

PREDICTING THE GLOBAL COASTAL OCEAN: TOWARD A MORE RESILIENT SOCIETY

PROPOSAL FOR A UNITED NATIONS

DECADE OF THE OCEAN PROGRAMME

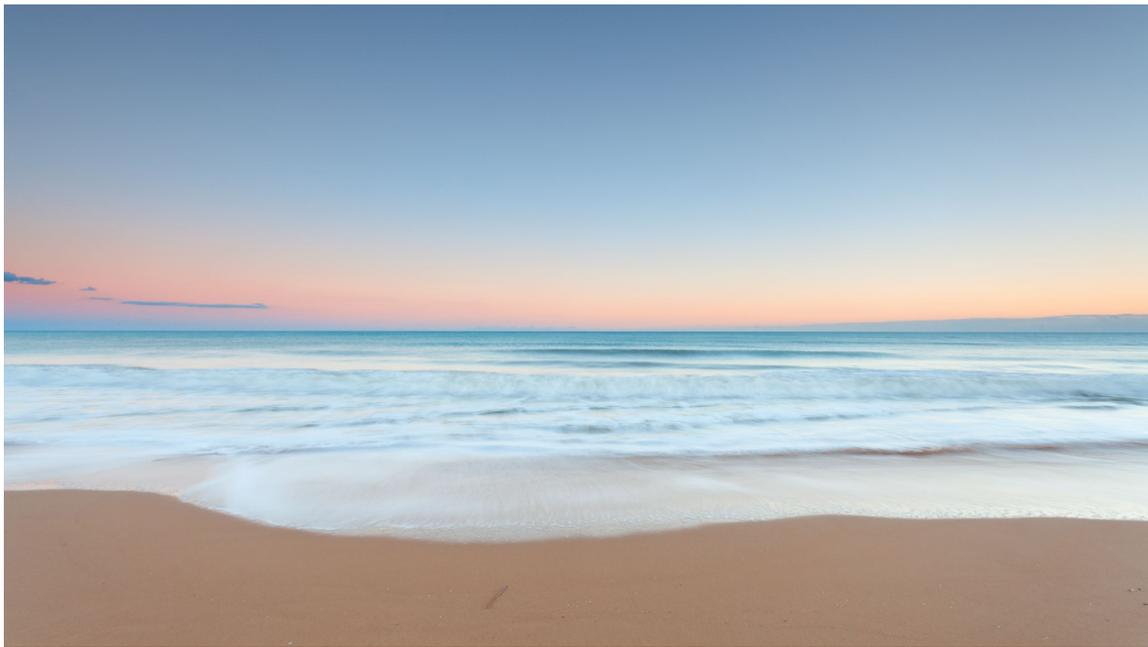


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BACKGROUND

The basic concept of a Global Coastal Ocean was defined about a decade ago in five Volumes of *The Sea* (Vols. 10 to 14, Harvard Univ. Press). The revised definition is:

- *the coastal ocean - that area, extending **inshore** from the estuarine mouths to river catchments affected by saltwaters and **offshore** from the surf zone to the continental shelf and slope where waters of continental origins meet open ocean currents.*

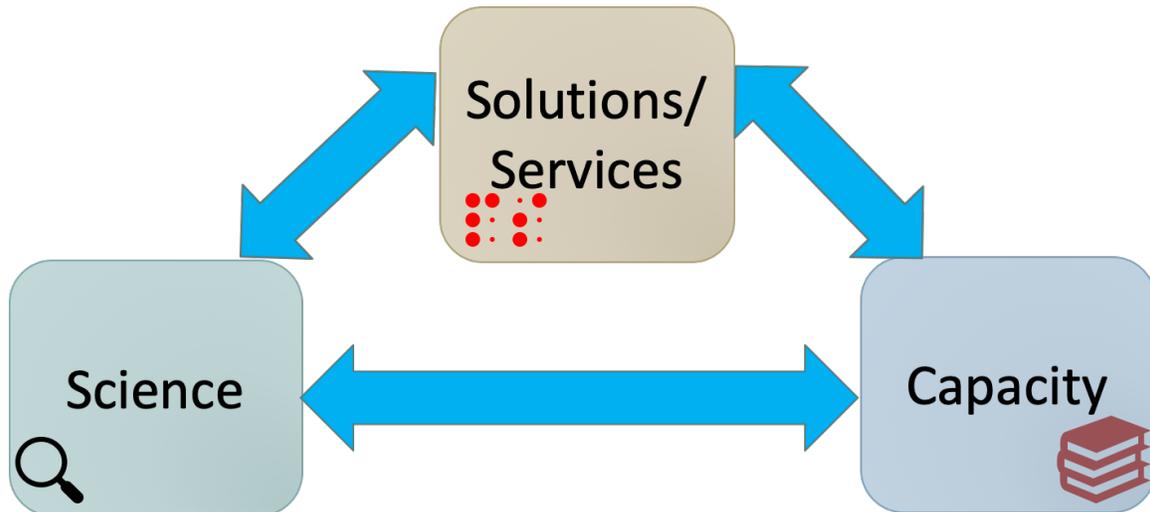
The coastal ocean is that interface area where land, hydrology, ocean and atmosphere interact in a multiplicity of space and time scales and give rise to the greatest ocean productivity and the strongest interaction between fresh waters, including glacier waters, and saltwaters.

