Journées OT-Med,
La Baume-les-Aix
6-8 January 2015

# WP1 Understanding and evaluating climatic changes and natural hazards

France Van Wambeke[1], Olivier Bellier[2]

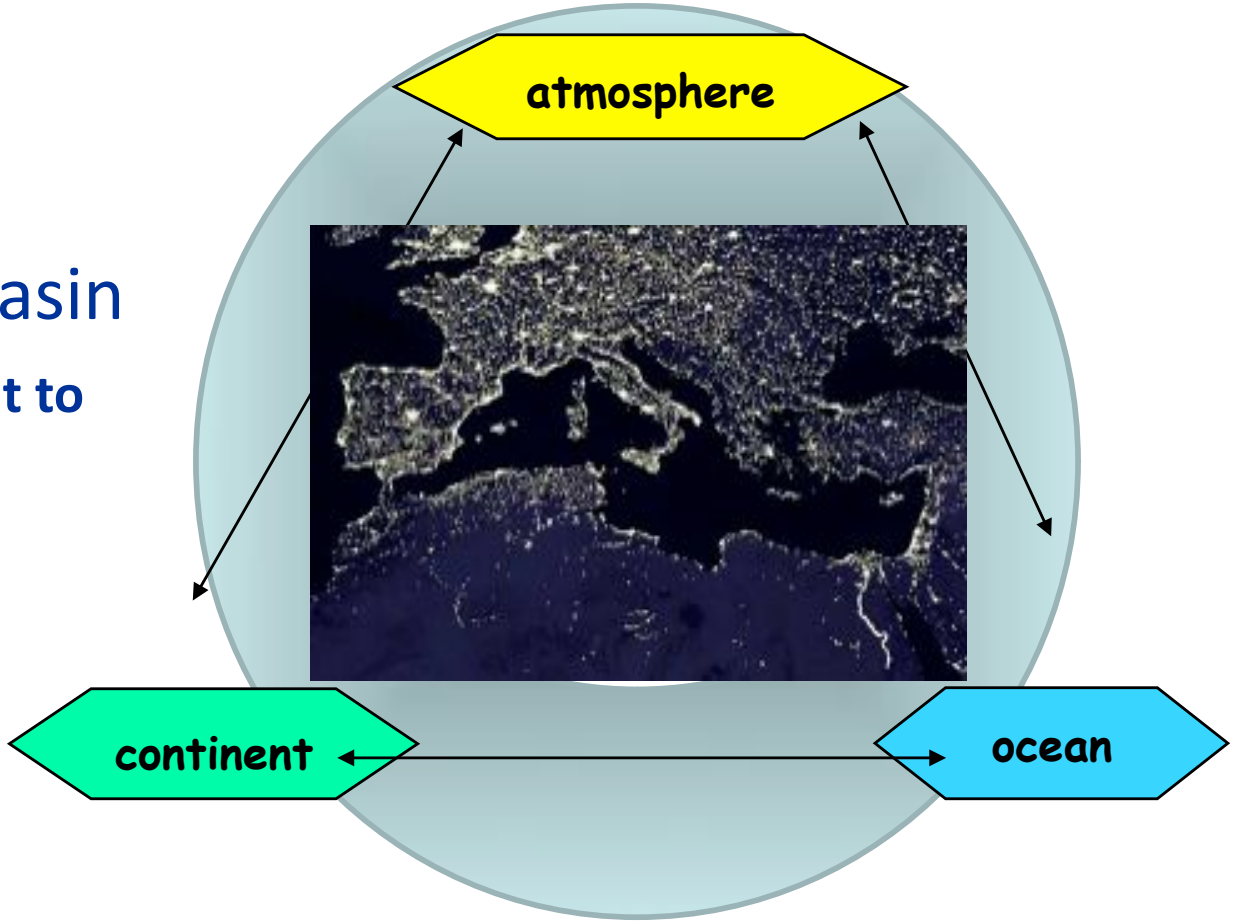
[1] MIO, Institut Méditerranéen d'Océanologie, **Marseille**

[2] CEREGE, Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement , **Aix en Pce**

