

The conditions related to this topic are provided at the end of this call and in the General Annexes.

LC-GD-9-3-2020: Transparent & Accessible Seas and Oceans: Towards a Digital Twin of the Ocean

Specific Challenge: Fit for purpose and sustained ocean and sea observations are essential for understanding and forecasting ocean behaviour. Measures to protect marine social-ecological systems and support the blue economy are based on these insights and forecasts. 10-20 years ago, marine data from these observations were difficult to find, only accessible through long and sometimes costly negotiations and hard to put together to create a complete picture because of different standards, nomenclature and baselines.

For the past two decades, the European Union invested in policies and infrastructures to enable this sustainability and fitness for purpose. Its Member States, together with neighbours, have created an unrivalled marine data, modelling and forecasting infrastructure, essentially based on EMODNet – the European Marine Observation and Data Network - gathering in-situ and reference ocean data in Europe and the Copernicus marine environment monitoring service (CMEMS) providing European and global operational ocean forecasting and ocean climate services based on the assimilation of these in-situ ocean observation into numerical ocean models. They are supported by European Research Infrastructures and by major R&D projects to deploy ocean observatories at sea and collect marine data (e.g. Eurofleets+, EuroArgo, Jerico, Danubius, EMBRC, EMSO, ICOS, LifeWatch, etc). Cooperation and the principles of free and open access, interoperability, and “measure once, use many times”, were largely promoted, as well as the added-value demonstrated through Copernicus, the European Research Framework Programmes FP7 and Horizon 2020, Blue Cloud and EMODnet activities.

The Digital Twin of the Ocean concept is to make a step further by integrating all European assets related to seas and oceans (data, models, physical ocean observatories at sea) with digital technologies (cloud, super HPC capacities, AI and data analytics) into a digital component that represents a consistent high-resolution, multi-dimensional and (nearly) real-time description of the ocean. It will contribute to the Commission’s Green Deal and Digital Package commitments to develop a very high precision digital model of the Earth (Destination Earth initiative).

AI and analytics, thematic or sectorial models and computing power will transform data into knowledge. They will facilitate co-creation and inter-disciplinary approaches between natural sciences, humanities and social sciences for the co-construction of methods, expertise and applications to support decision making. This digital view of the ocean will enable a multi-angle perception of the ocean: its physics, chemistry, geology, biology as well as the environmental and socio-economic impact of human activity.

It will be a simulator to test scenarios that deal with different evolutions of the ocean environment. It will empower citizens, governments and industries to collectively share the responsibility to monitor, preserve and enhance marine and coastal habitats, while supporting

also a sustainable blue economy (fishing, aquaculture, transport, renewable energy, etc.). It will enable measures to increase resilience to climate change, improve disaster risk management, develop spatial plans, report on the state of the environment, coastal or offshore activity and measure its impact.

Scope: Proposals for such a development should demonstrate their usefulness with regard to Green Deal priorities (e.g. impact of ocean climate scenarios on aquaculture and fisheries, impact of sea-level rise and extreme waves on coastal risks, pollution monitoring and scenarios for mitigation and remediation strategies, and maritime spatial planning). It needs to fulfil all of the following criteria: deliver break-through in accuracy and realism, represent optimal synergy between observations and models; fully integrate downstream impact sectors of the socio-economic areas addressed in their test case; include a rigorous handling of quality and confidence information.

Proposals should address:

- The development of an ocean digital twin at high resolution including the ocean model representation and the integration of all available datasets into a single digital framework compatible of Destination Earth infrastructure and technologies (cloud, euroHPC, AI-ready standards, datacubes, ...). It should build on existing infrastructures and relevant Horizon 2020 and R&D projects to achieve this integration at short-term (e.g. CMEMS, BlueCloud, EMODNet, portals from ERICs, IMMERSE, ESA Ocean Science Cluster);
- The configuration of it as a simulation environment built on a consistent multi-variable multi-dimensional description of the ocean consistent from estuaries to the coast and to open ocean, from the surface to the seabed and allowing a digital exploration in time and space of the ocean physics and biodiversity according to different scenarios. It should provide an integrated, timely and persistent description of the ocean including at least physics, biogeochemistry, geology and human activities;
- The integration of data from existing or new automated sensors and autonomous mobile and fixed platforms, additional structured and unstructured data, alternative sources such as private companies data, citizen science or historic data collected before the digital age (chemical, physical, biological and ecological) and delivered through EMODnet and Copernicus;
- The implementation of data and model outputs in state-of-art standards and formats (INSPIRE, FAIR, ontologies, ...) compliant with their exploitation by applications and appropriate user interfaces based on big data and artificial intelligence technologies;
- The development of what-if scenarios to validate the representativeness of the digital ocean simulator in “real conditions of use” by configuring different ocean conditions and exploiting AI/data analytics tools, on concrete cases in local or regional sea basins.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 12 million would allow this specific challenge to be addressed appropriately.

