surface ocean solas lower atmosphere study

Report for the year 2015 and future activities

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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

Is the sea surface microlayer a source of DMS?

Dimethylsulfide (DMS) flux to the atmosphere is generally determined using water sampled at or below 2 m depth, thereby excluding any concentration anomalies at the air-sea interface. Two independent techniques were used to assess the potential influence of near-surface DMS enrichment on marine emissions and the factors determining surface enrichment. Measurements were made in productive frontal waters over the Chatham Rise, east of New Zealand. DMS gradients in subsurface seawater (SSW, 0.01-6m) were negligible, whereas enrichment in the sea-surface microlayer (SSM) was variable with a mean enrichment factor (EF]) of 1.7. Physical and biological factors influenced SSM [DMS], with high EFs (> 1.3) only observed in a dinoflagellate-dominated bloom, and associated with low-medium wind speeds and near-surface temperature gradients. On occasion high EFs preceded periods when the ocean-air DMS flux, measured by eddy covariance, exceeded the expected flux calculated using COARE parameterised gas transfer velocities and measured SSW [DMS]. The results of these two independent approaches suggest that air-sea emissions may be influenced by near-surface DMS production under certain conditions, and highlights the need for further study to constrain the magnitude and mechanisms of DMS production in the sea surface microlayer.

Walker CF, Harvey MJ, Smith MJ, Bell TG, Saltzman ES, Marriner AS, McGregor JA and Law CS. 2016. Assessing the potential for DMS enrichment at the sea-surface and its influence on air-sea flux Atmospheric Chemistry Physics, submitted

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 NZ- Ocean Acidification Observing Network (NZOA-ON)
NZOA-ON is a network of coastal sites around the country – a mix of pristine and urban sites, and sites which are of particular interest to regional councils, the aquaculture and fishing industries, and sites of scientific interest. Water samples for analysis of carbonate system parameters are collected fortnightly, with SeaFET pH sensors deployed for periods of 4-5 months. There are currently 11 sites distributed around New Zealand, with sample collection by partners and stakeholders including regional councils and the shellfish aquaculture industry, using existing infrastructure where possible to take advantage of auxiliary data and historic records. Data will be used to determine local conditions and to provide a baseline against which to measure future change. Data is freely available on an open-access website, and the network is linked into the Global Ocean Acidification Observing Network (GOA-ON)
https://www.niwa.co.nz/coasts-and-oceans/research-projects/new-zealand-ocean-acidification-observing-network-nzoa-on

Coastal Acidification: Rates Impacts and Management (CARIM)
CARIM is a four-year national project that will provide new knowledge on the acidification of coastal waters to enhance protection and management of New Zealand coastal ecosystems. CARIM is led by NIWA, with three other partners and will involve interaction with Maori partners and national stakeholders, including the shellfish fishery sector, ministries, NGOs, regional councils, and scientists in the US and Australia. CARIM will establish the magnitude and variability of pH and the carbonate system at three sentinel sites, and build upon the NZ-OAON (see above). Monitoring information will underpin development of models to identify the main drivers of acidification, which will subsequently inform land and coastal management. The impacts of coastal acidification on primary production, food quality and habitat availability will be assessed, and there will be a particular focus on the sensitivity of different life stages of three iconic species, NZ Abalone, Greenshell Mussel and Snapper. Information on the rate of acidification, and the sensitivity of ecosystems and species, will be used in models to forecast populations for these species. In addition, novel research will investigate the potential for adaptation within different families of NZ Abalone and Greenshell Mussel. The CARIM project also has a major outreach component that includes a programme for schools and local communities at the sentinel sites.
http://www.carim.nz/

Ocean Acidification in the Pacific Islands
New Zealand scientists have been actively developing awareness and action on ocean acidification in the South-West Pacific. Following the ocean acidification workshop at the SIDS (Small Island Developing States in 2014). A *New Zealand Partnership on Ocean Acidification in the Pacific Islands*, led by SPREP (South Pacific Regional Environmental Protectorate) was initiated, with an initial workshop in October 2015 that identified existing and potential impacts and vulnerabilities, and potential priority sites and activities, and assessed options for policy and regional coordination.
https://www.sprep.org/climate-change/sprep-and-new-zealand-collaborate-to-address-ocean-acidification
Law CS, OA in the Pacific: NZ Perspectives. NZ Pacific Islands Regional Ocean Acidification Workshop, 7/10/2015, Stamford Plaza, Auckland, New Zealand
Currie, KI, Setting up a coastal ocean acidification observing network in New Zealand. NZ Pacific Islands Regional Ocean Acidification Workshop, 7/10/2015, Stamford Plaza, Auckland, New Zealand.

