Scientific conference
Climate Change and its implication to Smart ICZM and sustainable Blue Growth
Abstract book

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POSTER SESSION

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SESSION 1: PALEOCLIMATE AND THE CLIMATE SYSTEM

Adaptation of sandy coasts to changing climate conditions during the Holocene

Susana Costas
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Coastal barriers around the world developed following sea level stabilization about 7000 years ago. Along the Southwestern European coast, this fact was largely supported by recent works exploring the sedimentary record of coastal lagoons and estuaries. However, direct evidences of barrier evolution/age obtained from the actual coastal barriers are rare, limiting our understanding about the dynamics and life time of these systems at long time scales. The latter is highly relevant for understanding how sandy coasts adapt to changing climate conditions and contribute to more adequately facing future adaptation.

Here, we reconstruct the evolution of three coastal barriers located along the western Portuguese coast, determining their age, trends and life cycles. For that, we integrate information (stratigraphy and ages) from different coastal deposits indicative of major shifts on evolutionary trends, including published and unpublished data.

Examined beach deposits set the age of the explored sand barriers between 6400 and 300 years ago, suggesting the coexistence of very mature and very recent coastal barriers. In addition, the results document the occurrence of transgressive dunefields with ages older than the preserved coastal barriers, supporting the existence of former barriers from which the dunes could derive and migrate inland. The latter suggests the occurrence of episodes of barrier building and shoreline progradation alternating with episodes of inland migration of transgressive dunefields and thus barrier rollover.

Resultant trends are carefully examined to identify the major factors driving barrier evolution, with special attention to climate variability and local boundary conditions. Indeed, the episodic response of the explored sand barriers provides indications for shifting wave and wind conditions as a consequence of climate variability. Additionally, inter-site comparison provides significant insights into regional trends and allows rating the identified factors, based on the degree of direct influence over the evolution of the coast. In this regard, the exposure to wind and wave climate, usually linked to shorter time scale processes, may have a remarkable importance over coastal barrier response at long (hundreds of years) time scales. In addition, this work remarks the important role that transgressive dunefields have within the overall process of barrier transgression through rollover.

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Ocean-climate: the regulating role of the ocean on a planetary scale:

Paul Tréguer
University of Brest

After basics and fact-finding demonstrating the reality of climate change since the beginning of the industrial age, we will show how the ocean regulates the climate on a global scale and what are the impacts of the change and the predictions of the IPCC for the 21st century (rising waters, changes in thermohaline circulation, physical and biological carbon dioxide pumps, consequences for marine ecosystems).

Ocean-climate: the physical and biological pump of carbon dioxide

Paul Tréguer
University of Brest

After recalling the basic elements demonstrating the reality of climate change since the beginning of the industrial era, we will ascertain how the ocean regulates the carbon dioxide content of the atmosphere through the physical (physical pump) and biological processes. (biological pump) and what are the disturbances of these pumps due to climate change.

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Facing the challenge of climatic change: what can we learn from the marine macrophytes from Spain?

Ignacio Hernandez
University of Cadiz

Climatic change has been acknowledge as one of the main threats for the biosphere and the ecosystem services it provides, especially for marine and coastal ecosystems. These effects include a global decline in areas covered by seagrasses and shifts in the distribution of some relevant macroalgal species. Effects of climatic change in the communities of marine macrophytes are related to ocean acidification, increase in the seawater temperature and higher frequency and intensity of extreme climatological events. These effects often interact among them and also with other consequences of the global change. Based on the current knowledge of the communities of marine macrophytes in Spain, some possible trends and responses of these communities are forecast. These responses are discussed taking into account methodological difficulties. The use of indicators based in marine macrophytes can help to monitor further changes in the communities and thus promoting the adoption of management measurements.

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High-resolution survey in both space and time of the Gibraltar strait: the hydrochanges Gibraltar international program managed by CIESM

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Résumé

Ces travaux sont effectués dans le cadre du programme Hydrochanges piloté par la CIESM (www.ciesm.org). Sont impliqués des laboratoires et instituts du pourtour méditerranéen pour un suivi à long terme des paramètres hydrologiques de base (température et salinité). Il a permis de collecter, avec une résolution temporelle adéquate, dans les endroits clés de la Méditerranée (détroits et canaux de la formation d'eau dense, parties profondes des bassins), des données nécessaires à la compréhension des changements globaux et climatiques. L'entretien annuel 2012 des mouillages Hydrochanges opéré à Gibraltar conjointement par le Maroc (Marine Royale, FST-Tangere/FP-Larache) et la France (Institut méditerranéen d'océanographie / MIO / Université d'Aix-Marseille / CNRS / IRD / USTV). Ces travaux ont permis d'avoir un aperçu détaillé sans précédent de la situation hydrologique au niveau du détroit de Gibraltar avec une nette augmentation de la température des masses d'eaux échangées entre l'Atlantique et la Méditerranée à différentes profondeurs montrant clairement l'impact des changements climatiques.

Abstract

This work is carried out under the Hydrochanges program led by CIESM (www.ciesm.org). Mediterranean laboratories and institutes are involved for long-term monitoring of basic hydrological parameters (temperature and salinity). It has made it possible to collect, with adequate temporal resolution, in the key places of the Mediterranean (straits and channels of the dense water formation, deep parts of the basins), data necessary for the comprehension of the global and climatic changes. The 2012 annual maintenance of the HydroChanges anchorages operated in Gibraltar jointly by Morocco (Royal Navy, FST-Tangere / FP-Larache) and France (Mediterranean Institute of Oceanography / MIO / University of Aix-Marseille / CNRS / IRD / USTV). This work provided an unprecedented detailed overview of the hydrological situation in the Strait of Gibraltar with a marked increase in the temperature of the water masses exchanged between the Atlantic and the Mediterranean at different depths clearly showing the impact climate change.

Co-funded by the Erasmus+ Programme of the European Union

Les changements climatiques au Maroc depuis 21000 ans BP jusqu'à aujourd'hui.

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L'étude multidisciplinaire utilisant la minéralogie, la géochimie et les traces du feu au niveau des sédiments du lac Ifrah (Moyen Atlas, Maroc) offre de nouvelles perspectives pour une meilleure compréhension des variations climatiques depuis le dernier maximum glaciaire à nos jours. Depuis 21 000 jusqu'à 13 000 ans cal BP, la concentration des sédiments en microcharbons était très faible en liaison avec une faible activité de feu et un climat froid. La phase comprise entre 13000 et 10800 ans cal BP est une période de transition. Le début de l'Holocène moyen (entre 10800 et 4500 ans cal BP) se caractérise par une forte augmentation de la concentration de particules de microcharbons. Un pic de ces particules est observé à 8200 ans cal BP. Cette phase est marquée par une forte activité des feux au cours d'une période sèche. L'Holocène supérieur marque le retour des conditions climatiques humides manifestées essentiellement par une baisse modérée de la concentration de particules de microcharbons. Tous les autres paramètres (sédimentologiques, minéralogiques, géochimiques et paléoécologiques) montrent la même évolution climatique.

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SESSION 2: COASTAL HAZARDS AND CLIMATE CHANGE

Plastic debris in the ocean, a new problem at a biosphere globally changing

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In the recent decades, we are facing an unprecedented process of marine plastic accumulation in the global ocean, rising great international concern regarding the possible effects of the microplastic-associated pollutants on marine life and even human health. The scientific uncertainty on this issue is still large; however, recent work in which the “Ocean plastic research group” from University of Cádiz is taking an important leadership, is now giving some clarification of several aspects regarding (1) the general balance of plastics in the ocean; (2) the spatial distribution of plastics at coastal and offshore waters; (3) the temporal dynamics including the effect of episodic events; (4) the effects of plastics on trophic networks and ocean biota. Recent progress coming from several projects funded by Spanish Government (project MIDAS) or BBVA Foundation (project PLASTREND, both with participation of researchers from University Abdelmalek Essaadi), and from the European Spatial Agency (ESA) will be presented in this talk.

Co-funded by the
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Risk assessment and decision support tools for the evaluation of multiple climate change impacts in coastal and marine areas.

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Global climate change is expected to pose increasing environmental problems across different regions and sectors worldwide. The expected impacts at the land-sea interface have grown in complexity due to the interaction of multiple sources of hazards (sea level rise inundation, increased storm surges, saltwater intrusion, sea water quality deterioration, land use changes), with potential cumulative effects on population, ecosystems and economic activities. Moreover, the large amount of climate, environmental and socio-economic data and information that needs to be handled requires innovative methodologies and tools to produce comprehensive and multi-hazard risk scenarios.
A combination of vulnerability indicators, Geographical Information Systems (GIS), and Bayesian Belief Network (BN) methods have been implemented in the Decision Support System for Coastal Climate Change Impact Assessment (DESYCO), as supporting tool able to integrate and spatially represent the effect of multiple climate change impacts in coastal and marine areas.
By providing multiple evaluation modules, the actual version of the DESYCO allows potential end users to implement single and cumulative impact assessment processes, offering a wide range of functionalities to address risk assessment and management. In fact, the tool and its Graphical User Interfaces (GUI) closely follow the conceptual model of the Regional Risk Assessment procedure (RRA), enabling potential end-user to perform the step by step assessment, varying input parameters, testing and comparing different combinations of scenarios, receptors and adaptation options. So far the DSS was in a wide array of case studies characterized by different geographical features and environmental issues as well as planning and management needs, often linked to specific European and national regulatory requirements (e.g. terrestrial coastal environment, shoreline planning, land use and water resource management, flood risk reduction, ecosystem services evaluation).
After a preliminary overview about the structure and software architecture of the tool, some example of its application across a range of real case studies will be presented in order to show the capabilities of the tool to aid decision making and climate proofing in a wide range of situations.

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Impact of climate change on coastal sand mobilization

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The Moroccan coastline is a fragile and vulnerable environment intensely exposed to the phenomenon of silting, anthropogenic actions and pollution by heavy metals.
In this work, we are interested in the problem of the degradation of the coast of the Gharb region while underlining the impact of each factor.
Sediment inputs into this coastal area of Morocco have declined significantly. Removals of marine erosion, wind power and sand extraction in open pits and dredging are no longer compensated; hence the often intense environmental imbalance in many parts of the region.
The results of this study highlight the state of often advanced or even locally irreversible degradation of the coastline of the Gharb region. Such a finding suggests the need for the development and implementation of an integrated management plan for the protection and rehabilitation of this coastal zone.

