

MERMEEx

Marine Ecosystems Response
in the Mediterranean Experiment

PI's: Cécile Guieu (LOV, Villefranche), Xavier Durrieu de Madron (CEFREM, Perpignan)
and Richard Sempéré (MIO, Marseille)

MISTRALS

Ifremer



INSU
Institut national des sciences de l'Univers



Institut de recherche
pour le développement



Alliance nationale de recherche
pour l'environnement

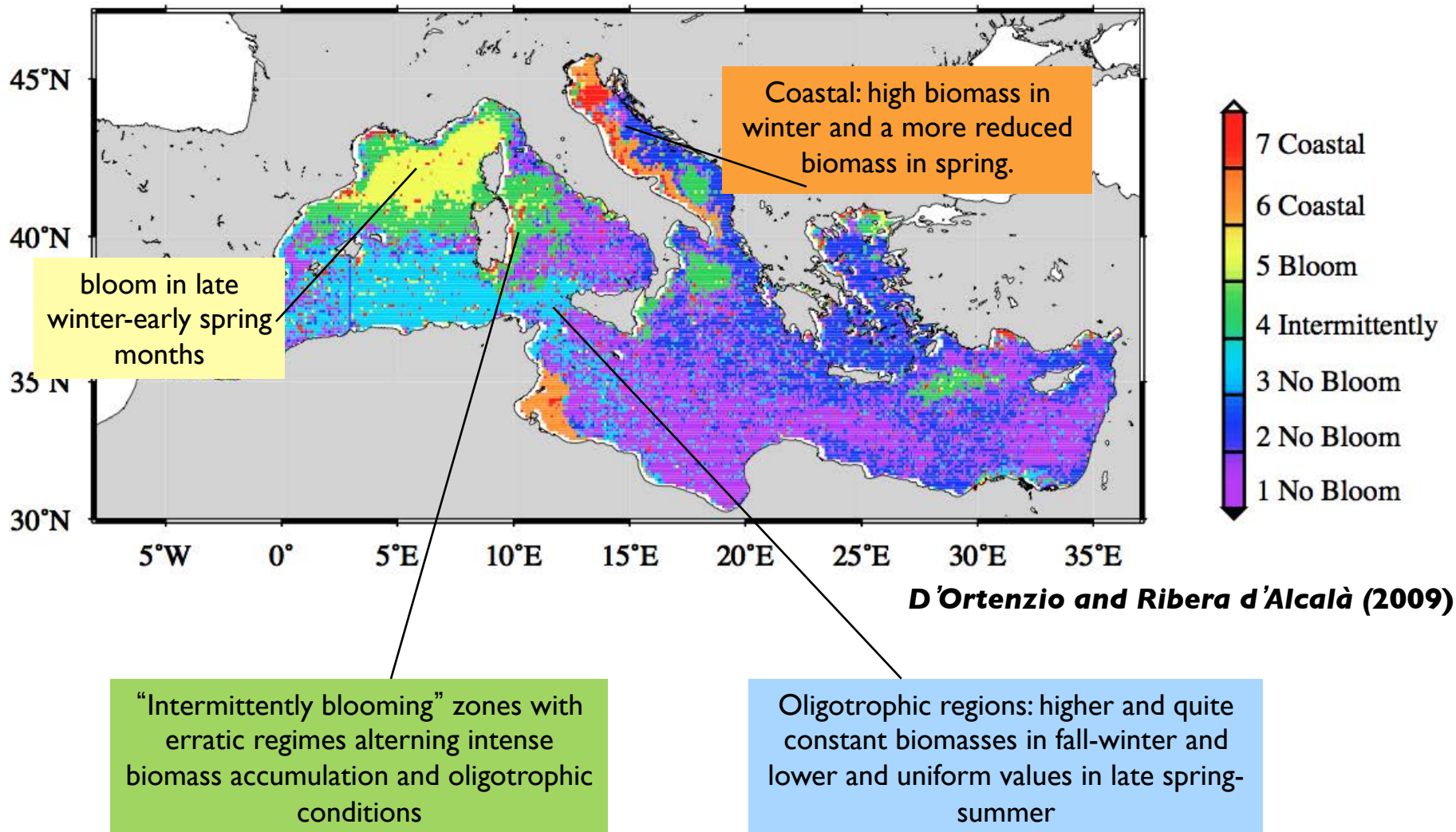
Mediterranean Sea, main features



- ✓ Semi-enclosed basin (2.5 millions km²), surrounded by major rivers
- ✓ High annual average total solar radiation flux = 168 Wm² due to weak cloud cover
- ✓ Averaged depth : 2200 m -Deep water temperature > 12°C
- ✓ Evaporation exceeds Precipitation+Runoff, that is compensated by an inflow of 0.5-1 10⁶m³/s at Gibraltar



