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A long-term study on *Coolia monotis* distribution from the south-east Mediterranean Sea

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ABSTRACT

The potentially toxic species *Coolia monotis* is widespread along the Mediterranean coasts. The Gulf of Gabès is one of the affected areas in the south-eastern part of the Mediterranean Sea. Distribution patterns of *C. monotis* in relation to temperature and salinity were investigated at 24 monitoring sites along the Gulf of Gabès coasts during 22 years (1997–2018). The analysis of *C. monotis* occurrence in the water column revealed a seasonal trend with high abundances ($\geq 10^5$ cells l^{-1}) recorded during winter. *C. monotis* was widely distributed in Gabès Gulf, it was most abundant in the southern part, particularly at the Cotusal Channel site, which is surrounded by marine solar salterns, where the highest concentration (2.54×10^6 cells l^{-1}), the maximum mean abundance ($3.74 \pm 51.87 \times 10^4$ cells l^{-1}) and the highest number of observations (75) were recorded over the study period. *C. monotis* was observed within a wide range of temperature (9–31.6 °C) and salinity (31–59) with high abundances ($>10^5$ cells l^{-1}) occurring at water salinity and temperature of 41.9–45 and 15–17.3 °C, respectively. A positive correlation was found between the abundance of *C. monotis* and salinity ($p < 0.05$), whereas no correlation was found as regards temperature. Culture experiments were conducted under varying salinity regimes (10–50) with *C. monotis* strain (Com.10) isolated from the Cotusal Channel. Growth occurred at salinities between 20 and 50 and the maximum growth rate of 0.23 $day^{-1}$was recorded at a salinity of 40. Results suggest that seawater salinity plays a central role in the *C. monotis* blooms development.

1. Introduction

The dinoflagellate *Coolia monotis* Meunier was first described in the North Sea at Newport, Belgium (Meunier, 1919) and it has since then been widely reported from the West Pacific (Fukuyo, 1981; Tan et al., 2013; Ho and Nguyen, 2014; Yong et al., 2018), the Northeast Atlantic (Fraga et al., 2008; Laza-Martinez et al., 2011; Aquino-Cruz and Okolodkov, 2016; Leaw et al., 2016; David et al., 2017; Lewis et al., 2018; Accoroni et al., 2020) and the Mediterranean, where it was broadly dispersed from the western (Halim, 1960; Vila et al., 2001; Penna et al., 2005; Cohu and Lemée, 2012) to the eastern basin (Aligizaki and Nikolaidis, 2006; Feki et al., 2008; Armi et al., 2010; Ismail, 2014).

The Gulf of Gabès, located in the Southeast of Tunisia, is one of the largest continental shelves in the eastern Mediterranean basin and it is characterized by high tidal amplitude reaching 2 m (Sammari et al., 2006; Othmani et al., 2017). The Gulf of Gabès is of significant economic importance in Tunisia, it holds the most important Tunisian harbours and intensive maritime activities; and it contributed about 33% to the total fish production of the country (DGPA, 2015). Furthermore, it is a highly productive area of the grooved carpet shell *Ruditapes decussates* (Linnaeus, 1758) (Derbali et al., 2016). Since 1994, shellfish production has markedly decreased due to gymnodimines contaminations produced by the toxic dinoflagellates *Karenia selliformis* (Marrouchi et al., 2009; Medhioub et al., 2010; Ben Naila et al., 2012) and a national monitoring network of phytoplankton and phycotoxinswas, therefore, set upin 1995 along the Gulf of Gabès coasts.

In the Gulf of Gabès, *C. monotis* is present with phytoplankton community and it was foundin the water column (Turki et al., 2006; Feki et al., 2008; Drira et al., 2009; Mabrouk et al., 2014) and attached on various substrata such as magnoliophytes and macroalgae (Ben Brahim et al., 2013; Moncer et al., 2017). Moreover, several reports highlighted correlations between epiphytic and planktonic dinoflagellates belonging

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Analyse de mesures courantométriques dans le golfe de Hammamet

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ملخص

يتعرض ساحل خليج الحمامات للخطر بسبب التدهور الطبيعي والبشري. هذا يؤثر على نوعية الحياة والمصالح الاستراتيجية للبلاد. التيارات البحرية هي المسؤولة بشكل رئيسي عن هذا التدهور. لفهم تدفق المياه في هذه المنطقة، قمنا بنشر آلتين لقيس التيارات المائية.
يشير التحليل التوافقي لمستويات المياه إلى أن المد والجزر التوافقي *M2* هو المسيطر. المد شبه نهاري في خليج الحمامات
يوضح التحليل بطريقة الدالة المتعامدة التجريبية لسلسلة السرعات الحالية على مستوى خليج الحمامات. أن التيار السطحي يتجه نحو الشمال الشرقي الموازي للساحل بأقصى سرعة على طول المحور الرئيسي حوالي 5.9 صم/ث. يتحول التيار بالقرب من القاع إلى الشمال الغربي ويتبع مسار متساوي العمق 20- مترًا وبسرعة قصوى تبلغ حوالي 2.2 صم/ث.

يوضح تطور متجه السرعة واتجاه التيار العام (الرياح والامواج والضغط الجوي و المد و الجز) خلال فترة التسجيل أن الاتجاه موازٍ للساحل في المياه السطحية بسرعة يمكن أن تتجاوز 20صم/ث. ومع ذلك، فإن التيارات بالقرب من القاع تكون أضعف ولكن يمكن أن تتجاوز 10صم/ث. هذه التيارات تتبع مسار متساوي العمق 20- مترًا. قد ترتبط التيارات الضعيفة بالقرب من القاع بتيارات الدوران العامة ذات الأصل الأطلسي.
يبدو أن التيارات السطحية ترتبط ارتباطًا وثيقًا بالتأثير المشترك للرياح والامواج والضغط الجوي. يلعب المد دورًا ضعيفًا إلى حد ما في تداول المياه في خليج الحمامات.
أتاح لنا تحليل السلاسل الزمنية التي تم الحصول عليها في خليج الحمامات تحديد الخصائص الديناميكية السائدة في منطقة الدراسة. قد تم إثبات مدى انخفاض المد والجزر (12 صم) وخاصة وجود التيارات القوية (صم/ث) والتي يتناوب اتجاهها بين الشمال والجنوب. شكل التيارات المقاسة بعيدًا عن الشاطئ نموذجي للديناميكية التي تتميز ببنية دوامة.
كلمات مفاتيح: *خليج الحمامات، قياسات موقعية، مستوي المياه، تيارات، المعادلات التجريبية المتعامدة.*

RESUME

Le littoral du golfe de Hammamet est menacé par la dégradation naturelle et anthropique. Celle-ci touche la qualité de la vie et les intérêts stratégiques du pays. Les courants marins sont en majeure partie responsable de cette dégradation**.** Pour comprendre la circulation des eaux dans cette zone, nous avons déployé deux courantomètres.

