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collapse into now

a glimpse into the past, a step into the future

BOOK OF ABSTRACTS

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Losing Ground: The Trauma of Postglacial Submergence and Lessons for the Future

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Cultural traditions from many coastal parts of the world include memories of submergence attributable to postglacial sea-level rise and associated land loss. Analyses of these traditions allow an appreciation of the multi-generational trauma that many coastal populations must have experienced, as they were forced to cope with continuous land loss. Their responses, several thousand years ago, include the construction of physical barriers but also likely an array of 'spiritual' responses intended to address the causes of submergence. Examples are presented from Australia and the Celtic fringes of northwest Europe.

These millennia-old responses parallel current responses to rising sea level (and climate change) that address adaptation and mitigation. As such, there are lessons for the future that can be gleaned from our ancestors' experiences of postglacial sea-level rise. These include the futility of short-term responses to long-term environmental stressors, the superiority of locally-designed and driven adaptation, and the fact that humanity can survive land submergence.

Geomorphological evolution of the Elea-Velia coastal area (Southern Apennines, Italy): an example of human induced acceleration of natural processes

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The Graeco-Roman town of Elea-Velia was founded in the 6th century BCE on a hilly promontory bounded by two gulfs along the Tyrrhenian coast of Southern Italy. This position led the town to become a leader in the maritime traffic in this portion of the Mediterranean basin. The town was inhabited until the Middle Ages, but its decline started since the Late Antiquity. The decline was favoured by socio-economic reasons, with a concomitant cause related to an acceleration in natural processes (e.g., alluvial flooding and costal progradation).

To detail the main morphoevolutive steps of this coastal area and their effect on the socio-economic dynamics of Elea-Velia we combined geomorphological and stratigraphical data. The former includes classical geomorphological analysis of detail scale topographic map (scale 1:5000). The latter includes boreholes and archaeostratigraphical trenches, with trenches providing chronological constraints to the morphoevolutive steps. Our data suggest that alluvial flooding was one of the main causes of the Elea-Velia decline and subsequent abandonment. Furthermore, alluvial events partially contributed to coastal progradation that reduced the importance of Elea-Velia as a maritime town. The increasing disruption of slope stability was driven by the neglect in the management of the hillslopes behind the town during periods of socialeconomic crisis, but a concomitant climate forcing cannot be excluded.

Characterization and evolution of the Mediterranean coast of Andalusia (Spain) and influence of anthropic interventions on it

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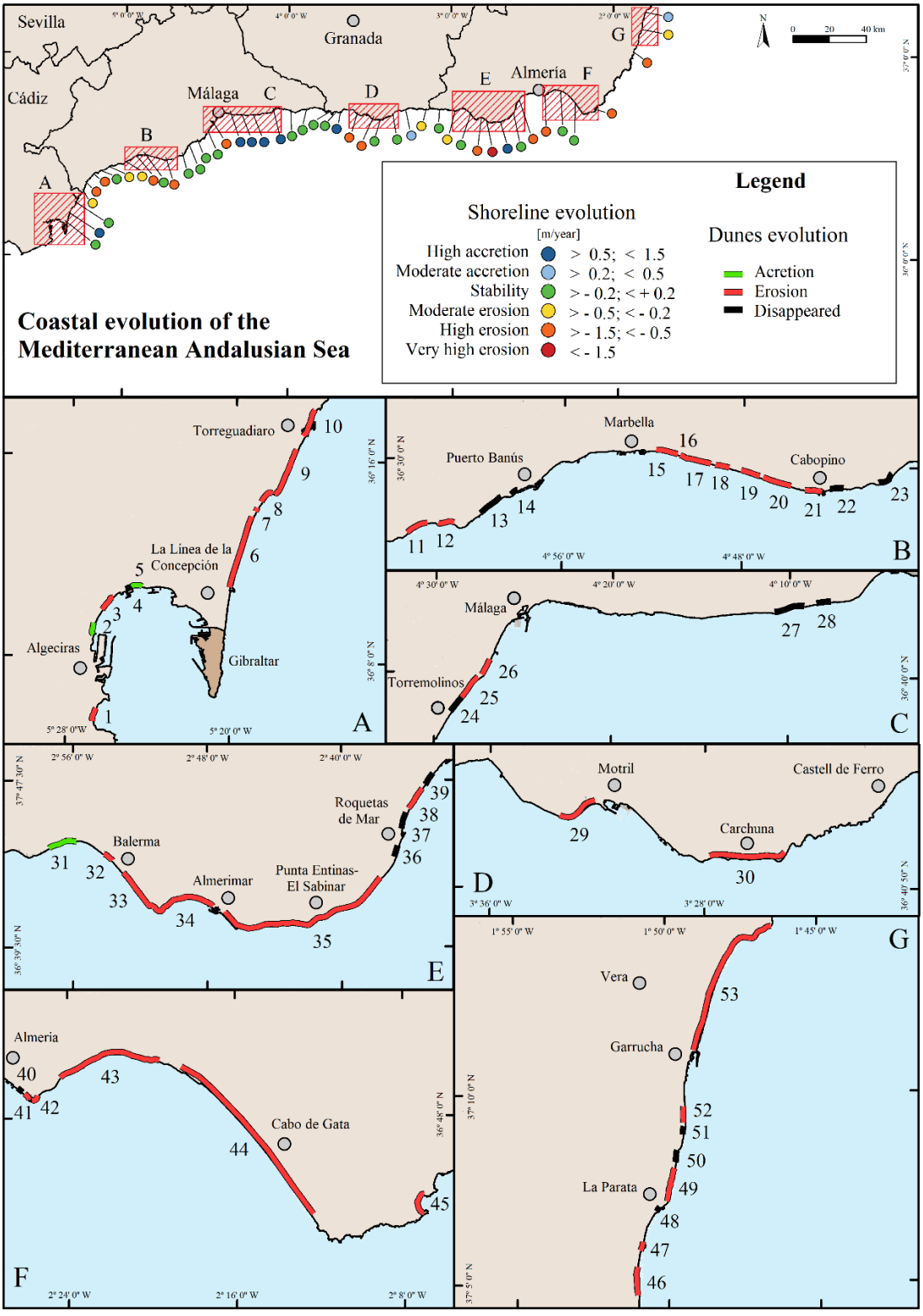
In past decades coastal erosion related impacts on the world's shorelines have been significantly growing due to ongoing coastal development and tourist occupation as well as to natural erosion/flooding events exacerbated by climatic change. Ocean coastlines are highly dynamic and changing environments since they show great temporal and spatial variability in response to the action of different and complex coastal processes. In order to prevent and reduce such impacts, coastal managers need to know the sensitivity of natural coastal sectors, which is related to wave energy, beach characteristics/evolution, and sea level trend as well as the potential vulnerability and economic value of the urbanized sectors.

This work shows coastal evolution and the impacts on it of coastal structures and the characterization and evolution of dune systems along the Mediterranean coast of Andalusia (Spain) in the 1956-2016 period. The analysis of coastal evolution evidenced the impact of hard structures: accretion was essentially observed up-drift of ports and groins and in correspondence of breakwaters, erosion was observed down-drift of ports and groins and in correspondence of seawalls and revetments, and at largest river deltas, and stability was observed at pocket beaches and coastal areas locally stabilized by protection structures and nourishment works.

