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Editorial

Estuarine and coastal morphodynamics

Coastal waters are permanently in motion in response to tides, waves and wind forcing. When the bed is composed of mobile sediments, as is usually the case, the water motion generates sediment fluxes. The spatial variability of these fluxes modifies the local bathymetry, creating areas of erosion and accretion. Finally, these morphological changes affect the waves and currents themselves, thereby creating a feedback loop between the morphology and the hydrodynamics. The term "morphodynamics" refers to the study of this interaction between the morphology, the sediments fluxes and the hydrodynamic processes.

Early studies of coastal morphological evolution were naturalist, based on observations or on the notion of equilibrium. Equilibrium models provide coarse predictions of equilibrium states of the system, typically established on empirical relationships. Because the focus was usually on equilibrium, the term "morphodynamics" was rarely used. The field of coastal and estuarine morphodynamics emerged around 35 years ago, and became a very active area of research in the past decade (Figure 1), with many applications in coastal management.

Morphodynamic studies rely on different tools (*in situ* data, physical and numerical models), which are often used in conjunction, as illustrated in this issue. A growing number of *in situ* measurement devices are now available, as is illustrated in Bio *et al.* (this issue). Remote sensing is also playing an increasingly prominent role due to its capability to provide data in harsh conditions and to the growing availability of low cost images. For instance, the evolution of a beach (Silva *et al.,* this issue) and a sand spit (Lisboa & Fernandes, this issue) are analyzed using satellite images. Empirical equilibrium models continue to be used due to their simplicity and low cost. This type of approach is illustrated in a study of beaches in Brazil (Silva *et al.,* this issue). However, these simple tools are progressively being replaced by process-based models. A simple approach consists in combining circulation process-based models with empirical models of bed evolution, as is shown in Guerreiro *et al.* (this issue). More sophisticated models solve conservation equations for the hydrodynamics, the bottom evolution and the sediment transport. These equations can be solved analytically in very simple cases (Larson & Hanson, this issue), but in general sophisticated numerical methods are required. Numerical process-based models are now routinely used in scientific and engineering studies. For instance, these models can provide insight into physical mechanisms (Bertin *et al.,* this issue), simulate the consequences of human interventions (Lisboa & Fernandes, this issue) or be used to design the deposition of dredging spoils (Larson & Hanson, this issue).

Morphodynamics is a complex field, and many processes remain poorly understood. Scientists must therefore continue to shed light on the behavior of coastal systems. Bertin *et al.* (this issue) provides an example of how process-based numerical models can be used to explain this behavior for the particular case of wave-dominated inlets. Engineers need to predict the impacts of human interventions on the environment or to verify if the observed behavior of a coastal system can be attributed to such interventions. Lisboa & Fernandes

