

**ERASMUS+ Capacity Building – ScolaMAR Project
SCIENTIFIC CONFERENCE ON COASTAL RISKS:
RISKS FOR SOCIETIES' FACING ENVIRONMENTAL
CHANGES VERSUS RISKS FOR NATURE UNDER HUMAN
PRESSURE**

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Abstract book

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Introductory conference

Systemic vulnerability: an integrated approach for analyzing coastal risks of erosion and sea flooding, special focus on social representations

Catherine Meur-Ferec¹, Elisabeth Michel-Guillou²

¹. Geography, LETG Brest (Géomer, UMR 6554 CNRS), Université de Bretagne Occidentale, Institut Universitaire Européen de la Mer, Université Européenne de Bretagne, France

². Environmental Psychology, CRPCC EA 1285, Université de Bretagne Occidentale, Institut des Sciences de l'Homme et de la Société, Université Européenne de Bretagne, France

First, this communication presents an interdisciplinary model of systemic vulnerability to erosion and sea flooding. This model brings together societies and nature in an advanced interdisciplinary research of coastal risks. We construct systemic vulnerability as the result of four main interactive components: (1) hazards (natural processes of erosion and sea flooding, sometimes reinforced by human actions and influenced by climate change), (2) stakes (what is at risk of being lost, people and goods exposed to hazards), (3) management (public risk-management policies, protection/safeguarding measures) and (4) representations (of risk, place, adaptation preferences). All the four components are essential to understand territorial vulnerability. Many researches focus on changing hazards influenced by climate change, on ever-increasing building stakes in coastal locations and on the adaptation of management strategies. But still few studies focus on the critical place of representations.

So, in a second time, we propose to focus on that representations component through an interdisciplinary approach mixing coastal geography and social psychology. What coastal inhabitants think, what they like and what they fear, what they are attached to... constitute crucial data to understand and manage coastal risks. From several large surveys conducted in France, we studied inhabitant's position towards risks, their relationships to their living-place and their preferences in coping strategies.

In general, the results show that people who are exposed have a low level of perceived vulnerability (they are not anxious), strong place attachment (they love their living place and want to live close to the sea), and are resistant to changes in adaptation strategies (they do not want to move away). Regarding adaptation strategies to climate changes, these positions can appear as paradoxes that enhance vulnerability and often lead to think that these people are "irrational", "in denial", "uninformed", or "uneducated". But psycho-social approach enables to go beyond these apparent paradoxes and to better understand inhabitant's positions. Moreover, coastal risks appear different to many other risks (industrial, other natural hazards...) because linked to the ambivalence of the sea: both dangerous and very attractive in many contemporary societies. These results allow grasping the human dimension of coastal risks. They highlight the importance for policies to take into account the individuals' positions in order to understand the gap frequently observed between policies and individual practices.

Keywords: coastal risks, systemic vulnerability, representations, adaptation strategies, place attachment, interdisciplinary, geography, social psychology

Session 1: Marine erosion and submersion risks in a context of climate change (part 1)

Tectonique et risques côtiers au Maroc: quelques exemples sur les côtes atlantique et méditerranéenne

Mohamed Benammi

Université Ibn Tofail, Faculté des Sciences, Département des sciences de la terre, Laboratoire « 3GE », BP. 133, Kénitra, 14 000

benammim@gmail.com

Des observations géologiques et des analyses tectoniques couplées parfois à des explorations sismiques (sismique de réflexion industrielle et tomographie sismique de haute résolution) montrent que les zones côtières sont structurées par un réseau de fractures hérité de la période paléotectonique ou engendré par des activités néotectoniques.

Ces failles, de différentes échelles, guident la formation de ces zones côtières et contrôlent les processus à l'origine de leur dégradation (érosion, dissolution, glissements de terrains). Les failles se distribuent souvent en plusieurs familles directionnelles qui découpent la côte en zones morpho-structurales. Les lignes de rivage miment ces orientations structurales notamment dans les zones côtières formées par des falaises rocheuses. Ce constat est illustré à travers quelques exemples sur les deux côtes marocaines.

Cette étude permet aussi de mettre en évidence le rôle important joué par ses structures cassantes (combinés aux phénomènes eustatiques) dans la segmentation longitudinale de la zone côtière en plages sableuses ou rocheuses ou en « low land ».

Capacity building program for a new generation of high energy events Moroccan researchers

N. Mhammdi (1), F. Medina (2)

(1). Geophysic and Natural Hazards Laboratory (LGRN), Institut scientifique; Geophysic, Natural Patrimony and GreenChemistry Research Center (GEOPAC), University Mohammed V Rabat, Maroc. mhammdi@israbat.ac.ma

(2). Moroccan Association of Geosciences, Commission of Natural Hazards, Rabat, Morocco. Summary: The Institut Scientifique (Mohammed V University) lead since 2008 a program for a new generation of high energy events Moroccan researchers.

