1. Overview of Proponent and Proposed Decade Programme

1. Lead Institution

Alma Mater Studiorum University of Bologna

2. Lead Institution type

International intergovernmental organisation
Regional intergovernmental organisation
Other regional organisation
National government
Sub-national government
XXX University
Research institute
Private sector enterprise
Philanthropic Foundation
Corporate Foundation
Multilateral or bilateral funding agency
NGO / civil society organization
Working group / expert group / taskforce
Community group
Other (please specify)

3. Lead institution physical address:

Via Zamboni 33, 40126 Bologna, Italy

https://www.unibo.it/en/homepage

4. Contact person:

Nadia Pinardi

https://www.unibo.it/sitoweb/nadia.pinardi/en

5. Contact details

Department of Physics and Astronomy, Viale Berti Pichat 8, 40121 Bologna Italy, Tel: +39 393 3827092

6. Partner details if relevant

(for each partner please list Institution name, contact details including address & email and role of partner)

The Partnership at the moment is outlined at the project web page: https://www.coastpredict.org/steering-structure/

For simplicity, it is reported here (web links for each partner are available on the project web page):

Co-Chairs:

FULL NAME	INSTITUTE	COUNTRY
Kourafalou, Villy	University of Miami - Rosenstiel School of Marine and Atmospheric Science & OceanPredict Coastal and Shelf Seas Task Team co-chair	USA
Tintore, Joaquin	Balearic Islands Coastal Observing and Forecasting System & IMEDEA (CSIC-UIB)	ES

Steering Committee

FULL NAME	INSTITUTE	COUNTRY
Alvarez-Fanjul, Enrique	Puertos del Estado	ES
Androulidakis, Ioannis	University of Thessaloniki	GR
Arbic, Brian K.	Department of Earth and Environmental Sciences University of Michigan	USA
Ba Thuy, Nguyen	National Centre for Hydrometeorological Forecasting - NCHMF	Vietnam
Bermudez-Monsalve, Jorge Rafael	Galapagos Marine Research and Exploration Program (GMaRE); Facultad de Ingeniería Marítima y Ciencias del Mar, Guayaquil	Ecuador
Blumberg, Alan	Jupiter Intel	USA
Bonne, Gina	Focal point for Indian Ocean Commission	Mauritius
Borja, Angel	AZTI Foundation, Marine Research Division	ES
Brix, Holger	HZG- Center for Materials and Coastal Research	DE
Byun, Doseong	Korea Hydrographic and Oceanographic Agency, Ocean research division	Rep. Korea
Canonico, Gabrielle	NOAA Silver Spring, Maryland	USA
Charria, Guillaume	IFREMER, Laboratory of Ocean Physics and remote Sensing (LOPS)	FR
Chassignet, Eric	OceanPredict co-chair & Florida State University	USA
Cirano, Mauro	Department of Meteorology Institute of Geosciences - Federal University of Rio de Janeiro	Brazil
Cobb, Kim	School of Earth and Atmospheric Sciences, Georgia Institute of Technology	USA
Coll, Marta	Marine Ecology and Conservation, Institute of Marine Science (ICM)-CSIC, Barcelona	ES
Coppini, Giovanni	Ocean Predictions and Applications Division, CMCC, Lecce	IT
Davis, Chris	Mesoscale & Microscale Meteorology Lab, NCAR, Boulder	USA
De Mey-Fremaux, Pierre	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), Toulouse	FR
De Souza Azevedo Correia Joao Marcos	MetOcean Solutions, part of the Meteorological Service of New Zealand (MetService) MetOcean Research and Development (MRD) Science Manager	New Zealand
Dufau, Claire	Collecte Localisation Satellites- CLS, Toulouse	FR
El Serafy, Ghada	Deltares, Delft	NL
Farrell, David A.	Caribbean Institute for Meteorology and Hydrology, Bridgetown	Barbados
Fujii, Yosuke	Meteorological Research Institute, Japan Meteorological Agency, Tokyo	Japan
Ford, Marcia Creary	University of the West Indies	Jamaica
Gregoire, Marilaure	Faculté des Sciences, University of Liege	BE
Hamilton, Robert	Woods Hole Group, WHG	USA
Hilmi, Karim	Institut National de Recherche Halieutique, Centre Régional de Casablanca	Morocco
Holt, Jason	National Oceanography Centre, Liverpool	UK
Hopkins, Joanne	National Oceanography Centre, Liverpool	UK
Jones, Sarah	Head Research and Development, Member of Executive Board, Deutscher Wetterdienst	DE
Jones, Emlyn	CSIRO, Coastal Environmental Modelling Hydrodynamics Team	AU
Krestenitis, Yannis	Department of Civil Engineering, University of Thessaloniki	GR
Le Traon, Pierre-Yves	Mercator Ocean International	FR
Lermusiaux, Pierre	Department of Mechanical Engineering	USA
Liu, Guimei	National Marine Environmental Forecasting Center, Beijing	China
Mafwila, Samuel K.	University of Namibia	Namibia
Mahu, Edem	University of Ghana, Department of Marine and Fisheries Sciences	Ghana
Maza Fernández, María Emilia	IHCantabria, Instituto de Hidráulica Ambiental de la Universidad de Cantabria	ES
Merryfield, Bill	MEOPAR/ Environment and Climate Change Canada/University of Victoria	Canada

FULL NAME	INSTITUTE	COUNTRY
Myers, Paul	MEOPAR/University of Alberta	Canada
Mitrani Arenal, Ida	Instituto de Meteorologia (INSMET)	Cuba
Nhamo, Senia	University of South Africa, Department of economics	South Africa
Paris-Limouzy, Claire B.	Department of Ocean Sciences, University of Miami, Rosenstiel School of Marine & Atmospheric Science	USA
Pearlman, Jay	IEEE France, Four Bridges	USA
Przeslawski, Rachel	Geoscience Australia, Canberra	AU
Rajan, Kanna	Fellow, SIFT Inc., Minneapolis, MN	USA
Santoleri, Rosalia	Institute of Marine Sciences, CNR, Venice	IT
Schiller, Rafael	Fugro, Houston	USA
Siddorn, John	Ocean Forecasting Research and Development, Met Office	UK
Siedlecki, Samantha	Assistant Professor Department of Marine Sciences University of Connecticut	USA
Simionato, Claudia Gloria	Centro de Investigaciones del Mar y la Atmósfera	AG
Sperrevik, Ann Kristin	Ocean & Ice Group, Norwegian Meteorological Institute	Norway
Straneo, Fiamma	Scripps Institution of Oceanography	USA
Tan Shau Hwai, Aileen	Universiti Sains Malaysia, marine biology	Malaysia
Tiampo, Kristy	CIRES Earth Science & Observation Center, Boulder	USA
Turra, Alexander	Universidade de São Paulo	Brazil
Wilkin, John	Rutgers University, New Brunswick, NJ	USA
Yniguez, Aletta T.	Marine Science Institute, University of the Philippines, Diliman	Philippines
Zhao, Yangyang	State Key Laboratory of Marine Environmental Science, Xiamen University	China

Advisory Committee

FULL NAME	INSTITUTE	COUNTRY
Bahurel, Pierre	Director General MERCATOR OCEAN INTERNATIONAL	FRANCE
Bayler, Eric	NOAA/NESDIS Center for Satellite Applications & Research (STAR)	USA
Benveniste, Jerome	Senior Advisor European Space Agency (ESA-ESRIN) Directorate of Earth Observation Programmes EO Science, Applications and Climate Department	ITALY
Belov, Sergey	International Ocean Data and Information Exchange-IOC of UNESCO	Russian Federation
Breuch-Moritz, Monika	Vice-chairperson of IOC	GERMANY
Calewaert, Jan-Bart	Head, EMODnet Secretariat & Seascape Belgium	BELGIUM
Delauney, Laurent	JERICO-IFREMER	FRANCE
de Bruin, Taco	International Ocean Data Exchange-IODE of UNESCO	The Netherland
Di Giacomo, Paul	NOAA/NESDIS Center for Satellite Applications & Research (STAR)	USA
Di Lorenzo, Emanuele	Ocean Visions and Program in Ocean Science & Engineering, Georgia Institute of Technology	USA
Lips, Inga	EuroGOOS	BELGIUM
Tanhua, Toste	GOOS Steering Committee Co-Chair	GERMANY
Valauri-Orton, Alexis	The Ocean Foundation	USA
Valdez, Luis	Instituto Español de Oceanografía, Santander	APAIN
Vinayachandran, P. N.	OceanPredict co-chair & Institute of Science, Bengaluru, India	INDIA

Early Career Ocean Professionals (ECOPs)

(a nucleus of ECOP has been started and it will be soon expanded)

FULL NAME	INSTITUTE	COUNTRY
Androulidakis, Yannis	University of Thessaloniki	Greece
Ansong K., Joseph	University of Ghana, Department of Mathematics	Ghana
Faillettaz, Robin	Ifremer, STH	France
Caballero de Frutos, Isabelle	ICMAN-CSIC,	Spain
Foster-Martinez, Madeline R.	University of New Orleans	USA
Guerra, Maria Teresa	Trinity College Dublin	Ireland
Kampel, Milton	Instituto Nacional de Pesquisas Espaciais - INPE	Brazil
Ntaganou, Nektaria	University of Miami, Rosenstiel School of Marine & Atmospheric Science	USA
Nyadjro, Ebenezer	Mississippi State University/ NOAA Northern Gulf Institute	USA
Ohishi, Shun	RIKEN Center for Computational Science (R-CCS)	Japan
Toublanc, Florence	Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), Toulouse	France
Vaz, Ana Carolina	University of Miami, Rosenstiel School of Marine & Atmospheric Science	USA
Verri, Giorgia	CMCC (Euro-Mediterranean Center on Climate Change)	Italy
Woo, Abe	Universiti Sains Malaysia, Centre for Marine and Coastal Studies	Malaysia

Prot. n. 0001536 del 07/01/2021

CMXXX

January, 07th 2021
To:
Mr. Vladimir Ryabinin
Executive Secretary
International Oceanic Commission,
UNESCO,
Paris

Dear Mr. Ryabinin,

it is with great pleasure that I am writing to you to support the international initiative "CoastPredict" presented as an activity under the "Decade of the Ocean" by Prof. Nadia Pinardi and her colleagues.

