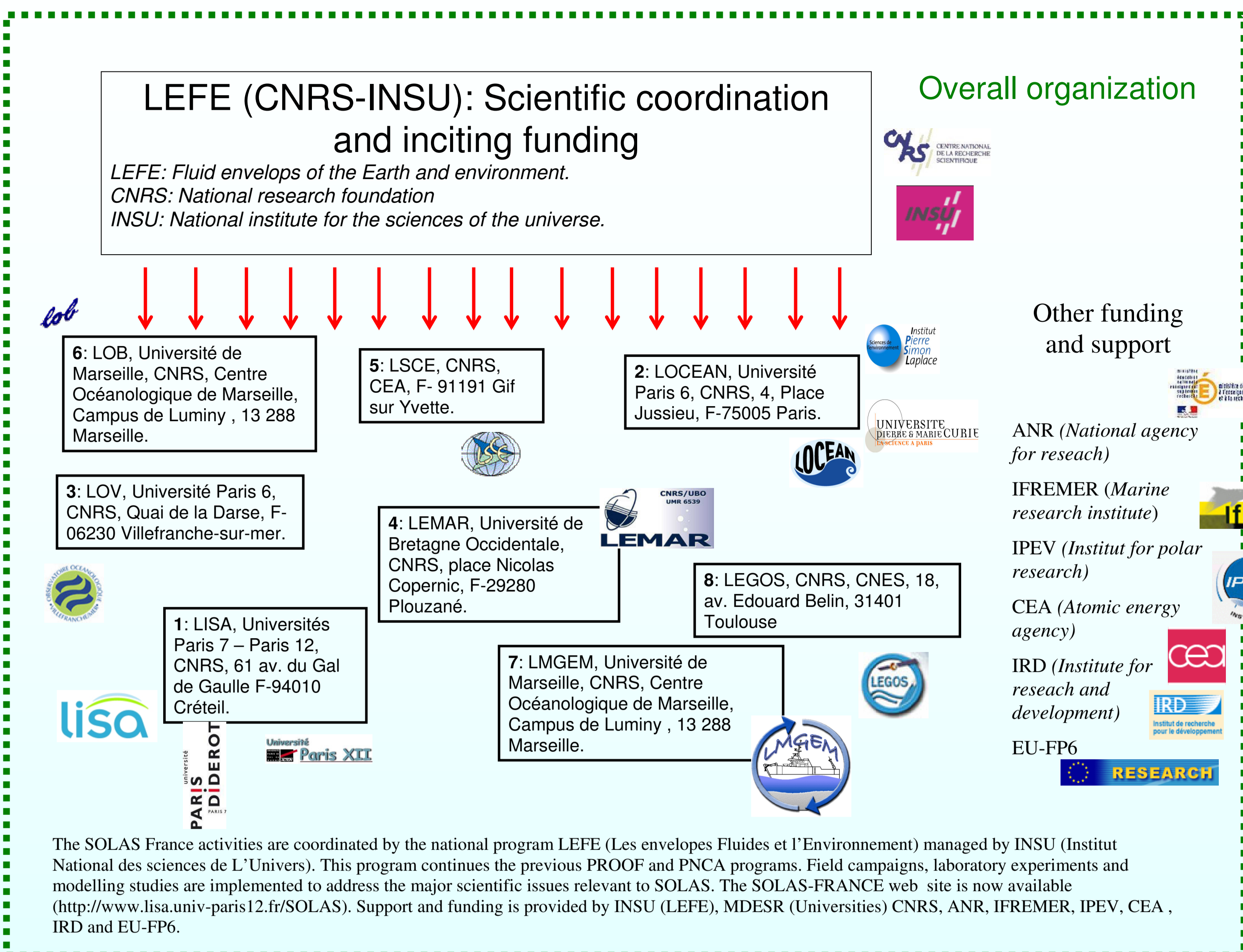


# SOLAS France: some aspects of today's research work,

Barcelona 15-19 November 2009

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surface ocean **solas 2019<sup>2</sup>** lower atmosphere study



Tagged event: SOLAS-IMBER join workshop in Paris, 22-24 June 2009



The objectives were to present the actual national implication in SOLAS and IMBER programs and projects, to point out collaborations between both actions

