Where land meets the sea: How Portugal is driving change in ocean research

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TURTLE is one of the first robots fully developed in Portugal with demonstrated operati...

When El Niño formed in mid-2023, all went as expected: The rise in ocean temperatures led to crop failures, looming food shortages, floods and drought, with widespread effects on marine life along the Pacific coast. However, La Niña's effects—the cyclical natural meteorological phenomenon counterpart to El Niño, characterized by a drop in Pacific temperatures—fell short.

The result? We experienced the hottest January on record, by a significant margin.

According to the climate experts at Copernicus, January 2025 was the warmest on record globally, "despite an emerging La Niña." In the aftermath of this news, the European Union's Earth Observation Program has stated that it will closely monitor ocean temperatures: These vast masses of water absorb about 90% of the excess heat trapped by greenhouse gases.

One of the ways to understand what's happening in the oceans is to look beneath the surface, where answers to some of Europe's pressing challenges may lie. But the question remains: can the Blue Economy and emerging sectors help mitigate climate change?

One thing is certain: scientific and technological advances will play an essential role in our oceans' future, simultaneously addressing environmental challenges and developing ocean-based economic activities. A thriving marine environment sustains fisheries, promotes tourism, and contributes to climate regulation, making it essential to prioritize conservation efforts.

"Approaching the ocean from different angles, paves the way to understand how they can be perceived and exploited, and at the same time protect its ecosystems, preserving all the fauna and flora, ensuring that human activities can coexist with minimal environmental impact," outlined José Manuel Mendonça, former Chairman of the Board of Directors of INESC TEC.

Europe's commitment to leveraging the ocean as an ally against climate change prioritizes expanding offshore wind and ocean renewable energy, while protecting marine life, advancing low-emission maritime transportation, and developing greener ports.

To this effect, the European Commission has launched the "Mission to Restore Our Ocean and Waters by 2030," backed by €0.5 billion from Horizon Europe and other funding mechanisms. Inspired by the European Green Deal, this initiative aims to drive environmental restoration efforts.

A country of the sea

At Europe's gateway to the Atlantic, Portugal is positioning itself as a hub and a key player in offshore innovation and ocean exploration. Portugal has one of the largest exclusive economic zones in the world—the fifth largest in Europe—spanning more than 1.7 million square kilometers (representing 95% of the national territory). The maritime triangle between mainland Portugal and the archipelagos of Madeira and the Azores accounts for 48% of all marine waters connected to the European continent.

But it's difficult to protect what we don't fully understand—around 80% of our oceans remain unexplored. "Go deeper, stay longer" is the approach pioneered by the Institute for Systems and Computer Engineering, Technology and Science (INESC TEC) in ocean exploration.

Over the past 15 years, the institution has developed multiple projects in this sector, trying to shed light and capturing a snapshot of what lies beneath the surface. Ocean-related research represents about 10% of the Institute's activity. Over the last six years, funding for ocean-related R&D projects has increased from €4M/year (2017) to more than €13.3M/year (2022), with a team of more than 70 researchers.

In addition, INESC TEC leads major technological infrastructures, like the ocean basin Leixões BLUE HUB, CEO—Companhia da Energia Oceânica, the Marine Renewable Energy testing platform in northern Portugal, and TEC4Sea, which includes the research vessel Mar Profundo and is part of the national roadmap of scientific infrastructures.

North and South teaming up

To advance knowledge and foster innovation, Europe encourages member-states to combine efforts, establishing new centers of excellence with support from leading EU or AC partner institutions to address key societal challenges. Where land meets the sea, Portugal and Norway are joining forces to develop emerging maritime sectors, like offshore renewable energy, and address complex challenges of the Blue Economy.

This year marks a significant milestone: the launch of INESCTEC.OCEAN, the first Portuguese Center of Excellence for ocean research. INESC TEC and SINTEF OCEAN—Norway's leading center for ocean R&D and project partner—signed a Memorandum of Understanding to create a network of onshore and offshore infrastructures for developing and testing technologies, upgrading existing infrastructures, and creating new spaces for experimentation.

Led by INESC TEC, the goal is to establish a sustainable and autonomous center over the next six years. To achieve this, a consortium will collaborate to advance knowledge in ocean engineering, develop laboratories and testing sites, leverage scientific competencies in ocean engineering, train researchers, and address industry's needs.

"The idea is to create brainware and increase the knowledge in ocean engineering and research capacity, always integrating academia to drive innovation in ocean engineering-related areas. We must work closely with universities and companies, collaborate with all stakeholders, and understand the needs and challenges in different markets addressing them," said José Manuel Mendonça, who is responsible for the high-level coordination of the INESCTEC.OCEAN application.

The sea can heat our homes

Deep-sea monitoring, environmental impact assessment of human activities, and exploration of Portugal's potential in offshore aquaculture are some stepping stones to this cooperation between both R&D institutions. In the long term, the plan for INESCTEC.OCEAN is to

accelerate innovation—reducing the time from prototyping to industry application—and provide answers to pressing questions.

These include how offshore and hydrogen combinations can benefit businesses, explore how digital twins can transform the modeling and understanding of ocean systems, develop innovative and eco-friendly solutions for marine offshore structures, and transform how data is transmitted wirelessly.

The goal is for INESCTEC.OCEAN to become an international leader in ocean engineering, capitalizing on Portugal's extensive coastline. The development of an offshore wind cluster can be a "key step in strengthening Portugal's renewable energy infrastructures and reinforcing its role in Europe's clean energy transition," explained José Manuel Mendonça.

"Climate change and zero-carbon strategies worldwide are moving the energy transition to renewable energy-based solutions—including green energy vectors, where offshore renewable energy is one of the biggest potential growing markets, along with ocean exploration."

SINTEF's expertise will be crucial to this initiative. Norway's leadership in marine technology and bio-marine research was highlighted by Arne Fredheim, who represented SINTEF in Porto at the signing of the MoU. "This journey continues a more than a 1000-year traditional collaboration and trade between the two countries. Working together in the ocean domain, I am confident we will succeed in this effort and continue strengthening this partnership through further joint projects, constructive discussions, and collaborative initiatives."

Provided by INESC Brussels HUB

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