

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 an essential part of worldwide efforts to understand and protect marine social-ecological systems whilst benefiting from their ecosystem services. Observations can be samples collected on ships, measurements from instruments on fixed platforms, autonomous and drifting systems, submersible platforms, ships at sea or remote observing systems such as satellites and aircrafts.

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. In two decades, the European Union invested in policies and infrastructures to make knowledge of the oceans and seas central to environmental and climate policies as well as the blue economy. Its Member States, together with neighbours, have created an unrivalled marine data, modelling and forecasting infrastructure. Working together and the principles of free and open access, interoperability, and “measure once, use many times”, were largely promoted and demonstrated through, Copernicus, the European Research Framework Programmes FP7 and Horizon 2020, and EMODnet activities.

The Digital Twin of the Ocean is the next step, filling the need to integrate a wide range of data sources (from physics to ecology through biology, chemistry and geology, as well as from social or economic sciences and business operators), to transform data into knowledge and to connect, engage, and empower citizens, governments and industries by providing them with the capacity to inform their decisions. It will empower a shared responsibility to monitor, preserve and enhance marine and coastal habitats, and support a sustainable blue economy (fishing, aquaculture, transport, renewable energy, etc.). It should allow assessment of the state of ecosystems, habitats and the impact of human activities (including along coasts); forecasts of their short and long-term changes; development of biodiversity conservation strategies; management of sustainable economic activities; assessment of infrastructure vulnerability; development of mitigation, adaptation and replacement plans to deal with climate risks and optimisation of emergency responses to severe events such as sea-level rise or storm surges. It should allow the design of efficient models for adaptive scenarios to face the risks listed above, through the implementation of new integrated multidisciplinary observation approaches and may also help, guide, steer and prioritize costly monitoring activities.

It will contribute to the development of digital interactive high-resolution models of the oceans and seas, as part of the Commission’s Green Deal and Digital Package commitments to develop a very high precision digital model of the Earth (Destination Earth initiative). Building on existing partnerships (such as EuroGOOS and AtlantOS) and on the integration of existing European and national leading-edge capacities and Marine Research Infrastructures in ocean observation (Eurofleets+, EuroArgo, Jerico, Danubius, EMBRC, EMSO, ICOS, LifeWatch, etc), data infrastructures (bluecloud, EDMONET), forecasting and climate services (Copernicus services

and space data) through innovative IT technology, it will bring together research and innovation, infrastructures and communities in support to the European Green Deal and to societal transitions.

Scope

This topic supports the development of a pilot ocean digital twin, addressing concrete cases in local or regional sea basins (connecting freshwater, coastal and marine ecosystems), and demonstrating their usefulness with regard to several of the Green Deal priorities. They should allow fit for purpose, timely, persistent and autonomous monitoring, in an integrated and harmonised way from estuaries to the coast and to deep sea and from the surface to the seabed), and the identification and testing of the most efficient solutions for sustainable ocean and coastal management (taking into account the societal dimension and the implementation of EU policies priorities). Proposals should cover the whole knowledge value chain, from data acquisition (from multiple sources: research, monitoring, industrial and citizen data) to users' services, for example and if relevant:

- Operationalising existing observing systems via the integration of existing or new automated sensors and autonomous mobile and fixed platforms allowing measurements at the required spatial, temporal scales and lower costs of a large set of parameters (chemical, physical, biological and ecological) targeting in particular observation gaps, (and the development of improved monitoring strategies and prioritisation methods;
- technologies to incorporate structured and unstructured data, e.g. from alternative sources such as citizen science or historic data collected before the digital age;
- data sharing, quality assurance, and modelling capacity, in particular through the application of big data and artificial intelligence technologies, to support timely ecosystem assessment, human impacts, and mitigation pathways;
- seamless modelling approach and advanced data assimilation to build a consistent multi-variable multi-dimensional description of the ocean, consistent from global ocean to coastal areas, and allowing a digital exploration in time and space of the ocean physics and biodiversity with different scenario;
- development of what-if scenarios, taking into account uncertainties on modelling (coupling and data assimilation) as well as on assessment of the ecosystem status, human and environmental stressors, biotic and abiotic interactions, and;
- co-creation and inter-disciplinary approaches and frameworks (cloud-based, digital, i.e. BlueCloud and Wekeo) between natural sciences, humanities and social sciences for the co-construction of research and development methods, as well as of expertise, towards decision making with local authorities, scientists, private sector to develop shared applications to increase resilience to climate change, improve disaster risk management capabilities, support maritime spatial planning, environmental reporting or sustainable economic activity; European-national coupled-modelling capacities to analyse impact of

preventive measures to adapt and mitigate climate risks at regional and local scale to foster socio-ecological synergies;

- development of close cooperation between leading European Research infrastructures, operational ocean services and e-infrastructures, and international counterparts to facilitate the operationalising of long term observing systems including common access to data on wider sea-basins and global scales and the operationalisation of a digital ocean twin that also aligns with the digital atmosphere and biosphere and objectives of the UN Decade of Ocean Science for Sustainable Development;
- developing and delivering information to citizens through new generation reporting and prediction of ocean health - how it is changing and how it might change in the future through interactive on-line tools including data, data visualisation, images, text and video on issues such as sea-level rise, species shifts, ecosystem change, conservation status.

Therefore proposals should integrate the assets from the existing European capacities already invested, valorising available data and services together with highly innovative digital technologies such as data analytics, AI, HPC computing and innovative modelling or statistical approaches to deliver societal solutions in line with the green deal priorities. Pilots should deliver a roadmap for interoperability to enable European services and infrastructures to evolve accordingly also in time in order to maintain a fully integrated digital picture of the ocean (a twin ocean) that matches ocean thematic ambitions, the green deal and the digital package.

Selected projects are expected to collaborate between themselves, with all other relevant H2020 projects, and with relevant projects from the ESA Ocean Science Cluster (<https://eo4society.esa.int> and <https://eo4society.esa.int/communities/scientists/esa-ocean-science-cluster>)

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 interactive virtual tools of the ocean in a unified digital environment to:

- move towards a European Ocean Observing System by contributing to significantly increase the capacity to develop integrated multidisciplinary observatories of estuarine, coastal and marine environments and socio-ecosystems, and by promoting shared strategies, infrastructure development, data standardization, sharing, availability, access, interoperability, visualisation and use of data according to the FAIR principles;
- 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;

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- allow for knowledge-based decision-making based on integrated sets of cross-cutting indicators at different scales, reduce risk and increase efficiency of coastal and marine economic activities and implementation of legal requirements (MSFD, Water Framework Directive, etc...);
- 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;
- encourage industry to look for business opportunities in ocean data and related services.

Type of Action: Innovation Action (IA)