L'évolution du vecteur vitesse et de la direction du courant dus aux phénomènes de haute fréquence (marée) et de basse fréquence (vent, houle et pression atmosphérique) durant la période de l'enregistrement montre que la direction est parallèle à la côte dans les eaux de surface avec une vitesse qui peut dépasser les 20 $cm.s^{-1}$. Cependant les courants près du fond sont plus faibles mais peuvent dépasser les 10 $cm.s^{-1}$. Ces courants suivent l'isobathe -20m. Les courants mesures peuvent aussi être associés, en partie près du fond aux courants de la circulation générale des eaux d'origine Atlantique.

L'analyse harmonique des niveaux d'eau indique que l'harmonique de la marée M2 est dominante. La marée est semi-diurne dans le Golfe de Hammamet

L'analyse par la méthode de la fonction empirique orthogonale de la série des vitesses des courants de la marée au niveau de Golfe Hammamet montre que le courant de surface s'oriente vers le nord-est parallèle à la côte avec une vitesse maximale suivant l'axe principal de l'ordre de 5.9 $cm.s^{-1}$. Le courant près du fond s'oriente vers le nord-ouest et suit l'isobathe -20 m avec une vitesse maximale de l'ordre de 2.2 $cm.s^{-1}$.

Les courants de surface sont étroitement liés à l'effet conjugué du vent et de la houle et de la pression atmosphérique. La marée joue un rôle assez faible pour la circulation des eaux dans le Golfe de Hammamet.

L'analyse des séries temporelles obtenues dans le golfe de Hammamet nous ont permis d'esquisser les caractéristiques dynamiques qui prévalent dans la région d'étude. Il a été démontré le faible marnage (12 cm) et surtout la présence de courants fort (15 $cm.s^{-1}$) et dont la direction s'alterne entre le Nord et le Sud. L'allure des courants mesurés au large est typique d'une dynamique marquée par une structure tourbillonnaire.
Mots clés : golfe de Hammamet, mesures *in situ*, niveaux de l'eau, courant, analyse en EOF.

ABSTRACT

The coastline of the Gulf of Hammamet is threatened by natural and anthropogenic degradation. This affects the quality of life and the strategic interests of the country. To understand the flow of water in this area, we deployed two current meters.

Harmonic analysis of water levels indicates that the tidal harmonic M2 is dominant. The tide is semi-diurnal in the Gulf of Hammamet. The Analysis by the method of the empirical orthogonal function of the series of tidal currents speeds at the level of Gulf Hammamet shows that the surface current is oriented towards the northeast parallel to the coast with a maximum speed along the main axis of the order of 5.9 $cm.s^{-1}$. The current near the bottom turns northwest and follows the -20 m isobath with a maximum speed of around 2.2 $cm.s^{-1}$. The evolution of the speed vector and the direction of the current which is due to the phenomena of high frequency (tide) and low frequency (wind, swell and atmospheric pressure) during the recording period show that the direction is

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Anthropogenic, Direct Pressures on Coastal Wetlands

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Coastal wetlands, such as saltmarshes and mangroves that fringe transitional waters, deliver important ecosystem services that support human development. Coastal wetlands are complex social-ecological systems that occur at all latitudes, from polar regions to the tropics. This overview covers wetlands in five continents. The wetlands are of varying size, catchment size, human population and stages of economic development. Economic sectors and activities in and around the coastal wetlands and their catchments exert multiple, direct pressures. These pressures affect the state of the wetland environment, ecology and valuable ecosystem services. All the coastal wetlands were found to be affected in some ways, irrespective of the conservation status. The main economic sectors were agriculture, animal rearing including aquaculture, fisheries, tourism, urbanization, shipping, industrial development and mining. Specific human activities include land reclamation, damming, draining and water extraction, construction of ponds for aquaculture and salt extraction, construction of ports and marinas, dredging, discharge of effluents from urban and industrial areas and logging, in the case of mangroves, subsistence hunting and oil and gas extraction. The main pressures were loss of wetland habitat, changes in connectivity affecting hydrology and sedimentology, as well as contamination and pollution. These pressures lead to changes in environmental state, such as erosion, subsidence and hypoxia that threaten the sustainability of the wetlands. There are also changes in the state of the ecology, such as loss of saltmarsh plants and seagrasses, and mangrove trees, in tropical wetlands. Changes in the structure and function of the wetland ecosystems affect ecosystem

Density Functional Theory Investigation of the Binding of ThioTEPA to Purine Bases: Thermodynamics and Bond Evolution Theory Analysis

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Dinoflagellates encystment with emphasis on blooms in Boughrara Lagoon (South-Western Mediterranean): Combined effects of trace metal concentration and environmental context

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ABSTRACT

Resting cysts (RCs), vegetative cell abundance, sediment characteristics, nutrient and trace metal concentrations were investigated in fifteen stations at Boughrara Lagoon during October and November 2016. Twelve morphotypes of RC were recorded. The sampling sites showed a similar cyst assemblage trend but differed in total cyst abundance. The cysts of heterotrophic dinoflagellates dominated over the cysts of autotrophic dinoflagellates throughout the study area and were correlated to the abundance of *Bacillariophyceae* explained by a likely trophic relationship. The abundance of cysts was positively correlated to phosphorus concentrations measured in the sediment. As well, cysts of *Polykrikos kofoidii* and *Scrippsiella trochoidea* were significantly correlated to nitrogen concentrations in water column. The trace metal concentrations did not show any effect on cyst abundances in most cases, except for Cr on mixotrophic dinoflagellates, suggesting that metal contamination is not determinant in the encystment of dinoflagellates. Autotrophic dinoflagellates cyst abundance was dependent on sediment characteristics with the highest densities being recorded in muddy sediments. The hydrodynamics of the lagoon, characterized by a weak water circulation and a low water renewal in the South-Western zone, was considered among the environmental factors most affecting RC distribution. The dominance of potentially toxic species cysts highlights the necessity of monitoring these forms suspected to constitute the precursor of toxic blooms in this area.

1. Introduction

The resting cysts (RCs), which correspond to dormant stages, are pervasive in the life cycle of Dinophyta, and are produced in response to specific conditions, such as temperature, salinity, nutrient availability, and/or pollution (Dhib et al., 2016; Pinyol-Gallemí et al., 2018). Two types of cysts are depicted in the life of dinoflagellates (Bravo et al., 2010). The first ones are formed during the asexually phase; it deals with temporary cysts, named pellicle cysts, characterized by their thin-walled and short-term endurance period caused by physio-chemical fluctuations. The second ones are formed during the sexual process and are characterized by their thick-walled and long lasting life cycles that keep them viable in sediments for an extensive period of time ranging from five to ten years or more (Dale, 1983). Usually, RCs are rarely present in the water column and generally confine themselves at the water - sediment interface (Shin et al., 2011).

