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2021 2030 United Nations Decade of Ocean Science for Sustainable Development

27 June 2024 | 18:00 - 20:00

Conference Room XI | UNESCO | 7 Place Fontenoy, Paris

Coastal Horizons: Pathways and Actions to Strengthen Resilience to Coastal Hazards

Side Event at the 57th Session of the IOC Executive Council

Welcome and Overview

Denis Chang Seng
Programme Specialist and Technical Secretary of ICG/NEAMTWS of the
Tsunami Resilience Section at UNESCO-IOC

Key statement on Ocean Decade Challenge 6

Vidar Helgesen
Executive Secretary of the Intergovernmental Oceanographic Commission (IOC/UNESCO) and Assistant Director-General of UNESCO

The Ocean Decade Tsunami Programme

Bernardo Aliaga
Head of the Tsunami Resilience Section, UNESCO-IOC

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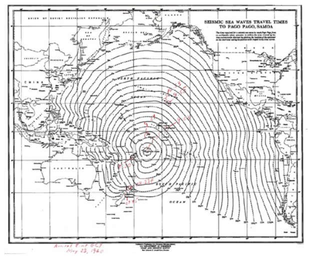
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

We have gone a long way…

1948 the **Honolulu Magnetic Observatory**, under the US Coast and Geodetic Survey (USCGS)established

ITSU
IOC/IV-6, International Aspects of the Tsunami Warning System in the Pacific, Paris, November 1965



ITSU development

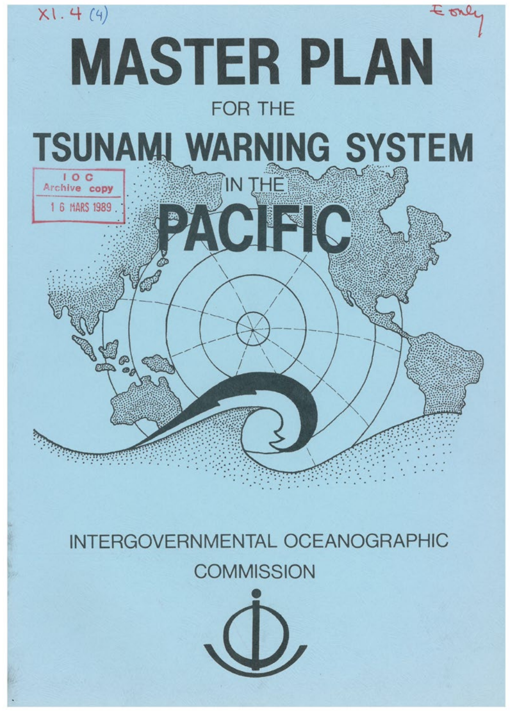
1965

The Honolulu Observatory renamed Pacific Tsunami Warning Center PTWC

1977

1989

First Master Plan


MASTER PLAN
FOR THE
TSUNAMI WARNING SYSTEM
IN THE
PACIFIC
INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

The tragedy brings world attention to the dangers of tsunamis in every nation and initiates the development of warning and mitigation systems in the Indian Ocean

Indian Ocean Tsunami

2004

ITSU renamed

September 2005, Vina del Mar, Chile

The 20th Session of the ICG/PTWS-XX decides to change its name to the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System

2005

3 ICGs established

Indian Ocean (ICG/IOTWS), Caribbean and Adjacent Seas (ICG/CARIBE-EWS), Mediterranean and North Atlantic (ICG/NEAMTWS) (IOC/XXIII-11, 12, 13, **June 2005**)

1952. The Japan Meteorological Agency started its national tsunami warning center

1965 - IOC Working Group on the International Aspects of the Tsunami Warning System in the Pacific, organized by the USCGS on behalf of the IOC, Honolulu, 27-30 April 1965

nature

6 January 2005 Volume 433 Issue no 7021

A divided world

The lack of preparation for last month's tsunami illustrates shocking disparities in how science is applied in different regions of the world. The global response to the disaster offers a glimmer of hope that these disparities will be addressed.

As the full horror of the Asian tsunami sinks in, the reactions of scientists echo those of the population as a whole. These range from a sense of hopelessness in the face of nature's power to concern for the victims and a determination that their suffering should be addressed.

The Indian Ocean tsunami of 26 December 2004 occurred at about 01:00 GMT, when the Indian tectonic plate moved underneath the neighbouring Burma microplate, raising it by about 10 metres along a length of more than 1,000 km and sending a wave propagating through the full depth of the overlying ocean at high speed. With wavelengths much larger than the depth of the ocean, such waves propagate across the great distances of the open sea without much surface perturbation and with very little energy loss, until shallower coastal shelves slow the wave and increase its amplitude — resulting, in this case, in a calamity of biblical proportions.

Such disasters have always been with us, but this particular event (see News, pages 3–5) had some characteristics that cry out for a global response that is more emphatic and sustained than a brief outburst of charity.

The most distinctive of these characteristics is the uneasy feeling, prompted by the delayed action of the tsunami, that a great deal of the suffering could have been avoided. Much of the damage, after all, occurred in Sri Lanka and on India's eastern coast about two hours after an earthquake had triggered the tsunami in the ocean. Monitoring stations in Japan and the United States, for example, had been able to observe the event in real time and yet apparently could do nothing — despite the ubiquity of modern telecommunications — to warn victims of the impending risk.

It turns out, on closer examination, that not all of this is true. The size of the earthquake wasn't apparent at first glance: early estimates put it at magnitude 8, which is not exceptional for submarine quakes and is an order of magnitude smaller than the eventual value of 9 that made this the world's largest seismic event for 40 years. And, in the absence of an ocean-based monitoring system, remote seismologists did not know that the quake had triggered a tsunami. Many researchers who were alerted to the event in the United States on their Christmas night, for example, went to bed quite oblivious to the carnage that was unfolding as they slept.

Additionally, as the awful scale of the disaster slowly emerged from remote regions of western Indonesia, it has become clear that most of the death and destruction had occurred in a region that was too close to the epicentre of the event for warnings to have made much difference.

Neglect

Nonetheless, an effective warning system, allied to a public education campaign of the sort that has already taken place around the Pacific Ocean, could have reduced the scale of the disaster.

It is clear, with the benefit of hindsight, that the arcane international bodies that manage tsunami protection have been neglected and underfunded for many years. Most of them have focused on the Pacific Ocean, and occasional attempts to widen their brief to the Indian Ocean have been rebuffed.

A master plan prepared in 1999 by ITSU, one of the international organizations that plans for the monitoring of tsunamis, stated: "Tsunami hazards exist on both sides of the Atlantic Ocean, in the eastern Indian Ocean, and in the Mediterranean, Caribbean, and Black Seas. Efforts to establish warning centers in those areas should be encouraged."

An important reason for the previous confinement of monitoring systems to the Pacific has been the occurrence of two tsunamis in the Pacific quite recently, in 1960 and 1964. The last tsunami produced by an earthquake in the Indian Ocean is thought to have occurred back in 1833.

However, the most important differentiating factor has been the readiness of 'Pacific rim' nations such as Japan, Australia and the United States to support a cheap but potentially effective system for monitoring and for educating the public about an infrequent risk. India, Indonesia and the other nations on the Indian Ocean's rim are relatively poor countries with needs that seemed more pressing than that of planning against the remote — but nonetheless inevitable — prospect of a tsunami.

Pushing for change

A great amount could have been done at relatively little expense to plan for a tsunami, however. The most important component of such preparation is public education, so that local inhabitants are aware, for example, of the fact that a dramatic recession of the ocean is in itself a warning of an impending event. The next most important component is the construction of a simple network that will quickly convey warning information from the seismological stations to some central point (such as the Pacific Tsunami Warning Center in Hawaii) and back out again to local radio and television channels, perhaps using siren systems in regions that can afford them.

Some of this will doubtless now take place — and so it must. As earthquake-mitigation programmes in Japan and California have shown, we can avoid vast carnage in the face of major natural disruptions. Scientists have a role to play in this. Biomedical researchers have taken global initiatives to address preventable deaths from tropical diseases that might otherwise be ignored. In the same spirit, Earth scientists around the world must now press even harder for resources in rich countries to be brought to bear to confront the risks of natural disasters in poor countries.

The same communications technologies that could have helped to mitigate this disaster have, instead, brought it home relentlessly to our living rooms. The science behind the event has been busily and prominently displayed for all to see — alongside the consequences of inaction in the face of well-established risks.

Is it too much to expect that people in rich countries, when confronted with evidence on such a scale, will ask that their governments start to pay modest respect to the value of human life amongst the poor, and adjust their budgetary priorities accordingly? Scientists, at least, should argue for a strengthening of research priorities that reflect the needs not of well-protected interest groups in their own nations, but of humanity itself. ■

UNESCO/IOC Tsunami Coordination Unit 2005

HQs

ICG/IOTWS
Secretariat

Tony Elliott
(Head of the Office)

Jane Cunneen

Peter Koltermann
(Head of the Unit)

Masahiro Yamamoto

Uli Wolf

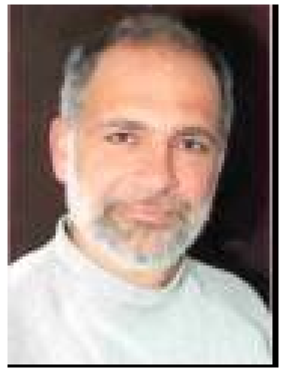
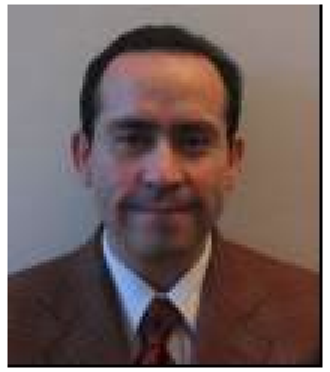
Bernardo Aliaga

ICG/PTWS
Secretariat & ITIC

Laura Kong
Head of the Office

Brian Yanagi

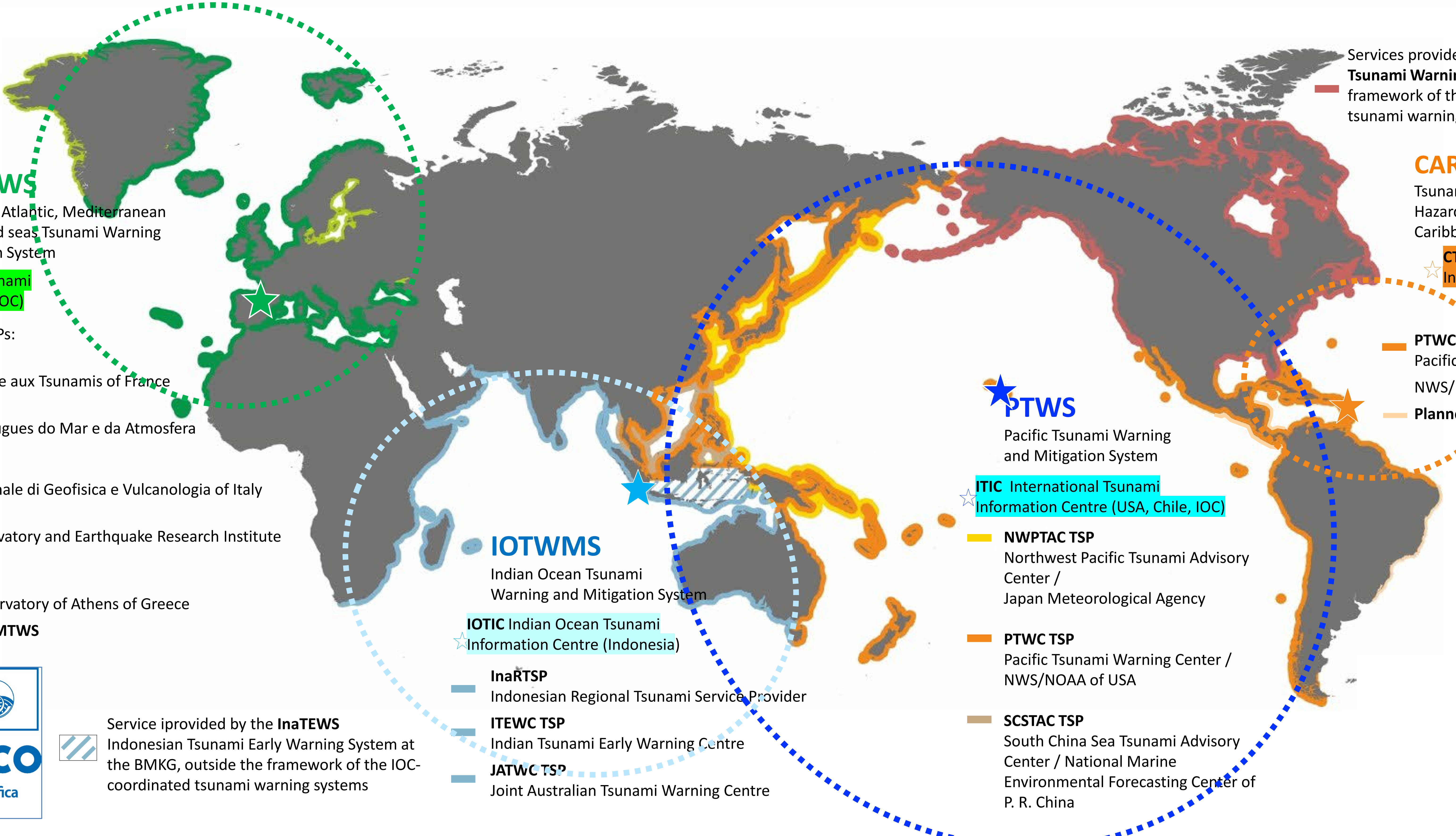


GLOBAL TSUNAMI WARNING AND MITIGATION SYSTEM

Intergovernmental Oceanographic Commission of UNESCO

2024 www.ioc-tsunami.org



NEAMTWS

North Eastern Atlantic, Mediterranean and connected seas Tsunami Warning and Mitigation System

NEAMTIC NEAM Tsunami Information Centre (IOC)

Accredited TSPs:

CENALT
Centre d'Alerte aux Tsunamis of France

IPMA
Instituto Portugues do Mar e da Atmosfera of Portugal

INGV
Istituto Nazionale di Geofisica e Vulcanologia of Italy

KOERI
Kandilli Observatory and Earthquake Research Institute of Turkey

NOA
National Observatory of Athens of Greece

Planned NEAMTWS

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Comisión Oceanográfica Intergubernamental

Service iprovided by the **InaTEWS** Indonesian Tsunami Early Warning System at the BMKG, outside the framework of the IOC-coordinated tsunami warning systems

IOTWMS

Indian Ocean Tsunami Warning and Mitigation System

IOTIC Indian Ocean Tsunami Information Centre (Indonesia)

InaRTSP
Indonesian Regional Tsunami Service Provider

ITEWC TSP
Indian Tsunami Early Warning Centre

JATWC TSP
Joint Australian Tsunami Warning Centre

PTWS

Pacific Tsunami Warning and Mitigation System

ITIC International Tsunami Information Centre (USA, Chile, IOC)

NWPTAC TSP
Northwest Pacific Tsunami Advisory Center /
Japan Meteorological Agency

PTWC TSP
Pacific Tsunami Warning Center / NWS/NOAA of USA

SCSTAC TSP
South China Sea Tsunami Advisory Center / National Marine Environmental Forecasting Center of P. R. China

Services provided by the **US National Tsunami Warning Center** are outside the framework of the IOC-coordinated tsunami warning systems

CARIBE-EWS

Tsunamis and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions

CTIC Caribbean Tsunami Information Centre (Barbados

PTWC TSP
Pacific Tsunami Warning Center / NWS/NOAA of USA

Planned TSP PTWS, CARIBE-EWS

Photo 1. Damaged sea level station the day after the 27 February 2010 tsunami, Talcahuano, Chile
Photo by Rodrigo Núñez Gundlach

2010 Chile

Minamisoma, Fukushima prefecture, Japan. 2011 March 11, Mw 9.0, Honshu, Japan earthquake and tsunami. (Credit: AFP/AFP/Getty Images.)

2011 Tōhoku earthquake and tsunami

2011

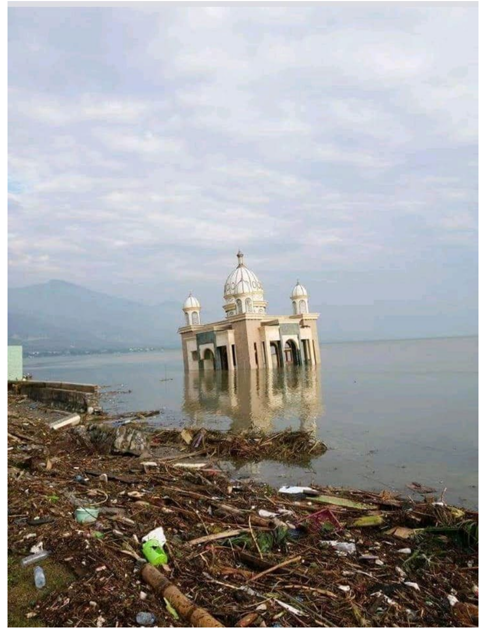
Inter-ICG Task Team on Hazard Assessment Related to Highest Potential Tsunami Source Areas

2016 ->Recent case studies demonstrated complexity and variability, as well as importance of other types of tsunami sources and that earthquake generated Tsunamis can happen in any subduction zones.

2018

Palu, Indonesia

Landslide generated tsunami



December 18, 2018 **December 30, 2018**

Volcano generated tsunami

Sunda strait, Indonesia

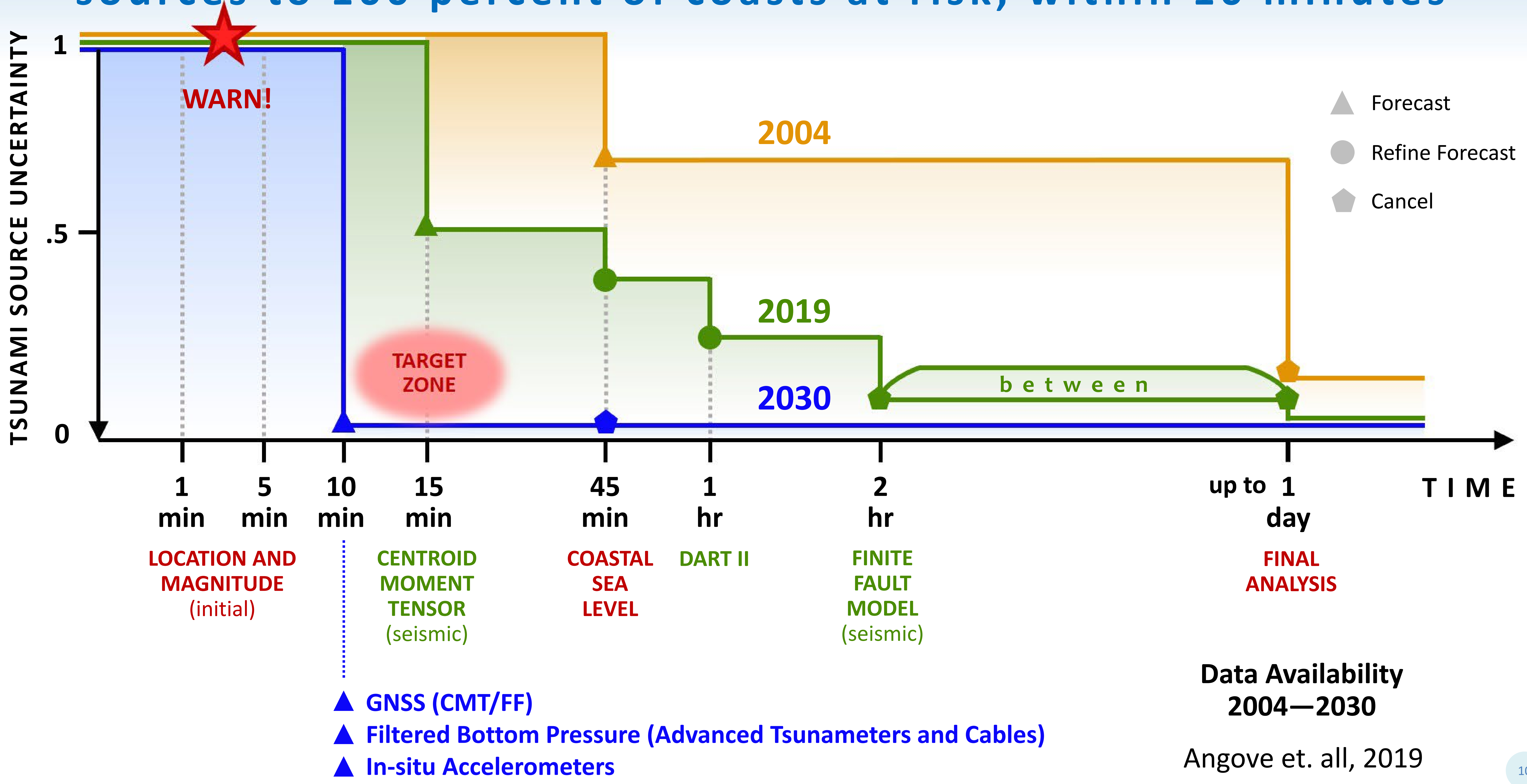
2018

Tonga

2022

The Group decided to establish a specific Ad Hoc Team on Meteo-tsunamis &Ad Hoc Team on Tsunamis Generated by Volcanoes

UN ODTP OBJECTIVE 1 - WARNING for tsunamis from all identified sources to 100 percent of coasts at risk, within 10 minutes



Data Availability 2004—2030

Angove et. all, 2019

UN OTDP OBJECTIVE 2 - 100 percent of communities at risk to be prepared and resilient to tsunamis by 2030 through efforts like the IOC-UNESCO Tsunami Ready Recognition Programme (TRRP)

THE MAIN SOCIAL OUTCOME

TO MAKE
100%

OF COMMUNITIES AT RISK OF TSUNAMI
PREPARED FOR AND RESILIENT TO TSUNAMIS

BY
2030

Intergovernmental Oceanographic Commission

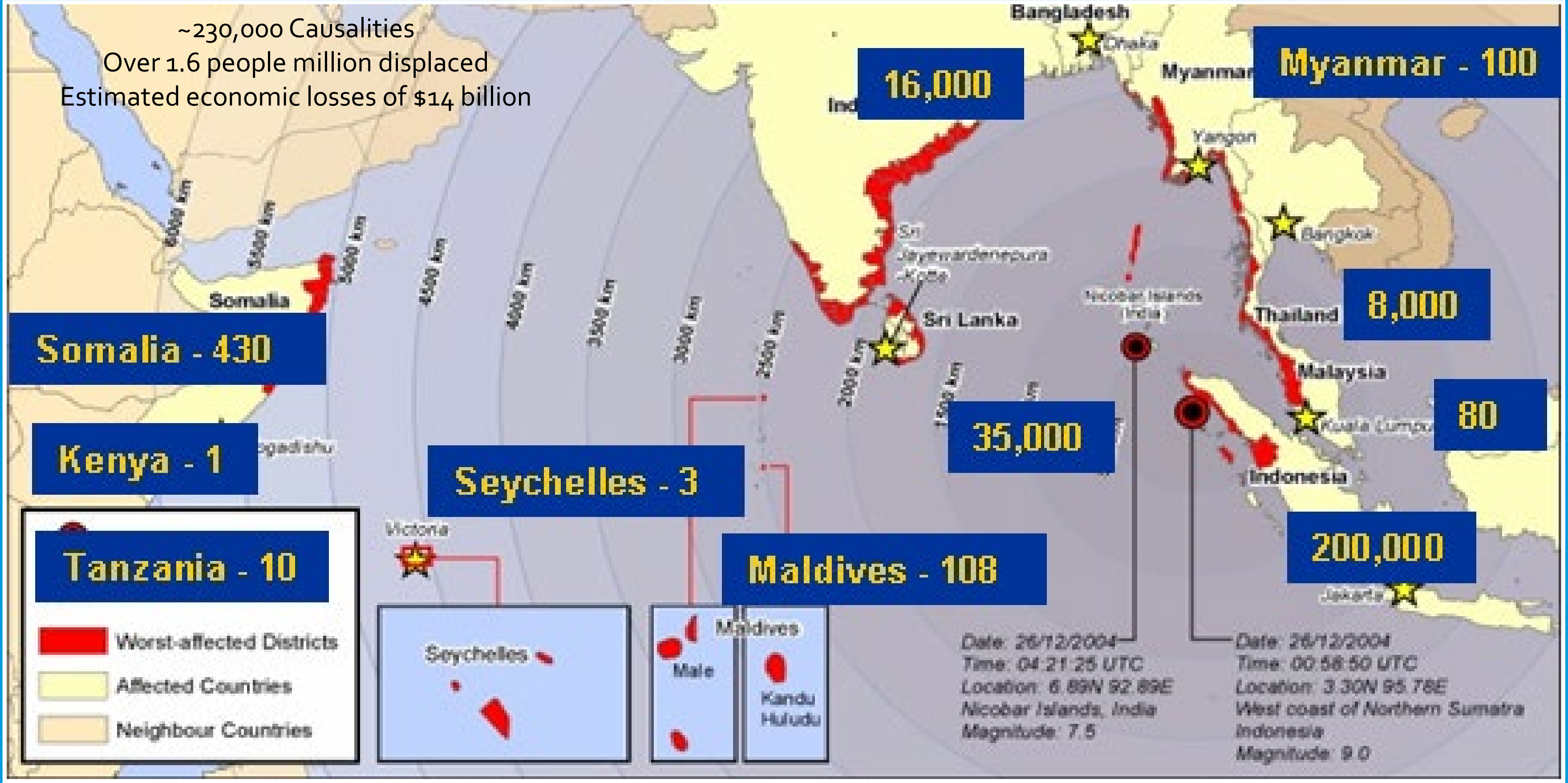
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

