Enhancing and development of coastal monitoring platforms through oceanographic instrumentation for a better climate change forecasting events adaptation

Università degli Studi di Palermo
dipartimento di ingegneria unipa

Emanuele Ingrassia
Wave masurement and ocean numerical modelling emanuele.ingrassia02@unipa.it

Sea States measurements

Through oceanographic instrumentation it is possible to retrieve information on sea states such as currents, wave heights, and direction of incoming waves. These information are crucial in coastal engineering in order to understand and study the physical phenomena that characterize sea waves and the incoming climate change. The research project aims to obtain a useful tool to record sea data, run numerical models and return reliable estimation of waves parameter in coastal areas in order to use them to more effective studies. The outputs will be useful for the decision maker helping in coastal area management in short-term and in climate change related long terms.

The research project is in collaboration with ISPRA (Istituto Superiore per la Protezione e Ricerca Ambientale) which collects wave measurements with the national ondametric network (RON).

The use of coastal High Frequency Radar (HFR) is promoted to develop the algorithm to retrieve the wave spectrum information, in collaboration with OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale). These antennas permits the remote wave measurement over larger areas using coastal instrumentation.

Scientific approach

The project will be driven by the need of larger dataset of wave data. The HFR network already installed in south of Sicily are measuring the sea currents optimally, but more effort must be done for wave measuring. The collaboration with ISPRA and OGS brings and important support in spectral wave analysis. Considering the increasing energy flux and the intensification of extreme events due to ongoing climate change, oceanographic instruments can retrieve information about the evolution of sea variables to better predict the coastal processes.

The omnidirectional and directional wave spectrum can be reconstructed from wave buoy. Once a relevant amount of data has been recorded with high accuracy, a numerical model can be set up to simulate physical processes on wave approach, developing accurate numerical model

Research objectives

The project will return valuable data for better understand coastal processes as sediment transport, flood risk and wave-structure interaction. The model will also make an important contribution to understanding climate change scenarios.

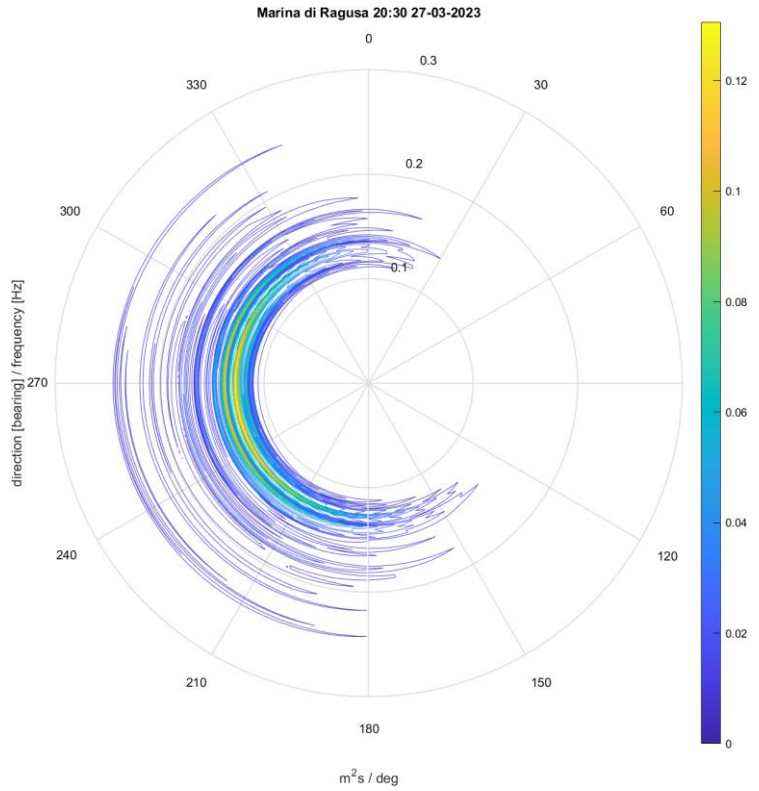

Fig. 1 –The spectral analysis returns important information about the frequency distribution of the energy carried by sea waves. The directional spectrum brings information about the spatial distribution of a sea states. During storms or extreme events like Medicanes, this representation contributes to understand the evolution of the sea waves energy during the time, the space and the frequency. *(directional spectrum recorded by Marina di Ragusa buoy)*.

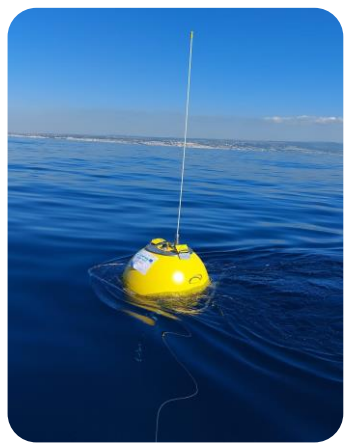

Fig. 2 –Wave buoys deployed in coastal areas are the principal instruments for wave measurement. Several buoys are located around national coastline contributing to sea wave monitoring. All the collected data provide valuable environmental information, allowing to measure the evolution of the climate change. *(Marina di Ragusa buoy during the deployment of February 2023)*.

Fig. 3 – The evolution of sea storms caused by climate change impose to reconsider the coastal infrastructures as ports, marinas and other coastal activities. The importance of measure waves variables is crucial for a well-designed infrastructure. *(Port of Cascais, Portugal, during a storm event)*.