Key words: coastline, Gharb, Sebou estuary, degradation, dredging, quarrying, silting, erosion.

Co-funded by the Erasmus+ Programme of the European Union

Vulnerability of the Moroccan coastal facing the extreme hazards

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Owing to their touristic and economic interest, Moroccan Coastal systems are home to a large and growing proportion of the population. The many human activities, coupled with climate change, make them vulnerable and sensitive ecosystems.

Risk (R) arises from the spatial and temporal combination of a hazard (A, phenomenon) and issues (E: physical, human, functional, economic, etc.) with a certain vulnerability (V: propensity to damage D). Then: R (Risk) = A (hazard) x E (issue) x V (Vulnerability).

The risk is canceled if one of the components is zero. Factors, criteria and indicators are the Risk Indices.

The Moroccan coast has a strategic position between Europe and Africa, between the Mediterranean and the Atlantic, at the crossroads of water masses of different origins with coastlines of nearly 3500 km (Atlantic and Mediterranean). The Moroccan coastline includes several types of habitats (lagoons, estuaries, bays, beaches, etc.) hosting a diverse flora and fauna.

Threats to the Moroccan marine and coastal environment are diverse. Indeed, historical and field studies have shown the existence of:

- Significant seismicity in the Gulf of Cadiz and therefore probable tsunamis,
- A large number of flood sites,
- Storms with significant impacts on infrastructures, coastline and human lifestyle.

The purpose of the presentation is:

1- To highlight the risks associated with threats caused by extreme events: (Storms and tsunami) and their impact on the Moroccan coastline.

2- To establish a state of knowledge in Morocco on these types of risk (are we prepared for such phenomena?)

3- The role of scientific research in developing decision support tools for integrated risk management.

Co-funded by the Erasmus+ Programme of the European Union

Impact of climatic variations on the vulnerability of coastal aquifers in western Morocco: The case of tbe Doukkala sahel and the coastal Chaouia

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The Doukkala sahel and the coastal Chaouia is part of the coastal Moroccan Meseta, the only water resources correspond to the groundwater of the Plio-Quaternary, cretaceous and paleozoic aquifer. Characterizing aquifer geometry will map permeable and vulnerable zones, determine the shape of hydrogeological substratums by geophysical, hydrogeological, geochemical and geological methods with the aim of studying the impact of marine intrusion on the coastal aquifer of the Sahel of Oualidia, taking into account climatic parameters (precipitation, temperatures, evapotranspiration), tidal oscillations and atmospheric pressure.

The climate study revealed a long series for the last three decades an increase in the average annual temperature, evaporation and evapotranspiration parallel strongest precipitations contributions have fallen and therefore higher water needs.

The study of marine tidal wave propagation in the coastal aquifer has made it possible to characterize the general hydrodynamic behavior of the aquifer and to evaluate the characteristic parameters of the environment, such as diffusivity.

The hydrochemical study revealed a contamination of groundwater. The multivariate statistical approach and the Stuyfzand classification showed a high salinization of groundwater in the littoral fringe indicating a probable contamination by the marine water.

The interpretation of the electrical tomography profiles indicate that the origin of the salinity is due to a marine intrusion in the studied aquifers.

Co-funded by the Erasmus+ Programme of the European Union

Marine submersion risk analysis of the Mehdia coast

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The Moroccan Atlantic coast is not sheltered from immune to the risk of marine flooding due to strong storms. These later are becoming more dangerous with the global warming which seem to strengthen with the warming of the earth. Different areas of the Atlantic coast have been crossed by swells several times over the past two decades (Salé, Casablanca,). These storms become more and more energetic and cause significant damage.

In this context, the purpose of this paper is to assess the risk of Kenitra coast flooding during extreme events of marine storms while taking into account the effect of sea level rise. In fact, this coast is presently involved in development projects for the entirety of its coastline and is raising controversy over its vulnerability to the risks of marine submersion. The outputs of this study attempt to enlighten coastal managers on this issue in order to stimulate protection measures adapted to this area.

The approach adopted in this study is based on the estimation of extreme oscillations of sea levels and their return periods, and their cartographic representation on the digital terrain model. Two methods are used here. The first is based on a static model. The second is approached by modeling using the SWAN and SWASH models. Both methods are developed taking into consideration the variation of the morphological configuration of the coast which includes sandy beaches of Mehdia and Chlihat and the mouth of Oued Sebou, maintained by dikes and protective walls.

The results of this analysis reveal a low vulnerability of this coast to flooding, with however a non-zero risk during extreme events. The area that seems to be most vulnerable is restraint and is located near the southern dike of Mehdia. The scope of this risk is otherwise limited and its protection does does not require complex interventions.

Co-funded by the Erasmus+ Programme of the European Union

Moroccan coastal zones: vulnerability to climate change

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Natural and human systems of the coastal zone are vulnerable to climate change and its various consequences. One of the main impacts of climate change is sea level rise which affects coasts worldwide. Ecosystems are also vulnerable to changes in water temperature and acidity, both of which have already changed notably in the world's oceans. In many, but not all regions, the intensity of extreme weather events has increased. In addition to these, local conditions, in the Moroccan Atlantic coast, are evolving and altering the natural dynamics of the coastline. All taken together, these factors lead to a generalized increase in coastal erosion rates, in added stresses for ecosystems and ultimately threats to properties, infrastructures and the livelihood of communities.

Co-funded by the Erasmus+ Programme of the European Union

Perception of coastal hazards relating to sea level rise in morocco

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In recent years, perception of coastal risks has become an important topic to policy makers concerned with risk management and safety issues. Understanding perceptions of climate change risks by the population is a prerequisite for effective climate change communication and adaptation. So Knowledge of the public risk perception is considered a crucial aspect in risk management as it will steers the development of effective and efficient coastal hazards mitigation strategies. This study examines the perception of coastal risks concerning sea level rise in the coastal zones of 4 Moroccan cities (Atlantic coast) among those impacted by energy waves and storms of the last 5 years: Particularly the residents in front sea in four cities, Salé, Rabat, Bouznika et Mohammedia coastal users and tourists.

We conducted a survey and interviews to analyze the perception of coastal changes due to erosion and submersion. Results show that:(1) In recent years, with the succession of marine storms and damage to the shoreline, the perception of flood risk has become an important issue for residents on the seafront; (2) hazard proximity influence the risk perception among coastline inhabitants; (3) Overall, perceptions did not vary with geographic location or socioeconomic status, but reflected residents perceptions of personal vulnerability to sea level rise and (4) the past experience was a significant influence.

Despite the risks, some local residents accepted to live there reflecting a strong sense of place that includes high levels of place attachment. Their willingness to participate in disaster risk reduction measures seemed associated with behavioral barriers driven by mistrust in authorities and the idea of being moved.

Others Residents also revealed low levels of preparedness towards coastal hazards, probably due to their low risk perceptions and their perception of threats as distant in time. However, in the future, climate change is more likely to bring about higher levels of concern Public. Positive Outreach strategies are critical for increasing SLR awareness, promoting action in seafront and can motivate residents to plan for the future and feel safe.

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SESSION 3: ICZM AND ADAPTATION TO CLIMATE CHANGE

An ecosystem service approach to decision-making in the Ria Formosa (South Portugal)

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A sustainable management for coastal areas requires an approach in which decisions are made based on the use of natural resources and the benefits and services provided by the ecosystems. This approach requires the evaluation of the services provided by nature and the understanding on how decisions can alter their provision. The Ria Formosa lagoon is a coastal lagoon along the southern Portuguese coast dominated by coastal vegetation including seagrass and macroalgae beds and salt-marshes. The lagoon is subjected to physical disturbance by bait digging and clam farming, sedimentation due to dredging activities, and high nutrient loads due to urban waste discharge and groundwater inputs, all of them causing the ecosystems' deterioration and potentially affecting their ecosystem services provision, such as water purification, carbon sequestration and nursery support for commercial species. The RiaValue and EcoFun projects aim to estimate the provision of ecosystem services by those vegetated ecosystems in the Ria Formosa when subjected to changes in their status. For that purpose, we have evaluated their carbon stocks, water purification capacity, and their role on the recruitment of commercial bivalves and biodiversity support. Predictions of changes in the delivery of the ecosystem services are being done by running spatially-explicit models under different management and climate change scenarios. The results are successfully providing a framework to help stakeholders to evaluate the impacts of their planning and decision n the environmental and human well-being.

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Climate change and coastal risks: embedded spatio-temporal scales

Catherine Meur-Ferec
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The strong storms of these past decades and their consequences on the coastline have highlighted the causal links that may exist between climate change and current shoreline developments subject to erosion and submersion. However, it seems necessary to put into perspective the contemporary coastal geomorphological dynamics in the context of their long-term evolution. Some examples of shoreline evolution in France thus make it possible to recall that the mobility of the coasts depends on processes acting at different time and space scales, between the post-glacial transgression at the origin of the setting up of the current coasts, historical shoreline developments and permanent adjustments of coastal forms subject to marine-weather phenomena, sedimentary balances and human interventions. Also, in terms of coastal risk management, the envisaged consequences of climate change appear to be aggravating factors in territories that are already very vulnerable, due in particular to the proliferation of constructed issues.

Keywords: coastal erosion, submersion, geomorphology, climate change, spatio-temporal scales, coastal risks

Co-funded by the Erasmus+ Programme of the European Union

Tools for supporting the adaptation of aquaculture to Climate Change

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Site selection is a key step in the implementation of the Ecosystem Approach to Aquaculture, endorsed by FAO. This complex task, should be carried in the general context of ICZM and Maritime Spatial Planning. The identification of AZA, Allocated Zone to Aquaculture, could play a major role in these processes, in particular for shortening the time required to obtain farming licenses and ensuring the environmental, economic and social sustainability of aquaculture in leased areas within an AZA. In order to achieve this goal, maps of suitability indices, targeting specific aquaculture activities, are key inputs for a science-based AZA identification process. In this talk, a methodology, i.e. Spatial Multi-Criteria Evaluation (SMCE) for mapping the suitability for both shellfish and finfish marine aquaculture is presented. The methodology is based on the combination of a set of spatially explicit criteria, concerning the environmental, economic and social sustainability of a specific aquaculture production. Criteria concerning the potential biomass yield, which it taken as a proxy of the expected revenues, are obtained by means of ecophysiological models, which simulates the growth of target species in relation to the prevailing environmental condition, such as water temperature and, for shellfish, chlorophyll a. These are estimated from remotely sensed Earth Observations, but can also be obtained from climate change scenarios, in order to assess the robustness of a given zoning with respect to likely changes in temperature and trophic conditions. The methodology, developed within the EU H2020 project "AquaSpace" (http://www.aquaspace-h2020.eu/) was successfully applied to mussel farming in the Adriatic Sea and is now being tested for seabass and seabream farming along the Italian coastline.