Concerning the characterization and evolution of dune systems, it was observed a general decrease in dunes' surfaces in the 1977-2001 period (-7.5 x 106 m2), linked to the increase of anthropic occupation (+2.3 x 106 m2), and dunes' fragmentation, especially in Málaga and Almería provinces. During the 2001-2016 period, smaller changes in the level of fragmentation and in dunes' surfaces were observed. An increase of dunes' surfaces was only observed on stable or accreting beaches (4 out of 53 dune systems), both in natural and anthropic areas (usually up-drift of ports).


Sevilla
Granada
Cádiz
Málaga
Almería
A
B
C
D
E
F
G
N
0 20 40 km
Legend
Shoreline evolution
[m/year]
High accretion > 0.5; < 1.5
Moderate accretion > 0.2; < 0.5
Stability > - 0.2; < + 0.2
Moderate erosion > - 0.5; < - 0.2
High erosion > - 1.5; < - 0.5
Very high erosion < - 1.5
Dunes evolution
Acretion
Erosion
Disappeared
Coastal evolution of the Mediterranean Andalusian Sea
Torreguadiaro
La Linea de la Concepción
Algeciras
Gibraltar
Puerto Banús
Marbella
Cabopino
Málaga
Torremolinos
Motril
Castell de Ferro
Carchuna
Roquetas de Mar
Balerma
Almerimar
Punta Entinas-El Sabinar
Almería
Cabo de Gata
Vera
Garrucha
La Parata

Application of UAV-derived data for beach monitoring and vulnerability assessment: the case of Molise coastline (southern Italy)

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The study proposed illustrates the developed method based on UAV-derived data for the assessment of short-term morphological-topographical changes of the beach system and its implications for coastal vulnerability assessment. Drone surveys were carried out during the summers of 2019 and 2020 along two stretches of beach, affected by erosion and stable respectively, located along the coast of the Molise Region (southern Italy). The acquired high-resolution aerial photographs were used to generate large-scale digital surface models (DSMs) and orthophotos of the beach using the Structure from Motion (SfM) image processing tool. Comparison of the generated 2019 and 2020 DSMs showed significant morphological changes for the beach located in the southern part of the Molise coastline with a sediment volume loss of approximately 780 m3 in an area of 4400 m2. Based on the DSM-derived beach profiles, a coastal vulnerability assessment was performed for this beach by using the CVA approach, showing a relative worsening of its stability conditions from 2019 to 2020.

The relative ease of use of these devices and the possibility to acquire DSMs and georeferenced images with high spatial and temporal resolution may allow an improvement of existing methodologies and databases for a more precise mapping of coastal evolution and erosion. Furthermore, the integrated use of UAV and GIS approaches has proven to be an effective tool not only for a rapid analysis of spatial data, but also to provide an objective approach with consistent measurement and calculation processes.

Palaeogeographic evolution of Alykes lagoon, Pydna, Northern Greece during the Holocene, based on geomorphological and sedimentological data

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This study deals with the palaeogeographic evolution of the Alykes lagoon, located on the western coast of the Thermaikos Gulf in northern Greece. For this purpose, detailed geomorphological mapping was conducted and two shallow boreholes were drilled in an attempt to recognize the late Holocene palaeoenvironmental changes.

In total 64 sediment samples collected from the cores were granulometrically and palaeontologically analysed. Moreover, two shell samples were 14C dated and provided the chronostratigraphy of the cores. Four biosedimentary units were identified corresponding to different depositional palaeoenvironments including coastal shallow marine, lagoonal, mesohaline to oligohaline and brackish mesohaline respectively. A shallowing upwards sedimentary sequence was recorded with the lower unit corresponding to a shallow marine environment which progressively changes to a more protected lagoonal one, with restricted communication to the open sea.

Based on the radiocarbon dates it is evident that the coastline was located a few hundreds of meters west of the present-day one by the end of the seventh millennium BP. Furthermore, we concluded that the establishment of the lagoon can be safely put around the sixth millennium BP and that its confinement can be attributed to the formation and evolution of two groups of beach ridges located at the eastern part of the lagoon. The fining upwards sequence of the sedimentary record of the cores is interrupted by a coarse-grained layer corresponding to a high energy marine inundation event attributed probably to a palaeotsunami which occurred not long before 4330–3920 cal BP. No, or negligible, vertical tectonic displacement can be concluded, for the past 4330–3920 cal BP.

Holocene paleoenvironmental analysis of the southern margin of the Salpi lagoon (northern Apulia, Italy)

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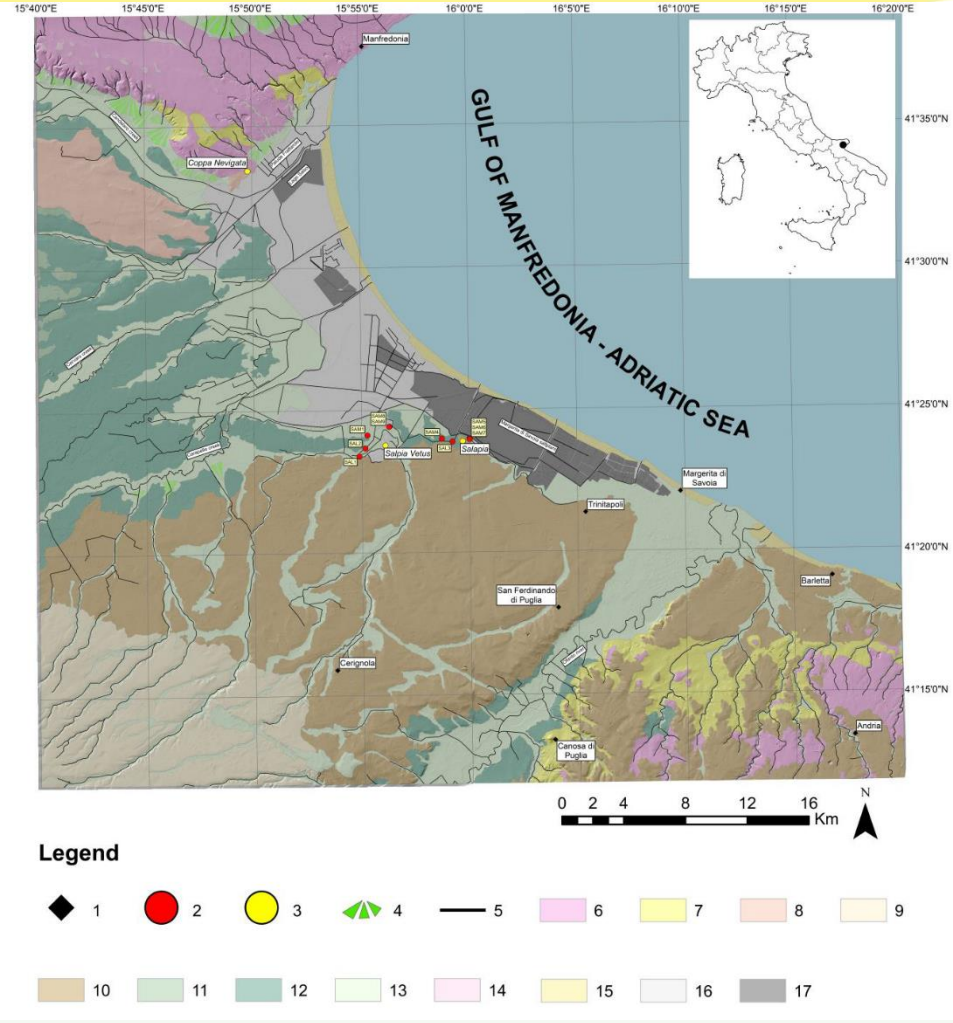
We present the Holocene paleoenvironmental investigation of the Salpi lagoon, located on the Tavoliere coastal plain (Apulia, Italy), through sedimentological, micropaleontological, and chronological analysis performed on sediment cores collected in the southern margin of the coastal plain (Fig.1). The area was already extensively studied in its northern sectors due to the nearby archaeological site of Coppa Nevigata.

