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# The influence of a set of calibration parameters and pre-storm bathymetry on modeling volumetric changes of the Southern Baltic dune coast

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The observed climate changes (increase in sea level as well as increased storminess) are a major hazard to coastal areas. Particularly to these coastal sections with low dune systems, which constitute the first line of defense. In order to minimize the negative effects of extreme events, tools in form of early warning or prediction systems are being created that allow for preparation and possible implementation of appropriate mitigation procedures. These systems use numerical hydrodynamic and morphological models, for which correct application and calibration as well as defining errors are necessary. In this context, the main goal of this research was to determine the calibration parameters of the XBeach model on a base of 19 cross-shore profiles and the possibility of using a set of parameters for all profiles simultaneously with calculation of associated errors. Moreover, because a matter of obtaining and updating data into systems seems to be crucial, the influence of pre-storm bathymetry on modeled volume changes in the shore was investigated.

The model was calibrated on a storm event of 2009 that caused significant changes of dune and beach. Cross-shore profiles were measured about a month before and after the storm. An evaluation of modeling correctness was made upon the Brier Skill Score (BSS), absolute volumetric changes error ($m^3/m$), relative volumetric changes error (%) and visual assessment of profile shape fit. The model calibration used following parameters: wetslp, facua, morfac and smax. The two latter parameters received permanent values, while facua and wetslp were changing.

The best results for calibration on all 19 cross-shore profiles were obtained for facua ranging from 0.16 to 0.40 and wetslp from 0.35 to 0.60. The calibration on individual profiles yielded good results, with the average absolute error of approximately 4 $m^3/m$ and the average relative error of ca. 20%. The poorest results were collected for the profiles situated nearby hydraulic engineering structures, where the average absolute error returned 10 $m^3/m$ and the relative one – 60%. A possibility to accept one set of parameters for all the profiles at once was also investigated. These studies revealed that, an application of one set of facua and wetslp parameters for all profiles simultaneously caused the relative volumetric changes error of ca. 25% on average, which may increase to 40%.

Due to difficulties with collecting data just before and after the storm event, complex studies with usage of all available bathymetric data were performed. Using joint data composed of pre-storm topography registered before that storm and bathymetry of 2004, 2006, 2008, 2010 and 2012, a simulation of the 2009 storm event was carried out. Studies revealed an impact of nearshore bathymetry on modeling volumetric changes of the terrestrial part of the shore is visible. Changes in slope inclination by 1–2% within a 40 m distance off the shoreline and a consecutive change in nearshore volume within a 60 m distance by 20–30 $m^3/m$ can cause an increase in difference of modeled volumetric changes of approx. 6–8 $m^3/m$.