Annexes

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Assessing, quantifying and valuing the ecosystem services of coastal lagoons

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Coastal lagoons
Ecosystem services
Climate change
Human welfare
Benefits
Wellbeing

ABSTRACT

The natural conservation of coastal lagoons is important not only for their ecological importance, but also because of the valuable ecosystem services they provide for human welfare and wellbeing. Coastal lagoons are shallow semi-enclosed systems that support important habitats such as wetlands, mangroves, salt-marshes and seagrass meadows, as well as a rich biodiversity. Coastal lagoons are also complex social-ecological systems with ecosystem services that provide livelihoods, wellbeing and welfare to humans. This study assessed, quantified and valued the ecosystem services of 32 coastal lagoons. The main findings of the study are: (i) the definitions of ecosystem services are still not generally accepted; (ii) the quantification of ecosystem services is made in many different ways, using different units; (iii) the evaluation in monetary terms of some ecosystem service is problematic, often relying on non-monetary evaluation methods; (iv) when ecosystem services are valued in monetary terms, this may represent very different human benefits; and, (v) different aspects of climate change, including increasing temperature, sea-level rise and changes in rainfall patterns threaten the valuable ecosystem services of coastal lagoons.

1. Introduction

Coastal lagoons occur along 13% of the coastlines of all continents (Barnes, 1980). These areas are important for many biogeochemical processes (Sousa, Lillebø, Gonçh, Sousa, & Alves, 2013) and they are known for their high productivity. These shallow water bodies support important habitats such as wetlands, mangroves, salt-marshes and seagrass meadows (Basset, Elliott, West, & Wilson, 2013). This typical, mosaic landscape provides support for a rich biodiversity, including vital habitats for bivalves, crustaceans, fish and birds. They provide a physical refugium from predation and are used as nursery and feeding areas for some endangered species (Franco et al., 2006). Coastal lagoons are also characterized by harbouring a large part of the human population that may depend directly on these ecosystems (Willett, 2014). However, these are one of the most threatened ecosystems in the world. Habitat destruction, pollution, water withdrawal, overexploitation and invasive species are the main causes of their degradation (MA - Millennium Ecosystem Assessment, 2005; Barbier, Acreman, & Knowler, 1997). Coastal lagoons are sentinel systems that are very vulnerable to potential impacts associated with climate change (Eisenreich, 2005), particularly, as these systems have a key role in regulating the fluxes of water, nutrients and organisms between land, rivers and the ocean (Brito, Newton, Tett, & Fernandes, 2012; Newton et al., 2014). Sea level rise, increased temperature and changes in precipitation patterns would affect flushing rates, salinity, dissolved oxygen concentration, and biogeochemical properties. These changes could alter the composition and diversity of natural communities, as well as their sensitivity to eutrophication (Anthony et al., 2009), and their capabilities to support goods and services (Cossarini et al. 2008; Molales Cano et al. 2011).

Lagoons deliver ecosystem goods and services that provide not only livelihoods but also numerous benefits to human health and welfare, which makes them complex socio-ecological systems (Newton et al., 2014). The main services provided by coastal systems include food provisioning (mainly fish and shellfish), freshwater storage, hydrological balance, climate regulation, flood protection, water purification, oxygen production, fertility, recreation and ecotourism (Solidoro, Bandelj et al., 2010; Solidoro, Cossarini, Libralato, & Salon, 2010; Barbier, 2012; Lopes & Videira, 2013). Coastal lagoon ecosystems also support a wide range of human activities, including economic sectors such as fisheries and aquaculture, as well as leisure and tourism (Newton et al., 2014). Therefore, these ecosystem goods and services are not only economically valuable but they also have societal, aesthetic and heritage value due to their contribution to improvements in mental and psychological health (Sandifer, Sutton-Grier, & Ward, 2015). The conservation of coastal lagoons is therefore relevant for their ecological importance, along with the valuable ecosystem services (ES) they provide for human welfare. Holistic management involving economists, ecologists, and environmental scientists that assesses the services of these social-ecological systems is thus required (Barbier et al., 2011; Carpenter et al., 2009; Turner & Daily, 2008).

The discussion about ecosystem services and their categories (De Groot, Wilson, & Boumans, 2002; Costanza, 2008) has been ongoing for more than 20 years, and despite recent efforts, there is no consistent definition or classification. The Millennium Ecosystem Assessment (MA - Millennium Ecosystem Assessment, 2005) was the leader in providing a globally recognized classification for ecosystem services consisting of "*the functions and products of ecosystems that benefit humans, or*

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Atmospheric bulk deposition of dissolved nitrogen, phosphorus and silicate in the Gulf of Gabès (South Ionian Basin); implications for marine heterotrophic prokaryotes and ultraphytoplankton

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ABSTRACT

Monthly variability of atmospheric deposition of dissolved nitrogen, phosphorus and silicate was assessed during the year period from June 2014 to May 2015 in the Gulf of Gabès, situated near the most active source of dust. Nutrient concentrations, ultraphytoplankton < 10 μm and heterotrophic prokaryotes abundances were simultaneously investigated in the surface coastal water near the sampling site. Results showed that most of the bulk nutrient deposition (more than 66%) occurred during wet season, from October to February, characterized by air masses originating from the Tunisian desert. Dissolved Inorganic Nitrogen (DIN) deposition was very low, whereas Dissolved Inorganic Phosphorus (DIP) bulk deposition was within the range of that observed in the Eastern Mediterranean. High organic nitrogen (30.47%) and phosphorus (83.5%) content contributed to the bulk nitrogen and phosphorus deposition respectively. Months marked by high deposition were accompanied by an increase of carbon biomass from picophytoplankton, *Synechococcus* and heterotrophic prokaryotes while nanophytoplankton biomass decreased from 62.38% to 43.39% towards the wet season. During the wet season, heterotrophic prokaryotes become the first contributors to the carbon biomass in the surface water. This suggests a possible contribution of bacteria to the organic nutrient pool driven by atmospheric deposition or/and a reinforcement of the heterotrophic character of the system due to the organic content mineralization processes.

1. Introduction

The Mediterranean Sea is a typical low nutrient-low chlorophyll (LNLC) ecosystem characterized by a decreasing gradient of nutrients and primary production from west to the east (Moutin and Raimbault, 2002). During the stratification period, nutrient concentrations in surface Mediterranean water are low or below the detection limit (Pujo-Pay et al., 2011), particularly in the Eastern Mediterranean Basin, where N and mainly P limitations have been reported (Herut et al., 1999; Krom et al., 1991). During this period, the atmospheric inputs that provide both natural (Saharan dust) and anthropogenic aerosols could be the main external sources of new nutrients to the surface mixed layer (Herut et al., 2001; Carbo et al., 2005). These nutrient atmospheric inputs are particularly important in the ultra-oligotrophic Eastern Mediterranean Basin, where 61% of the externally supplied N and 28% of the leachable P are supplied via atmospheric deposition (Markaki et al., 2003; Krom et al., 2004). In the Ionian Sea, the atmospheric nutrient deposition is equivalent to or even larger than riverine inputs reaching the pelagic zone (Loye-Pilot et al., 1986). The major part of the atmospheric deposition in this region occurs through wet deposition, whereas dry deposition has a lesser contribution (Bergametti et al., 1989; Loye-Pilot and Martin, 1996; Guerzoni et al., 1999; Ternon et al., 2010; Markaki et al., 2010).

From oceanographers' point of view nutrient deposition (N and P) has been pointed out as an important source of the new primary production, particularly for oligotrophic waters (Markaki et al., 2003; Herut et al., 2005; Paytan et al., 2009). The nutrient content of the atmospheric deposition, when considering the oceanic Redfield ratio, may induce a dramatic change in phytoplankton composition and abundance (Markaki et al., 2010; Koçak et al., 2010) impacting both the heterotrophic (Thingstad et al., 2005; Pulido-Villena et al., 2008) and autotrophic production (Klein et al., 1997; Bonnet et al., 2005) in the Mediterranean Sea. This is due to small phytoplankton cells and heterotrophic prokaryotes being more competitive than primary producers, resulting in a more heterotrophic natural assemblage (Gazeau et al., 2014). In addition, close relationships were pointed out between dust

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Controlling factors of harmful microalgae distribution in water column, biofilm and sediment in shellfish production area (South of Sfax, Gulf of Gabes) from southern Tunisia

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ABSTRACT

The aim of this study was to investigate the spatio-temporal distribution of harmful microalgae coupled with environmental factors in the most important area for natural stocks of the grooved carpet shell *Ruditapes decussatus* in southern Tunisia. Sampling was performed monthly from May 2010 to April 2011 in five stations through the Tunisian National Monitoring Stations Network of Phytoplankton and Phycotoxins along the southern coasts of Sfax (Gulf of Gabes). The presence of harmful microalgae species was explored in three compartments: water column, biofilm and sediment. Our results revealed fourteen species were identified belonging to dinoflagellates and diatoms with higher densities during the summer period. The co-inertia plot analysis exhibited that the seasonal fluctuations of these species were controlled by the temperature as well as the nutrients (particularly nitrogenous). Ternary diagrams showed that biofilm was the most colonized compartment by toxic benthic dinoflagellates species, namely *Amphidinium carterae*, *Prorocentrum rathymum*, *Prorocentrum concavum*, *Prorocentrum lima*, *Ostreopsis* cf. *ovata* and *Coolia monotis*. In addition, these species were recorded simultaneously in the water column and the sediment, a fact that could be explained by the resuspension of these benthic dinoflagellates from the biofilm by hydrodynamics. The data suggest that harmful microalgae could be the source of toxins in the studied stations, which provide support to the implication of these results on the future sampling strategy of harmful microalgae in shellfish collecting areas in Tunisia.

1. Introduction

Harmful microalgae species may have an increasing global distribution and become a real threat around the world (Wells et al., 2015). Harmful algae proliferation is a complex phenomenon linked to many interacting factors such as transport of resting cysts in ballast waters or on floating debris (Smayda, 2007), coastal water eutrophication (Rekik et al., 2012), building harbors which increase water residence-time (Masó and Vila, 2005) and global climate change (Hallegraeff, 2010).

Many studies have focused on phytoplankton and cysts diversity in the water column and sediment (Bravo et al., 2012), but little attention has been paid to the phytoplankton community present in the water adjacent to the sediment, the biofilm. These assemblages are known as benthic microalgae or microphytobenthos (Round et al., 1990). They are an important component of a significant number of photosynthesizers in intertidal and shallow marine waters (Queiroz et al., 2004), able to grow at low light levels and taking advantage of high nutrient concentrations in the sediment (Blanchard and Montagna, 1992). Tidal flushing is one of the main factors controlling phytoplankton abundance in estuarine systems. It constitutes a relevant phytoplankton driving force since it induces substantial horizontal and vertical mixing of the water column, as well as upstream and downstream displacement of water masses along the main longitudinal estuarine axis (Domingues et al., 2010). While tidally-induced horizontal mixing and advection have more mechanical than physiological effects on phytoplankton (Legendre and Demers, 1984), vertical mixing can seriously affect the phytoplankton physiology and growth due to its strong impact on the availability of phytoplankton resources as nutrients and light (Demers et al., 1979). Tidally-induced vertical mixing

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Distribution of Trace Metals (Cd, Hg, Pb, Cu) and Polycyclic Aromatic Hydrocarbons (PAH) in Loggerhead Turtles (Reptilia: Testudines: Cheloniidae: *Caretta Caretta* (Linnaeus, 1758)) Tissues Stranded Along the North Tunisian Coasts

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Abstract

Cadmium, mercury, Lead, Copper and Polycyclic Aromatic Hydrocarbons, in liver, kidney, muscle and heart samples of 5 loggerhead turtles *Caretta caretta* (Linnaeus, 1758) stranded along the north Tunisian coast were measured. Analyses were performed by using the Atomic Absorption Spectrometry (AAS, VARIAN 220Z) for trace metals and the mass chromatography for PAH. The results demonstrated that the kidney and the liver are the main concentrated organs and muscles generally display the lowest trace metals and PAH concentration. By comparing with some bibliographic data, the mean trace metals concentrations are about identical to loggerhead turtles' tissues of others localities in Mediterranean Sea. In addition, obtained results show that the kidney is relatively the most concentrated organ in cadmium, lead and PAH, the liver and the heart are relatively the two most organs concentrated in copper and the highest concentrations of mercury were found in the liver. This is the first assessment into metal and polycyclic aromatic hydrocarbons distribution in tissues of loggerhead turtles from Tunisian Mediterranean Coastline.

Key words: Trace metals; polycyclic aromatic hydrocarbons; loggerhead turtles; stranding; Tunisia;

Introduction

Three species of marine turtles: the leatherback turtle *Dermochelys coriacea* (Vandelli, 1761), the loggerhead turtle *Caretta caretta* (Linnaeus, 1758) and the green turtle *Chelonia mydas* (Linnaeus, 1758) are encountered in the Mediterranean. The leatherback turtle is a visitor from the Atlantic and can be found all over the basin, although it does not breed in the Mediterranean [9,24]. The other two species reproduce in the Mediterranean and have evolved local populations with a genetic divergence from the Atlantic populations (Casale & Margaritoulis 2010, and references therein). The main identified threats at sea to these two Mediterranean populations are incidental catch, collision and intentional killing while the impact of other potential threats like chemical contaminants and debris is not clear yet [28].