Paleoenvironmental analysis indicates a brackish-lagoon environment with limited seawater input at ca. 6000 cal BP. This appears to contrast with the northern margin of the coastal plain, where the contemporary lagoon is described as an open-sea environment. Available dating indicates that at ca. 3000 cal BP the semi-open lagoon had already developed into a shallow marshy-brackish environment, strongly influenced by low-energy freshwater and very scarce seawater inputs. However, the occurrence of the Avellino tephra within these facies seems to postdate their deposition a ca. 3800 cal BP.

Alluvial deposits have almost no chronological boundaries due to the absence of datable material. Nevertheless, their occurrence is in stratigraphic agreement with the northern portion of the coastal plain, thus confirming that the aggradation phase determined a discontinuity in the water body, separating the wetlands in two different environments.

Hence, the importance of this study is marked by the possibility to reconstruct the Holocene coastal landscape by comparing, for the first time, the southern and northern sectors of the Salpi lagoon. Furthermore, this study allows to better assess the influence of human impact on landscape evolution, particularly through Roman and Medieval times. In fact, notwithstanding the presence of the ancient settlements of pre-Roman Salpia Vetus, Roman Salapia and Medieval Salpi, analysis shows that, at least in the southern margin, natural causes are more likely responsible for the evolution of the lagoon.



Geological map of the study area modified from the on-line idro-geomorphological database of "Regione Puglia" (www.sit.puglia.it), and the National Geological Map from the "Istituto Superiore per la Ricerca Ambientale (ISPRA, www.isprambiente.gov.it). Datum: D_WGS_1984; GCS: WGS_1984_UTM_Zone_33N. Legend: 1) main town; 2) core location; 3) archaeological site; 4) alluvial fan; 5) water stream (natural/artificial channel); 6) Carbonate Units (Mesozoic); 7) Carbonate Units (Pliocene); 8) marine deposit – Middle Pleistocene; 9) alluvial deposit – Middle Pleistocene; 10) infralittoral deposit – Middle Pleistocene; 11) alluvial deposit – Middle/Upper Pleistocene; 12) alluvial deposit – Upper Pleistocene; 13) alluvial plain – Upper Pleistocene/Holocene; 14) karst depression filling (Terre Rosse) – Upper Pleistocene/Holocene; 15) beach deposit – Holocene; 16) reclamation deposit – Recent time; 17) artificial reservoir – Recent time.

Saltmarshes as Geological Tide Gauges to reconstruct Sea Level Change

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Sea level rise (SLR) is one of the most challenging consequences of climate change (e.g., IPCC, 2021). SLR varies in time and space in response to a suite of different controlling mechanisms. The World Climate Research Programme (WCRP) set the quantification and understanding of the mechanisms causing local to regional scale sea level variability as one of its Grand Challenges. However, modern-day sea level instrumental measurements are too short to reliably establish secular rates of SLR and unravel the relative contributions of the processes driving them. As an island nation, Ireland will be profoundly influenced by future SLR. My PhD research from part of the A4 project (Aigéin, Aeráid, agus Athrú Atlantaigh), which seeks to improve our projections of future SLR by better understanding the drivers of Irish sea level change over the past two centuries. This aim will be achieved by expanding the Irish tide gauge dataset through data archaeology and resurveying historical benchmarks around Ireland, and by the application of the "geological tide gauge" approach. This technique, based on the analysis of sea-level indicators in buried high-saltmarsh sediment, capable of producing multi-decadal relative sea level (RSL) reconstructions from saltmarsh environments extending back several centuries to millennia. The geological tide gauge approach will be also applied to produce a record of Common Era (past 2000 years) RSL change that will contribute to a growing network of high-resolution RSL reconstructions from the Atlantic coast of north America. Spatio-temporal modelling of this expanded dataset will provide new insights into RSL variability.

Project links:

https://a-ceathair.github.io/

https://www.maynoothuniversity.ie/icarus/active-research-grants/a4

Inverting marine terrace morphology to constrain paleo sea-level

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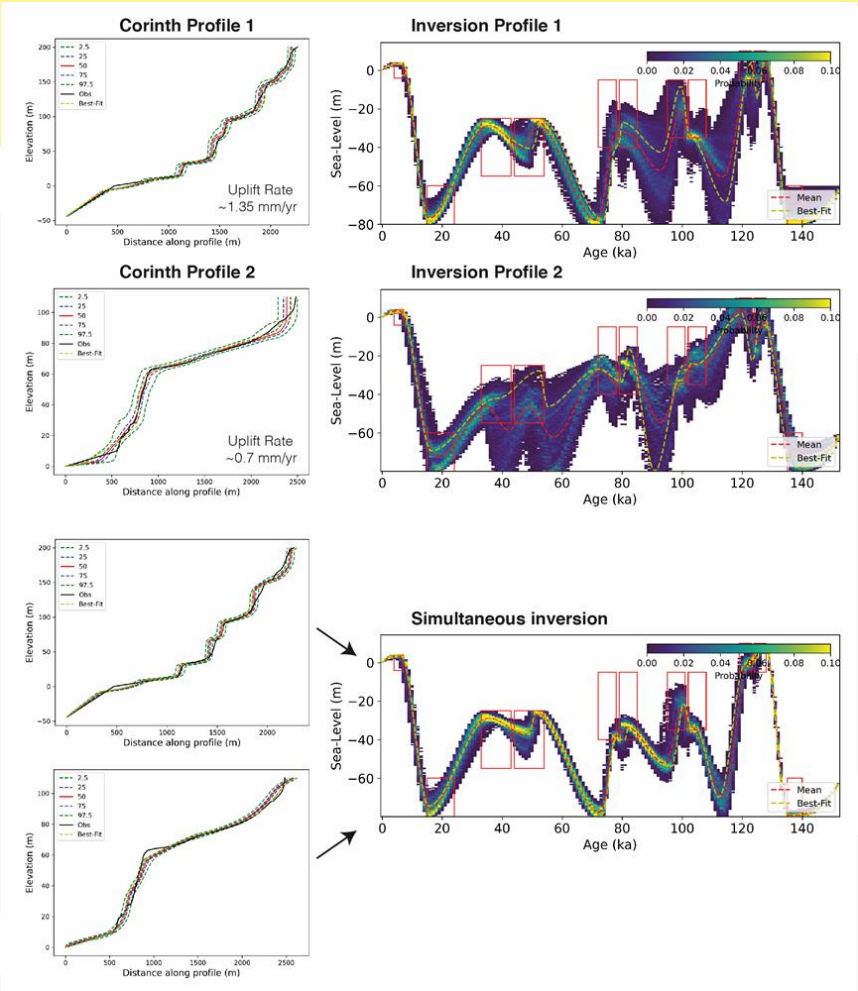
Quantifying paleo sea-level changes is an important challenge given its intricate relation with paleo-climate, -ice-sheets and geodynamics, but pre-Holocene uncertainties currently span several tens of meters. The world's coastlines provide an enormous geomorphologic dataset, and recent modelling studies have showed their potential in constraining paleo sea-level through forward landscape evolution modeling. We take a next step, by applying a Bayesian approach to invert the geometry of marine terrace sequences to paleo sea-level. Using a Markov chain Monte Carlo sampling method, we test our model on synthetic profiles and two observed marine terrace sequences. The synthetic profiles – with known input parameters – show that there are optimal values for uplift rate, erosion rate, initial slope and wave base depth to obtain a well-constrained inversion. Both the inversion of synthetic profiles and a terrace profile from Santa Cruz (Ca, US) show how sea-level peaks are easier to constrain than sea-level troughs, but that also solutions for peaks tend to be non-unique. Synthetic profiles and profiles from the Corinth Rift (Greece) both show how inverting multiple profiles from a sequence can lead to a narrower range of possible paleo sea-level, especially for sea-level troughs. This last result emphasizes the potential of inverting coastal morphology: joint inversion of globally distributed marine terrace profiles may eventually reveal not only local relative sea-level histories, but catalyse a better understanding of both global paleo sea-level and glacio-isostatic adjustments.