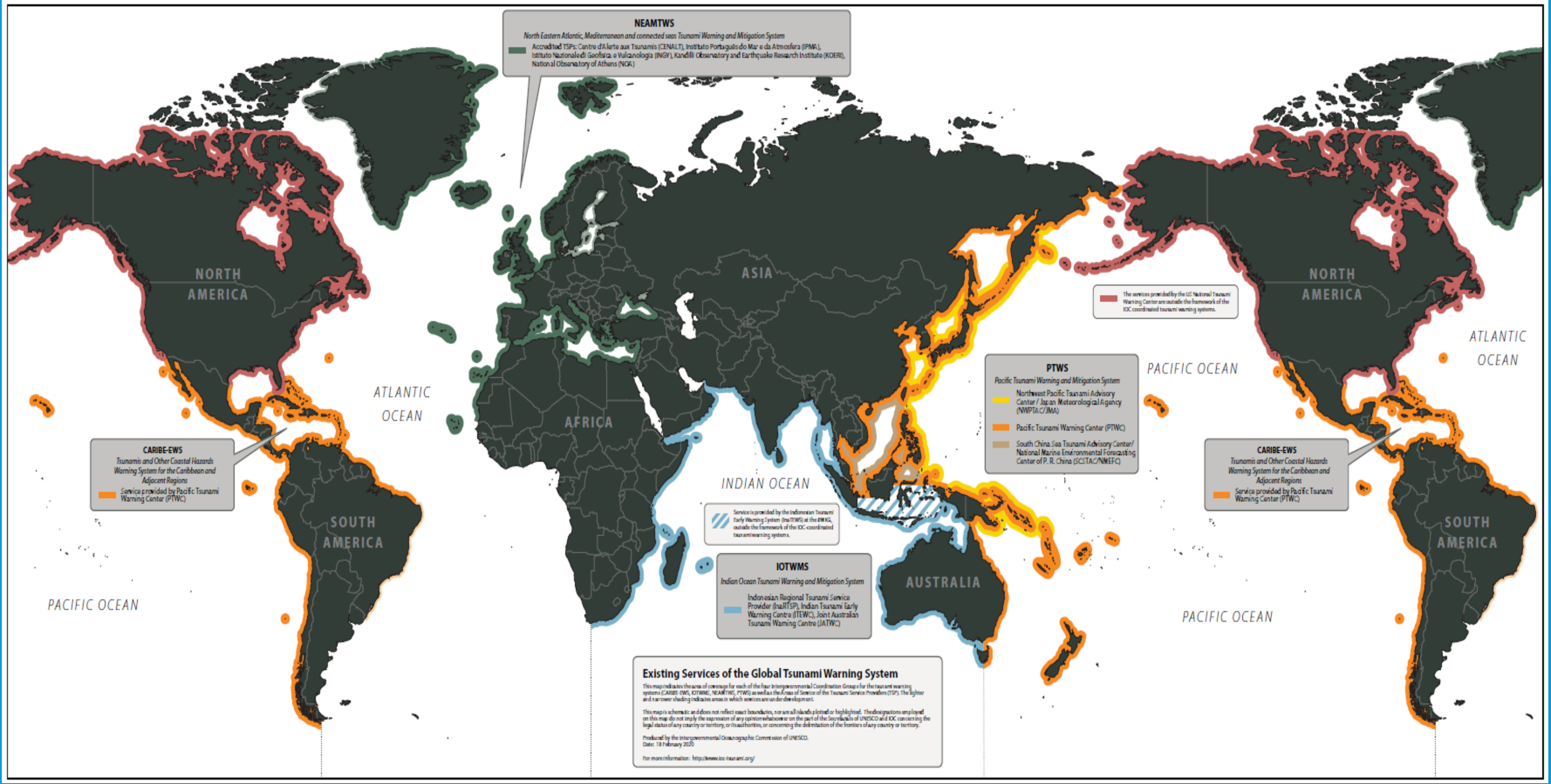
The Ocean Decade Tsunami Programme

The Research Development and Implementation Plan

Srinivas Kumar
Indian National Centre for Ocean Information Services (INCOIS)
ODTP RDI Chair

Global Tsunami Warning Systems



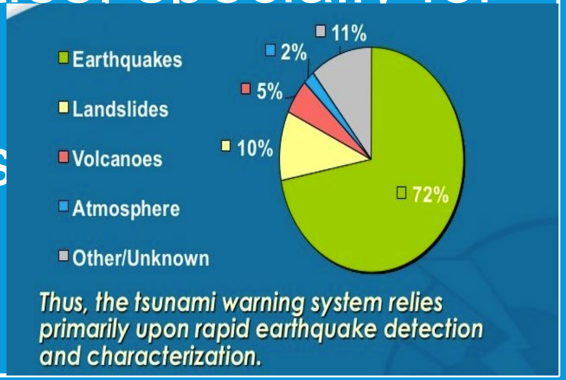


Progress since 2004

- 4 Regional Systems coordinated by the IOC UNESCO - PTWS, IOTWMS, CARIBE EWS, NEAMTWS
- Operate as inter-operable “system-of-systems”
- Network of NTWC/TWFPs receiving tsunami forecast information from one/more TSPs
- Sovereign responsibility of NTWCs/TWFPs to provide warnings, watches, and advisories to their citizens
- Seismic & Sea Level Observing networks, models, computational, communication facilities, DSS and SOPs
- Tsunami Ready
- Successfully monitored and issued warnings for several events

Several challenges evidenced from recent events

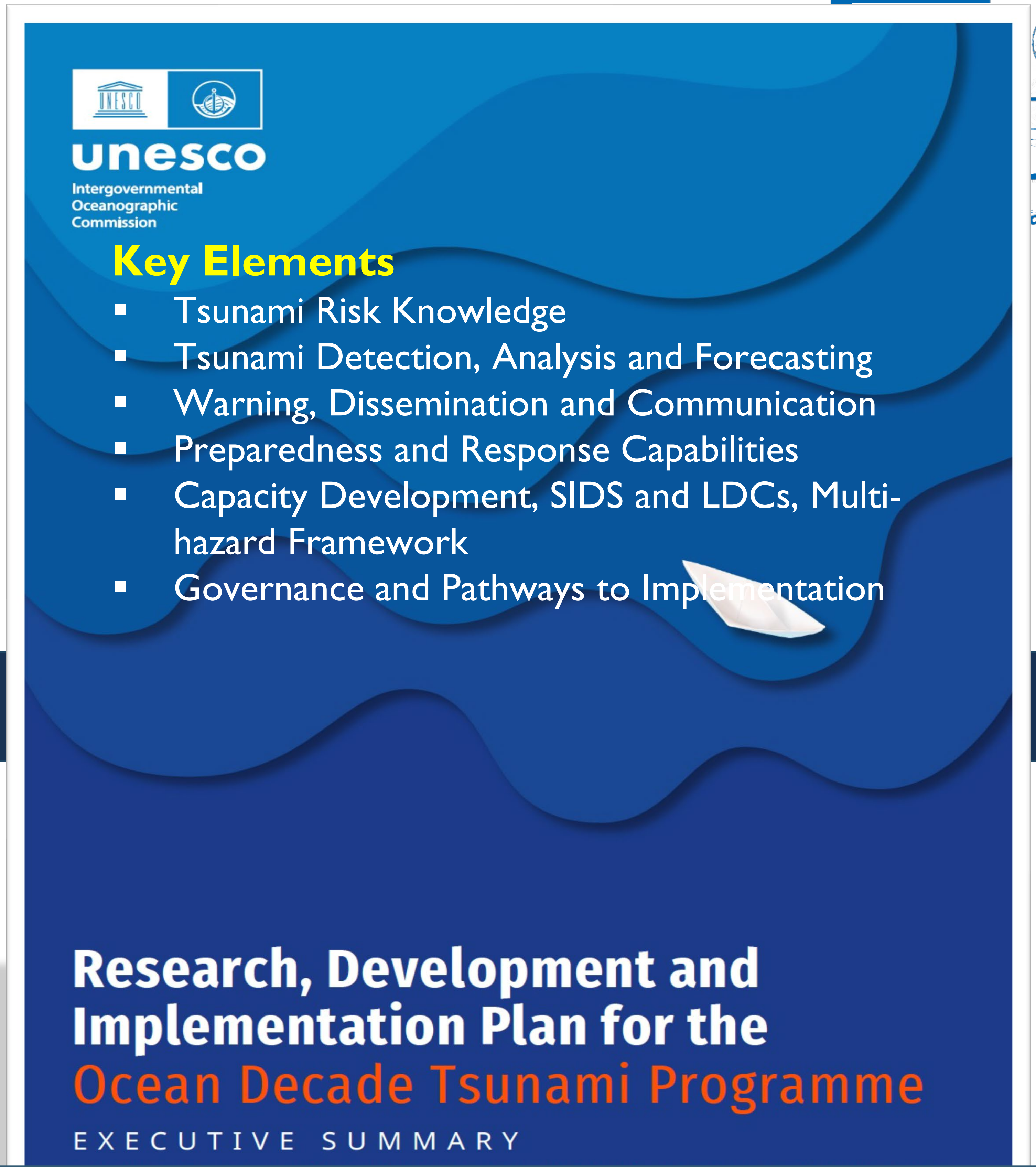
- Tsunami warning is race against time - Uncertainties in tsunami warning
- Gaps in Warning and Response capabilities, specially for non-seismic and near-field sources
- Gaps in SOPs and Early Warning Chains
- Gaps in preparedness & response



UN Ocean Decade Tsunami Programme

To develop the warning systems' capability to issue actionable and timely tsunami warnings for tsunamis from all identified sources to 100% of coasts at risk

100% of communities at risk be prepared and resilient to tsunamis by 2030 through programmes like the IOC-Tsunami Ready Recognition Programme (TRRP)



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Key Elements

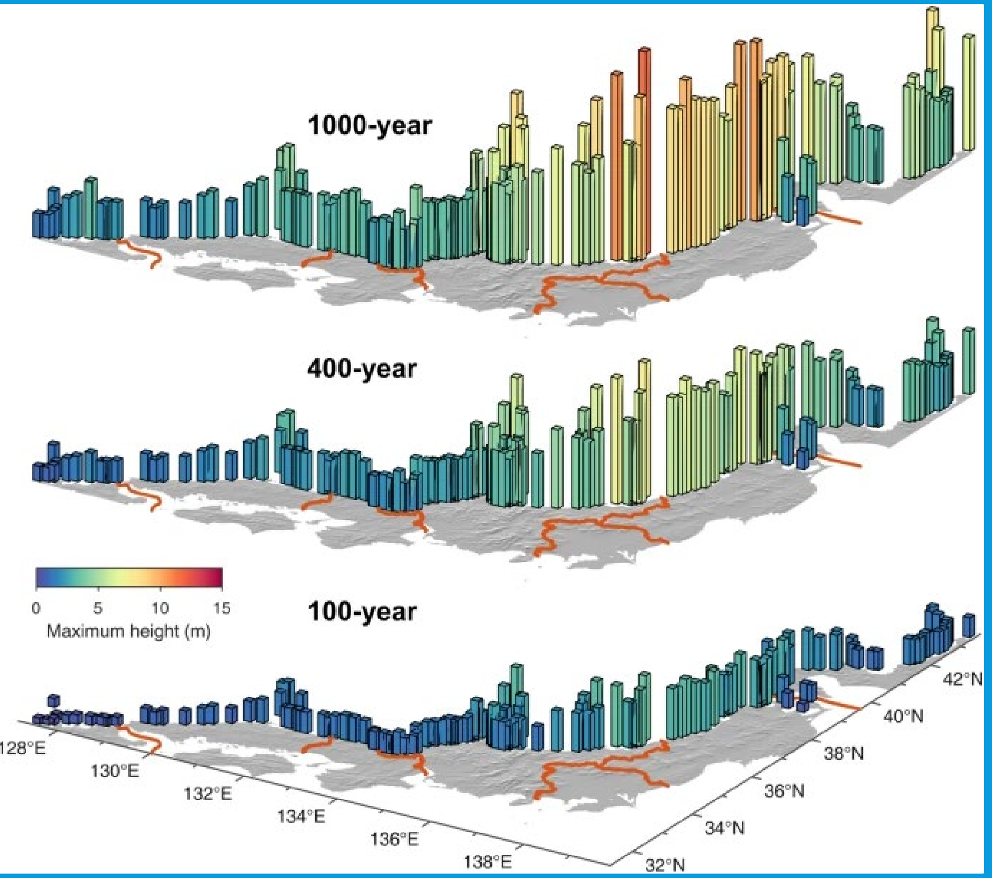
- Tsunami Risk Knowledge
- Tsunami Detection, Analysis and Forecasting
- Warning, Dissemination and Communication
- Preparedness and Response Capabilities
- Capacity Development, SIDS and LDCs, Multi-hazard Framework
- Governance and Pathways to Implementation

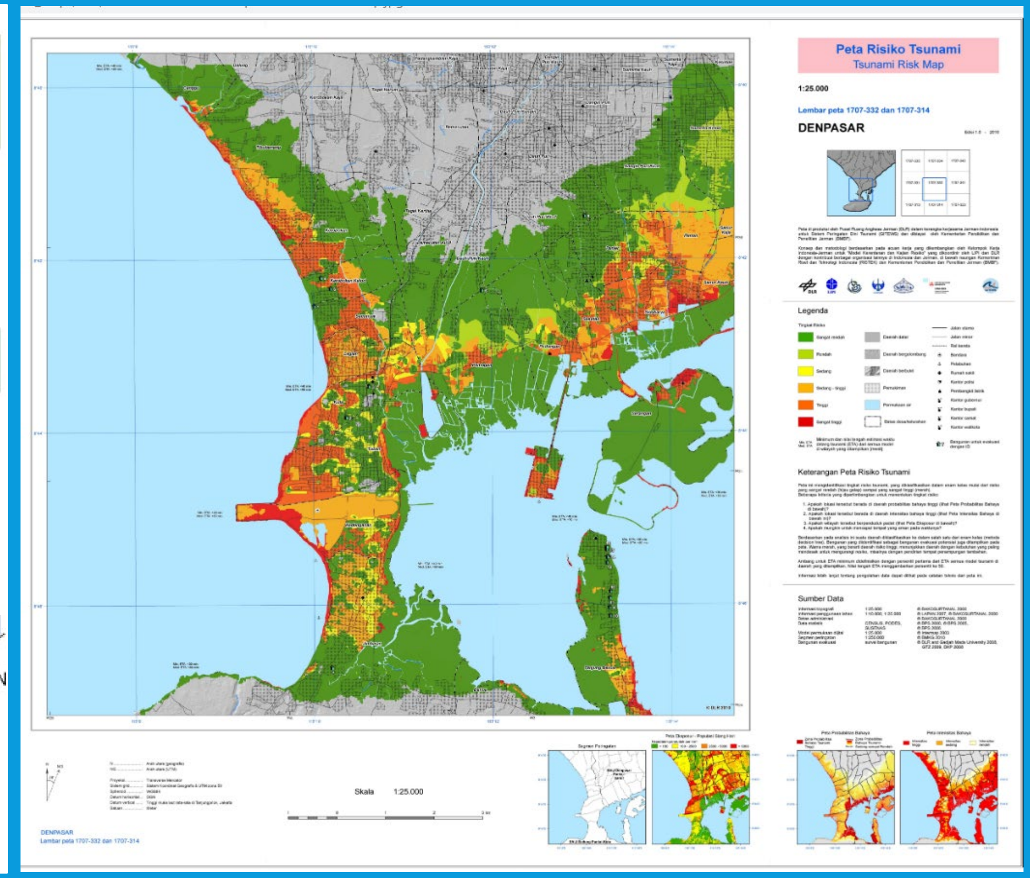
Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme

EXECUTIVE SUMMARY

The Scientific Committee developed the draft 10-Year Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme which was presented and endorsed at the IOC Assembly in June 2023

Tsunami Risk Knowledge





Definition of inundation areas, flow depths and arrival times through Tsunami Hazard Assessments

- Catalogue of historical tsunami records
- Database of tsunami source scenarios
- Coastal digital elevation data
- Access to Tsunami numerical models
- At least one person able to do tsunami modelling
- Defined the inundation area for the chosen community

Definition of vulnerability and exposure

- Identified critical infrastructure at risk
- Identified vulnerable groups
- Identified number of population
- Identified economic assets
- Identified built & natural environment

Definition of methodology to calculate risk

Definition of capacity to respond

- Bridged the gaps on legal framework
- Bridged the gaps on institutional framework
- Bridged the gaps on EWS

Using results from Tsunami Risk Assessments

- Performed TRA studies
- Developed tsunami risk reduction tools

Tsunami Detection, Analysis And Forecasting

Goals

- **Expand international cooperation to improve capability to directly detect and measure tsunamis and reduce reliance on seismic proxy relationships**
- **Issue actionable and timely tsunami warnings for tsunamis from all identified sources to 100% of coasts at risk**
- **Provide tsunami confirmation within 10 minutes or less of origin for the most at-risk coastlines**

Detection and Measurement

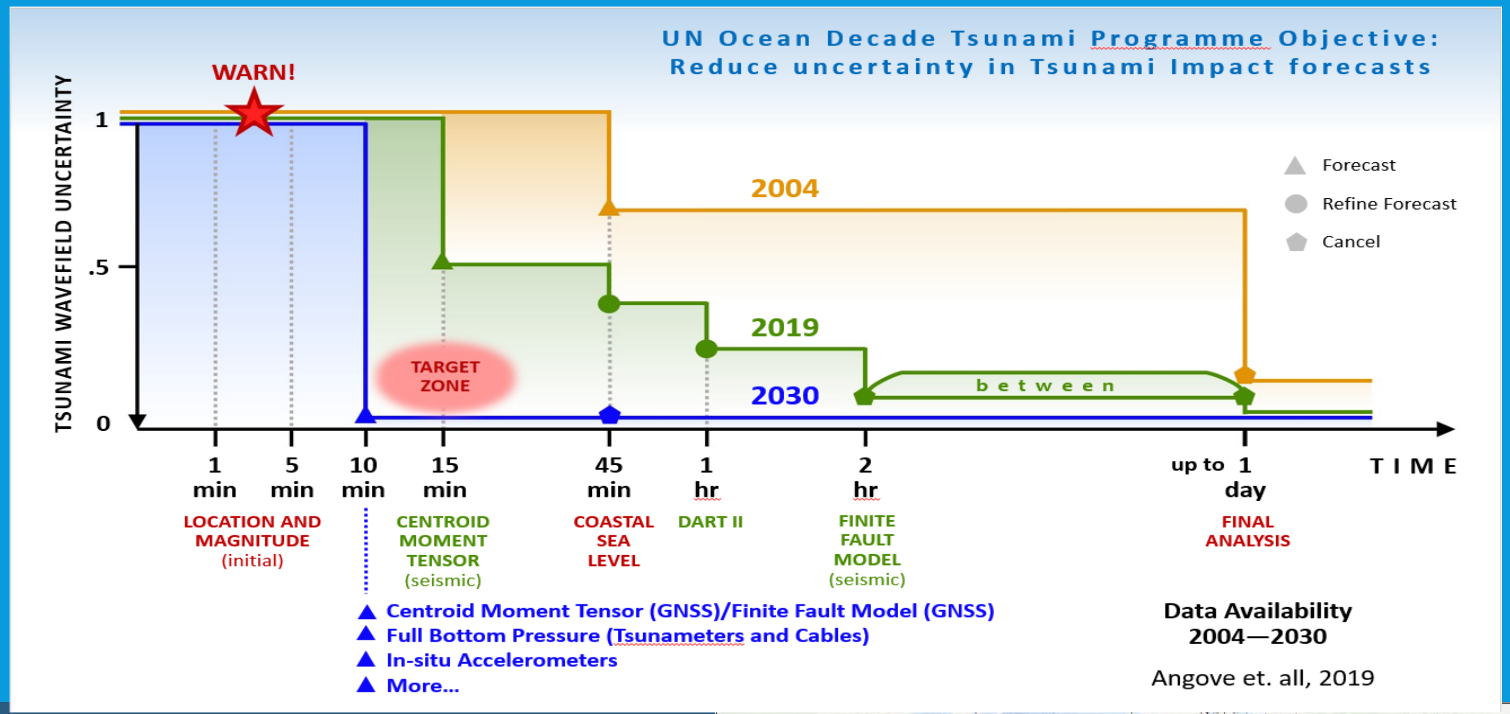
- **Maximize and expand current capabilities**
  - Seismic, Tsunameters, Tide gauges, GNSS, Dedicated observatories, Supporting capabilities
- **Implementation of existing capabilities not being applied to tsunami operations**
  - SMART Cables, Coastal RADARs, Passive/Active Remote Sensing, Infrasound
- **Identification of new candidate capabilities**
  - Ionospheric tomography (TEC), Fibre Optics (DAS)

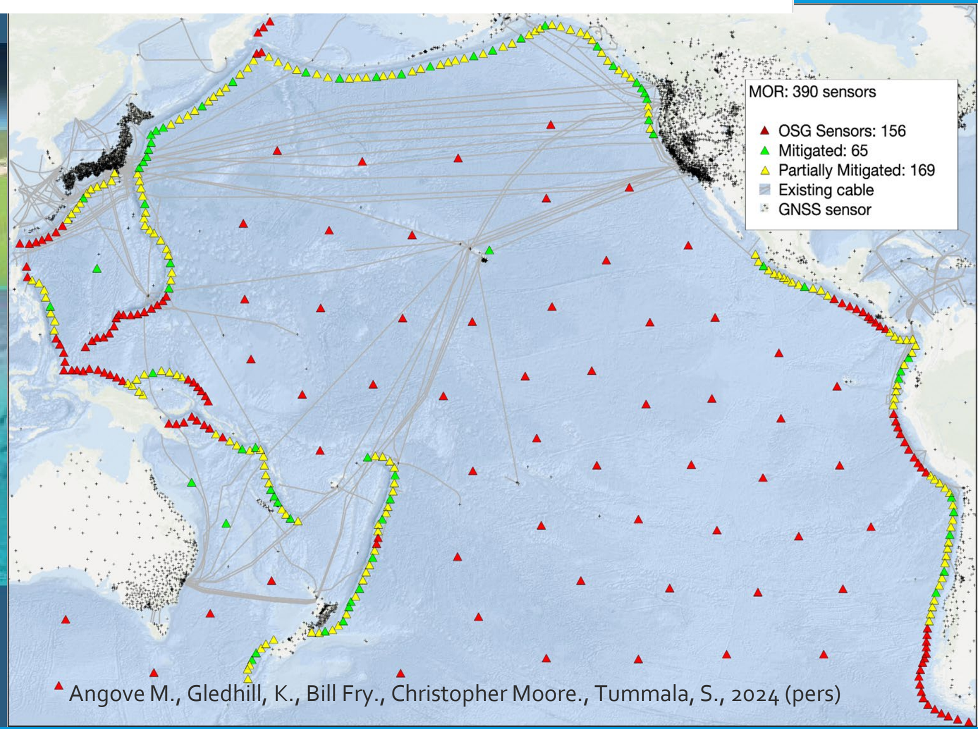
Characterization and Forecasting

- **Research on source mechanisms and characterisation, PTF Techniques, New Forecast methods**

Indicators

- Optimal notional global network design in all ICGs
- Optimal observing network implementation in all ICGs
- Enhanced data sharing in all ICGs
- High-Resolution Coastal Bathymetry and Topography
- Advanced computing/modelling/impact forecasting/assimilation/analytics in TSPs
- Access to data, tools and communication platforms in all TWCs





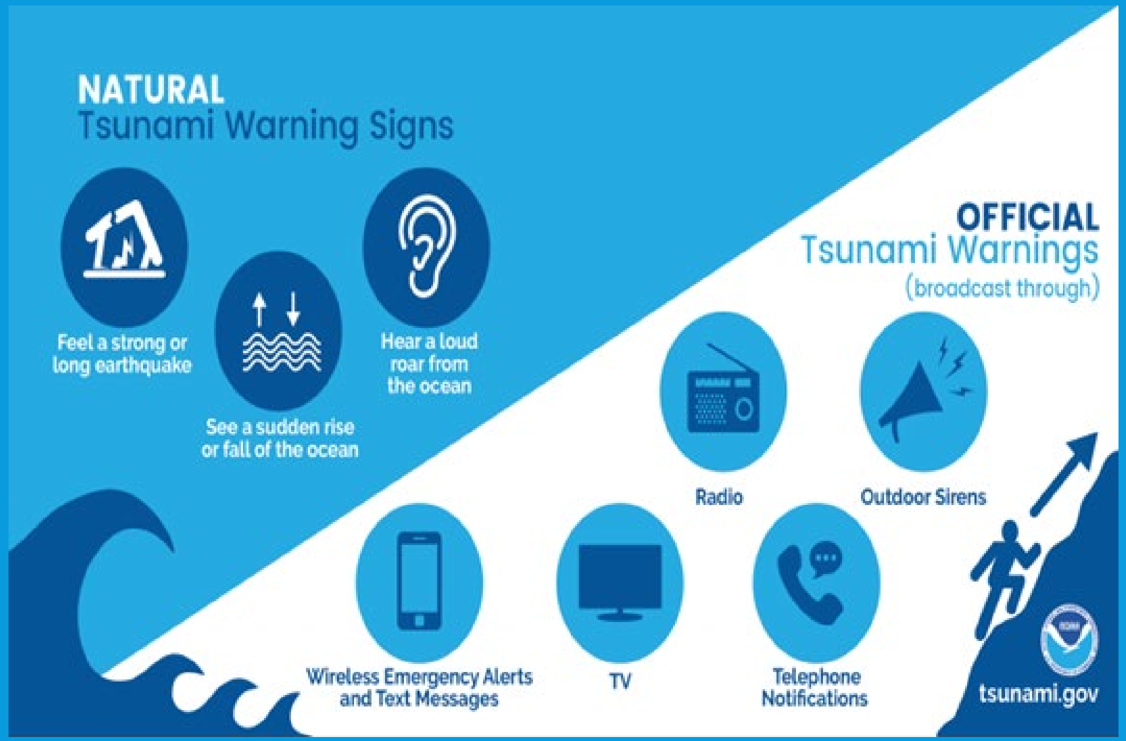
Tsunami Warning, Dissemination and Communication

Goal: Significant improvements in the national decision making to warn, and mechanisms in place for the effective and inclusive construction, dissemination and communication of warnings.