Regions characterized by similar trophic regimes

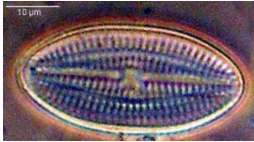
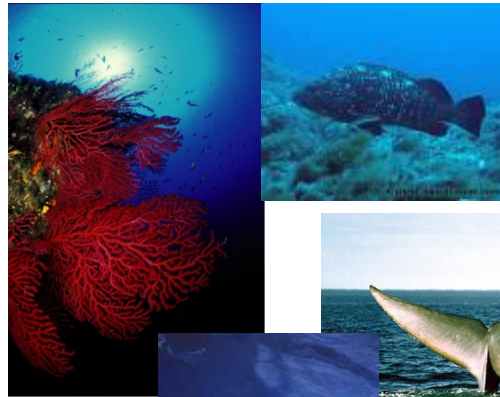
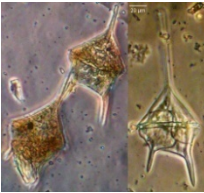
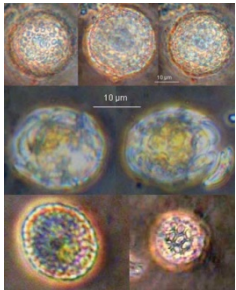
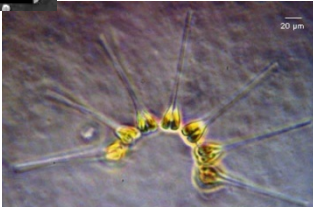


Med Sea Biodiversity

Med Sea = 0.7% of global Ocean volume, but a major reservoir of diversity (18%). Recently introduction of many thermophilic species

=> disturbance of ecological status, changes in the trophic chain and consequently on the resources

Links with Biodivmex

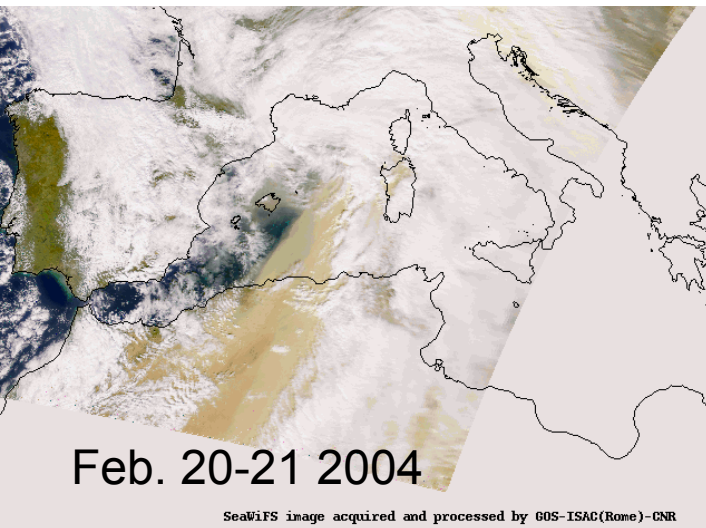


Occurrence of extremes atmospheric events in the Med Sea

2 examples

Saharan Dust event

ex. event in western Med.: dust input to the surface waters may reach **50 tons of dust km⁻² within 2 days**



Biomass burning

ex. in Greece in August 2007: several weeks of emissions and inputs to the surface waters



Due to increasing demographic pressure, these events are expected to increase: what will be the **impact the biogeochemistry of the Med Sea?**

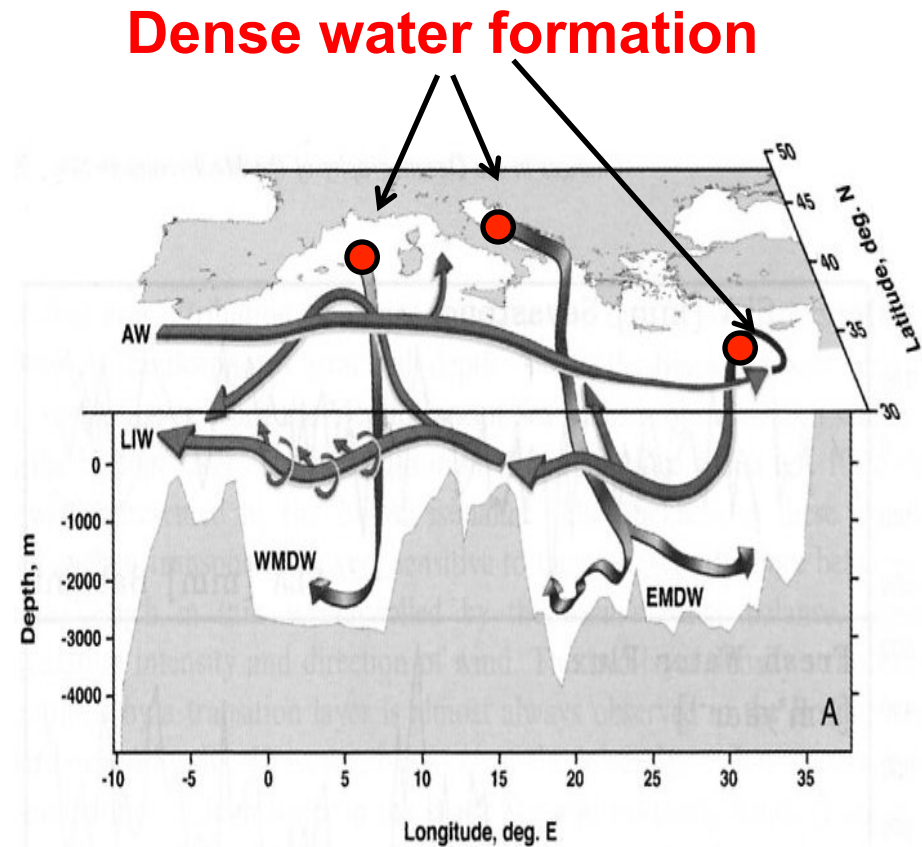
Recently, the occurrence of Saharan events with extremely strong fluxes (>20 t.km⁻².event⁻¹) was significantly higher than in the 90's: **how those high inputs of new phosphorus will impact New Production, in particular from diazotrophs**

Physical Oceanography features

There is a "Conveyor Belt" system similar to those of global Ocean

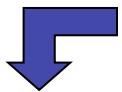
✓ Thermohaline circulation is driven by difference of density between Atlantic Ocean and Med Sea. There are significant differences between Atlantic and Med Sea waters chemical composition.

