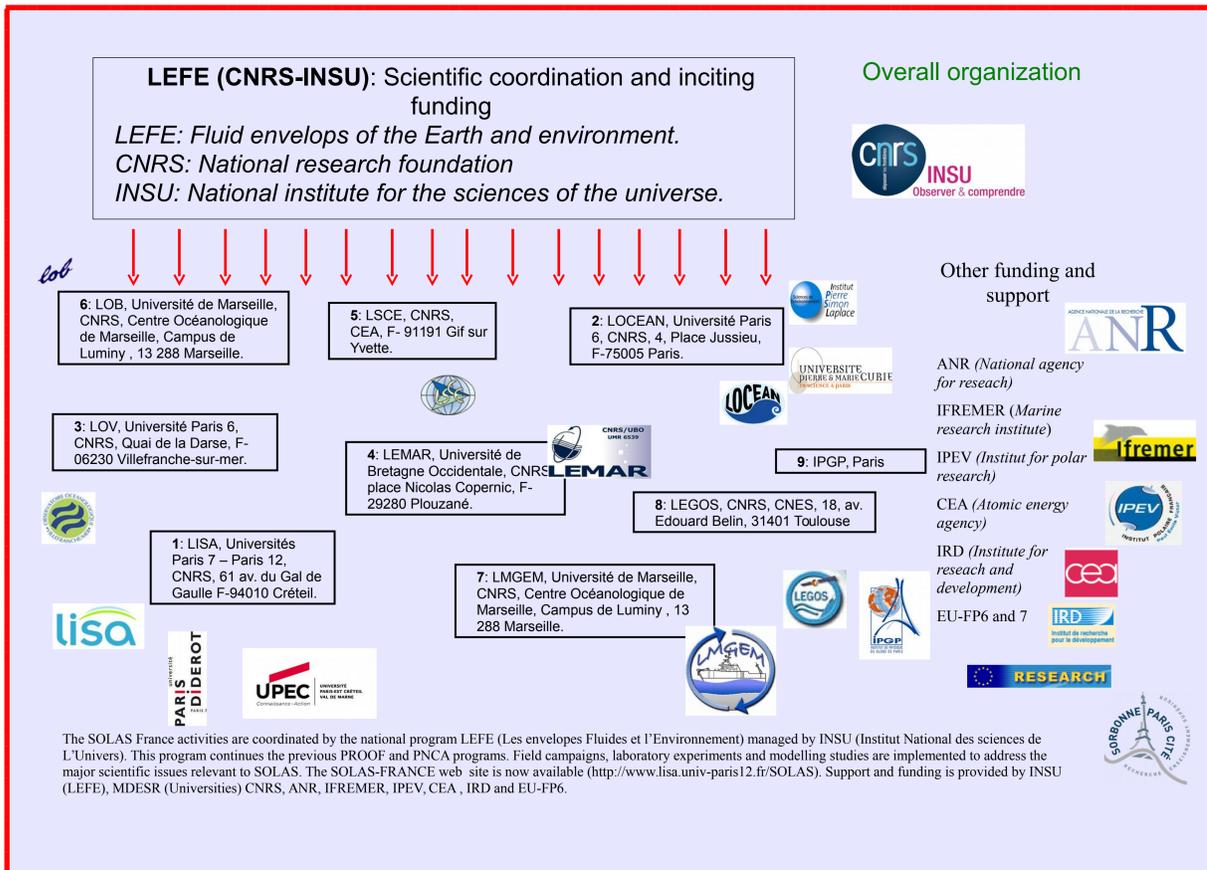


SOLAS France: an overview of today's research work and network

Kiel 7-11 September 2015



Cécile Guieu et al. The significance of the episodic nature of atmospheric deposition to Low Nutrient Low Chlorophyll regions

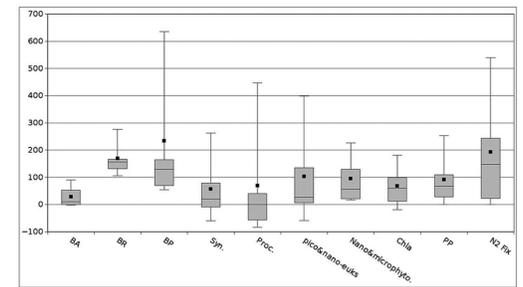


Figure 1. Whisker plots showing the responses of different biological variables to aerosol additions in LNLC waters: synthesized from available data from field and laboratory aerosol addition bioassay experiments and mesocosm experiments. The responses are % changes in the aerosol treatment relative to the control after 2-8 days, with zero indicating no difference between the aerosol treatment and the control, and a positive response indicating an increase in the parameter in the aerosol treatment relative to the control. Parameters: (BA) Bacteria Abundance, (BR) Bacteria Respiration, (BP) Bacteria Production, (Syn.) Synechococcus abundance, (Proc.) Prochlorococcus abundance, (pico & nano-euks) Nano- and Picoeukaryotes abundance, (nano & microphyto) nano- and micro-phytoplankton abundance, (Chl a) Chlorophyll-a, (PP) primary production, (N2Fix) nitrogen fixation.