Co-funded by the
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The role of dune system morphology on habitats development

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Well preserved dune systems act as the most effective barrier against the influence of the sea, such as salty and intense winds, storms, tidal waves and sand burial, protecting natural inland habitats as well as nearby urban and agricultural areas. Climate change can influence the balance between sediment supply, coastal erosion degree, modifying the morphology of coastal systems and eventually impair their protective function. The aim of the study is to investigate the relationship between the morphological characteristics of dune systems and the conservation status of coastal grasslands, which are among the most threatened coastal habitats. Data on vegetation were collected along twelve transects, composed of 4-m² plots, from the limit of the wooded area (fixed dunes) to the shoreline. In each plot, all vascular plant species were recorded and the projected cover of all species and moss layer cover were visually estimated. In correspondence of each transect we measured some geomorphological features (e.g. width of the active and inactive dune area, height of the active foredune). The conservation status of each plot was evaluated according to species composition and structure. Through logistic regression, we determined if the presence of the most conserved aspects depended on geomorphological features. We found that a good conservation status of grasslands was linked to higher or wider active dune areas, which better fulfill their protection function of the inland habitats, mitigating the natural disturbance. In order to conserve coastal grasslands, a sustainable beach management should be developed, avoiding direct dune destruction and other actions preventing dune development. To prevent the potential consequences of climate change, management plans should take into account also the preservation or restoration of the foredune plant communities, which are fundamental for the development and self-maintenance of the foredunes.

Co-funded by the
Erasmus+ Programme
of the European Union

Contribution of earth observation data in the analysis of the dynamics evolution of the littoral of Tangier bay: impact of anthropogenic factors on its evolution

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The coastline of Tangier Bay, with its privileged geographical location, is one of the coastal areas of the Mediterranean, which is experiencing urban pressure favoured by industrial and tourist activity. This ecosystem is undergoing many threats, mainly related to the population growth and increasing needs of the population. The fragility of this system risks increasing its vulnerability due to the effects of the urbanization growing and to climatic and coastal hazards. The aim of this study is to analyze the shoreline changes and temporal evolution in the Bay of Tangier between 1958 and 2017 and the impact of the land use dynamics (1987-2017) on the coastline evolution from the analysis of satellite images coupled with aerial photographs and cartographic data.

The analysis of morphological shoreline evolution of Tangier Bay shows that coastline changes have occurred at variable speeds. The period 1958-1984 is characterized by widespread erosion with an average rate of 1.3 m / year, while the period 1984-2017 shows an erosion of the eastern sector with an average rate ranging from 0.91 to 2, 42 m / year and accretion of the western sector with a rate of 2.18 m / year to 4.61 m / year. The mapping of changes and evolution of land use in the study area highlighted the urban extension over a period of 30 years with an estimated average rate of urbanization of 8.2%. The coastal development projects taking place in the bay of Tangier are responsible of the disequilibrium of the natural evolution of coastal ecosystems in this site.

Co-funded by the Erasmus+ Programme of the European Union

An overview about the usefulness of bio monitors and biomarkers in monitoring marine pollution

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The marine environment is exposed to various and complex pollution from both industrial and urban effluents. The molecules generated by this pollution reach the marine environment and are susceptible to alter the physiology the reproduction of marine organisms. In order to optimise without constraints the exploitation of marine resources, one of the major challenges is to distinguish between “clean” and polluted ecosystems.

Considering the disadvantages of using sea water and sediments in pollution monitoring, marine organisms such as bivalves were shown to be successful Bioindicators of pollution. In fact, these organisms accumulate contaminants usually from water and food. The accumulation reflects only the bio-available fraction and gives us information about the health status of on considered ecosystem.

Biomonitoring programs based on measuring contaminants in marine organisms are interesting from a human health point of view. However, it does not give information about the toxicological significance of pollutants accumulated and does not indicate the health status of the organisms particularly because xenobiotics can be stored in various forms such as insoluble precipitates and concretions. Consequently, biomonitoring programs are now involving biomarkers. These are measurable parameters at different levels of biological organisation, molecular, cellular or physiological. They traduce changes in the metabolic regulatory processes resulting from the effect of anthropogenic stressors. We can detect and quantify the biochemical interactions between a contaminant and its biological receptor in the living organism. In such case we can determine pollution concentrations needed to initiate this response which is assumed to be lower than those required to provoke a life threatening situation for the organism or a degradation of the ecosystem. This early warning system response is called a biomarker. Some biomarkers are specific to one class of contaminants, other are more global and reflect the general health status of the organisms. Biomarkers are also determined at different organisational levels: molecule, cell, organ, and organism.

This presentation is based on four main topics: (i) Ecotoxicological approaches, (ii) Biological models, (iii) Biomarker validation, and (iv) Biomonitoring programs.

(i)Results using different approaches: in situ, in vivo studies and on transplantation, will be presented.

(ii)Two sedentary filter feeding marine bivalves satisfying criteria required for good biomonitors of pollution: Ruditapes decussatus and Cerastoderma glaucum, will illustrate the biomonitors concept.

(iii)Biomarker validation was based on a multi parametric study taking into account both biotic and abiotic factors. Some mathematical models were used to describe the relationship between pollution levels and biomarkers.

(iv)Mussel watch, RNO and the Tunisian monitoring program, will serve as examples of biomonitoring programs.

Co-funded by the Erasmus+ Programme of the European Union

Protection of coastal urban fronts against global warming

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Global warming associated to climate change is producing a progressive rising of the sea level. The consequences of this sea level rise will affect millions of people, including infrastructures, industry, tourism and trade, which are essential pillars of the global economy. These effects will be amplified in the coastal fronts of cities and urban areas due to the high concentration of activities, services and population. The expected impacts will demand coastal protection measures whenever possible, mainly because relocating the activities as a generalizable alternative is not feasible.

Flooding risk in coastal urban fronts is mainly dominated by the concomitant action of maritime, atmospheric and fluvial drivers, most of which share generating mechanisms. Furthermore, on estuarine or deltaic areas the river discharge must also be included in the analysis. The complexity of the drivers and their interactions in these environments require joint probability methods for their appropriate assessment; in addition, sea level rise and the modification in the storm patters induced by global warming will change the probability of having extreme events.

This work is focused on introducing the international project “Protection of Coastal Urban Fronts against Global Warming (PROTOCOL)” (CYTED 917PTE0538, 2017-2020). This project addresses this topic with the aim of developing an assessment methodology and establishing recommendations for the design of coastal protections on urban fronts. The methodology is based on a global approach applied at local scale with the following main components: (1) quantification of the drivers and actions considering their different scales of affection and the predicted scenarios (projections) of sea level rise; (2) risk assessment at the coastal urban front (detailed scale); and (3) calculation of the overtopping rates and flooded areas based on the types of protection (including nature-based solutions) and the envisaged scenarios. Five study areas along the Ibero-American coasts have been selected in Spain, Mexico, Portugal, Uruguay and Chile to apply the developed methodology, including both estuarine and coastal sites. Some preliminary results for the Spanish study sites will be presented at the Conference.

The project will generate products of great value not only for the countries involved, but also for the scientific community: databases and user-friendly tools to be applied by public administrations, companies and entities working in the maritime-coastal environment. The expected impacts of this project should be reflected in: (1) a reduction in investment costs to protect against sea level rise, (2) an update in the scientific-technical methods to meet the protection needs of the coastal urban fronts in the upcoming decades, (3) an improvement in the technological credibility of this process with the society and (4) international and national transfer of this knowledge gaining in competitiveness and competence.

Co-funded by the Erasmus+ Programme of the European Union

Study and monitoring of salt marsh environments threatened by the effects of climate change

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Salt marshes in temperate regions of the world provide a wide range of ecosystem services, including coastal defence, carbon sequestration, wildlife conservation, and as sink/source of organic material, pollutants and nutrients. They also represent important historical and scientific archives, able to record important environmental parameters over many decades. However, the majority of salt marshes are increasingly threatened by direct (e.g. land reclamation, groundwater extraction) and indirect (e.g. the so-called "coastal squeeze") human actions, or by the effects of climate change. Indeed, salt marsh habitats have shrunk to half their historical coverage in the last century, and enhanced sea level rise will be responsible for the loss of 60-90 % of today's salt marsh areal coverage in the near future, according to whether or not effective measures to limit greenhouse gas emissions are undertaken. Exceptional management challenges are expected in the future to preserve and protect these environments from the many threats they are facing.

The proper management of this resource can be ensured only by a sound scientific background, defining past and present conditions and trying to foresee future changes. This contribution will present some of the most interesting outcomes relative to the study of Venice Lagoon's salt marshes (Northern Italy) and will discuss the coupling of traditional techniques and technologies for the future improvement of salt marsh studies under the Blue Growth perspective.

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SESSION 4: COASTAL MANAGEMENT IN MOROCCO: MAIN ISSUES AND SCOLAMAR CONTRIBUTION.

Master's degree "Climate change" at Ibn Tofail University. Training curriculum and employment integration prospects.

Echarfaoui Hassan
University of Kenitra

The Master's degree in "Climate change and sustainable development" was launched in 2013, as part of a Tempus project, in collaboration with 5 other universities from the Maghreb and Mediterranean. It is a multidisciplinary training dedicated to apprehending the many facets of climate change.

The proposed university program, spread over 24 months (4 semesters), combines fundamental theoretical knowledge with modern technical tools. It aims to strengthen the knowledge and skills of future graduates and to develop their capacity for analysis, interpretation and anticipation of issues relating to the vulnerability and adaptation of natural and man-made systems to climate change.

The scientific potential, and the environmental management skills provided to the winners, responds to the needs of public bodies and businesses to deal with the effects of climate change, and its global impacts.