- 100% of the national authorities will be able to effectively warn communities and population at risk.
- Communities at risk will be able to use these advances to improve local tsunami preparedness and response capabilities and become Tsunami Ready

Key elements that need to be addressed

- Effective decision making to warn - National/local tsunami warning chains and standard operating procedures; Decision Support Tools (Co-design, Competency Development)
- Effective construction of warnings – Time constraints, Inclusive, Actionable content (Use of IT, understand target audience, impact-based warning content)
- Effective dissemination and communication of warnings – Institutional capacity, Communication mechanisms, Multi-Hazard Warning Systems, Multiple sources of information (Standards & Formats, CAP, Broadcast & Social Media)



Preparedness and Response Capabilities

Goal: 100% of communities at risk from tsunamis are prepared for and resilient to tsunamis by 2030 through efforts like the IOC-UNESCO Tsunami Ready Recognition Programme

Key elements that need to be addressed

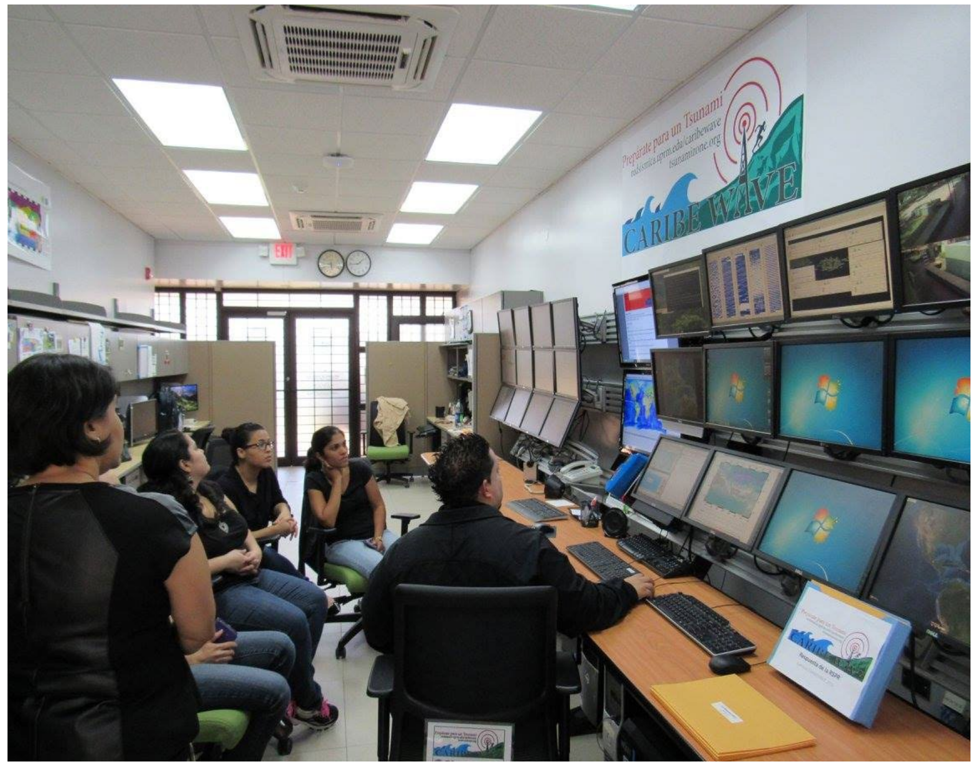
- **Risk Perception and Awareness** – Risk perception studies need to be encouraged across all regions
- **Preparedness**
  - All at-risk communities have tsunami hazard, inundation, evacuation maps, TEMPP trainings
  - Public display of tsunami information, Tsunami Signage
  - Locally relevant education and awareness resources, institutionalizing tsunami education
  - promote communities to actively participate in the World Tsunami Awareness Day
  - 100% of communities at risk conduct a local tsunami exercise every two years

- **Response Capability**
  - All countries with tsunami risk should have agreed parameters at the national and local level for warning and have approved response plans
  - 100% of at-risk communities have multiple effective and sustainable communication methods in place
  - Inclusive, inventory of resources, natural signs and self-evacuation, multihazard, capacity building
- **Mitigation**
  - Communities have access to an inventory of best practices of plans and structural and nature-based solutions
  - More communities have implemented plans and measures to minimize impacts to critical infrastructure and marine assets from tsunamis and other coastal hazards,
  - Mainstreaming disaster risk reduction into urban planning

Capacity Development

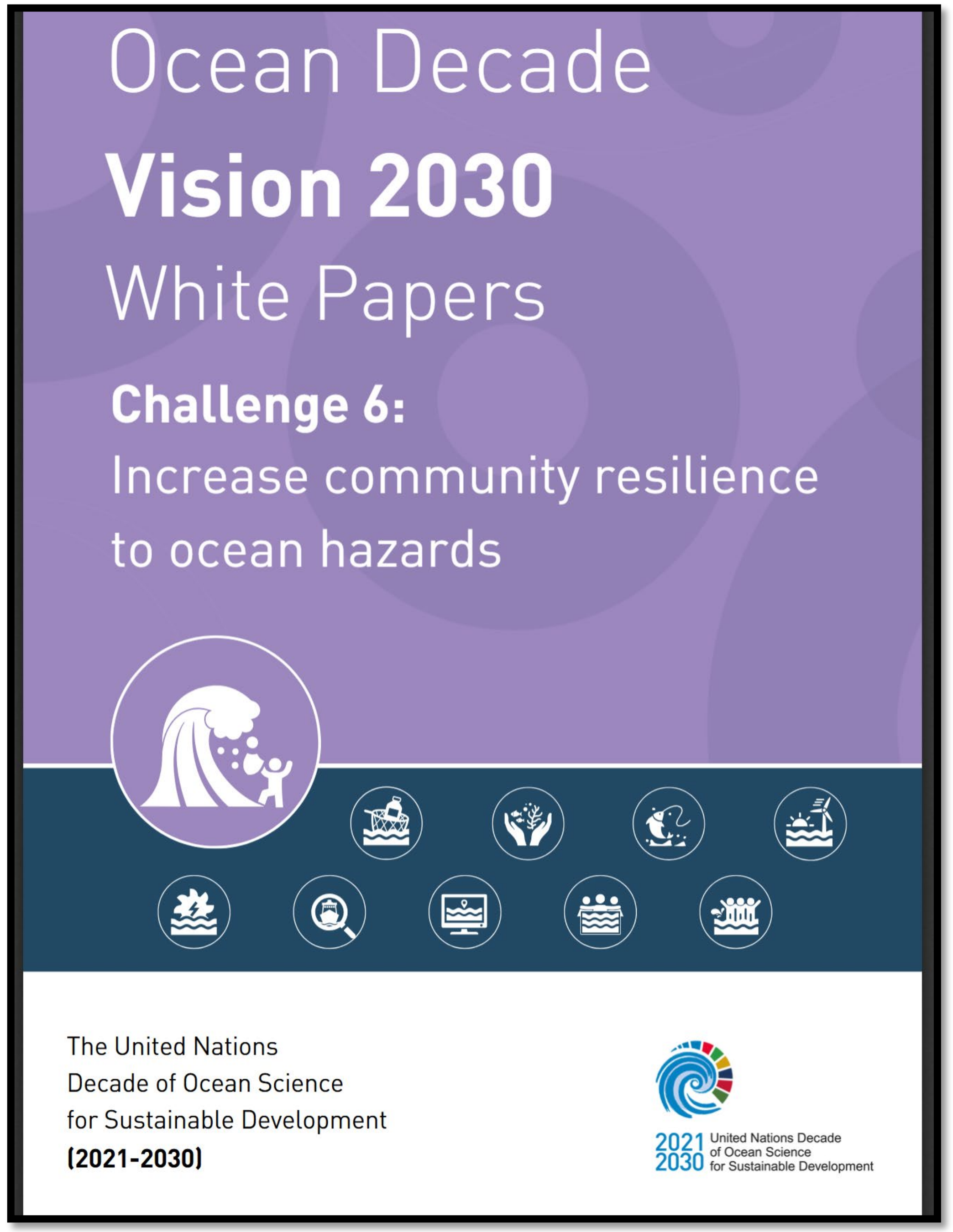
Ensure investment in capacity development for the different stakeholders including the generators and the users of the tsunami early warning system

- National, regional and local level initiatives to reach the objective of 100% at-risk communities to be prepared and resilient to tsunami
- Facilitate equitable access to data, information, knowledge, technology, and infrastructure, leaving no-one behind
- ICG-TICs and OTGA-STCs as the means for the delivery of capacity development
- Special consideration to be capacity requirements of SIDs and LDCs



Pathways to Implementation

- The ODTP provides a framework for identifying gaps, suggesting solutions, prioritise resources, and implementing actions within the timeframe of the Ocean Decade
- This plan outlines the pathways for achieving overall objectives of ODTP including challenges, solutions, performance indicators, milestones and target dates for the four main components of the tsunami early warning system
- Considering the nature of tsunami hazard, the optimal solutions should have a global design, address regional imperatives, and be implemented through contributions and actions of Member States and other stakeholders
- Scientific objectives of the tsunami warning enhancements will be achieved by maximizing and expanding current capabilities, identifying capabilities that exist but are not currently applied to tsunami, and developing new capabilities through innovation and research
- Member States may endeavour to dovetail their national plans/programmes with the ODTP objectives
- Member States, academic institutions and industries will seek, possibly through ICG consultation to identify candidate proposals aimed at addressing the solutions
- R&D community and Industry has the opportunity to develop and contribute to scientific understanding, technological solutions, product development and capacity building.
- The intent of the plan is to offer contribution pathways that cover the full spectrum or financial commitments by targeting the objectives most important to advancing MS capabilities



Goal: A safe ocean where life and livelihoods are protected from ocean-related hazards
- **Design people-centred multi-hazard early warning systems**
- **Design adaptation strategies to increase coastal resilience**

THANK YOU

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Decade Collaborative Centre for Coastal Resilience

Giovanni Coppini
Euro-Mediterranean Center on Climate Change (CMCC) Foundation
Decade Collaborative Centre for Coastal Resilience (DCC-CR)
University of Bologna, Italy

UN Decade Collaborative Centre for Coastal Resilience – DCC-CR

Nadia Pinardi, DCC-CR , University of Bologna, IT

and

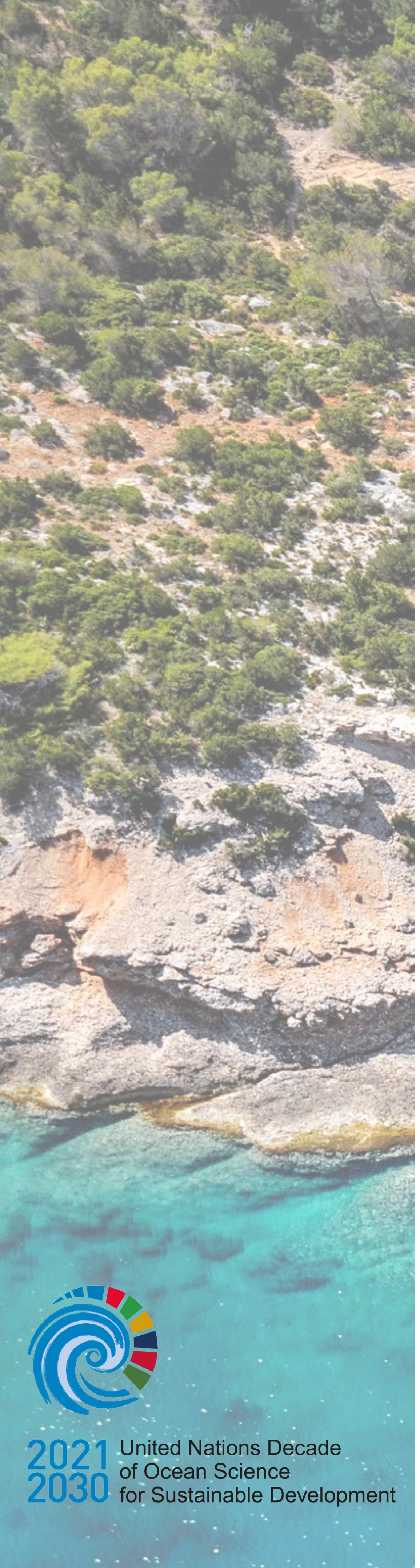
Giovanni Coppini, Euro-Mediterranean Centre on Climate Change -CMCC Foundation, IT

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

UN Decade Collaborative Centre for COASTAL RESILIENCE

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
DEPARTMENT OF PHYSICS AND ASTRONOMY "AUGUSTO RIGHI"

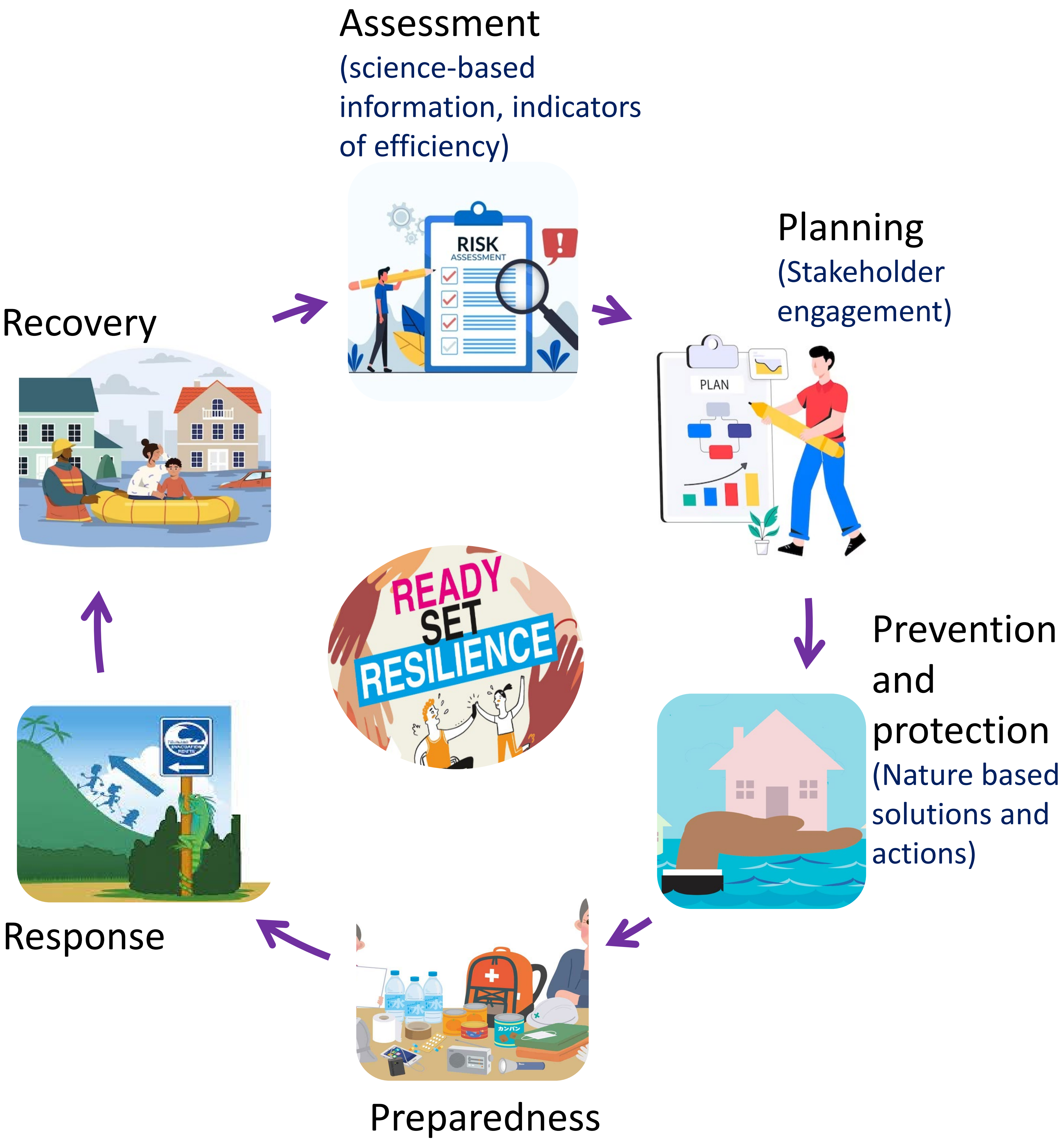
Regione Emilia-Romagna



Coastal Resilience?

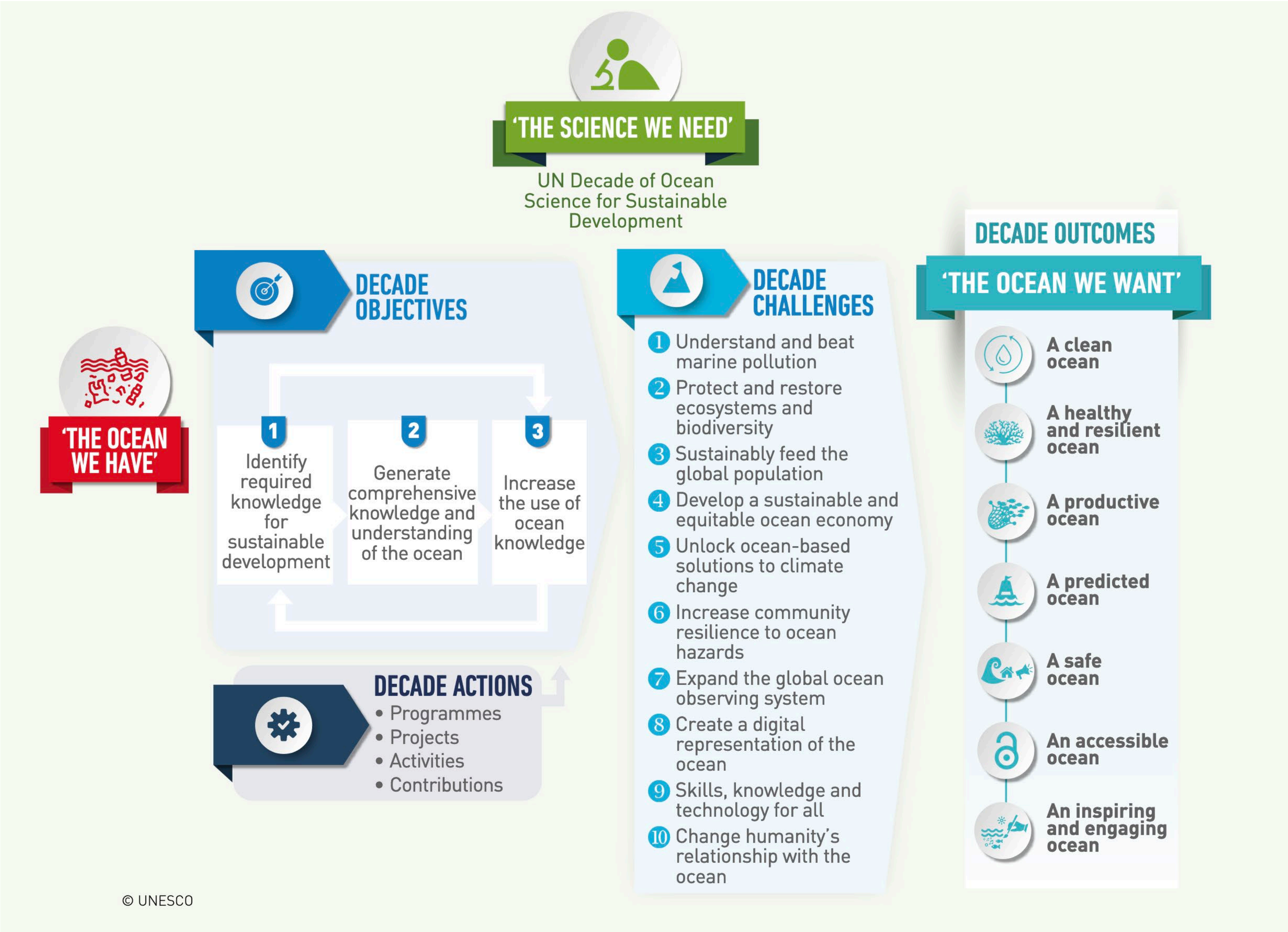
The UN International Strategy for Disaster Reduction definition:

Resilience is the capacity of a system, community or society to resist or to change so that it may obtain an acceptable level in functioning and structure.



Why coastal resilience is important?

- Coastal resilience is a system attribute and it has not been used to strengthen science-based environmental management
- The relationship between adaptive capacity (born in climate change science) and coastal resilience not yet clarified
- Almost no operational tools exist for coastal resilience planning of management



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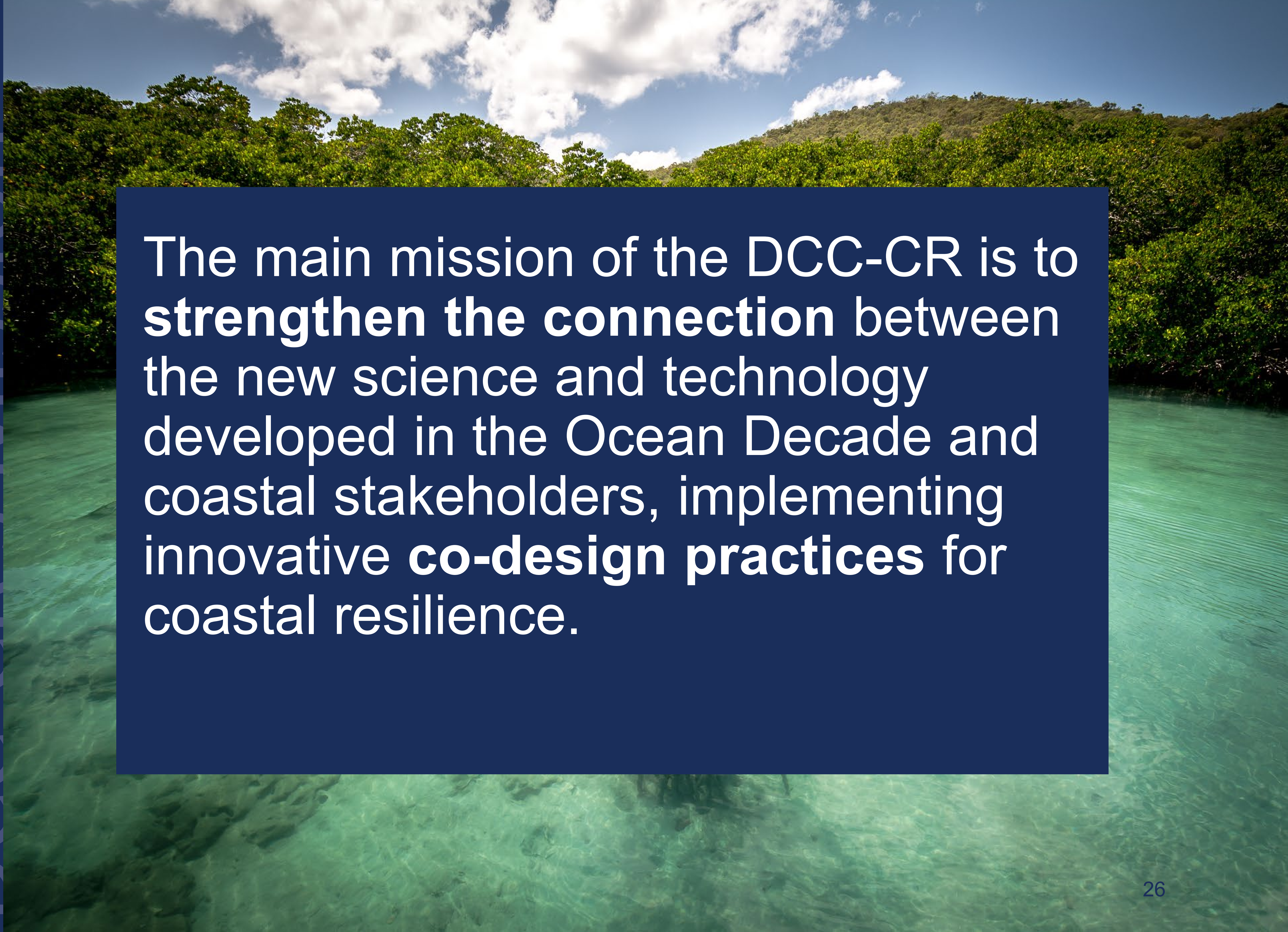
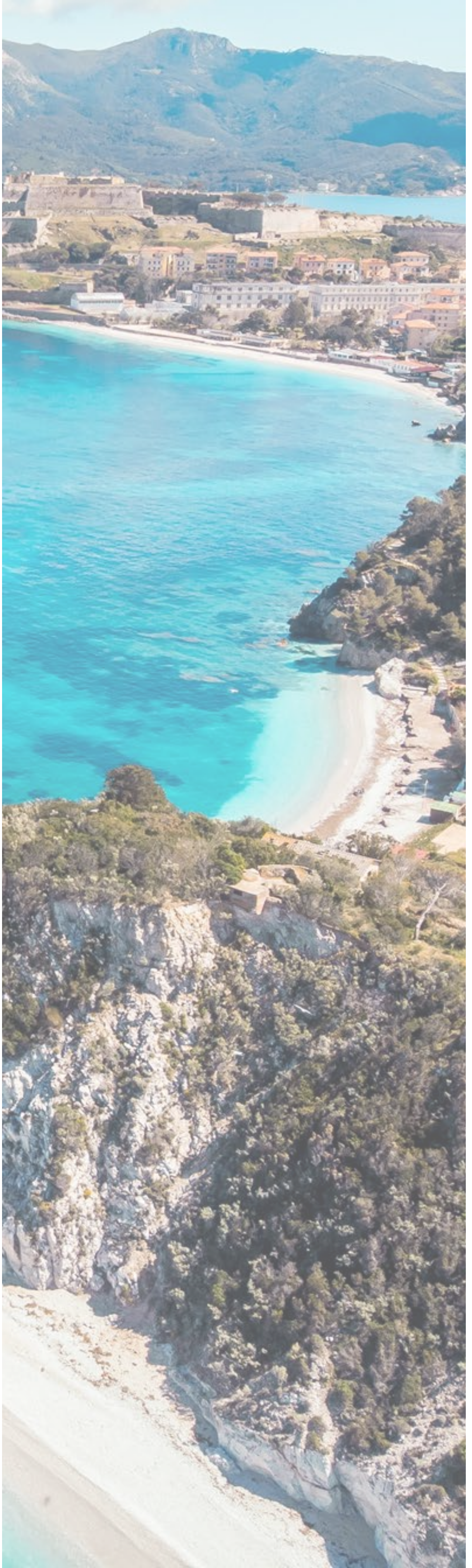
DCC-CR’s Mission

