

Notes:

Reporting Period is January 2013 – December 2013

Information will be used for: reporting, fundraising, networking, strategic development & outreach

1. Scientific highlights

- **AMOP** for “Research Activities dedicated to the Oxygen Minimum in the East Pacific (contact Aurélien Paulmier: aurelien.paulmier@gmail.com and Ivonne Montes: ivonne.montes@gmail.com, Boris Dewitte, Véronique Garçon, Isabelle Dadou and Andreas Oschlies).

The connection between the equatorial mean circulation and the oxygen minimum zone (OMZ) in the Eastern Tropical Pacific is investigated through sensitivity experiments with a high-resolution coupled physical-biogeochemical model. Two sets of climatological open boundary conditions for the physical variables which differ slightly on the intensity and vertical structure of the Equatorial Current System (ECS) are shown to lead to contrasted characteristics of the simulated OMZ by the regional model. Results demonstrate that the secondary Tsuchiya jet is a key feature of the sensitivity of the OMZ to the equatorial circulation. There is a significantly different balance between physical and biogeochemical processes within the energetic coastal current system between both simulations, illustrating the large sensitivity of the OMZ dynamics to the open boundary conditions.

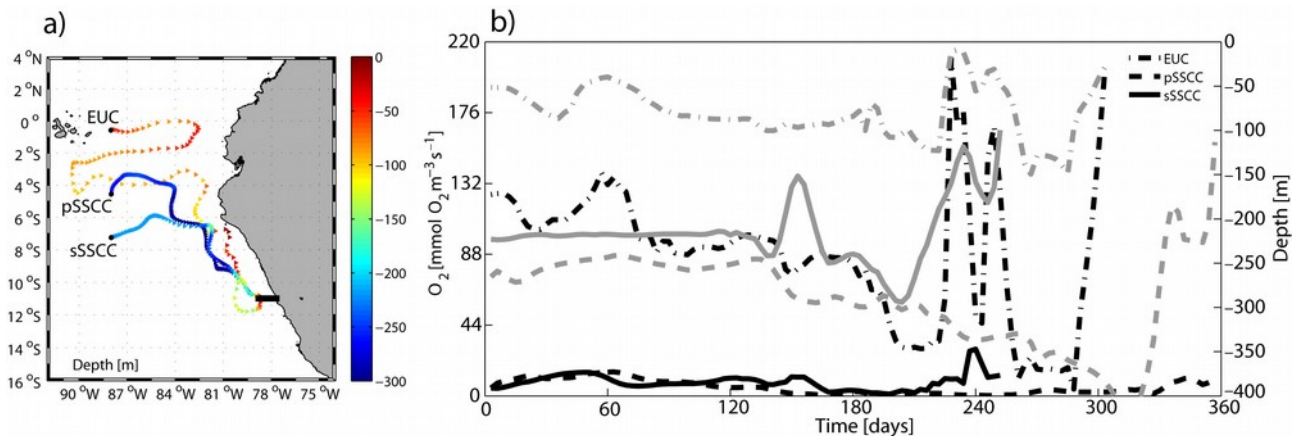


Figure 1. Spaghetti diagrams of selected particles showing typical routes of floats associated to each main eastward equatorial subsurface current (Equatorial Under Current -EUC, 1st and 2nd Tsuchiya jets) feeding the PCUC. Black circles are initial positions of each float, colors represent the along-trajectory depth (in m) and, the cross-shore black bar, at ~9°S, is the PCUC section reaching the floats. Evolution of b) the oxygen content (black lines, scale on left axis) and depth (gray lines, scale on right axis) along the float pathways. In b, the dash-dotted, dashed and solid lines indicate the EUC, and 1st and 2nd Tsuchiya jets, respectively. (Montes et al., 2014, in revision)

- **Atmospheric new nutrients associated with Saharan dust pulses do significantly stimulate N₂ fixation in the Mediterranean Sea and that N₂ fixation is not a key process in the carbon cycle in such oligotrophic environments.**

The response of N₂ (dinitrogen) fixation to contrasted (wet and dry) Saharan dust deposition was studied in the framework of the DUNE project (a DUst experiment in a low-Nutrient, low-chlorophyll Ecosystem) during which realistic simulations of dust deposition (10 gm⁻²) into large mesocosms (52m³) were performed. Three distinct experimental dust additions were conducted in June 2008 (DUNE- 1-P: simulation of a wet deposition, DUNE-1-Q: simulation of a dry deposition) and 2010 (DUNE-2-R: simulation of 2 successive wet depositions) in the northwestern oligotrophic Mediterranean Sea. Results (figure 1) show that wet and dry dust deposition induced a rapid (24 h or 48 h after dust additions), strong (from 2- to 5.3-fold) and long (at least 4–6 days duration) increase in N₂ fixation, indicating that both wet and dry Saharan dust deposition was able to relieve efficiently the nutrient limitation(s) of N₂ fixation. The contribution of N₂ fixation to primary production was negligible (≤1 %) before and after dust addition in all experiments, indicating that N₂ fixation was a poor contributor to the nitrogen demand for primary production. Despite the stimulation of N₂ fixation by dust addition, the rates remained low, and did not significantly change the contribution of N₂ fixation to new production since only a maximum contribution of 10% was observed.

