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PETRI-MED: Advancing Satellite-Based Monitoring for Microbial Plankton Biodiversity in the Mediterranean Sea

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The assessment and monitoring of microbial plankton biodiversity are essential to obtain a robust evaluation of the health status of marine environments. The PETRI-MED project addresses this imperative by developing novel strategies to monitor the microbial plankton community composition and function, based on satellite observations. PETRI-MED will focus on the Mediterranean Sea as a global biodiversity hotspot with profound ecological and cultural importance. The primary objectives of PETRI-MED project encompass (i) the development of innovative satellite-based indicators to determine the biodiversity status and trends of microbial plankton community, (ii) the identification of spatio-temporal patterns in microbial plankton distribution and diversity, and (iii) the elucidation of key controls of biodiversity patterns, including ecological connectivity, natural and human-related forcings, by focusing on key indicators of ocean's health and/or biogeochemical state. To do so, PETRI-MED will largely rely on satellite optical radiometric measurements (i.e, Ocean Colour, OC), exploiting the combined temporal and spatial characteristics of latest OC European datasets (i.e., Copernicus Sentinel-3 and European Space Agency OC-CCI) with state-of-the-art remote sensing observations and biogeochemical models (as provided by Copernicus Marine), marine currents modelling, and genomic techniques. To achieve the ambitious goal of merging remote sensing, biogeochemical/physical modelling, and *in situ* omics measurements, PETRI-MED will rely on Artificial Intelligence (AI). The overarching goal of PETRI-MED is to empower policymakers and stakeholders with the necessary knowledge to adopt prioritization approaches for ecosystem management based on quantitative, real-time metrics. This includes the design and implementation of protection strategies and policies to safeguard biodiversity, quantifying the impact of implemented actions at various levels, and enabling systematic, fact-supported management of Marine Protected Areas (MPAs), Key Biodiversity Areas, and Ecologically or Biologically Significant Marine Areas. Furthermore, PETRI-MED seeks to evaluate the viability of MPA management in response to climate change, ensuring adaptive strategies for the conservation of marine ecosystems in the face of environmental challenges. In summary, PETRI-MED represents a comprehensive and innovative approach to advancing our understanding of microbial plankton biodiversity in the Mediterranean Sea. Through the integration of satellite technology, omics techniques and AI, the project contributes valuable insights and tools for effective marine ecosystem management and conservation strategies.

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