9th International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS:
PROBLEMS AND MEASUREMENT TECHNIQUES

ABSTRACTS

Livorno (Italy) 14th - 16th June 2022

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Session *Coastal Environmental Engineering: pollution, energy production, monitoring and economic environmental assessment, regulatory context*

Session *Flora and Fauna of the littoral system: dynamics and protection*

Session *Underwater and Coastal Cultural Heritage*

SESSION

MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

ORAL PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **Impacted river and coastal sediment connectivity in the Mediterranean: a context for rampant coastal vulnerability in the face of climate change**

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

AUTHORS: EDWARD ANTHONY

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

Sediment connectivity refers to the continuity of the flux of sediment along defined transport pathways. The concept may be used in the context of both river network sediment cascades down to the sea controlled by water discharge, and fundamental to the formation of many clastic coastal deposits such as deltas, beaches and dunes, and alongshore/cross-shore sediment mobility and redistribution assured by waves and a variety of currents, and important in the maintenance and stability of these clastic systems. Clastic coasts composed of loose sand or gravel (bedload) and built essentially from sediments supplied by rivers are abundant in the Mediterranean. The nature of such bedload supply to the Mediterranean's clastic coasts has been modulated by river catchment characteristics and human influence. The plethora of pocket beaches in small embayments in the Mediterranean directly trap bedload supplied by small streams or eroded from nearby bounding headlands, whereas fluvial bedload supply to more or less long open-coast shores has been conditioned by longshore current redistribution of bedload from river-mouth bar deposits, many associated with deltas that have evolved in a wave-dominated context. These coasts include variably wide barriers and dunes, as well as spits, sometimes exhibiting more or less closely-spaced beach ridges. Sediment has also been derived from nearby abandoned delta lobes, older relict or actively formed nearshore deposits, and from shoreline reworking, but connectivity between shore and lower shoreface has always been limited in the Mediterranean because of the steep shelf context.

Significant sediment deficits along many of the Mediterranean's coasts have resulted from longitudinal and lateral fragmentation of rivers that have generated loss of sediment connectivity. The most important human interventions are reforestation, flow regulation by dams, and sediment entrapment by reservoirs, but fluvial channel engineering and sand and gravel extraction have also been significant throughout the Mediterranean. These impacts were largely preceded in many river catchments by multi-millennial climate and land-use changes. Because of the strong wave influence and low tidal ranges, longshore sediment transport from river mouths operates within the framework of one or several sediment cells with boundaries. Many such cells are now characterized by artificial boundaries that block bedload transport and alongshore sediment connectivity. These include

harbours and terminal groynes, products of coastal urbanization and economic development, especially over the last century. Some forms of artificial shoreline development have impinged on beaches. Climate change and sea-level rise will further impact sediment supply to coasts in the Mediterranean by affecting river hydrology relative to waves, thus impacting the ability of river mouths and deltas to trap sediments, balance subsidence, or release sediment to sustain adjacent coasts, and by modulating longshore bedload transport rates. These effects spell increasing vulnerability of Mediterranean coasts and call for the urgent need to foster efforts aimed at re-establishing sediment connectivity.

REFERENCES: (MAX 4)

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MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: BEACH SEDIMENT DYNAMICS FROM NATURAL RADIONUCLIDES POINT OF VIEW

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The morphology and sedimentary budget of beaches is mainly controlled by sand erosion and accumulation periods. Therefore, monitoring these processes closely is a key factor to a sustainable management of this high-value areas and better understand how beaches morphology can evolve with time. Thus, different techniques can be used to evaluate sediment dynamics and among them, natural radionuclides have proven to be an interesting tool in coastal areas (Thereska, 2009). Following this, a spatio-temporal analysis of the activity concentrations of natural radionuclides was performed in Las Canteras beach, Spain, during 2016 and 2019 (Arriola-Velásquez et al., 2021). This study evaluated the role of gamma emitting radionuclides ^{226}Ra, ^{228}Ra, ^{40}K, as well as the ratio proposed in the work of Dai et al., (2011) ^{226}Ra/^{228}Ra, as tracers of erosion and accumulation periods in beach areas. The sediment dynamics of this beach has been well studied in past years and it combines the characteristic dynamic of a closed beach protected against the wave action and that associated with a beach open to it (Alonso, 2005). These differences make this beach an ideal natural laboratory to evaluate the changes of natural radionuclides associated to the sediments that are transported under different dynamics, allowing to obtain results that could be applied in other parts of the world.

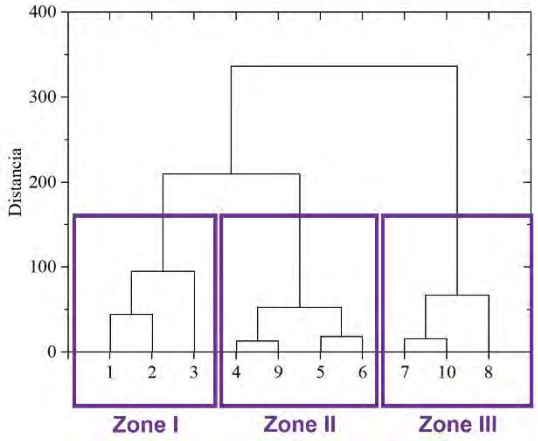

Fig. 1. Dendrogram showing clustering for the different sampling points based on their activity concentrations of ^{226}Ra, ^{228}Ra and ^{40}K.

For studying the spatial variability, a cluster and a principal component analysis were performed to the samples corresponding to the first year of study (a total 120 samples). The stationary averages activity concentrations of the studied radionuclides and other quantities, such as grain size or bulk density, were used to performs these tests. The results (Fig. 1) show that the activity concentration of ^{226}Ra, ^{228}Ra, ^{40}K group the samples in three clusters that agreed with three different zones related to the sediment distributions occurring due to the different sediment dynamics present in the beach.

The temporal variability analysis showed that the activity of the natural radionuclides studied was influenced by marine erosion and accumulation agents, such as significant wave height. As it is shown in Fig. 2, in zone I (the area totally exposed to the wave action) the activity concentration values found were lower when the significant wave height was higher (expected to occur during erosion periods). This pattern is clearer for ^{40}K and this could be related to the appearance and loss of some potassium rich minerals during erosion and accumulation periods. Therefore, ^{40}K seems to be a suitable tracer of beach sedimentary dynamics.

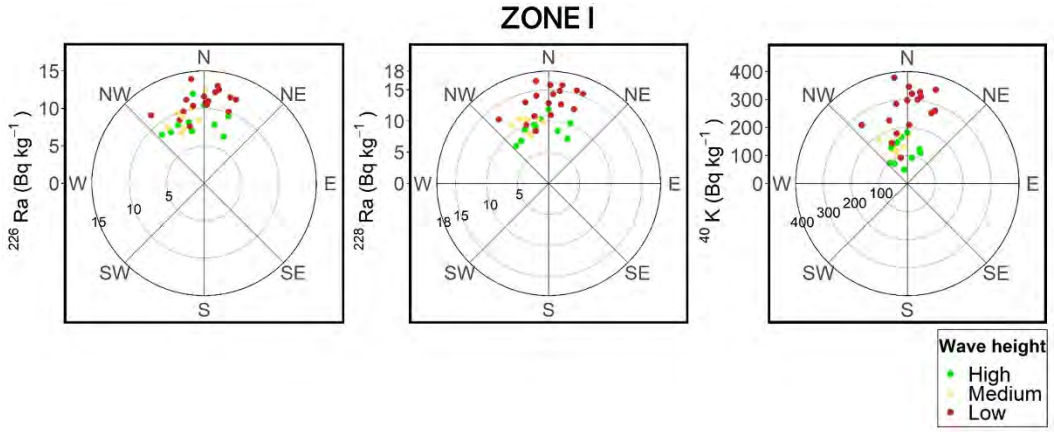

Fig. 2. Azimuth plot of wave height and direction and activity concentration of ^{226}Ra, ^{228}Ra and ^{40}K for zone I.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
SHORELINE AND ENVIRONMENTAL CHANGES DETECTION IN THE GULF OF GELA, SOUTHERN SICILY (ITALY)

SESSION:
MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Coastal areas are among the most biologically productive, dynamic and valued ecosystems on Earth. They are subject to changes that greatly vary in scale, time and duration and to additional pressures resulting from anthropogenic activities. The aim of this work was to investigate the shoreline evolution and the main environmental changes of the coastal stretch between the towns of Licata and Gela (in the Gulf of Gela, Sicily, Italy). The Gulf of Gela coincides with the second order coastal sub-cell n. 4.2 identified by the Regional Plan against Coastal Erosion and falling within the first order coastal sub-cell that extends from Capo Passero Island to Capo San Marco (Regione Siciliana, 2020). The methodology used in this work included the analysis of: (i) shoreline changes over the long- and medium-term periods (1955–2019 and 1989–2019, respectively), (ii) dune system fragmentation (Molina et al., 2020) and (iii) the impact of coastal structures (Aybulatov & Artyukhin, 1993) on coastal evolution. The image analysis has been performed using a heterogeneous cartographic dataset, like IGM aerial photographs (1955, 1966), orthophotos of the Italian National Geoportal (1989, 2000, 2006, 2012), Google Earth images (2016, 2019). The Digital Shoreline Analysis System (DSAS), free application of the ESRI ArcGIS© software, was used to compute the statistical indexes (SCE, NSM, WLR) and assess the shoreline movements. The shoreline change analysis mainly showed a negative trend both over the long- and medium-term periods, with a maximum retreat of 3.87 m/year detected over the medium-term period down-drift of the Licata harbour. The medium-term analysis was confirmed by the long-term assessment with a maximum erosion rate of 6.37 m/year recorded eastward the Southern Imera river mouth. The eleven breakwaters set few meters eastward the river mouth partly blocked the shoreline retreat and slight accretion has been here registered. Moreover, the highest retreats were also recorded down-drift of coastal structures (harbours and breakwaters), and sediment deposition was mainly found in correspondence of structures (i.e., breakwaters) and along coastal areas where beaches are backed by well-preserved dune systems and breakwater barriers. However, a few kilometres eastward from the harbour, significant accretion was registered where a set of breakwaters was emplaced. However, the Shoreline Change Envelope (SCE) showed that the main depositional phenomena occurred during the decade between 1955 and 1966, whereas progressive and constant erosion was observed between 1966 and 1989 in response to the increasing coastal armouring. Accordingly, our study show that (i) the implementation of the Licata harbour and the significant loss of the dune ecosystem significantly changed the coastal sediment dynamic, (ii) coastal armouring affected longshore sediment transport, giving rise to sediment deposition in correspondence and up-drift of structures (i.e., breakwaters), while relevant retreat is generally found down-drift of coastal structures (harbours and breakwaters); and (iii) beaches backed by a well-preserved dune system experienced sedimentation or maintained a stable trend as dunes likely provide sediment reservoirs to the shore and act as barriers to erosion and flooding processes (Borzí et al., 2021).

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: CLIMATE AND MORPHOLOGICAL EFFECTS ON THE COASTAL ENVIRONMENT EVOLUTION AND A NEW METHOD FOR SHORELINE IDENTIFICATION

SESSION: MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Coastal erosion coupled with human-induced pressure has severely affected the coastal areas of the Mediterranean region in the past and continues to do so with increasing intensity today (Luijendijk et al., 2018). In this context, the Pisa coastal plain shows a long history of erosion, which started at the beginning of the nineteenth century. In this work, shoreline positions derived from historical maps as well as airborne, DGPS surveys and drone surveys were analyzed in a GIS environment to identify the main changes occurred in the last 142 years. In this study, we have acquired new shorelines by DGPS and new images with the use of the drones and we identified a new and valid beach topography-based algorithm, able to automatically identify the shoreline. We apply the Structure from Motion (SfM) techniques to reconstruct a high-resolution Digital Elevation Model using a drone for image acquisition. The algorithm is based on the variation of the topographic beach profile caused by the transition from water to sand. The SfM technique is not efficient when applied to reflecting surfaces like sea water resulting in a very irregular profile over the sea (Kohv et al., 2017). Taking advantage of this fact, the algorithm searches for the point in the space where a beach profile changes from irregular to regular, causing a transition from water to land. The algorithm is promoted by the release of a QGIS v3.x plugin uploaded on the official repository of the software, which allows the easy application and extraction of other shorelines (Luppichini et al., 2020). The new acquired data were compared with all the available data in order to better understand the costal evolution of Pisa coastal plain. Specifically, our data were compared with 100 years of discharge data measured at the S. Giovanni alla Vena gauge to identify a possible correlation between the two sets of information. Finally, Sentinel-2 and Landsat images were studied to identify the dispersion of sediments transported by the Arno River. In particular, we found a minimum flow in the years 1954, 1978 and 2012 corresponding to peak erosion, while the reduced erosion rate and river flow increased in the years 1928-1944, 1954-1975 after 2012 (Bini et al., 2021). The qualitative anticorrelation between flow and erosion is particularly true, we take into account the floods with a flow value greater than 700 m3/s, which are those of transporting sand in suspension. The remote sensing analyzes of Sentinel-2 images show that a constant amount of sediment was transported up the river. However, the majority of these sediments do not settle along the coastline but are dispersed offshore.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: USE OF MIXED STUDY TECHNIQUES IN THE EVALUATION OF COASTLINE DYNAMICS - THE "PORTO CESAREO" MPA CASE OF STUDY

SESSION: MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI

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In recent decades, the much-discussed climate changes with the consequent variations in sea and weather conditions and the rise of the mean sea level are causing an indisputable set of negative actions on the entire coastal system mainly due to the increase of the erosive phenomenon along the shorelines. These critical scenarios have a major impact even on a local scale, and because of that, we decided to study a well knows tract of rocky/sandy mixed coast of about 4 km, in a highly anthropized area, even if located inside the "Porto Cesareo" Marine Protected Area (MPA) (Ionian Sea, Gulf of Taranto, Puglia Region, Italy). The effects of coastal erosion and anthropic pressures along this tract of coast require adequate efforts for a consistent and rapid evaluation of the coastal dynamics. The methodologies proposed in this work are based on mixed technics from different fields of study, integrating recent aero-photogrammetry surveys with drones, aerial images acquired by the Italian Military Geographic Institute (IGM), images that span from the '40s till the '90s, elaboration of paleo-shorelines related by underwater archaeological markers and their dating, and finally on the elaboration of satellite products useful for the study of vast areas, to be integrated with the other listed technics.

In the "Porto Cesareo" MPA, several nowadays submerged archaeological contexts – settlements, shipwrecks, cargos – were investigated in the framework of the UnderwaterMuse project (Programme Italia-Croatia), seem to be significant markers of sea-level changes and seascapes evolution during the centuries. The large submerged area in front of the Bronze Age site of Scalo di Furno represents the lower terrace of the settlement, showing structures and materials. Between the Torre Chianca and the tip of Belvedere there are other remains of structures and alignments of pole holes with pottery from the Middle Bronze Age, together with portions, partially submerged, of a Roman settlement and necropolis attested by funerary steles and tombs. In the same area, the wreck of a Roman navis lapidaria lays, with a cargo of monumental cipollino marble columns, probably beached when the sea level was lower than the current one of 1.5 m. Other two beached wrecks of medieval age (Bacino Grande e La Strea) testify significant coastal seascapes changes, as well as the presence of archaeological material and anthropic deposits on the islets of the Porto Cesareo archipelago, dated from the Archaic to the Roman Age, and the structures partially under the sea level on the Strea peninsula (Medieval age). Also, the quarry of Torre Castiglione, brought to the light by the powerful storms of 2019, is a precious testimony of a different ancient coastal landscape. The monitoring of coastal areas and the evaluation of shoreline dynamics are core topics in the implementation of managing actions of decision-makers on a local, regional, national, and international scale, above all in places like the chosen one, inside an MPA.

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Remote sensing through the use of RPAS (Remotely Piloted Aircraft Systems or Drones) has proved to be very useful for identifying phenomena that act on a small spatial scale and in supporting and implementing protective measures according to adaptive management approach, through multi-year surveys on habitats of conservation interest ([1]). In the specific, the study area, in recent years, has been already under survey in some beach spots with RPAS aero photogrammetry technics and geospatial elaboration with GIS software, but the coverage and the intrinsic autonomy of the drone itself have resulted in a consistent limit for the study of extended areas, so we have managed to implement our fine-scale monitoring actions, with the use of the Ground Range Detected (GRD) products from the Sentinel-1-satellite of the Copernicus constellation (European Space Agency - ESA)([2]) . These products made feasible the evaluation of the coastline positions along a chosen sensing period, in pair with the other listed actions; this last approach has a lesser detail but a broader spatial scale. Moreover, in this context, the use of satellite products provides a time-repeated view of the ground, useful in the short and long-term monitoring of changes in wide coastal areas, and in particular, offers a coastline positioning evaluation in near real-time. Local monitoring actions performed in recent years have already shown an erosive trend in the past decades, and even, negative forecasts for the next decade, so further surveys with mixed methodologies could be crucial in the evaluation of the evolution of this particular coastal area.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
SEDIMENTOLOGICAL CONSEQUENCES OF POSIDONIA OCEANICA BANQUETTE REMOVAL: SAKARUN BEACH CASE STUDY (DUGI OTOK, CROATIA)

SESSION:
MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Removal of *Posidonia oceanica* banquettes (Posidonia litter, Posidonia beach cast) on the Sakarun beach (Island of Dugi Otok, Croatia) using heavy machinery was a common multiyear practice in order to increase its recreational usage in Summer during the touristic season. Most banquettes were naturally deposited along the high intertidal to low supratidal zone, the most valuable part of the beach covered with sand. Over time it has been observed that the sandy strip of the beach has been narrowed and its thickness significantly reduced.

After the initial research of the basic geological and geomorphological characteristics of the beach, a nine months monitoring was conducted to examine the relationship between banquette removal and sediment loss. Grain size and carbonate content analyses, together with the microscopic examination were performed on beach sand sediment, collected in the supralittoral and intertidal zone along 7 profiles and on sand samples collected in the Bay at depths < 5 m. All sand fractions were microscopically examined. Pebble samples were used for thin sections preparation. Additionally, sediment was extracted from Posidonia banquette samples collected each month and subsequently analysed by the above-mentioned methods. Beach morphology was monitored along 7 profiles, while digital surface models were produced using aerial photographs.

Sakarun beach is a ~300 m long carbonate pebble beach, oriented to shore-normal Scirocco waves. Its carbonate bedrock is erodible and tectonically disturbed carbonate flysch, prone to mechanical weathering, forming thus elongated gravel beach body. Continuous exposure to Scirocco waves led to the development of highly indented Sakarun Bay associated with the Sakarun beach, which became famous for the sandy cover. Results of carbonate content analyses confirmed almost 100% of sand being marine origin (only minor part resulted from pebble chipping). Beach sand is of carbonate composition, formed by the accumulation of marine biogenous material, subsequently fragmented and well sorted by waves. The most common recognized skeletal remains belong to bivalves and gastropods, followed by foraminifera, serpulids, bryozoans and echinoids.

Sand is the dominant sediment population found within Posidonia banquettes, followed by fine

gravel. On average 64 kg/m^3 of sediment was extracted from banquettes. A rough estimation of the annual amount of sediment removed by Posiodnia banquette "cleaning" on the Sakarun beach led up to approx. 99 840 kg, that is ~37 m^3 of total carbonate sediment material loss from the beach. Following the known sedimentation rates in temperate carbonate depositional realms it is estimated that approximately 14 m^3 of new marine carbonate sand could be produced each year within the Sakarun Bay. Obtained results implied that continuous removal of sediment-loaded Posidonia banquette may cause a deficit in the beach sediment budget, the effects of which become visible with a several-year delay.

Furthermore, besides sediment accumulation, Posidonia banquettes cover mostly a sandy strip of the beach, thus protecting directly most erodible sediment population. In this way, sand erosion may be postponed or even reduced. Yet, stormy Scirocco episodes may cause complete short-term erosion of banquettes and sand, both re-deposited to some extent on the beach during the storm weakening.

Having in mind continuous man-caused sand erosion and current sea-level rise accompanied with higher storminess, Posidonia oceanica management practices (e.g. removal methods and their frequency) should be considered. Besides, beach re-branding is an additional option to avoid unrecoverable Posidonia banquettes removal.

REFERENCES: (MAX 4)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

Video monitoring and Convolutional Neural Networks for the assessment of extreme marine events on the rocky coasts of Maddalena Peninsula.

SESSION:

MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Coastal systems are characterized by energetic and mass balances which influence the physical and biological features on the coasts. Waves, currents, and tides define the energetic balance of the coastal system at different time scales, while marine and continental processes together with biogenic ones determine the sedimentary volumes for the mass balance. Changes in the energetic and mass balances determine different coastal landforms and sedimentary supply on the coasts, with annexed erosion/accretion phenomena. The global warming, the sea-level rise and the increase of extreme marine events, like the Mediterranean Hurricanes (Medicanes), can influence the energetic and mass balances [1]*. On the other hand, the impact of Medicanes determined significant coastal flooding and erosion, as happened in southeastern Sicily with Medicane Zorbas in 2018 and Medicane Qendresa in 2014* [2]*. For these reasons, the video monitoring represents an innovative tool for the acquisition of continuous data on the coasts in near-real time. In this work, the surveillance video records of Marine Protected Area of Plemmirio (Siracusa, southeastern Sicily), have been analyzed to assess the parameters of energetic balance on the rocky coasts (Fig. 1). The rocky coasts of Marine Protected Area of Plemmirio were surveyed through Terrestrial Laser Scanner for the topographic reconstruction, while a pressure sensor was installed to monitor the tide phases. The topography of the coasts was useful for the assessment of geometric elements recorded in the video frames. In particular, the video records allowed to obtain a series of continuous frames without direct monitoring by users, in which tide phases and wave impact are clearly observable. A convolutional neural network was trained in Matlab environment, developing a training set where it is possible to detect the tide phases, wave flow, and wave heights by video frames. Tide phases were assessed through classification and semantic segmentation techniques, while tracking and optical flow techniques were used to assess the wave flow and wave height impacting on the rocky coasts. Neural network results were compared with field data obtained from tide gauge and buoy of Catania. Furthermore, water level and wave height have been estimated through reference points obtained from topographic surveys in the proximity of video locations, so to improve the agreement between network results and field data (Fig. 2). An integration of tide phases, wave height and wave flow impacting allows to reconstruct the energetic balance on the coasts in order to predict the coastal changes in response of a given marine event. In this framework, the convolutional neural networks represent a suitable tool to automatically assess*

the energetic features of extreme marine events. The application of these techniques on the video records of Medicane Zorbas, occurred in southeastern Sicily, allowed to detect the energetic parameters of waves and to assess the storm surge that determined several meters of inland inundation. In a framework where the extreme marine events, like Medicanes, are becoming more intense in the Mediterranean than in the past decades, the convolutional neural networks can be a suitable tool for the assessment of energetic balances on the rocky coasts.

Fig. 1 – Rocky coasts surveyed in southeastern Sicily and monitored by webcams property of Marine Protected Area of Plemmirio.

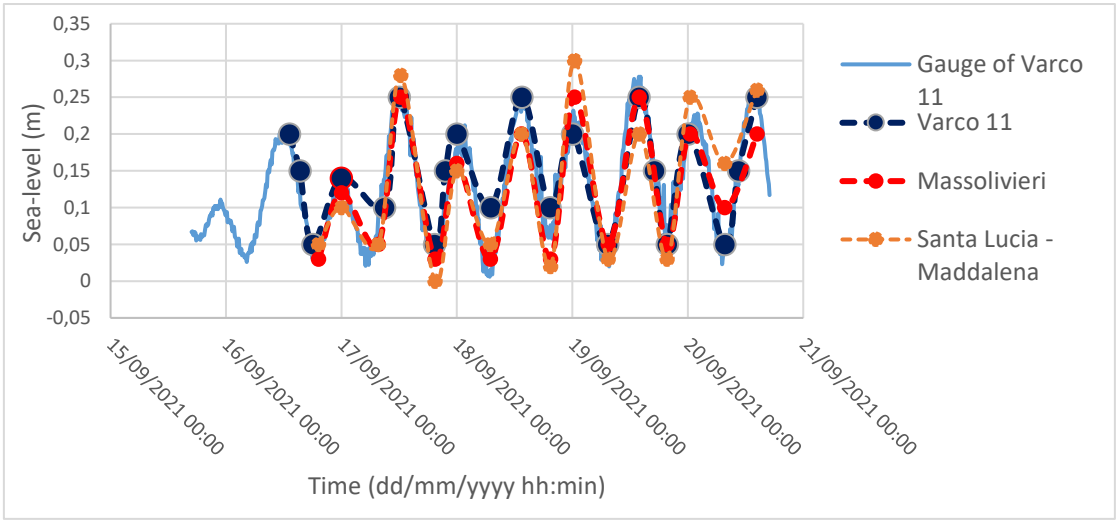

Fig. 2 – Tide phases measured on Varco 11 (green blue line) and tide phases assessed through convolutional neural networks on Varco 11 (dashed blue line), Massolivieri (dashed red line), Santa Lucia-Maddalena (dashed orange line).

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: IN-SITU RADIOMETRIC METHOD FOR MAPPING NATURAL GAMMA RADIATION FOR SEDIMENT DYNAMICS EVALUATION IN COASTAL AREAS

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Natural radioactivity measurements have been performing for radiological evaluation of ecosystems [1]. The natural radioactivity measurements can be treated and interpreted to estimate sediment dynamics in coastal areas, such as beaches and rivers mouths, as well. The natural radionuclides ^{226}Ra, ^{228}Ra and ^{40}K have been employing as tracers to study erosion and accumulation/accretion processes on sandy beaches [2]. The objective of present work was to use in situ radiometric measurement of beach sediments for sediment dynamics evaluation. The in-situ detection system KATERINA II [3], was employed to measure the natural gamma-ray radiation of sediments on two beaches in the region of Attica, Greece (Limani Passa and Legrena). The gamma-ray surveys were performed by mounting the spectrometer in a back pack enabling the mobile method to provide the gamma-ray spectra for a time lag of 20s. The measurement was done carrying the detection system around 90-100 cm above the surface and moving with a velocity of 0.5 m/s. The deliverable was to provide rapidly radiometric maps on beach sands for evaluation of sediment dynamical processes, such as erosion or accretion.

The spatial distribution of the total count rate (TCR) data at Limani Passa beach shows the alongside profiles (parallel with water line) are almost constant, which means that no apparent longshore sediment transport on the beach. Furthermore, there is a cross-shore TCR selection on the beach from waterline to dunes, with lower TCR near the waterline with a trend of increasing towards dunes while at both edges of the beach, there are areas of relatively higher TCR values, characteristic of fine sediment particles, probably indicating a slight erosion process on both sides. Another interpretation could be related to fine sediments transported by the streams during flooding (high precipitation) conditions.

The TCR spatial distribution on Legrena beach sediments exhibits relatively lower radioactivity, which could indicate slight coarser sand in Legrena beach compared to Limani Passa beach. TCRs in Legrena beach shows a slightly increasing trend from west to east direction that could indicate a slight decrease of sand particle grains from west to east or a different process of sediment movement. This trend may be attributed also to the construction of a small harbor at the west edge of Legrena beach and at the several rocky bars serving as a breakwater for the main

part of the beach. The Legrena beach as a whole could be seen as protected at half left side (west direction), where a small port and rocky bar protect the beach from wave action.
The in-situ radiometric measurement of beach sands provided interesting information about sediment dynamics in these two beaches. The total count rate (TCR) data showed changes and trends along the beaches that could be related with local and seasonal erosion and accretion processes. The TCR radiometric maps should be complemented and compared with spectrometric data of natural radionuclide concentration maps for validation of them. The spatio-temporal variation of TCR and natural radionuclide concentrations of Th-232, U-238 and/or K-40 in intertidal beach zone should be measured in different seasons of the year. Knowledge of coastal sedimentary properties is an essential tool in the sustainable coastal management, where radiometric method can contribute.

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POSTER PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: A COMPARISON BETWEEN TWO ANTHROPIZED COARSE-CLASTIC BEACHES IN THE MEDITERRANEAN AREA: MARINA DI PISA (ITALY) VS NICE (FRANCE)

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Clastic coasts are widespread worldwide, and the Mediterranean area makes no exception. Long, sandy beaches are common and in many countries are exploited as a primary source for the economy thanks to beach resorts attracting massive flows of people especially during the Summer. Many communities along the Mediterranean coasts rely on tourism revenues to survive. In this sense, global warming casting dark shadows about sea-level rise projections is a concern that cannot be neglected by nobody, in particular those living close to the coast. In such a scenario, coastal erosion effects must be dealt with even when they are limited to specific sectors. In fact, coastline retreats are way more serious when sea-level is rising. Many protection schemes have been implemented over the years, from hard approach systems such as breakwater and groins to softer interventions such as replenishments. As a rule of thumb, beach fills should be the first option for coastal managers, but fitting conditions for their durability are not often met. When erosion processes are not severe, the beach can be fed artificially to keep the coastline in equilibrium. The use of coarser sediments (gravel and pebbles) as refill may provide a higher level of efficacy because those grain-sizes are harder to be entrained and transported farther from the nourishment site (Buscombe and Masselink, 2006). Even though less common than the sandy counterpart, coarse-clastic beaches are frequent also in the Mediterranean area. Therefore, artificial replenishments made of coarse sediments have been increasingly used as a form of coastal protection: they not only prevent shoreline retreat, they also revive the usability of the beach for tourism purposes. Aside from the durability, coarse-clastic beaches showed two additional issues that were not entirely foreseen at the beginning: transport under low-energy conditions and mass loss. Pebbles are subject to intense movement even when wave motion is low (Grottoli et al., 2015), which leads to intense wear of the particles and ultimately to exceptional rates of mass loss (Bertoni et al., 2016).

For all these reasons further investigations about the physical processes on coarse-clastic beaches are crucial to protect natural environments as well as artificial sites. Many tracing experiments have been carried out at Marina di Pisa, Italy (Fig. 1a), where a series of pebble beaches were built in the last 15 years (e.g., Bertoni et al., 2013). However, such datasets are scarce from natural sites that are subject to frequent nourishments to make up for sediment losses. A recent experiment performed at Nice beach, France (Fig. 1b), provided interesting preliminary results, which allowed us to make a tentative comparison between the two situations. The experiment design was

identical for both sites: injection of pebbles marked by the RFID technology (Radio Frequency IDentification) along cross-shore transects and recovery after very short timespans (4 and 24 hours) under low-energy conditions. Topographic surveys were carried out concurrently to appreciate potential variations of beach morphology during the experiment. The recovery rates at Marina di Pisa were consistently high after both surveys: 92% after 4 hours and 85% after 24 (Bertoni et al., 2013). This is a major difference if compared to the rates recorded at Nice, especially after the first recovery: just 60% after 4 hours and 90% after 24. The reasons of such a different behavior can be explained observing the topographic evolution of beach morphology. Even though the wave energy was low during the Nice experiment, nonetheless the fair-weather berm was destroyed likely because of the rising tide. This process led to the displacement of many pebbles, which rolled down the beachface ending up burying several tracers. As the wave motion kept low during the night, the surficial layer of sediments was wiped off and many tracers surfaced back, leading to an excellent recovery rate of about 90%. Such a process was not observed at Marina di Pisa, where no topographic variations were recorded during the time of the experiment. The outcome of these investigations is essential to keep on gaining more information about the processes acting on coarse-clastic beaches: coastal management on such an environment may only benefit from increasing knowledge.

Fig. 1 - Pictures of the sites: the artificial pebble beach at Marina di Pisa, Italy (a); the natural, albeit nourished, pebble beach at Nice (France).

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
THE TAO PROJECT (TECHNOLOGIES FOR COASTAL MONITORING), STRATEGIES, OBJECTIVES AND FIRST RESULTS

SESSION:
MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The TAO Project (Technologies for coAstal mOnitoring) aims to develop innovative technologies for monitoring the coastal strip in the active beach area, i.e. between the maximum wave rise limit and the maximum interaction depth of the currents with the seabed, in order to investigate the dynamic mechanisms that cause coastal erosion and to evaluate the installation and functionality of the shore defense structures. The project purpose is to achieve a technological platform consisting of mobile and fixed monitoring stations, with low environmental impact and low cost, for the investigation of littoral and supra / sub-littoral areas, currently difficult to investigate with conventional techniques, accompanied by an instrumental park developed ad-hoc to create 3D models of the seabed and subsoil based on morpho-bathymetric and stratigraphic surveys. The geophysical investigations, integrated by taking samples of water and sediment, and by telemetry images of the shore line, constitute a monitoring system that shows great potential to improve the knowledge of these environments with strong anthropogenic pressure, and contribute to a better management of the entire coastal ecosystem.

Methods and tools

The main objective of TAO was the creation of an integrated technological platform and a protocol for the use and acquisition of multidisciplinary data by means of robotic systems (Stanghellini et al. 2020) which will allow to dynamically describe the evolution and the environmental state of coastal areas. The technological platform is based on the collection and integrated processing of data such as water quality, the study of the water-sediment interface and of the sub-surface, through acoustic and ultrasonic systems and innovative algorithms for acquisition, processing and interpretation of marine geophysical data (Gasperini and Stanghellini, 2009; Gasperini et al., 2020). An important aspect of the project was the integration of these geophysical methods with the monitoring of the coastline by means of cameras and image processing algorithms, and the formulation of procedures and methods for habitat-mapping based on the integration of biotic and abiotic data of the seabed.

The technological platform consists of an instrumented semi-submersible mobile vehicle, a new concept of a vehicle with variable attitude for autonomous movement for use in the coastal area. The instrumental park that constitutes the payload of the vehicle is made up of acoustic sensors for the study of the submerged environment, and in particular a morpho-bathymetric sensor integrated into the vehicle, a surface water sampler and a multi-purpose interface for sensors additional (chlorophyll and dissolved oxygen meters). The system architecture is completed by a series of video-monitoring stations for acquiring images of the shore line and sending them online. In its final stages, the project envisages the creation of a coastal dynamics forecasting system based on the optimization of a small-

scale hydro-morphodynamic model of the coastal nearshore.

First results

The TAO technological platform was tested in three sample areas of the Romagna Riviera: Lido di Dante, Riccione and the mouth of the Bevano River, diversified according to their natural characteristics, for the validation of the functionality and effectiveness of the instrumental park. The first data acquired include a series of morphostratigraphic surveys that allowed to formulate reconstructions on the temporal evolution of the seabed and of the processes (accretion/erosion) that affect the Lido Di Dante nearshore (Fig.1).

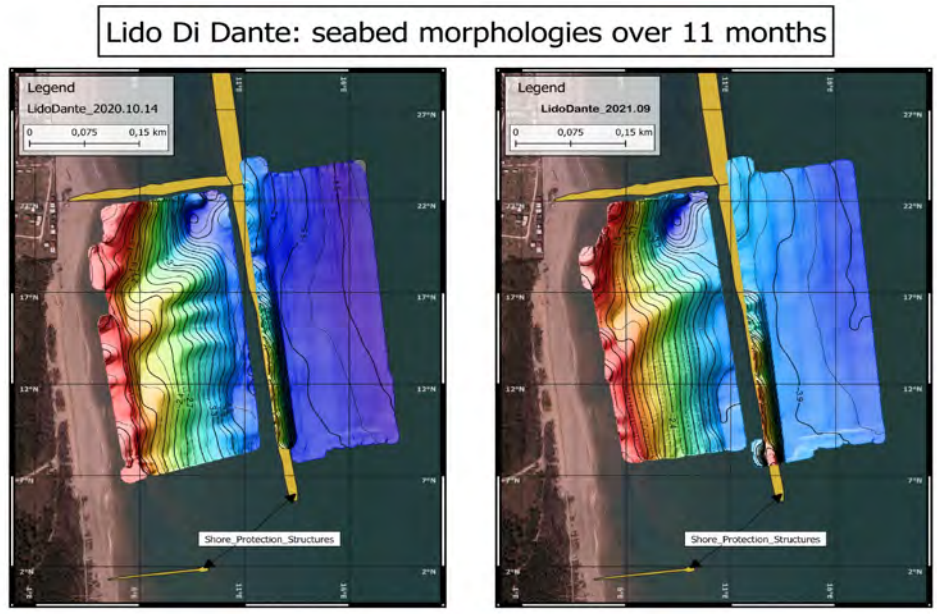

Figure 1 - Seabed morphologies created using data record acquired through the autonomous surface vehicle.

The most interesting feature of the acquired data is their accuracy and repeatability, which allow us to imagine a permanent monitoring system based on low-cost autonomous vehicles that will allow in the near future to implement observational networks at ever greater time scales, increasing the forecasting capacity and monitoring of natural phenomena, and making possible to evaluate the effectiveness of the strategies systems for risk mitigation.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **MONITORING THE PROTECTED COAST OF SOUTHERN CILENTO AS AN OPPORTUNITY FOR SUSTAINABLE MANAGEMENT**

SESSION: **MORFOLOGIA ED EVOLUZIONE DELLE COSTE E DEI FONDALI**

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ABSTRACT:
The coast of southern Cilento (Campania, Italy) is quite complex, even if the stretches with rocky cliffs jutting out into the sea (e.g. Capo Palinuro) prevail over those with beaches. The latter are set within not very pronounced promontories (e.g. Cala Bianca), or stretch out on no longer active cliffs (e.g. Cala del Cefalo beach), or even at the mouths of waterways (Lambro and Mingardo), which dissect this coast. There is also stretches of coast made "artificial" by harbour structures (Marina di Camerota, Marina di Pisciotta) or by works of defence against marine erosion, often of dubious effectiveness. In addition to the modelling of marine processes, more sensitive on low coasts, meteoric degradation acts on the high ones, which is also expressed through significant slope processes, such as landslides of different types and sizes.
The physical aspects of this coast have allowed the development of “Mediterranean” ecosystems for the most part still preserved, so as to enable the establishment of several Sites of Community Interest and Special Protection Areas. In particular, on the plunging cliffs of the promontory endemisms are recognized (e.g. Primula di Palinuro) or on the flared river valleys spontaneous formations of species are diffuse (e.g. hectares covered by Aleppo pines as Biotope of significant vegetational interest). Even in the seabed immediately close to the coast there are species of great ecological value such as Posidonia oceanica and bioconstructions formed by melobesias, madrepores, serpules, bryozoans, molluscs, etc. (Coralligenous habitats). The extreme richness of the underwater landscape of this coast allowed the establishment of the Marine Protected Area in 2009.
But this acknowledgement is not the last and not even the only one that this coast has had, in fact, it falls within the Cilento, Vallo di Diano and Alburni Park, as well as in the World Biosphere Reserve of the MAB (Man and Biosphere) program of the UNESCO. Furthermore, it has been included in the European and Global network of Geoparks of the same international organization due to the presence of an important geological heritage for its uniqueness and aesthetic appeal.

Beside these awards that bind the actions to be taken and underline the attention to be paid to protect and safeguard this territory, there is a great attractiveness of this coast for tourist activities. The pressure exerted especially in the summer on the coast becomes a threat to the integrity of this natural capital, so as to be able compromise the reception of tourists (beach erosion) and even the liveability of the residents (inaccessibility of coastal roads). This threat should include those situations deriving from the evolutionary trend of the beaches, from the natural hydro-geomorphological evolution of the slopes and from structural interventions on the territory. The consequences of these situations, in fact, could endanger public safety and/or the regular performance of production activities, therefore in order to prevent them it would be necessary to have in-depth knowledge of the entire stretch of coast.

This knowledge derived from observations carried out with the aid of direct and indirect methods both in the emerged and submerged portion of the coastal area was the opportunity in this area to respond to the highlighted critical issues. In fact, it was possible to create an integrated environmental monitoring plan, having to carry out projects to mitigate or restore the state of the coast, still in an environmental context of extreme value, protected under various aspects. The implementation of this plan, starting from the first phases dedicated to preliminary investigations, would make it possible to avoid stopping for any project or to lengthen its implementation times. Furthermore, such monitoring, managed at an institutional level, could overcome any emergencies, amplifying the opportunities for the territory and safeguarding its assets. These include the effective defence of the dune both for the existence of the beach and for the protection of the typical vegetation covering or the arrangement of the rocky cliffs projecting onto some stretches of beach with coatings of the same lithological nature or the enhancement of the meadows of Posidonia, including when they are beached on the seashore, lastly the protection of water quality. Definitely, this monitoring will allow, in addition to updated knowledge, targeted actions on the coast. In doing so, management will be more sustainable since it will combine respect for the environment and effective use of the territory.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
From coastline to backshore: a Geodatabase for the monitoring and analysis of the state of the Italian coasts

SESSION: **MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS**

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Knowledge of long-term dynamics, connected to the action of the sea, to anthropic activities and, more generally, to climate change, constitutes a fundamental element in coastal areas planning and management. In the past few years, the Italian National Centre for Coastal Defence (CN COS) of the Institute for Environmental Protection and Research (ISPRA) has been carrying out environmental monitoring and characterization of the coast and coastal dynamics at national level. As of today, the CN COS has gathered a range of information on the coastal strip (from the backshore to the shoreline) over a period of approximately 20 years (2000-2020). This study activity allowed to develop a Geodatabase containing the linear information on the characterization of the natural and artificial elements shaping the coast (LC) and the backshore (LR) as well as the areal elements representing the beaches, derived from photointerpretation of aerial and satellite images. The structure of the Geodatabase allows to perform many kinds of spatial analysis on the recorded geometrical elements, including also those imported from previous works, like the "historical" coastline obtained from the IGM1950 cartography, thus allowing to provide a periodic update, at national level, on the coastal dynamics and on the evolution of the coast line. As part of the update activities, high-resolution satellite images have been used, in order to characterize elements that in the past were difficult to interpret. Furthermore, the co-registration analysis made it possible to correct potential errors due to the

different georeferencing of the images. Consequently, it was possible to develop detailed analyses on coastal dynamics, applied to specific stretches of coast of particular interest to local communities.

The main objective of this work is, indeed, to highlight the potential of a continuously updated geodatabase over time in monitoring and analyzing the state of the coasts at a local level, through four case studies, following specific requests addressed to ISPRA by the stakeholders: coastal dynamics in Calabria, in the municipalities of Zambrone (Vibo Valentia) and San Lorenzo (Reggio Calabria) and in the stretch between Crotone and Le Castella (Crotone); coastal dynamics in Tuscany between Le Rocchette and Castiglione della Pescaia (Grosseto).

Specifically, the temporal variations of the coastline have been analyzed, in terms of advancement, stability and erosion, of the whole Physiographic Units to which the study areas belong, in order to obtain evolutionary trends.

The methodological approach developed and tested over the case studies resulted in a “tool” that the stakeholders can use to query the LC data, to obtain information about the coastal dynamics in the area of interest. In this context, guidelines to the access and use of the information contained in the Geodatabase, have been compiled, in order to facilitate the user of the “Linea di Costa ISPRA” tool.

In conclusion, the constant updating of the geodatabase through the analysis and photointerpretation of increasingly high resolution images allowed to define a new standard for the characterization of the coastal strip, with the possibility to build user-friendly analysis tools for the benefit of the scientific community and stakeholders at any administrative level.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

Coastal erosion: causes, methodologies and possible solutions.

SESSION:
Morphology and evolution of coasts and sea beds.

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives:
For a long time there has been discussion in the scientific field on the phenomena of hydrogeological instability, which in Italy manifest themselves with impetuous and rapid events, with a catastrophic trend, drawing the attention of institutions, politicians, scientists, technicians and the public. Hydrogeological instability is a powerful landscape modifier.
In their present virulent form, phenomena such as landslides, floods, coastal erosion have been defined as a disease of civilization, because it is the civilization of man, or better still, technological progress, which has accelerated the slow course of natural phenomena. in an overwhelming and concerning way.
Before planning and implementing interventions, it would be desirable to carry out an in-depth analysis of the territory for the purposes of forecasting, preventing and mitigating hydrogeological risk that also takes into account biodiversity, geodiversity and constantly evolving natural processes, foreseeing the consequent effects on the landscape.
In the last 50 years, in Italy, the dissipation of primary resources and the incorrect use of the land determined a widespread degradation amplifying the effects of destructive phenomena of natural origin such as floods, landslides and coastal erosion. The incidence and frequency of some of such phenomena is also increasing all over the world.
Often the causes of the such increase of the degradation and the consequent damage are to be found in current models of development that amplify the vulnerability of settlements through unsuitable forms of settlement and organizational dysfunctions.
The objective of the proposed intervention is the identification of territorial vulnerability factors, or those factors, of anthropogenic origin, which contribute to increase the degree of risk in the area.
In detail, the erosion of the coast is the direct and indirect result of the alterations in the sediment cycle caused by natural and anthropogenic factors.
Natural factors, causing erosion, play a significantly predominant role, especially in the long term, and the most influential ones are winds and storms, currents near beaches, sea level rise, soil subsidence and the liquid and solid contribution of rivers to the sea.
Anthropogenic factors (induced by human activity) include: the use of the coastal strip with the construction of infrastructures and works for residential, industrial and recreational settlements; land use and alteration of vegetation;

water extraction from the subsoil; cleaning the beach with mechanical or heavy equipments; the undermining and destruction of the dune; the regulation of waterways, both for the defense of the soil or for the withdrawal of the same water resource for drinking, irrigation and industrial use and the extraction of aggregates from rivers to be used in construction.
The anthropic actions destabilize the complicated and delicate balances that preside over the constitution of the beaches and their evolution.

In Italy of the 3.950 km of beaches, about 50% are in erosion and, in particular, in Lazio, of the 290 km of coastline, the beaches occupy about 220 km and 20% of them are at risk of erosion, especially those areas in proximity the mouth of the Tiber (Ostia and Fiumicino) and the coastal dune of Circeo. The environmental protection, over time, have been carried out for about 35% of the coast.
The proposed study that is exhibited analyzes the evolution of the coast with particular attention to the withdrawal of the shore line along the Roman coast, specifically on the coastal stretch that goes from Ostia to Fregene.
The conclusions highlight that the environmental protection implemented to date have not contributed in solving the problem of coastal erosion and propose, among other things, possible innovative solutions (e.g. mathematical modeling for the coast evolution and for the evaluation of interventions, environmental protection and maintenance innovative interventions on beaches).
The assessment of the erosive anthropic factors, the analysis and the feasibility of the proposals can be replicated in similar contexts.

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1. **Dr. ILARIA FALCONI**

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: **CASE STUDY OF THE LAVA FLOWS EFFECTS ON THE COAST AND SEABED (LA PALMA ISLAND) AND ITS IMPLICATIONS FOR IMPROVING EARLY WARNING SYSTEMS TO APPLY IN THE MEDITERRANEAN VOLCANIC ISLANDS MONITORING**

SESSION: **MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS** *(HAZARD AND COASTAL MANAGEMENT) – POSTER SESSION-*

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

During September 2021, earthquakes began to be recorded in the Canary Islands that could be associated with a submarine volcanic episode and, therefore, have a high direct or indirect impact on maritime safety. In this archipelago, the only region of the national territory affected by submarine volcanic risk at present, the submarine seismic activity is dispersed but has been concentrated in greater number between the islands of Tenerife and Gran Canaria and occasionally in the surroundings of the islands of Tenerife, El Hierro and La Palma. From September 11 onwards, a major seismic swarm took place on the island of La Palma, which has been associated with a subsequent eruption in the terrestrial zone that began a week later, and which continues at present (December-2021). The lava flows produced were sliding across the land surface of the island until they reached the coastline and accumulated to form a marine lava delta. During these days, an oceanographic cruise was carried out on board the research vessels Ramón Margalef and Angeles Alvariño, both from the Spanish Institute of Oceanography, to carry out an exhaustive multidisciplinary oceanographic study of the south-west area of the island of La Palma with special attention to the analysis of the morphological changes in the seabed and coastline, as well as to the possible outflow of gases of volcanic or hydrothermal origin, in addition to studying the effects of the lava flows on the morphology of the seabed. The presence of physicochemical and biological anomalies in the water column with possible effects on the marine ecosystem was also studied.

Firstly, using multibeam echosounders, very high resolution mapping was carried out to identify and characterize structures associated with active processes, analyze the morphology terrain deformation and the evolution and submarine advance of the lava. Secondly, a study of the physical-chemical properties of the water was carried out to detect anomalies and the possible existence of hydrothermal or magmatic flows.
A complete mapping and characterization of the seabed in the western part of the island of La Palma before and after the arrival of the lava was carried out, mapping about 24,000 hectares in different areas and obtaining samples of the seabed with rock dredges. Coral samples were obtained and will be analyzed to determine the presence of magmatic helium fixed in the coral skeletons during the eruption, as these are a precursor indicator of a volcanic eruption.

In addition, about 3000 seawater samples have been taken, representing more than 500 liters, collected from the surface to 1200 meters deep and, some of them, a few meters from the lava flow thanks to the use of drones piloted by the SeaDrone team of the Institute of Marine Sciences of Andalusia (ICMAN-CSIC), which have also allowed to analyze the surface temperature of the water around the lava delta thanks to a thermal camera. The study will be completed in more detail in the laboratories of the IEO-CSIC, where the following variables, among others, are being analyzed: salinity, dissolved oxygen, turbidity, photosynthetic pigments, pH, existence of reduced species, carbon dioxide system, heavy metals, methane, nitrous oxide, ash concentration, as well as the abundance and diversity of the different compartments of marine plankton. These chemical and microbiological analyses of the samples collected both from the ship and with the drones will allow the study of the plankton microorganisms located at the base of the trophic chain, which respond quickly to disturbances and, therefore, are sentinel bioindicators to monitor alterations of the good environmental status of the marine ecosystem.

The high-resolution mapping obtained then, together with the detailed characterization of the physico-chemical parameters of the water and seabed, will now make it possible to compare the results and detect very accurately changes in the morphology of the terrain and anomalies in the properties of the water.
This study, which has been a great milestone for science by having the opportunity to study in real time the arrival of a lava flow to the sea and the modification of the coast and seabed it generates, in addition to the effects on the marine ecosystem itself, will provide additional information on the development of the eruptive episode on the island of La Palma, allowing a more complete picture of the functioning of the volcanic system. The generation of this scientific knowledge will contribute to improve predictive and early warning systems that will help minimize the impact of these natural phenomena on populations and infrastructure that could be apply in the Mediterranean volcanic areas monitoring. In the Mediterranean Sea there are groups of islands of volcanic origin, whose study is often complex due to the geological age of the events and their monitoring. Therefore, the expertise generated in this context can be essential to help decision-making and improve early warning systems for motorization and emergency management.

