

WHAT KIND OF  
**ENVIRONMENTAL  
TRANSITION**  
FOR THE MEDITERRANEAN REGION?



# ABSTRACTS OF POSTERS

(version 4/10/19)

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<http://www.otmed.fr/conference2019>

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## WP1: CLIMATE CHANGE IN THE MEDITERRANEAN AND NATURAL HAZARDS

WP1 is devoted to the study of climatic and anthropogenic changes and natural hazards. This includes :

- sea: thermohaline circulation, mesoscale processes, air-sea interactions, impact of contaminations on the seas
- aquifers, Lake Chad, catchment areas: evolution, salinisation, water resources
- forest ecosystems: climate-fire-management interactions
- long time-scales: paleoclimatology, paleoceanography, paleoseismology, archeology
- morphogenesis, seismic risk, coastline changes, landslides.

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### **Modelling lake water and isotope mass balance variations of Lake Azigza in the Moroccan Middle Atlas under Mediterranean climate**

*ADALLAL Rachid<sup>1, 2\*</sup> (adallal.r@gmail.com), Christine Vallet-Coulomb, Laurence Vidal, Abdelfattah Benkaddour, Ali Rhoujjati, Corinne Sonzogni*

<sup>1</sup> Aix Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France.

<sup>2</sup> Georessources Laboratory. CNRST (URAC 42) FST. Cadi Ayyad University, Marrakech, Morocco.

\*PhD OT-Med

We present a detailed study of the Moroccan Lake Azigza, based on a 4-year (2012-2016) observation period, including lake level measurements, isotope analyses of precipitation, lake and spring waters, and local meteorological data. The approach is based on a step-by-step calibration of a lake water balance model, fed by precipitation and evaporation rates, to estimate the ungauged components of the water balance. Quantified results include: net groundwater balance, diffuse surface runoff, model simulation of a continuous lake level decrease (4 m) observed over 2012-2016. Results show the dominance of groundwater exchanges in the lake water balance, with significant interannual variations related to annual precipitation, suggesting that a threshold effect probably limits the seepage when the lake level decreases.

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### **Dynamics of continental atmospheric humidity and vegetation response: new insights from the tripleoxygen isotope composition of oxygen in the water cycle**

*Anne Alexandre (CEREGE, Aix-en-Provence)*

In 2020, a latest generation laser spectrometer, co-funded by OT-Med, ECCOREV and ANR, will be set up at the O<sub>3</sub>HP to measure the triple oxygen isotope composition of the atmospheric water vapor. A complete isotope monitoring of the water cycle at the soil-plant-atmosphere interface should help to further understand how plants respond to seasonal water deficit (WP2). Data from this outdoor experiment will be compared to data recently acquired from climate chamber experiments (Ecotron).

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### **A geoarchaeological approach on natural constraints and potentialities of two archaeological sites from Danube Delta, Romania**

*Bivolaru A. \*, C. Morhange, V. Andrieu-Ponel, V. Bottez, A. Asandulesei*

\* Aix-Marseille Université, UM34, CNRS CEREGE UMR 7330, Aix-en-Provence, France, bivolaru @ cerege.fr

We present the results of the geoarchaeological research conducted at Noviodunum and Histria (Danube delta, Romania). This research is devoted to the study of spatial occupation networks and their relation with coastal and fluvial environments in a highly dynamic deltaic context. Fluvial and deltaic sediments are excellent archives that provide high-resolution data to reconstruct paleo-environmental evolution and human impact on the environment since the Neolithic.

## **Atmospheric fluxes of soluble organic C, N and P to the Mediterranean Sea: potential biogeochemical implications in the surface layer (project AIOLOS)**

*Djaoudi K. (MIO), F. Van Wambeke, A. Barani, S. Hélias-Nunige, R. Sempéré, E. Pulido-Villena*

This study reports the first atmospheric fluxes of soluble organic carbon (C), nitrogen (N) and phosphate (P) to the NW Mediterranean Sea. We found an annual atmospheric flux of 59 mmol C m<sup>-2</sup> yr<sup>-1</sup>, 16 mmol N m<sup>-2</sup> yr<sup>-1</sup> and 24 μmol P m<sup>-2</sup> yr<sup>-1</sup>. These fluxes would be higher than dissolved organic C, N and P fluxes from the Rhône River by 6,17 and 2, respectively. Their contribution to the dissolved organic C, N and P pools in the mixed layer was low for C and P (<5%) and moderate for N (12%).

