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Assessment of a Sand Spit Morphodynamics Under Extreme Flood Events

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Spits are landforms that present a complex morphology, which depends on currents, waves, sediment transport, tidal range and anthropic-induced changes. Their position and shape is subject to extreme events like flood river discharges and storms. They can also respond to processes that take place at larger time scales, as plate tectonics, sea level rise or even climatological patterns with teleconnections all over the world, as the well know North Atlantic Oscillation (NAO) or El Niño-Southern Oscillation (ENSO). This is the case of the Douro river mouth sand spit located on the northern coast of Portugal. This naturally dynamic sand spit, which has moved landwards over the past decades, has caused frequent nuisance to navigation, affecting width and depth of the navigation channel. Therefore, a breakwater was constructed in an attempt to stabilise the sand spit and the estuary inlet.

Validated hydrodynamic numerical models (openTELEMAC-MASCARET and Delft3D) of the Douro river estuary have demonstrated ability to accurately describe the estuarine hydrodynamic patterns and water elevation under extreme flood conditions. Model results showed that for higher river flow discharges the sand spit is partially inundated.

In this work a morphodynamic model (Delft3D) of the estuary was implemented to assess both the morphodynamics of the sand spit under extreme events, including the effect of sea level rise due to climate change, and the variation of extreme water levels along the estuary due to spit erosional processes that can occur during flood events.

Preliminary results show that the sand spit will be locally eroded for the higher river flood discharges, forming a two-secondary-channels system, with one channel located near the breakwater's southern extremity and the other, narrower, near the south bank. Associated with these two channels, two depositional bars will be formed in front of the channels at the coastal platform. However, the inner immersed sand spit will be suffering a sedimentation process for all

of the simulated scenarios. This way, neither the river mouth discharge conditions nor the water levels inside the estuary will suffer significant changes according to the simulated scenarios.

These results will be complemented with further analyses considering the sediment size influence, tidal level, storm surge, sea level rise and river flood discharges.

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