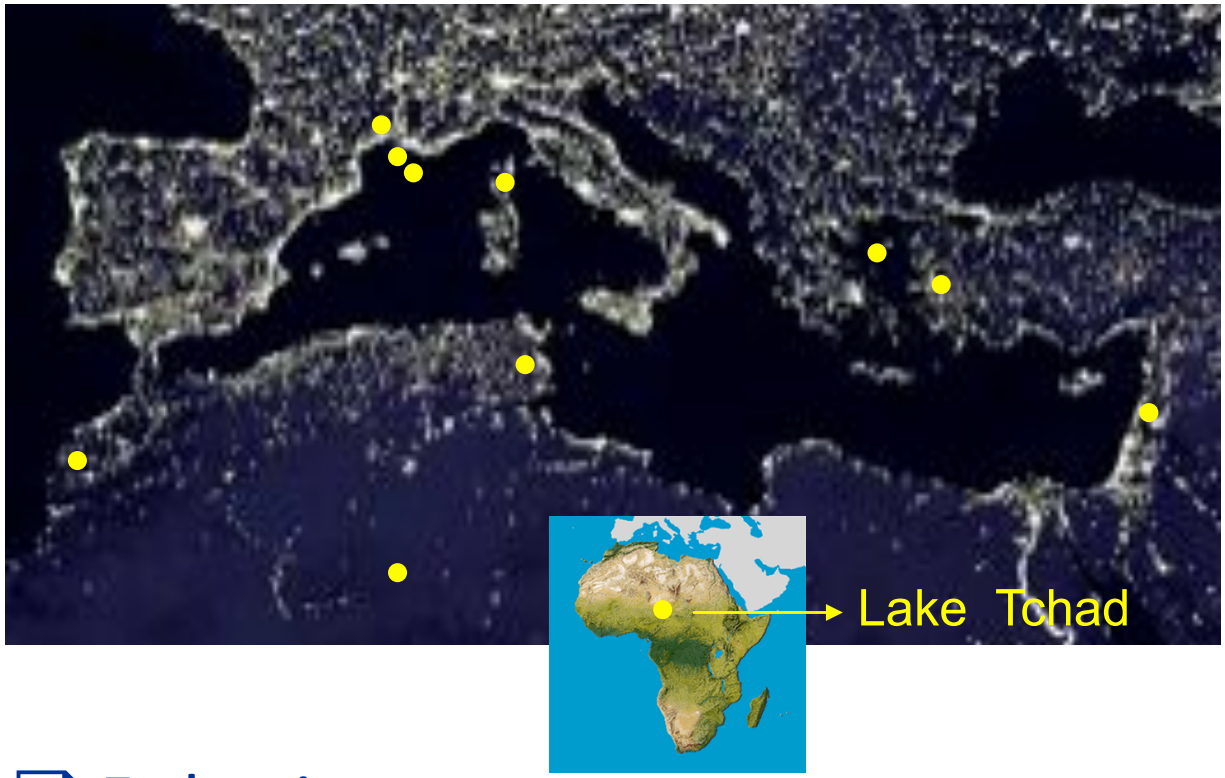
# Objectives

- Climatic changes & natural hazard assessment:
  - **Observing**
  - **Evaluating and analysing variabilities at different time scales**
  - **Modelling**

- Context:
  Mediterranean basin
  - **integration from continent to the Sea**
  - **amplification factors: urbanised area, high population densities, big cities, industries, contaminants**



# Projects funded since 2012




**Study domains – countries:**
**-France, Morocco, Tunisia, Tchad, Italy, Greece, Turkey, Lebanon…**

**-Study domains – topics:**
**- Seismic hazard, climatology, hydrology, oceanography**

❑ 5 thesis Benjamin Mary, Rachid Adallal, Chloé Poulin, Kahina Djaoudi, Aladin Danoary Andrisoa

❑ 6 post docs 'OT-Med' funds : Matteo Vacchi, Camille Contoux, Virginie Riou, Javier-Castro Jimenez ; combined with 'Fernand Braudel' funds : Wallid Chouari & Constantin Athanassas

❑ 20 projects

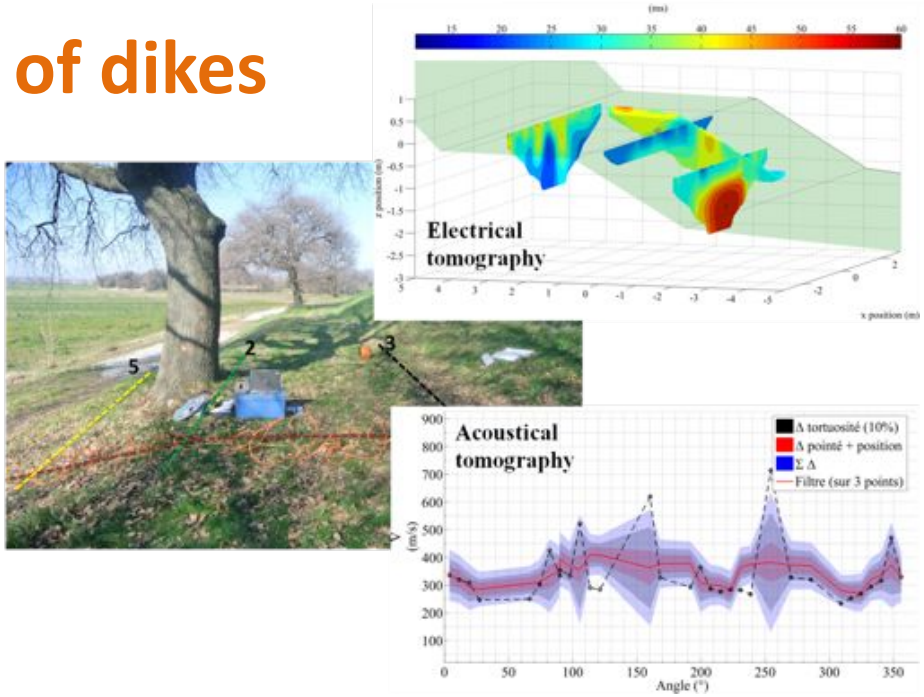
# Survey and rupture of dikes

## Detection of woody roots growing in earth dikes

***PhD B. Mary*** **, defended in Dec 2015**

**PIs L. Peyras & G. Saracco (IRSTEA, CEREGE)**

- **Development of a non-destructive method : Geophysical diagnostic of vegetation roots**
- ***Mary et al 2015 Physics Procedia 70 965-969***