RCs are excellent bio-indicators of past conditions and have the potential to provide information about current environmental parameters (Pospelova and Kim, 2010). They play a crucial role in the population dynamics of dinoflagellates and in species dispersal, apart from being

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Dynamique sédimentaire de la flèche sableuse de Kalâat Andalous (delta de la Medjerda, Méditerranée)

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ملخص

تندرج هذه الدراسة ضمن برنامج البحث MOSBIOCLIM (LR02INSTM04)، وتتمثل في متابعة التطور المورفوديناميكي للحاجز الرملي بقلعة الأندلس (الخليج الغربي لخليج تونس، تونس) في فترات زمنية متعددة. وتمكن متابعة التطور الزمني للشريط الساحلي للمدة المتراوحة بين سنة 1882 و2016 من فهم الديناميكية الرسوبية السريعة التي ساهمت في نشأة وتطور البحيرة الساحلية. إن انخفاض تدفقات رواسب نهر مجردة في مصبه القديم (فم الواد) بسبب تغيير مجراه الطبيعي باتجاه الجنوب، اضافة الى إنشاء السدود في تجمعات المياه يفسر الانجراف الحاد للشاطئ بمعدل 15.95- ±0.17 م / سنة وإنشاء حاجز رملي بإعادة التوزيع الجانبي للرواسب من جراء التيارات الساحلية. وتم في إطار هذا البحث دراسة قصيرة المدى لأعماق التضاريس الرسوبية سنة 2019. تبين النتائج وجود مسطحين رمليين مائيين في شكل هلالي ومواجه لاتجاه امواج البحر العاصفة، وهو دليل على تعديل ومحاولة تأقلم هذه الحواجز الرملية نتيجة لنقص الرواسب.

الكلمات المفاتيح: مورفوديناميكة، شريط ساحلي، الحواجز الرسوبية، DSAS، التعرية، البحر الأبيض المتوسط.

RESUME

Dans le cadre du programme de recherche institutionnel MOSBIOCLIM du LR02INSTM04, une étude multi approches a été entreprise pour suivre l'évolution morphodynamique multi–temporelle de la flèche sableuse de Kalâat Andalous (baie ouest du golfe de Tunis, Tunisie). L'analyse des variations du rivage entre les dates 1882 et 2016 permet de décrire sa genèse rapide dont l'allongement et le déplacement ont contribué à la création d'une lagune côtière. La diminution des apports fluviaux de l'embouchure historique de la Medjerda (Foum El oued) du fait de son avulsion vers le sud et la mise en place de barrages sur le bassin versant expliquent le recul très sévère du rivage EPR (*End Point Rate*) de -15,95 m±0.17 /an et de la construction de la flèche par redistribution latérale des sédiments charriés par la dérive littorale. A ces observations à long terme nous ajoutons une description morphologique inédite de la bathymétrie des petits fonds réalisée en 2019. La morphologie festonnée des corps sableux suggère un impact quasi frontal des houles lors des tempêtes marines ce qui contribuerait aussi à son ajustement dû au déficit sédimentaire.

Mots clefs : Morphodynamique, trait de côte, barres sédimentaires, DSAS, flèche sableuse, érosion, Méditerranée**.**

ABSTRACT

Sediment dynamic of the sandy spit of Kalâat Andalous (Delta of Medjerda, Mediterranean) : As a part of the MOSBIOCLIM institutional research program of the LR02INSTM04, a multi-approaches study has been undertaken to monitor the multi-temporal morphodynamic evolution of the coastal sandy spit of Kalâat Andalous (western bay of the Gulf of Tunis, Tunisia). The methodology is based on the monitoring the spatial evolution of the shoreline position from 1882 to 2016 in order to describe the rapid sandy barrier creation and the migration of the coastal lagoon sandy barriers. The reduction of the Medjerda River yields due to the displacement of the historic natural course (Foum El Oued) southward and the built up of dams on the watershed plain explain the alarming retreat of the shoreline with an average rate of EPR (End Point Rate) of -15.95 m ±0.17 /yr and the creation of the sandy spit by spatial redistribution of sediment under the coastal drift current. The long-term spatial observation was completed by the nearshore bathymetric surveys of the sandy spit in 2019. The crescentic inner sandbar morphology is a response to the wave-dominated swells during marine storms which would also contribute to its reduced sediment balance.

Keywords: Morphodynamic, coastline, sedimentary bars, DSAS, sandy spit, erosion, Mediterranean.

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Impact of cigarette butts on microbial diversity and dissolved trace metals in coastal marine sediment

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ABSTRACT

Cigarette butts are the most common plastic form of litter found in the marine coast, threatening the quality of the seawater and marine life. However, the impact of cigarette butts known to contain toxic chemicals has been investigated to date in very few marine species. This study aimed to evaluate the effects of cigarette filters (smoked or unsmoked) on the microbial diversity inhabiting coastal sediments by high-throughput sequencing of the 16S rRNA genes. Both bacterial structure and metals distribution were impacted by cigarette filter addition in laboratory sediment experiments, compared to control sediment incubations without filter. Both smoked and unsmoked cigarette filters decreased pH and dissolved Cd, Mo and V concentrations in marine sediment incubations, while they increased dissolved Fe, Mn, Zn levels in the surrounding environment. Smoked filters dramatically decreased the relative abundance of the phyla *Bacteroidetes* and *Cyanobacteria*, while the members of the phyla *Gammaproteobacteria*, *Firmicutes* and *Thermotogae* were enriched by smoked filters in marine sediments. Bacterial taxa associated with deep marine environments or hydrothermal seep fields were selected by smoked cigarette filters. This study demonstrated for the first time the microbial community changes and impacts from toxic cigarette filters in coastal marine sediments.

1. Introduction

Cigarette butts (CB) are one of the most common plastic forms of litter found in the environment (Kadir and Sarani, 2015). From 5 to 6 trillion cigarettes were smoked worldwide every year by one billion smokers living in large majority in low- and middle-income countries (Drope et al., 2018; Kostova et al., 2014; WHO, 2017; Zafeiridou et al., 2018). Most of them are discarded in the environment, and are transported by wind, rain, river, and marine currents to coastal areas. Nowadays, CB are the most collected item during the cleaning of beaches (Araújo and Costa, 2019; Addamo et al., 2017; Novotny et al., 2009). They can account for up to 40% of marine litter collected on beaches in some Mediterranean areas (Munari et al., 2016; Vlachogianni, 2019). CB are mainly composed of cellulose acetate, a kind of plastic, which slowly biodegrade for several years depending on environmental conditions (Benavente et al., 2019; Bonanomi et al., 2015). Moreover, CB are classified as hazardous waste according to European regulation (Rebinschung et al., 2018), mainly due to the toxic chemicals they contain, such as nicotine, metals (e.g. cadmium, arsenic) and others organic compounds derived from tobacco combustion (Moriwaki et al., 2009; Moerman and Potts, 2011). Furthermore, it was estimated that a single CB could contaminate 1000 L of water (Green et al., 2014). Due to their toxicity and slow degradability, CB in marine ecosystems pose a potential human health risk through their transfer, fragmentation, accumulation in the food chain and subsequent consumption.

