

Book of Abstracts

Keynote Presentations



Dr Esteves is currently an Associate Professor in Physical Geography at Bournemouth University. Most of her work concerns understanding coastal changes driven by natural and human-induced processes at time-scales relevant to coastal management. She has worked in sites spanning across Latin America, East Africa, the USA and the UK.

Coastal habitats are key to reduce exposure to coastal hazards in East Africa

This talk highlights results from a novel integrated assessment of social vulnerability and exposure to coastal hazards covering Mozambique, Tanzania, Kenya and Madagascar. An estimated 22% of the coastline and 3.5 million people are at higher levels of exposure in the region, which can increase to 39% and 6.9 million people, if mangroves, coral reefs and seagrasses are lost. Coral reefs protect 2.5 million people, mostly in Mombasa, Zanzibar and Dar es Salaam. Results demonstrate that nature-based coastal protection is critical in East Africa, particularly in Kenya and Tanzania. Applications of this knowledge to identify 'priority concern areas' and inform risk reduction strategies will be discussed.



Dr Mather holds a PhD focused on coastal climate changes and has advised a number of Southern African countries on the risk and potential impacts of sea level rise on their coastlines. He is active in the fields of stormwater design and management, river and canal design and management and coastal and port engineering at one of the largest coastal Metro's in South Africa. He has worked up through the ranks to Director level and in recent years as a Project Executive he has provided strategic direction to these sectors. He has been employed by the eThekwini municipality for the last 34 years. Andrew has been actively involved in sea level rise and coastal erosion research over the last two decades in South Africa. Following an assessment of international models, he developed a wave run

What could possibly go wrong? Coastal Hazards in the African context.

Planning for coastal hazards in Africa is often a haphazard process. Inadequate information, a lack of skills, poor buy-in and poor or non-existent data hampers the hazard planning process often leading to a crisis on the ground. Blame games and Climate Change becomes the scapegoats for the disaster. For the sake of our citizens, we need to move beyond this state of affairs. We will examine the potential range of coastal hazards that we should be planning for to reduce the impact on human life and property and the environment.





Dr. Kwasi Appeaning Addo is currently Associate Professor and Director of the Institute for Environment and Sanitation Studies at the University of Ghana in Accra. His research focus on shoreline morphodynamics, coastal erosion and flooding studies, coastal vulnerability assessment under sea level change scenarios, coastal zone management and application of drone and video technology in nearshore coastal studies. Prof. Kwasi has consulted for several organization in the area of coastal erosion and flooding management and he is a member of the Expert Group of the High Level Panel for Sustainable Ocean Economy, technical advisor to the West African coast observation mission (WACOM) project, and a member of the International Pool of Experts, UN Ocean Affairs and the Law of the Sea. He is also a member of several professional bodies and a visiting scholar to universities and has published extensively on coastal topics with a focus on the West African coast.

Coastal hazards in West Africa-Challenges and the way forward

The coastal zone of West Africa is a highly productive region that provides goods and services to the coastal nations. The presence of abundant marine resources, habitats that provide critical ecosystem services, fertile agricultural lands, and opportunities for trade and transport identify the West Africa coast as a major driver of economic growth, accounting for approximately 56% of the sub-region's GDP. However, the coastal environment is undergoing changes that increase the vulnerability of the over 31% of the region's resident population. Natural and human driven factors combine to increase risk in the vulnerable coastal areas. Hazards, such as erosion and flooding have damaged vulnerable communities, threatened coastal infrastructure, destroyed sources of livelihoods and increased poverty. The trend is projected to continue with increased intensity under climate change and sea level rise. Attempts by governments in the sub-region to protect the coastal environment against erosion and flooding hazards have not been very successful due to issues such as adopting ineffective management approaches, lack of capacity and non-coordinated monitoring regime. This paper discusses the coastal management challenges in the sub-region, and possible measures to increase resilience in the coastal ecosystems to enhance sustainable management.



Industry Spotlight

Obscape: Environmental Observations









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Affordable real-time catchment monitoring: A case study in Durban, South Africa

Adequate management of catchment areas is aimed at preserving vital water resources and preventing catastrophic flooding events. To that end, real-time availability of information regarding the state of all the water bodies and water flows that comprise the catchment area is an indispensable asset.

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A case study will be presented for Durban, South Africa, where Obscape's solutions have been used for more than 10 years for real-time monitoring of all 25 catchment areas that comprise the municipality. This has enabled the Durban municipality to manage their water systems and respond quickly to hazards like flooding, drought and beach erosion.



Conference Abstracts

Currents, waves and sediment transport in Nacala Bay, Mozambique.

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Abstract:

Nacala Bay is a sheltered, semi-enclosed coastal system that hosts one of the main deep-water ports on the east coast of Africa. The bay is located in the northern coast of Mozambique, which is characterised by an irregular coastline and a narrow continental shelf¹. A study was carried out to investigate tides, currents, waves and sediment transport in the bay using hydro- and morphodynamic models (Delft3D). It is estimated that tidal currents reach maximum velocities of 0.5 m s⁻¹ at the entrance of the bay and 0.2 m s⁻¹ inside. Winds of tropical storm intensity are expected to have a proportionately larger impact along the shallower areas (e.g. inner shores and points). Ocean swell almost does not propagate into the bay, waves being mainly locally generated. Due to the limited fetch, the maximum calculated significant wave height for a wind at the upper limit of tropical storm intensity (32 m s⁻¹) from the NE is 1.8 m. Thus, the transport of sandy sediments by currents and waves is estimated to be significant only for extreme events (tropical storms and cyclones) and near the shoreline (above the 5 m or, locally, the 10 m depth contour). The results appear to be consistent with the surface sediment distribution, medium to silty sands in comparatively exposed to semi-exposed shallow areas and fine-grained sediments in sheltered and deeper areas.

Keywords: Coastal systems; Modelling; Hydrodynamics; Morphodynamics; Mozambique.

¹ Palalane J, Larson M, Hanson H, Juízo D, (2016). Coastal erosion in Mozambique: governing processes and remedial measures. Journal of Coastal Research, 32: 700 – 718.

Stratigraphic and sedimentological signatures as proxies to interpret past extreme marine events along the South African coast.

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Abstract:

Natural hazards such as tsunamis and storm surges increasingly poses significant threats to the evergrowing coastal population of the world's coast¹. However, historical accounts documenting inundation of low-lying coastal areas by these extreme waves, especially for tsunamis, do not extend far back in time to provide reasonable information on their distribution, frequency and damages. While eyewitness accounts are utilized in identifying and interpreting extreme marine wave events inundating low-lying coastal areas, field investigation of geological and geomorphic evidence such as sedimentological and erosional features are important to provide estimates of the magnitudes and frequency of events documented in the palaeo record. Although the South African coast is not demarcated as a global high risk site for tsunamis, several events (e.g. 1969 and 2008 Dwarskersbos events, 2004 Indian Ocean tsunami) have demonstrated the vulnerability of our coastline to such events. This work presents anomalous sedimentary deposits preserved in the stratigraphic record of the Swartkops Estuary and low-lying Dwarskersbos coastal plain. We use microfossil evidence and grain microtextural signatures as proxies to identify and interpret past extreme marine events inundation in these contrasting environments. The interpretation of onshore extreme wave deposits is an important tool to evaluate the hazard of tsunami and severe storms, especially where the historical documentation is either short, fragmented and/or not available. While we acknowledge that extreme marine events such tsunamis and storms are unavoided natural hazards but we hope that this work will contribute to the understanding of the events along the South African coast thus leading to effective hazard and risk assessment of future events².