Aurelien Paulmier (aurelienLEGOS@gmail.com), Boris Dewitte, Véronique Garçon, and Christophe Maes: AMOP for "Research Activities dedicated to the Oxygen Minimum in the East Pacific."

AMOP international project is focused on the study of the formation of OMZ formation, in the largest OMZ and in the most productive upwelling system, the Peru system. Conversely to other projects dedicated to different OMZ impacts study, AMOP is specifically oriented on the oxygen parameter, with the objective to carry out the most complete O₂ budget as possible taking into account physical (advection/diffusion) and biological (e.g. O₂ consumption/production through bacteria and zooplankton) contributions.

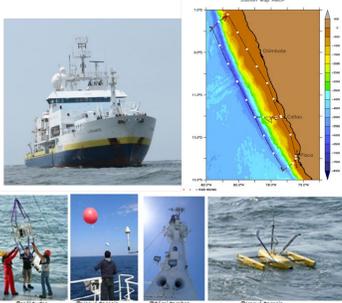


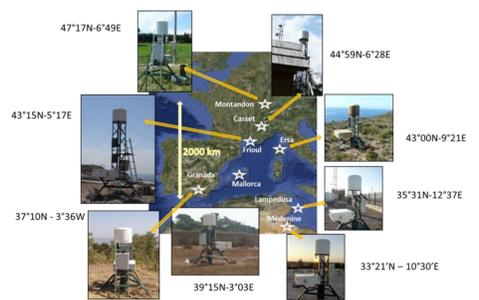
Figure 2: Atalante Research vessel (left) and cruise track in January-February 2014 (right) including the 8 fixed stations off Peru in red (up). In situ Oxygen Dynamics Auto-analyzer (IODA), radiosonde release, atmospheric mast, Ocarina tri-maran (down).

J.-P. Gattuso (gattuso@obs-lyfr.fr) and Frédéric Gazeau, eFOCE (BNP-Paribas, 2011-2014, 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);



Figure 8: Left: MedSea mesocosm experiment conducted in the Bay of Calvi in July 2012 (credit: OOV). Right: eFOCE chambers deployed in the Bay of Villefranche in summer 2014 (credit: OOV)

DEMO-ChArMEX: Dust Mass Deposition Monitoring in the Mediterranean Area (contact: B. Laurent, benoit.laurent@lisa.u-pec.fr, PRIMEQUAL-ADEME, ChArMEX-MISTRALS). DEMO network of total insoluble deposition collectors (CARAGA) in the Western Mediterranean area



Cécile Guieu, Céline Ridame, Eivira Pulido-Villena, Matthieu Bressac, Karine Desboeufs, and François Dulac, Impact of dust deposition on carbon budget: a tentative assessment from a mesocosm approach,

This work was done in the frame of the DUNE project, a SOLAS-endorsed project. A special Issue of the Biogeosciences journal comprises 13 papers and 2 other papers were published elsewhere.

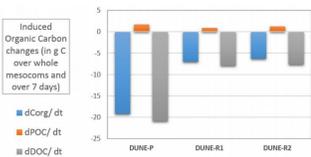
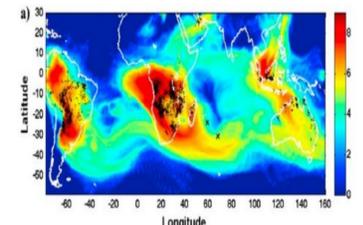


Figure 5. Estimated induced changes in the organic carbon pool inside the mesocosm where wet dust deposition was simulated (in g of C in the whole mesocosm during 7 days).

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 Réunion, 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.



Karine Desboeufs (karine.desboeufs@lisa.u-pec.fr), Marc Mallet (Marc.Mallet@aero.obsmp.fr), Elvira Pulido-Villena (elvira.pulido@univ-amu.fr) MERMEX (Marine Ecosystems Response in the Mediterranean Experiment)

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 found in the SOLAS endorsed projects reports. Among those, we briefly describe some of them here:

CALIBORON (Calibration of paleo-pH reconstruction technique based on boron isotopes in calcareous species (corals and bivalves) from the Mediterranean Sea: quantification of surface water acidification due to industrial era)

CARBORHONE (Carbon Cycle in the Rhône estuary and Gulf of Lions)

MEDSEA-14C-MESO 14C incorporation techniques applied to a large mesocosm experiment in the Bay of Villefranche during the bloom period

PARTICULE (Impact of anthropogenic particles on coastal zones in PACA area).

