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Editorial

Applied Sciences: "Coastal Deposits: Environmental Implications, Mathematical Modeling and Technological Development"

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A large percentage of the world's population lives along the coastal zones, with more than half of the world's population living in coastal areas. In such a manner, human beings depend on the coasts and oceans for their survival. In more than one way, the coastal areas remain an untapped and untamed resource; however, they are not uninfluenced by humankind. The coastal areas are affected by the urbanization, industrial progress, and the progressive expansion of a society of leisure and crowd tourism. Yet, it is an incomplete view in which an essential element we often forget: the coastal environment. Global climate change may accentuate the social pressure on the latter, namely increases temperatures and sea-level rise. On the other hand, extreme events are more frequent in recent decades.

The coastal zone is the limit between the open ocean and the continental interiors, and protect from coastal natural hazards by absorbing energy and momentum fluxes from the ocean. Examples of this are the coastal dunes, beaches, marshlands and diverse bio shields (reefs, seagrass, mangles and other types of coastal vegetation, etc.). A variety of processes, operating at a range of spatial scales, govern the stability of coastal systems. A good example of how it works and the complexity of coastal systems is presented in this Special Issue by F-Pedrera et al. [1]. The work analyzes the water circulation in a micro-estuarine environment, in the Ebro Delta in the Mediterranean coast, based on mathematical models. Results show complex dynamics of water circulation due to different processes, including wind forcing mechanisms. Another exemplification is provided by the work of Chang Y. et al. [2] in which research-based on video monitoring systems in South Korea is introduced, intending to prevent erosion by waves in a beach environment. Understanding wave incidence and maritime climate using remote sensing techniques improve the advancement in prediction models of sediment accumulation and erosion cycles. Both works highlight the importance of understanding the natural processes for the correct management and coastal protection.

These systems are highly vulnerable to storm-induced hazards, namely coastal erosion and flooding. Combine these with the effect of human activities, which have led to changes in these processes at all spatial scales, resulting in a severe threat for the survival of coastal ecosystems. Indeed, two works in this Special Issue cope with the human-derived impacts. On one side, the work of Dao, M. et al. [3] tackles with conflicting activities within the coast in Vietnam, particularly the Titan mining industry and the use of alternative natural resources and ecosystem preservation. The method used in the evaluation is a combination of Fuzzy AHP and Fuzzy TOPSIS, two analytical techniques to assess conflicting activities. On the other, the work of Quang Tri D. et al. [4] also assesses environmental impacts due to activities at sea, in a case in point, the dredging and dumping labours, which are a source of pollutants to the marine environment. They approached this problem using meteorological data and mathematical models for pollutant dispersion. Pollution by the dispersion of particles derived from dredging spoils and other sources is another significant cause of concern regarding the impact of human activities on the marine environment.

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Both pieces of research had stressed how the functionality of the coastal environments could be endangered by one single socio-economic sector, preventing the development of other sources of economy.

Moreover, considering that sea-level rise and changes in storminess are linked to climate change scenarios, the increase in risks in these highly populated areas are also expected to rise. In this context, two solutions to hinder coastal erosion are introduced in this Special Issue. First, Imran et al. [5] proposed a method via processes of biocementation, a technique consisting of inducing carbonate precipitation using microbes. Experimental results in Korea show differences in the efficiency of different species and the influence of environmental parameters. This research illustrates the development of ecofriendly techniques to protect the coast. In this vein, Nayantara el al. [6] present a research work based on carbonate precipitation using native bacteria to stabilize sandbanks in nearshore areas and minimize beach erosion.

Apart from the climate change-related factors, increase pressure on the coast leads to water pollution, overexploitation of water resources and coastal modifications (i.e., infrastructures, protection constructions and others). The related impacts put at risk coastal and marine ecosystems, which in many instances have protection figures.

In consequence, the understanding of the effects of these hazards and the impacts of humankind is crucial to prevent further environmental degradation and for increasing the safety and reducing the impacts over the exposed population in coastal areas.

These threats have made that the coastline monitoring programs and sustainable coastal management area are a priority. Ergo, information about the coastal state and dynamics are essential for coastal managers. Indeed, the research that places emphasis on the fight and the adaptation to climate change and the conservation of the oceans, seas and marine resources are priority objectives in many countries and communities. The UNESCO developed the Marine and Spatial Planning Programme (MSP), with the participation of many nations and territories, to achieve sustainable use of the marine and coastal environment and to develop a "Blue Economy" and biodiversity conservation. The European Community Union adopted two instruments for the coastal and marine protection, The Marine Strategy Framework Directive and the Integrated Coastal Zone Management, which aimed to reach a Good Environmental Status (GES 2020). There are many more strategic plans all over the world to protect the coastal and marine environments, because of the global deterioration suffered in the last decades. The goal of these programs is developing strategies for the environment protection in the frame of sustainable development, including stakeholders, managers, policymakers, private sectors and users.

In the shoot, researchers' different programs required that the scientific community use the high temporal and spatial resolution and accurate databases with coastline information to deliver to the coastal managers and policymakers to be used in the decision-making process. Yet, despite the need to monitor and manage sandy coasts, the high temporal resolution data-scarcity based on in situ measurements are limited to local areas around the world, even when these data are crucial to understanding past behaviour and calibrate predictive shoreline evolution models.

Traditional techniques for determining coastline changes include aerial photography and ground survey techniques. These conventional techniques used for coastline monitoring are expensive and time-consuming and require trained staff, which makes it challenging to have a time-updated database. Recently, advances in remote sensing, geographical information systems and mathematical modelling and techniques are essential to support conventional methods for monitoring coastline change. Additionally, free access to data from Earth Observation Satellites provides the capability to monitor the coastline in a low cost-effective manner. Furthermore, many advanced methodologies using digital images for change detection are of everyday use. In the present Special Issue, the new remote-sensing-derived index (RISI) is suggested by Fang H. et al. [7] to study resistant surface distributions from Landsat 8 OLI imagery. The aim is to evaluate the level of urbanization and growing of urban areas and the consequent changes in environmental quality in rapidly developing countries, using China as an example. The novelty of this index is that it allows discrimination of urban modified soils from bare soil, which allows the evaluation of coastal changes due to the growing urban development. We must not forget the growth of the open-source tools, which make them accessible to just about anyone. Considering all the advantages and potential of the data and the emergent methodologies availability, it is not surprising the increased interest in the scientific community to develop new methodologies to maximize the benefits of these data and platforms, notably in the maritime and coast field.

This special volume presents some of the many scientific challenges associated with nowadays coastal issues. In so doing, it highlights the need for a better understanding of the human impact over the coastal environment, and how to solve the adverse effects derived from these impacts, which will be required to both protect and make more resilient the invaluable coastal regions.

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