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GlobalCoast: THE GLOBAL COASTAL OCEAN EXPERIMENT

The CoastPredict initiative towards resilience



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Summary

GlobalCoast: the CoastPredict Global Coastal Ocean Experiment is a central framework for the coordination and practical implementation of the CoastPredict Programme.

GlobalCoast will coordinate implementation and integration of the science and technology advances from the CoastPredict Focus Areas in a range of contrasting Regions of the Global Coastal Ocean using best practice principles in observing, data management, modeling and co-design.

This will provide advanced knowledge and innovative products and services to support coastal community resilience, and will develop the basis to re-characterize the Global Coastal Ocean.



**Advancing
knowledge,
innovative
products and
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resilience.**

GlobalCoast goal



... is to demonstrate the value of an integrated and fit-for-purpose coastal observing and prediction system that delivers innovative products and services for coastal resilience in collaboration with local stakeholders.

This will be achieved by implementing the CoastPredict projects and guidance principles in a range of contrasting Regions of the Global Coastal Ocean.

Why?

Coastal areas are where most of the world's population lives and where the response to the UN Decade's challenges will have the largest impact. Coastal communities face urgent challenges that are amplified by climate change. Solutions are required on the scale of the "Global Coastal Ocean", to leverage methods and assets, to provide reliable tools to policy-makers and managers, based on cutting-edge, smart and efficient technologies that can enable – for the first time – the design and implementation of an integrated coastal observation and prediction system in support of better informed and better prepared coastal populations and increased coastal resilience.

CoastPredict has started to redefine an early concept of the Global Coastal Ocean: 'the coastal ocean - that area, extending inshore from the estuarine mouths to river catchments, to the urban settlements on the one side and on the other to the offshore, from the surf zone to the continental shelf and slope where waters of continental origins meet open ocean currents.'

The CoastPredict Programme puts scientific understanding and predictions of the Global Coastal Ocean for coastal resilience at the center of its activities. Scientific understanding of the multi-scale and multi-disciplinary processes that characterize the Global Coastal Ocean is hindered by inconsistent terminology and definitions (the coastal zone, coastal margin, continental shelf, continental margin, etc.), local approaches that use disparate practices and the use of inadequate observational and modeling technologies.

To overcome these limitations, it is necessary to have a coordinated effort that implements technologies and methods in contrasting Regions of the Global Coastal Ocean, intercompares the outcomes, finds gaps and leverages synergies. The Global Coastal Ocean Experiment (GlobalCoast) will enable intercomparison and sharing of new understanding, data and approaches to coastal resilience in the context of a changing climate and multiple human pressures across the world's ocean.

The overarching concept of GlobalCoast is to identify coastal ocean systems around the world, from a range of perspectives and scales, that have comparable characteristics and that behave in similar ways. Re-defining the interconnected global coastal ocean in this way will support the development of relocatable, fit-for-purpose observing and predicting systems for different coastal morphologies and ecosystems, river catchments and estuaries, ecosystem habitats and hydrodynamical regimes, from the shelf to the continental slope.

// COASTPREDICT

Value chain for coastal resilience

The GlobalCoast general hypothesis is that information for coastal resilience derives from a complex value chain that is represented in Box-1. GlobalCoast will implement demonstration activities at Pilot Sites that address all the different elements of the value chain from observing to modeling, innovative technologies such as AI, data management and tailored information and services for target user communities. The demonstration activities will consider drivers and impacts across all time scales, from individual events to longer term climate time scales.

Box-1 The Global Coastal Ocean value chain for coastal resilience



GlobalCoast will advance observing and modeling technologies (first column of Box-1) to improve forecasting and projection skills of climate variability, trends and extreme events for coastal hazards including: inundation, coastal erosion, harmful algal blooms and unhealthy oxygen trends and extremes. The observational and modeling tools and outputs will be provided through an open-access digital platform which will allow restorative and protective actions to be assessed (second column of Box-1). Solutions in the form of tailored services and decision support systems for coastal resilience will be developed based on information accessible via the digital platform (third column of Box-1). Training and documentation will be produced for the enlargement of the stakeholder and user base (fourth column of Box-1).

