

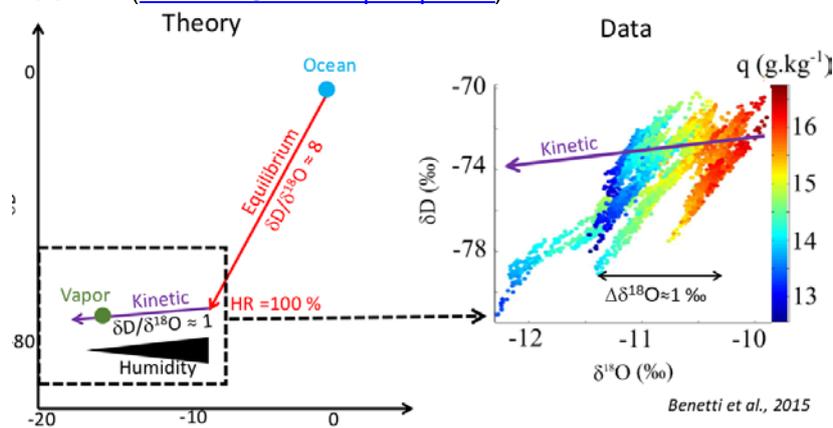
Report for the year 2015 and future activities

SOLAS France, compiled by R. Losno

PART 1 - Activities from January 2015 to December 2015

1. Scientific highlight

What have we learned on air-sea vapor exchange from water isotopologue measurements during cruises in the tropical and subtropical Atlantic. SPURS, PIRATA, Rara Avis projects, Marion Benetti LOCEAN (mabelod@locean-ipsl.upmc.fr)



The isotopic composition (H_2^{16}O , HD^{16}O , H_2^{18}O) of the evaporated flux is depleted compared to the surface sea water by equilibrium or kinetic effects. Kinetic effects are not well understood yet. This work aimed to search on how do local atmospheric parameters such as humidity and wind speed control the kinetic fractionation during evaporation. The investigations are made and result obtained using samples and data collected during the STRASSE oceanographic campaign in summer 2011. The figure shows a strong influence of the evaporation on the water vapor at 17 m. A new campaign was held in 2015 on a scientific sailor boat in the sub tropical North Atlantic Ocean (RARA AVIS 2015) to measure the seasonal variability of δ_e .

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.)

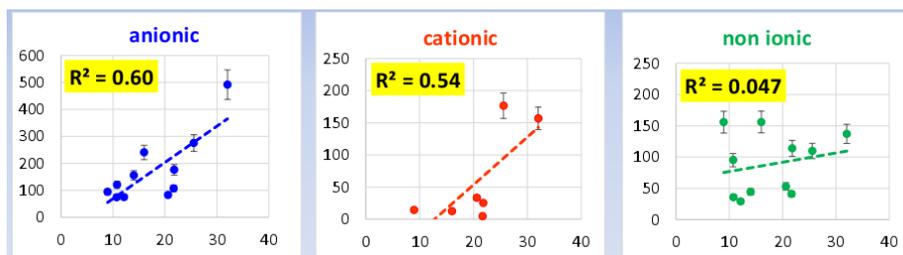
The year 2015 was marked by the SOLAS international conference and the participation of twelve French SOLAS active scientists. This conference was preceded by the SOLAS-France meeting held in Paris on June 29th. 32 attendants presented all the on going SOLAS topic with a snapshot of the active SOLAS work done in France during the year 2015. SOLAS-France congratulates the new position of Véronique Garçon as the SOLAS leader and wish her a total success.

Ongoing developments in the Meso-NH model for the generation of primary marine salts. Marine Claeys, CNRM (marine.claeys@meteo.fr)

An improved model published by Ovadnevaite et al. in 2014 was implemented in Meso-NH atmospheric model. These improvements take into account the effects of SST, sea state and also include smallest particles. The parametrization is made using field measurements.

Surface tension and anionic, cationic, and non-ionic surfactant concentration in aerosols from contrasting regions: filling the gaps in the ecosystems-aerosol-cloud relationship.

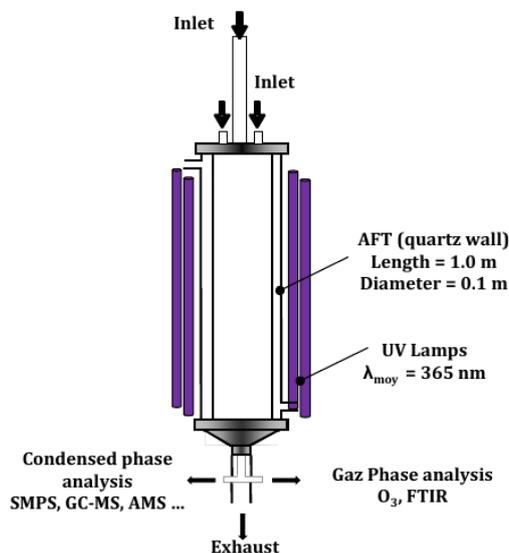
Barbara Nozière, IRCELYON (barbara.noziere@ircelyon.univ-lyon1.fr) and col. (Violaine Gérard, Christine Baduel, Amanda Frossard and Ron. C. Cohen).