To date, the ecological risk due to CB pollution in marine ecosystems is largely underestimated (Kadir and Sarani, 2015). A recent review on CB pollution in coastal ecosystems has reported only a few studies involving the quantification of CB in coastal ecosystems, which are largely concentrated to American and European coasts (Araújo and Costa, 2019). Moreover, few ecotoxicological studies have investigated the exposure and effects of CB on aquatic biota, despite the wide diversity of marine organisms. The few studies available reported that CB leachates were toxic to the marine bacterium *Aliivibrio fischeri* (formerly *Vibrio fischeri*) and the cladoceran *Ceriodaphnia* cf. *dubia* (Micevska et al., 2006), the marine fish Atherinops affinis (Slaughter et al., 2011), the

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Lignin - montmorillonite hydrogels as toluene adsorbent

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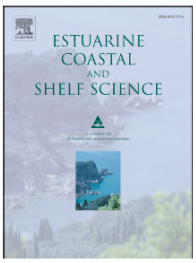

Microplastics in surface waters of the Gulf of Gabes, southern Mediterranean Sea: Distribution, composition and influence of hydrodynamics

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Prokaryotic Diversity and Distribution Along Physical and Nutrient Gradients in the Tunisian Coastal Waters (South Mediterranean Sea)

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Prokaryotes play an important role in biogeochemical cycling in marine ecosystems, but little is known about their diversity and composition, and how they may contribute to the ecological functioning of coastal areas in the South Mediterranean Sea. This study investigated bacterial and archaeal community diversity in seawater samples along the Tunisian coast subject to important physicochemical disturbances. The 16S amplicon sequencing survey revealed higher prokaryotic diversity in the northern Tunisian bays than in southeastern waters (Gulf of Gabès). The major taxonomic groups identified in all samples were *Alphaproteobacteria* (40.9%), *Gammaproteobacteria* (18.7%), Marine Group II *Euryarchaeota* (11.3%), and *Cyanobacteria* (10.9%). Among them, the relative abundance of *Alteromonadales*, *Prochlorococcus*, and some clades of *Pelagibacterales* (SAR11) significantly differed between the northern and the southern bays, whereas no difference was observed across coastal waters in the archaeal *Candidatus* Poseidoniales (MGII), *Synechococcus*, and *Pelagibacteraceae* (SAR11 clade Ia), for which no relationship was observed with the environmental variables. Both *Pseudoalteromonas* and *Alteromonas* levels increased with the increasing salinity, density and nutrients (NH_4^+ and/or PO_4^{3-}) gradients detected toward the southern waters, while the SAR11 clades Ib and IV and *Prochlorococcus*, decreased in the shallow, salty and nutrient-rich coastal waters of the Gulf of Gabès. *Rhodobacteraceae* was positively correlated with *Synechococcus* and chlorophyll levels, suggesting a relationship with phytoplankton biomass. The present study provides the first insights into planktonic prokaryotic community composition in the South Mediterranean Sea through the analysis of Tunisian seawaters, which may support further investigations on the role of bacterioplankton in the biogeochemistry of these ecosystems.

Keywords: bacteria, archaea, bacterioplankton, diversity, Tunisia, Gulf of Gabès, seawater

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Theoretical investigation of the ozonolysis reactions of acyclic monoterpenes

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Abstract

In this work, we conducted a theoretical study on the addition reactions between ozone O_3 **4** and double bonds of monoterpenes molecules such as Cis-Ocimene **1**, trans-ocimene **2**, and Myrcene **3**. In order to compare the reactivity of these monoterpenes molecules with the ozone, we discussed from thermodynamic and kinetic points of view, the possibility and the stereoselectivity of these reactions. The study of the frontier orbitals have been calculated and discussed.

1. Introduction

Monoterpenes have enough high atmospheric concentrations and a low life time. Librando and tringali [1] have shown that monoterpenes, due to their relatively high atmospheric concentrations for some of them, and their short life time, contribuate greatly to the formation of secondary organic aerosols (SOAs) in the troposhere [1]. These secondary organic aerosols (SOAs), which account for a large part of ambient tropospheric aerosols, affect atmospheric processes, climate, and human health [2-6].
Generally terpenes are hydrocarbons found in plants. Several research studies have been carried out on the ozonolysis of terpenes [1-4]. Indeed, this ozonolysis reaction takes place in two stages; the first stage is the addition of ozone on the double bond. This result in the formation of an intermediary called molozonide. Subsequently this molozonide opens to lead to the formation of a carbonyl compound and a biradical intermediate. Finally, the second stage by internal rearrangement of this intermediate, one obtains the formation of carbonyl compounds such as aldehydes, ketones and carboxylic acids,..etc.
In this work, we studied theoretically the ozonolysis reactions between the ozone O_3 on double bonds of monoterpene molecules such as cis-ocimene **1**, trans-ocimene **2** and myrcene **3**. These monterpenes molecules of the molecular formula ($C_{10}H_{16}$) and each have three doubles bonds, a first double bond

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Ultraphytoplankton community composition in Southwestern and Eastern Mediterranean Basin: Relationships to water mass properties and nutrients

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ABSTRACT

The composition, biomass, and spatial and vertical distribution of ultraphytoplankton (< 10 μm) were investigated at the single-cell level by flow cytometry during the INCOMMET oceanographic cruise carried out during the fall of November 2013, covering eleven stations spread out along coastal Tunisian waters at less than 100 m depth. Flow cytometry analysis of samples taken at different stations and depths allowed the determination of five major groups of ultraphytoplankton; among them two populations of pico-cyanobacteria *Synechococcus* and *Prochlorococcus*, picoeukaryotes, nanoeukaryotes and cryptophytes. In addition to these autotrophic groups, three unknown groups were resolved and were distinguished by their fluorescence and size signals. The unknown groups' integrated biomass was larger than that of the other ultraphytoplankton components. The abundance of picoeukaryotes, nanoeukaryotes and cryptophytes increased gradually southwards towards the Gulf of Gabès, whereas *Prochlorococcus* were more abundant in the Gulf of Hammamet at more than 60 m depth. Structural equation modeling analysis showed weak links between most of the cell groups and nutrients concentrations. Clustering analysis based on the abundance of the phytoplankton groups resulted in aggregation into three clusters and two major zones, discriminating the Gulf of Gabès from the more northern Bays. The results suggest that the physical features, essentially the water mass properties, were the main drivers shaping the ultraphytoplankton community composition and that the autotrophic biomasses were not determined by nutrient control.

1. Introduction

Marine phytoplankton play a fundamental role in pelagic food-webs by fixing inorganic carbon, producing chemical energy from light (i.e., primary production; Field et al., 1998; Chavez et al., 2010), and contributing to the carbon biological pump by exporting carbon to the deep ocean (Ducklow et al., 2001; Lutz et al., 2007). Phytoplankton aggregation and biomass are regulated and limited by many factors, such as the hydrology properties, the bioavailability of nutrients, sunlight (Falkowski et al., 1985; Agawin et al., 2000; Bel Hassen et al., 2009a; Drira et al., 2009), and biotic interactions, notably grazing, virus lysis, and species competition (Sommer, 1988; Sterner, 1990; Joint et al., 2002).

Phytoplankton biomass regulation, and interactions between constituting groups, have always been challenging issues for the description of structural and functional properties of pelagic food webs and for the identification of taxonomic groups contributing to the total ecosystem carbon inputs and their responsible mechanisms (Sakka et al., 2014; Meddeb et al., 2018). The carbon pathways, characterized either by the system herbivory generally assigned to microphytoplankton and large grazers or to the microbial web where autotrophs and heterotrophic organisms dominate and sustain the functioning of the system (Sherr and Sherr, 1988), might condition the efficiency in carbon channeling within the food chain. In particular, the Mediterranean Basin has been generally considered as an oligotrophic system, characterized by a dominance of picoplanktonic producers and nano-heterotroph grazers, leading to limited carbon-and energy-transfer up to the higher trophic levels through the microbial food web (Pulido-Villena et al., 2014).