✓ Different areas of dense water formation that play a role on the general circulation, transfer of carbon to deeper layers and availability of nutrients for marine organisms and resources.

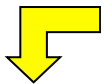


Possible change that may affect winter convection in open Mediterranean Sea

→ By using **IPCC-A2-scenario (Surface T (+3.1°C) and S (+ 0.48 psu))**
Somot et al. (2006) indicated



Possibility of decrease of surface density and winter deep-water formation at the end of the 21st century, **the Mediterranean thermohaline circulation (MTHC) weakening can be evaluated as -40% for the intermediate waters and -80% for the deep circulation with respect to present-climate conditions**



Change in organic matter export in the mesopelagic waters of the Med Sea? Decrease of nutrient uplift, Oxygen transfer and Ressources ?

The modern anthropic pressure in the Mediterranean basin

High concentration of people in coastal area:

Citizens:

450 millions in 2000 -
>550 millions in 2025

Tourism :

158 millions in 1996 (1/4 of
world' tourism!!)
=> 300 millions in 2025

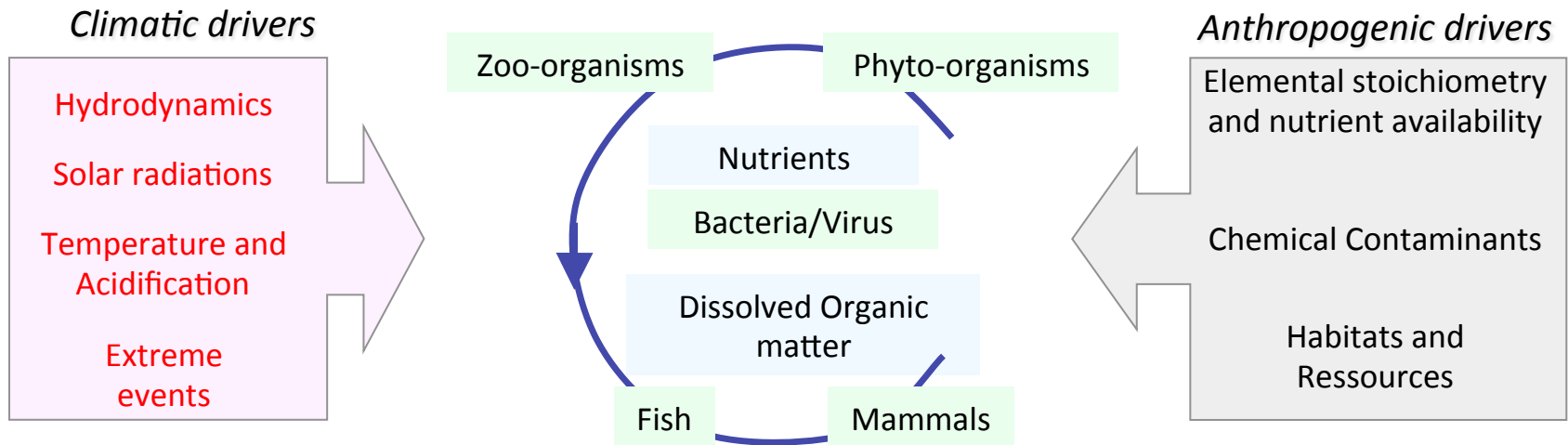


==> Pollution : metals, oil (1 million tons/year - i.e. 20% of the global oil pollution in the world' oceans), drugs, hormones, several organic compounds and plastics.

==> Impact on exploited Resources

MERMeX Scientific Objectives

Ecosystem end to end



→ *Some Key questions for MERMeX:*

- *Impacts of temperature increase, on Oceanic circulation including general circulation, dense water formation, cascading*
- *Impact of acidification and Temperature increase on ecosystem functioning*
- *How diversity and resources will react to changing environment ?*
- *Occurrence of extreme events including cascading, dust events, River floods, Heat waves on coastal ecosystems*
- *Impact of urbanization of Med cities on marine coastal ecosystems,*

Strategy, Implementation

Real Mermex start : 2011



MERMeX White Book

- Synthesis scientific paper on current knowledge and key questions
- (95 authors, 130 pages, 630 references)
- Document published in 2011 in *Progress In Oceanography*.