Corinth Profile 1
Inversion Profile 1
Uplift Rate
~1.35 mm/yr
Corinth Profile 2
Inversion Profile 2
Uplift Rate
~0.7 mm/yr
Simultaneous inversion
Elevation (m)
Distance along profile (m)
Sea-Level (m)
Age (ka)
Mean
Best-Fit
Obs

Holocene palaeoenvironmental evolution of the Piombino coastal plain (Tuscany, Italy)

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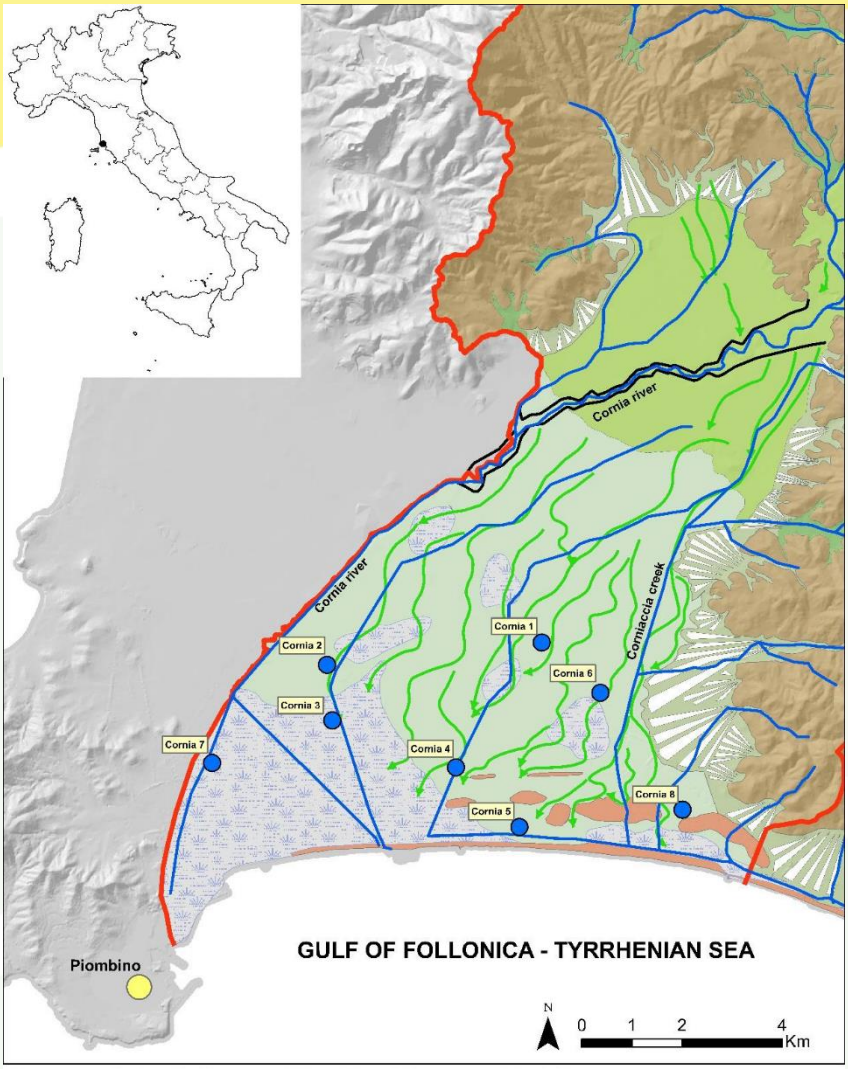
The coastal plain of Piombino (southern Tuscany, Italy) belongs to the Cornia river basin and holds a long tradition of archaeological studies, mainly referred to Classical Antiquity and medieval period. However, data concerning the palaeoenvironmental setting of the area during the Holocene are mainly limited to historical sources, reporting the presence of a paleo-lagoon along the coast and flooded-swampy areas in the inner part (Fig. 1). Therefore, within the ERC nEU-Med project, eight cores were drilled and studied to assess the chronology of the landscape evolution in terms of changes of sedimentary facies and related depositional environments. The location of the cores followed a geomorphological analysis of the area, carried out with traditional fieldwork and remote sensing analysis. Moreover, historical cartographic sources were analysed to outline the palaeohydrography and the boundaries of wet environments. Sedimentological and chronological analysis of the cores reveals a general regressive trend under nearly stable eustatic conditions since the Middle Holocene. Facies analysis shows the vertical stacking of swamp and alluvial deposits on top of the lagoonal facies, thus indicating the progressive closure of the lagoon, synchronous with the progradation of swampy and floodplain environments up to the definitive emersion of the whole landscape. Overall, the stratigraphy and chronology of the cores are consistent with the geomorphological analysis of the Piombino coastal plain, highlighting the migrations of the Cornia river through several phases of sediment redistribution and aggradation. The results indicate that the fluvial network played a key role in the evolution of the coastal plain, forming a complex system of poorly drained floodplain and wetlands, mainly as a response to the land use in the proximal and median portions of the drainage basin.



Geomorphological map of the Piombino coastal plain. Legend: 1) artificial drainage network; 2) paleochannel; 3) artificial levee; 4) Cornia river basin 5) hillslope; 6) minor tributaries valleys; 7) floodplain and fluvial terraces; 8) alluvial fan; 9) coastal plain; 10) lagoon-swamps (Catasto Leopoldino XVIII century); 11) dune belt; 12) cores

Study of the September 28th 2018 Tsunamigenic Landslide Deposits in Palu, Central Sulawesi, Indonesia Based on Foraminifera Data

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Based on Indonesian Meteorological, Climatological, and Geophysical Agency data, in September 28th, 2018 at 17.22 WIB a tsunami has destructed the areas of Palu, Donggala, and Mamuju, Central Sulawesi, Indonesia. The tsunami was related with the occurrence of submarine and coastal landslides soon after the earthquake. Field surveys of tsunami deposits have been conducted by the team from the Indonesian Institute of Sciences to determine the detailed characteristics of deposits. The purpose of this study that presented here is to determine the distribution of foraminifera in the tsunami deposits and their relation to tsunami deposition mechanisms. The location of the study was in Talise beach, Palu City. Spots sampling object were taken along 275 m transect away from the shoreline with a total of 52 samples. Detailed analysis of foraminifera was done every 1 cm interval vertically in each spot. Generally, the September 28th 2018 tsunami deposits were characterized by fining upward and landward trend as well as getting thinner landwards. Content of mud also being more abundant as the increasing depth and farther from the shoreline. The deposits were dominated by benthic foraminifera with transitional to middle neritic environment. The distribution of foraminifera is more abundant in line with increasing depth or thickness of the deposits. While laterally farther away from the shoreline, it shows fewer individuals and species. The sources of tsunami deposits sediment are marine sediments eroded from the transition zone to the middle neritic, and interpreted that the sediment were sourced from 0-100 m depth. The capacity of a tsunami to be able to carry sediment from the bottom of the seabed can be seen from the presence of deep water assemblages foraminifera but it may be governed by several specific factors including proximity of deep water to the locations where the tsunami sediments are deposited. This is a challenge that should be tested by future research.