The polyvalent managers thus trained will be able to elaborate operative propositions and methods of helping the management as well as the decisions regarding natural and anthropic spaces. They will also be able to intervene in the implementation of political strategies for sustainable development within territorial communities.

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SESSION 4: COASTAL MANAGEMENT IN MOROCCO: ROUND TABLE WITH STAKEHOLDERS

Climate change and its possible impact on the Moroccan coastal zone
Le changement climatique et ses éventuels impacts sur la zone côtière au Maroc

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Selon les récents travaux du GIEC, le changement climatique est « irrévocable » et ses impacts ne sont plus à démontrer à l'échelle du globe et régionale. Pour la partie maritime, on citera, entre autres, l'élévation du niveau de la mer, la hausse des températures des eaux marines, les problèmes d'acidification, l'augmentation des évènements extrêmes, les impacts sur les activités maritimes en général et les impacts sur les écosystèmes marins et côtiers en particulier…). Ces différents aspects seront présentés d'une manière générale selon les différents scénarios établis par le GIEC à l'horizon 2100 à l'échelle globale et un focus sera mis sur la région Nord Ouest Africaine dont le Maroc en fait partie.
Mots clés : Changement climatique, impacts sur les écosystèmes marins et côtiers, région Nord Ouest Africaine, Maroc.

Co-funded by the Erasmus+ Programme of the European Union

POSTER SESSION: Université Abdelmalek Essaadi

Impact of Tangier Med port works on the evolution of the coastline. Morocco North West

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The study of environmental impact has always been a reference tool to evaluate and document the consequences of a certain project on an area of interest.
In this research, the study will evolve around the impact of the port complex Tangier Med, which includes the port Tangier Med 1 and 2 and the port Tangier Med Passengers, on the evolution of the littoral zone.
The main objective of this work is to determine the disturbance generated on the coastal dynamics and how it evolves over time, and that would be done based on the influence of this work on the coastline and that of structural characteristics of the port work on the current and the sedimentary transit, using multi-dates aerial photography and geographic information systems.

Simulation of an Operation to combat the harbor's marine pollution

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The exercise of simulation to fight against accidental pollution in the port, joins within the framework of the national emergency Plan (PUN) that is related to the preparation and the combat against accidental marine pollution.
This exercise, also named SIMULEX, is made every two years to entail the participants to fight against the accidental marine pollution. It also allows verifying the feasibility to curb such type of marine pollution. Hundreds of people are committed during the theoretical and practical exercise under the harbor's authority, which coordinate the tasks, organize the means and test the procedures, etc. Indeed this exercise articulates around a scenario of intervention and fights, feigning certain events, which will be detailed in the poster.

Climate change on the ocean «Ocean warming and acidification»

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Through its constant exchanges with the atmosphere, the ocean plays a major role for the global climate. As the planet heats up, the ocean stores most of the energy it receives. It is possible to quantify and track the extent of global warming by measuring the amount of heat stored by the ocean. The ocean absorbs more than 90% of the heat accumulated in the climate system and heats up. It is a crucial regulatory role, but in the fact, is being disproportionately impacted by increasing carbon dioxide (CO2) and other greenhouse gas emissions (GHG), which are now at their highest levels in history from human activities. This causes changes in water temperature, ocean acidification and

Co-funded by the Erasmus+ Programme of the European Union

deoxygenation, leading to changes in oceanic circulation and chemistry, rising sea levels, increased storm intensity, as well as changes in the diversity and abundance of marine species.
The sustainable management, conservation and restoration of coastal and marine ecosystems are vital to support the continued provision of ecosystem services on which people depend. A low carbon emissions trajectory is indispensable to preserve the health of the ocean. Affordable and scalable solutions are now available to enable countries to move to cleaner and more resilient economies. The pace of change is accelerating as more and more people turn to renewable energy and a series of other measures that will reduce emissions and increase adaptation efforts.
The main objectives of this study are:
Grouping of very diverse information coming from several sources (articles, theses, books, conference communications ...) in the format of a computerized document.
Valuing the role of the ocean as being a heat reservoir and such as a Carbon pump.

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The stock assessment of the smooth clam *Callista chione* (Linnaeus, 1758) between Fnideq and M'diq of the Moroccan Mediterranean

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The stock assessment of the bivalve *Callista chione* had been achieved between June 2015 and April 2016 following a sampling plan pre-established according to radials perpendicular to the coast. Some of the samples had been collected using artisanal fishing boats of shells, motorized, containing two classic metal dredges per each. 100 stations had been dredged throughout the study area between Fnideq and M'diq. The metric and weight parameters had been measured.
The statistical handling of results had been achieved using the software XLSTAT 7.5.2. The estimation of the biomass (Bi) of the stock in number and in mass, had been carried out by the direct method. The geographic information system, through the software ArcGIS, allowed us to map the abundance and biomass of the species in the study area.
Out of a total number of 1089 individuals of *C. chione*, the results show that 93% of the population stock consists of individuals with market size of: an average size of 71 mm and a maximum size of 100 mm; an average weight and a maximum weight of 98g and 280g, respectively. The spatial

distribution of the number of individuals and of the weight of *C. chione* varies from one station to another. The most important concentrations had been observed at the level of M'diq and Cabo Negro and the lowest ones at the level of the three beaches of Soumia, Restinga and Marina Smir.
Key words: *Callista chione*, stock assessment, Mediterranean Sea, cartography, SIG.

Modeling the spatial repartition of precipitation in the region of Tangier (Northern North_Morocco)

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Climate change has become a subject of several studies for our country, Especially the far north west of Morocco. This main aims of this work to interpolate the rainfall fields in the Tangier region taking into account the effect of the relief, based on the numerical Terrain model (DEM). To achieve its goals we propose using the method AURELHY (Analyse Utilisant le Relief pour les Bésoins de l'Hydrométéorologie) [1], which allows, from the values of point precipitation their extrapolation to the points not measured Based on Geostatistics, the AURELHY interpolation technique has the advantage of taking into consideration the topography of the region considered according to several stages. The first of these was an integrated approach consists of the coding of the topography surrounding each rainfall station using the Python 3.4 software. The various altitudes are therefore shall be subject by analysis principal components, (ACP) via the R software. In order to identify the dominant trends of slopes for different own vectors. The residues resulting from multiple linear regression between own vectors, longitude, altitude and distance from the sea. Allowed us to make interpolation maps by Kriging of these residues. These intermediate maps were finally used to reconstruct the precipitation fields.
The temporal interval studied was subsequently placed in the context of climate change to identify the impact of this global phenomenon on the reduction of precipitation at the level of the region studied.

Key Words: Climate change, Precipitation, Geostatistics, Interpolation, Kriging.

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Detection and analysis of shoreline changes using Multi-Temporal High-Resolution Images and automatic computation: Case of the Tahaddart littoral (North West Morocco)

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Coastal shorelines, the interface between land and sea, change a variable in response to one or more factors, which may be morphological, climatological or geological in nature. Shoreline geometry depends on the interactions between and among waves, tides, rivers, storms, tectonic and physical processes. Erosion (landward retreat) and deposition (advance and growth through accretion) can both present challenges to coastal communities, coastal infrastructures and the adjacent estuarine systems (e.g. Benumof et al., 2000; Moore and Griggs, 2002; Collins and Sitar, 2008; Katz and Mushkin, 2013).

The coastal sector is located in the Tahadart area, between Tangier and Asilah towns, on the Northern Atlantic coast of Morocco (Fig. 1). The sector is composed of a 14 km long spit that encloses an estuary with well-developed salt marshes (Nachite et al. 2008), Tahadart's littoral zone is affected by east and west winds and is exposed to waves approaching from the NE with an associated SW-directed littoral drift.

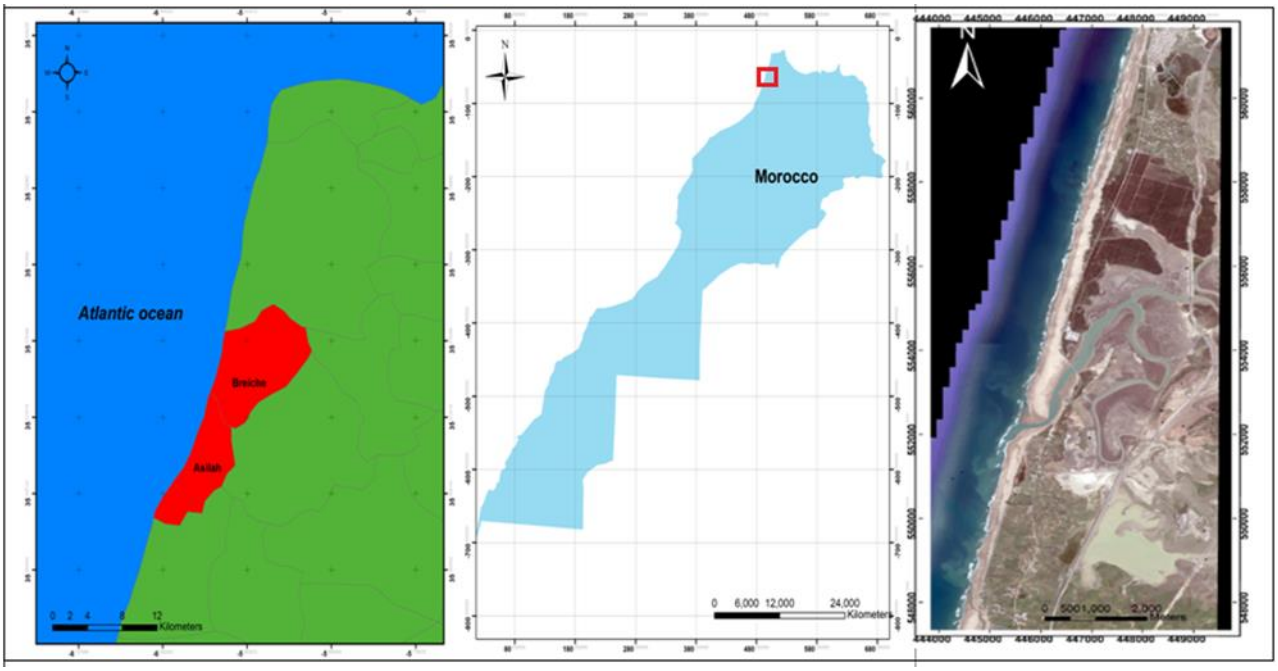

Fig 1: Location map of the study area

This study focuses on the detection and analysis of historical changes in shoreline position of the Tahaddart littoral (North West Morocco) occurred between 1972 and 2016 (45 years). Shoreline changes along the Tahaddart littoral were studied using multi-temporal interpretation acquired in 1972, 1981, 1997 and 2016, the correction of aerial photographs and satellite image was carried out using the remote sensing tools and Geographic Information System "GIS", Digital Shoreline Analysis System (DSAS).

