Simulating overtopping and coastal flooding in urban areas: Perspectives to quantify sea level rise effects

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Recent progresses in numerical modelling and data acquisition have allowed significant improvements in coastal flooding simulations, with a maturity of numerical tools that now allows very precise results in urban areas. Essentially used for hazard studies, their reliability now offers the perspective to estimate the impact of sea level rise on coastal flooding hazards.

Thepresented methodis based on simultaneous simulation of wave overtopping and resulting flood in urban areas. This type of two-dimensional simulationscan afford reproducingboth the chronology and the effect of urban areas on flood dynamics. The method consists in elaborating,from larger simulations, a time-series of instantaneous water levels, including waves. This time-series is imposed upon a time-dependent phase-resolving model to simulate dynamically wave overtopping and the resulting flood, using a Digital Elevation Model that includes buildings.

This method has been applied to the Johanna storm (2008) in Gâvres (France). SURF-WB, a NLSW model, allowed simulating both overtopping dynamics and flooding, taking into account buildings thanks to a 1m-resolution. Obtained results proved to be very consistent with available reports (overtopping sectors, flooded area, water heights and chronology). This method allows reproducingvery realistically overtopping andflooding dynamics in an urban area (water heights and velocities), with an increased accuracy and very realistic results compared to more classical approaches.

This type of simulations can be used to estimate the potential evolutions of coastal flooding processes in a context of sea level rise due to climate change, supposing nevertheless a non-modified morphology. Preliminary simulations realized on the site of Gâvres showed how sea level rise could increase overtopping for a storm like Johanna. For example, a rise of 20 cm of the sea water level may lead to a slightly larger flooded area, but with water heightsincreasing of about 28 cm, due to the modifications in overtopping flows and chronology.