It is believed that, after thirty years of development in ocean predictions and operational oceanography, we are capable of understanding and predicting this complex zone where most of the human population live and the impacts of climate change will be amplified.

Most sustainable development goals (SDGs) consider the socio-economic and environmental problems connected within this crucial area. All these goals require increased knowledge and advanced predictions of the global coastal ocean in order to provide solutions for the management and sustainable exploitation of the resources.

THE PROGRAMME IN A NUTSHELL

The Programme will coordinate scientific advancements and technological innovations following three pillars:



The Programme outcomes and outputs will be:

1. Integrated knowledge of the global coastal ocean;
2. Integration of the coastal and open ocean observing and modelling systems;
3. Improved, multidisciplinary and extended range predictive capabilities for the coastal zone;
4. Innovative and sustainable applications for coastal solutions/services;
5. Enhanced scientific collaboration and partnerships for solutions.

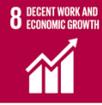
DRIVING SOCIETAL NEEDS

The 17 SDGs are the primary drivers for a UN Decade Programme on “Predicting the Global Coastal Ocean”.

In summary:

- Coastal urbanization exacerbates the need for advanced monitoring and predictions of coastal inundation, of coastal pollution, of coastal habitat health and multi-hazards;
- Climate change and related extremes are affecting population resilience at the coasts, thus coastal impact studies need to focus on extended range predictions, considering new monitoring systems, sea level rise and other coastal climate trends;
- Sub-seasonal to seasonal predictions in the coastal zones need to be improved through a deeper understanding of the multi-scale interactions and processes occurring at the coasts;
- Coastal ocean health issues require an innovative combination of observing and numerical prediction systems in order to evaluate solutions and protection measures;
- Assessment of policy target effectiveness in the coastal areas, and the connected catchments, requires the development of advanced Earth System numerical modelling with appropriate coupling between the meteorological, hydrological and oceanographic compartments at the coasts.

The contribution that the Programme could offer to the 17 SDG targets is discussed in the Table below.

SDG	Contribution from this Programme
	<p>Sustainable blue economy using a science-based approach that considers coastal predictions for management of resources and environmental protection.</p>
	<p>Fishery and mariculture rely on the accuracy of the “predicted” ocean</p>
	<p>Coastal oceans are essential components of human’s well-being and coastal ocean predictions help to preserve this natural resource.</p>
	<p>Coastal ocean literacy is a pre-requisite for responsible citizenship at public, private and corporate levels.</p>
	<p>Coastal ocean solutions will consider diversity issues at all levels of the programme development.</p>
	<p>Predict salinization of drinkable waters, understand and predict salt intrusions in rivers, develop integrated water management plans in the coastal areas.</p>
	<p>Improve the use of renewable energy from the coastal zone winds, currents (including slope currents) and waves using the predicted ocean products</p>
	<p>Promote safe working conditions for the coastal ocean communities using ocean prediction products</p>
	<p>Innovative coastal tourism, mariculture, transport, gas/oil extraction, safe transport and advanced port management using coastal prediction products</p>
	<p>Promote the inclusive participation of the coastal communities in the design and implementation of solutions, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status</p>
	<p>Reliable and extended coastal inundation predictions, hazard mapping of coastal pollution from different sources eliminating dumping in the coastal zone</p>
	<p>Connect the “predicted coastal ocean” to scientific and technological capacity to move toward more sustainable seafood production and consumption in the global coastal ocean.</p>
	<p>Promote downscaling of climate change scenarios in the coastal zone, designing new coupled ocean-atmosphere-land-hydrology at the local scales and define impacts of different scenarios, including coastal sea level changes and extreme events at the coasts</p>
	<p>Protect and restore coastal habitats, develop nature-based solutions for coastal erosion using coastal prediction products. Develop early warning systems for multi-hazards on the coasts.</p>

	<p>Improve the understanding of aquifer water flows and the management of the adverse effects of coastal area saltwater intrusions.</p>
	<p>Analyze and implement plans for coastal transboundary water problems, enhancing the collaboration of countries in setting the observing and modelling system that will enable water resources and their part of the global coastal ocean to be peacefully managed.</p>
	<p>Mobilize resources for the co-design between scientists and coastal stakeholders on the science, solutions/services and capacity in the global coastal ocean</p>

DRIVING SCIENCE IDEAS

The role of the coasts in the large-scale ocean circulation has been recognized since the beginning of modern oceanography and meteorology. Coasts are the waveguide for tidal waves and Kelvin waves, and play a key role in the dissipation of ocean energy. They are sources of energy for baroclinic Rossby waves crossing the ocean basins and accumulating energy in western boundary currents. Coasts shape specific upwelling/downwelling processes, are regions of freshwater influence from rivers and glaciers. Coasts interact strongly with slope currents, and lastly they are the sites where marine biogeochemistry and physics connect to produce the largest atmospheric CO₂ sinks.