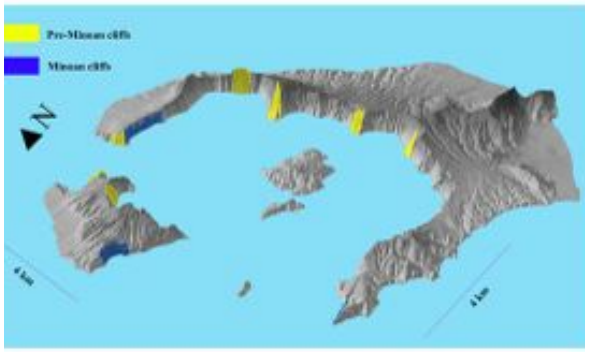

## Liquefaction risk assessment of dikes in Rhône valley

**PI C. Carvajal (IRSTEA, ESPACES, CEREGE, GREQAM)**

- **Identification and characterization of 10 major flood events since 1840**
- **Characterization of mechanical behaviour and liquefaction potential of dike materials in Camargue**


# Historical, geophysical and mechanical surveys / economic impacts of ruptures

# Geodynamic processes and related natural risks




**The impact of the Minoan volcanic eruption of Santorini, Aegean, on the Bronze Age civilizations of the Eastern Mediterranean** *Fernand Braudel-IFER fellowship*

*C. Athanassas*

**PI D. Bourles (CEREGE, NCSR Demokritos Athens)**

**- Cosmogenic dating reinforces the existence of a caldera prior to the Minoan eruption**

***- Athanassas et al 2015 Bull Volcanology under review***

***- Athanassas et al 2015 Quatern Inten under review***

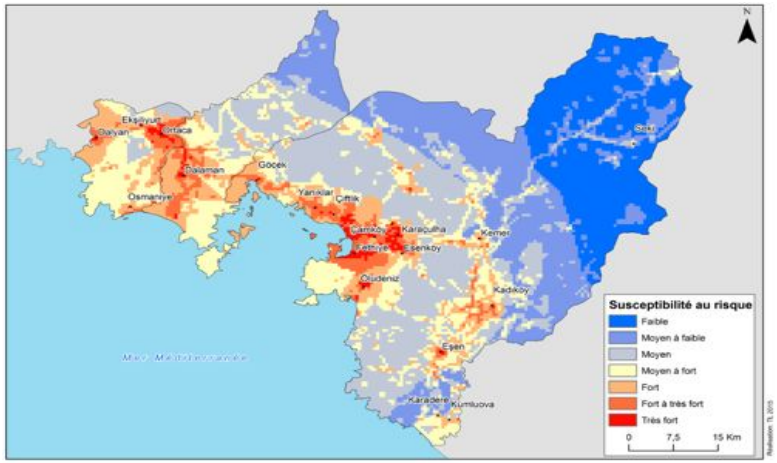
**Frequency of large past earthquakes in the Aegean and associated risk susceptibility.** **PI L. Benedetti , S Robert (CEREGE, ESPACE, coll ITU & Mugla univ. Turkey, GFZ)**

**- Combination of cosmogenic dating, historical data, and spatial analysis**

**-Evidence of clustering seismic events of few hundred years during the last 12 kyears**

***- Benedetti et al 2013, JGR, 2013***

***- Tesson et al., JGR, accepted, 2016.***




**Lessons from past (including antic societies) to future : volcanic, seismic and tsunamic risk, from hazard… and more and more to vulnerability**

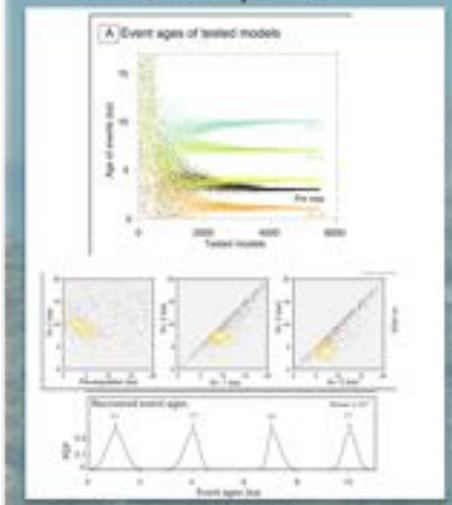
# Geodynamic processes and related natural risks

## Seismic histories of normal faults in Mediterranean

Jim Tesson
supervised by L. Benedetti

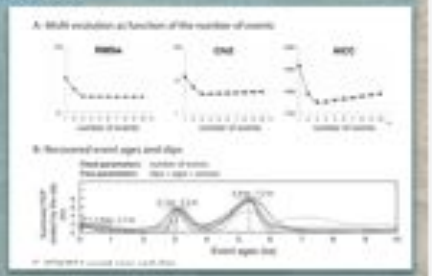
Project FEARS labex OTMED
L. Benedetti, S. Robert, M. Rizza, J. Fleury, O. Bellier, M. Ghilardi, C. Yildirim, V. Mouslopoulou, E. Aksoy, D. Bourlès, J. Tesson

### Methodological development



-> Better constrain the recovered seismic histories from $^{36}Cl$ dating of exhumed fault-histoire on the last 10-20 ky
=> 1 article in prep.

