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## Modelling Nature-based Solutions: an application to mitigate coastal erosion

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Nature based solutions (NBSs) address key societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems. In this work we present a modeling application of this innovative approach, inspired by nature, with the goal of mitigating coastal erosion. Within the framework of the OPEN-air laborATORIES for Nature based solUTions to Manage environmental risks (OPERANDUM) project, the natural reserve of Bellocchio in Lido di Spina (Italy) faces frequent marine floods and intense erosive phenomena, hence being chosen as Open-Air Laboratory for the NBS implementation. The project aims to mitigate coastal erosion through the realization of an artificial sand dune made of natural materials, such as sand, wood, geotextiles and geomembranes and covered by native herbaceous and shrubby vegetation. We present the modeling activities carried out in the context of the project, aiming on the performance and efficiency evaluation of the designed NBS, with a specific focus on the coastal morphological modelling. Thus, a numerical modeling chain has been set-up to simulate a long-term current scenario with and without the NBS. The chain is composed of the wave model WAVEWATCH III, the oceanographic model SHYFEM and the morphodynamic model XBeach for the coastal area.

XBeach was validated with available and specific (for the project) topo-bathymetric surveys of the area of interest as means to define the more accurate set-up of the model parameters. The 10 years period 2010-2019 was defined as the time range for modelling simulations. Sea level outputs from SHYFEM and wave outputs from WAVEWATCH III for the 10 years simulations are used to force the coastal model XBeach. Given the huge computational costs related to long-term simulations, an input-schematization was applied (so called "input reduction"). The approach followed for the long-term morphodynamic modelling of the NBS-XBeach setting will be shown. Moreover, the chosen coastal model domain, the model set-up and the input reduction applied will be presented.