Despite these key issues, the “generic” understanding of the global coastal ocean is still lagging behind other topics in oceanography, probably because of the fragmented scientific approach related to the varying coastal specificities. However, Robinson and Brink (2010) attempted to define the concept of the “global coastal ocean”, highlighting that a common scientific approach to studying the different coastal areas is possible and potentially very important. **This is the key idea for this Programme.**

In order to achieve the goal of understanding the different but similar “global coastal ocean” areas several scientific questions need to be investigated, including:

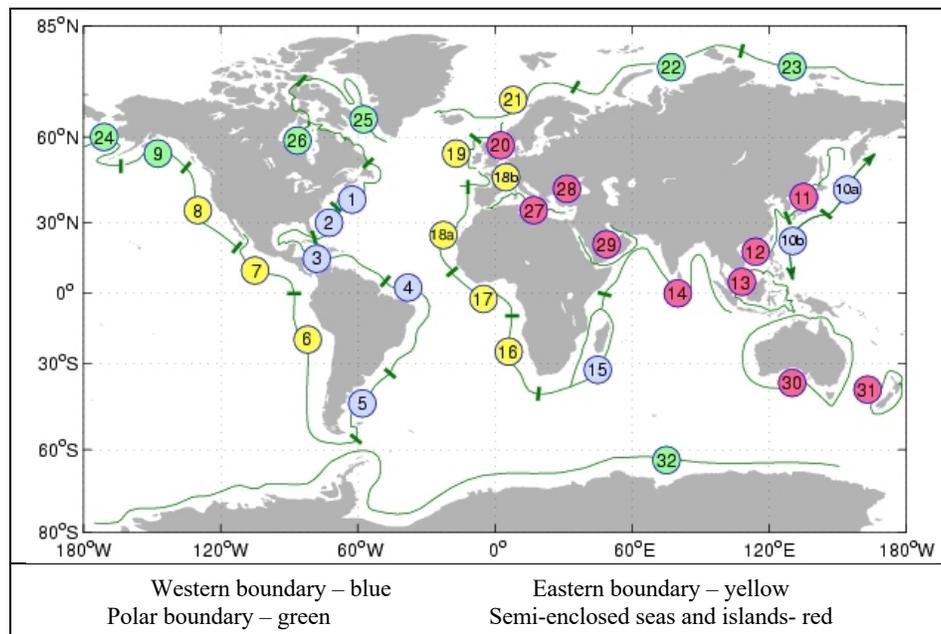
- *The scientific definition of the “global coastal ocean”, its physical and biochemical role in the large scale ocean circulation and ecosystem dynamics;*
- *The understanding of the predictability limits of the coupled atmosphere-land-ocean system at the coasts and the development of Limited area Coastal Earth System Modelling;*
- *The sediment-light-nutrient-physics nexus in the coastal zone, its connection to the nutrient limitation paradigm in the open ocean and its effects on the predictability of coastal marine food webs and coastal carbon cycle;*
- *The optimal design of a multi-scale multidisciplinary global observing system which considers both the open ocean and the coastal observations;*

- *The development of a coastal observation data management system to be synchronized with the Ocean Data Information System (ODIS) being developed during the UN Decade;*
- *The establishment of limited area modelling (nesting, downscaling) for increased process inclusion and resolution at the land-ocean interface and offshore, including probabilistic and ensemble coastal forecasting;*
- *The optimization of data assimilation methods in the coastal ocean for ocean predictions;*
- *The investigation and predictions of the salinization of inland coastal waters, both surface and underground;*
- *The development of coastal urban meteorology and oceanography concepts and tools;*
- *Sustainable coastal mariculture.*

Some of these topics will be matched to specific solutions and services to be developed by Projects within the Programme or will become Projects themselves.

SOLUTIONS AND SERVICES FOR THE GLOBAL COASTAL OCEAN

The Programme is aimed at furthering the understanding of the global coastal ocean and at demonstrating solutions/services in several different types of coastal areas of the world ocean. The original subdivision of the global coastal ocean into four categories is shown below, from Robinson and Brink (2010).



From Robinson and Brink, *The Sea*, Vol. 14 (2010)

Several Decade Projects should be created on the basis of scientific and implementation challenges in the contrasting coastal areas.

Projects should be formulated to devise solutions and services on the basis of the “predicted ocean products”, including:

- *Nature based solutions in the global coastal ocean for coastal protection, ocean health and blue carbon*
- *Early warning systems for coastal multi-hazards*
- *Maritime Spatial Planning hubs*
- *Sustainable Mariculture*
- *Port safety and sustainable transport*
- *Pollution reduction in the coastal areas*

- *Resilience against climate change in the coastal areas*
- *Ocean Best Practices for harmonized coastal and open ocean observing and modelling systems*
- *Ocean literacy for the global coastal ocean*

REFERENCES

The Global Coastal Ocean, 2010. The Sea, Harvard University Press, Vol. 13-14A and B, A.R.Robinson and K.Brink editors.