Surfactant concentration (Y axis, pmol/m³) versus chlorophyll concentration (X axis, mg/m³)

Surfactants present in atmospheric aerosols are expected to enhance the activation into cloud droplets by acting on one of the two key parameters of the Köhler equation: the surface tension, σ . But because the magnitude of this effect and its regional and temporal variability are still highly uncertain, various approaches have been developed to evidence it directly in the atmosphere. We made analysis of surfactants present in PM_{2.5} aerosol fractions collected at the coastal site of Askö, Sweden (58° 49.5' N, 17° 39' E) from July to October 2010. The total surfactant fraction was extracted from the samples using an improved double extraction technique. Surface tension measurements performed with the pendant drop technique indicated the presence of very strong surfactants ($\sigma \sim 350$ mN/m) in these aerosols. In addition, these extractions were combined with colorimetric methods to determine the anionic, cationic and non-ionic surfactant concentrations, and provided for the first time interference-free surfactant concentrations in atmospheric aerosols (figure). At this site, the total surfactant concentration in the PM_{2.5} samples varied between 7 to 150 mM and was dominated by anionic and non-ionic ones. The absolute surface tension curves obtained for total surfactant fraction displayed Critical Micelle Concentrations (CMC) in the range 50 - 400 μ M, strongly suggesting a biological origin for the surfactants. (in *Geophysical Research Abstracts*, Vol. 17, EGU2015-851, 2015, EGU General Assembly 2015).

Lab measurements of oxidation of fatty acid in marine organic aerosol. Ahmad El Masri PC2A, Lille (elmasri.ahmad@gmail.com), N. visez and Denis Petitprez (denis.petitprez@univ-lille1.fr).



Organic aerosols are produced with sea salt aerosol in film and drop jets. A laboratory experiment was set up to measure the reactivity of organic marine aerosol with Cl and O₃. A focus was made on fatty acids, reaction products and kinetics of oxidation reactions. Organic aerosol is generated in the laboratory using distillation and condensation under a nitrogen flow. The produced aerosol is introduced in the heterogeneous kinetic reactor (figure) where ozone is added. Ozone and the chemical composition of the remaining aerosol are analyzed.

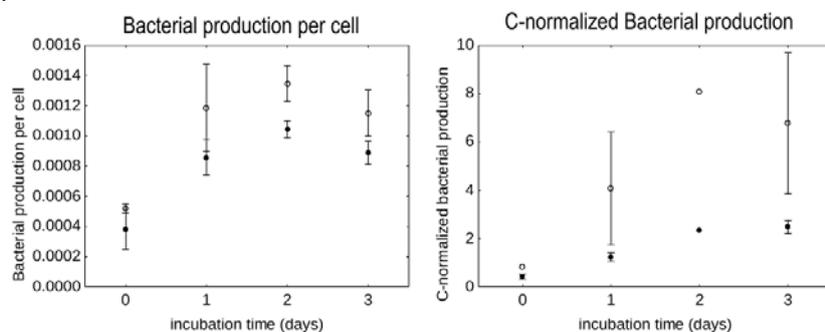
Secondary aerosol emissions from open sea waters via halogenated species: evidences from mesocosm experiment Karine Sellegri LaMP/OPGC (k.sellegri@opgc.univ-bpclermont.fr)

and col. (A. Culot, C. Rose, J. pey, S. Mas, B. D'anna, R. Sempere B. Charriere and N. Marchand). New particle formation through the gas-to-particle conversion is an important and complex process that generate aerosols which can, in turn, affect the climate on a global scale by influencing cloud radiative processes (Slingo, 1990). This phenomenon has been widely studied in many environments, including marine coastal areas where the largest nucleation rates have been reported so far in the literature, when macro-algae are exposed to ambient air at low tide during daytime. However, extremely scarce information is available for open-ocean conditions which represent 71 % of the earth surface. Nucleation is suspected to occur over open ocean areas (O'Dowd (2010)), but there were, to our knowledge, no direct measurement of new cluster particle significant formation. Iodine has been identified as a precursor to formation of new particles in coastal environment (O'Dowd 2002), and is also released by microalgae species (Thorenz et al. 2014), but in-situ measurement failed to identify iodine as a precursor to new particle formation events in the open-ocean atmosphere. Here, we evidence that new cluster particles (1-6 nm of diameter) are abundantly produced from open-sea-representative seawater, free of coastal macro-algae, from mesocosm experiments.

Experimental evidence of dust-induced changes in DOM bioavailability in the surface ocean.

DONUT project, Elvira Pulido MIO (elvira.pulido@univ-amu.fr)

DOC is the second largest oceanic C pool (662 ± 32 Pg C) and is a crucial advective/mixing pathway of carbon export, particularly in the oligotrophic ocean. DOC export through vertical mixing results from the decoupling between production and removal processes during the stratification period due to nutrient limitation of bacterial activity. Nutrient limitation of bacterial activity can be transiently relieved through the pulsed inputs of new nutrients derived from Saharan dust. The DONUT project aimed at revisiting the 'bacterial' link between dust deposition and C cycle. Its main objective was to assess the hypothesis that the bacterial and microbial loop responses to dust deposition might shape the DOM pool and modify its residence time with implications on DOM bioavailability. DONUT strategy was based on an original 2-step experiment: The first step of the experiment consisted on long-term incubations (21 days) in which a bacterial natural assemblage was submitted to dust enrichments. The second step of the experiment consisted on using the transformed DOM from DONUT-1 to re-initiate short-term incubations (3 days) in order to check for modifications on the DOM bioavailability caused by dust amendment. Bacterial abundance and production was lower in the treatment previously submitted to dust enrichment (Figure) suggesting a decrease in DOM bioavailability induced by dust addition. This is promising result which points to a new link between dust and carbon cycle through the modification of the residence time of the surface DOM pool.