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## **The Majerda delta (Northeastern Tunisia): From the interest of the archaeological and geomorphological landscape reconstruction by “Georadar GSSI” method to the environmental transition study.**

*ELGHALI Oumaima\*, Mohamed Khaled BOUZID, Mohamed Chedly RABIA and Ameer OUESLATI*

\* Université de Tunis ; Faculté des Sciences Humaines et Sociales, Tunisie ; oumaima\_elghali@yahoo.fr

The archeological and hydrological past of the Majerda delta (North East Tunisia) is the studies in this project thanks to an indirect reading of past legacies, using the "Ground Penetrating Radar GSSI" technic. The first campaigns, applied to several sectors selected in the plain, allowed to identify under the alluvium of structures with different geometric shapes pertaining to construction built or potential water projects or to ancient hydraulic managements. We will try to show the interest of such results for the reconstruction of palaeolandscapes and palaeodynamics. But also for the understanding of the changes of dynamics that the announced environmental change would impose, in particular following a modification in the sea level. Indeed, the plain, especially in its outer fringe, is very low. On the other hand, the river is not as influential in the plains than in the past because of new forms of exploitation and management of its watershed.

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## **O<sub>3</sub>HP (Oak Observatory at OHP), an Observatory to assess the impact of climate change on dynamics, functioning and biodiversity of Mediterranean forests.**

*Thierry Gauquelin\*, Ilja Reiter, Virginie Baldy, Catherine Fernandez, Jean-Philippe Orts, Mathieu Santonja.*

\* (IMBE thierry.gauquelin @ imbe.fr)

The O3HP site (Oak Observatory at OHP) is an experimental site developed within a forest of downy oaks (*Quercus pubescens* Willd.) on the OHP site (Alpes de Haute-Provence, France). The main objectives of the scheme are to assess the response of Mediterranean woodlands, in terms of dynamics, functioning and biodiversity, to climate change. An experimental rain exclusion system makes it possible to change the rainfall regime on a given plot comprising several dozen trees, in particular by modifying the summer drought period. The plot subjected to this climate change is thus compared to a "control" plot.

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## **The surroundings of the former mouth of Oued Majerda and the banks of the lagoon complex of Ghar El Melh-Sidi Ali Lmekki (north Tunisia): recent geomorphologic and landscape evolution and vulnerability to sea level rise.**

*KAROUI Saida\* & Ameer OUESLATI*

\* Université de Tunis, Faculté des Sciences Humaines et Sociales, CGMED, Tunisia (saidakaaroui @ gmail.com)

The lagoon complex of Ghar El Melh-Sidi Ali Lmekki is located in the North of Tunisia, at the north-western limit of the Gulf of Tunis. Separated from the sea by a sandy beach barrier, it is formed of a main lagoon, that of Ghar El Melh, and its “annex”, the lagoon of Sidi Ali Lmekki. This project focuses on the recent evolution of this environment and on our understanding of environment adaptation consequently to changes in the characteristics of the agents in action and particularly the sea level rise already recorded or

announced in the context of the climate change. Surveys with questionnaires are conducted, aiming to know the level of perception, by of the local population and mainly farmers, of the current dynamics.

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## **Dynamic and factors affecting natural regeneration of stone pine in Lebanon**

*NAKHOUL Joseph (IRSTEA)*

*Pinus pinea* is a species of great economic and ecological importance in Lebanon. In our study, we characterized the natural regeneration and dynamics of stone pine stands according to abiotic variables of the environment (climate, soil, topography, etc.) and local vegetation variables (stand density and maturity, vegetation undergrowth, etc.) in the Mount Lebanon region. We found that stone pine stands are old and rarely regenerating with a dynamic that goes towards oaks specifically *Quercus calliprinos*. We also tested the influence of vegetation and soil disturbances on pine regeneration; the influence of litter on seedling emergence; and the influence of site preparation (flipping, burning, control) upon germination. An autotoxic effect of pine pine on natural regeneration has been demonstrated.