The Alma Mater Studiorum – Università di Bologna hosts a large portfolio of research activities in the field of Marine Sciences, from biological and environmental issues to predictions and simulations of the ocean circulation, from experimental developments to coastal infrastructure and transportation. We have a significant number of teaching programs, both at graduate and undergraduate level that will allow a constant interaction between research and education, as well as the training of a new generation of researchers and practitioners.

The scope of "CoastPredict" will transform our vision of the ocean and our relation with it, opening a new phase. It will launch the original concept of the "Global Coastal Ocean' and transform it into a tool for understanding , allowing the development of better strategies and the informing of more beneficial policies for the citizens of the world.

I feel that "CoastPredict" is a major opportunity to advance to the next step in understanding the marine environment and to develop opportunities for social and economic development. Therefore, Alma Mater Studiorum – Università di Bologna fully endorses the application of Prof. Pinardi.

Sincerely yours,

Prof. Francesco Ubertini
Rector

7. Name of proposed Decade Programme

CoastPredict - Observing and Predicting the Global Coastal Ocean

8. Short title / acronym of proposed Decade Programme for communications purposes (if any)

CoastPredict

9. Summary description of proposed Decade Programme

(100 words or less to be used on website and in communications – please use lay terms that can be understood by a wide audience)

CoastPredict 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 obervations and predictions of natural variability and human-induced changes in the coastal areas and upgrade the infrastructure for exchange of data with standard protocols.

10. Start & end date of proposed Decade Programme

Start: 01/05/2021
End: 30/04/2031

11. Estimated total budget of proposed Decade Programme

The Programme should be coordinated by an International Programme Office and Outcenters, either thematic or geographically oriented, to be finalized , including University of Bologna and Universiti Sains Malaysia. They will most likely offered/decided in late 2021.

The budget estimation is done here only for the University of Bologna International Programme Office and it is briefly exposed here for three years (all amounts are in €). The total is 535000 € for three years and the details are offered in the supplementary material

	2021	**2022**	**2023**
Staff			
1 FTE(*) Junior assistant staff	15000	30000	30000
1 Senior scientist	40000	80000	80000
Meetings			
Preparatory Workshop early 2021 (Preparatory WS early 2021 (50 participants)	5000		
Assembly (100 participants)	25000	25000	25000
Executive meetings (10 people)	10000	10000	10000
Communication Office			
1 FTE Junior staff	15000	30000	30000
1 Technical	15000	30000	30000
Total	125000	205000	205000

(*) Full Time Equivalent

To construct the proposal in kind support has been already offered by the University of Bologna and CMCC Foundation for secretarial and web set up support, including the University of Miami's Institute for Data Science and Computing and the Centre For Marine & Coastal Studies (CEMACS) and SOCIB in Spain.

12. Percentage of estimated budget that is secured

Not available yet. The secured funding is the in-kind contribution of some of the Partner centers offering the time of the scientists belonging to the Steering Committee, the Advisory Committee and the Early Career Ocean Professionals who assisted in the Programme preparation and who are committed for the implementation phase.
Furthermore, many already funded projects, national and international, compose already a starting budget to be analyzed after the proposal is selected.

13. Secured funding sources

See above.

14. Do you require support to find additional resources for your Decade Programme?

Yes

15. Would you like to be put in touch with partners working on similar issues or proposing Decade Actions that could have synergies with your proposed Action?

Yes

16. Countries in which the proposed Decade Programme will be implemented

The 29 countries of the Steering Committee Members are:

Countries in the CoastPredict Committees
Argentina
Australia
Barbados
Belgium
Brazil
Canada
China
Cuba
Ecuador
France
Germany
Ghana
Greece
Italy
Jamaica
Japan
Malaysia
Morocco
Namibia
New Zealand
Norway

Philippines
Republic of Korea
South Africa
Spain
The Netherland
United Kingdom
USA
Vietnam

One Intergovernmental regional organization of the Western Indian Ocean, The Indian Ocean Commission, is also present.

17. Ocean basins in which the proposed Decade Programme will be implemented

X Indian Ocean
X North Pacific Ocean
X South Pacific Ocean
X North Atlantic Ocean
X South Atlantic Ocean
X Arctic Ocean
X Antarctic Ocean

All Oceans including their marginal seas and the adjoining land-sea interface.

2. Description of the proposed Decade Programme

18. What is the high-level objective(s) of your proposed Decade Programme?

Prologue

This programme proposal was prepared in consultation with the Steering and Advisory Committees, plus representation from the ECOPs. 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).

History and motivations

CoastPredict will capitalize on four major previous international initiatives:

- 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).
- 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.
- 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.
- 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.

All these activities have been disconnected and have not produced a global international network to bring together the fragmented coastal communities for advancing the science of the global coastal ocean. New advances that make a science-focused Programme such as CoastPredict urgent and achievable are: a) operational oceanography is now being implemented from the global to the regional scales, making available open and free data for coastal

downscaling; b) major technology advancements have taken place in observing, from satellites to in situ robotics and the use of Artificial Intelligence, which makes the monitoring of the coastal ocean practical and feasible. CoastPredict will capitalize on this game-changing operational oceanography framework and extend to coastal predictive capabilities, including the land-water cycle (rivers, underground and transitional waters) and, for the first time, integrating from the coastal ocean, through estuaries and rivers to the "urban ocean" (waters within and around coastal cities).

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 Global Coastal Ocean is a concept central to CoastPredict transformative science. The new concept considers that all coastal ocean regions are an interface area where atmosphere, land, ice, hydrology, coastal ecosystems, open ocean and humans interact on a multiplicity of space and time scales that need to be resolved with a proper downscaling methodology and consideration of uncertainties. This new concept is particularly well suited to: engage island nations and indigenous or local people; inspire Early Career Ocean Professionals; and be embraced by the general public. These objectives will be achieved with targeted educational, capacity building (including training and education) and public outreach activities, under principles of diversity, equity and inclusion. Also, the Programme can contribute to several of the UN Sustainable Development Goals (SDGs), through different indicators obtained from CoastPredict (see sections 25-27).

The legacy of this work will be the capacity to advance science, the observing systems and the methods for the development of reliable 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.

The beneficiaries of these science- and stakeholder-based observations and predictions under R2O best practices and standards will be the technical oceanographic, meteorological and civil protection infrastructure of each nation, the scientific community, the policy makers, the coastal communities and the civil society at large. The **transformative science of CoastPredict** stems from the co-design (footnote 2), implementation and assessment of:

1) **innovative multidisciplinary observational technologies and fit for purpose observing system in the Global Coastal Ocean**, encompassing satellite and in situ observations, that will be fully integrated with the open ocean observing system and developed in support of sustained coastal monitoring and predictions;
2) **innovative numerical modelling, data assimilation and data science tools** comprising the ocean best practices for integrated environmental, ecological and socio-economic coastal predictions and principled adaptive sampling taking that take all global coastal ocean system components into account (i.e., physical, chemical, geological, biological, ice, socio-economic) and including Coastal Earth System Modelling;
3) **coastal solutions/services** that will improve citizen welfare and human health, protect marine natural environments and their ecosystem services (footnote 3), provide early warning services for ocean related events, contribute to mitigate the impact of GHG emissions, restore habitats, produce science-based management plans and advance sustainable coastal and blue economies based on the outcomes of the new Global Coastal Ocean prediction science and technology paradigm;
4) **a virtual information/digital infrastructure** that supports full open and free access based on the FAIR (Findable, Accessible, Interoperable, Reusable) principles and offers an extended range of tools for an improved uptake of data, access to analyses and forecasts, and an improved understanding of the entire value chain from observations to end users in the Global Coastal Ocean;
5) a new **Global Coastal Ocean Network** coordinating the coastal scientific and technical communities for the purpose of sharing knowledge and protocols for the monitoring and prediction of the coastal ocean,

envisaging specific strategies to eliminate biases and inequities, capable of representing national needs and supporting policy development for the global coastal areas (including data-poor areas in developing countries) helping to mitigate against pollution and the negative impact of climate change.