The program aims to increase capacities of researchers, engineers and officials who conducive to earthquake and tsunami disaster sciences. The sedimentary record provides a promising key to reconstruct impacts of extraordinary waves. However, the differentiation between tsunami and storm surge deposits is extremely difficult, since most of their characteristics only indicate marine flooding. We until now, have about ten PhD students dealing with a high energy deposits on the Moroccan coastal areas. The program includes training on inter-disciplinary research, sedimentology, mineralogy, geochemistry ...

This discussion-based training focuses on issues related to the use of scientific data, publication practices, international collaborative research, peer review, fieldschool (fig.1). We discuss the most recent strategies to identify tsunami sand and mud deposits in coastal stratigraphies.

Multi- and transdisciplinary thinking are an important aspect of our education concept and are promoted in the paleotsunami deposits program. PhD students at IS-UM5 are supervised by a team of experienced scientists to ensure best possible guidance for their dissertation project. In addition, they can benefit from a large network of fellow PhD students from all over the world and from a range of disciplines.

With our educational activities, we closely cooperate with our partner institutions (national and international, (see below) and welcome trainees, PhD students and postdocs.

In order to pre-evaluate the local hazard, (i) potential tsunami triggering mechanisms (local – regional – far-field), (ii) local and regional historical accounts (including historical documents/tsunami catalogues, interviews with contemporary witnesses, etc.) on the effects of tsunamis and severe storms, and (iii) extreme atmospheric conditions have to be analyzed. A holistic study of the sedimentary environments within the area of interest is essential since it will determine the sedimentary record of any extreme wave event. Local reference deposits from either recent or historically well documented tsunami or severe storm surges guarantee the safest conclusions and should be favored over a schematic application of global ‘tsunami/storm signature types’.

Key words: High energy events (storms, tsunami), Paleotsunami deposit, Capacity building, Morocco

Assessment of Sand dunes volume using Seismic refraction profiling: A case study from the Atlantic coast of the north of Kénitra city, Morocco

Driss EL OUAI¹, Mounir HAKKOU¹, Benaisa TADILI², Abdellah AMMAR³

University Mohammed V

With this study, we are aiming to assess the volume of the loose sand in the area of interest. This area is part of the coastal dune system, along the Atlantic coast of Gharb, extending between Sidi Taïbi and Mouly Bousselham (NW of Morocco). This dune complex constitutes a natural barrier between the Gharb plain and the Atlantic Ocean. From the ocean to the mainland, the relief evolves from the beach with a sub-actual white dune made up of gray-white sand, partially overlapping other older dune, with 20 to 30 m high and gray sand. This dune which is not consolidated probably of Rharbian age (9.5 ka to 2.2 ka BP); partially or locally fills an often humid inter-dune depression, called Oulja. After this, comes the consolidated calcarenite of the old dunes. To achieve the goal mentioned above, we used seismic refraction method. Two profiles trending NW-SE, crossing perpendicularly the Atlantic coastal, in north of Kénitra city (NW of Morocco) were acquired. Each profile has about 600 m in length. The acquisition of the data was performed in set of 5 small profiles for each 600 m line. Each small profile has 24 channels, and the interval between geophones is of 5 meters. For the source, we used a sledge hammer of 5 kg to generate pulses. We used seven shots in and out for each line (4 out of the line and 3 inside the line) to have a better coverage of the underneath geological structure of the line. Preliminary results from the processed seismic data show three layers: (1) an upper layer, with low velocity (230 to 250 m/s), (2) a medium layer with velocity varying between 910 to 1500 m/s, (3) an underneath layer with velocities go from 1700 to 2430 m/s. We attribute the upper layer with low velocity to be the layer of the loose white-grey sand of the actual beach. The layer with medium velocity could be the unconsolidated grey sand. Finally the relatively high velocity layer would be either the consolidated calcarenite of the old dunes (D1 and D2 of Aberkane, 1989). However, the relatively large velocity variation of this underneath layer (from 1700 to 2430 m/s) could be explained by the existence of both, the consolidated Calcarenite and the basement, on which the recent sediments lays on. Using the results of the refraction, we calculate the volume of the loose sand of the study area, covered by seismic profiles. For an area of 600 m in width (from the shoreline to the abrupt valley of the consolidated Calcarenite), a length of 70 m along the Atlantic coast, and for an average depth of 4 m, we obtained a total volume of 170800 m³. This information can be of great importance to the government, local authority decision maker, and industrial partners, to a better management, and ecological protection of this coastal area.