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Title: DROWNED COASTLINES: CAN WE RESTORE THE DAMAGE OF GLOBAL WARMING?

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT:

The archetypal and primeval human settlements are mostly coastal, and especially estuarial, as the abundance of life and prosperity that ensues the mix of salt and freshwater, forms the basis not only of access to inland regions from the coast for trade, but also a bounty of life that encompasses the concoction of the sea and riverine domain. Thus, the coast is a very important region whose stability is paramount for the prosperity of human societies. Regrettably, trade itself has degraded coastal areas, as the major element of trade, a port, in order to be established, in essence pertains to the destruction of the coastal environment. There is no other way that a vessel can access the coast and its cargo to be serviced – the natural environment must be sacrificed. Yet, one would wish this was the only issue with reference to the coastal equilibrium and human intervention.

Recent research underlines the occurring problem of global climate change and of the ensuing alarming temperature rise. The excessive and predominant use of fossil fuels and their emissions gives rise not only to health concerns at the source of the emissions, but also to the issue of global warming, a long-term infringement in global weather patterns, systems, and dynamics. Global warming has impacted meteorological conditions, glaciers, sea ice, and is thereby linked to rising sea levels, that in turn impact our coasts. Science can study the morphology of not only coastlines, but fossils and most every single particulate time has left behind so one can have a solid understanding of how temperature should respond and thus be regulated so that the globe is healthy. The news is alarming. Rising temperature signifies that fact that the globe may not be sustainable and all because of human activities.

Evolution is part of the physical continuity of planet earth. What is abnormal is the fact that humans have been able to break and threaten the natural circle of landmarks of global continuity, such as the Ice age, a naturally reoccurring phenomenon with a period of nearly every 40,000 years that now due to global warming, will be delayed for hundreds of thousands of years. Mankind accelerates global warming, disrupting global weather systems and their externalities, such as El Niño events. Those changes as small as they might seem, can result to thousands of species rendered extinct. Effects to biodiversity, or biodiversity loss may sound like something innocuous, until we realize that reduction in biodiversity means death. And even the most miniscule weather pattern system and phenomenon can affect life. Glaciers are sensitive to rapid temperature changes and thus dissolve, break, and melt. Melting glaciers signal upcoming sea level rise and species' extinction, as ice itself is home and shelter to a plethora of plants and animals. In addition, as mentioned, most human settlements are coastal. Just to give an example, many Mediterranean cities are built near or on the coastline. Even minor rise in sea levels can flood cities, drown coasts, and destroy ecosystems.

Despite the challenges, proactive measures are a solution to address and prevent the issue of drowning coasts. Destroying something of sacred value such as our collective home proves insanely easy, yet fixing it on the other hand, is almost impossible, as many of the processes that humanity has brought upon the environment are irreversible. This research, through the critical and structured review of literature, provides a topology of strategies that have been deemed effective for mitigating the issue of submergent coasts that will hopefully guide policy decisions towards effectively mitigating the problem.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Evolution of the surface roughness of a coarse sand after a beach nourishment

SESSION:
MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT :

Beach nourishment is a common process when the coastline suffers a continuous process of erosion [3]. Since natural materials, mainly fine sands, are scarce, nourishment is currently conducted with coarse sands from quarries. The addition of new sediment (different to original ones) to beaches requires a sound understanding of form–process to achieve the desired response of morphodynamic systems [1]. Due to these, it is important to investigate the evolution over time of the borrow sand [4]. This work analyzes how the surface roughness of sand particles evolves one and a half years beach nourishment.

The sand samples were collected from the swash of the center of Los Locos beach (Torrevieja, Spain). This beach was nourished in January 2020 with coarse sand from a quarry. Sampling was performed between the 15th-20th of each month. Due to the Covid-19 pandemic and the mobility restrictions it caused, samples could not be collected between March and August 2020. Once the samples were collected, they were taken to the laboratory where they were washed and granulometry was performed. From each sample and sieve (1.60 mm, 1.25 mm and 1.00 mm as they retained the highest percentage of sample) 108 particles were photographed with a microscope with a wide resolution and a magnification of at least 50x.

The subsequent image processing (texture measures) and statistical treatment were performed using ImageJ. In ImageJ, this is accomplished using Julio Cabrera's plugin GLCM (gray level coocurrence matrix) Texture Analyzer [2]. The distance – offset – between two pixels was established on 1 (size of the step) and their spatial relationship was calculated for direction of the step of 0, 90, 180 and 270 degree angle). The output were angular second moment (known also as energy), contrast, correlation, inverse difference moment and entropy. Finally, the average for 0, 90, 180 and 270 were conducted.

The results show that contrast and entropy are the parameters that show the greatest relationship with particle surface roughness. The rest of the parameters, although they show a certain variability throughout the sampling, do not seem to have any relationship with the surface roughness. Figure 1 shows that entropy and contrast decrease with time. Some increase in values is observed (March 2021) which is related to sediment and wave movement. Large storms take a large amount of sediment from the backside of the beach renewing the sediment in the swash zone.

Figure 2 shows the particles with the highest and lowest contrast (C) and entropy (E). Particles with higher values of contrast and entropy have a high surface roughness, while those with lower values are smoother. Finally, both parameters have been interrelated by subtracting contrast and entropy (C-E), and it is observed that the smallest value of this relationship shows the highest smoothness of the particle surface.

A significant increase in surface roughness is observed with the passage of time. It is observed that in a year and a half the particles found in the swash zone reach a significant surface smoothness. It should be taken into account that there is an important period of absence of samples due to Covid, during which important storms occurred, so perhaps the fact that during the first year no significant variability in surface roughness is observed may be due to the movement of the sediment by the waves. However, it can be assured that in approximately 1.5 years the quarry particles are smoothed reaching values similar to those that can be found in a natural beach.

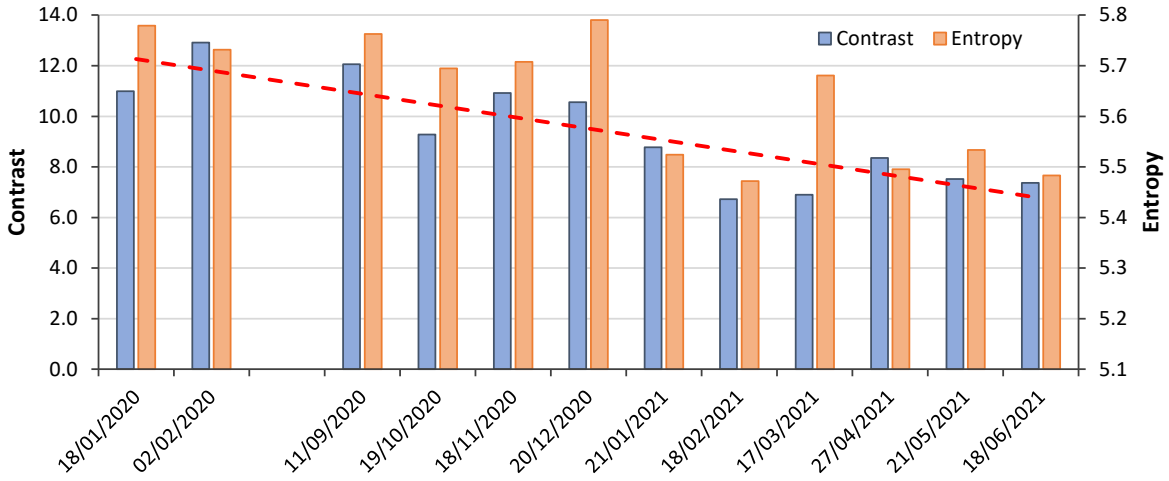

Fig. 1. Evolution of contrast and entropy since beach nourishment.

Fig. 2. a) Particles dumped on the beach in January 2020. b) Particles of a natural beach (Playa del Triador, Castellón, Spain). c-f) Particles with the maximum and minimum values of contrast (C), entropy (E) and contrast-entropy (C-E).

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
USE OF RPAS TO MONITOR COASTAL DUNE SYSTEMS AND BEACH EROSION IN GUARDAMAR DEL SEGURA, SPAIN.

SESSION:
MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):
Coastal dune ecosystems had a crucial role in coastal dynamics, so it is essential to measure their movements with high precision and monitor their changes over time. The natural interactions can be altered by anthropic actions, modifying the coastal dynamics, causing alterations in beaches and dunes and affecting their stability [1]. In recent years, the appearance of affordable low take-off weight Remotely Piloted Aircraft System (RPAS), together with the development of image-based computing techniques such as structure-from-motion (SfM), has increased the use of RPAS-based photogrammetry to produce high-resolution digital elevation models (DEMs) for the study of different surface processes [2], and specifically, for surveying dune ecosystems [3]. The aim of this study is to monitor the coastal dunes of Guardamar del Segura (Spain) and analyse their relationship with coastal erosion. Three flight campaigns were already done in June 2017, November 2020 and May 2021, and two more are expected to be carried out in November 2021 and May 2022.
The methodology applied was developed by [4]. The RPAS used was a DJI Phantom 4 quadcopter, valued at 1500€. This device was equipped with a FC330 built-in camera and a 1/2.3" CMOS sensor with a resolution of 12.4 Mpix. The flight altitude was set at 60 m above ground level, taking a picture every 2–4 s. The latitudinal overlap was set to 70%, and the longitudinal overlap was fixed to 80%. The flights were planned so that the study area, 1.68 km long and 200 m wide (33.6 ha), was covered in 2 passes, with approximately 600 images per campaign taken (Fig 1).

Fig 1. Camera position with image overlapping (a) and detail with thumbnails.

A series of targets distributed throughout the study area were used as ground control points (GCP) for the photogrammetric georeferencing process. Its coordinates were surveyed by a Leica Zeno FLX100 GNSS. This device was linked to the GNSS ERVA reference station network via GPRS/3G connection, using RTK with the NTRIP-based network solution to obtain the coordinates in UTM ETRS89 H30N (EPSG 25830). The accuracy obtained was 2 cm horizontal and 3 cm vertical. A total of 25 GCP were surveyed in each campaign.

The SfM algorithm enables the reconstruction of a 3D scene by resolving the geometry of the images, the camera positions and their orientation simultaneously using Agisoft Methashape software. The GCP surveyed by GNSS improves the model reconstruction results. Once the accuracy is satisfactory, a reconstruction processing algorithm is applied to generate the dense point cloud with RGB colors (Fig 2C). By means of the calculus of the confidence parameter, the noisy areas of the dense cloud (e.g. the sea) can be deleted prior to generating a full DEM with a spatial resolution of 5 cm/pixel and a point density of 450 point/m^2 (Fig 2B). This DEM was used to create an orthomosaic of the entire monitored area with a resolution of 5 cm/pixel (Fig 2A). This high point density allows the dune shapes to be modeled with great accuracy (Fig 2C). The errors obtained were < 1.5 cm in Z and < 3 cm in XY.

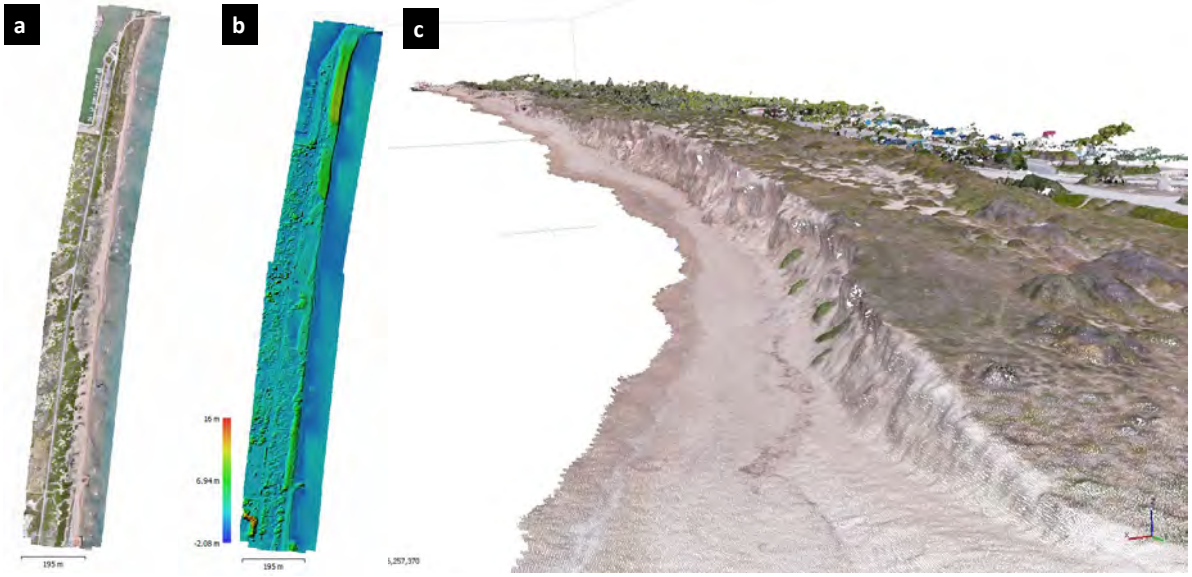

Fig 2. Orthomosaic (a) DEM (b) and detail of the dense point cloud.

Overall processing time using a Dell WorkStation with an Intel Xeon W2123 at 3.6 GHz, 16GB of RAM and a GPU Nvidia Quadro P2000 was, on average, less than 3 hours per campaign.

In the case of the study area, the comparison of the different DEMs obtained in each flight campaign, as well as with other public available DEMs derived from LiDAR sources shows that the loss of the beach berm has affected the dune, increasing its erosion. In a section of the beach, the shoreline has moved backward 15 m between 2017 and 2021, causing that during the storms the waves erode the dune. A displacement landward of the dune toe of 8 m was detected. This erosion causes an increment in the slope of the dune, increasing the risk of small landslides that can affect beach users, so it is necessary to monitor their evolution frequently.

In conclusion, despite the existing minor drawbacks, the advantages of RPAS surveys combined with SfM methodology are relevant: the time-saving processing and the fact that it is a consistent, high-precision method that enables modelling and monitoring rapid-changing environments, such as beach-dune systems, at considerably lower costs than others survey technologies.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: SOURCE TO SINK SEDIMENT BUDGET ALONG THE ALGERIAN COASTLINE

SESSION: MORPHOLOGY AND EVOLUTION OF COASTLINES AND SEABEDS

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The question of sediment supplies from fluvial systems to the coast, and more specifically, supplies capable of building up and maintaining beaches is a fundamental element of the integrated management of the river catchment-to-coastal cell continuum. While numerous studies have highlighted the role of dams in the blocking of river sediment supply, and the ensuing coastal erosion in the Mediterranean, the importance and quantification of these processes are still rather limited for the relatively arid North African Maghreb Mediterranean region, where numerous dams of various sizes and of variable longevity, have been erected across rivers to cater for the provision of water supplies for consumption, irrigation and hydropower in the context of rapid economic development. Despite the aridity of the climate, and the flash-flood functional dynamics of many of the rivers on these southern margins of the Mediterranean, the wadis and more permanent rivers have been important in providing sediments for the formation of deltas, beaches and dunes under various configurations of longshore sediment transport. Over the last century, anthropogenic modifications of the coast, notably in conjunction with the development of ports and harbours, have further affected coastal stability, generating intricate links with the supply and redistribution of fluvial sediment. We investigated the sedimentary link between the river catchments and coastal sediment cells associated with the mouths of some of the main rivers in the Algeri (Cheliff, Isser, Sebaou, Soummam, El Kebir, Seybousse). In the common absence of measured data on river fluxes, we resorted to theoretical quantifications based on existing algorithms. We then confronted changes in sediment flux in the course of the 20th century with coastal mobility identified from comparisons of ancient maps, aerial photographs and satellite images. We evidence a phase of progradation of the river mouths in the course of the first half of the 20th century, indicating healthy systems that supplied river sediments to adjoining coasts, followed by a phase of large-scale and rampant retreat that we attribute to the inception of river sediment by the construction of dams, although we note that the dates of construction of these dams do not coincide with those of aerial photographs, the most common source of data on shoreline change. The link between river-mouth retreat and the adjacent coasts thus clearly highlights the impact of declining fluvial sediment supplies that affect entire sediment cells. The interplay of river sediment supply and coastal stability has been

further affected by the impact of the various port and harbour constructions. The last two decades have been particularly characterized by exacerbated negative coastal sediment budgets that now prevail in virtually all the sediment cells. In a context of climate change and aggravated deficits in fluvial sediment supply to the coast, the sediment budgets and morphological stability of the coastal cells associated with these rivers are in peril. This negative situation will call for important, and unfortunately costly, adaptation strategies of coastal human occupancy.

REFERENCES: (MAX 4)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

Geomorphological approaches to study *Posidonia* banquettes and their effects on the coastal front of Schinias - Marathon National Park

SESSION:

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT:

Coastal environments and in particular beaches, are valuable natural assets, offering a wide array of ecosystem services and economic benefits. In this study UAV technology with RTK-GPS is used in order to map in detail, the beach morphological characteristics (Carvalho et al., 2020;), and the impact of Posidonia oceanica banquettes (Simeone et al., 2012) in Schinias Marathon National Park, Attiki, Greece. The principal aim of this research was to evaluate the relation between banquettes and sediments, therefore the overall role of banquettes in beach formation and protection. Field data were collected with a view to: a) identifying spatiotemporal changes in volume, shape and area covered by the banquettes, and b) analyzing relations between banquette deposition and sedimentary budget components and changes. Due to the smoothness of the terrain (a low-elevation beach front) the flights were horizontal parallel to the ground at a certain height AGL (Above Ground Level). The use of GCPs surveyed by RTK-GPS enhanced the accuracy of the results into cm level (*Papakonstantinou et al., 2016). Data were subsequently interpreted through Pix4D mapper v.4.5.6. to produce the Orthomosaics, the Digital Surface Models (DSM) and the Digital Terrain Models (DTM), based on which the banquette volume, height and surface area were determined.*

Sediment samples were collected during the photogrammetry missions (July 2020, September 2020, February 2021, June 2021). Sediments samples were acquired from the shoreline and the coastline area of the banquettes, along transects spaced approximately 50 m apart each other. All granulometric analyses were conducted at the Bio-Geo-Chemical Laboratory (ISO 17025) of HCMR, and results were statistically interpreted.

During Mission 1 (July 2020) the area covered by banquettes was approximately 2292.5 m^2 but the lack of RTK-GPS at that particular time did not permit further calculations. During Mission 2 (September 2020) the banquette covered an area of 2617.43 m^2 with an estimated volume of 692.57 ± 82.29 m^3. In Mission 3 (February 2021) the banquette was split in two parts covering 11468.49 m^2 in total (maximum area covered by the banquette in this research) with a volume of 2491.59 m^3 in total (volume 1: 2088.18 ± 403.41m^3 and volume 2: 329.34 ± 43.04m^3). Based on the granulometry analysis of two randomly selected banquette samples, two rough estimates of the amount of sediments entrapped in the deposits were calculated: (a) ~161.17 ±2.76 m^3 and (b) ~1692.26 ±312.52 m^3. During Mission 4 (June 2021), the banquette covered a total area of 4,674.7 m^2 split into three distinctive parts presenting volumes of a) 784.13±125.95 m^3, b) 281.25±29.19m^3) and c) 202.65±28.76 m^3.

Additionally, shoreline displacement over time was studied based on the use of remote sensing data covering a period of 76 years (1945 – 2021). Geoinformatics methodologies were used to highlight the evolution of the coastline throughout the selected time period. In particular, a comparison of digitized coastlines, which were extracted from the respective orthophotomosaics and images created (one for each time period), was conducted (Tsokos et al., 2018). Historical high-resolution analog aerial photographs (1945, 1960, 1969, 1988, 1996, 2001 and 2010), recent high-resolution digital satellite imagery (2012, 2014, 2018) as well as orthophotomosaic from photographs (taken in 2021) obtained using Unmanned Aerial Vehicle (UAV) were collected, for the detailed extraction of the exact location of the shoreline for each time period. Shoreline differences between 1945 and 2021 in the study site, reveal a loss of land surface. It becomes evident that our study site presents an ongoing coastline setback from 1945 until recent years, mainly due to the operation of the Marathon Dam (1929) causing high coastal erosion rates for the next 40 years. The setback rate is not constant for the entire dataset. It was particularly high between 1945 - 1969, then decreased between 1969 - 2021. The maximum setback value was -0.39 m / yr and the minimum -0.12 m / yr. The largest coastline changes (25 - 30 m) are recorded at the easternmost end of Schinias beach. Further analysis of shoreline displacements shows that the sedimentary equilibrium of this coast has probably been gradually restored within the last twenty years. Within 1996 - 2001, advance of the coastline is first observed, then alternating with periods of setback until 2010. Within 2010 - 2018, shoreline advance becomes more frequent (while again alternating with periods of regression). Across the study site, a rather remarkable shoreline accretion is observed for the latest period (2018 - 2021). This, is a rather interesting finding, possibly related with the extensive Posidonia banquettes that have accumulated here, following the no removal strategy adopted by the Management Body of Schinias - Marathon Protected Area, since 2018. Thus, the presence of the banquette on a beach mitigates the erosion processes, can contribute to the sediment budget, affect positively the shoreline displacement and it can dimmish the negative effects from a storm event. Therefore, the decisions of the extraction or not of such a formation must be taken under serious consideration. Management policies should be established if absent or to be updated concerning distinctive circumstances in order to avoid the erosion of the sediments, which will lead to shoreline retreat and therefore to economic losses and environmental degradation.

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SESSION

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

ORAL PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

Beach macro-litter monitoring on Monastir coastal sea (Tunisia): First Findings

SESSION:

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Marine litter is a growing environmental problem worldwide. It is threatening marine and coastal wildlife as well as causing loss of coastline aesthetic quality. It has a negative impact on the economy and on health (Thushari and Senevirathna 2020). Tunisian Mediterranean coast is characterized by a rich diversity of natural, environmental, cultural and economic resources. Monastir city is considered as one of the most important commercial capital in Tunisia. During the last decades, it has reported an increase in urban density and industrial activities (textile, agri-business industry, fishing activity offshore fish farm, etc.). Otherwise, the progression of the COVID-19 pandemic has created an upsurge in demand for plastic both for frontline healthcare workers and the general public. Therefore, the quality of coasts has deteriorated substantially over the last few years because of marine litter accumulation. For that reason, Monastir was selected by the COMMON (COastal Management and MOnitoring Network) project among the five pilot coastal areas for applying Integrated Coast Zone Management as a tool to tackle marine litter. The aim of this study is to:

1. Provide information on the types, quantities, and distribution of marine debris.
2. Provide an insight into problems and threats associated with an area.
3. Identify source of marine debris.
4. Increase public awareness of the condition of the coastline.

The waste monitoring activities was investigated on three beaches (Palmier, Marina, Karaia) and on Kuriat Island during four seasons (Winter, Spring, Summer and Autumn). The sampling activities carried out based on specific protocols common to the partnership and used in all the pilot areas involved in the project (IPA-Adriatic DeFishGear, 2014). To understand the situation about marine macro-litter on Monastir beaches and to compare the four beaches we have calculated the Clean Coast Index according to Alkalay et al. (2007).

The highest abundance and density of macro litter were recorded at the Marina and Karaia beaches with respectively 7447 and 6842 items belonging to 12 categories of debris types, during the spring season. These two beaches were classified as extremely dirty considering the clean coast index (CCI). Kuriat Island beach was ranked in moderate category with an index value of 5,5 during the summer period.

Plastic items corresponded to the larger part of the collected debris for all seasons and in all beaches varying between 69% and 89% of total items. Analyzing the marine litter, it has emerged that plastic fragments, cigarette butts and filters and crisps packets and sweets wrappers are the most frequent type of debris.

The first findings have shown that the pollution state of the studied beaches is alarming with a dominance of plastic

litters. One way to reduce plastic pollution is to increase the knowledge and understanding of plastic pollution among people. Therefore we recommend the intervention of all stakeholders to apply the Integrated Coastal Zone Management to reduce plastic pollution along the Monastir Touristic Coasts.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
TRIESTE, BACK TO THE SEA. DESIGNING SUSTAINABILITY AND DEVELOPMENT OF LOGISTICS AND INDUSTRIAL PORT AREAS AFTER THE PANDEMIC.

SESSION:
GEOGRAFIA E PAESAGGIO E DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Foreword

On 30 January 2014, the Accordo di Programma for the "Riqualificazione delle attività industriali e portuali e del recupero ambientale nell'area di crisi industriale complessa di Trieste" was signed.
The significance of this initiative - in addition to its specific contents - lies in the fact that it was the first application of the procedure contained in art. 252-bis "Siti inquinati nazionali di preminente interesse pubblico per la riconversione industriale" of the Codice dell'Ambiente (environmental Code).

A complex procedure that saw, among others, the Minister of the Environment and Protection of Land and Sea and the Minister of Economic Development, with the Minister of Labour and Social Policies, in agreement with the Friuli Venezia Giulia Region and the Port Authority of Trieste, enter into an agreement with the Arvedi Group, concessionaire of a large industrial area of over 270,000 sqm contaminated within the Port of Trieste

The aim was to implement an integrated project of safety, industrial reconversion and economic development in a Polluted Site of National Interest (SIN) in order to reuse these areas in conditions of health and environmental safety.

A renewed plan

Six years later, the aims of the agreement have been achieved, and in June 2020 a new document was signed to give impetus to further transformations in terms of development and sustainability for a total of EUR 100 million.

The so-called hot area with the old blast furnaces will make way for the expansion of the logistics activities of the Port of Trieste. The new cold rolling mill built in 2015, the core of the previous industrial reconversion project, will be doubled.

FIG. 01 - the hot area of the Servola ironworks undergoing demolition (author's photo, April 2021)

The new plant will provide an ambitious response in terms of eco-sustainable production, aiming at the complete decarbonisation of the steelworks site. Energy will be produced by a hydrogen plant, which in turn will be powered by the photovoltaic roof of the new 95,000 m2 building.

Adriagateway

Added to this scenario is the Port Authority's project: Adriagateway. A strategic project of coordinated investments for the logistic/industrial relaunch of the port system of the Eastern Adriatic Sea in a perspective of green and digital transition (2020-2026).

The Adriagateway Project, developed during the summer of 2020, defined a system of 57 potential actions (project components) to be implemented in the Port System, divided into 6 macro-categories and financed for 385 million Euros by the National Plan for Recovery and Resilience. For example, the electrification of the docks (cold ironing), which will reduce the impact of the generators of moored ships, which remain active during loading and unloading operations, as well as the strengthening of railway logistics, considered in terms of greater sustainability.

FIG.02 - Summary graph of the "Adriagateway Project" (AdSP MAO, September 2020).

Industrial innovation, logistical implementation, environmental and landscape requirements, social protection and job opportunities, quality of life, ecological transition, are overlapping themes that outline a complex interdisciplinary scenario.

Bringing industry back to the sea is a formula that has a precise and extensive strategic and planning significance. Today, logistics chains are getting shorter. This is a contraction of the excesses of globalisation. The pandemic in 2020 and the blocking of Suez in the spring of 2021 have demonstrated the need to create regional buffers capable of absorbing interruptions in the distribution of goods and processing them while also creating added value. The case of the Port of Trieste can be a model to be studied to understand how to effectively govern these transformations.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: " Monitoring of the evolution of "barene" borders and the safeguard of the Venice Lagoon morphology: a contribution from the Coastal Change from Space project results "

SESSION:
Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Abstract (min 3000 max 5000 characters):
General frameworks and Objectives :

Since time immemorial, the beauty and the life itself of Venice has been linked to the balance that the city could build-up and maintain with the lagoon environment it inhabits.
For more than a century this delicate balance has been increasingly compromised by human activities including industrial activities, the use of motorized vessels and cruise liners. A substantial part of the natural areas of the lagoon have disappeared as a result of these actions and as a result the national government has had to act both assessing the impacts and considering mitigating actions to reduce or reverse their effects.
Optical satellite imagery is widely used to monitor various earth phenomenon and to understand their evolution. Thanks to the Copernicus program and the Landsat missions we can access up to 25 years of data at high frequency, almost one image every 5 days in optimum conditions. Moreover, their wide acquisition extent allows us to easily access a large snapshot (100km x 100km for Sentinel-2) and thus repeatedly monitor multiple sites at the same time and under the same conditions. This research proposes to use a time series from optical satellites to monitor changes in the Venice Lagoon.
Following the successful delivery of the Coastal Erosion from Space project by ARGANS Limited and its partners isardSAT, adwäisEO, the British Geological Survey, Geological Survey Ireland, IHCantabria (Spain) and Arctus (Canada) the European Space Agency has initiated a change note to the contract 4000126603/19/I-LG commissioned under the Science for Society slice of the 5th Earth Observation Envelope Program (EOEP-5). The extension is supported by the user community and aims to:

- Extend the coverage of satellite derived product over the past 25 years for new sites for the four countries engaged in initial contract: UK, Spain, Ireland and Canada
- Add additional sites in a new country and a new partner ISPRA (Italy)
- Update the key coastal state indicators delivered in the initial contract by improving the enhancing the algorithm of the processing chain

We will present the manner in which co-registration improves image spatial accuracy and allows us to obtain a long time-period, high revisit rate and highly accurate shoreline time series. Very high-resolution images are used to co-register Landsat and Sentinel-2 images to reach a vertical and horizontal spatial accuracy within 3m. Satellite derived shorelines showed a higher precision accuracy within the mission pixel resolution.
The work that will be presented describes the specific validation process performed by ISPRA on the results obtained by this method as applied on the target sites of the Venice Lagoon.
Venice Lagoon is a particularly challenging study area, even from space with the remote sensing software, because of the presence of the sandbars ("barene"), which are vegetated intertidal areas, along with land. The evolution of such natural structures is normally slow, but some anthropogenic actions may force rapid change in such dynamics; examples of this are the navigation channels and the vessels-induced waves. As these natural settings are very important in the hydraulic and environmental balance of the Lagoon system, their defense is addressed by means of several regulations and laws, limiting human activities, thus preventing the loss of natural habitats. An important role in safeguarding the morphology of the Venice Lagoon, with respect to both anthropogenic drivers and sea level rise (expected as the result of climate change), can be managed by the possibility of developing tools to provide frequent monitoring of the evolution of the sandbars in the Lagoon.

Figure 1: Photo of barene north of the Venice lagoon

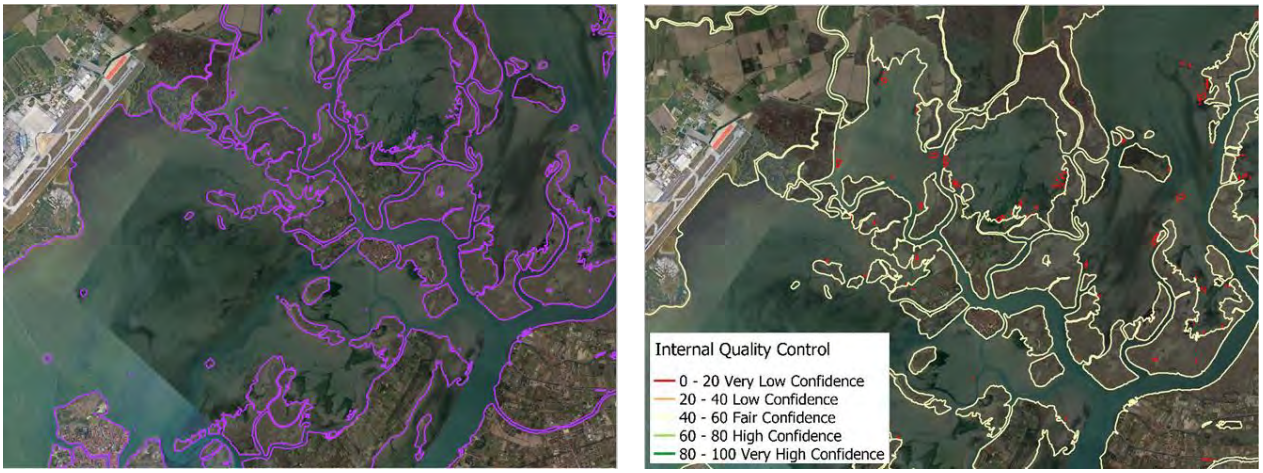

Figure 2: Waterlines around Venice north "barene" obtained from co-registered Sentinel-2 imagery and their quality score associated

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

Comparative analysis of beached macrolitter collection protocols: a variability-based perspective

SESSION:

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

AUTHORS:

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

Sandy beaches naturally act as sinks for marine litter brought from both land and sea. On the other hand, these environments are openly recognised as cost-effective location for campaigns on combating marine plastics litter. In particular beach cleaning campaigns have often led to evidence-based policies, such as bans on most common beached items -for instance, the EU directive 2019/904 banning single use items was based on the top ten items found on European beaches. Undoubtedly, beaches provide an exceptional asset for creating a base of empirical evidence related to marine plastic litter and at the same time mainstream information via scientific outreach and environmental education actions. Shared protocols and active citizenship therefore become essential. The use of standards is needed to ensure Findable, Accessible, Interoperable and Reusable (FAIR) data, and marine litter data are no exception.

Standard protocols need to be applied by scientists and citizen scientists alike. When comes to citizen science and monitoring, the best compromise between the a. capability to provide data over a spatial and temporal time otherwise inaccessible to scientists, and b. the information degradation related to the application of protocols by non-specialists has been debated for long.

When this relates to the macroplastics (1) fraction of beached marine litter, manuals with masterlists of items and univoque items'IDs have been provided, while intermediate lists were proposed by NGOs active at local scale and fostering grass-root movements to citizens bound to single, local beaches. In both cases, pictures of items are provided as a visual aid to identification.

Here we intend to compare the difference in information content between these two levels of detail by means of the intrinsic variability in models considering a) the OSPAR masterlist (2), one of the most widespread manuals, and b) the intermediate protocol, in this case the one by Surfrider Foundation Europe (SFE), a volunteers-adapted subset with a total of 30 items on the basis of the OSPAR masterlist,

on the same dataset obtained from beached macrolitter collected throughout one year of weekly sampling on the same transect. Sorting was performed in the lab, twice, independently, following the masterlist and the intermediate versions. Also consistently to the manuals, items were pooled in categories based on material (e.g. “glass”, “rubber”, “plastics”, (2)) and weighted, also twice, independently. Variables used as standards in beach ecology studies (3): beach width, beach exposure, substrate granulometry were used as independent variables to depict patterns of information proceeding from the application of the two protocols. Separate ordination (nMDSs) and multivariate models were developed for each protocol singly, and pointed to 1) different clustering and 2) significantly different variability in the models. Namely, in terms of both density of items and weight/m2, items belonging to a “grey zone” of protocols, such as small plastic fragments (5 mm - 2.5 cm) and items targeted by specific campaigns, such as plastic resin pellets, were found to have relevant weight in the definition of models variability. We conclude that target campaigns, calibrated to meet specific questions and /or societal needs on the local scale should be considered along with each general protocol. These would offer a finer detection of locally relevant issues, better connecting to the social template of the "beach" as unit for both social and ecological relevance (4).

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: AN INTEGRATED APPROACH FOR MARINE LITTER HOT SPOTS IDENTIFICATION

SESSION: COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Marine litter is among the most important environmental problems which are affecting oceans and the sea nowadays. All over the world, there is no sea basin free of solid elements, mostly floating, that are transported and dispersed by currents. Their size ranges from macroscopic dimensions, that is larger than about 2 centimeters, down to nanometers and, of all circulating objects, a part has natural origin, for example parts of trees, pollen and other biological stuff, but a relevant amount are litter.

Marine litter is defined as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment, so their origin is strictly identified in human activities. Because of the relevant impact on the marine ecosystem, plastic marine litters are those most monitored and studied.

When a floating litter is released in or it reaches the sea, then it starts a journey that can last for years, according to the sea currents and the surface wind. It is well known that the interaction of water mass with the coast, besides the water circulation patterns, bring marine litters to accumulate in some areas, while they are efficiently dispersed in others.

So, it is extremely important to identify the areas where the marine litter accumulate, which are referred as marine litter hot spots, because restoring action, meant to remove the pollutants from the environment, can be focused of those hot spots. Furthermore, the identification of starting points of the trajectories, showing the litter journey, are helpful to link the sources of pollutants, that is the environmental pressures, with the hot spots.

In this work, we present an integrated approach to the marine litter hot spots identification. The results come from a coordinate activity of filed campaigns, satellite monitoring and numerical model simulations carried on as part of the MARLESS INTERREG IT-HR project [1]. The method has been applied on the Adriatic basin and the focus is the coastal areas; some tests have been carried in the open sea too.

The method integrates the applications of a numerical dispersion model, the NOAA PyGnome code [2], the computation of floating objects trajectories by means of a cutting edge lagrangian model, the PARCELS model [3] and the systematic analyses of satellite images collected by ESA Sentinel missions [4].

The dispersion model runs simulate the litter transport, after the release from known sources of pollutants. We will show that, besides the tuning of the parameterization of physical effects causing the litter to move, to include the litter beaching and refloating action is mandatory to achieve a realistic description of accumulations areas. The likelihood of those areas is increased using the analysis of the backward trajectory distribution across the studied basin and assuming the main pollutants sources known with high probability, like river mouths and coastal points with high anthropic density. For this purpose, the Adriatic marine currents, which are available from COPERNICUS marine services, have been used for yearly simulations, producing a robust statistical dataset.

The simulated hot spots have been monitored systematically using the Sentinel 2 spectral imagery and the probability for a hot spot candidate is included in the identification process. In this content, we will describe in details the process to produce the spectral fingerprint for specific materials, like plastics, and the need of neural network application to elaborate massively all the imagery available from Sentinel mission.

Finally, the application of data, which have been collected thanks to in situ monitoring activities, are used to validate the remote sensing and the modelling results. The importance to coordinate the monitoring campaigns among many institutions, also across two countries, and to share a common measurement methodology is considered essential for the method validations, so it will be part of the present work.

Last but not least, preoperational products and services are presented and the portability of the method is underlined, since the required remote sensing imagery, software and numerical models are freely available.

The results presented in this abstract have been achieved thanks to the ERDF funds of the Italy-Croatia CBC Programme 2014-2020, in the frame of MARLESS Project.

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3. *PARCELS (Probably A Really Computationally Efficient Lagrangian Simulator) https://oceanparcels.org/*
4. *ESA Sentinel Missions https://sentinels.copernicus.eu/web/sentinel/missions*

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: LAND USE ANALYSIS AND COASTAL STRUCTURES: ADRIATIC COAST AS A CASE STUDY.

SESSION: COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT

Coastal areas are one of the most complex and frail nature environments. These are unstable and delicate systems resulting from mutual and continuous interaction between land-sea interface and inland processes (in particular in the water catchment areas).

Generally, these areas are densely populated, therefore pollution, habitat loss, coastal dynamics and climate change make these areas prone to be vulnerable with a resulting high risk for the population who lives in those places.

Moreover, these locations are often intensely anthropized and prone to intense transformative pressure that increases the exposure inducing a consequent increase of the risk of already compromised integrity of the ecosystem and their ecological function (Romano and Zullo, 2014). For these reasons, the knowledge of the present mosaic of land use/cover might be an important instrument to analyze the morphodynamic processes and also, for the definition of the rules necessary for the sector planning (e.g., Coastal defense planning, water catchment planning).

The main goal of the work is to analyze the current overview of land use at various distances from the coastline (from 1km to 10 km) investigating if there is a correlation with the deployment of coastal structures i.e., breakwaters, groins, etc. (e.g., Pasquali and Marucci, 2020)

The study area has been defined using the concept of physiographic unit (i.e., the coastal area in which the sediment transport exchange with neighboring regions is zero) using the classification given by the Italian Institute for Environmental Protection and Research, ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) (e.g., MATTM-Regioni, 2018). In this case, the coastal area between Conero Promontory to the north (Marche region) and that of Punta Aderci, to the south (Abruzzo region), with a total extension of approximately 200 km involving about 40 municipalities and 2 regions has been analyzed. The choice is motivated by the fact that in the last 20 years the area has been prone to intense coastal changes with a consequent deployment of coastal defense.

The analysis has been carried out using the Copernicus Land Monitoring Services database products (i.e., land use) with high resolution.

The nomenclature used for this data was produced based on the ecosystem typologies identified by the MAES (Mapping and Assessment of Ecosystems and their Services) (Maes, 2018).

Moreover, all coastal structures (groins, submerged and emerged breakwaters) have been surveyed using appropriate environmental, urban, and hydraulic indicators to identify a possible correlation or cause-to-cause relationship effect between presence/absence of coastal defense, urban pressure, and soil use/cover mosaic.

This procedure has made it possible to build an analytic picture of the analyzed physiographic units useful to identify critical areas with low permeability values and those in the opposite condition. Indeed, different soil uses can be translated on different runoff coefficients with direct effects on the river's solid transport and, therefore, on the sediment budget of the coastal area.

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Sessione: Geografia e Paesaggio della fascia costiera: dinamiche del territorio e tutela integrata

The economic and environmental impact of large ships on the territory, on the coast and on the sea: the MSC cruises case study

Emanuele Poli e Anna Rosa Candura

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Abstract

Cruise tourism is growing all over the globe, despite the COVID-19 pandemic having had major repercussions on the sector. The Cruise Lines International Association estimated that, worldwide and only between mid-March and September 2020, there were $77 billion in losses, $23 billion in unpaid salaries and 518000 jobs lost[1]. The CLIA, however, is noticing a positive trend already starting 2021: two out of three passengers plan to set sail within a year and 58% of travelers, who have never been on a cruise, are likely to do so in the next few years. The study of the economic impact of cruise tourism has been the subject of academic research for years and, together with the investigations of the shipping entities and companies it provides a huge amount of data that can confirm the importance of the sector in the panorama of tourism. What appears more and more urgent and of interest in the scientific community is the need to broaden the concept of impact through a multidisciplinary approach that also considers environmental, cultural and social aspects of the cruise industry. The results obtained the allow us to reconstruct a context much closer to reality and which appears to be of enormous significance for shipping companies to direct their choices in terms of eco-sustainability. This paper aims to offer an overview of the issue and, through the case study of MSC Cruises, to investigate the sustainable development policies promoted by a great institution. Finally, this work aims to provide a range of information in reference to the impact that large ships can have on the territory, the coast and the sea. But it is not just about the environmental impact, but also with regard to the socio-economic sphere. It will be seen that there has been a greater focus on the negative impacts that these large ships cause, but also on the positive ones.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

SPATIAL PLANNING INFLUENCE ON CHANGEABILITY PROCESS OF URBAN AND NATURAL (LAND)SCAPE RELATION: UNDERSTANDING THE DYNAMICS OF ANCONA ON THE WEST AND RIJEKA ON THE EAST ADRIATIC COAST

SESSION:

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES:
TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The process of urban and natural landscape relation testifies to 25 centuries of urban culture and tradition in the Mediterranean. The urban and natural landscape relation is comprehended as temporal, spatial, and perceptive phenomena as well as a heritage dimension that embodies landscape reality and its representation. The process of landscape relation is a layer of the *Urbanscape Emanation* concept [4] understood as the impact of the city systems on its landscape. The research theme is induced by the notion that urbanity emerged from the landscape, transforming the natural into a cultural landscape. Interrelation and connections of the urban development process and natural landscape transformation prove the entity wholeness and the changeability process of the urban and natural landscape relation.

The landscape relation can be traced through the history of settling [3], from the prehistoric dwellings, proto-urban settlements, ancient cities, and medieval towns that developed in harmony with the landscape setting and with respect for inherited landscape values and characteristics. The processes of industrialisation and urbanisation from the 19th century further intensified by the rapid change in urban development pace from the second half of the 20th century – disrupted the historically balanced urban and natural landscape relation. Spatial problems of extensive urban spread into natural resources indicate the disrupted relation between urban and natural landscape. In the specific context of the Mediterranean and the Adriatic, these spatial problems are further intensified in cities settled between two strong natural elements - the sea and the mountain. The emerged research question refers to how and to what extend (can) spatial planning influence the changeability process of urban and natural landscape relation in the context of East and West Adriatic Coast cities.

The urban and natural landscape relation presents unified and non-renewable spatial and heritage resource that can be explored by overlapping different perspectives on process features and relation changeability of urban and natural landscape. The relevance of proposed research is set in three levels – theoretical (existing knowledge) [2], spatial (field research and case comparison), and spatial planning (criteria) [4]. The landscape relation is explored as part of the *Urbanscape Emanation* [4] concept of multi-layered values detection and use in spatial planning. The *Heritage Urbanism* approach [4] to spatial development and enhancement is used in setting identity factors, evaluation criteria, and enhancement models. The research interconnects the *Urbanscape Emanation* concept and the *Heritage Urbanism* approach to aim a new dynamics in planning balance and achieving holism between multiple layers of the urban and natural landscape.

The knowledge on identity factors of urban and natural landscape relation is theory based on temporal / heritage, spatial / physical, and perceptive / representation factors complemented by functions / activities that related landscape provides and holistic / comprehensive character of the balanced landscape. The inclusive and holistic approach [1] is

achieved in overlapping different features of landscape relations that are confirmed during field surveys and data collection - historical setting as continuity, levels of landscape setting, landscape transformation in four natures of landscape, network of viewpoints and viewframes, communication system, heritage network (cultural and natural, tangible and intangible), and structure of spatial planning documents. The features of urban and natural landscape relation are used as evaluation criteria in comparing research cities of the East and the West Adriatic Coast. The city of Ancona and the city of Rijeka are selected as key representatives of the intensive landscape relation as cities settled between the Adriatic Sea and the mountain hinterland of Apennines and Dinarides.

The expanded understanding of the urban and natural landscape relation as a process is complemented by systems of versatile urban and natural connections, a variety of landscape networks, organisations forming a complex and unitary whole, and structures of interrelated landscape constituents that resist delineation and boundary setting. The dynamics of urban development and natural landscape evolution interconnect the past and present landscapes with spatial planning tendencies. The urban and natural landscape relation is the process that cannot be planned – just directed. The research contributes to proposing spatial planning principles that acknowledge the individual and common characteristics as well as the connections that complement urban and natural landscape as a whole where one benefits from the other.

Figure – Representation similarities and characteristics of urban and natural landscape relation of Ancona (left) and Rijeka (right) (photo: Authors)

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POSTER PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
WATERFRONT: TEST FOR RESILIENCE. MESSINA AND THE POSSIBLE VIRTUOUS CONVERGENCES BETWEEN PRG AND PRP

SESSION:
GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

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General frameworks and Objectives

The theme of waterfront regeneration exercises a particular attraction not only in terms of real estate value but also from a social-cultural and landscape-environmental point of view. Waterfront redevelopment policies are often presented as the last frontier for urban regeneration and reflection for cities' destinies becoming an opportunity to generate new development models to challenge with the most innovative tools for urban planning and design (AA.VV., 2019).
It is a complex theme, with different levels of overlap, in which historical and identity issues linked to the relationship with the sea overlap with political and technical choices, institutional contradictions, the efforts of copianification and the difficult coexistence with functional articulations ranging from logistical-infrastructural choices to economic and social issues, up to proactive responses to the solicitations of extreme calamitous events as a function of sustainable adaptation to climate change (Savino, 2010).
For the city of Messina, the reconquest of the sea is a cyclical theme that each time is charged with an increasing salvific value. It is a territory overlooking two seas and a maritime front of forty kilometers consisting of a morphologically varied natural system, with great landscape values and incomparable beauty; undoubtedly one of the most evocative places in the Mediterranean but forsaken and not saved aggressive urbanization, both made possible by the poor value of urban planning tools, that have ignored the qualities of this area.
In April 2018, the presentation of first step of the masterplan for the new Messina Prg, entrusted to the general consultant Carlo Gasparrini and currently under development, broke into the debate on the redevelopment of the waterfront, going beyond the dimension of a reflection that seemed to look exclusively to the historic port and giving new meaning to the urban redevelopment processes through an ecological, strategically, systemic and territorial key, unprecedented for this city. A plan based on the principles of sustainability and resilience, which invests in the theme of the landscape and green and blue infrastructures, focusing precisely on the redevelopment of the waterfront through the inclusion among the Guide-Projects of the "sequence of coastal landscapes and excellence on the two seas". In a context that up to now has not any driving territorial images and public policies, the plan inserts the long line of the waterfront from Giampilieri to Villafranca, attributing role and depth to became a new supporting system for green and blue infrastructures.
Of no less importance is the linking of a sequence of places and landscapes, representative of an extraordinary heritage for future development scenarios, which aims at a touristic and cultural relaunch of

the Messina area (Città di Messina, 2018).
In November 2021 the Port System Authority of the Strait of Messina, following the provisions of the Port Regulatory Plan and updating its principles, opened the debate on the redevelopment of the urban waterfront of Messina in the Boccetta-Annunziata area, one of the most valuable parts of the city.
This area includes, in fact, constructions and places that have great identity value such as the Promenade and the area of the former Fair but also parts taken from the city to develop private transport of wheeled traffic across the Strait and about these areas the controversy has never stopped (Autorità Portuale di Messina, 2010).
Through these two planning tools, a convergence of principles and objectives seems to take shape that could make Messina a laboratory of good planning inspired by resilient strategies shared between the Municipality of Messina and the System Authority.
The objective of the paper is to compare the two urban plans in the interface parts between the historic city and the waterfront and outline the elements of coherence and/or conflict; the topics on which the discussion will be developed will focus on some main issues: the redevelopment of the sea view through the application of resilient actions, the enhancement of fast and slow sustainable mobility, the protection and enhancement of the coastal landscape, the qualification of an increasingly sensitive tourist offer with respect to cultural and environmental issues, entrepreneurial and technological innovation, the recovery of urban identity through historical memory and functional and perceptive relationships with the sea.