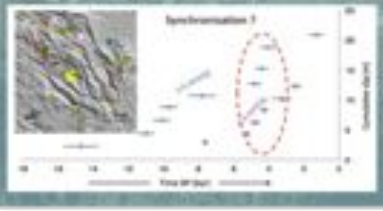
### Acquisition of seismic histories in Mediterranean

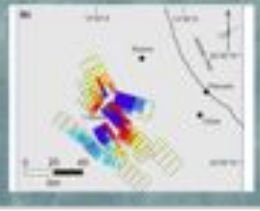


-> 6 sites analyzed (Italy et Greece)
=> 1 article submitted + 1 in prep.

### Analysis of seismic histories

- Common laws ? Collective VS individual seismic behavior of faults ?
- Modeling of the mechanical interactions between faults.





**Lessons from past (including antic societies) to future : volcanic, seismic and tsunamic risk, from hazard… and more and more to vulnerability**

# Fire risks

**Human Factors of Vulnerability to Forest Fires in Mediterranean Wildland Urban Interfaces (*FAVUL*) PI Eric Mallé (IRSTEA, IMBE, LPED)**

**- Social dynamics are critical in term of distribution of vulnerability to forest fire hazards**


- ✓ **Relationship between vulnerability criteria and local societal frame.**
- ✓ **Physical multi-criteria analysis-model of vulnerability & subjective assessment of vulnerability, culture of risk, diffusion through social networks**

# Interaction between climate and natural hazard

**Relative sea level history of the Mediterranean since the last glacial Maximum : lessons from past to future.**

***Postdoct Matteo Vacchi***

**PI Christophe Morhange (CEREGE)**

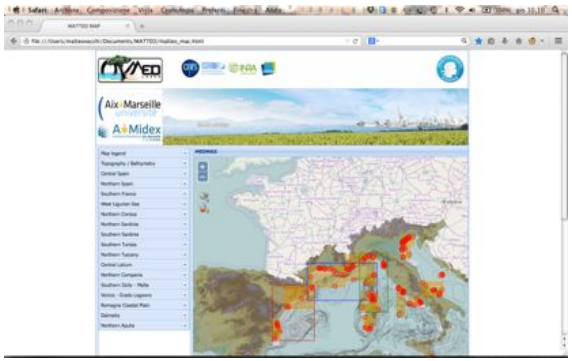
East Med
NAT fault

800 RSL data

***-10 papers in 2014-2015 in Marine Geology, Quaternary international, Quaternary Science Reviews, Current reports on Climate Change…***

***-3 papers under review***

**Next talk**



**Coast line change, paleoclimatology and hazards**

**A good example for an OT-Med Web data base**

**Standardization of Mediterranean Sea level indicators**

WebGis

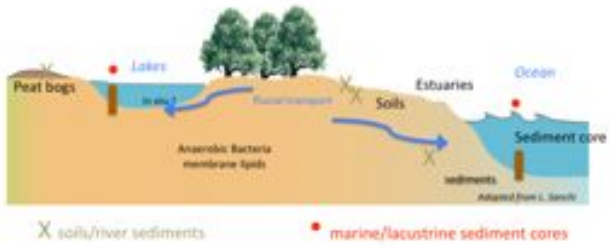
# Lessons from past to present: applications in paleoenvironment and paleoclimate

**MEDiterranean surface Hydrology during abrupt climatic events - An Econometric approach to build a new calibration model for Continental Temperature proxy? PI: Guillemette Ménot (CEREGE, GRECAM, GeoAzur)**

**Calibration in process**

**Leverage effect : a thesis founded by ENS fellowship and a BNP Paribas project founded**

***Tachikawa et al. Climate of the past 2015***

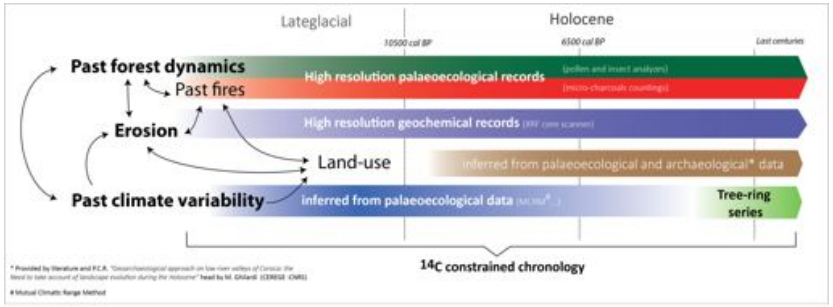



**Corsican Palaeoclimate, Palaeoenvironments & Anthropization (COPPA) PI Frédéric Guiter (IMBE, CEREGE, conservatoire de Corse )**