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## **Tracking Fires and domestic buRning using carbon isotopEs over the western Mediterranean Sea (TRACFIRE)**

*PANAGIOTOPOULOS Christos (MIO; christos.panagiotopoulos @ mio.osupytheas.fr)*

This project assessed the fate of burning biomass inputs at sea using compound specific isotopic measurements ( $\delta^{13}\text{C}$ ,  $\Delta^{14}\text{C}$ ) on individual molecules (levoglucosan etc) emitted from domestic burning, fires or other biogenic sources. The results showed that  $\delta^{13}\text{C}$  proved a powerful tool to track these species in marine seawater highlighting their terrestrial origin ( $\delta^{13}\text{C}_{\text{levo.}} = -27.2\text{‰}$ ) while  $\Delta^{14}\text{C}$  indicated that these species exhibit a modern age indicating their recent biosynthesis ( $\Delta^{14}\text{C}_{\text{levo.}} = 33\text{‰}$ ).

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## **Atmospheric input of terrestrial organic matter to the surface Mediterranean Sea: origin, fluxes and fate in the water column (project AIOLOS)**

*PULIDO Elvira\*, Christos Panagiotopoulos*

\* MIO, elvira.pulido @ mio.osupytheas.fr

This project assessed the fluxes and fate of organic carbon (OC) delivered to the surface Mediterranean Sea (MS) through atmospheric deposition of anthropogenic aerosols and Saharan dust. The annual atmospheric flux of soluble OC to the MS was  $59 \text{ mmol m}^{-2}$ , 6 times higher that inputs from the Rhone river. The content and fate of aerosol-derived OC was source-dependent. Anthropogenic aerosols showed a higher OC content and solubility than Saharan dust. However, OC derived from Saharan dust was more easily degraded by marine heterotrophic prokaryotes.

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## **Organic contaminants in coastal Mediterranean Sea: from the atmosphere to your plate (MEDPOP project)**

*SEMPERE Richard & Javier Castro Jiménez (MIO javier.castro-jimenez @ mio.osupytheas.fr)*

Results from MEDPOP project highlight that the contaminant status of Mediterranean coastal areas by persistent organic pollutants (POPs) is a "dynamic situation" with important seasonal patterns and high atmospheric transport potential, depending too on the climatic conditions and regulatory framework at both the European and African Mediterranean coasts. Atmospheric contaminants over the Mediterranean coasts are subjected to deposition processes reaching marine waters, many of them bioaccumulating in food webs containing commercial species, which will be consumed by humans giving rise to a potential health risk.

## **The past 23-kyr Eastern Mediterranean Sea circulation inferred from authigenic Nd isotopes, foraminiferal stable isotopes and bulk elemental composition**

*TACHIKAWA Kazuyo\*, Laurence Vidal*

\* Aix Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France (kazuyo @ cerege.fr)

The Eastern Mediterranean Sea (EMS) circulation is sensitive to climate changes as documented by the recent Eastern Mediterranean Transient and occurrence of organic-rich layers (sapropel) in precession cycle. We combine multi-proxy reconstruction obtained on two marine sediment cores collected in the Levantine Sea and the Strait of Sicily (Fig. 1). Authigenic Nd isotopic composition, foraminiferal stable isotopes and elemental composition of bulk sediment are used to trace bottom water masses, water column stratification and bottom/pore water oxygenation state (Figs. 2 and 3). The results confirm the sensitivity of circulation to hydrological changes.

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## **Vulnerability of coastal cultural heritage in the north coast of Cap Bon (Tunisia)**

*TRABELSI S., C. Morhange A. Mrabet*

This poster presents the vulnerability of coastal cultural heritage on the north coast of Cap Bon (Tunisia) and its study. Climate change affects coastal areas with diverse effects and the project takes into account : a research component (reflection on vulnerability and risk in coastal areas, applied to cultural heritage) ; an observation component (with the development of standardized tools, an interactive database and dedicated applications); and finally, a participatory approach (network development). Ultimately, it is the development of coastal preventive archaeology, at the interface of the marine and terrestrial domains.