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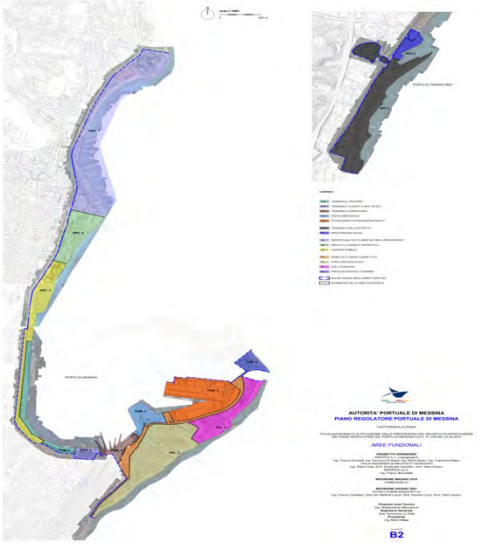
Schema di massima nuovo Prg di Messina (in corso di redazione)
Sistema delle infrastrutture ambientali



Piano regolatore portuale di Messina. Aree funzionali

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Coastal dunes along the Marche littoral (Adriatic side of Central Italy)

SESSION:
Geografia e Paesaggio della fascia costiera

AUTHORS:
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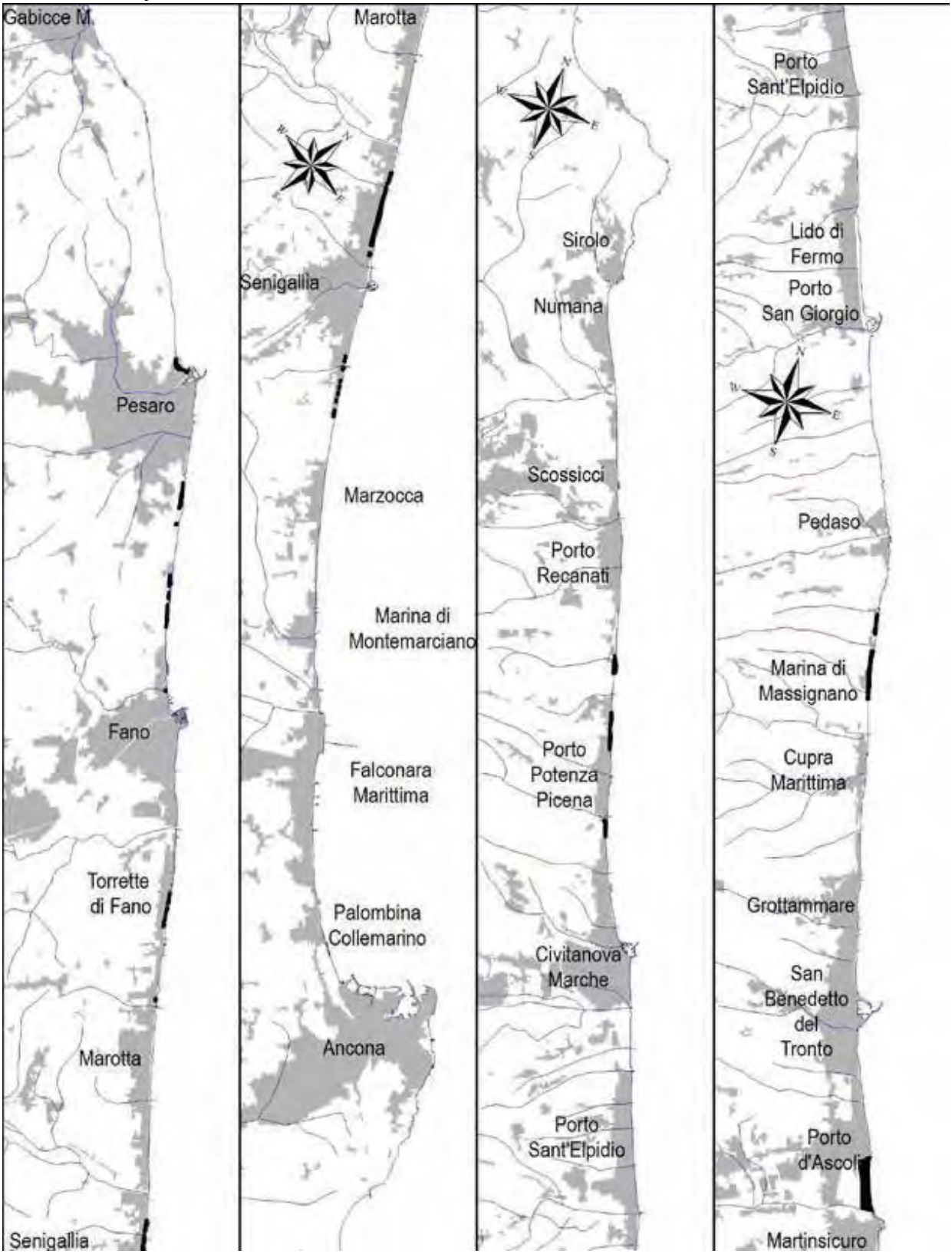
ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):
The results of a critical analysis of the main features of relict dunal coastal areas and scarcely anthropized zones located along the littoral of the Marche Region (Adriatic side of Central Italy) are synthetically reported.
The investigated coast is some 180 km long and is mainly characterized by low coasts with sandy or gravelly beaches of various width; the only exceptions are the high coast characterizing the San Bartolo area (close to the northern boundary with the Emilia-Romagna Region) and the Mt. Conero promontory (in the central portion of the regional coast).
The studied sector, strongly affected by man-made transformations, shows an almost continuous series of coastal protection works: emerged and submerged seawalls, groynes and revetments. Moreover, harbor structures and canalized outlets locally interrupts the lateral continuity of the shoreline.
Such interventions were mostly implemented starting from the '60s of the last century to face the beach erosion phenomena triggered by a dramatic reduction of river solid load: the latter, in turn, derived from man-made interventions in the hydrographic basins, such as construction of dams and check dams, gravel quarrying from the thalwegs, crops abandonment etc. Unfortunately, lack of territorial planning for the project of coastal interventions instead of solving the problem of shore retreat mostly brought to downdrift migration of erosional phenomena, thus requiring further interventions: in this way, almost all the regional shoreline was progressively artificially stiffened.
Also taking into account the effects of climate change and the strong anthropic pressure on the coast (and its touristic relevance), the present coastal dynamics of the area requires detailed, accurate and continuous monitoring to be carried out, in order to allow sustainable integrated territorial management.
In the XIX century, all along the Marche coastal belt several beach-dune systems were present, mostly close to the main river mouths. Many of those peculiar landforms were destroyed during

the construction of the Adriatic railway (1862-63), while others survived up to the second half of the last century.



Location of relict coastal dunes (in black) along the littoral of the Marche Region.

Presently in the Region, as a consequence of coastal erosion and construction of touristic facilities along the beaches, no real beach-dune still exists, even though locally some strongly eroded remnants can be still found. Among the others, particularly interesting are the deposits located close to Sejore Ditch (between Fano and Pesaro, in the North of the Region) and those bordering the southernmost reach of the Marche coastline, in the Sentina Regional Natural Reserve (close to the mouth of the Tronto R.).

The study carried out allowed to survey all the relict dune deposits still present in the Region, as well as the scarcely anthropized coastal areas where dunes could start to develop, and to characterize them from morphological, sedimentological and botanical-vegetational points of view.

As a rule, the investigated remnants of coastal dunes are small (as a maximum 2 m high and 20-25 m wide) gentle reliefs located about 20-30 m at the back of the shoreline. Locally, embryonal accumulations were individuated leaning against natural or artificial obstacles. Sediments are represented by mostly siliceous fine sand showing rather homogeneous grain size.

From a botanical-vegetational point of view, the typical vegetation of dunes is very fragmented, depleted and strongly altered. The most common coenoses are those made up by annual species, such as *Cakile maritima* and *Salsola kali,* constituting the *Salsolo kali-Cakiletum maritimae* association, often compenetrated by nithrophilous, sometime exotic, species. Perennial coenoses, such as the *Echinophoro spinosae-Agropyretum juncei* and the *Echinophoro spinosae-Ammophiletum arenariae* associations, are much rarer: mostly the latter, still individuated only in a very few places along the studied coastal belt.

Standing their extremely relevant ecologic function, mostly for protection from coastal erosion and habitat conservation, it is instrumental to accurately monitor relict beach-dunes and scarcely anthropized coastal areas, in order to carry out actions aiming at preserving them and at restoring the psammophilous phytocoenoses fundamental for their consolidation.

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Marine litter surveys on Boccasette beach (Rovigo, Italy).

SESSION:
Geography and Coastal Landscapes: territorial dynamics and integrated protection

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The presence of marine litter is a huge environmental problem affecting beaches on a global scale. The definition of sources, modes of transport and accumulation zones is quite hard considering all variables involved, but it is fundamental to improve the knowledge on these issues.
This study dues to evaluate the distribution and abundance variation of the beach marine litter through different marine and weather conditions, correlating the types of stranded materials with human activities. As part of the Interreg IT-HR NET4mPLASTIC Project, which aims to develop new technologies for monitoring micro and macro plastic in the Adriatic Sea, marine litter was collected during five surveys performed along the Boccasette spit (November 2019 – October 2020), in the Po Delta Veneto Regional Park. This spit separates the lagoon of Barbamarco from the Adriatic Sea. The Barbamarco lagoon lies between the two mouths of the Po River (Po di Maistra on NW and Busa di Tramontana on SE). In addition, Boccasette beach is considered as a semi-rural area (Vlachogianni et al., 2018), and the main human activities are fishery, aquaculture and tourism (mainly during the summer season).
Macro debris items (2.5 - 50 cm) were collected adapting the DeFishGear protocol for beach litter (Palatinus et al., 2015). The sampling site was selected according to the following criteria (Vlachogianni et al., 2018): minimum length of 100 m longshore for a fixed 100-metre stretch; low/moderate slope (~ 1.5 - 4.5°); breakwaters or jetties absence; easy beach access guaranteed all year round; no additional/few human cleaning activities.
The surveys were carried out at low tide, in different seasons and before/after meteoric extraordinary events (i.e. storm and flooding). The sampling area covered a 100 m shore-parallel line, while the width varied according to the hydrodynamic conditions. The beach litter was collected, classified and counted, to estimate the density of debris categories (Lippiatt et al., 2013) and to evaluate the beach cleanliness with the Clean Coast Index (CCI) (Alkalay et al., 2007).
A total of 5578 debris items was collected in all five surveys. The litter was classified into 8 macro categories according to the "Master List of Categories of Litter Items" *(Palatinus et al., 2015). The main representative category is* "artificial polymer materials" *with about 96%. Overall, other categories (rubber, cloth/textile, paper/cardboard, processed/worked wood, metal, glass/ceramics, unidentified and/or chemicals) represented less than 5%. The artificial polymer materials items differ in abundance and type, but the most represented are related to fishing/aquaculture activities (25.96 %, polystyrene fragments and mussel nets) and improper waste disposal (23.54 %, generical plastic pieces, caps/lids drinks and plastic bag/rip-off plastic bags fragments).*
Overall, the marine litter density is 0.35 items/m^2 (± 0.13 SD) and is in agreement with previous studies in the selected site (0.38 items/m^2, ± 0.26 SD) (Vlachogianni et al., 2018). However, the density obtained in autumn, winter and early-summer was higher (about 0.44 items/m^2) compared to the situation measured during late-winter and early-summer (0.21 items/m^2). By applying the CCI, Boccasette beach can be classified as "moderately clean" from late summer to winter and as "clean" during spring and summer.
The preliminary results clearly indicate the positive impact of the Covid-19 lockdown measurements activate during spring 2020, as shown by the low abundance of marine litter items collected in the study area. Comparing the presented results with previous works in the same area, is possible to note a main difference: the reduction of human activities

(i.e. fishing, aquaculture and tourism) can positively influence the reduction of beach marine litter. Furthermore, during the surveys, also the spatial distribution along the beach transect clearly indicate that most of litter accumulated close to the dune foot, or entrapped by plants and remains of vegetation. Therefore, the preliminary results could be an original point for further studies of the vegetation role as barrier for litter towards the inner vegetated dunes, entrapping anthropogenic litter. Such information could be useful also to define litter production reduction and clean up strategies.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

TITLE:

THE DEVELOPMENT OF "SUSTAINABLE" SURVEILLANCE AND MONITORING ACTIVITY CARRIED OUT BY THE COAST GUARD FOR THE SAFEGUARD OF THE PROTECTED MARINE AREAS

SESSION:

GEOGRAPHY AND LANDSCAPE OF THE COAST: DYNAMICS OF THE TERRITORY AND INTEGRATED PROTECTION

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The Mediterranean Sea represents one of the richest sites in matter of biodiversity on our planet, however, considering the nature of being a semi-closed basin, it is subject to little water exchanges with other seas, thus making it sensible to high risk of pollution due to either intense ship traffic, high number of inhabitants living along the coast and building speculation along with the exponential growth of economic and industrial activities developed along the coastal areas.

The peculiar geomorphological and biological formations which characterize the Italian peninsula, located in the middle of the Mediterranean, makes it a region of significant natural and environmental value, whose integrity, however, is strongly affected by the high anthropic impact that persists along the approximately 8,000 km of coastline.

The need to safeguard this natural heritage has led the Ministry of Ecological Transition (MiTE) to implement a strong policy of protection and enhancement of the sea and coasts. Among the various initiatives, for instance, is the establishment of national Marine Protected Areas (MM.PP.AA.), which have taken great importance in matter of scientific, ecological, cultural, educational and economic.

Those areas, according to the law no. 979 of 1982 "*Dispositions for the defense of the sea*" and by the law n. 394 of 1991 "*Framework law on protected areas*", are subject to environmental protection established with a decree of the MiTE, which contains the denomination and delimitation of those areas, the objectives and the regulations to which the protection is aimed.

Ordinarily, a M.P.A. it is divided into three distinct areas with different degrees of protection which, while not providing an absolute limit to traditional activities related to the sea, such as fishing and tourism, nevertheless their use is regulated based on the different conservation needs.

Up to now 29 MM.PP.AA. to which are to be added the submerged parks of Baia and Gaiola and the International Sanctuary for cetaceans, they, together, allow the protection of about 3 million hectares at sea, corresponding to a protected coastline of over 650 kilometers.

In order to fully combine the expectations of the sea users in harmony with the safeguard measures provided for the MM.PP.AA., it's mandatory to implement a constant monitoring and surveillance activity, adequately supported by a careful and balanced management.

In this context, according to art. 19 of Law 394/91, the Port Authority Corps - Coast Guard, is primarily responsible of supervising the MM.PP.AA., but also fulfills essential maritime environmental police tasks conferred, not only by the aforementioned framework law, but also by the numerous regulations set up to protect the maritime and coastal environment.

Over the years, various specific environmental maritime police campaigns have been planned and carried out, through a complex operational activity capable of completing and integrating the investigative tasks.

The main objective of the campaigns is summarized in a series of actions that combines the protection of the maritime environment, the safeguard of coasts and biological resources, which are closely connected with each other, through the use of the aero-naval assets and Coast Guard specialized units (Diving Centre, Environmental Analysis Laboratory and Environmental Remote Sensing) (**Figure 1**) able to discover, analyze and immediately repress illegal phenomena that may harm the environment, having in mind the target of harmonizing as best as possible the police procedures among those operational entities.

(Figure 1)

This methodological approach has allowed to assess numerous violations within the MM.PP.AA. that increase the effectiveness of deterrence and prevention of harmful behaviors of the marine-coastal environment.

Parallel to the maritime environmental police activity, the Coast Guard, through memoranda of understanding with the MITE, also carries out environmental monitoring activities, which involves the specialized Coast Guard branches, as well as part of the central and peripheral articulation of the Corps, consisting in the observation of the impacts related to climate change in the MM.PP.AA., carried out using electrical powered vehicles and technical instruments (multi-parametric probes) suitable for detecting temperature and main chemical/physical parameters of the sea water. All the information acquired over time will integrate the existing databases and will provide useful information to define projections on the evolution of the underway climate change, essential for the decision-making process aimed at preventing harmful impacts on natural ecosystems.

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: Fishing and territory. Status and Perspectives of Sardinia artisanal Fischeries.
Session: GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA
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MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

This contribution intends to propose a survey on the dynamics related to halieutics in Sardinia. The paper will first propose a quick overview of the regulatory contexts of reference and then a synoptic and updated quantitative analysis on the relevance of the aforementioned sector on a global scale (from the FAO 2018 report, it is clear in 2017, the total volume of world production of fish, molluscs, crustaceans and other aquatic animals grew further, reaching 172.6 million tonnes with an increase of 4.1 % compared to 2016. Of this quantity, the total volume of catches, i.e. all products caught by a country's fleet in any fishing area, regardless of the landing/sale area, represents 92.5 million tonnes while the remaining 80.1 million tonnes are to be attributed to aquaculture), continental scale (in 2017 the halieutic production of the European Union was about 7 196 541 tonnes) and national scale (192 202.6 tonnes of fish were caught in 2017, while aquaculture generated 156 307 239 tonnes of halieutic product), and then focused more closely on the analysis of the nautical and fisheries sectors in Sardinia (in 2016 there was an amount of about 7000 tonnes of fish caught, recovering compared to 2013 and 2014 but lower than the previous year and first years of the decade, especially compared to the peak reached in 2011 with over 9000 tonnes of product.

The production value in 2016 was 52 350 000 € and the price per kilogram was 7.50 €). With respect to the case study, through the consultation of institutional reports and intersectoral reference bibliography, the specificities related to the state of the fishing fleet in Sardinia and to the data of the boats that carry out fishing and aquaculture activities in Sardinian waters will be presented. In relation to the state and deployment of the fishing fleet to the major and minor port systems of the island and to the important link with the cultural and ethnographic dynamics from which they emanate, the main fishing techniques and instruments used by Sardinian seafarers (Fixed Longlines, Trawl Nets, Purse seines, Drop Nets, Drift Nets) will also be taken into consideration. The contribution will then present, in an updated form, data on employment in fisheries and the relevance of the sector in the local economy. Ultimately, the main objective of the contribution is to condense into a single location and with updated data and references the state of the art of a sector that could, in an island with almost 1900 km of coastline and a marked vocation for seaside tourism, play an important role in local development policies. While fishing is an economically and socially relevant activity in itself and an important historical and traditional heritage, it also represents a possible trigger to read the territorial dynamics of coastal areas, to identify possible extensions and enhancements of tourism (fishing tourism), to investigate the effectiveness and consistency of bottom-up governance formulas (LEADER projects). The contribution, operating on a descriptive track, therefore wants to be the premise for future, and more applicable, lines of research.

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Nineth International Symposium

**MONITORING OF MEDITERRANEAN COASTAL AREAS:
PROBLEMS AND MEASUREMENT TECHNIQUES**

Livorno (Italy), June 2022

TITLE:

Analysis and survey of Lake Garda lemon houses: A tool to understand and manage a Mediterranean landscape in Lombardy

SESSION:

COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT

Lake Garda, thanks to its mild microclimate, allowed in its North-West portion the settlement and flourishing of a unique cultivation, that of the lemon groves, which shares many characteristics with labour intensive Mediterranean landscapes. Despite the climate favour, the citrus cultivation nevertheless required a lot of care and attention. In fact to make citrus growing possible in whole earth at this latitude (the most Northerly in the World), monumental stone greenhouses were built, the lemon houses (*limonaie*), set on long terraces shaped on the slopes best exposed to solar irradiation and most sheltered from cold winds.

Figure 1. Gargnano (BS): the map highlights in yellow the *limonaie* documented by the cadastral maps of 1851 and in green the lemon houses still active in 1905.

Historical sources document that the architectural layout of the *limonaie* was consolidated in all its essential components since at least the 16th Century. During the 19th Century, up to 20 million lemons a year were exported to Northern and Eastern Europe, but from the end of the 19th Century various reasons led to the gradual abandonment of the production system (Fig. 1). Compared to the 50 hectares historically destined to citrus groves, today probably only 25-30% of those areas are still cultivated with citrus fruits, but the historical agricultural landscape – despite the recent urbanization and territorial transformations – is still clearly readable as the numerous remains of lemon groves connected to terraced olive groves, vineyards, woods, laurel trees and typically Mediterranean vegetation (cypresses, capers, oleanders, myrtles, agaves…; Fig.2).

The lemon groves and the landscape system related to them are the result of a complex process of territorial transformation and of a continuous maintenance work carried out for centuries by the same farmers who guaranteed its perpetuation. The future management of this peculiar traditional rural landscape will therefore not be possible if policies and strategies are not aimed at the knowledge and promotion of this unique heritage rich in historical, architectural, landscape, botanical and agronomic and intangible cultural values.

For the above, in order to better understand and be able to enhance the extraordinary and unique heritage of the upper Garda *limonaie*, the paper intends to highlight how urgent it is to analyze the current state of the lemon groves system, by surveying the *limonaie* structures and counting the productive citrus plants in the municipalities of upper Garda.

Figure 2. Gargnano today: this photo shows how much the *limonaie* (clearly recognizable by the terraces and pillars) still characterize the upper Garda landscape.

The first step will be an in-depth landscape analysis of the current situation, including a detailed

investigation and classification of the present components, in order to collect reliable data on architectural and material characteristics, state of conservation of the sites, nature and number of properties, state of the irrigation and infrastructural system, landscape context, citrus fruit varieties, processing activities and types of products, etc. The census is not a purely analytical-cognitive phase: actually it is a pillar to define the intervention strategies, essential for the architectural and landscape enhancement of the *limonaie* system, for the promotion of biodiversity in the upper Garda and for the settlement of the production chain. The census is conceived as a GIS based dynamic tool that allows continuous updates and additions to better manage and process all the data collected in the future. The goal of the mapping and census is to know the current state of the *limonaie* system, compared with the historical state documented by maps and archival documents and by previous studies prepared to define management criteria at the district level, identifying the compatible vocations and uses, and conservation, maintenance and management aims, hoping for possible incentives for owners to be actively involved in the valorization of this precious landscape.

It is really important now that conservation and recovery interventions are carried out not only with particular attention to maintaining the historical, landscape and documentary significance of the *limonaie*, but also to the agronomic and productive value, with the perspective of preserving the landscape ecosystem services. There is in fact a risk that the historical cultivation techniques are lost and that construction elements, materials and plant species are introduced that are not congruent with the historical landscape. Through a process of conservation and rehabilitation not only of the structure of the *limonaie*, but also of the hydraulic, infrastructural and landscape components, conserving and increasing species and cultivars traditionally cultivated in the upper Garda, it would be possible to strengthen a rural economy that could support and valorize monuments that are unique in the World.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
A NEW PROPOSAL FOR A STRATEGIC AND RESILIENT REGENERATION PLAN FOR SEASIDE WATERFRONTS. AN ADRIATIC CASE: RICCIONE.

SESSION:
COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT:
Affected by the increasing violence of the climate change effects and the neglected awareness of an unavoidable sustainable planning, the border areas between sea and land face recurring emergencies and worsening natural risks. That special environment along the coastline, sometime still enwrapped by wilderness sometime strongly marked
by urbanization, are threatened by the sea level increasing and the progressive coastal erosion with irreversible injuries. Consequently, a number of different and innovative strategies must be arranged to make up for effects of change and ensure a future to these territories.
This goal means to deal with different and from time to time contradictory problems, then tackle multifaceted issues and to survey carefully contexts with much diversified features and finally work out plans and project which could regenerate these environments and address social and economic development processes.
In fact, in the last years, although we recognise that a more sensible attention has been payed to the coastal environment deterioration and increasing fragility, we also have to note the lack of integrated and multisectoral policies for a very specialist intervention, managed by specific institutional bodies that are incapable for a comprehensive problem-solving approach. It also depends from a simplified way to observe the different features of the coast that underestimates its morphology's contrasts and the unlike settlement organizations developed along it. Looking to the urbanized coastal areas, for instance, this banalization involves the way urban waterfront areas are considered by policies and plans, without any careful distinction among various water's edges, between "urban portual waterfront" and "urban beach waterfront" and without attention to the complex and multi-layered system that from the seashore rises up to the backlands.
In the first case, planning will arrange foremost infrastructural facilities, best accessibility and logistic solutions entailing quite exclusively interventions for consistency between port activities and urban ones, trying to reduce pollution, noise and environmental impacts. The urban organization development will be strictly related to the improvement of the harbour facilities and all the interventions will be finalized to maintain port efficiency, even strengthening the artificialization of the coastal environment, sometime accepting an unavoidable landscape deterioration. In the second case, intervention requires not only the improvement of the coastline resources and seaside leisure facilities, but also a particular care for surrounding landscape and urban seafront which is one of the most relevant aspect of waterfront quality.
By observing the urban waterfronts, it's possible to realize the lack of attention to the differences between urban-port waterfronts and urban-seaside waterfronts. The difference stands into the complexity of the beach waterfront, a layer that lies just behind the sand , longitudinally closely connected with the whole coastline and transversely strongly integrated with the urban settlement. Observation and intervention are often limited only to the coastline resulting insufficient and temporary, a "palliative" since they just face to the emergency lacking a more general solution: A clear example is the beaches nourishment along the main seaside resorts, which must be renovated several times during the season, without solving the problem of the fragility of these areas.
Therefore, it is necessary to include the actions to protecting the natural and anthropic features along the coasts into an integrate systems. This may allow a greater synergy between policies and actions, between urban plans and environmental interventions, which goal must be an effective set of realistic proposals for adaptation to the

climate change underway.

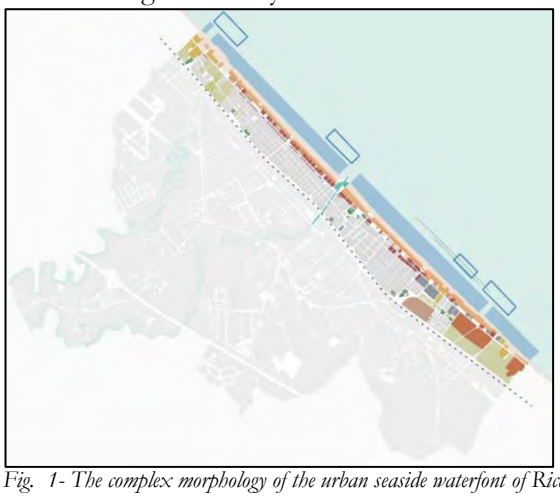

Fig. 1- The complex morphology of the urban seaside waterfont of Riccione

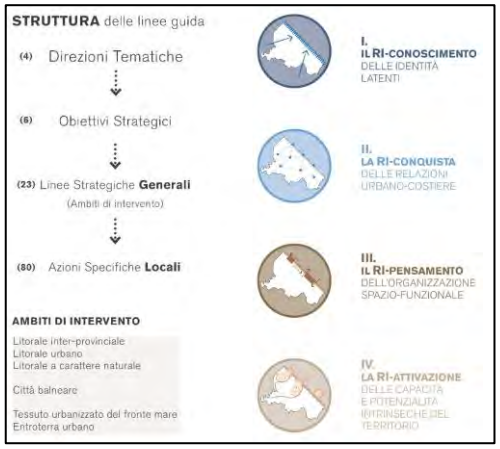

Fig. 2 – A strategic approach for a resilient regeneration of the waterfronts

In this perspective, the paper is intended to present an innovative focus on the coastline topic, moving from the analysis of the seaside waterfront peculiar features but refusing the current separation of border areas (seashore, beach, promenade and buildings overlooking the seaside) from the rest of the urban organization. Waterfont is not intended as a borderline but as a border complex and integrated urban area, with potential regeneration characteristics also strategic to trigger a redesign of the whole urban organization.

A new policy for an "inter-relational" coastal territory aware of the waterfront as a multitude of anthropogenic functions and landscape morphologies will be the key to understand in a single regeneration action all the complexity of a seaside seafront. This will be the first step towards defining a new city-beach-sea relationship.

The case study concerns Riccione, an Adriatic city and a seaside resort, which presents an easily recognizable and remarkable typological model, for urban structure, consolidated economic organization, social relationships, an appreciable balance between people needs and the natural resources (fig. 1). In this context, a paradigm of an "Adriatic seaside", the research attempts to propose a new territorial strategy to innovate the regeneration process based on the identification of new resilience conditions. The approach proposes action at the local level (planning and traditional procedures and innovative interventions aimed to a spatial-functional requalification of the whole waterfront system), but also at a territorial level (embedding urban elements and natural coastal components, economic issues and environmental needs).

The strategic proposal intends to arrange a set of guidelines (fig. 2) with the goal to change the seaside urban front into a "hybrid" space where interventions for urban and natural environment adaptation and regeneration fit into a single and comprehensive resilient design system.

The paper remarks the need of a methodological approach concerning the coastal areas, taking into account all the issues emerged in the survey (i.e. relationships and urban features shaped by the touristic vocation, the sandy shores as a well-identified space in the city and the related symbolic value, ecc.). These elements are crucial for the development of a strategic-planning voted to empower a resilient urban-coastal landscape, ensure the economic development of a seaside resort well matched with the natural environment, cultural heritage and and social identity matrix.

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KEYWORDS:
WATERFRONT. PROGETTAZIONE E PIANIFICAZIONE DEGLI INSEDIAMENTI COSTIERI E PORTUALI.

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: MARINE PROTECTED AREAS AND THE PROBLEM OF PAPER PARKS

SESSION: COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION
THE IMPORTANCE OF PROTECTED AREAS IN PARTICIPATORY AND SHARED TERRITORIAL GOVERNANCE

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Our global ocean covers more than 72% of the earth's surface provides a large portion of the world's food, jobs, and recreation for population (World Bank Group, 2016). The contribution of the ocean economy to global value added has been estimated in the order of 1.5 trillion US$ annually and the ocean economy could more than double its economic contribution to GDP equivalent until 2030 (OECD, 2016).
The ocean drives global systems that make the Earth habitable for humankind and careful management of this essential global resource is a key feature of a sustainable future: Marine Protected Areas (MPAs) need to be effectively managed and well-resourced and regulations need to be put in place to reduce overfishing, marine pollution and ocean acidification (UN, 2015). Marine Protected Areas (MPAs) must meet the International Union for Conservation of Nature (IUCN) protected area definition: A clearly defined geographical space, recognised, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (Day et al., 2012).
Essential MPAs characteristics should be:

- *conservation focused with nature as the priority*
- *defined goals and objectives which reflect these conservation values*
- *suitable size, location, and design that deliver the conservation values*
- *defined and fairly agreed boundary*
- *management plan or equivalent, which addresses the needs for conservation of the*
- *MPA's major values, and achievement of its social and economic goals and objectives*
- *resources and capacity to effectively implement*

as defined by the Guidelines for applying the IUCN Protected Area Management Categories to Marine Protected Areas (IUCN WCPA, 2018).
According to IUCN (2021), it is vital to have in depth knowledge of the area but also to have the support of the public and established techniques for surveillance and monitoring of compliance. Two key targets for ocean protection: the UN Sustainable Development Goal 14 and Aichi Target 11 under the Strategic Plan for Biodiversity 2011–2020 of the UN Convention on Biological Diversity explicitly recognize the need for networks of effective Marine Protected Areas (IUCN WCPA, 2018). According to UN World Database on Protected Areas more than 15000 MPAs protect more than 27 million square kilometers of ocean (7.68%) (Protected Planet, 2021) and IUCN

recommendation is to protect effectively at least 30% of the ocean by 2030, (Briggs, 2020). MPAs are more easily created and managed by governments in national waters while in Areas Beyond National Jurisdiction (ABNJ) it is more difficult to create MPAs due to the complex legal framework (Protected Planet, 2021).
Briggs et al. (2018) evaluated global targets and MPA definitions, highlighted key recommendations for improving the application of the IUCN categories for MPAs together with improved reporting standards in a paper Recommendations to IUCN to Improve Marine Protected Area Classification and Reporting. They suggested accurate application and compliance assurance of the IUCN marine protected area classification system and clarifying and strengthening the current IUCN classification system.
Oregon State University, IUCN World Commission on Protected Areas, Marine Conservation Institute, National Geographic Society, and UNEP World Conservation Monitoring Centre have created The MPA Guide - a science-based framework to categorize, plan and track MPAs and ecological and social outcomes they deliver. There are wide-ranging types of MPAs with various goals and expectations according to Stage of Establishment, Level of Protection, Enabling Conditions, and Outcomes. Establishment of an MPA can take several years and The MPA Guide recognizes four stages in the multi-step process: proposed/committed, designated (MPA exists on paper). Implemented and actively managed. The MPA Guide recognizes four levels of protection of biodiversity from extractive and destructive activities: fully protected, highly protected, lightly protected, minimally protected. By identifying the very different outcomes of MPAs with different levels of protection, The MPA Guide stresses that not all MPAs are equal for conservation or social outcomes. (Oregon State University, IUCN, Marine Conservation Institute, National Geographic Society, UNEP, 2021)
The IUCN Green List of Protected and Conserved Areas is the first global standard of best practice for area-based conservation: national parks, natural World Heritage sites, community conserved areas, nature reserves and so on. The Standard gave recognition to 59 well-managed and well-governed protected and conserved areas in 16 countries, based on three criteria: good governance, sound design and planning, as well as effective management. (IUCN Green List of Protected and Conserved Areas, 2021)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: THE INTEGRATION OF THE REGIONAL STRATEGY FOR SUSTAINABLE DEVELOPMENT IN LOCAL PLANS. THE CASE STUDY OF THE COASTAL CITY OF CAGLIARI.

SESSION: COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The signing of the UN Agenda 2030 by the 193 member countries of the United Nations in 2015, determined the shift from a sectoral approach to an integrated approach, which, moving from the study of the complex dynamics of the territory, identifies new development pathways, that take into account interrelations between environmental, social and economic objectives and enhances the identity values of the local communities. All the governments at all levels are invited to develop policies, that integrate the different dimensions of the human life and of the planet, from health and wellness to quality education, from ensuring decent work and economic growth to fighting or adapting to climate change. Principles and objectives of Agenda 2030 have been adopted in the National strategy for sustainable development, approved by the Italian government by the Resolution of the Inter-ministerial Committee for Economic Planning No. 108 of 22nd December 2017. The Sardinian region contextualized the National strategy at the regional level through the Regional strategy for sustainable development, approved by the Regional Government Resolution No. 39/56 of 8th October 2021.

This study discusses the complexity of the process of integration of the Regional strategy into spatial local plans, through the analysis of a case study related to the coastal city of Cagliari.

In compliance with art. 34 of the Legislative Decree No. 152 of 3rd April 2006, the Municipality of Cagliari undertook the process of Strategic environmental assessment for the definition of the municipal masterplan (MMP) in compliance with the Regional landscape plan and with the Hydrogeological setting plan, and able to contribute to the implementation of the objectives of the Regional strategy.

The proposed planning process is based on an innovative model of evaluation and monitoring of policies, plans and projects in the Preliminary environmental report of the Strategic environmental assessment. This model takes into account environmental and spatial aspects in relation to strategies of climate change adaptation, as well as economic and social issues. Following this approach, a set of indicators is defined in order to assess and monitor the current condition, the dynamics and the transformations of the urban environment.

The methodology builds on a model of strategic environmental assessment strongly connected with the Regional strategy, able to improve the decision-making process and to promote the sustainable use of the urban environment.

The idea of undertaking a process of strategic environmental assessment strongly linked with the Regional strategy, develops from the need to have a conceptual model of urban governance able to simultaneously guarantee the update of the Local plan and the contextualization of the Regional strategy.

The Preliminary environmental report, based on an assessment model, ensures, through a structured logical framework, a complete hierarchical relation among the objectives and the actions of the Preliminary MMP.

The methodology consists of the following four phases of construction of the logical framework: definition of the sustainability-oriented objectives, assessment of policy consistency, definition of the specific objectives and definition of the actions.

Spatial plans rely on assessment instruments to identify both the current state of the municipal area and the plan objectives. For this reason, it has been defined a set of indicators that identifies the items to be monitored, data sources, updated frequency, baseline values, benchmarks and critical, which may possibly redirect the definition f the MMP document. In this way, it is possible to assess the achievement of the sustainability-oriented objectives, the effects of the MMP on the environment and its potential critical aspects, and to redefine the plan actions.

The study proposes a pioneering experimental approach, which is exportable to other contexts for projecting spatial plans at different levels. A plan definition process is outlined, which is consistent with the objectives of the Regional strategy and with the goals of the United Nations Agenda 2030.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
The environmental function analysis: a promising tool to evaluate the coastal zone conservation potential

SESSION:
Geografia e Paesaggio e della fascia costiera: dinamiche del territorio e tutela integrate

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

In recent years, we have become aware of the concept that the complex dynamics that characterize coastal zone systems impose a close balance with the anthropogenic environment. Particularly, human activities and environmental resource exploitation are often responsible of changing the vocation of a coastal area. This becomes tangible when anthropic processes affect the coastal dynamic resulting in increased erosion processes, loss of biodiversity and habitats, and/or ecosystem fragmentation. Moreover, recent studies demonstrated that coastal zones have a capacity to provide ecosystem goods and services, this capacity can be heavily modified by uncontrolled human activities. In the framework of Integrated Coastal Zone Management (ICZM), a multidisciplinary and issue-oriented system analysis can be helpful to understand the ecological and socio-economic system functioning, while a complete assessment of the environmental quality of the coastal area can be performed by means of Environmental Function Analysis (EFA) employing physical and biogeochemical indicators coupled with socioeconomic indicators (1). This tool has been widely used to assess land use conflicts in planning and to enhance coastal management plans (2).

EFA permits to synthetize the information on coastal system functioning and on their potential for conservation or development by means a system of indicators and indices (1). In essence, by following a Cartesian principle, the mixed and complex coastal region can be divided into ecological and anthropic components identified by some specific features represented by selected indicators (1).

This operational framework is supported by a matrix based on the principles of Ecosystem-Based Management to describe the relationship between environmental functions and environmental characteristics (3).

Although the EFA methodology is a very interesting tool for coastal zone conflict use reduction, it is often arduous to apply it due to the lack of available data required for the quantification of some environmental parameters.

To overcome this limit and taking advantage of open access to national geo-databases, databases from environmental agencies and reports have been used as a part of the process to reduce the subjectivity of data acquisition.

The main goal of this study is to report and compare the application and usefulness of the EFA tool to discover the potential for conservation of two very different coastal areas located along the Campania Region coastline (Southern Italy).

The first EFA application site is the Volturno River Coastal Zone (Tyrrhenian Sea, Southern Italy), a human-impacted coastal marine area that extends for 50 km on-land and seaward. In this study site, a full set of EFA indicators for environmental and socioeconomic features was analysed using literature and territorial datasets. In this case the EFA analysis was aimed to testify a full conflict of use with a tendency towards high conflict rather than preservation as one might expect (4).

The second EFA study site is located at the western end of the Sorrento Peninsula in the Bay of Naples, southern Italy. In this area, the EFA application aimed to investigate the conservation potential and the possible anthropic influence on benthic habitats in the Punta Campanella Marine Protected Area (MPA). Seabed habitats have been characterized and mapped on the base of geophysical and sedimentological data together with results from benthic communities.

Moreover, for both case studies the EFA indicators included several environmental components both marine and terrestrial, comprising water column features, inorganic pollutants (heavy metals) and benthic foraminiferal assemblages as well as terrestrial biota, fresh water supply and quality, land use, and natural hazard.

Our results demonstrated that EFA is adaptable to different studies ranging from original beach application to territorial management and environmental assessment in coastal zones.

Particularly, in the case of Volturno River Coastal zone the EFA application demonstrated that despite the significant effort to preserve a pristine environment, the presence of various conflicts of use can obstruct both the potential for development as well and the conservation of the study area. This suggests that such holistic approach can actually support new effective strategies for territorial sustainable development scenarios.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
DIGITAL TECHNIQUES FOR THE PRESERVATION OF THE PORTUGUESE COASTAL HERITAGE. THE BELEM TOWER IN LISBON

SESSION:
GEOGRAPHY AND LANDSCAPE OF THE COASTAL STRIP: SPATIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT:

The research presents the results of the study conducted on the Tower of Belem, one of the iconic architectural elements that characterise the urban landscape of Lisbon's monumental riverside area.
This structure, an early 16th century fortification located on the northern bank of the Tagus River, served as both a fortress and a ceremonial gateway to the city. Built by architect Francisco de Arruda during the height of the Portuguese Renaissance to assert the power of King D. Manuel I, it combines the originality of a Gothic watchtower with an advanced modern bastion of pentagonal form and well armed, representing a prominent example of the Manueline late Gothic Portuguese style, as can be seen from the ropes, armillary spheres and shield-shaped battlements that adorn the exterior elevations, while incorporating hints of other architectural styles (Fig.1).

Fig.1 Belem Tower, south-west view.

In international recognition of its high historical and symbolic value, the Tower of Belem, together with the nearby Monastery dos Jerónimos, was classified as a UNESCO World Heritage Site in 1983.
In 1755, the Portuguese capital was hit by a major earthquake, which was followed by a tsunami that destroyed much of the architectural heritage located near the coast. Given the location of the Tower and the possibility of a similar

catastrophic event occurring again, the aim of the survey was to carefully document the state of conservation of the building, providing a digital source of graphic and iconographic data for possible reconstruction work on one of the jewels of Lisbon and Portugal in the event of a disaster.
The knowledge of all the peculiarities of the artefact was conducted through an instrumental survey followed by 3D modelling, which over time has become an indispensable tool for analysis, conservation studies, maintenance, structural evaluation and reconstruction of important architectural monuments.
For the acquisition of data and the subsequent graphic representation of the Tower of Belem, considering the dimensions and geometry of the object to be surveyed, the technique chosen was photogrammetry. The latter has had a rapid diffusion in the disciplinary field as it allows to obtain accurate measurements from photographs through the transformation of two-dimensional information into three-dimensional.
For a correct and complete recognition of the homologous points within the single frames by the software used, the images were taken not only orthogonally to the object but also at different angles, with an 80-90% overlap using a digital camera, for indoor environments, and with the aid of a drone for outdoor spaces. This approach has strengthened the calculation and processing of the dense point cloud capable of returning a very realistic perception of the surveyed study object, avoiding local deformations by the software (Fig.2).

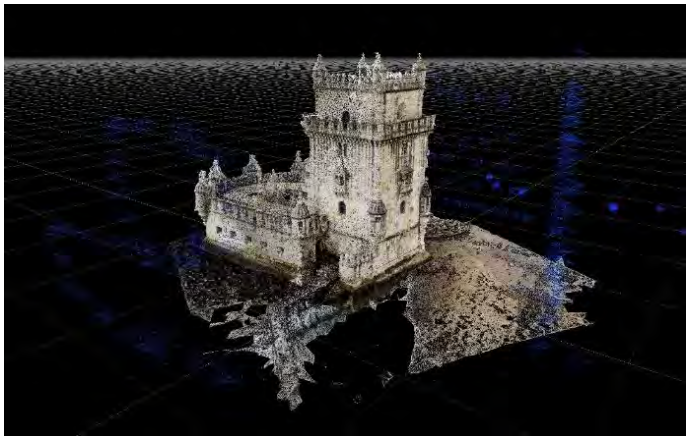

Fig.2 Belem Tower, point cloud obtained through photogrammetric survey on digital software.

The 3D mesh of the entire tower subsequently generated was then the basis for deriving two-dimensional representations such as plans, elevations and sections obtained by cutting in any desired direction. Given the spatial resolution of the documentation, the final products reveal details of elements such as vaults and floors, documenting almost the entire state of conservation of the UNESCO property.
The result is an exhaustive and accurate analysis, consisting of technical drawings at different scales, digital point clouds and 3D modelling to visualise the architecture of the Tower of Belem. This documentation, in addition to deepening a graphic and theoretical knowledge of the structure, will be able to be compared with any future study or intervention, giving the possibility to identify and quantify the degree of deterioration suffered over time.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: **OLD LANDSCAPES AND NEW FUNCTIONS. COASTAL ARCHITECTURES REDESIGN THE GEOGRAPHY OF THE COASTAL BELTS.**

SESSION:
4. GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

AUTHORS:

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The geographical space should be conceived as a progressive and conscious construction, resulting from the interaction between individual and collective actions. If from the second post-war period and for the following twenty years the coastal space has maintained even a minimal break with the anthropized spaces, starting from the 1970s the rapid industrial development has increasingly occupied the coasts. These changes along the costal space can be understood referring to the 'maritime-coastal region', by which Vallega (1980) defines a special region located between the two environments, that is the land and the sea, that, although being profoundly different, have established integrated forms of occupation and integration of resources. In the following years, the growing awareness of the economic importance of the sea and its immediate hinterland has generated further changes in the evaluation of the role of maritime spaces in the processes of territorial organization.
At the present, coastal areas still play a relevant role in for the contemporary urban condition both for their variety of environmental, historical, and cultural landscapes, but also for their character of transition and interface between the hinterland, coast, and sea. Perhaps, as Zunica (1987) points out, it must be admitted that the thickness of the coastal strips is a polyvalent concept, which assumes proportions commensurate with the phenomena, parameters, and functions under study. Historically, coastal regions have played the role of cultural transmission areas, where peoples, goods and ideas from abroad interact with local and traditional ones. Cultural heritage today plays a central role in the narratives of coastal regions and in their reorganization as places and/or containers of historical, cultural, social and economic protection. In this sense, the definition of Maritime Cultural Heritage, refers to that cultural asset that witnesses the relationship between people and sea. This definition refers to all the cultural materials (in the water and on the nearby land) and intangible assets that are an expression of a water-based culture (saltwater and fresh water) that has anthropological,

archaeological, historical, architectural, artistic, scientific or literary values or interests, among others (Baron, 2008). Indeed, communities have become aware of the importance of these maritime heritage, not only to narrate their territorial identity, but also to plan a locally based sustainable development. According to Gillis (2012) under the gaze of the tourist, coasts are considered places where human life was simple and picturesque, transforming.

Considering these premises, the research focuses its attention on one of the most symbolic maritime cultural assets: lighthouses. They are differently distributed along the European coastlines, responding to the same historical function, and evoking a common past. For all that, the main aim of the present research is to advance a comparative study about their use, rehabilitation, and conversion in two Mediterranean Countries, namely Italy and Spain. After a general introduction, the research will adopt a regional scale analysis to compare the strategies implemented by Finisterre regions such as Puglia, Sicily and Galicia to restore centrality and value of use to those artifacts abandoned over time. The landscapes of the three case-studies, characterized by the presence of lighthouses and other architectural structures for a long time at the service of the navy, is being redefined with new economic and social functions. As a result, lighthouses and other cultural resources are once again considered as an expression of that system of signs that binds the territorial components.

From a methodological point of view, the proposal will combine quantitative data and qualitative sources. They will be treated and presented differently to highlight the changes that have taken place. In reconstructing this evolutionary process, the proposal will go through the analysis of the new socio-cultural and economic dynamics which, always guided by an inner Mediterranean identity, are transforming the coasts. The contribution will mainly reflect on the growing tourist interest in the recovery and reuse of those abandoned coastal artifacts with a high attractive potential.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Nature protection and local development: A study concerning a natural park located in Sardinia (Italy)

SESSION:
GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

According to the Italian Constitution and international agreements, Law no. 394/1991 (National law on natural protected areas) defines and classifies the protected natural areas and identifies the regional natural parks among them. These can include inner land areas, rivers, lakes, and coastal areas endowed with high natural and environmental values. Within a park, such areas identify a homogeneous system based on natural characteristics and aspects of sites and on high-value views and landscapes, in respect of the cultural traditions of local communities. The law also introduces two main tools in order to guarantee and promote the conservation and enhancement of natural heritage, in a coordinated and balanced way: the spatial plan and the socio-economic program of the park.

Focusing on the first, defining appropriate spatial planning tools for these areas is of outmost importance and it is the objective of this study. The spatial plan organizes land use and plan actions. It is an operational tool through which the spatial transformations, which have effective consequences on the natural, social and economic environment, are addressed. Plans should identify and valorize the genius loci, that is the complex and peculiar identity of the local spatial contexts. Furthermore, as regards natural parks, on the one hand, plans should grant protection and conservation of local natural values and of ecological balances; on the other hand, plans should also promote social and economic development, by implementing planning processes aimed at valorizing the local identity, according to the sustainable development paradigm. This problematic dichotomy deserves careful consideration because protected areas can border, or even include, urban settlements, as well as tourism hotspots, subject to high anthropic pressures.

The Tepilora regional natural Park, located in central-eastern Sardinia (Italy), can be considered a relevant paragon for the issue at stake. As a matter of fact, the Park includes a relevant spatial context: it crosses four municipalities and different types of landscape. It develops from inland mountain areas to the coastal ones, it shows a rich microclimatic multiplicity, ecosystem diversity (in terms of habitat and species) and geological variety. In addition to the forest landscape, where the original natural features character prevails, the eastern part of the Park is characterized by an evident anthropization process. Here, the Park develops near the attractive town of Posada, includes the Rio Posada's (Posada River) environmental system, its alluvial-agricultural plain, the River's estuary connected with the coastal wetland zone and the adjacent beach, where a mainly seasonal tourism is developed in Summer. This complexity can be considered a unique feature stressed by the recent establishment of a UNESCO Biosphere Reserve which includes the Tepilora natural Park and the municipal land of other municipalities located around the Park.

This study implements a knowledge-based planning methodology that supports plan-making processes concerning natural parks. The methodological approach is based on the following phases: environmental analysis of the spatial context of the Park, that includes reports on site visits and analysis of the cognitive framework based on illustrative technical reports, analytical sheets, cartographic representation and diachronic study of the orthophotos; identification of the governance framework and spatial planning tools in force; characterization of the concept plan, consisting in the attribution of an ad hoc protection level to homogeneous zones on the basis of the grade of transformation planned by the local municipal administrations; interpretation and systemization of available spatial analyses which aim at defining a spatial taxonomy of homogeneous areas, defined as 'spatial reference units' (SRU), concerning both conservation needs and development expectations.

The proposed methodology is effective in recognizing both expressed and unexpressed potentials of the Park spatial context, and it makes possible to protect and enhance the Park-related opportunities and identity through the definition of place-based planning strategies. Finally, the methodology is readily exportable to other spatial contexts, at different spatial scales, where conservation and development pressures should be adequately balanced as regards areas characterized by relevant values of nature and natural resources.

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WATER, HERITAGE, AND CITY.
URBANIZED DELTAS ON THE LINE BETWEEN NATURE AND CULTURE

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Deltas are unique dynamic environments with respect to both natural and human activities, whose attractiveness to people and settlements may seem to contradict their high vulnerability to natural agents. Growing consciousness of issues such as rising sea level, subsidence, saltwater intrusion, extreme events, habitat loss, has been fostering new ideas to rethink the relationship between urbanization and the deltaic environment (Meyer and Nijhuis, 2014). In terms of urban form, the interface between land and water assumes multiple shapes, hard to trace back to the idea of a single uniform line or waterfront. A variety of physical – spatial, urban, environmental – and cultural issues, widely connected with each other, meet on such borders. Some of these issues, that appear to be key themes in urban and spatial regeneration theory and practice, can be linked to three types of transition places – coast and waterfront, river, irrigated fields.