Characterising high CO2 vent regions
A multi-disciplinary study by a team of national, & international (Australia, Belgium and the UK) scientists was carried out around White Island, an active volcano north of New Zealand. Led by the University of Otago Ocean Acidification Research Theme, the "White Island Blitz" aimed to assess the potential of shallow water high CO2 vents around the island as analogues for a future ocean.
http://www.otago.ac.nz/oceanacidification/index.html

Surface Ocean Aerosol Processes (SOAP)
SOAP is a SOLAS Endorsed multi-national collaboration incorporating marine biogeochemistry, air-sea exchange and atmospheric chemistry that seeks to establish the marine biogenic contribution to aerosols over the Southern Ocean. SOAP is lead by New Zealand (NIWA), with partners from the USA (UCI, U Chapman, SUNY), Germany (IFM-G), Eire (NUIG), U.K. (U. Cambridge), Canada (U. Laval), Australia (CSIRO and QUT), and Finland (UEF). A pilot study in 2011 (PreSOAP) was followed by the SOAP voyage in the subtropical Front south-east of New Zealand in February-March 2012. Analysis of preliminary results took place at a data workshop in Wellington in March 2013. To date 3 papers have been published in a joint Special Issue of *Atmospheric Chemistry Physics Discussions* and *Ocean Sciences* (see below); a further five papers are in the process of submission and preparation.
http://www.atmos-chem-phys.net/special_issue333.html

Sources and characterisation of marine aerosols
A workshop convened for environmental air quality regulators and practitioners in central and local government aimed to raise awareness of the aerosol science that underpins understanding of urban aerosol composition, chemistry and transport. From the SOLAS perspective, marine aerosols were one focus, being important to the background aerosol climatology of New Zealand, and a major contributor of mass in many coastal towns and cities.
Coulson, G., Longley, I., Harvey, M., Somerville, E. An Introduction to Aerosol Science: CASANZ Branch distributed video conference convened at NIWA 12/6/2015. Presentations available at: https://www.niwa.co.nz/our-science/atmosphere/research-projects/all2/healthy-urban-atmospheres/air-quality/workshops

Southern Ocean Aerosol and Cloud
The Deep South National Science Challenge http://www.deepsouthchallenge.co.nz/ research plan was finalised during the year with a 10 year plan, and a focus on understanding climate processes in the Southern Ocean and Antarctica to improve climate prediction. An initial project focus aims to improve representation of clouds and aerosols in the NZ Earth System Model. As a lead into this new programme, a voyage to the Ross Sea in February 2015 successfully deployed a CL-51 ceilometer making measurements of the altitude, depth, and MBL height in a region where only, satellite measurements exist that can lack detail on the lower level clouds.

McDonald, A., Plank, G., Harvey, M., Ridden-Harper, R., Schuddeboom, A., Ichoja, A. (2015) Ship-based ceilometer measurements of Clouds over the Southern Ocean. 26th IUGG General Assembly, Prague Conference Centre, Czech Republic, 27th June 2015.

Shallow methane seeps
Following the discovery of an area of shallow methane flares on the shelf to the east of New Zealand in an active tectonic subduction zone, a second research voyage to the region

established the extent and characteristics of the flare field. Acoustic mapping identified 766 individual flares with elevated methane saturation in surface waters and a direct contribution to the atmospheric methane pool. Further research will examine the fate of the methane released in this region.
http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/201753099/exploring-seabed-methane-seeps

Coastal mixing
Some estuarine coastal regions are a strong source of CO_2, but the pathway to the atmosphere is controlled by transport and vertical turbulent mixing processes. A study in the Marlborough Sounds, New Zealand, characterized the dynamical controls within an estuarine channel. Exchange was modulated by turbulent mixing through its effect on density stratification and scaling parameters were used to assess the effect across a tidal cycle. Benthically generated turbulence generally dominated over internal shear turbulence and surface wind-driven turbulence.

Stevens CL; Smith MJ. 2016. Turbulent mixing in a stratified estuarine tidal channel: Hikapu Reach, Pelorus Sound, New Zealand. 2016. NZ Journal Marine & Freshwater Research, accepted

SOLAS & Geoengineering
NZ SOLAS scientists have played a leading role in the in situ iron addition studies, which have been drawn into the broader debate on geoengineering. Indeed, the role of SOLAS in geoengineering is considered in the SOLAS Science and Implementation Plan (SOLAS Steering Committee and Breverie, 2015). As there are an increasing number of potential geoengineering purposes being proposed in the ocean-atmosphere domain, a discussion session at the SOLAS OSC in Kiel considered what role SOLAS scientists should play in their assessment and deployment. See report:-
http://www.solas-int.org/files/solas-int/content/downloads/Activities/SOLAS%20events/OSC2015/Geong_Discuss%20Session%20Report_OSC%202015.pdf