6 topics were evaluated

- Sesssion 1 : Nutriments and marine ecosystems (Chair : K. Desboeufs)
- Sesssion 2 : Atmospheric aerosol (Chair : C. Guieu)
- Sesssion 3 : Acidification and anthropogenic carbon (Chair : R. Losno)
- Sesssion 4 : Marine ecosystems and biogeochemical cycles (Chair : J.-P. Gattuso et H. Claustre)
- Sesssion 5 : Integrative actions (Chair : V. Garçon)
- Sesssion 6 : Trace gases and CO<sub>2</sub> (Chair : S. Belviso)

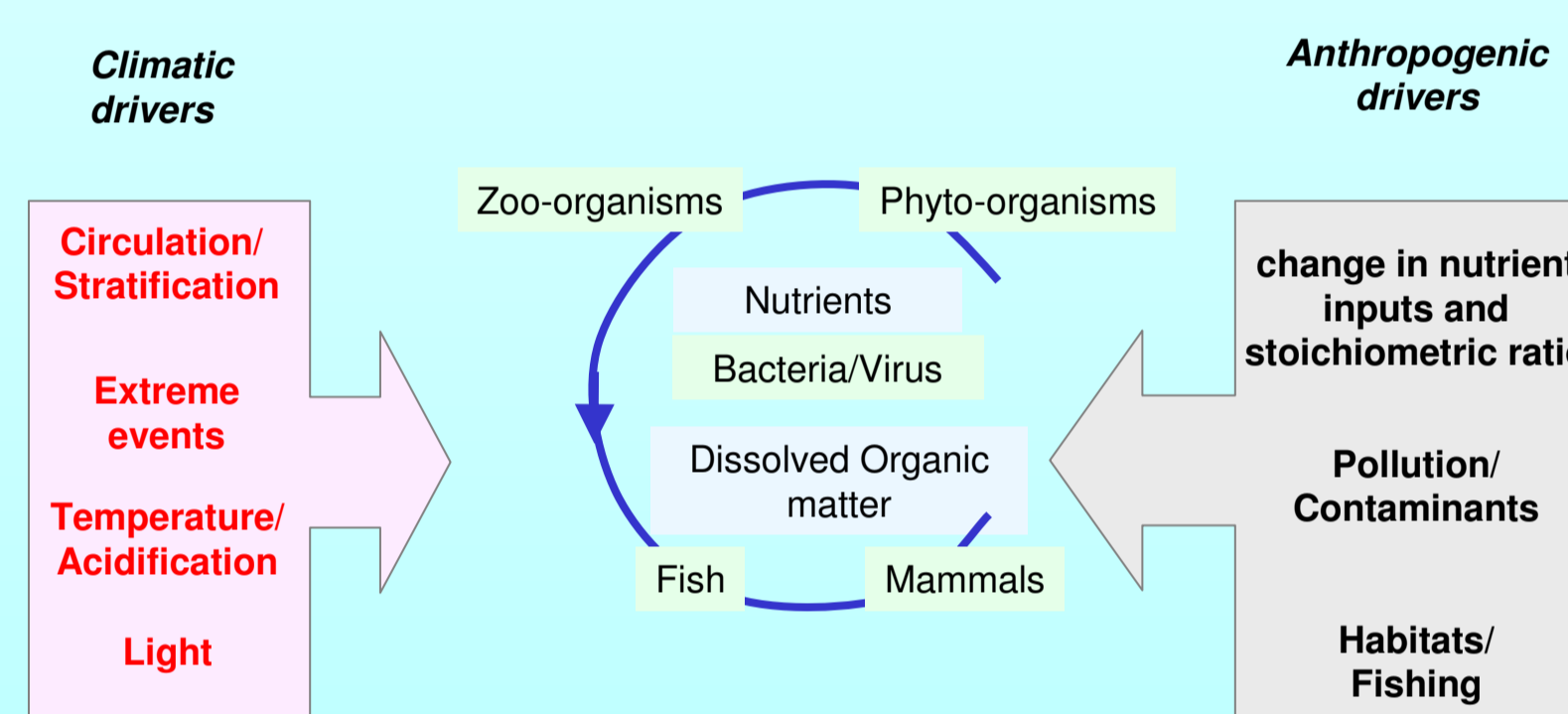
[http://www.imber.info/IMBER\\_SOLAS\\_Home.html](http://www.imber.info/IMBER_SOLAS_Home.html)

