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Combined storm and meteotsunami hazards: Data analysis and numerical simulation of Christina (Jan. 2014) and Leslie (Oct. 2018) events on the coast of Portugal

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Two hazardous storms, Christina (January 2014) and Leslie (October 2018), destructively affected the coast of Portugal and generated extreme sea level variations. We analyzed both the sea-level and meteorological data, and performed numerical simulations to examine the observed wave-induced coastal hazard and identify the background harbor resonances at each port. The results revealed that the sea-level variation is affected by the combined effect of low-frequency sea level rise (surges) and high-frequency (HF) waves. For the 2014 event, we found that wind was the main source of the HF sea surface variation, which excited the background harbor resonance. For the 2018 event, storm surges were significantly stronger and HF amplitudes were mostly induced by the movement of a pressure jump, leading to a meteotsunami formation. Commonly, wind is considered as a principal factor of the storm-generated HF waves, but we show herein that the atmospheric pressure jump can play an important role in their formation through meteotsunami. The latter, when combined to a storm surge, can cause serious impact on the threatened coastal areas.