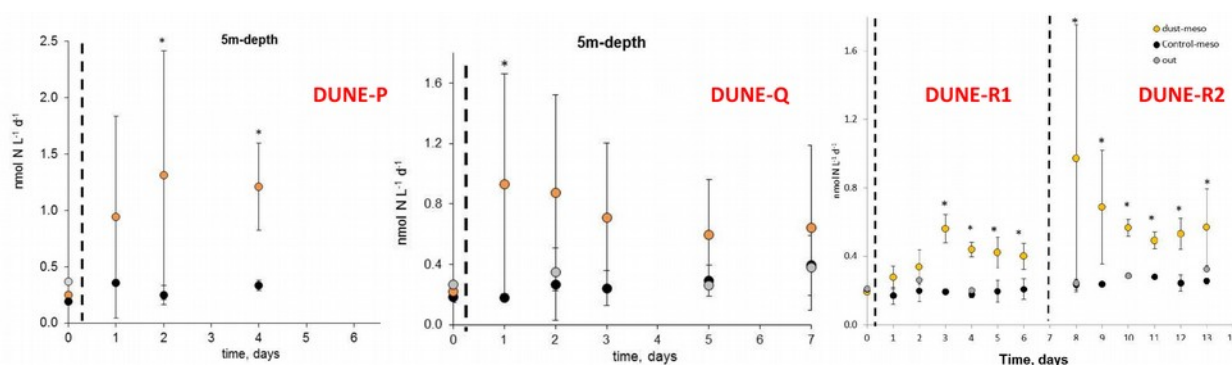


Figure 2. Mean N₂ fixation rate ($n=3$) in $\text{nmol N L}^{-1} \text{d}^{-1}$ during the 3 DUNE experiments in the Control-meso (black dot), Dust-meso (orange dot) and Out (grey dot) at 5m depth. The dotted line represents the time of the dust seeding. Data in the Control- and Dust-meso represent the average and standard deviation of the three replicate mesocosms. Means in the Dust-meso that were significantly different ($p < 0.05$) from the Control-meso are labeled with the * symbol. (from Ridame et al., 2013)

2. International interactions and collaborations (including contributions to international assessments such as the IPCC, links with observation communities etc)

Close international collaborations within AMOP: Peru, Germany, France, Spain, Denmark and Mexico. Participation of B. Dewitte (LEGOS) to the German Retreat SFB754 “Climate – Biogeochemistry interactions in the tropical ocean”, GEOMAR, Kiel Germany

MedSeA (EU FP7, started in February 2011, Mediterranean Sea Acidification in a changing climate. A first joint experiment using large pelagic mesocosms took place in Corsica (summer 2012) to assess the effects of ocean acidification on planktonic communities in oligotrophic areas (see article in this issue). Another experiment will take place in the Bay of Villefranche in Feb-March 2013. (see report in SOLAS NEWS issue 14, summer 2012).

eFOCE (BNP-Paribas, started in 2011, European Free-Ocean Carbon dioxide Enrichment experiments: development of benthic experimental systems to study the effects of ocean acidification of benthic communities in the field (Bay of Villefranche, Mediterranean Sea); started in 2011; J.-P. Gattuso, gattuso@obs-vlfr.fr).

3. Activities/main accomplishments (research projects, cruises, special events, workshops, remote sensing used, model and data intercomparisons etc)

- **Workshop** on “Towards an integrative regional coupling in the Eastern Boundary Upwelling Systems (EBUS), Instituto Geofísico del Perú, Lima, 26- 27 November 2012 , as a Contribution to the SOLAS Mid-Term Strategy Initiative “Air-sea gas fluxes at Eastern Boundary upwelling and Oxygen Minimum Zone systems (<http://solas-int.org/mts/research-strategy-5.html>), 30-31 and Oceanflux projects: a collaboration between the European Space Agency (ESA) and SOLAS , 39-40.
- **SOLAS Mid-Term Strategy Initiative** “Air-sea gas fluxes at Eastern boundary upwelling and Oxygen Minimum Zone (OMZ) systems”:
- **Participation to the Symposium : Microbial Ecology and Biogeochemistry of Oxygen-Deficient Marine Waters**, March 17-11, 2013, Santa Cruz, Chile, supported by the Agouron Institute and the Gordon and Betty Moore Foundation (V. Garçon)
- **-SCOR Working Group on Microbial Community Responses to Ocean Deoxygenation, Approved for 4 years (V. Garçon, full member)**. Summary: Water column oxygen (O₂) deficiency shapes food web structure by progressively directing nutrients and energy away from higher trophic levels and into microbial community metabolism. There is increasing evidence that ocean warming trends will decrease dissolved O₂ concentrations within the coastal and interior regions of the ocean, resulting in oxygen minimum zone (OMZ) expansion. These processes will directly impact coastal benthic ecosystems and fisheries productivity due to habitat compression and changes in nutrient cycles with currently unconstrained feedbacks on the global ocean. This SCOR working group will catalyze knowledge creation at the forefront of research on microbial community responses to changing levels of water column O₂-deficiency. It will unite oceanographers, microbial ecologists and biogeochemists to define model ecosystems, new standards of practice, and economies of scale needed for effective comparative analyses and enhanced forecasts of ocean deoxygenation. The deliverables will include one field experience, two program meetings, a white paper on best practices, and a peer-reviewed monograph.
- **ESA-EGU-SOLAS international workshop** "Air-sea Gas Flux Climatology; Progress and Future Prospects, Brest, 24-27 September 2013, (Session co-Chairman : V. Garçon)
- **EUR-OCEANS** Hot topics Conference: a changing ocean, 6-8 November, Telde, Gran Canarias, Spain

SOLAS ENDORSED PROJECT.

- **AMOP** for “Research Activities dedicated to the Oxygen Minimum in the East Pacific (contact Aurélien Paulmier : aurelien.paulmier@gmail.com, Boris Dewitte, Christophe Maes and Véronique Garçon).

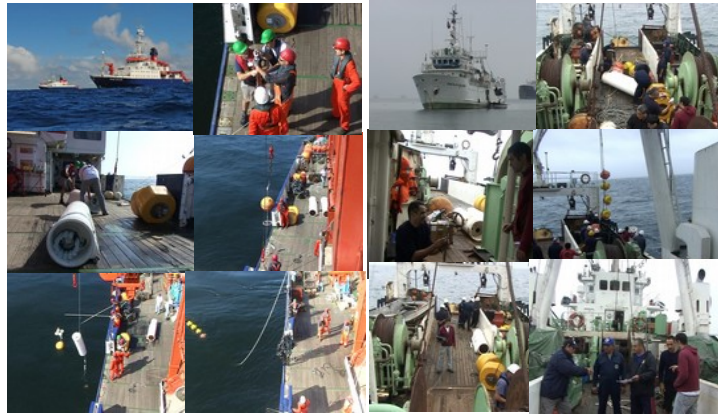


Figure 3. Deployment of multidisciplinary mooring on January 5, 2013 from R/V Meteor off Callao (12°S, 77°40'W) for a 3 years period, serviced in June 2013 with R/V Olaya and February 2014 with R/V L'Atalante. Sensors include 5 O₂-optodes (SBE63), 5 P-T-S (SBE37), 6 T (SBE56), 1 fluorimeter and 1 ADCP (RDI: Workhorse Quatermaster) sensors, 2 sediment traps (PPS3 Technicap) and buoyancy.