Keywords: Natural hazards; sedimentary deposits; tsunamis; South African coast

- 1. Röbke, B. R., & Vött, A. (2017). Progress in Oceanography The tsunami phenomenon. *Progress in Oceanography*, 159(August), 296–322. https://doi.org/10.1016/j.pocean.2017.09.003
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South Africa's coastal climate risk: a national assessment.

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Abstract:

South Africa's coastal zone is an attractive space for economic and recreational activities. Approximately 60% of the South African economy depends on coastal natural resources and trade infrastructure such as ports. As of 2013, an estimated 3.5 million people are residing within 5-7 km from the coast line, 60% thereof in dense metropolitan areas¹. Natural and man-made coastal infrastructure is being exposed to natural hazards such as floods and erosion, regularly causing severe damage to infrastructure, livelihoods and economy. This an expected coastal population increase exceeding national and regional growth, the amount of people and infrastructures potentially being exposed to coastal hazards is expected to increase significantly within the next 30 years. This risk is exacerbated by the expected effects of climate

In order to assess the extent of people and coastal infrastructure at risk, the South African Department for Environmental Affairs commissioned the conduction of the geospatial National Coastal Assessment for a comprehensive, cross-disciplinary and integrated Status Quo Assessment of the coast and the development of a Coastal Climate Change Vulnerability Assessment, which focused on the assessment of future coastal and estuarine flood and erosion risk.

In this presentation we will show some of the core findings of the amalgamated results of these both projects, e.g. identifying core areas at risk of flood and erosion, vulnerability profiles of people and communities affected, as well as some cross-disciplinary results highlighting potential and existing coastal land use conflicts and synergies.

Keywords: Coastal flooding; Coastal Erosion; Climate Change; NCA; GIS.

change, such as sea level rise and increased storminess on SA's coasts².

References

¹ Le Roux A, Van Huyssteen E, Van Niekerk W, Mans G. 2017. Chapter: Profiling the risks and vulnerabilities of South African Settlements. South African Risk and Vulnerability Atlas 2nd edition.

² https://greenbook.co.za/.

Towards a high-resolution sea-level reconstruction along southern Africa's southern Cape.

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Abstract:

Sea-level records for the southern African coastline have traditionally been compiled using sedimentological, geomorphological and biological proxies. These data provide a framework for understanding Pleistocene sea-level variability however, they do not provide a detailed record of recent sealevel change. Instrumental data from tide gauges are restricted to the past 70 years and are hampered by large data gaps, poor instrument calibration, geographical distribution and availability. When compared with traditional proxies and tide gauge data, salt marsh foraminifera as a sea-level proxy have the advantage of producing high resolution and continuous records of sea-level variability. The distribution of saltmarsh foraminifera in modern salt marshes provides a high-resolution analogue for sea-level position reflecting the frequency and duration of tidal inundation and therefore acts as a reliable sea-level indicator. This research has produced a regional synthesis of late Holocene sea-level variability on the South African coastline. This was achieved using salt-marsh sediment archives from the Keiskamma, Kariega and Knysna estuaries. Saltmarsh foraminifera were used as indicators of relative sea-level change based on a detailed regional transfer function that was developed using modern distributional data from the three sites. High resolution reconstructions from Kariega and Keiskamma estuaries show evidence of a late Holocene highstand c. 1200 cal yr BP. The results of this study sheds light on common signals of sea-level events in sedimentological records across sites and aid a better understanding of estuarine environmental responses to sea-level variability and fluctuations in the recent past.

Keywords: Sea-level; Late-Holocene; Foraminifera; Reconstruction; Sedimentology.

Beach Webcam Analysis of Coastal Change Induced by the 2014 Austral Spring Storm Cluster.

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Abstract:

We analyse, a cluster of four high-swell events (HSE's) that struck the KwaZulu-Natal (KZN) coast, southeast Africa during austral spring 2014. This HSE cluster was followed by erosion in the Durban Bight, central KZN, which lasted until early 2018. This HSE cluster was analysed using serendipitous webcams and captured wave data. Each HSE had a different propagation direction. The first three had a progressively more easterly swell direction component which moved the coastal erosion focus within headland bound bays from the south to the north, causing beach rotation. The fourth had a more southerly direction and moved the point of erosion back towards the south. We focus on low-tide fixed-webcam images from the Chain Rocks (Amanzimtoti, South Durban) headland-bound embayment and the urban New Pier Beach, Central Durban.

Large changes in the positions of the low water mark (LWM) and offshore surf bar were noted at Chain Rocks. The longshore bar trace moved offshore and then back onshore with the passage of each HSE. At some locations the distance between the LWM and the longshore bar trace more than doubled. We investigate the role of swell height (Hs) and (Hmax), swell direction and period (Tp) on the coastal erosion changes during the 2014 Austral Spring and conclude that the direction of the forecast swell can be used to predict the coastal erosion impact point. To our knowledge this is the first attempt to quantify coastal change brought about by a seasonal storm cluster on the southeast African Coast.

Keywords: Coastal Erosion; High-Swell Events; Swell Direction Variation; Swell Clusters; Webcam Analysis.

Littoral Drift Sand Budget and its Role in Coastal Erosion and Deposition.

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Abstract:

We are analyzing the littoral drift sand budget and forcing mechanisms along the KwaZulu-Natal central coast between Scottburgh and the Port of Durban's southern break water; a region of increasing developmental pressure. The ultimate near field sediment input is from 13 fluvial sources, however this input is poorly constrained. Estimates do exist for certain parts of the coast but these are based on meandering rivers (5-15% of sediment load is sand), whereas KwaZulu-Natal's rivers are braided (40-80% of sediment load)is sand) thus likely under-estimate fluvial contributions. Further, estuaries appear to be acting as temporary sediment sinks with limited transfer to the near shore. Consequently, fluvial sediment input to the littoral drift system is presently very poorly constrained. Littoral drift sediment is quantized into shoreface-connected ridges (SCRs). These giant bedforms (H < 20m, λ < 450 m) move northward on average at unknown rates. These submarine features grow to within -12m of the sea surface (fair-weather wave base). Evidence exists that the March 2007 megaswell event depressed the SCR crests by more than 4m and likely transported this sediment offshore. Qualitative evidence from sandtrap dredging activities (a process required to keep Durban Harbour open) indicates that sediment volume fluctuates on an 18 – 20-year cycle. Three such cycles have been noted which suggests that tidal forcing (possibly the Lunar Nodal Cycle) may contribute to the northward along-shore circulation sediment transport mechanism. Understanding sand budget forcing mechanisms is vital to better inform coastal management of KwaZulu-Natal central coast.

Keywords: Littoral drift; Sediment budget; shoreface-connected ridges; Coastal zone management.

