

SOLAS France: an overview of today's reseach work, Xiamen 4-7 march 2007



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LEFE (CNRS-INSU): Scientific coordination and inciting funding

LEFE: Fluid envelops of the Earth and environment.
CNRS: National research foundation
INSU: National institute for the sciences of the universe.

Overall organization

Other funding and support

ANR (National agency for reseach)
IFREMER (Marine research institute)
IPEV (Institut for polar research)
CEA (Atomic energy agency)
IRD (Institute for reseach and development)
EU-FP6

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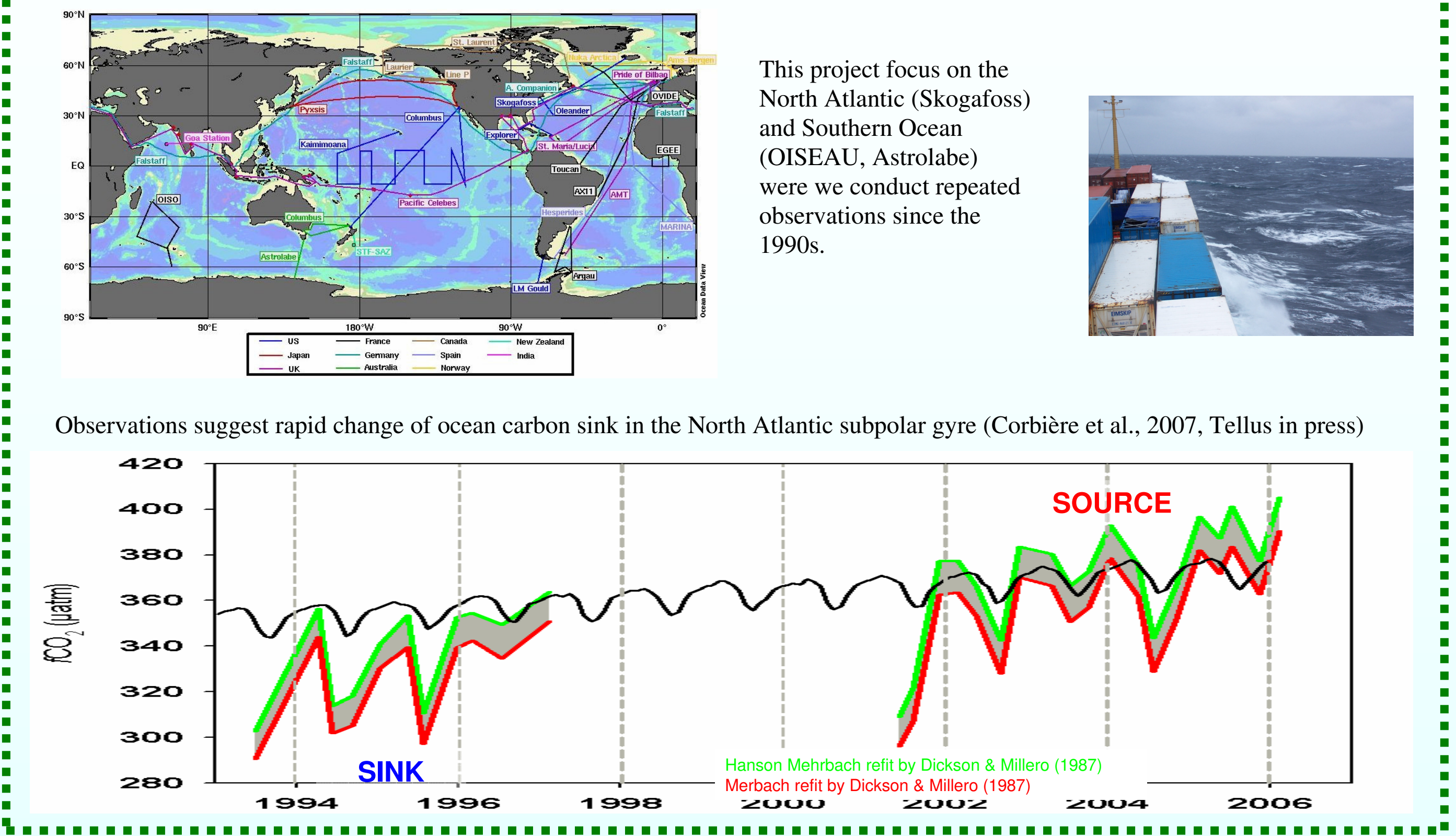
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The SOLAS France activities are coordinated by the national program LEFE (Les envelops Fluides et l'Environnement) managed by INSU (Institut National des sciences de L'Univers). This program continues the previous PROOF and PNCA programs. Field campaigns, laboratory experiments and modelling studies are implemented to address the major scientific issues relevant to SOLAS. The SOLAS-FRANCE web site is now available (<http://www.lisa.univ-paris12.fr/SOLAS>). Support and funding is provided by INSU (LEFE), MDESIR (Universities) CNRS, ANR, IFREMER, IPEV, CEA , IRD and EU-FP6.