- **FLATOCOA**, R. Losno (losno@ipgp.fr) SOLAS endorsed. This program was set up to sample atmospheric deposition at Kerguelen (49.30°S 70.12°E) and Crozet (46.35°S 51.70E) in the South Indian Ocean.

Despite sampling is stopped for 4 years, new results are still obtained from new sample analyses and data interpretation. It was found that solubility of most of the crustal elements are ever more than 70% and mostly 90% in rainwater over Kerguelen Islands. Time series of 18 12 months at Kerguelen and Crozet respectively were published. A seasonality is suspected and Crozet Island is found to be influenced by Austral Africa whilst dust deposition at Kerguelen comes mostly from Patagonia. Ref: Heimburger et al. (2013a), Heimburger et al. (2013b)

- **MedSea**: Mesocosms experiment (contact Frederic Gazeau – gazeau@obs-vlfr.fr),

SOLAS endorsed. MedSea (EU FP7, started in February 2011, Mediterranean Sea Acidification in a changing climate. Two experiments using large pelagic mesocosms took place in Corsica (summer 2012) and in the Bay of Villefranche to assess the effects of ocean acidification on planktonic communities in oligotrophic areas. The first experiment in Corsica has been a real success. The conditions were highly oligotrophic and no significant effects could be observed for the vast majority of measured parameters, suggesting a rather strong resilience of oligotrophic Mediterranean waters to CO₂ enrichment. Interestingly, as it has been already observed in many laboratory experiments, nitrogen fixation rates responded positively to the CO₂ enrichment, although only at the 2 highest levels of pCO₂ (~1000 µatm). All available parameters have been uploaded to the Pangaea database (<http://doi.pangaea.de/10.1594/PANGAEA.811018>). A blog has been published during the experiment: <http://medseastareso2012.obs-vlfr.fr>. The second experiment has been conducted in February/March as this early spring period corresponds to the maximum of chlorophyll *a* in the bay of Villefranche and very different environmental conditions than the ones in the ultra-oligotrophic bay of Calvi in Summer. The experiment was anticipated to run for at least a month but had to be stopped after 2 weeks because of bad weather conditions. A dedicated blog has been published during the experiment: <http://medseavillefranche2013.obs-vlfr.fr>. Once all data will be available, they will be uploaded to the Pangaea database as we did for the results of the first mesocosm experiment.

- **DONUT**, E. Pulido-Villena (elvira.pulido@univ-amu.fr), SOLAS endorsed. The main goal of DONUT is to experimentally assess how and to which extent the response of heterotrophic prokaryotes (Hprok) to atmospheric inputs of nutrients shape the oceanic DOM pool and modify its bioavailability.

A first experiment was conducted between November and December 2013. Mediterranean surface water collected during the stratification period was amended with a Saharan dust end-member and incubated in the dark at controlled T during three weeks. Bacterial activity and biogeochemical characteristics of the dissolved organic matter (DOM) pool were determined at selected time points. Although most obtained samples are still being analyzed, some preliminary results are already available. The dust addition induced an increase in mineral nutrient concentration, dissolved organic carbon and fluorescent DOM. Interestingly, at the end of the incubations a higher amount of DOC had been consumed in the dust-amended treatments but lower bacterial production rates were recorded. We hypothesize that the addition of dust reduced the bioavailability of DOM with presumed, and so far unexplored, consequences on the role of dust on marine C cycle. A new experiment will be conducted in April 2014 in an attempt to assess the proposed hypothesis.

- **DUNE**. a DUst experiment in a low Nutrient, low chlorophyll Ecosystem, C. Guieu (guieu@obs-vlfr.fr).

The main goal of project DUNE was to estimate the impact of atmospheric deposition on an oligotrophic ecosystem based on mesocosm experiments simulating strong atmospheric inputs of eolian mineral dust. Our mesocosm experiments aimed at being representative of real atmospheric deposition events onto the surface of oligotrophic marine waters and were an original attempt to consider the vertical dimension after atmospheric deposition at the sea surface. After a series of mesocosm experiments conducted in the Mediterranean Sea in 2008 and 2010, the project activity in 2013 was the valorisation of the pluridisciplinary results obtained and a special issue in BIOGEOSCIENCES is devoted to the outputs of the project. From laboratory results on the solubility of trace elements in dust to biogeochemical results from the mesocosm experiments and associated modelling, these papers describe how the strong simulated dust deposition events impacted the marine biogeochemistry.

- **MERMeX** (Marine Ecosystems Response in the Mediterranean Experiment)-WP4. (contact: Karine Desboeufs - karine.desboeufs@lisa.u-pec.fr, Marc Mallet - Marc.Mallet@aero.obs-mip.fr, Elvira Pulido-Villena elvira.pulido@univ-amu.fr).

The main MERMeX activities relevant to SOLAS are the assessment of gas fluxes (CO₂) and acidification and the impacts on ecosystems and biogeochemical cycles, the study of aerosol fluxes at the air-sea interface [coupled with the component ChArMeX of MISTRALS (Chemistry-Aerosol Mediterranean Experiment)] considers both the formation of marine aerosol and the atmospheric deposition of nutrients and the influence of solar radiations on biogeochemical cycles includes the potential effect of aerosol and tropospheric ozone attenuation on marine ecosystems. A full report of the MERMeX-SOLAS activities can be find in the SOLAS endorsed projects reports.