All three marine turtle species mentioned were reported in Tunisian waters and were protected by several international conventions [25]. Loggerhead turtles, the most common sea turtles found on the marine habitats off the Tunisian coasts [22], are the only species that nest mainly in the Kuriat Islands [10,22,23].

Since 1988, the data of first record of the loggerhead sea turtles nesting in Tunisia, a Tunisian Sea Turtle Program (TunSTP) included in the activities of the National Institute of Sea Sciences and Technology (INSTM) was launched in order to identify appropriate conservation measures for these species, which are listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [15]; this program include (i) the monitoring of the loggerhead turtles nesting sites, (ii) the by-catch surveys and (iii) the national stranding network [10]. Moreover, a specialized sea turtle rescue centre has been established in the National Institute of Marine Sciences and Technologies at Monastir in 2004.

Following industrialization, high quantities of chemical pollutants have been released and continue to be released into the sea altering the natural biological equilibrium [20] and the sanitary of aquatic animals, particularly those long living species such as marine mammals, sea birds and sea turtles which have the potential to accumulate organic and inorganic contaminants from food, sediment and water in their tissues [4,18]. Therefore, the concentrations of these contaminants may vary depending on biological factors such us age and migration habits.

Trace elements are natural components of rocks and soil. The erosions favour their release in aquatic ecosystem. These elements occur naturally in very low concentrations in the environment.

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Picoeukaryotic diversity in the Gulf of Gabès: variability patterns and relationships to nutrients and water masses

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ABSTRACT: Marine picoeukaryotes show high phylogenetic diversity worldwide, notably in oligotrophic waters. In the Gulf of Gabès (south-eastern Mediterranean), characterized by oligotrophic conditions and a complex water mass circulation, information on picoeukaryotic diversity is still lacking. In this study, we investigated the diversity and spatial variability of picoeukaryotic assemblages in relation to nutrient availability, physical parameters and water masses in 3 cruises carried out in the Gulf of Gabès in June of 2008, April of 2009 and November of 2009. High-throughput sequencing revealed a dominance of sequences from non photosynthetic picoeukaryotes, mostly represented by the presumably parasitic marine alveolate MALV-II (33.20%) and the bacterivorous Bicosoecida (13.56%). Differences in picoeukaryotic assemblages were higher between coastal and open-sea stations, and depth in the water column also affected community differences, with surface (5 m), intermediate (25–100 m) and mesopelagic (>200 m) samples forming separate groups. A clear temporal variability was also evident, particularly for communities collected from the surface layer and open-sea stations. Co-inertia analysis revealed that picoeukaryotic groups were more affected by salinity in deep waters, whereas at the surface, they were dependent on nutrients and temperature. During the November cruise, samples that shared similar water mass properties generally clustered together. The Levantine water mass, observed for the first time in this area, was characterized by the presence of Acantharia and Polycystinea. Our study highlights the role of physical and chemical features, such as water mass origin, the wide continental shelf and trophic status, in determining the diversity of marine picoeukaryotes.

KEY WORDS: Picoeukaryotes · V4 · 18S rDNA · Diversity · Inorganic nutrients · Water masses · Mediterranean Sea · Gulf of Gabès

INTRODUCTION

Marine picoeukaryotes (protists up to 3 µm in size) are important players in planktonic food webs of coastal and offshore ecosystems (Massana 2011). Picoeukaryotic diversity has been widely studied in different types of aquatic ecosystems, showing high phylogenetic diversity worldwide. This diversity seems to be crucial in maintaining the functional stability and resilience of ecosystems (Caron & Countway 2009). In the past, diversity of natural picoeukaryotic assemblages has been widely analyzed using Sanger sequencing of cloned environmental genes (Díez et al. 2001a, Massana et al. 2004, Countway et al. 2010, Wu et al. 2014), as well as denaturing (DGGE) and temperature gradient gel electrophoresis and terminal restriction fragment length polymorphism fingerprinting tools (Díez et al. 2001b, Zeidner & Beja 2004, Marie et al. 2006, Wu et al. 2009, Lie et al. 2013). High-throughput

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water

MDPI

Article

Formation of Palygorskite Clay from Treated Diatomite and its Application for the Removal of Heavy Metals from Aqueous Solution

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Abstract: Environmental contamination by toxic heavy metals is a serious worldwide phenomenon. Thus, their removal is a crucial issue. In this study, we found an efficient adsorbent to remove Cu^{2+} and Ni^{2+} from aqueous solution using two materials. Chemical modification was used to obtain palygorskite clay from diatomite. The adsorbents were characterized using X-ray florescence, Fourier transform infrared spectroscopy and X-ray diffraction. The effects of contact time, initial concentration, temperature and pH on the adsorption process were investigated. Our results showed that the (%) of maximum adsorption capacity of diatomite was 78.44% for Cu^{2+} at pH 4 and 77.3% for Ni^{2+} at pH 7, while the (%) of the maximum adsorption on palygorskite reached 91% for Cu^{2+} and 87.05% for Ni^{2+}, in the same condition. The results indicate that the pseudo-second-order model can describe the adsorption process. Furthermore, the adsorption isotherms could be adopted by the Langmuir and the Freundlich models with good correlation coefficient (R^2). Thus, our results showed that palygorskite prepared from Tunisian diatomite is a good adsorbent for the removal of heavy metals from water.

Keywords: palygorskite clay; diatomaceous earth; heavy metals; adsorption capacity

1. Introduction

Heavy metal ions play a very important role in certain industries due to their technological importance. However, they pose serious dangerous effects because they are persisting in the environment. In addition, metal ions have a chronic toxicity, persistency and accumulation tendency in body tissues. For example, copper is known as the highest mammalian toxic specie; its inhalation is linked with an augmentation in lung cancer and its accumulation in the vital organs causes many diseases and disorders [1]. It is widely used in ornamental ponds and in water supply reservoirs. Nickel is recognized as the most recalcitrant pollutant. It is not biodegradable and can cause dermatitis, allergic sensitization, respiratory distress and dizziness. It is extensively used in electroplating, zinc base casting, battery industries and silver refineries. Thus, the removal of Cu^{2+} and Ni^{2+} is considered of high importance. Traditional methods were applied for heavy metals elimination such as ion exchange, chemical precipitation, membrane filtration, biological treatment and adsorption [2,3]. Among all these technologies, adsorption is the most useful method due to its efficiency and lower cost. For this purpose, many researchers used various kinds of low-cost and natural adsorbents, such as coconut coir

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Harmful epiphytic dinoflagellate assemblages on macrophytes in the Gulf of Tunis

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Coolia monotis
Environmental factors
Gulf of Tunis

ABSTRACT

The patio-temporal distribution of epiphytic and planktonic microalgae coupled with environmental factors was investigated for a one-year period in the Gulf of Tunis (northeastern Tunisia). Harmful microalgae assemblages were dominated by three toxic epiphytic dinoflagellates: *Ostreopsis* sp., *Prorocentrum lima* and *Coolia monotis*. They were observed, both on macrophytes (1.03×10^6 cells g^{-1} FW ; 1.3×10^4 cells g^{-1} FW and 865 cells g^{-1} FW, respectively) and in the water column (2.35×10^4 cells L^{-1}; 3.72×10^3 cells L^{-1}; 1.04×10^3 cells L^{-1}, respectively). Species abundances decreased with depth and maximum concentrations were found in shallow waters (0.5–1 m). The highest species abundance was registered both on macroalgae and seagrass with no special preference observed for either of these substrates. Redundancy analyses (RDA) show significant changes in these species abundances according to sites and seasons. The proliferation of *Ostreopsis* sp. is widespread in summer, when water temperature is warm, and especially in bay zones. The occurrence of *P. lima* and *C. monotis* blooms was mainly correlated to nutrients. In this study, macrophyte beds in the Gulf of Tunis were a reservoir of potentially toxic species that could pose a real threat, both to ecosystems and to public health.

1. Introduction

Harmful benthic dinoflagellates (BHAB) have aroused the interest of scientists over the last decade due to their increasing distribution, from tropical waters to temperate zones such as the Mediterranean Sea (Hallegraeff, 1993; Van Dolah, 2000; Masó and Garcés, 2006; Aligizaki et al., 2008; Rhodes, 2011). The most common harmful benthic dinoflagellate species, *Ostreopsis* sp., *Prorocentrum lima* and *Coolia monotis*, are mainly epiphytic, found on macrophytes and are following the same increasing trends (Vila et al., 2001a; Aligizaki et al., 2009; Ignatiades and Gotsis-Skretas, 2010; GIOHAB, 2012; Blanfuné et al., 2015). Blooms of the epiphytic species *Ostreopsis* are increasingly observed in several areas of the Mediterranean (Penna et al., 2005; Aligizaki et al., 2008; Gohu et al., 2011; Accoroni and Totti, 2016), causing negative impacts on both ecosystems and human health (Deeds and Schwartz, 2010; Ramos and Vasconcelos, 2010) due to production of palytoxin (PLTX) and the palytoxin-like compounds called ovatoxins (OVTXs) (Ciminiello et al., 2008; Aligizaki et al., 2008; Accoroni et al., 2011). Like *Ostreopsis*, *P. lima* produces okadaic acid (OA) and can cause DSP events (Faust, 1991; Nascimento et al., 2012; Rhodes et al., 2006), while *Coolia monotis* synthesizes cooliatoxin (Holmes et al., 1995). The toxicity of the former species makes their monitoring necessary.

In this context, research institutes, universities, environmental agencies and technological enterprises based along Mediterranean coasts (including Tunisia) came together under the umbrella of a EU funded project, to reduce the hazards related to harmful benthic algae. The MS-HABs project was launched in January 2014 in order to increase awareness and implement measures to manage harmful benthic algal blooms in the Mediterranean Basin through the development of common monitoring procedures, automated counting methods and predictive modelling tools.

In Tunisia, the first phase of this project investigated the harmful benthic dinoflagellates in the Gulf of Tunis. Despite the critical situation of this part of the coast, which is the most urbanized and industrialized area in the country, little attention has been paid to large-scale spatial and temporal distribution of phytoplankton communities, especially the harmful benthic dinoflagellates in the shallow Gulf coastal waters. Most of the previously existing studies treated only a restricted geographic area (Daly Yahia-Kéfi et al., 2001; Turki, 2005; Aissaoui et al., 2014) or nearby lagoons (Romdhane et al., 1998; Sakka Hlaili et al., 2006; Sahraoui et al., 2009; Amri et al., 2011; Smida et al., 2012; Turki et al., 2006, 2014; Dhib et al., 2015).

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Morphodynamique d'une plage microtidale à barres subtidales en condition de tempête : cas de l'avant plage de Mahdia, Tunisie

Morphodynamics of a microtidal sandbar beach under storm condition: case of the Mahdia nearshore, Tunisia

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Résumé. L'effet du changement climatique s'illustre dans l'élévation du niveau de mer et l'agressivité ascendante des évènements météo-marins sur les milieux côtiers, voué à une accélération extrêmement forte (IPCC 2007). L'action des tempêtes marines va entraîner des réponses morphologiques rapides et des impacts importants sur les littoraux sableux particulièrement l'érosion des plages et le recul du trait de côte. Certains rivages tunisiens sont déjà touchés par cet aléa notamment la baie de Ras Dimas-Cap Africa (Mahdia), objet de cette étude. L'objectif de ce travail consiste à suivre la réponse de deux profils de plage sableuse dissipative à barres subtidales sous des conditions de forçages hydrodynamiques de tempête au niveau de Mahdia au Golfe de Hammamet en Tunisie. La méthodologie adoptée s'est basée sur des mesures bathymétriques de l'avant côte acquises lors de deux campagnes de mesures en 2004 et 2006, complétées par la simulation numérique grâce à un nouvel modèle morphodynamique: Système de Modélisation côtière (SMC). Cet outil a été développé et validé en Espagne par la Direction Générale des Côtes et le Groupe d'Ingénierie Océanographique et Côtière (GIOC) de l'Université de Cantabrie. La modélisation côtière appliquée fournit une estimation de l'évolution spatiale de la hauteur de la houle en fonction de la bathymétrie, un suivi de la surélévation de la masse d'eau ainsi que le déplacement des barres sédimentaires engendré par les courants de fond (courant de retour). Soumises à des conditions de haute énergie d'une houle de tempête, les barres sableuses migrent vers le large puis reviennent vers la côte. Le rapprochement des barres du rivage est associé à un engraissement de la plage sous des conditions de forte houle au niveau du centre de la baie où la plage est à faible pente et à deux barres sableuses. Néanmoins au sud de la baie, où une seule barre est présente, le bilan sédimentaire s'oriente vers une érosion et un recul de la ligne de rivage lors d'événements météo-marins de forte énergie et il est marqué par une migration vers le large de la barre subtidale.

Mots-clés: Tempête, profil de plage, barre sédimentaire, SMC-PETRA, morphodynamique, Mahdia, Tunisie.