An investigation into and potential solutions for the spit and beach erosion at St. Francis Bay, South Africa.

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Abstract:

The sandy beach at St. Francis Bay in the Eastern Cape Province of South Africa has suffered significant erosion over the past few decades. This can be attributed to the stabilisation of large headland bypass dune-fields during the 1970's and 1980's which has led to a reduction in sediment supply to the beach and resulted in a rapid retreat of the shoreline. The construction of Impofu dam upstream of the Kromme river mouth (completed in 1983) limited the supply of sediments that would be flushed out during floods and deposited onto the adjacent beaches, thereby exacerbating the problem.

The erosion has threatened to undermine beach properties and infrastructure, leading to the placement of rock revetments along much of the beach. The northern most 800 m of the beach which is backed by a narrow artificial sand spit has remained unprotected and has experienced significant erosion¹. This is a narrow barrier dune in imminent danger of breaching.

Several studies have been undertaken over the last 20+ years to evaluate and address this erosion, resulting in several proposals on possible remedial solutions. An investigation and review of all previous studies was undertaken, and an updated report compiled that included cost and timelines for the possible best solutions in solving the problems identified.

Conceptual design of appropriate protection options was subsequently undertaken, including highlevel costing as well as wave and shoreline evolution modelling to assess the expected performance of these options.

Preliminary design of the preferred erosion protection options was undertaken and a recommended option consisting of rock revetments, geotextile sand containers and beach nourishment was put forward. This scheme is currently going through the environmental approval process, following which, if successful, the preferred option will be implemented.

Keywords: St. Francis Bay; Beach Erosion; Geotextile Sand Containers; Revetments; Beach Nourishment

References

1 Anderson, DR, (2009). A hybrid approach to beach erosion mitigation and amenity enhancement, St Francis Bay, South Africa. MSc. Thesis. Nelson Mandela Metropolitan University.

A Regional scale Assessment of coastal flooding in South Africa.

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Abstract:

The coast of South Africa is subject to flooding from a combination of waves, storm surges and tides. Present flood risk can be exacerbated due to climate change, which can induce changes in the Agulhas current system. This would have a direct influence on the regional sea-level and atmospheric conditions and could affect flooding along the coast. The CASISAC* project aims to assess these changes and their implications on coastal flooding in South Africa by a modelling chain that combines models of ocean, atmospheric and coastal processes.

We focus on the coastal flood modelling part using the storm surges and tides generated from the modelling chain, and waves from CSIRO¹, as hazard scenarios. Flooding is simulated at regional scale for the entire South African coast using the simplified hydrodynamic model LISFLOOD-FP², which simulates the dynamic propagation of the flood wave, also accounting for surface roughness. Due to model limitations, we divide the coast of South Africa in 27 subdomains of varying size, depending on the coastline orientation, for which flooding is simulated independently. We explore different parametric approaches for incorporating the wave contribution to the still water hydrograph as LISFLOOD_FP does not account for wave propagation processes.

Last, we compare our results to those of the national coastal climate change vulnerability assessment conducted by the CSIR for DEA, in which a modified bathtub model was used. Through this comparison we assess the uncertainties introduced in regional flood assessments due to the modelling approach and selection of hazard scenarios.

Keywords: Coastal flooding; Hydrodynamic modelling; LISFLOOD-FP; bathtub; South Africa.

^{*} CASISAC (Changes in the Agulhas System and its Impact on Southern African Coasts: Sea level and coastal extremes) is funded by the German Federal Ministry of Education and Research (BMBF) through the project management of Projektträger Jülich PTJ under the grant number 03F0796C

¹ Durrant, T., Hemer, M., Trenham, C., Greenslade, D., (2013), CAWCR Wave Hindcast 1979-2010. v8. CSIRO. Service Collection. https://doi.org/10.4225/08/523168703DCC5

² Bates, P.D., De Roo, A.P.J., (2000), A simple raster-based model for flood inundation simulation. J. Hydrol. 236, 54-77.

Adaptation options for East Africa mangrove users with changing climate.

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Abstract:

Mangrove forests support livelihoods of many coastal communities in developing countries. This is in addition to their role in providing natural coastal protection, carbon sequestration and mitigation of climate change impacts. Mangroves around the world are however threatened from both climate and human induced stresses¹. Mangrove degradation result in biomass loss, increased carbon emissions² and can lead to coastal erosion³. Faced with rapid changes and trade-offs between socio-economic development goals and environmental sustainability targets, communities and coastal managers require tools that can assist in the dissemination and practical application of new knowledge. Adaptation measures can significantly reduce losses attributed to climate and environmental changes⁴. This paper provides results of a survey (592 households interviews) conducted in Lamu County, Kenya, to ascertain effects of environmental changes on mangrove resources. Respondents have noted no changes in mangrove species composition but reported changes in forest cover and density and availability of mangrove products. Key adaptation strategies that are being used by mangrove users to cope with the changes include: changing the main source of income and the use of alternatives to mangrove wood. Based on the survey results, recommendations are made of possible future adaptation measures that could be used by coastal communities and coastal managers to adapt to changing climate.

Keywords: Mangroves; Climate change; Adaptation; Lamu; Kenya.

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Impact Assessment of an on-shoreline highway (VDN) Extension in Dakar (Senegal): Coastal Erosion and Flood Risks

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Abstract:

During the last two decades, the African continent is experiencing the highest urban growth rates estimated at 3.5% per year. Among fast-growing capitals, Dakar concentrates 3,732,284 inhabitants in 2019, representing 48% of the urban population. As a peninsula of 550 km², Dakar is reaching its limits, leaving peripheral coastal areas the only available zones for new infrastructures developments, such as the extension of the existing northern highway so called "Voie de Dégagement Nord" (VDN). Launched by Senegalese government for 51 billion Fcfa (88,224,609 US dollars) (Ageroute 2010), the 28km highway aims to reduce traffic jams and ease mobility. Reshaping both coastal and urban landscapes, the VDN is located in the Niayes region, a geomorphologic unit of coastal sandy dunes covered by filaos (Casuarina equisetifolia), from Dakar to Saint-Louis and supplying the country with market gardening. Through an approach combining GIS, remote sensing and run-off flows modelling, this study assesses and compares the erosion and flood risks before and after the highway extension. Before its development (2000-2010), the coastline retreated of -37,96m, while the beach lost -25,42m of width at an estimated rate of -3,8 m/year despite a few sectors in accretion (+1,92m). Since the VDN construction (2010-2019), rates dropped, with a global retreat of-23,04m at an average rate of -1,22m/year. Between 2012-2018, the coastal sandy dunes protecting the inland from the sea, were then converted into an extension of the highway VDN and residential housing, in addition to the infrastructure development blocking the run-off flows to the sea. Furthermore, this study outlines the increasing pollution risk stemming from the Tivaouane-Peulh wastewater management unit (Office National de l'Assainissement du Sénégal 2017) developed between the VDN extension and the sea. Nevertheless, the flood management is deemed inefficient while the environmental policy doesn't reflect an integrated water resources management in Dakar urban planning. Therefore, retreat can be a sustainable coastal management strategy reducing losses resulting from floods and balance priorities between coastal ecosystems protection and urban sprawl.

