Reflections and Outcomes From IO-Con24

Challenges 6,7 & 10

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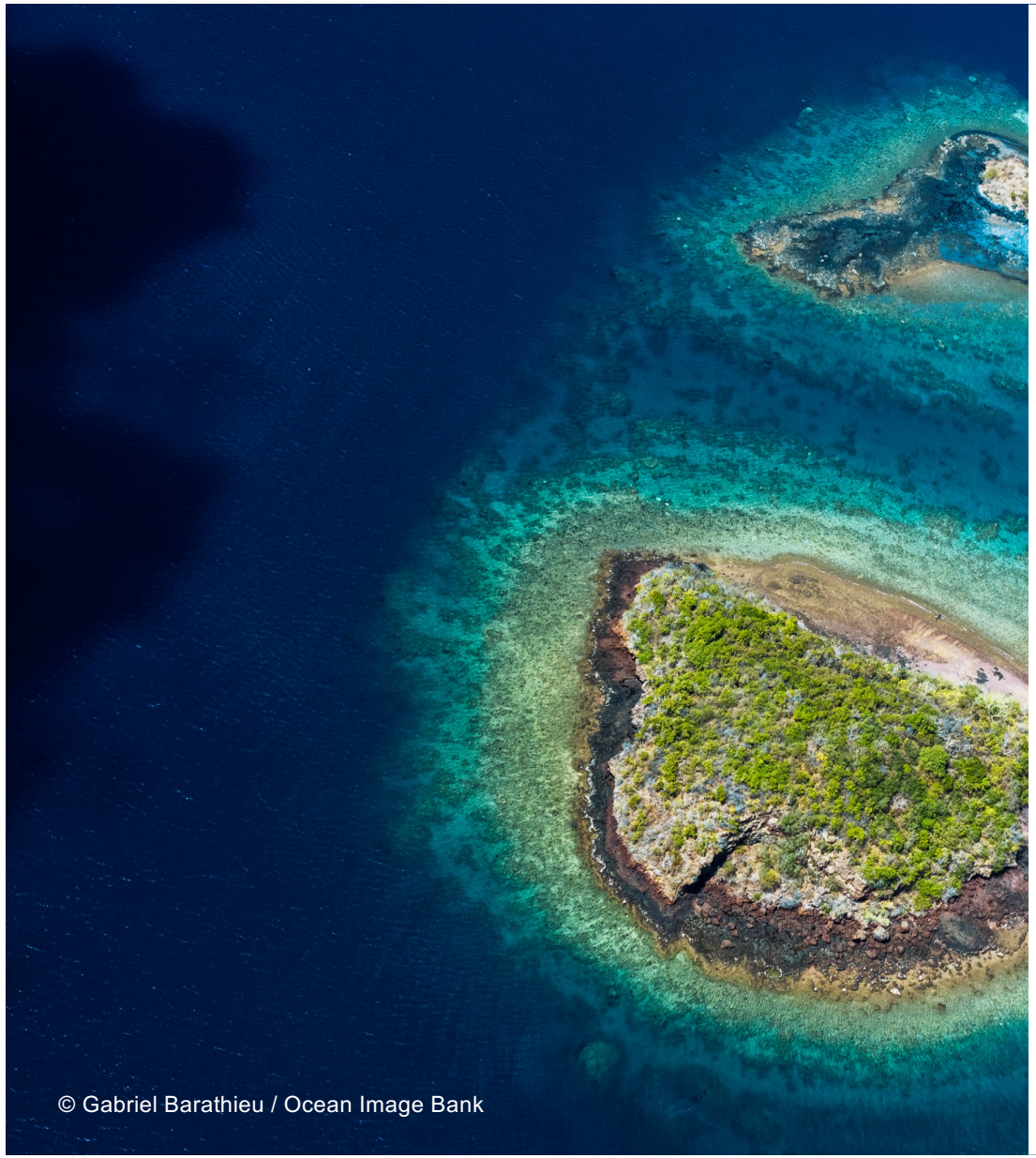
Co-Chairs Vision 2030 WG-6 on Coastal Resilience

Presented to the ICG/IOTWMS Steering Group Meeting
INCOIS, Hyderabad, India
5 – 6 February 2024

Indian Ocean Regional Decade Conference 2024

- The United Nations has declared the years 2021-2030 as the "Ocean Decade" with the goal of advancing global efforts to sustainably manage and protect the world's oceans.
- To support and organize ongoing Ocean Decade activities, IOC/UNESCO has officially designated certain institutes as Decade Collaborative Centres (DCCs) and Decade Coordination Offices (DCOs).
- INCOIS is recognised as the "Decade Collaborative Centre for Indian Ocean Region (DCC-IOR)".
- As part of its commitment, the DCC-IOR organized the 'Indian Ocean Regional Decade Conference 2024: Bridging Billions to Barcelona', an Official Prelude to the Ocean Decade Conference-2024'.
- This conference was organized as a platform to engage in meaningful discussions, share innovative solutions, and strengthen our resolve to address Ocean Decade challenges, serving as a significant milestone en route to 2030, particularly leading up to the 2024 Barcelona Conference
  - Climate change,
  - Food security,
  - Sustainable management of biodiversity,
  - Sustainable ocean economy, marine pollution, and
  - Coastal resilience to ocean hazards



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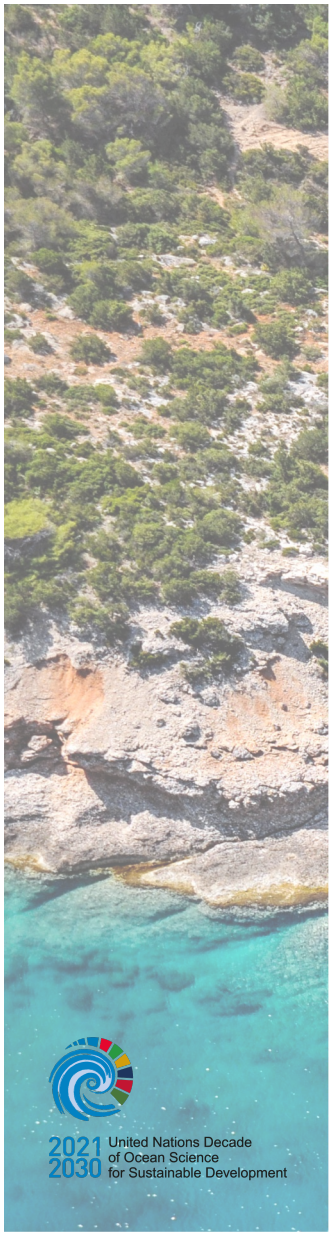
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Working Group 6