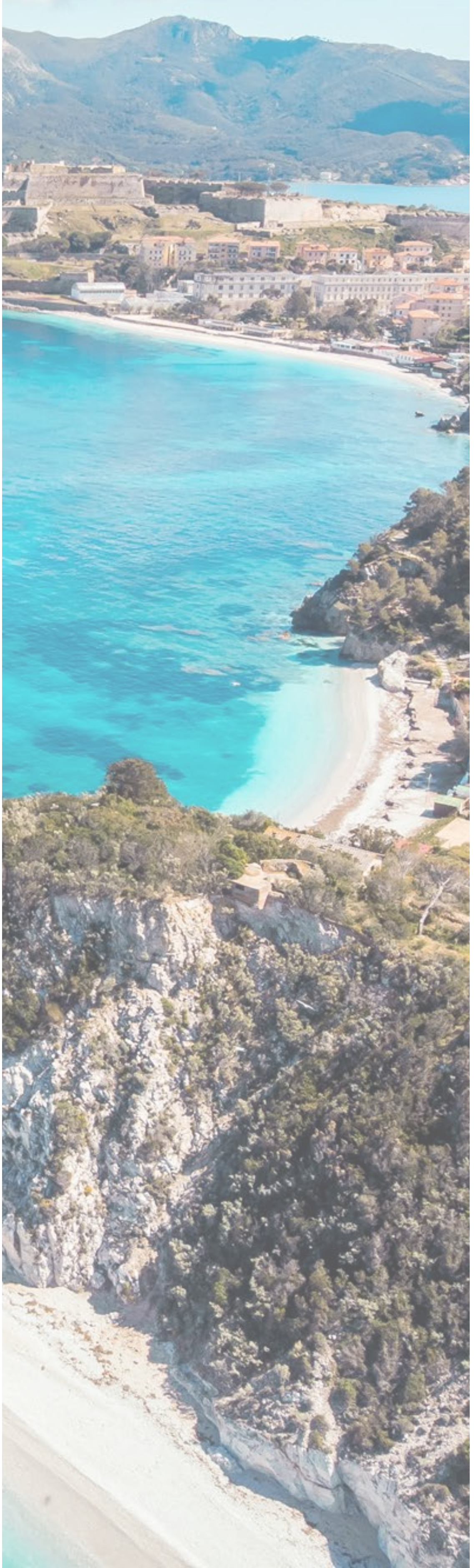


The main mission of the DCC-CR is to **strengthen the connection** between the new science and technology developed in the Ocean Decade and coastal stakeholders, implementing innovative **co-design practices** for coastal resilience.



DCC-CR‘s strategic objectives

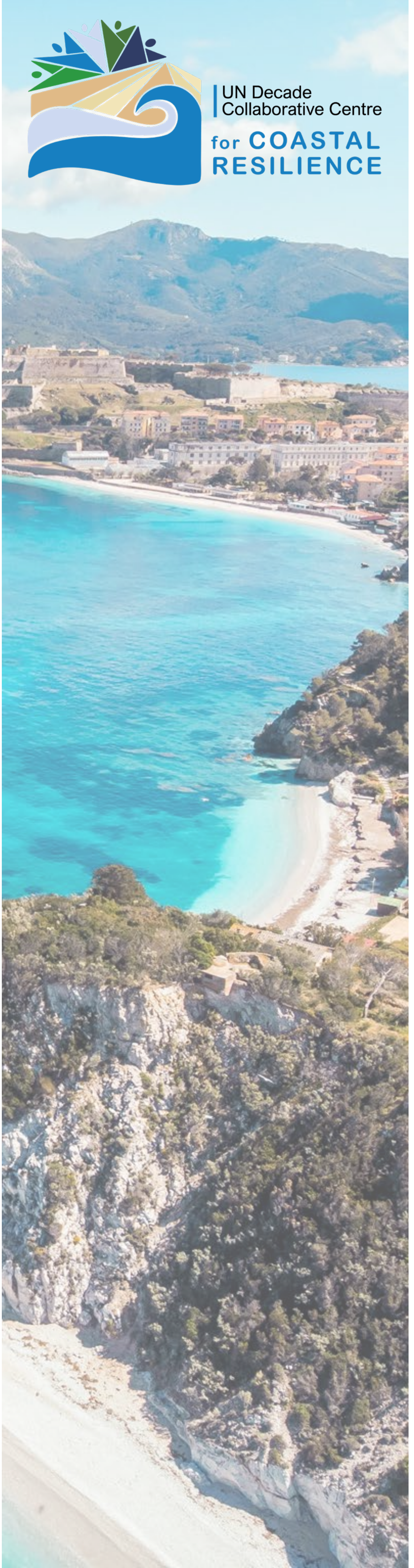
- Improve science information for all
- Enhance stakeholder engagement
- Promote equitable education
- Uphold environmental justice for coastal communities



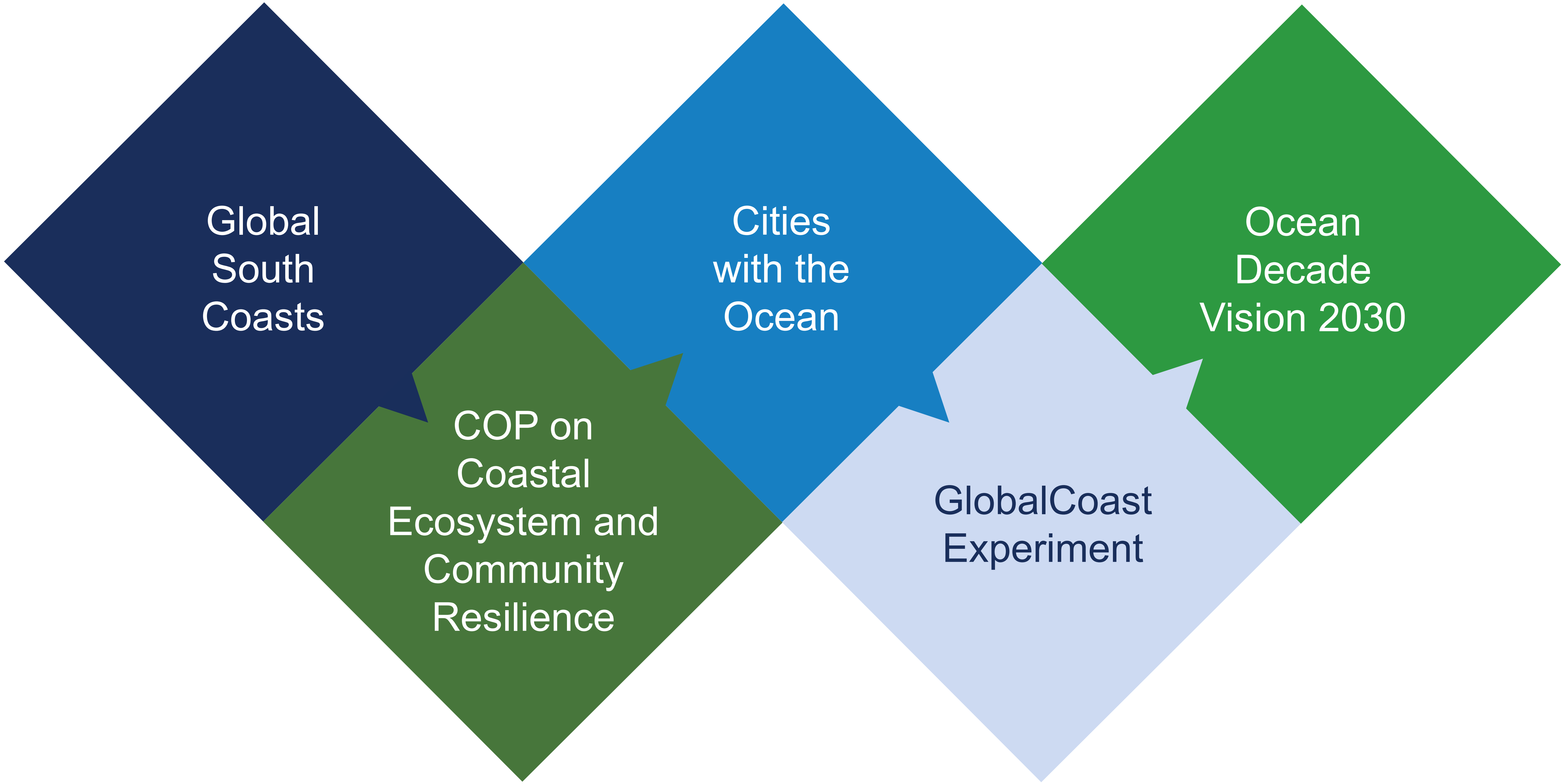
DCC-CR's relevance to SDGs

- **Coastal Resilience aligns with multiple SDG targets, particularly:**
  - **SDG 14: Positive impact on oceans and marine resources**
  - **SDG 13: Strong alignment with Climate Action goals**
  - **SDG 11: Supports sustainable cities with a focus on disaster risk reduction**
  - **SDG 17: Participatory decision-making**

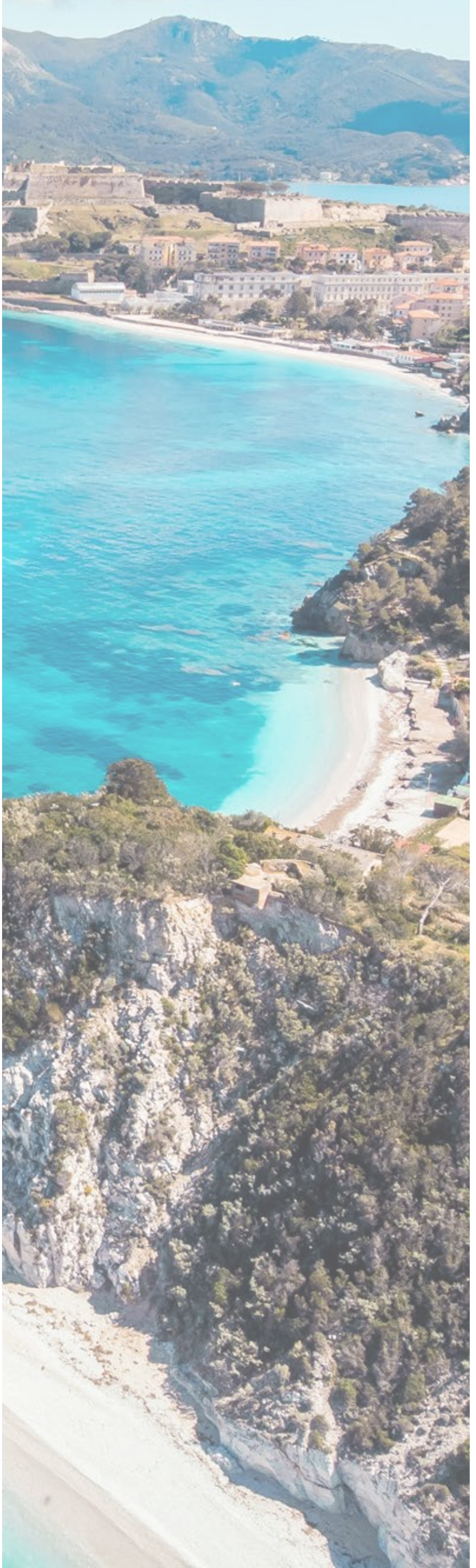
Gaps in SDGs: Need for more comprehensive inclusion of coastal resilience targets and indicators within the SDGs



DCC-CR's Cross-cutting activities



UN Decade Collaborative Centre for COASTAL RESILIENCE



Cross-cutting: Vision 2030 Increase resilience to ocean hazards

- DCC-CR and DCC-IOR **co-chairing the Vision 2030 White Paper**
- The White paper is now published:
- https://unesdoc.unesco.org/ark:/48223/pf0000390122?posInSet=6&queryId=d61fb5dd-1226-4649-a508-7dd636d457fe

Design 'people-centred' multi-hazard early warning systems

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

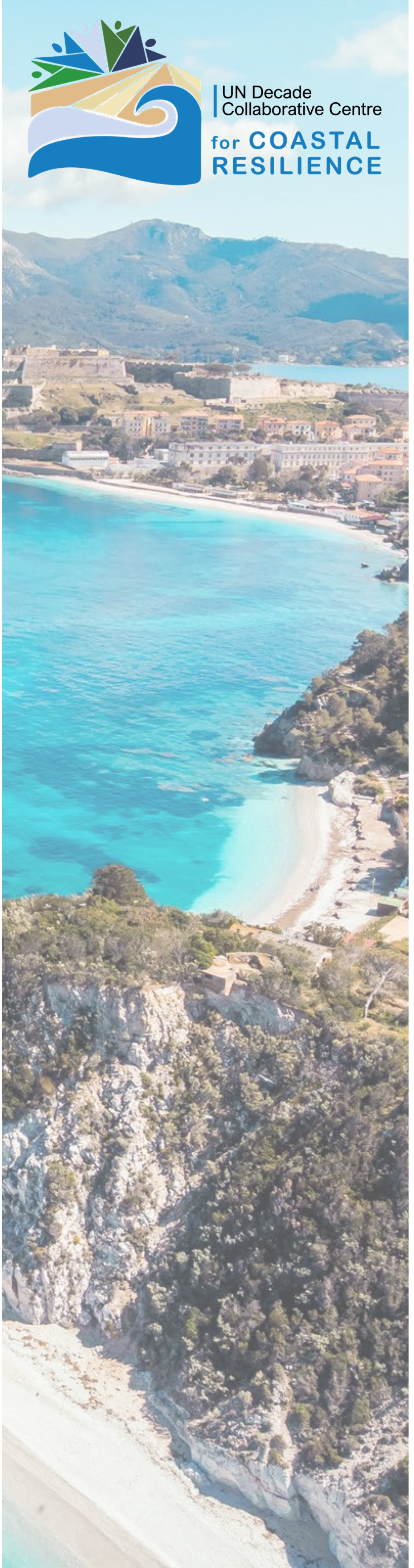
GOAL:
A safe ocean where life and livelihoods are protected from ocean-related hazards

Design adaptation planning strategies to increase coastal resilience

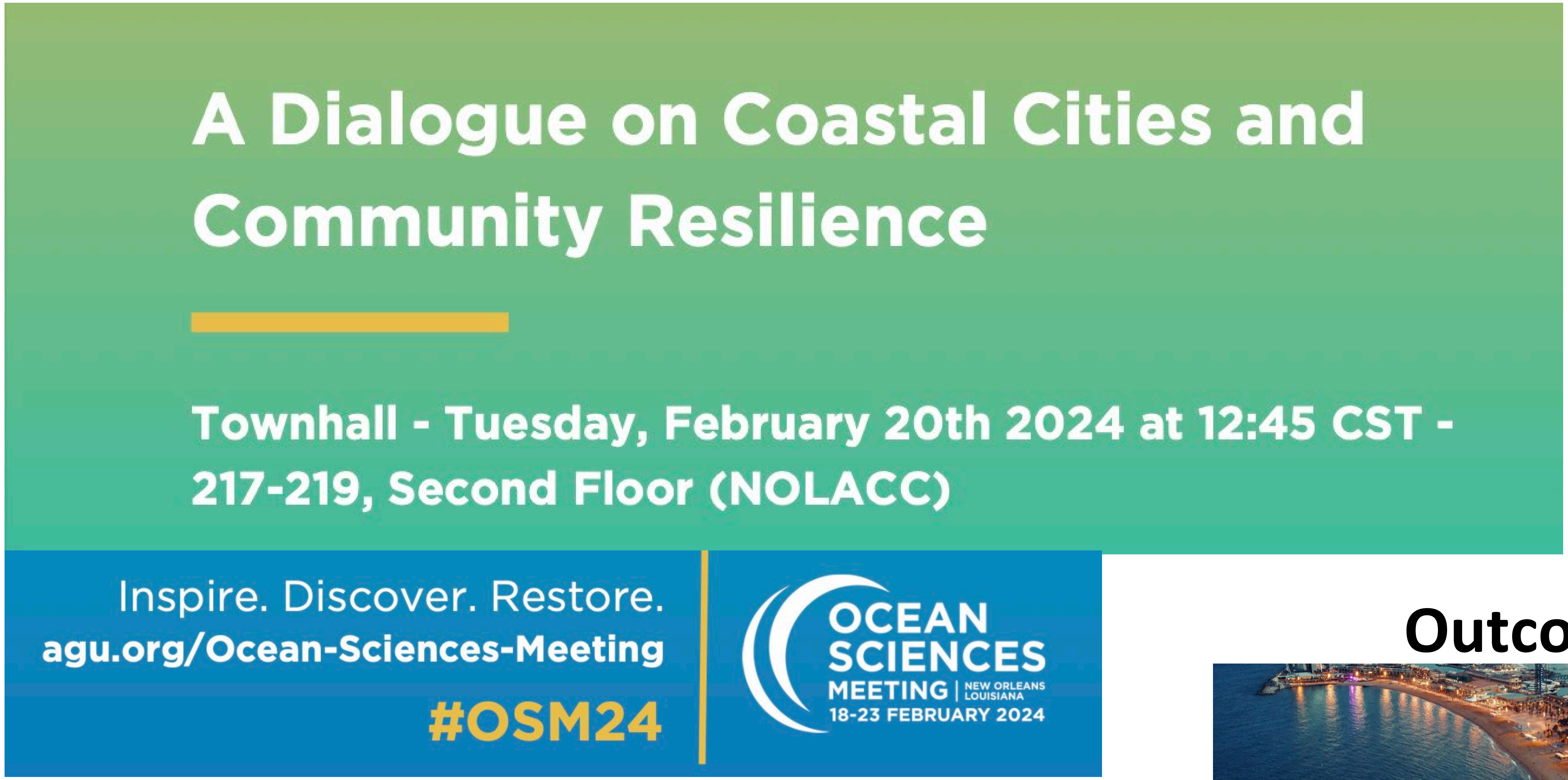
Use the new data from the Ocean Decade to prepare updated plans and solutions, also in view of the Marine Spatial Planning process

Cross-cutting: Cities with the Ocean – UN Ocean Decade Initiative

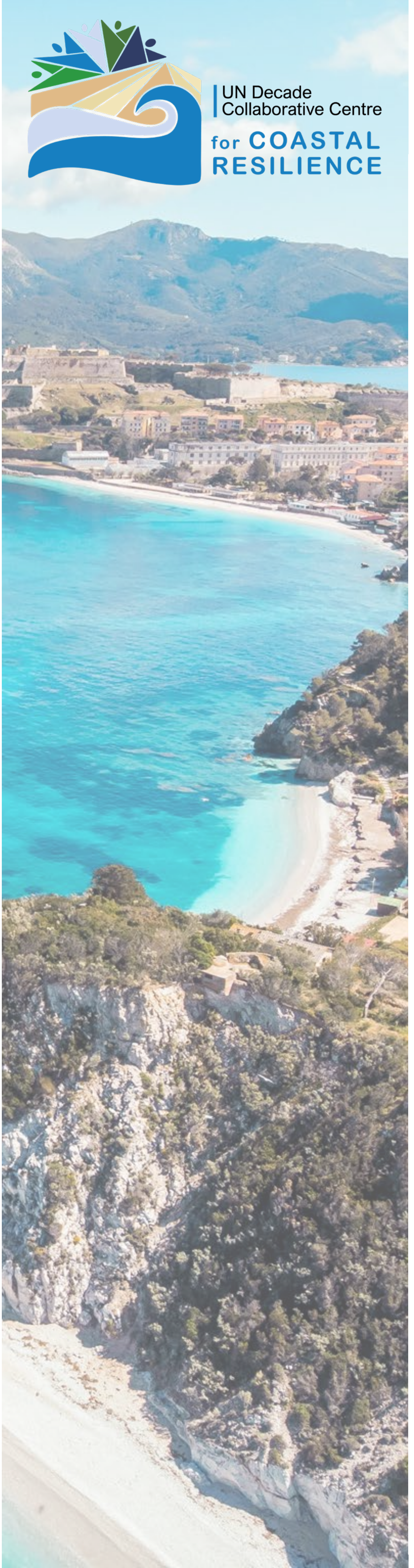
Mobilizing the Ocean Decade ecosystem to enable coastal cities around the world to take up ocean science and give the ocean a key role in their sustainable development.



The DCC-CR’s recent activities



Outcome



The DCC-CR's ongoing activities

- Course done in collaboration with the Ocean Teacher Global Academy

"Resilient Coastal Business:
Sustainability, growth and human capital"
February 2025

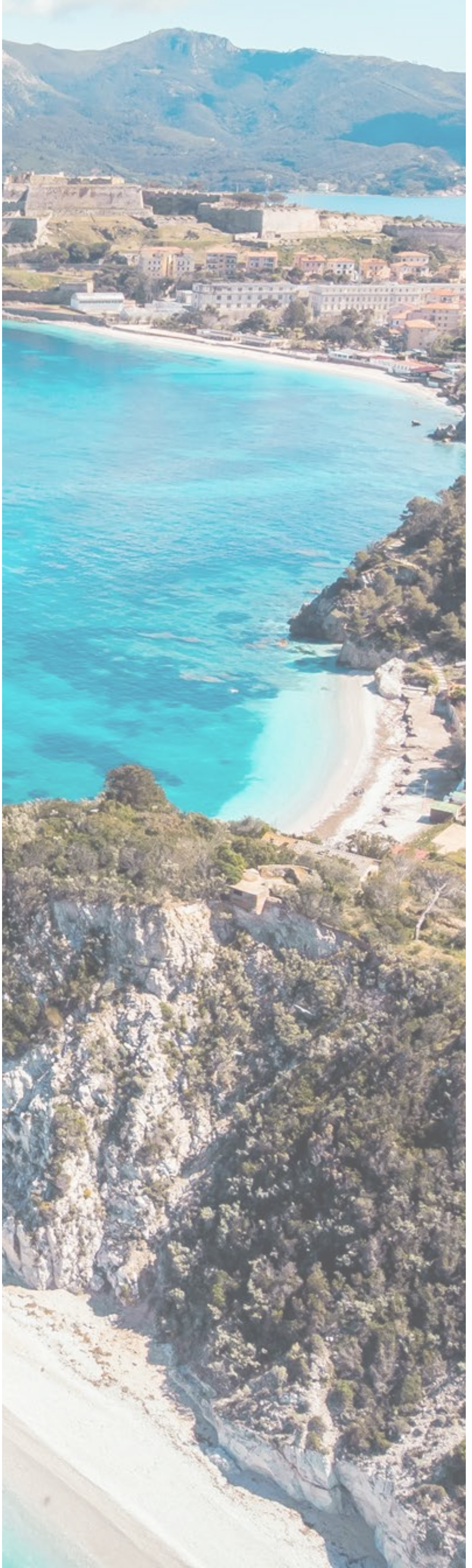
Who is this course for:

- Post-graduate and early-career course for **professional development** and **continuing education (25 students max)**

Target audience:

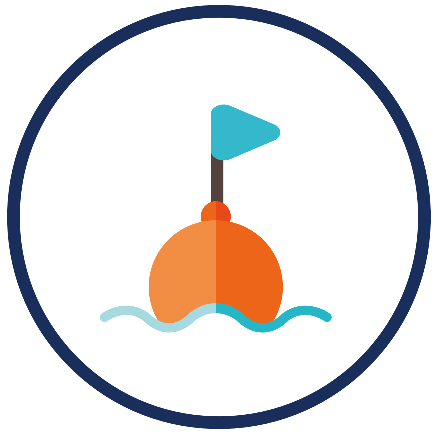
- coastal consulting companies
- coastal managers and operators
- environmental protection agencies
- civil protection

UN Decade Collaborative Centre for COASTAL RESILIENCE



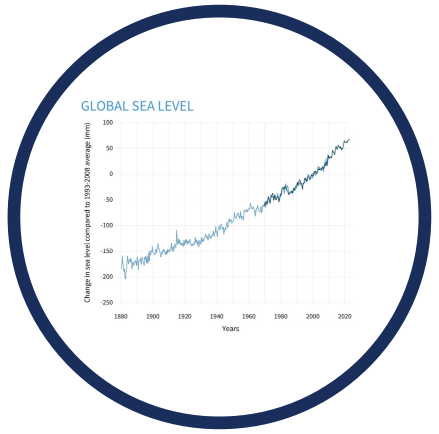
Cross-cutting: GlobalCoast Initiative

GlobalCoast is a CoastPredict initiative that will advance knowledge, innovative products and services to support coastal community resilience.



