Influence of morphological changes in a lagoon flooding regime: case study of Ria de Aveiro (Portugal)

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Coastal lagoons are dynamic interface zones where land, water and atmosphere interact in a dynamic balance that is constantly being changed by natural and human influence. As extremely productive areas they are usually densely populated, and therefore highly subjected to natural and anthropogenic pressures. It is expected that the current natural pressures will future intensify as result of climate change effects. Coastal lagoons continuously adapt to these changes modifying its hydrodynamics and morphology. Furthermore, their marginal flooding patterns also change, influencing the lagoons ecological processes. Therefore, understanding the lagoons morphological changes and its associated flooding patterns is fundamental in order to identify areas in risk of flooding and protect local ecosystems.

The present study aims to assess the influence of morphological changes in Ria de Aveiro tidal prism and flooding regime. The Ria de Aveiro is a coastal lagoon located at the northwest Portuguese coast, which recent morphological evolution is strictly dependent on human works, namely the construction and maintenance of an artificial inlet, and frequent dredging operations of its navigation channels.

A flooding assessment of the marginal areas of this lagoon was performed applying the hydrodynamic model ELCIRC to the Ria de Aveiro, under different morphological conditions, but considering marginal topography and tidal conditions unchanged. The lagoon tidal prism was also determined for the same conditions. Four different numerical bathymetries are used in this study, constructed based on along the time topohydrographic surveys of the overall lagoon or of some restricted regions: one corresponding to a general survey carried out in 1987/88; in 2001 was performed an update of the inlet bathymetry; in 2011 the update of the majority of the lagoon channels and in 2012 a final update restricted to the inlet. These data show that the inlet evolving region had experienced mostly erosion, namely at a deeper area located at the lagoon entrance. Furthermore, between 1987/88 and 2011, a deepening of the lagoon main channels was observed.

The numerical results suggest that the lagoon flooded area had increased about 15% between 1987/88 and 2012 due to the lagoon deepening. The new regions flooded correspond essentially to salt pans, salt marshes and low-lying areas. The tidal prism results evidence an increase between 1987/88 and 2012 of about 10% and 18%, for spring and neap tide conditions, respectively.