 of the Surface Ocean CO₂ Atlas (SOCAT). 2016. *Earth System Science Data* 8(2): 383.

Baltar F, Currie K, Meyer M, Verdugo P, 2016. Proportion of marine organic carbon present in self-assembled gels along the subtropical front and its increase in response to reduced pH. *Marine Chemistry* 184: 53-59.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2016? If yes, who? How did you engage?

CARIM

<http://www.carim.nz/>

The CARIM project has major interaction with maori and other national stakeholders, including the shellfish fishery sector, MPI, regional councils, DOC and the Hauraki Gulf Forum, as well as international scientists in the US and Australia. CARIM scientists presented and discussed the issue of coastal acidification with iwi (Maori tribes) at hui (meeting) in both the North and South Island. In addition, discussions with regional councils and the mussel industry has led to spin off projects and co-funding. Novel research in CARIM, such as into the potential for adaptation within different families of Pāua (NZ Abalone) and Greenshell Mussel will benefit the shellfish industry. The CARIM project also has a major Outreach component that includes an "Oceans Guardians" programme for schools and local communities around the sentinel sites.

The New Zealand Ocean Acidification Observing Network (NZOA-ON)

<https://marinedata.niwa.co.nz/nzoa-on/>

NZOA-ON – Collaborators collect fortnightly water samples, and are the backbone of the NZOA-ON. Engagement is via email and website; and sampling Partners include Auckland Council, Auckland University, NIWA, Bay of Plenty Regional Council, Cawthron Institute, Aquaculture New Zealand, Paua Industry Council, University of Otago, Fishing Industry, Department of Conservation, Ngai Tahu).

Climate change Impacts on NZ EEZ - Marine Case Study

<http://ccii.org.nz/wp-content/uploads/2016/12/RA2-Marine-Case-Study-Synthesis-report.pdf>

Research aims were developed in discussion with a variety of stakeholders including Ministry of the Environment, Ministry for Business, Ministry of Primary Industries (Fishing & Aquaculture), Department of Conservation, Statistics New Zealand & regional Councils.

The 9th New Zealand National Ocean Acidification Workshop

<http://nzoac.nz/workshops/>

A one-day meeting at the (Victoria University Wellington), which included a stakeholder panel discussion session.

Educational resource Unit for Secondary Schools on Ocean Acidification – in development

International: **NZ-USA Joint Science Committee Meeting (JCM): Ocean Acidification**

PART 2 - Planned activities from 2017/2018 and 2019

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

The New Zealand Ocean Acidification Observing Network (NZOA-ON)

<https://marinedata.niwa.co.nz/nzoa-on/>

Network observations will continue with data made available through a web portal

CARIM

<http://www.carim.nz/>

Monitoring and data collection will continue at the 3 sentinel sites, including a high-resolution study in the Firth of Thames.

Deep South Aerosol-Cloud interaction observations

As a component of the New Zealand Deep South National Science Challenge: <http://www.deepsouthchallenge.co.nz/> one project is examining biases in the representation of clouds and aerosols as a component of the New Zealand Earth System Model (NZESM) development, a derivation of the UK Earth System Model (UKESM). The project has a Southern Ocean focus for both measurement and modelling; this is the region where cloud representation is poor and measurements are sparse. The observational focus is on aerosol-cloud interaction for both ice and cloud-condensation nuclei. A proposal led by Dr Mike Harvey (NIWA) has been developed for an aerosol-cloud interaction voyage into the Ross Sea region in Feb/Mar 2018 with RV Tangaroa. The voyage will overlap in time with other similar Southern Ocean projects including CAPRICORN: clouds, aerosols, precipitation, radiation and atmospheric composition over the Southern Ocean led by Dr Alain Protat, (BOM). A trial voyage TAN1702 (March 2017) has tested some of the planned measurement technologies.

Mitigation of Coastal Acidification around Mussel Farms

A pilot study examining the potential of two different techniques to mitigate coastal acidification at Mussel aquaculture farm scales funded has been funded by the New Zealand Sustainable Seas National Science challenge Innovation Fund. Laboratory experiments will commence in March 2017.

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

The 10th NZ National Ocean Acidification Workshop will take place at the University of Otago in February 2016, and celebrate a decade of NZ research on Ocean Acidification. The meeting will include presentations on national programmes (such as **CARIM**), as well as a Discussion session on Maori and Ocean Acidification. See <http://nzoac.nz/workshops/>

Educational resource Unit for Secondary Schools on Ocean Acidification published & rolled out.

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 and Organisation (downloadable from the SOLAS website) the activity topics relate – including the core themes and the cross cutting ones)

See above for details on the following projects:-

NZOA-ON

CARIM

Mitigation of Coastal Acidification around Mussel Farms

The Deep South National Science Challenge – process and observation studies of Aerosol-Cloud interactions includes collaborative activity under SOLAS Theme 4- Interconnections between Aerosols, clouds and ecosystems examines biogenic influences on Cloud Condensation nuclei and Ice Nuclei in polar waters and at New Zealand latitudes

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)

NZ MBIE Endeavour Fund proposals (submission Feb 2017):

Methane seeps – Economic opportunities and environmental implications of energy extraction from gas hydrates

Marine Carbon model - *How will climate change alter carbon cycling in New Zealand's oceans?*

Process and observation studies of Aerosol-Cloud: "Sea2Cloud Are marine living microorganisms

influencing clouds?" (PI Karine Sellegri, Laboratoire de Météorologie Physique – CNRS, France

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

SCOR Working Groups:

WG 143 *Dissolved N₂O and CH₄ measurements: Working towards a global network of ocean time series measurements of N₂O and CH₄* : intercalibration of standards and samples

WG149: *Changing Ocean Biological Systems (COBS): How will biota respond to a changing ocean?*: Workshops

IOCCP Scientific Steering Group

SOCAT Global QC Group

OA-ICC Advisory Board and member of SOLAS-IMBER Working Group on Ocean

CSIRO Access ESM and Southern Ocean Aerosol-Cloud Research

New Zealand Earth System Model development is collaborating with CSIRO and the Australian Community Climate and Earth System Simulator (Access) with GLOMAP aerosol model (PI: Dr.Matthew Woodhouse) for Surface Ocean aerosol production and the Southern Ocean Aerosol-Cloud Research.

The Deep South National Science Challenge: <http://www.deepsouthchallenge.co.nz/> polar aerosol processes.

Ice nucleation measurement programme PI: Paul J. DeMott, Colorado State University

The Deep South National Science Challenge: <http://www.deepsouthchallenge.co.nz/>

Comments