Deltas, rivers and dunes: submerged shorelines reveal the effects of meltwater pulses on the SE African coast

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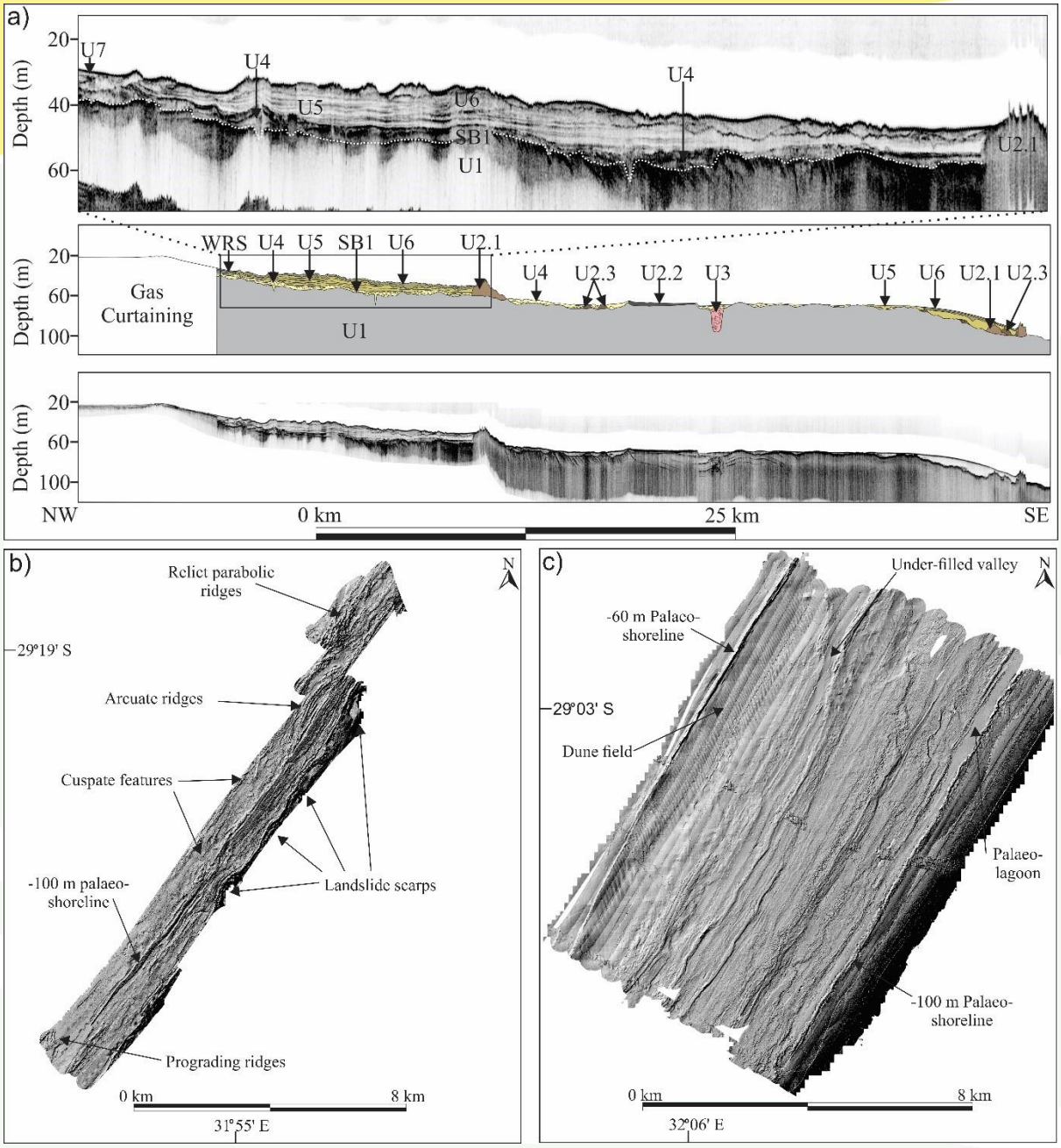
This research investigates the interplay between allocyclic controls and antecedent topography in the evolution of submerged coastal landforms. Using a combination of geophysical techniques, we examine the wide wave-dominated Thukela shelf, and define the major seismic units and seafloor features. Utilizing high-resolution seismic reflection data, bathymetric data and gravity core samples, we document the post-glacial stratigraphic development and architecture of the shelf off eastern South Africa and define key features of development and subsequent preservation. During the Last Glacial Maximum, fluvial valleys incised the acoustic basement. Ensuing transgression fostered the development of several well-preserved aeolianite palaeoshorelines, at defined water depths of - 105 m and - 60 m, representing positions of former sea-level slowstands or stillstands. The development of the – 105 m and – 60 m shorelines are linked to high sediment supply from adjacent fluvial sources associated with the debouchment of the Thukela River, as well as relative sea-level quiescence during the Older Dryas and Younger Dryas, respectively. Preservation of these palaeoshorelines are attributed to a complex interplay between i) early diagenesis, ii) alternating sea-level stillstands and periods of rapid sea-level rise, and iii) antecedent conditioning. Protracted periods of shoreline occupation at defined depths of – 105 m and – 60 m were followed by periods of significant increases in rates of sea-level rise corresponding to Meltwater Pulse 1A (MWP1A) and Meltwater Pulse 1B (MWP1B), respectively. Antecedent conditioning further facilitated preservation of these former shorelines, as the gentle shelf gradient predisposes them to overstepping, exacerbated by rapidly rising sea-levels during MWP1A and MWP1B. A series of prograding and backstepped deltas fringe the landward and seaward edges of the palaeoshorelines. Delta development was favoured during sea-level stillstands, with the step-back of the delta corresponding to sharp increases in the rate of sea-level rise. The overall gentle palaeo-bathymetric gradient has moderated erosion associated with rising sea level, which coupled with the sandy delta deposits occurring in the swell shadow of the elevated palaeo-shorelines partitioning accommodation for sediment accumulation, have culminated in preservation of the deltaic bodies, and moderated the efficiency of ravinement.



Topas seismic reflection profile (a) and southern (b) and northern (c) bathymetric maps of the Thukela continental shelf.

The *Pomatoleios kraussii* serpulid worm – an Indo-Pacific sea level marker in Late Pleistocene and Holocene

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Pomatoleios kraussii annelid tube worm l lives nearby sea level, attached to any hard substrate. It can form 'reefs' between low and high tide, in high-nutrient, high-energy, exposed locations. We studied living organisms in Dubai and Japan, and fossil ones in Oman. Colonies live in the middle of the tidal range, right below the barnacle belt. Counter-intuitively, the thickly populated zone is narrower on exposed sites and wider on protected ones. Significance for the Indo-Pacific region is in its widespread occcurrence, being a most precise marker of relative sea level change (10-20 cm accuracy). It can record sea level change (and/or coastal tectonics) beyond historical records. It was found in Late Interglacial rocky coasts, indicating range of sea levels not markedly different from modern ones.