Session 2: Marine erosion and submersion risks in a context of climate change (part 2)

Reconstitution and implementation of a methodology to evaluate the risk of marine submersion: return of experience on maritime storms in morocco

Khalid MEHDI¹, Bendahhou ZOURARAH¹, Khalid EL KHALIDI¹, Frederic LEONE²

¹Laboratoire Géosciences Marines et Sciences du Sol URAC 45, UCD-Faculté des Sciences El Jadida

²UMR GRED Université Paul Valéry, Montpellier III

The Moroccan coastline with these two maritime facades (Mediterranean and Atlantic) has become an area overoccupied and overused by urbanization (industrial, port, fishing and leisure activities ...). Coastal and oceanic activities, such as shipping, resource extraction, fish farming, recreation and tourism, are an integral part of the country's economy.

The Moroccan coast is not immune to the risks of sea floods due to strong storms, a consequence of extreme metrological conditions In fact, this coastline shelters development projects for its entire coastline and raises controversy as to its vulnerability to the risks of marine submersion.

The Moroccan coast, especially the Safi - Kenitra axis, the economic heart of the country, is a highly vulnerable area exposed to specific natural hazards and coastal areas. The storms of maritime origin in this region are nevertheless recurrent and relatively destructive. In the perceptive of an increase in the sea level (in relation with global warming), in addition to an increase in vulnerability and stakes, it is important to study the storm hazard, which risks being a natural hazard more and more frequent and destructive.

With regard of all these arguments, it is important to study the marine submersion risk by integrating data as well on the hazard, the stakes, the vulnerabilities, the coastal dynamics as the phenomena of societies.

The objective is to create a methodology and a database, which can be used in the study of future storms in Morocco. Our questioning focuses on the methodology to be applied in the field to reconstruct a past phenomenon. Precisely this approach is part of the implementation of a methodology assessing the phenomenon of marine submersion in a risk approach. We achieved this by reconstructing the storms of January 7 and February 4, 2014.

Response to coastal erosion: examples from Spain and Italy

Giorgio Anfuso

Universidad de Cádiz, España

This work deals with the different modalities of response to coastal erosion/flooding processes, i.e. “do nothing”, “adaptation”, “relocation” and “protection”. Protection can be linked to the emplacement of hard protection structures such as seawalls, revetments, groins and breakwaters, or beach nourishment (“the soft solution”). In Spain, approaches used to halt beach erosion were coastal structures as coastal tourism was the main beach management target. The aim was to stop beach erosion and, essentially, to increase beach carrying capacity without consideration of ecological and environmental aspects. In the last few decades, coastal defence policies experienced important changes based on reshaping/removal of hard structures and the realization of nourishment works with sediments dredged in the seafloor. In Italy, shore protection structures started to develop at the beginning of the 20th century, first to protect settlements and coastal roads, later to maintain a beach for tourist activity. The changing of the goal and the increasing awareness of the negative impact of some structures resulted in an evolution of coastal defence projects: initially, seawalls and revetments, later detached breakwaters and, more recently, groins. Today, a reduction in hard structures is perceived by removing or lowering detached breakwaters and groins below mean sea level. In Mediterranean countries the growing tourism industry is producing a strong demand for wide beaches. Such projects should be based on the correct design of a long-term, general, erosion management plan devoted to restore the natural sediment circulation patterns and environmental conditions.



Assessing land use scenarios and climate change related risks in the Italian coast: an integrated approach supporting climate change adaptation.

Andrea Critto, Silvia Torresan, Elisa Furlan, Petra dalla Pozza, Melania Michetti and Antonio Marcomini

Ca' Foscari Univ. of Venice

Understanding how natural and human-induced drivers concur to determine exposure, vulnerability and risks in coastal areas is of paramount importance for mainstreaming effective climate adaptation and risk reduction policies into coastal zone management.

Accordingly, a Climate Change Coastal Vulnerability Index (CC-CVI) was developed to provide guidance and operative criteria for exposure, vulnerability and risk assessment in Mediterranean coastal areas. The overall aim of the index is to identify map and prioritize coastal areas at higher risk from climate-related hazards (sea level rise inundation and storm surge flooding) in vulnerable (flood-prone) areas, providing a knowledge base for national-scale adaptation planning and disaster risk management. The index was applied to the Italian shoreline considering a baseline scenario representing current climate and land use condition, and a future one for the 2050, integrating both climate projections and data simulating changes in the environmental and socio-economic systems.