FLAMENCO2: Analyses of the decadal variability of air-sea CO2 fluxes.



ISLAND: Iron / Sulfur : how iron Limitation Affects the productionN of DMS (LEFE 2006-2009).

IPCC, 2001: « Sulfate aerosol: low level of scientific understanding »

65% of biogenic sulfate aerosols come from oceanic DMS

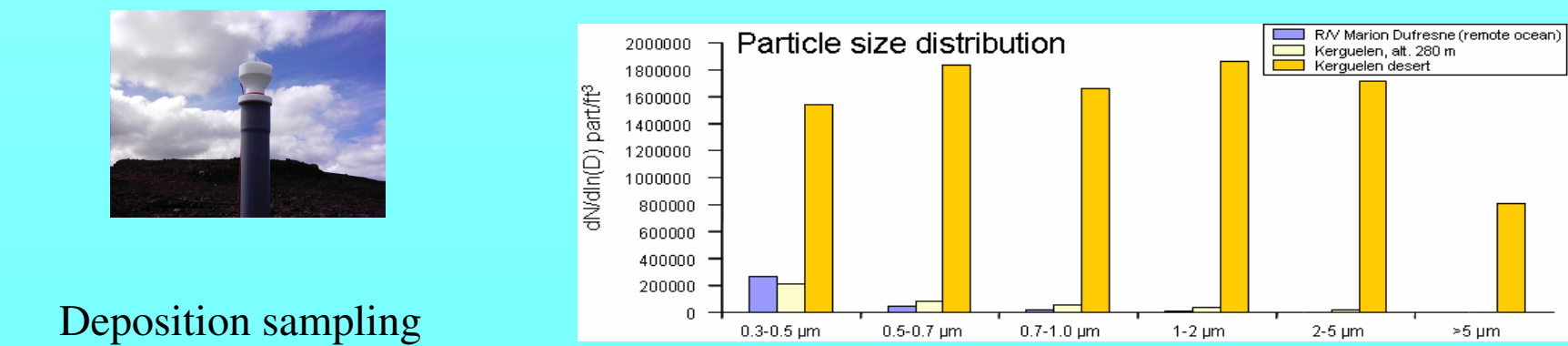
In 1987, the CLAW hypothesis (after its authors, Charlson, Lovelock, Andreae and Warren) postulated that planktonic marine emissions of the volatile organic sulfur compound dimethylsulfide (DMS) are involved in the biological regulation of climate (Charlson et al. 1987). The oxidation products of marine atmospheric DMS, mainly sulfuric acid, form aerosols that act as cloud condensation nuclei (CNN), thereby influencing the planetary albedo and climate (Charlson et al. 1987; Bates et al. 1987). Significant questions remain regarding the physiological roles of DMSP and DMS in marine algae and the environmental factors that regulate their production. In particular, iron limitation affects oceanic ecosystems in at least 40% of the world ocean: low concentrations of this metal partly control phytoplanktonic production, the structure of the planktonic community and thus DMSP and DMS production (Turner et al. 1996, DiTullio et al. 2001). In this context, the objectives of the ISLAND project are to study the interactions between iron limitation, phytoplankton growth, and the production of DMS, DMSP, DMSO. This will be achieved through laboratory experiments (coll. ANR BOA) and modelling experiment.