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## **Historical and paleo-hydrological changes recorded from Moroccan Middle Atlas lakes inferred from sedimentological and geochemical approaches**

*L. Vidal\*, G. Jouve, H. Idabdellah, R. Adallal, K. Tachikawa, C. Sonzogni, A. Benkaddour and A. Rhoujjati*

\* Aix Marseille Univ, CNRS, IRD, INRA, Coll France, CEREGE, Aix-en-Provence, France. Vidal @ cerege.fr)

The Moroccan Middle-Atlas is considered as the “Moroccan water tower” and contains several natural lake systems of tectono-karstic origin functioning as pluviometer. The first study conducted on Lake Azigza via XRF scanning and the microstructures observations provided proxies of runoff activity and lake-level changes. These proxies were calibrated with regional hydro-climatic and instrumental measurements available over the last 50 years and used to reconstruct past hydrological changes on inter-annual to decadal time-scales between 1879 and 2013. A 3 m sequence cored at Flower Lake studied through high-resolution geochemistry (XRF), and sedimentological and isotope analysis, establishes links between the chemical composition, the humidity conditions, and the surrounding landscape during the last 2500 yrs BP.

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## **Geoarchaeology and geomorphology of pharaonic harbors of the Red sea and Giza (Egypt)**

*YOUNES Gamal, Nick MARRINER, Christophe MORHANGE*

The project objective is the study of palaeo-environmental changes that have affected the development and spatial organization of Pharaonic harbors of the Red Sea (Gawasis harbor) and Giza harbor in Egypt for about 5000 years, in a historical and geomorphological context. In this study we used a multidisciplinary approach where the field techniques and laboratory tools are linked to the geosciences and biological sciences for make recommendations on protection of the archaeological heritage.

## WP2: IMPACT OF CLIMATE AND SOCIO-ECONOMIC CHANGE

WP2 aims to understand the impact of climate and socio-economic changes on ecosystems with a focus on the ecosystem services, in particular related to :

- biodiversity: databases, conservation, management, services, evolution
- soils: impacts of land use and climate, quality indicators, modelling, management
- agriculture and forestry: modelling and scenarios
- marine ecosystems: functioning, resources, trophic webs, artificial reefs, marine protected areas.

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### **Climate change effects on soil biota in Mediterranean forests mainly depend on taxonomic group and forest type (project CYCABIOCLIM)**

*Aupic-Samain A\*, Santonja M., Chomel M., Pereira S., Lecareux C., Reiter I., Limousin J.-M., Ourcival J.-M., Simioni G., Gauquelin T., Fernandez C., Baldy V.*

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In forest ecosystems, water availability can directly affect soil organisms by altering microclimatic conditions, but also indirectly by altering litter quality produced by trees. However, our knowledge about such effects in Mediterranean forests still limited. In this context, we experimentally manipulated in three Mediterranean forests the precipitation patterns (direct effect) and the litter type (indirect effect) in order to determine their relative effects on soil microbial and mesofauna communities. After two years, we observed no indirect effect of decreasing precipitation on soil biota, while direct effects were mainly dependent on taxonomic group and forest type.

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### **Hologenome diversity and adaptation in Mediterranean gorgonians: tools for new management strategies of marine forests**

*Didier AURELLE (didier.aurelle @ univ-amu.fr)*

In the A\*Midex "HoloDiv" project, we will investigate the adaptive potential of the yellow gorgonian *Eunicella cavolini*, through an integrative analysis of the genetic diversity of the host and its microbiome (bacteria, viruses and eukaryotes). The project relies on the study of the diversity of populations in different Mediterranean regions and ecological conditions (depth, pollution). The results will feed the reflexion conducted with MPAs managers to design innovative management actions.