Co-funded by the Erasmus+ Programme of the European Union

To attain our objective, the study area was divided into four sectors for analysis: (1) the beach of Haouara, (2); Tahadart littoral spit, (3) the beach of breiche (4) the beach of kouass (fig2). Estimation of the rates of erosion and accretion along the site (littoral of Tahaddart) was calculated from a range of statistical change measures are derived within DSAS, based on the comparison of shoreline positions through time. These include several statistical methods End Point Rates (EPR), Linear Regression Rates (LRR) and Weighted Linear Regression (WLR) (fig 2).

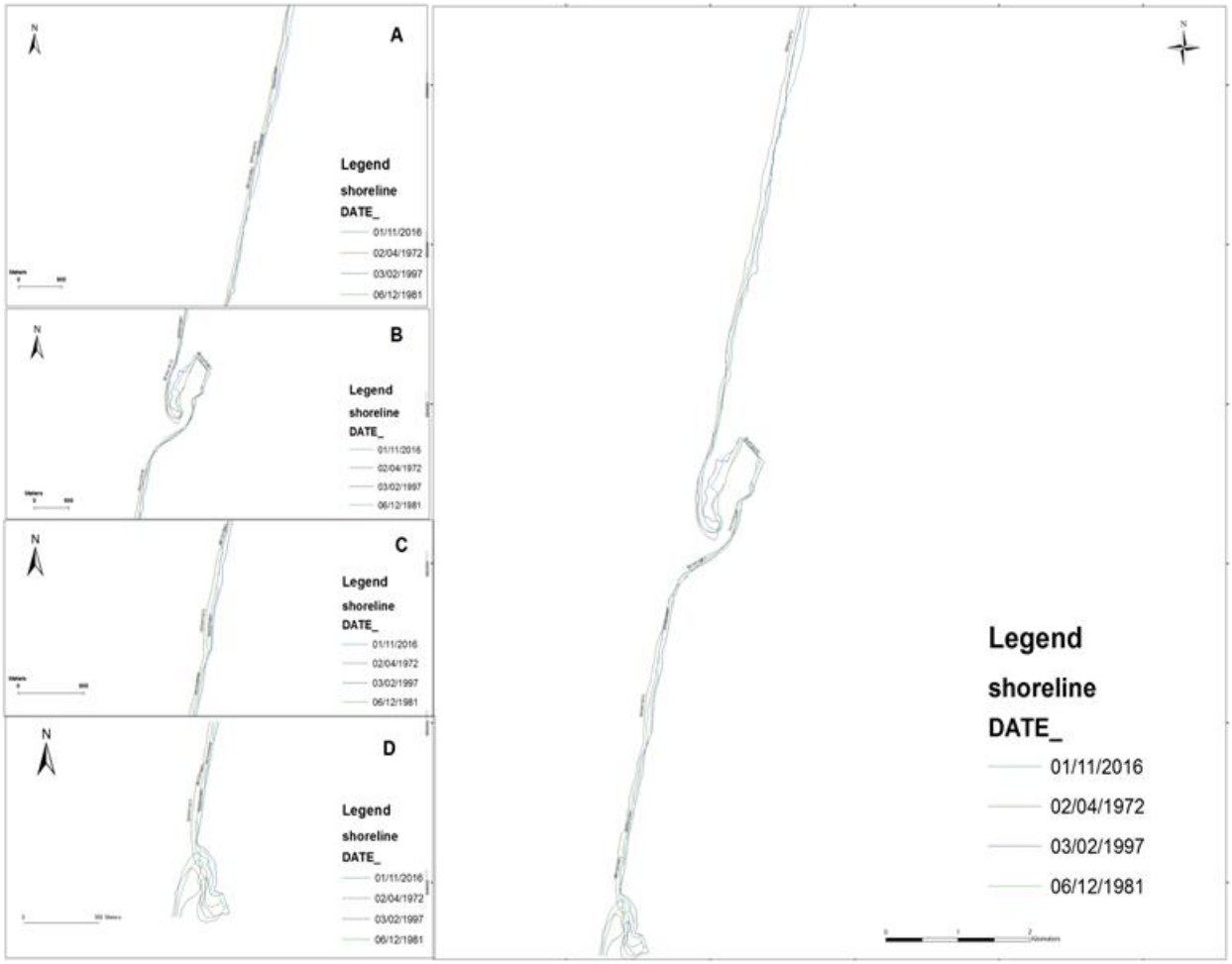

Fig 2: The study area was divided into 4 sectors: (A) the beaches of Haouara, (B); Tahadart littoral spit, (C) the beaches of breiche (D) the beaches of kouass.

Keywords: Tahaddart, accretion, erosion, GIS, Digital Shoreline Analysis System (DSAS), End Point Rate (EPR), Linear Regression Rate (LRR) and Weighted Linear Regression Rate (WLR).

The lagoon of Nador facing local and global changes: Involvement of ecosystem services

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Biodiversity and climate change are interconnected. Biodiversity is affected by climate change, with negative consequences for human wellbeing and even threats to its survival (Cop23) [1]. Ecosystems present important services that can help people adapt to climate change. Given that there's growing

interest in a series of solutions stimulated by nature. These nature-based solutions are defined as "actions to protect, sustainably manage and restore natural or modified ecosystems, to directly address societal challenges in an effective and adaptive manner while ensuring human well-being and benefits for biodiversity" (UICN, 2016) [2]. Assuming that most ecosystems are vulnerable to climate change, even in low and medium range global warming scenarios (Scholes et Settle, 2014) [3]. In addition, the Millennium Ecosystem Assessment (MEA, 2005)[4], defines ecosystem services as the benefits that humans derive from ecosystems.

The lagoon of Nador, an exceptional site not only on the national scale but on the Mediterranean scale. With its 115 km² of surface, a depth of 8m and a 25 km long coastline separates it from the Mediterranean, includes a number of habitats of high ecological value.

Our objective is to reinforce the theoretical knowledge on the link between climate change and the evolution of lagoon ecosystems and their services, by a multidisciplinary approach, based on ecosystems. This knowledge will be cross-referenced with existing data, in order to develop experimental protocols for assessing the impact of climate change on lagoon ecosystems on the one hand, and the impact of the changes induced by human activity on the other hand, a tool to help manage coastal lagoons by setting up an biological database on the biodiversity of Mediterranean lagoons. This work is therefore a tool for understanding the relationships between the factors of climate change, the processes of ecosystem evolution and the goods and services offered. Beyond that, it will contribute to the definition of a status for these ecosystems to better manage them and the development of adaptation scenarios.

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Dynamic and genetic structure of the population Donax trunculus in the Mediterranean and the Atlantic of Morocco.

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Donax trunculus is a species of intertidal strictly which dominates macrofauna of sandy beaches of the Atlantic coast of Morocco. Its geographic distribution extends from the atlantic coasts French (Guillou & Le Moal, 1980) to the Coasts of Senegal (Fischer & al., 1981) and is widespread in the Mediterranean.

The distribution of the species depends on their evolutionary history and their ability to disperse and colonize new territories. In the marine environment, this capacity of dispersion is conditioned by the duration of the larval phase and the distribution more or less continues to their habitat. In order to

better understand the respective share of these various factors, the present study on the population of Donax trunculus fits in the framework of a follow-up of dynamic ecology and the genetic structure of the population of Donax trunculus, between the Mediterranean and the Atlantic coast of Morocco. This work aims first of all a follow-up of dynamic ecology and the genetic structure of the population of Donax trunculus whose objective to describe and compare among D. trunculus sin on two sites the Atlantic and the Mediterranean in Morocco:

The study of the dynamics of populations of D. trunculus in following the distribution of frequencies of size classes and the parameters a biometric.

Histological study of the male and female gonads of Donax trunculus of a duration of 13 months.

The study of the genetic structure of populations of Donax which allows to deepen considerably the knowledge of mechanisms directly linked to the organization and the evolution of species (migration, mutation, selection, drift).

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POSTER SESSION: Université Chouaib Doukkali

Contribution to the study of the diversity and exploitation of cartilaginous fish of the Atlantic central morocco

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The present work is a contribution to the study of the diversity and exploitation of cartilaginous fish in the Moroccan central zone. Sharks are a diverse group of cartilaginous fish (class Chondrichthyan) that has evolved over 400 million years. Historically, these fish were considered to have low economic value for industrial fisheries and as a result were neglected by fisheries management organizations. Today, many of these fish have become the target of commercial and recreational fisheries around the world, and they are also increasingly caught as by catch in fishing activities targeting other species.
Most of these species unfortunately have slow growth, late maturity, low fecundity and a long life span, resulting in low population growth rates, so many shark populations are now reduced, and some are threatened.
The objective of this work is to present the diversity of sharks and sharks landed in the central Atlantic Morocco to identify the main information available. We will also present the structure of the fleet, the fishing gear used, the fishing effort and the marketing circuit.
Sharks are not only sought for the quality of their flesh, but also for the uses that can be made in such diverse fields (leather, chemistry, pharmacology, cosmetology and medicine).
The management of shark fisheries in the Moroccan central Atlantic has been hampered by the lack of biological and fishery data. Global warming also indirectly affects sharks by changing their distribution and behavior patterns.

Keywords: Fish cartilaginous, Shark fisheries, Atlantic Moroccan center, diversity, structure of the fleet, fishing effort, marketing Circuit, Management, Global Warming

The spatio-temporal evolution and contamination assessment of heavy metals in marine sediments from Tahaddart estuary (NW of Morocco)

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The Tahaddart estuary (NW of Morocco) has been declared as a biological reserve with an international interest for avifauna. It is also one of Morocco wetland that has been considered by RAMSAR convention. Nevertheless, this area is being gradually affected by anthropogenic activities (agriculture, tourism, sand extraction, Road & Infrastructure Industry….) which could affect the environmental quality of estuary (Nachite & al., 2007; Achab, 2011). The concentrations of Al, Fe, Zn, Pb, Cu, Ni, As, Cd and Cr were measured in superficial and cored sediments. Trace elements assessment was carried out using different environmental indices. In addition, trace elements concentrations were compared with consensus-based sediment quality guidelines.