**Untangling climate versus anthropogenic forcing in the Holocene dynamics of Corsican Mediterranean Environments (littoral to mountains »**

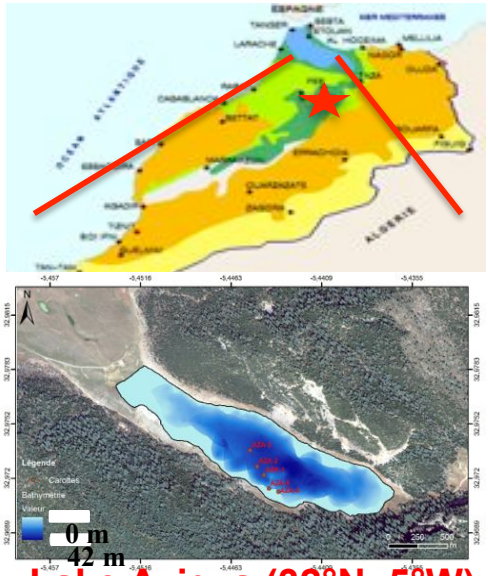
**Leverage effect : co-funding of the project with OEC grant (Office Environnement de la Corse)**

**Large tree-ring datasets covering the last 600 years for an original palaeoclimatological prospective**




- ✓Simultaneous use of different proxies in the same archives - effort of calibration
- ✓Simultaneous estimates of past precipitation, hydrology, temperatures, landscapes, ecosystems.
- ✓Parametrization for modelling the future.

# Lessons from past to present: applications in paleoenvironment and paleoclimate




Lake Azigza (32°N, 5°W)
(1544 m absl)

**Recent and Past Hydrological changes in the Moroccan Middle Atlas (PHYMOR)**
***PhD Rachid Adallal*** **PI Laurence Vidal (CEREGE, Marakech univ.)**

**Main results**

**-Hydro-isotopic modelling approach to reconstruct the lake level history over the last century**

**-Flood-induced turbiditic structures as indicators of past extreme precipitation events**

**Leverage effect :**

**-Project PHC TOUBKAL funded (2016-2018)**

**-Collaboration with climate modellers and LMI –TREMA (Marrakech)**

**-Study site integrated in the « Transect Maghreb » of MISTRALS-PALEOMEX-2**

***Adallal et al., 2014, IAH (Marrakech); Adallal et al., 2015, IAEA (Vienne), Vidal and Rhoujjati, 2015, Colloque AMU; Benkaddour et al., 2015, AFQUA, Cape Town; Adallal et al., 2015 Colloque MISTRALS ; Jouve et al., ASF (Chambéry), Colloque MISTRALS, EGU-Vienne 2016***

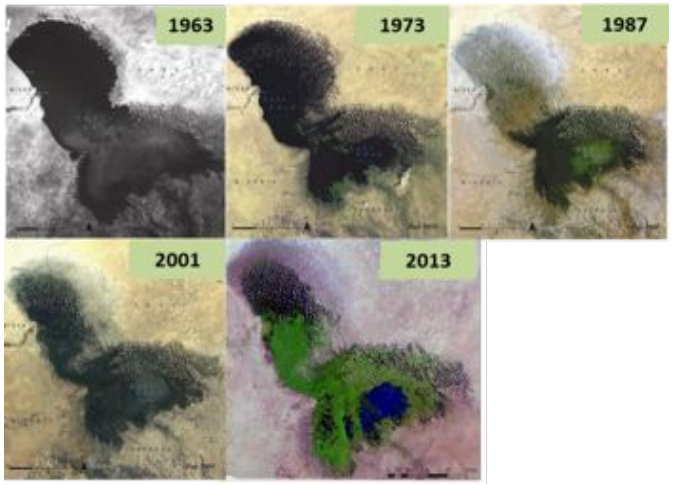
✓**Simultaneous use of different proxies in the same archives - effort of calibration.**

✓**Simultaneous estimates of past precipitation, hydrology, temperatures, ecosystems...**

✓**Parametrization for modelling the future.**

# Water resource and crisis, hydrogeology and flooding

**Modern and Past recharge of the Saharan Aquifer Systems**
***PhD C. Poulin*** **PIs P. Deschamps, C. Muller (CEREGE, GREQAM)**
**-Aquifer recharge constrained by geochemical tools and groundwater datating $^{14}C$, $^{36}Cl$.**




**Paleoclimate modelling to assess future change in Lake Tchad environment.** ***Postdoct C. Contoux*** **PI F. Sylvestre (CEREGE, IMBE, LSCE)**
**-Statistical downscaling of the climate model**
***-Blanchet et al, Quat Sci Rev, 2015***

**Wetlands in Tunisia : Cartography of the spatio-temporal dynamics and the natural systems deterioration.** ***F. Braudel fellowship W. Chouari***
**PIs A. Arnaud, J-C Raynal (LIEU, OHM Bassin Minier de Provence)**
***- Chouari 2015 Confins, 24, 2015***