A successful story to be continued

Global open ocean observing and forecasting is now 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.

At present, satellite altimetry, infrared and passive microwave sensors, ocean color, synthetic aperture radars and scatterometers monitor the ocean sea surface in real time, together with open-ocean profiling floats measuring the ocean interior essential ocean variables. Based upon this observing system, the data assimilation and the realistic ocean modelling, a daily 10 days forecast, ~50 years reanalysis and analyses are available for hydrodynamics, marine pelagic biochemistry and sea ice. All this information is available following the FAIR principles from systems around the world, for example the Copernicus Marine Environment Monitoring Service (CMEMS) in Europe. The slow revolution of operational oceanography/ocean forecasting has started and it will impact all human activities at sea and our capacity to better predict ocean climate variability and change.

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.

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. **In order to do so, it is necessary to**:

1) define scientifically and objectively the relevant processes that matter in each coastal area, giving a range of importance and uncertainty in their monitoring/modeling;

2) make use of all newly available or soon-to-be-available satellite observations, such as coastal altimetry, hyperspectral radiometry, high resolution active and passive microwave missions providing continuous information across the land and ocean interfaces;

3) co-design the coastal in-situ system to meet the needs of the prediction systems and other related societal needs across climate and ocean health, complementary to the satellite system and with real time data transmission protocols, and fully connected to the open ocean observing, as one system. Take advantage of emerging technologies e.g., combine networks of low-cost sensors for water level, temperature, salinity, oxygen, pH, chlorophyll and more, to achieve affordable and sustainable high quality monitoring at the local to regional level;

4) optimally merge the first guess information from the global systems with the observations and models of the coastal areas, the river estuaries and the salt marshes. Advance data assimilation for both parameter and variables optimal estimates, using hybrid modelling with data science and machine learning components when necessary.

5) determine the limit of predictability of different components of the coastal marine ecosystem at different process resolution scales. Utilize uncertainty predictions and observational assets to predict and collect the most informative ocean observations using adaptive sampling, so as to reduce costs and maximize impact.

6) develop from the beginning coupled sedimentary, ice shelves, physical and biogeochemical models to address the needs for services connected to coastal erosion, marine biodiversity protection, ecosystem services provision, and adaptation/mitigation plans against adverse climate change impacts, including probabilistic predictions and quantitive risk management for all of these communities and services. Use this information to develop the coastal ocean observing system.

7) experiment with continuous land-sea simulations or regional/coastal earth system models augmented with regional socio-economic choices (e.g. land-use changes and regional emissions) to empower coastal communities with tools that can address multiple issues facing them, moving forward in a multi- stressor world through targeted management strategy evaluation exercises and various "what if" scenarios.

(footnote 1) Downscaling is the conventional methodology to insert dynamical processes and features starting from a first guess where such properties are not included. In numerical met-ocean forecasting it is mainly connected to the increase of grid resolution, the inclusion of geometrical complexities and high frequency processes. Recently data-science techniques were also developed for downscaling.

(footnote 2) Co-design combines the knowledge of multiple experts and stakeholders, helping to create innovative concepts and ideas that meet the needs of these stakeholders and that could not have been produced by any one of the involved working groups alone. Co-design in CoastPredict is understood as a continuous process, a collaborative and iterative effort among all stakeholders. It is done at multiple levels, across the programme, in its projects and within working groups, where the working groups may have different objectives and expertise within the scope of the overall programme. At any level, co-design includes jointly designing work and coordinating actions as a team of designers, developers and users to ensure the final result is achieved and it is fit for purpose.

(footnote 3) Marine ecosystem services include goods such as fish harvest and mariculture, wild plants and animal resources, raw materials, genetic material, water; human activities such as recreation and tourism, transportation, scientific and educational opportunities, breeding and nursery habitats, carbon sequestration; cultural benefits such as bequest for future generation, religious significance.

19. What are the key expected outcomes of your proposed Decade Programme?

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 (see Sections 25-27 and the Supplementary material) (footnote 4).

The Programme has already established an Early Career Ocean Professional (ECOP) group that will be actively participating in CoastPredict Projects and governance structures, continuing the post-2030 legacy of CoastPredict. They will benefit from professional development and networking opportunities, and opportunities to join and lead

scientific collaborations and partnerships. They will form the new generation of scientists supporting coastal prediction, trained under the transformative concepts of CoastPredict and any bias that might prevent them from advancing their careers on an equal footing will be removed.

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 the following international groups, which have provided initial input and which are committed to further **collaborating in co-designing the Programme:**

1) GOOS will contribute to the design and the coordinated implementation of coastal observing networks, their interface with the open ocean systems; as well as setting standards for forecasting and predictions at the different scales;
2) IODE is contributing its Ocean Data and Information System (ODIS) as a distributed, robust, and collaborative "digital ecosystem" of interoperating elements, that leverages open, scalable, easily implementable, and responsive digital management frameworks, and providing access to coastal data and information for CoastPredict
3) IODE/GOOS Ocean Best Practices System (OBPS) will help to design, develop and promote global adoption of methods for trusted data/information exchange and interoperability across the value chain;
4) OceanPredict, its Task Teams (especially the COSS-TT) and its proposed UN Decade Programme ("ForeSea") will work in synergy with CoastPredict to make sure there will be appropriate uptake of global ocean analyses and forecasts and to advance the intercomparison of coastal system forecasts (ForeSea and CoastPredict have submitted already a common Project, see the Supporting documentation) ;
5) CEOS-COAST will help to interface with all satellite observing systems for the coasts and will work with CoastPredict to facilitate the continuous uptake of satellite data streams;
6) The World Weather Research Programme (WWRP) of WMO will work with CoastPredict to advance the seamless prediction of ocean-driven hazards that affect large the lives and livelihoods of populations in coastal zones.
7) GEOS- Global Ecosystem for Ocean Solutions, another Programme to be submitted to the Decade, will work in synergy with CoastPredict helping to use the new scientific knowledge and the CoastPredict technology prototypes to advance solutions and involve stakeholder communities (GEOS and CoastPredcit have already submitted a common Project, see the Supporting documentation);
8) EquiSea- The Ocean Science Fund for All, another Programme to be submitted to the Decade and dedicated to more equitable funding for ocean sciences will work in synergy with CoastPredict, l helping to fund transformative ocean science in under-resourced nations;
9) Ocean Corps, another Programme to be submitted to the Decade, will work with CoastPredict to build more collaborations (summer schools, workshops, MS degree programs, etc.) between higher-resourced and under-resourced nations;
10) Global Ocean Oxygen Decade (GOOD), another Programme to be submitted to the Decade, will work with CoastPredcit to promote understanding the mechanisms of coastal hypoxia, its impact on marine living resources, biogeochemical cycles and human-well-being;
11) Marine Life 2030, another Programme to be submitted to the Decade, will work with CoastPredict to engage policy, society, and industry in the co-design of a global, interoperable coastal network for the observation of marine life, built on existing and new environmental monitoring systems;
12) The Digital Twins of the Ocean - DITTO, another Programme to be submitted to the Decade, will work with CoastPredcit to develop a Digital Twin for the Coastal Ocean, establish and advance a digital framework for all model and observational data that can be explored with advanced visualization methods and a platform for "What if" scenarios on High Performance Computing.

(footnote 4)
Integration is considered an integral part of the ethos of CoastPredict from the beginning. Adequate resources and agreeing responsibilities to coordinate the integration process for each working group, project or action etc. will be considered and provided (it often happens that everyone is convinced that integration is necessary but see it as someone else's job!). Real integration can be time-demanding (much more than we generally imagine), so a realistic assessment of needs and priorities for coordination, methods, time required, and where/what level different aspects of integration might occur will be carried out.

20. Please describe the activities that will be implemented as part of the proposed Decade Programme

(600 words or less)

CoastPredict will be implemented by several Projects that will be carried out across similar/contrasting global coastal ocean areas. Briefly, the projects revolve around ten key themes:

Theme 1: **the redefinition of the concept of the Global Coastal Ocean**, including the nexus of the predictability of the coastal physical-sedimentary-biological-chemical-ice coastal coupled system and the role of the coastal ocean in the large-scale circulation and ecosystem dynamics.

Theme 2: **the co-design of the satellite and in situ observing system for the global coastal ocean**, with and responding to the CoastPredict modelling community, fully exploiting the new generation of the satellite missions, optimal smart sensors, robotic observatories and traditional networks, all optimally designed for the newly defined area of the coastal ocean (i.e., including rivers, estuaries, salt marshes, deltas and urban settlements).

Theme 3: **a multi-hazard coastal prediction system**, developing new prototypes of the integrated observing and modelling system for forecasting in order to support innovative early warning systems and hazard mapping from extreme events to Seasonal and Subseasonal time scales, in a Disaster Risk Reduction framework.

Theme 4: **a virtual information infrastructure** that supports fully open access and offers a range of tools to discover, use and analyze information for different coastal areas of the world, interoperable with the open ocean information system, as well as their adoption as best practices.

Theme 5: **reliable climate change projections in the coastal ocean and resilient coastal communities**, developing reliable whole-system coastal ocean models for long-term projections, and urban ocean modeling and innovative risk-based assessment innovative methodologies. Furthermore, this theme develops the methodologies for assessing engineering and nature-based solutions for resilient coastal planning services and the protection of the coastal areas, against the adverse effects of land-based pressures and climate change trends.