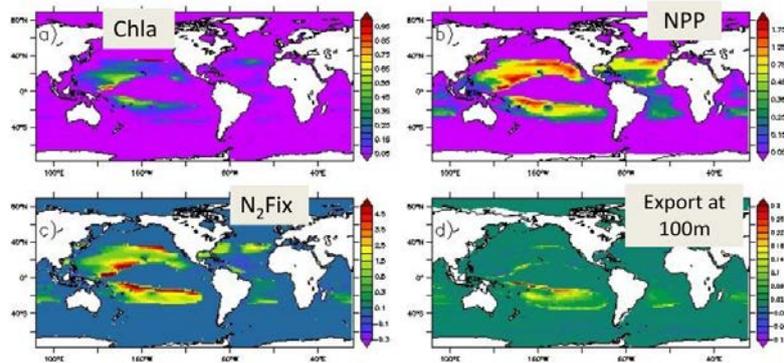
Bacterial production per cell and per unit of available DOC was significantly lower under dust-enriched conditions (solid circles).

Atmospheric impact on ocean biogeochemistry: from experiments to modelling Cécile Guieu

LOV (guieu@obs-vlfr.fr).

The objectives are to assess the importance of atmospheric deposition of elements (μ -)nutrient for oligotrophic areas in the ocean, including N, P and Fe. We aim to compare the results from experimental studies and modeling at a global scale. Deposition fluxes are highly variable from place to place and large portions of ocean surface is poorly documented with field data necessitating model calculations. We used the concept of "atmospheric turnover time (ATT)" which is the time required for atmospheric deposition alone to reach the actual sea surface concentration. The lowest ATT values are found in the LNLC regions and are different between N, P and dissolved iron. Consequently, atmospheric deposition may change the N:P:DFe ratio in the ecosystem. In the global warming conditions, an extension of LNLC regions and a reduction of oceanic nutrients inputs is foreseen, enhancing the role of atmospheric deposition. Computation of oceanic response to a pulsed dust input is also spatially variable (figure showing maximum relative change after a

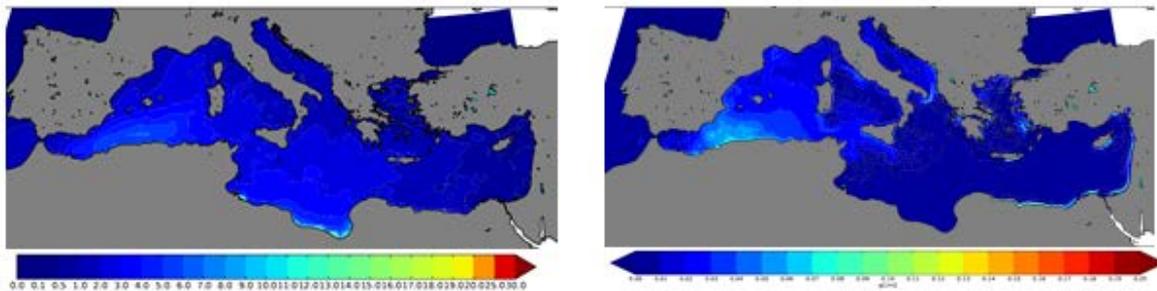
dust pulse input).



A large spatial variability is due to variable LNLc physico chemical conditions. This fast response is limited to one to two weeks inducing a limited long term effect .

Impact and dust deposit modeling in the Mediterranean. Jean-Claude Dutay (jean-claude.dutay@lsce.ipsl.fr), François Dulac LSCE (francois.dulac@cea.fr) and Camille Richon (camille.richon@lsce.ipsl.fr).

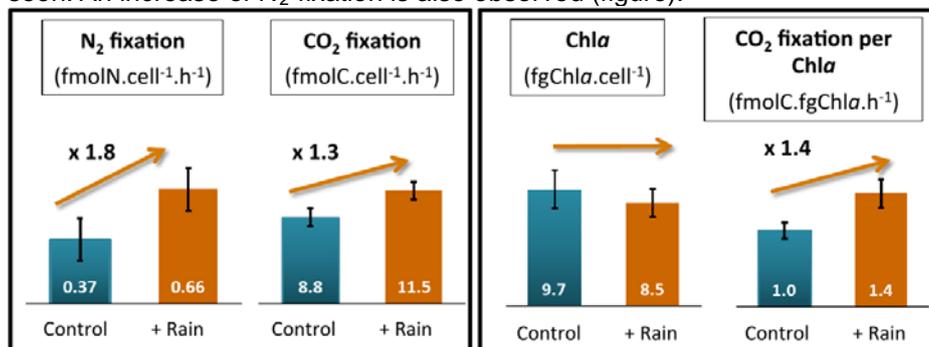
A high resolution (1/12 deg) coupled dynamical-biogeochemical model of the Mediterranean (NEMOMED12-PISCES) was implemented with new high resolution dust deposition forcings (ALADIN-Climat, Nabat et al.) and low resolution nitrogen deposition (INCA, Hauglustaine et al.). Atmospheric deposition is the major source of nutrient (especially P through dust deposition) for some remote parts of the Mediterranean (e.g. the Ionian Basin in Spring and Summer). Our results suggest that the effects of atmospheric deposition are greater during intense deposition events occurring in the stratified period. The fertilizing effects of aerosols are visible in the areas of deposition and are quickly transmitted along the biological chain.



Average dust deposition in June (left) and corresponding surface enhancement of Chla concentration (right) (Camille Richon, on-going PhD, CEA-LSCE)

Impact of atmospheric iron from Saharan dust on *Crocospaera watsonii* Violaine Jacq LOCEAN (violaine.jacq@locean-ipsl.upmc.fr) and col. (C Ridame, S L'helguen, K Desboeufs).

Diazotrophic cyano bacteria have an ecological advantage in N-Limited areas. The impact of atmospheric iron deposition on N₂ fixation is still poorly known. experiments were done with Fe limited *C. Watsonii* WH8501 cultures. Artificial Saharan rain were added and a bioavailable iron release is seen. An increase of N₂ fixation is also observed (figure).



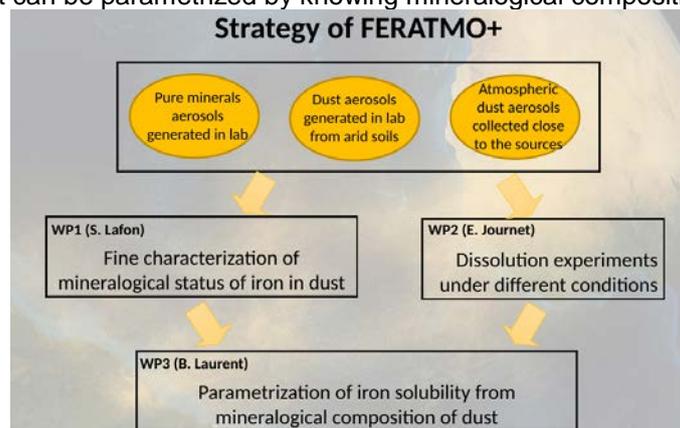
Increase in synthesis of enzymes involved in N₂ fixation and photosynthesis. Increase in CO₂ fixation rate per Chla inducing a more efficient photosynthesis. Saharan dust juice have an higher impact on N₂ fixation than on CO₂ fixation.

Role of the atmospheric contribution to the degradation process and stoichiometry of dissolved organic matter in the Mediterranean Sea. Kahina Djaoudi MIO (kahina.djaoudi@mio.osupytheas.fr) and col. (Elvira Pulido-Villena and France Van Wambeke).

It has become increasingly apparent that atmospheric transport plays an important role in the supply of macro and micro-nutrients to the surface ocean. This atmospheric input is especially important in oligotrophic regions where the vertical supply from the subsurface is low particularly during the stratification period. Compared to its inorganic counterpart, the organic fraction of atmospheric deposition and its impact on surface ocean biogeochemistry has been poorly explored. In the ocean, carbon export to depth (and therefore, its long term storage with presumed consequences on climate) occurs both through particle sedimentation and through the transfer of dissolved organic matter (DOM) via diffusion or convection. DOM export from the surface ocean represents up to 50% of total organic carbon flux to the deep ocean in oligotrophic regions such as the Mediterranean Sea. The efficiency of this C export pathway depends, among others, on the elemental C: N: P ratios of surface DOM which might be affected by the relative contribution of microbial processes and allochthonous sources such as atmospheric inputs.

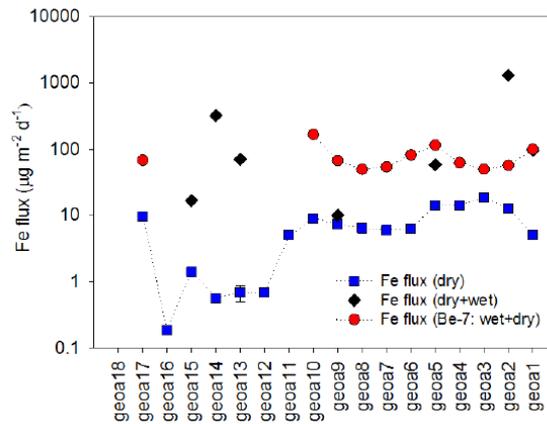
Dust mineralogical composition to study Iron nutrient solubility. FERATMO+ project, Emilie Journet LISA (emilie.journet@lisa.u-pec.fr) and col. (S. Lafon, M. Bandak, S. Nowak, S. Chevallier, P. Ausset, B. Laurent).

Objective of FERATMO: The global objective is to describe iron dissolution processes from a mineralogical point of view in order to improve modeling of dissolved iron inputs to surface ocean: (i) How iron status and content in dust varies according to the dust mineralogy/source and particle size? (ii) What is the solubility of the different iron-bearing mineral found in dust? How solubility is sensitive to the size particle? to the dissolution condition (pH, organic complexation, light...)? (iii) Are there iron status differences of freshly emitted dust play significantly on iron solubility? (iv) How solubility of iron dust can be parametrized by knowing mineralogical composition of dust?