Among those project, we briefly describe some of them here:

- **CHIPIE**: Comportement des éléments d'intérêt biogéochimiques et du carbone Particulaire a l'interface atmosphère-océan dans un contexte d'évolution des conditions Environnementales (Cécile Guieu, guieu@obs-vlfr.fr). (co-funding UPMC, MERMeX). The objective of this project is to study the impact of climate and environment change (temperature, acidification) on the behaviour of chemical elements and particulate carbon at the atmosphere-ocean interface. We have developed a new experimental approach that consists in performing artificial dust seeding over large tanks (300L) inside a clean room where temperature, turbulence and pH can be controlled. In 2013, three experiments were conducted in the frame of a PhD thesis (J. Louis) in order to follow the evolution of the total concentrations and organic/inorganic speciation of nutrients (P, N, Fe) after the dust seeding. Experiments were performed with seawater representative of different trophic regimes under two different pCO₂ conditions.

OTHER PROJECTS RELATED TO SOLAS

- **OCEANFLUX –Theme Upwelling** (http://due.esrin.esa.int/stse/projects/stse_project.php?id=160 and <http://upwelling.eu/index.php?id=2>).

This project is funded by the European Space Agency (ESA) Support To Science Element Program and performed in collaboration with LEGOS, University of Heidelberg, Karlsruhe Institute of Technology in Germany and INRIA Bordeaux in France. In recent years the role of submesoscale activity is emerging as being more and more important to understand global ocean properties, for instance, for accurately estimating the sources and sinks of Greenhouse Gases (GHGs) at the air-sea interface. The scarcity of oceanographic cruises and the lack of available satellite products for GHG concentrations at high resolution prevent from obtaining a global assessment of their spatial variability at small scales. In this project we develop a novel method to reconstruct maps of CO₂ fluxes at super resolution (4km) using SST and ocean colour data at this resolution, and CarbonTracker CO₂ fluxes data at low resolution (110 km). The responsible process for propagating the information between scales is related to cascading properties and multiscale organization, typical of fully developed turbulence. The methodology, based on the Microcanonical Multifractal Formalism, makes use, from the knowledge of singularity exponents, of the optimal wavelet for the determination of the energy injection mechanism between scales. We perform a validation analysis of the results of our algorithm using pCO₂ ocean data from in-situ measurements in the upwelling region off Namibia.

- **ETIC: Study of atmospheric transport over Indian ocean**, PI J.L Baray (J.L.Baray@opgc.fr), LaMP, Clermont Ferrand, new project. This program is a collaboration between LaCy (La reunion, LSCE and LATMOS (Paris).

This program worked on the fate of atmospheric pollution over Indian Ocean. Time series measurements of ozone, CO and aerosols are done at La Réunion Island and during travels of "Marion Dufresne" ship. In addition, radiosondes were performed at Kerguelen Island. The most important result is the highlight of an inter hemispheric transport from South-East Asia.

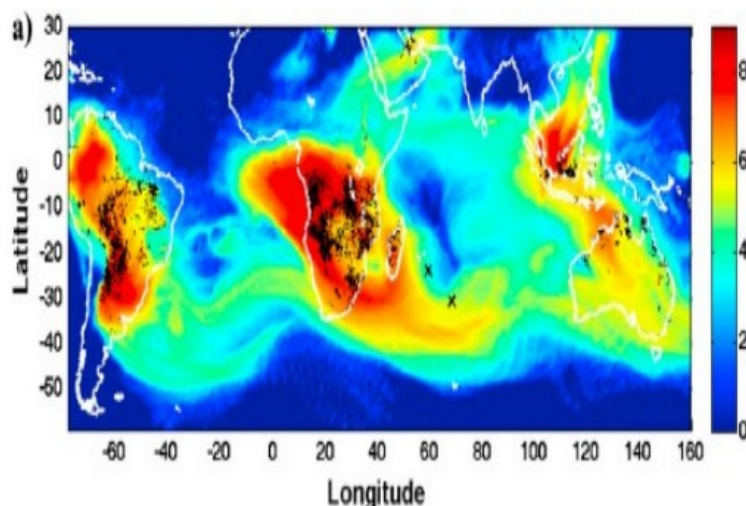


Figure 4. Particle distribution between 14 and 16 / 09 / 2009 computed by GIRAFE.

- **DORADE: Dissolved Organic matter composition and degradation in the ocean, HMWDOM measurements**, Christos Panagiotopoulos (christos.panagiotopoulos@univ-amu.fr), MIO, Aix-Marseille.

About 50 novel sugar compounds were identified as methylated sugars within the HMWDOM pool. Methylated sugars (APS-F3 fraction) accounted for 2-3% of the acyl polysaccharides (APS). Mono and dimethylated hexoses were the most abundant in the surface, while at 1800 m monomethylated 6-deoxy hexoses were the dominant sugars. The overall results suggest various sources of methylated sugars in the DOM. In addition we detected for the first time anhydrosugars within the APS pool. These compounds are known to be tracers of burning biomass of cellulose (e.g. forest fires) and are delivered in important amounts in the atmospheric aerosols. Although additional measurements are necessary, our results suggest that anhydrosugars may be delivered in seawater by atmospheric deposition. *Ref: Panagiotopoulos et al (2013).*

- **CLIOPP:** *CLImatic scenarios on Ocean Primary Production in low metal environments*, Denis de la Broise (denis.de-labroise@univ-brest.fr), LEMAR, Brest.

Started in 2013, this project aims to determine the evolution of oligotrophic ecosystems caused by increasing environmental carbon dioxide concentrations. This project is based on laboratory experiments in ultra clean environments. Four Coccolithophores species are introduced in an open flow bio reactor with a close control of pH using gaseous carbon dioxide injection. Another system uses microplates techniques in trace metal free synthetic seawater. Because of ultra-clean operating conditions, trace metal concentration (including Zn, Cd and Co) are well determined without any usage of EDTA. This program is at its development stage and results are expected next years.

- **SAMOA:** *Monitoring mercury atmospheric deposition on austral ocean*, Aurélien Dommergue (dommergue@lgge.obs.ujf-grenoble.fr), LGGE, Grenoble.