## The Mediterranean Sea: MerMex, CharMex, DUNE

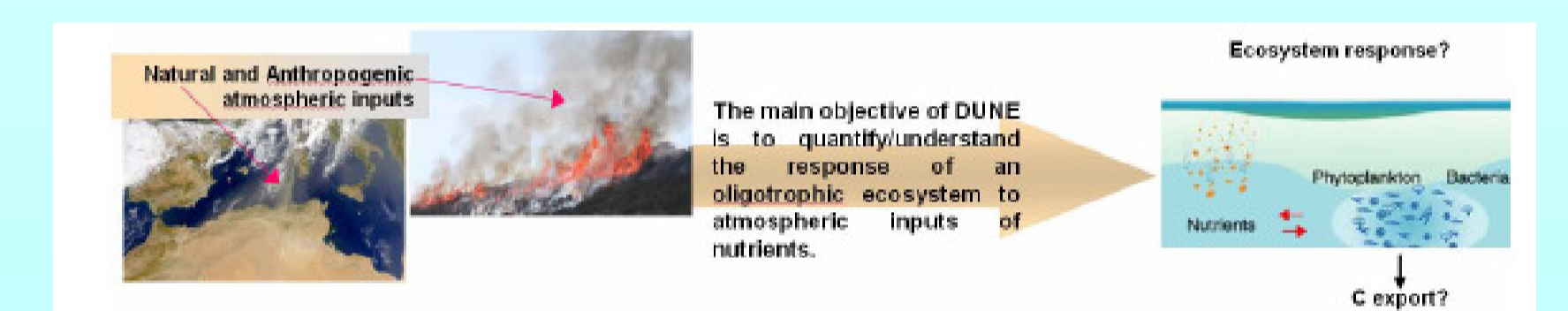
### MerMex

The French community working in marine biogeochemistry and biological ecosystems is currently structured to initiate the MERMEX project (Marine Ecosystems Response in the Mediterranean Experiment). This programme led by the 'Institut National des Sciences de l'Univers (INSU)' will be associated to other programmes related to the study of the hydrological cycle (HyMEX) and atmospheric chemistry (ChArMEX) in the Mediterranean basin. MERMEX aims to deepen the current understanding of the Mediterranean marine ecosystems to better anticipate their upcoming evolution. It will focus on the response of ecosystems to modifications of physico-chemical forcing at various scales, both in time and space, linked to changing environmental conditions and increasing human pressure. We propose a comprehensive, integrated approach considering the continuum between the coastal zone and the open sea and its interfaces, including ocean-continent, ocean-atmosphere and water-sediment to precisely describe and model the current state of the Mediterranean ecosystems and the complex interactions existing between the environmental and human factors. Only a coordinated and ambitious strategy, addressing simultaneously the physics and biogeochemistry of these systems will permit to explore and analyse the present sensibility of marine ecosystems, and to validate the tools used to forecast their change.

A discussion session on Ocean-atmosphere interactions in the Mediterranean Sea will take place at this conference. This session will address key questions dealing with ocean-atmosphere interaction in the whole Mediterranean Sea with the aim of identifying new research directions, and appropriate observation. The MerMex objectives relevant to SOLAS will be discussed within this frame.



**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 areas.



The **Chemistry-Aerosol Mediterranean Experiment** is a large multi-year project on atmospheric chemistry and aerosols in the Mediterranean initiated by France and calling for joint national initiatives.

(see ChArMEX poster by F. Dulac et al.)