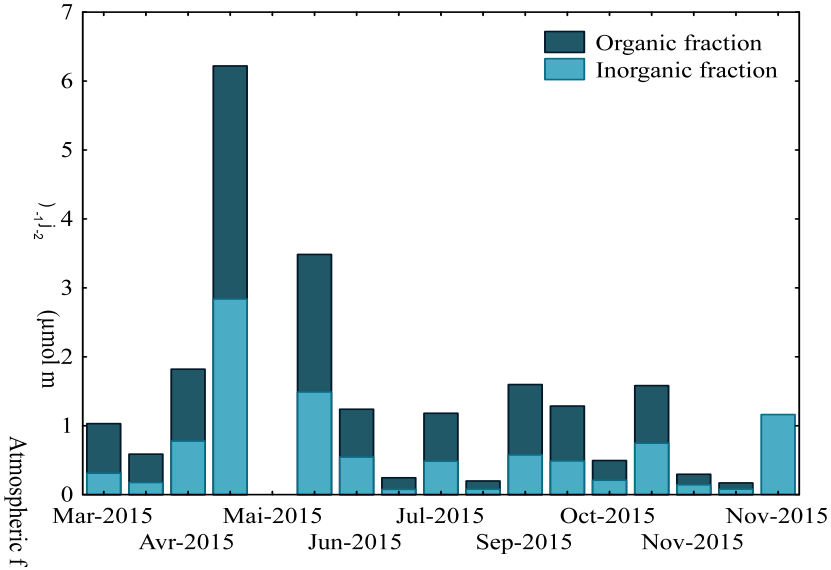
**Lessons from past to present**
**From estimation of resource to risk assessment and management**
**Merging of geophysical and economical models**

# Anthropogenic and climate change on ocean carbon sequestration

**Impact of atmospheric input on the stoichiometry of dissolved organic matter in the surface Mediterranean Sea**

***PhD K. Djaoudi*** **PI E. Pulido-Vilena (MIO, CEREGE)**

**– next talk**




## Remineralization of Organic particles in Presence of Ballast MInerals

***Postdoc V. Riou*** **PI C. Tamburini (MIO, CEREGE)**

**Field cruise in June2015, enzymatic degradation faster in particles**

***Jacquet et al. Mar Chem, 2015***

**– next tal**

- ✓Continent - ocean interaction
- ✓Episodic events (aerosol deposition), acidification, enhanced stratification
- ✓Consequences on surface and deep sea ecosystems

# New project: pollutants

**Integrated assessment of the fate and impacts of organic pollutants in the MS (started in 2015)** ***Post doc Javier Castro-Jiménez***

**PI R. Sempéré (MIO, CEREGE)**

## GLOBAL OBJECTIVES

**FATE / TRANSPORT**
**LOADINGS**
**CYCLING**

⇔

**EXPOSURE**
**BIOACCUMULATION**
**IMPACTS / ENV. RISK**

## STUDY AREAS

## CONTAMINANTS

**Legacy POPs (PCBs and Organochorine pesticides)**

-Regulated pollutants (Stockholm Convention on POPs, WFD, MSFD, OSPAR…)
-Tracers of past anthropogenic activities

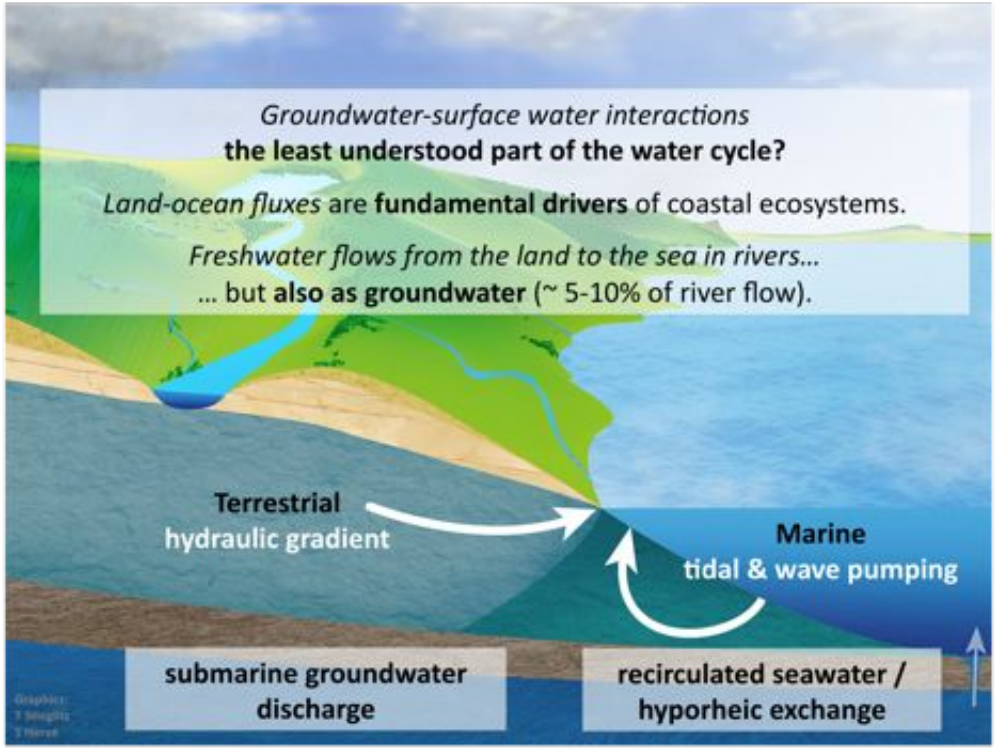
**Emerging (organophosphorus esters (OPEs) flame retardants & plasticizers**