Abstract. The effects of global climate change are illustrated by rising sea level and the increase of intensity of storm events. The highest waves generated attack the upper beach. This combination of the two factors would produce severe erosion, threatening the coastline. The Ras Dimas-Cape Africa (Mahdia, Tunisia) coastline and adjacent areas are particularly exposed to such impact. The aim of this study is to assess the response of wave-dominated sandbar beach under storm events in two different cross shore cases in the Mahdia beaches. The methodology adopted is based on the surveyed bathymetry of the nearshore (2004-2006), completed with the morphodynamic numerical model SMC (Tunisian SMC software, Hispano-Tunisian project of coastal rehabilitation, TUNEROSION). The model has been developed and validated by the Spanish Government and the Ocean and Coastal research Group (GIOC) (University of Cantabria, Spain). Coastal modelling provides the wave high and wave induced set-up created by breaking wave and the sediment transport volume calculated as a function of local conditions. The response of sandbars to storm condition is moving onshore and migrates seaward. The morphodynamic result is however an accretion of the nearshore under the storm wave at the center of the bay (two sandbars with gentle slope). Nevertheless, in the southeast beach, where we find single sandbar, the sediment budget is characterized by shoreline retreat during high wave energy and the migration offshore of this sanbar beach.

Keywords: Storm, beach profile, sandbar, SMC-PETRA, morphodynamics, Mahdia, Tunisia.

Abridged English version

Introduction

Mahdia beach, located in oriental sahel of Tunisia, is a sandy beach with morphodynamic stages ranging from dissipative to intermediate but still close to the dissipative regime. This beach can display up to two sandy bars which are active during high energy events. Since the beach is located in a microtidal regime, flood events are mainly

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PRIMARY RESEARCH PAPER

Multi-table approach to assess the biogeography of phytoplankton: ecological and management implications

Wafa Feki-Sahnoun · Asma Hamza · Béchir Béjaoui · Mabrouka Mahfoudi · Ahmed Rebai · Mallika Bel Hassen

Received: 30 October 2017 / Revised: 20 February 2018 / Accepted: 25 February 2018 / Published online: 8 March 2018

Abstract This study aimed to determine whether temporal variation of Bacillariophyceae and Dinophyceae changed spatially, to examine which biogeographical features determined the spatial structure of Bacillariophyceae/Dinophyceae assemblages, and to compare between-zones variations in the phytoplankton taxonomic composition. The study is based on dataset collected during the period 2004–2007 along the coastal zones of the Gulf of Gabès using the STATIS multi-table method. This method allowed a measure of similarity between 15 sampling zones, the visualization of the species assemblages showing similar spatial variations and the reproducibility of this pattern for each zones' association. High spatial gradient was evident for most species, and three large regions were obtained. Thirteen different taxa assemblages were then detected performing a common pattern of phytoplankton composition. For each assemblage, the most representative region which encompasses groups of zones with similar properties was identified. The hydrodynamic processes and geomorphologic properties of the different areas as well as anthropogenic activities are incriminated to play a major role in shaping the structural patterns of phytoplankton along the coastal zones of the Gulf of Gabès. This study suggested considering the biogeographical features in the assessment of phytoplankton spatial assemblage.

Keywords Coastal zones · Bacillariophyceae and Dinophyceae · Biogeography · STATIS analysis

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Introduction

Dispersal of phytoplankton can be mediated by a variety of physical and biological vectors whose effectiveness might be different in relation to the geographic distribution of water in a given area (Incagnone et al., 2015; and literature therein; Naselli-Flores et al., 2016; Padisák et al., 2016; and literature therein). Phytoplankton has therefore a true biogeography with well-defined geographic patterns (Naselli-Flores & Padisák, 2016), which allows for identifying a regional pool of species contributing to establish a metacommunity network. The distribution

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PLANKTON AND SEDIMENT IN BALLAST WATER DISCHARGE IN THE GULF OF GABES (TUNISIA)

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BALLAST WATERS
HARMFUL PHYTOPLANKTON
NON-INDIGENOUS SPECIES
ZOOPLANKTON VIABILITY
SEDIMENT
GULF OF GABÈS
TUNISIA

ABSTRACT. – Ballast water in international navigation is deemed to play a key role in the unintentional movement of non-indigenous aquatic species across their geographical borderlines. In this context, the Gulf of Gabès is regarded as being exposed to species invasion due to its extensive human impact. The investigations carried out during the years 2009-2010 in the four port areas concerned 19 commercial ships. This study focused on the specific composition, status, abundance and viability of plankton in ballast water. For all ships, the qualitative analysis of samples was mainly marked by low diversity. The major groups were diatoms and Dinophyceae to a lower extent. The abundance of phytoplankton varied between 0 and 27.6 10^3 ind.dm^{-3}. Most of the species found in ballast water were reported in different regions and were assumed to be cosmopolitan. The cell viability assessed by flow cytometry, revealed a viability rate ≤ 1 % for 85 % ships. Microfauna in the ballast water was very weakly represented and had a cosmopolitan distribution. No introduced species was detected. The quantity of sediment discharged in the Gulf of Gabès via ballast water during this period was described and estimated.

INTRODUCTION

Ballast water is absolutely essential to the safe and efficient operation of modern shipping, providing balance and stability to unladen ships. Over 10 billion tons of ballast water are worldwide transferred each year between ports (Oemcke & van Leeuwen 2003). It was estimated that every day, up to 7,000 marine and coastal species are crossing the world ocean in ballast tanks (Battle 2009). Hallegraeff & Bolch (1992) estimated that 150 to 22,500 cysts m^{-3} were present in ballast sediment. Cysts as well as resting cells of diatoms can survive very harsh conditions, including anoxia, and can remain viable for 10 to 20 or more years (McQuoid *et al.* 2002). Biological invasions in marine habitats represent a recognized worldwide threat to the integrity of native communities, to economy and even to human health (Streftaris & Zenetos 2006) and ballast water discharge was identified as a leading vector for marine invasive species (Aguirre-Macedo *et al.* 2008, Hess-Erga *et al.* 2010, Miller *et al.* 2011, Wenschkun *et al.* 2012, Martinez *et al.* 2013). Successful invasions are facilitated by a multiple-step process in which organisms taken up in ballast water tanks first survive during journeys and then must be sufficiently abundant to reproduce in the receiving waters (Carlton 1996). Following introduction, the successful development of foreign organisms was linked to abiotic and biotic characteristics of local environments as well as characteristics of the invading species (Wonham *et al.* 2000, Pertola *et al.* 2005). Genetic variability, body size, physiological tolerance, and reproductive strategy can play a role in promoting invasions of non-indigenous species. The successful transfer of exotic species was also intensified by coastal eutrophication and by the vessel size and volume (Hallegraeff & Bolch 1992, Hallegraeff 1998). The vulnerability of an area to the introduction of non-native species via ballast water depends on the intensity and type of activity of its ports, including the frequency and volume of ballast water and sediment it receives, vessel types, source regions, journey length and seasonality (Carlton *et al.* 1995, Smith *et al.* 1999, Drake & Lodge 2004, Verling *et al.* 2005). Sometimes, impacts are quick and dramatic but more often they are indirect and subtle and may escape notice for some time (Foerter 2009).

Ballast water contains a diverse mix of phytoplankton, including those generating harmful algal blooms, cysts and zooplankton eggs, benthic organisms, bacteria and viruses (Aridgides *et al.* 2004). Many studies, that were conducted to evaluate ballast invaders, have focused on macro-organisms such as metazoans (Occhipinti-Ambrogi & Savini 2003), so that micro-organisms present in ballast water remained largely ignored. Paradoxically, micro-organisms such as plankton and bacteria characterised by their very small size (from 0.2 µm to 200 µm), their large abundance (up to 10^9–10^{11} dm^{-3} for prokaryotes and viruses) and their wide distribution, are commonly found in ballast waters (Drake *et al.* 2007).

Several studies addressing to species introduction via ballast water were conducted in the Atlantic and Pacific Oceans. In contrast, very few concerned the Mediterra-

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Baseline

Seasonal variability of picophytoplankton under contrasting environments in northern Tunisian coasts, southwestern Mediterranean Sea

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ABSTRACT

We investigated at the single cell level during 16 months (June 2012 to September 2013) the temporal distribution of picophytoplankton (picoeukaryotes, *Synechococcus* and *Prochlorococcus*) communities in two contrasted ecosystems: the Bay of Bizerte characterized by an oligotrophic regime typical of the Mediterranean Sea and the Bizerte Lagoon that exhibit a mesotrophic/eutrophic state. We aimed at depicting seasonal variations and quantifying the relationships between the environmental factors and the structure and abundance of picophytoplankton communities. Results showed that picophytoplankton groups were able to grow under a wide range of environmental conditions varying seasonally, although their abundances and contribution to the total chlorophyll biomass significantly varied and showed importance in the Bay of Bizerte. *Synechococcus* was the most abundant group reaching 22.5×10^3 cellscm^{-3} in the Bay and 278×10^3 cellscm^{-3} in the lagoon. This group was present all over the year in both ecosystems. Structural equation model results pointed out a different configuration regarding the picophytoplankton environmental drivers. The complexity of the configuration, i.e. number of significant links within the system, decreased under enhanced eutrophication conditions. The less exposure to anthropogenic stress, i.e. in the Bay of Bizerte, highlight a larger role of nutrient and hydrological conditions on the seasonal variations of picophytoplankton, whereas a negative effect of eutrophication on picophytoplankton communities was unveiled in the Bizerte lagoon. We stress that such influence may be exacerbated under expected scenarios of Mediterranean warming conditions and nutrient release in coastal ecosystems.

Picophytoplankton cells are autotrophic microorganisms, < 2 μm in size, that substantially contribute to the phytoplankton biomass and carbon export in all aquatic environments (Richardson and Jackson, 2007; Stockner, 1988). In particular, these microorganisms dominate the total phytoplankton biomass and production in oligotrophic ecosystems (Li et al., 1993; Šilović et al., 2011). Such dominance is based on the efficient uptake of dissolved nutrients at low bulk concentrations, coupled with reduced sedimentation loss and subsequent grazing (Caroppo, 2000; Raven, 1986). In environments characterized by a marked seasonality, the abundance and structure of picophytoplankton change throughout the year along with the decrease of nutrient concentration and increasing temperatures, which characterize the shift from new to regenerated production (Kuosa, 1991).

Picophytoplankton is represented by two genera of picocyanobacteria *Synechococcus*, *Prochlorococcus* and picoeukaryotes (Sieburth et al., 1978). The genus *Synechococcus* is ubiquitous in all marine environments, although it shows larger abundances in nutrient-rich environments than in oligotrophic ones (Partensky et al., 1999a, 1999b) and appears also favoured by low salinity and/or low temperature (Dvořák et al., 2014). Conversely, *Prochlorococcus* is well adapted to high light levels of stratified oligotrophic waters, although the genus has been also recorded in shallow, meso- and eutrophic systems

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Strain selection of microalgae isolated from Tunisian coast: characterization of the lipid profile for potential biodiesel production

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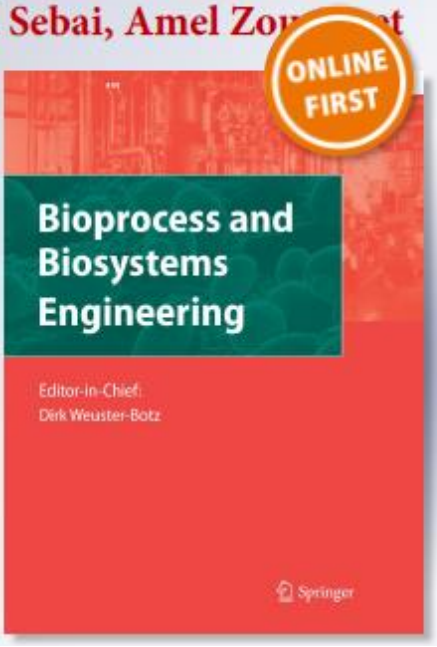

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ORIGINAL PAPER

Theoretical investigation of the regioselective ring opening of 2-methylaziridine. Lewis acid effect

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Abstract

The formation of substituted 1,2-diamines via the regiospecific nucleophilic ring opening of 2-methylaziridine with methylamine was performed by nucleophilic attack at aziridine carbon atoms. A detailed theoretical study was investigated by density functional theory (DFT) at the B3LYP level and second order Moller Plesset perturbation theory (MP2) by using the 6-311G(d,p) basis set. The third Grimme correction term (D3) was used to take into account weak interactions. Solvent effects were computed in methanol and dimethylsulfoxide using the polarizable continuum model (PCM). Emphasis was placed on the ring opening mechanisms of neutral aziridines and aziridinium ions obtained through N-complexation with the BF_3 Lewis acid. Moreover, the effect of substituent groups on the regioselectivity of the ring opening was investigated. The nucleophilic attack was carried out via two pathways (frontside attack M1 and backside attack M2) where activation barriers proved the preference for ring opening through the backside attack at the C3 aziridine carbon atom. The obtained results showed that the frontside attack with methylamine takes place along a concerted mechanism that leads to formation of products through one transition state. However, the backside attack is carried via a stepwise process in which the methylamine attack takes place in an S_N2 fashion where the leaving group is the ring nitrogen. It first conduces a ring opening considered as the rate-determining step followed by formation of a zwitterionic intermediate. This latter undergoes a rotation to allow the proton transfer step and finally leads to formation of the thermodynamic products.

Keywords Aziridine · Ring opening · Nitrogen inversion · Activation energy

Introduction

Aziridines, nitrogen containing three membered ring heterocycles, represent one of the most valuable systems in organic synthesis and medicinal chemistry [1, 2]. Even though less common than the corresponding oxygenated heterocycles (oxiranes), the chemistry of aziridines has received much attention due to their manifold potential applications and their useful properties centered around their ring opening transformations [3–5].