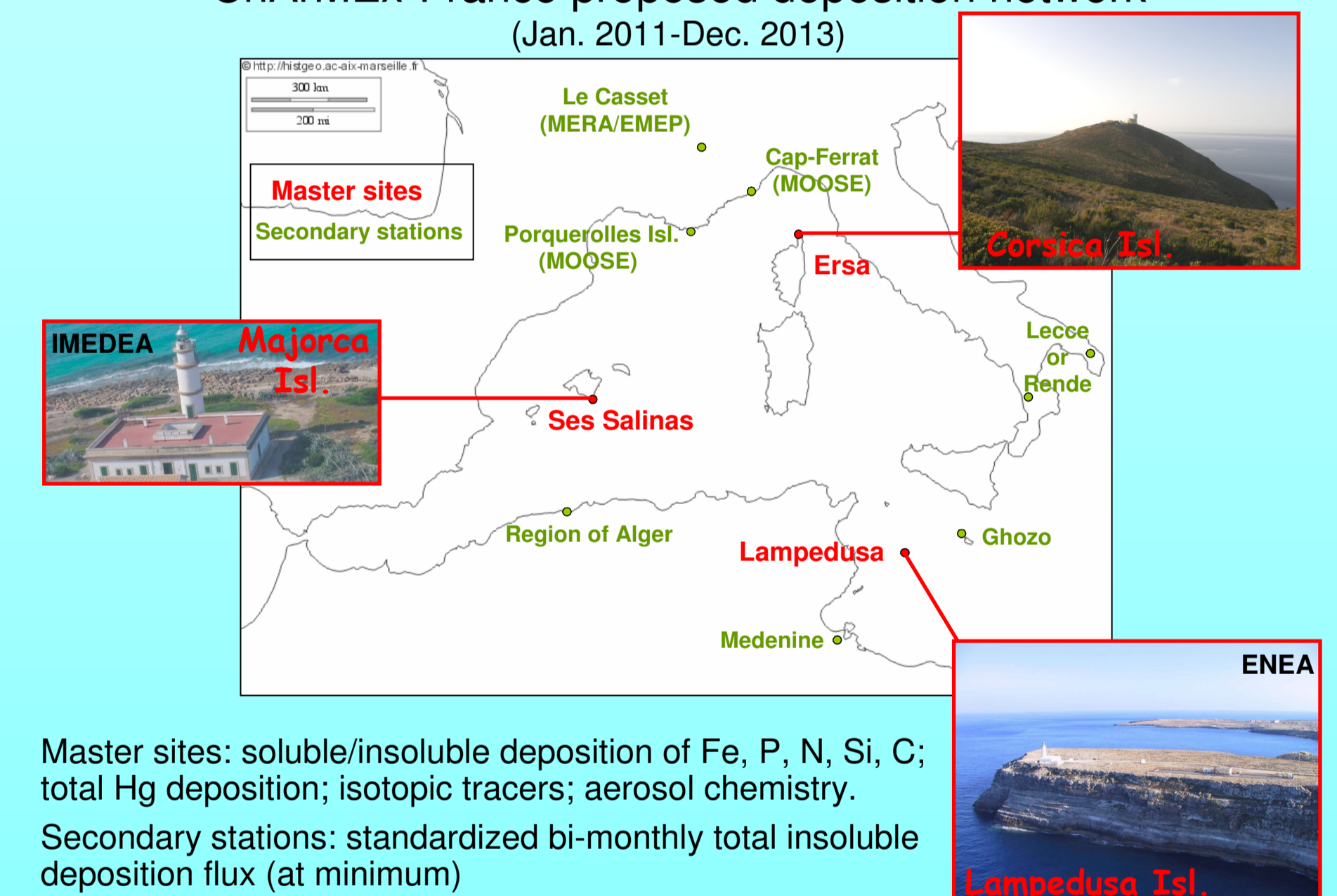
**Objectives:** assessment of (i) the recent past, present and future states of the atmospheric chemistry, and (ii) related impacts on air quality, regional climate and marine biogeochemistry.

**Strategy:** integrated modelling and observational approach to study emissions and sources of short-lived species, chemical and dynamical processes, variability and trends, deposition to seawater, impacts, and future evolutions. The experimental strategy is based on long-term monitoring on island-based remote observatories, 2-3 years of enhanced surface observations (2011-2013), and field campaigns (western basin: summer 2012 (pre-campaign in 2011) and spring 2013; eastern basin: summer 2014).

