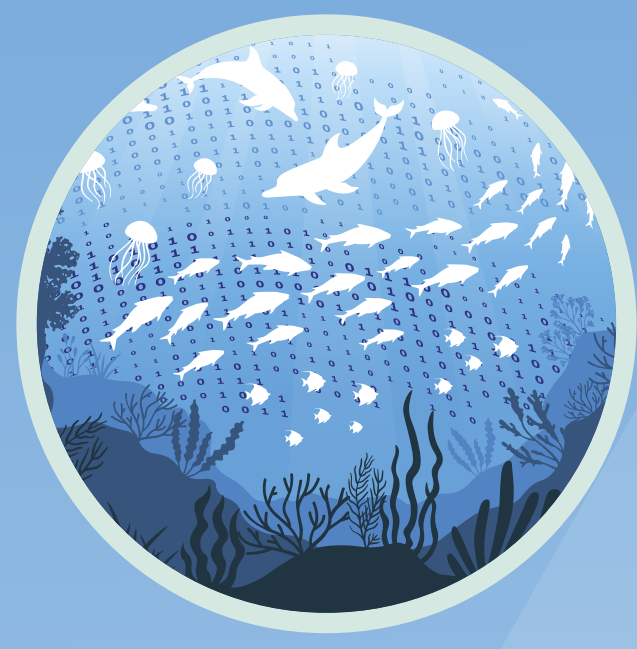




DTO-BioFlow

Integration of biodiversity monitoring data into the Digital Twin Ocean

From data source to user application DTO-Bioflow Concept

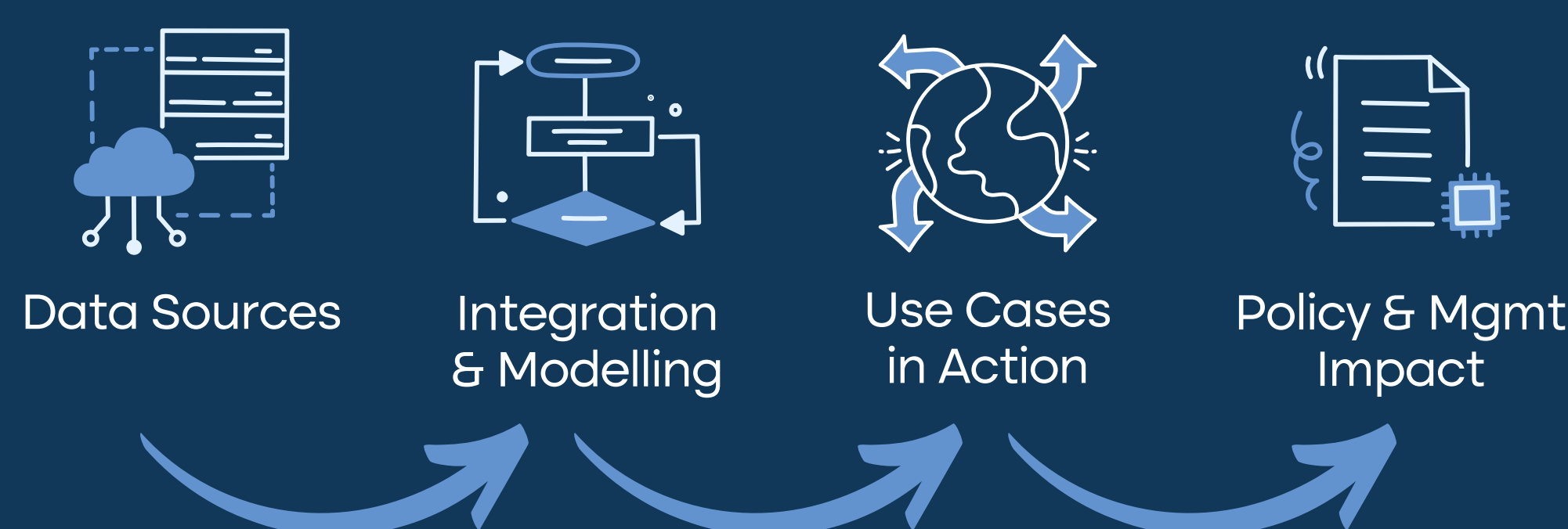
Two Data Calls resulted in 19 projects that were awarded grants to enable ingestion of previously inaccessible data and the development of sustained flows into EMODnet and EDITO, the public infrastructure of the European Digital Twin Ocean. Best practices guidelines for data generation, quality control and formatting have been created and sustainable flows to EDITO are being built for different types of biodiversity data (genomics, imaging, biologging, passive acoustics, citizen science, industrial activities and literature-based).

Revolutionising Access to Ocean Biodiversity Data and Driving Sustainable Integration

DTO-BioFlow facilitates the access to "sleeping" marine biodiversity data and enables **the sustained flow of these and new data via primary integrators and EMODnet into the European Digital Twin Ocean.**

It will create a **digital replica of marine biological processes and build capacity among data providers and the community through training, access to resources, financial support and outreach.** The project aligns with the EU's Biodiversity Strategy and Nature Restoration Law and with the EU Mission: "Restore our Ocean and Waters", both of which advocate for the protection and restoration of land and sea regions.

From Insight to Impact



The Demonstrator Use Cases (DUCs) are at the heart of the DTO-BioFlow initiative, translating complex scientific capabilities into tangible digital solutions for marine biodiversity monitoring and management.

Designed to showcase the power of an **end-to-end digital approach**, these use cases connect cutting-edge biodiversity observations with AI-enhanced models, analytical tools, and the infrastructure of the EDITO.

Each DUC serves as a living example of how real-world marine challenges can be addressed through integrated digital workflows. They all address a pressing challenge for ocean sustainability and proposes an integrated, evidence-based solution.