They are well established as versatile building blocks owing to a combination of their ring strain and their reactivity as carbon electrophiles [6–10]. Several naturally occurring molecules

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Turbulence in the Sicily Channel from microstructure measurements

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ABSTRACT

Small scale turbulence in the two main deep passages of the Sicily Channel was characterized for the first time with microstructure measurements collected during four cruises spanning a two year period. Large turbulent kinetic energy dissipation rates (ε) were observed, with averaged values below the mixed layer reaching 10^{-7} W kg^{-1}, confirming that the Sicily Channel is a hotspot for turbulence. Contrasted depth-averaged ε were observed between the two passages below the mixed layer: enhanced ε in the northeastern passage ranging from 1.3×10^{-8} - 2.7×10^{-7} W kg^{-1} over the different cruises, and much weaker ε in the southwestern passage ranging from 3.5×10^{-9} to 7.7×10^{-9} W kg^{-1}. This contrast in ε occurs due to a stronger deep flow at the northeastern passage, resulting in larger shear and stronger turbulence. Internal tides act as another important source of turbulence in both passages, modulating the subinertial flow and inducing shear instabilities. Enhanced turbulence was also revealed by additional measurements made downstream (with respect to the deep flow) in the northeastern passage towards the deeper Tyrrhenian Sea, as dense water overflow above steep topography.

A wave-wave parameterization was tested for ε, which showed a reasonable consistency for the less turbulent southwestern passage, but not for the more turbulent northeastern passage, suggesting a difference in the mechanism of turbulence.

1. Introduction

The Sicily Channel is a narrow and shallow passage that connects the Western and Eastern Mediterranean Basins (Fig. 1 a), and is one of the few sites of strong turbulent mixing in the Mediterranean Sea (Ferron et al., 2017). This paper investigates the dynamical processes responsible for turbulent mixing based on in-situ microstructure and finestructure measurements.

The transport in the Sicily Channel is driven by density gradients (Herbaut et al., 1996). The surface circulation, characterized by the south-eastward flowing Atlantic Water (AW), shows a complex pattern where meso- and submesoscale processes prevail with a strong variability on timescales of the order of days (Manzella et al., 1988). At the western entrance of the channel, the surface Algerian Current splits into one branch entering the Sicily Channel and a second branch flowing into the Tyrrhenian Sea (Fig. 1 a). In the channel, two major surface currents are identified: the Atlantic Tunisian Current (ATC), following the Tunisian coast, and the Atlantic Ionian Stream (AIS), along the southern coast of Sicily and more prevalent during the summer (Jouini et al., 2016). Some characteristics of the circulation vary seasonally, such as the cyclonic Pantelleria Vortex in winter, and the cyclonic Adventure Bank Vortex and the anticyclonic Maltese Channel Crest in summer (Jouini et al., 2016). The north-westward bottom outflow into the Tyrrhenian Sea, consisting mostly of Levantine Intermediate Water (LIW), is guided and controlled by the small scale topography (Béranger et al., 2004). The cascading of this outflow through narrow canyons and over sills leads to instabilities and mixing (Spamocchia et al., 1999). The deep flow was monitored through moorings installed in the main two deep passages of the channel, CD1 at the northeastern passage and CD2 at the southwestern one (Gasparini et al., 2004; Figure 2), separated by the shallow Talbot Bank (Würtz et al., 2014). Based on in-situ measurements, Stansfield et al. (2001) showed that the deep western branch of the bottom current recirculates around Talbot Bank and merges with the northward flow from the northeastern passage (Fig. 1 b). They also inferred intense mixing from hydrography measurements at and immediately northward of CD1.

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Using general linear model, Bayesian Networks and Naive Bayes classifier for prediction of *Karenia selliformis* occurrences and blooms

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ARTICLE INFO

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Karenia selliformis
Naive Bayes classifier
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Bayesian Network
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the Gulf of Gabès

ABSTRACT

The prediction of the dinoflagellate red tide forming *Karenia selliformis* is a relevant task to aid optimized management decisions in marine coastal water. The objective of the present study is to compare different modelling approaches for prediction of *Karenia selliformis* occurrences and blooms. A set of physical parameters (salinity, temperature and tide amplitude), meteorological constraints (evaporation, air temperature, insolation, rainfall, atmospheric pressure and humidity), sampling months and sampling sites are used. The model prediction included general linear model (GLM), Bayesian Network (BN) and the simplest BN type which is, Naive Bayes classifier (NB). The results showed that these models incriminated high salinity in *Karenia selliformis* blooms and the sampling sites, mainly Boughrara lagoon, in the occurrences. The BN performed better than linear models (NB and GLM) for both *Karenia selliformis* occurrences and bloom prediction. This later is related to the facts that BN considered the inter-independency between predictive variables and that the relationships between the variables and the outcome are often non-linear such us; the transition to bloom situations appeared to be triggered by a salinity threshold. This study is useful in the management of this ecosystem so as to use the best disposal options in the early prediction of the toxic blooms.

1. Introduction

The harmful *Karenia* species are found throughout the world. They have been described as a result of investigations into extensive animal mortalities or human health problems. They have become the most studied species of harmful algae with extensive investigations on the physiology and bloom formation. *Karenia selliformis* (Haroun et al., 2004) has been the most abundant species causing severe harmful blooms in the Gulf of Gabès (Hamza and Abed, 1994). Since the year 1990, *K. selliformis* blooms have occurred annually along the coast, and represented over 64% of the reported blooms in this area (Feki et al., 2008, 2013). It has been argued that their proliferation has been usually related to shellfish toxicity (Ben Naila et al., 2012; Marrouchi et al., 2009; Medhioub et al., 2010). Little is known about the effect of environmental factors on *K. selliformis* occurrences and blooms. Information on optimal growth of this species under controlled temperature and salinity was documented in culture experiments (Medhioub et al., 2009). Tentatively models have been developed to apprehend the effects of physical and meteorological variables on its occurrences and blooms in the Gulf of Gabès. A generalized linear mixed-effect model (GLMM) incriminated mainly water temperature and some nutrients in the spatiotemporal occurrences of *Karenia selliformis* (Feki et al., 2013). Bayesian Network approach showed that the bloom can be predicted based on salinity threshold (Feki-Sahnoun et al., 2017). However, the best performance model having the highest goodness of fit on the prediction of *Karenia* blooms and occurrences still needs to be

Abbreviations: Generalized linear mixed-effect model, GLMM; *Karenia selliformis*, *K. selliformis*; Analysis of Variance, ANOVA; General linear model, GLM; Bayesian Network, BN; Naive Bayes classifier, NB; Tunisian National Meteorological Institute, INM; Akaike Information Criterion, AIC; Bayesian Information Criteria, BIC; Samlam, Sensitivity Analysis, Modeling, Inference And More software; Directed Acyclic Graph, DAG; Conditional Probability Tables, CPTs; Maximum likelihood, ML; Maximum A Posteriori, MAP; Evaporation, Evap; Insolation, Insol; Salinity, Sal; Humidity, Humid; Water temperature, WatT

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Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions

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A Naïve Bayesian Network Approach to Determine the Potential Drivers of the Toxic Dinoflagellate *Coolia monotis* in the Gulf of Gabès, Tunisia

Wafa Feki-Sahnoun, Hasna Njah, Moufida Abdennadher, Asma Hamza, Nouha Barraj, Mabrouka Mahfoudi, Ahmed Rebai, and Malika Bel Hassen

Keywords

Coolia monotis • Prolifération • Naïve bayesian network • Environmental factors • The Gulf of Gabès

1 Introduction

Coolia monotis has occurred recently in many coastal areas of the Gulf of Gabès (South of Tunisia) as potentially toxic marine phytoplankton. It was reported in water column reaching 3×10^5 Cells L^{-1} (Feki et al. 2008) and attached on the phanerogam plants (Ben Brahim et al. 2013). This harmful epiphytic dinoflagellate was thought to produce cooliatoxin (Holmes et al. 1995), to have hemolytic activity (Pagliara and Caroppo 2012) and to be toxic to mice (Holmes et al. 1995). The prediction of the *C. monotis* proliferation is a relevant task to help optimize management decisions in marine coastal water. Our goal, from the national phytoplankton monitoring program REPHY (REseau du PHYtoplancton) data, was to identify the phytoplankton community composition, the physical and meteorological variables that are the most incriminated in the *C. monotis* proliferation when it yields an alerting threshold and highlight the month and the site that are the most affected by the species proliferation assuming a set of stable conditional independencies along the Gulf of Gabès coasts. The development of Naive Bayesian network allows us to establish a model of *C. monotis*, referring to the parameters previously cited, so as to define its ecological attributes.

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2 Materials and Methods

Data were collected in the framework of the National Phytoplankton Monitoring Program in the shellfish harvest areas from 1997 to 2007 in the Gulf of Gabès. Fifteen sites were weekly sampled and phytoplankton was enumerated with Uthermöhl method. The enumerated phytoplankton community consisted of dinoflagellates, diatoms, Cyanobacteria and Euglenophyceae. Hydroclimatic parameters were simultaneously collected. Meteorological data were provided by the National Tunisian Meteorological Institute. The tide amplitude in this coast was obtained from Tunisian Hydrographic and Oceanographic Services. All hydro-meteorological parameters were discretized into three

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Assessment of the Impact of Dams on River Regimes, Sediment Transports to the Sea, and Coastal Changes

Gil Mahe, Oula Amrouni, Thouraya Ben Moussa, Laurent Dezileau, Rajae El Aoula, Hamadi Habaieb, Abderraouf Hzami, Ilias Kacimi, Abderrahmane Khedimallah, Fatma Kotti, Mohamed Meddi, Nadia Mhammdi, and Saadi Abdeljaouad

Keywords

Rivers • North Africa • Dams • Sediment transport • Coastal morphological changes Sands

A great number of rivers of North Africa are equipped with many dams for multiple purposes, mainly potable water, irrigation and energy production. In most of the countries—Morocco, Algeria and Tunisia, the storage capacity exceeds the runoff capacity, which means that water is stored several times in a row during its course to the sea. This leads to the storage of massive amounts of sediments into the dams' lakes, but nothing is known about how much sediment is released from these dams. This topic is mainly unstudied by the regional scientists due to lack of measurements of sediment transport, or poor access to observed data when available. Thus there are no time series of sediment loads to the sea from the North African rivers. One of the consequences is that it is impossible to relate recently observed coastal morphological changes to changes in the sediment recharge from the continent. This study brings a synthesis of recent works on this topic over the largest rivers of North Africa in the three countries. In Morocco and Tunisia there no continuous time series of sediment transport observations. There we sampled sediment cores in river meanders, to draw the history of real sediment exportations to the sea, on the basis of granulometry, geochemical and isotopic studies. Only in Algeria are there observations of sediment transport at main hydrological stations. The times series show many lack of data which are reconstructed according to runoff/concentrations correlations, taking seasonal factor

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Characterization of Marine Dredged Sediment, from the Port of Kalâat Andalous (Bay of Gulf of Tunis), Tunisia

Oula Amrouni, Wième Ouertani, Alberto Sánchez, Lassaâd Chouba, Abdelaziz Sebei, Waleed Chmingui, and Saâdi Abdeljaouad

Keywords
Sediment • Dredging • Harbour • Kalâat andalous • Inorganic • Organic pollutants • Organic matter

1 Introduction

The dredging of the navigation channel of the Port of Kalâat Andalous is an important technical operation for the maintenance of the harbor activities. However, the quality of dredged material, usually qualified by moderately to high contaminated (IFREMER 1999), is one of the most critical issues in marine ecosystem. In Tunisia, dredging of marine sediment takes place on an average of ten years and can reach 15 years. The total volume of dredged sediment is estimated about 8.5 mm^3 $year^{-1}$ (Feki and Mbarka 2015). Nevertheless, the dredged sediment was clapped at sea or deposit in terrestrial area without any prior study of their impact on the environment. The present investigation was conducted under the ***RYSCMED* 16G1005** bilateral project, in an attempt to characterize the submarine dredged sediment from the fishery Port of Kalâat Andalous, (Western bay of Gulf of Tunis, Medjerda river valley) and deposited outside the port, close to the access channel. The scope is to characterise the sediment compound quality and their possible environmental impacts.

2 Materials and Methods

The methodology was based on sedimentological, mineralogical and geochemical investigation. The sediment samples were collected in march 2016, in the fishery port of Kalâat Andalous during the dredging operation. The sedimentological analysis was carried by sieving under the AFNOR column. The computation of granulometric parameters (Modal value, average mean size Md & *Mz*, standard deviation σ, and skewness Ski, were carried out following Folk and Ward 1957 method. The microgranulometric analysis was undertaken by sedigraphy (*Malvern Mastersizer 2000*). The quartz surface description was established under the binocular Microscope (*LCD digital system*), in the Laboratory of Marine Environment at INSTM institute. The geochemical analysis was carried out on the sedimentary material using the X-Ray Diffraction (DRX) and treated by the *Highscore* Software. Determination of the level of major and trace elements was carried out by Atomic Absorption Spectrometer at the Mineral Resources and Environment laboratory (*LRME*), Faculty of Science El Manar.

