Optimal design and integration of the wave energy converter into the existing breakwater

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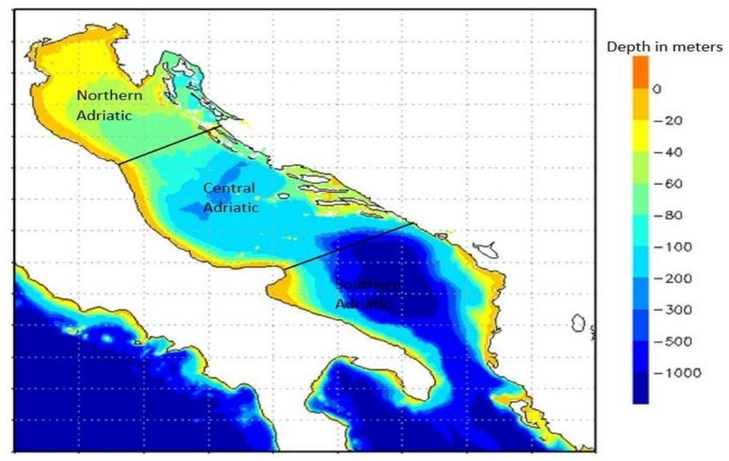
Introduction:

The **Adriatic Sea** is a semi-enclosed body of water about 750 km long and 200 km wide, connected to the Mediterranean Sea through the Strait of Otranto. Based on the bathymetric differences, the Adriatic basin is divided into three sub-areas such as northern, central, and southern parts. The northern Adriatic Sea has relatively shallow waters (depth is less than 50 m) and mild bottom slopes, and the central Adriatic Sea with an average depth of 270 m. The southern part basin reaches maximum water depth up to 1200 m.

Two winds dominate the surface wave situation in the Adriatic Sea: Bora and Sirocco. The waves generated by the Bora come from the northeast and move towards the Italian coasts, and they are less frequent but are the more energetic ones. The Sirocco waves blow from South-East to North-West along the axis of the Adriatic basin, and they are more frequent, but they generate less energy than the waves generated by the Bora.

Despite its reduced extension from the point of view of energy from waves, the Adriatic Sea can be divided into four specific areas: the NE Adriatic Sea, the N Adriatic Sea, and the Central and Southern Adriatic Sea. The potentials of the four sectors were calculated using data from the RON (Rete Ondametrica Nazionale-ISPRA). Based on the wave data collected, the north-eastern Adriatic is one with limited potential of 0.17 kw/m; the north Adriatic Sea has a wave energy potential of 2.75 kW/m; the central Adriatic has a 2.6 kW/m potential; and the southern part of Adriatic Sea the estimated wave energy potential is about 2.57 kW/m.

However, the study of wave assessment and the possible wave energy converter technologies for the extraction of waves in the Adriatic Sea is limited. The project aims to study and evaluate the optimal wave energy potential of an Adriatic Sea to design and install a suitable wave energy converter to extract the wave energy.



Methodology:

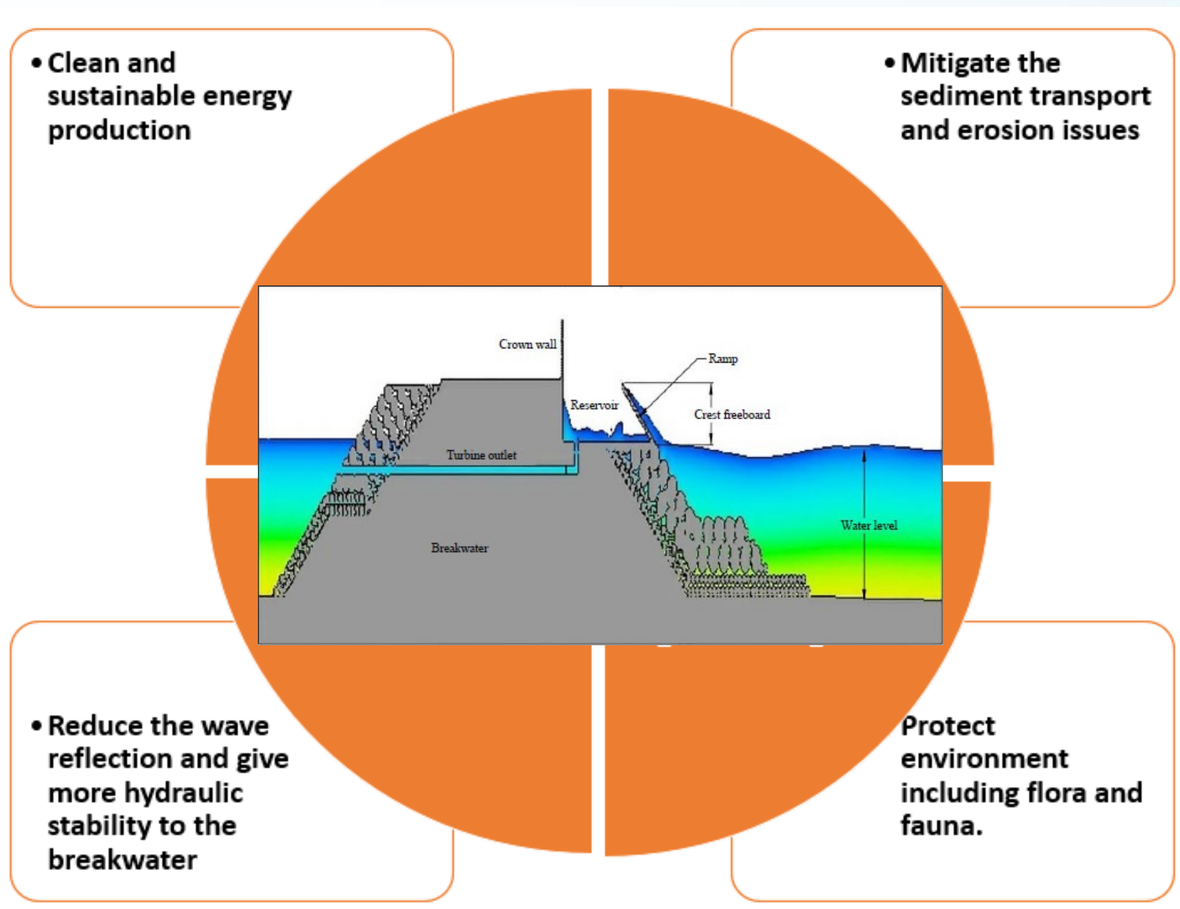
Using available literature and websites to collect the data related to wind, wave, and bathymetry