Theme 6: **predictions relating to the river catchment-estuary/delta-coastal/shelf-ocean biogeochemical coupled system** from events to climate. The target here is to monitor and predict coastal changes due to human and climate impacted river flows, river and groundwater salinization, coastal groundwater and sediment contamination, biodiversity/ecosystem services changes due to pollution and climate change and empower communities to weigh the impacts of these choices against important cultural and economic resources regionally.

Theme 7: **comprehensive assessments of coastal marine-relevant contaminants** and their origins, fate and dispersal (oil, (micro)plastics, Hazardous and Noxious Substances, etc.) in view of the improved observing and forecasting capacity developed by CoastPredict. Ensemble risk mapping and "what if" scenarios will be developed to provide support for marine pollution hotspots screening in coastal zones and help develop remediation solutions.

Theme 8: **one-health concept applied to the Global Coastal Ocean (Ocean and Human Health-OHH):** unraveling the connections and predictions of coastal ecosystem health to human health, including harmful algal blooms, invasive species and (micro)plastic contamination through the food web up to humans, raising awareness of the relationship between human physical/mental health and a healthy coastal environment.

Theme 9: **forecasting for sustainable coastal economic activities and climate adaptation strategies**, connecting prediction products to socio-economic activities in the coastal areas toward sustainable exploitation of coastal resources and climate adaptation. Blue economy activities in the coastal ocean, e.g. mariculture, tourism, shipping and renewable energy extraction, will be planned with the new knowledge coming out of multi-hazard coastal early warning systems, reliable coastal climate change predictions and "what if" scenarios for the coastal zone.

Theme 10: **equitable participation, cultural heritage, arts and coastal urban development**, fostering interactions between scientific knowledge and "that part of the past which we select in the present for contemporary purposes, be they economic, cultural, political, or social". In particular, this theme will promote education and capacity building (including ocean literacy) under principles of diversity/equity/inclusion.

21. Please describe the theory of change that underpins your proposed Decade Programme i.e. how will the activities being carried out achieve the outcomes and objectives that you envisage

(400 words or less)

The 10 CoastPredict themes (see Section 20) and their projects will contribute to the transformative science outlined in Section 18. Projects will be constructed following these principles and guidelines:

1) Have a clear stakeholder engagement plan, including local and regional stakeholders, multiplicators and indigenous people;
2) Have several implementation coastal areas of the study (transferable solutions are essential), some of which in a developing nation;
3) Develop and/or engage new methodologies and technologies with real integration between the different components of the project, in particular assuring full co-design & implementation, observational, modelling and data components;
4) Include data management and related best practices for open access data from the start;
5) Include multi-national, multi-disciplinary and diversity balanced groups;
6) Include a plan for after-the-project sustained, continued development of the basic information infrastructure and solutions/services with adequate public/private partnerships;
7) Include capacity building including professional educational activities, promoting careers of ECOPs and under-represented scientists.
8) Include a communication plan.

The Steering Committee of CoastPredict has already offered 28 Project ideas that are described in the Supplementary material.

In order to achieve its ambitious objectives, CoastPredict will proceed through 5 phases, approximately consisting of:
Phase 1) 1 year (2021), where the Strategic science and implementation Plan will be completed and the First Round of Projects (FR Projects) designed (already advanced in 2020).
Phase 2) 3 years (2022-2024), where the FR Projects will be carried out in different coastal ocean areas of the world. These projects shall be applied to different and contrasting areas of the world ocean, e.g. upwelling and the western boundary current coasts, the polar areas and the tropical islands, focusing on the same theme;
Phase 3) 2 years (2025-2026), where the FR Project outcomes will be reviewed by the scientists and stakeholders driving the design of the follow-up Projects for the next three years;
Phase 4) 3 years (2027-2029), where Second Round (SR) Projects, including revised FR and new Projects, will be carried out;
Phase 5) 1 year (2030), for synthesis of CoastPredict outcomes and planning their further exploitation.
The duration of the FR and SR Projects will be decided on the basis of the scope and the funding required. Every phase will include extensive dissemination, education and communication activities as well as a specific assessment of the impact of results on society.

22. Will your proposed Decade Programme enhance the sustainability of ocean science initiatives, including infrastructure or individual / institutional capacity, in light of the current Covid-19 pandemic?

Yes

23. If yes, how will your proposed Decade Programme enhance the sustainability of ocean science initiatives, including infrastructure or individual / institutional capacity, in light of the current Covid-19 pandemic ?

The improved observation / modelling / knowledge systems that will be developed and globally disseminated by CoastPredict will improve the resilience of these systems themselves and of the inter-connected international

population against catastrophes like COVID-19. This will be one of the transformational targets of CoastPredict developments.

There are five major areas of impact for a post-pandemic COVID-19 research and development in CoastPredict, which are to:

1) embrace and develop the concept of the Ocean and Human Health (OHH), including the connections with the WHO One Health program, and other regional initiatives, e.g., the European Marine Board OHH project, as outlined in Theme 8 above (Sect. 20);
2) increase knowledge for disaster risk reduction and climate change risks in the urban ocean and generally the global coastal ocean (Themes 3, 5 and 6);
3) help to understand the potential connections between the two big crises of our era: zoonosis (footnote 5) and climate change in the specific area of the global coastal ocean and how to increase the resilience of our marine socio-ecological systems (Theme 9).
4) break down the existing silos along the value chain, assuring a fit for purpose and sustainable system of systems infrastructure.
5) contribute to design a blue economy that will fit the principles of "Building Back Better", e.g. develop coastal socio-economic systems for long-term emission reduction goals, factoring in resilience to climate impacts, slowing biodiversity loss and increasing circularity of supply chains.

The focus of CoastPredict on disaster risk reduction for extreme coastal events and climate change with innovative observing and forecasting of the Global Coastal Ocean is at the basis of the sustainability of ocean science in light of the current crisis.

(footnote 5) A zoonosis is an infectious disease caused by a pathogen (an infectious agent, such as a bacterium, virus, parasite or prion) that has jumped from a non-human animal (usually but by no means always a vertebrate) to a human.

24. Please describe the coordination / management structure for the proposed Decade Programme

(400 words or less)

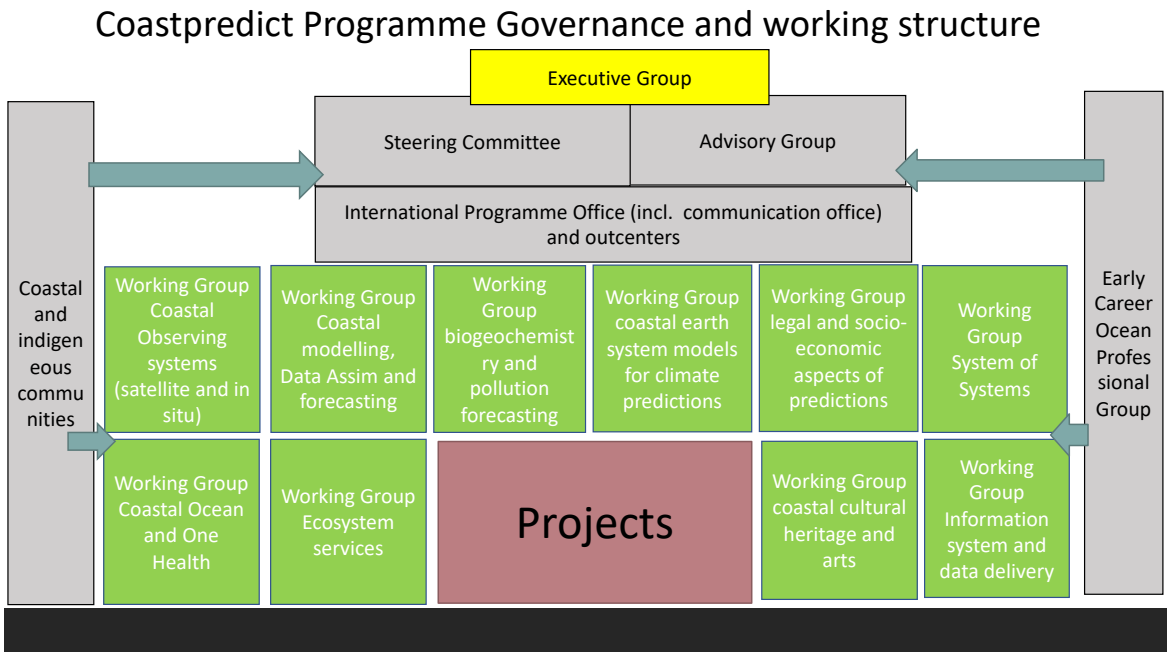
The initial coordination/steering/management/communications structure of CoastPredict has been designed and it is outlined below. For more details, please see the supporting documentation.

