

Interactive comment on “Mapping wave set-up near a complex geometric urban coastline” by T. Soomere et al.

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We thank the referee for the overall positive evaluation of the manuscript. We agree that the issues of wave modelling in shallow water and particularly the adequacy of WAM model in the nearshore were originally discussed somewhat sketchily. It is customary to use a medium-resolution version of the WAM model in deep water and to pass the resulting wave spectra to the SWAN model in order to reduce computational loads and to properly handle the impact of near-resonant triad interactions. Such a sequence of models is not necessary in the study area where wave periods are short and the shallow nearshore (in which triad interactions may be important) is narrow. Commonly wave periods are 3–6 s in the open Baltic Proper (Broman et al., 2006) and usually

C1117

even shorter, 2–4 s in its semi-enclosed sub-basins (Soomere et al., 2011). They very seldom reach 8–10 s and these only occur in very strong storms in the Baltic Proper but almost never in the Gulf of Finland or in Tallinn Bay. As the deep, intermediate and shallow environments are defined in wave applications in terms of the ratio of the wave length and water depth, for wave periods with 5–6 s the WAM model remains adequate until depths of at least 5 m.

Thank you for the suggestion to include a discussion of Ursell numbers for wave fields at the nearshore grid cells. For a 1 m high and rather long (in the context of Tallinn Bay) wave with a period of 6 s the Ursell number in 5 m deep water is about 11. Therefore, Stokes' theory is applicable up to about 3.5 m high waves, that is, even for the largest significant wave heights that occurred in the model grid corresponding to coastal sections prone to high set-up during the last three decades.

Moreover, the relatively shallow (less than 20 m deep) nearshore is fairly narrow, usually less than 1 km wide in most of the study area. The wave field thus experiences various non-linear shallow-water effects (such as the the frequency shift and spectral shape changes as water depth decreases or the impact of triad interactions) only during the propagation over a few 100s of metres. Therefore, it can be assumed that the described triple-nested implementation of the WAM wave model, run in the finite-depth mode, allows a satisfactory description of wave properties in the coastal zone, down to depths of about 5 m and as close to the coast as about 200–300 m in the study area.

We also agree that the discussion of various estimates for the breaking parameters is perhaps too detailed and lengthy, and may to some extent defocus the main message of the paper (especially because the maximum setup linearly depends on this parameter in our approximation). Still, our experience (strengthened by some remarks of Referee 1) is that its values have been subject of quite controversial claims in the past and presenting the relevant material in some detail helps the reader. The same applies to some possibly redundant parts of the text: most of which has been added to meet questions that have arisen during presentations of the material at different fora.

C1118

Running a Boussinesq or even a full 3D model of wave transformation and impact in the nearshore would indeed give a more accurate picture about what exactly happens during an extreme set-up event. The practical usefulness of such an exercise is, however, undermined because of transient nature of the set-up phenomenon. It develops on the background of “open sea” water level. Therefore, the area (both along and across the coast) where it happens usually changes with time. Thus, the shape of the coastal area, bottom roughness, etc., usually change when the “open sea” water level changes. For this reason we are of opinion that running of a Boussinesq model, although it would strengthen our analysis, may defocus the main message of the paper.

The changes to the manuscript to meet the recommendations of the Referee are indicated using violet font in the revised manuscript.

References

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