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. In line with the Union's strategy for international cooperation in research and innovation, international cooperation is encouraged.

Expected Impact: The action will deliver a digital interactive framework based on digital technologies compatible of Destination Earth and the Digital Package including an digital ocean simulator based on a high-resolution numerical model of the ocean, including available ocean observation datasets in Europe and digital analytic toolboxes to configure the digital ocean simulator and to access what-if scenarios.

This will enable:

- Complementing the core European existing operation ocean forecasting and ocean climate services provided by Copernicus to European public, scientific and private users, with a simulation capacity that will enable the plug-in of vertical applications based on innovative solutions (sectorial methods, coupled models, statistical approaches, assimilation, ensembles, massive computing, deep learning, ...) to support science-driven policies implementation;
- Moving towards a European Ocean Observing System, fully integrated with multidisciplinary observatories of estuarine, coastal and marine environments and socio-ecological systems, and promoting shared data management strategies (infrastructure development, data standardization, sharing, availability, access, interoperability, visualisation and use of data according to the FAIR principles).

It will:

- Support science-driven approaches to policies implementations by users that reinforce conservation and ecosystem-based management of marine habitats/green infrastructure, improve the planning and management of marine areas, and safeguard productivity and biodiversity of marine ecosystems and how this is influenced by the river-to-sea interaction;
- Increase citizen engagement, taking into account cultural and emotional aspects, through increased awareness and understanding of the dynamics, interactions and evolution of seas and oceans and their role in our well-being and survival, and promoting bottom-up actions, empowering citizens in innovative co-designed services and new project designs where citizens' opinions are considered from the initial stages;
- Encourage and enable the infusion of 'non-scientific data streams', in a coordinated way, through citizens engaged in data gathering, and through joint efforts from a community composed of users of the sea, including private companies, public authorities, social innovators, researchers, citizens and policy makers;
- Support industry to develop new business models and opportunities in ocean data and related services.

- Facilitate the operationalising of long term observing systems and contribute to the objectives of the UN Decade of Ocean Science for Sustainable Development.

Type of Action: Innovation action

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Area 10: Empowering citizens for the transition towards a climate neutral, sustainable Europe

The European Green Deal communication stresses that the transition towards sustainability must be just and inclusive, put people first and bring together citizens in all their diversity. This calls for citizen engagement and social innovation in all areas of the European Green Deal. This also requires ambitious cross-cutting actions to engage and empower people and communities and to support behavioural, social and cultural changes wherever this is most needed for a fair and inclusive transition, leaving no-one behind. Such actions must address change at the collective level through participatory processes and experimental research on behavioural, social and cultural change; and at an individual level by empowering citizens as actors of change, including through the co-creation of R&I contents ¹⁶⁵.

Activities under this area will be implemented through three different topics addressing both collective level actions (topics LC-GD-10-1-2020 and LC-GD-10-2-2020) as well as individual level actions (topic LC-GD-10-3-2020)

Proposals are invited against the following topic(s):

LC-GD-10-1-2020: European capacities for citizen deliberation and participation for the Green Deal

Specific Challenge: All areas of the European Green Deal, from climate action to zero pollution, require citizens' active support at all stages of the transitions. Workable solutions, accepted and taken-up at scale, can only be found through the active participation of all concerned. This is particularly the case of complex issues with diverging views or interests at stake, such as the rural-urban gap, attitudes to the bio-economy, water management, the choice of energy sources, etc. Such issues can best be addressed through participatory processes involving citizens from different cross-sections of society across Europe, including by engaging them throughout the innovation life cycle¹⁶⁶ as social innovators. The Conference on the Future of Europe has further heightened awareness of the need for participatory processes and raised expectations in this respect. Strong expectations of citizen participation have also been raised in the context of Horizon Europe preparation, in particular for Horizon Europe Missions, which will be highly relevant to the European Green Deal.

¹⁶⁵ See UN Global Sustainable Development Report 2019, *The Future is Now – Science for achieving sustainable development*, <https://sustainabledevelopment.un.org/gsdr2019>.

¹⁶⁶ From co-design to co-implementation and co-evaluation.