The relationship with water is, first, a relationship with an irreducible and unavoidable nature in the urbanized landscape. Different ideas of nature and the environment underpin different design approaches. Ventura *et al.* identify two opposed visions in the context of river management, which they call "anthropocentric" and "ecocentric", that generate a conflictual dualism. The only way to overcome the conflict is to introduce in its place a complementary "environmental" dualism, in which the anthropic and ecosystemic components are seen as parts of the same system (Ventura *et al.*, 2002). When trying to trace back to these three models the major contemporary trends in planning and nature, "environmental" approaches show the common trait of thinking the natural environment not as an "absolute" environment mankind is surrounded by, but as a "co-evolved" environment where humans and their transformative action are embedded (Magnaghi, 2020).

Such research and design attitudes also showcase a willingness to mend the modern divide between nature and culture. An impulse here seems to come from the two branches of UNESCO responsible for natural and cultural heritage respectively. Namely, ICOMOS has been promoting since 2013, in the Netherlands, initiatives that aim at incorporating heritage in resilience thinking and policy, starting precisely from the unique vulnerability and richness of deltas. The underlying idea is that deep understanding of places and awareness of historical continuity are key to implementing successful strategies, and that creative heritage reuse can bring ideas for the future challenges while contributing to spatial quality and wellbeing (Hein, 2020).

The Dutch research efforts, however, remain intrinsically bound with their specific context, where national identity itself has been linked to water for centuries. One might wonder, then, how heritage can contribute in different contexts to the reconstruction and reinforcement of an environmental balance of water anthropized landscapes. In literature and national policies, growing attention is being given to community resilience and cultural resilience, but beyond the positive effects it has on the response to disasters, the role of heritage should be explored also with respect to the ordinary life of territories, and the pursuit of wide-ranging, long-term solutions to ecological disruption and deterioration.

Some valuable contributions may come from the studies developed in Spain by the Landscape Observatory of Catalunya and in Italy by the "Scuola Territorialista". Here the paradigm of landscape is seen, thanks to its interdisciplinary and integrative nature, as a powerful tool to address anthropogenic environmental issues, seeking solutions in the social and cultural sphere, which is where the problems come from. For water especially, landscape can interact with the complexity of uses and actors involved (Nogué *et al*., 2016). Starting from a concept of heritage far from the reifying and globalizing definition of UNESCO (Choay, 2008), an ecological conversion project can finally be conceived, which is grounded on a reconstruction of the relationship between the territory and its people, and a redefinition of the elements that contribute to the production of space.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Marine Spatial Planning in a recently established Protected Marine Area

SESSION:
Coastline Geography and Coastal Landscape: territorial dynamics and integrated protection

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Marine habitats' impacts and conflicts are mainly due to humanity development (pollution, coastal management, tourism, navigation, fisheries, etc.) and each Marine Protected Area has in its own mission the mapping and monitoring of the habitats' conditions in order to set the right rules for managing both protection and sustainable development at the same time.

Marine habitats are generally defined by physical features and characteristic species. Nonetheless, habitat types are not clearly distinct regions with precise boundaries in nature. Benthic habitats are considered as important drivers of diversity and therefore modifications or losses of habitats represent as serious threat to marine ecosystems. Due to the heterogeneity of habitats and limited available data, the monitoring of habitat status is a great challenge for ecological assessment programs.
Monitoring and assessment of the sea and coast, based on scientific knowledge, are the indispensable basis for the management of human activities, in view of promoting the sustainable use of the seas and coasts and conserving marine ecosystems and their sustainable development. Habitat's typical species and communities' definitions are based on published data issued from recent or ongoing research projects/studies, therefore they are also subject to revision as further knowledge and baseline data become available on a risk-based approach.

Habitat destruction is one of the most pervasive threats to the diversity, structure, and functioning of Mediterranean marine coastal ecosystems and to the goods and services they provide (Bazairi et al., 2010, Danovaro et al., 2010, Martin et al., 2014, Telesca et al., 2015, Boero, 2003, Claudet and Fraschetti, 2010 and Airoldi and Beck, 2007).
The proliferation of coastal and marine infrastructures, such as breakwaters, ports, seawalls and offshore installations calls for special concern, being them all associated with loss of natural habitats and alteration of hydrographic conditions (Perkol-Finkel et al., 2012).

*Specific attention should be given to the types of marine habitats (defined at different levels) covered by the Updated Reference List of Marine Habitat Types for the Selection of Sites to be included in the National Inventories of Natural Sites of Conservation Interest in the Mediterranean (UNEP/MAP-RAC/SPA 2017) and EU Nature directives. Marine habitat types in Annex I of the EU Habitats Directive (92/43/EEC), based on MSFD Common Implementation Strategy (2012), with the exclusion of estuarine habitats, are given below (the asterisk * after the code stands for Priority habitats):*
1110: Sandbanks which are slightly covered by sea water all the time
1120: Posidonia beds (Posidonion oceanicae)*
1140: Mudflats and sandflats not covered by seawater at low tide
1160: Large shallow inlets and bays
1170: Reefs
1180: Submarine structures made by leaking gasses
8330: Submerged or partially submerged sea caves

Each information needs to be defined in space and time dimensions.
For a good knowledge of marine habitats we need powerful tools to survey, locate, analyse, monitor, manage: GIS (Geographic Information Systems) environments and spatial tools are commonly used to overlay, correlate, process, store and distribute information in relation to space and time.

In the absence of good distribution datasets or distribution data at all, we need to plan, fund and carry on new sea bottom surveys.
The mapping procedure includes different actions, which can be synthesised into three main steps:

1) *initial planning*
2) *surveying*
3) *processing and data interpretation*

1) Initial planning includes the definition of the objectives in order to select the minimum surface to be mapped and the necessary resolution. During this initial phase, tools to be used in the following phases must be defined and the effort (human, material, and financial costs) necessary to produce the mapping evaluated. A successful mapping approach requires the definition of a clear and feasible survey strategy.

2) Surveying is the practical phase of data collection. It is often the costliest phase as it generally requires field activities. A prior inventory of the existing data for the area being mapped is recommended, to reduce the amount of work or to have a better targeting of the work to be done. 3) Processing and data interpretation are doubtlessly the most complex phase, as they require knowledge and experience, so that the data gathered can be usable and reliable. The products obtained must be evaluated to ensure their coherence and the validity of the results achieved.

This paper shows the steps that have been already taken by the recently established Protected Marine Area "Capo Testa – Punta Falcone" and the further ones still needed in the near future to keep a seasonally updated and efficiently managed GIS, a specially useful tool for managing protection and sustainable development.

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IX Simposio Internazionale “ll Monitoraggio Costiero Mediterraneo: problematiche e tecniche di misura”
Livorno, 2022

Coastal municipalities of Campania. Urban load, environmental load, sustainability, and climate change adaptation.

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Abstract

Among the environments, coasts are one of the most affected by phenomena related to climate change. They represent a delicate interface connecting the terrestrial environment with the marine one whit the creation of very relevant interrelationships and criticalities.
Furthermore, the coasts are characterized by a considerable presence of human settlements. Consequentially, increasing vulnerability of the population and ecosystems becomes a challenge for the management of the coast lines, which should achieve a reduction in their vulnerabilities through the coherent spatial organization of coastal zones and by increasing the resilience of coastal systems.
The Campania coast is characterized by a multiplicity of natural environments which, presumably, will respond in different ways to the processes of climate change. A special attention should be paid to the stretches of low and sandy coast present in the northern and central sections of the territory, potentially affected by sea level rise phenomena. The rest of the coast, which is higher and rockier, also presents critical issues that must be kept under control and therefore investigated in order to intervene with the most appropriate measures. These measures are no longer just the classic ones deriving from soil and water engineering, but they involve the planning tools, with the inclusion of measures based on principles of adaptation to climate change.
From these considerations derives the interest in analyzing the relationship existing between territorial planning and dynamics of the Campanian coasts. To this end, the analysis will develop in three phases: 1) deeping of the urban and territorial plans in use in the provinces and involving the coastal municipalities of Campania; 2) formalising of a system of indicators; 3) construction of an environmental pressure index of the municipalities of the Campanian coast using multi-criteria analysis techniques. The results can be viewed using a GIS application.
Starting from this methodology, main results of the paper are: a) to identify the pressure conditions present on the Campania coast, and b) to determine the level of awareness of local authorities regarding the impacts of climate change along this specific territory characterized by a high settlement density.

Sessione: GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
COASTAL ENVIRONMENT AND LANDSCAPE IN A SCENARIO OF CLIMATE CHANGE: THE INCIDENCE OF PORT AREAS

SESSION:
GEOGRAFIA E PAESAGGIO

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

In the history of the development of the coastal strip, the activities linked to the port (such as fishing and its induced activities, nautical tourism, etc.) have represented the main cause of its expansion.
Here, the theme of tangible cultural heritage and its forms of expression will be revisited in a different key, referring above all to the constructive archetypes, which constitute the first testimony of the activities of the craft-industrial type activities, which originally strongly characterized the minor ports.
In a preliminary way, we want to focus the analysis on the potentialities from a system of areas predominantly free of buildings and available to be subjected to a regenerative process, introducing the theme of reconfiguration of the soil and starting from available data and surveys, highlighting the most representative contemporary built elements and theirs relationships with the open areas. The main interest is directed to materials and technologies that are considered suitable for a green conversion of surfaces (vertical and horizontal), starting from the crucial issue of climate change, until the definition of any nature-based solutions (NbS). The latter seem essential for a different and more sustainable complementarity in the organization of open spaces, keeping in mind a principle of balance between effectiveness / time / costs to ensure a rapid impact in urban transformation policies.
The global climate change and its local projection have imposed in recent years a careful analysis of the complexity of urban systems, as well as the relationships and connections with the peripheral systems that represent the boundary conditions of the city. For coastal cities this relationship is identified especially from the city-port interface, generally declined as waterfront capable of representing an ever renewed element of exchange of flows, flanking its infrastructural function also the social, economic and environmental (Carta, 2012).
In this direction, the regeneration of port-cities has always been considered one of the most important fields for experimenting with new development policies, thanks to the decisive role that the waterfront assumes for urban dynamics (De Luca, 2012)
The case studies examined belong to the category of small Adriatic ports; in particular the port of San Benedetto del Tronto and Civitanova Marche. As one travels through the two linear cities that wind along the coast, the perception of the presence of ports is almost absent. This sensation seems to be a constant in all the coastal Adriatic landscape, despite the fact that the size of the port areas (looking at the parameter of land occupation) has a significant impact on the urban areas in direct contact with the historic centers.
Therefore, the availability of a large amount of free space near the city centers makes these sites particularly suitable to be the object of urban regeneration, or "green densification".

In the case studies examined, the percentage of land occupied by the port with respect to the urban area defined by a compact built-up area is 34% for Civitanova Marche and 29% for San Benedetto del Tronto. It is therefore a portion of the city capable of offering a significant contribution to the transition towards sustainable transformation processes.
In this context, we believe that the complexity of the port system requires a transdisciplinary methodological approach, capable of studying open areas micro-climatically, interpreting the relationship between open space and the presence of the built environment - very often consisting of "light" technologies (sheds) -, working on horizontal surfaces with "de-sealing" actions in order to translate the waterfront plant into an element of thermodynamic mediation, exploiting for example the evapotranspirative action of green, the permeability of natural materials, the retroreflective action of the "cold surfaces" and the shading capacity of horizontal surfaces of coverage.
This complexity suggests the use of a parametric system that allows to "associate functionally" the material, morphological, meteoclimatic characteristics through complex relationships, describing the environmental system in respect of its information complexity (Cocci Grifoni,2018).
The workflow can use different tools for analysis and numerical simulation managed in a single platform (Grasshopper). It consists of a software development environment with which it is possible to generate proprietary algorithms also in iterative form and always have a parametric control on every aspect of the process. To move adequately within this space of work it is necessary to place side by side to the common "project" thought a new "parametric" thought.

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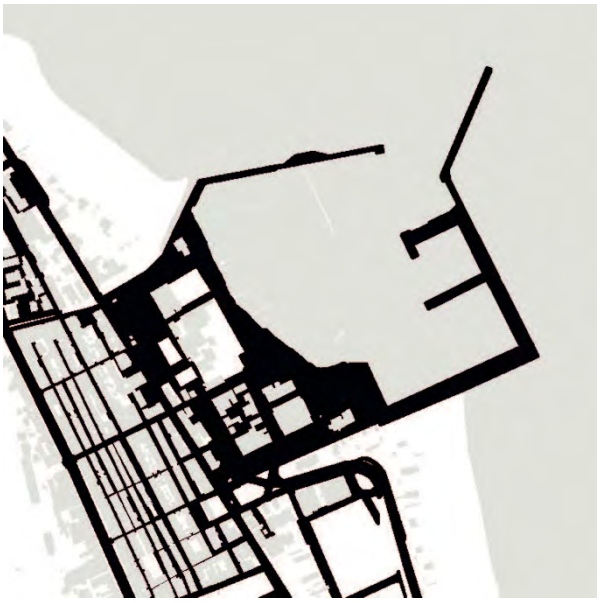
Porto di Civitanova Marche e di San Benedetto del Tronto – Incidenza delle superfici asfaltate



Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: NOT JUST RESTRICTIONS. THE MIPAT PROJECT: A SOUNDSCAPE AND PROACTIVE CONSERVANCY EXPERIENCE OF THE NATURAL RESERVE' LA TIMPA' IN ACIREALE.

SESSION:
Geografia e paesaggio della fascia costiera: dinamiche del territorio e tutela integrata

AUTHORS:
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ABSTRACT

The Sicilian coastline was dramatically modified between the 1960s and the 1990s by an aggressive building construction activity. What remained of this natural heritage was conserved by the establishment of protected areas, such as parks and nature reserves. As evidence of what mentioned, it is enough to observe that almost half of the 72 regional natural reserves (integral and oriented) are comprised in coastal areas (to name but a few: RNI of Zingaro, RNI Saline of Trapani and Paceco and RNO Biviere of Gela). Hence, today's protection of natural heritage and coastal ecosystems is based mostly on the weak efficacy of these statutory and normative instruments.

In fact, the current Sicilian regulatory system, concerning the protection of natural heritage (Regional Law 98/81, Regional Law 14/88 and Regional Decree 970/91) is limited to define boundaries for dividing the protected areas into zones with different levels of restrictions. In this respect, little attention has been paid to the management and enhancement strategies for a systemic and holistic care of the natural heritage. Furthermore, although the idea that it is necessary to implement proactive forms of management – as governance innovations and collaboration of a multitude of territorial actors - has long been advanced in the academic debate, there remains a large gap between theory and practice (Giacomini & Romani, 2005).

With the aim of getting a deeper understanding of how to operationally advance research, improve socio-ecological relationships, and promote a new alliance between people and nature, the case shows a research experience in the coastal area of the Oriented Natural Reserve "La Timpa" in Acireale (Eastern Sicily). The research process is particularly inspired by contemporary epistemological theories and the transformative power of collective learning (Argyris & Schon, 1996).

The Timpa – a precious example of Etnean rural-coastal landscape – was established after a troubled history. The reserve, if on the one hand, took away a portion of territory from the mafia business, on the other hand, its management never really existed.

Since 2019, it has been possible to experiment innovative ways of scientific investigation and a collective process of territorial identity thanks to the MIPAT project (funded by Fondazione con il Sud in a Public/private partnership).
An integrated approach was adopted for the study and monitoring of the Natural Reserve of La Timpa in Acireale. The contribution of highly diverse partners to the project enabled the coupling of bio-ecological monitoring activities with the mapping and definition of the hydrogeological and environmental risks affecting the area. An eco-acoustic investigation (Pijanowski et al., 2011) was performed within the Reserve, based on the analysis of the spatial and temporal trends of the main biological, environmental, and anthropogenic components of the local soundscape. Terrestrial biodiversity was investigated, with a focus on native and transient birdlife. Furthermore, the acoustical characterization of the surveyed area resulted in the identification of sites more subject to anthropogenic pressure and sites that maintain higher naturalistic content. External participants were involved in the research, starting a process of "citizen science" (Irwin, 1995). Finally, project results were shared with the local population during dissemination seminars and interactive laboratories.

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: PLAN OF USE OF THE MARITIME STATE PROPERTY OF CAPO D'ORLANDO AS AN OPPORTUNITY FOR SUSTAINABLE PLANNING OF THE COASTAL ZONES AND RE-DESIGN THE WATERFRONT

SESSION: GEOGRAPHY AND LANDSCAPE OF THE COASTAL STRIP: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The instrument of territorial planning of the coasts defined as a plan for the use of maritime property (in accordance with Regional Law 29 November 2005, n. 15 and subsequent disposal law) represents for the coastal zones of the Sicilian Region the opportunity to reflect and make the use of these areas in very delicate from an ecological point of view. Like most of the coastal municipalities also the town of Capo d'Orlando (administratively falling within the Metropolitan City of Messina, which is about a hundred kilometers away and located on the Tyrrhenian coast with the Nebrodi Park behind it and in front of the World Heritage Of the Aeolian Islands) it is necessary to draw up the tool to allow a more balanced use of the use of the sea, not only for the free use but also for the use of these areas for private seasonal initiatives for the *loisir*. At the base of the plan there is a strong cognitive and evaluative apparatus of the territorial identity, in particular the territory has been the subject over the years by strong environmental and complex criticalities (cyclical events of coastal erosion, widespread urbanization and infrastructure along the coast, in the summer season a strong weighting of road traffic and the intense use of the sea, ...). The plan acts as an instrument of governance of the coastal territory in terms of economic, ecological, social, local and large area self-sustainability to allow a balanced management and a use compatible with terrestrial resources. This planning makes it possible to revise the overall structure of the municipal territory moving, first of all, from the management of the coast, penetrating into the urban redesign of the waterfront and inserting the themes of general urban planning on the various fronts up to the implementation tools. The plan sets out a broader vision of coastal planning based not only on administrative guidelines but starting from the recognition of territorial value, the weight of its heritage, its geography, its landscape and the dynamics that insist on this area. The coastal territory of Capo d'Orlando has a considerable extension of the sea front and articulated with a first strip (from the promontory of Capo d'Orlando in the direction of Palermo) consisting of a flat and sandy coastal extension; a second strip (from the promontory in the direction of Messina) consisting of a more material extension, made of stacks, coastal inlets with bays of modest entity of enormous historical, cultural and landscape value. The methodology of the plan - which has at its core the knowledge of the territory - identifies seven strategic areas of intervention (ASI) that constitute the areas of implementation design with the focus on some Key Areas on which the future coastal planning will focus on the relationship between man and the environment.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: REGENERATION OF HISTORIC CENTERS IN MEDITERRANEAN CITIES: THE CASE STUDY OF THE VENICE DISTRICT IN LIVORNO

SESSION: Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection

AUTHORS: Professor Claudio Piferi and PhD Student Valentina Spagnoli

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The contemporary city today is dense but discontinuous, made up of built, semi-built and open systems that need to be resolved with a new intervention methodology: the urban regeneration. Regeneration acts on the existing city both by upgrading infrastructures and services and by giving back regenerated spaces to the community. In Italy, historic center are not only of architectural value but are also the focus of the city's commercial, tourist and social interests: the first urban settlements took place, the first activities developed and the first buildings were constructed in these areas. In the case of the Mediterranean city, the value of the historic center is increased by the presence of the sea, which has often been the starting element for the development of the city and where activities, as well as places of interest, have settled from the coastal strip. Following the industrial period, with the growth of the population and the introduction of new means of transport, there was a weakening of the historic center in favor of an urban expansion towards the suburbs. On the other hand, today the redevelopment trend of the underused and degraded building stock of historic centers encourages construction in the already built-up area [Schiaffonati et al., 2017]. Part of the buildings composing the waterfront of Mediterranean cities, once indispensable for promoting the relationship between land and sea, are now presented as empty spaces that, now de-functionalized, show the degradation caused by the years and the saltiness: the waterfront of the city of Livorno represents, from this point of view, an emblematic case.

The first settlements in the city of Livorno were defensive, coastal and port structures. The Venice District, that is the city's central core, is located between the two 16th-century fortifications: the Fortezza Vecchia, near the port, and the Fortezza Nuova, in the city center. The visual identity of the city can be read from the system of navigable canals, called the Fosso Reale, which delimits and crosses the district, and for this reason takes on the name of "Venice". The system of existing canals and fortresses is the evidence of the historical-architectural development of a specific urban model, and represents for Livorno, an environmental, commercial, cultural, social and touristic heritage [Massa, 2015]. The fish market building was constructed in this part of the district near the port in 1967. The building, designed by architects Beata Di Gaddo (1921-2007) and Pietro Barucci (1922), stands out with its contemporary structure from the rest of the buildings and has become a landmark within the urban fabric, also due to its original roof [Tentore et al., 1964]. The area in which it is located has a complex morphology, divided into two parts by the Fosso Reale and connected by a raised roadway dating back to 1989. The road infrastructure, since its construction, has complicated the normal course of fishing activities and still constitutes a break in the neighborhood, rather than a connecting element. In addition to the overpass, the decline in the number of fishermen engaged in the sale of fish also contributed to the degradation of the building and the area, which quickly took on marginal roles. However, thanks to its centrality and significant proximity to some points of interest such as the ancient fortification, the port and the Museum of the City, the area has all the requirements to be a meeting place and a reference point for the inhabitants.

The following contribution wants to tell an experience of project research, aimed at the regeneration of this area, through the re-functionalization of the fish market and the design of all the access systems to the area, driveways, pedestrian and bicycle paths, which can allow a proper use by citizens and tourists. The change from a wholesale market to a city market would guarantee total accessibility of the building, which for years has been limited to a restricted circle of users. The outdoor space released from the overpass would become more spacious and be returned to the inhabitants of Livorno as a place of social cohesion. The project, by pedestrianizing almost the entire area of intervention, promotes not only a rationalization of the routes but, above all, a slowing down of the user's viability: it obliges him to cross it and observe it slowly, to take possession of it again [Careri, 2006]. In addition, the non-functional and degrading additions that have accumulated the area over the years will be eliminated. The design of the direct link with the port entrance, the new car parks and the large equipped green areas, at different levels, accentuate the new vocation of the site, which has been transformed from a transit place into a meeting place.

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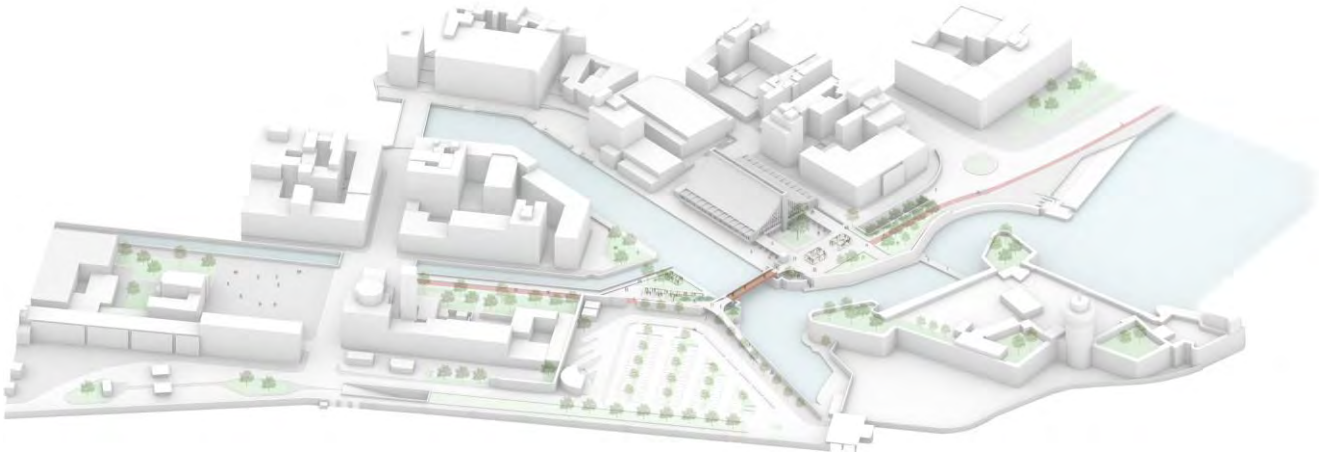
IMAGES: (MAX 2)

1. Livorno port area and fish market

2. Project



Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
Protecting Vagueira (Portugal) waterfront: preserving natural, recreational, residential, and commercial functions

SESSION:
Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection

AUTHORS:
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ABSTRACT:
It has been observed the shoreline retreat in Vagueira, a sandy beach located in the Central Portuguese littoral. Linked to it, there is the occurrence of overtopping and flooding events during the maritime winter and a lack of bathing areas in the summer, especially during high tide. The typical wave climate at this coastal strip is from the northwest and the sediment transport is wave-driven from north to south. In this regard, a longitudinal defence and one groin were installed in the late 1970s, having been subjected to further repair and maintenance operations since the construction date.

When analysing historical long-term tendencies, in the past 52 years occurred between 1958 and 2010, there was an average retreat of 5.2m per year from Costa Nova (updrift beach) to Vagueira and 3m per year from Vagueira to Areão (downdrift beach). For recent years and future horizons, it is predicted a lower rate of retreat, due to the bulkier and more frequent operations of artificial nourishment that are being carried out by the Portuguese Environment Agency and the regional Port Authority. Concerning the overtopping framework, the occurred events affected mainly the north and south limits of the Vagueira urban settlement, where the beach width is narrower, near the edges of the existing longitudinal defence. Also, the sediment trap updrift the groin promotes an intensified shoreline retreat in the south Vagueira. The last occurrences registered caused damage in the longitudinal defence and the utilities nearby. Regarding the bathing area, people usually flow and settle near the main accesses (Figure 1). However, the north access conflicts with the corridor used by fishing boats, although it is the preferred zone for sunbathers given its wider area; the middle access has almost no dry area during high tide; and in the access southwards there is the need to walk a longer distance to find a wider strip of dry beach, so people tend to avoid bathing there.

That being said, the goal was to develop a three-pronged solution to mitigate the erosion and overtopping phenomena and increase the beach width in front of the Vagueira urban settlement. Given the actual context (existing coastal structures and planned artificial nourishment operations), it was proposed to assess the efficiency of a wave-breaking structure - a detached breakwater placed parallel to the coastline, in front of the existing longitudinal revetment and north of the existing groin, to accumulate sediments in its wave shadow zone. For that, several scenarios were considered to explore design alternatives. A variety of lengths and distances to the shoreline was tested, as well as different orientations of the longitudinal axis in relation to the shoreline.

a) Urban waterfront and existing rocky revetment

b) View of the access located south of the Vagueira groin

Figure 1. Vagueira beach, Portugal.

The numerical model used to predict the shoreline position for each scenario (reference situation and detached breakwater alternatives) is called LTC – Long-Term Configuration (Coelho, 2005; Lima e Coelho, 2017), and it is calibrated for recent monitoring data and historical reference values. To map risk areas and analyse the modelling outputs (erosion and flooding areas), the QGIS tool was used. The model domain was defined centred in Vagueira beach with a total area of 6x5.6 km^2. To identify the land use and land cover classes, it was considered the COS2018 map produced by the Portuguese Directorate-General for Territory. To have a careful analysis of the impact of each scenario near the urban settlement, a more comprehensive classification of Vagueira was made according to COS2018 nomenclature, detailing the nearby land classes (essentially urban, commercial, and road network areas). The simulations were made for the medium-term, corresponding to a time horizon of 20 years, with annual outputs.

To assess the impact and efficiency of the additional defence structure, corresponding to the avoided coastal erosion and flooding areas, the final shoreline for each breakwater alternative is compared to the reference scenario (where the natural evolution of the shoreline is considered, according to present conditions). Specifically for the flood analysis, a land strip 50m wide was defined, based on historical measurements, with origin in the final shoreline position for each year and scenario.

Results demonstrate that there is no one-size-fits-all solution and the coastal management strategy to adopt must consider the following: on one hand, the implementation of a detached breakwater will increase the erosion downdrift the urban waterfront; on the other hand, the increase of the beach width in the shadow zone of the structure will expectably protect the Vagueira community during winter, promoting a safety settlement and less risky investment for the commercial and recreational utilities, and enhance coastal tourism in the summer since this beach is sought by Portuguese and Spanish visitors. The construction and maintenance costs of the detached breakwater must also be considered by the decision-makers.

Acknowledgements

The results derive from the Program coordinated by the Portuguese Environment Agency co-promoted by POSEUR - Programa Operacional Sustentabilidade e Eficiência no Uso de Recursos (Reference: POSEUR-02-1809-FC-000039). The work was also financially supported by the project "Integrated Coastal Climate Change Adaptation for Resilient Communities", INCCA - POCI-01-0145-FEDER-030842, funded by FEDER, through "Competividade e Internacionalização" in its FEDER/FNR component and by national funds (OE), through FCT/MCTES.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **THE TERRITORIAL ORGANIZATION OF THE AMALFI COAST: NATURE AND MAN'S INTERVENTION**

SESSION: GEOGRAFIA E PAESAGGIO DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The Amalfi Coast corresponds to the southern part of the Sorrento Peninsula, between Positano and Vietri sul mare and enclosed between the Lattari mountains, an offshoot of the Campania Apennines, the province of Naples and the valley of the Sarno river. The territory is marked by high and jagged mountain peaks, interspersed with deep valleys in which torrential streams flow, coming from the mountains behind, and overlooks the sea with high cliffs, here and there interrupted by short sandy coasts. Through a capillary work, between the X and XIII centuries, the land, strongly sloping, was tilled and terraced, obtaining narrow strips of earth, contained by dry stone walls, which allowed the development of cultures. The work led to the transformation of the impractical environment into a hospitable context, while at the same time constituting an organic system for controlling the soil and water, captured and used for irrigation. A dense network of roads, mainly stairways, was traced to serve the possessions, constituting the backbone for urban settlements, in the full fusion of the natural landscape with the built.

The connective element of this complex was the road network, which also ensured communications with the Neapolitan and Sorrento area, the Agro Nocerino-Sarnese and the Salerno area, which remained almost unscathed until the first half of the nineteenth century. This structure is still legible, despite the multiple alterations of the original topography, produced over time by natural events, such as landslides and floods, or by the construction of driveways started in the early nineteenth century, which completely subverted the way of traveling with the trend on the limit of the coasts, tunnels, hairpin bends, viaducts and bridges necessary to overcome reliefs, differences in height and frequent valleys.

The different villages, of common medieval origin, are located both on the coast and in the inland areas, at very different altitudes. Celebrated for their beauty and panoramic views, they are, in particular, the result of ingenious adaptations to often prohibitive tectonic conditions and of the maximum exploitation of the scarce resources available.

Examining the various areas we see that the coastal agglomerations west of Amalfi - located in the center of the coast - are located high above rocky walls that plunge into the sea. Instead, Amalfi itself and those on the eastern side are arranged at the mouth of streams, overlooking the beaches and exploiting the sides of the riverbed in which the waters flow for the plant. The narrowness of

the planting sites has produced particularly compact ensembles, in which the houses, distributed on the terraces and adhering to the hills, overlap, rising one on top of the other. Instead, if there are no restrictions on expansion, there are different villages, more or less spaced apart, as is the case in the hamlets of Amalfi, in the municipalities on the west side and in the mountain ones of Scala, Ravello and Tramonti.

The centuries-old isolation in which the coast lived up to the nineteenth century has preserved much of its landscape and environmental characteristics, which led, in 1997, to the recognition of a World Heritage Site.

The study aims to analyze the whole in its natural and man-made components, the criticalities of the environment, threatened by the abandonment of crops and terraces with consequent geological instability, carrier of landslides and floods and intense action anthropogenic, aimed at strengthening infrastructure, in view of the growing mass tourism.

REFERENCES: (MAX 4)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title:
Atmospheric agents and spatial planning. Case study of the Municipality of Rosignano Marittimo in Tuscany.

SESSION:
Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General framework and Objectives

From a historical point of view, the recent IPCC report (2021) exposes weather changes in every region of the Globe and the entire climatic system without precedents, and is irreversible, in hundreds or thousands of years. The report highlighting human influence on the climate both past and future, contributes to fundamental decision processes for limiting ongoing climatic change, at this stage only possible through a rapid and constant reduction of carbon dioxide (CO2) emissions and other greenhouse effect gases. Today, deciding to reduce climate altering gases on a large scale would mean sure benefits on air quality in the short term, but we would have to wait another 20 to 30 years to see global temperatures stabilize. Differently, the rise in temperature, even by only 1,5°C, would mean changes in water cycles, with heavy rains and flooding on the one hand, and severe drought in several regions, on the other. Coastal areas will be characterized by a continuous rise in sea level with more frequent coastal flooding in a much reduced time scan of events.
In Italy, a new climatic model was presented in 2018, with the variation of level of the Mediterranean, which was the result of a study by a group of ENEA researchers, in collaboration with the MIT of Boston. Its aim was to map coastal areas that risk flooding, as well as planning the territory and making it safe. The studies presented foresee that there will be a loss of tens of square kilometers in Italy's coastal areas by the end of the century, with receding beaches and agricultural areas, where half of the Italian population is concentrated.
However, the rising sea level and coastal erosion highlight the additional problem of delimitation of the maritime state properties and their management. The "navigation Code" of 1942 defines the assets of the maritime state properties, quoting, amongst other things, the shore, beach, ports and infrequent use. It not only regulates their use but also mentions possible extension, even to private areas, in case of need for public use of the sea.
Concerning this matter, the problem of managing the bathing concessions on state properties seems to be current more than ever, but with a different profile. The State Council has recently established that in 2024, the so-called Bolkstein European Directive will have to find an application with the competition, therefore, the bathing concessions will no longer be extended. The problem solicited by the reassignment of the bathing concessions on the assets of the maritime state properties affected by climatic changes along coastal areas, seems evident.
The proposed paper intends to have an in-depth study of the role of planning in the maritime state properties subject to the effect of atmospheric agents, through the presentation of a case study of a coastal municipality in Tuscany.

In the past few years, the Municipality of Rosignano Marittimo has been repeatedly affected by ever increasing and intense meteorological phenomena, causing damage to people and urban settlements along the coast. The extreme

meteorological events like intense downpours, floods, tornadoes, intense storm surges together with the critical issues caused by the ongoing coastal erosion, point out a series of problems.
The Council administration has recently participated in the ADAPT European project, a Program of transborder cooperation between Interregional Maritime Italy and France - 2014 - 2020, aimed at defining a local Climatic Profile and a Plan of Adaptation to Climatic changes. At the same time, the editing staff of the municipal structural plan has started a method investigation in coherence with the regional Tuscan law 65/2014 on the governance of the territory, with the scope of finding answers to some of the critical issues investigated. However, the topic of climatic change expresses deep profiles of uncertainty, due to potential long term climatic response times, as compared to possible actions to be taken today. The evolutionary framework of the coastal belt produces a dynamic definition of a coastline to which the continuous delimitation even of areas of maritime state property assets, correlates in the making. Therefore, the dynamism of the coastline immersed in uncertain flows of atmospheric agents raises a fundamental question to the delimitation of state property areas, on which the political decision maker is called upon to express himself through a territorial planning setup.
The physical definition of the coastal system and the management definition of same are topics that are treated in the paper proposed, that sets the goal of defining a possible methodological approach through the presentation of the case study for territorial planning in coastal areas, able to define a flexible cognitive framework, by means of which to distinguish strategies in the short and long term, for planning and managing of maritime state property assets.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

TITLE: DEVELOPMENT OF A SUSTAINABLE ACCESSIBILITY MODEL FOR THE MARINE PROTECTED AREA GAIOLA UNDERWATER PARK, IN NAPLES, ITALY.

SESSION: GEOGRAFIA E PAESAGGIO E DELLA FASCIA COSTIERA: DINAMICHE DEL TERRITORIO E TUTELA INTEGRATA E/O PATRIMONIO CULTURALE COSTIERO E SUBACQUEO.

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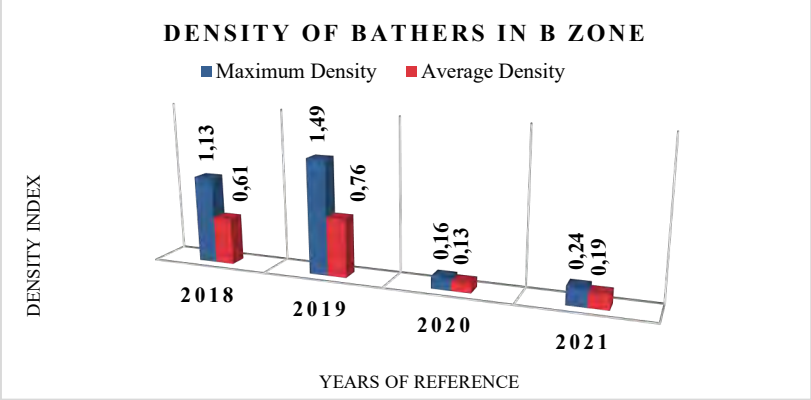
ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

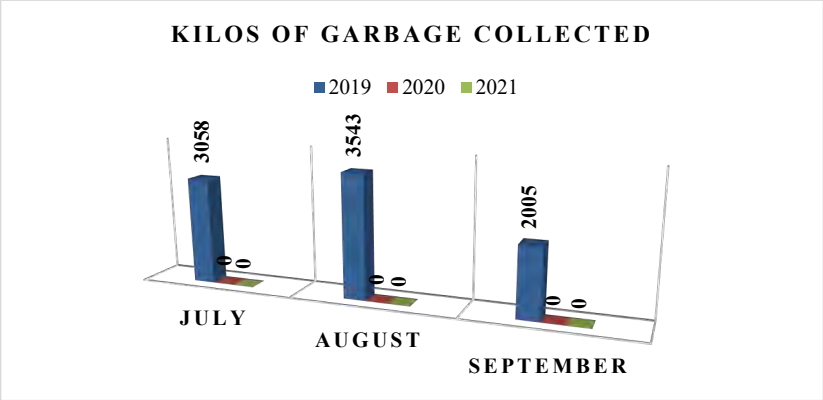
The Marine Protected Area (MPA) Gaiola Underwater Park was instituted in 2002 and since 2019 is managed by the Centro Studi Interdisciplinari Gaiola onlus. The MPA is located in the extremely densely inhabited coastline of the city of Naples, in Italy.



Graph. 1-This graph shows the difference in space occupation/density in the MPA public beach considering both maximum and average density in 2018, 2019, 2020 and 2021. The density is calculated counting the number of people per square meter.

Due to the urban context where the MPA is located, the anthropic pressure on the site has always been high and it has always undermined the preservation of the cultural and environmental heritage of the site itself. Particularly, it is important to mention that in the General Reserve Zone B of the MPA there is a public beach, which, as the data collected over the years prove, has always been impacted by great problems of overcrowding that have always undermined a safe and sustainable use of the area. Until 2019, the average people flow in this beach of the MPA was of 500/800 people per day in April and May and up to 800-1200 people per day between June and August in an area of 500 m^2, with a vital space per person of only 0,67 m^2 in the most crowded days. This situation clearly undermined the protection of the cultural and natural site, as well as the safety of bathers and visitors.
The overcrowding was due to the misleading perception of the of the Gaiola MPA as a simple sun-and-bathe destination. This issue is particularly serious if considering that the area where the public beach is located, in the General Reserve Zone B, is also characterized by a high archaeological interest and is the area where all the findings of the last years occurred. As it has been monitored, the overcrowding had also a huge environmental impact on the area; for an instance, during the summer months of June, July and August 2019 it was registered a production of up to 90 kg of waste per day (3000 kg per month ca).
Moreover, studies carried out throughout the years prove how the overcrowding of the area during the summer months was an obstacle to the many awareness creation campaigns carried out by the Manager Authority of the MPA; in fact

the presence of a high number of people on a small stretch of coastline constantly drove the attention of the MPA staff towards monitoring and prevention of illicit activities and safety problems. The need of constantly monitoring the situation of the overcrowded beach was an obstacle to carry out environmental and cultural education activities directed at the sun-bathers of the MPA.



Graph. 2 – Kilos of garbage collected in the MPA public beach

During the recent Covid-19 crisis, the problems related to the overcrowding of the Park became even more urgent due to the need of guaranteeing social distancing to prevent the diffusion of the infections. The safety problems highlighted by the pandemic drove the Manager Authority attention on the need to finally change the paradigm of management of the MPA and to study a new model of accessibility that allowed to keep a safe environment, a more respectful preservation of the environmental and cultural heritage of the Park and, at the same time, a safer and more enjoyable experience for the visitors. Particularly, thanks to the collaboration with other public institutions of the city of Naples, a new accessibility model was developed, starting from an evaluation of the actual and sustainable carrying capacity of the area, so to manage the number of accesses to the MPA and keeping at the same time the site totally enjoyable for the citizens. The new management model was developed between 2019 and 2020 during the Covid-19 pandemic by creating an online booking system and it was experimented starting from July 2020. Furthermore, as an outcome of the excellent 2020 results, in 2021 this management model has been enhanced to keep ensuring the safety of the visitors and the preservation of the natural and archaeological heritage of the MPA, as required by the competent Ministries and authorities. Since the beginning of the experimentation in 2020 a monitoring activity was carried out so to evaluate the impact of the new model on the experience of the visitors, on awareness creation campaigns and on the preservation of the environmental and cultural heritage of the MPA. This work is aimed at presenting the results of the monitoring activities carried out in 2020 and in 2021 after the experimentation of the new management model and it represents a good case study for developing accessibility strategies in densely visited or urban sites where it is necessary to find a balance between accessibility and preservation as well as to allow visitors and sun bathers to enjoy cultural and natural heritage in a safe environment.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: SMART CRUISE DESTINATION: ELEMENTS FOR SUSTAINABLE DEVELOPMENT

SESSION:
COASTLINE GEOGRAPHY AND COASTAL LANDSCAPES: TERRITORIAL DYNAMICS AND INTEGRATED PROTECTION

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):
IN THE CONTEXT OF A SEARCH FOR MORE SUSTAINABLE MARITIME TRANSPORT SYSTEMS AND SEEKING TO REDUCE THE ENVIRONMENTAL IMPACT PER PASSENGER, IT IS NECESSARY TO IMPLEMENT TECHNOLOGY IN PORT FACILITIES UNDER THE SMART PORTS APPROACH, IT CAN ALSO CONTRIBUTE TO ACHIEVE THE SUSTAINABLE DEVELOPMENT GOALS (SDG) 2030 AGENDA. THE OBJECTIVE OF THIS COMMUNICATION IS TO PRESENT THE MAIN CHALLENGES ASSOCIATED WITH THE ADOPTION OF THIS PERSPECTIVE IN PORT TERMINALS AND CRUISE LINES, FOR WHICH AN ANALYSIS IS CARRIED OUT FROM A TECHNOLOGICAL POINT OF VIEW, WHICH IS RELATED TO THE IMPLEMENTATION OF NEW TECHNOLOGIES IN ORDER TO IMPROVE THE OPERATIONAL PERFORMANCE OF PORTS, PROVIDING SOLUTIONS IN ENERGY MANAGEMENT AND ENVIRONMENTAL PROTECTION THAT RESPOND TO CURRENT WORLDWIDE CHALLENGES. FURTHERMORE, ACCORDING TO THE OBJECTIVES, THE AVAILABILITY AND VIABILITY OF INFRASTRUCTURES THAT CAN SUPPORT CRUISE SHIPS TOGETHER WITH THE STUDY OF THE USE OF ALTERNATIVE FUELS AND OTHER SUSTAINABLE METHODS ARE BEING STUDIED. A BIBLIOGRAPHIC REVIEW IS ALSO CARRIED OUT ON NEW METHODS AND EFFICIENT MANAGEMENT SYSTEMS IN THE PASSENGER TERMINAL IN THE CITY OF CÁDIZ. ON THE OTHER HAND, IT IS CONSIDERED TO PROMOTE A MORE SUSTAINABLE MARITIME TOURISM FROM A SOCIAL, ECONOMIC AND ENVIRONMENTAL OUTLOOK, IN ACCORDANCE WITH THE EUROPEAN STRATEGY FOR BLUE GROWTH AND THE CONTEXT OF SMART TOURISM. TAKING INTO ACCOUNT ALL THESE ASPECTS ALONGSIDE OTHER RELATED ISSUES, THE RESULTS MATERIALIZE IN CONCRETE PROPOSALS FOR PORTS AND THEIR FACILITIES UNDER STUDY.

KEYWORDS: BLUE ECONOMY, SUSTAINABILITY, SMART TOURISM, TERMINALS, GOVERNANCE.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **Analysis of the social and institutional adaptive capacity to climate change in the Catalan coastline**

SESSION: **Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection**

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The aim of this communication is to carry out an analysis of the social and institutional adaptive capacity to climate change of the Catalan coastline at the municipal level. It is presented to the session Coastline Geography and Coastal Landscapes: territorial dynamics and integrated protection which coincides with the topics dedicated to the geography of the coastal strip, to the dynamics of landscapes and anthropized areas; to the history, description, and classification of the landscape, to its design, planning, legislation and integrated management. This work is part of the initiated research: C3RiskMed (PID2020-113638RB-C21/AEI/10.13039/501100011033)

The conceptual framework of the study is adaptive capacity, a multidimensional concept that for a long time, in climate change vulnerability studies, has remained in the field of social sciences but has recently started to be used in other disciplines beyond the strictly physical-climatic one, due to the fact that vulnerability is a dynamic process determined by social, economic, political, cultural and institutional processes (Sauer et al. 2021; Mussetta et al., 2016).

The most used approaches are socio-economic, biophysical and the one that integrates the two approaches (Choden et al., 2020). Beyond the characteristics of the physical system, institutions and human systems may be able to cope with climate variability and risks from natural phenomena. This adaptive capacity Adaptive Capacity (AC) is multidimensional and is expressed at different scales. Thus, in the fifth IPCC report (2014) vulnerability is not expressed exclusively based on climatic factors, but as a product of the intersection of social processes expressed in socio-economic inequalities.

Our study area encompasses all the municipalities along the coast of Catalonia. It consists of 12 counties in which there are a total of 70 coastal municipalities, an area with a length of 580 km and a high linear population density that corresponds to more than 10,000 inhabitants per kilometre of coastline for Catalonia as a whole.

The indicators developed in this study have been classified following the same classification proposed by Klein et al. (2014), Biesbroek et al. (2013), Calliari et al. (2019) of institutional barriers to adaptation, which can be related to three types of indicators or subgroups:

1. policy and policy frameworks and approaches (plans and regulations at different scales).

2. Governance structures (Associated tissue)

3. Values and perceptions (environmental education endowments and conflictivity).

The results are presented in a series of adaptation maps that show the situation at the municipal level. There are also 4 focuses of approach and deeper analysis on the territories that for different reasons are of interest to us: Alt Empordà (tourism versus environmental protection), Maresme (high exposure of infrastructures and urban land), Barcelona Metropolitan Area (overpopulated and heavily anthropized area) and the Ebro Delta (the paradigm of vulnerability in our house).

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Coastline Geography and Coastal Landscapes: Territorial Dynamics and Integrated Protection Session

STORYTELLING IN WATERFRONT PLANNING AND DESIGN: KADIKÖY-YELDEĞIRMENI CASE, İSTANBUL

SUSTAINABILITY OF HISTORICAL AND CULTURAL HERITAGE IN WATERFRONTS: LEARNING FROM KADIKÖY-YELDEĞIRMENI STORY, İSTANBUL

A CASE OF WATERFRONT PLANNING AND DESIGN STORYTELLING: KADIKÖY-YELDEĞİRMENİ, İSTANBUL

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Abstract – In terms of planning and sustainable development of coastal areas; preservation and development of natural landscape, historical and cultural values, planning and design in harmony with natural, structured and socio-economic environment are extremely important.

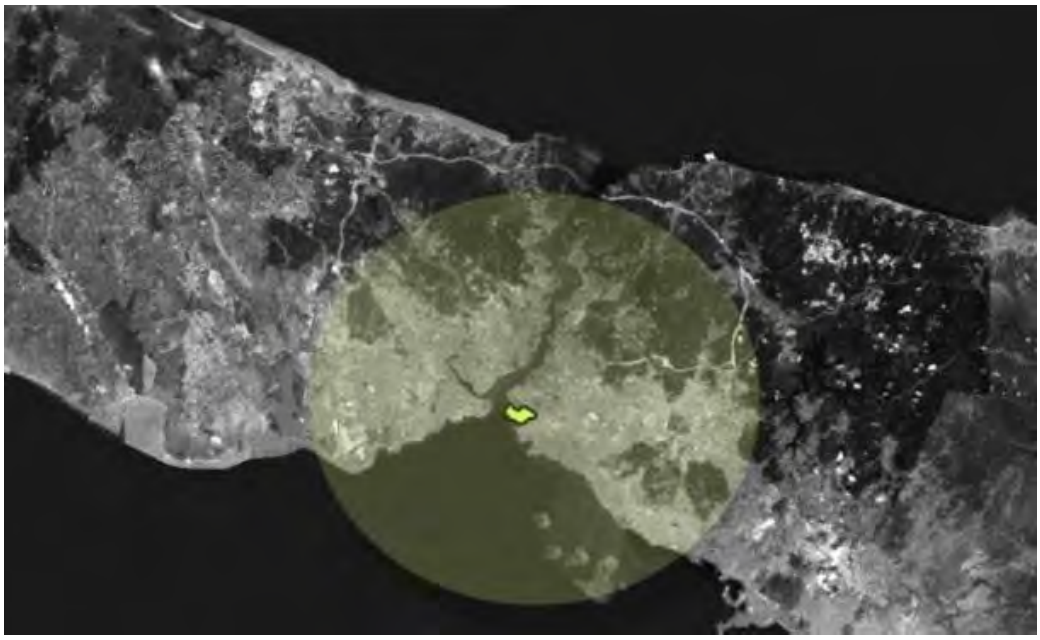
For a successful coastal development, an active and participatory planning based on interaction and a common consensus among the public and private interest groups, non-governmental organizations and the public in the region, is considered as a prerequisite in today's planning approach, (Millspaugh, 2001; Bruttomesso, 2001; Wang, 2003; Sairinen and Kumpulainen, 2006; Radosavljević, 2008; Bertsch 2008, Zyl, 2009; Yassin et al., 2011; Chiau, 2011; Jelovac, 2013).