INCREASE COMMUNITY RESILIENCE TO OCEAN HAZARDS



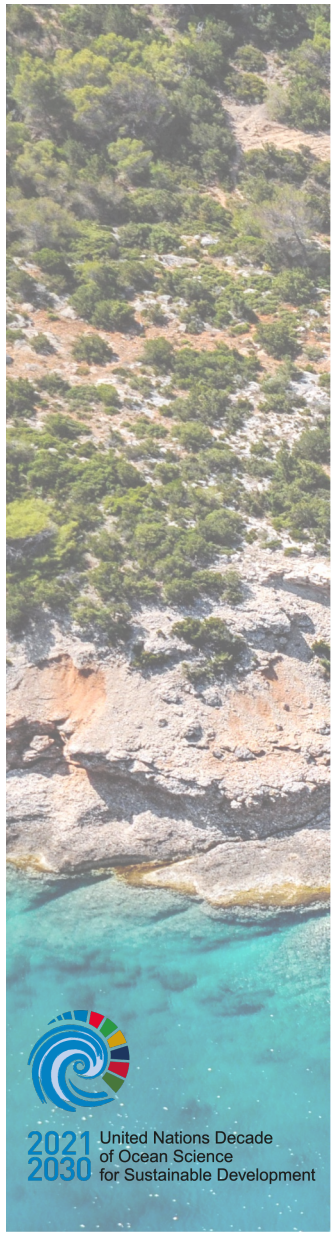
WG-6 Members

Co-chairs:

- **Nadia Pinardi** (Decade Collaborative Centre for Coastal Resilience, University of Bologna, Italy)
- **Srinivasa Kumar Tummala** (Decade Collaborative Centre for Indian Ocean Region, Indian National Centre for Ocean Information Services, India)

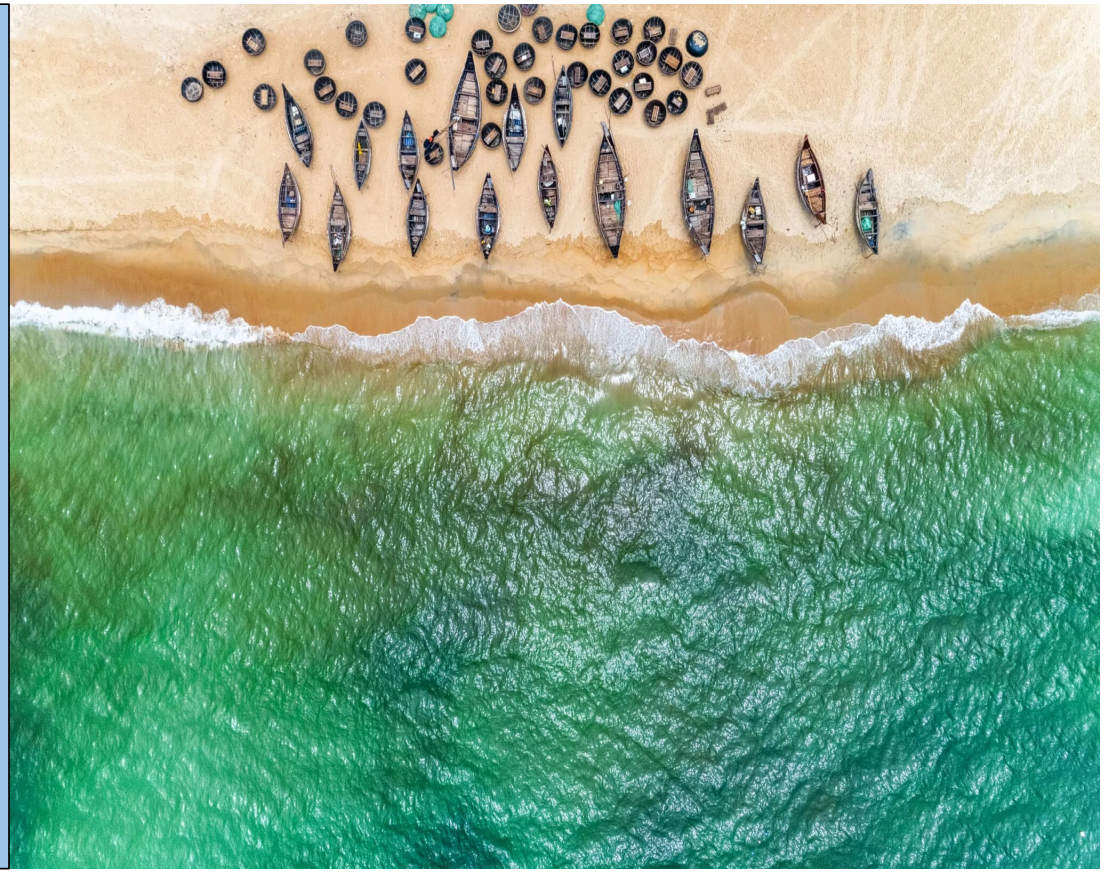
Members:

- Joseph Ansong (University of Ghana, Ghana)
- Alessandra Burgos (Oregon State University, United States)
- David Cabana (Helmholtz-Zentrum Hereon, Climate Service Center, Germany)
- Purificació Canals (MedPAN, Spain)
- Giovanni Coppini (Euro-Mediterranean Centre on Climate Change Foundation, Italy)
- Loreto Duffy-Mayers (Caribbean Alliance for Sustainable Tourism)
- Enrique Alvarez Fanjul (OceanPrediction Decade Collaborative Center, Mercator Ocean International, Fance)
- Mitchell Harley (UNSW Sydney, Australia)
- Juliet Hermes (South African Environmental Observation Network, National Research Foundation, South Africa)
- Jason Holt (National Oceanography Centre, UK)
- Dwikorita Karnawati (Indonesia Agency for Meteorology, Climatology and Geophysics, Indonesia)
- Hellen J. Kizenga (Institute of Marine Sciences, University of Dar es Salaam, Tanzania)
- Sunanda Manneela (Indian National Centre for Ocean Information Services, India)
- Iris Monnereau (Food and Agriculture Organization of the United Nations)
- Martina Müller (United Nations Office for Disaster Risk Reduction)
- Joel Kamdoum Ngueuko (Naturalia Environment, France)
- Antoine Queval (Alcatel Submarine Networks, France)
- Martin D. Smith (Nicholas School of the Environment, Duke University, United States)
- Andrea Valentini (Decade Collaborative Centre for Coastal Resilience, University of Bologna, Italy)



Ocean Decade Challenge 6

Ocean Decade Challenge 6 is:
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**.



WHY COASTAL RESILIENCE TO OCEAN HAZARDS IS IMPORTANT?

GLOBALLY, during the 1900-2015 there have been:

121

EXTREME STORM SURGE EVENTS

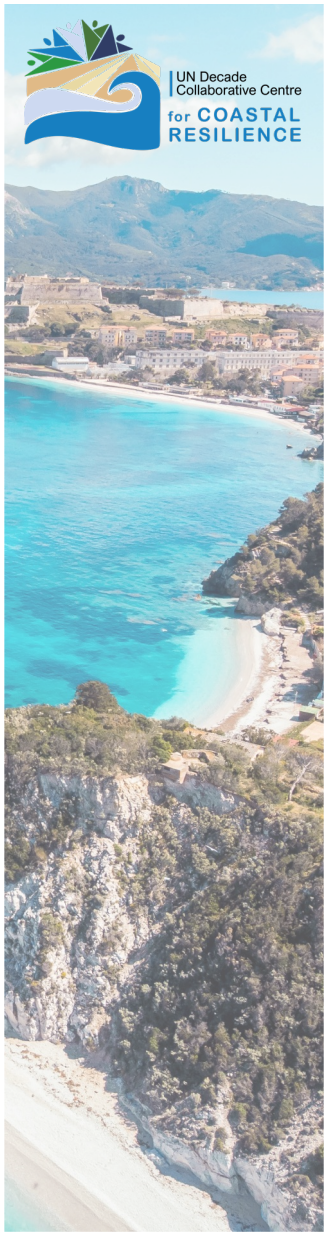
172 500 000

PEOPLE AFFECTED

967 000

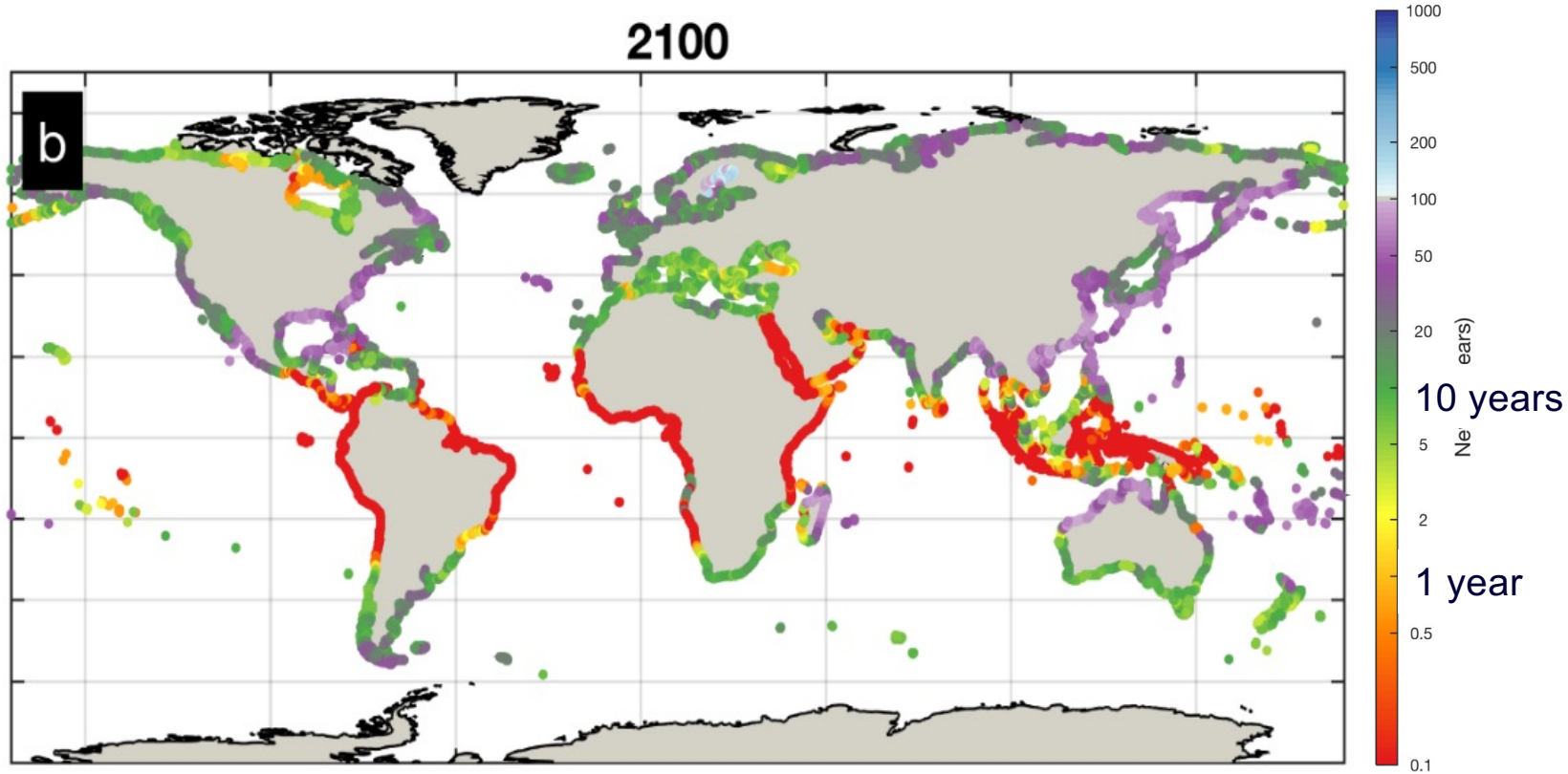
FATALITIES

FROM: L. M .Bouwer and S. N Jonkman 2018 Environ. Res. Lett. 13 014008

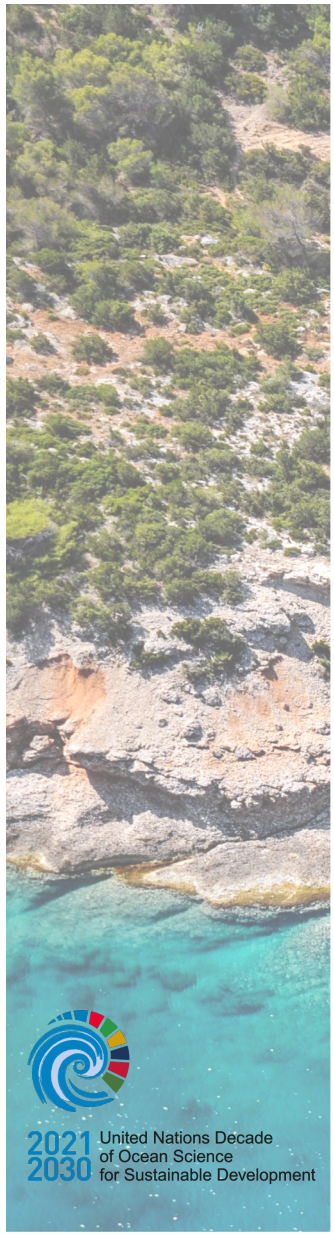


The future:

how frequent will become the present 100 yr sea level extremes?