The eastern Mediterranean Basin, where the thermohaline circulation and physical processes establish conditions of low nutrient concentration and low primary production, is by far the most oligotrophic region of the Mediterranean Basin (Azov, 1986; Psarra et al., 2005; Tselepides et al., 2000). In oligotrophic waters, the ultraphytoplankton

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Using a naive Bayes classifier to explore the factors driving the harmful dinoflagellate *Karenia selliformis* blooms in a southeastern Mediterranean lagoon

Wafa Feki-Sahnoun[1] · Hasna Njah[2,3] · Asma Hamza[1] · Nouha Barraj[4] · Mabrouka Mahfoudi[1] · Ahmed Rebai[5] · Malika Bel Hassen[4]

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Abstract
The blooms of the toxic dinoflagellate *Karenia selliformis* can be predicted with accuracy derived from knowledge of the main forcing variables. A naive Bayes classifier modeling framework, a member of the Bayesian network family, is used to identify the phytoplankton community and the physical and meteorological parameters involving *K. selliformis* blooms in the eutrophic Boughrara Lagoon (BL), Tunisia. The proposed model takes into account the physical environment parameters (salinity, water temperature, tide amplitude), meteorological constraints (evaporation, air temperature, insolation, rainfall, atmospheric pressure, and humidity), phytoplankton groups (diatoms, dinoflagellates, cyanobacteria, Euglenophyceae), and the sampling months on *K. selliformis* blooms. The shift to highest salinity and atmospheric pressure, associated with reduced tide, are the most favorable conditions for *K. selliformis* blooms in BL. The results show that *K. selliformis* formed nearly monospecific blooms. A shift in species composition was pointed out between the bloom and non-bloom conditions. The Euglenophycea and some dinoflagellates like *Peridinium minimum*, *Prorocentrum minimum*, *Prorocentrum micans*, *Prorocentrum gracile*, *Protoperidinium minutum*, and *Scrippsiella trochoidea* appeared during blooms, whereas diatoms, diazotrophic cyanobacteria, and dinoflagellates (*Akaskiwo sanguinea*, *Karlodinium veneficum*, *Gyrodinium spirale*, *Oxyrrhis marina*, *Polykrikos kofoidii*) were observed under non-bloom conditions. This study highlighted the most favorable physical and meteorological conditions for *K. selliformis* bloom occurrences and also pointed out species indicators for bloom establishment and others for non-bloom conditions. Monitoring the dynamics of these species with the associated physical and meteorological variability offers valuable information to plan for the best options for prediction of potentially toxic blooms of *K. selliformis* and associated dystrophic consequences.

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Water renewal in the Boughrara lagoon (Tunisia, central Mediterranean Sea) under tidal forcing

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ABSTRACT

The aim of this study is to estimate the water renewal time in the Boughrara lagoon. This is a key parameter for ecological studies of the lagoon. The method used consists of the injection of a soluble tracer which has a concentration of zero at the open boundaries of the domain ($C_0 = 0$) and is equal to one inside the lagoon ($C_1 = 1$). In this study, we use numerical simulation modules developed by Deltares: the hydrodynamic Delft-Flow module and the Horizontal Large Eddy Simulation (HELS) module. We compute the horizontal advection and dispersion and get estimates, at every mesh of the computational grid, of the time needed for the tracer's concentration inside the lagoon to drop from 1 (C_1) to 0.38. This time is known as the Local Renewal Time (LRT).

A spatial distribution analysis of the LRTs enables a subdivision of the domain based on the similarity of values near the LRT (at every mesh of the domain) and on the physical configuration of the domain (e.g. bay, deep/shallow zone, harbor). Then it becomes simple to compute a renewal time for each region in the domain, which is the Integral Renewal Time (IRT). If we want to take into account the whole domain, we consider the maximum value of the IRT.

The numerical simulations were run taking into account the effect of the predicted tide. The computational grid has a horizontal mesh size of 150 m × 150m. The LRT under only the effect of the tidal forcing at the zone where an aquaculture farm is located is estimated at one week. Moreover, in the region of the mini-gulf of Guellala, this LRT is estimated to be one month.

The encounter between the waters coming from the two channels of the lagoon occurs after a period of four months in the zone bounded to the south by the island of Djilij and to the north by the mini-gulf of Guellala. South of the fishing port of Boughrara and Djilij Island, the local water renewal time varies between 5.5 and 6.5 months.

1. Introduction

The Boughrara lagoon located to the south of the island of Djerba is Tunisia's largest lagoon (surface area ≈50 000 ha). It communicates with the sea through two channels. The first one is to the east, is narrow and shallow, and has a road/dyke (Kantara) which was built in 1953 and rehabilitated in 2007 (width = 150 m and mean depth = 4.5 m). The second channel is wider (≈2200 m) and is located in the north-western part of the lagoon. The mean depth of the lagoon is of the order of 5 m.

The lagoon is quasi-enclosed (Fig. 1) and has the shape of a stomach. The "Pylori" is undergoing a clogging due to solid transport in the east of the lagoon (Brahim et al., 2014; Masmoudi et al., 2005; Atoui, 2017). The "Pharynx" to the northwest is fed by, among other sources, polluted waters flowing from the gulf of Gabes (Ben Aoun et al., 2007; Guetat et al., 2012).

The dynamics of the lagoon are strongly linked to those of the gulf of Gabes where the semi-diurnal tide is dominant (Molines, 1991; Tsimplis et al., 1995; Sammari et al., 2006; Abdennadher and Boukthir, 2006; Brahim et al., 2014; Atoui et al., 2009) and where a resonance of the amplitudes of the principle tidal constituents occurs (Sammari et al.,

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Liste des chapitres d'ouvrage édités en 2020

Chapter 16
Removal of Dyes and Heavy Metals with Clays and Diatomite

Nadia Tahari, Houwaida Nefzi, Abdelkader Labidi, Sameh Ayadi, Manef Abderrabba, and Jalel Labidi