Keywords: GIS; run-off; erosion; urban sprawl, coastal systems

Modelling compound flooding in the Breede Estuary, South Africa.

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Abstract:

Extreme coastal flooding along the South African coast can be caused by the co-occurrence of waves, storm surges and tides. Importantly, in low-lying areas such as estuaries, the additional influence of river discharge can further exacerbate flooding intensity. The CASISAC* project aims to assess these compound flood impacts on a local scale by modelling flood extents with boundary conditions generated from ocean and atmospheric models.

In this study, we model the flood extent and flood depth of compound flooding events, induced by high river discharge, large waves, storm surge and tides at the Breede Estuary, South Africa. We simulate compound flooding using the open source hydrodynamic model Delft3D by coupling the two modules FLOW and SWAN. The model boundary conditions are river discharge time-series, observed tides, and modelled extreme water levels and waves. We use a high-resolution elevation dataset in combination with freely available global elevation data (MERIT¹) and bathymetry created by combining the freely available GEBCO² dataset with nearshore bathymetric contour lines. We further analyse the influence of the individual flood drivers, i.e. coastal and river flooding, on flood extent and depth. Preliminary results show non-linear increases in flood characteristics when accounting for all flood drivers. We also observe that the combination of moderate intensity individual events can lead to extreme flooding. These results highlight that not accounting for compound flooding in coastal impact assessments may lead to the underestimation of flood impacts.

Keywords: Compound flooding; estuary; hydrodynamic modelling; Delft3D; South Africa.

^{*} CASISAC (Changes in the Agulhas System and its Impact on Southern African Coasts: Sea level and coastal extremes) is funded by the German Federal Ministry of Education and Research (BMBF) through the project management of Projektträger Jülich PTJ under the grant number 03F0796C

¹ Yamazaki D, Ikeshima D, Tawatari R, Yamaguchi T, O'Loughlin F, Neal JC, Sampson CC, Kanae S, Bates PD, (2017). A high accuracy map of global terrain elevations. Geophysical Research Letters, 44: 5844-5853

² GEBCO Compilation Group, (2019). GEBCO 2019 Grid. Available at: https://www.gebco.net/data_and_products/gridded_bathymetry_data/

Emplacement and movement of boulders by storm waves – Field evidence from Laghdira beach - Larache (NW of Morocco).

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Abstract:

The rocky coastal areas of north-west Morocco host several accumulations of large boulders ridges related to waves generated by either tsunamis or extreme storm events (Medina *et al.*, 2011). Along Larache rocky coast, Laghdira site presents two boulders communities: (1) underwater very large to small isolated-individual and/or imbricated boulders and (2) numerous individual-isolated and imbricated boulders distributed on top of a 1-2 m a.s.l (above mean sea level) paleo-rocky-platform.

We present a multi-disciplinary study, which aims to define the characteristics of the supralittoral boulders of Laghdira beach. This study will also include the surveys carried out to monitor and quantify the recent displacement of some of these boulders during the November-December 2019 storms. We identified recent boulder movements using filed-site investigations and unmanned aerial vehicle digital photogrammetry (UAV-DP). The comparison between September 2019 and December 2019 images reveal that storm waves displaced by sliding, moved-up and overturning three different boulders. One other boulder moved offshore during the same conditions. Through the hydrodynamic equations (Pignatelli *et al.*, 2009 and Nandasena *et al.*, 2011), the boulders characteristics (shape, morphometry and density), the morphological characteristics of the rocky platform, we will estimate and discuss the observed boulders movements of and we will try to project on the conditions of storms and/or tsunamis that have shaped the boulder deposits on this part of the Moroccan NW coast.

Keywords: boulder movement; storm waves; hydrodynamic equations.

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Preliminary Assessment of Coastal Erosion by Data Integration of Optical and SAR Satellite Data.

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Abstract:

The enhanced threat of climate change on natural and built environments has become more visible through numerous studies. Softer shores are most vulnerable to erosion leading to adverse effects on land use and ecosystem services¹. Coastal processes occur over various space and time scales, limiting in-situ approaches of monitoring change. As such it is imperative to take advantage of multisensory, multi-scale and multi-temporal modern spatial technologies for multi-dimensional coastline change².

There has been little progress in coastal studies in Western Cape that encompass the diverse and dynamic aspects of coastal environments and in particular, sediment movement. Cape Town is socioeconomically diverse and spatially segregated with heavy dependence on its 240km of coastline. Sea levels have risen roughly 1.57mm yearly which was intensified by doubling real-estate development between 1980 and 2007 close to the high water mark and on reclaimed land³.

This study intends to showcase a conceptual review of the synergy between remote sensing techniques through the combined application of spatial regression on Landsat, IKONOS and Sentinel2 optical imagery (1986-2020); and the interferometry based waterline method on sentinel 1 SAR imagery (2015-2020) to quantify and assess coastal erosion in the Milnerton and Kommetjie beach areas. It presents a roadmap based on the combination of these datasets to yield topography DEM's as well as shoreline change maps for the deduction of geomorphology, coastal slope, rate of sea-level rise, mean tidal range and shoreline erosion-accretion rates with hopes that this study can support further development of interactive coastal information systems.

Keywords: Coastal Erosion; Remote Sensing; Spatial regression; Interferometry; Waterline method

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Flooding Effects of Bimodal Wave Overtopping of West African Coastline.

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Abstract:

Coastal flooding may occur whenever there is extreme wave overtopping of coastal defences during storms. It has been well established that whenever a storm occurs, locally generated wind waves would naturally be combined with long period ocean swell to produce bimodal waves. Several research efforts have been devoted to wave overtopping studies under unimodal (wind-driven) sea states while extremities of wave effects are often related to bimodal seas. In the present study, a bimodal spectrum with the same energy as the equivalent wind (unimodal) sea have been applied to examine how well different spectral characteristics would affect wave overtopping estimates. As shown in Fig. 1, the swell percentages and peak positions of the bimodal spectrum were varied to examine how changes in the spectral shape of the bimodal spectrum influence wave overtopping. These tests were conducted computationally and experimentally. More than 800 overtopping tests were performed under a minimum of 1000 random storms in the Swansea University Coastal Laboratory wave flume. Time series of surface elevations were captured across the flume domain using a set of well-positioned resistant-type wave gauges. Also, overall flood-inducing overtopping waves were recorded.

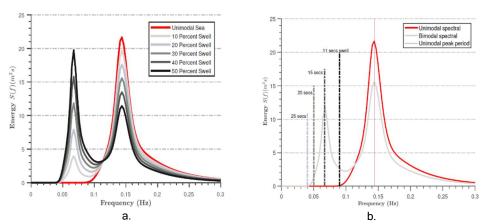


Fig 1. An example of the tested energy-conserved bimodal spectrum showing different: (a) swell percentages and (b) swell periods¹.

Results show that wave overtopping was very sensitive to the wave groupiness and spectral bandwidth parameters of the bimodal spectrum. As the separation between the two spectral peaks increases, the spectral width of the resulting bimodal spectrum also increases and in turn, creates a larger overall spectral wave period and corresponding wavelength. These trends vary with differences between peak frequencies of the swell that are closer to the wind waves in the frequency domain.