Major cruises (2004-2005)

BIOCOPE (Biogeochemistry and Optics South Pacific Experiment) took place in the South Pacific gyre in November 2004. The main objective of the BIOCOPE project is to study, during austral summer (likely in 2004), the biological, biogeochemical and optical characteristics of different trophic regimes in the South East Pacific, and especially the oligotrophic area associated to the central part of the South Pacific Gyre (SPG). This area has been one of the less studied major oceanic entities of the world ocean and presents the interesting particularity of being far away from any desert dust (iron) source. The second objective of the project, which is an important prerequisite for the success of this South Pacific cruise, is to develop or adapt methods in order to be able to quantify stocks or fluxes at levels close to detection limits, which are expected to be encountered in the highly oligotrophic conditions associated to the SPG. These developments will be undertaken during the first two years of the project (2002 and 2003). The third objective of the project deals with a synthesis on the (biological, biogeochemical and optical) characteristics of various oligotrophic regime that have been studied (and will be studied here in the Pacific) as part of various JGOFS projects which were carried out during the last decade, in particular by the French community See: <http://www.obs-vlfr.fr/proof/vt/op/ec/biosope/keo.htm> 61 papers are going to be published including 35 for a special issue of Biogeosciences.

KEOPS (Kerguelen Ocean and Plateau compared Study) is a multidisciplinary and international project which, aims to improve our understanding of the response of the Southern Ocean to climate change. Particularly, KEOPS is studying the impact of the natural iron fertilisation on the biological pump of CO2 and on the cycles of other chemical compounds relevant for climate. The campaign took place in January/February 2005 above the Kerguelen Plateau. The results show that substantial differences in key biogeochemical cycles exist above and outside the plateau. This was the case for carbon cycling and particularly carbon export, the relative nitrate and silicic acid utilization and the production of DMS. For all these issues the results of KEOPS differ from previous findings of artificial iron fertilization experiments in the Southern Ocean and shed new light on the impact of long term iron fertilisation of the Southern Ocean (<http://www.obs-vlfr.fr/proof/vt/op/ec/keops/keo.htm>). 41 papers are about to be published including 25 in a special issue of DSR.

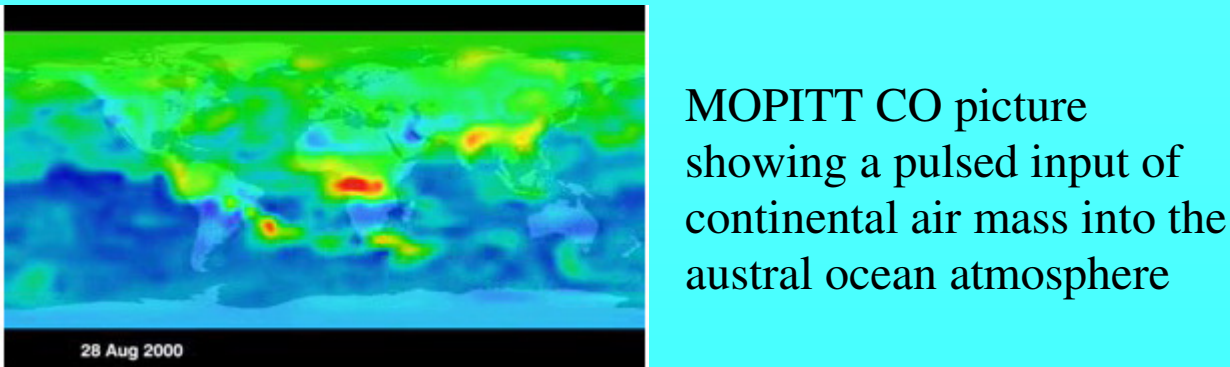
An atmospheric campaign (**KEPHREN**, Kerguelen, study of deposition and erosion of metals and nutrients, F. Dulac and R. Losno, 2005) was associated to KEOPS to measure deposition and emission flux of iron and other trace metals to and from the Kerguelen Island at the same time.



