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Morphodynamic forecast uncertainty due to bathymetry unknowns

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Operational morphodynamic modelling is becoming an attractive tool for managers to forecast and reduce coastal risks. The development of highly sophisticated numerical models during the last decades has underpinned the simulation of beach morphological evolution due to wave impacts. However, there are still some fundamental aspects, such as the bathymetric uncertainty, that needs to be regularly updated in the modelling chain to avoid a worthless forecast. It is also very well known that the surf zone is the most highly dynamic area although the bathymetry changes between certain limits. In this work, we explore the influence of bathymetric changes in morphodynamic forecasts. XBEACH is used to model the morphological response of a dissipative urban low-lying sandy coastal stretch (Barcelona, Spain) for different forecasted storms to determine the uncertainty bands of predicted coastal erosion and flooding. We consider as benchmarks the results of XBEACH simulations fed with the bathymetric information taken from existing nautical charts. An analysis of the possible beach states of the studied area following the Wright and Short (1984) is later performed to determine a range of topo-bathymetric configurations that will be used to run the model again. These new simulations are used to determine the uncertainty of the erosion and flooding results. The energy content of the storm in terms of intensity and duration uncertainty is also considered in the analysis. The proposed ensemble approach will serve to determine the likelihood of the modelling forecast outputs. Such statistical characterization is aligned with ensemble forecasting in meteo-oceanographic fields and will provide robust information for coastal decision making, for instance when considering proactive rapid deployment measures against a forecasted storm.