surface ocean solas lower atmosphere study

Report for the year 2015 and future activities

SOLAS: Chile *compiled by: Laura Farías*

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.*

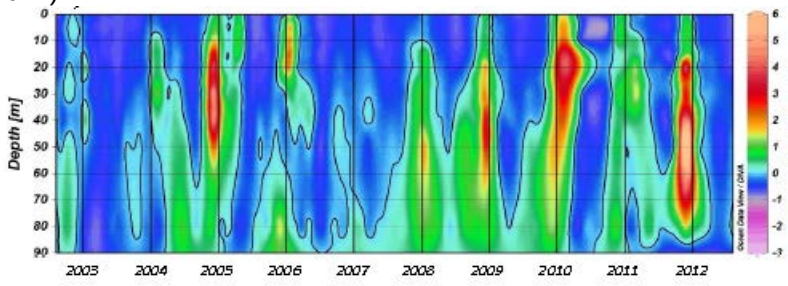
IMPORTANT*: May we remind you that this report should reflect the efforts of the SOLAS community in the* ***entire country*** *you are representing (all universities, institutes, lab, units, groups)!*

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.

Seasonal and inter-annual variability of biogeochemical variables, including nitrous oxide (N2O) an important climate active gas, were analyzed during monthly observations between 2002 and 2012 at the Center for Oceanographic Research in the South Pacific (COPAS) Ocean Time-Series station in the coastal upwelling area off central Chile (36° 30.8'; 73° 15'). Oxygen, N2O, nutrients and chlorophyll-a showed clear seasonal variability associated with upwelling favorable winds (spring-summer), and also inter-annual variability, which in the case of N2O was clearly observed during N2O hotspot occurrence with saturation levels of up to 4849%. The hotspots consistently occurred during the upwelling-favorable period in years 2004, 2006, 2008, 2010 and 2011, below to the mixed layer (15-50 m depth) in waters with hypoxia and specific NO2- accumulation. They displayed a three times greater excess of N2O (ΔN2O) than the average monthly anomalies (2002-2012).



Estimated relationships of ΔN2O vs. apparent oxygen utilization (AOU) and ΔN2O vs. NO3- suggest that aerobic ammonium oxidation (AAO) and partial denitrification are the processes responsible for high N2O accumulation in subsurface water. Chlorophyll-a levels correlated fairly well with the presence of the N_2O hotspots, suggesting that microbial activities fuelled by high availability of organic matters lead to high N2O production. This in turn results in a huge efflux into the atmosphere of up to 260 µmol m-2 d-1. N2O hotspots are transient events or hot moments,

which may occur more frequently than they are observed. If so, this upwelling area is producing and emitting greater than expected amounts of N2O and resulting in an important source of N2O that should be considered in the global atmospheric N2O balance. Taken from Farías L, Besoain V, and García-Loyola S. (2015). *Presence of nitrous oxide hotspots in the coastal upwelling area off central Chile: An analysis of temporal variability based on ten years of a biogeochemical time series*. Environmental Research Letter 10 (2015) 044017 doi:10.1088/1748-9326/10/4/044017

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.)

Temporal variability in biogeochemical variables (including nitrous oxide and methane) have been evaluated from time series (TS) stations off Concepcion ~36°S (COPAS TS;) and one new with two years of monitoring off Valparaiso ~32°S). We participated in the CIMAR 21 expedition to the eastern South Pacific (Valparaiso to Eastern Island, October 2015). We took our recently implemented system (own technological development) for continuous measurement of nitrous oxide and methane in surface oceanic waters to estimate the air-sea fluxes in the region. We also collected samples for studying the very fine vertical distribution (each meter) of the variables in the water column in order to determine the origin of gases in the South Pacific gyre. We also participate in LOWPHOX cruise in order to investigate the impact of ocean acidification on nitrifying activity, preliminary results suggest that OA does not seem affect nitrification but N2O yielding rates (Frame et al., in progress).