MerMeX Implementation Plan

Organisation in 5 workpackages including different actions

- **WP1** Biogeochemical budgets
- **WP2** Ecological processes: biogeochemistry and food web interactions
- **WP3** Land-Sea interactions (in particular extreme events)
- **WP4** Natural and anthropogenic air-sea interactions
- **WP5** Ecosystem Based Description (ecological clustering)

Endorsement
application submitted

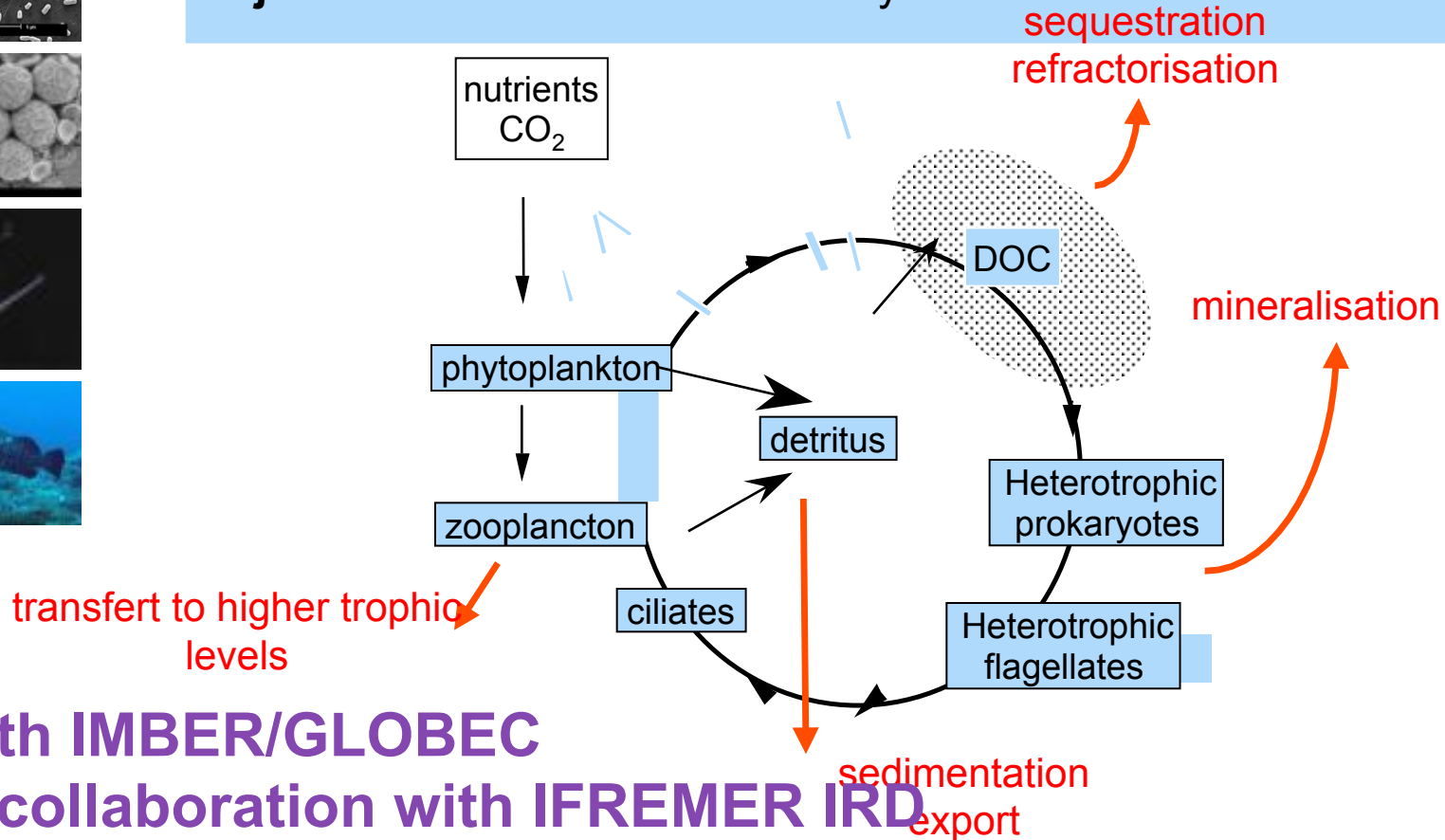
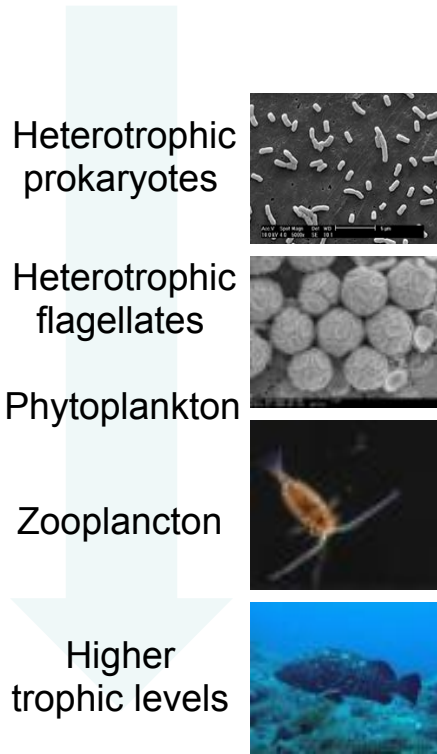


WP2. Ecological processes: biogeochemistry and food web interactions (F. Carlotti, F. Van Wambeke)

Obj. 1 Sensitivity and response of **key** pelagic and benthic species to Global change

Obj. 2 Responses of **trophic food webs** in term of community structure, functioning