Coordination will be undertaken by several groups linked to external international organizations that will help to assess, control and disseminate the scientific and technological outcomes of the Programme. They are:

1) The Executive committee – the Science and Strategy Planning Group, periodically also delivering the overview of the main outcomes, overseeing Programme execution and regularly assessing progress towards goals;
2) The Steering Committee – the Governing body of the Programme that approves the Strategy and assesses the project developments, following principles of innovation and diversity;
3) The Advisory Committee – brings unique knowledge to the formal Steering and Executive Committees in order to more effectively guide the Programme;
4) The International Programme Office and outcenters – follow the every-day life of the programme and help to coordinate all the activities, keeping a close contact with internal and external groups, ensure needed connections between the working groups and projects. These outcenters are decentralized;
5) The Early Career Ocean Professional (ECOP) Group – prepares the new generation of scientists/engineers/managers that will carry the CoastPredict achievements into the future;
6) The Working Groups – drive the technical discussion and project implementations fully aligned with CoastPredict principles and expected final outcomes. These Working Groups should evolve with the Programme and have a well defined life time, being replaced during the Decade with fit-for-purpose expert teams with trans-disciplinary missions.

The general Strategy of the Programme will be designed by the Executive Committee and approved by a General Assembly composed of the Steering, Advisory, ECOP and Working Group representatives. The implementation will be coordinated by the Working Groups (WG), that include: Coastal Observing Systems, Coastal ocean modelling, data assimilation and forecasting; Biogeochemistry and Pollution forecasting; Coastal Earth System

Models for Climate projections; Legal and Socio-economic aspects of predictions; System of Systems; Coastal Ocean and One Health; Information System and Data Delivery; Coastal Cultural heritage and Arts; Ecosystem Services.
The initial Terms of Reference for each Committee are written in the Supplementary documentation attached to this application.
The Programme will be coordinated by a set of decentralized coordination centers where staff will be dedicated to support the management and communication office.



3. Contribution of Proposed Decade Programme to the UN Decade of Ocean Science for Sustainable Development

25. To which Sustainable Development Goal(s) (SDG) will your proposed Decade Programme contribute? Please select a maximum of three SDGs

GOAL 9: Industry, Innovation and Infrastructure
GOAL 13: Climate Action
GOAL 14: Life Below Water

26. How will your proposed Decade programme will contribute to the SDGs selected? Please Explain

(200 words)

1) GOAL 9 (Target 9.5 and all indicators for 9.a,b,c): CoastPredict will advance the international basic information infrastructure for the global coastal ocean monitoring and forecasting. The Programme will establish a network of scientists, engineers and managers, including regional and local stakeholders, that will formulate the requirements and the working standards for observing and predicting the global coastal ocean.

2) GOAL 13 (Target 13.1 and 13.3): CoastPredict will promote the downscaling of climate change scenarios in the coastal zone, designing new coupled ocean-atmosphere-land-hydrology models at the necessary scale to resolve processes in the coastal areas and define impacts of different climate scenarios, including coastal sea level changes and extreme events on the coasts, biogeochemical cycles and pollution.

3) GOAL 14 (14.1, 14.2, 14.3, 14.5 and 14.a): CoastPredict will advance the science of the Global Coastal Ocean and develop multi-hazard early warning systems for the coasts as well as assessments of pollution and contamination at the coasts, in the surface and underground waters; it will characterize sources, including land sources, of pollution, including regional emissions, eutrophication and invasive species. It will advance understanding of how to ensure sustainable seafood production in face of multiple climate stressors and human health relationships.

27. How will your proposed Decade Programme contribute to the vision and mission of the Decade?

(400 words)

From Ryabinin et al. (2019) the idea of the Ocean Decade is to achieve a major change in the knowledge and management of the ocean. This is reflected in the following two over-arching goals that provide the high-level motivation for the Decade:

Goal 1: To generate the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the ocean.
Goal 2: To provide ocean science, data and information to inform policies for a well-functioning ocean in support of all Sustainable Development Goals of the 2030 Agenda.

CoastPredict will contribute to both Goals. Regarding the first, it will develop new knowledge about the concept of the global coastal ocean, its characterization from a multi-disciplinary point of view and in view of extreme events and climate change impacts at the coastal scales. Furthermore, CoastPredict will increase our knowledge, for example, of the complex interactions across the coastal ocean continuum from rivers/estuaries/deltas to coastal/shelf and adjacent open ocean waters, the coastal biodiversity and ecosystem services, and land-based pollution, to name but a few. CoastPredict will also take prompt initiatives to connect to the game-changing revolution of operational oceanography and forecasting, increasing the observing and modelling capabilities in

the coastal areas.

All new observational and modelling data collected during the Projects under CoastPredict will be framed in the context of open and free access, interoperability and connections with the UNESCO-IOC data management initiatives such as IODE Ocean Data Information System (ODIS), IODE/GOOS OBPS and the WMO WIS-2.0. CoastPredict will thus contribute to the establishment of a virtual oceanographic infrastructure for the dissemination of observational and modelling information, as well as standards for the new coastal technologies. CoastPredict will work in synergy with the new satellite capabilities for the coasts, enlarging their uptake and integration with in-situ observational data sets, promoting the newest technologies, from cheap sensors to future technologies, thus contributing to science-based management.

The enhanced modelling capabilities for multi-hazard early warning systems, downscaling of climate scenarios and "what if" socio-ecological scenarios based upon well calibrated and validated numerical models, together with advanced machine learning algorithms for selected forecasting aspects, will help the coastal management and the policies addressing the SDG targets and indicators.

28. To which Decade outcome(s) will your proposed Decade Programme contribute?

Outcome 4: A predicted ocean where society understands and can respond to changing ocean conditions.
Outcome 6: An accessible ocean with open and equitable access to data, information and technology and innovation

29. How will your proposed Decade Programme contribute to the Decade outcomes selected

(200 words)

CoastPredict will:

1) Increase predictive capabilities from events to climate;

2) Focus on the land sources of pollution that are a key source of global marine pollution and can compromise healthy marine ecosystems and, ultimately, human health and well-being;

3) Design, plan and implement the basic data sharing infrastructure, through collaboration and interoperability arrangements with existing infrastructures, for the global coastal ocean information to increase availability and appropriateness of data for many stakeholders;

4) Build and maintain processes that capture uncertainties in current and new knowledge and create trust and transparency for all stakeholders;

5) Connect to Programmes such as GEOS for the development of solutions where information is made accessible to coastal communities and stakeholders;

6) Connect to other Decade Programmes such as GEOS, EquiSea and Ocean Corps to increase capacity and disseminate the S&T developed in CoastPredict.

7) Connect to the relevant international programs such as GOOS, IODE ODIS, IODE/GOOS OBPS, CEOS-COAST, OceanPredict, WWRP.

8) Develop close relationships with coastal communities, managers and policy-makers as stakeholders for co-designing solutions, honoring indigenous and local knowledge, increasing awareness (ocean literacy) and trust on ocean science and forecasting, and promoting scientific integrity under principles of diversity, equity and inclusion.

30. To which Ocean Decade Challenge(s) will your proposed Decade Programme contribute?

Challenge 5: Enhance understanding of the ocean-climate nexus and generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather.

Challenge 6: Enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience.

Challenge 7: Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely, and actionable data and information to all users.

Challenge 8: Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering, and visualizing past, current, and future ocean conditions in a manner relevant to diverse stakeholders.

Challenge 9: Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders.

31. How will your proposed Decade Programme contribute to the Decade Challenges selected?

(200 words)

For Challenge 5: CoastPredict will define the basic, dynamical and structural characteristics of the global coastal ocean in order to understand the nexus between climate and coastal ocean response and impacts. It will downscale climate change scenarios with innovative coastal earth system models capturing the interconnections between atmosphere, land, ice shelves, rivers, the near shore and the ocean slope waters;

For Challenge 6: CoastPredict will develop coastal multi-hazards early warning systems to improve services and risk assessments, transforming deterministic forecasts to probabilistic predictions and impact-based forecasting in the coastal zone;

For Challenge 7: CoastPredict has been co-designed with IODE and GOOS and as such it will provide access to ocean observations and data products through a global interoperable “digital ecosystem”;

For Challenge 8: CoastPredict will integrate three-dimensional observational and model data, information and products across the land-sea coastal ocean continuum including a transformative digitization and visualization of the products for fruition by many stakeholders and the public.

For Challenge 9: CoastPredict will promote, develop and implement a trusted information infrastructure that supports fully open access, offers a range of tools and support significantly improved global interoperability.

32. To which Decade Objective(s) will your proposed Decade Programme contribute?

Objective 2: Build capacity and generate comprehensive and integrated knowledge and understanding of the ocean including human interactions, and interactions with the atmosphere, cryosphere and the land sea interface.

33. How will your proposed Decade Programme contribute to the Decade Objective(s) selected?

(200 words)

CoastPredict will first generate comprehensive knowledge of the Global Coastal Ocean and its interactions with atmospheric-land-cryosphere, considering biogeochemical cycles and biodiversity.

CoastPredict will develop the observational and modeling technology in a process-wise manner, promoting the new generation technologies for multidisciplinary measurements (marine physical and biogeochemical, surface and underground waters flow and loading, ice, atmosphere), also exploiting new cheap sensors, and forecasting-wise with innovative predictive models coupling meteo-hydro-ocean and ice compartments describing the different coastal areas. CoastPredict will prioritize both forecasting and observing for the high-impact events, such as inundation, coastal erosion, salt intrusions, coastal pollution and habitat loss. CoastPredict will develop data science tools for better predictions at different time scales.

