CoastPredict- Observing and Forecasting the Global Coastal Ocean. A UN Decade of Ocean Science for Sustainable Development proposal

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Abstract: The UN Decade of Ocean Science for Sustainable Development started January 1, 2021 and it is calling for transformative science to meet the targets of the SDGs. CoastPredict is a programme submitted for endorsement to Unesco-IOC that will transform the science of observing and predicting the Global Coastal Ocean, from river catchments, including urban scales, to the oceanic slope waters. It will integrate observations with numerical models to produce predictions with uncertainties from extreme events to climate, for the coastal marine ecosystems (their services), biodiversity, co-designing transformative response to science and societal needs. CoastPredict will re-define the concept of the Global Coastal Ocean, focusing on the many common worldwide features, to produce observations and predictions of natural variability and human-induced changes in the coastal areas and upgrade the infrastructure for exchange of data with standard protocols.

Keywords: Coastal ocean dynamics, observing and forecasting, best practices, standards, oceanographic infrastructure

1. INTRODUCTION

This programme was prepared in consultation with the Steering and Advisory Committees, plus representation from the an Early Career Ocean Professional (ECOP) group. The proposal has also included input from several meetings with broader representation of the international bodies that the Advisory committee represents (such as GOOS, IODE, IODE/GOOS OBPS, OceanPredict, ESA, NOAA, Mercator Ocean International, EMODnet and The Ocean Foundation). For more information on the collective intelligence that has driven the writing of the Programme, a web page is available: https://www.coastpredict.org/.

2. History and motivations

CoastPredict will capitalize on four major previous international initiatives:

1) The Coastal observation panels of GOOS (the Coastal Ocean Observing Panel, COOP, and the succeeding Panel for Integrated Coastal Observations, PICO). COOP started in 2000 to define a strategy for integrated observing and forecasting in the coastal areas. One of the main outcomes was the recommendation that a global network of observations, data communications, data management, and data analysis/forecasting should be secured providing economies of scale. Another important COOP/PICO outcome was the initial definition of common variables to monitor and forecast in the coastal areas. Even after such a great start, PICO did not continue because the international ocean observing network was not adequately organized and technology was not ready yet for biogeochemistry, biodiversity and other marine environmental variables. Furthermore, the satellite observing system was still under development for the coastal areas (except for coastal ocean color).

2) OceanPredict and its Coastal and Shelf Seas Task Team (COSS-TT). OceanPredict organized the global ocean observation uptake for the development of global and regional forecasting systems. Furthermore, OceanPredict/COSS-TT defined the international quality control standards for ocean analyses, reanalyses and forecasts in the coastal ocean and shelf seas. COSS-TT promoted the use of OceanPredict large scale products for seamless integration of ocean to coastal forecasting, defined the state-of-the-art methodology for downscaling (footnote 1), data assimilation, array design in the coastal/shelf areas. COSS-TT focuses on advancing science in support of coastal forecasting and is one of the backbones of CoastPredict. One problem COSS-TT had to face was about a ten years delay in the open and free dissemination of large scale, operational oceanographic products that started only 5 years ago, in particular from the advent of the Copernicus Marine Environment Service in 2006.

3) The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). JCOMM has coordinated from 2000 to 2019 the ocean observing networks, in particular the GLOSS network for tide gauges and the HF radar network. Furthermore, it started to develop coastal services for wave and storm surges by meteorological offices in developing countries. In addition, it has coordinated the development of marine environmental emergency services. However, such developments were not really integrated between them, and not connected with the growing oceanographic research communities of OceanPredict and COSS-TT. While the observing systems and the large-scale ocean forecasting systems are now coordinated at the level of the GOOS framework, the coastal downscaling and forecasting research developments are not currently connected to coastal services.

4) In 2010, the Global Coastal Ocean volumes of The Sea monograph series started the process of redefining the coastal ocean from a dynamical point of view, proposing the concept of coastal regimes similarities and differences. The work is unfinished and requires effort to really produce a scientific transformation.

