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Comparison of local amplification factors for fast forecast coastal tsunami amplitude modeling based on the extended Green's law

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In the framework of operational conditions, the real time coastal modeling in near field is challenging to obtain accurate and reliable tsunami warning products for flooding hazard. Two main approaches are usually developed to generate maps of forecasting inundation and impacts for planning community response. One produces coastal predictions with run-up computation by solving numerically high-resolution forecast models in real time, taking into account all local effects. However, these runs depend on the availability of fine bathymetry/topography grids along the shore and are too time consuming in near field and operational context. The second approach is based on early prediction tools of the coastal wave amplitude calculated from empirical laws or transfer functions derived from these laws. Such tools are suitable in near field context (almost ten times faster than the high-resolution runs), but all local effects are not well taken into account and the assessment of run-up is missing. The linear approximations of coastal tsunami heights are provided very quickly, with global and conservative estimates.

Within the French Tsunami Warning Center (CENALT), a forecast method based on coastal amplification laws is being implemented. This fast prediction tool provides a coastal tsunami height distribution, calculated from the numerical simulation of the deep ocean tsunami amplitude and using a transfer function derived from the Green's law. The method involves maps of regionalized values of the empirical correction factor function of the coastal configuration, as a way to amplify or attenuate specific local geometries. Due to a lack of tsunami observations in the NEAM basin, coastal amplification parameters are defined by trial and error regarding high resolution nested grids simulations on the basis of a set of historical and synthetic sources. A method to optimize these local amplification factors by minimizing a cost function is being developed at UCD. Comparisons are shown for several French coastal sites.

The local tsunami wave heights modeled from the extended Green's law present a good agreement with the time-consuming high resolution models. The linear approximation is obtained within 1 min and provides estimates within a factor of two in amplitude. Although the resonance effects in harbors and bays are not reproduced and the horizontal inundation calculation needs to be studied further, this method is well suited for an early first estimate of the coastal tsunami threat forecast.