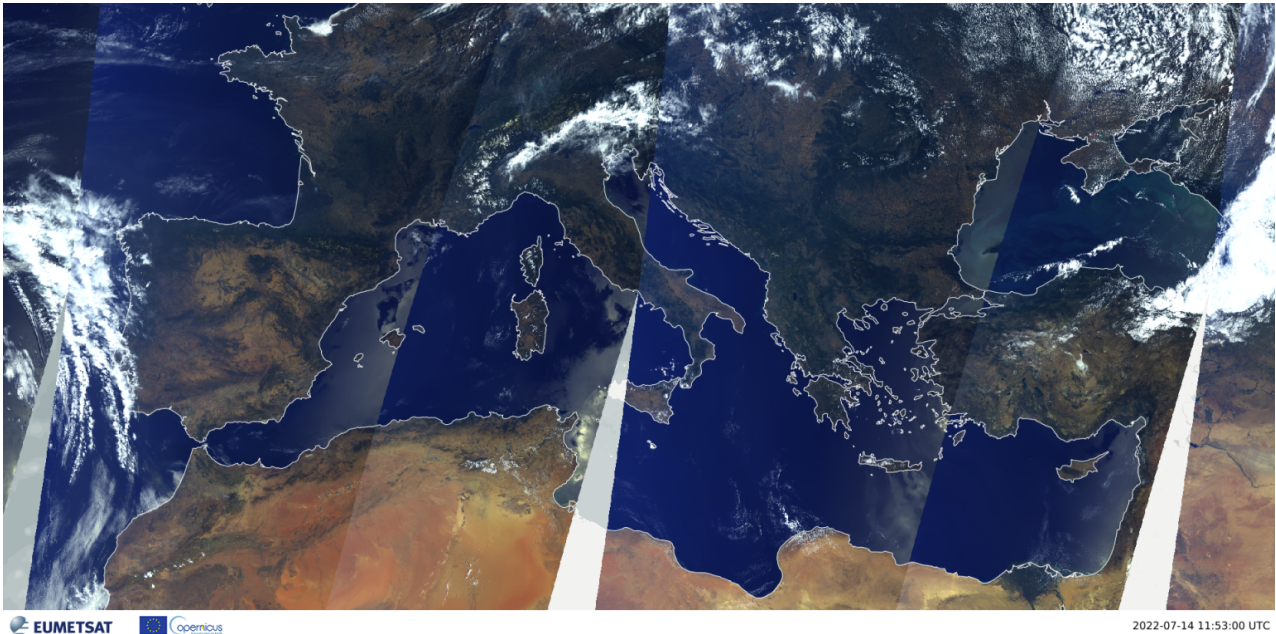


PETRI-MED: Enhancing marine phytoplankton diversity monitoring in the Mediterranean

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1-day RGB composite image of the Mediterranean Sea as observed by Sentinel 3A and 3B on July 14th, 2022. ©EUMETSAT [2024]

Preserving biodiversity is crucial for sustaining life on Earth. Unfortunately, it is facing growing threats. Marco Talone and the PETRI-MED Team discuss their objectives for the PETRI-MED project and explain why it is urgently necessary

Why is marine biodiversity important? And why focus on phytoplankton?

Marine biodiversity is crucial for maintaining healthy and resilient ecosystems. The variety of life forms in our oceans—from microscopic plankton to giant whales—plays a key role in sustaining ecological balance. Each species contributes to ecosystem services such as oxygen production, carbon sequestration, and nutrient cycling, which are vital for the planet's health. Marine biodiversity also supports the global food web, providing a primary source of protein for over three billion people. Additionally, it contributes to the blue economy through fisheries, tourism, and biotechnology. Lastly, healthy marine ecosystems are better equipped to withstand and recover from environmental changes and human impacts, such as climate change and pollution. Among the various life forms inhabiting our ocean, phytoplankton is one of the most important.