Results of the analysis include a range of spatial vulnerability indicators and statistics allowing to rank Italian coastal provinces according to their relative vulnerability to extreme sea level scenarios. The main steps of the methodology and the applicability of results for decision-makers and risk practitioners are here presented and discussed.

The OSIRISC project: towards an integrated observatory of coastal risks of erosion and sea-flooding.

Alain Hénaff and OSIRISC Team

UBO-IUEM, LETG-Brest UMR 6554 CNRS

Management strategies of coastal risks of erosion and seafloor dingneed a integrated based approach of the four components of the systemic vulnerability. This approach is based on both knowledge of hazards, stakes, management and social representations of coastal risks. But none of these components is stabilized over time and their respective evolution regularly alter the vulnerability of coastal territories. While the hazards and morphological dynamics of coastlines, such as accumulation coastlines or cliffs, are rather well supplied with monitoring means and indicators, the same is not true for the evolution of issues, management and social representations. These components do not have equivalent methods and tools. However, integrated temporal monitoring of their development and regular evaluations can improve their knowledge and inform management strategies.

In order to address these gaps, the OSIRISC project proposes to experiment, in close relationship with the practitioner managers and decision-makers, an innovative inter disciplinary observatory of coastal risks. With this objective this observatory implements a monitoring of the four components of the systemic vulnerability and defines relevant indicators of their dynamics.

The projects based on the development of an original interdisciplinary methodology that integrates all dimensions of systemic vulnerability through the selection or creation of multi-criteria indicators adapted to both research and management. In the long term, OSIRISC aims to co-design an observatory for long-term monitoring of coastal risks. The main challenges relate to the monitoring of issues, management measures, and even more, social representations. The methodology is currently evaluated and consolidated through experimentation with local actors on test sites and the best compromise between scientific requirements and operationalization of methods are sought. Within the Geographical Data Infrastructure (GDI) Indigeo specific tools for dissemination, geographic information sharing and dynamic mapping are implemented. A web-mapping tool, OSI, is therefore developed in order to produce a decision support tool based on all the individual evolutions of the components of systemic vulnerability.

Key-words: Coastal risks of erosion and sea-flooding, systemic vulnerability, interdisciplinarity, observatory, indicators

Session 3: Coastal pollution related to domestic and industrial discharges

Modernity and the Environment: pollution case histories in lagoons and coastal areas

L.G. Bellucci and S. Giuliani

Institute of Marine Sciences, C.N.R. - Via P. Gobetti, 101 - 40129 Bologna, Italy

As part of the research activities carried out by the Institute of Marine Sciences - National Research Council of Italy, the coupling of scientific evidence from sediment cores with historical information represents an effective way to reconstruct and evaluate anthropogenic impacts and changes in transitional and marine-coastal environments. Bottom sediments behave like natural historical archives, keeping significant information on the environmental conditions at the time of their deposition and accumulation. Good practices for the selection of sampling sites and specific survey techniques will be described as well as some application examples in different geographic and geomorphological contexts. To understand pollutant dynamics, in some cases we used independent tracers, natural or anthropogenic, for which input chronologies were well known. For example, the strong correlation between Hg and Hexachlorobenzene profiles in the Augusta Bay (Italy) suggests that the high levels of Hg measured in superficial sediments are probably attributable to phenomena of resuspension and redistribution of deep sediments caused by dredging and maritime traffic and not to active outfall. Our scientific approach also enabled us to see the effect of past management choices in sediment cores. For example, the PCDD/F vertical profiles in cores collected in the Venice Lagoon's Nord Industrial canal clearly show a polluted layer at the water-sediment interface. This was the effect of urgent dredging activities promoted for navigation purposes without a prior characterization of sediments to be removed, and without a monitoring plan during and after completion of the work. The case-histories here presented should provide a warning, mostly addressed to those countries where intense industrialization and economic growth have not reached their peaks yet, and where the environmental regulation on sediment management is still lacking.

Analyse des tendances de la pollution en Méditerranée

Mohamed Fekhaoui

Institut Scientifique,

Université Mohammed V, Rabat.

La gestion efficace environnementale des rejets liquides et solides est devenue une priorité dans la majorité des pays méditerranéens. Ainsi, la question de l'assainissement urbains est devenu un défi à relever au cours des dernières décennies. Un accroissement important de la population et une très forte demande en eau ont seulement augmenté les pressions exercées sur les ressources en eau mais ont également créé une demande supplémentaire très élevée en infrastructures d'assainissement urbaines.

