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High-resolution 3D Forecasting System for Barcelona's beaches and coastal waters

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The ocean is an essential part of the planet that plays a crucial role in the global life system and provides vital resources for humanity. Coastal areas are the most affected by direct pressure from human activity, and their management is very complex due to the multiple interconnected processes that occur there. To conserve and protect our coastal areas, we must observe and understand how they interact. Despite its paramount importance to society, there are fundamental gaps in coastal observing and modelling. Therefore, current forecasting systems limit our capacity to manage this narrow border between land and sea sustainably. Improved numerical models and sustained observations of our ocean are needed to make informed decisions and ensure that human-coastal interaction is sustainable and safe.

EuroSea initiative is an innovation action of the European Union entitled "Improvement and integration of the European oceans Observation and prediction systems for the sustainable use of the oceans'. EuroSea brings together the leading European players in the ocean observation and forecasting with users of oceanographic products and services and provides high-resolution coastal operational prediction systems in domains such as ports, beaches and nearby coastal waters.

In the EuroSea project framework, we present a 3D hydrodynamic tool to improve Barcelona's beaches' inner dynamics solution. We use the Coupled Ocean-Atmosphere - Wave - Sediment Transport (COAWST) Modeling System that utilizes the Model Coupling Toolkit to exchange prognostic variables between the ocean model ROMS, wave model SWAN, and the Community Sediment Transport Modeling System (CSTMS) sediment routines. As part of the system, the wave and ocean models run with nested, refined, spatial grids to provide increased resolution, scaling down to resolve nearshore wave-driven flows, all within selected regions of a larger, coarser-scale coastal modelling system.

Bathymetry was built using a combination of bathymetric data from EMODnet (European Marine Observation and Data Network), and specific high-resolution sources provided by local authorities. Copernicus products have driven these high-resolution simulations.

Results have been validated with field campaigns data, displaying preliminary agreements between model outputs and in-situ observations. The model provides results that will be used to study interactions between sea-level hazards, economic activity, and risk. These results will develop new forecast capabilities, such as erosion and flooding, rip currents, floating debris and flushing times.

Finally, we look ahead to the future of the operational prediction systems as useful tools to make informed decisions, minimize risks and improve environmental management.