Continuous mercury measurements are performed since 2012 at Pointe Bénédicte station on Amsterdam Island (Figure 5). They are carried out using Tekran 2537B gas-phase mercury vapor analyzer and Tekran 1130-1135 speciation units for gas phase and total deposition is also sampled. Gaseous elementary mercury (GEM) is stable about 1 ng.m^{-3} while reactive gaseous mercury (RGM) and Particulate mercury (PHg) are very low and very variable with an average of $0.37 \pm 0.47 \text{ pg.m}^{-3}$ and $0.34 \pm 0.49 \text{ pg.m}^{-3}$ for RGM and PHg, respectively. Generally, GEM reactivity is found to be much lower than model previsions. These measurements are also supported by GMOS-Global Mercury Observation System (FP7), the French Polar Institute (IPEV, program GMOstral) and LABEX OSUG@2020.



Figure 5. Tekran front-end modules 1130 and 1135 installed on the roof Pointe Benedicte's laboratory at Amsterdam Island ($37,79604^{\circ}\text{S}$, 77.55095°E). (from Barret M., A. Dommergue, C.P.)

Ferrari and O. Magand, *The monitoring of atmospheric mercury species in the Southern Indian Ocean at Amsterdam Island (38°S)*, *E3S Web of Conferences 1*, 27001 (2013), DOI: 10.1051/e3sconf/20130127001

- **SPURS** program and results of STRASSE cruise (NO Thalassa). Gilles Reverdin (reve@locean-ipsl.upmc.fr), LOCEAN, Paris.

The SPURS program is aimed at better understanding surface salinity variability in the North Atlantic subpolar gyre and how its changes relate to the variations of evaporation and of ocean circulation. This will contribute to understand what has been causing the increase of upper ocean salinity of the subtropical gyres in the last 30 years. An array of in situ instrumentation (in particular, moorings, gliders, special Argo profilers, surface drifters) was operated to monitor upper ocean variability on a large range of spatial and temporal scales as well as analyses of data from Aquarius and Smos band-L radiometric satellite. Argo profilers and drifters still contribute to provide intensive sampling in this region and measure upper ocean currents, temperature and salinity, STRASSE took place in 2012 but data are exploited in 2013. We aimed to understand how horizontal and vertical variance of salinity in summer are enhanced by stratification and evaporation. We focussed on the investigation of wave and swells and their influence on the air-sea exchanges (LOS, LATMOS, LPO, LOCEAN), exchanges of water isotopologues across the sea surface. We also studied the primary production of the very stratified upper waters and the contribution of diazotrophy. Because of the strong warming (in particular, during the afternoon), the ocean was found to be a source of CO₂ for the atmosphere. Ref: Reverdin et al. (2013), Kolodziejczyk et al. (2013), Benetti et al. (in press).

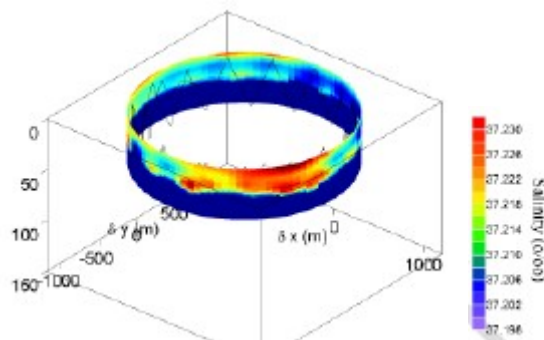


Figure 6. Salinity measured in North Atlantic during the cruise STRASSE (29.5°N, 32.7°W).

- **DATABASE**, Building a database to collect offshore biogeochemical data.

This project is lead by Catherine Schmechtig (schmechtig@obs-vlfr.fr), LOV, Villefranche sur mer. The database is 15 year old and is hosted by the laboratory LOV. This data base was firstly devoted to store results obtained during oceanographic campaign and is now extended to host buoy and profilers like BIO-ARGO. A new web interface was developed to grant an access to the base (<http://www.obs-vlfr.fr/proof/>).

- **EUCFe-ISO FERIX**, Iron isotopic ratios, François Lacan (francois.lacan@legos.obs-mip.fr) and Marie Labatut, LEGOS, Toulouse.

In the context of the EUCFe cruise (RV Kilo Moana, 2006, PI J. Murray) along the Equatorial Pacific, iron isotopes have been measured in aerosols and in seawater both in the dissolved (<0.4µm) and particulate phases (>0.4µm). Whereas aerosols had previously always been characterized by an isotopic composition in a narrow range around the crustal value ($\delta^{56/54}\text{Fe}_{\text{IRMM}}$ around +0.07‰), we found a slightly heavy iron isotopic signature for the aerosols sampled in the Western Equatorial Pacific, in the Papua New Guinea Area (Bismarck Sea), with $\delta^{56/54}\text{Fe}_{\text{IRMM}}$ around 0.3‰. Compared to the surface seawater data, found in the ranges [-0.03;+0.53‰] and

[+0.01;+0.30‰] for the dissolved and particulate phases respectively, these data help deciphering the different sources of iron (rivers, sediments, aerosols, hydrothermalism) to this oceanic area.

- **Heat and mass exchange à the water interface**, Guillemette Caulliez (guillemette.caulliez@univ-amu.fr).

The characterization and parameterization of the various turbulent processes affecting the upper water surface layer, of crucial importance for modelling heat and mass exchanges at the air-sea interface, remains a challenging task owing to the technical difficulties raised by investigation of water subsurface dynamics. Among these processes, wave breaking and microbreaking generating mean flow, vorticity, turbulence and bubbles in water as well as droplets in air play a key role in these exchanges. However, the basic features of naturally occurring wind wave breakers as observed at sea are far from being identified up to now. Therefore, to better describe these phenomena, in particular their surface signatures at small-scales, an investigation of breaking wind wave motions were made in the large Marseille-Luminy wind wave tank for a wide range of fetches and wind speeds. Using high-resolution visualizations of longitudinal surface wave profiles, the ranges of scales for which wave microbreaking and breaking occur were determined, and a number of kinematical and dynamical wave features associated with these breaking events were documented. This study reveals that microscale breaking takes place for wind waves longer than 10 cm and manifests itself in a very localized surface disruption on the forward face of the crest. This crest breakdown generates turbulent motions in water but no bubbles. More strikingly, in an unexpected way, plunging wave breaking with the formation of a crest bulge, a microjet hitting the water surface and a splash-up was found to occur for short gravity waves just exceeding 20 cm in wavelength. This small-scale event generates significant turbulent mixing in water and may cause air entrainment. *Ref: Caulliez et al. (2013)*