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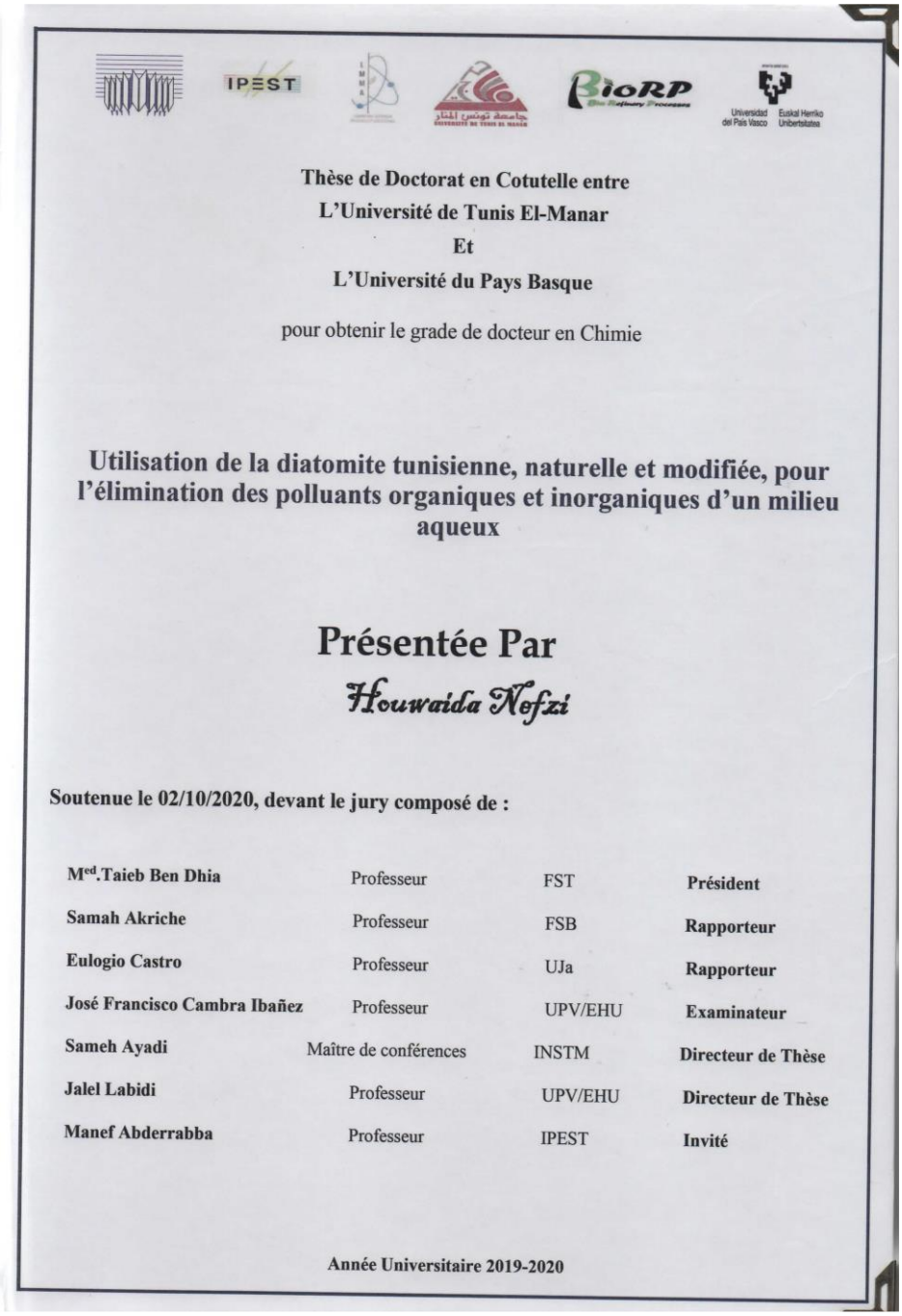

Thèse de Doctorat en Cotutelle entre
L'Université de Tunis El-Manar
Et
L'Université du Pays Basque

pour obtenir le grade de docteur en Chimie

Utilisation de la diatomite tunisienne, naturelle et modifiée, pour l'élimination des polluants organiques et inorganiques d'un milieu aqueux

Présentée Par

Houwaida Nefzi

Soutenue le 02/10/2020, devant le jury composé de :

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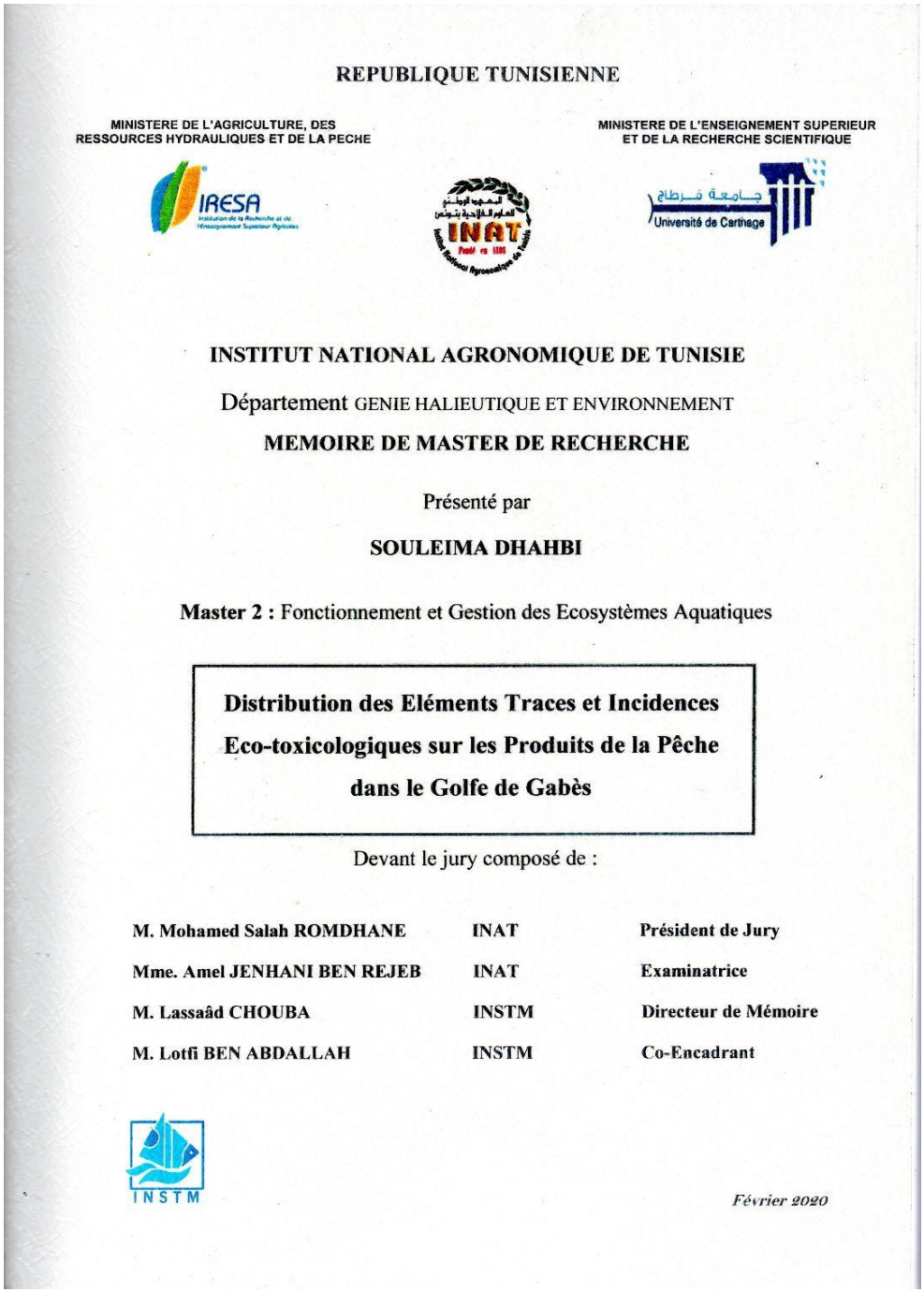