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Salinity as a Growth-Regulating Factor of the Toxic Dinoflagellate *Alexandrium Minutum*

Moufida Abdennadher, Amel Bellaaj Zouari, Wafa Feki Sahnoun, and Asma Hamza

Keywords
Alexandrium minutum • Toxic dinoflagellate • Growth • Salinity tolerance

1 Introduction

The dinoflagellate genus *Alexandrium* is one of the major harmful algal bloom (HAB) genera. It involves more than 30 species and produces paralytic shellfish poisoning (PSP) saxitoxins and a number of related derivatives (Anderson et al. 2012). In the Mediterranean *Alexandrium* forms blooms in many harbors or confined water areas subject to increased eutrophication. This includes toxic species *A. minutum* that frequently occur in the shellfish production areas through the Gulf of Gabès coast (South-eastern Mediterranean Sea) (Abdennadher et al. 2012). Diverse environmental factors, such as salinity, are known to affect the population dynamics of *Alexandrium* (Lim and Ogata 2005; Lim et al. 2011). Such information is valuable in predicting the occurrence of algal blooms. Therefore, in this study, the response of *A.minutum* growth rate to salinity was determined under controlled laboratory conditions.

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2 Materials and Methods

Clonal cultures of *A. minutum* (n = 4, labeled Am.2, Am26, Am.1b and Am.3b) were isolated from the Gulf of Gabès. The cultures were established by micropipetting cells and maintained at salinity 40 in L1 medium, temperature of 22 °C and an irradiance of 100 µmol photons $m^{-2}s^{-1}$ in a 12: 12 h light: dark regime. For the salinity experiment, *A. minutum* cells were inoculated into nine salinity treatments (10, 15, 20, 25, 30, 35, 40, 45 and 50). A lower salinity medium was prepared by diluting filtered seawater with distilled water. The experiment started with the inoculation of exponential phase culture at salinity 40 with approximately 350 cells mL^{-1} into 500-mL Scott Duran flask containing 300 mL of medium L1 at the desired salinity. Growth of isolated strains was monitored by sub-sampling for cell counts at 2-day intervals. The cells were fixed in Lugol's solution and counted microscopically using a Sedgewick Rafter chamber. The specific growth rate, μ (day^{-1}), was calculated over the exponential growth phase as in Guillard (1973).

3 Results and Discussion

The growth curves of *A. minutum* strains isolated in this study are plotted in Fig. 1. In all salinity treatments, *A. minutum* cells grew exponentially with a short lag phase. Our results show that the four isolated strains presented a similar behaviour, with a gradually increasing growth rate with the increasing salinity and decreasing in experiments with salinity higher than 40. The maximum growth rates of around 0.41 day^{-1} (for Am.2, Am.1b and Am.3b) and 0.82

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Satellite Images Survey for the Identification of the Coastal Sedimentary System Changes and Associated Vulnerability Along the Western Bay of the Gulf of Tunis (Northern Africa)

Abderraouf Hzami, Oula Amrouni, Gheorghe Romanescu, Cristian-Constantin Stoleriu, Mihu-Pintilie Alin, and Saâdi Abdeljaouad

Keywords
Satellite imagery • Sedimentary system • Shoreline evolution • Gulf of Tunis

1 Introduction

The coastal system is a fragile and unstable environment. The demographic pressure together with the importance of industrial and economic issues associated requires taking awareness of the fragility of coastal fronts. A shoreline is idealistically defined as the interface of land and water (Dolan et al. 1980). This sedimentary feature is one of the rapidly changing coastal landforms (Mujabar and Chandrasekar 2013). Accordingly efficient methods were needed to handle the spatio-temporal data of coastal applications within a GIS environment. Thieler et al. (2009) developed an extension for ArcGIS soft allowing an automatic measurement of the shoreline changes.

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2 Materials and Methods

In the present study, three cloudless satellite images from SPOT1, SPOT4, and Sentinel A2 were treated. Synthetic maps obtained by ArcGIS 10.2, were carried out with limits land/sea as a reference line for processing of satellite imageries, topographic map and aerial photography. As part of diachronic synthesis, all of which are extra means to evaluate the state of the beach before drawing conclusions on the coastal kinematics (Robin 2002). Numerical data were used to calculate shoreline evolution of statistic changes from multiple coastline positions using ESRI ArcGIS 10.2.2 software and its extension from the United States Geological Survey (USGS), Digital Shoreline Analysis System (DSAS) version 4.3 and developed by Thieler et al. (2009). In this step, the DSAS software was used to create transects and analyze different points to calculate the rate-of-change at the specified time interval (Thieler and Danforth 1994). DSAS provides a calculation for each transect (Bush and Young 2009). Based on the settings DSAS, 200 transects have been generated at 200 m spacing and about 40 km along the western bay of the Gulf of Tunis coast. The baseline was built offshore (the Gulf of Tunis) parallel to the general trend of the coastline. Afterwards, all the different shorelines were stacked and compared to the last map (2016). In our project, this error is a maximum of 2.33 m. The calculation of the rate of error of our photo-interpretation was based on the report from the USGS (2006) which expressed the calculation of the margin of error equations 1, 2 and 3. However, we will not take into account the error of digitization for the development of the error margin. In our graphics, we used an error margin of $\pm$ 0.15 m/year.

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Sedimentological Study for the Monitoring of the Sediment Transport Pattern in the Lagoon of Bizerte (Northern Tunisia)

Nessim Douss, Oula Amrouni, Nadia Gaaloul, Alberto Sanchez, Béchir Bejaoui, and Mohamed Moncef Serbaji

Keywords
Bizerte lagoon • Grain size • Sediment trend analysis • Micro fauna

1 Introduction

The Lagoon of Bizerte is located on the southern mediterranean basin. It corresponds to a semi-closed depression with maximum depth of 12 m. It is connected to the sea by a channel in its eastern part and to the Ichkeul lake in its western part, which gives it a rather unique geographical position as a crossing point for continental and marine hydrological systems. Several studies have been carried out and focused mainly on the sedimentological aspects (Soussi 1981; Ibrahim et al. 2013), paleogeographic, ecological, hydrodynamic (Bejaoui 2009; Harzallah 2003 or geochemical (Zaaboub 2016).

This work is based on two approaches: a sedimentological investigation, which consists in assessing the spatial facies distribution of subsurface lagoon sediment and to define coastal sediment transport. The Paleontological approach was used in order to identify the environmental changes of the current benthic micro-faunal populations related to the physico-chemical characteristics of the lagoon, the dynamics of the lagoon and the nature of the substratum.

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2 Materials and Methods

The studies have been carried out by the classic methods of the sedimentology and paleontology. The sedimentologic analysis was performed in sands between −2 and −12 m. A total of 23 samples underwent a granulometric analysis by sieving (AFNOR column). In order to characterize the grain size distribution, a numeric exploitation has been made by calculating the classic indication (average mean size Mz and/or median value, the sorting index σ, the asymmetry index SKI and kurtosis index KG), according to Folk and Ward (1957). The microgranulometric analysis was undertaken by *The Malvern Mastersizer 2000* which was designed for the measurement of particle size distributions within the range of 0.01–1000 µ. We tried to relate the sediment transport directions to the spatial changes in grain size parameters using a kinematic model established by Sunamura and Horikawa (1971) modified by Barrera-Gaona (1998) known as the Sediment Trend Analysis (STA). The grain size parameters used to identify sediment trends were the mean grain size (phi scale), sorting (σ) and skewness (SKI).

The fauna observation and species identification were carried out under the binocular loupe (Laboratory of Marine Environment, INSTM).

3 Results and Discussion

3.1 Grain Size Analysis

The lagoon sediments show a mixture of distribution facies which the sandy fraction dominate (65%).

The sandy sediments are mainly unimodal with modes varying from 630 to 63 µm, exceptionally for the B14 (south

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Kalâat Andalous Harbor Lagoon Sediments: Quality and Characteristics

Samia Khsiba, Oula Amrouni, Karim Ben Mustapha, Nadia Gaâloul, and Chrystelle Bancon-Montigny

Keywords
Sedimentology • Macrophyte • Microorganism • Kalâat Andalous harbor lagoon

1 Introduction

Lagoons are defined as paralic environments (Guelorget and Perthuisot 1983). These ecosystems constitute sensitive productive environments. They receive many inputs from the watershed. The organization and characteristics of lagoon environments are closely dependent on the balance between marine and continental influences. Climatic and hydro-sedimentary irregularities in the sea-communicating area influence this balance (Maanan 2003). These coastal ecosystems have been the subject of several scientific works on the geological, biological and environmental levels in the Mediterranean basin (Ben Alaya 1970; Ben Mosbah et al. 2010; Raji et al. 2015; Ouertani 2017). They are often in great demand at the socio-economic level that makes them very fragile in face of natural (marine submersion, floods, marine storms, etc.) and anthropogenic pressure (urbanization, wastewater discharges, pollution, coastal works, etc.,) (Ben Mosbah et al. 2010). The purpose of our study was to assess the quality of the subsurface sediment of Kalaât Andalous harbor lagoon while identifying its vegetation cover, rarely studied before, and evaluating its state to define the lagoon quality. The Kalâat Andalous recently formed lagoon is bordered by a dynamic sandy spit of Foum El Oued estimated as sedimentary accretion as 35 m since 2011 (Samaali 2011) and that has recently developed southward to northward (Hzami et al. 2017), interrupted by a channel which is actively frequented by fishermen.

2 Materials and Methods

14 subsurface lagoon sediment samples (P1 to P14) were carried out during a campaign in July 2016. The sampling of the algae was carried out during a campaign in March 2017 at the level of 6 radials in order to encircle the lagoon. Each radial measuring 25 m with 10 stations (separated by 2.5 m), applying the *EXCLAME* method (Examination tool for Coastal Lagoon Macrophytes Ecological status) using the calculation of several parameters among which specific richness "Rs" (Number of species), and the ratio between reference Species number and species richness. The macrophyte and microfaune identification was established by the LCD (Liquid Crystal Display) digital system Microscope (Laboratory of Marine Environment, INSTM). The 14 samples underwent a grain-size analysis by sieving using an *AFNOR column*. The grain-size distribution was characterized by calculating indices (average mean size MZ, sorting index σ, asymmetric index SKI) according to Folk and ward 1957. The microgranulometric analysis was undertaken by sedigrapher *Malvern Mastersizer 2000*.

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The sedimentological changes caused by human impact at the artificial channel of Medjerda-River (Coastal zone of Medjerda, Tunisia)

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Abstract. Recent sedimentary and morphological changes at the new mouth of Medjerda-River (Gulf of Tunis) are investigated using a multiproxy approach of sediment cores complited by ^{210}Pbex and ^{137}Cs method dating. The subject of the study is to focus on surveying the sedimentary evolution of Medjerda-Raoued Delta caused by the human intervention in the management of the main tributaries of the Medjerda-River (artificial channel of Henchir Tobias). Sediment cores (CEM-1 and CEM-3) were subjected to both multiproxy approaches (Grain size, geochemical analysis and dating radiometric ^{210}Pbex and ^{137}Cs). The sedimentological analysis of the new deltaic deposits shows a progradation sequence with the silt and clay deposits on the historic sandy substratum. The mean grain size evolution on the old beach profile shows a decreasing trend from backshore (CEM-3) to nearshore (CEM-1). The geochemical results show varying concentrations of chemical elements such as Fe, K, Rb, Nb, Cr, Ti, Ba, Ca, Sr, Zr, V, and potentially toxic metal trace elements such as Pb, Zn and the As. The Principal component Analysis (PCA) applied in the geochemical elements evolution confirms the marine origin of the sand deposits in the basic layers of the two cores. The chronological method (^{210}Pbex and ^{137}Cs) affirms that the first fluvial deposits were set up only after 1950. The sedimentological and geochemical result confirm the actual unless of coarser fluvial supplies under the human activities leading the negative coastal sediment balance and the shoreline retreat as well.

1 Introduction

The sediment budget of the coastal area is subject to several factors. The natural one is related to the sand supply sources and the eolian/hydrodynamics regime. The human factor represents an important element on the equilibrium of the coastal budget. Considering the coastline in its three dimensions, some authors have concentrated on the geomorphological balances of sedimentary flows, cell per cell (Suanez and Sabatier, 1999; Amrouni et al., 2014). The scientific community has also raised the question of the natural and human factors impacton the coastal sandy beach supplies (Flemming and Hansom, 2011).

The study of coastal environments linked to different global rivers is all the more important as they can be considered as markers of the evolution of sedimentary contributions in marines environments in relation to climatic as well as human variations (Milliman and Meade, 1983; Syvitski and Kettner, 2011; Kotti et al., 2015). The evolution of the nearshore sedimentary distributionis also related to the variability of hydrodynamic forcing and sediment availability in coastal areas (Perillo, 1995). The study area constitutes the coastal alluvial plain of the Medjerda River, the western bay

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Satellite images survey for the identification of the coastal sedimentary system changes and associated vulnerability along the western bay of the Gulf of Tunis (northern Africa)

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Abstract. The aim of this study consists in testing the effectiveness of satellite data in order to monitoring shoreline and sedimentary features changes, especially the rapidly changing of Gulf of Tunis coast. The study area is located in the Gulf of Tunis western bay (Southern Mediterranean Sea) which is characterized by sandy beaches of Ghar Melah and Raoued (Medjerda Delta area). The aerial photographs and satellite imageries were used for mapping the evolution of shoreline. Diachronic data (satellite imagery, aerial photography and topographic maps) were used to monitor and to quantify, the evolution of the coastal areas. These thematic data were digitally overlaid and vectorised for highlighting the shoreline changes between 1936 and 2016, in order to map the rate of erosion and accretion along the shoreline. Results show that the accretion and degradation are related to the Medjerda: change of outlet in 1973 and impoundment of the Sidi Salem dam in 1982. We found that the general trend of the coastal geomorphic processes can be monitored with satellite imageries (such as Sentinel A2, Spots 4 and 5), due to its repetitive coverage along the time and their high quality concerning the spectral contrast between land and sea areas. Improved satellite imageries with high resolution should be a valuable tool for complementing traditional methods for mapping and assessing the sedimentary structures (such as shoreline, delta, marine bars), and monitoring especially the lowlands coastal areas (slightly eroded).