Selon CE, 2006, une partie très importante des effluents urbains générés dans les villes des côtes de l'Afrique du Nord ne sont pas traitées du tout avant d'être déversées dans la mer ou les eaux de surface. Une partie de la population côtière de ces régions est connectée à des unités d'épuration primaire (et quelques stations d'épuration secondaire peu nombreuses), mais une partie importante des effluents urbains générés sont déversés sans être traités dans le milieu marin côtier, avec un impact négatif sur la santé humaine, la stabilité de l'écosystème marin et l'économie de la zone côtière (impact sur le tourisme et l'industrie de la pêche).

Le Maroc comme d'autres pays de la région, plus de la moitié des stations d'épuration des eaux usées ne fonctionnent pas correctement à cause du manque d'entretien. Cette situation conduit à des impacts négatifs sur l'environnement et à des dangers pour la santé, provenant de la réutilisation en agriculture d'eaux usées insuffisamment traitées, soit à la non disponibilité de cette ressource en eau de plus en plus importante pour l'irrigation.

D'une manière générale les principaux polluants liés aux effluents urbains rejetés sont les matières organiques (évaluées par la DBO5 et DCO), les MES, les éléments nutritifs (azote et phosphore) et les micropolluants tels que les métaux lourds, pesticides, hydrocarbures chlorés sont également présents dans les eaux usées.

Ainsi, il y a un important défi à relever mais aussi une opportunité d'investissement dans cette stratégie, dans un avenir proche.

Dans le but d'évaluer l'évolution de cette situation au niveau national, une analyse globale des différentes composantes pour faire ressortir les différentes tendances durant la période d'observation 2006-2012 a été réalisée.

Assessment of the risk of contamination in chemical elements of the Atlantic coast of Gharb (Morocco)

Chakiri Said

*Université Ibn Tofail, Faculté des Sciences, Laboratoire Géosciences des Ressources Naturelles, Département de Géologie
BP 133, Kénitra, Maroc*

L'étude des caractéristiques géochimiques des éléments majeurs et traces dans les sédiments superficiels de la côte littorale de la région du Gharb et de l'estuaire de l'oued Sebou a permis l'identification d'un maximum d'éléments métalliques à partir des analyses effectuées sur des échantillons prélevés le long de la zone littoral. La détermination des facteurs d'enrichissement a dévoilé les principaux contaminants dans chaque secteur de cette frange littorale du Gharb.

Les résultats de cette étude soulignent l'état de dégradation souvent avancé, voire localement irréversible du littoral de la région du Gharb.

Estimation of health risks due to the presence of polycyclic aromatic hydrocarbons in a coastal lagoon

Luis Nunes

University of Algarve, Faro, Portugal

Polycyclic aromatic hydrocarbons (PAHs) have a direct impact on human health due to their mutagenic and / or carcinogenic properties. Consequently, there is a high interest in assessing population exposure to PAHs through different routes of exposure and associated health risks.

In the present study the potential environmental risks for the public health due to exposure to PAHs in the Ria Formosa coastal lagoon were calculated.

Data for environmental concentrations together with a partition equilibrium model (Level II fugacity model) were used to estimate exposure. Toxic equivalent factors were applied to convert 15 of the PAH congeners into Benzo (a) pyrene equivalent before estimating the excess probability of developing cancer.

Benzo [a] pyrene was the contaminant that showed the highest risk, and naphthalene the lowest. Cumulative carcinogenic risks for the mixture of PAHs indicate that for high consumers of shellfish risk values are above the internationally accepted 1×10^{-6} threshold.

Results point out the need to implement risk prevention measures for decreasing PAH emission loads (e.g., by reducing boat traffic, and/or using electric boat engines).

Effects of urban and industrial pollution on the reproduction of marine organisms

Amel Hamza-Chaffai

Marie Ecotoxicology, IPEIS PoBox 1172-3018-Sfax University-TUNISIA

amel.chaffai@tunet.tn

A growing concern about the potential ability of anthropogenic chemicals present in the environment to disrupt the normal endocrine function of humans and animals occurred since the 1990s. In fact, these chemicals (endocrine disruptors EDs) interact with the endocrine system to disrupt the hormone homeostasis. The potential effects of chemicals can alter the normal endocrine function and physiological status of animals and especially steroid metabolism and effect on reproduction.

At the beginning, studies focused on the ability of chemicals to mimic or antagonise the hormones naturally produced by the gonads and on the possible consequences for reproductive life. During the last four decades, insidences of reproductive abnormalities have been noted around the world, for number of populations of wildlife species (mammals, birds, reptiles, fish and molluscs) generally at highly polluted sites.