Co-funded by the Erasmus+ Programme of the European Union

The results show that the concentrations of trace elements found in surface sediments are significantly higher than those from the local background, especially at sampling stations located near to the Highway Bridge and Thermal power plant. Additionally, the probable effects levels (PEL) were especially exceeded for Cr at these stations. The contamination factor and pollution load index (PLI) obtained from the superficial sediments indicated that Tahaddart estuary was moderately to considerably contaminated, except for stations TSS17, TSS16 and TSS15 that showed high contamination by Cr which were attributed to the human activities. At sediment cores, the highest concentration of metallic trace element in the uppermost part of sediment cores compared to lower depth samples for most of trace elements suggests increases in metals delivery to sediments in recent years. These results confirm the need to implement an effective management policy to avoid the spreading of contaminants in the estuary.

Keywords: Tahaddart estuary; metallic trace elements; sediment quality; environmental assessment.

Catalytic wet peroxide oxidation of p-nitrophenol using local pillared clay catalysts

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Organic non-biodegradable pollutants have increasingly become a serious environmental issue and a real challenge for industries and thus disposing safely these compounds is becoming a necessity and an important area of research. Among other wastewater treatment methods (chemical, biological and physical treatments), catalytic wet peroxide oxidation (CWPO) has attracted considerable attention. The main objective of this work is to study the CWPO of p-nitrophenol from aqueous solutions, using pillared Moroccan clay (PILC). P-nitrophenol, also known as 4-nitrophenol (4-NP), is one of the highly toxic and hardly biodegradable organic pollutants listed by the United States Environmental Protection Agency (USEPA), as one of the 129 priority pollutants. It is used in the fabrication processes of drugs, fungicides, insecticides, and dyes. The prepared PILCs, with different metal pillaring percentage following a conventional pillaring method, showed good activity toward 4-NP degradation. In fact, under optimum conditions (3 g L^{-1} catalyst, 10 mM H_2O_2, 50°C T and 50 mg L^{-1} p-NP), more than 90% of 4-NP was experimentally degraded after 4 h of reaction time.

Keywords: p-nitrophenol, pillared clay catalysts, catalytic wet peroxide oxidation.

Impact of dredging on the evolution of the beaches of the strait of Gibraltar

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The objective of this work is the evaluation of the impact of dredging on the platform on the morpho-sedimentary evolution of different coastal beaches between Tangier and Sebta. A multi-technique approach was conducted to follow the spatio-temporal variations of four ranges. On the coastal fringe stretching from Sidi Kankouch beach to Ras Cires beach, topographic surveys were carried out, using a millimeter precision DGPS, in order to follow the evolution Beach profiles in terms of erosion, stability or fattening, and / or change of morphological profile of the Profile itself.
The results showed that all Beach Profiles have not undergone any remarkable changes, especially in terms of width and height, except in places, where they undergo a slight increase. Most of the beaches have a stable sedimentary equilibrium, especially the beaches of Oued Aliane and Ras Cires, which always keep a dune system, fixed by a more or less dense vegetation, in perpetual evolution allowing the protection of the geomorphological entities coastline.
All the wadis that reach this coastal fringe, during floods during this mission, participated in the local change of Beach Profiles and also favored the considerable contribution of sandy stock, especially for Oued Aliane and Ksar Sghir., whose load also feeds offshore. Added to this is the significant effect of the ravines, which in turn contributed to the coastal sediment supply of sedimentary detritus from the adjoining greso-pelitic cliffs.
The approach methodologies adopted on the evolution of the coastline through the Topographic Profiles allowed us to bring a global reflection on the different scenarios of evolution of the littoral in the region and to plan the interventions of fight against concrete environmental phenomena. They will also allow us to monitor the impact of the dredging operations that we intend to present their results after stopping the dredging of the marine sands.
Keywords: The integrated development geo-ecotouristic - Eco-tourism –geo-tourism -Mirleft sidi ifni.

Impact of the installation of the sediment-trash on the hydro-sedimentary behavior of the Oualidia's lagoon

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Coastal environments in general and lagoons in particular, constitute highly anthropized zones because of the enormous socio-economic interests they present. The Oualidia lagoon is a typical example of a Moroccan lagoon that suffers from the effects of anthropogenic activity. Because of its favorable physicochemical characteristics, this lagoon constitutes an aquaculture site, hence the installation of numerous aquaculture parks along its main channel. Salt extraction is the second major activity in the lagoon that has forced decision-makers to set up the lagoon to protect the salt basins. This is done by constructing two dikes upstream of the lagoon. These various developments have negatively affected the quality of the waters of the lagoon, by the development of what is called the phenomenon of confinement of lagoon's water. In order to solve this problem, a solution has been proposed which is to install a sédiment trap in the upstream zone of the lagoon in order to improve its hydrodynamism. The objective of this study is to study the impact of the installation of this sediment trap on the hydro-sedimentary behavior of the lagoon, especially from the bathymetric point of view. The methodological approach is summarized in the study of the morphological evolution by photo-interpretation. This study showed that the different parts of the lagoon had some changes

caused by the variation of its hydrodynamic conditions. The amount of sand located in the downstream part of the lagoon for example had two main dynamic phases : a decrease from 2006 to 2011 and an increase between 2011 and 2016. The channel broadened because of the installation of sediment trap. In addition, a bathymetric comparison in two distinct dates before and after the realization of the soil, respectively 2006 and 2012, has been done and it showed the role of this solution in the deepening of the majority of the lagoon parts.

Keywords: sediment trap, bathymetry, GIS, modeling, lagoon, Oualidia, Morocco.

Bio-pesticides from seaweeds for the protection of plants and the environment

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On the Atlantic and Mediterranean coasts of Morocco, the algae are very abundant (about 143 species on the coasts of El Jadida) and currently the exploitation of this algal richness concerns only few species used for the extraction of the agar-agar and carrageenan. These seaweeds are a great source of complex natural products that could be a promising source of new bioactive compounds that can help plant survival by providing protection against stress imposed by pathogens.

In order to highlight new molecules that could contribute to the enrichment of the therapeutic arsenal of our country, a study of marine substances from benthic algae of the El Jadida coasts was undertaken. This study must also allow the exploitation and a possible valorization of this very abundant resource on our coasts. Our approach, in light of the work done on algae in recent years, is to look for substances that have interesting biological activities, purify them and determine their structures.

The biological activity sought is the antimicrobial activity of various algae harvested from the Atlantic coast of El Jadida. The active ingredients responsible for the biological activity of interest are extracted and purified.

Keywords: Algae, Bio-pesticides, plants, Environment, El Jadida.

Recent kinematics of the coastline of the shoreline of El Jadida (Moroccan Atlantic coast)

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The coastal zone is one of Morocco's greatest environmental and economic assets. The dynamics of the coastline has received particular attention in recent decades from researchers (DOLAN et al. 1991, MORE et al. 2006), especially most of the world coasts show a trend towards erosion relative to shoreline retreat. The excessive anthropisation of coasts and the severity of the marine climate have intensified the regressive process observed at the coastal level, and the historical study of the coastline is necessary to estimate its fate (ex: DOUGLAS et al. 1998; DOUGLAS &

CROWELL, 2000; APPEANING ADDO et al. 2008) and better coastal spatial planning and management (MORTON, 1979; MOORE, 2000).

This research focuses on the analysis of the coastline change rate by automatic analytical techniques using photo-interpretation acquired in 1970, 1982 and 2010 which is analyzed under the Geographical Information System (GIS) using the DSAS (Digital Shoreline Analysis System) extension along the coast of El Jadida.

From the multi-date aerial photos of the coastline of El Jadida, the change rate was calculated using the End Point Rate (EPR).

Analysis of the results obtained shows that the coastline has a generally regressive evolutionary trend along the 18 km of coastline studied. Of the 910 transects analysed, 744 (70.77%) are eroding and 266 (29.23%) are accreted.

This regressive situation due both to human settlements, mainly the city's port, and to marine energy (swell and tidal), will contribute to the destruction and long-term disappearance of the sandy beaches of the city of El Jadida.

The methodology is based on many existing works in the field of diachronic analysis of coastal evolution on a historical scale (Crowell et al. 1991; Dolan et al. 1980 and 1991). The objective of this methodological

Approach is to identify the reference line in order to analyze the evolution of the coastline, the approach adopted and based on the following steps:

- Selection of the adapted reference line.
- Extraction of the reference line by photo-interpretation.
- Determination of the rate of shoreline change.

The historical evolution of a coastline is determined from two types of documents: topographic maps and aerial photographs. These documents have compared and analyzed in order to obtain maps of the evolution of the coastline and average rates of receding or advancing of the shoreline. However, the large number of existing methodologies, both for document analysis and for the exploitation of results, justifies the importance that should be attached to the choice of methodology used. The indicators can be used to identify different reference lines according to the Supports and detection methods. In a diachronic study based on photo-interpretation. The selection and extraction of a line

common to the different images used is necessary (FAYE et al, 2008).

The comparison of the results of the interpretation of the aerial images used (1970, 1982 and 2010) provided information that enabled us to apprehend the evolutionary behavior of the coastline for 40 years. Variations in the position of the coastline between 1970 and 2010 reflect a generally progressive trend regressive along the 18 km of coast studied. Of the 910 transects analyzed, 744 (70.77%) are eroding and 266 (29.23%) are accreting.

The results obtained from the diachronic study of the study area show an accretion at the site of El Jadida Bay with an erosion zone that tends towards stabilization in the centre of the bay; thus, Deauville beach is characterized, in general, by stabilization, and then, El Houzia beach is characterized by quite significant erosion.

The bay of El Jadida is bounded to the north-west by the harbour dike, which acts as a barrier that stops the sediments transported by coastal transit in a southeasterly direction. Thus, the swells at the bay are divergent and therefore low in energy, which favours sedimentation. This explains the accretion in El Jadida Bay. At Deauville Beach, sedimentation is weak as well as erosion, and

therefore it is a more or less stable area. The beach of El Houzia is an open beach, characterized by fairly strong swells and is not protected by protective installations; all these factors explain the strong erosion at this beach.