It forms the foundation of marine ecosystems, being at the base of the oceanic food web and supporting a diverse array of marine organisms. Through photosynthesis, phytoplankton produces about 50% of the world's oxygen, at the same time absorbing carbon dioxide from the atmosphere and helping to mitigate climate change. Phytoplankton is also a key player in nutrient cycles, recycling essential elements like nitrogen and phosphorus, which are vital for the growth and health of marine ecosystems. Monitoring microbial plankton diversity and abundance provides valuable insights into the overall health of marine environments.

Why the Mediterranean Sea?

The Mediterranean Sea is a crucial marine and coastal biodiversity hotspot, providing essential ecosystem services such as carbon storage, food provision, and wellbeing to millions of people. In the last decades, the Mediterranean marine ecosystem has faced severe threats due to human activities and global changes. These include overexploitation of fisheries, maritime traffic, pollution, coastal development, and climate-induced events like heat waves, leading to a considerable loss of biodiversity and making it imperative to implement effective conservation and restoration measures.

What will PETRI-MED do?

The PETRI-MED project aims to significantly advance marine biodiversity assessment by integrating genomic data, satellite observations, and Artificial Intelligence (AI) technologies. Its innovative approach will offer crucial insights for ecosystem management and conservation efforts in the Mediterranean Sea. It aims to enhance our understanding of marine biodiversity and support sustainable management of marine ecosystems.

The main objectives of PETRI-MED are:

- Develop novel satellite-based indicators to monitor the status and trends of microbial plankton community composition and biodiversity across the Mediterranean Sea;
- Identify spatiotemporal patterns in the distribution and diversity of microbial plankton communities; and
- Understand key natural and human-related factors influencing biodiversity patterns, including ecological connectivity, river runoffs, marine currents, and coastal ecosystem usage.

How does PETRI-MED plan to achieve its objectives?

PETRI-MED will employ a multidisciplinary approach that integrates satellite observations, field measurements, biogeochemical and ecosystem modeling, and Artificial Intelligence (AI) technologies. This comprehensive strategy enables a detailed and holistic assessment of marine biodiversity, addressing the complexity of marine ecosystems and their dynamic nature. The project will develop two AI-based algorithms:

1. Global open-water Mediterranean Sea diversity index algorithm:

This algorithm uses multi-spectral satellite ocean color data and physical/biogeochemical variables to generate a comprehensive diversity index based on phytoplankton groups; and

2. Region-specific algorithm:

Tailored to specific regions, this algorithm incorporates metabarcoding and metagenomics data to focus on microbiologically-driven ecosystem functions relevant to each area, considering key regional physical indicators like cross-shore and along-shore transport indices.

How will PETRI-MED support policymakers and stakeholders?

In alignment with international directives and recommendations such as the [EU Biodiversity Strategy for 2030](#), the [European Green Deal](#), the [Convention on Biological Diversity](#),

the [Sustainable Development Goals of the UN Agenda 2030](#), the [UN Decade of Ocean Science for Sustainable Development \(2021-2030\)](#), and the [Intergovernmental Platform on Biodiversity and Ecosystem Services \(IPBES\)](#), PETRI-MED will provide policymakers and stakeholders with the necessary knowledge to:

- Adopt prioritization approaches:
Implement ecosystem management strategies based on quantitative and real-time metrics;
- Design protection strategies:
Develop policies to protect and enhance ecosystem biodiversity;
- Quantify action results:
Assess the effectiveness of conservation actions at European, basin, and local levels;
- Manage Marine Protected Areas (MPAs) systematically:
Enable fact-supported, area-based management of MPAs, which can also be applied in Key Biodiversity Areas (KBAs) and Ecologically or Biologically Significant Marine Areas (EBSMAs); and
- Evaluate MPA viability:
Assess the management of MPAs in response to climate change using long-term data records and future forecast model outputs.

How to engage with PETRI-MED?

Facing the biodiversity crisis of our planet, and in particular, in the Mediterranean Sea, requires a joint effort of science and society. Thus, engaging stakeholders and ensuring efficient information flow between users, scientists, and policymakers is crucial for the success of PETRI-MED. This engagement will help ensure that the project's findings and recommendations are effectively implemented. MPA managers and regional and national policymakers are encouraged to visit our project [webpage](#) and contact us to join our stakeholder list.

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