Several naturally occurring and anthropogenic chemicals in the environment can cause adverse effects in organisms by disrupting the endocrine system, as shown by in vivo and in vitro laboratory based studies. Laboratory studies corroborate the abnormalities of reproductive development observed in the field and, in some cases, define toxic mechanisms causing adverse effects. Among chemicals of concern, are fungicides and xenoestrogens from domestic and industrialised harbours. Effects include the masculinization of female molluscs exposed to the antifouling agent TBT (tributyltin), and the feminization of male fish exposed to estrogenic chemicals in effluent from water treatment plants.

Various reproductive abnormalities caused by endocrine disruption have been identified. The observed effects have included alteration gonad size and structure, inter-sex, changes in plasma sex steroids, abnormal induction of vitellogenin (an egg yolk protein), alter reproductive behaviour and, in some cases reduced production of viable offspring.

The present work is an overview of recent research work about the effect of EDs from urban effluents. It is based on in situ and in vivo studies. We have focused on different compartments: Water treatment plant effluent, Sea water, Sediments and Bio monitors (Bivalves).

Novel methods, based on the quantification of both estrogenic activity (YES test) and Androgenic activity (YAS test, will be discussed).

Keywords: *Reproduction, Endocrine disruption, xenoestrogens, xenoandrogens, YES and YAS essays.*

Session 4: Other coastal risks related to anthropogenic activities

The implications of globalization for conservation in Morocco: Case of Saharan areas

Hamid Rguibi Idrissi & Youssef Bakri

Faculty of Sciences, University Mohammed V

Rabat, Morocco

Morocco and its people are undergoing profound and rapid change socially, economically and environmentally, a change that is already threatening the long-term conservation of its immense biodiversity and natural heritage. Real concern exists on the African continent and worldwide about the cost to the environment of rising and growing Morocco and of the implications of globalization on the well-being of its people and ecosystems. Leveraging on globalization to expand and improve conservation efforts in Morocco, while avoiding its negative consequences, is a crucial skill that the conservation community in Morocco needs to hone and perfect. Managing these unprecedented socio-economic changes implied by globalization, while maintaining biodiversity and ecosystem services, requires a unified commitment by the Moroccan scientific and practitioner community to generate there search and experiences needed to identify appropriate policies and practices for successful long-term conservation.

Globalization describes the process in which national and regional economies, societies and cultures become increasingly interconnected through a global network of trade, communication, immigration and transportation.

The outcome of globalization is the integration of economies, industries, markets, cultures and policymaking around the world (Global Policy Forum, 2016). Its effects can be desirable and undesirable and can affect different members of society disproportionately in wide-reaching and profound ways. The effects of globalization on natural resource conservation are variable, complex and difficult to disaggregate from the many other processes occurring simultaneously.

In Morocco, as elsewhere around the Africa, globalization in the conservation sector manifests itself in numerous ways, notably in the similarity across nations in their strategies and approaches to conservation through the influence of international nongovernmental organizations and in the sensitivity of local conservation actions to shifts in global economies, funding trends and global stakeholder interests.

***Assessing the hazard for benthic biodiversity due to aquaculture activities
using an integrated carrying capacity model***

Roberto Pastres, Daniele Brigolin, Erika M.D. Porporato

Ca' Foscari Univ. of Venice

The environmental impact of marine fish farming in cages on coastal ecosystems depends on both husbandry practices and the assimilative capacity of the farming site. The latter is related to the local bathymetry, hydrodynamic circulation and seabed morphology, as the main impact is due to the release of uneaten feed and faeces, which are ultimately deposited on the seabed, causing the organic enrichment of surface sediment. In this talk, the model FiCIM (Fish Cage Integrated Model) will be presented. The model allows one to estimate the "footprint" of a seabass/seabream farm on the seabed, in terms of surface sediment organic enrichment and changes in indices related to the biodiversity of the benthic community. The model was tested at several Mediterranean site and used for demonstration and hands-on session in a training organized by FAO-GFCM and ANDA on March 13th-15th 2019 in Rome, which was delivered by the authors of this communication to ANDA staff.

Human impact on mixed sand and gravel Mediterranean deltas: insights from the Guadalfeo case study (Southern Spain)

Miguel Ortega-Sánchez

Andalusian Institute for Earth System Research. University of Granada (Spain)

The main topic of this work would be to present a case study in Southern Spain where severe coastal retreat problems are being produced as a consequence of the river regulation, as well as the expected impacts of the climate change that will increase these consequences.