Use of seaweeds as a bio-pesticides for controlling the plant disease and reduce the use of chemicals products

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The repeated use of synthetic chemicals products to control phytopathogenic diseases has yielded limited results in the medium and long term. They often result in environmental pollution, slower pathogen progression and not total loss, the emergence of resistant strains and increased amounts of residues on food.
The development of an efficient and sustainable agricultural system requires alternative methods to reduce the use of synthetic chemical pesticides. Among these alternatives, the use of bio-control agents or bio-pesticides may be one of the keys to the sustainable development of agricultural activities around the world for the reason of their ecological and economic benefits. In this context, seaweeds are a great source of complex natural products and a promising source of new bioactive compounds.
Our study focuses on the valorization of algal biomass in the El Jadida region as a bio-pesticide to ensure a good protection of our environment by minimizing or limiting the environmental impact generated by chemicals products.
Keywords: Bio-pesticides, Chemicals products, El Jadida, Environment, Pollution, Seaweeds.

Adsorption of reactive red141 dye and chromium (vi) from aqueous solution by fly ash: kinetic and equilibrium studies

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The increase in the number of industrial sites and human activities have had a negative impact on the environment prompt a continuous release of toxic pollutants from heavy metals, dyes, synthetic manure and organic compounds into the encompassed water bodies which oftentimes cause water pollution. For this reason, fly ash was scrutinized as an adsorbent material for two common water pollutants reactive red 141 and chromium (VI). Fly ash was characterized by Fourier transform infrared spectroscopy and X-ray diffraction. The adsorption properties of fly ash were explored as a function of contact time, fly ash dosage, initial concentrations and the initial pH value. The uptake process of all the examined pollutants is represented by pseudo-first-order and pseudo-second-order kinetic models. The adsorption equilibrium modeling of reactive red 141 and Cr (VI) was examined

with Langmuir and Freundlich isotherms. The results show that fly ash could be used as adsorbents for the removal of disperse blue 165 dyes from textile effluents.
Keywords: Reactive red 141, chromium (VI), adsorption, kinetics, fly ash, isotherm.

Tidal inlet dynamics in response to the events of storms along the Atlantic coast of Morocco: Moulay Bousselham lagoon

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The objectives of this work and the methodological approach adopted are based on an approach at two spatial and temporal scales, And the implementation of a dynamic morpho model to evaluate the impact of storms on the dynamic morpho of tidal inlet, the case of the mouth of Moulay Bousselham. At the scale of events, the topo-bathymetric measurements taken before and after the storm of 7 January 2014 underlined a very important morphological response, caused by exceptional swells with a maximum height of 13m and an N320 direction during this storm storm. This very contrasted response results in a very well developed sedimentary body, erosion of the beach and the reduction of the section of the grau, which tends to close. In the long term, for 68 years, the evolution of the coastline showed a strong regression throughout the sector studied between 1949 and 2017. A general average decrease observed is -0.38m / year. This is confirmed by the dominance of NOA negative throughout this period and the erosive impact by frequent storms during these years despite attempts to restore balance during periods of resilience.
Keywords: tidal inlet, storms, morphodynamics, coastline, morphodynamic modeling, SWAN.

POSTER SESSION: Université Ibn Tofail

Shoreline changes and sea-level rise at Moulaye Bousslham coast (Morocco)

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As part of a broad assessment of climate change impacts in Morocco mark by several events in the recent years, such as storms happened in january 2014 (Hmax= 13,62m) and january 2008 (Hmax=15,85m), This study represents a first attempt to assess and estimate the future coastal erosion of the Moulaye Bousselham beaches in response to the sea level rise (SLR), and a number of results have been achieved. The approach used in this study is based on a set of analytical morphodynamic models and a GIS-based inundation analysis; the evolution of erosion that occurred in the study area, the potential physical vulnerability to accelerated sea-level rise was investigated, and the most vulnerable socio-economic sectors were assessed. Results indicate that 35% of the areas will be lost by flooding. Such results may help decision makers in the implementation of preventive management strategies in the most sensitive areas.

Sea level rise

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The coast of Morocco is, in many locations, physically and socio-economically vulnerable to accelerated sea-level rise, due to its low topography and its high ecological, economic and touristic values. Assessment of the potential land loss by inundation and erosion, based on a modeling approach and Geographical Information Systems, has enabled to identify both locations and the socioeconomic sectors that are most at risk to accelerated sea-level rise and extreme events. The case studies of Saidia littoral on the Mediterranean coast, and Tangier and Mohammedia coasts on the Atlantic side, show that the most severely impacted sectors, are expected to be the settlements, the recreational and industrial areas, agricultural land, and the natural ecosystems.

Impact of climate change on the north-west coastal zone of morocco

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As part of a broad assessment of climate change impacts in Morocco, an assessment of vulnerability and adaptation of coastal zones to sea-level rise was conducted. Tangier Bay, which is the most important socioeconomic pole in Northern Morocco, represents one of the cases studies. Using a GIS-based inundation analysis and an erosion modelling approach, the potential physical vulnerability to accelerated sea-level rise was investigated, and the most vulnerable socio-economic sectors were

Co-funded by the Erasmus+ Programme of the European Union

assessed. Results indicate that 10% and 24% of the area will be at risk of flooding respectively for minimum (4 m) and maximum (11 m) inundation levels. The most severely impacted sectors are expected to be the coastal defences and the port, the urban area, tourist coastal infrastructures, the railway, and the industrial area. Shoreline erosion would affect nearly 20% and 45% of the total beach areas respectively in 2050 and 2100. Potential response strategies and adaptation options identified include: sand dune fixation, beach nourishment and building of seawalls to protect the urban and industrial areas of high value. It was also recommended that an Integrated Coastal Zone Management Plan for the region, including upgrading awareness, building regulation and urban growth planning should be the most appropriate tool to ensure a long-term sustainable development, while addressing the vulnerability of the coast to future sea-level rise.

Global warming

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Over the past 50 years, the average global temperature has increased at the fastest rate in recorded history. And experts see the trend is accelerating: All but one of the 16 hottest years in NASA's 134-year record have occurred since 2000.
Climate change deniers have argued that there has been a "pause" or a "slowdown" in rising global temperatures, but several recent studies, including a 2015 paper published in the journal Science, have disproved this claim. And scientists say that unless we curb global-warming emissions, average U.S. temperatures could increase by up to 10 degrees Fahrenheit over the next century.

Climate change and its impacts on coastline

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Climate change can be considered as one of the biggest threats to our environment, with significant impacts on coastline evolution. Global warming causes sea-level rise as oceans expand, and makes storm patterns more energetic. Consequently, it will have a big effect on coastlines through inundation and increased erosion. Coastal flooding is somewhat easier to predict than erosion since inundation can be estimated using coastal contours. However, its prediction is not trivial since rapid reshaping of the shoreline by, amongst other, waves, tidal currents and human intervention may follow inundation.
Understanding of coastal morphological response to climate change and sea-level rise is quite difficult. This is partly because the timescales over which concern of its effects are greatest (annual to centennial) falls between the small scales addressed by most numerical models and the large sales described in the conceptual models of geomorphologists.
Key words: Climate change, coastline, inundation, erosion, morphology.

Impact of climate change on marine and coastal biodiversity in the Mediterranean Sea

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Climate change is putting additional pressure on biodiversity today Biological. These climatic changes, and in particular the rise in temperature, affect the breeding periods and / or migration of certain species, the duration of growth phases, the frequency of parasite infestations and the emergence of new diseases. The predicted changes are therefore likely to result in changes in species distribution and population densities, by habitat displacement. Thus a change in the composition of the majority of current ecosystems is likely. Similarly, the risks of extinction of species, and in particular those already vulnerable, are likely to increase significantly, in particular for species with a restricted climatic range, those with very specific habitat and / or small populations naturally more vulnerable to changes in their habitats. Finally, the introduction of new alien species could be facilitated, a phenomenon whose long-term consequences are difficult to predict.

Erosion of the furnished coast of the extreme northeast of Morocco (Saïdia)

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The coastal erosion is a worldwide reality. This tendency is largely related to two factors: the decrease, in some cases even the disappearance, of the detrital sedimentary input, and the eustatic movements. The erosion of unconsolidated coasts is similarly linked to the relative sea level rise, estimated to about 1 mm/year over the past century. This evolution is especially worrying because the current sedimentary contribution to the coasts is no longer able to compensate for the rise of water as it was previously during the Holocene. The coasts of Morocco also suffer from such a situation that, following the rules of a sustainable development, should be taken into account in their touristic planning. The human interventions in the Moulouya watershed and along the coastline have increased the erosion of the coasts of NE Morocco. In particular, the recent increase in coast anthropisation is spectacular, with considerable geomorphological and environmental impacts that can be evaluated by the use of remote sensing data covering more than 50 years. At the long or even the middle term, this threatens the beach of the Saïdia sea resort.

The SIG tool for a coastal flood risk assessement due to climat change the case of the coast of Mohamadia

Naoui basma
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The potentials impacts of sea level rise related of storm surges at the coastal area of Mohamadia, this increase of level has several effects that are why a lot of adaptation measures has been taking to face the risks of coastal flooding; that influence the coastal zone management.

Co-funded by the Erasmus+ Programme of the European Union

Morocco's coastal vulnerability to climate change

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With a strategic geographical location as Africa's gateway to the European horizon, Morocco is naturally predisposed to play a catalytic role in North-South and South-South cooperation for the protection of the environment. As much as it is considered among the countries most exposed to the negative effects of climate change.

The advantage that Morocco derives from its privileged position and its coastline of 3500 km, on which is concentrated the majority of the socio-economic activities (80% of its industrial and energy infrastructures), can become a serious handicap because of the risks of ascent the sea level and the scarcity of water resources, the likely consequences of climate change.

The awareness of this vulnerability has been confirmed over the many years of drought that hit the country at the end of the last century and has heavily affected the national economy, largely dependent on agriculture, sector affected by this drought recurrent.

Thus, climate change could have disastrous consequences in the medium and long term on the Moroccan coast resulting in conflicts of uses linked to natural resources, the loss of biodiversity, the construction of infrastructures, the maintenance costs and the means of subsistence of inhabitants of coastal areas.