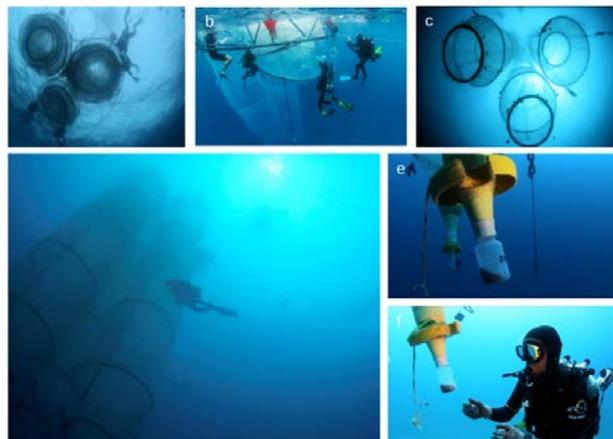
The final objective of this project is modeling the flux of dissolved iron from the mineral soil maps

Trace element composition, solubility and flux estimates of aerosols from contrasting regions of the North Atlantic Ocean. GEOTRACES GA01 and offshore Senegal, Rachel Shelley LEMAR (rachel.shelley@univ-brest.fr) and col. (Geraldine Sarthou, Eric Machu, Habib Senghor, Muntsa Roca Marti, Pere Masque, Georges Tymen, Christophe Messenger, Thomas Gorgues, Hamet Diadihou, Patrice Brehmer).



Atmospheric deposition of aerosols is an important source of trace elements (TE) to the surface ocean. Aerosols contain both essential bioactive elements, e.g. Fe, Cu, Co, Zn, and pollution-derived elements which have no known biological role, e.g. Pb. In particular, the aerosol Fe flux is a key component of biogeochemical and ecosystem models. At present, TE flux estimates are poorly constrained. The largest contribution to this uncertainty results from the use of a fixed deposition velocity. In this study, we take a novel approach to estimate TE fluxes. Beryllium-7 (^7Be) is a cosmogenically-formed radioisotope ($T_{1/2}=53$ days). By multiplying the water column inventory of ^7Be activity with the TE/ ^7Be ratio in the bulk aerosol we are able to significantly reduce the uncertainty of the flux estimates. As only a certain fraction of the aerosol TE are soluble (the most readily bioavailable fraction), it is of paramount importance to determine this fraction. To this end, samples were collected from two contrasting regions of the North Atlantic Ocean. Data is presented from the French-GEOTRACES cruise (GA01) which sampled a low aerosol regime (e.g. total aerosol Fe = 0.19-18.7 ng Fe m⁻³ air filtered), and from the AWA series of cruises (ECOAO, Upsen-2, AWA) off the coast of Senegal, under the Saharan plume with tropical influence (Fe = 52.4-3471 ng Fe m⁻³ air filtered). Aerosol-Fe solubility was lowest for the AWA samples (<0.5% soluble in DI water). However, what the combined effects of changing meteorological conditions, increasing industrialisation and land-use changes will have on aerosol solubility is largely unknown.

VAHINE project first publications in Biogeosciences journal: VARIability of vertical and tropHic transfer of diazotroph derived N in the south wEst Pacific. Sophie Bonnet (MIO, sophie.bonnet@univ-amu.fr).



At the global scale, N₂ fixations provides the major external source of reactive nitrogen to the surface ocean, before atmospheric and riverine inputs, and sustains ~50 % of new primary production in oligotrophic environments. The main goal of the VAHINE project was to study the fate of nitrogen newly fixed by diazotrophs (or diazotroph-derived nitrogen) in oceanic food webs, how it impact heterotrophic bacteria, phytoplankton and zooplankton dynamics, stocks and fluxes of biogenic elements and particle export. Three large-volume (~50 m³) mesocosms were deployed in a tropical oligotrophic ecosystem (the New Caledonia lagoon, south-eastern Pacific) and intentionally fertilized with ~0.8 µM of dissolved inorganic phosphorus (DIP) to stimulate diazotrophy and follow subsequent ecosystem and fluxes changes. VAHINE was a multidisciplinary project involving close collaborations between biogeochemists, molecular ecologist, chemists, marine opticians and modelers.

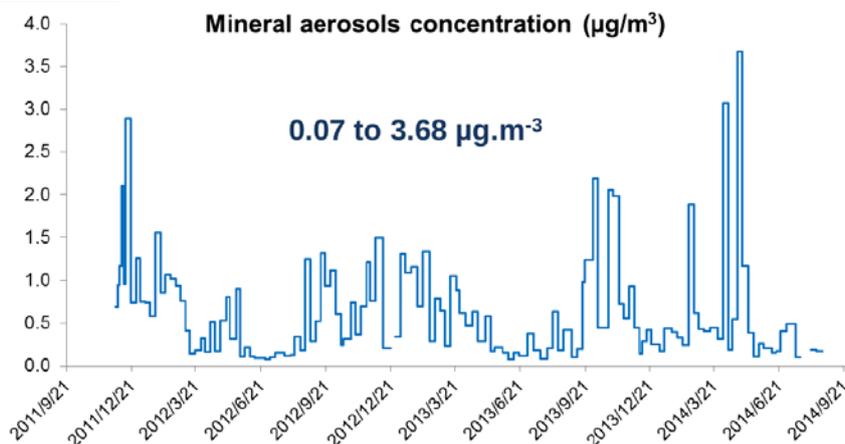


Starting the Polar Pod project (Severine Alvain, LOG, severine.alvain@cnrs.fr). **POLAR.POD** is a project lead by Dr. Jean Louis Etienne and his team that is developing a new oceanographic platform for sub-antarctic regions. The Southern ocean is a region of strong ocean-atmosphere interactions. Being a key region controlling heat and CO₂ flux between the ocean and the atmosphere, the Southern Ocean plays a major role in the regulation of global climate. POLAR.POD will be a tool dedicated to basic and applied research in the Southern Ocean with a capacity to host a wide variety of atmospheric and oceanic captors and samplers on a long term lasting. Its scientific program is described using four topics: 1) Air-Sea Exchange in the Southern Ocean, 2) Long-term monitoring of the Southern Ocean from remote sensing, 3) The biodiversity of the Southern Ocean and 4) Anthropic Impact.

