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Title: A transparent & accessible ocean: Towards a Digital Twin of the Ocean

Specific Challenge

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

The Digital Twin of the Ocean is the next step, filling the need to integrate a wide range of data sources, 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 habitats, and support a sustainable blue economy (fishing, aquaculture, transport, offshore energy, etc.). It should allow assessment of the state of ecosystems, habitats and the impact of human activities; 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 storm surges.

It will contribute to the development of digital interactive high-resolution models of the oceans, 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 the integration of existing EU leading-edge capacities in ocean observation (such as Eurofleets+, EuroArgo, Jerico, EMBRC, etc), data infrastructures and forecasting services (Copernicus, EMODnet, Blue Cloud, ERICs, -) through innovative IT technology, it will bring together infrastructures and communities in support to the EU Green Deal and to societal transitions.

Scope

This topic supports the development of interoperable pilot digital twins, 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 continuous, timely, persistent and autonomous monitoring (from the coast to deep sea and from the surface to the seabed), identification and testing of the most efficient solutions. 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:

- the integration of new automated sensors and autonomous platforms allowing measurements with increased frequency and lower cost;
- technologies to incorporate structured and unstructured data, e.g. from alternative sources such as citizen science or historic data collected before the digital age, and allowing for the application of big data and artificial intelligence technologies and improving data sharing and modelling capacity;
- development of what-if scenarios, taking into account uncertainties on modelling as well as on assessment of the ecosystem status & environmental stressors, and EU-national coupled-modelling capacities to analyse impact of preventive measures to adapt and mitigate climate risks at regional and local scale;
- 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 expertise towards decision making with local authorities, scientists, private sector to develop shared applications to support resilience to climate change, disaster risk management, maritime spatial planning, environmental reporting or sustainable economic activity;

- development of close cooperation between leading European data infrastructures and e-infrastructures, and international counterparts to facilitate common access to data on wider sea-basins and global scales and 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;
- delivering information to citizens through new generation reporting 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.

Expected impact

The action will deliver interactive virtual tools of the ocean in a unified digital environment to:

- contribute to significantly increase the capacity to observe coastal and marine waters, the sharing, availability, visualisation and use of data;
- reinforce conservation and ecosystem-based management of marine habitats/green infrastructure, planning of marine areas, and safeguard productivity and biodiversity of marine ecosystems
- increase citizen engagement through increased awareness and understanding of the dynamics, interactions and evolution of seas and oceans and their role in our well-being and survival;
- encourage and enable the infusion of 'non-scientific data streams' through citizens engaged 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;
- allow for knowledge-based decision-making, reduce risk and increase efficiency of coastal and marine economic activities and implementation of legal requirements (MSFD, Water Directive, etc...)
- encourage industry to look for business opportunities in ocean data and related services.

Type of Action: Innovation Action

Select 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>)