A numerical study of the February 15, 1941 storm in the Tagus estuary

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Abstract

On February 15, 1941, a storm caused one of the major natural disasters in the Iberian Peninsula in the past century. The storm made landfall in the north of Portugal, leading to a large surge in the Tagus estuary. Adverse meteorological conditions combined with a high spring tide led to extensive flooding of dry land, causing severe damage and casualties. A suite of regional and local scale models is developed to analyze the event and the relative contributions of the different forcing agents to the extreme water levels. Quantitative and qualitative validations show that the models adequately reproduce this type of events. The models are then used to assess the inundation in the upstream reaches of the estuary where extensive agricultural lands are protected by dikes. Results show that over 25 km^2 could be inundated today, a value that would increase threefold for a sea level rise of 0.5 m. Then, the relative importance of the different forcing mechanisms on the extreme water levels is investigated through numerical experiments. It is shown that the regional surge and the setup induced by swell are the two main drivers of the inundation. In particular, the modulation of the wave setup by tides induces a semi-diurnal signal which is amplified by resonance inside the estuary.

Highlights:

- Hindcast of the most severe storm of the 20th century in the Iberian Peninsula
- Physical drivers for flooding are identified
- Regional surge and swell-driven setup are the main causes of storm surge
- Wave setup is modulated by tides and amplified by resonance
- Extensive agricultural lands can be submerged

Keywords: tide-surge interaction; numerical modeling; SCHISM; flooding; 2010 Xynthia storm; Portugal.

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