

Coastal defense systems based on the 'Building with Nature' principles: interdisciplinary research involving coastal engineering; ecological engineering and marine biology

Rahi Joe¹; Stratigaki Vicky¹; De Troch Marleen² and Troch Peter¹

¹ Department of Civil Engineering; Faculty of Engineering and Architecture; Ghent University; Technologiepark 60; 9052 Zwijnaarde; Belgium

E-mail: joe.elrahi@ugent.be

² Marine Biology Research Group; Department of Biology; Ghent University; Campus Sterre S8; Krijgslaan 281; 9000 Gent; Belgium

Sustainable coastal protection is of growing importance in the adaptation process towards global climate change and sea-level rise. Hence; knowledge on the mitigation of flooding and erosion hazards using coastal defense structures with low environmental impact is vital for future developments. Coastal vegetation like salt marsh and seagrass meadows can play an important role in coastal protection by dissipating energy from waves and currents. The growing awareness of the potential of salt marshes and seagrasses in contributing to coastal protection has led to an increasing number of experimental and numerical modeling studies that target the integration of natural ecosystems in coastal engineering and sustainable coastal defense ([1]; [2]). This target is based on the 'Building with Nature' principles (also called 'nature-based solutions'); thus employing an interdisciplinary approach that combines coastal and ecology engineering with marine biology. Pioneering works provided the basis for the conceptual models of wave damping by submerged vegetation ([3]; [4]-[5]); but knowledge gaps are still present in the validation of numerical models and in the lack of comprehensive studies addressing different seagrass species and salt marsh vegetation.

The general research objective of this research is to establish a theoretical understanding of the physical processes governing the vegetation-induced wave and current dissipation under a wide range of wave/current conditions and considering a wide range of coastal vegetation characteristics; by developing a 3D numerical and analytical model; fully validated using 3D experimental data. Some of the most important impacts of this research are: i) the integration of natural ecosystems in coastal engineering and sustainable coastal defense based on "Building with Nature" principles; ii) the demonstration of the ecological and economic value of these ecosystems; which will also enhance their protection and will boost their engineering applications on an international level; iii) covering the main knowledge gaps identified in this proposal and upgrading the current state-of-the-art; iv) focus on validation of 3D numerical and analytical models.

The research project has started recently (10/1/2019); therefore the objectives and research methodology; jointly with the envisaged research tools will be presented in more details.

Keywords: Nature-based solutions; Coastal defense; Numerical modeling; Vegetation; Wave attenuation