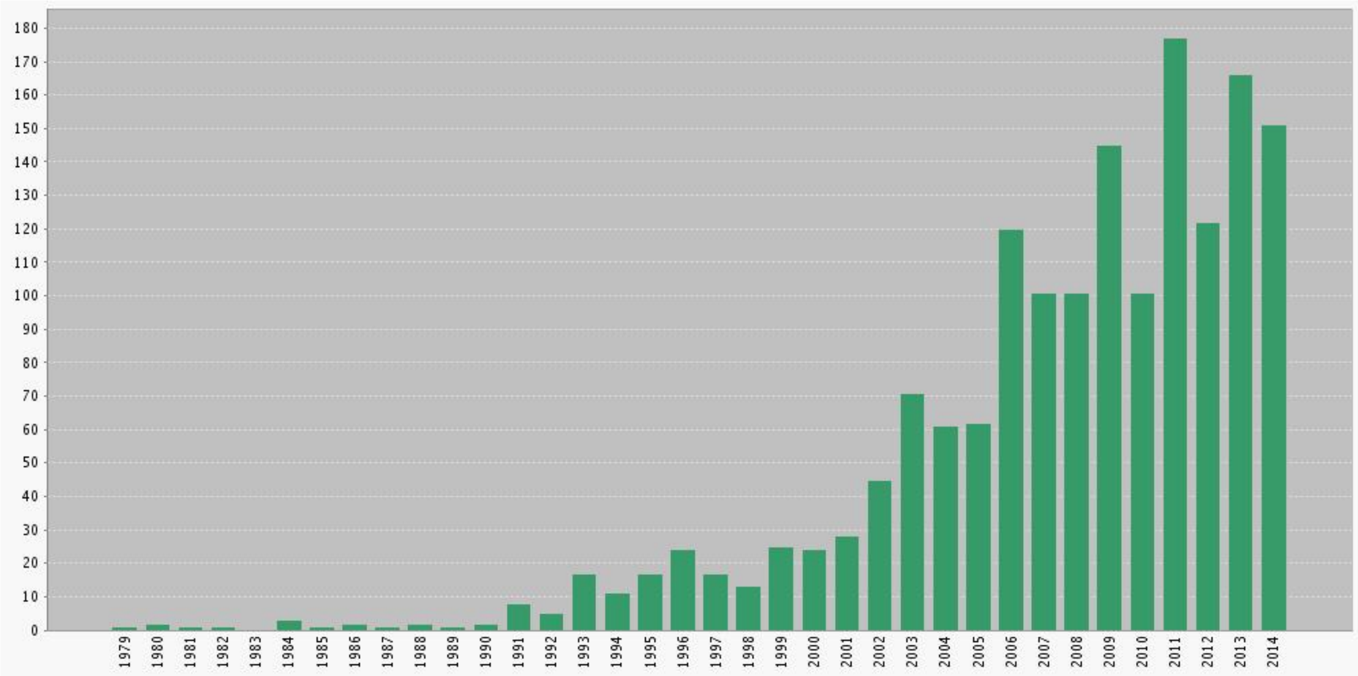

Figure 1 - Evolution of the research in estuarine and coastal morphodynamics: number of papers per year referenced in the Science Citation Index Expanded until 2014 (search string: *Topic=((estuar* or coast* or inlet* or beach) and (morphodynamic or morphodynamics))*, performed on March 10, 2015). The peaks in 2009 and 2011 are partly explained by the large number of papers published on the subject in the special issues of the Journal of Coastal Research associated with the International Coastal Symposiums that occurred in those years. These papers originate mostly from the USA, Europe (Netherlands, England, France, Spain, Italy, Portugal and Germany), Brazil and Australia

(this issue) show how an intervention in a tidal inlet affected a coastal lagoon, while Larson & Hanson (this issue) describe a new model that can help design the deposition of dredging spoils in the coast. Also, coastal managers need projections on how sea level rise and extreme events will affect coastal systems. Guerreiro *et al.* (this issue) shows how sea level rise and sedimentation will change tidal propagation and extreme water levels in a Portuguese estuary. Germani *et al.* (this issue) assesses the vulnerability of a stretch of Brazilian coast to sea level rise. Verocai *et al.* (this issue) addresses the problem of extreme sea levels in the Uruguayan coast. Both sea level rise and extreme sea levels are putting an enormous stress on the world's coastlines, whose protection has prohibitive costs. Cost-benefit analyses, such as the one described in Maia *et al.* (this issue), can thus help coastal managers make the best decision.

This thematic issue originated in the meeting "2ª Conferência sobre Morfodinâmica Estuarina e Costeira", held in Aveiro, Portugal, in 2013. This series of biennial meetings brings together a diverse audience of scientists, engineers and managers to share their experience and ideas on coastal morphodynamics. This issue aims at extending the geographical reach of the conference to provide an overview of the state-of-the-art in morphodynamics to a diverse audience of coastal scientists, practitioners and managers.

While the field of morphodynamics has evolved enormously over the past decade, much still needs to be done. The limits of predictability of the models remain modest, partly due to large computational costs, and partly due to model simplifications. These simplifications are often related to the need to limit computational costs, but also to insufficient knowledge on the physical processes. Hence, models need to be improved in terms of efficiency and accurate representation of the relevant physical processes. Simultaneously, further research is required to provide qualitative and quantitative understanding on the processes and their interactions. Also, the lack of data is a common limitation in most morphodynamic studies. Hence, new developments in *in situ* and remote sensors, as well as techniques to extract better information from the measurements, are needed to provide better data at a lower cost.

References

Bertin, X.; Fortunato, A.B.; Dodet, G. (this issue) - Processes controlling the seasonal cycle of wave-dominated inlets. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):9-19. DOI: 10.5894/rgci524.

Bio, A.; Bastos, L.; Granja, H.; Pinho, J.L.S.; Gonçalves, J.A.; Henriques, R.; Madeira, S.; Magalhães, A.; Rodrigues, D. (this issue) - Methods for coastal monitoring and erosion risk assessment: two Portuguese case studies. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):47-63. DOI: 10.5894/rgci490.

Germani, Y.F.; Figueiredo, S.A.; Calliari, L.J.; Tagliani, C.R.A. (this issue) - Vulnerabilidade costeira e perda de ambientes devido a elevação do nível do mar no sul do Brasil. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):121-131. DOI: 10.5894/rgci540.

Guerreiro, M.; Fortunato, A.B.; Freire, P.; Rilo, A.; Taborda, R.; Freitas, M.C.; Andrade, C.; Silva, T.; Rodrigues, M.; Bertin, X.; Azevedo, A. (this issue) - Evolution of the tidal dynamics of the Tagus estuary (Portugal) in the 21st century. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):65-80. DOI: 10.5894/rgci515.

Larson, M.; Hanson, H. (this issue) - Model of the evolution of mounds placed in the nearshore. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):21-33. DOI: 10.5894/rgci530.

Lisboa, P.V.; Fernandes, E.H. (this issue) - Anthropogenic influence on the sedimentary dynamics of a sand spit bar, Patos Lagoon Estuary, RS, Brazil. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):35-46. DOI: 10.5894/rgci541.

Maia, A.; Bernardes, C.; Alves, M. (this issue) - Analysis of cost-benefit of coastal defense in Vagueira and Labrego beaches (NW of Portugal). *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):81-90. DOI: 10.5894/rgci521.

Silva, E.R.M.; Mallmann, D.L.B.; Pereira, P.S. (this issue) - Análise da estabilidade da Praia do Janga (Paulista, PE, Brasil) utilizando ferramenta computacional. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management,* 15(1):109-120. DOI: 10.5894/rgci492.

Verocai, J.E.; Gómez-Erache, M.; Nagy, G.J.; Bidegain, M. (this issue) - Addressing climate extremes in Coastal Management: The case of the Uruguayan coast of the Rio de la Plata System. *Revista Gestão Costeira Integrada / Journal of Integrated Coastal Zone Management*, 15(1):91-107. DOI: 10.5894/rgci555.