1 Introduction

The general characteristics of coastal erosion worldwide are described in terms of geography by the types of erosion, the causes which starts the erosion processes, and the effects generated by erosion processes. A shoreline is defined as the linear interface between land and water areas (Dolan et al., 1980). Shoreline is an element with a high spatial variability which imposes a rapidly changing for coastal landforms (Mujabar and Chandrasekar, 2013). Hence the efficient methods are needed to handle the spatial and temporal variability of coastal shoreline using GIS techniques. Thieler et al. (2009) developed an extension for ArcGIS software which allows automatic measurements for shoreline changes. Many researches utilized remote sensing data to analyse coastal environments: Louati et al. (2014), Oyedotun (2014, 2017), Thinh and Hens (2017). Many studies in Tunisia have shown the effect of coastal degradation related to different natural and anthropogenic factors (Paskoff, 1988; Oueslati, 2004,

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Etude de l'impact des barrages sur la réduction des transports sédimentaires jusqu'à la mer par approche paléohydrologique dans la basse vallée de la Medjerda

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Résumé. The sedimentary contributions of the Medjerda to the coastal zone are poorly measured, and there is no chronicle of observations. In this context, the sediment monitoring appears indispensable for the quantification of sediment transport at the outlet. This study focuses on the largest watershed in Tunisia, the Wadi Medjerda (23 600 km^2). The main objective of this work is to assess the reduction of sediment transport following anthropogenic intensification on the basin, especially since the construction of many large dams. In order to collect information on actual deposits over several years, the paleo-hydrological approach was applied through the study of sediment cores sampled in the low valley meanders on alluvial terraces, after the last dam (Sidi Salem, the largest water storage capacity over the basin), but before the estuary to avoid marine influence and near a hydrological station (Jdaida). The sedimentary deposits of the river provide key information on the past sedimentary inputs. A visible succession of sedimentary layers corresponding to the deposits of successive floods on the study site has been determined and the history of the sedimentary contributions of the Medjerda is reconstructed by this approach. The thickest layers of sedimentary deposits are related to exceptional events. They are mainly concentrated on the lower part of the core and are mainly composed of sands. The first 1.2 m of the core from the bottom upward relates to 10 years of river discharges, as can be determined from the ^{137}Cs datation. The next upward 1.05 m of core relates to the following 20 years of discharges, up to 1981, date of the construction of the Sidi Salem dam, and is composed of a mix of sand, silts and clays. The last 75 cm of core near the surface is only composed of clays with thin silt bands, and relates to a period of 32 years. We thus observe that there is no more sand deposits in the river bed since the construction of the Sidi Salem dam. The deficit of sediment supply to the sea is viewed as a major factor to be taken into account for better understanding of the dynamics of coastal areas in the context of global climate change.

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LA DYNAMIQUE SEDIMENTAIRE DANS LA BAIE DE MONASTIR

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ملخص

ديناميكية الرواسب في الشريط الساحلي لخليج المنستير: ان عديد الأنشطة الصناعية وصيد الأسماك في خليج المنستير تساهم في فقدان التوازن البيئي البحري. حاليا الإتجاه نحو ضعف وتدهور الشريط الساحلي. والهدف من هذا العمل هو تحديد العوامل الطبيعية والبشرية وتقييم آثارها وذلك باستخدام تحليل الرواسب السطحية لتوضيح ديناميكية الرواسب في الشريط الساحلي لخليج المنستير.

وبين تحليل حجم الجسيمات الرواسب السطحية للحافة الساحلية لخليج المنستير أن الشريط الساحلي المغمور بالماء مبطنة بالرمال المتوسطة والرمال الناعمة ، التي عادة ما تكون مصنفة بدرجة متوسطة ومتدرجة بدرجة سيئة. هذه الرمال تتحرك ،أساسا ، عالقة في الماء او متجرة في قاع البحر. يوضح توزيع حجم الرواسب السطحية على طول الصورة العرضية لميناء المنستير في البحر ، حتى عمق 17 م ، تناقص تدريجي للساحل إلى البحر المفتوح. عادة ما تكون المنحنيات التوزيعية التراكمية الرواسب السطحية للشاطئ تحت الماء أكثر انتشارا في شكل ، مما يشير إلى ان الرمال متوسطة الحبيبات و ديناميكية المياه غير قوية. تظهر التحليلات المعدنية أن هذه الرمال تتكون أساسا من الكوارتز والكالسيت. يأتي الكوارتز بشكل رئيسي من الأراضي الجيولوجية المتاخمة للساحل ، ومدخلات الاودية وطاقة الرياح من المناطق الساحلية. الكالسيت يأتي من ركام القش في منطقة الدراسة ومدخلات الاودية. يعتمد نقل الرواسب السطحية في الماء بشكل رئيسي على الرياح و الأمواج

كلمات مفاتيح : تحليل الرواسب السطحية- ديناميكية الرواسب- الكالسيت- الرمال- خليج المنستير

RESUME

La baie de Monastir est sollicitée par plusieurs activités industrielles et de pêche qui contribuent à son démaigrissement. Actuellement la tendance est plutôt vers la fragilisation et la dégradation de la côte. L'objectif de ce travail est d'identifier les facteurs naturels et anthropiques et d'apprécier leurs effets, en utilisant des méthodes d'analyses granulométriques et minéralogiques des sédiments de surface afin de préciser la dynamique sédimentaire dans la frange littorale de la Baie de Monastir.

L'analyse granulométrique des sédiments superficiels de la frange littorale de la baie de Monastir, montre que la plage sous-marine est tapissée par des sables moyens et sables fins, généralement modérément classés et mal classés. Ces sables se déplacent, essentiellement, par saltation, roulement et suspension graduée.

La répartition granulométrique des sédiments de surface le long d'un profil transversal du port de Monastir vers le large, jusqu'à 17 m de profondeur, montre un granoclassement décroissant de la côte vers le large. Les courbes cumulatives semi-logarithmiques des sédiments de surface de la plage sous-marine, ont, en général, la forme d'un S plus ou moins étalé qui indique des sables à classement moyen et un milieu plus ou moins agité.

Les analyses minéralogiques montrent que ces sables sont constitués essentiellement de quartz et de la calcite. Le Quartz provient, essentiellement, des terroirs géologiques limitrophes du littoral, des apports détritiques terrigènes et des apports éoliens en provenance des zones bordières. La calcite provient des débris coquilliers dans le secteur d'étude et des apports détritiques terrigènes. Le transport des sédiments de surface dans la zone est tributaire essentiellement du vent et de la houle.

Mots clés : Granulométrie, minéraux, Dynamique sédimentaire, Baie de Monastir.

ABSTRACT

Sedimentary dynamics in Monastir Bay of the Tunisian waters: The Bay of Monastir is subjected to several industrial and fishing activities that contribute to the loss of biodiversity. Currently the trend is towards the pollution and the degradation of the coast. The objective of this work is to identify the principal natural and anthropogenic factors controlling the ecosystem functioning and to appreciate their effects, by using granulometric and mineralogical surface sediment analysis methods in order to specify the sedimentary dynamics in the coastal fringe of the Bay of Monastir.

Particle size analysis of the superficial sediments of the coastal fringe of Monastir Bay shows that the submarine beach is lined with medium sands and fine sands, which are generally moderately classified and poorly graded. These sands move, essentially, by saltation, rolling and gradual suspension.

The grain size distribution of the surface sediments along a transverse profile of the port of Monastir offshore, up to 17 m depth, shows a decreasing gradation of the coast to the open sea. The cumulative semi-logarithmic curves of the surface sediments of the underwater beach are generally in the form of a more or less spreading S, which indicates medium-grained sands and a more or less agitated environment.

Mineralogical analyzes show that these sands consist essentially of quartz and calcite. Quartz comes mainly from geological land bordering the coast, terrigenous detrital inputs and wind energy from the coastal areas. The calcite comes from shelly debris in the study area and terrigenous detrital inputs. The transport of surface sediments in the area is mainly dependent on wind and swell.

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CONTRIBUTION A L'ETUDE DE LA STRUCTURE TROPHIQUE ET DE L'ETAT ECOLOGIQUE DU BENTHOS AU NORD DE LA LAGUNE DE GHAR EL MELH

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ملخص

مساهمة في دراسة التركيبة الغذائية والحالة الإيكولوجية للمجتمعات الحيوانية القاعية في شمال بحيرة بوغواره : تصنّف بحيرة غار الملح كموقع راسمار (معاهدة دولية للحفظ والاستخدام المستدام للمناطق الرطبة) بسبب تزايد الأنشطة الأنتروبية من حولها تعرضت بحيرة غار الملح منذ سنة 1994 إلى تدهور هام في نوعية المياه و التربة و نقص حاد في الموارد السمكية والثروة البيولوجية عموما. لهذا الغرض هذا العمل مساهمة بسيطة لدراسة الشبكة الغذائية للاقفاريات القاعية وحالتها الإيكولوجية شمال بحيرة غار الملح، بعد بضع سنوات من توسيع قناة البوغاز الرابطة بين البحيرة والبحر المفتوح. لقد تم القيام بثلاث حملات من الرواسب على مستوى ثلاث محطات قبالة مدينة غار الملح خلال ربيع 2017. وتبيّن النتائج المتحصل عليها بأنّ مجتمع اللافقاريات القاعية عموما قليل التنوع. أما متابعة العوامل الفيزوكيميائية والمتعلقة بالتربة فقد أظهرت تجانسا بين محطات الدراسة.

تظهر الشبكة الغذائية بدورها سيطرة المجموعات التي تتغذى على المواد العضوية على سطح الرواسب ، مما يعني ضعف التركيبة الغذائية للاقفاريات القاعية ورغم أنّ معظمها ينتمي إلى المجموعة الإيكولوجية الحساسة. وهذا ما يفسّر أنّ المؤشرات الحيوية المستخدمة صنّفت محطات الدراسة في حالة إيكولوجية ممتازة.

كلمات مفاتيح : بحيرة غار الملح، اللافقاريات القاعية، التركيبة الغذائية، الحالة الإيكولوجية.

RESUME

La lagune de Ghar El Melh est un site Ramsar soumis à des activités anthropiques croissantes. Elle connait depuis 1994 une dégradation importante de la qualité des eaux et des sédiments, une réduction de ses ressources halieutiques et de sa richesse biologique en général.

Le présent travail est une contribution à l'étude de la structure et de l'organisation trophique de la macrofaune benthique dans la partie nord de la lagune de Ghar El Melh, quelques années après l'élargissement de la seule passe de communication "El Boughaz" qui relie la lagune à la mer ouverte. Trois stations ont été échantillonnées en face de la ville de Ghar El Melh au cours du printemps 2017. Les résultats obtenus montrent que la communauté macro-zoobenthique y est généralement peu diversifiée. Le suivi des paramètres physico-chimiques et édaphiques montre une homogénéité spatiale de cette partie de la lagune. L'organisation trophique, à son tour, montre une dominance des espèces déposivores de surface traduisant ainsi une faible structuration des communautés benthiques et un état de déséquilibre trophique même si la quasi-totalité des espèces sont des espèces sensibles appartenant au groupe écologique 1. Ainsi les indices biotiques utilisés (AMBI et BENTIX) classent les trois stations dans un état écologique excellent.

Mots clés: lagune de Ghar El Melh, macrofaune benthique, structure trophique, état écologique.

ABSTRACT

Contribution to the study of the trophic and ecological structure of the benthos in the north of the lagoon of Ghar El Melh : The lagoon of Ghar El Melh is a Ramsar site subject to anthropogenic activities. The lagoon ecosystem has been progressively deteriorated since 1994. Its water/sediment quality, its fisheries resources and its biodiversity have been reduced.

The present work is a contribution to the study of the functional organization of the benthic macrofauna within the north part of the Ghar El Melh lagoon a few years after the extension of the El Boughaz channel which connects this lagoon to the open sea. Three stations in front of the Ghar El Melh town influences were sampled during spring 2017. Generally the results show a poor diversity of the benthic macrofauna. The registered values of the physico-chemical and sediment parameters show a spatial homogeneity of this part of the lagoon. The trophic organization, in turn, showed the dominance of selective deposit feeders resulting in trophic imbalance despite they are sensible species belonging to the ecological group 1. This allows biotic indices (AMBI and BENTIX) to classify sampled stations at a high ecological status.

Keywords: lagoon of Ghar El Melh, benthic macrofauna, trophic structure, ecological status.