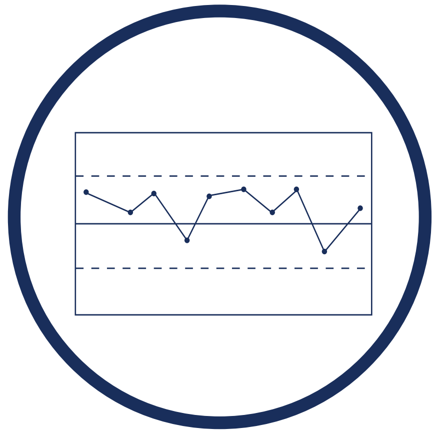
01. New observing technologies

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



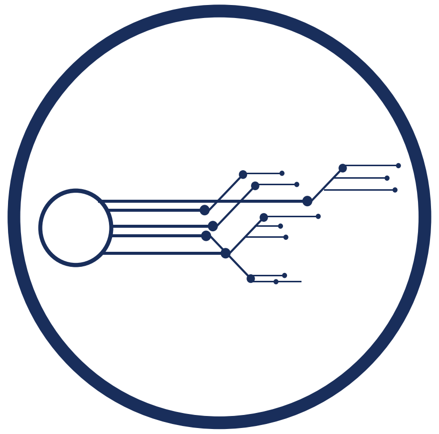
03. 100 years projections

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



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

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



04. High resolution reanalysis to instruct AI networks

will be produced at the coastal scale

GlobalCoast survey insights

GOOS | CoastPredict
with The Global Ocean Observing System

125

Pilot Sites

34

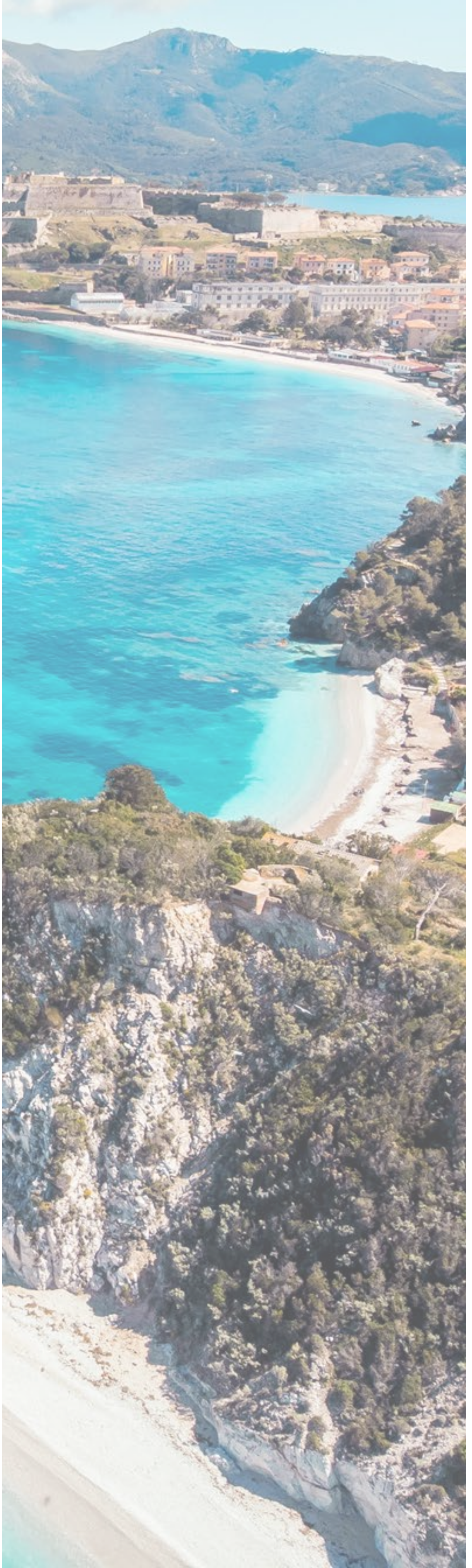
Regions of the Global Coastal Ocean

365

institutions in 64 countries

Pilot Site locations*

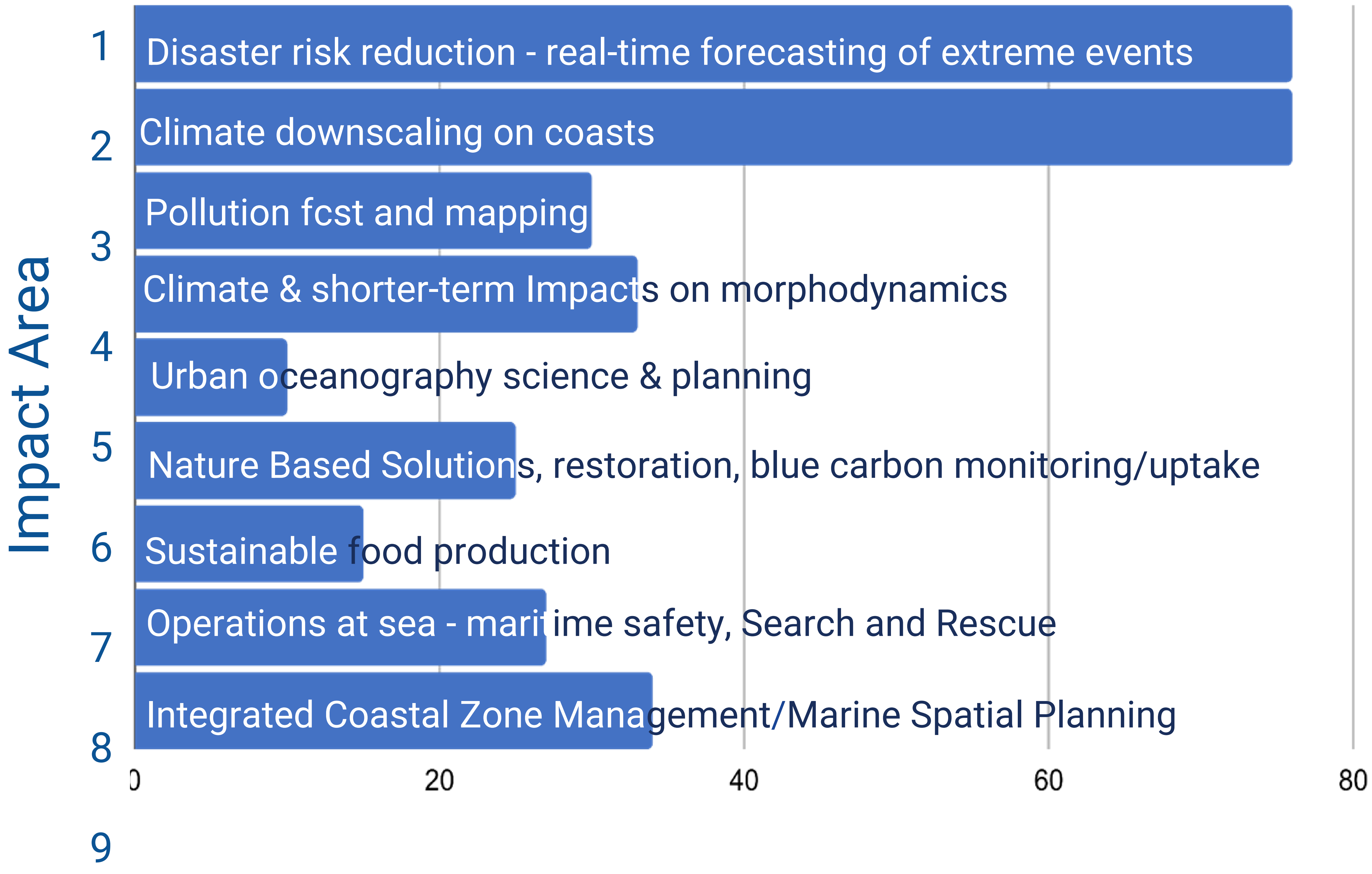
*subject to change - some locations to be verified

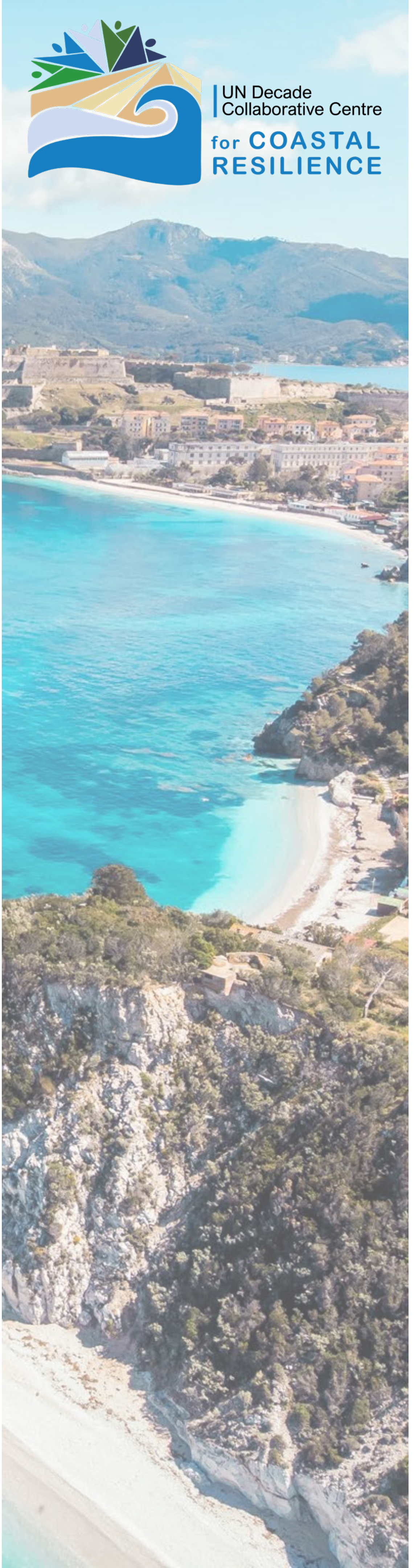


Cross-cutting: GlobalCoast Initiative

Focus on 'Impact Areas'

What impact areas are most important for Pilot Sites?





Get in touch

DCCs and DCOs network will build the next generation infrastructure for the UNESCO-IOC contribution to the Sustainable Development Goals.

How to Engage
DCC-CR website
https://shorturl.at/bhzl9

Subscribe to our Newsletter
https://shorturl.at/fzAO7

UN Decade Collaborative Centre for COASTAL RESILIENCE

https://centri.unibo.it/dcc-cr/en

difa.dcc-cr@unibo.it

The Decade Collaborative Centre for Coastal Resilience is a departmental centre of the University of Bologna and it is funded by the Emilia-Romagna Region.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Regione Emilia-Romagna

Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Global Real-time Early Alarm for Tsunami (GREAT)

Usama Kadri

Reader in Applied Mathematics

Cardiff University, United Kingdom of Great Britain and Northern Ireland

Global Real-time Early Assessment of Tsunami (GREAT)

Operational Software

Usama Kadri
School of Mathematics, Cardiff University

(with Ali Abdolali & Maxim Filimonov)

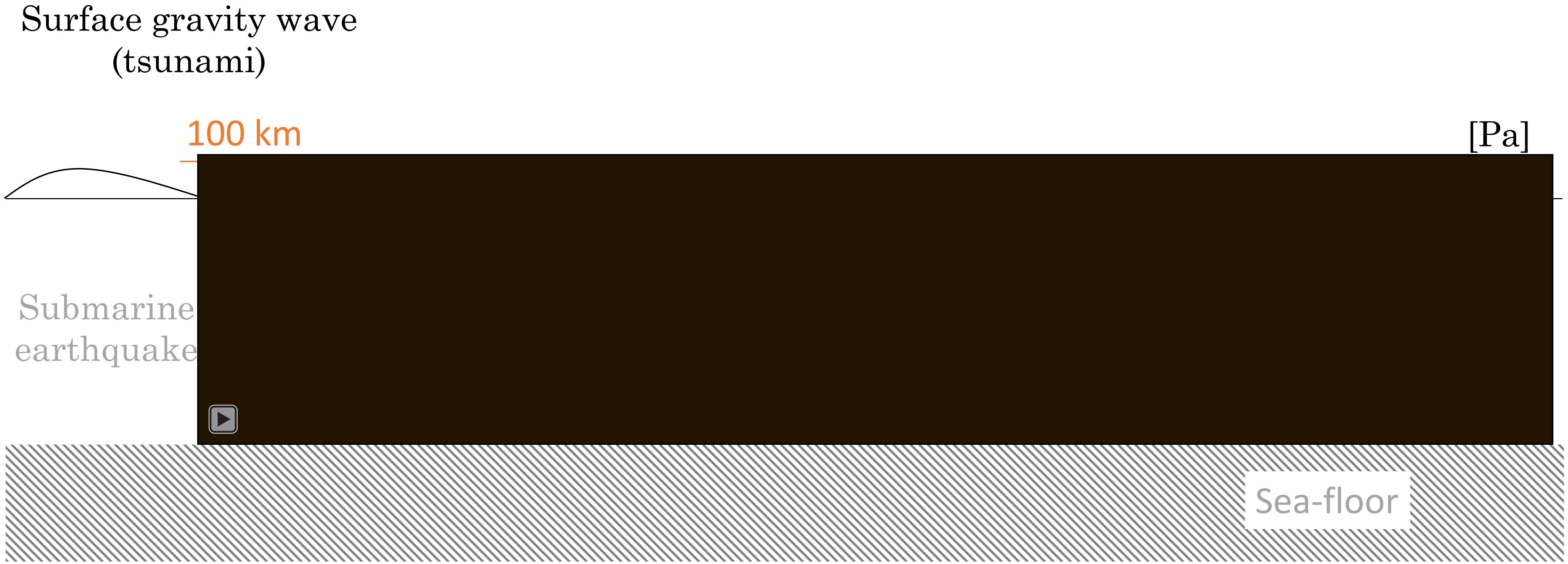
Fifty-seventh Session of the IOC Executive Council (side event)
Paris, 27 June 2024

Content

- Background - on the Technology / Software
- Progress – technical / operational
  - ➢ Challenges & Opportunities
- Work in progress / future work

Real-time Tsunami Detection by Acoustic-Gravity Waves

Background



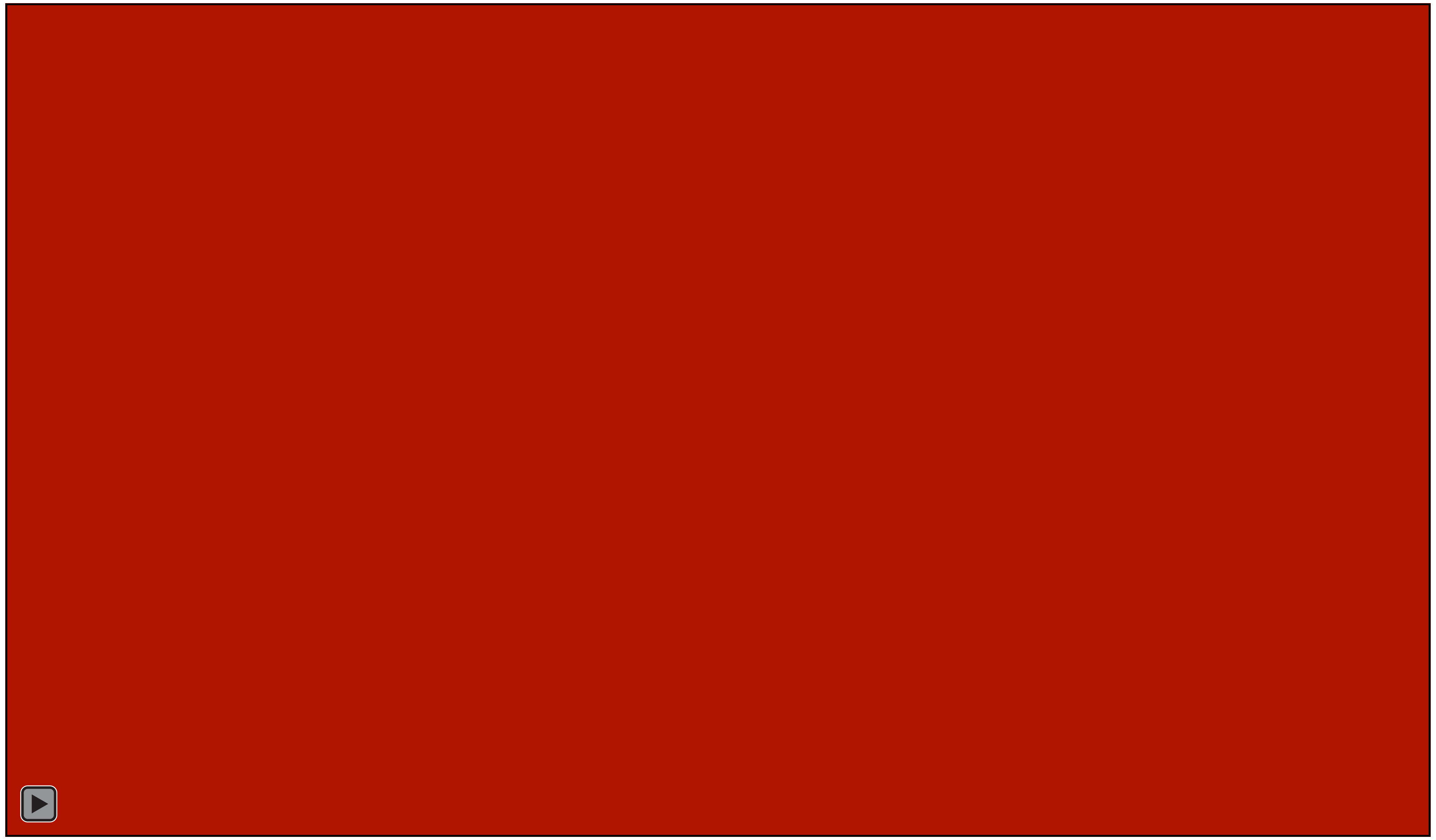
Operational Software

Global Real-time Early Assessment of Tsunami (GREAT)

- Provides **initial assessment** based on EQ epicentre, sensors' locations, and required evacuation time.

- Detects signals; **categorises** earthquakes; **analyses** hydroacoustic data; calculates **tsunami size,** analytically & using ML

- Operates **automatically**, and **manually** (after training)



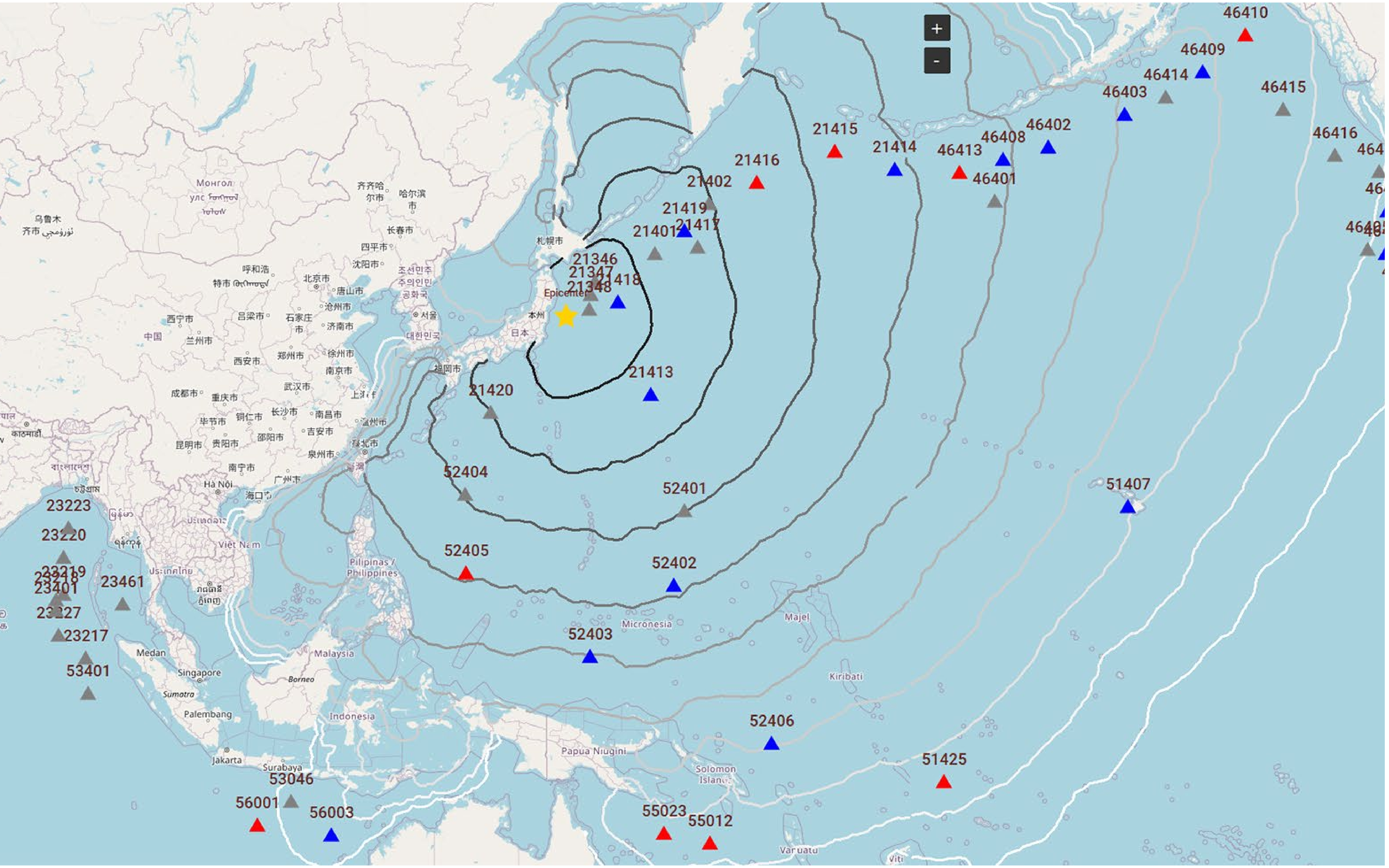
- Hydrophones & Tide-gauges data are already integrated; other data sources can be integrated, e.g., seismic/GNSS, SMART cables, ...

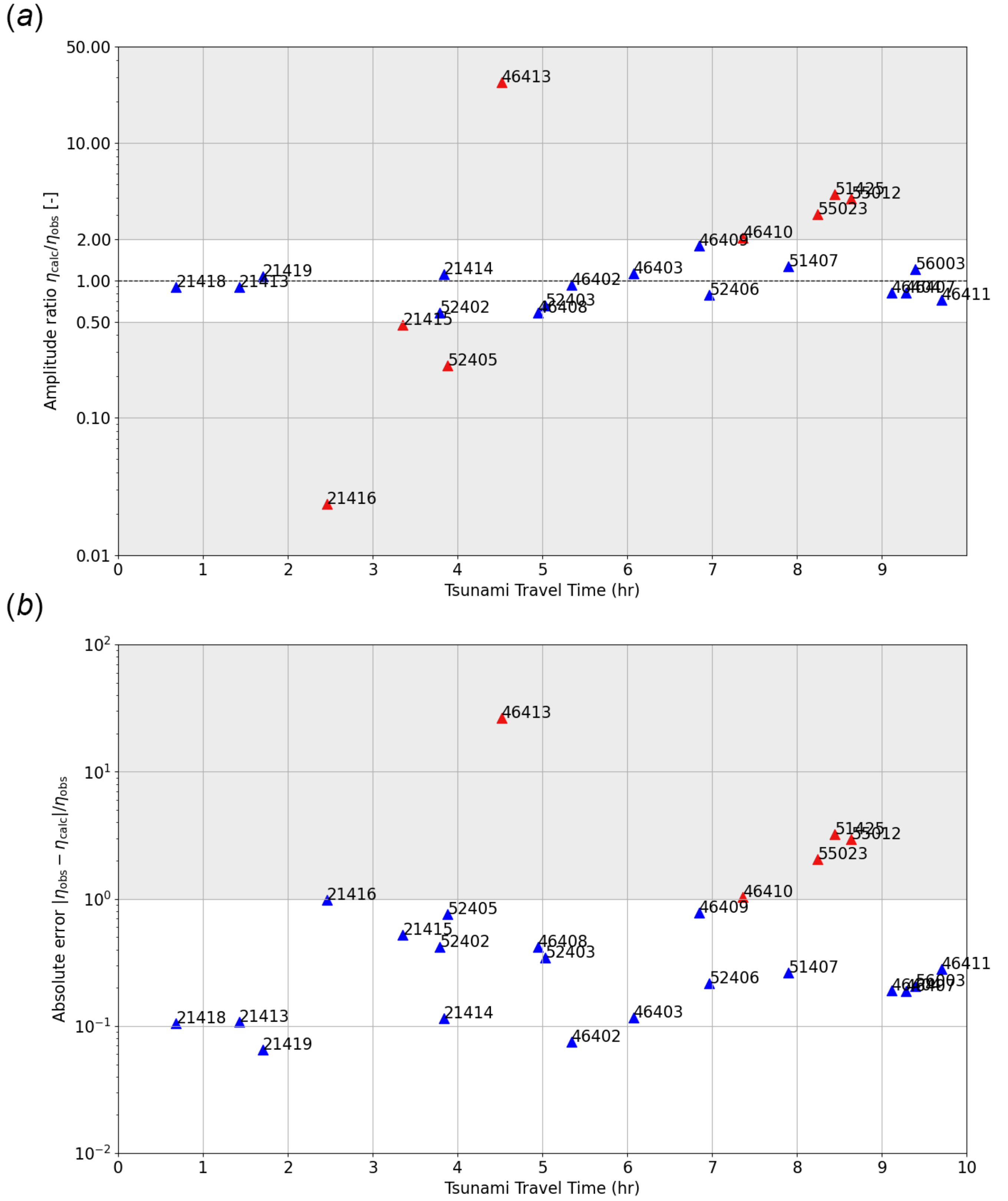
Comprehensive study

calculations vs dart-buoys

Comprehensive study: calculations vs dart-buoys

Example: M 9.1 Tohoku Oki 2011





GREAT 2024a Software

Technical updates

Machine Learning (ML) Model
Predicts *Surface Elevation* from *Acoustic Signals*

- The ML model uses pressure recordings, earthquake epicentre and locations features to:
  - **A)** **classify** whether the event is **tsunamigenic** or not;
  - **B)** **predict** earthquake magnitude & surface elevation globally.