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### **Genomic study of red coral *Corallium rubrum* at different depths : in the search of local adaptation.**

*Didier AURELLE (didier.aurelle @ univ-amu.fr)*

The Mediterranean red coral has been affected by long term harvesting, and by recent mortality events linked with heat waves. This species present different thermotolerance levels according to depth. We used population genomics to study the potential local adaptation of this species to thermal regime. We evidenced a significant differentiation between depths, along with differences in diversity. These results allow better understanding the evolution of red coral facing global change.

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### **Plankton as biological pump for contaminants in marine ecosystems: a trans-Mediterranean approach (MERITE HIPPOCAMPE cruise, April-Mai 2019)**

*François Carlotti\*, Jacek Tronczynski, Marc Tedetti, Marc Pagano, Cédric Garnier, Daniela Banaru, Cherif Sammari, Malika Bel Hassen*

\* MIO University of Aix-Marseille, University of South Toulon-Var, CNRS/INSU, IRD, UM 110, 13288 Marseille, France



Recent research works on bioaccumulation of contaminants along trophic food webs suggests that plankton plays a central role as a 'contaminant pump'. The MERMEX-MERITE-HIPPOCAMPE oceanographic cruise carried out in spring 2019 (April-May) aimed at studying the interactions between plankton and metallic and organic contaminants along a North-South trans-Mediterranean transect in contrasted areas of scientific and economic interests (primary production, fishing zones, ecoregions, urbanized bays).

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## **Diet and body condition temporal variations of the French Mediterranean sardines**

*CHEN Chia-Ting\**, *BĂNARU Daniela*, *HARMELIN-VIVIEN Mireille*, *CARLOTTI François*

\* Aix Marseille Université, CNRS/INSU, IRD, Mediterranean Institute of Oceanography (MIO), France (chia-ting.chen @ mio.osupytheas.fr)

In the Gulf of Lion, a shift occurred during the last decade in the feeding behavior of sardines, probably linked to a bottom-up control of plankton. During this period was noticed a decrease in their biomass and body condition. In this study, we showed the temporal variation of their diet and the quality of their prey in terms of community composition, biochemical and energy content. Sardines relative body condition was correlated to the energy content of their alimentary bolus.

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## **Abiotic degradation of terrestrial particulate OM (TPOM) discharged by the Rhône River in Mediterranean Sea (BALTOMS project)**

*GALERON M.-A.*, *RONTANI Jean-François\**

\* Aix Marseille Université, CNRS/INSU, IRD, Mediterranean Institute of Oceanography (MIO), France

Thanks to the use of new lipid tracers specific to the autoxidation of higher plants, we could generalize observations made in the estuary of the Mackenzie River (Canadian Arctic) at the mouth of the Rhône River. We have been able to demonstrate that the autoxidation of MOPT is induced by certain radical-producing enzymes (lipoxygenases), whose activity is exacerbated by the increase of salinity in the transitional waters.

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## **Mediterranean coastal conditions and litter type drive litter microbial responses to drought stress (FORESOILMED project)**

*KHEIR Maya\**, *K. ROCHE*, *A. M. FARNET DA SILVA*

\* (maya.kheir @ imbe.fr)

Aix Marseille Université, CNRS, IRD, Avignon Université, IMBE UMR 7263, Marseille & RECOVER, IRSTEA, Aix en Provence

Microbial responses to drought stress were shaped by the origin of litter (coastal/inland) and the effect of litter type (*Pinus halepensis*, *Pistacia lentiscus* and their admixture) was smoothed by the coastal print. Fungal and bacterial catabolic potentials were controlled by coastal conditions and litter type respectively: fungi were more sensitive to coast-specific conditions and bacteria to their immediate surrounding. Catabolic potential of inland microbes was more impacted by drought.