Within the spatial planning and design process, which itself is also a storytelling; the investigation of the stories (experiences) of the actors involved in the process allows the detailed evaluation of the whole planning duration. Research on the important role of urban stories and storytelling approach in planning and design processes has been increasing in the last 20 years. (Bruner, 1991; Throgmorton, 1992; Forester, 1996; Webster and Mertova, 2007; Childs, 2008; van Hulst, 2012; Asada, 2015; Campbell, 2016; Vaananen, 2016). Revealing the stories of actors which reflect their subjective and social experiences specifically about the place, is seen as a powerful tool, in developing an inclusive and participatory planning approach. This approach, revealing the perspective of many actors with different backgrounds, values and interests, supports a social learning process to build the future of society together in the preservation of historical and cultural values specific to the place, improving the quality of life and building the identity of the place.

In this study, which intends to protect the historical and cultural heritage of Kadıköy-Yeldeğirmeni, it is aimed to present the interviews with the actors involved in the spatial planning and design process with the storytelling approach and to evaluate the planning process. It is seen that actors with different social, economic and cultural backgrounds can socially interact with each other in the spatial planning process, and this interaction plays a direct role in protecting local values, creating sense of belonging and building community identity. Participatory methods and tools used in the planning process are found to be effective in increasing social interaction and building trust relationships, revealing the interaction between people and space and developing a human-oriented design approach.

Keywords: Waterfronts, historical and cultural heritage, spatial planning and design process, storytelling, Kadıköy-Yeldeğirmeni, İstanbul.

It is intended to present this study for Coastline Geography and Coastal Landscapes: Territorial Dynamics and Integrated Protection Session.



Location of Study Area (Kadıköy Yeldeğirmeni) in İstanbul Bosphorus, Turkey

Aerial Photo of Study Area - Kadıköy Yeldeğirmeni

SESSION

COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

ORAL PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

The ESA Project ULYSSES: Soil Sealing Assessment and Monitoring

SESSION:

COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

AUTHORS:

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Soil sealing – also called imperviousness – is defined as a change in the nature of the soil leading to its impermeability. Soil sealing has several impacts on the environment, especially in urban areas and local climate, influencing heat exchange and soil permeability; soil sealing monitoring is crucial for the Mediterranean coastal areas, where soil degradation combined with drought and fires contributes to desertification.

Some artificial features like buildings, paved roads, paved parking lots, and other artifacts can be considered to have a long duration. In general, these land cover types are referred to as permanent soil sealing because the probability of coming back to natural use is low. Other land cover features included in the definition of soil sealing can be considered reversible. For them, the probability of coming back to natural use is higher. The land cover classes that are included in the reversible soil sealing have been defined with the users of the project, and include solar panels, construction site in early stage, mines and quarries, long-term plastic-covered soil in agricultural areas (e.g., non-paved greenhouses).

The project Mediterranean Soil Sealing, promoted by the European Space Agency (ESA) in the frame of the EO Science for Society – Mediterranean Regional Initiative, aims to provide specific products related to soil sealing, its degree and reversible soil sealing over the Mediterranean coastal areas by exploiting EO data with an innovative methodology capable to optimise and scale-up their use with other non-EO data. Such products have to be designed to allow – concerning current practices and existing services – a better characterisation, quantification and monitoring within time of soil sealing over the Mediterranean basin, supporting users and stakeholders involved in monitoring and preventing land degradation. The project started in March 2021, will produce the first results in March 2022 and the final products in March 2023.

The targeted products are high-resolution maps of the degree of soil sealing and the reversible soil sealing over the Mediterranean coastal areas (within 20km from the coast) for the 2015-2020 time period, at yearly temporal resolution with a targeted spatial resolution of 10m.

The team

The project team is led by Planetek Italia, and composed by ISPRA and CLS.

Planetek Italia is in charge of the development of the infrastructure, the engineering of the algorithms and the communication activities. CLS is in charge of the soil sealing mask and of the experimental reversible soil sealing processing algorithms, ISPRA of the soil sealing degree processing algorithms. The interaction

with the users is led by ISPRA, institutionally involved in the land degradation theme into international and regional organisations and the national body responsible for the theme in Italy.

Methodology

The general workflow for the production of Ulysses products is shown in Figure 1.

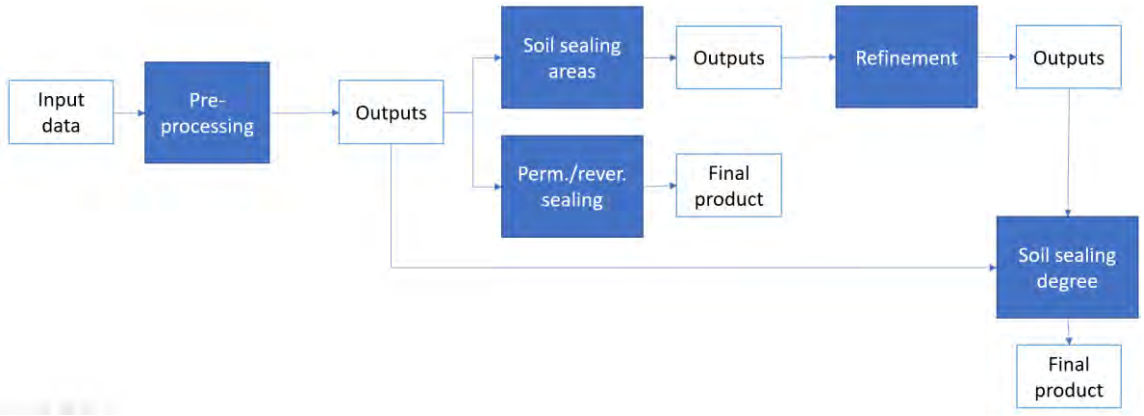

Figure 1: General workflow of the processing chain.

The processing chain is split into four parts: Pre-processing; Soil Sealed Masks Production; Permanent/reversible Soil Sealing Production; Computation of the Soil Sealing Degree.

In the pre-processing, L2A and L3 images are derived from L1C Sentinel 2 data, while, from the Sentinel 1 acquisitions, the backscatter images and the coherence images are derived. The core of the processing chain is the second step in which AI algorithms are applied to derive the soil sealing mask: a binary image in which artificially covered pixels are identified. A refinement step is required to improve the quality of the mask. In parallel to the production of the sealing mask, the identification of Reversible Soil Sealing is performed. In the final step, the soil sealing degree is computed.

REFERENCES: (MAX 4)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
OPTIMIZATION MODEL FOR A HYBRID PHOTOVOLTAIC/COLD IRONING SYSTEM: LIFE CYCLE COST AND ENERGETIC/ENVIRONMENTAL ANALYSIS

SESSION: INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):
As reported from the 4th GHG study [1], the greenhouse gas (GHG) emissions of total shipping have increased of 9.6% from 2012 (977 million tons) to 1076 million tons in 2018, passing from 2.76% to 2.89% of the global anthropogenic emissions. The progressive increase of the maritime traffics has caused an always greater impact on the port, often located in densely populated area. The decarbonization of maritime traffics turns out to be a mandatory step to reduce the environmental impact of the sector.

Among the studied solutions, cold ironing systems plan to power berthed ships with an onshore power supply. In fact, ships keep auxiliary engines running during the stay time at the quay, to produce the necessary electricity to hoteling activities (such as indoor air conditioning, lighting, pumps and fans). Cold ironing ensures a high level of local pollutants abatement, as allows to replace on-board diesel generators with the national electrical grid. Globally, with a lower environmental impact of the grid energy mix, a higher abatement efficiency is achieved.

In addition, the present trend of local and smart grid must be considered. Traditional grid is designed to transmit electricity from large centralized producers to consumers, while in future multidirectional network consumers are the producers themselves. Producing electricity locally has technical benefits, such as reducing losses and congestion in the grid. In this sense the integration of renewable sources is fundamental to produce clean energy, given its proximity to urban areas, and to match the energy demand of ports.

This research work investigates the energetic, economic and environmental feasibility of a photovoltaic (PV) plants located in port. An optimization model was developed and implemented on a software, to provide the best sizing of the system. The method is based on an hourly time step over a one-year period. The chosen parameter for the optimization is the Life Cycle Cost (LCC), as it allows to consider the entire life of the components. The dependent variable is the size [kilowatt] of the PV plant installed in the port. Both energy production and demand are analyzed. As regard the first group, solar radiation data and type of PV panels are considered. This way the power available in port is estimated at each time step. Energy demand is calculated through the maritime traffics in port and the energy requested by auxiliary engines from each ship. The model provides the match between the producer plant and consumers. Figure 1 shows the diagram flow for a single PV plant size.

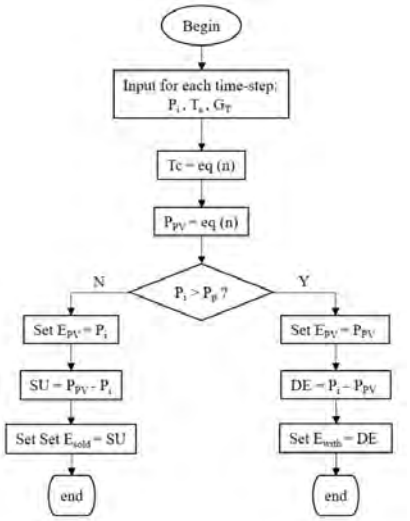

Fig. 1. Diagram flow of photovoltaic scenario.

Economically, the cost of PV plant per kilowatt is hypothesized, as well as the cost of energy withdrawn and given to the national grid. As regard the environmental impact, the emission factors of the major pollutants are involved in the calculation. Then the loop increases the PV plant size of a power step and repeat the loop. For each scenario the LCC associated is calculated and at the end the optimal size of the plant is highlighted. Figure 2 shows the diagram flow.

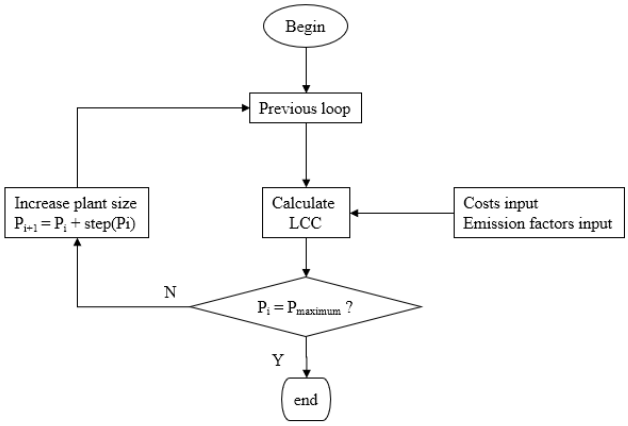

Fig. 2. Diagram flow of LCC loop.

Results, for each size of the plant simulated, provide:

- Covered percentage of the demand of berthed ships.
- Energy balance with the national grid (energy withdrawn and given).
- Life Cycle Cost (LCC).
- Environmental savings of major pollutants.

The port of Ancona is taken as a case study to verify the model. Ferry ships traffic is considered in the analysis over a one-year period.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
First investigation of microplastic pollution in Monastir sea surface water (Eastern Tunisia)

SESSION:
COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT

Microplastic pollution in the environment is a worldwide concern, as proven by the growing research interest on this issue. Almost all of the world's oceans and seas are currently contaminated with microplastics, but the Mediterranean Sea has been identified as a target hotspot of the world, with a microplastic concentration four times that of the North Pacific Oceanic threats across the globe and is becoming a topic of intense study for environmental researchers. Almost all of the world's oceans and seas are currently contaminated by microplastics, but the Mediterranean Sea has been identified as a global target hotspot, with a microplastic concentration four times that of the North Pacific Ocean.

The city of Monastir is a peninsula located on the east coast of Tunisia (eastern Mediterranean Sea), with a coastline stretching over 15 kilometers which offers a variety of beaches. The tourist and hotel industry are well developed and constitutes the main characteristic of the economic activity of the city with 48 hotel units and 15,000 tourists per year. In addition, the city is densely populated with 3,300 inhabitants and 2015 inhabitants / km² and an urbanization rate of 100%.

This study is the first to investigate the microplastic abundance and composition in Monastir Sea water. In the framework of COMMON MED-project, a sampling campaign was carried out during the month of December 2020 along two radials located in front of two tourist areas with different characteristics. The first radial (T1, Palmiers Beach) is distinguished by an intense tourist activity while the second radial (T2, Marina Beach) is characterized by the presence of a marina in addition to a high rate of urbanization. In each radial, three stations located at a distance of 1.5; 3 and 6 miles from the coast were sampled using a manta net (200 µm mesh size) dragged for 20 minutes. In each station, the surface water collected from the collector was filtered through an assemblage of two sieves of 5 and 0.3 mm in order to recover the microplastic particles which will subsequently be stored in 70% ethanol. In the laboratory, microplastics were characterized by size, type and color using a stereomicroscope and polymers were identified using Fourier Transformed Infrared (FT-IR) spectroscopy.

The results showed that the particles of microplastic (MPs), ranging between 0,31 and 4,9 mm have larger average sizes in radial T2 than those of radial T1 (2.2 mm and 1.7 mm respectively). For all the stations surveyed, white particles were the most frequently observed colors, while the most dominant type was fragment. Of all the MPs identified, High Density Polyethylene (HDPE) and Polyethylene (PE) were predominant in the water. MPs concentrations varied between 17,098 6,321 and 166,486,681 elements / km² with a density of 4 times greater in the T2 radial compared to the T1 radial, which shows the influence of urban and marina origin on plastic contamination

among seaside tourist one. In addition, the greatest concentrations were recorded at the level of stations S1 and S4 which are closest to the coast (26,997.84 and 166,486.68 items / km² respectively). This preliminary study should be consolidated by other surveys in time in order to study the effect of the season and in the space with the objective of covering the whole area and mapping the distribution of microplastics in the bay of Monastir.

Key words : Microplastic monitoring, Sea water, Polymers, Monastir, Tunisia

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title:

Environmental investigations in the Gulf of Pozzuoli (Naples) in relation to PAHs contamination

Session:

Coastal Environmental Engineering: pollution, energy production, monitoring and economic environmental assessment, regulatory context

AUTHORS:

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT:

The Gulf of Pozzuoli (GoP) is a marginal sub-basin of the south-eastern Tyrrhenian Sea, that is semi-enclosed by the Cape Miseno in the northern part of the GoP, and by the Island of Nisida in the southern part. This area is characterized by a strong anthropogenic impact, due to high population density and intense commercial and tourist traffic (Arienzo et al., 2017).

The area of Bagnoli located in the southern side of the GoP hosted important industrial plants (steel mills, cement factories, production of asbestos and fertilizers) until the end of the 20th century. These anthropogenic activities caused high levels of environmental pollutants and potentially hazardous chemicals, which affected the quality of marine ecosystems and, as a consequence, the human health. Toxic and potentially toxic metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) are the main contaminants found out in the soil and along the shoreline area (Ausili et al., 2020).

Historically, the GoP is dedicated to the farming of bivalve mollusks which are constantly subjected to chemical and microbiological monitoring to protect the health of consumers. The monitoring plans detected high levels of PAHs in the mussels from the Lucrino area.

This study presents the activities carried out in order to investigate the levels and sources of contamination by PAHs.

Samples of *Mytilus galloprovincialis* collected from sea farms located along the coastal areas of the GoP (Fig.1) were transferred to the laboratory of Istituto Zooprofilattico Sperimentale del Mezzogiorno. The PAHs analysis was performed by using a method developed in accordance with the Regulation EU 836/2011; the method involves the saponification of the sample followed by extraction, purification and analysis by HPLC-FLD.

For the environmental monitoring plan, twenty sampling sites were identified along the GoP, from Bagnoli to Baia (Bacoli), where sediment samples were taken from the ARPAC; three other sampling stations relate to Legislative Decree 152/06 (Fig.1). Depth, geographical coordinates and distance from the coast were measured for each station using a GPS. All samples were analyzed for the 16 US EPA priority PAHs by means GC-MS.

The results of the monitoring PAHs in mussels collected in the GoP, show a very different situation for the sampling stations.

In the Monte di Procida and Lake Fusaro plants, the concentrations of Benzo[a]pyrene (BaP) and other PAHs were almost always (mostly) lower or slightly higher than the quantification limit, regardless of the withdrawal season. The area near the Island of Nisida may also be considered at low risk, since no non-compliant value was found and concentrations were generally low. On the contrary the areas of Punta Terone and Punta Pennata showed appreciable concentrations of PAHs without exceeding the maximum limit (ML), except for three samples. It should be noted that these cases always occurred in the winter season (2016, 2019, 2020).

Moving towards the center of the GoP, in the area of Lucrino, the concentrations of PAHs in mussels were significantly higher than those measured in the other sites. In particular, during the winter season, the levels of Bap and PAH4 exceeded the ML in 17 samples out of 100 and the average concentrations of Bap and PAH4 were 3.1 and 14.0 µg/kg, respectively.

As reported by other Authors (Perugini et al., 2007), the seasonal variability can be related to hydrodynamic processes of remobilization, suspension and transport of contaminated sediments. These phenomena could be attributed to wave motion and sea currents. Literature studies suggest that contamination could be associated to the pyrolytic source of PAHs from the brownfield site of Bagnoli. In order to confirm this hypothesis, a study was carried out on the presence of PAHs in marine sediments along the coast of GoP.

The concentrations of Σ16PAHs in all sediment samples from the Bagnoli brownfield site were above the limit values as already reported in previous studies (Albanese et al., 2017). The results of environmental analysis demonstrate that the eight stations located in the Bagnoli area show the same pattern of contamination. Furthermore, three stations (10-11-12) located around the town of Pozzuoli, and other two stations (13-14) are characterized by different PAHs distribution, compared to all the previous ones.
Finally, the results, in terms of percentages of individual PAHs, from sampling stations located in marine area of Lucrino (18-19-20) are very similar to those found in the Bagnoli stations. These similarities seem to suggest a common source of contamination between the sediments from the Bagnoli area and those collected close to the mussel plants.

In conclusions, this study confirms the use of bivalve mollusks as good bioindicators to assess levels and trends of seawater contamination, due to their filter-feeding behavior and sedentary life, that lead to the accumulation of pollutants in their tissues.
The results of environmental analysis seem to confirm the hypothesis that the contamination of mollusks raised in the Lucrino area of the GoP can be attributed to contaminated sediments. The seasonality of the phenomenon may be related to waves and sea currents. Further studies are necessary to identify additional sources of contamination.

Figure 1. Sediment sampling locations along the Gulf of Pozzuoli (Naples, Italy)

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:
An energy and cost effective autonomous seawater ammonium sensor

SESSION:
COASTAL ENVIRONMENTAL ENGINEERING

AUTHORS: YITZHAK JACOBSON*, JAN STICKLUS, ERIC ACHTERBERG

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Nitrogen is an essential nutrient in the marine environment. Ammonium is the preferred form of fixed nitrogen for phytoplankton, due to the low energy required for its assimilation. Ammonium is a natural waste product from the metabolism of marine biota, but inputs from aquaculture and waste water discharges are often significant. High ammonium inputs into seawater may lead to enhanced algal growth, eutrophication, hypoxia and toxicity to fish, imposing a threat on marine ecosystems (1).
The rapid development of aquaculture industry during recent decades has resulted in enhanced ammonium production, imposing strong negative effects on local aquaculture operations and regional water quality. In-situ real time monitoring of ammonium at fish farms will enable detection of enhanced concentrations at an early stage. An alarm can then be raised to act and prevent irreversible damages to the commercial fish and surrounding ecosystems. Nonetheless, in order for such a system to be widely implemented, costs and maintenance requirements must be minimized. Since ammonium is a key factor to understanding nitrogen cycle in aquatic systems (2), such a sensor will also be beneficial for studying its cycling in polluted estuarine and coastal environments.
In recent years, in situ chemical sensors for carbonate chemistry variables and nutrients have been emerging (e.g. 2-4) with a metrology typically inferior to laboratory analysis, relatively high-power consumption and physical size, limited depth range (typically <10 m) and at costs >30 k€. Demonstrated long deployments (>1 month) of such sensors are rare.
We developed an autonomous in-situ ammonium sensor, applicable to industrial aquaculture and scientific demands. Using low cost off-the-shelf and 3D printed components can bring costs down to < 3.5 k€.
Our unique sensor development approach is expressed through the following features: a) A syringe-based sample and reagent propulsion, utilizing microfluidics (i.e. manipulation of fluid volumes of 10-100 µL), minimizing size, reagent usage and power consumption. Modifications of the chemical formulations of reagents increase sensitivity and reagents stability. b) A novel, prism shaped, sample void, enables the measurement of low concentrations in small sample volumes. The cell is 3D printed using a specially formulated chemically resistant resin. c) The low cost and energy efficient electronic setup consists of a miniature syringe pump, a LED light source and a large area photodiode for detection, in conjunction with optical filters.

The result is a miniaturized sensor with increased endurance. With a detection limit lower than 15nM, it is capable of measurement of minute changes in both natural environments and aquaculture facilities. It is intended for deployments at depths down to 300m (with an appropriate housing) for periods up to 1 year or for use in autonomous platforms (e.g. AUVs), measuring ambient ammonium concentrations at a high frequency. Data from a deployment in Haifa, Israel, will be presented and discussed.

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An automated drift correction method for in situ NaI(Tl)-detectors used in extreme environments

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Abstract

Gamma-ray detection systems are exposed to extreme environments during in situ measurements and the NaI(TI)-detectors in these systems are frequently subjected to significant temperature fluctuations. Several elements within these detectors are sensitive to temperature deviations, which ultimately causes a drift in gamma-ray spectra. This study aimed to determine the relationship between temperature deviation and spectrum drift and found a linear relationship over a wide range of energies. It was found that an increase in the detector temperature shifts the gamma-ray spectrum to lower channels, whereas a decrease in the detector temperature shifts the spectrum to higher channels. Using this information, a novel drift correction method based on the Gaussian distribution of the 1460 keV gamma-peak of ^{40}K was developed. Dividing the peak into five regions of interest (ROI), a weighted gain correction factor is calculated based on the comparative skewness of the measured data and the sensitivity of the drift. The detector gain is then adjusted by the same factor to correct the drift in gamma-spectrum. This method was first tested in a simulated in situ environment, followed by in situ measurements along a beach. As expected, the gain adjustments followed the trend in detector temperature. The corrected counts in each of the five bins also presented good results and a close fit to the Gaussian distribution.

1. Introduction

In situ measurements and the mapping of naturally occurring radionuclides are applied in many geoscience-based fields of research. Natural radionuclide concentrations are typically measured by means of characteristic gamma-ray emissions, and NaI(Tl)-detectors are commonly used for this purpose. These detectors are, however, susceptible to drift, which is mainly caused by temperature changes (Bu et al., 2018). Several elements within the NaI(Tl)-detector are dependent on temperature, such as the decay constant and light output of the scintillation material, multiplication factor and drift of the photomultipliers, and quantum efficiency (QE) of the photocathode (Moszyński, 2006; Ianakiev, 2009; Wright, 2017). The optimal relative light yield of NaI(Tl) detectors typically occur at approximately 300 K with a decay time of 215 ns. This yield, however, decreases at both higher and lower temperatures (Knoll, 2010). Decreasing the temperature also leads to longer decay times peaking around 150 K (Sailer, 2012). Long-term drift can also occur in NaI(Tl)-detectors due to changes in the charging of the dielectric surfaces (TB-5 User Manual, 2021), as well as hysteresis of the gain (Tsankov and Mitev, 2006).

Several techniques have been proposed to compensate for the shifts in gamma-ray peaks that occur due to this drift, but most of these methods were designed and tested in reasonably stable conditions (Tsabaris and Ballas, 2005; Kong et al., 2010; Casanovasas et al., 2012; Mitra et al., 2016). The extreme environments where

in situ measurements are typically conducted can cause severe temperature fluctuations, and spectrum drift in these circumstances is problematic. These environments range from dry and hot desert regions to underwater areas. The change in temperature in these environments can be erratic, specifically if the system is mobile and transported through these extreme conditions. The detector drift can consequently become acute, and an aggressive drift correction method is therefore required. Mobile systems can also be required to measure for extended periods of time, which further enhances the likelihood of drift.

The Delta Underwater Gamma System (DUGS) was recently developed to measure the natural radionuclide concentrations of beach and aquatic sediment. This system was deployed on beaches, ocean floors and riverbeds to investigate sediment transport. This required the system to be mobile over extended periods and periodically be submerged during the measurements. This caused high and irregular fluctuations in the internal temperature of the detector, which resulted in sporadic drift in the acquired in situ spectra.

A rapid drift correction method was consequently developed based on the ^{40}K radionuclide of potassium. Potassium is abundant in nature and the ^{40}K radionuclide consists of 0.0117% of the weight of natural potassium (NIST, 2018). The ^{40}K radionuclide has a single 1460 keV gamma emission and is subsequently significant in environmental gamma-ray spectra. Using this as a region of interest (ROI) in the gamma spectra, a mathematical model for continuous drift correction was developed. This energy-drift correction was implemented and tested, and the methods and results are demonstrated in the following sections.

2. Materials and Methods

2.1. Measuring System

The Delta Underwater Gamma System (DUGS) utilized in this study consists of a NaI(Tl)-detector (7.62 x 7.62 cm) coupled to a TB-5 digital tube base multichannel analyzer (MCA) produced by AMPTEK®. The system operation and spectra acquisition were handled by a Trimble® YUMA® rugged tablet. Data transfer between the TB-5 and YUMA was established using user data protocol (UDP) over Ethernet. Power was delivered to the MCA by injecting 12 V direct current (DC) onto the Ethernet line using passive power over Ethernet (PoE). This voltage was then split off and stepped-down to 5 V using a DC-DC buck converter and delivered to the system. The basic system architecture is shown in Fig. 1.

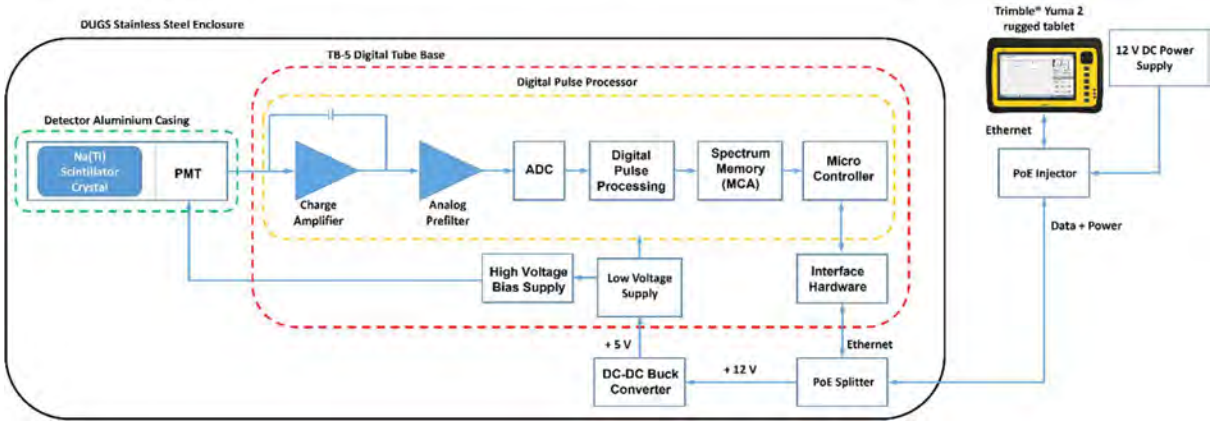

Fig 1. Diagram depicting the DUGS' architecture

The system configuration and spectrum acquisition were done using a combination of AMPTEK®'s DppMCA software and custom-written code in VB.net. The MCA was configured to use 2048 channels with a high voltage of 825 V. This positions the ^{40}K peak close to channel number 1460, depending on the detector gain, yielding a resolution of approximately 1 keV per channel. Positioning the peak at an exact location is not necessary since the acquisition software is calibrated before measurements, translating each region of interest (ROI) to specific channels. The detector system was encapsulated in an in-house developed stainless steel (SS316) watertight container.

2.2. Experimental Setup

The drift in gamma-ray spectrum causes a deviation in the channels where certain gamma decay energies are found. This results in a change in the calibration parameters. This is particularly problematic if these energies are placed in specific ROIs for analysis. The consequence is either a change in boundaries for the ROIs, or a recalibration of the detector. The latter is typically done by increasing or decreasing the detector gain, which extends or suppresses the gamma-ray spectrum within the total number of channels allocated to the MCA.

To determine the number of channels the gamma-ray spectrum shifts due to temperature deviation, two simulated in situ experiments were done. In the first, the NaI(Tl)-detector was calibrated at room temperature (~298 K), using a radium (^{226}Ra) source. The temperature of the detector was then reduced to 273.15 K using an ice bath. In the second experiment, the detector temperature was gradually increased from room temperature to 323.15 K by placing the detector in direct sunlight.

Measuring the temperature was done using the MCA's Silicon Labs® 8051F340 805-compatible microprocessor core, which is capable of measuring the temperature of the onboard electronics to an accuracy of ±2 °C over a temperature range of -40 °C to 80 °C. The board temperature is then approximated through offset calibration since the sensor is internal to the microcontroller and the die will always be hotter than the board. The detector temperature is determined by an onboard Analog Devices® AD592 temperature sensor with a ±1.5 °C accuracy. Throughout the process, these temperatures, along with the channels measuring radium's three prominent gamma peaks, 352 keV, 609 keV and 1764 keV, were tracked and the results logged.

Afterwards, the drift of the radium peaks was analysed and compared to their channel-position at room temperature, and their relationship graphed.

Using this information, the drift correction method was developed and implemented to adjust the detector gain. To verify its correct response, the detector was again calibrated at room temperature and then placed in direct sunlight for 30 minutes until the onboard temperature sensors measured a temperature of 313 K for electronics and 306 K for the detector. The detector was then immediately placed into an ice bath to emulate a significant and immediate change in temperature and left for an hour. Throughout the process, the temperature of the detector and electronics were logged at 5 second intervals, along with the adjustments made by the drift correction to the detector's fine gain.

To verify the method's ability to correct for centroid drift of ^{40}K during in situ measurements, radionuclide measurements were performed along a beach for approximately 1 hour and 45 minutes. As per the drift correction method discussed below, the 1460 keV gamma peak was divided into five ROIs, and the number of counts in each ROI tallied. The total counts in each ROI were then compared to the expected Gaussian distribution to determine if the centroid has drifted from its calibrated position. The drift correction method was then applied and the total counts in the corrected bins again compared to the Gaussian distribution. A match between the corrected total counts and the expected statistical distribution will indicate that the gamma-ray spectrum was successfully shifted back to its calibrated position.

2.3. Drift Correction method

The drift was monitored by following the 1460 keV gamma peak of ^{40}K as well as the immediate area around the peak. The 1460 keV gamma emission is the only gamma in the decay of ^{40}K and it is also relatively isolated from other gamma emissions in the decay chains of uranium (^{238}U) and thorium (^{232}Th). The nearest gamma emissions of ^{238}U and ^{232}Th is 1378 keV and 1588 keV, respectively.

The general peak resolution (R) of a detector is given by (Knoll, 2010)

$$R = \frac{FWHM}{H_0} \quad (1)$$

where H_0 is the centroid of the peak and the full width at half maximum (FWHM) is given by 2.35σ, with σ representing the standard deviation of the peaks that is normally in a Gaussian shape. The resolution of NaI(Tl)-detectors is typically between 6% and 8% (Akkurt et al., 2014). The main ROI for the drift correction was therefore chosen 50 keV, or 3.4%, to each side of the centroid of the ^{40}K decay (1460 keV), which ranges from 1410 keV to 1510 keV. This selection of the centre ROI equates to 6.8% of the energy bins around the centroid, which compares well to the average resolution of NaI(Tl)-detectors. Following the Gaussian distribution, the FWHM (2.35σ) of the ^{40}K peak therefore integrates 75.8% of the central area of the full peak (see Fig. 2).

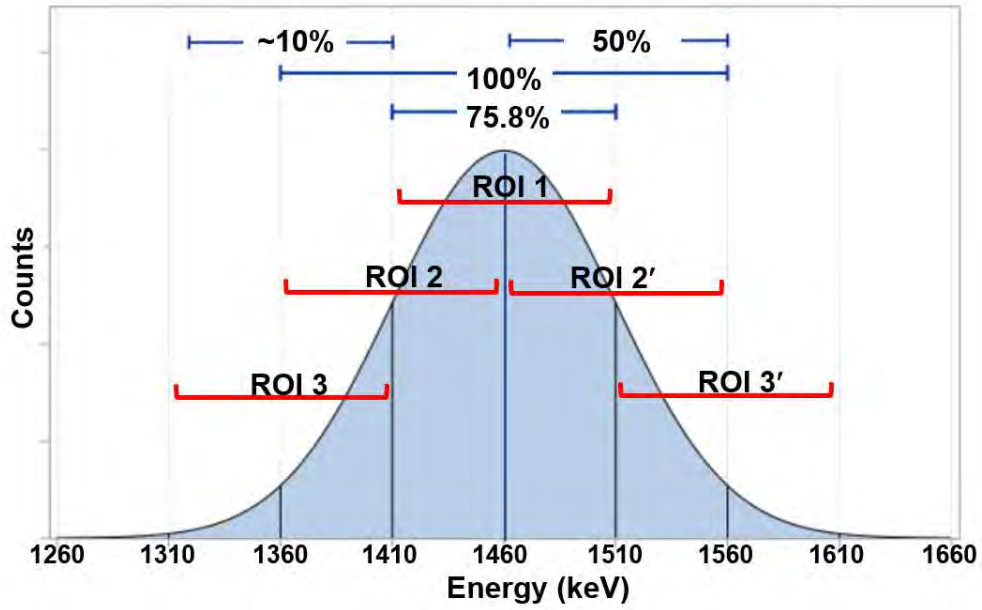

Fig. 2. A Gaussian approximation of the 1460 keV gamma peak of ^{40}K illustrating the five ROIs into which the peak was subdivided. The percentage of the total counts in each ROI and boundaries are also shown.

Two more ROIs were selected at the lower (1360 keV to 1460 keV) and upper (1460 keV to 1560 keV) boundary of the centroid, each covering 6.8% (100 keV) of the energy bins above and below the centroid of the peak. Bezuidenhout (2013) showed that the counts in the total area of an emission peak in the gamma spectra of a NaI(Tl)-detector can be extracted by choosing a 14% window around the centroid. The ROIs at the lower and upper boundary of the centroid should consequently each integrate 50% of the total counts of the peak. Comparing the counts in these regions with those in the main ROI will determine the drift of the 1460 keV gamma peak.

To enhance the resolution of the drift correction algorithm, two final ROIs were selected on both the upper and lower edge of the peak, ranging from 1310 keV to 1410 keV, and 1510 keV to 1610 keV. These peaks each integrates about 10% of the total counts in the peak.

The 1460 keV peak of ^{40}K and its surrounding area was therefore subdivided into five 100 keV-wide ROIs named ROI 3, ROI 2, ROI 1, ROI 2′ and ROI 3′, with counts C_3, C_2, C_1, C_2' and C_3', respectively. The counts in centre ROI 1 (C_1) were approximated to be ~80%, ROI 2 (C_2) and ROI 2′ (C_2') to be 50% and ROI 3 (C_3) and ROI 3′ (C_3') to be 10% of the total counts in the full peak. The sensitivity (S) of the drift correction is, therefore, the weighted ratio of the counts in each ROI compared to the total counts under the peak:

$$S = \frac{1}{TC_1}|A_2(C_2 - C_2') + A_3(C_3 - C_3')|$$
$$where\ T = A_1 + A_2 + A_3 \qquad (2)$$

The constants A_1, A_2 and A_3 are the contributing factors of each ROI to the drift correction sensitivity. The factors were estimated as 1, 5 and 8 for A_1, A_2 and A_3, respectively. This was derived from the ~80%

contribution of ROI 1, the 50% contribution of ROI 2 and 2′, and the 10% contribution of ROI 3 and 3′ towards the total counts in the full peak.

The ratio between ROI 2 and ROI 2′ is the predominant indication of the deviation from normality. The difference in counts in these regions are therefore normalized to the values of A_2 and A_3, and scaled to the systematic detector sensitivity with a factor F_N. A weighted gain correction (ΔG), which is an indication of the percentage change in the fine gain (GAIF) of the MCA, can then be calculated by:

$$\Delta G = \frac{S}{2F_N}\left[\frac{A_2(C_2 - C_2') + A_3(C_3 - C_3')}{A_2 + A_3}\right] \quad (3)$$

3. Results and discussion

3.1. NaI(Tl) temperature dependency

Shown in Fig. 3 is the drift in calibrated channels for the three prominent radium energy peaks, 352 keV, 609 keV and 1764 keV, as the detector temperature is increased from 273.15 K to 323.15 K. The data from the two experiments (temperature decrease and temperature increase) were combined and arranged according to increasing temperatures. In this experiment, the drift was primarily due to temperature deviation, but long-term drift can also occur. Therefore, sample time was used to plot the change in the MCA channel where each energy centroid was found.

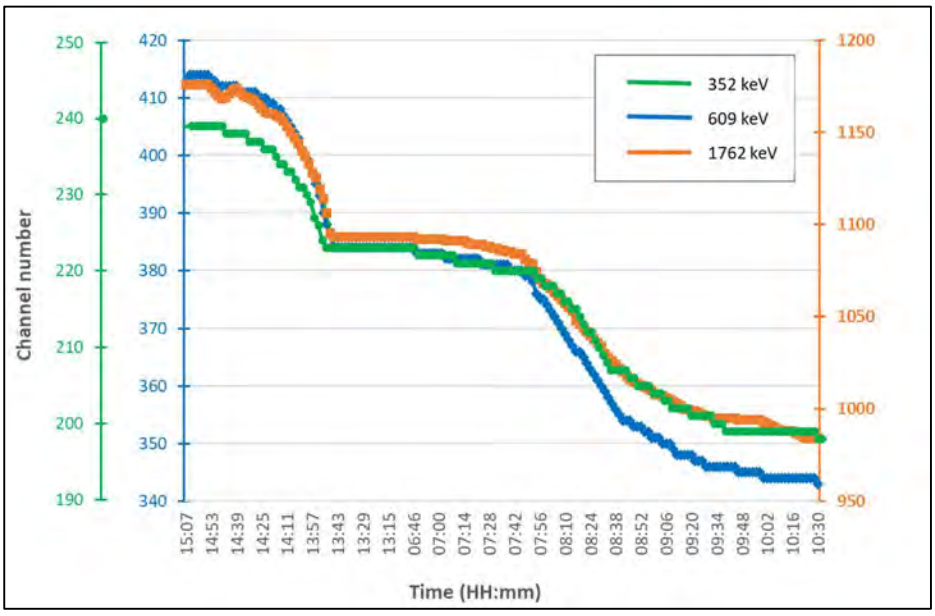

Fig. 3. The combined results of the two temperature deviation experiments. The results have been ordered according to the increase in temperature and shows the MCA channel drift for the three prominent ^{226}Ra energy peaks as the detector temperature is increased from 273.15 K to 323.15 K at different time intervals.

Starting at 13:15, moving towards the left of Fig. 3, the detector was left at room temperature for 30 minutes, before being placed in an ice bath for approximately an hour, until 15:07. At room temperature, the centroids

of the three peaks were found in channels 217, 374 and 1068, respectively. After an hour, these peaks have drifted to 240, 414 and 1176, respectively. As seen in Table 1, this implies a drift of 23 channels for the lower energy peak of 352 keV, a drift of 40 channels for the 609 keV, and a drift of 108 channels for the high-energy peak. On the right-hand side of Fig. 3, starting at 06:46, the effect of increasing the temperature can be observed. The initial calibrated channels of 223, 384 and 1093 for the three energy centroids decreased to 198, 343 and 984. As shown in Table 2, this is a drift range of 25, 41 and 109 channels for the three centroids, respectively.

Table 1

The calibrated and final channel position of the three prominent ^{226}Ra energy peaks as the detector temperature is decreased from 298 K to 273.15 K. The range of the drift is also listed.

	Energy centroid		
Channels	**352 keV**	**609 keV**	**1762 keV**
Calibrated	217	374	1068
Final	240	414	1176
Range	23	40	108

Table 2

The calibrated and final channel position of the three prominent ^{226}Ra energy peaks as the detector temperature is increased from 298 K to 323.15 K. The range of the drift is also listed.

	Energy centroid		
Channels	**352 keV**	**609 keV**	**1762 keV**
Calibrated	223	384	1093
Final	198	343	984
Range	25	41	109

Fig. 4 shows the normalized channel drift for the three prominent ^{226}Ra energy centroids, starting at 273.15 K. As can be seen from the sixth order polynomial fit, the response of all three energy peaks to a change in temperature correlate. In fact, as illustrated in Fig. 5., plotting the drift-range of each energy centroid against its energy, a linear relationship was found. The implication being that a percentage drift in the spectrum due to temperature variations could therefore be corrected by shifting each energy centroid by the same percentage.

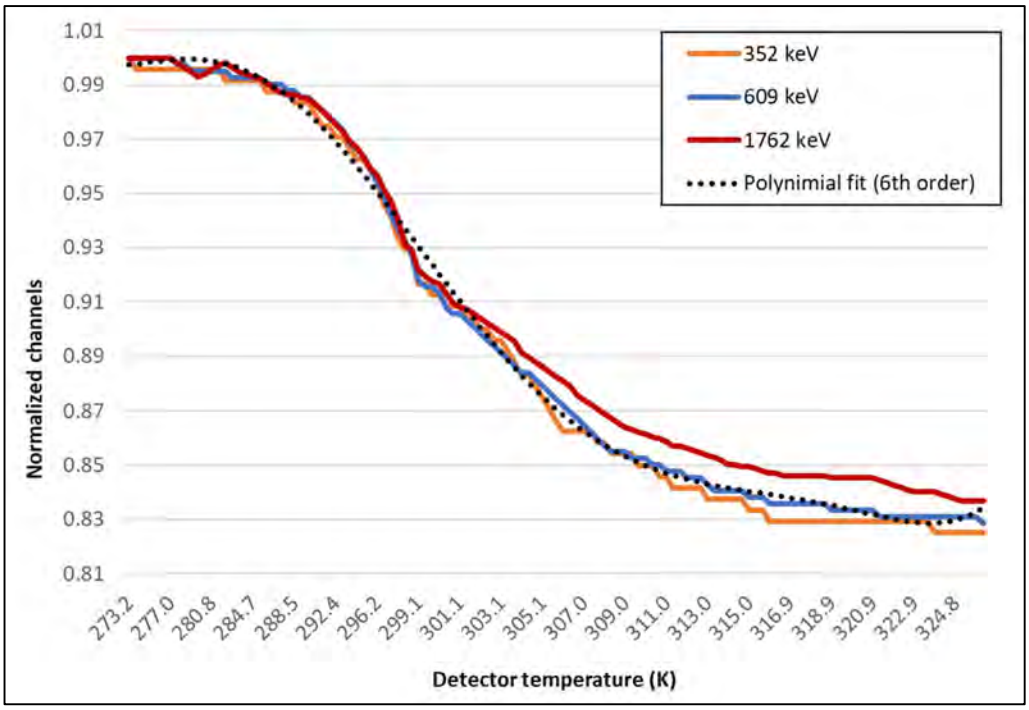

Fig. 4. The correlation of the normalized MCA channel drift of the three prominent ^{226}Ra energy peaks with an increase in detector temperature. A 6th order polynomial fit can be observed for all three peaks, implying a similar response in channel drift due to a change in detector temperature.

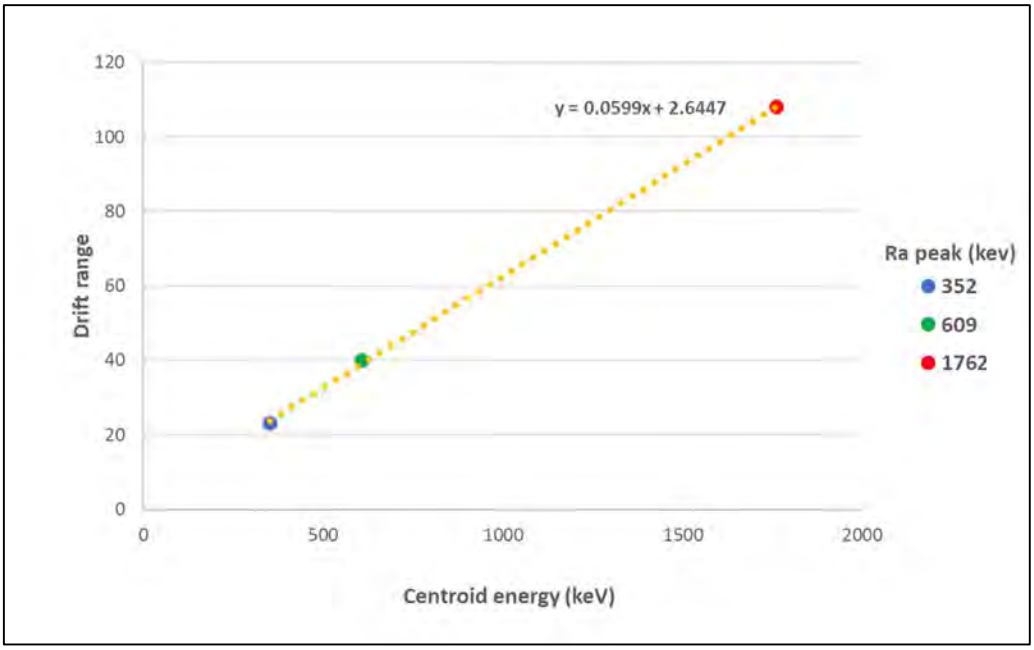

Fig. 5. The linear relationship between the centroid energy of each prominent ^{226}Ra peak and its drift-range with temperature deviation. All energies in the gamma spectrum therefore drift by the same percentage due to a change in temperature.

3.2. Drift correction

As was seen in Fig. 3, a decrease in temperature shifts the spectrum to higher channels, whereas an increase in temperature shifts the spectrum to lower channels. The output from the drift correction method, ΔG, is

therefore expected to follow the temperature trend: an increase in temperature causes the fine gain to be increased to shift the spectrum back to the higher channels where it started. Conversely, a lowering in temperature reduces the fine gain to shift the spectrum back to the lower channels. This trend is clearly observable in Fig. 6. which shows the results of the simulated in situ measurements with the drift correction method implemented. As the detector heats up from ambient temperature to approximately 306 K, the drift correction method gradually increases the fine gain of the detector from a calibrated value of 1.205 to a new value of 1.270. The moment the detector is placed in the ice bath, the drop in temperature causes the drift correction method to react and decrease in the fine gain of the detector. The impulse-drop in detector temperature is expected to cause a sudden and significant shift in the gamma-ray spectrum. To correct for this, the drift correction method initially reacts aggressively, causing a significant decrease in the detector's fine gain. This is observed in Fig. 6. by the overshoot observed at around 13:18:07. However, once the detector temperature starts to stabilize, so does the scintillation output of the NaI(Tl)-crystal. This causes the spectrum to shift back toward the lower channels, causing the fine gain to be increased.

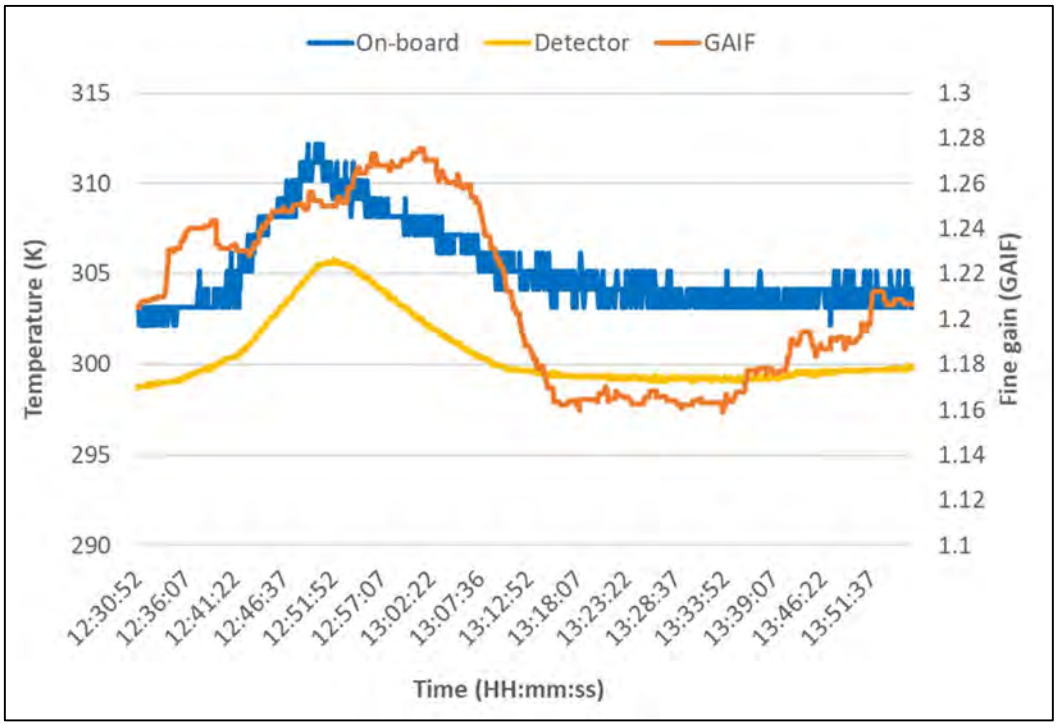

Fig. 6. The results of the simulated in situ measurements with the drift correction method implemented. As can be seen, the fine gain (GAIF) follows the temperature trend. As the detector heats up from ambient temperature, the drift correction method gradually increases the fine gain of the detector. Once dropped into the ice bath, the drift correction method reacts and decreases the fine gain to compensate for the drift in spectrum.

Seen in Fig. 5. are the total number of counts in each of the five ROIs for the 1460 keV gamma-peak of ^{40}K obtained by the in situ beach measurements. Also illustrated is the expected Gaussian distribution for ^{40}K. As per Fig. 2, 75.8% of the power centroid is expected in ROI 1, 50% in ROI 2 and 2', and 10% in ROI 3 and 3', respectively. However, as can be seen, the total counts in ROI 2 and ROI 3 have increased over the duration of the measurements, indicating a leftwards drift in the spectrum being measured due to an increase in detector

temperature. Applying the drift correction shifts the spectrum to the right, back to its calibrated position. As can be seen, the total counts in each bin of the corrected spectrum observes the expected statistical Gaussian distribution.