-**Unregulated** pollutants
-Tracers of current anthropogenic activities (industrial applications)
-Increasing scientific evidence of POPs properties : LACK of DATA

✓**Relative importance rivers & atmosphere on global transfer (W MED)**
✓**Biogeochemical drivers & contaminant concentration (Air/W/Bio/Sed)**
✓**Exposure, bioaccumulation and environmental risk**

# New project: Continent-ocean interactions : groundwater discharges

## Biogeochemical and Ecological effects of coastal groundwater discharge into Mediterranean Lagoons (ECO-medLOC) - *Doc A. Danoary Andrisoa,* PI T Stieglitz , P Raimbault (MIO, CEREGE)




**Study example - Etang de La Palme: Chaire ANR 2015-19**

(1) Fresh groundwater inflow reduces lagoon salinity.

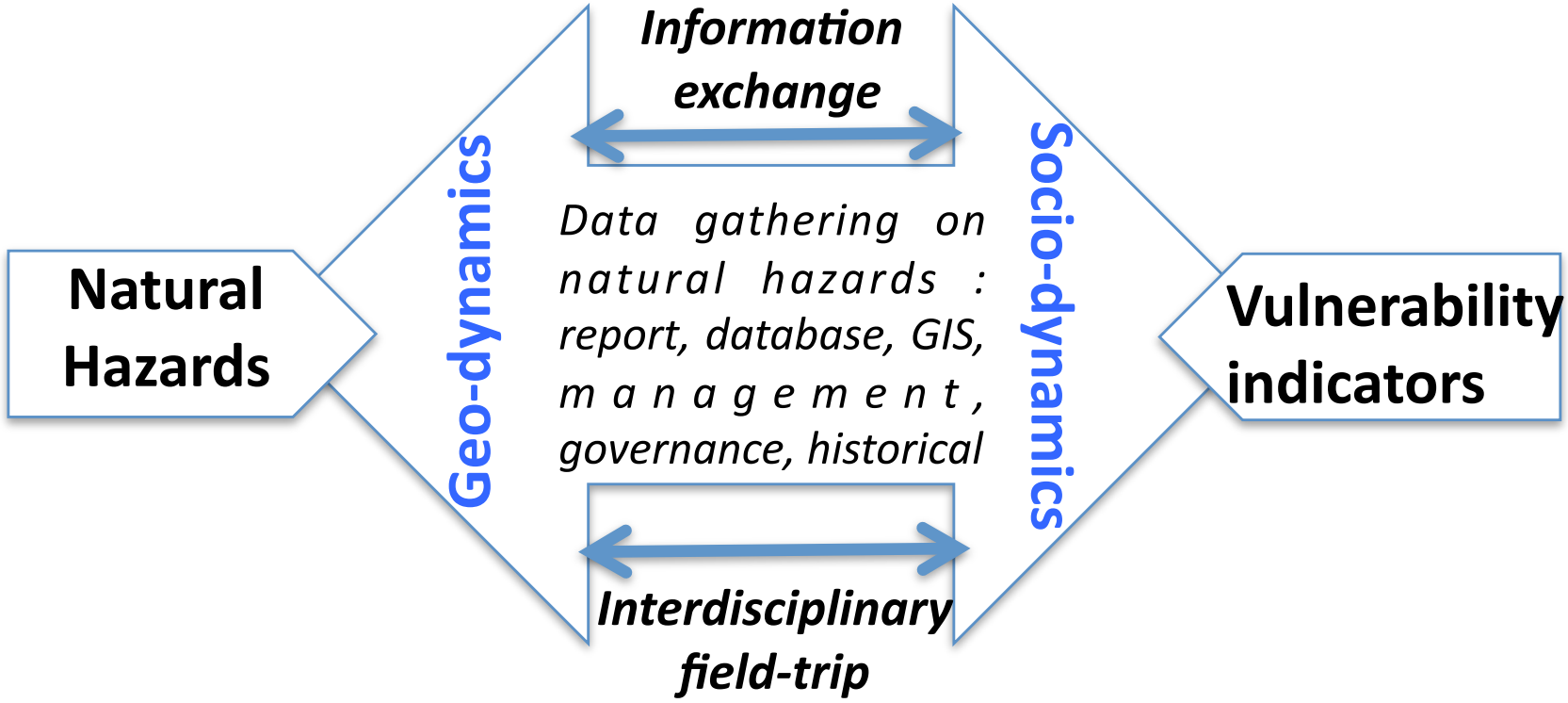
(2) In summer, the entire lagoon 'flows' through the sediment once a month.

