Evaluation of Wave Energy Extraction in a Sheltered Bay

*Emiliano N. Gorr-Pozzi#1, Héctor García-Nava#2, Francisco J. Ocampo-Torres*3*

emigorr@uabc.edu.mx [1] hector.gnava@uabc.edu.mx [2]
#Instituto de Investigaciones Oceanológicas (IIO), Universidad Autónoma de Baja California (UABC) Ensenada, Baja California, 22860 México
ocampo@cicese.mx [3]
**Departamento de Oceanografía Física, Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE) Carretera Ensenada-Tijuana 3918, Ensenada, Baja California, 22860 México*

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The extraction of energy from renewable sources is currently envisioned as a possible solution to the global energy crisis [1]. Ocean waves are one of the most promising sources of energy because their high energy density per unit area and because the energy naturally flows to the coast where it can be harvested more easily. The Pacific Coast of North America has one of the most important marine renewable energy resources in the world in terms of waves [2]. However, most Wave Energy Converters (WECs) are designed to work in relatively high seas. This limits their performance in sub-tropical and tropical regions, typically dominated by gentle swell. The present study analyzes and compares the performance of two types of WECs within a sheltered bay in the subtropical zone (Fig. 1).

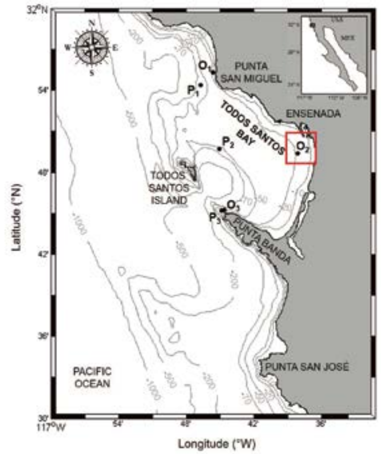

Figure 1. Location of the study site within the Baja California peninsula. The positions for each evaluated points are indicated. Ppoints represent the sited areas for Pelamis devices and the Opoints for the Oyster2 converter. The red lines show the located of nested grids for the WEC arrays analysis area. The solid lines represent the isobaths and their value is expressed in meters.

The spatial and temporal variability of the wave power in the study area were determined from a ten-year hindcast performed for this purpose. The wave hindcast is based on a local implementation of the SWAN spectral model [3] forced at its open boundaries with wave data from the IOWAGA hindcast [4].

The extraction of energy with Pelamis [5] and Oyster2 [6] was simulated based on its power matrix and the effects of the different WEC arrays on the nearshore area were determined with the model SNL-SWAN [7].

In accordance with the results, the studied area has several sites suitable for wave energy extraction. The area has a moderate available wave power with a clear seasonality and a large spatial variability caused by the sheltering effect of Todos Santos Island. Both analyzed devices work better in the southern region; however, Pelamis is more effective than Oyster2 on extracting the available wave power. All the different WEC array configurations examined induced changes near-field and nearshore (e.g. Fig. 2).

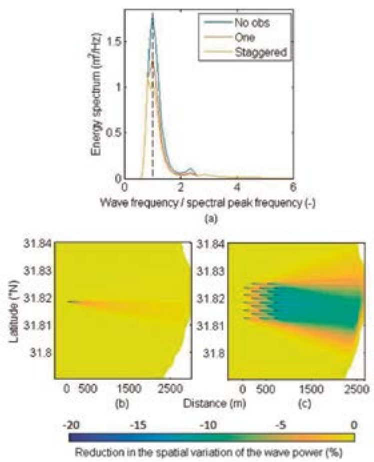

Figure 2. Reduction in wave power (ΔP) in percentage for the various examined Oyster2 arrays configurations: (a) associated wave energy spectrum; (b) single obstacle; (c) staggered array, adding a total of 25 devices with the same spacing distance of devices between rows and columns.

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