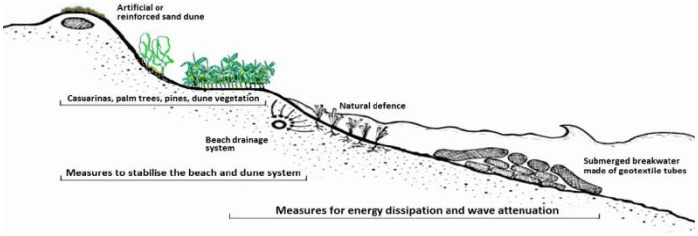
# Emerging Technologies to Manage Climate Change in Coastal Areas

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## Abstract

Tens of millions of people living in coastal zones will be affected in the next few decades by climate change and coastal flooding due to sea-level rise and associated increases in wave action and surges. The issue of sea-level rise is complex and produces a range of environmental problems. As the sea level rises, the water depth increases and the wave base becomes deeper; waves reaching the coast have more energy and therefore can erode and transport greater quantities of sediment. In the meantime, coastal habitats are facing increasing risks world-wide as a result of human action. These habitats provide a number of ecosystem services, or benefits, including coastal protection, fish production, recreation and other economic and cultural values. Therefore, the degradation of coastal habitats in various regions of the globe will result in damage of high economic and cultural value and a decrease in coastal protection, thereby increasing the risk of coastal flooding. In several countries, strategy studies have shown that managed retreat or '*do nothing*' options are the only cost-effective solutions to coastal erosion. Such options are often not popular and should be seen as possible alternatives, but should never be considered as unique or even priority. In fact, it is also recognized and many studies confirm that '*do nothing*' is usually the worst solution. Equally worrying is that, in coastal areas of several countries, both authorised and unauthorised privately funded coastal protection works are being implemented and in some cases without an understanding of the overall system dynamics. In the face of ongoing climate change and new uses of the coastal zones, the development of novel solutions to address coastal processes as an alternative to traditional coastal protection structures (seawalls, groynes and breakwaters) is becoming increasingly important. The innovative approaches seek to strengthen the benefits of traditional natural defences, such as beaches and natural dunes. These novel approaches are typically marketed as being characterised by lower environmental impacts, lower costs and easier implementation, and include: submerged breakwaters made of geotextile tubes, beach dewatering, buffer zones and artificial or reinforced dunes (see Image). This work intends to discuss general guidelines on managing key processes of the coastal dynamics, and show how novel approaches can be combined depending on the types of coast, such as: cliff coast, clayey bank coast, intertidal/muddy coast, sand dune coast and sandy coast. This work also aims to alert coastal managers to an increased demand for accommodation alternatives in coastal areas. Measures that are less common today may become essential in the near future, such as: building on pilings; building emergency flood shelters; tidal houses; houseboats, and floating houses. An increasing demand for this type of housing and a reduction of current living conditions in coastal areas are foreseeable, especially from the middle of the present century.

## Image




**Innovative approaches combined to maximize energy dissipation and wave attenuation, with the goal of stabilizing the beach and the dune system.**

## Recent Publications

1. Antunes do Carmo J.S., 2017. "Climate change, adaptation measures and integrated coastal zone management: The new protection paradigm for the Portuguese coastal zone." *Journal of Coastal Research*, CERF, doi: 10.2112/JCOASTRES-D-16-00165.1 (*in press*).
2. Antunes do Carmo J.S., 2017. "Natural responses to changes in morphodynamic processes caused by human action in watercourses: A contribution to support management." *International Journal of Disaster Risk Reduction*, Elsevier, Volume 24, 109-118, doi: 10.1016/j.ijdrr.2017.05.014.
3. Antunes do Carmo J.S., 2016. "Nonlinear and dispersive wave effects in coastal processes." *Journal of Integrated Coastal Zone Management*, Volume 16, Issue 3, 343-355 (doi: 10.5894/rgci660).
4. Antunes do Carmo J.S., 2016. "Physical processes and computational models in Coastal Engineering" (book), 452 p. (*peer review*), UC Press, ISBN 978-989-26-1152-5 (doi: http://dx.doi.org/10.14195/978-989-26-1153-2).
5. Antunes do Carmo J.S., 2015."Modeling of wave propagation from arbitrary depths to shallow waters - A review", chapter of the book "*New Perspectives in Fluid Dynamics*", 44 pages, pp. 23-66 (*peer review*). Chaoqun Liu (Ed), InTech - Open Access Publisher. ISBN 978-953-51-2228-9.
6. Gomes M.P., Pinho J.L.S., Antunes do Carmo J.S. & Lara L.I.V., 2015. "Hazard assessment of storm events for The Battery, New York." *Ocean & Coastal Management*, Elsevier, Volume 118, Part A, 22-31 (doi:10.1016/j.ocecoaman.2015.11.006).



## Biography

José Simão 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 Director of several degree and master courses in Civil Engineering and Environmental Engineering in the period 1995-2010. He was a scientific advisor of twenty-four Master Dissertations, and two Ph.D. theses in Civil Engineering, Hydraulics and Water Resources. 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 forty scientific papers in International (peer review) journals; twenty in Portuguese scientific (peer review) journals, and over one hundred and thirty 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". Its main scientific areas of research are: hydrodynamics; morphodynamics; coastal management; coastal processes; coastal protection, climate change and water quality.

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**Notes/Comments:**