Reference:

Falkenroth, M, Adolphs, S, Cahnbley, M, Bagci, H, Kázmér, M, Mechernich, S and Hoffmann, G. 2020. Biological Indicators Reveal Small-Scale Sea-Level Variability During MIS 5e (Sur, Sultanate of Oman). – Open Quaternary, 6: 1, pp. 1–20. [open access]

Future Fens: using palaeoecology to inform restoration and conservation of the Lincolnshire Fenlands

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The Lincolnshire Fenlands were once an environmentally diverse and species rich landscape. Archaeological evidence for long-term human land use and settlement is widespread on the boundaries of the Fenland basin, with the wetlands providing both challenges and opportunities for fen-edge communities. However, artificial drainage and agricultural intensification has left only 1000 fragmented hectares of undrained fenland and caused desiccation and wastage of the once extensive peat soils. Additional challenges associated with climate change and accelerated sea-level rise increase the vulnerability of the region to biodiversity and ecosystem services loss. In this research, palaeoecological research techniques have been applied to aid conservation and inform the land management potential of managed fenland, addressing the paucity of palaeoenvironmental data for the Lincolnshire Fenlands and increasing the understanding of long-term human-environment interactions in the region. Preliminary pollen, microcharcoal and loss on ignition analyses will be presented and compared with regional palaeoenvironmental data, revealing a dynamic environmental history of fluctuating marine and freshwater inundations and human-landscape interactions throughout the Holocene.

Hindu temple marks 8th century sea level (Mahabalipuram, Tamil Nadu, India)

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The Shore Temple in Mahabalipuram (Tamil Nadu, Southern India) exists since the late 7th century. Historical sources suggest that it was was built on an island in honour of the gods Vishnu and Shiva. A former bridge over the canal, which connected the island to the mainland, and a seawall, which protected the shore from the waves are dysfunctional now as they are located too high above the present day sea level. A holy well, part of the temple complex, reaches down to the modern freshwater lens. We suggest that about 1 m uplift occurred between the construction of the temple and the well (during the rule of King Rajasimhan in the early 8th century), which in most likelyhood was caused by an earthquake of magnitude $M > 6.5$ that led to the uplift of the island. There are thick walls of a ruined masonry building in the former, sand-filled canal, tilted in various directions. These are evidence for liquefaction of subsoil, caused by a second earthquake of intensity IX-X. The east coast of India has remained prone to destructive earthquakes: archaeoseismology proves to be useful tool which can help to identify these areas.

Holocene beach ridge evolution at Río de la Plata estuary, Argentina: Former answers for future questions?

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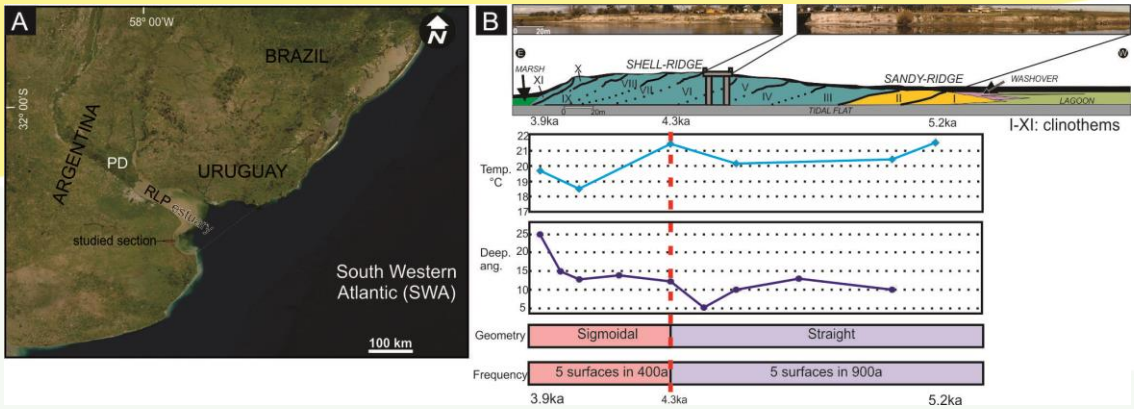
The Holocene shows rapid climatic changes associated with alternating intervals of glacier advances and retreats. The coastal regions, where beach ridges constitute common preserved landforms, are highly sensitive to register such changes and bring light into past littoral environments. Excellent marine Argentinean Holocene deposits associated with the last climate optimum are preserved at the Río de la Plata estuary (Argentina). In this beach ridge a palaeoenvironmental model was performed, including the analysis of major hierarchy surfaces (clinoforms) that subdivide it into eleven clinothems (two siliciclastic; nine carbonatic). Selected clinothems were dated between 5,240±110 and 3,900±90 calBP, while stable isotope analyses allowed to infer that the temperature during the evolution of the ridge has two maximum values of 22.5 °C. The sudden change from sandy to carbonate sediments in the ridge, could be interpreted as a combined result of an increase of carbonate productivity along with a decrease of siliciclastic supply at the coast. This stage would have been developed approximately around 5ka B.P., when propitious climatic conditions may have led to the proliferation of large communities of warm-temperate benthic organisms. We stress that, the strong activity of the Brazilian current during the Mid-Holocene enabled excellent conditions for the development of a carbonate warm beaches similar to that occurring at tropical and subtropical areas nowadays. This study provides an example of the strong changes occurred in coastal environments as a result of climate change, particularly in the context of global warming episodes which characterized interglacial periods of the Late Quaternary in eastern South America.



A - Study area. B - Relationship between environments, ages, palaeotemperatures and clinoforms.

Submerged fortifications of ancient Mesembria

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The town of Nesebar is located on the Southern Bulgarian Black Sea coast, just 35 km North of the largest city in the region, Burgas. Its history dates back to the 6th c. BC when Dorians from Megara settled a Greek colony on the peninsula where according to sources was the Thracian settlement of Mesembria. Since then, the town played an important role in the politics and disputes throughout the ages.

Combined aerial and underwater orthomosaics of ancient Mesembria (Dr B. Prodanov, Eng T. Lambev, P. Georgiev)

Because of its significance, the waters (aquatory) around the ancient town were one of the first sites for underwater archaeology in Bulgaria. Conducted in 15 expeditions

from 1960 to 1984 under the supervision of Luba Ognenova, a pioneer and one of the first female divers in the country. The results of which were supplement and crucial to Nesebar's application for a UNESCO World Heritage Site in 1983.

After more than 30 years the studies of the submerged parts of the town were renewed. Here we will present the results of the annual research conducted by the Centre for Underwater Archaeology since 2017. The focus of this has been the rediscovery and detailed documentation of the structures found by Ognenova as well as to search for new ones. For that modern methods such as digital aerial and underwater photogrammetry and bathymetric survey were applied. On some of the structures, archaeological excavations were conducted to determine their origin, date and relationship to the surrounding sea and landscape. It is our goal to give a clear explanation of how those walls became underwater.

Protection and enhancement of vulnerable coastal environments through a geomorphological multi-temporal analysis: study of the recent evolution of some Mediterranean coastal areas

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Coastlines are highly dynamic and complex environments in which natural and anthropogenic processes combine and interact, modifying their geomorphological, physical and biological/ecological characteristics. Especially, serious erosion processes threaten worldwide the coasts, which are often, densely inhabited and populated by human infrastructure; therefore, the analysis of coastal vulnerability represents an essential tool for coastal management and risk reduction.

The work refers to the research activities in progress within a PhD project, which aims at analysing and comparing, especially from a geomorphological point of view, different areas of low coast to safeguard and enhance particularly vulnerable coastal environments.