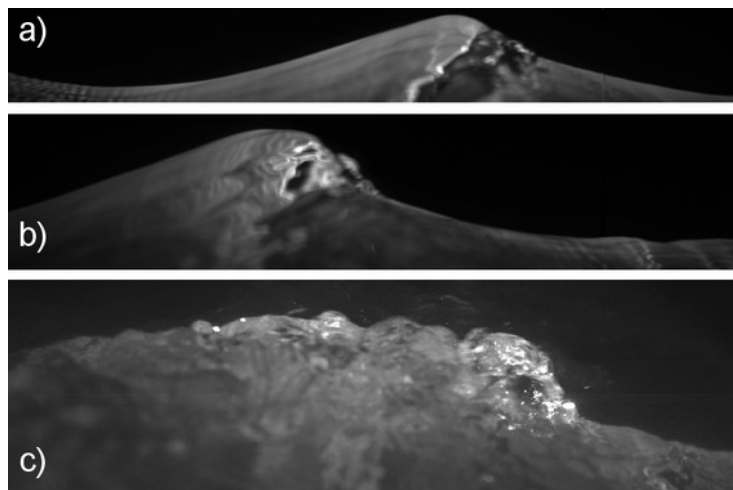


Figure 7. Various type of breaking observed in a large wind-wave tank: a): Microbreaking observed at 13 m fetch and 6 m/s wind speed; b): Small-scale breaking observed at 13m fetch and 8 m/s; c): Spilling breaking (successive small jets) observed at 26 m fetch and 12 m/s. The wavelength of visualized breaking waves is 18, 24 and 75 cm respectively with a camera field of view of ~20 cm in length.

- **DFP, Dust From Patagonia**, R. Losno (losno@ipgp.fr).

An extensive sampling of about 150 Patagonian soils is undergone. A chemical analyse is performed and aerosols are generated from these soils using a laboratory device. The finest fraction (<10 µm) of the soil is extracted by a vibrating system and an elemental analyse is performed. We have produced maps of chemical composition of soils and generated aerosols. A Lidar network for aerosol measurements was installed to cover most of the Patagonian area; this network is primarily supported by the air transport companies to prevent problems caused by volcanoes ash and data are used here to map dust layers in the atmosphere.

DEMO-ChArMEx: Dust Mass Deposition Monitoring in the Mediterranean Area (contact: B. Laurent, benoit.laurent@lisa.u-pec.fr, PRIMEQUAL-ADEME, ChArMEx-MISTRALS). In the framework of the DEMO project, a number of original results have been achieved. A sampler for collecting atmospheric insoluble deposition with a large autonomy (up to six months) was developed as part of this project, tested on site and adapted to meet particular constraints like intense rain events or intense snowfall. In order to form a network of insoluble atmospheric deposition measurements in the Western Mediterranean area, this collector was deployed on six stations (Lampedusa - Italy; Mallorca - Spain; Ersas, Frioul, Casset and Montandon - France), as well as two more stations of partner sites in Granada (Spain) and Medenine (Tunisia).

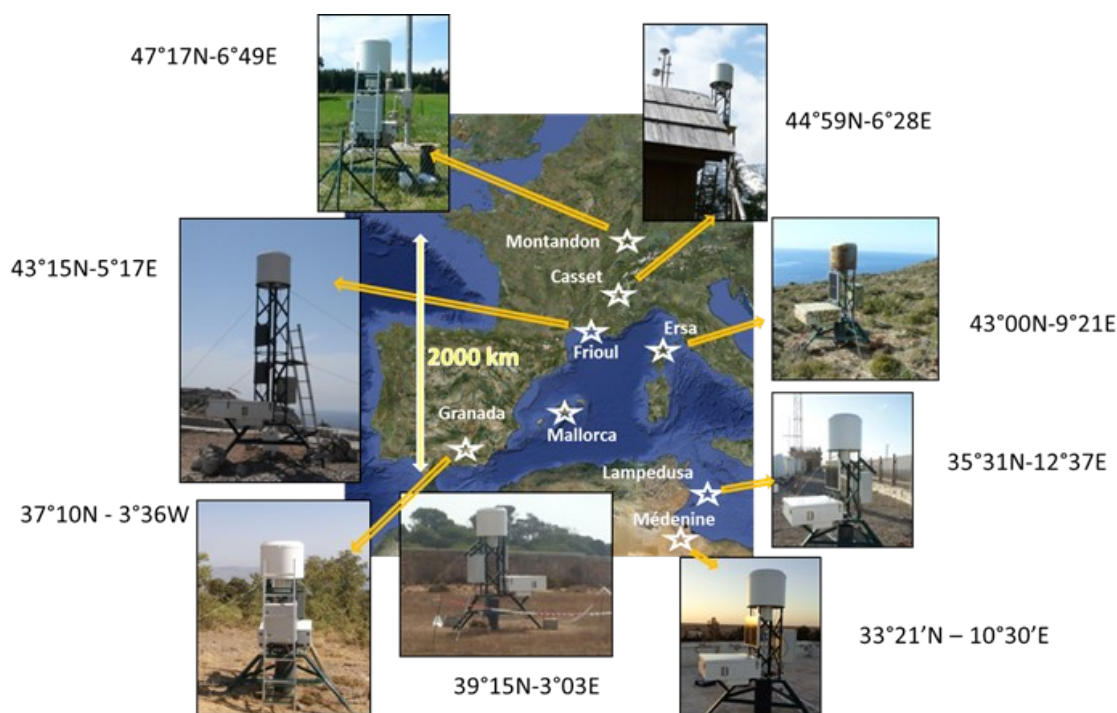


Figure 8. DEMO network of total insoluble deposition collectors (CARAGA) in the Western Mediterranean area (LISA, DEMO-ChArMEx project).

