

Coastal and Continental Shelf Dynamics in a Changing Climate

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The coastal and associated shelf environments constitute the interface between the land and ocean regime. Hence, a reliable interpretation of the nature of these environments, particularly of their dimensions and dynamics, is based on the understanding of the interactions of the ocean with land as well as on the identification of the imprints of human interventions and climate trends over various time scales. On the other hand, the proper management of coastal land and water resources is of vital importance for humanity, as more than 600 million people (~10% of the world's population) live in coastal areas that are less than 10 m above sea level.

The first volume of the present Special Issue comprises the output of ten authentic and effective research efforts, dealing with diverse subjects and mainly providing information and evidence concerning the Mediterranean region, hopefully useful for the scientific community. The Mediterranean basin, comprising the Mediterranean Sea and the 21 countries it borders (with their population being ~530 million), is often referred to as a hotspot for dynamic geology, climate change, and biodiversity. This emphasizes the multiple risks for the region, its people, and its ecosystems; based on the scientific literature, we may conclude that the sum of climate change, pollution, unsustainable use of land and sea, and the invasion of non-native species (more than 700 due to warmer conditions) has begun triggering overlapping risks that should not be underestimated. For instance, the higher temperature rise (+1.5 °C) in relation to the present global warming trend (+1.1 °C), the increasing frequency in droughts, the sea level rise acceleration (half of the 20 global cities set to be mostly impacted by 2050 are in the Mediterranean), the enhancement of seawater acidification (causing mass deaths of marine species) and, finally, the higher risks for sediment degradation, quality, and excessive erosion constitute a cocktail of hazards which make the Mediterranean region particularly vulnerable, especially on its eastern and southern shores. Therefore, any research effort investigating the previous issues, even at a local scale, is of major importance.

Coastal landforms, i.e., floodplains, estuaries, lagoons, beach barriers, and a variety of types of beaches, owing their formation to sediment availability (mostly of terrigenous origin) and nearshore hydrodynamics (configured by tidal and wind-driven currents, buoyant plumes, and incoming offshore wave energy), appear quite sensitive to both anthropogenic activities (e.g., land use practices, development of coastal infrastructure, installation of coastal defense structures, and dredging operations) and effects arising from climate change and/or variability (e.g., sea level rise acceleration and enhancement of storm intensity). Such a distinct example is presented by Poulos et al. [1], who show that specific combinations of primary terrestrial and marine processes can cause extreme flooding in the deltaic area of the transboundary Evros River, located at the microtidal northeastern Aegean Sea (northeastern Mediterranean).

Changes in the global atmospheric conditions have the potential to substantially influence the coastal and shelf environments, with far-reaching negative consequences for the associated ecosystems. Therefore, an increasingly worrying issue concerns the accelerated



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transgressive processes over the last decades, which have already started causing an obvious shoreline retreat (being the combined result of inundation and erosion), especially in the low-lying sedimentary coastal zones; the investigation of Vandarakis et al. [2], dealing with the coasts of the highly touristic Rhodes Island in the eastern Mediterranean, provides good evidence. Further, another issue of great importance, related to the currently rapid transgression processes, is the intrusion of seawater into the aquifers of several coastal cities, which will most probably initiate irreversible adverse effects on the quality of drinking water; such a representative case is thoroughly analyzed by Garces-Vargas et al. [3] for the Chile estuary, where the Valdivia River debouches.

Continental shelves are depositional environments where the complicated patterns of sediment distribution play a major role for the establishment of the equilibrium for the occurring ecosystems. The nowadays shelf ‘surficial’ deposits are the result of the sedimentation processes acting since the early stage of the ongoing last transgression, starting 18,000–20,000 years ago. Hence, the biostratigraphic analysis of the shelf becomes more complex in terms of depositional pattern and relative sea level change identification in the shallow coastal embayments, as the studies of Triantaphyllou et al. [4] and Kouli et al. [5] indicate for the semi-open Saronikos Gulf and the landlocked Elefsis Bay (both located in the central Aegean Sea, northeastern Mediterranean), respectively. However, despite the difficulties, these kinds of studies provide valuable local and regional paleoclimate reconstructions, which may significantly contribute to the production of more accurate scenarios concerning the future climate trend. In addition, shelf sedimentation processes acting in the geological past, configured by a combination of tectonics and global climate change, have formed deeply seated strata that are the sources of eruptive muddy material developing characteristic deep-water seabed domes and ridges, i.e., the well known mud volcanoes, which are potential sources of gas hydrates. The investigation of Nikitas et al. [6] sheds light on the thermal maturity of the pre-Messinian sedimentary strata occurring below the evaporite giant formed during the Messinian Salinity Crisis in Mediterranean, analyzing the eruptive breccias of mud volcanoes located in the Mediterranean Ridge accretionary complex. Further, shelf sedimentation may demonstrate highly variable characteristics at different latitudes in accordance with the climate-affected thermohaline circulation. Therefore, climate change could strongly affect sedimentation rates, thus influencing terrestrial inputs, marine productivity, and mixing processes, as in the case of the Terra Nova Bay (Ross Sea, Antarctica) investigated by Rivaro et al. [7]. Additionally, the study of Bassukas et al. [8], analyzing the Holocene climate variability using a number of proxies from very different environmental settings in the eastern Mediterranean region, argues that the variation in climatic conditions may decisively affect the shelf evolution.

Finally, the coastal and associated shelf environments, via their ecosystems and services that provide (e.g., recreational activities), have a significant contribution to the coastal population health and prosperity, while the shelf benthic environments play a particularly important role in the economic development and sustainability of many coastal states through the provision of food and non-living resources (e.g., marine aggregates) and their crucial support for climate amelioration. Within this framework, two studies of Paramana et al. [9,10] are included in this volume. The first [9] deals with the issue of Marine Spatial Planning based on the ‘good environmental status’ of the marine environment, while the second [10] deals with the assessment of the first implementation cycle of the Marine Strategy Framework Directive (2008/56/EC) in Greece, mainly focusing on the biodiversity and contaminants. Both studies emphasize the great need for an effective implementation of the Marine Strategy Framework Directive and Maritime Spatial Planning Directive for the mitigation of the harmful effects of the evolving climate trend to be accomplished.

Now we offer a second volume of this Special Issue, aiming to present topics not covered by the first. These are expected to focus on the degree of impacts of the current climate trend on specific coastal environments (e.g., beach zones, lagoons, coastal dunes, coral reefs, estuaries, and river deltas) and their mitigation in terms of adaptation, building

capacity (through monitoring and remote sensing tools), and assessment of their social and economic consequences. Furthermore, our ambition is to address issues related to marine biology, such as invasion of alien species, acidification, and eutrophication phenomena. Finally, submissions concerning the reconstruction of paleoclimate and paleoceanographic conditions throughout the world are highly recommended, as the understanding of past climates can provide vital clues for a reliable assessment of the future global warming and its effects on ecosystems and human prosperity.

To close out the current editorial, we must truly thank all the authors for their valuable contribution to the successful completion of the first volume of this Special Issue. We look forward to the second volume, and hope to include research efforts of global significance.

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