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## Coastal processes, climate change and adaptation needs

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Vulnerabilities and risks in coastal areas have been increasing, particularly since the middle of the past century and a much more marked increase is anticipated after the middle of the current century. It is clear that human action has been the primary cause of imbalances, both directly (through local actions) and indirectly (through contributions to global warming and climate change). It is well known that traditional protection techniques of hard engineering, such as using rubble-mound breakwaters, groins and seawalls are inadequate to combat erosion on a large scale. These types of structures have high maintenance costs and may not be cost-effective or sustainable in the medium and long term. In some cases, these structures may even accelerate erosion by redirecting wave energy. This type of protection also has significant environmental effects in sectors linked to tourism and in industrial, agricultural, commercial and/or recreational activities. Coastal zones sustainability depends on the success of an integrated adaptation to human action and other changes that consider and promote the system's ability to adapt. Using primarily events and imbalances caused by human action along the Portuguese Atlantic coast in the last decades of the past century, such as those shown in Figure 1, this work aims to show the paradigm shift that has occurred in Portugal since the 1990s. Options of this type lead to major changes in coastal morphodynamic processes and are difficult to reverse. Several such options have been implemented in most coastal areas all over the world and have had very damaging consequences that must be reversed. In such circumstances, it is necessary and urgent to find answers to what to do and how to do it. Adding to the current coastal vulnerabilities those arising from ongoing climate change, we conclude by the need to accelerate the processes of implementing appropriate adaptation measures. Less successful interventions carried out along the Portuguese coast in the years between 1970 and 2010 will be shown and discussed together with possible solutions in the context of integrated coastal management. This work thus aims at assisting coastal communities in carrying out operational coastal management by presenting and discussing management tools and primary options that should be considered in any adaptation program to be implemented.

## Biography

Jose Simao Antunes do Carmo has completed his MSc in Hydraulics and Water Resources in 1990 from University of Lisbon and his PhD in Engineering Sciences in 1995 from University of Coimbra, Portugal. He has been the Director of several degree and master courses in Civil Engineering and Environmental Engineering in the period 1995-2010. He is Co-Editor of the *International Journal of Integrated Coastal Zone Management* and Editorial Board Member of the *Ocean & Coastal Management*. He has published over three dozen papers in ISI/WoS journals; two dozen papers in Portuguese scientific journals and over one hundred publications in international conferences. He is author of two books: "Modeling in Fluvial Hydraulics and Environment" and "Physical Processes and Computational Models in Coastal Engineering" and Co-Editor of three books: "Wastewater Treatment", "River Basin Management III" and "Water Pollution VIII: Modeling, Monitoring and Management". His main scientific areas of research are hydrodynamics, morphodynamics, coastal management, coastal processes, climate change and water quality.

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## Notes: