



Inside Europe's virtual ocean platform: a game-changer for marine protection

Europe is building a virtual twin of the ocean to allow scientists, policymakers and citizens to test ideas, fight pollution and protect marine life – without even getting wet.

09 September 2025 - By MICHAEL ALLEN

Imagine predicting how an oil spill will spread, or which cleanup strategy will work best, without ever touching the water. What if we could test solutions for protecting the world's oceans before putting them into action?

That vision is already becoming reality through the European Digital Twin Ocean (DTO) – an initiative where EU-funded researchers are creating a powerful virtual replica of the seas. It will be like having a high-tech ocean laboratory on your screen, ready to run what-if scenarios for real-world challenges.

“With this platform, we can anticipate challenges and act together for a healthier ocean,” said Alain Arnaud, head of Digital Ocean at Mercator Ocean International, a non-profit organisation in France that leads the DTO's development.

The latest demonstration phase of the European Digital Twin of the Ocean – its core infrastructure known as EDITO – was unveiled at the UN Ocean Conference (UNOC3) in Nice, France, in June 2025.

This promises to transform how scientists, policymakers and citizens understand and manage marine environments. Potential applications are many, from predicting pollution hazards to identifying the most efficient shipping routes across the Pacific.

Another possible use is tackling plastic pollution. EDITO can trace whether rubbish is flowing down a river or drifting in on the tide and model the best ways to stop it, from cleaning up a particular beach to tackling waste upstream.

Who's behind this ocean twin?

Behind these advanced capabilities is a network of leading European institutions.

The DTO's core technology was developed by Mercator Ocean International, running the EU's Copernicus Marine Service, and the Flanders Marine Institute in Ostende, Belgium, representing the 120 partners of the European Marine Observation and Data network (EMODnet).

They have merged these two key European ocean data systems – Copernicus Marine and EMODnet – into one scalable framework. In the future, it will be linked with the EU's "Destination Earth" digital twin of the whole planet.

The platform will recreate the ocean's past and present, as well as plausible futures, using satellite data, marine sensors, advanced simulations and AI. This will allow scientists, policymakers, and even curious citizens to experiment and make better decisions.

Arnaud described the platform as more than just a technological achievement: "It's our shared compass for navigating the future of our vital marine ecosystem."

A consortium of leading oceanographic, climate and computational science institutions across Europe is now designing next-generation ocean models that will let DTO users create real-world management scenarios. This initiative – the EDITO-Model Lab – began in 2023 and runs until the end of 2025.

Model scenarios, from pollution to turtles

The plastic pollution tracker is just one application created by the EDITO-Model Lab researchers. Several other models are also able to generate informative what-if scenarios.

These include seasonal pollution hazard maps for the Mediterranean, programmes to highlight the optimal locations for windfarms and simulations showing how different climate change scenarios will impact fish stocks. There is also a model studying the best marine habitat locations for different species, such as marine turtles.

"Starting from the beach where they hatch, we can model where they will go during their juvenile life and then their adult life, before coming back to the beach," said Yann Drillet, director of research and development at Mercator Ocean International.

This helps conservationists decide which nesting sites and marine areas to prioritise.

Accessible ocean intelligence

EDITO is a key component of the [European Ocean Pact](#), launched in June 2025 to unite all EU ocean actions in protecting the seas and promoting a thriving blue economy based on the sustainable use of oceans.

Its main strength lies in its accessibility. Large-scale models of ocean systems already exist. According to Drillet, however, EDITO offers unprecedented volumes of data and is designed for both experts and newcomers.

"Our aim is to create a digital twin that is completely open so everyone will be able to access it," he said. "Untrained users can explore basic scenarios, while advanced users can develop their own programmes using the platform's tools or their own datasets."

The DTO brings together real-time and historical observations from thousands of marine sensors and satellites. It started with the consolidation of data from the Copernicus Marine Service and EMODnet, but it aims at an even broader range of data sources, including socioeconomics.

By using AI and high-performance computing, it can model the impacts of both natural events and human activities. Users can adjust parameters to explore how different scenarios might unfold.

Optimising shipping routes

One EDITO model analyses shipping routes between America and Asia, and addresses two critical issues for shipping: time and fuel efficiency.

“We show how to optimise the journey across the Pacific from the US west coast to Asia using environmental information,” said Drillet.

Maritime traffic produces 3–4% of the EU’s total CO2 emissions each year. By factoring in ocean currents and weather, the DTO can suggest routes that cut fuel use, emissions and costs.

The EDITO-Model Lab research has also headed in the direction of Japan, where it is being showcased at the World Expo in Osaka (April–October 2025).

Visitors will have a chance to explore the marine plastic pollution simulation, as well as another that models the best places to develop seagrass meadows for coastal protection in the Adriatic Sea and along the German North Sea coast.

A new wave of marine research

By simplifying and modernising how ocean simulations are built and run, EDITO should facilitate more marine research, said Lórinč Mészáros from Deltares, an independent, not-for-profit applied research institute in Delft, the Netherlands.

“It enables ocean scientists to work with modern cloud-based technologies, even if they are not well versed in ICT,” he said.

The hope is that researchers and policymakers will use the platform to explore effective, sustainable ways to protect marine and coastal habitats, support the blue economy and respond to climate change.

By 2030, the DTO is expected to be operational, offering an even more powerful decision-support system for tackling global marine challenges.

As Arnaud put it, “with this platform, we can anticipate challenges and act together for a healthier ocean.”

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Showcasing EU research at the World Expo

Osaka, Japan

13 April – 13 October

This summer, millions of people from around the world will head to Osaka, Japan, for **Expo 2025**. At this global gathering, countries and regions will share how they’re tackling some of today’s biggest challenges, from sustainability and digital connectivity to inclusivity and security.

The central theme of this year’s event is **Designing Future Society for Our Lives**. Visitors will get a chance to see how **EU-funded research** is helping shape that future.

The EU pavilion is hosting exhibitions, talks and interactive experiences that spotlight **cutting-edge EU research and innovation projects** – all aimed at solving real-world problems and building international cooperation. Whether you're curious about the future of clean energy, digital tech, or inclusive design, there's something for everyone.

The **EDITO-Model Lab** research will be featured in the EU Pavilion, where visitors will be able to engage with an interactive avatar (in English and Japanese) that explains the functioning, benefits and applications of the EU Digital Twin Ocean, including managing marine plastic pollution and coastal hazards via what-if scenarios.

The EU Digital Twin Ocean will be a particular highlight of **The Future of Earth and Biodiversity Week** from 17 to 28 September 2025.

Virtual visit

Can't go to Osaka? Explore the Expo online at:

<https://www.expo2025.or.jp/en/future-index/virtual/virtual-site/>

More info

- [EDITO-Model Lab \(CORDIS\)](#)
- [EDITO-Model Lab project website](#)
- [European Digital Twin Ocean \(EDITO\)](#)
- [European Digital Twin of the Ocean \(European DTO\)](#)
- [EU Mission Restore Our Ocean and Waters by 2030](#)
- [EU Marine Strategy Framework Directive](#)
- [Integrated Maritime Policy](#)
- [The European Ocean Pact](#)