Differences between DOME and other Decade-endorsed programmes

DOME will build an international network of research platforms, using observational, experimental, modeling, and technological approaches to study deep-ocean microbiomes and ecosystems (DOMEs) of both the water column and seafloor sediment biosphere in all ocean basins, to determine microbial genetic and functional diversity, and how microbial diversity influence ecosystem functions in response to climate change. There are fundamental differences in scale, scope, and outcomes between DOME and other Decade-endorsed programmes, e.g., Challenger 150, DOOS, GEOS, GOOD, DITTO, POGO, OBON, Digital DEPTH, SmartNET, TOWER, Global ONCE, Marine Life 2030, etc., as shown below. For example, Challenger 150 focuses on the water column deeper than 2,000 m, and study primarily animals rather than microbes. DOME is unique in that it will characterize microbial diversity and ecosystem processes in the water column as well as sediment biosphere of the deep ocean. GEOS is a solution-oriented programme, focusing on reducing and removing CO_2 from the ocean and repairing critical ecosystems. TOWER focuses on the Twilight zone of the West Pacific, rather than all deep ocean ecosystems in all five oceans. The OBON programme studies life "from viruses to whales" "from coastal areas to open ocean", from viruses and whales. Digital DEPTH focuses on specific deep-sea habitats, like seamounts, cold seeps, etc., rather than the seafloor biosphere and all the deep-water columns. DOME adopts the biodiversity-ecosystem functioning paradigm and stands alone in that it studies all ecosystems in the deep ocean of all ocean basins, particularly focuses on studying the three currencies of life (energy, matter, and information) and their transfer and interconversions within and among deep ocean ecosystems.

The current Ocean Decade-endorsed programmes and projects do not cover either all ocean basins or all depths, let alone the seafloor sediment biosphere. DOME is a globally coordinated and inclusive large-scale deep ocean programme, complementary to and will create positive synergies with existing Decade-endorsed programmes.

A comparison of DOME with other Decade-endorsed programmes and projects

Name	Scale	Scope	Outcomes
DOME	➢ All 5 oceans; ➢ All depths below 1,000 m; ➢ The seafloor sediment biosphere included; ➢ Will also make the connections in selected studies (e.g., OMZs, OAEs) between deep ocean ecosystem processes and shallow sea parameters; ➢ Microbial genetic resources and ecosystem processes and functions are determined.	➢ Map microbial genetic and functional diversity and ecosystem processes of deep ocean microbiomes and ecosystems; ➢ Assessing the present and future health state and carrying capacity of the oceans	➢ Deep ocean microbial genetic, metabolic, and functional diversity, and life processes in the water column and seafloor sediment are characterized; ➢ Digitalized catalogs and atlases of deep ocean microbiomes and ecosystems are produced; ➢ Cumulative human impact indexes are derived and genome-enabled, process-based models have been built to reveal the current health state and predict the evolution, future state, and carrying capacity of ocean ecosystems in facing global climate change.
Challenger 150	➢ Focuses on the southern and polar latitudes, ➢ Below 2,000 m depth in the midwater environments. ➢ Not including the seafloor sediment	➢ A vehicle for coordination of deep-sea research that advances understanding of deep-sea life (mainly animals, rather than microbes), and their functions and services to human society	➢ Build capacity for deep-sea research globally; ➢ Expend deep-sea biological observations; ➢ Build fundamental ecological understanding; ➢ Increase use of deep-ocean knowledge.

	biosphere.		
DOOS	➢ Aiming to the ocean below 2,000 m depth, ➢ Focusing on forming a network of networks for ocean observation. ➢ Not including the seafloor sediment biosphere.	➢ Create a network of networks and act as an agent to coordinate existing deep observing effort; ➢ Act as an integrator to create linkages among research, intergovernmental, industry, regulatory, and funding agencies to achieve deep-ocean societal objectives through science; ➢ Fostering observing objectives and demonstrating integrated approaches at multi-use, multi-disciplinary sites.	➢ Setting for a fit-for-purpose deep-ocean observing system that meets the needs of science and society; ➢ Implementing deep-ocean observations; ➢ Transferring scientific knowledge to stakeholders including business, policy makers, and civil society to promote science-based decision making; ➢ Designing activities to develop the next generation of deep ocean observing leaders and advance frameworks that promote the Findability, Accessibility, Interoperability, and Reusability.
GEOS	➢ A solution-oriented programme, focusing on developing CO_2 removal technologies, the seafloor sediment biosphere not included.	➢ Develop, testing, and deploy a series of equitable, durable, and scalable ocean-based solutions for addressing climate change and Ocean Decade's challenges.	➢ Convene a global multi-sector community; ➢ Build the capacity for co-developing new decade projects to address equitable system-level ocean solutions; ➢ Act to prototype, accelerate and fund ocean science-based solutions; ➢ Empower, connect and train the next generation of ocean leaders and professionals.
GOOD	➢ Main differences: focusing on the shallow sea; the seafloor sediment biosphere not included.	➢ Raise global awareness about ocean deoxygenation, provide knowledge for action and develop mitigation and adaptation strategies and solutions.	➢ Increase capacity to measure, document, map, monitor and understand ocean deoxygenation; ➢ Provide indicators and related methodologies to agencies and industries to ensure safe operating spaces and extension of the concepts of planetary boundaries and planetary health to marine oxygen;