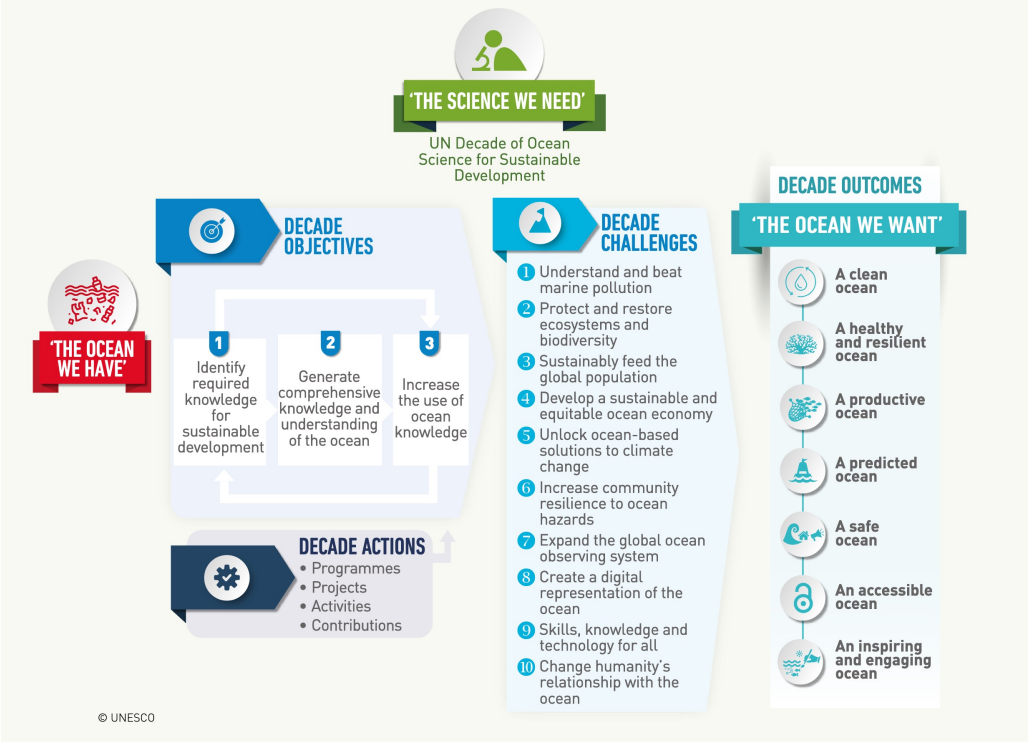


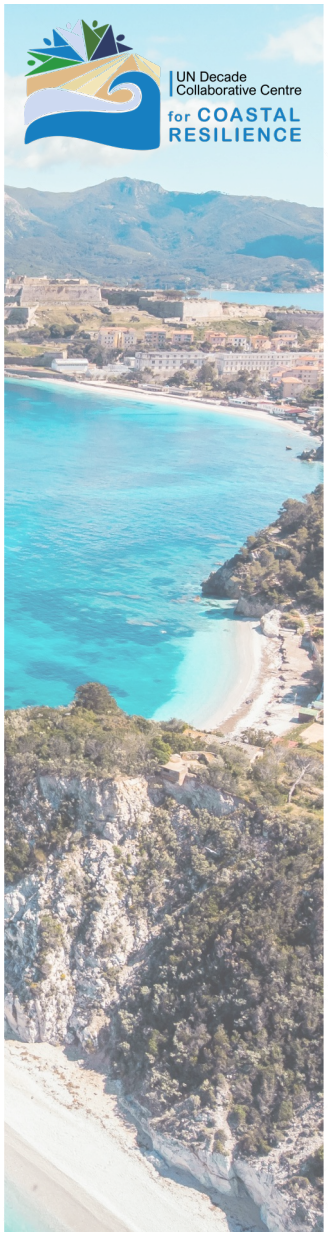
From: Vousdoukas et al., Nature communication, 2018



What do we need to do?

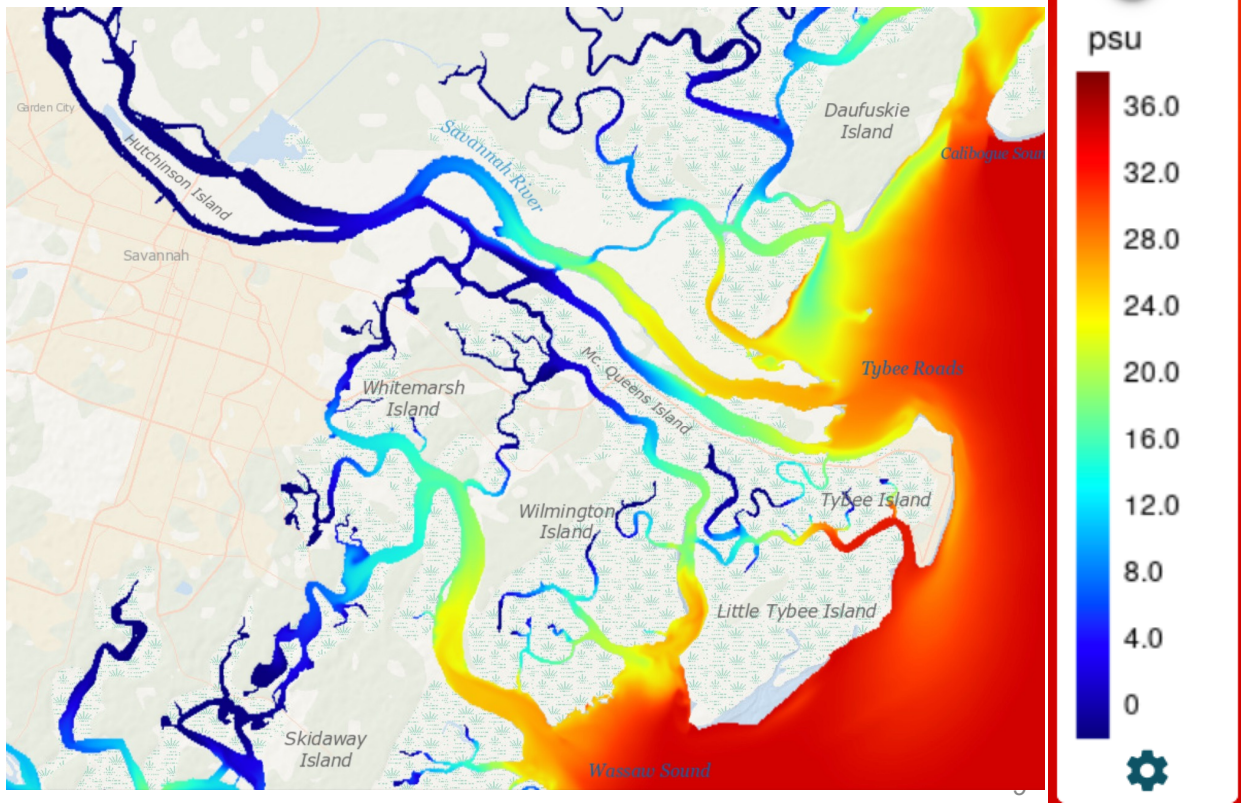
- Strengthen science-based environmental management
- Connect adaptive capacity and coastal resilience in a solid way
- Build operational tools for coastal resilience planning in management

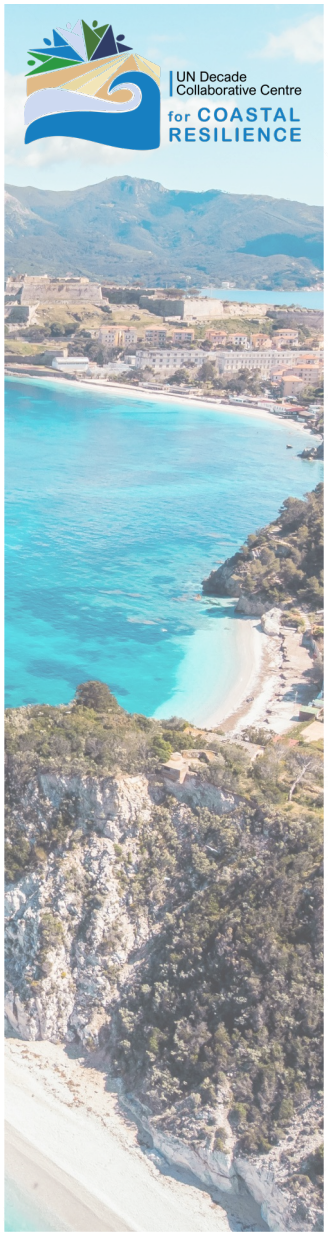




The Decade is developing the new science:

Couple catchment and urban Settlements with the ocean

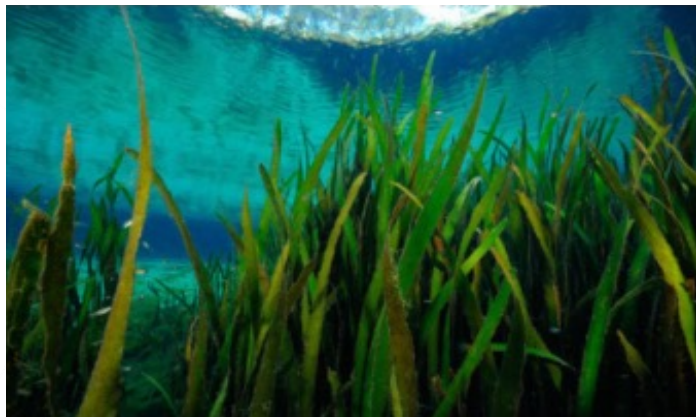




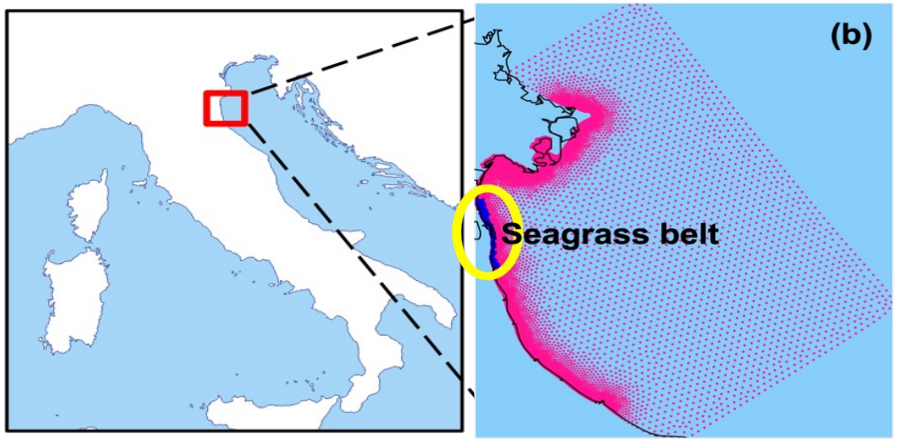
The Decade is developing the new science:

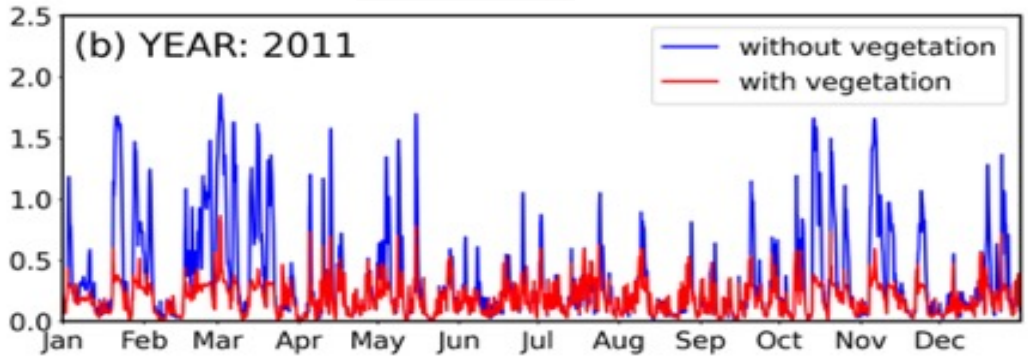
Digital Twin Solutions with high-fidelity coastal models

Are seagrass meadows capable of attenuating waves?



Pillai et al., Sc. Total Env., 2022





Ocean Vision 2030: what do we want to achieve?

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Outcome 1:
Design 'people-centred' multi-hazard early warning systems

Characteristics:

- Stakeholder engagement
- Responsibility sharing
- Accessible communication
- Institutional capacity building

GOAL:
A safe ocean where life and livelihoods are protected from ocean-related hazards

Outcome 2:
Design adaptation planning strategies to increase coastal resilience

Use the new data from the Ocean Decade to prepare updated plans and solutions, also in view of the Marine Spatial Planning process

Map/List the Ocean and Coastal Hazards

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Geophysical/Geological Related

Tsunamis, Landslides, Subsidence, Volcanic eruptions, Coastal erosion, Earthquakes

Biological

Harmful algal blooms, invasive species, aquatic diseases, nuisance blooms

Ocean, weather, hydrology and climate

Tropical and extratropical cyclones and storms, sea-level rise, storm surge, meteo-tsunami, coastal flooding, waves and wave runup, currents, marine heat waves, glacial melt, heavy rainfall and river flooding, saltwater intrusions, droughts

Map/List the Ocean and Coastal Hazards

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Ecological

Wetland degradation, acidification, de-oxygenation, biodiversity loss, seabed habitat loss, coral bleaching, eutrophication, connectivity

Local anthropogenic

Coastal urbanization pressures, coastal wastewater system outflow, marine pollution, overfishing, chemical spills, oil spills, nuclear waste, agricultural runoff, coastal tourism pressures, political interference and corruption, maladaptive planning

Current work in the Ocean Decade

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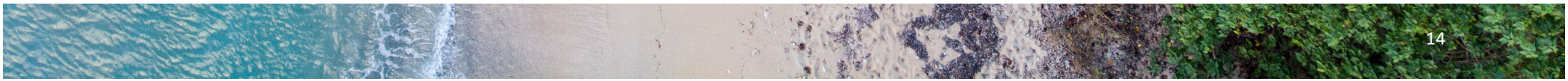
Decade Collaborative Centres dedicated to **Coastal Resilience and Ocean Predictions**, both contribute to the coordination of existing initiatives

As of November 2023, Challenge 6 is the focus of

- **4 Programmes**
  - Covering all ocean basins, but polar oceans are less represented at the Programme level
  - 3 Led by European-based institutions and One led by an Asia-based institution
- **24 Projects**
  - North Atlantic Ocean is the most represented, while the Southern Ocean is the least represented
  - Europe dominates in representation, while Africa, Small Island Developing States (SIDS) and Australia in the Pacific region lack both Projects and Programmes
- **6 Contributions** addressing specific components within the challenge



Components of Coastal Resilience

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Risk Assessment

RA.1 Multi-hazard evaluation frameworks

RA.2 Multi-level, multi-sector risk analysis

RA.3 Exposure and vulnerability analysis

Risk Reduction

RR.1 Monitoring, Forecasting and Early warning systems (multi-hazard)

RR.2 Warning Dissemination & Communication

RR.3 Preparedness & Response

RR.4 sectoral medium to long term planning (zoning, infrastructure)