Seasonal cycles of air-sea CO₂ fluxes in the Southern Ocean: what do we learn from observations around Kerguelen? is a project conducted by Claire Lo Monaco (LOCEAN, claire.lomonaco@locean-ipsl.upmc.fr) and col. (N. Metzl, F. d'Ovidio, J. Llort, C. Ridame, R. Gomez, C. Mignon, V. Racapé, S. Blain et B. Quéguiner).

Iron, light and silicic acid availability are the main factors limiting the biological CO₂ uptake in the Southern Ocean (south of 50°S), leading to a small uptake of atmospheric CO₂ in this region (~0.1 PgC/yr). Iron fertilization experiments have demonstrated the potential for increased CO₂ uptake for short periods (a few weeks), but little is known about the seasonal evolution of biogeochemical cycles in iron-fertilized ecosystems. In the frame of the KEOPS2 and OISO projects, observations were collected in October-November 2011 over and downstream of the Kerguelen Plateau, allowing to investigate for the first time the mechanisms that control the oceanic CO₂ uptake at the onset of the blooming period. As soon as vertical mixing is reduced, we observed the rapid establishment of strong CO₂ sinks in waters fertilized with iron (up to -20 mmolC/m²/d). We then used all data available since 1991 to draw the seasonal evolution of air-sea CO₂ fluxes in different regions of Kerguelen's phytoplankton bloom. The impact of iron fertilization on the ocean CO₂ uptake is revealed by comparing estimates in the bloom (1-1.5 molC/m²/yr) and in the iron-poor waters (about 0.4 molC/m²/yr). Extrapolating these results to the large High-Nutrient Low-Chlorophyll area in the Southern Ocean (~50°S-60°S) suggests that iron fertilization may increase the uptake of atmospheric CO₂ by less than 0.1 PgC/yr, i.e., less than 1% of the current anthropogenic CO₂ emissions.

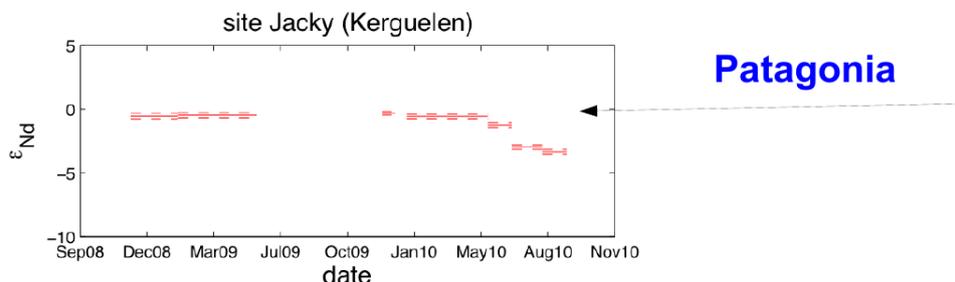
Airborne Aerosol time series at Rio Gallegos (Patagonia). DFP project, Zihan Qu LISA/IPGP (zihan.qu@lisa.u-pec.fr).



Patagonia (South America) is a major atmospheric mineral dust source in the South Hemisphere. The input of Patagonian dust plays a critical role in the biogeochemistry of Southern Ocean. From November 2011 to August 2014, aerosol samples were continuously collected on a weekly basis in Río Gallegos (69.32°W, 51.60°S), by the south Patagonia east coast. This three-year measurement is the first long term time series of mineral dust concentrations obtained in the sub-Antarctic region. Backward trajectories by HYSPLIT model showed that up to 90% of air mass arrived at Río Gallegos originated from the west side (between NNW and SSW) of sampling site. Amounts of Al, Si and Fe were determined by XRF analysis. The compositions of the three elements remained stable during the three years samplings. Weekly dust concentrations measured in South Patagonia varied from 0.07 to 3.68 µg.m⁻³ and reveals a strong seasonal variation pattern. Average winter dust concentrations could decrease down to five times lower than in other seasons. Higher wind speeds unexpectedly did not result in higher dust concentrations. However, variations of the

temperature and the air relative humidity correlated significantly with the dust concentration variation. This suggests that surface soil moisture changes are the primary regulating factor of dust concentration variation in Patagonia. Land frozen effect was potentially another factor resulting low level of dust concentration in winter. The temperature and relative humidity dependence of seasonal dust concentration variation implicate a feedback of dust emission in response to short term climate variations. Our results permit also the improvement of atmospheric dust modelling in the South Hemisphere.

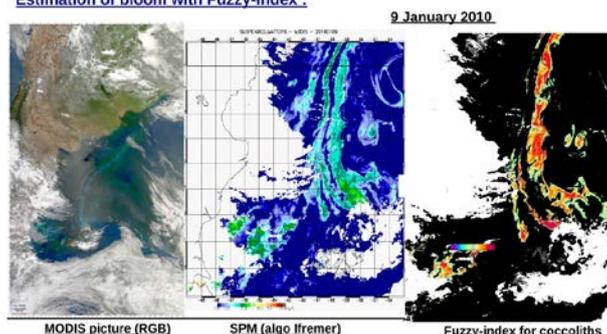
From Patagonia to Kerguelen, dust transport. FLATOCOA and DFP project, Rémi Losno IPGP (losno@ipgp.fr) and col. (A Heimbürger, A Cogez, F Monna and J Gaillardet)



Elemental and isotopic composition was measured at Kerguelen Island. Neodymium isotopic ratio pattern bring a strong evidence of Patagonian origin of the deposited mineral material during spring, summer and winter time. A shift is observed during winter time that is probably caused by Southern African inputs.