- ML model was trained with **1,400 earthquake** events with magnitudes from 5.0 to 9.1. That includes **all recorded** earthquake events **from January 2000** with magnitudes **higher than 6.5.** All signals were downloaded from IMS/CTBTO, with a newly developed automatic script.

- GREAT software has new functionality to predict surface elevation at the shoreline contours and compare the results with the values calculated by the direct model.

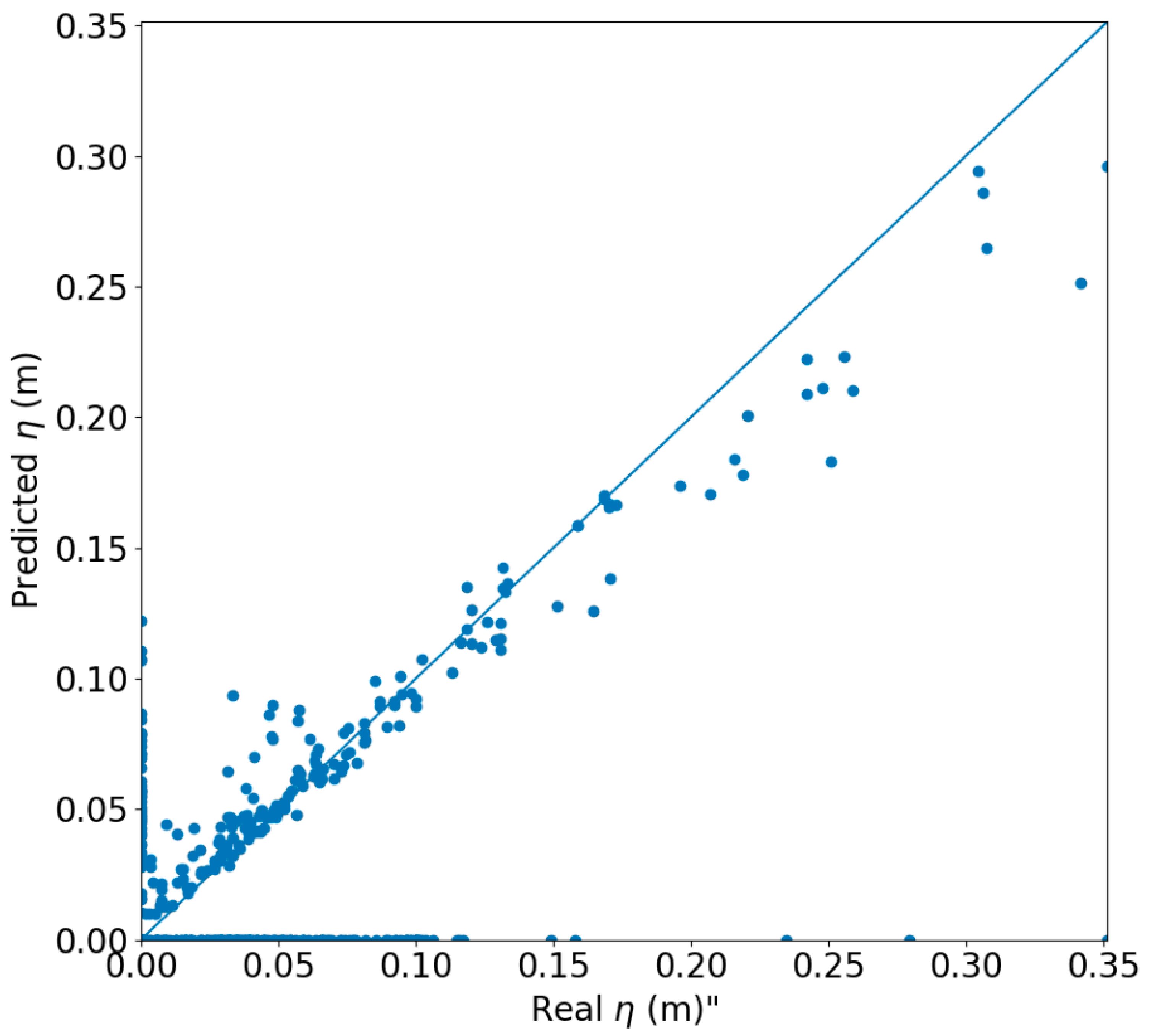


Figure 1 – Evaluation of surface elevation machine learning model

Analytical Model
Calculates *Surface Elevation* from *Acoustic Signals*

- Implemented a new model that takes **elasticity** into account → **essential for T-phase**

- Implemented new method of getting orientation of the fault. GREAT software has now two options for the orientation of the fault:
  - based on the global active fault lines.
  - inverse problem model calculations.

- Updated GREAT software now has a selection between different types of direct models:
  - presenting results for both elastic and rigid direct models at the same time for comparison.

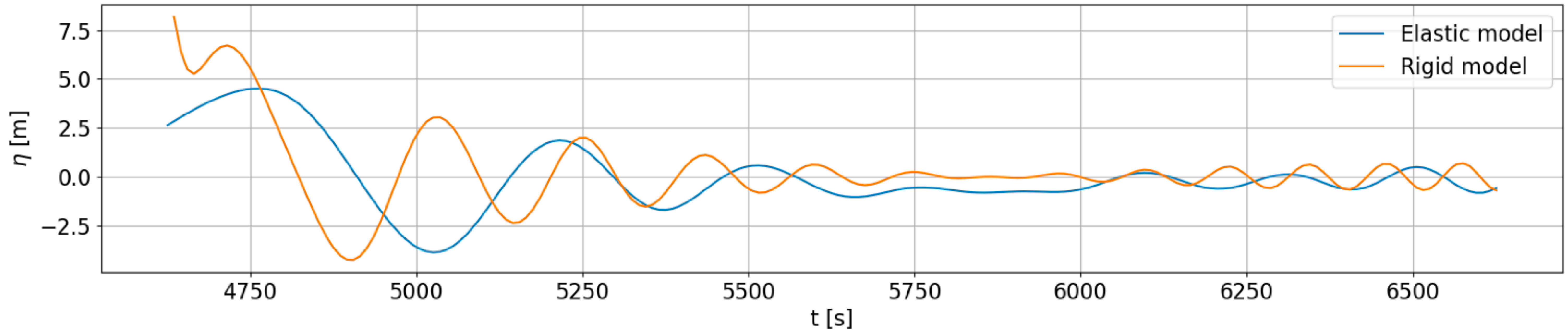


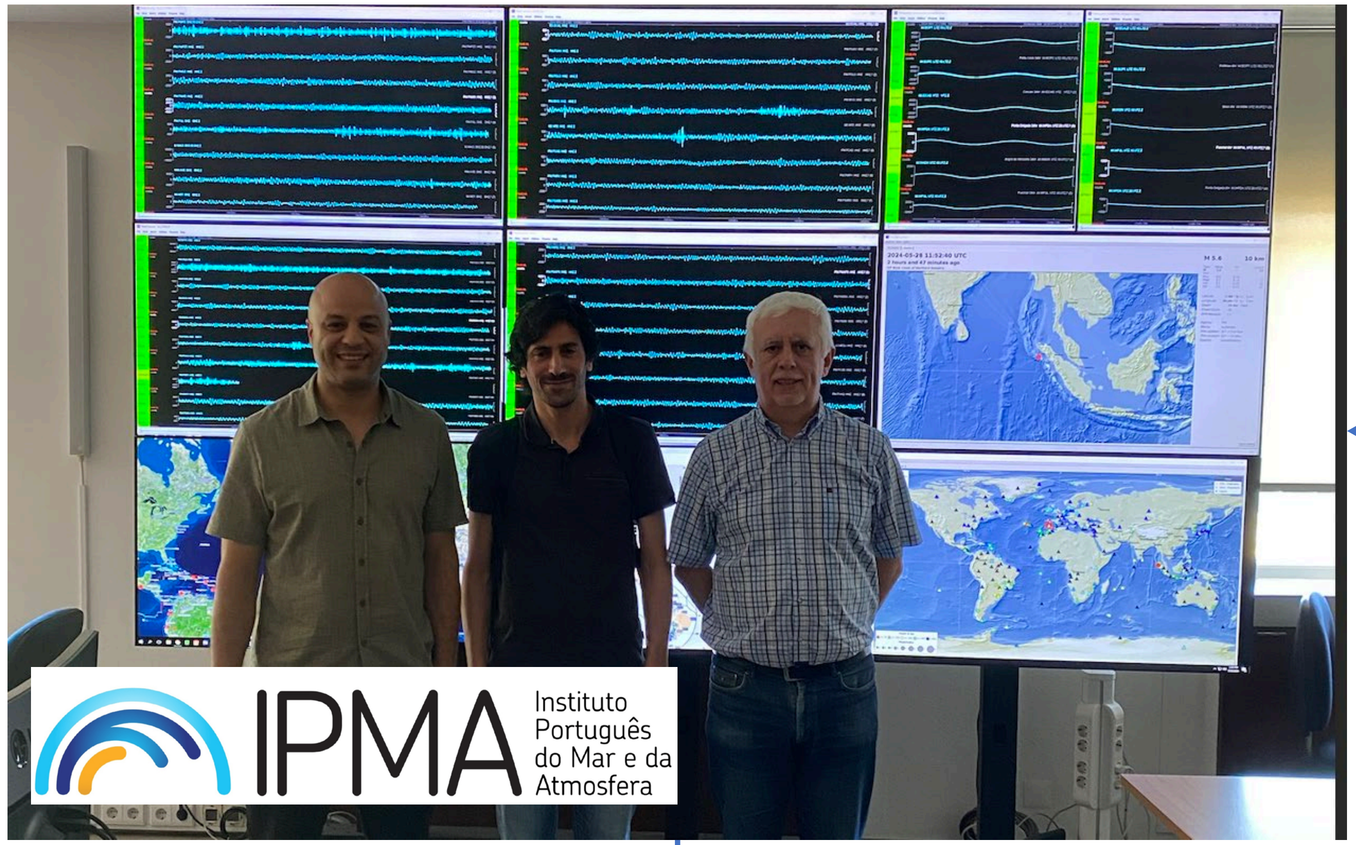
Figure 2 - Surface elevation results for DART 21413 for Tohoku 2011 earthquake

GREAT 2024a Software

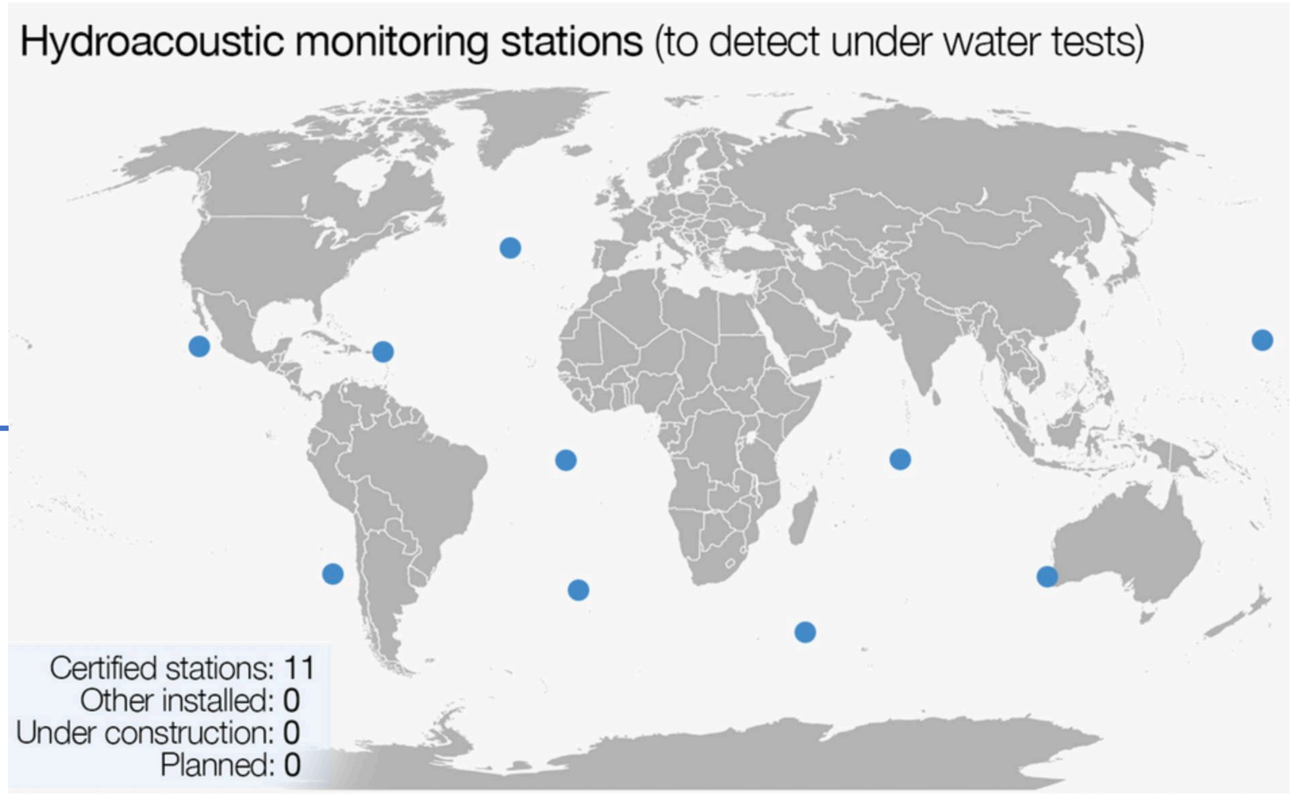
Operational updates

Access to IMS/CTBTO Real-Time Hydroacoustic Data

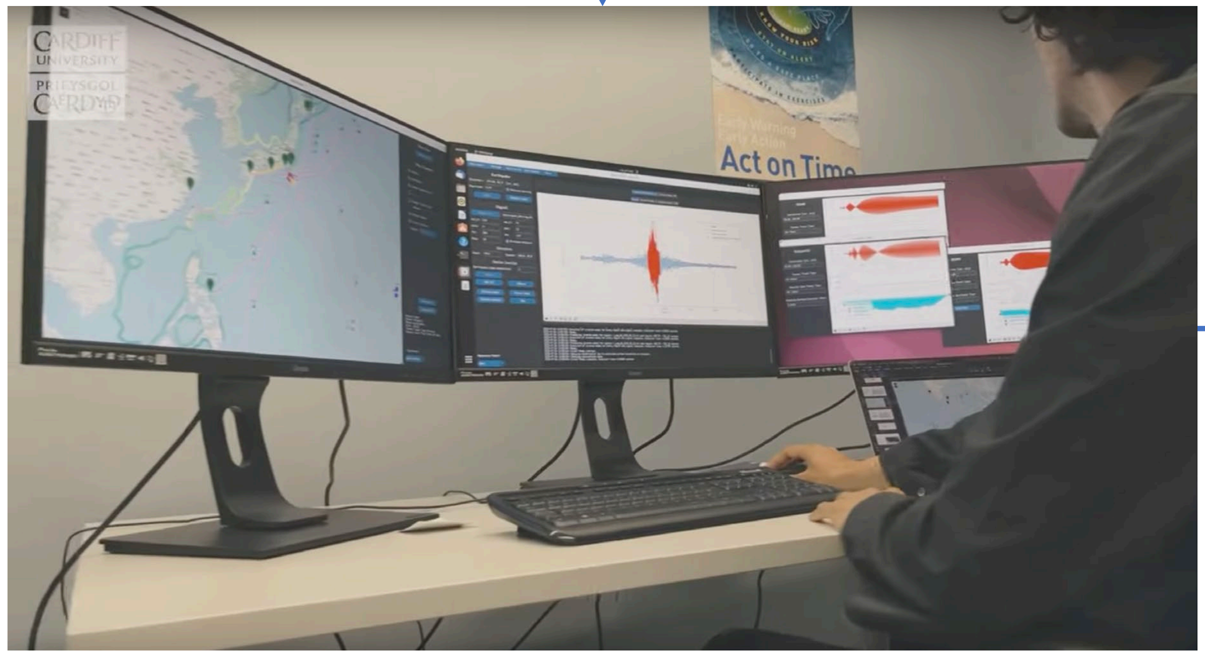
Software deployed at IPMA June 2024



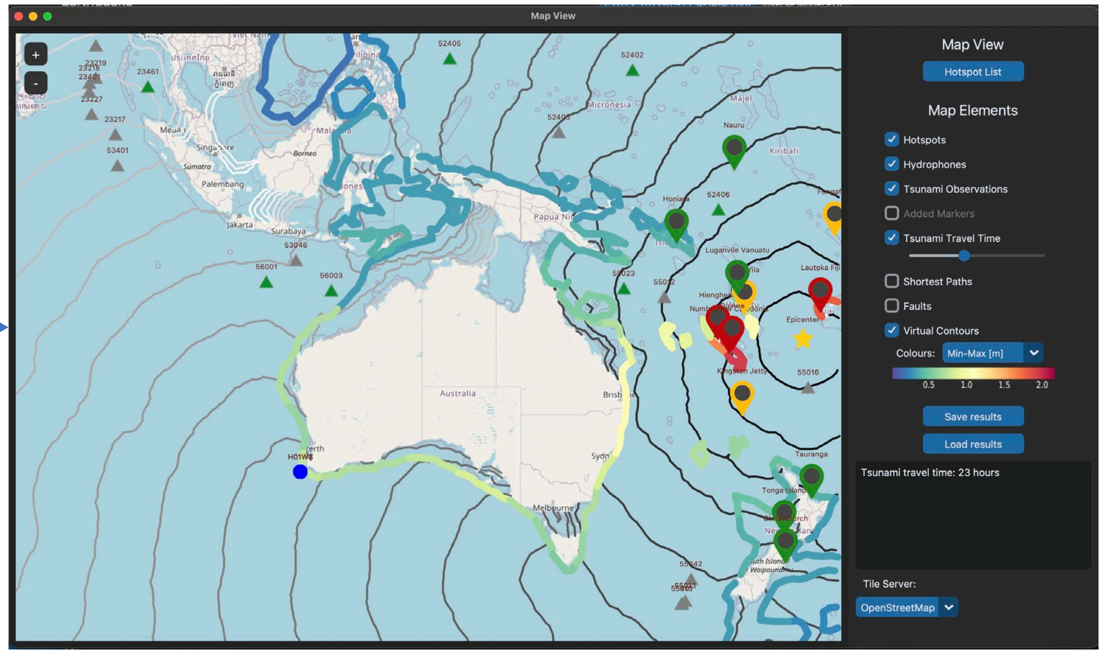
Real-time access



Source: Comprehensive nuclear-test-ban treaty organisation (www.ctbto.org)



Cardiff University Tsunami Centre, UK

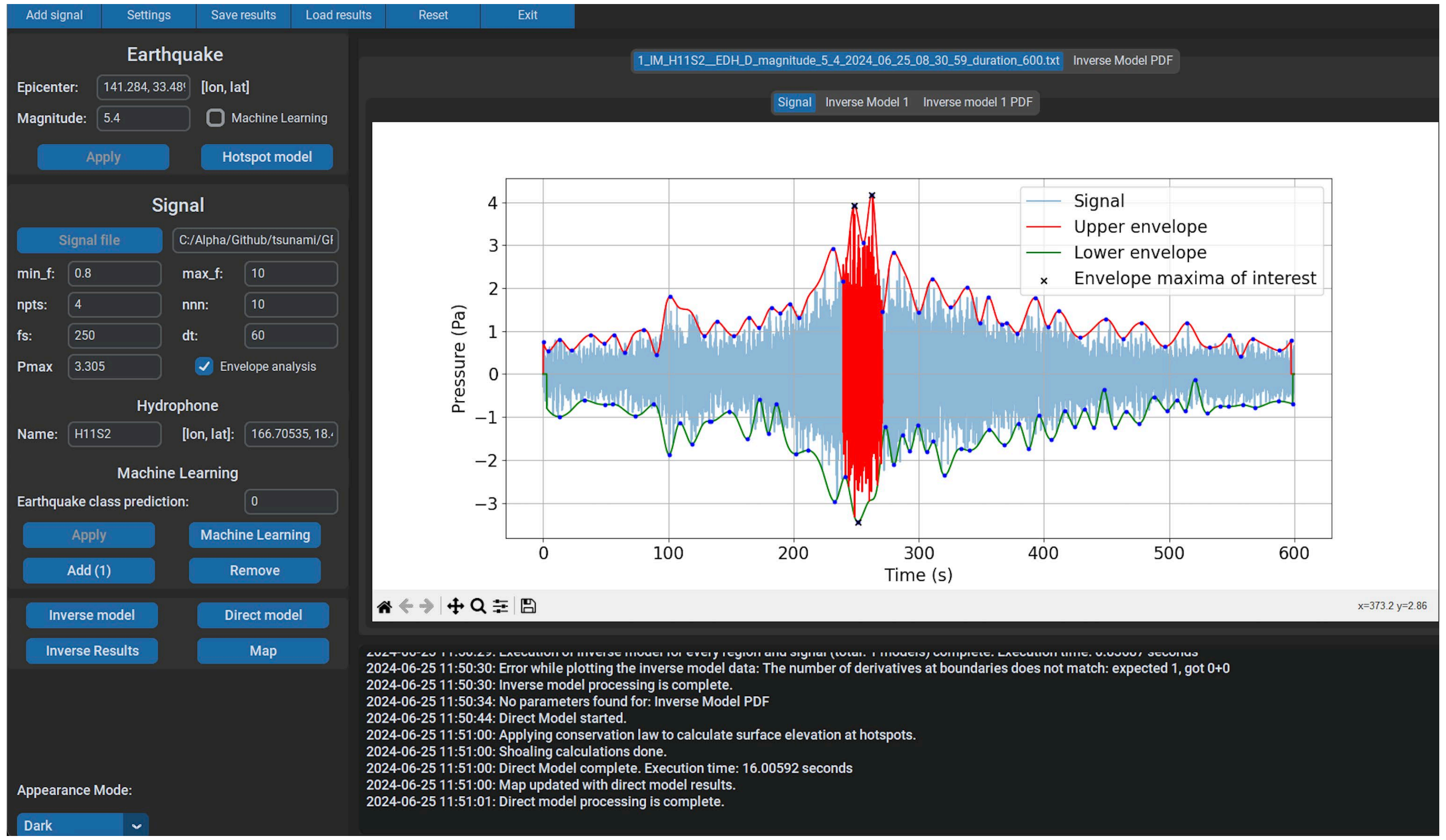


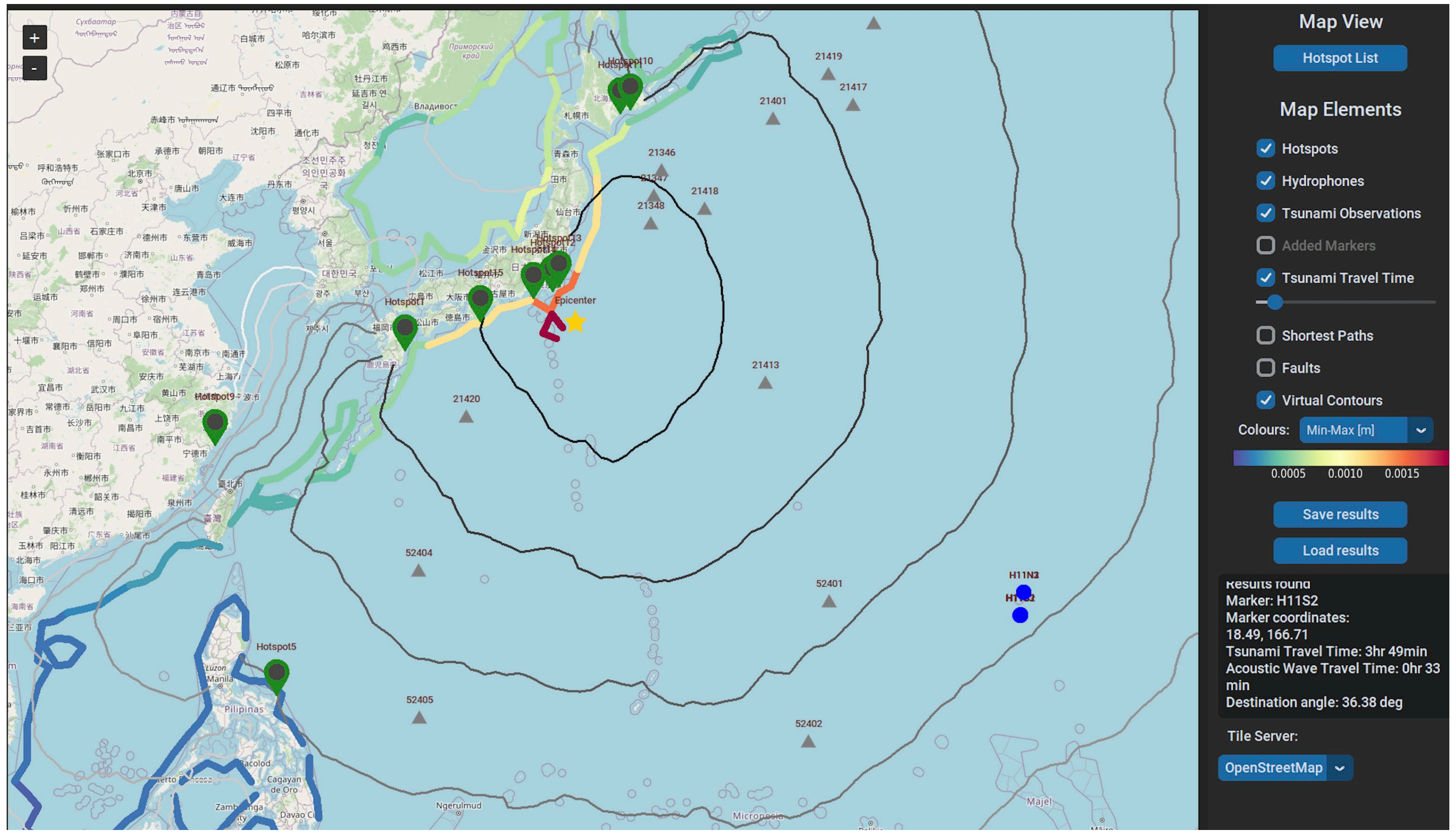
- Assess Tsunami globally & benefits coastal communities, especially SIDS and LDCs
- Test T-phase data
  - More stations
  - Less time
- Focused study on Portuguese coast