Sampling performed simultaneously and identically by CARAGA allowed acquiring a unique data set to study the spatial and temporal variability of the occurrence and intensity of Saharan deposits (in the period 2011-2013). The sporadic nature of the Saharan events was observed with 10 major events sampled at Lampedusa and 6 in Mallorca over a one-year period. The results show that the deposition intensity decreases with distance from the African coast with average annual values of $10 \text{ g m}^{-2} \text{ yr}^{-1}$ in Lampedusa (very close to sources) and $2\text{-}3 \text{ g m}^{-2} \text{ yr}^{-1}$ for stations located in the center of the western basin. These values are significantly lower than those obtained in the late 1980s from samples taken in Corsica. These dust deposition measurements, combined with the concentrations, optical thickness, particles size data obtained during the 2012 and 2013 ChArMEx summer SOP in the Western Mediterranean basin, form an original set of data to perform a complete validation of chemistry-transport models (CHIMERE, REG-CM, ALADIN).

4. Human dimensions (outreach, capacity building, public engagement etc)

6th International SOLAS Summer School 23RD August- 2nd September 2013, State Key Laboratory of Marine Environmental Science, Xiamen University, China (Co-chairs :V. Garçon and M. Dai)

5. Top 10 publications in 2013 (Reports, **ACCEPTED** articles, models, datasets, products, website etc)

- Barret M., A. Dommergue, C.P. Ferrari and O. Magand, The monitoring of atmospheric mercury species in the Southern Indian Ocean at Amsterdam Island (38°S), E3S Web of Conferences 1, 27001 (2013), DOI: 10.1051/e3sconf/20130127001.
- Benetti, M., G. Reverdin, C. Pierre, L. Merlivat, C. Risi, F. Wimeux, 2013. Deuterium excess in marine water vapor: dependency on relative humidity and surface wind speed during evaporation. *J. Geophys. Res.*, in press.
- Bressac M., C. Guieu. Post-depositional processes: What really happens to new atmospheric iron in the ocean surface? *Global Biogeochemical Cycles*, doi:10.1002/gbc.20076, 2013
- Bressac M., C. Guieu, D. Doxaran, F. Bourrin, N. Leblond K. Desboeufs and C. Ridame. 2013, Quantification of the lithogenic carbon pump following a simulated dust deposition event in large mesocosm, *Biogeosciences*, sous presse, 2014, (Special Issue DUNE)
- Caulliez G., 2013, Dissipation regimes for short wind waves, *J. Geophysical Res.*, vol. 118, 2, 672-684, doi:10.1029/2012JC008402.
- de Leeuw, G., C. Guieu, A. Arneth, N. Bellouin, L. Bopp, P. Boyd, H. Denier van der Gon, K. Desboeufs, F. Dulac, C. Facchini, B. Gantt, B. Langmann, N. Mahowald, E. Maranon, C. O'Dowd, N. Olgun, E. Pulido-Villena, M. Rinaldi, E. Stephanou, T. Wagener (2013). Ocean-Atmosphere interactions of particles. In: P. Liss and M. Johnson (Editors), in: "Ocean-Atmosphere Interactions of Gases and Particles" Springer Berlin Heidelberg, p. 171-246
- Garçon, V. C., Bell, T. G., Wallace, D., Arnold S. R., Baker A., Bakker, D. C. E., Bange, H. W., Bates, N. R., Bopp, L., Boutin, J., Boyd, P. W., Bracher, A., Burrows, J. P., Carpenter, L. J., Fennel, K., Font, J., Friedrich, T., Garbe, C. S., Gruber, N., Jaeglé, L., Lana, A., Lee, J. D., de Leeuw, G., Liss, P. S., Miller, L. A., Olgun, N., Olsen, A., Pfeil, B., Quack, B., Read, K. A., Reul, N., Rödenbeck, C., Rohekar, S. S., Saiz-Lopez, A., Saltzman, E. S., Schneising, O., Schuster, U., Séférian, R., Steinhoff, T., Yves Le Traon, P., Wittke, F. (2013) Perspectives and Integration in SOLAS science. In: Liss, P. S. and Johnson, M. T. (Editors), "*Ocean-Atmosphere Interactions of Gases and Particles*" Publisher: Springer, Heidelberg, pages 247-306.
- Giovagnetti V. , C. Brunet, F. Conversano, F. Tramontano, I. Obernosterer, C. Ridame, and C. Guieu , 2013, Assessing the role of dust deposition on phytoplankton ecophysiology and succession in a low-nutrient low-chlorophyll ecosystem: a mesocosm experiment in the Mediterranean, Sea , *Biogeosciences* 10, 2973–2991 (Special Issue DUNE)
- Goubanova, K., Illig, S., Machu, E., Garçon, V., and Dewitte, B., (2013), SST subseasonal variability in the central Benguela upwelling system as inferred from satellite observations (1999–2009), *Journal of Geophysical Research*, 118, 1–19, doi:10.1002/jgrc.20287.
- Guieu C., Dulac. F., Ridame C. and Pondaven P., 2013, Introduction to project DUNE, a DUst experiment in a low Nutrient, low chlorophyll Ecosystem, *Biogeosciences*, 11, 425-442, 2014, (Special Issue DUNE)
- Gutknecht, E., Dadou, I., Le Vu, B., Cambon, G., Sudre, J., Garçon, V., Machu, E., Rixen, T., Kock, A. Flohr, A., Paulmier, A., Lavik, G., 2013a. Coupled physical/biogeochemical modeling including O₂-dependent processes in the Eastern Boundary Upwelling Systems: application in the Benguela. *Biogeosciences*, 10, 3559–3591.
- Gutknecht E., Dadou, I., Marchesiello, P., Cambon, G., Le Vu, B., Sudre, J., Garçon, V., Machu, E., Rixen, T., Kock, A., Flohr, A., Paulmier, A., Lavik, G., 2013b. Nitrogen transfers off Walvis Bay: a 3-D coupled physical/biogeochemical modeling approach in the Namibian upwelling system. *Biogeosciences*, 10, 4117-4135, 2013

