Numerical benchmark study of “far field” effects of farms of WECs using linear and weekly non-linear models

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This work is a continuation recently completed doctorate research at the Civil Engineering department of Ghent University (Belgium) focusing on the numerical modelling of “far field” effects of Wave Energy Converter (WEC) arrays [1,2,3,4,5,6]. During this research a numerical coupled model has been developed between the wave propagation model MILDwave [7, 8] and the wave-structure interaction solver NEMOH [9] using the generic coupling methodology introduced by [10,11].

The aim of this study is to estimate the wave height reduction in the lee of a WEC farm for two different WEC types, a heaving point absorber (HPA) and an oscillating surge wave energy converter(OSWEC), using two different numerical approaches. Specifically for each WEC farm the wave height redistribution around the WECs which absorb wave power from incoming waves has been modelled using: (a) the traditional sponge layer technique which is implemented in MILDwave as presented in [8,10], and (b) the MILDwave-NEMOH coupled model [11,12,13]. Within the latter numerical approach, for each WEC the Power-Take-Off (PTO) is modelled considering: (i) an optimal linear PTO; (ii) a sub-optimal linear PTO; and (iii) a Wave-to-Wire (W2W) [4] model of an hydraulic PTO.

The above mentioned numerical approaches result into four simulations for each WEC farm in the present study. Comparisons between the different cases of the simulated WEC farms show that the numerical approach described in (a) tends to overestimate the wave height reduction in the lee of the WEC farms for both WEC types studied. When analyzing the results obtained using the second numerical approach (b), it can be seen that, using a different WEC PTO system (cases (i)-(iii)) does not have a significant impact in the wave height reduction in the lee of the WEC farms for both WEC types studied. Additionally, it has been observed that even though the wave height reduction in the lee of the WEC farm does not differ much for each PTO system (cases (i)-(iii)), there is a variation in the two WEC farms power performance for all simulations. This is reflected in different average power output of the WEC farms for both WEC types studied and different PTO systems. This work fits in the “WECANet **Working Group 1**: Numerical hydrodynamic modelling of WECs”, and more specifically in the topic that focuses on coupling between codes for WEC simulation.

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