Furthermore, CoastPredict will strongly enhance our ability to model and predict the coastal system and the human interactions occurring in the coastal zone, from the coastal urban resilience to the man-induced pollution. Such new science and technology will inform policies and the overall management practices, supporting sustainable economic development and the human physical and mental health and well-being. CoastPredict will furthermore ensure the availability to a wide variety of stakeholders, of all data and data products, through the "digital ecosystem" approach.

34. With respect to the Decade Objectives selected above, to which Decade Sub-Objective(s) will your proposed Decade Programme contribute?

2.1: Generate a comprehensive inventory, mapping, and understanding of the role and function of ocean components including their human interactions and interactions with the atmosphere, cryosphere and the land sea interface.

2.2: Generate a comprehensive understanding of thresholds and tipping points for ocean components, including human interactions.

2.3: Innovate and expand the use of historical ocean knowledge to support sustainable development solutions.

2.4: Improve existing and develop new generation ocean models for improved understanding of the past, current and future states of the ocean, including human interactions.

2.4: Improve prediction services and increase predictive capability for oceanic hazards or events including extreme weather and climate.

2.5: Expand cooperation in ocean-related education, training, capacity development and transfer of marine technology.

35. How will your proposed Decade Programme contribute to the Decade sub-objectives selected?

(200 words)

CoastPredict will essentially contribute to all sub-objectives of the Decade Objective 2:

(2.1) the Global Coast Ocean will be redefined, advancing the knowledge of how the global coastal ocean works, both locally and in the context of the global ocean circulation and biogeochemical cycles.

(2.2) the enhanced modelling capabilities fostered by CoastPredict through predictions at different lead times will offer the appropriate datasets for studying the thresholds for coastal pollution and climate change impact tipping points.

(2.3) the new observational and modelling data sets, both process-wise and real time, will be connected to ocean historical data archives that will support science-based management of the coastal area socio-economic activities.

(2.4) new ocean models will be developed, uncoupled and coupled to meteo-hydrology, ice, land and marine biogeochemistry and coastal habitat and biodiversity modelling.

(2.4) improved predictions services for multi-hazards in the coastal areas is at the heart of CoastPredict.

(2.5) engagement across CoastPredict network and with diverse stakeholders (also in coordination with other Programmes such as GEOS) will strengthen the global coastal ocean observational and modeling capacities, and enhance ocean science literacy and use of the knowledge generated for coastal solutions.

36. Please check which of the following criteria are relevant to your proposed Decade Programme as far as they are relevant to your proposal:

X Accelerate the generation or use of knowledge and understanding of the ocean, with a specific focus on knowledge that will contribute to the achievement of the SDGs and complementary policy frameworks and initiatives.

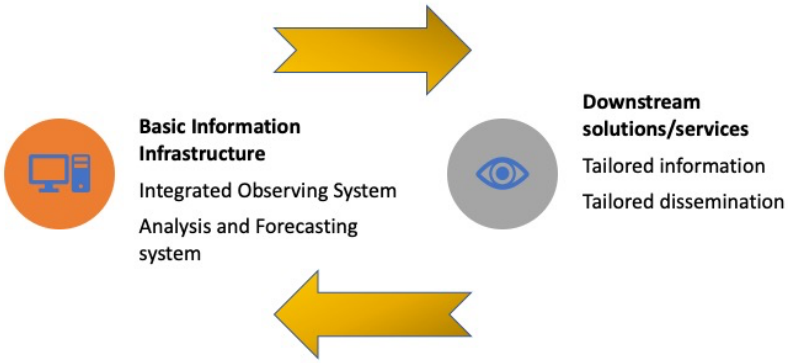
37. How will your proposed Decade Programme contribute to the Decade criteria selected

(no words limit)

CoastPredict will develop, test and standardize new methods of observing and predicting the Global Coastal Ocean that build on the availability of operational oceanographic products at the open ocean scales. Thus, the strategy is to have observing and modelling systems that will be incrementally upgraded, nested into large-scale products and that will include multidisciplinary and relevant coastal processes. The incremental approach will be the basis of CoastPredict science and technology developments.

Operational coastal monitoring and forecasting of the global ocean is the final outcome of CoastPredict based upon new scientific knowledge of the global coastal ocean dynamics and the analysis of high-impact events from weather time scales to climate change. This downscaling system can now be planned because significant progress has been made in the past years at the large scales in operational oceanography. The Global Coastal Ocean approach is the needed continuation of this success story.

Observational technologies, numerical coastal models and data-science-based algorithms have reached maturity and they need to be applied in the framework of operational infrastructural services that will offer high quality data for the SDG targets/indicators. Operational services of this kind (so-called “basic information infrastructure”) precede the customized services where specific indicators can be extracted and analyzed for the SDG targets.



Building the "Basic Information Infrastructure" requires four main ingredients that are specific outcomes of CoastPredict:

1) a sound scientific understanding of how the global coastal ocean works, its interactions with all the other components, the atmosphere, the land, ice and hydrological cycles, the sedimentary and biogeochemical compartments, coastal urban settlements and human activities on the coasts.

2) an integrated and accessible system of observations and models that can forecast all the components of the coastal system and evaluate the skill. Forecasting is actually the only way to validate the "theory" of the global coastal ocean and understand uncertainties in an objective way.

3) standards for availability and appropriateness of the data, both observations and models, that are freely and openly available to the largest possible user base.

4) tailored information and services (co-designed with coastal communities) that will fit the SDG target indicators based on the new "Basic information infrastructure". This last part will facilitate the virtuous loop of feedback needed for the basic infrastructure to improve. The co-design will produce an engaged community that will build a society that understands and that can respond to changing ocean conditions.

4. Communications

38. Please describe how you plan to communicate about your proposed Decade Programme including the main target audiences and methods of communications

(400 words or less).

The target audience was identified in the Costal Ocean Observing Panel Final report (COOP, 2004) and will be used here the same:

Sector	Code	User Group
Commercial	U1	Shipping
	U2	Marine energy and mineral extraction
	U3	Insurance and re-insurance
	U4	Coastal engineers
	U5	Fishers (commercial, recreational, artisanal)
	U6	Agriculture
	U7	Aquaculture
	U8	Hotel - restaurant industry
	U9	Consulting companies
Government	U10	Fisheries management
	U11	Search and rescue
	U12	Port authorities and services

	U13	Weather services
	U14	Government agencies responsible for environmental regulation
	U15	Freshwater management/damming
	U16	Public health authorities
	U17	National security (including navies)
	U18	Wastewater management
	U19	Integrated coastal management
Public / NGO / International	U20	Emergency response agencies
	U21	Ecotourism
	U22	Conservation and amenity (including environmental NGOs)
	U23	Consumers of seafood
	U24	Recreational swimming
	U25	Recreational boating
	U26	UN-organizations like UN Office for Disaster Risk Reduction (UNDRR)
	U27	UNEP Offices
Research & Education	U28	News and social media
	U29	Educators
	U30	Scientific community

CoastPredict will start an immediate dialog with the Research & Education community, progressing as rapidly as possible to the engagement of commercial, government, public and NGOs.

Preferable means of communication in the first two years are:
1) Web space with information and Forums for FAQ, publication of key deliverables, list of events, etc
2) Social media accounts on Facebook, Twitter, Instagram
3) Quarterly Webinars featuring presentations by experts and panel discussions with global audience
4) Townhalls at key professional meetings (AGU, EGU, AMS, Ocean Sciences, IEEE Oceans)
5) YouTube channel for publishing webinars, townhalls, and short video features of CoastPredict members & projects
Later, after products and results accumulate also:
6) Large scale events for public awareness
7) Training and education for professionals on developed prototypes and standard practices, including specific PhD scholarships/ research fellowships that relate to some objectives of the proposed Decade Programme
8) Stakeholders interface forums

39. Have you developed a communications strategy or plan as part of your proposed Decade Programme?

If so, please attach it as part of the supporting documentation.
Yes

40. If yes, please attach the communications documents requested.

5. Supporting Documentation

41. Please attach any relevant supporting documents to your submission that will aid in its evaluation e.g. project log frame, research proposal, high-level budget, data management plan, communications strategy, or letters of support.

Please note that none of these documents are obligatory, but can be provided at the discretion of the proponent if they feel it will help in the understanding of their request.

The supporting documentation consists of:
1) The list of Projects from Steering Committee Members
2) Terms of reference of Governing structures

Supplementary Material to the UN decade application

CoastPredict - Observing and Predicting the Global Coastal Ocean

Projects submitted by 13 January, 2021. More documentation is available at the University of Bologna.