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## **Climate change alters leaf litter chemistry, slowdowns litter decomposition and modifies "Home field advantage" in three Mediterranean forests (CYCABIOCLIM project)**

*Pereira S.\**, *Quer E.*, *Santonja M.*, *Gauquelin T.*, *Simioni G.*, *Ourcival J.-M.*, *Joffre R.*, *Limousin J.-M.*, *Aupic-Samain A.*, *Greff S.*, *Lecareux C.*, *Dupouyet S.*, *Orts J.-P.*, *Reiter I.*, *Bousquet-Mélou A.*, *Sagova-Mareckova M.*, *Fernandez C.*, *Baldy V.\**

\* virginie.baldy @ imbe.fr

We followed the litter decomposition in three experimental Mediterranean forests with rain exclusion device (Aleppo pine in Fontblanche, holm oak in Puechabon and downy oak in O<sub>3</sub>HP). Drought intensification

altered leaf litter quality of the three tree species, had an overall negative direct effect on leaf litter decomposition but had not an indirect effect mediated by a change in leaf litter quality, suppressed home field advantage for litter to decompose at home. These results may suggest important alterations of plant-soil interaction in Mediterranean forests under amplified drought conditions.

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### **Soil respiration responses to the reduction of rainfall events in a Mediterranean oak forest in southern of France (CYCABIOCLIM project)**

*Pereira S., Ruffault J., Gauquelin T., C. Fernandez C\*, V. Baldy V.\**

\* virginie.baldy @ imbe.fr

In Mediterranean regions, soil respiration (SR) is highly dependent on temperature and precipitation regimes, which are both projected to be affected by climate change. We measured soil CO<sub>2</sub> effluxes under natural drought conditions and amplified drought conditions in Mediterranean downy oak experimental forest (O<sub>3</sub>HP). The variability of SR with the soil water content and temperature did not change with drier conditions, however it was strongly affected by season. GAM and BRT models revealed a positive relationship between SR and soil relative water content and temperature till certain threshold. Projections of SR from simulation from historical data indicates an increase of SR in 2100.

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### **Tracking shoreline erosion of “at risk” coastal archaeology (Persian Gulf: Sassanid-Islamic heritage relicts in southeastern Bataneh, Iran)**

*Majid Pourkerman\*, Christophe Morhange, Nick Marriner, Morteza Djamali, Hamid Alizadeh Lahijani, Hossein Tofighian*

\* Aix-Marseille Université, CEREGE, CNRS, Europôle de l'Arbois BP 80, 13545 Aix-en-Provence, France & Iranian National Institute for Oceanography and Atmospheric Science (INIOAS), Tehran, Iran.

The Persian Gulf hosts numerous waterfront heritage sites of both national and international importance and numerous sites are eroding today. The Bataneh archeological site has been selected because of its location in the coastal zone and due to the importance of its Sassanid-Islamic cultural heritage. In order to evaluate shoreline erosion, we used multi-temporal Landsat images series since 1973 and meteorological data for the last 26 years and quantified windspeed increase, whilst precipitations dropped and temperatures increased. Overall, the rate of coastal erosion has increased dramatically and threatens the waterfront archaeology of the Persian Gulf.

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### **Biotic degradation of terrestrial particulate OM (TPOM) discharged by the Rhône River in Mediterranean Sea (BALTOMS project)**

*P.I. RONTANI Jean-François (MOI, jean-francois.rontani @ mio.osupytheas.fr)*

We could demonstrate that priming effect (biodegradation of recalcitrant substrates in the presence of readily assimilable cosubstrates) plays an important role in the biotic degradation of TPOM in the Rhône Estuary. Diatoms appeared to be cosubstrates particularly well adapted to the degradation of TPOM. The use of <sup>13</sup>C labelling higher plants allowed to characterize the main bacteria involved in the degradation of TPOM (DNA-SIP and RNA-SIP analyses).

## WP3: HUMAN-ENVIRONMENTAL INTERACTION: PERCEPTION, ADAPTATION AND MITIGATION

WP3 will analyse **human-environment interactions**, looking at the perception of hazards, adaptation and mitigation.

- modelling decision making in the context of risks
- co-evolution of climate and societies, adaptation to climate change
- comparison of international governance regimes for climate and biodiversity
- improved management of ecosystems for conservation and sustainable delivery of ecosystems.