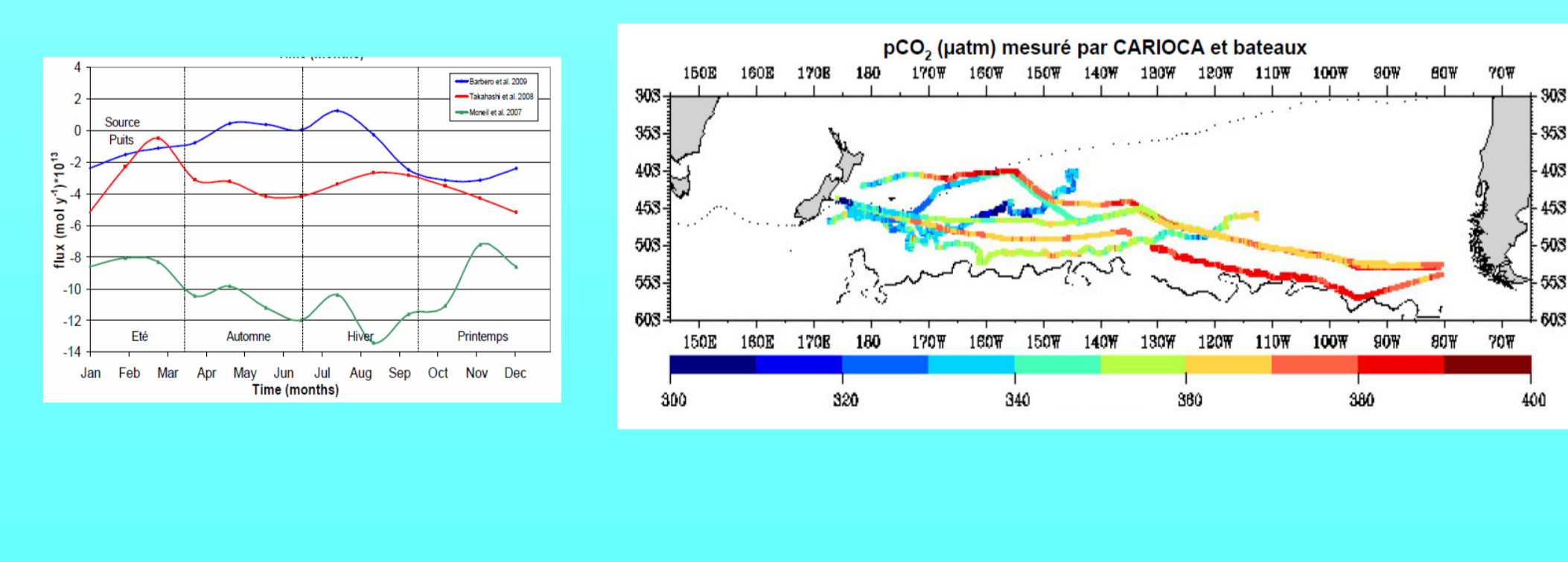
### Proposed SOLAS-related actions:

- Chemical and physical characterization of primary organic aerosol emissions by sea salt using a bubble bursting chamber (contact: [K.Sellgren@opgc.univ-bpclermont.fr](mailto:K.Sellgren@opgc.univ-bpclermont.fr))
- Shipping emissions? Workshop to be organized in 2010 (contact: [nicolas.marchand@univ-provence.fr](mailto:nicolas.marchand@univ-provence.fr))
- Formation of secondary gaseous organic matter (contact: [agnes.borbon@lisa.univ-paris12.fr](mailto:agnes.borbon@lisa.univ-paris12.fr))
- Background aerosol chemistry, secondary aerosols (contact: [jean.sciare@lisa.univ-paris12.fr](mailto:jean.sciare@lisa.univ-paris12.fr))
- Deposition of nutrients and micro-nutrients (contact: [karine.desboeufs@lisa.univ-paris12.fr](mailto:karine.desboeufs@lisa.univ-paris12.fr))
- Deposition of mercury (contact: [remi.losno@lisa.univ-paris12.fr](mailto:remi.losno@lisa.univ-paris12.fr))
- Radiative budget at the sea surface, impact of aerosol dimming on evaporation and ecosystems (contact: [marc.mallet@aero.obs-mip.fr](mailto:marc.mallet@aero.obs-mip.fr))