Name of proposer	Theme (short name)	Main outcomes
1. Kim Cobb, Georgia Tech, USA	Smart Sea Level Sensors for Flood Forecasting and Coastal Resilience Planning and Education	1) Distributed sensor networks of rainfall and water level across urban landscapes in support of integrated earth system model to forecast floods and study key processes; 2) educational modules for K-12 students and college students
2. Chris Davis, NCAR, USA	Global Coastal Inundation Prediction; a potential project to bring together atmospheric, fresh water and ocean prediction for extreme events on time scales of hours to a week, including exploration of the social science of behind creating effective hazard messaging.	Improved understanding of predictability limits, complex impacts on infrastructure from multiple hazards, and the development of effective risk communication strategies
3. Kanna Rajan SIFT Inc., Minneapolis, USA	PROCOPIO: A Portable Robotic Observatory for Diagnosing Coastal Ocean Health for Human Well Being	An integrated portable to observe the onset of blooms, coastal plumes (effluents or spills from ship traffic), anoxic zones or coastal erosion. The methods articulated will have dual-use capabilities including for coastal security and surveillance.
4.Vinayachandran, P.N. Institute of Science Bengaluru, India	Integrated observing, modeling and predicting system for the coastal ocean	Costal ocean forecasts including ecosystem, pollution and fisheries.
5. Yniguez, Aletta University of the Philippines, Marine Science Institute, Philippines	Supporting our seas through automated and integrated networks (SUSTAIN): strengthening ocean observation and management of risks from harmful algal blooms and coastal ecosystem threats.	Develop tiers of ocean observation systems that can be used depending on the socio-economic context. Capacity-building of local scientists and communities in ocean observation
6. John Wilkin Rutgers University, New Brunswick, NJ, USA	To develop strategies to implement sustained growth in local regional oceanographic intellectual capacity and infrastructure for observing and predicting the global coastal ocean	1. On the ground training using proven and novel techniques 2. Establishment of a global fund to enable capacity development for learning opportunities and new observing networks 3. Creation of a coordinating body with equitable representation 4. online platforms for sharing and coordinating knowledge bases, cataloging best practices, and foster intra-regional collaboration
7. Kristy Tiampo	High-resolution characterization of changing coastlines	Workflow to produce high-resolution maps of coastlines around the world.

CIRES Earth Science & Observation Center, Boulder,USA		
8. Alan Blumberg Jupiter Intel, NY, USA	Coastal Urban Resilience in a Changing Climate	1) Urban Ocean Modeling Research 2) Risk Assessment Research 3)Resilient Design Research 4) Urban Planning Services 5) Education and Professional Development
9. Aileen Tan Shau Hwai School of Biological Sciences, Universiti Sains Malaysia, Malaysia	Investigation into the impacts of the 1.5-2.0ºc rise on the natural coastal ecosystems	1) TRANSLATION OF THE 1.5-2.0ºC CHANGE at global scale locally 2) IMPACT OF RISING TEMPERATURE AND SEA LEVEL. 3) THE IMPACT OF OCEAN ACIDIFICATION (OA) ON THE NATURAL COASTAL
10. Maria Maza IH-Cantabria, Institute of environmental hydraulics, Spain	Nature based solutions (NBS) for coastal protection and climate change adaptation.	1. New approaches and methodologies to implement these NBS including stakeholders engagement and public consultation. 2. New methodologies and tools to quantify ecosystems services. 3. New methodologies to perform a correct monitoring of these actions. 4. New guidelines to include these NBS in coastal defense policies.
11. Mauro Cirano Federal University of Rio de Janeiro, RJ, Brazil	Project 1 - Brazilian Coast Monitoring System (SiMCosta) Project 2 - NOAA AX97 High Density XBT Line	Long term monitoring of in situ EOVs at strategic locations
12. Jay Pearlman/ Joaquin Tintore IEEE France, Four Bridges/Balearic Islands Coastal Observing and Forecasting System	Coastal Ocean Resource Environment or "CORE". Virtual information infrastructure that supports fully open access and offers a range of tools	Astate of the art discovery and access system for users of all typesto better understand the coastal oceans in diverse coastal regions across the world.
13. Yannis Krestenitis/ Yannis AndroulidakisDepartment of Civil Engineering, University of Thessaloniki, Greece Vassilis Zervakis University of Aegean, Greece	Operational early-warning prediction system and numerical hydrodynamic modelling to provide short-term forecasts for the warning and protection of the coastal zones in risk and also climatic changes of the sea surface elevation.	The main outcome is the development of a global wide operational observation and prediction system that will provide reliable continuous sea level forecasts, especially for tsunami formation and propagation, and storm surges, but also climatic mean sea level alterations.
14. EdemMahu University of Ghana, Department of marine and fisheries sciences, Ghana	Coastal environmental change and ocean productivity in the gulf of Guinea-(CEeCOP)	1) understanding of the extent of present and future changes in the coastal ocean environment of the GOG and how they translate into the global coastal oceans. 2) how changes in the GOG's environment are driving changes in species abundance, diversity, 3) enhancement of both institutional and human resource capacity in the GOG in coastal environmental

		monitoring through knowledge and technological transfer.
15. Ingrid Puillat IFREMER, Brest, France	Automated measurements for biodiversity, running jointly complementary observation systems	A demonstration of an operational use of complementary systems at selected site(s)
16. Rafael Schiller Fugro, Houston, Texas, USA	Advancing global coastal ocean observing and prediction systems	1) Implementation of new platforms for datadelivery 2) Improved prediction systems 3) Knowledge sharing between stakeholders across regions and countries 4) Ability to transfer technology and lessons-learned on a country-to-country scale 5) Improvement in regional coordination between different ocean observing systems
17. Jason Holt National Oceanography Centre, Joseph Proudman Building, Liverpool, UK	Reliable Climate Projections in the Global Coastal Ocean	1) Understanding of the performance of CMIP, downscaled and RESM models in the context of coastal ocean future climate projections, and providing advice for their improvement. 2) Developing rigorous protocols and analysis tools for the use of global models in the coastal ocean, including understanding the various sources of uncertainty and mitigating these through ensemble selection and analysis approaches. 3) Develop an engaged community of coastal-ocean future climate model practitioners, and working towards a Coastal-Ocean MIP.
18. Guillaume CHARRIA IFREMER, Laboratory of Ocean Physics and remote Sensing (LOPS), Brest, France	i. PRESTHA [Towards a global PRediction of ESTuarineHAbitat changes under climatic and human pressures]: to better predict estuarine habitat changes – in terms of morphology, hydrodynamics, hydrology and turbidity – supporting ecosystem studies (i.e. physics, sedimentary, biology, biogeochemistry and ecology); ii. NETFLUX [Towards a global prediction of particulate NET FLUXes between estuaries and coastal oceans under climatic and human pressures]: to better predict the net export of terrigenous particulate matters toward coastal oceans, which represent the main vector of nutrients, pollutants and contaminants.	One of the main objectives of the PRESTHA project is to provide a global conceptualization of estuarine sediment dynamics, based on a limited number of parameters characteristic of estuarine forcing. The conceptualization will offer a tool to better understand, quantify and manage estuarine socio-ecosystems. In addition, PRESTHA will investigate long term estuarine morphodynamics (i.e. forecast modeling around 50-100 years), providing insights in potential estuary trajectories under different global change scenarios (e.g. changes in climatic and anthropogenic pressures).
19. Emlyn Jones CSIRO, Coastal Environmental Modelling, Hobart, Australia	Tropical Regional –Earth System Model (TR-ESM)	Phase 1: Development of the Tropical Regional Earth System Modelling system and Data Assimilation system using the Great Barrier Reef as a testbed. Phase 2: TR-ESM will be transformedin arapidly deployable system that can be used