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The conference proceedings will be published online on 10 November 2018 at SpringerLink in the book series "Advances in Science, Technology and Innovation" (ASTI). All authors will receive a soft copy of the proceedings during the conference. Authors of the best papers will be invited after the conference to submit an extended version of their conference papers in the AJGS and other related Springer journals.

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SPRINGER NATURE

Recent geochemical and grain size distribution of terrestrial sediment in coastal area from the watershed of Medjerda River, Gulf of Tunis

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Abstract. Geochemical and grain size analysis were carried out on surface and down core sediments from the present-day alluvial-coastal plain of the Medjerda River, Gulf of Tunis, Tunisia. The aim is to characterize the geochemical and grain size distribution of sediments and its relationship with the hydrodynamics extreme events occurring during the last century. Using a multi proxy approach, six turbidities layers have been identified in down core sediment (i.e. TL-1, TL-2, TL-3, TL-4, TL-5, TL-6, TL-7 and TL-8) characterized by multimodal grain size distribution. The terrestrial sediment which feeds the northern coastal of the Gulf of Tunis is characterized by very fine-grained sediment (clay and silt). The geochemical signature show a highly concentration of Rb, Ti, Zn and Pb. The Medjerda River is the mainly source of silts and clay sediment. Besides, the mining pollution (Zn and Pb) is relatively strong in the coastal area, especially during the great floods events of Medjerda watershed recorded in the 1953; 1957; 1969 and 1973. Even during high frequency events, the sediments are devoid of any coarse fraction.

Keywords: Coastal, Medjerda River, Extreme floods, Turbidities layers, Mining pollution.

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12-15 NOVEMBER 2018, HAMMAMET, TUNISIA

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SPRINGER NATURE

Grain size distribution and enrichment evaluation of trace metals in Mediterranean harbor lagoon (Kalaât Andaous, Tunisa)

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Abstract. Sediments are important carriers of pollutants and they allow to express the aquatic ecosystem state. The aim of this study is to characterize Kalaât Andalous harbor lagoon sediments' grain size spatial distribution and their quality, by studying their trace elements content and to highlight both natural and anthropogenic contribution. Therefore, 12 subsurface lagoon sediments are carried out at the level of 6 radials. Sediment samples were subjected to a granulometric analysis. The calculation of several indexes average mean size MZ, sorting index σ, asymmetric index SKI) allowed the definition of the grain size distribution. Samples went through different analysis to evaluate the rate of 7 trace metals (As, Cd, Cr, Cu, Ni, Pb, Zn). The obtained metal concentrations were compared to the American Oceanic and Atmospheric Administration (NOAA) guidelines ERL and ERM. The enrichment factor is used to assess the contamination level and differentiate between natural and anthropogenic sources using the Enrichment Factor (EF). Results displayed that sediments are predominantly sandy with fine sand dominating the area, medium sand is located at the channel and the southern west part of the quay. the latter is characterized by a muddy facies. The majority of trace elements concentrations are lower than ERL. Enrichment factors indicated that the lagoon is mainly enriched in As and Cd.

Keywords: Kalaât Andalous lagoon, Grain size distribution, trace metals, Enrichment Factor

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Hydrological Processes and Water Security in a Changing World

Beijing, China
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TUNISIAN CHEMICAL SOCIETY

20th

Tunisia Chemistry Conference

16-20 December 2018, Bel Azur Hotel, Hammamet, Tunisia

CERTIFICATE

The Organizing Commettee of the Tunisia Chemistry Conference - **TCC 2018, 20th edition** - certifies that

Sameh AYADI

presented a **Poster Communication** entitled:

Characterization of hydrological parameters and study of the metal content in algae taken at the coastal level of the city of bizerte

Halim HAMMI

General Secretary of the SCT

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الجمعية الكيميائية التونسية

TUNISIAN CHEMICAL SOCIETY

20th Tunisia Chemistry Conference

16-20 December 2018, Bel Azur Hotel, Hammamet, Tunisia

CERTIFICATE

The Organizing Committee of the Tunisia Chemistry Conference - **TCC 2018, 20th edition** - certifies that

Sameh AYADI

presented an **Oral Communication** entitled:

Theoretical study of epoxide molecules reactivity with amines and alcohols

Halim HAMMI

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CMCH 2-2018

ATTESTATION

Décernée à:

Emna CHERNI

Qui a présenté **une Communication Poster** au **Deuxième Colloque Maghrébin sur la Chimie Hétérocyclique**: **CMCH 2-2018**, organisé par l'Association Tunisienne de Chimie Hétérocyclique et ses Applications **STCHA** les 26 et 27 Octobre 2018 à l'Institut Supérieur d'Informatique et de Gestion de Kairouan - Tunisie.

Intitulée:

DFT INVESTIGATION OF LEWIS ACID CATALYTIC EFFECT ON AZIRIDINE RING OPENING

Co-auteurs: *Khaled Essalah, Néji Besbes, Manef Abderrabba, Sameh Ayadi.*

Néji BESBES
Président de la STCHA
Co-Président du CMCH 2-2018

Taha GUERFEL
Président du CMCH 2-2018
Trésorier de la STCHA

Kairouan, le 27 Octobre 2018

CMCH 2-2018

ATTESTATION

Décernée à:

Emna CHERNI

Qui a présenté **une Communication Orale** au **Deuxième Colloque Maghrébin sur la Chimie Hétérocyclique**: **CMCH 2-2018**, organisé par l'Association Tunisienne de Chimie Hétérocyclique et ses Applications **STCHA** les 26 et 27 Octobre 2018 à l'Institut Supérieur d'Informatique et de Gestion de Kairouan - Tunisie.

Intitulée:

DFT INVESTIGATION OF THIOTEPA INTERACTIONS WITH DNA BASES

Co-auteurs: *Khaled Essalah,Néji Besbes, Manef Abderrabba,Sameh Ayadi.*

Néji BESBES
Président de la STCHA
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Kairouan, le 27 Octobre 2018

ISSN 1727-3528

PROCEEDINGS 3RD INTERNATIONAL CONFERENCE ON INTEGRATED ENVIRONMENTAL MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

Achraf Ghorbal, Ali Sdiri, Leila Basti, Boubaker Elleuch
Editors

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ICIEM 2016 3rd International Conference on Integrated Environmental Management for Sustainable Development

ISSN 1737-3638

Analyzing biofilms community structure and abundance by flow cytometry for antifouling tests

Imen HMANI[1], Amel ZOUARI[1], Wafa CHERIF[1], Monia EL BOUR[1], Leila CHEBIL[1] and Leila KTARI*[1]

[1] INSTM- National Institute of Marine Sciences and Technologies

RESEARCH LETTER

ISSN: 1737-3638

Keyords: Marine biofilm, antifouling paints, flow cytometry, algal extract

Correspondence to: Leila Ktari
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Received 24 FEB 2016
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Abstract

Marine biofouling is the undesirable accumulation of microorganisms, plants, and animals on every artificial surface immersed in seawater. Biofilm constitute the first step of a complex mechanism leading to surfaces colonization. The identification of efficient antifouling paints is important to determine the coating action on abundance and structures of biofilm populations. In present study, flow cytometry has been used to analyze early stage biofilms for different types of coatings. The results showed that this technique can significantly determine the abundance of particular heterotrophic and autotrophic microorganisms depending on the site, the time of immersion and the coating type.

1. Introduction

Biofouling is a common phenomenon that occurs on every submersed surface in a marine environment. A wide range of micro and macro-organisms that settle and fixe on surfaces, cause many problems affecting several fields like shipping, farming industries and aquaculture. The first step of this phenomenon is the biofilm establishement which occurred in the early stage of immersion and is constituted essentially of microorganisms. Later, this biofilm will influence the settlement of other epibionts. Thu,s the efficiency of antifouling paints depend on their effect against biofilm settlement (Camps *et al.*, 2014). In order to find a natural antifouling, an algal extract was used to test its potential inhibition of biofilm. Flow cytometry (FCM) was used to determine the structure and abundance of heterotrophic prokaryotes and autotrophic pico- and nano-eukaryote populations in early stage formed biofilms on different coatings depending on the site, the time of immersion.

2. Material and Methods

Different rectangular steel plates (98.5x15.5cm) have been used for the experiment protocol (figure 1). A surface of 82.5 cm^2 was painted with different coatings, N: antirust (ASTRAL®); V: Marine varnish (ASTRAL®); V+EtOH: varnish with ethanol; Ext: seaweed extract (30 mg/ml) in marine varnish; $CuSO_4$: Copper sulfate (50mg/ml) in marine varnish; P: antifouling paint (ASTRAL®). Structures were then immersed in seawater at two localities (Salammbô (36°50'38.77"N and 10°19'46.17"E) and la Goulette harbor (36°48'30.36"N and 10°18'31.59 "E). The different samples were brought after 48 hours and one week of immersion. For each plate, three tiles of 1 cm^2 of coatings were cut, preserved with paraformaldehyde (final concentration 2%) and stored at -80°C until FCM analysis.

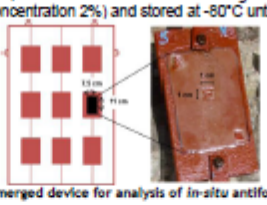

Figure 1. Submerged device for analysis of *in-situ* antifouling activity

Seawater was also daily sampled during the experiment to be analysed by FCM. Biofilm destruction has been performed according to Camps (2011) with some modifications. The abundance of heterotrophic prokaryotes, pico- and nano-eukaryote populations was carried out with the cyflow®Space flow cytometer (Sysmex Partec) equipped with a blue diode pumped solid-state laser (20mW) at 488 nm and a red laser diode at 638 nm (25mW). Staining and analysis of heterotrophic prokaryote were achieved according to the protocol detailed in Marie *et al.* (1997). Bacteria were determined with 0.9µl of SYBR-Green II. Autotrophic organisms represented by pico and nanoeukaryotes were determined by adding 5µl of calibration beads (2 µm and 10 µm respectively).

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We hereby certify that

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We hereby certify that:

Lamia Dammak Walha

has displayed the poster N° 72

Title:

Variability patterns of toxic epibenthic microalgae Prorocentrum lima in the Gulf of Gabès (south-eastern Mediterranean Sea)

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Asma Hamza
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FROM ECOSYSTEMS TO SOCIO-ECOSYSTEMS
ICHA 2018
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Ecology – from the ecological niche to population dynamics and biogeography
ICHA2018/454

Application of Solid Phase Adsorption Toxin Tracking (SPATT) for the field detection of toxins in Sfax Region (Gulf of Gabès, Tunisia).

Walid Medhioub* [1], Asma Hamza[2], Mabrouka Mahfoudhi[2], Lamia Dammak[2], Fabienne Hervé[3], Eric Abadie[4], Mohamed Laabir[5], Philipp Hess[3]

[1]Laboratoire Milieu Marin, National Institute of Marine Sciences and Technologies, Monastir, [2]Laboratoire Milieu Marin, National Institute of Marine Sciences and Technologies, Sfax, Tunisia, [3]Laboratoire Phycotoxines, Institut Français de Recherche pour l'Exploitation de la Mer, Centre Atlantique, Nantes, [4]MARine Biodiversity, Exploitation and Conservation, Institut Français de Recherche pour l'Exploitation de la Mer, [5]MARine Biodiversity, Exploitation and Conservation, Université de Montpellier, Montpellier, France
*Presenting author

Select your prefered type of presentation: Oral or poster
Second topic: Ecology - harmful algae and global change

Abstract: Passive sampling of toxins in seawater has been successfully implemented using Solid Phase Adsorption Toxin Tracking (SPATT) devices which present a simple and sensitive technique for retrieving lipophilic toxins from sea water.
Passive samplingusing SPATT was carried out during one yearat the site Ras Younga in the region of Sfax. SPATTs containing 20 g of HP-20 resin were suspended at 1m sea water depth and retrieved monthly. In parallel, one liter for sea waterwas collected at each sampling pointfor identification of toxic phytoplankton by conventional light microscopy.The resin from the mesh bags was extracted with methanol and analysed for lipophilic toxins by liquid chromatography coupled to tandem mass spectrometry (LC/MS/MS).
Results showed the i) detection of trace concentrations of Gymnodimine (GYM-A), Spirolide(SPX-1) and Pinnatoxin(PnTx-G)ii) increase of concentrations of Okadaic Acid (OA) and Dinophysistoxins (DTX-1) from March to June associated with the presence of *Prorocentrum lima* cells at the surface of sediment. This study exemplified the usefulness of the SPATT technique for sites in the Gulf of Gabès as many other coastal areas. It is anticipated that passive sampling will eventually help to better understand and monitor toxic events.