RR.5 nature-based solutions

RR.6 digital twins

Institutional/ Governance/Social Transformation

GIS.1 Marine and Maritime Spatial Planning

GIS.2 Governance Framework

GIS.3 Disaster recovery planning

GIS.4 Equitable coastal resilience

GIS.5 Government investments, financing and insurance

GIS.6 Capacity building

GIS.7 Corporate social responsibility

RA1. Multi-hazard Evaluation Frameworks

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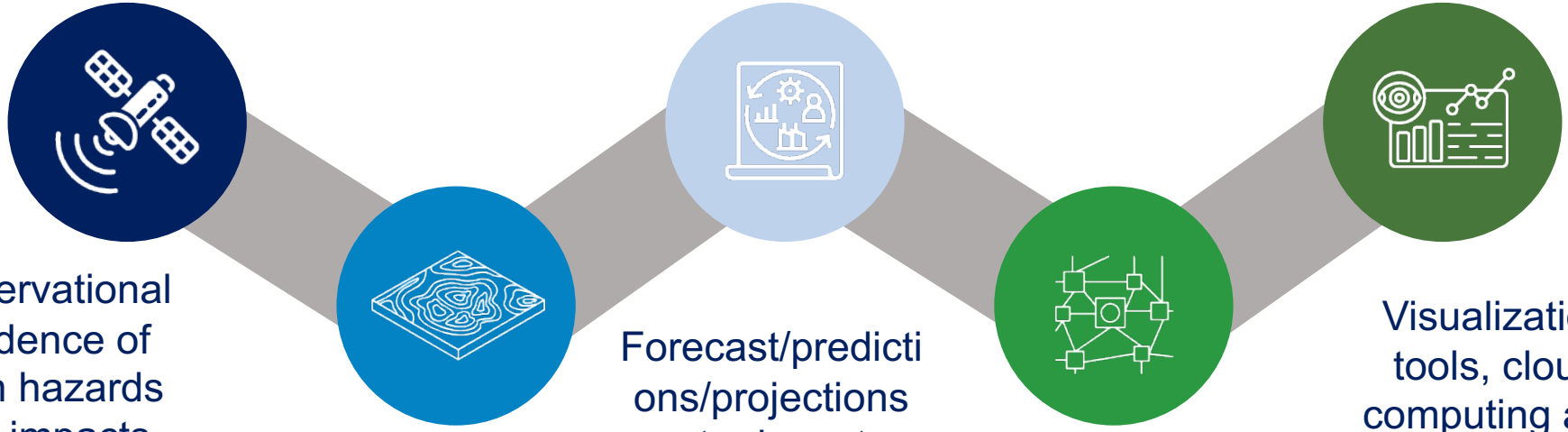
What is needed:



Observational evidence of both hazards and impacts, satellite and in situ measurements

Merged topography and bathymetry data set

Forecast/predictions/projections at relevant scales

Toolbox to represent dynamical interactions and overlaps between hazards

Visualization tools, cloud computing and friendly user interfaces

RR1. Monitoring, Forecasting and Early Warning Systems (multi-hazard)

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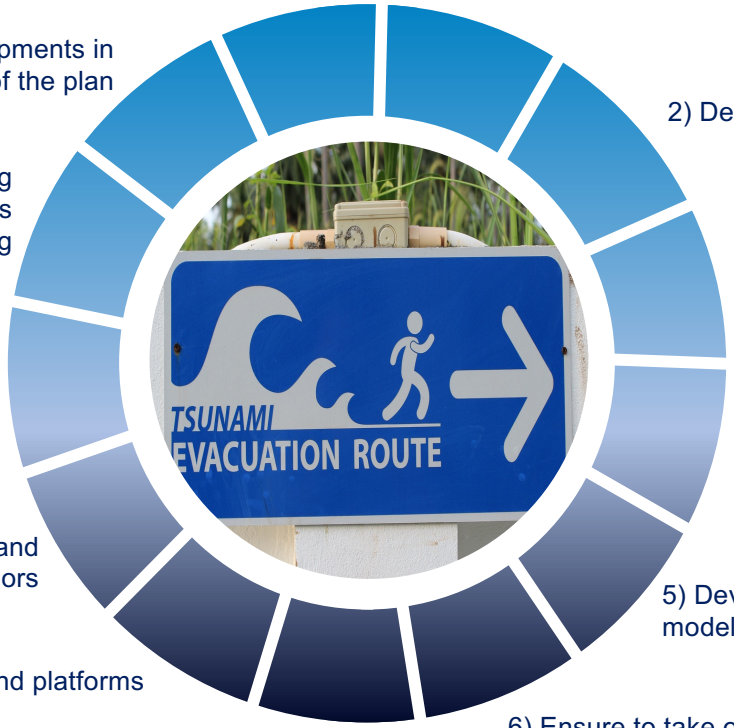
13. Advocacy with all stakeholders for rapid development and implementation of new observational technology

1. Optimal notional global network design consisting of a mix of observation platforms/types

12) Keep track of the new technology developments in observing systems and include them in the update of the plan

2) Developing and maintaining a monitoring infrastructure

11) Big data Analytics, High Performance Computing and Processing techniques for real-time data analysis and forecasting



3) Data collection systems with advanced technology and resources

10) Promote technologies for possible co-deployment of sensors with met-ocean moorings to enhance network coverage and maintenance

4) Enhanced data sharing

9) New use cases of existing observation systems and development of new sensors

5) Development and maintenance of advanced numerical modelling and AI-based forecasts

8) Multi-purpose observation networks and platforms

6) Ensure to take on board the groups working on common tasks so that the observation networks can address multi-hazard requirements

7) Identify hotspots from a multi-hazard perspective for prioritization and redundancy of installations

Preliminary User Needs for Coastal Resilience Components

➢ Priority Issues

- **Vital Role of Observations:** Observations are essential inputs for early warning systems, especially in predicting high-impact weather and ocean hazards within a few days
- **Global Data Sharing:** Early warning systems depend on countries freely sharing data globally, using advanced computing centers for processing
- **Crucial Datasets for Warnings:** these datasets are a suitable combination of past information (observations) and predictions by numerical modelling or AI
- **Adaptation Planning Data:** Adapting to climate change requires downscaling climate scenarios and carry out impact modeling

➢ Annex 3: Priority Data Sets

Thematic data set	Variables
Meteorological Data	Real-time weather data from both instruments and numerical models, including temperature, humidity, wind speed, and wind direction, precipitation and atmospheric pressure.
Seismic and Geophysical Data	Earthquake data from seismometers, strong motion accelerometers to detect seismic activity, Global Navigation Satellite System (GNSS) data to monitor ground deformation due to earthquake, volcanic activity, landslide etc.
Hydrological Data	River discharge for water levels and flow rates from gauges and from hydrological modelling, and soil moisture data to assess landslides and flooding risk. Dissolved chemicals in water and their loading, sediment mass balance at the river-estuary interface with the coastal ocean.
Oceanographic Data	Sea level data to monitor for potential tsunamis, Sea level from in situ, satellite and numerical models for storm surges, wave buoy data and numerical model outputs for high-waves and swells etc., sea temperature and salinity, and marine current data from satellite, in situ and numerical oceanographic models to track heat anomalies and transport of pollutants and sediments. Biogeochemical variables from satellite, in situ and numerical models including phytoplankton, PH, oxygen, dissolved and particulate chemical species.
Human activities	Population density and distribution data, Vulnerability and exposure data, Vessel traffic density, Marine Protected Area domain extension and number, aquaculture and mariculture sites, fishing intensity, housing stock, transportation, energy, public safety, wastewater treatment, and educational infrastructure.
Seabed habitat Data	Seagrass meadows, mangroves, and coral covers.
Bathymetry, terrain and geological data	Digital elevation model data combining terrain and bathymetry, seabed sediment grain size, substrate classification and sedimentation rates, submerged landscapes.
Climate downscaled scenarios	Downscaled IPCC climate scenarios for all hydrological, meteorological, ecosystem and oceanographic thematic variables listed above.
Human health	Water quality monitoring to detect microbial contamination, monitoring for pollutants such as heavy metals, pesticides, and industrial chemicals, harmful algal blooms monitoring, mosquito and tick surveillance, monitoring and reporting of waterborne, foodborne, and other communicable diseases in coastal communities

Preliminary User Needs for Coastal Resilience Components

➢ Knowledge generation and sharing

- **Systematic Risk Knowledge Building:** Building risk knowledge relies on collecting data systematically and communicating region-specific hazards and vulnerabilities to communities
- **Initiatives for Enhanced Risk Knowledge:** Primary initiatives involve investing in interdisciplinary research, leading to innovative tools for data analytics, risk mapping, and accessible repositories.
- **Dissemination:** training programs are essential. Examples include initiatives such as the WMO Global Multi-hazard Alert System (GMAS), the UNESCO-IOC International Tsunami Information Center (ITIC) training program, and the Ocean Teacher Global Academy (OTGA) of UNESCO-IOC.