Keywords: wave overtopping; peakedness; bimodal waves; swell percentages.

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Public and environmental health risk associated with consumption of fish contaminated with organohalogenated compounds and heavy metals in the Tanzanian coast.

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Abstract:

Fish consumption is known to have health benefits for humans. However, the fast-growing population and industrialization have polluted aquatic environments with organohalogenated compounds and heavy metals. Farmed and wild milkfish and mullet from Tanzanian coast were investigated for these contaminants and evaluated for their potential health risks. DDE and Pb were the major contaminants in the fish.

Concentrations of DDT were higher in the wild than in farmed milkfish from the same area. The varying ratios of DDTs reflected both historical and recent use in Tanzania. Influence of human activities in Tanzania were reflected by low but varying levels of PCBs and PBDEs. Pb was detected in concentrations above maximum limit (ML) for consumption in all analysed fish and were higher in wild than in farmed fish suggesting that Pb pollution is more prevalent in wild fish in the Indian ocean than in farmed fish. Hg concentrations did not comply with the Environmental Quality Standards (EQSBiota) in all analysed fish. Whereas the exceeding concentration of Pb might pose potential health risk to human, the concentrations of Hg beyond EQSBiota might affect fish health and threaten biodiversity. In general, this study revealed that wild fish are more prone to anthropogenic pollution than farmed fish and; Pb is ubiquitous in the environment and may pose health risk to consumers. Findings of this study calls for further investigation of sources and levels of Pb in the environment and human, regular monitoring of heavy metals and POPs in farmed and wild fish in Tanzania.

Keywords: Anthropogenic pollution; DDT; Pb; Health; Fish Human.

Looking at a Nurdle Spill in Another Light: Nurdle deposition along the KwaZulu Natal shoreline – a proxy for sediment transport and the defining of coastal cells

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Abstract:

The spillage of 49 tonnes of plastic pellets from a container into the sea along the KwaZulu-Natal coast of South Africa in October 2017, was identified as a significant marine pollution event. The ensuing clean-up response to this event, which was undertaken between Durban and Richards Bay lasted nearly 2 years. During this time, analysis of the distribution of the nurdles along the coast line indicated that these plastic pellets are ideal proxies / surrogates for sediment transport and inshore processes and that their deposition along the beaches between these two cities indicates the presence of sand sinks, erosion points and other coastal processes. As such, the differing levels of nurdle contamination on beaches may thus be aligned with and used to identify coastal or littoral cells which are useful tools in coastal management practice.

Keywords: coastal cells; littoral cells; beach transport; nurdles; sediment transport.

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Proposal on Assessment of groundwater quality relative to saltwater intrusion in Ndlambe Municipality, Eastern Cape South Africa.

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Abstract:

One of the most pressing issues of concern in South Africa is the availability and quality of water, both as a natural resource critical for human development as well as a commodity that contributes significantly to the country's economic growth. South Africa is overexploiting its water resources at a national level. This means that national water withdrawals for municipal, industrial and agricultural sectors exceed levels of sustainable supply [1]. Groundwater quantity and quality are equally important factors in the context of modern water management. Quality of water is mainly affected by pollution from different sources. In the coastal area, the major cause for groundwater pollution is seawater intrusion. While it is recognized that groundwater resources in coastal areas of South Africa must play an important part in securing the future water supplies, the lack of knowledge, understanding and data of hydrogeological parameters and water quality on this valuable resource needs to be urgently addressed if this resource is to play a meaningful role. It is evident that systems-based approaches to conventional water management of water supply and modes of ensuring water quality are required [2]. Therefore, the main aim of the project is to evaluate the quality of groundwater relative to pollution and saltwater intrusion. Geological, geophysical and geochemical techniques will be integrated in order to delineate the extent of saltwater intrusion, determine the mixing zone and groundwater aquifer hydraulic properties. Assessments and management of groundwater resources in the coastal areas of Ndlambe Municipality will contribute to the available of suitable water for different economic purposes with specific reference to improvements in the tourism sector.

Keywords: Groundwater quality; Saltwater intrusion; Coastal Aquifers; Geology.

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Nowhere to hide? The future of South Africa's endangered Indian Ocean humpback dolphin Sousa plumbea

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Abstract:

Indian Ocean humpback dolphins (*Sousa plumbea*) are endangered coastal predators at the top of the foodweb with a very limited distribution, restricted to a narrow belt in waters less than 20m depth. They serve as useful indicators of coastal ecosystem health, because they reflect the state and functioning of the environment they live in. To combine knowledge and research efforts, a formalised network of biologists and conservationists, the SouSA Consortium, was established in 2016. We aim to make coordinated decisions with the goal of conserving this endangered species and thus coastal ecosystem functioning. Our first joint project was able to refine a national population estimate and indicated that there are likely fewer than 500 animals remaining in South African waters. Combined with other information, there is strong evidence that the species is declining due to a marine environment increasingly impacted by anthropogenic developments.

The various environmental causes are challenging to identify, but alarmingly high levels of various chemical pollutants, increasing noise pollution, habitat degradation, declining prey species and bycatch in shark nets are all contributing to the rapid decline of the species. Unanimously, the Consortium members conclude that cumulative effects of multiple factors are at play. Although striving to continue research into these factors, the Consortium acknowledges this will take considerable time and may result in another case of "documenting extinction". We thus feel an urgent need for a shift in thinking towards more action-focused conservation to prevent the future extinction of yet another cetacean species.

Keywords: Indian Ocean humpback dolphin, *Sousa plumbea*, cumulative impacts, SouSA Consortium, indicator species, coastal ecosystem health

Influence of currents and winds on pollutant dispersal, as indicated by the Durban nurdle spill.

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Abstract:

A spill of 2.25 billion polyethelene nurdles from a container ship into Durban Harbour, South Africa, on 10 October 2017 following an extreme storm, caused an environmental disaster along the South African coast. The spill was not contained and nurdles leaked offshore into the Indian Ocean, initially dispersing northwards into the KwaZulu-Natal (KZN) Bight under the influence of south-westerly winds and northward longshore drift, to be deposited on beaches north of Durban up to Richards Bay, 160 km away. Additional nurdles were transported offshore into the south-westward flowing Agulhas Current and, under the influence of summer south-easterly winds, were deposited onto South Africa's Eastern Cape and South-Western Cape beaches, up to 1 600 km away.

Large scale ocean circulation patterns and NOAA satellite-tracked drifters suggested that nurdles could circulate via the Indian Ocean gyre eastwards towards Western Australia (WA), while some could leak westward into the South Atlantic Ocean and then onward to Brazil. High concentrations of nurdles fitting the description of those from the spill were observed on St Helena Island (South Atlantic Ocean) during May 2018, while low concentrations of nurdles with the same signature as those from Durban were observed at a beach near Walpole, WA since November 2018. Both these observations were within a similar timeframe as NOAA drifter tracks.

This incident serves to illustrate how a localized pollution incident can have far reaching implications for pollutant dispersal both locally and worldwide and can be used as a proxy for determining dispersal of future pollution events.