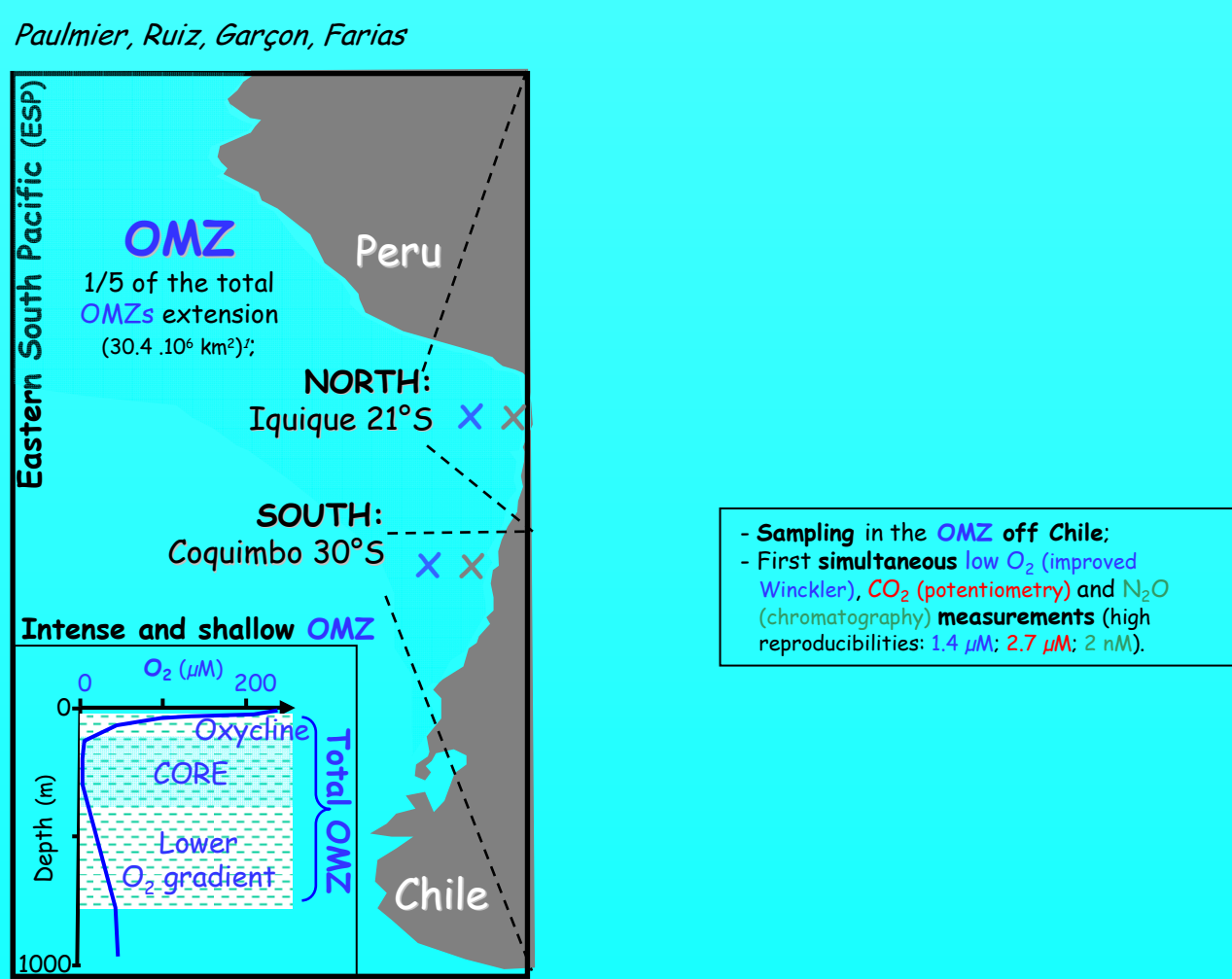
Submitted and incubating projects

FLATOCOA (Flux over South Ocean) Is a project to measure atmospheric deposition on Kerguelen Island during two years in order to evaluate atmospheric flux from continent to ocean over South Oceans. MOPITT pictures of CO (mopitt.mov on <http://earth.rice.edu>) suggest pulsed inputs from South America and South Africa to the South Ocean Atmosphere.

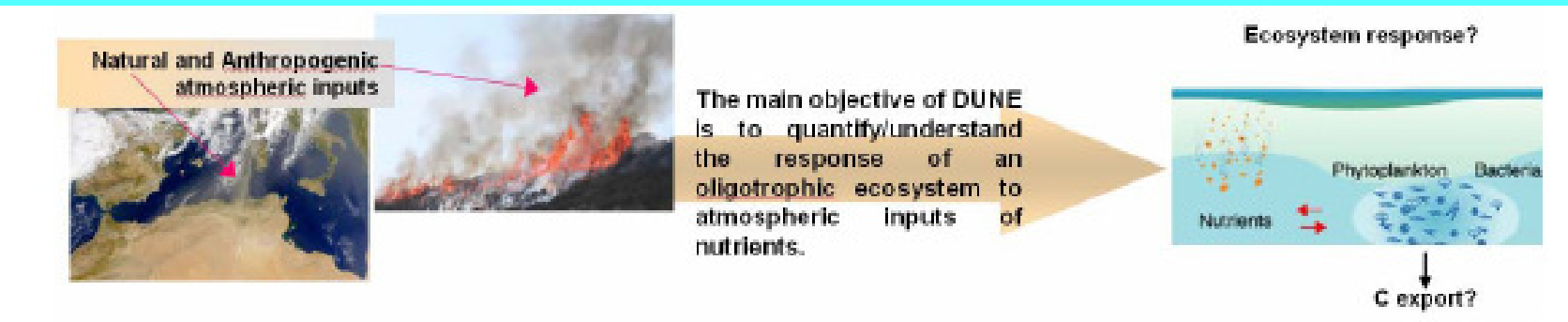
AERO-PATAGONIA is a project coupled to FLATOCOA to sample atmospheric aerosol blowing from Patagonia to Austral Ocean.



Oxygen Minimum Zone (OMZ). The OMZ off Chile induces CO2 and N2O sources, up to 10 times stronger than all previously reported for OMZs. Assuming than the total ESP OMZ area has a similar behavior than the OMZ off Chile, the potential greenhouse gases (GHG: CO2 + N2O) effect will produce 1.3 GtCeq, equivalent to 20% of the total anthropogenic release; Thus, OMZs should be one of the key feedback mechanism to take into account for the understanding of the GHG variations in the atmosphere; The known expansion of OMZs from glacial to interglacial and predicted for the next decades in response to the climate change could drive to produce a positive feedback increasing both CO2 and N2O in the atmosphere.



DUNE (a DUst experiment in a low Nutrient, low chlorophyll Ecosystem) is an emerging project that aim at studying the vulnerability and the fate of oligotrophic ecosystems to climatic change and the consequent increase in natural and anthropogenic atmospheric input of nutrients, using mesocosm experiments. Answers to the atmospheric particles migration and dissolution in the surface mixed layer, are expected on i) the marine ecosystem reactions to those inputs, ii) the evolution of the biological response with increasing atmospheric forcing, iii) the role of natural/anthropogenic mixed/combined events and, iv) the intensity of the biological pump induced by atmospheric deposition to oligotrophic waters. Carbon export will be compared to carbon budget in such oligotrophic area.



