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Digital Twins of the Ocean for the Cabo Verde Archipelago and the FUTURO Initiative

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At GEOMAR, we are developing Digital Twins of the Ocean using a process-oriented and co-designed approach. Instead of building one large model, we create modular systems that reflect local needs and priorities. A key focus is the West African region, with its unique environmental and social challenges. These digital twins combine in-situ measurements, satellite data, and advanced models that link ocean physics, biology, and ecosystem processes. This helps us understand the ocean in a more comprehensive way—across different disciplines. To support these tools, we are upgrading the observation and research infrastructure around Cabo Verde. Long-term GEOMAR platforms are being improved to deliver real-time data, using advanced telemetry and a high-end buoy system. In addition, mobile and autonomous platforms will be used continuously to monitor the ocean. In addition, a key future initiative will be FUTURO, a one-year, interdisciplinary research campaign in the eastern tropical North Atlantic. It will bring together multiple research vessels and a large fleet of autonomous systems to study the dynamic upwelling region off West Africa. The campaign will collect high-resolution data, strengthen regional partnerships, and build knowledge for sustainable ocean use. The concept of the digital twins will turn this data into practical tools for marine spatial planning, sustainable fisheries, coastal protection, and biodiversity conservation. They will also support scientific experiments, education, outreach, and stakeholder engagement—helping to shape a new, inclusive way of managing the ocean in West Africa.

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