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Impact of sea level rise in coastal systems – Ria de Aveiro case study

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The mean sea level rising is an important consequence of climate change because of its impact on society and coastal ecosystems. Tide gauge information evidences that global mean sea level has increased in the 20th century, and it is expected that its rise will continue during the 21th century. However, the sea levels are not changing uniformly around the world, as both tide gauge and satellite data confirm.
Sea level rise can have a wide variety of impacts on worldwide coastal areas, causing flooding, land loss, the salinization of groundwater and the destruction of built property and infrastructures. In Portugal, the region's most affected by the sea level rise are probably the Aveiro and Formosa coastal lagoons as well as the Tagus and Sado estuaries. A good understanding of the sea level rise influence in the estuarine tidal dynamics is crucial to mitigate these problems. However, the response of each coastal region to sea level rise depends on the physical features of the coastal system, and therefore their effects should be locally assessed.
Thus, this work aims to investigate the potential impacts of the mean sea level rise in coastal regions, analysing the particular case of Ria de Aveiro, which is in risk of flooding. To assess these changes the numerical model Mohid was implemented in Ria de Aveiro. Mohid is a finite volume model, designed for coastal and estuarine shallow water applications. Although Mohid is a 3D baroclinic model, it was used herein in baratropic mode with a single vertical layer, considering that due to its shallow depths, Ria de Aveiro circulation can be simulated with a depth integrated model.
The model was used initially to characterize the lagoons hydrodynamic under the actual sea level, through the determination of the amplitude and phase of the main tidal constituents, maximum levels and velocities, tidal asymmetry, as well as the tidal prism in the main sections of the lagoon. After, a realistic regional sea level rise scenario (0.42 m) was imposed in the open boundary, in order to evaluate its consequences and to identify the more vulnerable regions. The same parameters were determined under the sea level rise scenario, and differences between both scenarios were evaluated.
Generally, the model results suggest that maximum levels and velocity increase in response to the sea level rise. The most significant maximum levels changes occurs at the heads of the main channels evidencing that these regions are the more vulnerable to risks of marginal flooding at Ria de Aveiro. Also, the sea level rise induces an amplitude increase and a phase decrease of the main tidal constituents and subsequently the intensification of the tidal asymmetry in the lagoon. An intensification of the tidal prism was also found, revealing a higher tendency for the salinization of the lagoon adjacent lands in a sea level rise scenario.