Obj. 3 **Feedback** of marine ecosystem



⇒ Links with IMBER/GLOBEC

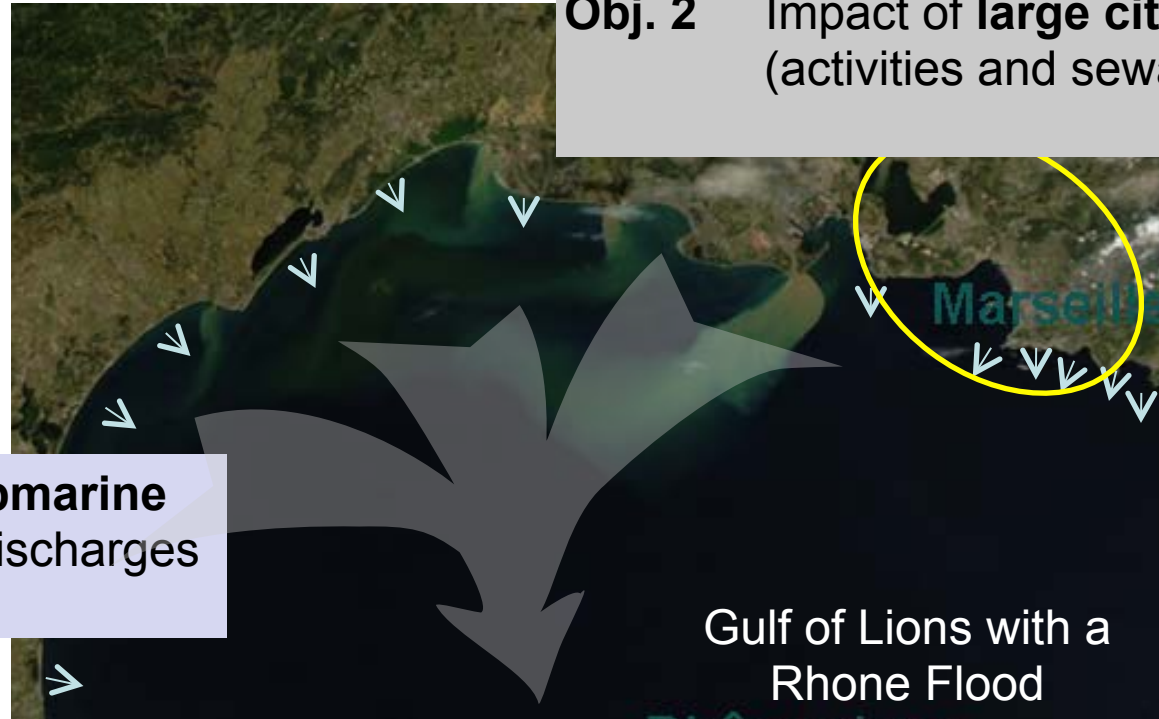
⇒ Need of collaboration with IFREMER IRD

WP3. Land-Sea interactions including Extreme Events

(C. Rabouille, O. Radakovitch)

Obj. 1 Fate and **transport** of elements to the **open sea**

Obj. 2 Impact of **large cities**
(activities and sewage)



Obj. 3 Influence of **Submarine
Groundwater** discharges

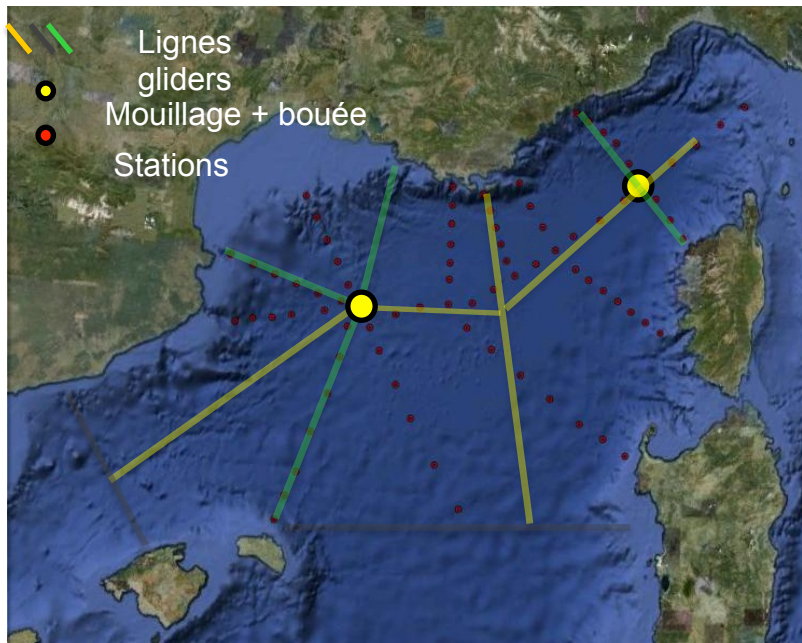
Obj. 4 Transfer and impact of **contaminants**
through **marine food webs**

=> **Links with HYMEX, SICMED and LOICZ**

WP1 - Action DeWEX (2012-2013)

DeWEX = **DE**ep **W**ater formation **EX**periment

Integrated project : observation-modelling : Biogeochemical budget in the NW Mediterranean



Strategy

→ *Oceanographic cruises*

✓ **Gliders, Profilers:** suivi minimum des masses d'eau entre les campagnes

✓ **Modelling:**..