			➢ Provide actionable strategies to mitigate and adapt to ocean deoxygenation on local to global scales.
OBON	➢ At fixed ocean locations, e.g., HOT, BATS, Monterey Bay, Western Channel Observatory (English Channel), coastal and fixed observatories; ➢ Not in all ocean basins; ➢ Not at all depths.	➢ Uses techniques to analyze biomolecules to greatly enhance coastal and open ocean biodiversity observations.	➢ Build a coastal-to-open ocean biodiversity observing system through the collection, analysis and archival of biomolecules and reference samples from fixed locations (e.g., the HOT and BATS); ➢ Develop and transfer capacity so as to initiate additional marine biomolecular observation activities; ➢ Enhance marine ecosystem models by adding biomolecular components; ➢ Address pressing scientific, management, and policy questions.
DITTO	➢ Main differences: creating a digital representation of environmental processes or systems; ➢ The seafloor sediment biosphere not included.	➢ To build a world where Digital Twins of the Ocean are used to support ocean protection, ocean governance, and a sustainable blue economy.	➢ Support the development of digital twins of the ocean as "a realistic digital representations of assets, processes or systems in the built or natural environment". ➢ Enable users and partners to create their own digital twin of the ocean to answer "what if" questions in support of a wide range of use in the context of ocean development addressing issues such as development of a sustainable Blue Economy and effective Maritime Spatial Planning.
POGO (A Decade Implement	➢ South Pacific Ocean; ➢ Main differences: not all ocean basins;	➢ Assist in bridging the gap between developed and developing countries, making use of low-cost/open access	➢ Coordinating existing Decade actions ➢ Catalyzing new initiatives; ➢ Leading targeted communications and outreach, and

ing Partner)	➢ not all depths, ➢ not seafloor sediment biosphere.	technologies; ➢ To support and/or coordinate actions in respond to Decade calls for collaborative programmes and projects between POGO members and other parties; ➢ To support Decade communications and outreach effors.	mobilizing resources.
TOWER (a project of the JETZON programme)	➢ The twilight zone of the North Pacific Ocean; ➢ Not all oceans; ➢ Not all depths; ➢ Not seafloor sediment biosphere.	➢ Obtain high-standard multiple temporal and spatial data of formation and dynamics of ecosystems in the twilight zone of the Western Pacific Ocean and particularly, of the South China Sea	➢ In-situ observation and imaging processing for suspended particles and organisms at different size scales in twilight zone; ➢ In situ activities of organisms in the twilight zone of the Western Pacific region; ➢ Understanding the ecological resources and challenges in the twilight zone; ➢ Providing a baseline ecosystem assessment for reference by the countries involved.
SmartNET	➢ Build a network of networks for studying areas of mutual interests for all partner organizations.	➢ Establish a global knowledge network for ocean science by strengthening and expanding the collaboration of ICES/PICES and partner organizations	➢ Support and leverage ICES/PICES member countries' activities related to UN Decade of Ocean Science, by emphasizing areas of mutual research interest including climate change, fisheries and ecosystem-based management, social, ecological and environmental dynamics of marine systems, coastal communities and human dimensions, and communication and capacity development; ➢ Incorporates strategies to facilitate the Ocean Decade's cross-cutting inclusivity themes relating to

			gender equality, early career engagement, and involvement of indigenous communities and developing nations in the planning and implementation of joint activities
Digital DEPTH	➢ Focusing on studying 4 types of deep-sea habitats: seamounts, mid-ocean ridges, continental slopes, and abyssal plains; ➢ Main differences: focusing on studying the 4 types of habitats and ecosystems in the deep sea, but not microbial genetic diversity; ➢ Not in the seafloor sediment biosphere.	➢ Observe, simulate, and map these deep-sea typical habitats	➢ Use advanced technology to carry out deep-sea research, build intelligent observation systems, and promote sharing of data and samples; ➢ Develop mapping and numerical simulation techniques to reveal multi-scale cross-habitat connectivity and information transfer processes; ➢ Build an "observation-simulation-prediction" digital platform to provide "digital deep-sea habitats atlas" as public products and to update deep-sea area-based management tools; ➢ Exchange knowledge and experience in deep-sea science and management with young generation, especially those from SIDS, LDCs, and LLDCs.
Global ONCE	➢ Main differences: focusing on carbon sequestration in the ocean; ➢ Focusing on life in the water column, but not in the seafloor sediment biosphere.	➢ Undertake and facilitate the science required to evaluate and implement eco-technological interventions, including learning from paleo-oceanic carbon processes to predict the future, restoring impacted marine ecosystems, fostering nature-based systems of land-sea integrated management, upwelling	➢ Develop an international network of field stations and research facilities; ➢ Co-design interdisciplinary collaborative research; ➢ Develop an evaluation framework for mitigation and adaptation approaches; ➢ Co-ordinate capacity building; ➢ Facilitate equitable policy, governance and societal understanding.

		manipulation, microbial-driven comprehensive carbon sequestration, adjustment of nutrients, DO and pH.	
➢ Marine Life 2030	➢ Main differences: focusing on diversity of life, but not ecosystems processes; ➢ Focusing on life in the water column, but not in the seafloor sediment biosphere.	➢ It will build a network of networks to link technical, management and policy stakeholders to build and exchange capacity for advancing society's grand challenges of managing activities for a healthy and resilient ocean and the vibrant and healthy society that depends on it.	➢ Convene stakeholders to chart the course together, implementing equitable management for long-term coordination and financing of global marine life observation and applications; ➢ Leverage emerging innovation to democratize marine life knowledge, using 'omics, acoustics, imaging, and AI, and a sequence-based Ocean Biocode of global marine species; ➢ Integrate biodiversity into a global ocean observation system by establishing and promoting interoperable biodiversity standards and best practices, integrating with other disciplines; ➢ Apply enhanced knowledge of marine life to co-develop solutions, informing conservation and sustainable use of marine life by trained stakeholders in every coastal nation.

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