Evaluating the wave characteristics data by using statical analysis and numerical modelling (SWAN) for the area of interest

Identifying the optimal potential sources of the wave energy and the selection of the suitable WEC.

Design and cost estimation of the WEC.

Applications



Objectives:

1. Wave assessments in terms of wave significant height, mean wave period, and direction for central Adriatic Sea (Pesaro).
2. Finding the optimal wave energy sources for installation of Wave Energy Converters (WECs).
3. Design and optimize the suitable wave energy converters.
4. Cost estimation analysis for WEC.

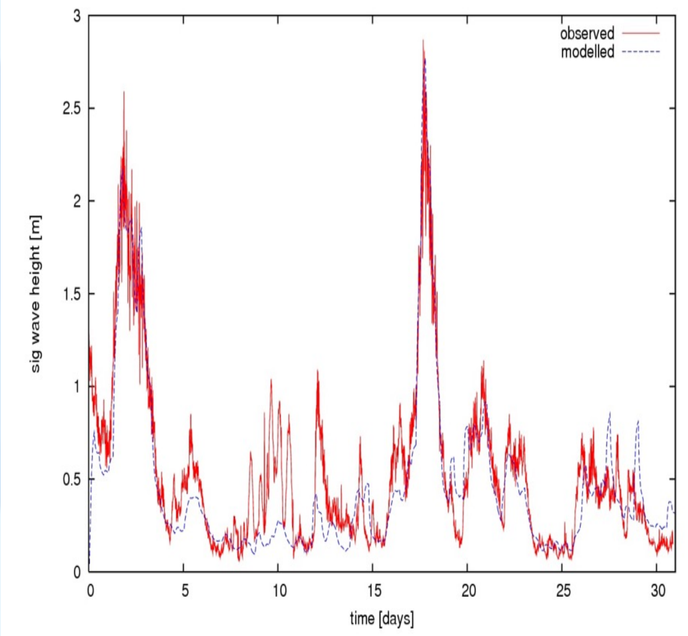
Next steps.

Currently, we are working on:

- the optimal design of the wave energy converter (Overtopping device)
- Cost analysis for the design and installation of the WEC.
- The next steps will also imagine “active” breakewater in the most appropriate areas for coastal protection

Key findings:

T_p/H_S	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	Sum
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	4934	1666	14	0	0	0	0	0	0	0	0	0	0	6614
4	3552	6815	861	20	0	0	0	0	0	0	0	0	0	11248
5	589	3800	2616	666	36	0	0	0	0	0	0	0	0	7707
6	260	1114	1533	1256	500	113	5	0	0	0	0	0	0	4781
7	166	326	459	445	393	255	70	14	3	0	0	0	0	2131
8	93	103	138	159	128	111	91	51	21	7	1	0	0	903
9	28	68	36	44	54	38	38	22	12	5	1	1	1	348
10	11	29	14	10	13	11	10	7	2	1	4	1	0	113
11	4	8	4	2	0	1	0	0	0	0	0	0	0	19
12	8	3	4	1	0	0	0	0	0	0	0	0	0	16
13	14	0	1	0	0	0	0	0	0	0	0	0	0	15
14	4	1	0	0	0	0	0	0	0	0	0	0	0	5
Sum	9663	13933	5680	2603	1124	529	214	94	38	13	6	2	1	33900



- We found that central Adriatic sea , the maximum significant height between 0.5 and 1 m with respect to the time periods of 3 to 4 sec.
- We became familiar with the required data and their capturing sources which is in our case COPERNICUS

References:

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- Bertotti L, Cavaleri L. Wind and wave predictions in the Adriatic Sea. J Mar Syst 2009;78. https://doi.org/10.1016/j.jmarsys.2009.01.018.

Ackowledgments