- Heimbürger, A. R. Losno and S. Triquet (2013), Solubility of iron and other trace elements over the Southern Indian Ocean, *Biogeosciences*, 10, 6617-6628, doi:10.5194/bg-10-6617-2013.
- Heimbürger, A., R. Losno, S. Triquet and E. Bon Nguyen (2013), Atmospheric deposition fluxes of 26 elements over the Southern Indian Ocean: time series on Kerguelen and Crozet Islands, *Global Biogeochemical Cycles*, 27-2, 440-449, DOI: 10.1002/gbc.20043.
- Hernández-Carrasco, I., Rossi, V., Hernández-García E., Garçon, V., López, C., 2013, The reduction of plankton biomass induced by mesoscale stirring: A modeling study in the Benguela upwelling, *Deep Sea Research, Part I*, <http://dx.doi.org/10.1016/j.dsr.2013.09.003>
- Kalvelage, T., Lavik, G., Lam, P., Contreras, S., Arteaga, L., Löscher, C., Oeschies, A., Paulmier, A., Stramma, L., and M.M.M. Kuypers, 2013, Organic matter export regulates nitrogen cycling in the South Pacific oxygen minimum zone, *Nature Geoscience* , DOI: 10.1038/BGEO1739, in press.
- Kolodziejczyk, N., O. Hernandez, J. Boutin et G. Reverdin, 2013. SMOS salinity in the subtropical North Atlantic salinity maximum : Part II : Observation of the surface thermohaline horizontal structure and of its seasonal variability. *J. Geophys. Res.*
- Law, C.S., Brévière, E., de Leeuw, G., Guieu, C., Garçon, V.C., Kieber, D.J., Konradowitz, S., Paulmier, A., Quinn, P.K., Saltzman, E., Stefels, J., and Roland von Glasow, 2013, Evolving Research Directions in Surface Ocean-Lower Atmosphere (SOLAS) Science, *Environmental Chemistry*, 10,1,1-16.
- Moore, C.M., Mills, M.M., Arrigo, K.R., Berman-Frank, I., Bopp, L., Boyd, P.W., Galbraith, E.D., Geider, R.J., Guieu, C., Jaccard, S.L., Jickells, T.D., La Roche, J., Lenton, T., Mahowald, N.M., Marañón, E., Marinov, I., Moore, J.K., Nakatsuka, T., Oeschies, A., Saito, M.A., Thingstad, T.F., Tsuda, A., Ulloa, O., 2013, Processes and patterns of oceanic nutrient limitation, *Nature Geoscience*, doi:10.1038/ngeo1765.
- Panagiotopoulos, C. Daniel J. Repeta, Laura Mathieu, Jean-François Rontani , Richard Sempéré, Molecular level characterization of methyl sugars in marine high molecular weight dissolved organic matter, *Marine Chemistry*, 34-45, 2013.
- Reverdin, G., S. Morisset, D. Bourras, N. Martin, A. Lourenço, J. Boutin, C. Caudoux, J. Font, J. Salvador. (2013) A SMOS surface drifter for air-sea interaction (SURPACT). *Oceanography*, 26, 48-57.
- Ridame, C., Guieu, C. and S. L'Helguen, 2013, Strong stimulation of N₂ fixation in oligotrophic Mediterranean Sea: results from dust addition in large in situ mesocosms, *Biogeosciences*, 10, 7333–7346, 2013, (Special Issue DUNE)
- Sudre, J., Maes, C., and Garçon, V., 2013, On the global estimates of geostrophic and Ekman surface currents, *Limnology and Oceanography: Fluids and Environments*, 3, 1-20.
- Wallhead, P., Garçon, V., and Martin, A., 2013, Efficient upscaling of ocean biogeochemistry, *Ocean Modelling*, 63, 40-55, doi:10.1016/j.ocemod.2012.12.002.
- Wuttig K., T. Wagener, M. Bressac, A. Dammshäuser, P. Streu, C. Guieu, and P. L. Croot, Impacts of dust deposition on dissolved trace metal concentrations (Mn, Al and Fe) during a mesocosm experiment *Biogeosciences* 10, 2583-2600 (Special Issue DUNE) 2013

6. Goals, priorities and plans for future activities/events

Plan for future activities

- **AMOP** for “Research Activities dedicated to the Oxygen Minimum in the East Pacific” (Aurélien Paulmier: aurelien.paulmier@gmail.com, C. Maes : christophe.maes@ird.fr, B. Dewitte and V. Garçon.): Ongoing cruise 25 January -23 February 2014 on board French

R/V L'Atalante off shore the OMZ of Peru. The main objective is to understand all mechanisms controlling the OMZ off shore Peru and to study the impacts of deoxygenation on biogeochemical cycles of nitrogen, oxygen, etc.. and marine ecosystems. The team cruise is multi-disciplinary combining physical oceanographers, marine biogeochemists, microbial ecologists, atmosphericists and is aiming to produce an O₂ budget as complete as possible. It is planned to try to establish on Hormigas de Afueras Islands an ocean site off shore Peru to monitor regional climate, sea level and seismic activity (PI: IGP Peru).

- **PEAcEtIME** "ProcEss studies at the Air-sEa Interface: a Mediterranean Experiment" (Cécile Guieu, Karine Desboeufs). In the frame of MERMEX and CHARMEX projects, this cruise is planned for summer 2016. The main objective of the PEACETIME cruise is to study the fundamental processes and their interactions at the ocean-atmosphere interface following an event of Saharan dust deposition. These key processes are defined in 4 objectives: (1) *Effect of dust deposition on chemical element (including nutrients) cycling and ecosystem functioning, and their modelling from 0D to 3D*; (2) *the impact on gas/aerosols emissions from the surface water*; (3) *Impact on optical properties both above and below the air-sea interface*; (4) *Future of the Med Sea*

Future events

A meeting SOLAS-France is going to be held in Paris 7-8 July. The future of SOLAS activities in France will be fully discussed here.

7. Other comments