The 8th NZ National Ocean Acidification Workshop (University of Otago, Dunedin)
http://nzoac.nz/workshops/

SOLAS 2015-2025 Science Plan and Organisation (2015) - NZ contribution to planning and production of SOLAS V2 proposal

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

Burrell, TJ, Maas EW, Hulston DA and Law CS 2015. Bacterial abundance, processes and diversity responses to acidification at a coastal CO2 vent. *FEMS Microbiology Letters* 2015; doi: 10.1093/femsle/fnv154

Sander, SG, Tian, F, Ibisanmi EB, Currie KI, Hunter, KA, and Frew, RD 2015. Spatial and seasonal variations of iron speciation in surface waters of the Subantarctic front and the Otago Continental Shelf. *Marine Chemistry* 173:114-124.

MacLeod, CD, Doyle, HL, Currie, KI. 2015. Technical Note: Maximising accuracy and minimising cost of a potentiometrically regulated ocean acidification simulation system. *Biogeosciences* 12(3):713-721.

Stevens CL; Smith MJ. 2016. Turbulent mixing in a stratified estuarine tidal channel: Hikapu Reach, Pelorus Sound, New Zealand. 2016. *NZ Journal Marine & Freshwater Research*, accepted

Baltar, F.G., Stuck, E., Morales, S., Currie, K., 2015. Bacterioplankton carbon cycling along the subtropical frontal zone off New Zealand. *Progress in Oceanography* 135, 168-175, doi: 10.1016/j.pocean.2015.05.019

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.)

NZOA-ON (see above) – ongoing coastal ocean acidification monitoring campaign with fortnightly sampling and moored sensors at 11 sites throughout New Zealand. Collaborators include the NIWA, University of Otago, aquaculture and fishing industries, Dept, of Conservation, and regional councils.

CARIM (see above) - ongoing ocean acidification monitoring at 3 focal sites in the New Zealand coastal region with moored pH sensors and bottle sampling. Collaborators include NIWA, University of Otago, University of Auckland, Cawthron Institute, local stakeholders

Deep South Aerosol-Cloud interaction observations – plans are evolving and funding being sought for a voyage in 2017/18 summer to further in situ study of boundary layer aerosol – cloud interaction over the Southern Ocean. This activity will attempt to coordinate with The Southern Ocean Clouds, Radiation, Aerosol Transport Experimental Study or SOCRATES, an international and multi-agency initiative that is under development. Collaborators include CSIRO, Australia

Shallow Shelf methane seeps (see above) - further sampling plans are under discussion with US collaborators, with a potential research voyage in 2016/17

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

The CARIM project (see above) has an active outreach component with information on coastal acidification made available to the public and stakeholders via a variety of media and platforms including a participatory programme for schools and local communities. In addition pH data is publicly available at the NZOA-ON website.

Web: http://www.carim.nz/ - just a landing page visible at present but I'll be releasing more pages as I complete them in the short term
Facebook: www.facebook.com/CoastalAcidificationNZ
Facebook Group for Ocean Guardians: https://www.facebook.com/groups/242608429405803/
Twitter: @CARIM_NZ https://twitter.com/CARIM_NZ
Instagram: carimnz https://www.instagram.com/carimnz/

The 9th NZ National Ocean Acidification Workshop, will take place in July 2016 in Wellington. The workshop attracts ~70 scientists, stakeholders and policy makers.

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')

CARIM (see above) – Theme 1 Greenhouse gases and the Oceans
The Deep South National Science Challenge http://www.deepsouthchallenge.co.nz/

- Theme 4 Interconnections between aerosols, clouds and ecosystems

NZOA-ON (see above) - Theme 1 Greenhouse gases and the Oceans
NZ Core funding – Ocean-Climate Interactions – Themes 1,3 & 4, SOLAS Science & society, SOLAS Science & geoengineering

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)

Funding is being sought to further develop SOAP research in Southern Ocean aerosols within the New Zealand National Science Challenge *Deep South* and the SOCRATES programme, and into the influence of marine biogenic sources of aerosols via the New Zealand Royal Society Marsden Fund.

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

CSIRO Access ESM and Southern Ocean Aerosol-Cloud Research
The Deep South National Science Challenge: http://www.deepsouthchallenge.co.nz/
GOA-ON
IOCCP Scientific Steering Group, and SOCAT Global QC Group, NZ committee member member, K. Currie
SCOR Working Group "Dissolved N2O and CH4 measurements: Working towards a global network of ocean time series measurements of N2O and CH4", NZ member C. Law

Comments