M 5.4 - 204 km SSE of Katsuura, Japan

Analysed in Real-Time

2024-06-25 08:30:59 (UTC) | 33.489°N 141.284°E | 30.6 km depth

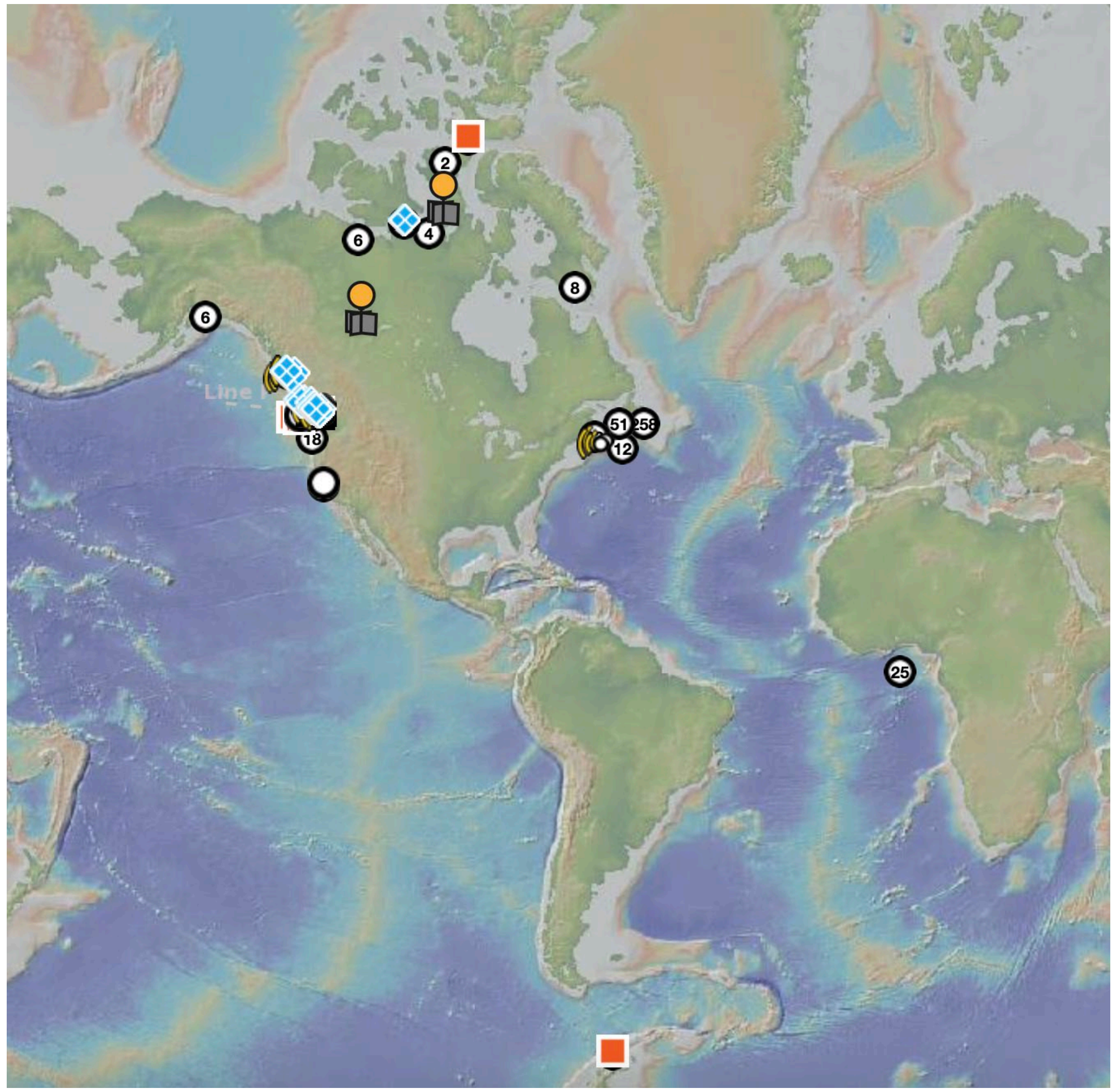




- Data is updated every 5-10 min on IPMA server.
- Took ~33 min to arrive to Hydroacoustic Station H11S (~3,000 km away).
- Took less than 7 sec (on a standard laptop) to make the calculations/analysis by the software.
- If a hydrophone was available within a 1,000 km range → Tsunami assessment time < 11 min.
  - ➢ Kick-off meeting with IAA / OD partners (11 March 2024) --- community evacuation (collab. with Soc. Sci.)
  - ➢ Optimisation of hydrophone locations

Access to Ocean Networks Canada (ONC)

- Tested recordings on hydrophone type icListen AF.
  - ➢ High sampling frequency & relatively low cost
  - ➢ Opportunity – real-time data requires governmental approval



M 7.9 Alaska 2018

Work in progress / future work

Technical

- Automate real-time analysis (IMS/CTBTO).
- Implement more recent analytical models (incl. evacuation times).
- Develop next generation AI model (Satellite data).
- Develop analytical models for T-phase and Seismic data.
- Secure funding to maintain R&D.

Operational

- Automate Tsunami Assessment and Dissemination (in particular for SIDS & LDCs)
- Request Real-Time ONC Data – requires governmental approval.
- Deploy GREAT in more Warning Centres.
- Seek governmental funding to sustain operational work.

Thank you

Strengthening the Resilience of Coastal Communities

Denis Chang Seng
Programme Specialist and Technical Secretary of ICG/NEAMTWS of the Tsunami Resilience Section at UNESCO-IOC

IOC UNESCO EU DG ECHO **CoastWAVE**

CoastWAVE


TSUNAMI HAZARD ZONE
IN CASE OF EARTHQUAKE GO
TO HIGH GROUND OR INLAND

Intergovernmental Oceanographic Commission

Funded by the European Union

IOC DG-ECHO Funded CoastWAVE Project

CoastWAVE

Strengthening the Resilience of Coastal Communities in the North-Eastern Atlantic and Mediterranean Regions to the Impact of Tsunamis and other Sea level-related coastal hazards.

- Amount: 1.2 M Euros -Phase –I
- Start: 1 Sep 2021
- Duration : 3 years
- Direct Beneficiary Countries: 7
- Maintaining CoastWAVE countries: Egypt, Cyprus, Greece, Malta, Morocco, Spain, Türkiye,

01 INTRODUCTION: ABOUT COASTWAVE PROJECT

CoastWAVE NEAMTWS

Improved understanding and better communication strategies of tsunami and sea –level related risks

Improved Detection & Monitoring Systems

Improved Alerting Systems

Resilient Tsunami Communities Tsunami Ready Recognized Communities

unesco
Intergovernmental Oceanographic Commission

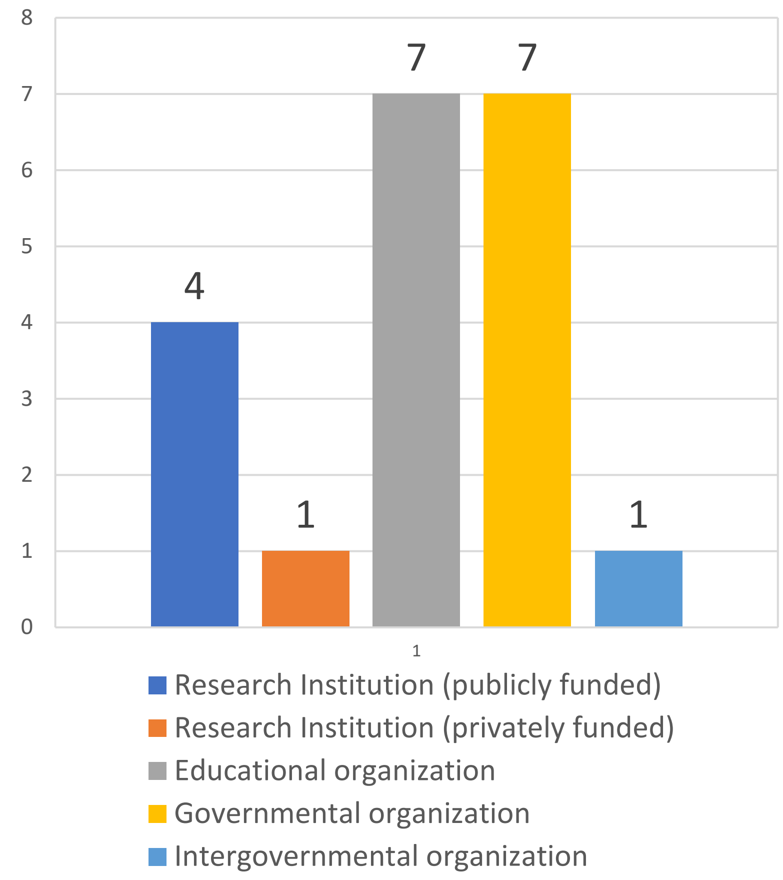
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Funded by European Union Humanitarian Aid

Ocean Basins Decade Action Implemented

2 North Atlantic Ocean and Mediterranean Sea

Project Partners



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Intergovernmental Oceanographic Commission
DENIS SENG
SUPERVISOR-IOC-UNESCO

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DERYA VENNIN
COORDINATOR-IOC-UNESCO

KHALID EL KHALIDI
PARTNER-UCD

DIDEM CAMBAZ
PARTNER-KOERI

AMR HAMOUDA
PARTNER-NIOF

NIKOS KALLIGERIS
PARTNER-NOA

AHMET YALCINER
PARTNER-METU

IGNACIO AYERBE
PARTNER-IHCANTABRIA

PAULINE GALEA
PARTNER-UM

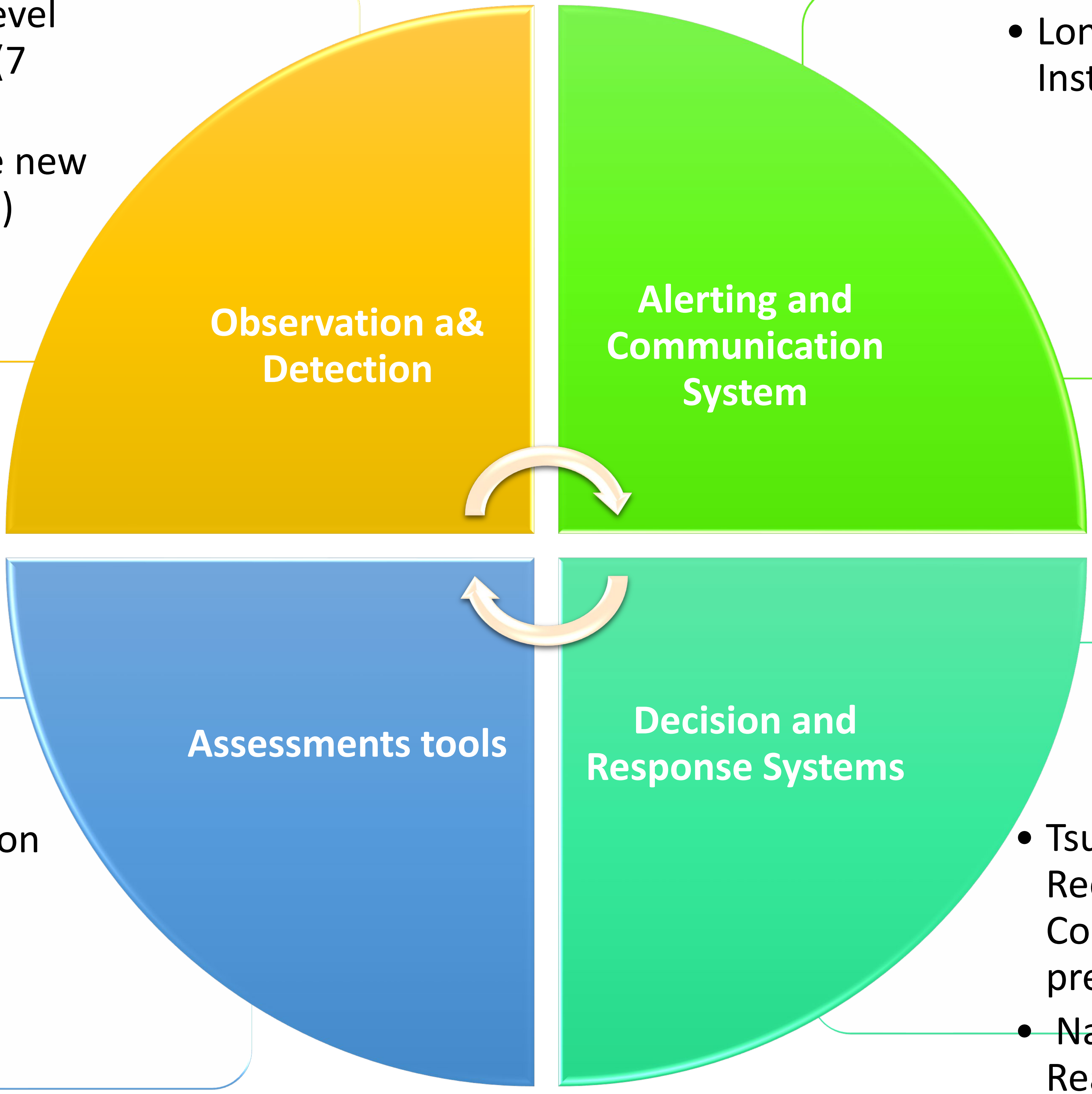
SYLVANA PILIDOU
PARTNER-GSD

Partnership between IOC-UNESCO and 7/8 entities

New Infrastructure/ Tools Related Elements for Coastal Resilience

- Maintained a sea level network for TEWS (7 countries)
- Installed affordable new sea level devices (5)
- Installed seismic devices (4)

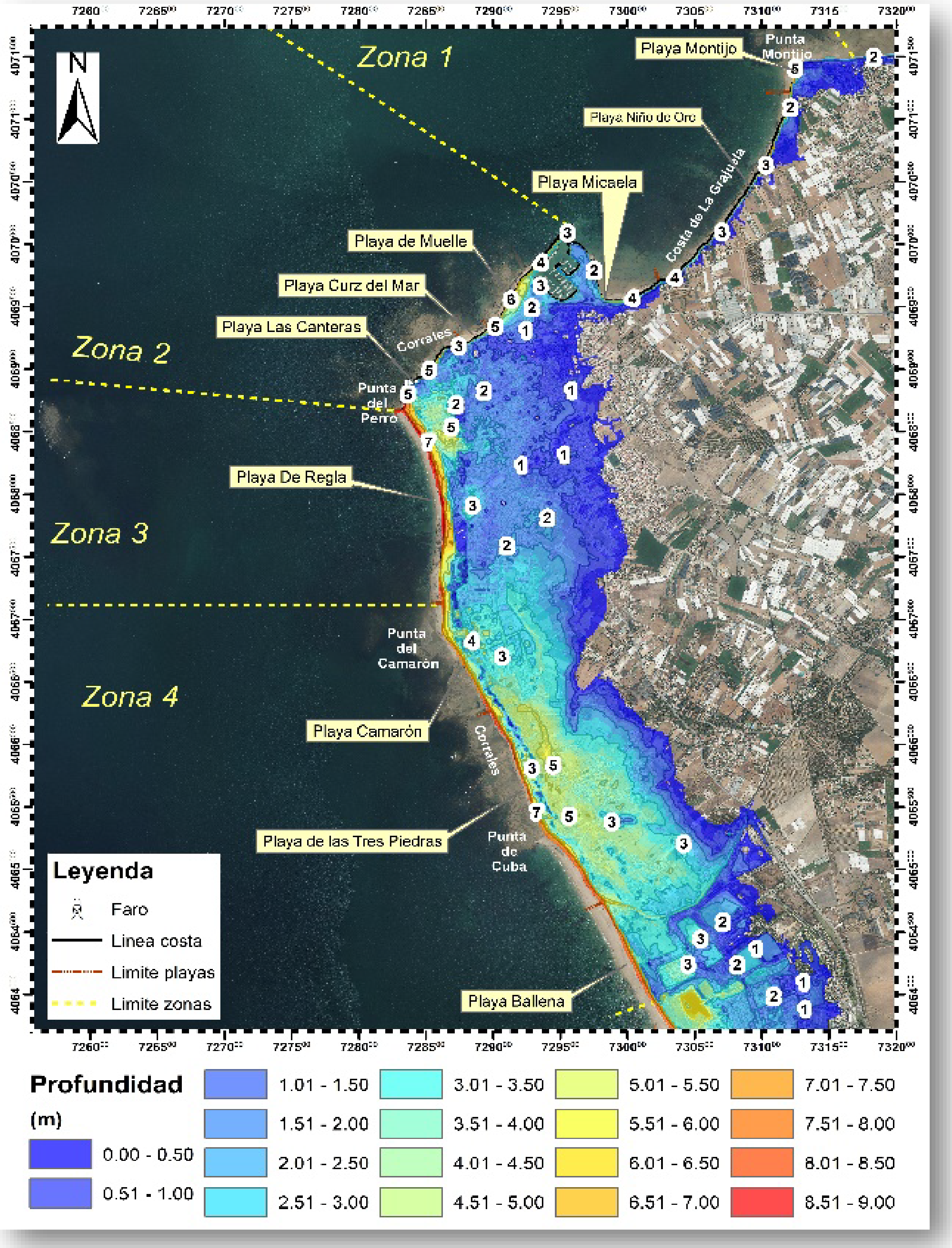
- Long Range Sirens Installation (10)

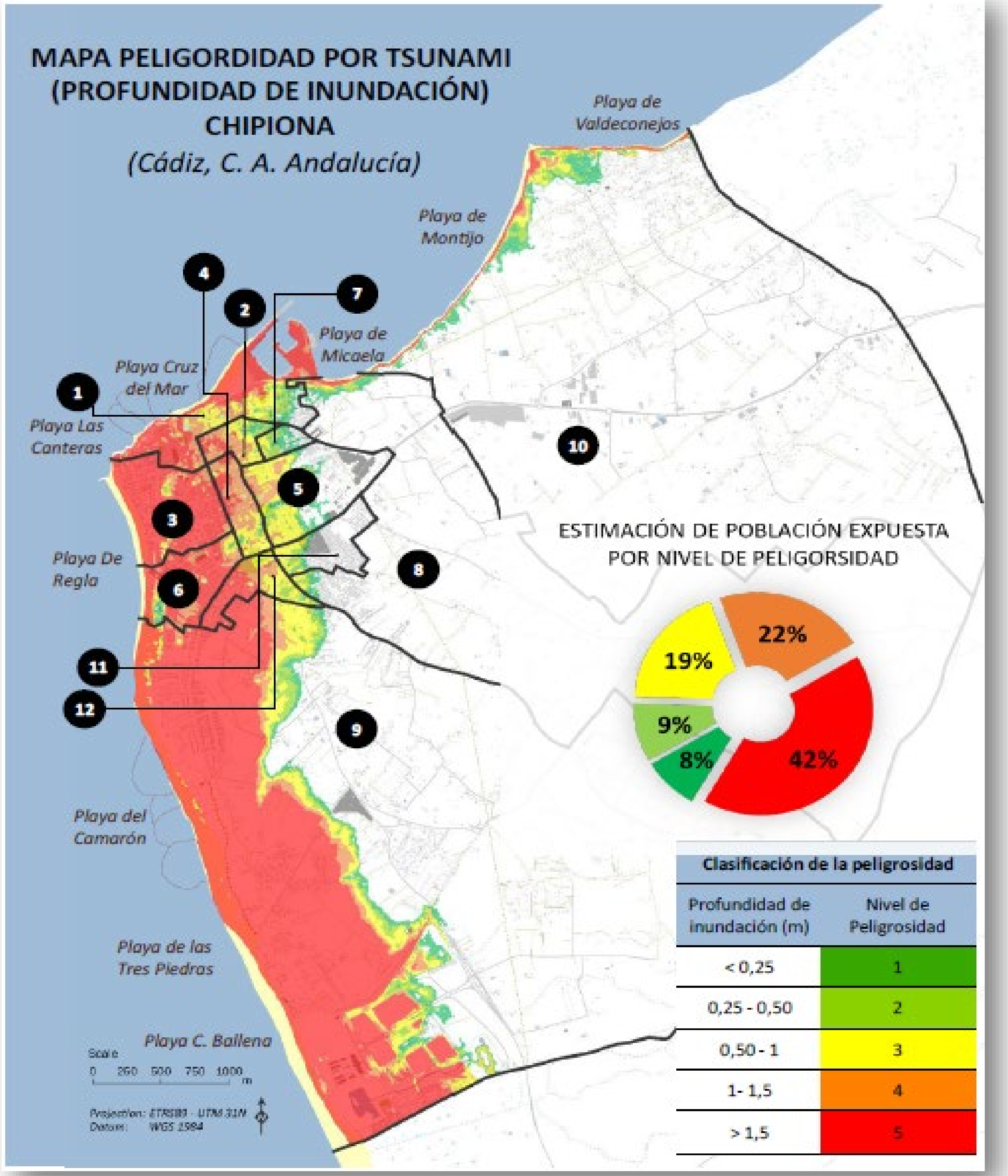


- Tsunami Inundation tools (7)
- Evacuation Mapping (7)

- Tsunami Ready Recognized Communities (7) 3 preparing dossier
- National Tsunami Ready Boards (7) 2 final stages