How?

CoastPredict subdivides its activities into six Focus Areas that are briefly described in Box-2. All of them aim to develop innovative integrated methodologies involving observations, models and numerical tools / algorithms for the Global Coastal Ocean across multiple time and space scales. The Focus Areas are driven by scientists, engineers and practitioners that devise specific methods and technologies to find best practices and common science paradigms to advance monitoring and predictions in contrasting Regions of the Global Coastal Ocean.

Box-2 The CoastPredict Focus Areas, Core and Affiliated Projects as of May 2023



The Butterfly Approach

In order to arrive at a synthesis of the methods and technologies required to advance science for coastal resilience at the Global Coastal Ocean level, the development strategy is shown in Box-3. We call this the 'Butterfly Approach' composed of the methodology development, the local implementation through an 'experiment' and the generalization step.

GlobalCoast is an experiment because several technologies will be evaluated through practical implementation in Pilot Sites within contrasting Regions of the Global Coastal Ocean. By ensuring open and free access of the data and methods / tools developed in selected Regions, GlobalCoast will allow optimal, fit-for-purpose combinations of observational and modeling information for coastal resilience to be realized.

Box-3 The Butterfly Approach: the methodology development by Focus Area Projects, the localization through the GlobalCoast Experiment and the final generalization step



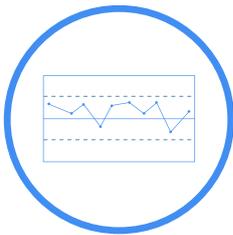
Transformational science and technology

that will be implemented at GlobalCoast Pilot Sites is summarized here:



01. New technologies

for the coastal observing system will be implemented, innovated and tested at each Pilot Site to validate/calibrate regional and coastal models



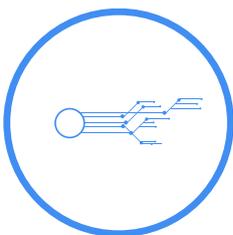
02. Regional-coastal limited area models & AI-based models

will be implemented to assess the range of predictability and understand uncertainties, and provide an impact ensemble framework



03. 100 years projections

will be produced by implementing regional to coastal climate limited area and AI-based models to downscale climate scenarios



04. High resolution reanalysis to instruct AI networks

will be produced at the coastal scale

Where?

To draw together the new CoastPredict methods and principles developed within each of the six Focus Areas (the Localization Step of the Butterfly Approach), a set of contrasting Regions of the Global Coastal Ocean and more localized coastal 'Pilot Sites' within them must be identified. Pilot Sites might be different due to the specific science and technology research to be carried out.

Robinson and Brink (2010) defined at least 32 contrasting coastal regions based on the offshore regimes, freshwater influences and different processes of importance that characterize the interaction between physics and biology. See Figure 1 - map adapted from Robinson and Brink (2010) with two additional regions identified (now 34 total). These Regions are where Pilot Sites will be identified to implement the different components of the Global Coastal Ocean value chain for coastal resilience.

The Robinson and Brink (2010) definition was more connected to open ocean regimes whereas CoastPredict now gives equivalent weight to the landward components of the coastal ocean and the coastal communities that rely on coastal ocean services.

The key socio-economic activities in each GlobalCoast Pilot Site should help to define the priority challenges connected to coastal resilience. Cultural values and perceptions of the coastal environment should be considered in the co-design phase of the experiment.