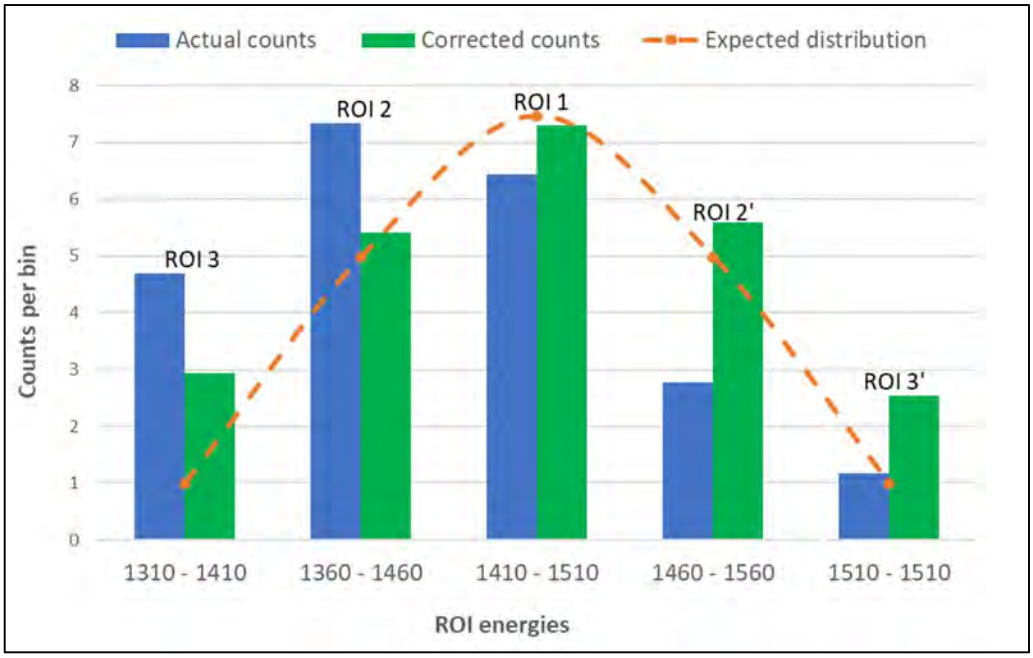

Fig. 7. A comparison between the expected Gaussian distribution of the 1460 keV gamma emission of ^{40}K with the in-situ measured results. The increase in total counts in ROI 2 and 3 indicates a leftward drift in the measured spectrum due to an increase in detector temperature. The drift correction method was then applied, shifting the spectrum to the right. The corrected spectrum observes the expected statistical Gaussian distribution.

4. Conclusion

Various elements within a NaI(Tl)-detector are dependent on temperature. A deviation in temperature causes a shift in the measured gamma-ray spectrum from its calibrated channels in the MCA. A decrease in temperature shifts the spectrum to higher channels, whereas an increase in temperature shifts the spectrum to lower channels. A linear relationship was found between the temperature deviation and the range of drift experienced. This implies that a percentage drift in the spectrum could be corrected by adjusting the detector gain by the same amount.

This principle led to the development of a drift correction method based on the expected Gaussian distribution of the 1460 keV gamma peak of ^{40}K. The deviation of the peak form its calibrated position was first determined using five bins, which were set up using the expected Gaussian distribution and the FWHM of NaI(Tl)-detectors. This implied that a perfectly distributed power peak will have its total counts equally distributed about the power centroid, with 75.8% integrating the central area of the full peak. For enhanced resolution, two more bins were added to the upper and lower edge of the peak, each containing 10% of the total counts. Any deviation from this distribution indicated a drift in the measured spectrum.

The amount of deviation was then used to determine the sensitivity of the drift correction method, which dictates its aggressiveness. Using this, a weighted gain correction factor (ΔG) was determined, which was then used to change the fine gain of a NaI(Tl)-detector to correct for any drift in the measured gamma spectrum. In the event of a detector drift, the weighted gain correction factor therefore adjusted the fine gain of the detector until the statistical distribution of the total counts inside the five bins compared with the expected Gaussian distribution. As a result, ΔG followed the temperature trend: an increase in detector temperature shifted the measured spectrum leftwards, which required an increase in detector gain to move the spectrum rightwards, and vice versa. The power centroid of the ^{40}K radionuclide can therefore be tracked and corrected.

Funding

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: APPLICATION OF STATISTICAL ANALYSIS TO ESTIMATE THE COSTAL HAZARD. A CASE STUDY IN LIGURIA REGION

Session: Ingegneria dell'Ambiente Costiero: inquinamento, produzione energetica, monitoraggio e valutazione economico ambientale, contesto normativo

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

Liguria region is totally exposed to the action of the sea storms and too the natural evolution of the profile of the shore line. The modification along the time of the shape of the shoreface is measured from the official administrative and technical offices of the Liguria Region and Environmental Ministry, this different information are available in shape format from 1944. Different parts of the coast classified as "beach" shown the phenomenon of erosion and deposit of sediment as consequence of the natural action of the circulation of the sea motion (long shore currents) either consequence of a new costal structure or an intensive flood events characterized of significant amount of sediment transported from the inland to the sea.

The phenomenon of beach erosion produce non only a loss of soil but also an economical damage that it is not always easy to evaluate because the direct damage of loss of soil it is easy to estimate while the estimation of the indirect damage as the impact on tourism activity, social aspect or damage at heritage building are not immediate. In the recent years another source of damage is necessary to take into account and this is the phenomenon of the increasing of the mean sea water level, known as Sea Level Rise (SLR), that it is necessary to introduce in the hazard analysis and it is mainly forced by the effect of the climate change. It is now known that in the Mediterranean area this phenomenon produce a negative effect like loss of soil on the coastal area where the main percentage of the population, economical activities and heritage are located.

For this reason we have analyzed the future scenario of density of population near the coast according to the different Shared Socioeconomic Pathways (SSPs) scenarios the consider the forecast of amount of carbon dioxide (CO_2) emissions and the increasing of mean temperature over the world, that is one the main cause of the increasing of the mean sea level, considering also the social and economic developments in different part of the world.

Each SSP represents a qualitative description of future changes on demographics, human development, economy and lifestyle, policies and institution, technology, and environment and natural resources.
According to the international literature a general coastal hazard index (CHI) is calculated taking into account the following variables: shoreline type, habitats, relief, SLR, wind exposure and surge potential.
In the Liguria region the data generally utilized to evaluate the exposure of the hazard along the coast as consequence to wave actions are available in shape format, it is also available, as official data, the indications of intensity and direction of the predominant waves and the estimation of Run Up for various return periods of marine storms.
We have utilized the information relevant to the shape of the inland, the location of the principal line of communication utilized for the civil and public transport, the classification of civil structure according to their use public or private and, finally, the economic information relevant to the private enterprises
Using a Geographical Information System (GIS), the different data above described and a detailed Digital Terrain Model (DTM) [3], it is possible to evaluate the Coastal Hazard Index [4] for the area chosen for the case study and knowing the different exposed elements present inside of it to estimate the Coastal Risk considering the possible range of vulnerability according to the exposed elements considered.
Results from the hazard index encompass both the relative magnitude of erosion and/or coastal flooding, and the probability that these hazards may occur based on the distribution of the index using different scenarios. The paper analyzes a Liguria case study in which the effects of SLR is particularly critical in terms of heritage and economic activities risk.

Keywords: Sea level Rise, Climate Change, Coastal Hazard Index

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

BIODIVERSITY SMART MONITORING INFORMED BY HISTORICAL ANALYSIS OF COASTAL EVOLUTION

SESSION:

INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

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ABSTRACT

Basically, environmental monitoring is aimed to measure biological, chemical, and physical parameters that characterize the environmental components. The monitoring can be then carried out periodically or continuously depending on the general scope of the activity. Recently, smart environmental monitoring has gained much attention from the technical and scientific community as it is recognized as a crucial tool for gaining insight into the state of the environment when the protection of biodiversity and ecosystems must be pursued. Indeed, it is one of the best means to understand the dynamics that develop, and any changes induced by anthropic activities upon the various environmental components/factors.

Within the frame of the BEST project (Addressing joint Agro and Aqua-Biodiversity pressures Enhancing SuSTainable Rural Development), funded by the INTERREG VA Greece-Italy 2014/2020 Program, a specific analysis on the evolutionary dynamics of the coastline in the coast of an Adriatic coastal stretch and the implementation of a smart monitoring system, to be extended to a nearby enclosed basin, are foreseen. The project, as a whole, aims to protect the natural and cultural heritage, restore biodiversity and rural and coastal natural habitats, involve local stakeholders in cross-border projects and joint pilot actions also through the use of new technologies with low environmental impact, with the final goal of improving the quality of life of the citizens of the regions concerned. The environmental monitoring is intended to be smart (Smart Environmental Monitoring – SEM). Indeed, this approach has been identified as an effective tool to solve both the spatial and temporal resolution of standard methods (i.e. [1]) to be used to identify structural and environmental issues and the best management strategies to conserve as well as to restore biodiversity. Starting from the definition of the initial state, the study aims therefore to monitor and evaluate the evolutionary dynamics of the selected coastal stretches in terms of biodiversity. The considered coastal areas fall within the territory of the municipalities of Polignano a Mare, Monopoli, Fasano, and Ostuni on the Adriatic coast of the Apulia Region (hereinafter referred to as Area 1, Fig. 1), as well as the territory included in the boundaries proposed for the Regional Natural Park of "Mar Piccolo", Taranto (hereinafter referred to as Area 2, Fig. 1).

This paper is aimed to describe the architecture of the smart environmental monitoring system as well as the data analysis needed to synthesize the collected data. Particular attention is paid to the criteria behind the scene: the selection of the locations of monitoring stations (i.e points), as well as the identification of the instrumentation and type of sensors (i.e. [2], [3]). The use of low-cost sensors while keeping the smart features of the system management (i.e. the minimization of the role of human presence at the sensing stations) is also investigated (e.g. [4]).

The analysis of the evolutionary dynamics of the coasts, starting from a robust definition of the initial state based on previous studies and new analyses and monitoring activities, has been firstly carried out to characterize the areas and to inform the monitoring strategy. The latter is aimed to get a real picture of biodiversity (i.e. habitats and species) and to relate its spatial and temporal evolution to environmental parameters. Then, measurement of physical

parameters (e.g. air temperature, air and soil humidity, atmospheric pressure, wind direction and speed, precipitation, etc…) must be foreseen.
It should be stressed that the achieved results may be intended as general, due to the different features of the two monitored areas, i.e. sandy coastal stretches characterized by the presence of coastal dunes (Area 1 in Fig. 1) and heavy anthropized enclosed basins (Area 2 in Fig. 1).

Figure 1. Localization of the two selected areas. The colored zones on the right panels refer to the Regional Parks in the areas.

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POSTER PRESENTATIONS

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: THE ARPA FVG SUPPORT TO OIL SPILL EMERGENCY RESPONSE IN THE GULF OF TRIESTE

SESSION: INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Maritime transport has characterized the human activities since the beginning of the mankind history and it has increased over time its impact on the environment. Nowadays almost all the seas are interested by shipping lanes where the density of the ships per unit time is very high and that results in a not negligible probability of pollutants release in the sea, besides the accidental collisions between ships.

The hazard of oil spill along the routes, or in the harbors, may be caused by adverse weather and sea conditions, besides to be function of the density of potential sources of pollutants; furthermore, the oil dispersion over the sea surface is directly related to the atmospheric conditions and to the surface marine currents.

In this work, we focus the attention on the north Adriatic area, in particular the Gulf of Trieste, where two important harbors operate, namely Trieste and Monfalcone, which activities have increased fast in the last decade, with the perspective to rise further in the next future. In addition, a third port, Porto Nogaro, is located inside the Marano and Grado lagoon and, even if has a limited ship traffic in comparison with the two main terminals, it is set inside an important ecosystem that is included in the NATURA2000 sites [1] (code: IT3320037).

According to the above frame, it is extremely important to be able to react promptly to an oil spill emergence avoiding the pollutant spreads over the limited area of the gulf, the lagoon and it reaches the shores. In fact, once the oil spill occurs, the size, the shape and the drift of the oil slick have to be contained to avoid it impacts vulnerable areas and to ease the pollutant reclaim. ARPA FVG [2] gives support to the local authorities in managing the oil spill emergency in the Gulf of Trieste, so it has been developing and implementing operationally environmental services that are ready to be part of the decision chain, which is activated in case of accidental releases of oil in the sea.

Here we present an operational service [3] that integrates weather and marine forecasts into a numerical model that simulates the dispersion of oil slick, in particular it is the GNOME model [4], a NOAA dispersion model.
The model requires sea surface currents and winds forecast as mandatory inputs, which are forecasted by means of state-of-the-art of atmospheric and oceanographic numerical models. A multi weather and marine forecast outputs combination minimizes the probability that the GNOME model inputs are not updated when they are needed, that is during emergencies, and this results in a service available 24 hours a day, seven days per week. A description of the computational chain implementing the environmental service is presented together with applications of the model during simulated ship collisions or accidental released along the routes. In addition, the contribution given by the set of instruments, that ARPA FVG deploys in the field during the emergencies for the identification of the oil type and the real time validation of the model forecasts, is described with the aim to underline that it is the synergy among information collected in situ and simulations of the spill evolution that makes the service efficacy high.

The organization of the dispersion model and inputs availability for runs on a common laptop, that allows the environmental technicians to execute the simulations everywhere their expertise is required, that is in the emergency coordination room of the Port Authorities, from the ARPA FVG headquarters or till on the field, completes the presentation of this cutting edge service, that can be easily exported in other local realities since it has been developed to be sharable.

The results presented in this abstract have been achieved thanks to the ERDF funds of the Italy-Croatia CBC Programme 2014-2020, in the frame of FIRESPILL Project.

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3. Real Time example of ARPA FVG oil spill forecast http://interreg.c3hpc.exact-lab.it/FIRESPILL/pygnome_sims/pygnome_sims.html
4. Gnome oil spill dispersion model https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/gnome-suite-oil-spill-modeling.html

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: Assessment of trace metal contamination and phosphorus dynamic in sediments of Monastir bay (Tunisia, Mediterranean Sea)

SESSION: - COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Located in the eastern coast of Tunisia, the Monastir bay is, since a few decades ago, is considered as a fragile area due to its reduced hydrodynamics and its high sensitivity to anthropogenic discharges, which influence the physico-chemical quality of the water and so of the sediment. To establish the state of pollution of the sediment, geochemistry of Metallic Trace Elements (MTE), Total Organic Carbon (TOC), Nitrogen (N), Total Phosphorus (Total P), Phosphorus fractions : bound to iron Hydroxide (P-FeOOH), calcium carbonate (P-$CaCO_3$) and organic matter (Acid soluble Organic P. and Residual Organic P.) and granulometric distribution were analyzed at 26 surface sediment sampling stations. The purpose of this research are to evaluate the state of contamination of the sediments surface and to discuss the sediment phosphorus dynamic : sediment is a sink or a source of phosphorus ?

The interpretation of MTE data set has been performed by GIS spatial representation. Furthermore, in order to establish the relationship between phosphorus fractions and environmental variables, Principal Component Analysis (PCA) and inter-elemental correlation have been performer by PCA R-software.

Then the geochemical data and the statistical analysis highlighted a moderate pollution of the sediments, in particular by Mn, Ni and Cu, in the northern part of the bay. Concentrations varied in the following ranges: 1.2-27 ppm for Ni; 3.4-21 ppm for Co; 30-77 ppm for Zn; 2.1-24 ppm for Pb; 8.1-22 ppm for Cu; 24-55 ppm for Cr and 97-296 ppm for Mn.

The concentrations of MTE were compared with those recorded in other similar marine environments in Tunisia (Ghar El Melh lagoon, Oueslati *et al*., 2019 ; Gulf of Tunis, Oueslati *et al*., 2017; Bizerte lagoon, Ben Mna *et al*., 2017). Overall, the MTE concentrations are much lower than those reported in the north of Tunisia (the Gulf of Tunis and its bordering lagoons) and also in the Gulf of Gabès. Although the metal contents are low, not much exceeding the different standards, they show that even if the sediments of the bay of Monastir do not seem to be affected by strong inorganic pollution, the impact of human activity is felt.

Furthermore the sediment phosphorus distribution seems to be controlled by the ROP with an average of 51% and the P-$CaCO_3$ (average 32%) fractions. The ROP fraction was very high in the sediments of the bay of Monastir and can thus be understood by the enrichment with seagrass. The CPA results show two trends: surface sediment enriched with MTE and TOC versus an other one enriched with carbonate but with weak concentration of MTE and TOC.

Furthermore, loading plots of the F1 factor highlight two groups of sediment sampling stations : the first one enriched with P- FeOOH P-CaCO3 fractions and poor in ROP and TOC, the second one, at the opposite : poor with P- FeOOH P-CaCO3 fractions and enriched in ROP and TOC. In contrast, the loading plots of the F2 factor demonstrate a trend with sediment stations enriched with organic matter and total phosphorus in opposite with others sediment stations poor in organic matter and total phosphorus. Then organic matter is clearly the phosphorus source. These CPA results demonstrate the environmental sediment conditions necessary for the phosphorus dynamic: (i) well oxic sediment and with basic pH conditions enhance the FeOOH formation and consequently the phosphorus fixation on FeOOH or CaCO3 in sediment (P-FeOOH, P-CaCO3) whatever the sediment lithology: (ii) anoxic and acidic sediment enhance the formation of ROP (Residual Organic Phosphorus) in correlation with the presence of algae (Posidonia) in the sediment.

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: **THE FORGOTTEN NAUTICAL ASTRONOMICAL INSTRUMENTS**

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Astrology and meteorology have always had great importance for agriculture and navigation. This paper describes some measuring and forecasting instruments which, at their design epoch, had a moderate success in sailing a small sea like the Mediterranean, but then over time they were forgotten because they were supplanted by others. The connection between astronomy and meteorology started long time ago and remained stable for a long period.

The Alexandrian astronomer Claudius Ptolemy (circa 100 - circa 175) in his work, *Phaseis - Phases of the fixed stars and their data collection*, included a meteorological calendar, a list of dates of regular seasonal climate changes, first and last apparitions of stars or constellations, at sunrise and sunset, and solar events such as the solstices; all organized according to the solar year. Ptolemy believed that astronomical phenomena caused the seasonal changes of the weather; he attributed the lack of perfect correlation between these events to the physical influences of other celestial bodies; for the astronomer, the weather forecasting was a particular aspect of astrology.

This description gives more space to the more markedly astronomy-oriented instruments that were fundamental for navigating the "small" Mediterranean Sea and, later, to get out of it and to start the great ocean crossings. It will therefore be no surprising to note that the most ancient instruments were ascertainment and carried out in Mediterranean regions, where they were found, even in their most archaic forms.

- *Parapegma* (5th century BC). The Greeks had no meteorological instruments to confirm or deny their insights regarding the weather, which was related as a rule to astronomical events. For this purpose, public almanacs were placed in many squares in Mediterranean cities, called *parapegma* (from the Greek verb to fix into), which indicated the position of the stars and the weather in the local area, sometimes with the addition of rudimentary forecasts. For example: *The shoulders of the Virgo* [constellation] *rise or rising of Arcturus* [of the constellation Boötes]*: south wind, rain and thunder, or the weather will likely change* [Hamblyn, 2001].
- *Antikythera calculator* (1st century BC). In 1902 in the north-west of Crete, in a wreck in the depths of the Antikythera island, an indefinable mechanical device was found because it was covered with encrustations. On the mechanism some engravings were glimpsed that referred to astronomical events dating back to 77 BC. The first rigorous studies on this strange mechanism were carried out in 1951, but only in the 1970s it was possible to understand, at least in part, its functioning. The X-ray investigations

allowed to explore the interior of the limestone block. This made possible to understand that it was a complex mechanical machine that allow to predict the position of celestial bodies, the dates and times of eclipses, the lunar phases, etc.

- *Astrolabe* (2nd century AD); from the Greek *astrolabon*, lit. "which takes *the stars"*. The instrument allows to measure the (angular) height of the Moon, the Sun, and other celestial bodies, without using mathematical formulas. The astrolabe also allows to determine the hours of the day and night, to draw horoscopes, to establish the height of the mountains, etc. The theory on which the astrolabe is based (about 150 BC) can be traced back to the Greek astronomer Hipparchus of Nicaea. It's perhaps of the thirteenth century a similar instrument designed by the Spanish astrologer, from Palma de Mallorca, Ramon Lull, for the night sky: *nocturnal or nocturlabe.*). In the 16th century, a Spanish-Portuguese reinterpretation of the astrolabe made it particularly useful in the seafaring, for the detection of the height of the Sun and the Pole Star.
- *Jacob's staff* or *cross-staff*, also known in Italian as *Baculo mensorio* (13th-14th century). The first descriptions of this instrument have been attributed to the rabbi and mathematician Levi ben Gershon, who lived in Provence. The device was able to measure an amplitude or angular opening, with respect to a predetermined point, for example of two stars, or the extremes of a tower or mast of a ship. This instrument was widely used in Europe throughout the Middle Ages; between the 15th and 16th centuries, its construction and use were described in numerous treatises. With the 17th century the staff was replaced by the *quadrant* which in turn was abandoned in the 18th century, with the adoption of the octant. But at the end of the eighteenth century even the latter was replaced by the sextant, an instrument still used today.

. *Ship log* or *chip log* (16th century). Until the 16th century, the measurement of the speed of a boat could not be performed reliably because there were no fixed references in open sea. […] *Experienced helmsmen could dare some conjectures about the pace held by spitting into the water and timing (reciting the Hail Mary) how quickly the spit receded* [...]. More reliable was the use of a board, fixed with a long line to a roller placed at the stern. The tablet was thrown into the sea and after an interval of time, measured with a sandglass, it was measured how much rope the tablet had dragged into the sea. An estimate of the ship speed was given from the length of the rope and the time taken to unwind itself.

- *Storm indicators* (18th – 19th century). During navigation it was important to always know the direction and speed of the ship, but it also needed to forecast the arrival of storms. This quick excursus on forgotten navigation instruments ends by citing two versions of *storm indicators*, or meteorological instruments, as is the first instrument with which this work begins. The first, called *Stormglass*, was a sealed glass bell containing an aqueous solution of ammonium chloride and potassium nitrate, which, according to the author, *was clear in good weather and became more and more cloudy as it spoiled*. The second, more fanciful, hypothesized that the leeches behaved differently as the weather changed: *calm in good weather, they were agitated when the storm came*.

All these now forgotten apparatuses have made, more or less, the history of nautical-astronomical instruments.

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Ninth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: SEA LEVEL MEASUREMENTS IN MEDITERRANEAN COASTS

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The great travels around the world in the 18th and 19th centuries and the affirmation of physical geography as a discipline of study, highlighted that in order to establish the height of mountains or the depth of terrestrial depressions, it needed to refer to a starting level, reference datum zero or zero elevation, common to all.

In the volume *La Terra nelle sue relazioni col cielo e coll'uomo*, the geographer Alfeo Pozzi wrote: […] *The continents, the islands and their various parts rise to different heights. In order to measure all these heights so that they are comparable to each other, it is necessary to find a term common to all, an equal starting point, a surface in sum equally distant in all points from the center of the globe. This surface is that of the Ocean. The sea level is therefore the fixed term from which we start to evaluate the elevation of any point on earth. The elevation of a place evaluated in this way is called absolute altitude or height* [...].

However, the sea surface level is neither the same nor constant throughout the Earth. If there were no currents, waves and tides in the seas, their surface would be arranged orthogonally to the direction of gravitational acceleration and shape of the Earth could be defined as the average of the sea. In fact, at any point on the Earth, the average sea level (in addition to being conditioned by the Earth's rotation) is generally higher at the end of summer, when water is warmer, than at the end of winter, when water is colder and is deposited on the mainland as surface water, snow, and ice, in larger quantities. All this has led to the need to establish a method to define zero elevation in reference to the average level of the sea surface; the level must be reassessed at least every decade following the aforementioned annual changes.

The oldest protocol for a rigorous sea level survey is by R. Moray (1666), where indications are also given on how to build the observatory and with which devices and instruments to provide it, including meteorological instruments [Moraty, 1666].

The first measurements of the Mediterranean level were carried out manually in 1777/8 in Toulon and only in 1842 the French coasts were equipped with automatic tide gauges of A. Chazzalon.

The first tide gauge on a "geographically" Italian coast was installed in Trieste in 1859 which, in 1857 with the Vienna-Trieste railway, had become the main commercial port of the Austrian Empire.

In 1864, European countries met in Berlin to establish a common protocol for measuring mean sea level. In addition to traditional meteorological instruments, specific instruments, such as tide gauges and medimaremeters, had to be used. In addition, in the ports, a conventional elevation had to be identified, a benchmark, with respect to which to refer to detect, over time, the level variations of the free surface of the water.

- Italy: after Trieste, the tide gauge were installed in Rimini (1867), Venice (1871), Genoa (1883); all the benchmarks of the peninsular leveling network still derive from the Genoa benchmark. The same role is played by the tide gauge of Catania and Cagliari (both made after 1896), in order, for Sicily and Sardinia. Today the National Tide-Gauge Network has thirty-five measuring stations.
- France: after Toulon, in 1884 also Marseille had its own tide gauge. Over time, the measurement stations have become eleven on the Mediterranean coast of mainland France and four on Corsica.
- Spain. In 1870 the first tide gauge in the Mediterranean was installed in Alicante; in the same port, in 1953, a second one was installed, still in operation today. Therefore, the Alicante tide gauge sea-level data constitute the longest series in the Mediterranean. Spain currently has fourteen tide stations on the mainland Mediterranean coast, seven on the Balearic Islands and two in the small Spanish enclaves of the Moroccan coast.
- Traveling along the eastern Adriatic coast, from Trieste to all of Albania, there are no tidal stations capable of forming even a very small altitude measurement network.
- Greece. The most "ancient" sources that we have traced back to the first tidal surveys before 1969. Today the Greek survey stations, in operation, are 23.
- Turkey, Syria, Lebanon. As for Greece, we have no indications of its tide gauge stations from the Turkish past and the current situation is absolutely lacking. The other two aforementioned nations, from this point of view and beyond, are even worse off.
- Cyprus. In 1974 the island was divided, horizontally after the Turkish military intervention, into two distinct national entities: the Turkish-Cypriot one in the north and the Greek-Cypriot one in the south. In the southern part there are two British military bases which, most likely, influenced the construction of four tide gauge stations on this coast.
- Israel. It differs from all other Mediterranean nations because the first leveling was not done through tidal gauge surveys, but the more classic system of triangulations was used with respect to a known elevation point on earth. The first sea-level measurements were made in the port of Jaffa in 1927 and in the port of Haifa in 1928. The tide gauge measurements became a reference for the leveling network starting from 1934
- Malta. In 1974 the island was proclaimed a Republic within the Commonwealth, maintaining the British military bases already present on the territory until 1979 and with them the pre-existing tide gauge references.
- North Africa. Unfortunately. The geographical distribution of the instruments and their quality are of a very low level. There is also a lack of instruments that could be extremely useful to allow quick decisions in the event of a tsunami on a coast that hosts cities of significant tourist and cultural interest.

Today, instruments based on technologies completely different from those of the first instruments are used for tide gauge measurements. Ultrasonic altimeters, altimetric radars and the latest satellite altimetry systems are widely used.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: STATUS OF WATER QUALITY AND IMPACT OF DREDGING ACTIVITIES IN FOUR PORTS OF THE GULF OF AIGUES MORTES (FRANCE)

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Coastal hydrosystems, located at the land-sea interface, are both subject to autochthonous sources of pollution but also form a receptacle for terrigenous inputs from upstream areas. The attractiveness of these environments leads to high population densities, the permanent development of activities and the construction of infrastructures, resulting in the qualitative degradation of coastal aquatic environments. This is particularly true in the case of marinas, which are both places of dense internal activities (yachting, marina, shipyards (careening and maintenance of boats)) but also receptacles of waters from the catchment areas loaded with suspended solids and / or contaminants, to which they are connected.

The Gulf of Aigues-Mortes (GAM) extends along the western margin of the Rhone delta. The marinas spread over this restricted geographical area present variable management problems depending on their size and location. Siltation or silting phenomena exist and the situation is becoming more and more difficult to manage in order to maintain the depths for most of the harbours. In these marinas that are not dredged regularly, the quantities of potentially contaminated sediments (organic and metallic micro-pollutants) to be extracted represent from a few thousand to several tens of thousands of m^3 of sediments on the scale of each port.

Four harbours of the GAM have joined together to set up a mutualized dredging project in line with the regional dredging scheme in Occitania, based on the valorization of dredged sediments by distinguishing between ports with sand inputs of wind or current origin and ports confronted with sand and mud inputs, which may be contaminated by the port activity and/or the watershed

The objective of this project is to carry out a diagnosis of the chemical and microbiological contamination of the waters of the 4 ports located in the Gulf of Aigues Mortes. The size of the marinas varies from 130 to 5000 boat places. The volume of dredged sediments is between 5 000 m3 of sand and 30 000 m3 of mud.

Regular water samplings were done before, during and after dredging operations. Water column quality/contamination was characterized by major physicochemical water parameters (pH, temperature, dissolved oxygen, salinity, turbidity), inorganic compounds including major and trace metallic elements, organic compounds organotin compounds (including tributyltin). Trace elements were then determined using an ICP-MS, X Series II (Thermo Fisher Scientific), equipped with a collision cell technology (CCT) chamber and the organotin species monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT) were determined using a gas chromatograph (Focus GC – Thermo Fisher Scientific) coupled with an inductively coupled plasma mass spectrometer (ICP-MS X Series II-Thermo Fisher Scientific).

In addition to chemical parameters, indicators of fecal contamination (BTCF thermotolerant coliforms and intestinal enterococci) were also monitoring at the same frequency.

The originality of the results lies in the fact that it will not only make it possible to compare the chemical and microbiological qualities of the waters of the marinas, but also to determine the impact on the quality of the waters of the same type of dredging on the resuspension of contaminants in the water column, thanks to mutualized dredging. Finally, it will make it possible to determine, when contaminant resuspension occurs, the time required for the quality of the water to return to its initial state after dredging operations.

The possibility of working on sites with heterogeneous materials and disparate levels of contamination allowed us to take into account the parameters likely to influence the phenomena of sorption/desorption of contaminants (temperature, salinity, pH, porosity, nature and age of the sediments...) and to better understand the impact of the activities of these marinas, including the dredging operations on the whole Gulf of Aigues Mortes.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: A FIRST ASSESSMENT OF WATER COLUMN MICROPLASTIC'S (SENSU MSFD 2008/56/EC) ALONG THE COAST OF PUGLIA REGION.

SESSION:
COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The growing impact of microplastics on marine ecosystems is now in the public domain as an emerging issue of global concern thanks to the numerous actions undertaken worldwide, both in the research field than in the public awareness campaigns, but also in the field of environmental policies.
Marine litter (ML) persist in the marine environment with different timing depending on their nature but atmospheric agents still degrade them or break them into smaller fragments, the microplastics (MPs).
MPs are divided into two class. The primary microplastics are produced directly by industries. Them are found in commonly used products (e.g. some cosmetics, toothpastes, bubble baths, etc.) or derive from the abrasion of large plastic during the production, the use and the maintenance phases (e.g. from synthetic fabrics when washing, from cigarette butts and tires when driving, etc.). Plastics such as bottles, bags, fishing nets etc. are degraded by marine atmospheric agents such as sunlight, wind or brackish, giving rise to the so-called secondary microplastics (IUCN, 2017).
Since MPs can be composed of toxic/carcinogenic substances (contaminants such as phthalates) or they can absorb substances on the surface such as molecules of organic pollutants (eg. Persistent Organic Pollutants, POPs), bacteria and/or viruses, invasive species etc., could become a vector of contamination along the food chain. Studies are also underway on food and drink to find microplastic presence at these levels and understand the effect on human health.
It has been estimated a total of 268,940 tons of microplastics floating on the surface of the world's oceans. Simulation study of the distribution and transport of floating plastic debris in the ocean have been performed by estimating inputs from both terrestrial and marine sources (Lebreton et al. 2012). Thus, the Mediterranean Sea is declared one of the potential plastic accumulation zones in the world caused by a gradual increase in the concentration of marine litter mainly due to its semi-closed basin conformation. The estimation of the load of surface plastic in the Mediterranean Sea was approximately 23,150 tons (Eriksen et al., 2014).
The European Union in recent years has taken numerous steps to tackle the problem of plastic. The last important step was the entry into force of the European Directive on Marine Strategy (MSFD, 2008/56 / EC, transposed and implemented in Italy with D.Lgs. 13 October 2010, n.190) which aim to monitor the

marine environment and related activities to achieve the "Good Environmental Status (GES)". In particular it includes, among the eleven key descriptors of marine environmental status quality, the Descriptor #10 ("The properties and quantities of marine litter do not cause damage to the coastal environment"), focus on MLs and MPs and them impact on the marine environment and biota.

Following the MSFD disposals, across the Apulia region the quantitative and qualitative study of microplastics were achieved during three sampling years (2015, 2016 and 2017). The monitoring was performed across six survey areas. Six transects running perpendicular to the coastline were identified (CA, FO, BA, CB, PC, PN). Among them, three sampling stations where fixed at progressive distances from the shore: 0.5 Nautical Mile (0.926 km), 1.5 NM (2.778 Km) and 6 NM (11,112 Km). A total of 90 samples were collected and analysed. From the analysis of the ARPA Puglia MPs' data collected, a distribution at regional scale was performed.

Furthermore, considering the effects of microplastics in the food network and on humans' health, this regional MPs' overview is a valid information to be taken into consideration in future sea use programs managed at regional level, such as the granting of concessions for aquaculture or mussel farming facilities.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: CITIZEN SCIENCE BASED MARINE ENVIRONMENTAL MONITORING. THE MOANA60 EXPERIENCE.

SESSION: COASTAL ENVIRONMENTAL ENGINEERING:
POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives
Sea water quality monitoring is an extremely important activity that following traditional methods is extremely demanding and expensive. This results often in the sea being largely undersampled while scientific models are increasingly hungry of high resolution and high coverage data. A different approach needs to be pursued that could complement what already available within the traditional practices with new data. We will report here on the technologies we are developing and the experience we are making at National Institute of Oceanography and Applied Geophysics - OGS in the field of citizen science applied to marine environmental monitoring in order to improve spatial and temporal coverage of data.
Citizen science is based on a paradigm where voluntaries (generally laypeople) embrace research activities providing facilities they own and/or time they can spend, mostly to measure or acquire data on physical phenomena that could be relevant to scientists. The citizen science approach introduces advantages non only for researchers but for the society at large since participation in the research activities fosters awareness in the public for the topics there addressed. In the case of the environment of course this is particularly important.
Citizen science initiatives are rather common in many scientific fields (McKinley et al., 2015.) while only few can be tracked in the case of marine environmental monitoring (Lauro et al., 2014) notwithstanding the fact that several authors such as for example Fraisl (2019) highlighted that this field is very promising. Diviacco et al. (2021) reported on the application of the citizen science approach within the MaDCrow project that focused on the area of the Gulf of Trieste. In that work low-cost sensors were deployed on a group of small recreational boats to create a real-time full fledged infrastructure that from the sensors to the web based geographic representation of data could provide a snapshot of the marine environment status in the surveyed area. In that experience, the dimensions of the test area were relatively small and the possible variation of sea conditions were also limited. This meant that the sensors were only partially tested in largely varying environments, while instrumentation, transmission, power supply and infrastructure were only partially stress tested. Notwithstanding this the results have been very important to devise the new work we are reporting here.
This latter has been devised in strict collaboration with Moana60 Lab, which is an open platform that aims to link research institutions, schools and companies that could be interested in preserving the environment with a particular attention to citizen science initiatives. Moana Lab is a sailing boat that can host researchers and instrumentation and

that schedules regular cruises in several areas of the Mediterranean Sea. After an initial phase of preparation that has been severely influenced and unfortunately reduced by the COVID pandemic outburst, we were able to focus on a research cruise in the sector of the Tyrrhenian Seas corresponding to the northern part of the Sicily Island starting from the Aeolian Island sailing all the way towards theadian Islands. The covered area comprised several stopovers in various ports, both commercial and touristic, populated areas and marine protected areas. Particularly interesting has been the measurements in dynamic areas such as the Aeolian islands, or between the harbour of the city of Trapani and the Aegadian islands protected area. At the same time the experience allowed us to focus on several issues such as deployment of the acquisition system on private sailing boats, which of course is a very complicated topic since owners are very careful not to ruin the hulls of the vessels and generally do not want to be bothered by cumbersome instruments on deck. The data acquired are made openly available following the FAIR perspective, using OGC and ISO compliant standards.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: ASSESSMENT OF THE CHEMICAL QUALITY OF SEDIMENTS IN THE MARITIME PORT OF RÉUNION. *CONCENTRATIONS IN TRACE METALS AND NATURAL GEOCHEMICAL BACKGROUNDS.*

SESSION: 5 COASTAL ENVIRONMENTAL ENGINEERING

AUTHORS: JULIE DROIT, MOHAMED EL FADILI[1]

AFFILIATIONS: CEREMA RISQUES EAU ET MER
E-MAIL ADDRESS: JULIE.DROIT@CEREMA.FR

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Introduction: *The analyzes carried out on the marine sediments collected in the port and coastal areas of Réunion show, for certain metals, significant variations in their content and regular exceedances of the contamination levels set by the regulations governing the management of dredged sediments. Several studies relating to the geochemical context of Réunion show naturally high metal contents due to the geology of the island. However, given the high variability of the results, the cause of the exceedances is not systematically due to the volcanic origin of the sediments. The objective of this study is, on the basis of existing data, to define to what extent the observed exceedances of the dredged sediment management thresholds (N1 and N2) are due to the volcanic environment of the island or to anthropogenic inputs.*

Methods: *The analysis of the metal contents of sediments in Réunion is based on the following data:*

- Port sediment quality monitoring network,
- sediment analyzes carried out by the Grand Port Maritime de La Réunion,
- measurement campaigns carried out under the implementation of the Water Framework Directive,
- results of the CARTOMAR program [1],
- monitoring instituted by the water law decrees and impact studies produced in Reunion Island.

In order to avoid grain size variations, the measured concentrations were normalized with respect to an aluminum content of 5%.

Port activities and different releases may generate heavy metal intakes were identified : careening area, stormwater discharges, refueling stations…

To determine the natural part and the anthropogenic part of exceeding the dredged sediment management thresholds, the measurement results were analyzed using two indices: the enrichment factor and the geo-accumulation index [2].

Enrichment factor	Interpretation
< 1,5	Natural geological composition
1,5 à 3	Low enrichment
3 à 5	Moderate enrichment
> 5	Important enrichment

Fig. 1: *Interpretation of sediment enrichment factor values.*

Finally, the concentrations of elements for which an anthropogenic contribution is suspected were correlated with the concentrations of contaminants of exclusively anthropogenic origin (TBT, DEHP...).
Results: *Data from the Cartomar program [1] correspond to analyzes of sediments taken off the coast of Réunion. Considering that anthropogenic inputs are limited there, the results of these analyzes were used to define indicative levels of geochemical backgrounds for trace metals.*
According to the various analyzes of the results, the nickel and chromium concentrations are mainly of natural origin. The indicative levels of the geochemical background for these metals exceed the N2 levels, and they show no correlation with anthropogenic contaminants. Some peaks in concentrations may however be due to anthropogenic inputs. For other metals (copper, lead, mercury, and zinc), the indicative levels of natural geochemicals are lower than level N1 The copper, mercury and lead concentrations only occasionally exceed the N1 or N2 levels. However, enrichment factors and iGeo indexes show significant anthropogenic inputs on the entire port area. In addition, the concentrations of these metals are positively correlated with certain anthropogenic contaminants.
Discussion: *Regarding the quality of the dredged sediments, the high concentrations of nickel and copper may be due to anthropogenic inputs. These high levels can lead to sediment management difficulties. An environmental diagnosis of the port area could make it possible to identify the origin of the anthropogenic inputs observed in the different basins and to target the actions to be implemented.*

Thanks to the teams of the Grand Port Maritime de la Réunion and the DEAL for their help and their welcome.

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Development of an underwater gamma ray detector for measurement of radionuclides in different aquatic sediments

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Abstract

Sedimentation is a problem affecting most harbours and bays since its transportation can clog shipping channels. It is therefore desirable to trace its movement. This is traditionally done by using artificial radionuclides, but this poses an environmental risk and does not allow for the characterization of sediments. The naturally occurring radionuclides; thorium (^{232}Th), uranium (^{238}U), and potassium (^{40}K) are proposed as alternatives to artificial tracers. Though gamma-ray spectroscopy has been used by some systems to map aquatic radionuclides, they were mostly concerned with detecting those of anthropogenic origin, and their deployment has predominantly been stationary. The Delta Underwater Gamma System (DUGS) was consequently developed to provide a modular, mobile, waterproof detector system, capable of extracting potentially low radioactive counts from sediments over large areas. The system consists of a 3″×3″ NaI(Tl) detector, multi-channel analyser (MCA), and power management electronics in a custom, waterproof enclosure. Data logging, which includes the geotagging of the data, and gamma ray spectroscopy is done by using a custom VB.net code running on an external computer. The data link and power between the enclosure and the computer can be USB or power-over-Ethernet (PoE). The system was first tested in the laboratory using black sand, before being field-tested in Saldanha Bay, South Africa, where it was dragged through the aquatic sediments using a boat. The system's capacity to extract the count rates from low concentrations radionuclides was demonstrated.

1. Introduction

Coastal management and engineering are critical in the functioning of harbours. The development and maintenance of a harbour is a cost-intensive venture due to the accumulation of sediments that need to be dredged to allow passage in navigation channels. There is thus a need to measure and predict the transport of sediments on the seafloor and riverbeds. This was traditionally done by tracking an artificial tracer, such as paint or radioactive material, that migrates with the sediments (Ciavola and Grottoli, 2019). This, however, not only poses an environmental risk, but the method also does not allow for the characterization of sediments. A proposed alternative for studying sediment transport is tracing by means of gamma ray spectroscopy (Hai *et al.*, 1997; Jurado Vargas *et al.*, 1997; Pant *et al.*, 2013; Thereska, 2009). Gamma ray spectroscopy is a sensitive and simple method for estimating the distribution of primordial and anthropogenic radionuclides (Naumenko *et al.*, 2018; Zhang *et al.*, 2015), and has been successfully used to map large seafloor areas (Povinec *et al.*, 2008). It has also been successfully deployed to investigate natural radionuclides as tracers for monitoring the sedimentation processes on beaches (Bezuidenhout, 2020).

Studies involving the measurements of aquatic radionuclides primarily include the use of stationary detector systems for long-term or continuous measurements (Cao *et al.*, 2020; Kim *et al.*, 2018; Lee and Kim, 2021; Naumenko *et al.*, 2018; Povinec *et al.*, 1996; Tsabaris *et al.*, 2018, 2008; Tsabaris and Ballas, 2005; Zhang *et al.*, 2018). Many of these systems are concerned with the measurement of caesium (^{137}Cs) in waterbodies, and NaI(Tl) scintillation crystals are preferred because of their high energy efficiency, low power consumption and low cost. The radon daughters are also commonly measured to determine submarine groundwater discharge in coastal zones (Tsabaris *et al.*, 2011).

Other crystals are available for gamma detectors, but their use is limited due to lower energy efficiencies (Povinec *et al.*, 1996). These include high purity germanium (HPGe), CsI, fluorides (e.g., CsF and BaF_2) and semiconductor crystals, e.g., CdTe and CdZnTe. HPGe detectors have better energy resolutions compared to NaI(Tl) but consumes more power and need to be cooled with liquid nitrogen. These systems are therefore bulky and difficult to use for in situ measurements.

Traditionally, the content of aquatic sediments has been determined by the laboratory analysis of individual samples. This gives accurate information of individual locations but lacks spatial

variation. This is particularly problematic when surveying large areas as large amounts of sediment samples need to be taken and analysed. In situ gamma ray spectrometry offers several advantages over this classical sampling method (Osvath and Povinec, 2001; Zhang *et al.*, 2018), but requires a mobile, or towed system. Miller *et al.* (1982) discussed a towed seabed gamma ray spectrometer to survey the radio-effluent distribution in the Irish Sea. Noakes *et al*. (1999) developed and operated a survey system to measure and map a variety of physical and geochemical parameters in the surficial sediments of aquatic environments. Van der Graaf *et al.* (2007) used a towed underwater detector to determine the correlation between contaminants and radioactivity of sediments.

The use of mobile gamma ray systems for sediment tracing using natural radionuclides is limited. Not only do these systems need to be waterproof, but they also need to be robust and able to withstand a high-pressure environment. The concentrations of thorium (^{232}Th), uranium (^{238}U) and potassium (^{40}K) can also be extremely low, depending on the type of sediment deposition. In addition to large areas typically needed to be covered, the temperature fluctuation over these areas also complicates spectrum analysis.

This work presents the development and characterization of an in situ underwater gamma ray detector system, the Delta Underwater Gamma System (DUGS). This system was designed for the aquatic measurements of natural radionuclides (^{232}Th, ^{238}U progenies, and ^{40}K), with the intention of monitoring sediment transportation. The system is therefore able to extract potentially low radioactive counts from the sediment and determine the count rates. It is also capable of measuring anthropogenic and cosmogenic radionuclides. Of specific interest are the secular equilibrium nuclides, such as protactinium (^{234}Pa) and actinium (^{228}Ac), since they are often used as tracers of processes such as boundary scavenging, particle transport and ocean circulation. Their relative concentrations can also be used to investigate beach and ocean morphology (Gdaniec *et al.*, 2018).

To test the system, Saldanha Bay, a natural harbour on the south-western coast of South Africa, was proposed as a test site. This site is a functioning harbour with a lot of possible debris. The system consequently had to be robust and capable of absorbing impact. The proposed area of measurements covered an approximate area of 56 km^2, with a maximum water depth of 23.7 m. The DUGS thus had to be capable of measurements over an extended period and be rated for a

minimum water pressure of approximately 233 kPa. Despite the water temperature being relatively constant, with an average between 11° C and 19° C, the ambient temperature at which the Na(Tl) detector was calibrated could be significantly higher. These detectors are susceptible to spectrum drift due to temperature changes (Bu *et al*., 2018), and the system therefore had to include drift stabilization and correction methods.

1. Materials and Methods

1.1. System architecture

The architecture of the DUGS is illustrated in Figure 1. The system consists of a 3"×3" NaI(Tl) scintillation detector in an aluminium casing, and a commercial off-the-shelf (COTS) multichannel analyser (MCA), a TB-5 Digital Tube Base from Amptek®. The NaI(Tl) detector was chosen for its low cost, spectroscopic performance, and 90% to 100% light yield for most in situ temperatures (Knoll, 2010; Sailer *et al.*, 2012).

The TB-5 digital tube base contains a digital pulse processor and interface logic. It also contains preamplifiers, an analogue to digital converter (ADC), spectrum memory, and a microcontroller that facilitates external communication through the interface hardware. Combined, this constitutes the digital pulse processor. Typically, an external computer is connected to the TB-5 through the digital pulse processor's interface hardware for data logging and processing. A Trimble® Yuma rugged tablet PC (https://www.trimble.com/, n.d.) managed the systems and data acquisition.

Also included in the TB-5 are power management systems which provide a high voltage supply to the photomultiplier tube (PMT), and supply power to the low voltage components of the system (Amptek, n.d.-b). As will be discussed later, external power can be supplied via different methods, but passive power-over-Ethernet (PoE) is shown in Figure 1.

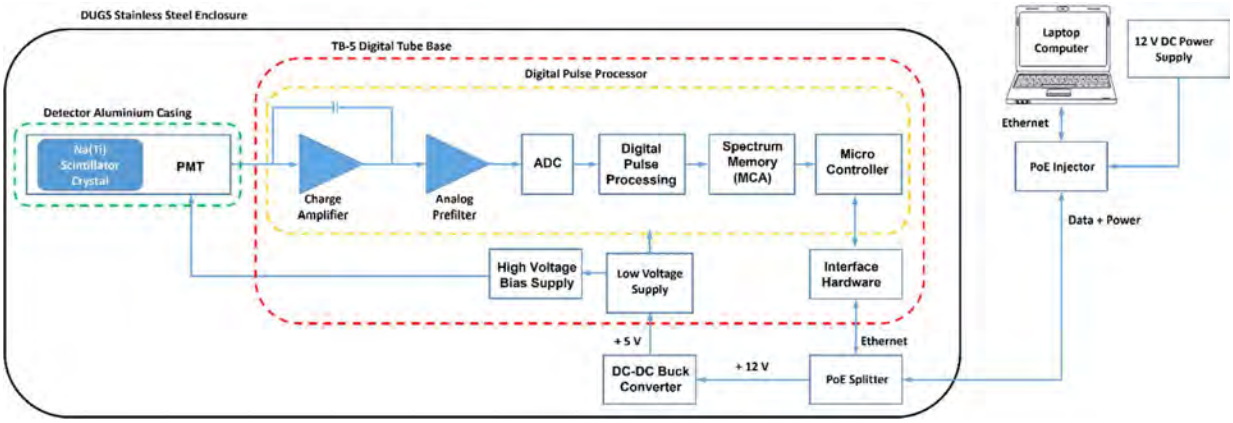

Figure 1: Block diagram showcasing the DUGS' architecture

To provide waterproof and robust protection against the underwater environment, the submersible components are enclosed in an in-house developed waterproof stainless-steel 316 (SS316) enclosure.

The DUGS was designed with the ability to detect gamma radiation autonomously, correlate the gamma ray counts with position and time, and the ability to be operated offshore and onshore. Figure 2 shows the photographic image of the DUGS assembly.

Figure 2: Assembly of DUGS detector system

1.2. System design

1.2.1. DUGS Enclosure

Figure 3 shows an isometric view of the designed enclosure. The material for the enclosure is stainless steel 316. Some studies have used stainless steel as a construction material for watertight enclosures (Povinec *et al.*, 2008; Wedekind, 1973), typically chosen for its strength, cost, pressure and corrosion tolerance. It is also a robust material, able to withstand impact from rock outcrops and debris when dragged through aquatic sediments. Some gamma-ray absorption will take place in the material, and the thinnest available wall thickness (1.5 mm) was consequently chosen for the cylinder housing of the detector.

