SCENARIO BASED RESULTS ON THE WAVES POWER RESOURCES IN THE ROMANIAN PORTS' AREA

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Numerical simulations provide the offshore and nearshore wave climate evaluation for a better selection of the navigation and port protection measures, establishing the hydrodynamic conditions for various shelters, but also marine energy collection facilities for safe navigation, by establishing the average annual wave climate in different locations adjacent to the Romanian Ports'Areas. Although, some primary studies concerning the assessment of the expected waves conditions in adjacent areas of Constanta - Agigea Port, the subject is still a priority for continuous wave power evaluation of incident waves from East direction, due to the northern jetty extension, the direct incidence of waves from the port opening directions may cause the wave regime intensifications inside the area of interest basin, due to the diffraction and refraction processes at the port entrance.

Regarding the evaluation of the wave propagation conditions, including evaluations of the wind, wave and current conditions were required to be carried out in the area of the Constanta – Agigea port. Comparisons between coupled simulations and in situ measurements indicate that the wave amplification or decrease is highly dependent on the current's magnitude and the incident angle of the wave, determined by the port basin configuration. In predictable scenarios, the significant wave's height can increase by 20-40% and 60% in cases of extreme storms, due to the captive, resonant waves, as well as the sea level rise in the port in the storm situation.

Waves and currents models validations, although not possible in the extended and coverage mode, given the lack of in-situ data, were performed using drone observations and in situ measurements of currents (with ADCP) and waves (from vertical post-processing of GPS recordings). It was observed that the directional dispersion of the waves penetrating the basin is significantly influenced by the port island. This is especially important in the cases where the induced current meets waves from opposite directions, which can change direction up to 20°.

Wind-induced surface currents may be responsible for changing the wave's characteristics along the transport corridors in the port basin, as well as in the port adjacent areas. To evaluate these

changes, wave simulations were performed with certain models. These simulations were compared with each other, as well as with measured data obtained from an ADCP and from short-range remote observations/drones. Numerical simulations on wave propagation processes, including surface currents, were close to the values recorded in situ, under normal regime conditions, but similar in pattern to those of extreme regime in the area of interest. It has been found that changes in wave height due to the currents are largely due to the intensity of the surface current and the relative direction of the waves, taking in consideration several modeling scenarios, especially for the case when the current flows in oblique or opposite directions to the incident or diffracted waves in the area of interest.

The present work also presents some of the first in situ investigations of the coupling/interaction effect of the wave with the current in the area of Constanta port basins. The currents recorded in situ also proved to be dependent on the wave direction developed in the frame of low fetch of Constanta Port, there are recordings of more prominent currents in the vicinity of port entrance, including the access corridor, were some mobile renewable energy convertor are investigate to be places in definite cases. In these high energy cases, the directions of wave propagation, in virtual test stations of propagates waves were investigated for safe port operation during storms.

The wave transformation needs to be well described for a good selection technical solution, taking in consideration that the wave periods decrease from offshore to nearshore/quay. The wave heights near the port area are generally lower than offshore, but due to the diffraction and wave multiple reflections, as well as the effects of refraction and breaking waves at to port entrance, a strong directional wave train can be propagated in the port basins.

Thus, the significant heights of the waves propagated in the basin underline the necessity to extend in the future the northern jetty to the south to ensure increased conditions for sheltering and safe port operations or to use in storm situation a rapid waves barrage, considered as a mobile Wave Energy Convertor/WEC at the port entrance, the area of interest, further studied for an installation of a waves attenuation device with increased capacity of lowering by conversion the waves power in the port basins.

Keywords: marine renewable energy, wave power, modelling scenarios, safe navigation and port operation, extreme events

Acknowledgment: This work was carried out in the framework of the research project DREAM (Dynamics of the REsources and technological Advance in harvesting Marine renewable energy), supported by the Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding – UEFISCDI, grant number PN-III-P4-ID-PCE-2020-0008.

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