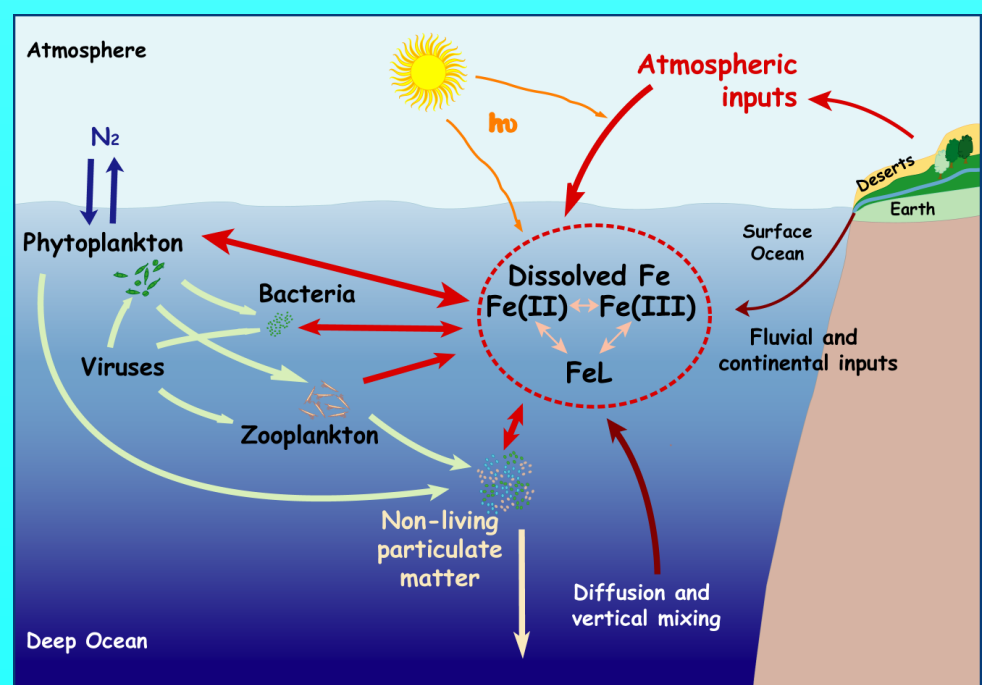
Large parts for laboratory experiments

The **UVECO** project (<http://www.com.univ-mrs.fr/LMGEM/uveco/Uvecoanglais/index.htm>) evaluates the effect of UVR on bacterial and phytoplankton communities and on photochemical transformations of dissolved organic matter with a special emphasis on the Mediterranean Sea. Experimental work has been undertaken after coastal seawater collection in the Banyuls/mer Institute and at the Center of Oceanology of Marseille France. In these two institutes, atmospheric UV-R are now continuously monitored whereas UV-R penetration in the coastal Sea are regularly measured and freely available. This research also help for a better understanding of the impact of UV light in marine biogeochemical cycles, such as for example, the acclimation of phycobilisomes of *cynobacterium Synechococcus* to high light (Six et al., *Journal of Bacteriology*, **187**, 1685-1694, 2005), or the capability of heterotrophic bacteria to degrade dissolved organic compounds. Furthermore, UVECO allowed to identify new dissolved organic compounds i.e. dicarboxylic acids which are abundantly produced by UV effects on fatty acids (Tedetti et al., *Analytical Chemistry*, **78**, 6012-6018, 2006).



UV incubator

BOA (Biogeochemistry of iron at the Ocean-Atmosphere interface; Interactions between atmospheric iron inputs and food web, ANR 2005-2008) Involves both laboratory experiments and modeling on the iron chemistry at the ocean/atmosphere interface, with a special emphasis on the bioavailability of this metal. It includes a complete characterization of this element in the atmospheric phase and impact studies on the carbon cycle through biological activity (http://www.univ-brest.fr/IUEM/UMR6539/prog_scientif/boa/boa.htm).



General objective: to better understand and quantify how the coupling between the Ocean and the Atmosphere will influence the chemical, physical, and biological processes that govern the biogeochemical cycle of iron and their interactions with food web.

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