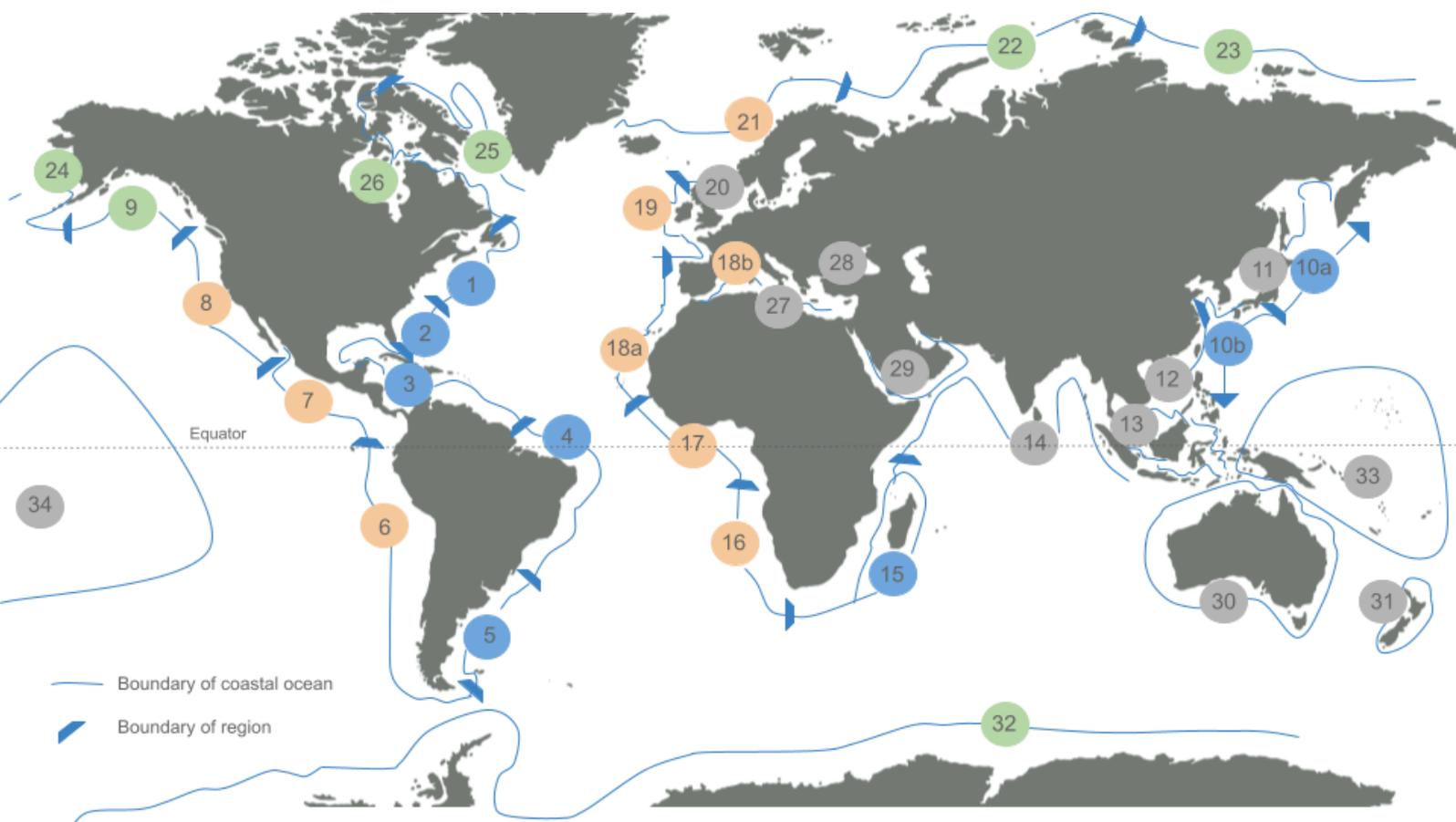


Figure-1: Map adapted from the Robinson and Brink (2010) characterization of coastal regimes via four pan-regions (color) and 34 different Regions, where GlobalCoast activities will be implemented at Pilot Sites

Key to colours:
Blue – western boundary current systems
Orange – eastern boundary current systems
Green – polar regions
Grey – islands and semi-enclosed seas

GlobalCoast Pilot Site Map

The GlobalCoast survey carried out by CoastPredict in 2023 identified 131 Pilot Sites across more than 66 countries, as illustrated in Figure 2. The map highlights the global distribution of these pilot sites, showing their geographic locations across various continents. Each colored pin represents a Pilot Site, with different colors corresponding to the 34 regions outlined in Figure 1. For more detailed information, an interactive version of the map can be accessed [[here](#)].