Marine Non-Indigenous Species (NIS) Management

Marine Non-Indigenous Species (NIS) are a major threat to marine ecosystems and biodiversity across Europe. Early detection, forecasting, and rapid response are essential tools to prevent their spread. This DUC focuses on **using genetic monitoring, citizen science, and environmental data** to provide **early warnings** and **predictive models** for **managing NIS** in Europe's coastal regions.



Impact from Off-shore Infrastructure

The expansion of offshore infrastructure (such as wind farms, energy cables, and subsea installations) introduces new pressures on marine biodiversity. This use case explores how these human-made structures affect species movement, connectivity, and behavior, especially for mobile species like fish and marine mammals. The goal is to support **adaptive planning** and **low-impact infrastructure development** by integrating biodiversity knowledge into the early stages of marine spatial planning.



Assessing Pelagic Biodiversity and Human Impact

Plankton play a foundational role in ocean ecosystems and are highly sensitive to environmental change. This use case enhances biodiversity assessments by integrating traditional microscopy, automated imaging, and genetic methods to **better track plankton diversity** and **assess how it is affected by human pressures** such as climate change and pollution.



Spatial Planning of Sustainable Mariculture

Aquaculture is a rapidly expanding sector with high potential for sustainable food production, but it must be carefully managed to avoid environmental harm. This use case supports **data-driven spatial planning for mariculture** by integrating environmental, biological, and eDNA data to identify optimal farm sites, minimize ecological risks, and promote ecosystem-based aquaculture.



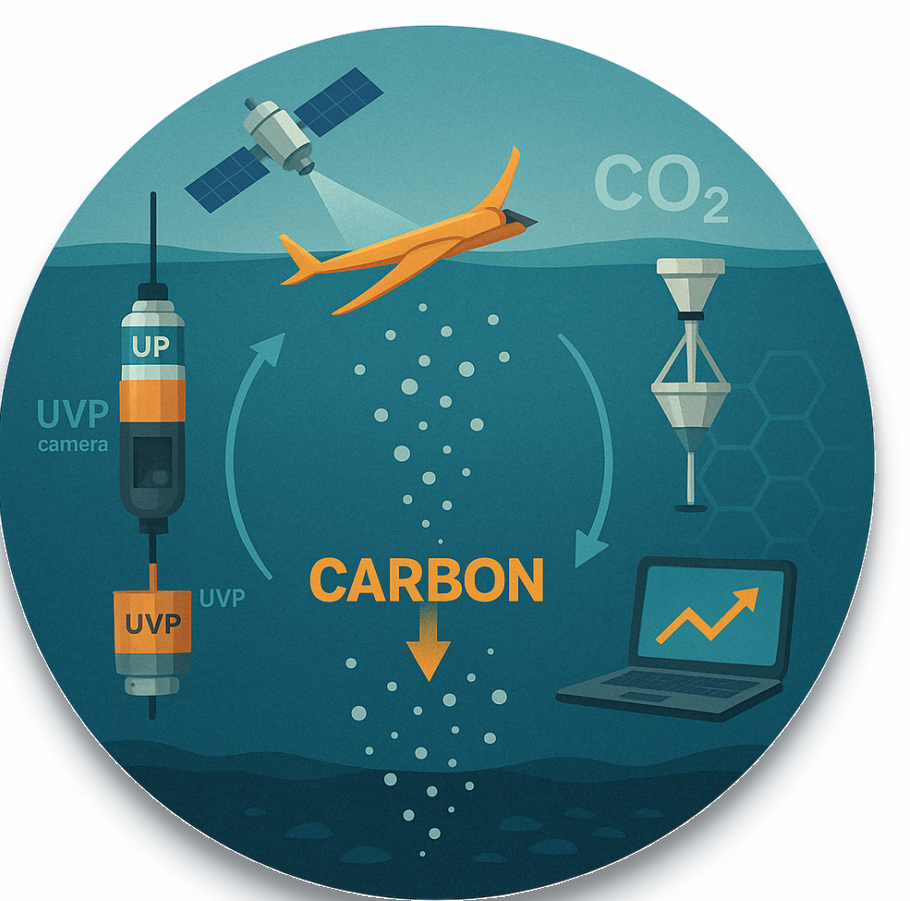
Ecosystem-Based Spatial Planning & MPA Management

Marine habitats provide vital ecosystem services—such as carbon sequestration, habitat buffering, and biodiversity support, but species-level traits underpinning these services remain largely unlinked to spatial planning and MPA design. This use case builds a **species-traits database** to map benthic biodiversity to ecosystem services, enabling more informed and ecosystem-based marine spatial planning.



Lower-Trophic Level Biomass Monitoring for Ocean Governance

Zooplankton such as Calanus species form a vital link in marine food webs and act as key indicators of ocean health. This use case builds a continuous **monitoring system to track plankton biomass** at high resolution using acoustic and optical sensors, supporting data-informed governance decisions like fishing quotas and marine traffic management.



Ecosystem Services Including Carbon Sequestration

The ocean plays a vital role in the global carbon cycle by capturing CO₂ through the biological carbon pump. This use case develops a **global 3D/4D carbon flux product** by integrating particle size and concentration data from UVP sensors with existing carbon export measurements, supporting policy, climate models, and governance of marine carbon removal approaches.



Machine Learning for Ocean Colour Seasonal Forecasting

Chlorophyll-a and primary production are key indicators of marine ecosystem health, carbon cycling, and fisheries productivity. This use case applies machine learning to **improve seasonal forecasting of these variables**, supporting more effective monitoring and marine management.



Want to share your data and contribute to the European Digital Twin of the Ocean, but you are not sure how? **Explore DTO-BioFlow publications on our website.**

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