CHIPIE Evolution of the behavior of chemical elements with biogeochemical interest (N, P, Fe etc.) and carbon at the atmosphere-ocean interface under changing environmental conditions.

SUNMEX (Potential effect of aerosol and tropospheric ozone attenuation on marine ecosystems and seagrass rarefaction)

PHOTOMED Metabolic and structural changes of the bacterial community in response to the phototransformations of dissolved and particulate organic matter in the Mediterranean Sea

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

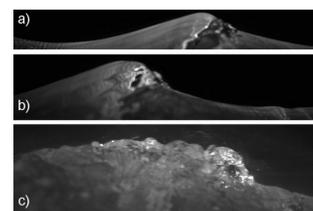


Figure 7. Various type of breaking observed in a large wind-wave tank: a) Microbreaking observed at 13 m fetch and 6 m/s wind speed; b) Small-scale breaking observed at 13m fetch and 8 m/s; c) Spilling breaking (successive small jets) observed at 26 m fetch and 12 m/s. The wavelength of visualized breaking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

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 seleniation units for gas phase and total deposition is also sampled. Gaseous elemental 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±0.47 pg.m⁻³ and 0.34±0.49 pg.m⁻³ for RGM and PHg, respectively. Generally, GEM reactivity is found to be much lower than model predictions. 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 Bénédicte's laboratory at Amsterdam Island (37.79604°S, 77.55095°E). (from Barret M., A. Dommergue, C.P.

Future actions

AtlantOS: Optimizing and enhancing the integrated Atlantic Ocean observing system. This H2020 project has been accepted. One objective is to equip the PIRATA mooring at 6°S, 8°E with a CARIOCA sensor for surface CO₂ monitoring. This mooring is located close to the Congo outflow.

PEACETIME (ProcEss studies at the Air-sea Interface after dust deposition in MEDiterranean sea). (C. Guieu and K. Desboeufs) PEACETIME proposes to study the fundamental processes and their interactions at this key interface in the Mediterranean Sea, and how these processes impact, and will impact, the functioning of the pelagic ecosystem and the feedback to the atmosphere, today and in the future. This 4-year project, centered both on a cruise in the central MS (planned in May 2016 when the high dust deposition occurs) and on strong modeling developments (from 0-D to 3-D), involves 14 research institutes in France and 9 abroad for a total of 80 scientists. Such pluridisciplinary project focusing on the chemical, physical (with a strong focus on optics) and biological characterization of the Atmosphere-Ocean interface is the first of its kind for the French 'Ocean-Atmosphere' research community. The Mediterranean Sea is an area designed as a hot spot for biodiversity but also a hot spot for climate change and anthropogenic pressure: PEACETIME constitutes an integrated approach at different time and space scales to the study of this environment at the air-sea interface: this will also be the first project of this kind to be conducted in the Mediterranean Sea. PEACETIME has received support from the two international projects SOLAS and IMBER and was also endorsed by GEOTRACES as a process-study. A pre-proposal was submitted to ANR Blanc in October 2014. This coordinated multidisciplinary effort comprises 14 research institutes in France and 9 abroad for a total of 80 scientists. The PEACETIME proposal has been evaluated by the French fleet commission and the PEACETIME cruise has been ranked in priority number 1 for a scheduling in 2016 or 2017

LandSO (Land Supply of Limiting Nutrients in the Southern Ocean), R. Losno, F. Monna, L. Meynadier, J. Gaillardet, E. Viollier, D. Cardinal, C. Provost, D. Ruiz-Pino, Y. Balkanski, E. Quel and P. Ristori. We propose to quantify the impact of trace metals and silicon release by continents on the Southern Ocean and to determine how it is recorded in sediment. This ocean is of paramount importance in the global carbon cycle because it is the largest potential sink of anthropogenic CO₂ and its active biological pump exports large amounts of carbon to the deep ocean and sediments. Large uncertainties still remain on the evolution of this carbon sink and especially: i) on its forcing by atmospheric deposition of dust transported from the arid continental areas contribution to ocean micronutrient inputs and ii) on the transportation process downward the water column. In the present anthropogenic conditions related to greenhouse gas increase and global warming, feedback from the Southern Ocean biological pump produced by land nutrient supply are highly probable and must be investigated. One of the major goals of this project is to determine how the atmospheric deposition signal can be transferred into the surface sediment of the ocean. This project is today at a proposal state and not yet funded, it will be proposed to SOLAS endorsement.