



Let's talk about Coastal Challenges

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Abstract

Coastal Digital Twins: powerful simulation tools to replicate coastal conditions and forecast future scenarios

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Coastal Digital Twins are advanced simulation tools that replicate coastal conditions and predict future scenarios. CMCC's "Global Coasts as a New Frontier" programme envisions a Digital Twin of the Coastal Ocean (DTCO)—a dynamic, data-driven virtual model of coastal environments. Continuously updated with real-world data, it will enable real-time monitoring, predictive modeling, and "what-if" scenario analysis to support decisions on extreme events, climate adaptation, hazard mitigation, and coastal planning. This technology is part of the GlobaCoast initiative under the CoastPredict Ocean Decade Programme.

Digital Twins offer customizable, relocatable, and cost-effective solutions using open-source tools, satellite data, and accessible software—particularly beneficial for under-observed regions. They integrate multidisciplinary science to tackle complex coastal issues. Their growing strategic value is evident in initiatives like ESA's Coastal Digital Twin of Cyber Italy (IRIDE Programme, PNRR) and the European Commission's EDITO-Model Lab.

Examples include Nature-Based Solutions (NBS) Digital Twins by CMCC with Capgemini and the University of Bologna, which combine real-time data and climate projections to guide erosion control, flood prevention, and habitat restoration. These tools allow users to simulate NBS strategies, such as wetland or dune restoration, under various climate and sea-level rise scenarios.