### ChArMEX-France proposed deposition network (Jan. 2011-Dec. 2013)



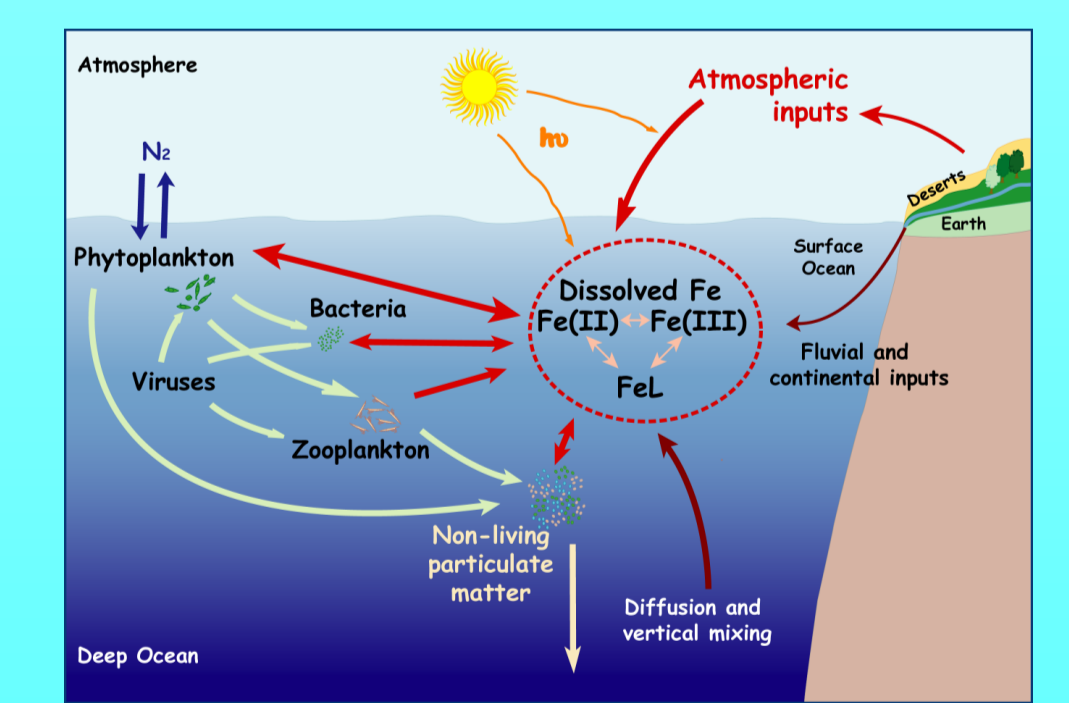
### CARIOCA experimental results (Leticia Barbero, Jacqueline Boutin, LilianeMerlivet)



**FLATOCO (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 (see poster).

## 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 modelization 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](http://www.univ-brest.fr/IUEM/UMR6539/prog_scientif/boa/boa.htm)).



During the last 20 years, iron (Fe) biogeochemistry has been shown to be of critical importance to the cycling of carbon and nitrogen. Far from being a series of simple chemical reactions, an improved ability to understand and constrain the chemical and biological reactions of the Fe cycle has become one of the major challenges in marine biogeochemistry. A better understanding and description of Fe biogeochemistry and the interactions with other components of the ecosystem allows for improved forecasting of the oceanic response due to climatic change and in particular feedbacks between the atmosphere and ocean.