Human impact on mixed sand and gravel Mediterranean deltas: insights from the Guadalfeo case study (Southern Spain) Miguel Ortega-Sánchez. Andalusian Institute for Earth System Research. University of Granada (Spain) Deltaic systems are located at the transition between fluvial and maritime environments. They all have high environmental, economic and social importance, and respond rapidly to both natural and human-driven changes. On the other hand, mixed sand and gravel (MSG) beaches are common in previously para-glaciated coastal regions and coasts with steep hinterlands, and are widespread in the UK, Denmark, Canada, New Zealand and Mediterranean countries. They are also found when nourishment projects use gravel to protect eroded sandy beaches. Despite their societal importance, the research advances on gravel and MSG beaches have been limited compared to those on sandy beaches. The main objective of this presentation is to summarize the dynamics of MSG deltaic coasts based on a multi-scale investigation carried out in the Guadalfeo, a Mediterranean delta in a semi-arid and high-mountain basin of southern Spain. The effects of the construction of a reservoir 19 km from the mouth on the dynamics of the delta will be described. The sediment volume transported as bedload and accumulated in the delta was estimated under two scenarios by means of a calibrated hydrological model: a managed scenario, considering the flows drained by the dam, and an unmanaged scenario, considering the absence of such infrastructure. Bathymetric and topographic measurements were analyzed and correlated with the fluvial and maritime forcing agents. Results indicated that the reservoir has significantly modified the dynamics downstream: the coast has lost almost 0.3 hm³ of sediments since the entry into operation of the dam, generating a 1.4-km coastline retreat around the mouth, with a maximum retreat of 87 m (92% of the initial). Under unmanaged conditions, more than 2 hm³ of bedload would have reached the coast. The changes in the morphology and sedimentology of the MSG beach forced by wave and waterlevel variations as well as human intervention through nourishment will also be summarized. Monthly and storm event-driven field surveys, consisting of topographical measurements and sediment sampling, were carried out over a one-year period (October 2013 - September 2014). Three prevailing sediment fractions (sand, fine gravel and coarse gravel) and two end-member morphological states of the upper beach profile (convex with multiple berms and concave with a single storm berm) were identified. Between them, several transitional profiles were formed, characterized by developing berms that progressively overlapped, generating sediment variability both across the beach profile and with depth. Results indicated that the total run-up (including water-level) reached during an event represents a more accurate threshold than wave height for differentiating between erosional and depositional conditions. They also suggested that MSG coasts recover faster from storm erosion than sandy beaches.

Suivi des changements d'occupation du sol de la frange littorale de la ville de Tanger à partir des images Spot5 et Sentinel2

M.WAHBI, H. BOULAASSAL, M.MAATOUK O. EL KHARKI, et O. YAZIDI ALAOUI

Equipe : Géoinformation et Aménagement du Territoire, UAE FST de Tanger

La ville de Tanger, pôle économique et destination touristique par excellence, a connu ces dernières décennies diverses mutations et dynamiques de l'occupation du sol avec notamment l'implantation d'unités industrielles et touristiques et le réaménagement du port de la ville en port de plaisance.

Le but de cette étude diachronique par télédétection sur des images Spot multispectrales de 1995 et 2005 et d'une image Sentinel2 de 2018, vise à suivre les changements de l'occupation du sol sur les communes littorales de la ville et de mesurer l'incidence de la pression anthropique et l'artificialisation des zones côtières sur la stabilité du littoral et l'exposition aux risques.

Mots-clés : Suivi diachronique, Télédétection, SIG, artificialisation de la zone côtière.

Session 5: Integrated Coastal Zone Management

Blue growth and development opportunities

El Khalidi Khalid*, ***ZourarahBendahhou****, ***Mehdi Khalid****, ***HakkouMounir***** and ***Aajjane Ahmed****

** LGMSS, URAC-45, Earth Sciences Department, Faculty of Sciences El Jadida, University ChouaibDoukkali, Morocco*

*** Scientific Institute, University Mohamed-V, Rabat, Morocco*

In kingdom of Morocco, coastal population grew rapidly last decades. This expanding human presence has dramatically changed the ecosystem. The construction of habitats, agriculture, waste water diversion, tourism and uncontrolled fishing has altered the area's natural hydrology.

The policy of Morocco related to the international cooperation has resulted in the signing or ratification of a number of conventions and international agreements, among which those directly or indirectly related to the management of coastal areas. Morocco is a contracting party to the Barcelona Convention and is committed to the Action Plan for the Mediterranean.

The national ICZM strategy was started in February 2005, with the main focus being the Coastal Law 81-12. The approach was confirmed in January 2008 with the signature, along with thirteen other countries, of the 7th Protocol of the Barcelona Convention on ICZM. However, the worries come strongly from the capacity of the public management system to abandon sectoral approaches in favor of an integrated approach, especially in the absence of a transversal public operator.