Keywords: Pollutant dispersal; Nurdles; Agulhas Current; Satellite tracked drifters; Ocean circulation patterns.

Maritime risk assessment: Strait of Gibraltar case study.

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Abstract:

The oil spill is among the most dangerous sources of pollution that can affect maritime safety due to its severe consequences, especially in the Mediterranean: shipping accounts for 52% of total oil spills compared to 48% in other seas¹.

According to recent statistics from the "Alerts and Accidents database" ² around 990 marine incidents occurred between 1977 and 2018 in the Mediterranean Sea, these accidents caused various kind of spills (chemicals, petroleum products, etc..). The most frequent spill accidents in the Mediterranean Sea result from accidental causes such as the grounding or collision between ships ^{3,4}.

In this context, a detailed study has been carried out on the maritime transport of oil products in the area of the Strait of Gibraltar, which supports a significant volume of maritime traffic as the main shipping channel linking the Atlantic Ocean and the Mediterranean Sea. This study is based on a Lagrangian model of spills. This model allows the prediction of the impact area of the oil spill and its trajectories on the sea surface⁵. The estimation of the probability of an accident and the analysis of the consequences are based on statistical data, on the occurrence of an oil spill accident, on the probability of different sizes of discharge and on the combined probability of wind speed and direction.

The results of this study can be used to support a decision-making process and/or as a basis for further analysis.

Keywords: Oil spill model, Maritime risk. Modelling and Simulation.

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Evaluation of the quantity of macro / microplastics in coastal waters. Case Study: North West Morocco.

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Abstract:

Marine pollution of plastics is becoming an increasing concern for the scientific community, environmental policy makers and society¹.

In particular, micro-plastics represent a serious problem because, due to their size, they can be ingested by them and pass through food webs. In addition, they can cause damage in terms of ingestion².

In this context, this work is the first study that highlights the ingestion of plastics and microplastics in algae (chlorophylls).

In this study, a study on micro- and macro-plastics in algae was approached, for the moment all along the beach of Martil. (Afterwards we will extend the sampling area), in order to know the degree of marine pollution in the area under study. After sorting the algae, the presence of Plastic, Fibre, Thread, Film, Textile and others was found.

In the total of algae 1374g the number of wastes found for each element:

- Plastic 505 fragments;
- Fiber 181 fragments;
- Thread 91 fragments;
- Film 55 fragments;
- Textile 54 fragments.

Keywords: Marine pollution, Algae, micro- and macro-plastics.

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Coastal evolution and risks of an urbanized sand spit in Senegal: The case of Joal.

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Abstract:

Joal town is located on the western edge of the Senegalese coast. Built on a sand spit, Joal town is today experiencing a speculative boom in land ownership and a strong spatial extension of buildings, including in areas at risk, coupled with a very marked demographic growth that is weakening the coast. This highly socio-economic coastal zone of Senegal will certainly heighten exposure and vulnerability to future global changes.

The main objective of this study is to contribute to the identification of the vulnerability and risks to climate and non-climate forcing of this urbanized sand spit. Several vulnerability and risk assessment methods, based on multiple physical and socioeconomic variables, have been developed and improved during the last decades (Aitali et al. 2020). The risk assessment methodology proposed in this study is an index-based method combining GIS based (Mocenni et al, 2009) and Coastal Vulnerability Index (CVI) approachs (Gornitz et al., 1991, 1994; Thieler and Hammar-Klose, 1999). This commonly used method in the literature is based on a set of environmental and socio-economic indicators that express vulnerability and the exposure of this zone. The results of this study will serve as a basis for reflection and a decision tool for the site managers and the authorities in order to implement a sustainable management plan for Joal town.

Keywords: Sand spit; risks; vulnerability; CVI; management.

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Multistatistical approaches and sediment quality index for geoenvironmental, ecological and human health risk assessment of heavy metals (HMS) in Nador Lagoon sediments, northeast Morocco.

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Abstract:

Due to the rapid development of urbanization, industrials and agricultures activities, the contamination by heavy metals in coastal ecosystems has become one of the major concerns of environmental and risk to humans. The comprehensive pollution indices were used to assess environmental quality and contamination level of twenty heavy metals and sulfurs in fifty sediment samples, and also to evaluate the potential ecological risk and the associated health risk via diverse indices for adults and children. The mean order of the 20 heavy metal and sulfurs concentration is S > Sr> Ba> V> Zr> Zn> Cr> Rb> La> Cu> Pb> Ni> Ce> Nd> Co> Sc> Nb> Ga> Th> Y> Hf in the study area. Sulfurs, Pb Sr and Nd were found to be higher than the geochemical background values. According to the different sediment quality indexes, the coastal environment of Nador lagoon is found to be moderately to strongly pollute by heavy metals on account of different anthropogenic activities. SQGs results show that the heavy metals concentrations indicate a toxic response has started to be observed in benthic organisms in the lagoon. Ecological hazard analysis showed that the environmental risk index in the study area was 140.74 and showing a considerable hazard by heavy metals in ecosystem. The heavy metals to the non-carcinogenic / carcinogenic risk of humans in the investigated lagoon are less than 1 and the Lifetime Cancer Risk (LCR) values were lower than the limit reveals that there is no carcinogenic risk. Therefore, this study has highlighted the implication of a large range of sediment quality indexes, potential ecological and human health risks of heavy metals occurrence in sediments of the Bou Areg Sebkha (Nador lagoon), in consequence indicating the important impacts of geomorphological changes due to land exploitation by humans' activities.

Keywords: Nador lagoon – Pollution indices - Numerical sediment quality guidelines (SQGs) - Potential Ecological Risk (PERI) - Potential human health risk.

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Dangerous marine faunal attack events and their management among a selection of seascape users at the Kenyan coast.

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Abstract:

Tropical seascapes, support local marine resource users, beach recreation activities and service industries, however, they also harbour a plethora of poorly documented and known dangerous marine fauna. These fauna cause trauma, envenomation and intoxication to the unwary and inexperienced, precipitating morbidity and mortality. Conventionally, tropical marine attack medicare is supportive, due to paucity of effective antidotes, inaccessibility and costs, and hence requires elucidation.

This study explores dangerous marine faunal trauma, envenomation and intoxication prevalence and management through interviews of a cross-section of typical seascape users at Mtwapa and Gazi, Kenya. Faunal encounters were frequent (84%), leading to 0.95 attack.wk⁻¹, mainly by traumatogenic urchins and envenomating stingrays, lionfish and stonefish. Traumatogenic attacks (2.2 wk⁻¹), were several fold more prevalent than envenomation (0.7 wk⁻¹), while intoxications were rare. Beach boys and footfishers at Mtwapa, were particularly prone to traumatogenic urchins, while footfishers and gear fishers to venomous stingrays and lionfish.

This was attributed to variation in dangerous faunal assemblage, coupled with seascape user habits. Over 60% of respondents attacked, consulted conventional hospitals for event care, but traditional healers and self-medication, were also important. Among indigenous interventions, wound management and herbal poultices, incorporating pawpaw, coconut, lemons, predominated. Marine dangerous faunal prevalence and respective management, should be incorporated into seascape use policy.