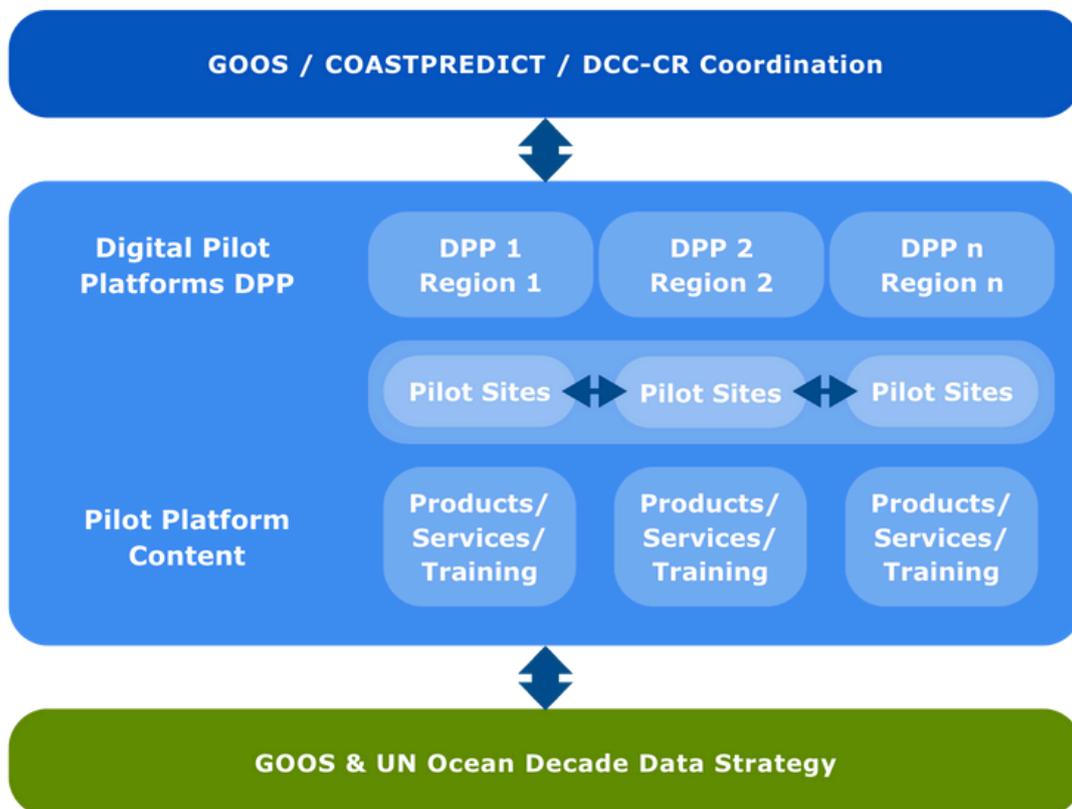
Figure-2: Global Distribution of GlobalCoast Pilot Sites

What?

Digital Pilot Platforms to support collaboration

For the selected Pilots Sites and corresponding Region, a Digital Pilot Platform (DPP) should be developed and implemented containing all the input and outputs of the experiment implementation (Box-4). The DPPs contribute to form a hub system that allows teamwork and the immediate sharing of the results with the international community so that knowledge dissemination and technology harmonization between regional Pilot Sites can start in parallel to the implementations.