2012



2013



MOOSE GE

DeWEX

DeWEX

DeWEX

MOOSE GE



Strong synergy between **MOOSE** and 3 MISTRALS projects and one FP7 project (Perseus)

A large OBSERVATION NETWORK to fulfill the long-term objectives of those projects

MISTRALS

scientific projects, time scale 10 years

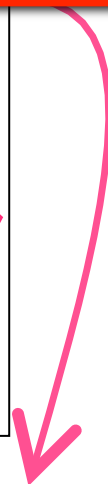
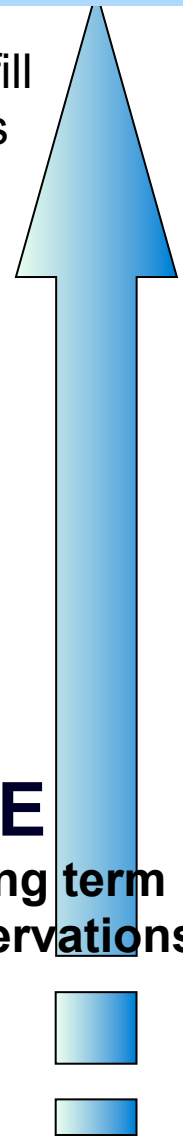
MERMEX
Marine Ecosystems Response

PERSEUS
FP7

CHARMEX
Chemistry-Aerosols

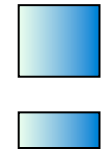
HYMEX
Hydrological Cycle

MOOSE
Long term observations



Atmospheric impact on biogeochemistry

Impact of physics on biogeochemistry



MeRMEX: International (2012-2013)



In discussion : Bizerte, Alger, Sebta Oues laou, Palma, Sfax



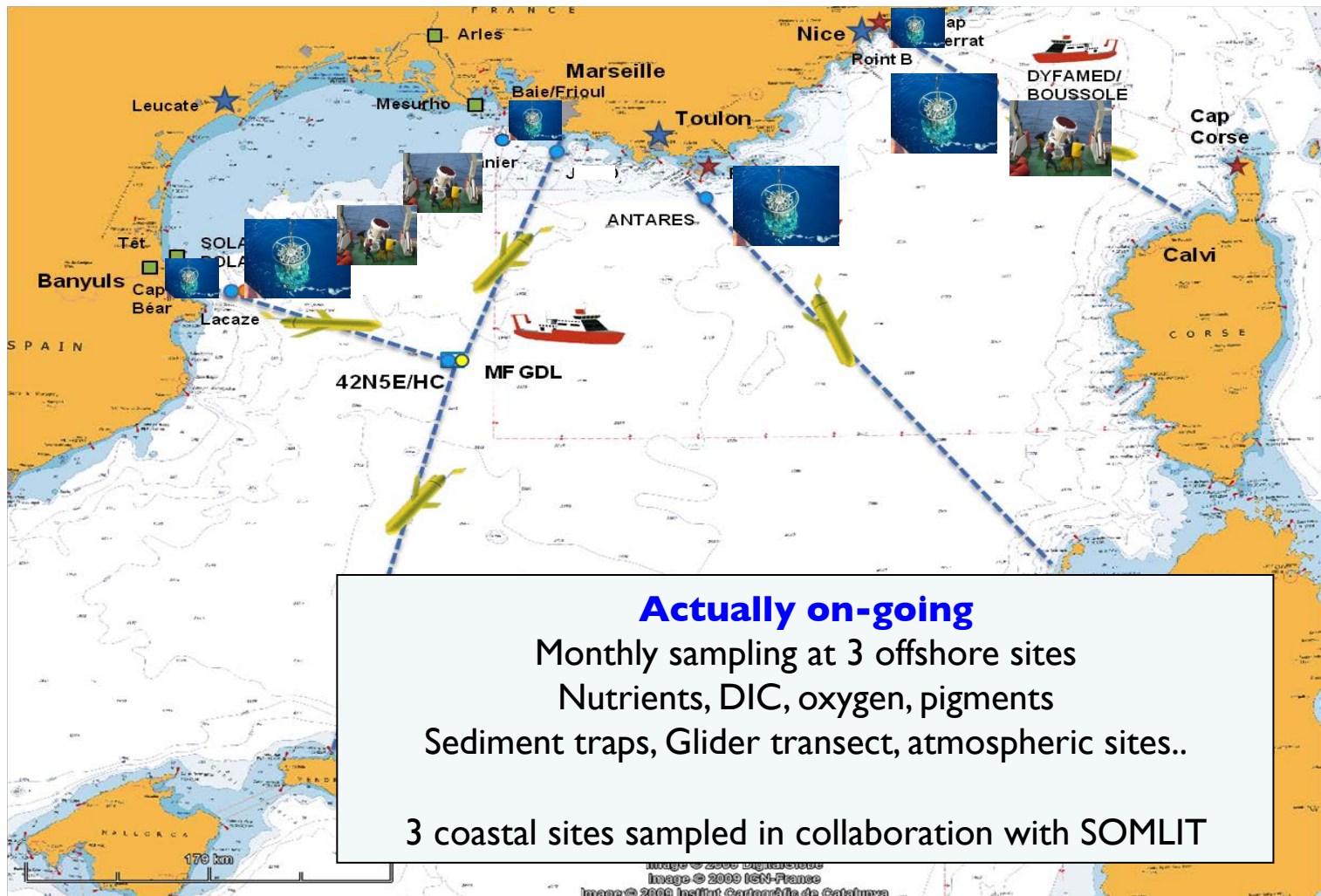
In preparation : Pise, Naples, Zagreb, Beyrouth