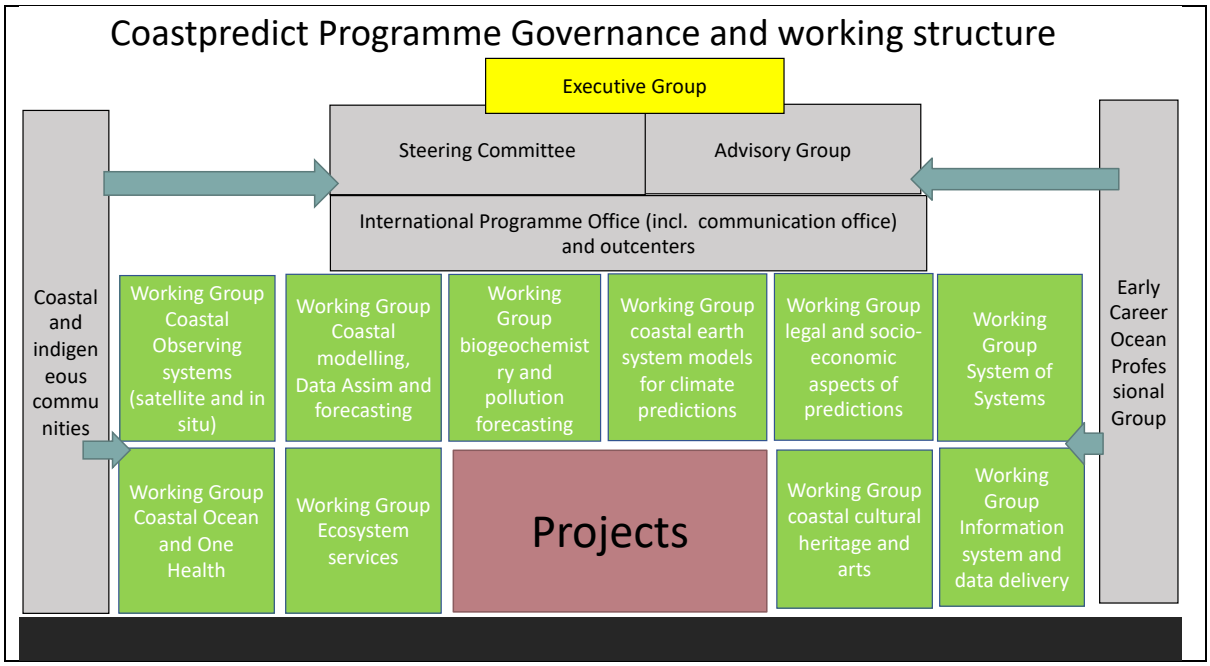
		by the community in other tropical/coral reef regions.
20. Marilaure Grégoire Faculté des Sciences, University of Liege, Belgium	FULLCONTINUUM: Next-generation of models for a full coupling of the river-estuary ocean-atmosphere continuum. Application to the North Sea.	1) better understanding of the coupling between the river-estuary- ocean continuum and in particular, a better quantification of the fluxes of organic and inorganic materials from the land to the sea. 2) To progress in the use of unstructured grid model (finite elements) in the coupling with biogeochemical models 3) A better quantification of the impact high frequency meteorological events on the SPM dynamics and water clarity.
21. Joanne Hopkins National Oceanography Centre, Liverpool, UK	ROTATE- Redefining the concept of the global coastal ocean	1. A more comprehensive understanding of the multi-scale interactions that take place within the coastal ocean and the interconnected nature of coastal and shelf sea environments (land-shelf-atmosphere-open ocean). 2. A new process-based set of coastal ocean typologies, applicable worldwide 3. New understanding with which future coastal ocean observing systems can be optimally designed 4. An online tool, accessible to all, where users can generate a customised map of global coastal ocean typologies based on the processes and dynamics most relevant to their problem/interests.
22. Giovanni Coppini Ocean Predictions and Applications Division, CMCC, Lecce	Comprehensive marine environment status assessment with respect to marine-relevant contaminants (oil, plastic debris, HNS, etc) to provide support for marine pollution hotspots' screening in coastal zones.	1) Model-and-observation based tool for near-real time tracking the pollutants in coastal zones 2)Unique methodology of hazard/risk mapping that is based on state-of-the-art meteo-oceanographic models, Lagrangian particle tracking techniques. 3)Identification and quantification of uncertainties in the predictions of transport and fate of marine pollution in coastal zones. 4)Mobile applications to allow citizen to report about marine and coastal pollutions
23. Gianandrea Mannarini, Ocean Predictions and Applications Division, CMCC, Lecce	"NAVIgating in the COASTal ocean" (NAVICOAST)	NAVICOAST will involve three main interrelated activities: 1) advanced meteo-oceanographic routing for Short Sea Shipping; 2) navigation in busy waterways; 3) emissions into both air and water.
24. Ghada El Serafy Deltares, The Netherlands	Coastal hazards at a global scale through an open-access data platform: Blue Earth Data	Our project will build upon the BlueEarth Data platform (https://www.deltares.nl/en/software/blueearth-data/), a recently launched open source community data platform for flooding, coastal management and offshore planning to provide relevant coastal hazard information.

25. Fiamma Straneo, Scripps Institution of Oceanography, USA	Eyes on the Arctic Fjords: Rapid mass loss from the Greenland Ice Sheet and Arctic ice caps is affecting sea level and, through increased freshwater and sediment discharge, ocean circulation, sea-ice, biogeochemistry, marine ecosystems and communities in the Arctic.	Long-term records of physical, biological and biogeochemical variables at key locations around the Arctic will be obtained through an international, monitoring collaboration. These, in turn, will provide key data for model validation and inform understanding of processes.
26. Emanuele Di Lorenzo, Georgia Tech, USA	Equitable Coastal Ocean Solutions. This project is done in collaboration with the GEOS Programme submitted to the Decade call	The goal is to develop a set of equitable coastal solutions services and technologies for under-represented and Indigenous coastal communities to enhance resilience and adaptation to the growing human and climate pressures.
27. Yosuke Fujii Meteorological Research Institute Japan Meteorological Agency, Japan	Synergistic Observing Network for Impactful and Relevant Ocean Predictions (SynObs). This project is done in collaboration with MOPSIR programme submitted to the Decade call	This project mainly seeks the way to extract the maximum benefit or synergy from various combinations of different platforms in the ocean observing network, typically of in situ and satellite observations, for ocean state (including the sea-ice state) monitoring and predictions using ocean prediction systems.
28. Guillaume Charria, Ingrid Puillat, Laurent Delauney, IFREMER, Laboratory of Ocean Physics and remote Sensing (LOPS), Brest, France	A European Integrated Coastal Ocean Observing and Predicting Systems – E-ICOOPS	• Improving the design of the observation capabilities for modelling needs • Delivering a larger number of coastal observation data suitable for integrated multidisciplinary modelling and predicting systems • Driving a breakthrough in integrating information from the whole coastal observations (in situ and remotely sensed) in modelling and forecasting systems
29. Clemente Tanajura, Universidade Federal da Bahia Brazil	Title: River plumes as major mediators of marine plastic pollution (PLUMPLAS)	• A new observational approach to assess the plastic concentration in estuaries and ocean will be attempt by employing ship-borne ultraviolet fluorescent LiDAR. • Another expected outcome of the project is associated with modeling experiments on river plumes and verification if the plume dispersion is highly correlated to plastic dispersion.

Supplementary Material to the UN decade application

CoastPredict - Observing and Predicting the Global Coastal Ocean

Governance structure and Terms of Reference



Executive Committee (EC)

The Executive Committee of CoastPredict has the following Terms of Reference:
(a) Review and prioritize the short- and long-term planning of the CoastPredict work programme and advise on its implementation;

(b) Take all necessary actions to ensure that the CoastPredict strategy, work programme and operating plan are aligned with and contribute directly to the UN Decade of Ocean Science for sustainable development objectives and priorities, as well as with the IOC Plans;

(c) Assess the resources required for the implementation of the work programme, as well as approaches to identifying and mobilizing these resources;

(d) Coordinate and integrate the work of CoastPredict, as implemented through the various Working Groups;

(e) Ensure that the CoastPredict requirements for satellite and in situ data are properly documented and communicated to the appropriate mechanisms of IOC;

(f) prepare the yearly Assembly of the Steering Committee and Advisory Committee of CoastPredict, prepare a revised CoastPredict work Programme for approval at the Assembly;

(g) Coordinate and integrate the work of CoastPredict, as appropriate, with that of IOC and UN Decade of Ocean Science major programmes, and in particular initiate, coordinate and provide oversight for joint projects and activities with these programmes;

(h) Review the internal structure and working methods of CoastPredict, including its relationship to other bodies, develop proposals for modifications, and approve such modifications at the yearly Assembly.

(i) coordinate with GOOS, OceanPredict/COSS-TT, IODE/OBPS, CEOS-COAST, WWRP and other relevant international programs and activities

Up to 10 people plus the Chair and the co-chairs of CoastPredict will compose the Executive Committee

Steering Committee (SC):

It is composed by scientists and managers from academia, government and the private sector that might also belong to the working groups. It is keeping the overall view of the program and the overall construction of the Global Coastal Ocean Network.
It is chaired by the Chair and co-Chairs of CoastPredict who are nominated by the Steering Committee and they will be in charge for 3 years with the possibility of a 2 years re-nomination. The Committee will be responsible for approving the updates of the general science and implementation strategy, proposed by the Executive committee, in consultation with the Advisory Group. It should meet once a year to approve the science and strategy and to assess progress of the Projects. This is a large committee ~70 people that will act as the decision-making body through the Assembly.

Advisory Committee (AC):

It is composed of representatives of IOC structural elements, GOOS and IODE, representatives of the UNESCO International Hydrology Program, United Nation Environment Program (UNEP), Joint Collaborative Board of WMO and IOC and other international Programmes such as CEOS-COAST, Geo-BluePlanet, OceanPredict, as now listed in the proposal.
Its aim is to widen the scope of CoastPredict and advice on the strategic implementation and have an external guidance on the Program. The AG should meet with the SC yearly but it could also be asked by the EC and SC at intermediate times.
This Committee should be formed by ~30 Members.

International Project Office (PO) and Outcenters

The PO has the mission to follow the everyday activities of the Programme, connect with sponsors and the parent IOC organization, the other UN decade Programmes and have a control on the Project execution through the Working Groups and the Projects. It is chaired by two Programme Specialists and it will support the EC and SC-AG meetings. The Outcenters will support the PO sharing part of the responsibility to oversee the everyday life of the Programme, being either thematically or regionally-oriented.

Communication Offices (CO)

The COs are contained in the PO and the outcenters: they will work under the guidance of the PO to develop activities with strategic communication components. They will advise all teams on best practices as it relates to strategic communications.

Working groups (WG)

These groups have the mission to discuss methodologies, best practices, technical issues and to steer the projects. The working groups should be composed of the coordinators of the projects and other project partners that could help the maintain efficient cross-disciplinary and cross-project activities.