The nose cone, located at the top of the vertical orientation in Figure 1, is not only designed to improve the hydrodynamic drag of the system, but also to protect the delicate electronics from possible impact when the system is dragged at the eye bolt. It is therefore constructed using 6 mm SS316 sheets. To provide further protection against bumps, the interior of the cylinder was padded with polymeric foam to act as a shock absorber.

The system was designed so that only the cylinder is waterproof. The nose cone is left open and allows for additional measuring equipment, such as pressure, salinity, and conductivity sensors, to be equipped. Located between the cylinder and the nose cone are two SS316 discs with ethylene-propylene-diene monomer (EDPM) gaskets which acts as a sealing material between the metal contacts. EPDM gaskets were chosen for their outstanding elasticity, flexibility at low temperature, resistance to heat, good electrical insulation and resistance to salinity (Li *et al.*, 2020). An IP68 stainless-steel cable gland from Rittal® was installed in the nose cone to provide a watertight seal for the Ethernet cable coming through the hole in the eye bolt into the cylinder.

The system was designed to be modular and can be used in horizontal and vertical orientations in both mobile and stationary applications. As its name suggests, the shape of the DUGS initially resembled that of a delta-wing aircraft. The function of the wings was to stabilize the system and prevent rotations when dragged in aquatic sediments in their horizontal orientation. Two wings, however, increased the risk of the system bumping into rocks and debris and getting stuck, and one wing was removed from the final product. Instead, it was designed to have a righting buoy attached to the remaining wing to stabilize the system when dragged. For stationary applications this wing is designed to be easily removable.

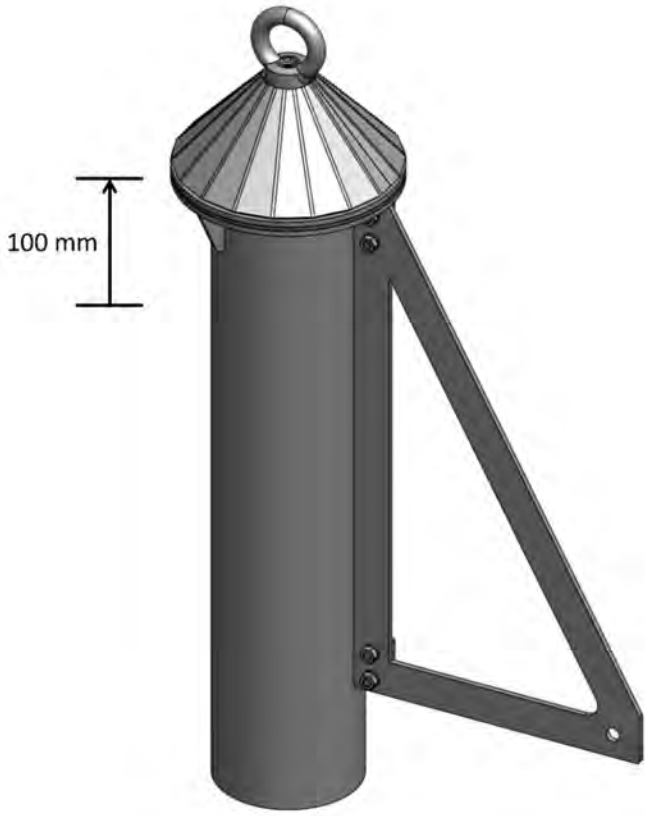

Figure 3: An image of the isometric view of the DUGS enclosure

1.2.2. Communication and power management

The modularity of the DUGS requires numerous communication and power links between the submersible unit and research vessel. In terrestrial applications, for example, with short distances of up to 5 m between the DUGS and the computer, the system can be powered from 5 V direct current (DC) using USB. In this configuration the USB is also used for the data transfer. For longer distances, Ethernet must be used for data transfer since the attenuation of the USB cable increases significantly. The system then has to be powered using the external power port, or through IEEE 802.3 standard PoE. This, however, can be impractical for in situ measurements since a PoE capable router, or similar device, is required.

For the proposed Saldanha Bay measurements, the DUGS was required to measure at depths of up to 30 m. To maintain portability and extend the system's battery life, it was decided not to use the IEEE 802.3 standard PoE. Instead, a custom passive PoE system was implemented that uses an external 2200 mAh battery pack to inject 12 V DC onto the Ethernet line. Inside the DUGS

enclosure, a PoE splitter then separates the power from the data lines and the power is stepped down to 5 V using a DC-DC buck converter. Data transfer still occurs over the Ethernet line, but the user diagram protocol (UDP) was used instead of transmission control protocol/internet protocol (TCP/IP) to improve transfer speeds.

1.2.3. Software

The default software supplied with the TB-5 is Amptek's® DppMCA (Amptek, n.d.-a). Though this software can be used for in situ measurements, it was primary developed for laboratory use and is consequently not customizable. Fortunately, a software development kit (SDK) is also supplied that allows custom software applications to be developed. Visual Basic (VB.NET) was chosen as the development programming language since it provides a good graphical user interface (GUI) and development capabilities. The basic flow of the developed software is shown in Figure 4.

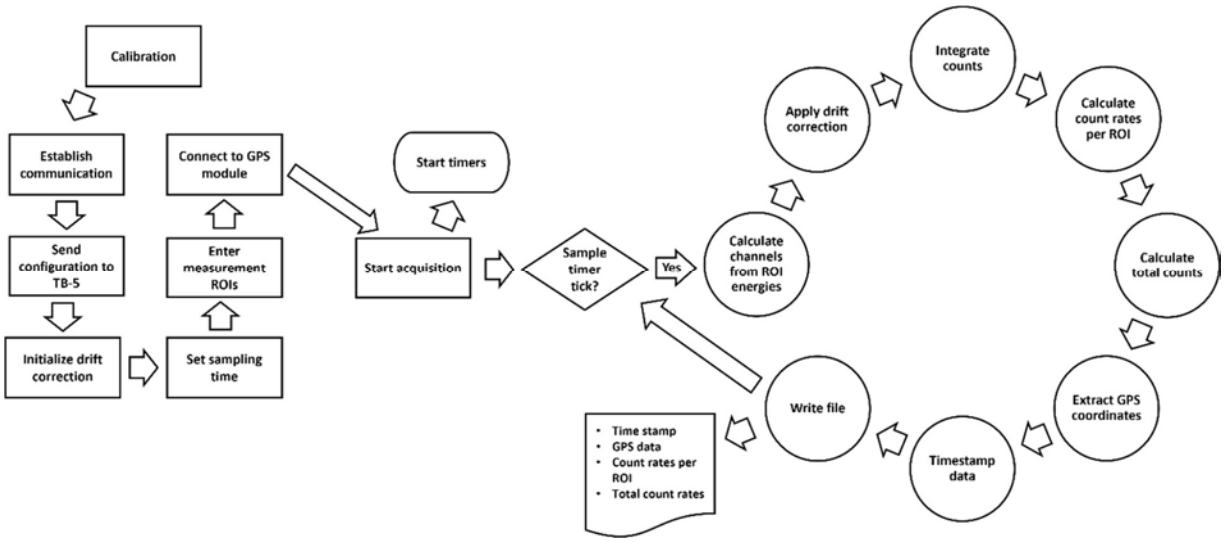

Figure 4: DUGS Software flow diagram developed in VB.NET

One of the main features of the DUGS software application is integrating the Yuma's on-board GPS system (a U-blox Neo-6 GPS module) and adding the geographic location to each sample point. The software was designed to read the strings generated by the GPS through the COM port. These strings are encoded using the NMEA protocol and are transmitted at a baud rate of 9600 bps (U-blox, n.d.). Various strings are available (GSV, RMC, GSA, GGA, GLL, VGT, TXT), but only the GGA strings are used to extract the GPS coordinates before converting it to world geodetic system (WGS84) format.

The software also performs spectrum analysis on specific regions of interest (ROIs) while measuring. These regions are set up according to the energies of the radionuclides of interest and translated to MCA channels using the calibration discussed later in the paper. The output from the spectral analysis is the count rates for each ROI, as well as the total count rates over the accumulation time. These results are stored, along with the raw spectrum files, as text files containing the count rates, sample time and GPS data. Three dynamic spline charts are also displayed for ^{232}Th, with the gamma emission from 2614.5 keV (^{208}Tl daughter), ^{232}U with the gamma emission from 1764.5 keV (^{214}Bi daughter), and the ^{40}K gamma emission. These provide situational information and show the concentration of the radionuclides over the last 20 measurements. They can also be monitored for correct operation and allows the user to identify anomalies.

As mentioned, NaI(Tl) detectors are susceptible to temperature drift which potentially shifts the energy centroids of gamma emissions out of the defined ROIs. To allow measurements over a wide temperature range, the automated drift correction method proposed by Le Roux and Bezuidenhout (2021) was implemented in the software. This method follows the 1460.8 keV peak of ^{40}K and determines the spectrum skewness in comparison to the expected Gaussian distribution. A weighted gain correction factor is then calculated, and the detector gain is adjusted by the same amount to compensate for the drift.

1.3. System characterization

1.3.1. General specifications

The characteristics of the DUGS enclosure are listed in Table 1. The TB-5 is designed to be compatible with standard 14 pin scintillation detectors using 10 stage photomultiplier tubes (PMTs). This includes NaI(Tl), CsI(Na), BGO, LaBr and many others. The resolution, efficiency, and maximum count rate are primarily determined by the scintillation crystal. When coupled to a TB-5, the typical performance characteristics are those listed in Table 2.

Table 1: The characteristics of the DUGS enclosure

Characteristic	**Description**
Material	Stainless-steel 316
Dimensions	Cylinder: Ø101.6 mm × 581.58 mm
	Nose cone: Ø101.6 mm ×77.02 mm
Thickness	1.5 mm (cylinder)
	4.0 mm (nose cone)
Weight	5466.71 g

Table 2: Typical performance characteristics of the TB-5 when coupled to a NaI(Tl) detector

Characteristic	**Range/Type**
Energy Range	< 3000 keV
Energy resolution	7% FWHM@662 keV
Spectroscopy	2048 channels
Operating temperature (TB-5)	-40° C to +85° C
Operating Voltage	3.0 V to 6.4 V
Operating current	150 mA to 300 mA (typical 190 mA)
High Voltage	~850 V
Power consumption	750 mW to 1500 mW (typical 950 mW)
Coarse gain (selectable)	1.57, 2.56, 4.09 or 6.77
Fine gain (adjustable)	0.75 to 1.25
Total gain	0.75 to 150
Pulse shape	Trapezoidal
Peaking time	0.8 µs to 102.4 µs (typical 2.4 µs)
Communication	10 Base-T or UDP, USB (12 Mbps), RS232

1.3.2. Pressure testing

The proposed testing site for the DUGS requires operational depths of up to 23.7 m. For safety, it was decided to rate the system for a maximum depth of 30 m. This implies that the enclosure must withstand pressures of up to 300 kPa. It was consequently pressure tested by filling the enclosure with water and pressurizing it to the maximum compressor pressure of 600 kPa. The system was

then left for 10 minutes after which no visible leaks were observed. A pressure rating of 600 kPa implies that the system can measure depths of up to 60 m.

1.3.3. Gamma ray attenuation

A commercially available 1.5 mm SS316 cylinder was used for the enclosure that holds the NaI(Tl) detector and MCA. To determine the attenuation coefficient of SS316, an experiment similar to that used by Buyuk (2015) was performed whereby the intensity of gamma rays from a point source was determined through different thickness sheets.

The photon emission of the following energies: 351.9 keV, 609.3 keV, 1120.3 keV, 1764.5 keV and 2204.0 keV were used, and the initial count rates were determined without any material (R_0). The count rates through different steel thickness (R) were then measured and the relative count rates (R/R_0) were calculated at the different thicknesses: 0 mm, 3 mm, 6 mm, 9 mm, 12 mm, 15 mm, and 18 mm.

The mass attenuation coefficient (μ/ρ) is a parameter used to measure the amount of radiation transmitted through a material and is affected by its chemical composition. Stainless steel is a group of ferrous alloys, with the chemical composition of SS316 given in Table 3. Using this composition, the mass attenuation coefficient for SS316 was first determined experimentally and then calculated using the US National Institute of Standards and Technology (NIST)'s XCOM software (Berger *et al.*, 2010; Marashdeh *et al.*, 2015; Sultan Al-Buriahi *et al.*, 2021). This software uses equation 1, an online database, and the weight fraction of each element in the composition, w_i, to calculate the total theoretical mass attenuation coefficient for a material (Waly *et al.*, 2016).

$$\left(\mu/\rho\right)_{total} = \sum_i w_i \left(\mu/\rho\right)_i \qquad 1$$

with $\left(\mu/\rho\right)$ the mass attenuation coefficient of the individual elements. ρ is the density of SS316 and was determined experimentally using the mass and volume of a given sheet.

Table 3: Chemical Composition of SS316 (Rotshtein *et al.*, 2006)

Element	Fe	Cr	Ni	Mo	Mn	Cu	Si	C	P	S
Composition (Wt. %)	68.667	16.250	10.150	2.170	1.630	0.360	0.690	0.045	0.025	0.013

1.3.4. Geometry efficiency

An experiment was conducted to compare the effects of the DUGS' horizontal and vertical geometry on its efficiency. The experiment measured the spectra of natural sediments and compared the difference in the detector's efficiency for the two geometries. Figure 5 shows graphs of the measured count rates for the two geometries, and exponential curves fitted to the data shows similar trends. Figure 6 shows the measured spectra of the two geometries, and as can be seen, there was no significant difference between the two orientations. This proves a negligible difference in the efficiency of the detector when operated in horizontal and vertical geometry.

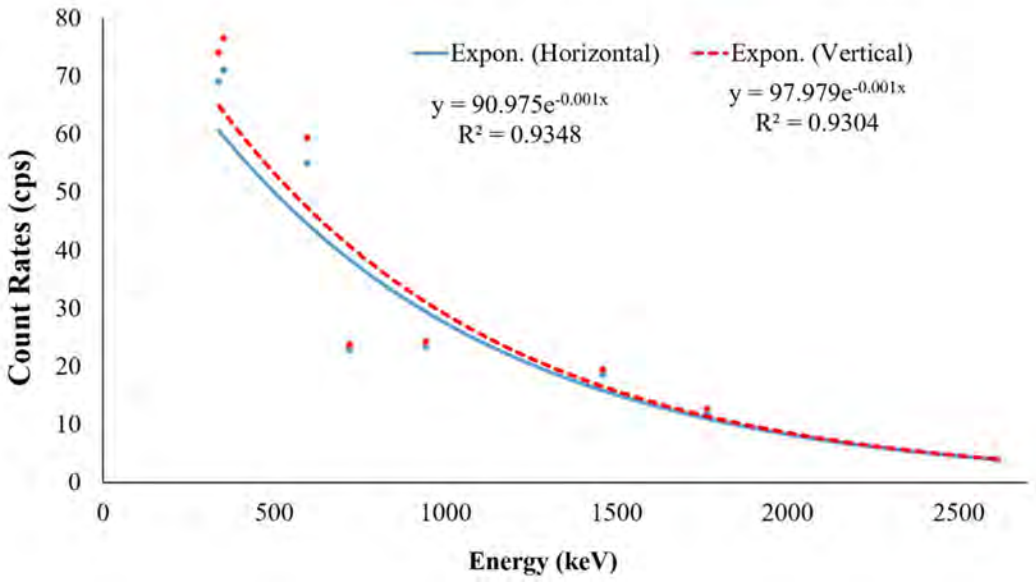

Figure 5: Gamma ray count rates to energy which were measurements by a 3″×3″ NaI(Tl) detector at horizontal and vertical geometry. Exponential curve fits were used to indicate the trends.

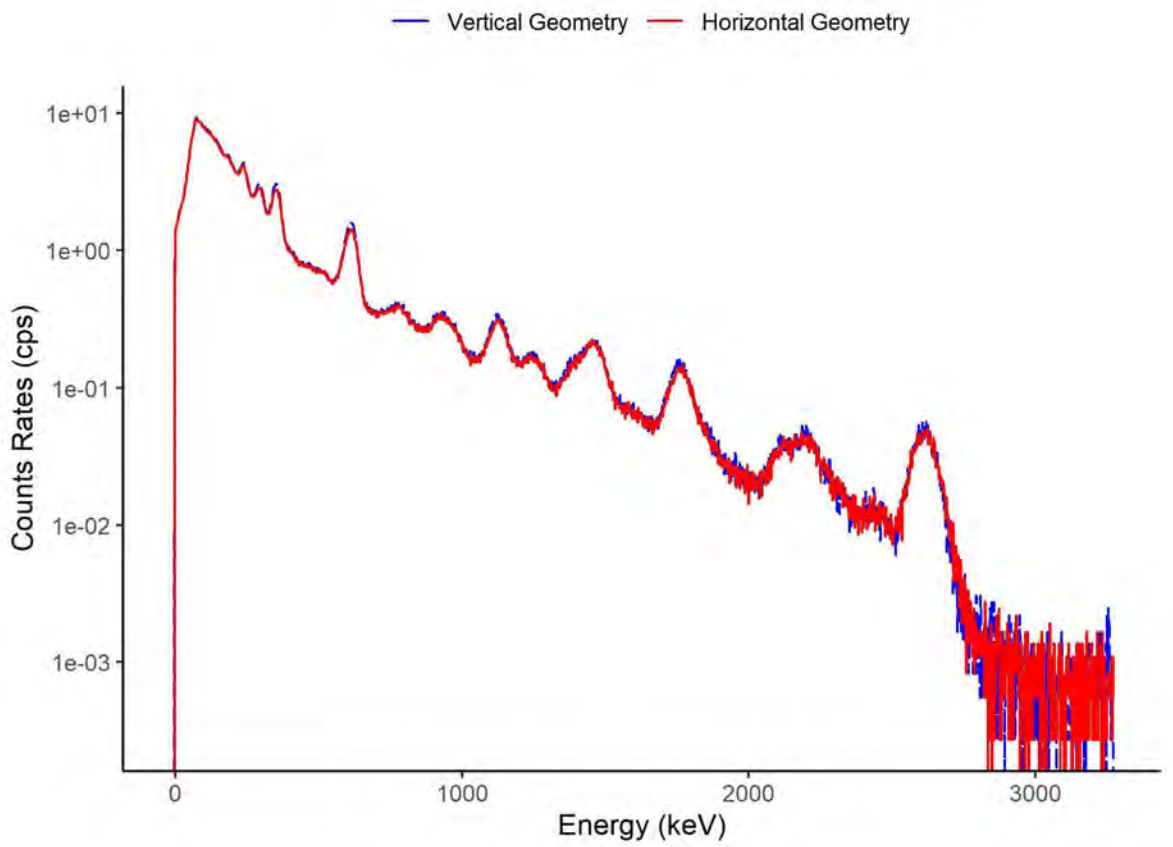

Figure 6: Two spectra of natural sediments measured in vertical and horizontal geometries

1.4. Calibration

1.4.1. Energy Calibration

Energy calibration was performed before each measurement by using anthropogenic nuclide sources similar to the method of Bezuidenhout (2013). The photon energy emissions used for this purpose were 351.9 keV (^{214}Pb), 609.3 keV (^{214}Bi), 1120.3 keV (^{214}Bi), and 1764.5 keV (^{214}Bi). The channel where each energy centroid was found was then plotted and a second-degree polynomial fit was done to the data. Even though a linear relationship exists between the data, a polynomial fit was marginally better ($r^2 = 1$ compared to $r^2 = 0.9998$). Figure 7 shows an example of a typical fit. The relationship between energy and channel number can then be determined by means of equation 2, where E_γ is the gamma energy in keV and Ch is the centroid channel number corresponding to the emitted energy:

$$E_\gamma = (Ch^2)A + (Ch)B + C \qquad 2$$

A, B and C are the calibration parameters calculated during the fitting of the calibration plot (Al Oraini, 2018), and are used to determine the channel numbers for specific regions of interest (ROI). These parameters are also used by the drift stabilization method to define the regions where the 1460.8 keV photopeak of ^{40}K is expected.

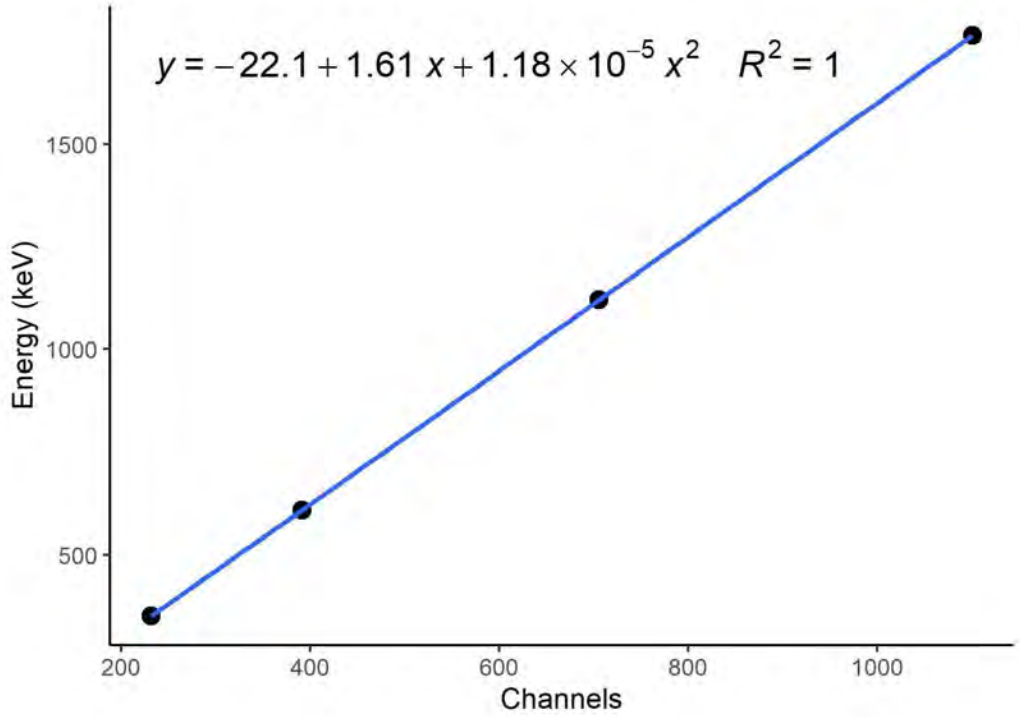

Figure 7: Polynomial energy calibration curve of the DUGS using 351.9 keV (^{214}Pb), 609.3 keV (^{214}Bi), 1120.3 keV (^{214}Bi), and 1764.5 keV (^{214}Bi).

1.4.2. Efficiency Calibration

The efficiency calibration of the DUGS was done using three standard reference pads at the Nuclear Energy Corporation of South Africa (NECSA). These concrete pads are respectively mixed with known concentrations of K_2O, U_3O_8, and ThO_2. The detector's efficiency calibration constants were calculated for the horizontal geometry while the detector was in the enclosure.

According to Chiozzi *et al.* (2000), the count rate for each ROI in a spectrum is influenced by the concentration and interference of radioactive elements, energies of the transmitted radiation, and detector sensitivity. The efficiency calibration values for ^{40}K, ^{238}U, and ^{232}Th were therefore calculated for each individual window. The conversion of the count rates to the activity concentration (Bq/kg) was achieved by solving 3×3 simultaneous equations according to Bezuidenhout (2015) and Chiozzi *et al.* (2000) and equation 3 shows the matrix equation that was used to calculate the efficiency calibration values.

$$\boldsymbol{R} = \boldsymbol{eA} \qquad 3$$

with **R** a 3×1 matrix representing the count rates in the ^{40}K, ^{238}U and ^{232}Th peaks in the calibration spectra. **e** is a 3×3 matrix representing 9 efficiency coefficients, and **A** is a 3×1 matrix with the activity concentrations for ^{40}K, ^{238}U, and ^{232}Th in the standards. The calibration efficiencies were then used to calculate stripping ratios (α, β, γ and a) using the equations in 4. These ratios were then used to determine the energy resolution of the DUGS (International Atomic Energy Agency, 2003).

$$\alpha = \frac{e_{2Th}}{e_{3Th}} \quad \beta = \frac{e_{1Th}}{e_{3Th}} \quad \gamma = \frac{e_{1U}}{e_{2U}} \quad a = \frac{e_{3U}}{e_{2u}} \qquad 4$$

1.5. Field testing of the detector system

The DUGS was tested on the seafloor of Saldanha Bay, South Africa, by dragging the detector through the sediments using a boat. Its robustness and effectiveness in measuring specific gamma ray energies were assessed. A rugged tablet, a Trimble Yuma® 2, was used to log the data. The spectra were acquired and saved on the tablet while simultaneously being analysed to extract the count rates of different ROIs. Gamma emissions from ^{214}Pb, ^{214}Bi, ^{208}Tl, and ^{40}K were of particular interest. External power was supplied to the TB-5 through passive PoE using the discussed 2200 mAh 12 V DC power supply. Ethernet also provided the data link. The detector was deployed in its horizontal geometry for easy towing. A 2 m heavy-duty chain was attached between the enclosure and the towing cable to ensure that the enclosure is pulled among the sediments. This

reduces the gamma ray attenuation of the water and enhances the count rates (Jones, 2001). Figure 8 shows the geometry and setup for the in situ measurements. The operating range of the TB-5 also stipulates a non-condensing environment. The system was therefore checked for water leaks.

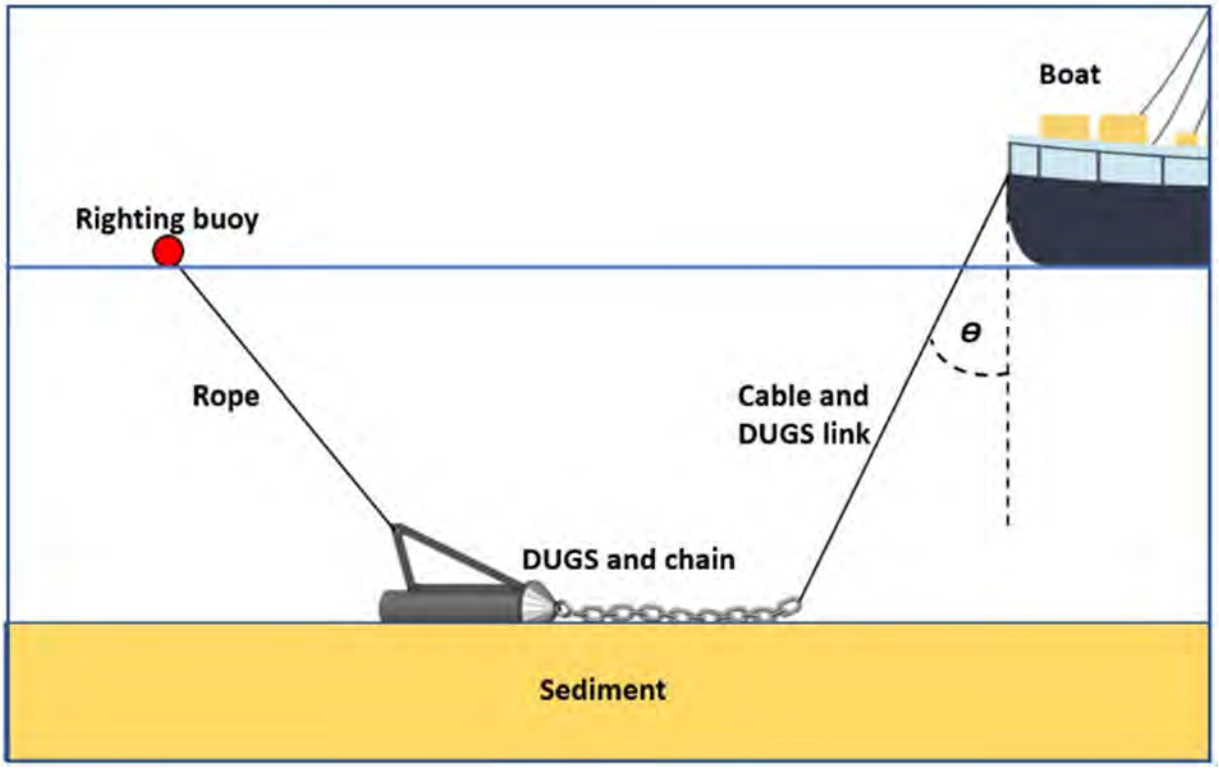

Figure 8: Configuration of the DUGS during the in situ measurement of Saldanha Bay, South Africa

2. Results and Discussions

2.1. Energy Resolution

The stripping ratios were calculated and used to estimate the energy resolution of the DUGS. The calculated values using the NECSA reference pads are shown in Table 4. The results also compared well to those determined by other studies. The low values for the stripping ratios indicate excellent detector resolution. It also indicates that the detector's resolution is unaffected by the change in typical geometry and the surrounding enclosure.

Table 4: Typical stripping ratios of DUGS for the horizontal symmetry compared to other studies

Stripping Ratio	DUGS stripping ratio	Løvborg *et al.* (1979)	IAEA (2003)
α	0.786317	0.64	0.586
β	0.884447	0.58	0.484
γ	1.017902	0.77	0.769
a	0.067847	-	0.034

2.2. DUGS enclosure characterization

The attenuation of gamma rays by the enclosure was computed and linear attenuation coefficients extracted. The ratio of attenuated gamma rays against the thickness of the steel at different gamma energies is graphed in Figure 9. As expected, the relative count rates decrease with an increase in material thickness (Buyuk, 2015). The cylindrical portion of the DUGS enclosure housing the detector has a wall thickness of 1.5 mm, implying a 13.87 % attenuation at 351.9 keV and 8.67 % at 1764.5 keV, respectively.

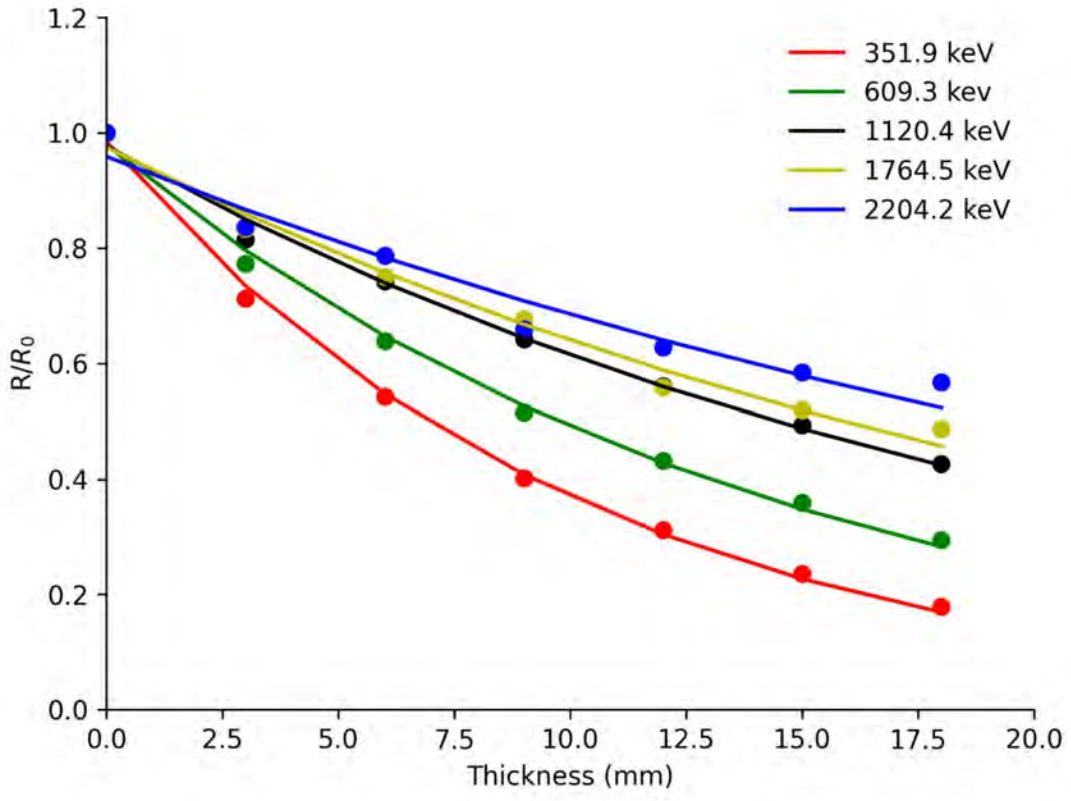

Figure 9: Exponential fitting of the relative count rates against the thickness of the steel at different photon energies. The relative count rates (R/R0) are the ratios between the detected count rate with and without the steel material.

The mass attenuation coefficient for SS316 was then determined experimentally, and the values compared with the calculated XCOM values. As seen in Figure 10, these values are comparable. The slight differences can be attributed to counting statistics, systematic errors, or the interpolation of XCOM values (Abdel-rahman and El-mongy, 2017; Çevik *et al.*, 2006; Sayyed *et al.*, 2019).

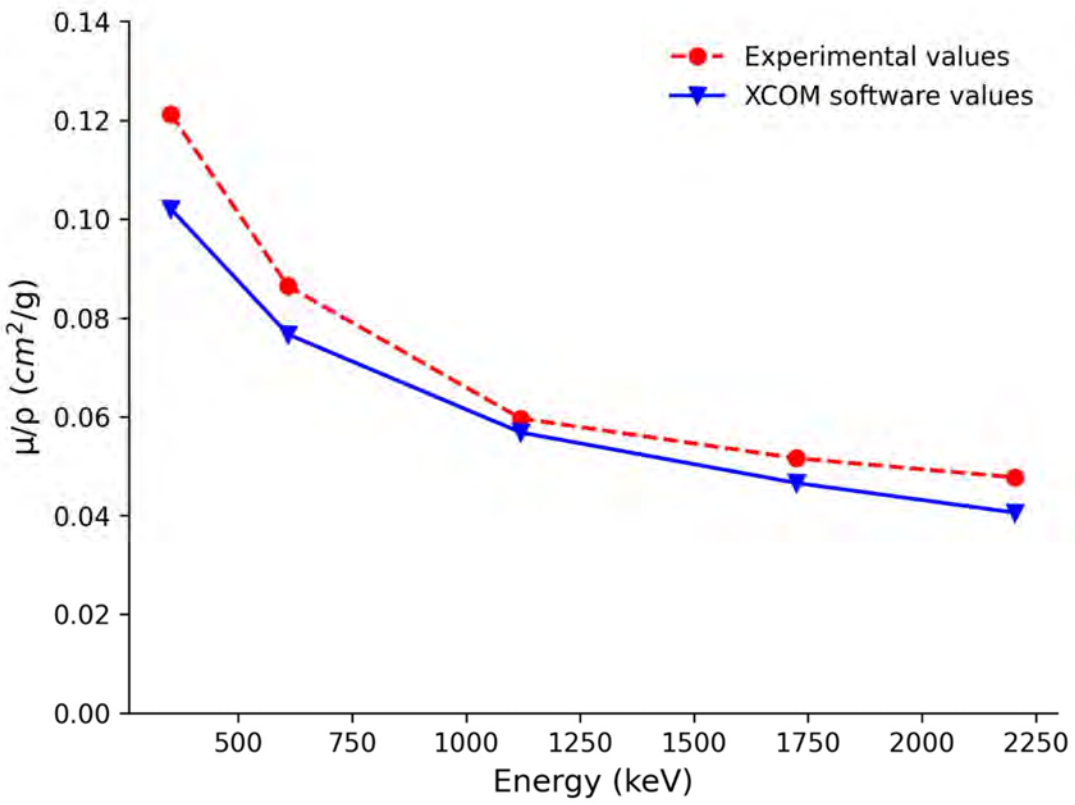

Figure 10: Plots for the experimental and XCOM software-calculated mass attenuation coefficient for SS316 at different gamma energies.

The data shows that the mass attenuation coefficient decreases with increasing photon energy. The lower energy photons (351.9 keV) have a higher mass attenuation coefficient compared to the high energy radiation (1764.9 keV). This implies that the interaction of gamma radiation with electrons at high energies is minimal, hence the low mass attenuation coefficient (Waly *et al.*, 2016). This is a result of the photoelectric effect dominating at low photon energies (Sultan Al-Buriahi *et al.*, 2021). At low energy radiation, information may consequently be lost due to the attenuation of gamma rays by the steel. Fortunately, for sediment transport studies and other radiotracer

experiments in a marine environment, higher energy photo peaks are preferred during in situ measurements (Tsabaris *et al.*, 2021).

A container with black sand was then used in the laboratory to evaluate the attenuation of the gamma radiation from the natural radionuclides commonly found in sediments. Black sand typically contains high concentrations of these radionuclides. Measurements were done with and without the enclosure, and the spectra shown in Figure 11 was obtained. It is evident from the figure that there is a difference in attenuation between the two configurations, specifically at low energy gamma rays, particularly those below 300 keV. The difference in attenuation at higher energies is, however, negligible. The gamma ray energies that are used for radiometric measurements in this study typically have energies exceeding 351.9 keV. The gamma ray attenuation from the enclosure is therefore negligible for this study. Also seen from Figure 11 is that the various daughters of ^{238}U (351.9 keV, 609.3 keV, 1120.3 keV, and 1764.5 keV) and ^{232}Th (911.2 keV, and 2614.5 keV) can be identified by their energies. The 1460.8 keV photopeak of ^{40}K is also clearly visible.

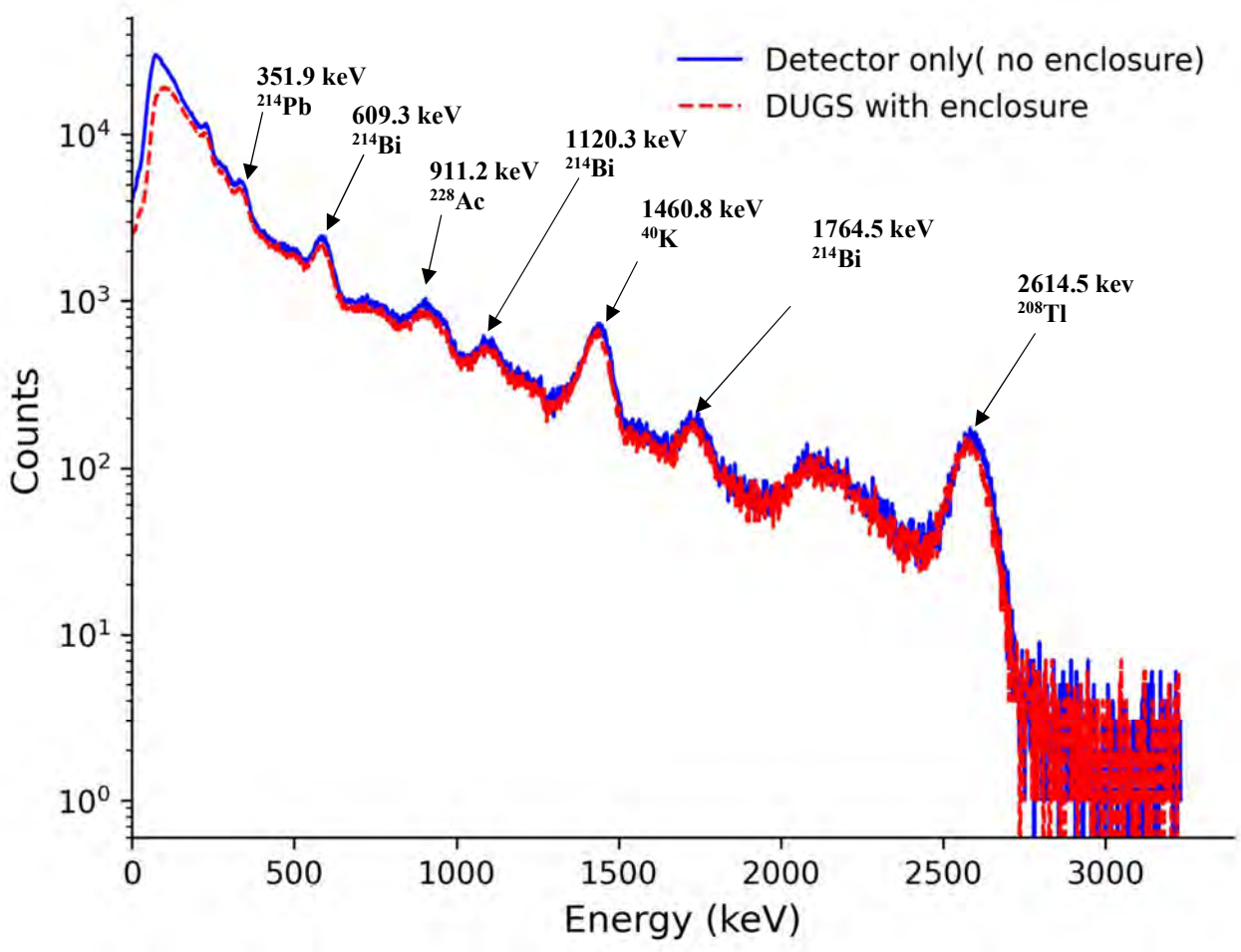

Figure 11: Typical laboratory spectra acquired by DUGS with and without the enclosure on black sand that contains high concentrations of heavy minerals and natural radionuclides.

2.3. Field test data

No leaks were detected during the underwater measurements, implying the EPDM gaskets and Rittal cable gland were effective in providing waterproof seals. Figure 12 shows the typical spectrum obtained by measuring the seafloor of Saldanha Bay. Due to the surrounding geology and the fact that no freshwater flows into the bay, depositing upstream sediments into the water, low radioactive activities were expected in the sediments of the bay. Despite this expectation, the DUGS managed to detect the low concentrations of ^{40}K (1460.8 keV emission), and ^{214}Bi at (351.9 keV emission) which is in the ^{238}U progeny (Osvath and Povinec, 2001; Povinec *et al.*, 2008). For comparison, the DUGS was also deployed to measure sediments in the lower Berg River region

near Velddrift, South Africa. A spectrum from these measurements is shown in Figure 13. As can be seen, the 609.3 keV peak for ^{214}Bi and 2614.5 keV peak for ^{208}Tl are also now identifiable.

As per Table 2, the typical operating current of the TB-5 when connected to a NaI(Tl) detector is 190 mA. Powering the DUGS with a 2200 mAh 12 V DC power supply implies an operational period of more than 11 hours. The battery of the Trimble, however, only lasts approximately 4 hours, depending on its configuration. Both sets of underwater samples were taken at a speed of 2 Knots, or 1 m/s, which implies that approximately 14.4 km was covered over the period. Faster speeds increased the diagonal force on the detector and risked the detector being pulled away from the sediments. To cover larger areas, an external battery pack can be used to extend the Trimble's operation, or the length of the chain can be increased to allow for faster boat speeds without increasing the diagonal force.

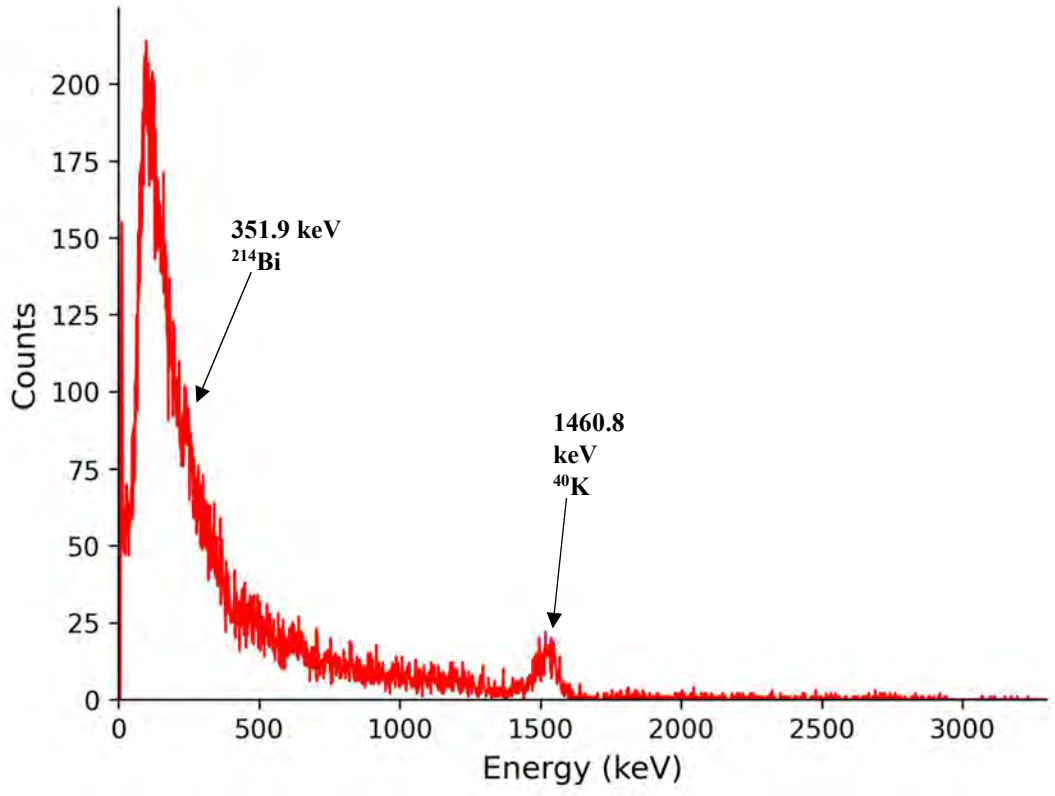

Figure 12: A typical underwater spectrum acquired on the seafloor sediments of Saldanha Bay, South Africa by using the DUGS.

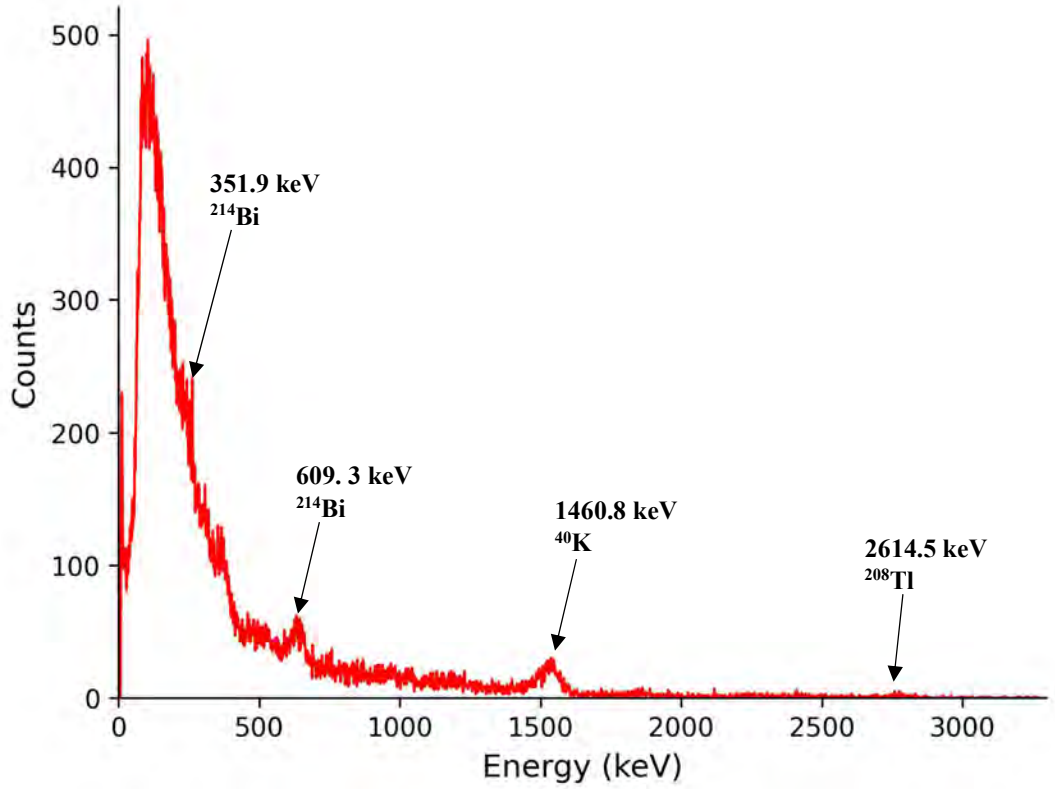

Figure 13: A typical underwater spectrum that was acquired on the riverbed sediments of the Berg River, South Africa using the DUGS.

3. Conclusions

The Delta Underwater Gamma Ray System (DUGS) was primarily developed as a mobile platform for measuring the gamma rays of natural radionuclides to be used as tracers for aquatic sediments. The functionality and effectiveness of the system were successfully demonstrated by first extracting the radionuclide concentrations of black sand, before deploying the system to measure the seafloor of Saldanha Bay, South Africa. Despite the low radioactive concentrations expected in the bay, the system managed to calculate the count rates of the natural radionuclides. The system is rated to withstand pressure up to a maximum of 600 kPa, and the SS316 enclosure therefore provides adequate waterproof protection against impact. It also has a negligible mass attenuation coefficient for energies above 300 keV and was found to have a linear attenuation coefficient of 13.87% and 8.67% for 351.9 keV and 1764.5 keV, respectively.

Though the system was designed for mobile gamma ray tracing of aquatic sediments, measuring the secular equilibrium isotopes also opens the possibility to investigate boundary scavenging, and ocean circulation. The modularity of the system also allows it to be used in stationary applications, such as in the detection of submarine groundwater. It was found that the detector can be deployed in both horizontal and vertical orientation since there was no significant difference in the detector efficiency between the two orientations. Terrestrial measurements are also possible, and the system can be used to determine beach morphology and erosion. The system can also easily be adapted to measure and detect anthropogenic nuclides, such as ^{137}Cs.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

Biomonitoring of trace metals in mussel *Mytilus galloprovincialis* from coastal areas along the Atlantic coast of Morocco, and its related public health hazards assessment

Session: Coastal Environmental Engineering: pollution, energy production, monitoring and economic environmental assessment, regulatory context

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Abstract

Seafood as a major dietary food worldwide is greatly consumed by world‟s growing population. Seafood products are a rich source of proteins, essential minerals and vitamins, all significant for human health. Seafood consumption by humans can induce health risk because seafood may be contaminated by various pollutants. Mussels are a kind of seafood commonly consumed in coastal areas. However, mussels are known for the ability to accumulate a wide range of trace metals and that makes them valuable bioindicators of marine pollution. The mussel *Mytilus galloprovincialis* is widely distributed in the coastal waters of Morocco. For seafood safety, we need to increase our understanding of the metal bioaccumulation processes in marine and coastal ecosystems and their potential health risk to humans. The objective of the present study was (i) to analyze the concentrations of four trace metals (Cadmium „Cd‟, Chromium „Cr‟, Copper „Cu‟ and Zinc „Zn‟) in soft tissues of the wild mussel *Mytilus galloprovincialis* collected from six different sampling stations in northwestern Morocco, and (ii) to evaluate the human health risks of Cd, Cr,

Cu, and Zn, associated with the consumption of contaminated mussels.