Nowadays, global open ocean observing and forecasting is a reality, with standards and quality assessment protocols, delivering information on the past, present and future state of the ocean. The operational oceanographic system started in the 1990s through coordination by different Space Agencies and international bodies, such as GOOS, JCOMM and OceanPredict.

The UN Decade of Ocean Science for Sustainable Development offers a unique opportunity to rapidly accelerate this successful story, and CoastPredict is dedicated to reproducing it for the global coastal ocean. Indeed, the present resolution of the open ocean global and regional models is not adequate for the coastal areas, land-sea coupling is not properly considered and high frequency processes, such as tides are also generally not considered in the large-scale analyses, reanalyses and forecasts. The available horizontal resolution is about 3-8 km in different parts of the world ocean and several meters in the vertical, for physics and pelagic biochemistry. The target CoastPredict resolution is the tens of meters in horizontal and less than a meter in vertical. These issues, including the new developments of coastal and regional multi-disciplinary observing systems from the nearshore, the urban settlements and the open ocean, are accompanied by scientific challenges associated with the dynamics of the interactions across the coastal ocean continuum and the need to develop appropriate methodologies to integrate observations across multi-scales in space and time and across disciplines.

3. High Level Objectives of CoastPredict

Three are the high-level Objectives of CoastPredict:

1) A predicted global coastal ocean;

2) The upgrade to a fit-for-purpose oceanographic information infrastructure;

3) Co-design and implementation of an integrated coastal ocean observing and forecasting system adhering to best practices and standards, designed as a global framework and implemented locally.

The legacy of this work will be the capacity to advance science, the observing systems and the methods for the development of reliable coastal predictions that extend as far as possible into the future and solve problems co-defined with stakeholders. Additionally, CoastPredict will enhance the capacity to formulate Research to Operations (R2O) practices, a new set of coastal observing and modelling standards for all. This will go hand-in-hand with the organization and upgrade of the basic global ocean information infrastructure for sharing information using standards and best practices.

4. Outlook

It is now time to advance the understanding and representation of all coastal processes and related interactions, properly downscaling large-scale forcings to the coastal areas with appropriate resolution, leveraging networks of observations from local to regional scales for co-analysis, validation and/or data assimilation efforts. In doing so, these frameworks must account for estuaries, land surface waters, rivers and ice shelves, including coastal lagoons and bays, salt marshes and marine coastal habitats, including coastal morphological changes and large urban settlements with drainage canals terminating at sea.

The expected outcomes are:

1. Integrated knowledge of the global coastal ocean from events to climate (advancing Knowledge);
2. The design and implementation of an integrated river/estuarine/coastal/open ocean observing and modelling multidisciplinary system (integrated observing and predicting);

3. Improved coastal marine forecasting and extended range predictive capabilities for the coastal zone (accurate predictions from hours to centuries ahead);
4. Methods for trusted data/information exchange and interoperability across the value chain to be adopted as best practices (open and free access to coastal information);
5. Innovative and sustainable applications for coastal solutions/services that directly benefit local populations, including ecosystem services such as food provision, well-being and human health (solutions);
6. Increased equitable education and capacity for observing and forecasting in the global coastal ocean (capacity building).
7. Strong engagement of Early Career Professionals and promotion of education, training and research under principles of diversity, equity and inclusion (education, no-one left behind)

The Programme will be implemented through several interconnected projects that will focus on major science-technology and co-design issues for the global coastal ocean, including the SDGs. CoastPredict also will help to expand regional Programmes, eventually concentrating on the coastal areas beyond their specific geographical areas of implementation. This will also be done for projects that will be submitted to the Decade calls and that have a more focused or a partially overlapping scope but that will enrich the community working on the Global Coastal Ocean. Some of these outcomes will be possible because of the tight connections that CoastPredict has already developed with international groups such as GOOS, IODE, IODE/GOOS OBPS, OceanPredict, CEOS-COAST, WWRP.