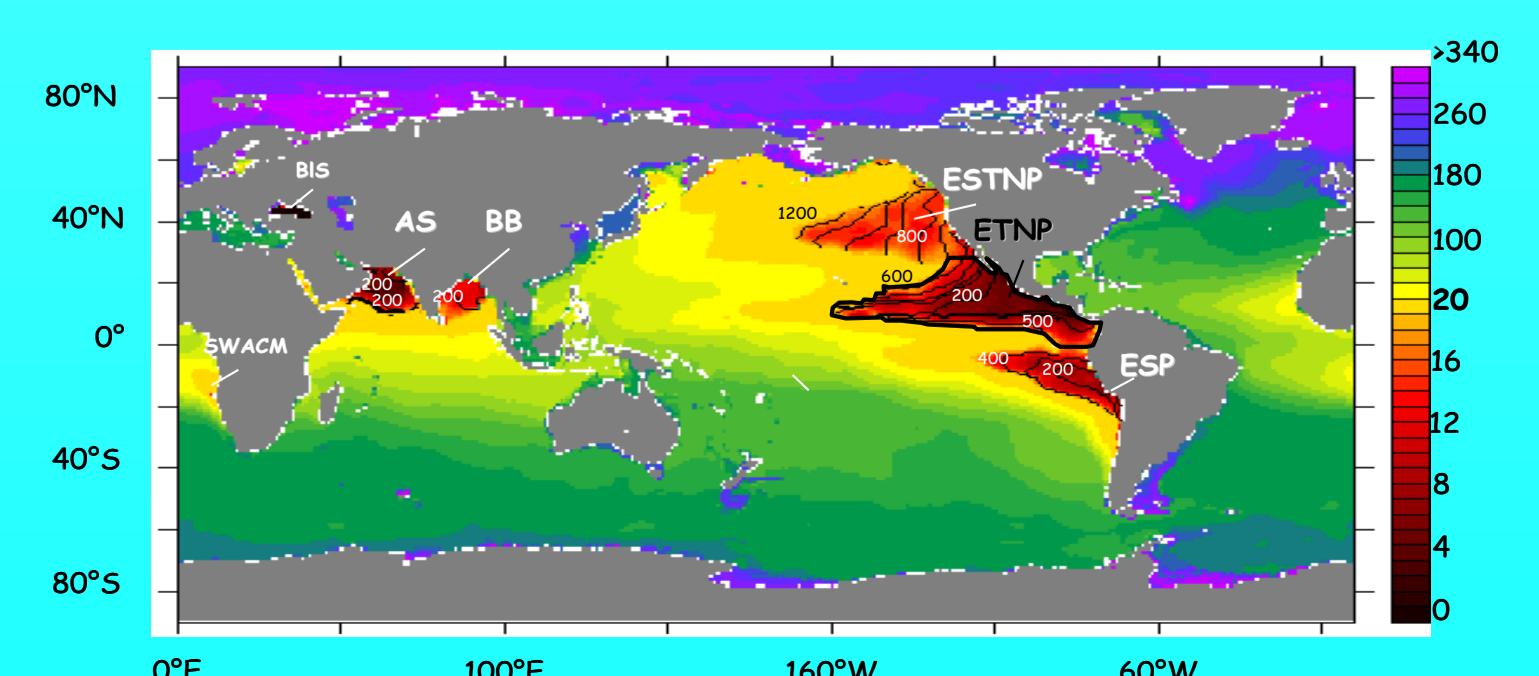
The objective of the BOA project was to describe the biogeochemical cycle of Fe with a complete and innovative point of view. One aspect aimed to study iron chemistry in both the atmosphere and ocean (redox, organic, and physical speciation). Another aspect concerned the interactions with the food web (from bacteria to zooplankton) in terms of bioavailability and/or regeneration. Using both experimental and modelling approaches, we were able to: (i) exhaustively characterize the physico-chemistry of Fe in atmospheric wet and dry depositions; (ii) quantify the physico-chemical processes (biotic and abiotic) that control Fe transfers at the air-sea interface; (iii) study interactions between atmospheric inputs, Fe bioavailability, and phytoplankton (diatoms and cyanobacteria, including diazotrophs); (iv) study feedbacks of biological activity on Fe speciation and bioavailability; and (v) study the impact of all these processes on the carbon cycle.

PIs: G. Sarthou (LEMAR/UMR6539) and K. Desboeufs (LISA/UMR7583). Other team members: C. Ridame (LOCEAN), E. Bucciarelli (LEMAR), P. Pondaven (LEMAR), C. Guieu (LOV), O. Aumont (LOCEAN).