✓ **Rethinking Land-Ocean Connectivity – an Integrated Approach for Understanding the Effects of Groundwater on Coastal Ecosystems**

✓**How changes in groundwater resources (quantity / quality) affect hydrological and ecological functioning of the coastal zone**

# New project: Geosciences and Risk assessment in Morocco : an integrated approach. Georisk mor PI L Vidal , H Mazurek (CEREGE, LPED)

**Partners: CEREGE, LPED, Geoazur (Nice), Morocco Univ – Marakech, Tanger-Tétouan…**
**Studied natural hazards: earthquake, submersion, flood, landslides…**



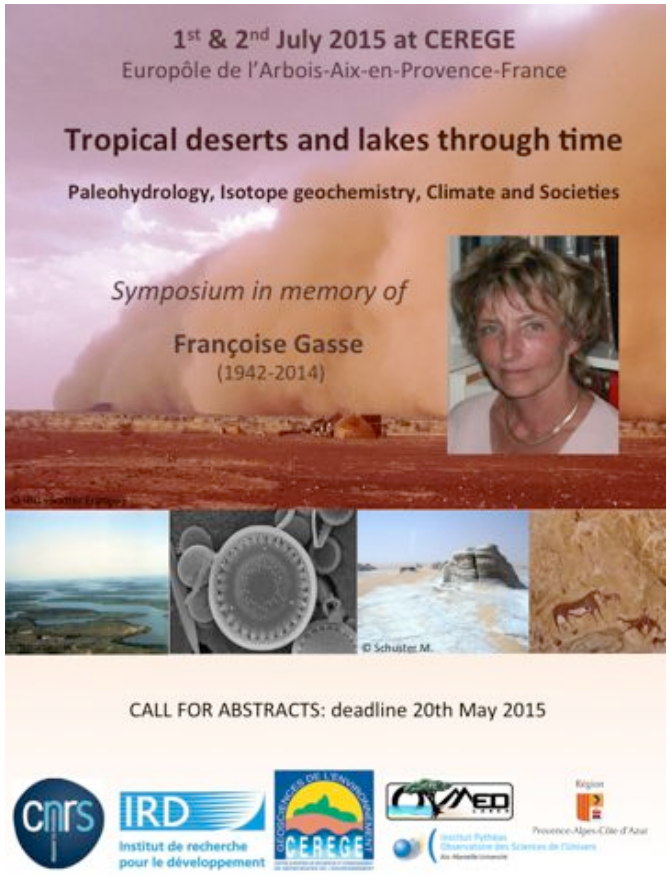

- ✓ Critical analysis of the "used" indicators and their interactions
- ✓ Provide risk indicators integrating « geological and societal » aspects of the risks
- ✓ Design a methodology for risk prevention and building a resilience capacity to be tested to other regions of the Mediterranean area

# Thematic events, workshops

✓**Mermex (MISTRAL) International Workshop**, 7-10 Avril 2015, at Oceanomed, Marseille, Org. R. Sempere, MIO (40 talks and posters; about 60 attendees).

✓**Colloquium « Multidisciplinary approaches to paleoenvironmental changes and the human occupation in the Mediterranean islands since the last glacial maximulm »** (GEOMEDISLANDS), 30 june - 2 July in Cargese - Corsica, org. M. Ghilardi, CEREGE (50 talks and invited conf.; about 80 attendees).

✓**Colloquium «Tropical deserts and lakes through time: Paleohydrology, Isotope geochemistry, Climate and Societies »**, 1-2 July 2015, CEREGE, Aix-en-Provence, Org. F. Sylvestre, F. Chalié, C. Paillés (45 talks and posters; about 85 attendees).



## Answer to the CS « Natural hazards: what is the niche of OT-Med in the international community?

✓ natural hazards associated with climate changes (flood, submersion…) as well as specific to the Mediterranean area (earthquakes, landslides…)

✓ proper consideration of the environmental and economical drivers of the Mediterranean region

✓ targeted and specific research studies on natural risks in the Mediterranean region in an integrative mode associating social, economical and natural sciences.

✓ unique consortium of to assess natural hazards with a multidisciplinary approach but also to acquire dataset and observations with an unprecedented resolution thanks to the ground breaking techniques developed by OT Med, e.g. dating earthquakes or other events over the last 20 ka with a few hundred years uncertaint;analyses of sea level changes over the entire Mediterranean area with a few cm résolution, polutant survey with high resolution…

✓ a large partner network covering the entire perimeter of the Mediterranean : Maghreb (Morocco, Tunisia, Algeria), Turkey, Greece, Egypt, Italy, Spain, Lebanon, Iran, Cyprus ...

# Future plans…

**Make effort to insert socio economics (association with WP3)**

- ✓ in studying the main parameters triggering the hazards
- ✓ in assessing the risk perception of different societal groups
- ✓ in integrating the feed back of the society to risk management

**see future projet on multiple RISKS - RISK MED…**

**Increase data share**

**See future project on a web data base for coastal contaminants**

**Carbon sequestration**

**See future project on exploration of the links between surface and deep layers facing climatic changes (pH, stratification, circulation)**