



Mathematical modeling of a tsunami propagating over the mobile bed reaches of the Tagus-Coina estuary

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A recent revision of the catalog of tsunamis in Portugal (Baptista and Miranda, 2009) has shown that Tagus estuary has been affected by catastrophic tsunamis numerous times over the past two millennia. One of the most relevant features of the propagation of the tsunami over solid boundaries is its ability to incorporate debris, either natural sediment incorporated from the bottom or remains of human built environment. Often, these waves generate important geomorphic impacts, changing the shoreline and the morphology of estuarine regions (Dawson, 1994).

The earthquake of 1755 generated a tsunami whose impacts on the Tagus estuary are well-documented. It is known that the region of Palhais, Barreiro, suffered severe morphological changes that led to the destruction of Vale do Zebro Royal Complex, namely the factories and ovens for wheat processing.

The objective of this paper is to simulate the propagation of a tsunami whose wave crest is compatible with that observed in 1755 at Bugio in the Tagus-Coina estuary in today's bathymetry and altimetry conditions. The emphasis is placed in the analysis of the morphological changes occurring in the Vale do Zebro region, where, presently a military facility is located.

The model employed for the simulations is based on a 2DH shallow-flow solver applicable to discontinuous waves over complex time-evolving geometries. A finite-volume discretization scheme is employed, based on a flux-splitting technique incorporating a reviewed version of the Roe Riemann solver. The model remains conservative, provided that source terms are properly formulated and the stability domain reevaluated accordingly. It has been validated in a benchmark test featuring a mobile bed, clearly showing its main advantages and shortcomings.

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References

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