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### **Biotic Interactions (large mammals, Hominins, ecosystems) and climate changes over the last 3 Ma in Turkey.**

*ANDRIEU-PONEL V., Rochette P., Demory F., Alcicek H., Boulbes N., Bourlès D., Helvacı C., Lebatard A.E., Mayda S., Moigne A.M., Nomade S., Perrin M., Ponel P., Rambeau C., Vialet A., Cihat Alçiçek M.C*

Not available

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### **Outcomes of the Summer School “Mediterranean Ecosystem Restoration” held in May 2013.**

*BSUISSON Elise (IMBE / Avignon Université)*

In May 2013, 20 people joined the Summer School cofunded by OT-Med. Participants came from Europe, Russia, America, as well as Algeria, Tunisia and Niger. Nineteen experts gave talks and led excursions. Talks tackled subjects from genetic diversity, agricultural landscapes, wetlands and phytoremediation in relation with restoration. The field trips went from Mont Ventoux 19<sup>th</sup> century afforestation project to the Camargue wetlands and from the steppe of La Crau to the dunes of the Berre Lagoon.

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### **Impact of metal contaminants from the Gardanne alumina plant in the Cassidaigne canyon (Mediterranean Sea) (CONTALT project)**

*JACQUET Stéphanie (MIO stephanie.jacquet @ mio.osupytheas.fr)*

The submarine discharge of a high pH clarified Bayer effluent of the Gardanne alumina plant in the NW-Mediterranean Sea leads to the massive formation of concretions and particles at the outfall. We determined their chemical and mineralogical composition, and estimated their formation rate, size distribution and settling rate. This work is part of an on-going investigation of the impact of trace metal contaminants in marine ecosystems in urbanized/industrial mediterranean coastal zones.

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### **Transparency and Accountability In Climate Finance Governance (CIRCULEX project)**

*TABAU Anne-Sophie, Sandrine Maljean*

Not available

## TWP1. THE OBSERVATION SYSTEMS AND DATABASES

The objective of TWP1 is to coordinate existing observation systems in relation with modelling (TWP2):

- Marine Observation Services
- Human-Environment Observatory Bassin Minier de Provence
- Oak Observatory in Observatoire de Haute Provence (O3HP)
- The Chad Observatory
- Climed Observatory

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### **Carbonate system and air-sea CO<sub>2</sub> fluxes dynamics at the regional scale of the Bay of Marseille (France) under natural and anthropogenic atmospheric forcing: a modelling approach (AMC project)**

*LAJAUNIE-SALLA K, Dominique Lefèvre, Irène Xueref-Remy\* (MIO)*

\* irene.remy-xueref @ univ-amu.fr)

The Bay of Marseille is impacted by the urbanized and industrialized area which is subject to significant increases in emissions of CO<sub>2</sub>. A carbonate chemistry balance module has been implemented within a biogeochemical model of planktonic food web. We quantify from model results the contribution of external physical forcing (wind, river discharges and temperature variations) and also the atmospheric CO<sub>2</sub> emissions on the variability of carbonates variables and air-sea CO<sub>2</sub> fluxes in the Bay.

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### **Temporal variability of the carbonate system and air-sea CO<sub>2</sub> exchanges in the Bay of Marseille over a two-year period**

*WIMAR-ROUSSEAU C, Dominique Lefèvre\*, Irène Xueref-Remy (MIO)*

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The SOLEMIO coastal observation site, located in the Bay of Marseille, is under anthropic influence. A two-year time-series (2016 - 2018) shows that, on an annual scale, the Bay acts as a sink for atmospheric CO<sub>2</sub>. In addition, our study shows that temperature, rather than biological processes, mostly drives the air-sea pCO<sub>2</sub> difference. On this land-ocean boundary area, no linear relationship between A<sub>T</sub> and salinity is observed due to sporadic intrusions of Rhone River freshwater.

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## TWP2. TOWARD AN INTEGRATED MODELLING OF THE MEDITERRANEAN SYSTEMS

The goal of TWP2 is to develop **integrated model** for the Mediterranean based on several major coupled components:

- Complex general circulation models (GCM) (ex. IPSL and intermediate complexity models to make joint climate simulations ex. [LOVECLIM](#))
- Downscaling using statistical models and meso-scale models (collaborations with labex L-IPSL)
- Ecosystem models to simulate the natural vegetation and water budget at the scale of the catchment basin: LPJ-GUESS, LPJmL
- Agro-ecosystem model LPJ-managed Lands ([LPJmL](#)) Collaboration will be also developed with the LABEX BACS around the model IPSL-ORCHIDEE.
- Marine model, OT-Med partners are developing their own codes for 3D physical-biogeochemical coupled models, coupled to hydrodynamical models developed in by other collaborating institutes (e.g. Eco3M).
- Modelling of societal behaviour in the face of changing climate will be based on multi-agent socio-economic models.