Three study sites spreading over ~294 km southwards, along the northwest Atlantic coast of Morocco were analyzed: El Jadida, Safi and Essaouira. In each site, samples were collected from two sampling stations on four seasonal occasions. Stations "Azemmour" (S1), "Cap Beddouza" (S3) and "Bhibeh beach" (S5) that we can assume as pristine stations, were not exposed to pollution sources while stations "Jorf Lasfar" (S2), "Jorf Lihoudi" (S4) and "Sekkala" (S6) were highly exposed to polluting discharges from industrial activities (phosphoric acid and chemical products industry for S2 and S4, and urban effluents and fishing activities wastes as well as sewage effluents for S6). Specimens of *M. galloprovincialis* were collected seasonally during 2017-2018.

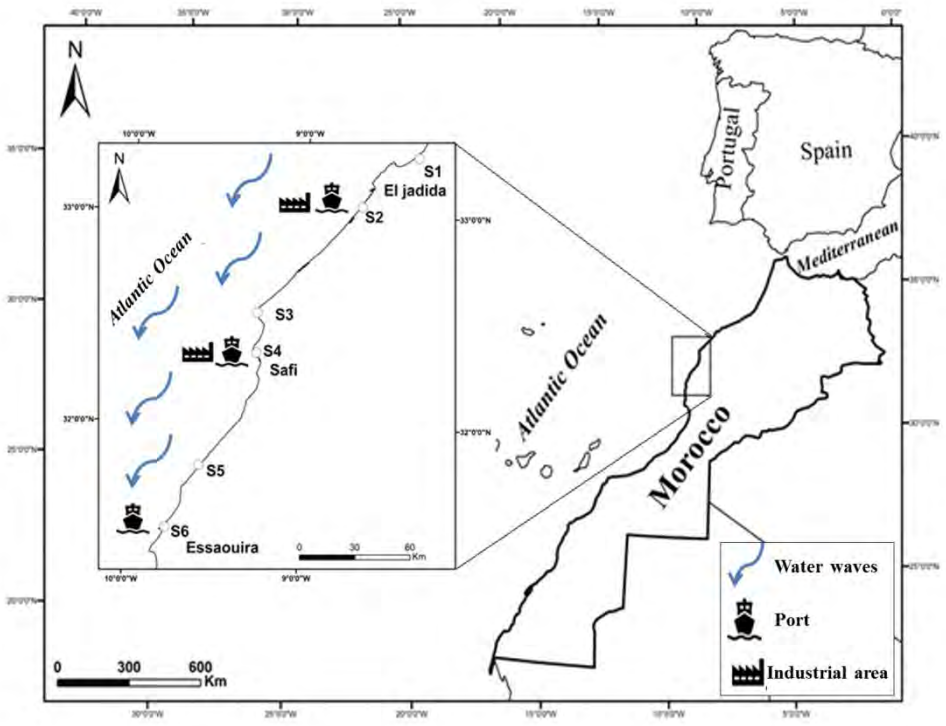

Figure 1. Geographical position of study areas and location of sampling stations along the NW Atlantic coast of Morocco.

The spatial distribution of trace metals showed similar patterns for all sampled mussels. However, specimens from polluted stations (S2, S4 and S6) were found to be significantly more contaminated than those from presumed control stations (S1, S3 and S5). Significant correlations between trace metals were found in mussels from all sampling stations and mean metal concentrations in their soft tissues were ranged as follows: Zn (141.61±78.06 µg g^{-1} dry weight) >

Cr (22.57±15.47 µg g^{-1}) > Cu (18.95±20.01 µg g^{-1}) > Cd (16.33±19.01 µg g^{-1}). Nonetheless, the highest concentrations for all metals were recorded in wet seasons while the lowest in dry seasons. Among investigated metals, only Cd has exceeded all safety limits for the mussel consumption established by international organization standards. In addition, the "Individual Mean Bioaccumulation Index" and "Metal Pollution Index" revealed that there were no real reference/control stations. Both indices showed that the pollution occurred in all the study stations, but more obviously in stations S2 and S4 exposed to pollution sources. Furthermore, the "Estimation of Daily and Weekly Intakes" for Cd and Cr suggested that mussels of stations S2 and S4 pose a health risk to consumers‟ health. Thus, the average concentrations of all trace metals lead to rather low values of the maximum safe consumption and may represent a risk at levels affecting children in particular. The "Target Hazard Quotients" and the "Hazard Index" represents a risk to public health level with Cd at stations S2 and S4, regardless of consumers‟ age and sex.

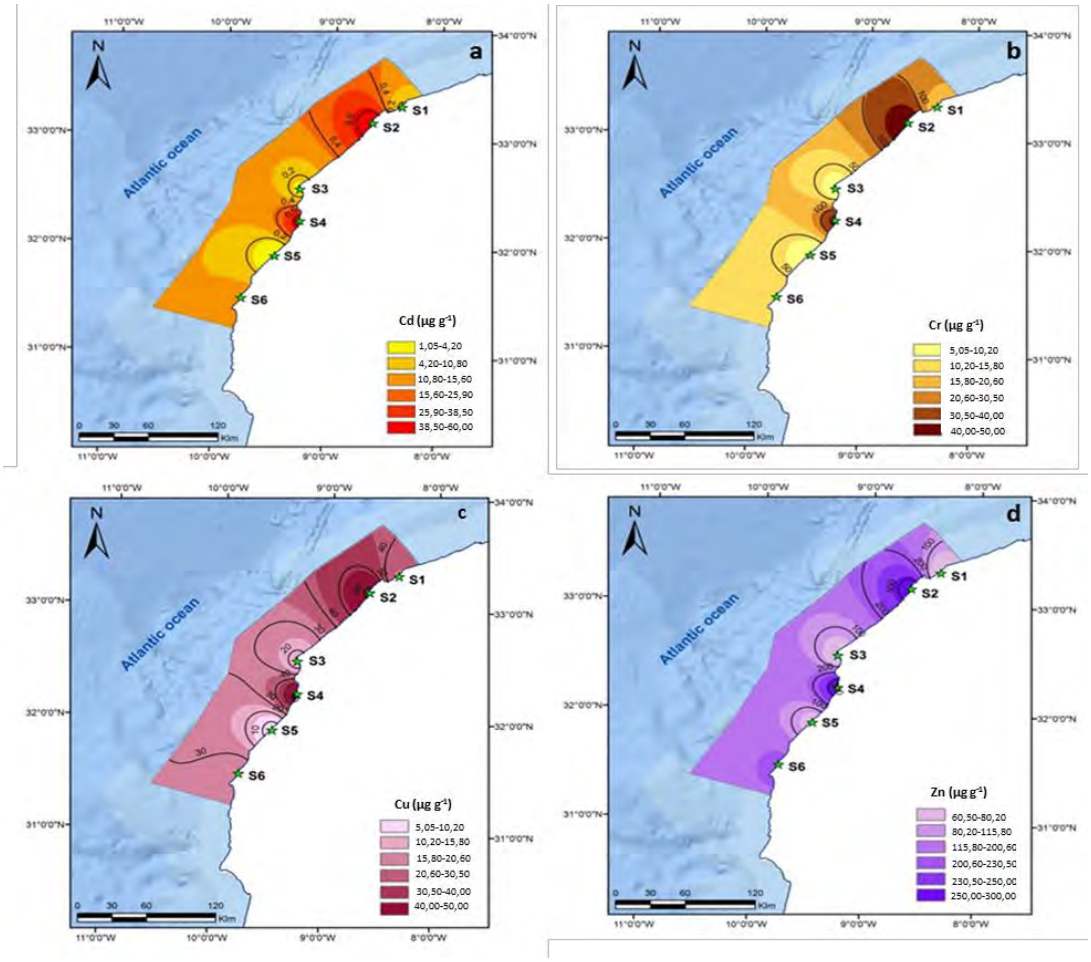

Figure 2. Spatial distribution of Cd (a), Cr (b), Cu (c), and Zn (d) concentrations (µg g^{-1} dry weight) in mussels *Mytilus galloprovincialis* from the studied areas.

The higher contribution of Cd levels to the provisional tolerable daily and weekly intakes in mussels suggest a careful approach for consumption. Therefore, *M. galloprovincialis* can be considered as a product unsafe for human consumption between the regions of Safi and El Jadida, the local population is therefore not encouraged to consume this mollusk. Thus, efforts are urgently needed to resolve the current and potential risks associated with the negative impact of trace metal intakes from seafood on human health.

Keywords: Trace metals, mussel consumption, human health risks, biomonitoring, coastal areas.

MANAGING WATER COMMONS USING MEDIATOR VARIABLES TO BRIDGE THE GAP BETWEEN ENVIRONMENTAL FACTORS AND ANTHROPOGENIC POLLUTION INDICATORS

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Water is the lifeblood of all life, so population concentrates near potable sweet water sources. People also concentrate near the coastline for economic reasons. Much of the drinking groundwater resources in the Croatian coastal area is stored in karst aquifers. Because of its quick pass-through nature and nonpoint source pollution, its protection is challenging. There have been many monitoring and measurement challenges in the past. For example, there was no empirical confirmation of a conjectured link between rainfalls and microbiologic pollution in the monitored coastal areas. Before the use of δ^2H and $\delta^{18}O$ stable isotopes as mediators for the analysis of groundwater dynamics in karst aquifer characterisation, the causal links between rainfall and aquifer- as well as marine pollution were elusive. Data analysis of groundwater dynamics required also some dynamic statistical modelling, as for example dynamic panel data modelling in form of a General Method of Moments with First Differences transformation to control for unobserved time-invariant individual effect heterogeneity in. Static statistical models that include $\delta^{18}O$ values successfully represent the microbial pollution variations within a closed system. We understand this to be a characteristic of a stock pollution. At an open sea location, the results of static microbial pollution modelling have not been as good. Dynamic modelling using first differences of $\delta^{18}O$ values indicate that in these circumstances we deal with flow pollution.

Whether a pollutant is a stock or a flow is not only dependent on the pollutant itself, but mostly on the medium, and the environment it is propagating through, as the medium determines its pass-through velocity. Policies regarded as optimal for stock and flow pollutants are different. In terms of Elinor Ostrom categorisation, aquifers are common goods as they are predominantly stocks of water and karst aquifers are common pool resources as they are predominantly flows of water. The question of stock or flow is of great importance to decide whether the regulatory body should use price or quantitative allocation mechanisms. There are circumstances where we would prefer the one to the other because of political and administrative reasons, but it is ultimately up to the marginal costs and benefits to use the one or the other. When supply and demand curves are flat, it is better to use quota-like quantitative methods for avoiding planning mistakes. For inelastic costs and benefits, a price system of regulation is optimal instead. Whether an ecological system produces elastic or inelastic costs and benefits depends on factors such as pass-through velocity and its sustainability. Stocks are common goods and prefer price mechanisms. Flows are common pool resources, and prefer quantitative mechanisms. The amount of pollution which makes a spring unfit for drinking could be at a point where the marginal benefits of an extra unit of output of a pollutant change very rapidly. It is not optimal to regulate prices or impose taxes in such situations. In some situations, mixed schemes may be optimal.

Keywords: economic institutions, water commons management, mediator variable, pollution measurement, stock pollutants, flow pollutants

STUDY OF ^{2}H AND ^{18}O ISOTOPES AS A BASIS FOR CHARACTERIZATION OF A COASTAL KARSTIC AQUIFER

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Karst encompasses about 50% of the Croatian land territory. The major part of the Croatian karst belongs to the Dinaric Karst and is found at the Adriatic Sea coastline. Carbonate aquifers are the primary source of freshwater in those areas and their protection is of the highest priority. Karst aquifers are sensitive to pollution since pollutants easily enter the groundwater channel system without prior self-purification process that is characteristic for other types of the aquifers. Once pollutants enter the karstic underground they spread through the aquifer very quickly. Therefore, a thorough knowledge of the karst aquifer is essential for a timely and appropriate reaction to possible pollution incidents. Complexity of the karst landforms and groundwater networks requires implementation of a standard hydrogeological monitoring as well as unconventional methods of investigation.

Analysis of stable water isotopes ^{2}H and ^{18}O proved to be helpful complementing method to a standard hydrogeological karst studies. We present the results of a two-year systematic analysis of the stable isotope composition of the coastal karst spring Dobrica in the Bakar Bay and rain water collected in the hinterland of the spring. Dobrica is one of the springs under supervision from the local water supply company but it is rarely in use due to sea water intrusions related to rainfall regimes, recharge conditions and sea tides. Occasional contaminations by saline seawater require additional research to better understand Dobrica's functioning mechanisms. Spring water samples were collected on a weekly basis and rain samples were collected once a month. The stable isotope composition of the karst groundwater was modelled using Gaussian mixture modelling, time series analysis and autoregressive integrated moving average modelling. The main results of the study are: winter precipitation dominates the spring's recharge, presence of a multiple water masses in the system, mean residence time up to one year and lower mean recharge elevation in comparison to bordering Rječina River catchment.

Keywords: coastal environmental physics, coastal karstic aquifer, stable isotopes, statistical modelling

GRAIN SIZE, NUTRIENTS AND HEAVY METALS OFFSHORE THE SARNO RIVER (NAPLES BAY, ITALY): AN ATTEMPT TO EVALUATE NATURAL *VS* ANTHROPOGENIC SOURCES AND THE INFLUENCE OF THE TERRESTRIAL IMPUT AT THE SEA.

Ingegneria dell'Ambiente Costiero: inquinamento, produzione energetica, monitoraggio e valutazione economico ambientale, contesto normativo

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Geochemical mapping was originally directed at mineral exploration, in post-mining and industrialized areas it is now primarily used for environmental and health purposes. One application of geochemical mapping is to assist with the development of environmental regulations, but this ideally requires the separation of natural from anthropogenic sources of metals (1). Because heavy metals entering surface waters from natural or anthropogenic sources and become part of the water suspension and sediment system by absorption, precipitation and ion exchange processes arriving to the sea, it is important to extend the geochemical study offshore.

The Southeast Naples Bay represents a wide continental shelf environment with terrestrial sediment supply mainly from the Sarno River. The Sarno river basin, including about 500 km^2 of the alluvial plain, is located in Campania Region (SW Italy) between the volcanic complex of Somma-Vesuvio (on the NW), the Sarno Mts. (on the NE), the Lattari Mts. (on the S), the Tyrrhenian sea (on the W) and the Picentini Mts. (on the E). Currently, the Sarno river, partially used for irrigation, is affected by an extreme environmental pollution as a result of the outflow of industrial waste. Consequently the area of the Naples Bay is influenced by sediment loads derived from the Sarno River (2-3). However, the influence of the river sediments in this area remain unresolved.

A high density sediment survey (71 samples collected by van Veen grab) along a transect (long about 9 km) perpendicular to the coast has been used to evaluate: 1) the relative influences of parent lithology and anthropogenic effects offshore the Sarno river in the Southeast part of Naples Bay; and 2) the extension of the influence of the river in the submarine area. Different environmental indicators were selected for the contamination assessment such as total nitrogen (TN) and phosphorus (TP),

total organic carbon (TOC), grain size of particles, metals, priority polycyclic aromatic hydrocarbons (16 USEPA, PAHs), total petroleum hydrocarbon (TPHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), pesticides (OCPs) and organotin compounds (OTs).

SIMCA 16 Program (16, MKS Umetrics AB, Sweden) was used to perform multivariate statistical analyses. The whole dataset is constituted by 71 observations, countersigned with TA_n code, where *n* is the number order of the sampling site starting from Torre Annunziata coastline to offshore (TA1 up to TA71), and 52 variables which consisted of the absolute values of concentration of the eight trace elements (Hg, Cd, Pb, As, Cr_{tot}, Cu, Ni, Zn), including also Fe and Mn, 16 polycyclic aromatic hydrocarbons (PAHs) congeners, 14 polychlorinated biphenyls congeners, including upper-bound total PCB (ΣPCB), Total Organic Carbon (TOC), Total Nitrogen (TN), Total Phosphorous (TP), Total hydrocarbons (VOCs and TPH), Pesticides, Butiltins compounds (in terms of – mono-, di- and three-butilin' congeners, as representatives of Organotin compounds.

The multivariate analysis (PCA) allowed us to recognize three main clusters with peculiar characteristics: TAa characterized by the prevalence of As, Fe, and coarse grained sediments; TAb mainly characterized by nutrients, Cd, Cu, Pb, Cr, Zn metals and fine grained sediments; and TAc characterized by Ni and Mn metals, with an increase in the sediments granulometry and a decrease of nutrients. The results of this study compared to the published onshore data permitted us to evaluate natural *versus* anthropogenic sources and to delimit the influence area of the Sarno River supply into the Naples Bay.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: DETERMINATION OF NATURAL RADIOACTIVITY LEVELS OF SLUDGES COLLECTED FROM WASTEWATER TREATMENT PLANTS OF ANTALYA/TURKEY

SESSION: COASTAL ENVIRONMENTAL ENGINEERING

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

To determine whether the use of wastewater treatment sludge in agricultural areas poses any radiological risk or not, In the present study, the both natural ^{226}Ra, ^{232}Th , ^{40}K and artificial ^{137}Cs radionuclide activity concentration levels of the sludges, collected from wastewater treatment plants located in Alanya, Beldibi, Belek, Çamyuva, Göynük, Hurma, Kemer, Serik, Side and Tekirova districts of Antalya were measured. Sludge samples were collected from each wastewater treatment plant on a monthly basis for one year period. The sludges were numbered and labeled after they were transferred to the sample preparation laboratory of Akdeniz University, Faculty of Science, Department of Physics. Foreign materials and impurities in each sludge sample were removed. Before the measurements, all sludge samples samples were stored (air-dried) 4–7 d until they reached a constant weight in a ventilated room. All samples were homogenised with the grinding machine and then sieved through a 2-mm mesh in the sample preparation laboratory. The sieved samples were then filled into hermetically sealed (6cm x 5cm) 150 cc polyethylene cylindrical containers, labelled,weighed and stored for 4 weeks in order to reach secular equilibrium between ^{226}Ra and ^{222}Rn prior to counting. Approximately 5 g of sludge from each sample were put in 6-cm diameter cylindrical containers and dried at 80^{0}C for 14 h to determine the moisture rate of the samples. Radioactivity measurement was conducted by using a p-type, coaxial, electrically cooled, high-purity germanium gamma-ray detector AMATEK-ORTEC with Full Width Half Maximum (FWHM) at 122 keV for ^{57}Co and 1.85-keV FWHM at 1332 keV for ^{60}Co. It is connected to an NIM consisting of ORTEC bias supply, spectroscopy amplifier, analogue-to-digital converter and a computer. The detector was placed into a 10-cm thick lead shield with an inner surface covered by a 2-mm thick copper foil to shield from the X-rays originating in lead. Data acquisition and analysis were carried out with MAESTRO32

software.

All samples were placed to the front face of the detector and counted for 50 000 s. Background intensities were obtained with an empty beaker for 50 000 s under the same conditions before and after measurement of the samples. Then, the average of the background counts was subtracted from the sample spectrums. ^{238}U and ^{232}Th activity concentrations were determined from their daughter products indirectly, while ^{137}Cs and ^{40}K were determined directly by their gamma-ray peaks. To determine the activity concentration of the ^{238}U nuclide, daughter nuclides ^{214}Pb and ^{214}Bi were used, while ^{228}Ac concentration was chosen for the parent ^{232}Th. The gamma transitions of 351.9 keV ^{214}Pb and 609.3 keV ^{214}Bi were used to determine the concentrations of ^{238}U. The gamma transition of 911.2 keV ^{228}Ac was used to determine the concentration of ^{232}Th. 661.6 keV and 1461.0 keV gamma transitions were used to determine the concentration of ^{137}Cs and ^{40}K, respectively. Details of the activity and dose calculations were presented by Ozmen et.al. [1].

Measurement results of the wastewater sludge samples indicate the existence of natural (^{226}Ra, ^{228}Ac, ^{40}K) and artificial radionuclides (^{137}Cs) from the Chernobyl accident and other nuclear activities. The calculated mean ^{226}Ra (10.8 Bq kg^{-1}), ^{232}Th (13.4 Bq kg^{-1}) and ^{40}K (135.7 Bq kg^{-1}) and ^{137}Cs (3.2 Bq kg^{-1}) activity concentrations of the sludges were observed to be below the world average [2]. Findings were found to be consistent with the published results in the literature for Turkey and other countries. The absorbed gamma dose rate (D: 3.1 - 17.5 nGyh^{-1}), radium equivalent activity (Ra_{eq}: 6.4 - 37.7 Bq kg^{-1}), annual equivalent dose (AED: 3.8 – 21.4 µSv h^{-1}), internal (H_{in}<1.0) and external (H_{ex}<1.0) hazard indices were calculated by using sample activity concentrations. The calculated average values for D, Ra_{eq} and AED are in the permissible limits published by IAEA. As a result, it was observed that the use of wastewater treatment sludge in agricultural areas would not create any risk in radiological terms.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: **CHEMICAL COMPOSITION OF MICROPLASTICS FLOATING ON THE MEDITERRANEAN SEA SURFACE**

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

The Mediterranean Sea is one of the most studied regions in the world in terms of microplastic (MP) pollution. With an estimated input of plastic of approximately 100 kt per year [1], it is considered as one of the largest hotspots of plastic litter accumulation in the world. Despite an important spatial and temporal variability, highest microplastic concentrations are found to be near the more densely populated coastlines [2]. However, the observation of a consistent distribution and concentration pattern is difficult. Indeed, microplastic investigations in the Mediterranean Sea surface often concern localized areas. Moreover, the different studies are uneasy to compare due to the heterogeneity of the Mediterranean Sea environment and the variety of methodologies used. In addition, only a few studies have analysed the chemical composition of microplastics at the Mediterranean Sea surface. In this context, the main objectives of the present study are to describe the chemical composition of MP collected in the surface waters of the Mediterranean Sea, as well as the size of the particles and their concentrations in mass and number. The results were first analysed at the Mediterranean Sea scale. Then results between basins were compared to evidence spatial and temporal variations.

Microplastic samples were collected in Mediterranean Sea waters during the Tara Mediterranean Expedition between May and November 2014 (Fig. 1). This expedition was conducted by the Tara Ocean Foundation, a French non-profit organisation dedicated to the study of the world's oceans.

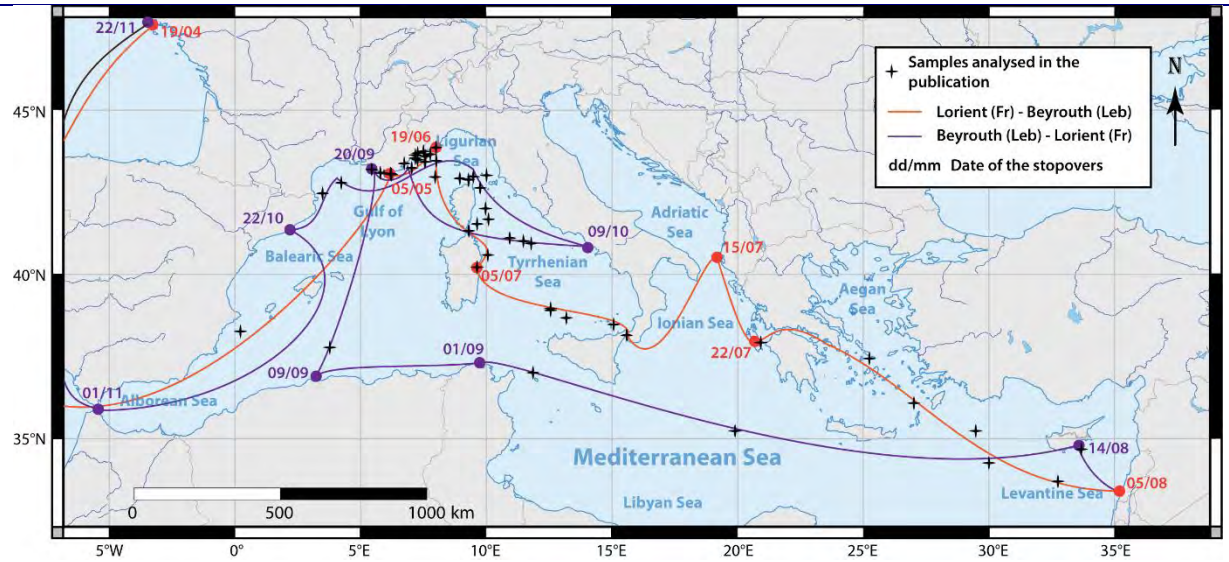

Figure 1 – Routes of the Tara schooner during the TARA Mediterranean Expedition in 2014

Using a 300µm-mesh size manta net, samplings were carried out in surface waters in 120 sites across the Mediterranean Sea. In the laboratory, plastic debris were carefully separated from the other components (plankton, wood, etc.) under a dissecting microscope. Plastic particles were then counted and measured using a ZooScan digital scanner at the Laboratoire d'Océanographie de Villefranche-sur-Mer (LOV, Villefranche-sur-Mer, France) [2]. A total of 15,654 particles from 55 selected sites were wet sieved by size class (]5-2mm],]2-1mm],]1-0.5mm],]0.5-0.315mm]), sorted and transferred to 96-well microplates and named with a unique identifier at the Institut de Recherche Dupuy de Lôme (IRDL, Lorient, France). A particle random drawing enabled to limit the amount of work required to analyse the sorted MP by infrared spectroscopy (ATR-FTIR) [3]. All the spectra were then identified using the POSEIDON (Plastic pOllutionS ExtractIon, DetectiOn and aNalysis) software [4] which was developed with R i386 3.1.2.

Our results pointed to a certain homogeneity at the Mediterranean Sea scale. The main polymers collected were polyethylene (PE) (67.3±2.4%), polypropylene (20.8±2.1%) and polystyrene (3.0±0.9%). Nevertheless, discrepancies, confirmed by the literature, were observed at a mesoscale level. Thus, in the North Tyrrhenian Sea, the proportion of PE was significantly lower than the average value of the Mediterranean Sea (57.9±10.5%), whereas it was on average higher in the Levantine Sea. In congruence with the current state of knowledge, different hypotheses are proposed to explain these discrepancies: anthropic sources, rivers, horizontal and vertical distribution phenomena. Afterwards, methodological recommendations are suggested to better investigate the microplastic pollution in the Mediterranean Sea.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title:

Marine energy deployment in the Mediterranean: the experience of the BLUE DEAL alliances.

SESSION: INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The exploitation of marine energy sources is a promising field of research and innovation in the Mediterranean. Blue energy technologies have been developed mostly in Northern Europe, in the Northern Sea and the Ocean, but can be eventually adapted for implementation in Southern Europe, with lower potentials but higher predictability and lower investment risks. Nevertheless, blue energy deployment not only concerns technology; environmental impacts, landscape compatibility, social acceptance, interference with other marine activities, such as tourism, shipping and fishing, are crucial issues for the energy transition. How can we expect the Mediterranean landscape to change accordingly? What shall we take into consideration to manage this transition in terms of landscape impact?

The Interreg Med BLUE DEAL project (2019-2022) has been developed to pursue the goal of raising awareness on the potential of marine energy sources in the Mediterranean and fostering their concrete deployment. The consortium of project partners provided tools as guidelines for both blue energy planning in marine areas and business development and performed activities addressed to Public Administration, SMEs and citizens. In particular, BLUE DEAL Labs have been conducted in Malta, Albania, Greece, Croatia and Cyprus to demonstrate a comprehensive methodology of blue energy planning combining marine energy potentials with physical and legal constraints, technological requirements and environmental impact assessments, including visual impact. Business forums have been conducted in Greece and Spain as participating initiatives engaging private stakeholders to discuss on business opportunities. Open Innovation actions have been developed through the launch of open calls for proposals by businesses and practitioners. Moreover, the “BLUE DEAL for future” school contest has been addressed to young students to let them imagine a possible future with human settlements supplied by marine energies. Citizens have been also directly engaged by polls conducted in specific coastal areas of the partner countries to know their feeling with hypothetical blue energy plants.

As a final result, BLUE DEAL Alliances have been established in eight Mediterranean regions. By joining the Alliances, Public Authorities are claimed to include opportunities and rules for the exploitation of marine energy in their master plans; similarly, companies are expected to combine their competences and expertise as value chain actors for the planning, manufacturing and maintenance of blue energy plants. Acting as public-private partnerships, the Alliances could be able to develop sustainable business models and improve welfare of energy self-sufficient local communities, also exploring virtuous cooperative processes such as those of the energy cooperatives, taking care of fostering their replicability. Institutions, companies and associations of citizens commit themselves to cooperate to identify suitable and sustainable forms for the implementation of blue energies in the Mediterranean. The alliances *are* intended to kick-off a new course for the blue economy based on marine energy.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **Monitoring marine litter at the SE Mediterranean (Israel) continental shelf and slope (2017-2020)**

SESSION: COASTAL ENVIRONMENTAL ENGINEERING

AUTHORS: YAEL SEGAL & HADAS LUBINEVSKY

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Abstract (min 3000 max 5000 characters):

The continuous discharge of plastic litter into the oceans is considered one of the most significant pollution problems worldwide. Two of the top three countries contributing to plastic pollution into the Mediterranean Sea are located in the eastern-most Mediterranean-Levantine basin (Boucher & Bilard, 2020). The Israeli coast, located north of the Nile Delta, is often described as a terminal coast for the Mediterranean large-scale circulation (Rosentraub & Brenner, 2007). Therefore, it could be considered a potential hotspot for the accumulation of floating plastic litter from neighboring countries and the entire Mediterranean Sea.
To better understand the classification and the spatial-temporal distribution of marine litter on Israeli beaches, coastal and open sea waters, continental shelf, and bathyal sediments, an Israeli National Monitoring Program for marine litter has been carried out since 2017 in the Mediterranean and the Red seas. Here we present results from the continental shelf and slope of the Israeli Mediterranean waters.
Bottom (surface sediment) marine litter was monitored at two areas: in the Northern Israeli coast, in 200, 500, 600, 1100, 1400, and 1700m water depths, and in the Southern Israeli coast, in 20, 40, 60, and 80m water depths. Samples were collected using fish towing net 42m mesh size and an opening of 12m or 8m for the northern and southern transects, respectively. Sampling was done once a year, with four replicates for each water depth, in the shallow transects (<80m). The sampling was done twice a year, and annually in the deeper transects (>200m), with two replicates for each water depth. Debris bigger than 2.5cm were characterized for composition and type, based on UNEP protocol (with some modifications). When possible, the barcode was used to identify the litter source.

More than 1,000 debris were collected at the shallower transects (at the continental shelf), and more than 10,000 were collected in the dipper transects (at the continental slope). More than 88% of the bottom litter found, in all water depths, was made of plastic. Cloth and metal represented additional 1-8% of the litter, which most likely was thrown from passing vessels.
Most of the debris found are plastic bags and plastic wrapping. In some cases, these two products represented more than 90% of the total litter found. In all cases the degradable litter was the dominant one. Figure 1 is an example of the relative contribution of bags & wrapping found on the bottom at 80m water depth. It can be clearly seen that the whole litter represent up to 15% of the total debris found, whereas the pieces of bags and wrapping reach up to 80%.

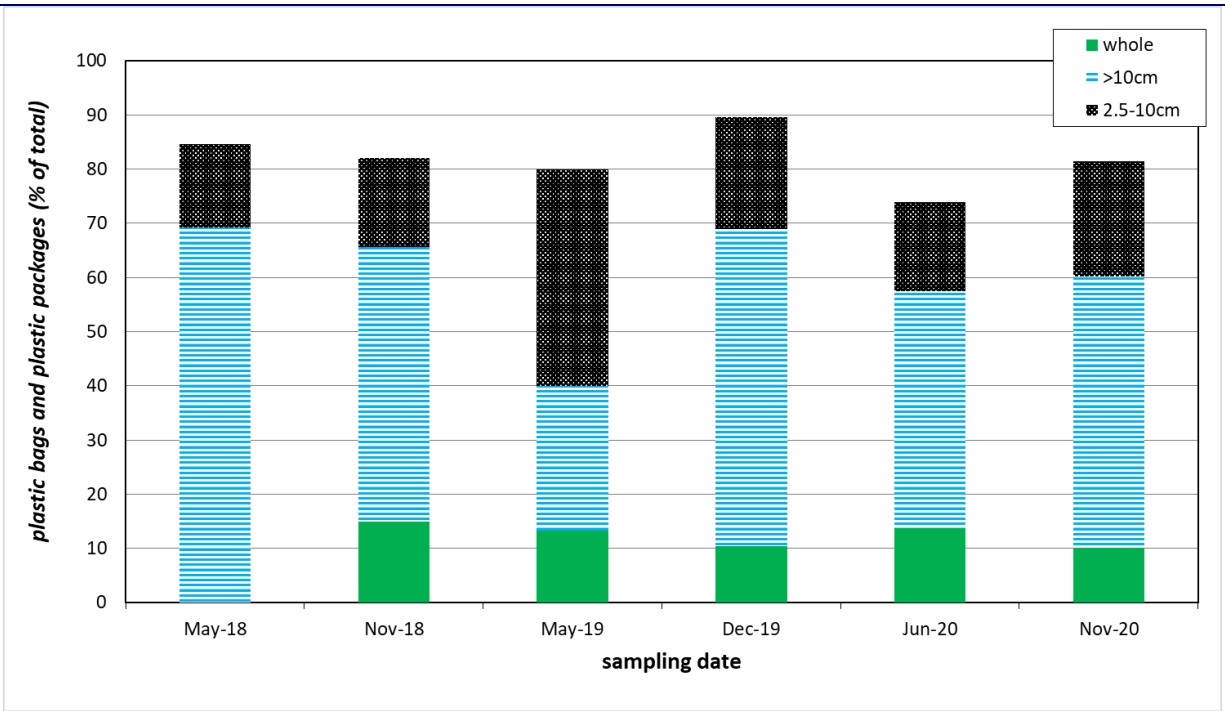

Figure 1: relative contribution of bags & wrapping >2.5cm found on the bottom at 80m water depth.

Based on the barcode (found on a few tens of debris only), about one-third of the debris collected in the deeper transects came from Israel and Egypt.
The marine litter concentration increased with depth along the continental shelf, reached a maximum at the upper part of the continental slope (500m), and then decreased at deeper water depths (figure 2). The concentration of marine litter in the slope was higher in magnitude than the one on the continental shelf. Csanady and Shaw showed in 1983 a minimum current velocity along the continental slope. Low velocity may reduce the movement of the litter along the slop, and therefore it accumulates there.
The bottom litter concentration in all sampling depths (excluding 80m) was increased up to June 2020 and then decreased. The reduction might be tribute to COVID-19. The decline in tourism and beach recreation activity since the plague outburst in March 2020 might have reduced the shore sources for marine litter.
The current study may reinforce the importance of marine litter monitoring in studying the spatial-temporal distribution of marine litter in Israeli waters.

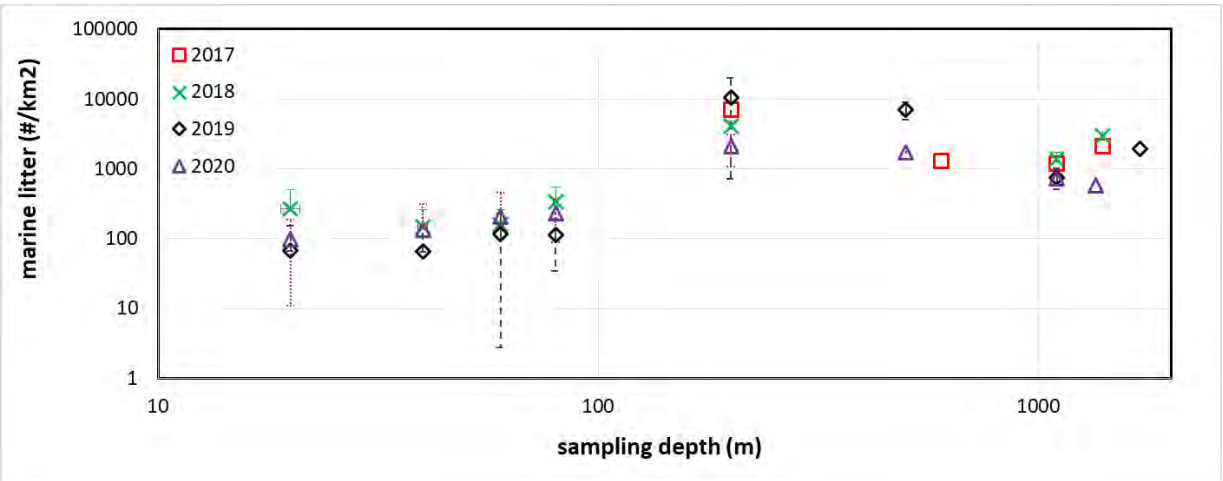

Figure 2: Marine litter in the bottom of the Israeli continental shelf and continental slope.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: ANALYSIS OF THE LIMITS FOR THE DETECTION OF SMALL GARBAGE ISLAND IMMERSED IN CLUTTER RADAR

SESSION: INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

The aim of this work is to show the limits of the detection capacity of X-band radars, as the sea state changes, for the purpose of identifying, discriminate, characterizing and tracking the small floating aggregations of marine litter (Small Garbage Island - SGIs) made up mainly of plastic.

To this end, two distinct radar measurement campaigns were conducted with controlled releases at sea of SGIs modules assembled in the laboratory. The measurement campaigns and the related controlled releases of the SGIs modules were carried out respectively in conditions of calm sea and almost no wind and in conditions of rough sea and presence of wind.

To verify the ability of an X-band radar to identify and track small islands/aggregations of waste in the sea, and to make the measurements repeatable and standardizable, it was first necessary to fabricate some SGI modules in the laboratory. A first basic module with dimensions 1 m x 1 m that could be representative of the garbage aggregations typically found on the sea surface and could be used as a reference for the definition of the radar detection capability in terms of resolution and Radar Cross Section (RCS) was created. In addition to the basic module assembled using mixed waste, a second SGI module was then created using only plastic bottles; furthermore, in order to verify the radar's detection capability also for for smaller-size plastic objects, and to check the sensitivity limits of the signal with respect to the targets size, two other consisting respectively of three plastic bottles tied whit a plastic band and a single plastic bottle were assembled.

The area in which the measurement campaign was conducted is the stretch of sea in front of the south entrance of the port of Livorno, which is where the building called "Scoglio della Regina", the headquarters of the IBE-CNR, is located. On the roof of the building, an X-band radar is installed. The area investigated covers a radius of approximately 0.98 nautical miles.

To evaluate the radar's detection capabilities and the maximum distance at which it can detect the SGIs, in both measurement campaigns, three different releases of the modules were carried out at three different distances from the antenna (first release 0.12 nautical miles; second release 0,24 nautical miles, third release 0.39 nautical miles).

To define the radar's ability to detect SGIs, an analysis of the intensity of the radar signal received and reflected by the modules released into the sea was carried out. The experimentation was carried out both in calm sea conditions, in order to verify the sensitivity of the radar in an ideal scenario, and in rough sea conditions and presence of wind, in order to check the upper limit of target detection capability. The radar was switched on for the entire duration of the measurement campaigns, recording the raw data that was subsequently analysed with appropriate algorithms in order to highlight the presence of the SGIs and reduce the background noise always present in the radar data.

The results of the work showed that in calm sea conditions the characteristics of the signal reflected by the SGIs are different, and therefore discriminable, from that reflected by other targets and by marine clutter. In particular, the empirical data have shown that in calm sea conditions the X-band radar distinguishes the experimentation targets within the maximum distance of 0.39 nautical miles from the receiving antenna; beyond this distance, the intensity of

the signal received by the radar mixes with the average sea clutter. The analysis in the rough sea and wind conditions of the second measurement campaign, characterized by a significantly higher average clutter level compared to the conditions of the first experiment, made it possible to verify that in those certain conditions the intensity of the signal reflected by the SGIs it is barely distinguishable from the average sea clutter. In particular, it can be stated that the conditions in which the second measurement campaign was conducted identifies the threshold of the state of the sea beyond which the intensity of the backscattered signal mixes with the average marine clutter, making its detection impossible.

The conditions in which the two measurement campaigns described in the memory were carried out identify respectively the ideal condition (calm sea and no wind) and the limit condition (rough sea and presence of wind) of use of the X-band radar for the purpose of detection of SMGs; it follows that in the future it will be necessary to conduct further measurement campaigns also in intermediate conditions, in order to obtain a complete statistics and to be able to evaluate the performance of the radar system as the average clutter of the sea changes.

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

Title: **Organic-walled dinoflagellate cysts and benthic foraminifera in coastal sediments of the Egyptian Mediterranean Sea coast as proxies for monitoring environmental pollution**

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

General frameworks and Objectives

Micropaleontological proxies including benthic foraminifera and organic-walled dinoflagellate cysts were studied to strengthen their position as bioindicators of environmental pollution. Micropaleontological and geochemical analyses were performed on surface sediment samples collected from twenty stations that were collected along the Mediterranean Sea coast of Egypt. Analyses include TOC% (total organic carbon content) and grain size distribution of the sediment, micropaleontological analysis using the standard palynological techniques and chemical analyses of POPs (persistent organic pollutants) in bivalve soft tissue samples that girdle the sediment stations. The relationship between biotic and abiotic components were done by a set of statistical methods, i.e. Q- and R- mode clustering and CCA (canonical correspondence analysis).

The study results suggest that the dinoflagellate cysts reserved in sediments are a useful bioindicator for tracing forms of pollution. The CCA identified POPs concentrations and the sediment grain size as the most important factors influencing the cyst assemblages. The study proposes the use of these cyst taxa as pollution indicator with increasing POPs concentrations; the heterotrophic taxa *Selenopemphix nephroides*, *Trinovantedinium applanatum, Pyxidinopsis*

reticulata, Brigantedinium spp., cyst of *Gymnodinium catenatum* and the autotrophic taxa *Operculodinium israelianum*, *Spiniferites hyperacanthus, Impagidinium* spp. and *Spiniferities ramosus.* Moreover, concentration influence the assemblage composition reducing diversity and density, besides encouraging the increase of pollution-tolerant species. The CCA identified POPs concentrations and the sediment grain size as the most important factors influencing the foraminiferal assemblages. The study proposes the use of these cyst taxa as pollution indicator with increasing POPs concentrations; *Ammonia tepida*, *Ammonia beccarri*, *A. parkinsoniana* and *Elphidium advenum* species.

Key words: benthic foraminifera, dinoflagellate cysts, Persistent organic pollutants, Egyptian Mediterranean Sea coast

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Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE: EXTRACTION AND CHARACTERIZATION METHODS FOR MICROPLASTICS FROM ESTUARINE AND COASTAL SAMPLINGS – EXAMPLE OF THE 2019 TARA EXPEDITION

SESSION: COASTAL ENVIRONMENTAL ENGINEERING: POLLUTION, ENERGY PRODUCTION, MONITORING AND ECONOMIC ENVIRONMENTAL ASSESSMENT, REGULATORY CONTEXT

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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Microplastics (MP) in marine ecosystems is a global pollution of increasing scientific and societal concern. With the majority of plastics found in these ecosystems coming from land-based sources [1], through rivers and run-off, studies on MP has recently shifted focus toward freshwater ecosystems. The Tara Microplastics 2019 mission aims to investigate plastic pollution in rivers across different scientific fields of study: plastic chemistry, physical oceanography and marine biology. The Tara schooner collected samples from 9 of the main European rivers: Thames, Elbe, Rhine, Seine, Ebro, Rhone, Tiber, Garonne, Loire. Among the 19 partner laboratories, the Research Institute Dupuy de Lôme (Lorient, Fr) objectives are i) to quantify the microplastic contamination, and ii) to identify the chemical nature of microplastics. For the specific case of the Mediterranean Sea whose plastic litter inputs are poorly understood [2], results from the Rhone, Tiber and Ebro rivers will provide valuable new data.

Figure 1 – Routes of the Tara schooner during the Microplastics Expedition in 2019

Using a 300µm-mesh size manta net, 50 samplings were carried out in surface waters offshore and along the course of rivers. Even if the net contents were filtered and the larger pieces of organic matter removed on board, a high amount of it persisted in the samples, hindering the characterization of MP: algae, branches, leaves, small animals, etc. Therefore, using in-lab methods to accurately and safely extract microplastics from field-collected waters is a key element to characterize this plastic contamination. Thus, an extraction process combining chemical digestion (in alkaline or acidic solutions), density separation (in a NaI salt suspension), filtration and sieving was applied to the samples. These protocols have shown to maintain MP physical integrity, to allow a clear polymer identification by infrared spectroscopy, and to achieve high rates of organic and inorganic matter removal.

The extracted MP were arranged in Petri dishes. After a drying step, they were photographed, counted and measured through image analysis. A particle random drawing enabled to limit the amount of work needed to analyze the extracted MP by infrared spectroscopy (ATR-FTIR) [3]. All the spectra were then identified using the POSEIDON (Plastic pOllutionS ExtractIon, DetectiOn and aNalysis) software [4] which was developed with R i386 3.1.2.

The study of MP in rivers can be more arduous than that of marine MP. Indeed, the large amount of organic and inorganic matters is a major obstacle to overcome for further analyzes. Non-anthropogenic particles and biofouling could make polymer spectra identification more difficult. Although drawing a consistent pattern from the obtained results is complex - as they depend on the seasons, the run-offs on the sampling date, and the hydrodynamic features of the sampling station-, they will provide valuable data on European rivers. These data have the great advantage of having been acquired by the same methods, allowing a relevant comparison between samplings.

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Keywords: Microplastics pollution, microplastic extraction, organic matter removal, rivers, infrared spectroscopy

Nineth International Symposium

MONITORING OF MEDITERRANEAN COASTAL AREAS: PROBLEMS AND MEASUREMENT TECHNIQUES

Livorno (Italy), June 2022

FORM FOR ABSTRACTS PRESENTATION

TITLE:

NEW ARTIFICIAL REEF IN COASTAL PROTECTION RECONVERSION

SESSION:
INGEGNERIA DELL'AMBIENTE COSTIERO: INQUINAMENTO, PRODUZIONE ENERGETICA, MONITORAGGIO E VALUTAZIONE ECONOMICO-AMBIENTALE, CONTESTO NORMATIVO

AUTHORS:
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ABSTRACT (MIN 3000 MAX 5000 CHARACTERS):

Sea energy is characterized by the conversion of offshore pulsing vertical wave energy into inshore horizontal current energy in the seabed transition of shallow coastal waters. These currents cause excessive erosion compared to natural summer-winter erosion, when, as is widely known, is greatly increased by anthropogenic activities. The issue therefore, is to contain the kinetic energy in excess of the sea currents. The proposal is to dampen this by means of artificial reef positioned close to the "calm belt". This is certainly brought about by the abovementioned energy conversion, which mimics the location of coral reefs. This makes it possible to overcome the delicate problem of maintenance of the new reef, which are situated far from the storm area. In contrast, the annual costs of upkeep of artificial nourishment and of breakwater barriers are very high and add to public spending. Coastal and seabed monitoring, particularly by satellite, has highlighted for many years the fact that breakwaters, rather than reducing erosion, have exacerbated it, to the extent that in America breakwaters have recently been banned. It is therefore necessary to experiment with new solutions, above all "soft" ones, which do not have strong eroding effects, as with breakwaters, or which can be rapidly carried away or cause silting, as with artificial nourishment, lacking in m^3 and granulometrically unsuitable. The first project (Ventura 1992), tested in the naval basin, is for a prototype of articulated barriers in staggered floating finned tubes, just below sea level. These horizontal floats, which also damping in torsion, are chained to mobile and reusable counterweights, and allow the sedimentation of suspended sand for natural nourishment. The new project is integrated with turbines to further dampen of kinetic energy of currents transformed in electricity. Turbines rather than vertical axis (Palmarocchi, Ventura 2020) are with more efficient horizontal axis. The impeller is between the floats and the blades are semi-submerged, close to an indifferent buoyancy, in order to favor the number of revolutions even at minimum currents. In this regard the measurement of the speed of the current is fundamental to evaluate the spacing of the reef type and the dimensions of the underwater supports which are positioned counter to the current. This must be calibrated experimentally on site according to the geomorphology of the seabed and the marine weather data. For an *environmental evaluation* of the barriers, it is clear that, as they do not emerge above the water, they do not impact on the landscape in the way that breakwaters do. Moreover, they allow seagrass (posidonia) to grow in the protected area of the seabed, thus favoring the repopulation of fish stocks. The banking of the beaches also counteracts flooding, caused by the rising of the sea level (3mm/year), corresponding in10 years to 1m shoreline with the slight slopes (3%). Another important function of the barriers regards the *depollution* and the removal of plastics from the water *(seabin)*, as they can be used as a linear filter for rubbish collection, as well as providing a site for sensors to monitor both chemicals and the weather. The *economic evaluation* is based on the fact that maintenance costs, as mentioned above, are significantly offset, and the cost of a barrier is further offset by the benefits deriving from every square meter of beach reclaimed for use by beach resorts. The cost of a barrier can also be compared both with that of breakwaters and artificial nourishment. The proposal is therefore to reconvert existing coastal protection works by substituting existing breakwaters with an artificial reef, specially *integrated with new blue energy* productions. Initially a section of the breakwater should be removed to test the effectiveness of the new system in the most disadvantageous conditions of

enhanced erosion. This proposal requires initial *monitoring* for experimental research and innovative contracts which officially integrate this first phase of the contract. This can be developed by a public / private *Energy-Tourism Consortium* of beach establishments and berth managers *(outcome funds)*. As regards the *regulatory context,* it is worth noting that the NTC2018 standards allow for the employment of the observational method, as is especially the case, for example, with regard to tunnels, where *initial experimental worksite criteria* must be respected. The importance of finding new ways to protect coasts makes the proposed experimental research truly desirable, allowing rapid validation of efficiency.

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