REPUBLIQUE TUNISIENNE

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INSTITUT NATIONAL AGRONOMIQUE DE TUNISIE

Département GENIE HALIEUTIQUE ET ENVIRONNEMENT

MEMOIRE DE MASTER DE RECHERCHE

Présenté par

SOULEIMA DHAHBI

Master 2 : Fonctionnement et Gestion des Ecosystèmes Aquatiques

Distribution des Eléments Traces et Incidences Eco-toxicologiques sur les Produits de la Pêche dans le Golfe de Gabès

Devant le jury composé de :

M. Mohamed Salah ROMDHANE	**INAT**	**Président de Jury**
Mme. Amel JENHANI BEN REJEB	**INAT**	**Examinatrice**
M. Lassaâd CHOUBA	**INSTM**	**Directeur de Mémoire**
M. Lotfi BEN ABDALLAH	**INSTM**	**Co-Encadrant**

Février 2020

UNIVERSITE DE TUNIS EL MANAR
FACULTE DES SCIENCES DE TUNIS
DEPARTEMENT DE GEOLOGIE

MEMOIRE

Présenté pour l'obtention du

Diplôme de Mastère de Recherche en Géologie

Parcours : GéoRessources et Développement Durable

Présenté par

Yasmine Beji

Dynamique sédimentaire du littoral de Ghar El Melah : Evolution naturelle et impacts anthropiques

Soutenu le : 24/01/2020 devant le jury composé de :

Mr Saâdi ABDELJAOUED	**Professeur Emérite (FST)**	**Président de Jury**
Mme Oula AMROUNI	**Maître Assistante (INSTM)**	**Directrice de mémoire**
Mme Zeineb GARGOURI	**Maître Assistante (ENIS)**	**Examinatrice**
Mr Faowzi MAAMOURI	**Directeur WWF**	**Invité**

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

Année Universitaire : 2018/2019

REPUBLIC OF TUNISIA

MINISTERE DE L'AGRICULTURE, DES RESSOURCES HYDRAULIQUES ET DE LA PECHE

MINISTERE DE L'ENSEIGNEMENT SUPERIEUR ET DE LA RECHERCHE SCIENTIFIQUE

NATIONAL AGRONOMIC INSTITUTE OF TUNISIA
Research MSc Thesis Defence

Presented by

Inès BOUJMIL

Master of Science in Geomatics applied to Agriculture and Environment GEOMAG

COMBINING GLIDER DATA WITH SATELLITE DATA TO STUDY MESOSCALE COHERENT VORTICES IN THE SARDINIA CHANNEL

Presented in front of the Jury:

Pr. Jamila Ben Souissi	**INAT**	**President of the Jury**
Pr. Sana Ben Ismail	**INAT/INSTM**	**Adviser at INAT and INSTM**
Pr. Zeineb Kassouk	**INAT**	**Examiner**

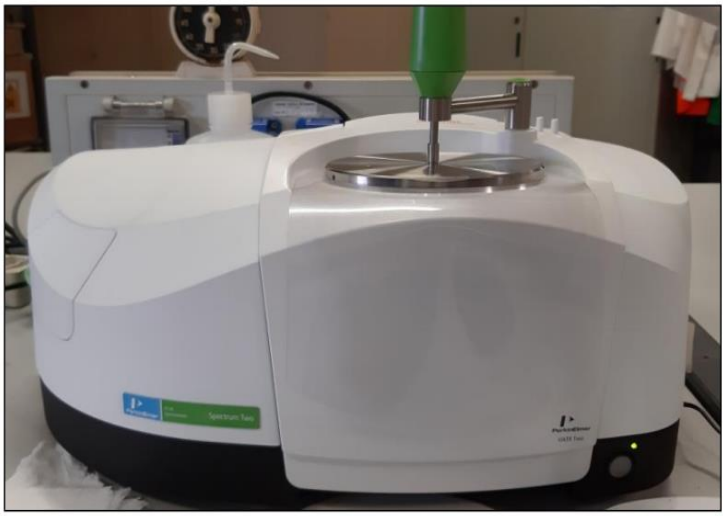
Dissertation defence on Monday, January 6, 2020

Séminiares, journées et ateliers scientifiques organisés en 2020

La gestion et la conservation de la plage de Rejich

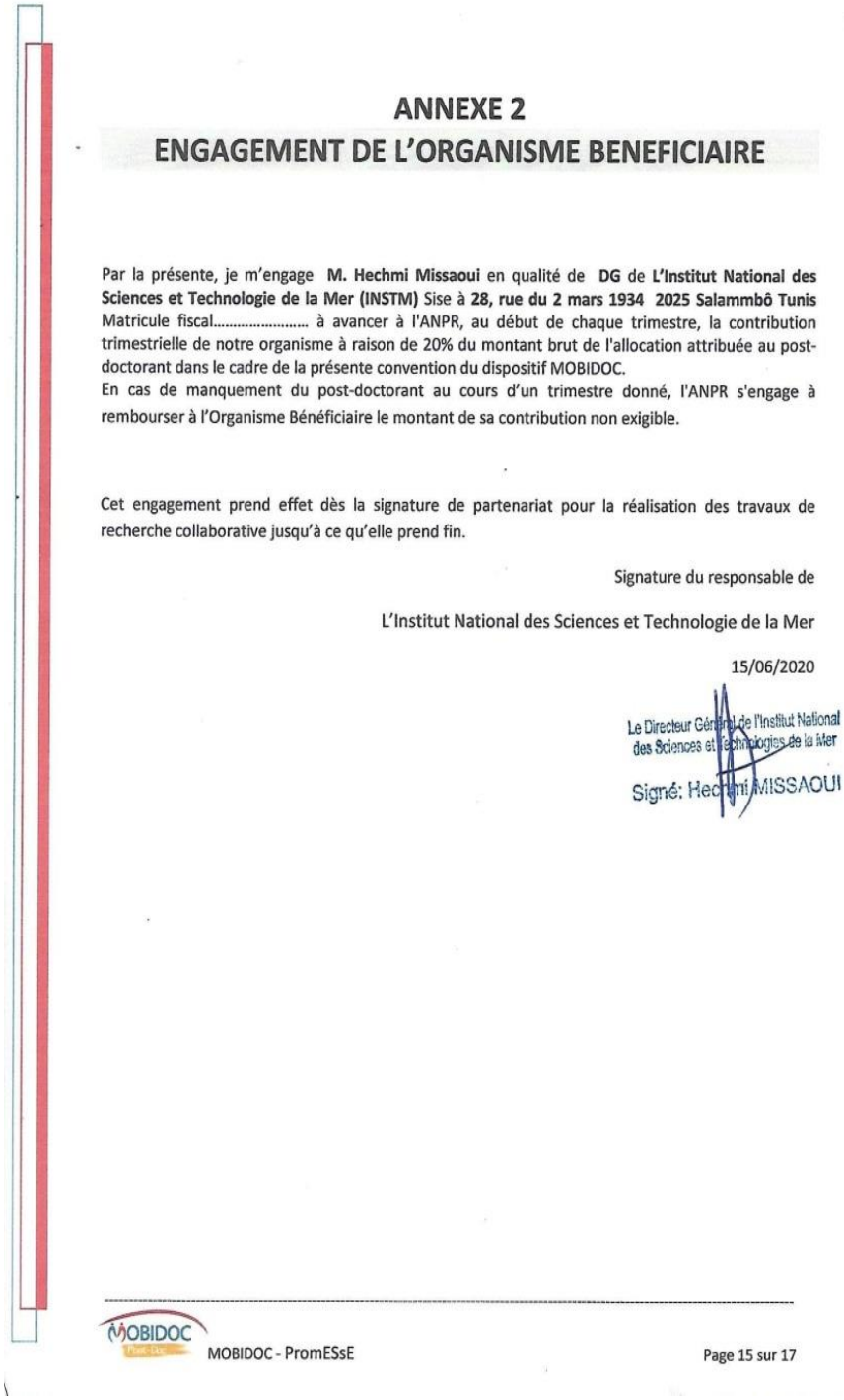
Mediterranean Forum for Applied Ecosystem Based Management, MED4EB