Preliminary User Needs for Coastal Resilience Components

➢ Technology and innovation solutions

- **Technology for Resilience:** Advanced sensors, satellites, and AI/ML is vital for early warnings against ocean hazards, following F.A.I.R. principles. Numerical modeling and Digital Twin Frameworks improve forecasting.
- **Climate-Resilient Infrastructure:** Mix grey and green infrastructure with smart technologies for climate resilience. Innovations in sand mobilization, sustainable aquaculture, and waste management contribute to overall resilience.
- **Effective Communication with ICT:** Use emerging ICT technologies, such as cellphone apps, for efficient early warnings, especially in vulnerable communities. Detailed technology requirements are listed in **Annex 4**.

WG6 White paper in synthesis

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Key Outcomes:

- Design and implement ‘people-centred’ multi-hazard early warning systems
- Design and demonstrate innovative adaptation planning strategies

Challenges:

- Adopting a multi-hazard framework involves dealing with complex technologies
- Ocean hazards have important cascading effects not yet fully understood

Recommendations:

- utilize a risk framework instead of solely relying on a hazard-based approach
- **Focus on technologies that remove barriers to rapid innovation uptake**

Expected impacts:

- Reconceptualization of challenge 6 within the framework of risk assessment and management strategies
- Establishment of an evaluation matrix to be used to measure and assess progress.

Bridge Coastal Resilience with SDGs

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Defining key indicators of resilience specific to each typology of coastal environment

Aligning these indicators with relevant SDGs targets/indicators

Establishing regular consultations to gather feedback, assess progress, and adapt strategies based on evolving needs and challenges

Coastal Resilience Requirements Review Process

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UNESCO-IOC Member States

unesco Intergovernmental Oceanographic Commission

Requirements for early warning services and adaptation plans for coastal resilience

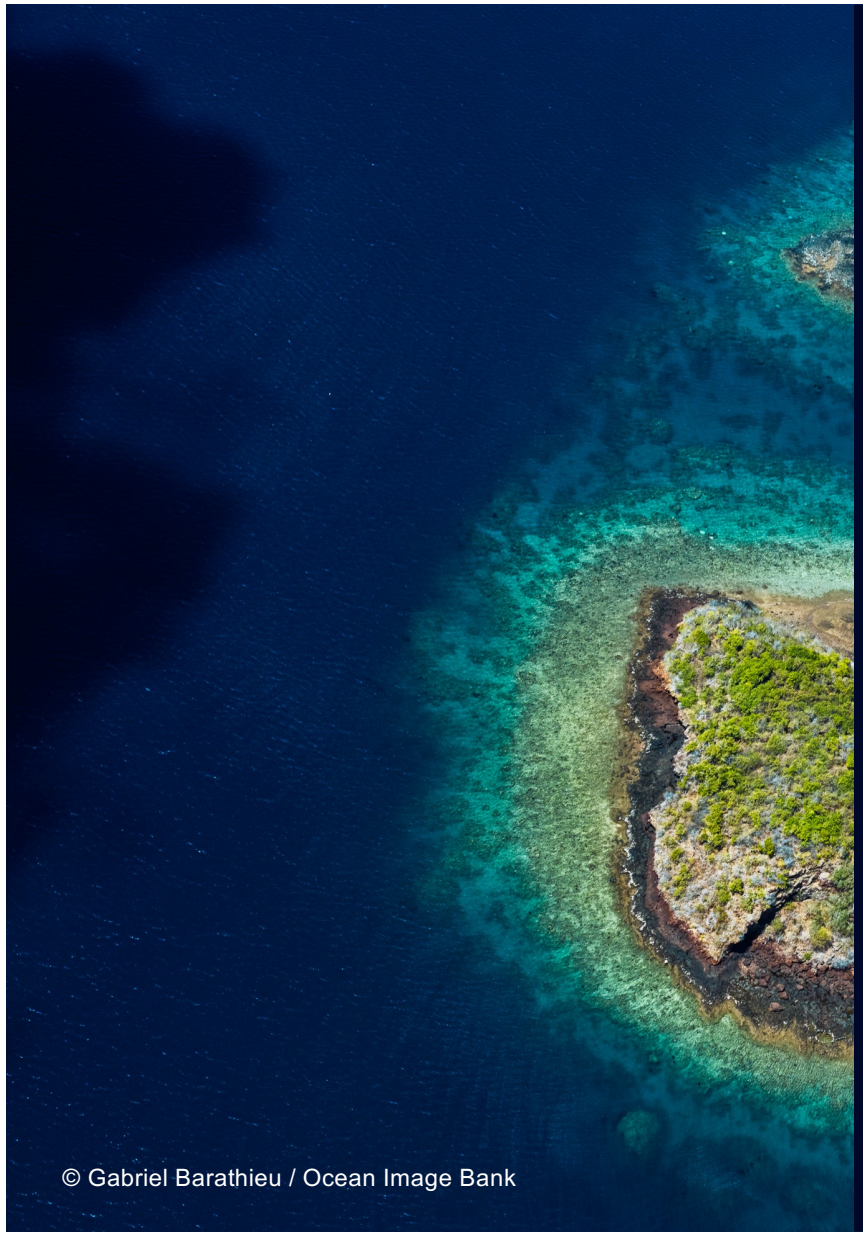
Periodic consultation with application area stakeholders

Relevant impact studies for specific requirements

Undertake **Critical Review**

Preparation of high level guidance for evolution

Implementation from UNESCO-IOC Members



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THANK YOU!