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### **Changing agro-ecosystems and urban areas in the Mediterranean basin: modelling the dynamics of the land-sea nutrient transfer. (LaSer-Med project)**

*AYACHE Mohamed , Wolfgang Cramer, Melika Baklouti, Alberte Bondeau, Dominique Ami*

Runoff from rivers and coastal plains delivers significant amounts of nutrients to the Mediterranean sea. Agricultural seepage and urban waste waters have strongly altered the natural biogeochemical cycles of the entire basin, affecting the overall nutrient transfer to the sea and impacting the marine ecosystem. A representation of the land-sea nutrient transfers has been implemented within the agro-ecosystem model LPJmL. First simulations indicate the magnitude of impact caused by changes in cities and agro-ecosystems of the basin on the land-sea transfer dynamics during recent decades. Alternative scenarios for land change will allow to explore the future amounts of terrestrial nutrients that will reach the sea and its ecosystems.

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### **Towards an integrated prediction of Land & Sea Responses to global change in the Mediterranean Basin: The LaSeR-Med Project**

*BAKLOUTI Melika (MIO), Alberte Bondeau (IMBE), Dominique Ami (AMSE)*

The LaSeR-Med project (Towards an integrated prediction of Land & Sea Responses to global change in the Mediterranean Basin) aims at studying the impact of climate change alone or combined with socio-economic scenarios on some key ecosystem services provided by this basin. A multi-disciplinary approach based on an integrated model has been used for this purpose. The different components (economics, agro-ecosystems, oceanography) of the integrated model of this model have required specific preliminary studies that are presented in dedicated posters.

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### **Modeling *Pelagia noctiluca* dynamics in the Mediterranean Sea (LaSer-Med project)**

*BERLINE Berline, Guiart Pierre, Poggiale Jean-Christophe, Augustine Starrlight, Melika Baklouti*

In the Mediterranean Sea, most jellyfish outbreaks are caused by *Pelagia noctiluca*, but its abundance and biomass remained non-quantified, as well as its impact on zooplankton. Here we use a Lagrangian-DEB model to study the dynamics of *Pelagia noctiluca*. Each jellyfish-particle is forced by the temperature and

zooplankton taken from a coupled physical-biogeochemical model. Results on distribution of abundance, biomass and reproduction variables are discussed.

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### **Challenges to maintain Food security conditions at the scale of the Mediterranean region (LaSer-Med project)**

*MARDESIC Ivana, Claude Napoléone, Pierre Batteau, Melika Baklouti, Alberte Bondeau, Dominique Ami*

Our study aims to implement innovative and interdisciplinary methods, to better understand the relationships between agricultural production and food security at a sub-national scale, in the Mediterranean basin, facing two major challenges: climate and population changes. Facing these changes, we predict, using econometric model, agricultural food production in 2050 and explore several scenarios of land use changes to maintain a given level of agricultural food security, defined as the current level of the food self-sufficiency ratios.

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### **Changes in rivers inputs during the last decades significantly impacted the biogeochemistry of the eastern Mediterranean basin: a modelling study (LaSer-Med project)**

*PAGES Remi, Mohamed Ayache, Nicolas Barrier, T Moutin, Melika Baklouti, Alberte Bondeau, Dominique Ami*

Recent studies have shown that rivers inputs variations may play a significant role on the biogeochemistry of the Mediterranean Sea though additional studies are necessary. Here we show that phosphate concentrations in the surface layer have decreased, especially in the eastern basin, resulting in higher dissolved organic carbon concentrations and export. This study also provides a new potential explanation for the shift between the top of the nitracline and the phosphacline in the eastern basin.

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