Présentation du nouvel équipement scientifique, un spectromètre FTIR (FTIR-Fourier-transform infrared spectroscopy)



Liste des conventions signées avec des entreprises et partenaires socio-économique en 2020

ANPR/INSTM



ANNEXE 2

ENGAGEMENT DE L'ORGANISME BENEFICIAIRE

Par la présente, je m'engage **M. Hechmi Missaoui** en qualité de **DG** de **L'Institut National des Sciences et Technologie de la Mer (INSTM)** Sise à **28, rue du 2 mars 1934 2025 Salammbô Tunis** Matricule fiscal..... à avancer à l'ANPR, au début de chaque trimestre, la contribution trimestrielle de notre organisme à raison de 20% du montant brut de l'allocation attribuée au post-doctorant dans le cadre de la présente convention du dispositif MOBIDOC.
En cas de manquement du post-doctorant au cours d'un trimestre donné, l'ANPR s'engage à rembourser à l'Organisme Bénéficiaire le montant de sa contribution non exigible.

Cet engagement prend effet dès la signature de partenariat pour la réalisation des travaux de recherche collaborative jusqu'à ce qu'elle prend fin.

Signature du responsable de

L'Institut National des Sciences et Technologie de la Mer

15/06/2020

Le Directeur Général de l'Institut National des Sciences et Technologies de la Mer

Signé: Hechmi MISSAOUI

MOBIDOC - PromESsE

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ARTICLE 16 : NOMBRE D'EXEMPLAIRES ORIGINAUX

La présente convention est signée en quatre (04) exemplaires originaux dont trois reviendront à chaque partie signataire. Une copie est adressée à l'Unité de Gestion de Projet PromESsE du MESRS pour information.

SIGNATURES

Lu et approuvé
Pour L'Institut National des Sciences et Technologies de la Mer
(Le représentant légal)
M. Hechmi Missaoui

Date : 15/06/2020

Le Directeur Général de l'Institut National des Sciences et Technologies de la Mer
Signé: Hechmi MISSAOUI

Lu et approuvé
Pour le Docteur

Mme. Samira Ben Romdhane

Date : 15/06/2020

Lu et approuvé
Pour L'Agence Nationale de la Promotion de la Recherche Scientifique

Le Directeur Général
Pr. Chedly ABDELLY

Date : 15/6/2020

MEDREC/INSTM

LE CENTRE MÉDITERRANÉEN DES ENERGIES RENOUVELABLES
MEDITERRANEAN RENEWABLE ENERGY CENTRE
المـركز المـتوسطي للـطاقـات المـتجـددة

INSTM
LMM
Laboratoire Milieu Marin

CONVENTION de COOPÉRATION

Entre

L'Institut National des Sciences et Technologie de la Mer, établissement public de Recherche Scientifique à caractère administratif, placé sous la tutelle de l'Institution de la Recherche et de l'Enseignement Supérieur Agricoles (IRESA), Ministère de l'Agriculture, des Ressources Hydrauliques et de la Pêche, sis à 28 rue du 2 mars 1934 - 2025 Salammbô.
Désigné ci-après par l'acronyme : «**INSTM**»
Représenté par son Directeur Général, M. Hechmi Missaoui,

Et

Le Centre Méditerranéen des Energies Renouvelables, Groupement d'Intérêt Économique (GIE) à but non lucratif, créé conjointement par le Ministère Tunisien de l'Energie et le Ministère Italien de l'Environnement, sis au 3, rue Moslim Ibn Walid - Notre Dame, 1082 Tunis.

Désignée ci-après par l'acronyme : «**MEDREC**»
Représenté par ses Directeurs, M. Marco Polverari et M. Hassan El Agrebi.

Désireux de consolider davantage leurs liens de coopération, l'INSTM et le MEDREC, ci-après désignés par les Parties, ont convenu de ce qui suit :

EcoMedSure/Co-Evolve4BG

Med-EcoSuRe

Co-Evolve4BG

Ref 1253

CONVENTION DE SYNERGIE ENTRE LES DEUX PROJETS ENICBCMED

Med-EcoSuRe

Mediterranean University as Catalyst for Eco-Sustainable Renovation

(Le Centre Méditerranéen des Energies Renouvelables – MEDREC)

&

Co-Evolve4BG

Co-evolution of coastal human activities &Med natural systems for sustainable tourism & Blue Growth in the Mediterranean

(L'Institut National des Sciences et Technologies de la Mer – INSTM)

AGG/MED4EBM

Réf: 1003

- 1 OCT 2020

CONTRAT DE SERVICES

Entre :

L'Institut National des Sciences et Technologies de la Mer (INSTM) sis au 28 rue du 2 mars 1934 - 2025 Salammbô -Tunis, représenté par son Directeur Général Monsieur **Hechmi MISSAOUI** (Matricule fiscale : 000NN609519G),
D'une part,

Et,

L'association de la Continuité des Générations Sfax (ACG) domiciliée à l'Avenue Hedi Nuira, Imm Bellaaj, 1er étage,App13-3027 Sfax, représenté par Dr **Sana Taktak Keskes** en sa qualité de Présidente, dûment habilité aux fins des présentes, et dont le matriculefiscal :1234402V/P/N/000,
D'autre part,

Préambule
Le contrat de subvention No. 56/1563 signé le 04 octobre 2019 entre l'Union Européenne représentée par le Management Autority (MA) du programme **ENI CBC MED** d'une part et d'autre part le bénéficiaire le Programme des Nations Unies pour le Développement (**PNUD**)-Bureau de la Jordanie, boite postale 941631-Rue Ishaq Aledwan, immeuble no. 16 Amman, 11194, Jordanie, en qualité de demandeur et représenté par Madame Sara Ferrer Olivella, en collaboration avec :

1. Le conseil en planification et développements.r.l. (**PROGES**),Rue Appennini 46, 00198 – Rome, Italie, représenté par Monsieur Marco Francesco Falcetta, partenaire 1 ;
2. Ente gestoreRiserveLago di Tarsia e dellaFocedel Fiume Crati – Associazione Amici della Terra (**AdT**) Onlus, Rue Ippolito Nievo 62, 00153 Rome, Italie, représenté par Madame Monica Tommasi, partenaire2 ;
3. La Société Royale de Conservation Marine de Jordanie (**JREDS**), boite postale 2353, Al Farabi St. Fifth Area 77110, Aqaba, Jordanie, représenté par MonsieurEhab Eid, partenaire 3,