Keywords: Gulf of Gabès, SPATT, Toxic Phytoplankton


وزارة الفلاحة والموارد المائية والصيد البحري
مؤسسة البحث و التعليم العالي الفلاحي
LMM
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Projet PEER-RPGTun
La Journée du LMM 2018
Milieu marin tunisien, applications
énergétiques sous un environnement changeant
Observations, Analyses, Pollution, Dynamique, Changement
Climatique, Modélisation Numérique, Potentiel Energétique
Hotel Golden Tulip El MECHTEL, 28 juin 2018
Ouverture, conférences invités
09 :00-09 :30 Accueil et Ouverture
Présentation de la journée et du projet PEER-RPGTun
M. Hechmi Missaoui, DG
Ali Harzallah, Pr.
09 :30-09 :50 Invité : La mer source d'énergies renouvelables et stockeur d'énergie thermique
Mohamed Jomaâ Safi, Pr.
09 :50-10 :10 Invité : Le littoral tunisien : un parcours de ses caractéristiques morpho-dynamiques
Rafik Ben Charrada, IHE
10:10-10 :30 Invité : H2020-BlueMed une opportunité pour une économie bleue en Tunisie
Samir Regad, BlueMed UGPE-MESRS
10:30-11 :00 Pause café
Session 1 Modérateur
Amel Zouari
11:00-11 :20 Y a-t-il un potentiel énergétique en mer Méditerranée et le long des côtes tunisiennes
Ali Harzallah, Pr.
11 :20-11 :40 Interaction dynamique-biologie, l'exemple du Golfe de Gabès, une revue
Malika Bel Hassen, Dr.
11 :40-12:00 Monitoring du milieu marin pour une gestion durable des pêcheries
Amna Hamza, Dr.
12:00-12:20 Réponse des écosystèmes marins méditerranéens à l'input de contaminants, le projet MERITE-MISTRALS
Marc Pagano, Dr.

République Tunisienne

Ministère de l'agriculture des ressources hydrauliques et de la pêche

Institution de la Recherche et de l'Enseignement Supérieur Agricoles

Institut National des Sciences et Technologies de la Mer

Laboratoire Milieu Marin

l'INSTM-LMM organise une conférence :

Harmful algal bloom in a changing environment: Implications for coastal ecology and aquaculture

Dr. Leila Basti

Marine Environmental Physiology Laboratory, Department of Ocean Sciences, Tokyo University of Marine Science and Technology, Minato, Tokyo 108-8477, Japan. *E-mail: lbasti1@kaiyodai.ac.jp

lundi 7 mai 2018 09:00 à INSTM Salammbô

Harmful algal blooms (HAB) are the mono-specific and, in some cases, the multi-specific outgrowths of several microscopic algae in aquatic environments leading to cascading detrimental effects to aquatic organisms and humans, in addition to several other organisms depending on the food web. Several industries are affected following HAB outbreaks. The frequency, magnitude, duration and in several cases the geographic distribution of HAB have been increasing putting coastal ecosystems, fisheries, aquaculture, tourism and related service businesses under further stress. Multiple factors have been attributed to such increase in HAB, including eutrophication and climate change, with recent reports of range expansion of some cosmopolitan HAB species across the North Atlantic and North Pacific associated with warming ocean temperature and with projected range expansion of some other cosmopolitan HAB species across the North Western European Shelf-Baltic Sea system and North East and South East Asia. In the present lecture, the HAB phenomenon is reviewed based on data from several regions of the world. Their effects on ecologically- and economically- important coastal organisms, notably bivalve molluscs, are presented. The projected complex effects of eutrophication and climate change on HAB physiology, toxinology, and biogeographic distribution are presented.

République Tunisienne

Ministère de l'agriculture des ressources hydrauliques et de la pêche

Institution de la Recherche et de l'Enseignement Supérieur Agricoles

Institut National des Sciences et Technologies de la Mer

Laboratoire Milieu Marin

Dans le cadre du Projet PEER-195 Tunisie-USA (INSTM-NOAA) USAID l'INSTM-LMM organise une conférence :

Building Subseasonal Outlook Systems

The Case of Excessive Heat Events and Health

Application to assist in subseasonal outlooks of ocean conditions

Dr. Augustin Vintzileos,
University of Maryland – ESSIC

vendredi 11 mai 2018 10:00 à INSTM Salammbô

Excessive heat events (EHE) are the leading cause for human morbidity/mortality associated with atmospheric extremes. As population ages and EHE are projected to increase in intensity and frequency, the associated abnormal mortality is expected to grow. Under these circumstances the necessity for early warning systems becomes clear. In this presentation we will first explore elements of the heat/health connection and then introduce two measures of the impacts of heat on health. We will then use these definitions and reanalysis products to investigate EHE that occurred in the past in several geographical areas. We will describe the elements of a subseasonal outlook system (a) bias correction techniques, and (b) calibration, which are based on reanalysis and reforecasts data. The system is evaluated by applying the receiver operating characteristic (ROC) technique to reforecasts. We will see that depending on location EHE can be forecasted at lead time of Week-2 while at Week-3 forecast is less skillful. Finally, we will study the real time EHE outlook system and discuss avenues for its improvement. We will conclude the seminar with a discussion on how methodologies presented can be transposed to assist in subseasonal outlooks of ocean conditions and present an example of the importance of coupled ocean – atmosphere models when forecasting at subseasonal lead times.

Augustin Vintzileos a une longue expérience dans l'utilisation de modèles environnementaux pour effectuer des simulations numériques et fournir des analyses diagnostiques. Il a développé un modèle couplé atmosphère-océan pour étudier la dynamique et la prévisibilité de l'ENSO. Il a mené des études diagnostiques de prévisions quasi-opérationnelles avec le modèle de la NASA (NASA Seasonal to Interannual Prediction Project). En collaboration avec le personnel de la NOAA / NCEP / EMC, il a utilisé le modèle CFS pour effectuer des reforecasts afin d'étudier la prévisibilité de l'oscillation de Madden-Julian. En collaboration avec la NOAA / NCEP / CPC, il a fourni des prévisions en temps réel pour soutenir la campagne DYNAMO. Il a mis au point la première version du système de prévision de la semaine 3 et 4 basée sur le CFS qui était utilisé au CPC. Il a élaboré la première version du système de prévisions de chaleur excessive par sous-saison qui a été utilisé de façon quasi opérationnelle à la CPC. Il est en train de développer le système mondial de prévision de chaleur excessive de la prochaine génération.

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Présentée par:
Pr. Ali Harzallah

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à partir de 10h00

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Institut National des Sciences et Technologies de la Mer

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« Risque littoral et dYnamique morpho-Sédimentaire des Corps sableux de l'embouchure du fleuve de la MEDjerda, golfe de Tunis »

08-09 octobre 2018, Hôtel Dar El Marsa, La Marsa, Tunis

Contact: Mme Oula AMROUNI
Email: oula.amrouni@instm.rnrt.tn
Institut National des Sciences et Technologies de la Mer, Carthage, TUNISIE

IDAMS, International Conference on Marine Data and Information Systems, Barcelona, 5-7 November, 2018

Sea Data Cloud:Tunisian marine data mangement

Sana Ben Ismail , Nouha Barraj, Mohamed Anis Ben Ismail, Cherif Sammari
INSTM, National Institute of Marin Sciences and Technologie. Tunis, Tunisia

Abstract:

Access to oceanographic data is of vital importance for marine research. Data acquired from various observational activities and techniques have problems of heterogeneous data sources, accessibility and standardization. SeaDataNet and now SeaDataCloud project is a leading infrastructure for marine and ocean data management. It is a Pan-European infrastructure for managing, indexing and providing access to marine data and metadata in compliance with the INSPIRE directive (ISO 19139 standards).

Introduction:

We have set up a Tunisian marine observation and monitoring system based on very high frequency and long-term surface data from automatic sensors of physico-chemical (T, S) and biological parameters (Chla, ph, Turbidity, ..). This is done using a new means of measurement "The Ferrybox" installed in February 2016 aboard the Tunisian CF Carthage of the Tunisian Company of Navigation (CTN). The latter makes two weekly trips Tunis-Marseille and Tunis-Genoa. Following the installation and validation of data collected by the Ferrybox. We are working on preparing a new data stream for integration into the SeaDataNet infrastructure as part of the SeaDataNetCloud project.

STANDARDIZED MANAGEMENT STAGES OF CONTINUOUS OBSERVATION DATA FROM THE FERRYBOX :

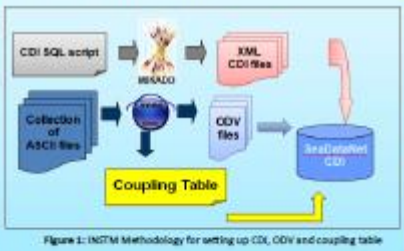


Figure 1: INSTM Methodology for setting up CDI, ODV and coupling table

FerryBox Database:

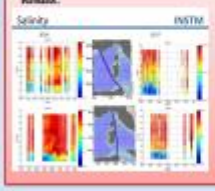
Data storage

Data visualisation

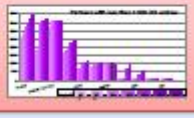
Statistics

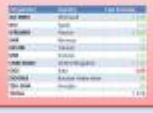
Data download

Results:



Currently, we have processed more than 500 ferrybox transects.
Only 18 examples were used to test the next steps regarding
Download Manager (DM) and Request Management System (RMS)





Conclusion:

INSTM oceanographic data play a central role in Euro-Mediterranean and African projects. Because the gaps still important along the southern coast of Mediterranean Sea.

Our involvement within the Seadatanet 1 and 2 and SeaDataCloud projects has been successfully completed and we intend to add the time series of the Ferry Box data as well as the few missing CTD stations along the Tunisian coast and develop a new CSR products during the next year.

Liste des mastères soutenus en 2018

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MEMOIRE

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Parcours : Biodiversité et Ecologie Aquatique

Présenté par

Samia Khsiba

Etude de la qualité des sédiments de la lagune côtière de Kalaât Andalous (golfe de Tunis) : impact sur l'écosystème marin

Soutenu le : 24 /01/2018 devant le jury composé de :

Mme Sabiha Tlig	**Professeur (FST)**	**Présidente de jury**
Mme Oula Amrouni	**Maître Assistante (INSTM)**	**Directrice de mémoire**
Mme Chrystelle Bancon Montigny	**Maitre de conférences (HSM, Montpellier)**	**Examinatrice**
Mr. Kerim Ben Mustapha	**Assistant (INSTM)**	**Invité**

En collaboration avec l'Institut National des Sciences et Technologies de la Mer Salammbô, Tunis.

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UNIVERSITE DE MONASTIR

FACULTE DES SCIENCES

Mémoire

Présenté pour l'obtention du diplôme de :

MASTERE EN MATHEMATIQUES ET APPLICATIONS

Préparé par :

Fathia Dardour

Sujet :

Modélisation Numérique Des Vagues Le Long Des Côtes Tunisiennes

---

Soutenu le 26 Novembre 2018 , devant la commission du jury :

Mr. Maatoug Hassine	*Président*
Mr. Ali Harzallah	*Encadrant*
Mr. Mohamed Jellouli	*Encadrant*

Unité de Recherche : EDP (code : UR13ES64)

N° d'ordre :

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Mémoire

Présenté pour l'obtention du diplôme de :

MASTERE EN MATHEMATIQUES ET APPLICATIONS

Préparé par :

Marwa Ouni

Sujet :

Modélisation numérique de l'énergie du vent au large des côtes Tunisiennes

---

Soutenu le 26 Novembre 2018 , devant la commission du jury :

Mr. Mohamed Jellouli	*Président*
Mr. Ali Harzallah	*Encadrant*
Mr. Maatoug Hassine	*Encadrant*

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LA RECHERCHE SCIENTIFIQUE

INSTM

Mémoire de Mastère

Présenté par :

Marwa MISSAOUI

Spécialité :

Modélisation Mathématique et calcul Scientifique

Sujet :

Vers la mise en place d'un modèle numérique haute résolution de la circulation marine le long des côtes tunisiennes

---

Soutenu le 20 /12 /2018, devant la commission du jury :

Mr. **Ahmed Bchatnia**	***Président***
Mr. ***Ali Harzallah***	***Membre***
Mr. ***Mohamed Jellouli***	***Encadreur***

UNIVERSITÉ DE TUNIS EL MANAR

Mémoire

Présentée pour l'obtention du diplôme de mastère de recherche
en chimie analytique

Par

Rihab BELHADJ AMMAR

Intitulé

Etude de l'élimination d'un colorant anionique par des biomatériaux

Soutenue le 27/01/2018 devant le jury composé de

M. Chiraz HANNACHI	Maitre de conférences à l'FST	Présidente
M^me^ Fatma GEUSSMI	Maitre-Assistant à l'FST	Examinatrice
M^me^ Sameh AYADI	Maitre de conférences à l'INSTM	Encadrante

Année universitaire 2017-2018

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Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
Université de Tunis El Manar
Ecole Nationale d'Ingénieurs de Tunis
Ecole Doctorale STI

Master's Dissertation

Presented with a view to obtaining

Master of Research Degree

Speciality : Modeling in Hydraulics and Environment : Path FPE

Established by :

Noussaiba ROBBANA

Study of Traffic and Water Masses from FerryBox Data Compared to Satellite Data

Presented in [05 December 2018] in front of the examination jury composed of:

President	:	M. Mahmoud Moussa
Examinator	:	Mme Hedia CHAKROUN
Supervisor	:	Mme Sana BEN ISMAIL

Research Laboratory

[Institut National des Sciences et Technologies de la Mer]

INSTM

Liste des conventions signées avec des entreprises et partenaires socio-économique en 2018

République Tunisienne
Ministère de l'Enseignement Supérieur et de la Recherche scientifique

Agence Nationale de la Promotion de la Recherche scientifique

Allocation de Mobilité

MOBIDOC Post-Doc

CONVENTION DE PARTENARIAT POUR LA REALISATION DE TRAVAUX DE RECHERCHE COLLABORATIVE DANS LE MILIEU SOCIO-ECONOMIQUE

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