Monitoring coccolithophores at a global scale from satellite data. Laurie Perrot, IFREMER (Laurie.Perrot@ifremer.fr) and col. (Diana Ruiz-Pino, Francis Gohin).

Estimation of bloom with Fuzzy-index :



Calcareous phytoplankton group (coccolithophores) has an ubiquitous repartition and is the main calcifying organism in the open ocean. At a global scale coccolithophore blooms are studied in regard of CaCO_3 production and three potential feedback on climate change: albedo modification by the way of dimethylsulfide (DMS) production and atmospheric CO_2 source by calcification and a CO_2 pump by photosynthesis. Contradictory assumptions were pointed out about the evolution of coccolithophore blooms during the anthropogenic era. At one hand, calcification and coccolithophores blooms extension could be decreasing as a consequence of acidification (pH decrease). At the contrary an extension and an increase of blooms and propagation to high latitudes have been pointed out by recently studies. The remote-sensing approach based on Ocean Colour data give us a large temporal and spatial view allowing us to understand the phenology of these calcareous phytoplankton blooms. Determination of the trend of blooms, from satellite data, in a long term view (inter-annual variability), needs the discrimination of the coccolithophore signal from other active materials, such as mineral particles (Suspended Particulate Matter SPM) mainly in coastal waters. To detect coccolithophores from satellite reflectance and overcome the induced noise in the signal calcareous phytoplankton SPM signal we developed a method based on fuzzy mathematical scheme principles. It uses as input the 6 wave lengths of colour satellite reflectance signal of the SeaWiFS and MODIS satellite and extracted from the SPM signal the associated signal of coccolithophores. The calibration of the algorithm is made from Suspended Particulate Matter (SPM) concentration derived from SeaWiFS (1998-2002) and MODIS (2003-2014) reflectance obtained in a region of strong bloom of coccolithophores: North-East Atlantic ocean. The algorithm is calibrated with in-situ taxonomic data obtained during the years 98 and 99. The SPM concentration derived from the semi-analytical algorithm appear to be well correlated to the coccolithophores mass derived from the NASA calcite algorithm. Although a regular pattern in the phenology of the North east Atlantic blooms is observed, starting south in April and moving

northwards until July, there is a high temporal (seasonal and inter-annual) variability in the blooms extension. To be used at global scale and for the long trend studies the method has to be validated in other oceanic region where in-situ observation of coccolithophores has been obtained. This method applied to the reflectance of chlorophyll pixels could provide a daily and quantitative variability of other groups of phytoplankton as a function of their spectral reflectance.

Oxygen Minimum Zone (OMZ) dynamics in the context of the ocean deoxygenation: the case off Peru. The AMOP (Activities of research dedicated to the Minimum of Oxygen in the eastern Pacific) project, Aurélien Paulmier LEGOS, Toulouse (aurelien.paulmier@gmail.com) and col. (M Bretnon, B Dewitte, V Garçon, C Maes, F Campos, A Franco-Garcia, K Mosquera, O Vergara, C Barus, L Coppola, E Carrasco, O Depretz-De-Gesincourt, G Eldin, E Garcia-Robledo, J Grelet, S Illig, I Montes, N Leblond, A Oschlies, J Quispe, J Sudre).

Oxygen Minimum Zones (OMZs), defined as suboxic ($O_2 < 20 \mu\text{mol/L}$) subsurface layer and mainly associated with Eastern Boundary Upwelling Systems (EBUS), would contract and expand during cold and warming periods, respectively. In the current context of the ocean deoxygenation, OMZs are known to play a key-role on the evolution of climate (greenhouse gases) and on the ecosystems and fisheries (nitrogen loss, respiratory barrier, sulfidic events) at both local and global scales. The objective of AMOP project ("Activities of research dedicated to the Minimum of Oxygen in the eastern Pacific") is to carry out a complete O_2 budget off Peru considering physical (advection/diffusion) and biological (O_2 consumption/production) contributions. The central hypothesis is that the physical and biogeochemical O_2 contribution to the OMZ maintaining and variability depends on the different OMZ layers, in particular the oxycline which would be the engine of an intense but intermittent biogeochemical and ecosystem activity. The project is focused in one of the most intense and shallow OMZs associated with the most productive upwelling system (10 % of the world fisheries), the Peruvian OMZ. The trans-disciplinary approach is based on: a cruise (January-February 2014; in the Peruvian OMZ) focused on 8 fixed stations (~54 h) on 3 transects at 7°S, 12°S and 14°S with the RV Atalante associated with an effort of experimental development (instrumentation, sensors: Argo-floats experiments; drifting lines; a trimaran dedicated to ocean-atmosphere exchanges, OCARINA; nanomolar O_2 measurements); a monitoring (2013-2014) mooring at 12°S at 30 nm from the coast; a complementary high resolution regional coupled modeling platform integrating the different spatio-temporal scales. This French-Peruvian-German project involving 5 other countries (~90 participants) is viewed as one of the main pilot projects of the SOLAS Mid Term Strategy Initiative on OMZ-EBUS. Preliminary results, in particular from recent high frequency (15-30 min) mooring data complemented with models simulations show a intra-annual variability of the OMZ dynamics associated with the productivity and environmental forcing (i.e. tide, wind-forced upwelling, meso-scale activity and equatorial Kelvin wave). For the first time, three main regimes of variability have been reported (sub-daily: < 1 day; sub-monthly: 1-30 days; sub-seasonal: 30-90 days), which should be taken into account for the validation of regional models and the interpretation of the evolution of marine resources along the coast of Peru. Cruise and fixed and drifting sediment traps core parameters (including O_2 and nutrients, organic matter, and respiratory rates from incubations) will be analysed in order to estimate the physical and biogeochemical contributions to the OMZ dynamics. In particular, the influence of the phytoplankton on the OMZ and of the OMZ on the organic matter quantity and quality will be explored.

