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Nature Based Solution simulation design methods – A storm surge seagrass application

Umesh Pranavam Ayyappan Pillai[1], Nadia Pinardi[1], Ivan Federico[2], Salvatore Causio[2], Jacopo Alessandri[1], Silvia Unguendoli[3], and Andrea Valentini[3]

[1]Department of Physics and Astronomy, University of Bologna, Bologna, Italy (umesh.pranavam@unibo.it; nadia.pinardi@unibo.it; jacopo.alessandri2@unibo.it)

[2]Euro-Mediterranean Center on Climate Change (CMCC), Lecce, Italy (ivan.federico@cmcc.it; salvatore.causio@cmcc.it)

[3]Hydro-Meteo-Climate Service of the Agency for Prevention, Environment and Energy of Emilia-Romagna, Arpae-SIMC, Italy (sunguendoli@arpae.it; avalentini@arpae.it)

Nature Based solutions (NBS) have been presented in the recent past as a potential solution to natural and climate change adverse effects on human well-being and socio-economic activities. In this study, we present a simulation design methodology for NBS that can mitigate the effect of storm surges and coastal erosion. The chosen NBS is marine seagrass and it will be applied to the coastal strip of the Emilia-Romagna coasts. Within the framework of the OPEn-air laboRAtories for Nature baseD solUtions to Manage environmental risks (OPERANDUM) project, the seagrass NBS is presented within a simulation design methodology consisting of the comparison between validated wave numerical simulations for the present climate and modified wave simulations with marine seagrass. In this context, the unstructured version of WAVEWATCH III (WW3) model has been implemented for simulating the wave characteristics across the Emilia-Romagna coastal strip with and without seagrass.

The calibration/validation of WW3 was carried out and sensitivity experiments using the various wind-input dissipation source packages and bottom friction formulations were also attempted to evaluate the model performances (validation results presented here are for the entire 2017 year). The ST6 physics along with SHOWEX bottom friction formulations were chosen ideal for the study area. To evaluate the model results a directional wave rider buoy data was utilized. The model simulated significant wave parameters namely Hs (significant wave height), Tm (mean wave period) were compared with buoy observations and high correlations (0.93) were found with Hs comparison. Further the WW3 model was modified by including the modified bottom dissipation stress due to submerged vegetation, thereby incorporating the NBS as a potential mechanism for wave amplitude reduction. The seagrass species ‘Zostera marina’ was chosen in this study and comparisons showed that seagrass is capable to reduce the wave energy in the study area. Furthermore, the dependence on seagrass plant high-density and low-density scenarios, together with seagrass parameters (height and width of the seagrass) and species show the sensitivity of the results even on reduction of wave energy as obtained with different degrees by all NBS scenarios.

Keywords: Nature-based solutions, WW3, marine seagrass, storm surge, Zostera marina.