MOOSE: The observation programme : The implementation plan

WP3- Biogeochemical cycle, acidification and contaminants

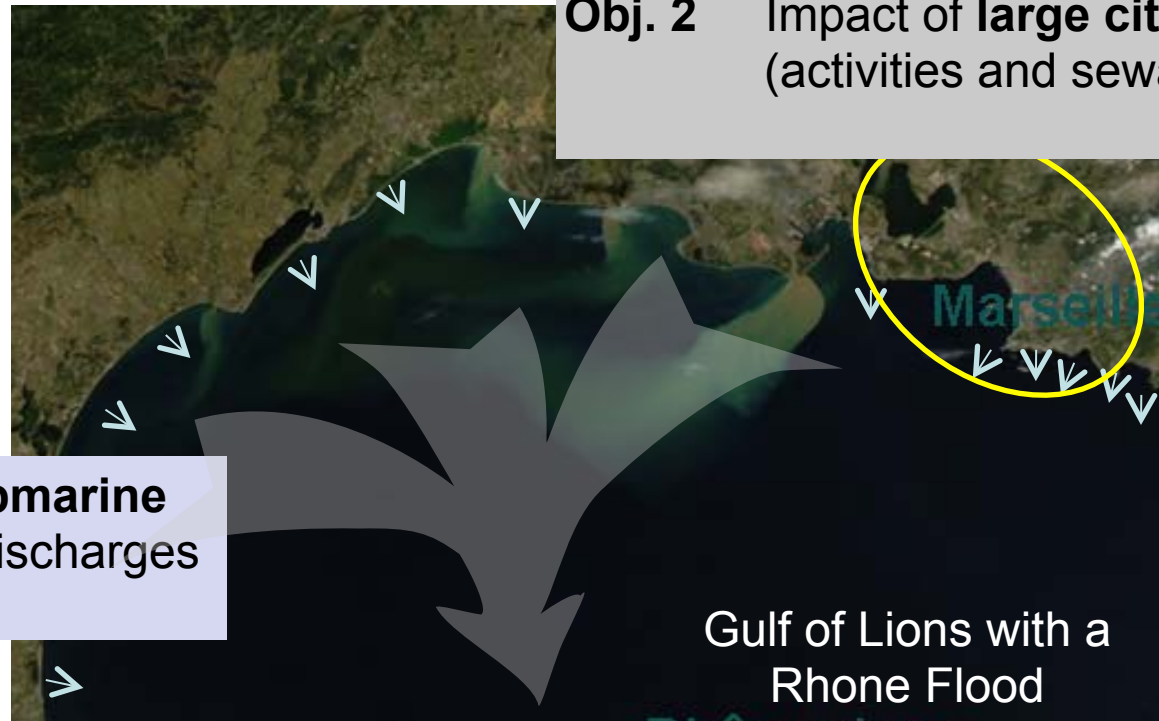
WP4- Biodiversity and biological resources



Example: Land-Sea interactions Including Extreme Events

Obj. 1 Fate and **transport** of elements to the **open sea**

Obj. 2 Impact of **large cities**
(activities and sewage)