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

Benetti M, Aloisi G, Reverdin G, Risi C and Sèze G (2015), Importance of boundary layer mixing for the isotopic composition of surface vapor over the subtropical North Atlantic Ocean. *Journal of Geophysical Research: Atmospheres*, 120(6), 2190-2209.

Bettencourt J, López C, Hernández-García E, Montes I, Sudre J, Dewitte B, Paulmier A and Garçon V (2015), Boundaries of the Peruvian Oxygen Minimum Zone shaped by coherent mesoscale dynamics, *Nature Geoscience*, 8, 937-940, doi:10.1038/ngeo2570

Bonnet S, Rodier M, Turk-Kubo K, Germineaud C, Menkes C, Ganachaud A, Cravatte S, Raimbault P, Campbell E, Quéroué F, Sarthou G, Desnues A, Maes C and Eldin G (2015), Contrasted geographical distribution of N_2 fixation rates and nifH phylotypes in the Coral and Solomon Seas (southwestern Pacific) during austral winter conditions, *Global Biogeochemical Cycles*,

10.1002/2015GB005117.

Brown CW, Boutin J, and Merlivat L (2015), New insights of pCO₂ variability in the tropical eastern Pacific Ocean using SMOS SSS, *Biogeosciences*, 12, 7315–7329.

Merlivat L, Boutin J, Antoine D (2015) Roles of biological and physical processes in driving seasonal air-sea CO₂ flux in the Southern Ocean: New insights from CARIOCA pCO₂, *J. Mar. Syst.* 147,9-20, <http://dx.doi.org/10.1016/j.jmarsys.2014.04.015>

Merlivat L., Boutin J, and d'Ovidio F (2015), Carbon, oxygen and biological productivity in the Southern Ocean in and out the Kerguelen plume: CARIOCA drifter results, *Biogeosciences*, 12(11), 3513-3524.

Nozière B, Kalberer M, Claeys M, Allan J, D'Anna B, Decesari S, Finessi E, Glasius M, Grgic I, Hamilton J, Hoffmann T, Iinuma Y, Jaoui M, Kahnt A, Kampf C J, Kiss G, Kourtchev I, Maenhaut W, Saarikoski S, Schnelle-Kreis J, Stephanou E G, Surratt J D, Szidat S, Szmigielski R, Wisthaler A (2015), The Molecular Identification of Organic Compounds in the Atmosphere: State of the Art and Challenges, *Chemical Reviews*, special issue "Chemistry in Climate", 115, 3919.

Schwier AN, Rose C, Asmi E, Ebling AM, Landing WM, Marro S, Pedrotti ML, Sallon A, Luculano F, Agusti S, Tsiola A, Pitta P, Louis J, Guieu C, Gazeau F and Sellegri K (2015), Primary marine aerosol emissions from the Mediterranean Sea during pre-bloom and oligotrophic conditions: correlations to seawater chlorophyll-a from a mesocosm study, *Atmospheric Chemistry and Physics*, 15, 7961-7976, doi:10.5194/acp-15-7961-2015.

S. Sobanska, J. Barbillat, M. Moreau, N. Nuns, I. De Waele, D. Petitprez, Y. Tobona and C. Brémard (2015) Influence of stearic acid coating of the NaCl surface on the reactivity with NO₂ under humidity, *Phys. Chem. Chem. Phys.*, 17, 10963-10977.

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.)

End of VAHINE project and special issue in *Biogeosciences* (diazotrophy)

PLAR.POD launching and experiments on Southern Ocean

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

SOLAS-France meeting will become an annual meeting held in June or July

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')

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)

- Southern Ocean as a key point for climate control, including air-sea exchange and biogeochemistry, including POLAR.POD as a new tool.
- Atmospheric deposition to the oceans
 - Volcanic ashes supplying nutrients to the surface ocean
 - More investigations on ⁷Be results for atmospheric deposition measurements
 - Improving our knowledge on atmospheric deposition of macro and micro nutrients into the ocean surface.
 - Working on the mutual influence of dust particles and plankton excretions in the organic carbon export.
 - Using mineral soil maps to model atmospheric dissolved iron flux at a global scale
- Focussing model and experimental integration at the Mediterranean basin scale.
- Work on marine atmospheric organic carbon chemistry and oceanic DOM including relationship with dust deposition, experimental developments for surfactants determination.
- Satellite remote sensing determination of phytoplanktonic species.

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

Close collaborations from SOLAS participants with former IMBER and IGAC community, implication in the global policy of Future Earth organization

Comments