Keywords: Trauma, envenomation; encounter, attack; indigenous management

How examples from palaeo record of sea-level, climate and environment can help to inform future trends.

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Abstract:

Global sea level changes constantly, in accordance with glacial-interglacial cycles every ~100,000 years. In South Africa, the rock record shows that the highest height that sea level reached during the Pleistocene is 11 m above present, and the lowest depth is 130 m below. This trend has persisted for approximately the last 900,000 years. For ~90% of the Pleistocene Period, sea level has been significantly lower than the present position, exposing the continental shelf as a terrestrial landscape. During the glacials, what is now seafloor becomes exposed subaerially as a coastal plain. Our ongoing work in the marine environment focusses on marine geophysical mapping and various methods of sampling, and aims to understand a now-submerged terrestrial landscape on the Cape South Coast shelf. We consider (1) the variation in width of the continental shelf as an impacting factor on sediment deposition and incision of erosional features. We demonstrate (2) the links to the archaeological record and how changing sea levels and environments affected human use of ancient coasts. Finally, we show (3) palaeoclimate records from marine cores, extending back up to 14,000 years. Using these data and information, we ultimately aim to project forward using high-resolution marine archives of global change by holistically considering coastal vulnerability, predicted fluctuations in climate, and changes in the natural environment. Because a certain consequence of global warming is a rise in sea level, the overall objective of the work highlighted in this presentation is to review available palaeo proxies as analogues for future expectations.

Keywords: Southern Cape shelf; human use of ancient coasts; marine geophysics; core records; palaeoarchives.

The value of research in risk avoidance and management in the Environmental Impact Assessment Process.

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Abstract:

The coastal and marine environment in South Africa is under significant development pressure. In the absence of a comprehensive integrated management system, risks associated with growing coastal populations and expanding settlements and infrastructure development, unsustainable resource abstraction, pollution, amongst others, have the potential to impact ecosystem quality and function.

The identification, assessment and management of development risks in the coastal and marine environment is governed by the National Environmental Management Act (107 of 1998) (NEMA), and the NEM: Integrated Coastal Management Act (24 of 2008). The Environmental Impact Assessment (EIA) Regulations were published under Chapter 5 of NEMA, and set out the procedure for making application to the environmental authority for approval to undertake specified activities that have the potential to cause environmental or social harm. The concept of 'sustainable development' and implementing the 'precautionary principle' in risk avoidance and management are key to the EIA process. The value and success of any impact assessment process is largely dependent on comprehensive and scientifically-defensible information to accurately identify and assess potential risks. Time and budget do not always allow for detailed and long-term studies in the EIA process. This emphasizes the need for a collaborative approach between researchers and industry in identifying target-based research that can be used for good decision-making.

This paper illustrates typical risks and how they are addressed in the EIA process in two case studies in the coastal environment. Uncertainties due to 'information gaps' are described, to highlight research needs.

Keywords: EIA; risk avoidance and management; coastal development; collaborative approach; targeted research

Investigation of XBeach Cross-Shore Capacity Under Fixed Model Parameters.

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Abstract:

An accurate, computationally efficient shoreline model is fundamental to understanding long term shoreline behaviour. Currently, one-line models can be used to do this but are limited to either cross-shore or alongshore changes only. A simple, more robust model could be developed based on volumetric beach profile changes. However, this requires large empirical datasets to explore the relationships between wave and shoreline variables. In instances where such data is not available, process-based models such as XBeach are an attractive solution. It is essential to explore the ability of processes-based model such as XBeach to predict shoreline changes under varying wave conditions accurately. The coastal areas of South Africa are known for their high energy wave climate resulting in a dynamic shoreline, with significant onshore and offshore sediment transportation. Deans' Heuristic model was used to select the two wave conditions associated with erosion (H_{mo} =3m) and accretion (H_{mo} =1m). These wave conditioned were used in XBeach to explore XBeach's ability to simulate erosion and accretion. The wave non-linearities were calibrated using the wave asymmetry and the skewness weighting factors. The sensitivity of the sediment transport to these parameters was investigated by running 180 1D wave flume simulations. The 180 simulations were formulated by varying the wave asymmetry and skewness weighting factors, sediment transport models, and approaching wave conditions. In this study, the increase in the value of weighting factors led to an increase in the advection velocity, which increased the onshore sediment transport. The investigations on the model capacity showed that the wave asymmetry and skewness related parameters control the cross-shore sediment movement direction. It was found that a single set of model input parameters were not able to produce both onshore sediment transport during low energy wave conditions and offshore sediment transport during high energy wave conditions. This study demonstrated that weighting factors should depend on incoming wave energy. Currently, they are not implemented like this in XBeach.

Keywords: Numerical modelling; Sediment transport; Shoreline Recovery; Accretion; XBeach model.

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Baseline assessment of community awareness on solid waste management: Central, Port Elizabeth, Nelson Mandela Bay Metropolitan Municipality

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Abstract:

How communities manage household and business waste, is a key contributing factor towards waste streams reaching marine environments, and being particularly important in coastal zones. Factors that impact on household management of waste include the availability of services to collect and recycle waste and the awareness of the impact of pollution.

A perception survey of households and businesses located in the suburb of Central, Port Elizabeth. was undertaken to measure attitudes towards waste management, recycling, litter and single-use plastics. The survey was undertaken within the historic neighbourhood of Central, an area that has struggled for decades with urban decay, absentee landlords, crime and poor waste management. In 2020, the newly established Central Special Rates Area (SRA) instituted waste management interventions, e.g. waste education. The study aimed to create a baseline of information on perceptions and habits within the community towards waste management before the interventions were instituted. The survey will be repeated in a follow-up study, to determine if there has been any change to perceptions and household activities after implementation. The study considered what impact improper waste management has on households and businesses, including its perceived impact on property prices, safety, health and business sales. The study offers insight into perceptions on key issues within waste management, findings that can be used to develop more responsive municipal waste management programs and develop better awareness. The study offers recommendations that can be used by city improvement districts, municipal development agencies, community action groups and municipalities regarding interventions into waste management.

Keywords: Community perceptions; waste management; litter; recycling; single-use plastics.

Baseline estimation of marine litter in Algoa Bay.

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Abstract:

To meet litter reduction targets set by international treaties, quantitative data are required to determine current litter baselines and to monitor changes in litter loads over time to assess the efficacy of management interventions. Such quantitative data are lacking in Africa.

As part of a novel collaborative marine litter monitoring programme within seven African countries, four macrolitter (>2.5 cm) accumulation surveys were conducted on each of two identified beaches in Algoa Bay, South Africa, between June 2019 and June 2020. Cape Recife beach (CR) is situated within a nature reserve with limited public access, and no river input, while Bluewater Bay beach (BWB) is a public beach near the Swartkops River mouth.