The chosen study areas are represented by three segments of low coast, which are located respectively along the Adriatic, the Ionian and the Tyrrhenian coast: the about km long coastal stretch, between the Termoli and Campomarino harbours (Molise coast), the 9 km long coastal stretch between Nova Siri and Rocca Imperiale (Calabrian-Lucanian coast) and, coastal stretch extending starting from the mouth of the Mingardo River towards south for about 4km (Campanian coast). The work involves a common methodology that includes the morphological-topographical and sedimentological characterization and the study coasts, the study of their long to short-term evolution, the assessment of related vulnerability aspects and anthropic impacts, and the definition of a beach quality index to better define the criteria for the enhacement and protection of the coastal systems studied.

Data acquisition occurs by means of a multi-temporal analysis in a GIS environment of historical maps, aerial photos, orthophotos, the elaboration of previous data, field surveys and the large-scale geomorphological mapping of the study coasts.

Obtained dated will be used to estimate the variations of the shoreline, of the beach-dune systems and river mouth areas during the last centuries, reconstruct with precision the coastal landforms of high environmental value, and to assess their the state of preservation/naturalness, so as to provide useful data and indications for territorial planning and for the design of targeted interventions of restoration, environmental protection and coastal risk reduction.

Quaternary palynological investigation of the Kornati islands' climate change

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Paleoenvironments along the Eastern Adriatic coast experienced rapid changes during the Late Quaternary due to sea-level rise and transition from lacustrine to marine setting. Environmental change was best reflected in the vegetation cover which is an effective proxy for paleoecological reconstruction.

Numerous isolation basins along the Eastern Adriatic shore offer a unique insight into the transitional conditions of terrestrial karst. Since a more comprehensive study was needed, a project titled QMAD - Sediments between source and sink during a Late Quaternary eustatic cycle:

The Krka river and the Mid Adriatic Deep (MAD) System was funded by the Croatian Science Foundation. The main idea is to reconstruct the paleoenvironmental evolution from the Lake Prokljan in the Krka River estuary to MAD. A variety of climate and environmental proxy data will be obtained that will shed light onto the Late Quaternary landscapes and their impact on human migration along the Eastern Adriatic coast.

The Kornati Channel was chosen as a study area due to its specific morphology consisting of barrier seamounts and sills along a major fault line. Geophysical and bathymetric data were obtained from previous field campaigns. A field sampling was conducted in September 2021. Seven long marine cores were taken of total 34.5 metre length. The longest core is 7.71 metres long. Twelve Van Veen grab samples were also collected, extracting surface marine sediment from the depths of 60 to 100 metres. The cores will undergo extensive geochemical analyses, ^{14}C and OSL dating and palynofacies analysis. There are some indications of Quaternary anthropogenic vegetation influence which will be thoroughly investigated. In the first phase of our research, palynofacies analysis will be done to get more information about depositional environments.

Winds of change: Marine Isotope Stage 4 conditions inferred from submerged aeolianites on the Durban Bluff continental shelf and climate data from Sibudu, South Africa

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Here, we present an optically stimulated luminescence (OSL) age estimate of 64 ± 5 ka for an offshore aeolianite and draw regional correlations (within 45 km) between these Pleistocene geological sequences offshore of the Durban Bluff and contemporary palaeoenvironmental records from Sibudu on the South African sub-tropical east coast.

Offshore geological units were mapped with multibeam bathymetry, side-scan sonar and medium-penetration boomer sub-bottom profiling and sampled by scuba diving. The age and depositional characteristics of the composite Bluff-Blood Reef aeolianites suggest that dune-building events were linked to sea-level stillstands on both sea-level highstands (preserved above water) and lowstands (preserved below water, specifically, Marine Isotope Stage (MIS) 4).

Aeolianite remnants of late MIS 4 suggest that the wind regime during this mild glacial was dominated by 'Cape-type winds' typical of modern-day temperate latitudes, with prevailing directions preserved in foresets pointing towards northerlies and southeasterlies. This stands in contrast to the northwesterlies and southwesterlies that prevail at present.

We postulate the role of a narrow shelf in the characteristics of the sedimentary depositional system, consider the influence of palaeorainfall on sediment deposition, and demonstrate (1) the need to correlate offshore and onshore Quaternary sequences and (2) the role of submerged landscape deposits in unravelling glacial conditions on ice-free continental shelves.

Dive sampling methods. (A) Tools for underwater mapping include a lift bag and net, 14-pound sledgehammer, camera protected in an underwater housing, and a watertight float for a GPS. (B) Photographs of sampling and observation of submerged geological features.

Why land elevation matters for flood risk assessment – The case of the Ayeyarwady Delta, Myanmar

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Land elevation changes are a critical issue when studying relative sea level, contributing to sea-level rise (SLR) in regions where subsidence is dominant. Due to combined effects of sediment load and compaction, deltas are naturally subsiding areas and prone to relative SLR and other flood hazards.

Especially for Southeast Asian deltas, characterised by high population and socio-economic growth, the vulnerability to flooding increases and thus a comprehensive flood risk assessment, including the impact of relative SLR, is required.

To generate realistic assessments of flood exposure, and consequently risk and vulnerability, accurate elevation data is needed. In countries such as Myanmar, where high-accuracy elevation data is not accessible, often only global satellite-based digital elevation models (DEMs) can be used by the public and scientific community.

However, when studying relative SLR, the use of these DEMs is problematic for two reasons: First, their comparably large vertical errors of several metres affect the quality of the SLR-impact assessment, particularly in low-lying areas where changes occur on decimetre-scale. Second, the elevation data of these DEMs is given either in height above the global geoid or ellipsoid.

However, local sea level often differs up to more than a metre from the global geoid reference. Consequently, the neglection of datum conversion can lead to additional errors and a misjudgement of the flood risk.

Since these issues have not been addressed in the Ayeyarwady Delta of Myanmar so far, this study investigates the accuracy of common satellite-based DEMs through validation with geodetic benchmark elevations and spot heights from topographic maps. Though still work in progress, the results will allow for first conclusions on the impact of SLR in the Ayeyarwady Delta.

Relative sea-level change and palaeoearthquakes at Lopud island (Dubrovnik archipelago, Southern Adriatic, Croatia)

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Fixed sea-level indicators represent one of the best lines of evidence of RSL change as they always occur within a restricted elevation range with respect to the surface of the sea.

The coralline alga Lithophyllum byssoides can, in favourable conditions, construct algal rims revealed to be a good proxy record suitable for reconstructions of relative sea-level change. The vertical precision of L. byssoides in the microtidal environment comes from the restricted environmental conditions of the alga, while the 14C dating allowed precise geochronological control since the marine radiocarbon reservoir effect was determined.

A detailed survey of Lopud Island allowed the distinction of seismotectonically uplifted sector of coast. The established high-resolution geochronology enables to separate coseismic uplift events from periods of interseismic subsidence.

Consequently, we provide the first reconstruction of assumed number, timing, and displacements of past seismic events. The most important uplift occurred in well-known AD 1667 Dubrovnik earthquake. After correction for local coseismic displacements, the sea-level trends were quantified with full consideration of the available uncertainty.

This high-resolution study confirmed the precision of L. byssoides bioconstructions not only in studies of RSL variations but also in the studies of palaeoearthquakes in seismotectonically active areas. This research was supported by Croatian Science Foundation project HRZZ-IP-2019-04-9445 – Relative sea-level change and climate change along the eastern Adriatic coast – SEALeveL.