### Air-sea fluxes at Eastern Boundary Upwelling and OMZs systems

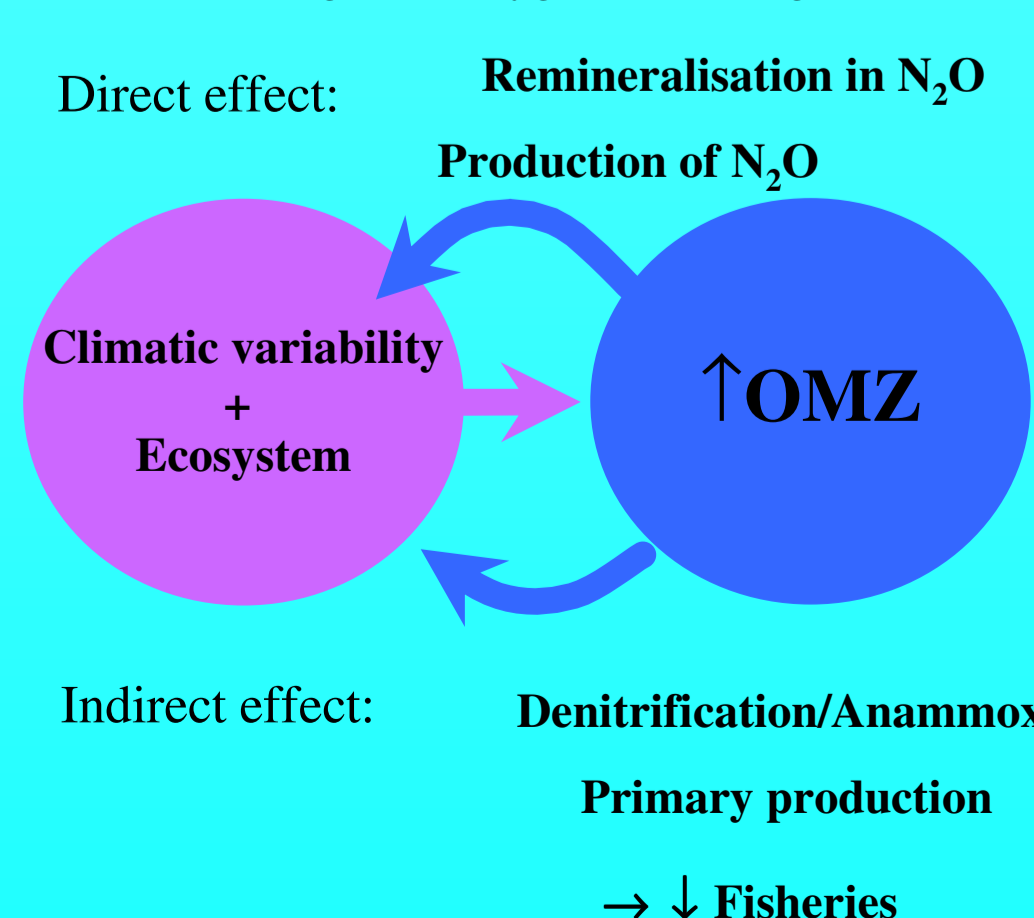
(Aurélien PAULMIER and Véronique GARCON, LEGOS)

Discussion Open Science Conference SOLAS (16-20 November 2009)



O<sub>2</sub> distribution at depth where O<sub>2</sub> concentrations are minimal (WOA 2005)

Potential influence of the OMZs on the climatic change (e.g. N<sub>2</sub>O, CO<sub>2</sub>) and on the vulnerability of the environment (budgets of oxygen and nitrogen)



### Key Questions

- Are the emissions of N<sub>2</sub>O, CO<sub>2</sub> and CH<sub>4</sub> coupled or decoupled during upwelling events, and which is the net greenhouse (GH) effect of the OMZs? (Focus 3)
- Are the OMZs relevant for clouds formation (aerosols: DMS, halogen acids/oxides) and for the control of O<sub>3</sub> (stratospheric: N<sub>2</sub>O; tropospheric: halogen compounds) and O<sub>3</sub> (long-term)? (Focus 1)