Daily litter accumulation rates were estimated over a 500 m stretch of beach for ten days after an initial cleanup. Preliminary results indicated similar daily litter accumulation rates between beaches (CR: 0.5 items.m⁻¹ and BWB: 0.6 items.m⁻¹), although mass accumulation was higher at CR (9.9 g.m⁻¹ vs. 1.1 g.m⁻¹ at BWB). Plastic constituted most litter items found on both beaches (CR: 70% and BWB: 88%), and the majority of litter was deposited by the tide at both sites (56 - 85% of litter items found in the intertidal zone). Brand audits revealed that more than 93% of litter items are of South African origin. It is likely that the litter is littered locally and transported via rivers into the bay, then deposited on the shores. Local interventions are therefore warranted to reduce litter loads in Algoa Bay.

Keywords: Litter; Baseline; Algoa Bay; Accumulation rate; Plastic

Implementing a decision support system for coastal management in Inhambane Bay (Mozambique): hydrodynamic characterization.

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Abstract:

Establishing tools to minimize the risk of property damage and environmental degradation is mandatory in highly anthropogenic pressure areas such as Inhambane Bay (IB)¹. IB is a shallow bay characterized by small-scale coastal traditional fishery and tourism use; with an important marine biodiversity. A project started in 2017 pursue to characterize hydrodynamically the unexplored region of IB. In this sense, several field campaigns are carried out which will serve to implement a hydrodynamic numerical modeling as a basic tool for coastal management. These field campaigns has enabled a first physical characterization of the estuarine dynamics in Inhambane Bay. This contribution analyze the seasonal and inter-annual Sea Surface Temperature (SST) variability of Inhambane Bay, obtained from GHRSST project², from June 1st 2002 to August 20th 2020 period. IB is a meso-tidal bay, forced by semi-diurnal tides, with a tidal range of ~3.41 m, and a flushing time range of 1 to 3 days³.

The SST wavelet analysis confirms a remarkable annual seasonality, and suits the results obtained in the monthly mean SST series. A cooling cycle from May to July, a heating one from Agust to November, and a stable warm cycle to December to March. The mean temperature is ~25,75°C, with a seasonality range of \pm 2°C and other factor's range of \pm 1,5°C. The surface distribution shows a regular pattern, with parallel isotherms to the coastline and with a positive gradient when moving away from it and a lower temperature range, -3,65°C, in the inner points of the IB.

Keywords: Coastal management plan, estuaries, Inhambane bay, GHRSST, SST.

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Monitoring the water and sediment quality of the Port Tanger Med 1, Morocco.

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Abstract:

Morocco has experienced sustained economic growth over the last 20 years thanks to the policy adopted for the major development of basic infrastructure projects, which will contribute to the development of the kingdom [1]. Among these projects is the construction of Tanger Med port complex located on the Mediterranean coast in a strategic location.

The Tanger Med port complex is one of the most remarkable economic achievements in Morocco, which plays a key role in promoting economic development of the country and the African continent in general. The complex extends 1,000 ha and includes: Tanger Med Port 1, Tanger Med port 2 and Tanger Med port Passenger and Ro [3].

During the construction phase and since the launch of the activity of Tanger Med Port 1, environmental protection is also part of its legislated mandate, deploying significant efforts to ensure sustainable and responsible growth of the port, its development is carried out on the basis of studies within a regulatory framework. Ratified several international conventions on ensuring environmental protection in the port and the basin that is most affected by pollution [2]. In this context, the present study aims to examine the influence of maritime activity at the basin level of the Tanger Med Port 1 while implementing environmental follow-up programs to measure environmental effects and evaluate the effectiveness of their project measures. It consists of a control and / or monitoring of water and sediment quality of the basin.

For this, the purpose of this study is to:

- Mapping the basin Tanger Med 1;
- Studying sedimentology at the basin level;
- Characterize seawater by physic-chemical analysis.

Keywords: Tanger Med Port; sedimentology; physic-chemical.

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Application of multi-criteria analysis for the mapping of flooding risk areas in Douala.

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Abstract:

Since the 1980s, the city of Douala has been facing numerous floods with increasing human and material damage (Bruckmann et al., 2019). In search of a solution, many projects have been implemented, with ephemeral results probably due to poor knowledge of the hazard. This study on areas at risk of flooding in the city of Douala in Cameroon, specifically in the largest watershed (*Tongo Bassa* watershed with 42 km² area) helps city managers to effectively implement management actions against risk of flooding. The data used come from the field (household survey), satellite sensors (Landsat mission, SRTM) and used under free GIS (Qgis). The areas at risk of flooding were identified by a hierarchical multicriteria analysis model (Saaty 1980), whose reasoning consistency was established at 0.05%. At the end of the cartographic representation of the four criteria used for this analysis, it emerges that the high-risk areas are those whose altitudes are ≤ 10 m, with a drainage density between 2.5 and 4.5 km / Km², the various issues of which are located at a distance of \leq 100 m from rivers, and the ground surface of which is occupied by humid vegetation. Also, medium-risk areas are those whose altitudes are between 10 and 30 m, with a drainage density of between 1.5 and 2.5 km / km², whose various challenges are located at a distance of between 100 and 200 m from rivers, and the land surface of which is occupied by dwellings. On the other hand, low risk areas are those whose altitudes are \geq 30 m, with a drainage density between 0,1 and 1.5 km/km², whose various challenges are located at a distance of \geq 200 m from rivers, and whose ground surface is occupied by roads. A combination of these criteria indicates that topography (especially areas of low altitudes) is the main criterion that contributes to the genesis of floods in the watershed studied; Thus, a lowland development idea should be given priority among the management options. The multicriteria analysis is proving to be a detailed and explicit method for determining the areas exposed to flooding. But this is limited for estuarine areas like the city of Douala, which is subject to the action of the sea and whose contribution to flooding has not been neglected.

Keywords: flood risk; multicriteria analysis; watershed; Tongo Bassa; Douala.

² University of Douala-Cameroun, laboratory of technologies and applied sciences

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The monitoring of port's structures using topo-geodetic methods Case study: Tanger Med port,

Morocco.

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Abstract

Port's structures are considered critical, they are subjected to mechanical and environmental solicitations (Operating loads, waves, attack of seawater, etc.) [1]. The monitoring of these works is carried out by visual inspections and on-site measurements.

this work has been carried out within the Tanger Med Engineering, the aim is to present the contribution of topo-geodetic methods for the auscultation of port's structures. These methods constitute a way to determinate the existing state of the structure, monitorate the evolution of the observed deformations, evaluate the state of health and guarantee an acceptable level of performance of these structures by using four methods. But first of all, the structuring and determination of the type of auscultation for each kind of work according to its nature and constituent elements is essential.

The first method consists of monitoring all the structures concerned and providing data that shows and quantifies horizontal displacements using GPS technology combined with the total station, the second method, consists of using the digital level for monitoring vertical displacements, the third method considers the measurement of the openings of the joints by the caliper, as regards the last method uses the Vinchons to measure and quantify the displacements of the caissons to take place in the three dimensions. Several campaigns were carried out, the comparison of the results obtained with the initial state gives precise information on the state of health of the structure and the evolution of the anomalies detected.

The validation of the results obtained in relation to the field data shows the reliability of the measurements carried out and gives similar and significant results in terms of mapping the risks of displacement and deformation.

Keywords: Port's structures, monitoring, Topographical surveying, Auscultation.

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