KEYNOTE

Stratigraphic records of a macro-tidal, tropical estuarine embayment reveal episodic sea-level rises: Mocimboa da Praia, northern Mozambique

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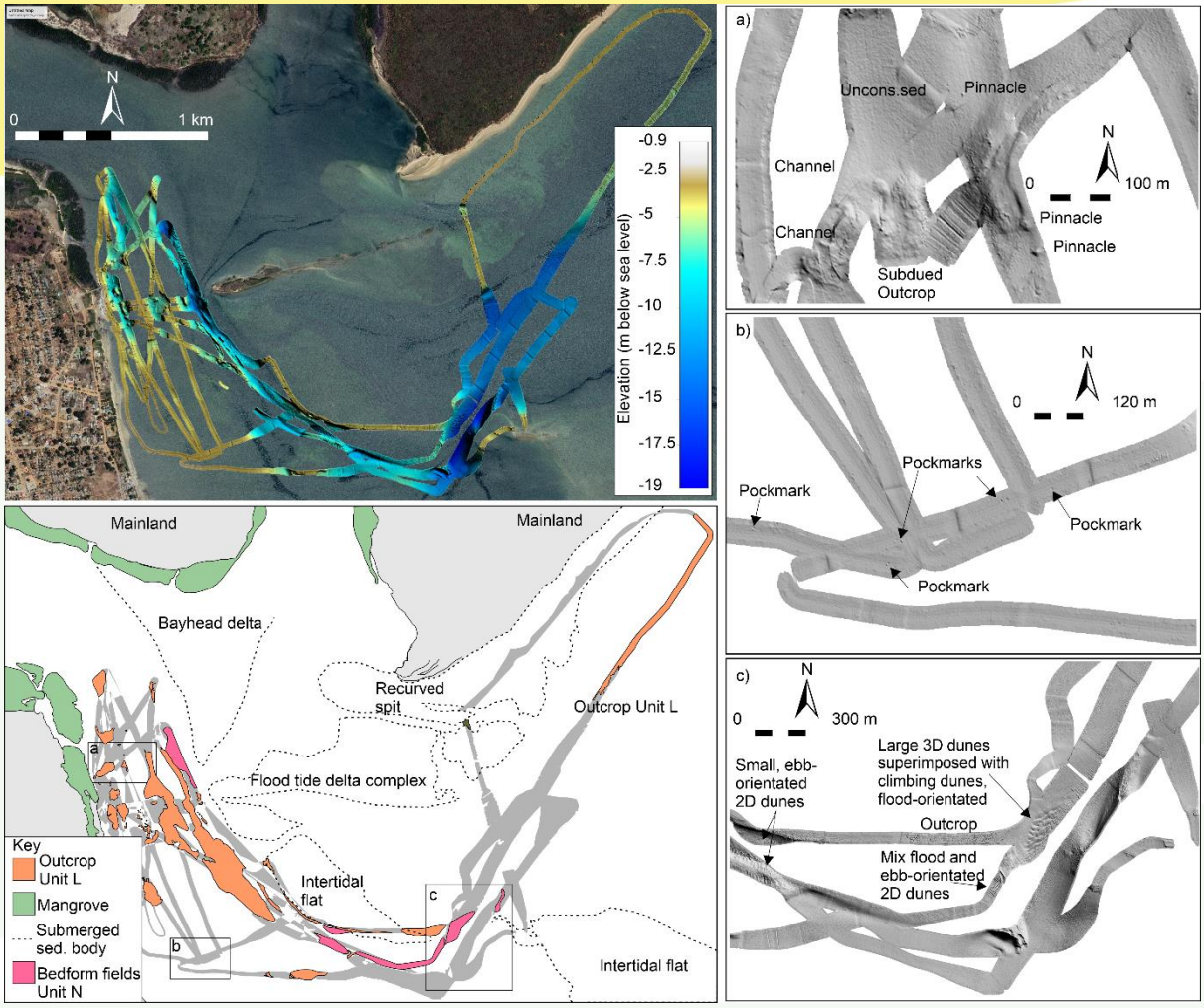
The records of transgressive sedimentation in macro-tidal, tropical estuaries are relatively scarce when compared to their better known and richly-documented temperate and subtropical counterparts. This study examines the embayment and associated incised valley systems of the Mocimboa da Praia area of northern Mozambique. Using a combination of multibeam bathymetry, very high resolution seismic reflection data, cores and jet probes, these systems are examined in the context of the postglacial sea level rise following the Last Glacial Maximum.

Records reveal periods of deepening, that alternate with periods of basin shallowing associated with normal regression linked to localised shallowing and progradation of bayhead deltas, spits and prominent flood and ebb tide delta complexes. Transgression is recorded in the development of central basin fills. Back stepping and wholesale preservation of the normal regressive features reflects abrupt drowning associated with meltwater pulses 1C and 1D. To landward, Beach rocks with basal depths of approximately 10 metres below mean sea level are found. These relate to a slowing of sea level rise and stabilisation of the back barrier shoreline.

With the stabilisation of sea level approximately 7000 years ago, the system has maintained a prominent and diverse network of tidal channels, within which a series of large scale tidal bedforms developed and were incorporated into the stratigraphy. These are apparent in the modern day seafloor geomorphology. Given the sheltered nature of the embayments that host tide dominated estuaries along the Mozambican coastline, these appear to be ideal environments in which large scale sandy deposits are developed and preserved in the stratigraphic record.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Large 3D dunes
superimposed with
climbing dunes,
flood-orientated
Outcrop
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KEYNOTE

Coastal inundation scenarios in the Mediterranean areas: from the susceptibility to the risk assessment

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As highlighted by the international literature on the analysis of global and regional climate data, one of the most evident consequences of ongoing global warming is the rise in the mean sea level whose impacts, in terms of variation in intensity and frequency of marine events, are already affecting coastal areas worldwide. Future projections provided by the Intergovernmental Panel on Climate Change (IPCC, 2014, 2019, 2021) for the end of the 21st century show an increase in global mean sea level up to 1 m compared to the reference period. At a regional scale, sea level rise can be exacerbated by vertical ground movements due to natural phenomena mainly linked to tectonic, glacio-isostatic, and volcanic processes. At a local scale, soil deformations can be further accentuated by anthropic activities, such as the over-exploitation of groundwater resources and structural overloading. In the context of future sea level rise, coastal zones and related natural and anthropic assets are considered highly exposed to the impacts of marine- and climate-related processes, such as coastal erosion and flooding. Such kind of processes are expected to cause not only loss in exploitable coastal land, but also to reduce the services provided by the coastal ecosystems, and to affect local economic activities.

For this reason, several research studies have focused on the identification of the most susceptible coastal zones, which are in general characterized by very low topographic height and relevant subsidence rates. This contribution aims to present examples of studies carried out for the assessment of the coastal inundation risk in the Mediterranean areas. In the first instance, medium- and long-term susceptibility scenarios were defined coupling local topographic data with sea level projections for the year 2050 and 2100. In addition, the local coastal exposure and vulnerability data are also taken into account in order to provide an overall risk assessment of those areas. These aspects, evaluated by means of index-based approaches and validated by expert-based judgments, were then overlaid with the susceptibility informative layer by means of specific GIS tools. Finally, with the aim to zone the investigated territory in different risk levels, the obtained risk values were classified in classes ranging from "low risk" to "very high risk". The inundation risk maps to future sea levels resulting from such kind of analysis represent the scientific basis for understanding critical climate impacts and related vulnerabilities along a coastal system. Therefore, they can be considered as an effective tool for the identification

of tailored risk reduction actions and for supporting the local authorities in the development of climate adaptation strategies.

BOOK OF ABSTRACTS

collapse into now

a glimpse into the past, a step into the future

NEPTUNE

INQUA
Founded 1928