Chile through Laura Farías participates in the Scientific Committee on Ocean Research (SCOR) Working Group: Dissolved N_2O and CH_4 measurements: Working towards a global network of ocean time series measurements of N_2O and CH_4. This group aims to improve and consolidate measurements of the greenhouse gases nitrous oxide (N_2O) and methane (CH4) dissolved in seawater. an intercalibration exercise is being conducted amongst WG members targeting discrete N_2O and CH_4 measurements. Recommendations and protocols for calibration, quantification, and data reporting will be published following this exercise.

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

1.-Cornejo M, Murillo AA, Farias L. (2015) An unaccounted for N2O sink in the surface water of the eastern subtropical South Pacific: Physical versus biological mechanisms. Progress in Oceanography. Vol.137(A):12-23. doi:10.1016/j.pocean.2014.12.016

2.-Farías L, Besoain V, and García-Loyola S. (2015). *Presence of nitrous oxide hotspots in the coastal upwelling area off central Chile: An analysis of temporal variability based on ten years of a biogeochemical time series*. Environmental Research Letter 10 (2015) 044017 doi:10.1088/1748-9326/10/4/044017

3.-Farias L, Flores L, Besoain V and Fernandez C. (2015). *Dissolved greenhouse gases (nitrous oxide and methane) associated with the natural iron- fertilized Kerguelen region (KEOPS 2 cruise) in the Southern Ocean*. Biogeosciences, doi:10.5194/bgd-11-12531-2014

4.-Lambert, F., A. Tagliabue, G. Shaffer, F. Lamy, G. Winckler, L. Farias, L. Gallardo, and R. De Pol-Holz (2015), Dust fluxes and iron fertilization in Holocene and Last Glacial Maximum climates, Geophysical Research Letters, 42(14), 6014-6023, doi:10.1002/2015gl064250.

5.- Vuille, M., Franquist, E.,Garreaud, R., Lavado, W., Cáceres, B.Impact of the global warming hiatus on Andean temperature Journal of Geophysical Research: Atmosphere doi: 10.1002/2015JD023126

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.)

Next years, our research will be focused on the behavior of water vapor in Northern Chile is representative of a much larger region that includes the subtropical anticyclone. The region of the subtropical anticlyclone in the Eastern Pacific is the locus of some of the critical feedbacks in the climate system, in particular, low cloud feedbacks and water vapor feedback. The dynamics of water vapor is tied to the general warming of the planet, as on the zeroth-order, the distribution of water vapor in the subtropical free troposphere is controlled by the temperature of last saturation of air parcels which can have a high and mid-latitude origin. Changes in the water vapor distribution in regions of low water vapor are relatively more important than changes in regions of high water vapor due to the saturation of the radiative response in the infrared. This region is the locus of significant radiative cooling to space that occurs from the top of the stratocumulus cloud base or from the surface of the ocean. This cooling is instrumental in regulating the radiative response of the planet to climate change. This highlights the interest in understanding what controls the water vapor amount in this region and what are the mechanisms that control possible trends of water vapor in similar regions of the planet.

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

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')

Most of researchers related with SOLAS issues are making in the new Center for Climate and Resilience Research (CR)2, (www.cr2.cl) a world-class research center focusing on Earth System Science, which in a interdisciplinary manner and in close relation to stakeholders, improves our understanding of the Earth System and is functional to the enhancement of societal resilience in Chile. The proposed research tackles highly relevant questions in biogeochemistry, climate dynamics, ecosystem services, social science, and modeling and observing systems. This research is oriented towards addressing with an integrated approach pressing issues for Chile: scarcity and variability of water resources in Central and Northern Chile, growing urbanization in Central and Southern Chile, and fast land use changes in Central and Southern Chile. Natural scientists convened at (CR)2 will address interactions in the regional climate system in a quantitative manner, by means of paleorecords, in situ and remote measurements, and model simulations. Social scientists at (CR)2 will use comparative studies and multi-criteria evaluations to examine attainable adaptation, mitigation, and practices to confront the expected climate changes. This center is founded by CONICYT

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.

Comments