Obj. 3 Influence of **Submarine
Groundwater** discharges

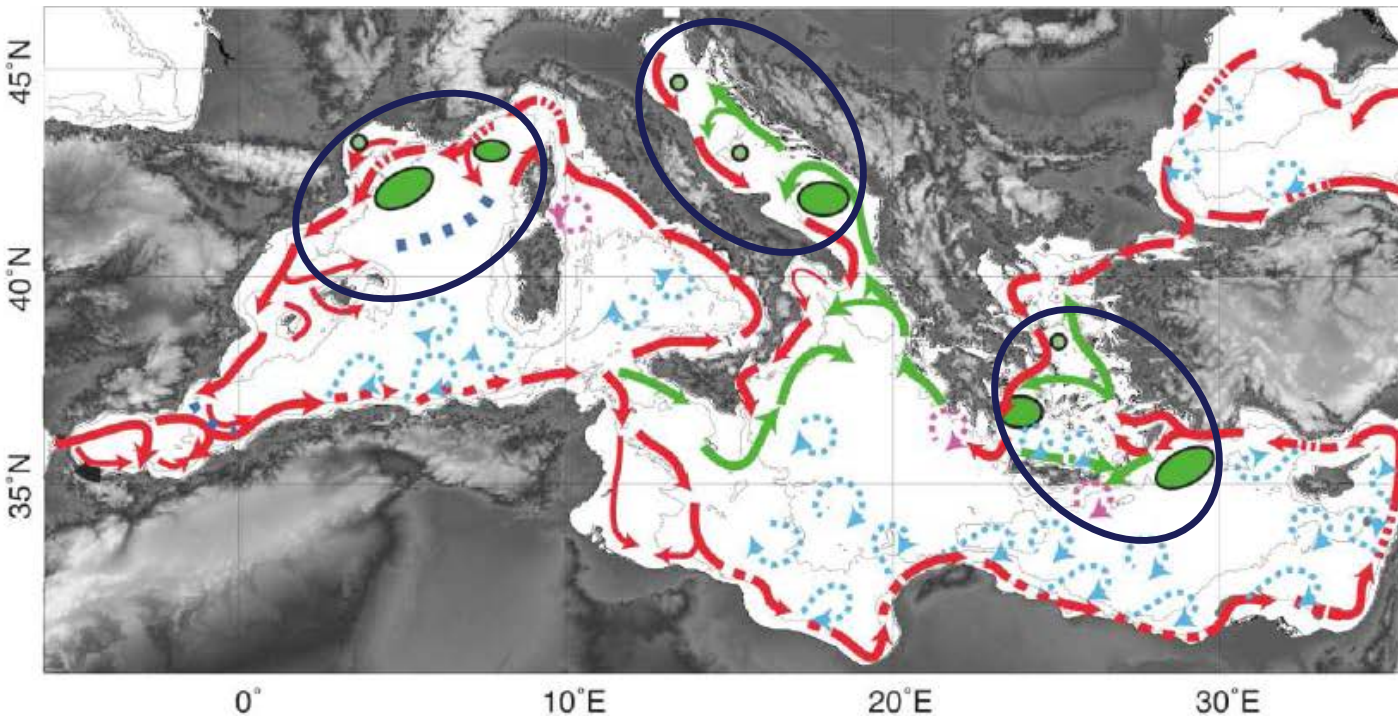
Gulf of Lions with a
Rhone Flood

Obj. 4 Transfer and impact of **contaminants**
through **marine food webs**

=> **Links with HYMEX, SICMED and LOICZ**

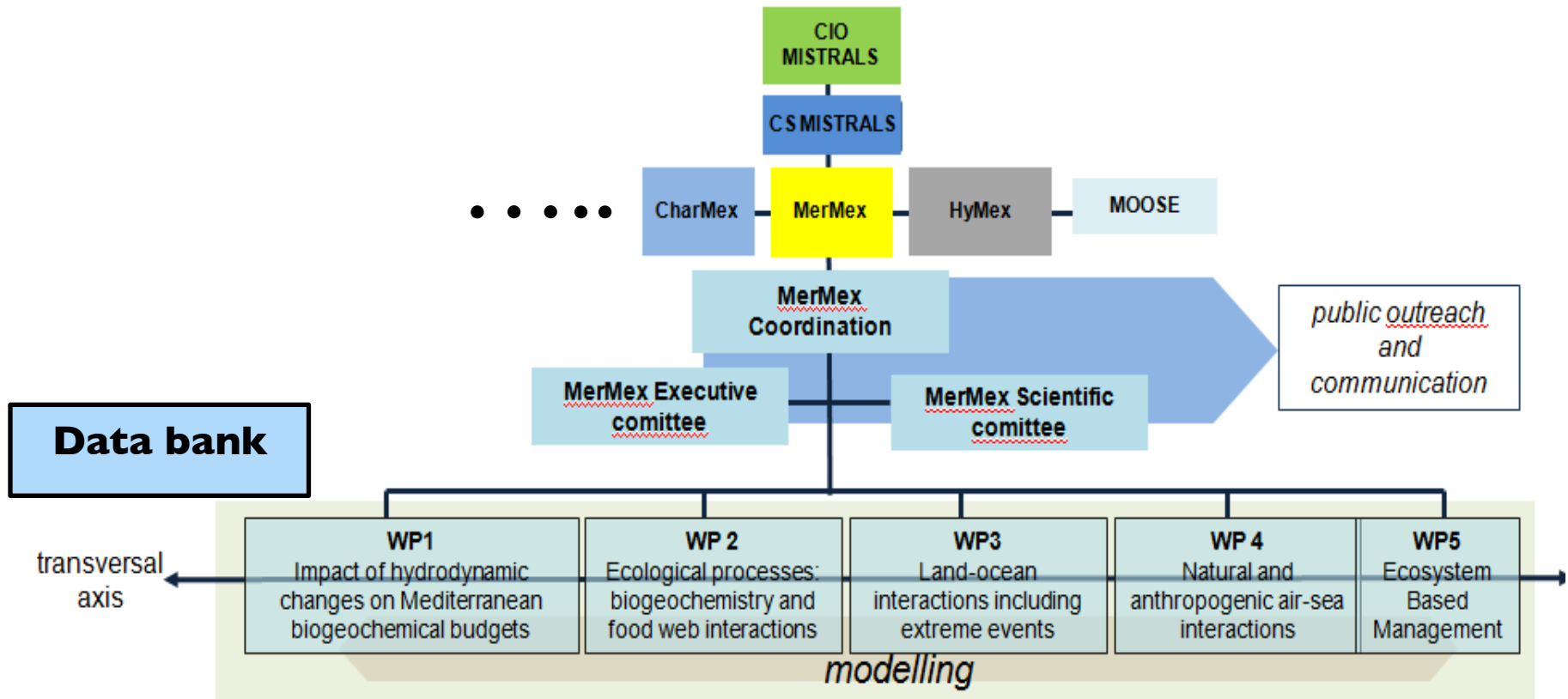
Some propositions...

Study of the convection areas and their impact on biogeochemical budgets in the eastern and western basins, assess the recent changes



Governance

PI's: Cécile Guieu (LOV, Villefranche), Xavier Durrieu de Madron (CEFREM, Perpignan) and Richard Sempéré (MIO, Marseille)



The Officers of the SC-MerMex are: MISTRALS representatives and MerMex coordinators

- INSU/INEE/CNRS, IRD, IFREMER, IRSN, Meteo France, CNES representatives
- Foreign scientists

socio-economy interactions