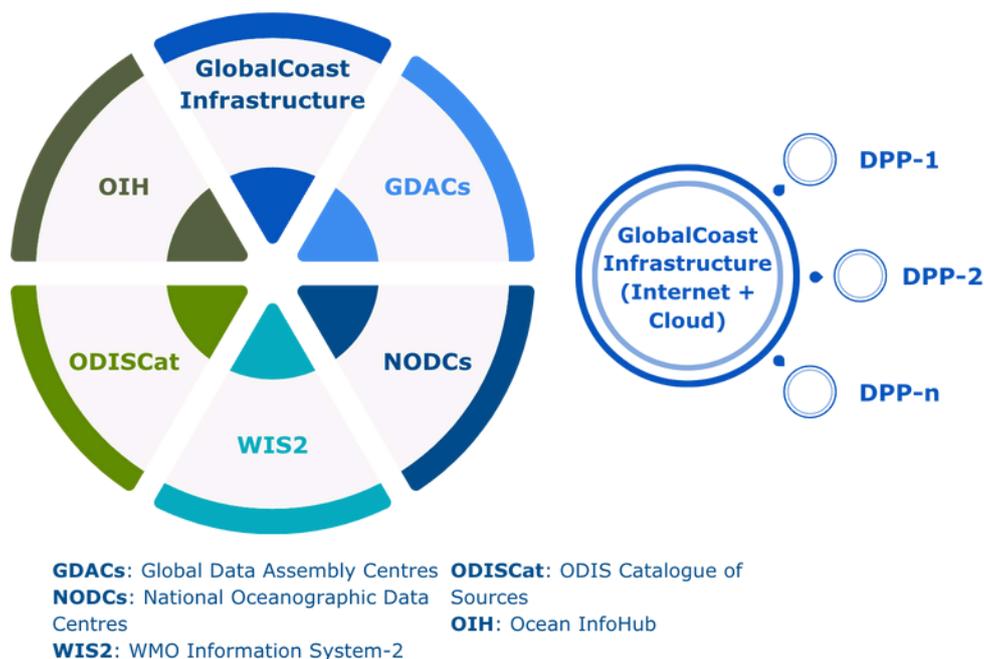
Box-4 The GlobalCoast digital infrastructure design: local to global connectivity



Data management and adequacy assessment

Data Management protocols for sharing and producing data and software (observational and model data sets standard formats and accessibility) should be obtained from and contributed to CORIS, thus linking to UNESCO-IOC ODIS Ocean InfoHub (OIH) and the ODIS Catalog of Sources. The DPPs form a digital federated ecosystem of hubs that contain information about the Pilot Sites data and could connect with other data repositories and data sharing international networks from UNESCO-IOC and WMO as outlined in Box-5.

Box-5 The distributed and interlinked ocean data ecosystem framework



After the initial implementation of the GlobalCoast experiment in a range of different locations, a phase of data adequacy analysis should follow. Data adequacy here means fitness-for-use of the observational data and the fitness-for-purpose of the products and services, given the specific, local end-users in the Pilot Sites. A success matrix should be elaborated where usability of the observing and modeling data and the value of the products will be assessed.

When?

The planning of GlobalCoast requires careful investigation of present-day capabilities, coordination of efforts across multiple institutions and new technologies to be developed and successfully implemented. It is anticipated that this will require:

Phase 1 2023-2024

- Analysis of Pilot site characteristics within ~5 Regions of the Global Coastal Ocean with existing Focus Area communities
- Development of specific Pilot Site scientific plans
- DPP implementation and fundraising

Phase 2 2025-2026

- Running of the experiment with the deployment of the technology in the Pilot Sites

Phase 3 2027-2029

- Assessment and intercomparison of first GlobalCoast sites and expansion to 20 Regions using lessons learned
- Definition of the GlobalCoast legacy after the Decade: science-based coastal management services and evolution pathways

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