The alarming drawdown of the majority of coastal groundwater and sea-level rise can, in different coastal segments, lead to a significant shrinkage of the shoreline either by erosion or submersion and the intrusion of marine waters which can lead to forms of degradation by salinization in extensive land exploited by coastal agriculture.

Evolution of the external coastline Rabat Tamara

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The Atlantic coastline in the Temara area (SW of Rabat, Morocco) is composed of Quaternary formations that form elongated costal ridges running subparallel to the present shoreline. Several early studies considered its constitution and age, but they led to contradictory conclusions. This study focuses on the morpho-litho-stratigraphic analysis of the last consolidated ridge. The results show a common structure for the ridge with a dominance of coastal aeolianites, in which a supratidal deposit occurs. Stratigraphic observations are completed by OSL dates showing that all the units constituing the ridge were formed in the 5c isotopic sub-stage.

Co-funded by the Erasmus+ Programme of the European Union

POSTER SESSION : Université Mohammed V de Rabat

Vulnerability assessment of tangier bay to sea level rise (Morocco)

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This study presents an assessment of the projected shoreline retreat of Tangier bay, under different Intergovernmental Panel on Climate Change (IPCC) scenarios of sea level rise (SLR), using analytical and numerical morphodynamic models. The results show that the shoreline retreat in 2100 with regard to the current level would be between 16 % and 38 %. Thus, the socio-economic impacts would be significant, in particular for the tourism development in the coastal areas.
The importance of the expected damage leads to saying that it is time to think about reflect on the design and the implementation of an integrated management plan of Tangier Bay taking into consideration the adaptation of this coastal area to climate change effects.
Keywords: Sea level rise, Tangier Bay, Erosion, morphodynamic models.

Moroccan coastline facing climate change

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The Moroccan coastline subjected by climate change to two major risks: erosion and submersion; coastal erosion is accelerating the retreat of the coastline, and marine submersions are increasing with storms as a result of the thermal expansion of the oceans and the melting of glaciers that contribute to sea level rise.
What draws to think of preventions, scenarios to contain this global warming and the vulnerability of Moroccan coastal areas. By mapping the most fragile, most vulnerable areas, to inform all stakeholders of new risks, reorganize these areas, continue construction on the seashore, either by stopping buildings or by reinforcing some dams and dikes (ports and industrial sites), either the relocation of roads, businesses and homes set back from these most vulnerable areas.

Co-funded by the Erasmus+ Programme of the European Union

Geo-ecotouristic heritage as an alternative to the effects of climate change for sustainable development in the Mirleft -Sidi Ifni region

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The area of Mirleft – Sidi Ifni, devoted by this study and located on the Atlantic facade of the Anti Western Atlas. By its desert climate, its poverty in agricultural land, its marginalization compared to the major roads, the absence of tourists infrastructures. This area conceals exceptional sites geo-ecotouristic.

The geo-ecotouristic development strategy integrated of this area must be based on an improvement the accelerate deffects of the drought in relation to the total climate and a diversification of the existing offer within a framework of local development in order to cure the accelerate deffects of the drought in relation to the total climate changes and mainly buildings in this area.

The most development socio-economic of the sites geo-ecotouristic of Mirleft– Sidi Ifni proves to be necessary currently as alternate considering the speed with which we attend the negative effects produced by the climate changes on the South of Morocco.

The most important today is to preserve the natural wealth which makes the beauty and the pride of this area by enforcing standards and rules and an ethics of the natural environment of this area. In summary, the integrated development geo-ecotouristic, can be essential as being the only alternative to cure the effects harmful of the drought.

Keywords: The integrated development geo-ecotouristic - Eco-tourism –geo-tourism -Mirleft sidi ifni

The future effects of climate change on the rabat-sale-kenitra region

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The coastline of the Region Rabat Sale Kenitra has become the main axis around which the cities and all the productive activities of the Province are structured.

With global warming and rising water levels, all these urban settlements and industrial areas are directly threatened by rising sea levels and floods.

The main aspects of climate change (climatic fluctuations) in this region are manifested by rising temperatures and long periods of drought, disturbances in the precipitation cycle and rising sea levels. Based on the most recent scientific knowledge, this poster provides a panorama of developments expected over the next decades and their socio-economic impacts on the Region.

Co-funded by the Erasmus+ Programme of the European Union

Recent evolution of surge-related events and assessment of coastal flooding risk on the Moroccan Atlantic coast

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This study brings out the effects of the storms, on the Moroccan coasts, caused by the combination between the depression, the high tide, the huge winds but
also the climate change. The scientific evidence indicates that storm surges are intensified by climate change, as a warmer ocean amplify the cyclone activity
and then the storm surges increase and create more damaging flood conditions in coastal areas. The approach combines a brief characterization of the storms
and the field survey after the storms, in order to identify and manage risk coastal areas in the future. Indeed, the depression off the Atlantic Ocean combined
with huge winds and high tide cause giant waves that affect Moroccan coast and damages caused are especially recorded in the coastal infrastructures of
protection but also in the coastal habitations and then reveal some management weaknesses of these areas.

Deposition-erosion alternation and progradation: indicators of climate change in the Alboran Sea

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In the Alboran Sea the seismic reflection shows that the Plio-Quaternary sedimentary filling consists of an alternation of deposition sequence and erosional surfaces.
The opening of the Strait of Gibraltar put an end to the Messinian crisis and allows the resumption of sedimentary filling. It is made by a succession of sedimentation phases interrupted by periods of erosion visible especially on the edge of the West-Alboran basin.
During the Plio-Quaternary, erosional notches are of particular importance off some rivers. This erosion confirms that the continental shelf has been repeatedly under a very small slice of water or even completely exposed. Some streams are digging their beds, parallel to the coast, at the current platform. This is further proof that it was in the open air.
When we subtract the role of tectonics that seems negligible during the Plio-Quaternary in this part of the margin, this alternation is mainly the result of glacio-eustatic variations and therefore of climate change.
The progradation of the outer edge of the continental shelf is also an important indicator of eustatic and therefore climatic variations. Indeed, it has been shown that, in general, the prograding sedimentary processions follow the direction of the variations of the sea level:
During the climb, the deposits are organized in nested prisms and more and more recent towards the shoreline, During the lowering of the sea level, the sediments deposited on the platform during the climb are taken up by erosion and added to the direct arrivals, they will progressively fatten the outer edge of the continental shelf.

Co-funded by the Erasmus+ Programme of the European Union

Reconstruction of the extreme floods of the Bouregreg river, Morocco

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Bouregreg is the second largest river in Morocco, and whose watershed is located between the middle Atlas ridges and the Atlantic ocean, the waters flows through to be retained by the dam of Sidi Mohamed Ben Abdellah. The estuary recently is almost at the mercy of the marine currents. It appears that no serious study has been conducted to survey the sediment charge, therefore the picture is still blurry if we want to assess the degree of vulnerability of the coastal shelf in a climatic context. The noticed sedimentary deficiency can be a useful tool for a better understanding of the coastal dynamics. Our goal was to sketch a sedimentary log based on time scale all along the river's route, thus our study is divided in two axis: the first one is the cores survey, the second axis is to establish a relationship between the sedimentary archive and the paleo environment e.g: surges, extreme events, The results are compared to the runoff time series of the Bouregreg River ahead of the dam, to set the main time frame in terms of extreme events and periods of low level floods. Further analyses allowed to (partially) relating the hydrographical evolution since the last last millenniums.

These analyses associate (i) geomorphological data, derive from aerial photo-interpretation, topographical and geological maps, (ii) geophysical surveys, and (iii) stratigraphic data coming from cores (≈3 m deep) we extracted from the site. Many additional proxy (palynology, ostracology…) are ongoing but first results have already allowed to done a diachronic mapping of the site, raising the question of the fluvio-maritime metamorphosis and its control factors.

Quaternary evolution of the Imlili Sebkha related to climate change (Dakhla, Morocco).

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The climate of the Holocene, which was globally rather close to the current climate, has known important changes during this era. The paleoenvironmental studies aim to restore the history of past changes. In this respect, the object of this Work is to understand the history of the past environment of the Moroccan Sahara based on the analysis of a sedimentary sequence obtained in Sebkha.

The reconstruction of the environmental changes which affected Imlili Sebkha during the last millenniums is based on an approach integrating sedimentological and geochemical data. Those data

will allow us to reconstitute the spatiotemporal distribution of the sedimentary stock and to study fauna associations as bio and geographic indicators to force our environmental reconstructions.
A preliminary core (IM01) covering the last millenniums show that the deposits consist mainly of silts clayey muddy, sands and evaporitic sediments.
On the one hand, the Sebkha recorded an alternation of get grey and green clays in addition to sandy sediments with a heavy presence of salt. This lithology shows that the site went through less dry periods than today. In fact, the wet periods allowed the extension of a more important vegetation and the deposition of organic matter. On the other hand, the microfossils (Foraminifera) in some levels of the core indicate a marine submersion periods of Sebkha.
This recording, taken in the South of Morocco, could represent a unique continental archive of climate change during the Holocene since the paleoclimatic community possesses no similar recording, of which the resolution of analysis could be lower than 50 years in the region.

Atlantic coastal dunes of Morocco: a natural heritage to protect

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The Moroccan Coast is an environmental and economic treasure composed of interlocking, interdependent ecological systems. Coastal sand dunes are a crucial part of that system. In the Atlantic coast, sand dunes display a range of diverse morphologies that has largely developed after emplacement.
Modification of the initial dune structure through natural and human processes has led to a complex and chaotic geomorphology within the dunes. The objectives of this study are to map the main coastal dunes in Morocco using aerial photos and satellite images and to present (field studies) the state of the coastal dunes to highlight the main problems encountered (wind erosion, marine and anthropogenic). Cases of restoration of coastal dunes in Morocco are presented. Despite their seeming abundance on Morocco, many coastal dune ecosystems have been severely degraded as a result of an excessive exploitation of natural resources, demographic expansion, urban sprawl and industrial growth. Many dune systems are already irreversibly altered and lost. Fortunately, there remain still impressive stretches of ecosystems of coastal dune that are in urgent need for appropriate management, to protect their characteristics (i.e. ecologic, geomorphologic, socio-economic and recreational opportunities) and their contribution into protecting the environment from coastal flooding from storm as natural (green) infrastructure and will be available for future generations that will enjoy the natural beauty of the Coast.