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Srinivasa Kumar: srinivas@incois.gov.in

Challenge 6 Feedback

1. Is the strategic ambition clear and comprehensive? 12/22 Yes

strengthen relationship with coastal communities

Concentrate on Nature based solutions

Prioritize the work for developing countries (LDCs and SICs)

More focus coastal cities

Safety of Coastal Infrastructure

2. Are the data, knowledge and information requirements addressed? 8/29 Yes

strengthen the relavance of compound effects in hazards, considering land, river and ocean

local knowledge to be mentioned

organisational changes needed to break the silos

prioritize the infrastructure requirements and the open data

Challenge 6 Feedback Contd…

3. Are the necessary partnerships, funding, expertise, and technology identified? 15/28 Yes

Regional and local knowledge to be priritized

better for physics and for bio-ecology

More stakeholders need to be reached

More collaborations

ICZM to be better connected

4. Are the needs for capacity development sufficiently addressed? 10/25 Yes

Connections with other challenges

Wider reach needed

Inclusion in school curriculums

Innovative methodologies and suitable methods for capacity development to be strengthened

Challenge 6 Feedback Contd…

5. Have the links between Challenge 6 and other challenges identified?

15/24 Yes

Opportunity to highlight links/synergies eg challenge 4 and 7

Cascading and compounding impacts to be accounted

Link between all challenges needs to be made priority

More connection with Challenge 7 needed

links needed Challenge 7, GOOS, GEBCO project

6. Are the proposed milestones and indicators realistic and sufficient?

8/21 Yes

Need a tool to monitor the progress using suitable technology

Need pathways defined and KPIs

Biological indicators need to be identified

Milestones and indicators are broad. Need to work on detailed indicators during implementation

Challenge 6 Feedback Contd…

7. Recommendation actionable and potential to integrate into policies? 6/16 Yes

More work needed to come to an agreement

Pathways for implementation and resourcing need to be identified

Operational difficulties may be considered

Implementation of policies and practices is tough

Consider various climate change nbs frameworks

8. Additional comments to improve? 8/16 No

National priorities to be considered while regional planning

Engaging many sectors and local context

More attention to Ocean governance and policies

Clearly quantify the benefits to stakeholders and Climate impacts on marine environment

Need sustainable development policies

Challenge 7: Expand the Global Ocean Observing System

Time	Speaker	Title
1400-1430 IST	WG Co-Chair Dr. Joe O' Callaghan, Director, Oceanly Science, New Zealand.	Virtual Keynote: Vision 2030 White Paper - Challenge 7
1430-1445 IST	Dr. Nick D'Adamo, University of Western Australia, Australia	Invited talk: Indian Ocean Observing System and related family of alliances - supporting Decade Challenge 7
1445-1500 IST	Dr. Jenny Huggett Oceans and Coasts, Dept. of Forestry, Fisheries & Environment, South Africa	Invited talk: Ocean observations off Southern Africa and priorities for the Indian Ocean
1500-1515 IST	Dr Aneesh Lotliker Ocean Observations Network INCOIS, Hyderabad	Invited talk: Sustained Ocean Observation Networks in the North Indian Ocean for services and climate studies
1515-1530 IST	Will Reis, Güralp Systems Limited, United Kingdom	Invited talk: Successful Deployment of a 21km SMART Cable with Force-Feedback Seismometers and Accelerometers in the Ionian Sea: Facts, Findings and the Future
1530-1600 IST	*High Tea*	
1600-1615 IST	Dr. Subrata Sarker, Shahjalal University of Science & Technology, Bangladesh	Invited talk: NANO-DOAP Global Project: An Alumni Network Global Monitoring Program
1615-1645 IST	Speakers of the session along with, •Dr. Eric Raes, Minderoo Foundation, Australia •Mr. Dinesh, M/s Samhitha Marine, India •Dr. Isa Olalekan Elegbede Researcher, Lagos State University, Nigeria •Representative, Sathyabhama Institute of Science & Technology •Dr. Surya Chandra Rao	•Panel Discussion
1645-1700 IST	Session Summary and Conclusion	

Challenge 7: Expand the Global Ocean Observing System

Key messages from the draft White paper

- Integrate data across several platforms in easily accessible and useable formats, incorporating new and emerging technologies like autonomous platforms and AI to support and increase long-term observation capacities.
- Emphasis on the need to prioritize the collection of region-specific, societally relevant ocean-observing datasets, expand observational density and frequency in poorly observed ocean basins, and
- Strengthen capacity development programmes for ocean observation, data collection, quality control, and analysis.
- Emphasize the need for global cooperation and collaboration among the nations to design the observation network.

Challenge 7: Discussions and feedback

1. There was a general appreciation for the extensive work put forward by the working group
2. There is a need for Challenge 7 to further assess the existing GOOS and GRAs networks and all other observing related programs for the different ocean basins
3. Need to identify and then prioritize the gaps that are to be addressed by Challenge 7
4. We need to develop an objective prioritizing framework
5. Some of the key issues that were identified in the meeting were:
    1. citizen data collection
    2. increase deep ocean glider observations and in-situ ocean state (waves) using drifters and moored buoy platforms
    3. microplastic monitoring
    4. industry-lead innovations for ocean obs should be better interfaced with UN Decade Challenge 7 aspirations
    5. The need for the improvement of transparency and ethics in data collection

Challenge 10: Agenda

Time	Speaker	Title
1000-1030 IST	WG Co-Chairs or rep. (Dr. Diz Glithero / Dr. Nicola Bridge) / DCU rep.	Vision 2030 White Paper of the Challenge
1030-1045 IST	Dr. Achare Elvis Ayamba, Founder & Executive Director Environment and Food Foundation, Cameroon	Ocean Education as strategy to face Ocean climate issues for sustainable developments
1045-1100 IST	Prof. Raghu Murtugudde Emeritus Professor, University of Maryland, USA	Oceans and Humans – Lessons from sustainable Economics
1100-1115 IST	Ms. Isabelle Thomas Social Innovator BhuME Woman, India	Molding Young Minds: Nurturing love for our oceans
1115-1130 IST	Dr. Thamban M, Director, ESSO-NCPOR, India	Warning of the Polar regions – Impacts ad tropical teleconnections
1130-1200 IST	*High Tea*	
1200-1215 IST	Dr. Sourav Paul Director, Estuarine and Coastal Studies Foundation, India	From Plankton to Cyclone research and institution building : businessing with estuaries
1215-1245 IST	Speakers of the session along with, •Prof. Jayachandran KV, Ocean Soc. of India •Dr. Velvizhi S, MS Swaminathan Research Foundation, India •Mr. Senthilkumaran S., Reliance Foundation, India •Emenyonu Uchenna Martin, Founder/Project Contact Person African Youths Sustainable Ocean Campaign (AYSOC ID 215)	Panel Discussion
1245-1300 IST	Session Summary and Conclusion	

Challenge 10: Change Humanity's Relationship with the Ocean

Highlights of the presentations:

- Emphasised on priority drivers of pro-ocean behaviour (Knowledge sys, education, communication, cultural connections)
- Emphasised on the barriers, enablers and motivators of pro-ocean behaviour
- Priority actions and measuring progress (key actions, who enables these actions, resources required and performance indicators
- Need of a matrix to identify human relationship with ocean and data required to measure
- Move out of human centric thinking practice
- What we can innovate to undo our wrong doings to the oceans

Major Gaps Pointed in The White Paper

The major issues in the process of conservation and restoration are:

- Norms/rules/punishments needed to be included in WP
- Inclusion of indigenous knowledge systems & knowledge transfer across communities/countries
- Sharing of benefits of marine economy with people who protect marine ecosystem-inclusive agile marketing
- Training the trainers to pass the knowledge to the local community
- Include more ECOPS in marine protection activities
- Coastal communities should be made part in the policy-making process
- Documentation of indigenous wisdom/its validation and integration with decision support systems/prediction systems
- Co-development of language for scientific and society
- Integration of ocean protection with the village level development plans

Feedback

- Technology-driven education in ocean protection/awareness
- Involvement of Private sectors
- UNESCO/The GLOBE Program may include Ocean Education.
- Youth concerns over profitability vs sustainability to be addressed
- Ocean literacy for Finance Sectors
- Youth involvement in decision making for smooth transition of information over generations.

THANK YOU