The Moroccan coastline management is dispersed among several state actors and poorly coordinated, has proved its limits and has only accentuated the various problems. It is recognized that the management of this complex and coveted system requires an integrated approach, capable of bringing together and coordinating the multiple and interdependent interests of all stakeholders, while respecting environmental values.

Tackling climate change, understanding ecosystem function, managing sustainability: all of these require a much more tangible initiatives and strategies. Hence, the Blue Growth policy represents a long-term strategy to support growth in the maritime sector as a whole by harnessing the untapped potential of oceans, seas and coasts for blue jobs creation and economic growth.

Integrated Management of a coastal lagoon (Ria Formosa) using a quantitative DPSIR approach

Luis Nunes

University of Algarve, Faro, Portugal

The Driver-Pressure-State-Impact-Response (DPSIR) conceptual framework brings together natural sciences, social sciences and economics in one framework for adaptive management. Though most of its applications are qualitative, we show here an example of its use as an integrative model for combining qualitative and quantitative ecosystem and socio-economic interactions.

A shallow mesotidal lagoon in the south of Portugal (Ria Formosa) served as case-study. Urban development, tourism, aquaculture, and transports acted as driving forces. A set of indicators was chosen to reflect the pressures, state, and impacts (of negative or positive signal), and quantitative causality relationships were established between them, such that the change in one would cause the automatic alteration of the value of connected indicators. Impacts were first quantified as CO₂eq using specific quantitative relationships, and then converted into Euros using the value of CO₂ European emission allowances for a reference period. A final DPSIR index was calculated by the sum of individual impact values.

Alternative management scenarios, acting upon pressures, states, or impacts, were simulated by changing the value of indicators, which would then be reflected in the value of the DPSIR index. The signal and magnitude of the change in the original value of the index is a measure of the contribution of the scenario for the long-term sustainability of the lagoon.

The analysis allowed the study of policy and management scenarios, using indicators that policy makers and stakeholders can easily understand, facilitating communication and decision making.

Coastal risks and Integrated Coastal Zone Management (ICZM)

Ana Macías Bedoya

Universidad de Cádiz, Facultad de Ciencias del Mar y Ambientales , Campus Universitario de Puerto Real , Apartado nº 40, 11510-Puerto Real (Cádiz)

Coastal risks related to climate change are one of the most urgent challenges facing coastal management. The integrated perspective allows all the factors involved (economic, social, administrative, natural and environmental) to be incorporated into the decision-making processes, providing effective solutions for complex problems; that is, solutions based on knowledge and the recognition of said complexity.

Les risques côtiers dans la région Tanger – Tétouan – Al Hoceima (RTTA); état des lieux et proposition d'outils de gestion

Abdelmounim EL M'RINI

Université Abdelmalek Essâadi

Avec deux façades maritimes, méditerranéenne et atlantique, d'une longueur totale de 3500 km environ, le littoral marocain est un secteur stratégique pour le pays et constitue un patrimoine de grande valeur. Cette côte se trouve très sollicitée pour son intérêt touristique et économique, ainsi la population littorale ne cesse de s'accroître, la pression urbaine y est considérable. Le Maroc connaît depuis une cinquantaine d'années une littoralisation rapide. Le littoral concentre aujourd'hui plus de 60% de la population urbaine, plus de 90% des unités industrielles et près de 70% des capacités hôtelières homologuées, et toutes les prévisions indiquent l'intensification de ces tendances. D'autre part, les façades littorales sont soumises à plusieurs aléas d'origines différentes : océanique, atmosphérique, climatique et géologique.

Les littoraux de la (RTTA) bénéficient d'une situation remarquable, de ce fait, ils enregistrent un degré d'urbanisation nettement au-dessus de la moyenne nationale. Cette situation impose l'exposition des populations et de leurs activités aux différents aléas côtiers (érosion, submersion, pollution, ...). Ainsi, cette présentation sera une synthèse des différents risques auxquels sont exposées les côtes de la région, en se basant sur des travaux réalisés ou en cours, pour dresser un état des lieux des connaissances et identifier les lacunes.

Finally, nous proposerons un outil qui serait de grand intérêt pour la gestion des risques côtiers, il s'agit de la mise en place d'un Observatoire des risques côtiers de la (RTTA), l'idée est née suite à un colloque sur les risques côtiers que nous avons organisé à Tétouan les 4, 5 octobre 2018. Cet observatoire aura pour vocation d'aider à la mutualisation et au renforcement de l'information scientifique sur les risques côtiers au niveau de la région, puis de pérenniser cette connaissance en la coordonnant et en la diffusant.

Mots clefs :

Risques côtiers, gestion des risques, observatoire, Région Tanger – Tétouan – Al Hoceima