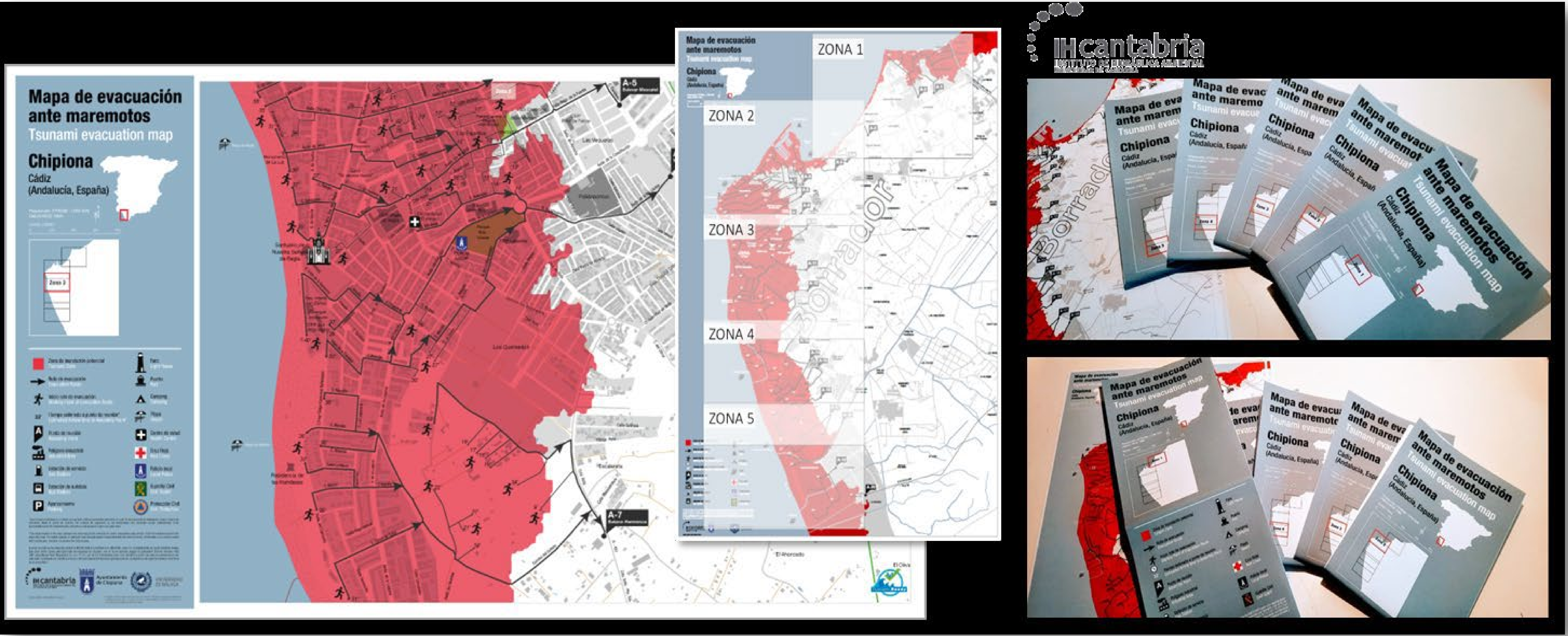
Tsunami Hazard Inundation Mapping Chipiona, Spain	Estimation of the Total Exposed population by Danger Level and Census Districts





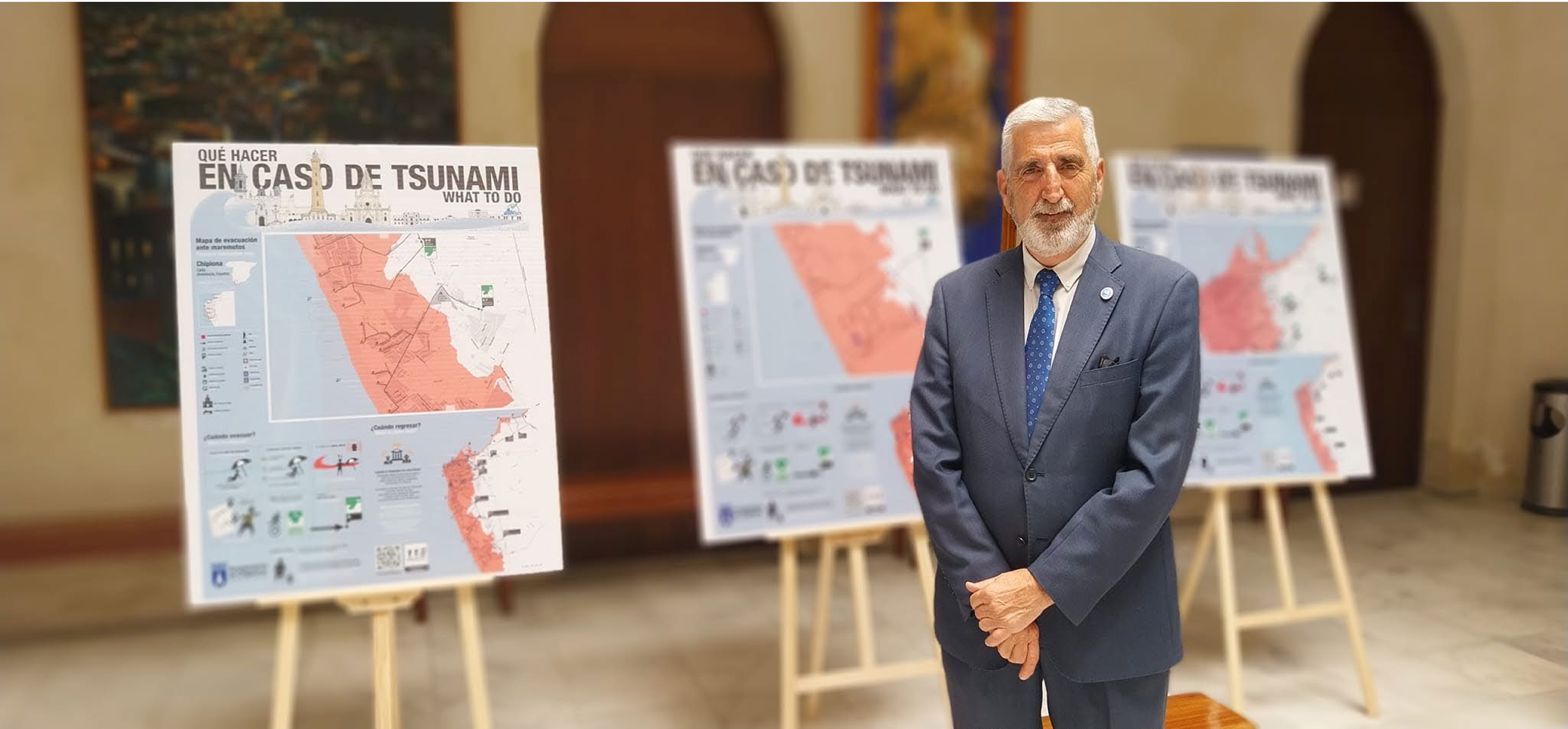
UNESCO/ Chipiona, Spain, IH Cantabria, 2024

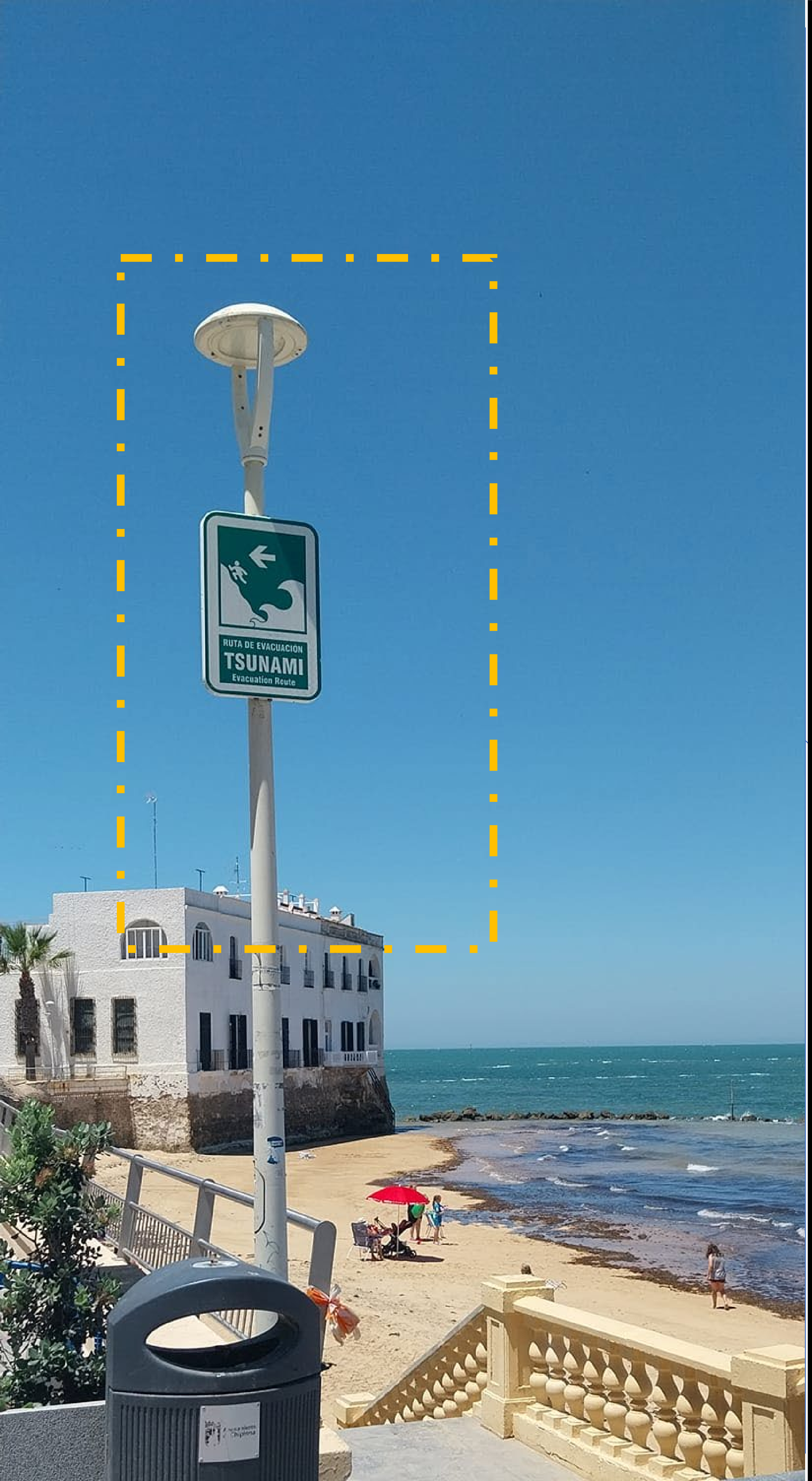
Evacuation Maps



Chipiona, Spain,
UNESCO/IH Cantabria,
2024

The Mayor and His Decision Support Tools




RUTA DE EVACUACIÓN
TSUNAMI
Evacuation Route

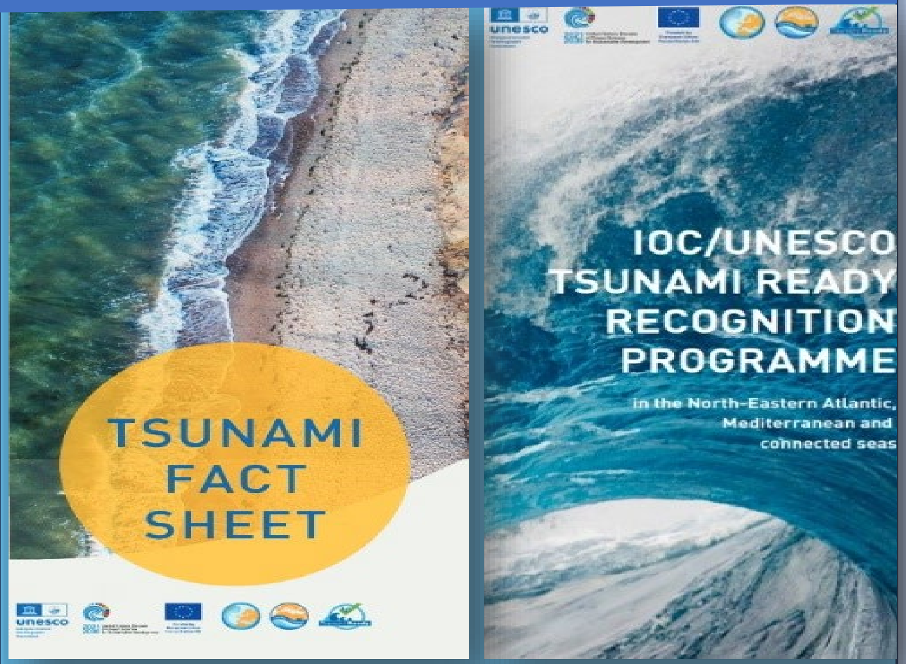
Decade Action Capacity Development Activities

- **10** Skills training (SOP, Tsunami Hazard Assessments and Evacuation Mapping and Planning)
- **8** End-to-End Coastal Tsunami Exercises

Impact Level
Knowledge and Uptake

>30
Articles

10
Brochures, Leaflets and Posters



10
Videos

5
Technical Documents

International Engagements

2 International Ocean Decade Events

Resilient and Safer Coasts, African Conference, UN Decade of Ocean Science for Sustainable Development", Cairo, Egypt 11 May 2023	Coastal Cities and Communities Joining TR, 2024 ODC, Barcelona , 11 April

International, National, Local Engagements

City Mayors and Governor

Cannes, France

Büyükçekmece, Itanbul, Turkeye

Alexandria, Egypt

Chipiona, Spain

Samos, Greece

2024 Ocean Conference, Barcelona 11 April 2024

Change and overall Impact

- Awareness of hazard has grown significantly at both national and local levels.
- Governance of tsunami risk improved (Institutional strengthening)
- New partnerships created
- New interest and engagement
- Active role /participation of city/community leaders, including mayors/governors
- Improved safer behavior , relationship with the ocean hazards/risk

New IOC DG-ECHO Funded CoastWAVE Project

- Amount: 1.2 M Euros -Phase –II
- Start: 1 July 2024
- Duration : 2 years
- Direct Beneficiary Countries:7-8

CoastWAVE 2.0

Scaling-Up and Strengthening the Resilience of Coastal Communities in the North-Eastern Atlantic and Mediterranean Regions to the Impact of Tsunamis and other Sea level-related coastal hazards.

1. Hazard Assessments and Evacuation Mapping and Planning
2. Enhance Detection , Monitoring and Alerting Systems
3. Upscale TRR
4. Creating dialogues on HILP in a MHEWS context

CoastWAVE 2.0 NEAMTWS

CoastWAVE NEAMTWS

Capacity Building

Professor Amr Hamouda
President of the National Institute of Oceanography and Fisheries (NIOF)
Egypt.

Coastal Horizons: Pathways and Actions to Strengthen Resilience to Coastal Hazards Side Event at the 57th Session of the IOC Executive Council

unesco

Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Building Capacity of Pathways and Actions to Strengthen Resilience to Coastal Hazards for Development Countries (Africa) under the Framework of Ocean Decade Challenge 6

Prof. Amr Hamouda

President of MHMC - NIOF

Vice-Chair of IOC-UNESCO

BACKGROUND OF THE CHALLENGE

- Coastal regions represent areas where **human well-being is most significantly affected by ocean hazards, human activities, and climate change.** These **influences contribute** to substantial **losses in human lives, economic resources, infrastructure, and natural habitats** (Schinko et al., 2020).

- Challenge 6 of the Ocean Decade aims at enhancing people-centered **multi-hazard early warning services and adaptation planning for all geophysical, ecological, biological, weather, climate, and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience** (United Nations Decade of Ocean Science for Sustainable Development, 2021).

DEFINITION AND IMPORTANCE

- **Coastal hazards:** Natural events such as tsunami, storms, sea-level rise, erosion, and flooding.

- **Resilience:** The ability of communities to anticipate, prepare for, respond to, and recover from these hazards.

- Importance of strengthening resilience in Africa: Many African coastal regions are **<u>highly vulnerable</u>** due to **dense populations, economic activities, and limited adaptive capacities.**

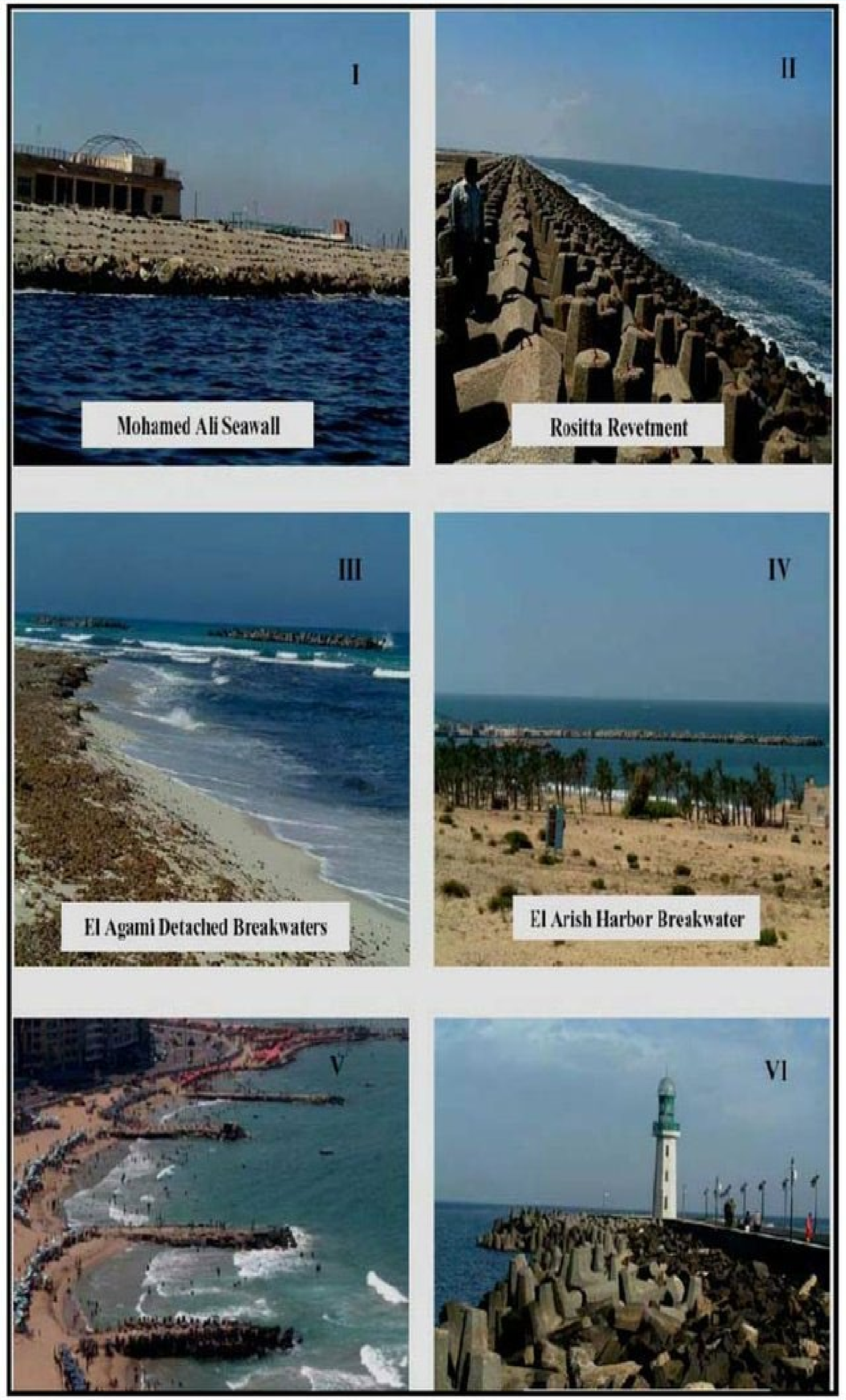
CURRENT CHALLENGES

ENVIRONMENTAL CHALLENGES

- **Sea-Level Rise:** Accelerating due to climate change, leading to coastal erosion and increased flooding.
- **Extreme Weather Events:** Increased frequency and intensity of storms and cyclones.
- **Erosion:** Natural and human-induced processes causing loss of land and habitats.

SOCIOECONOMIC CHALLENGES

- **Population Growth:** Rapid urbanization in coastal areas.
- **Economic Dependence:** Reliance on coastal resources for livelihoods.
- **Infrastructure Deficiencies:** Poorly planned or inadequate infrastructure increases vulnerability.



PATHWAYS TO STRENGTHEN RESILIENCE

Integrated Coastal Zone Management (ICZM)

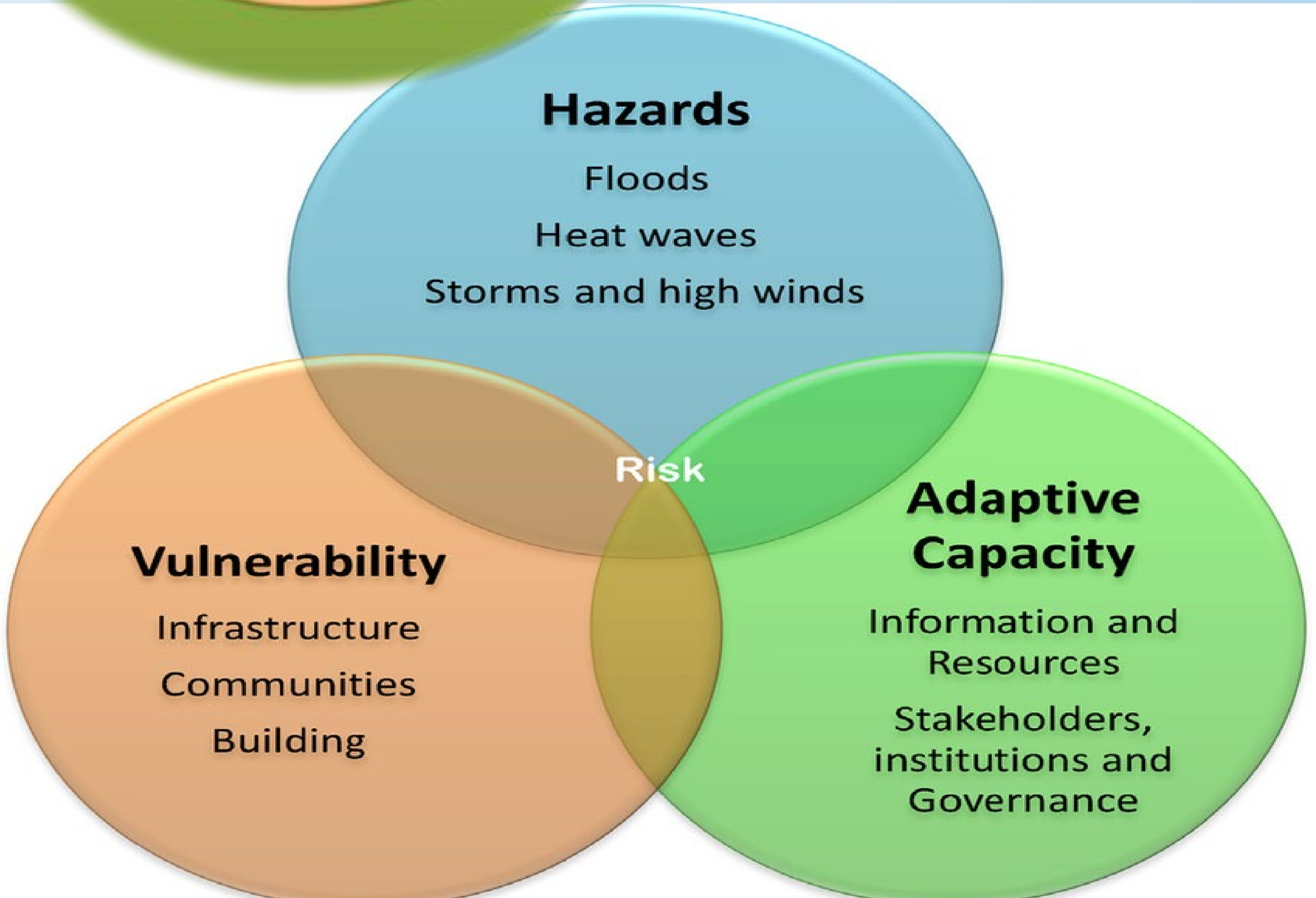
- **Holistic Approach:** Combining environmental, economic, social, cultural, and recreational objectives.
- **Stakeholder Engagement:** Involving local communities, governments, and private sector.

Ecosystem-Based Adaptation (EbA)

- **Natural Solutions:** Restoring mangroves, coral reefs, and wetlands to provide natural barriers against hazards.
- **Biodiversity Conservation:** Protecting ecosystems to sustain their protective functions.

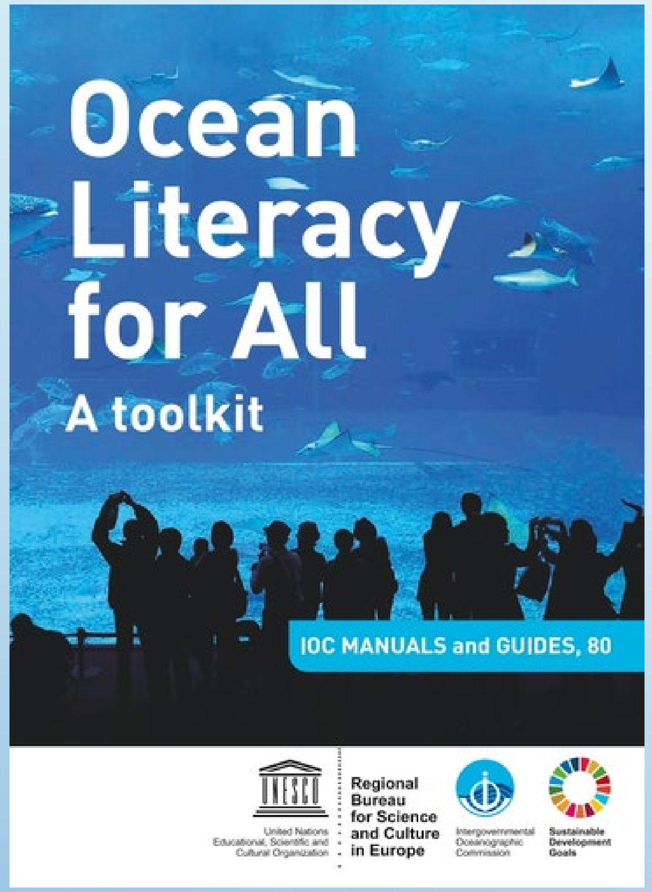
Sustainable Development Planning

- **Risk-Informed Planning:** Incorporating hazard risk assessments in urban and infrastructure planning.
- **Building Codes and Standards:** Enforcing regulations to ensure resilient construction.

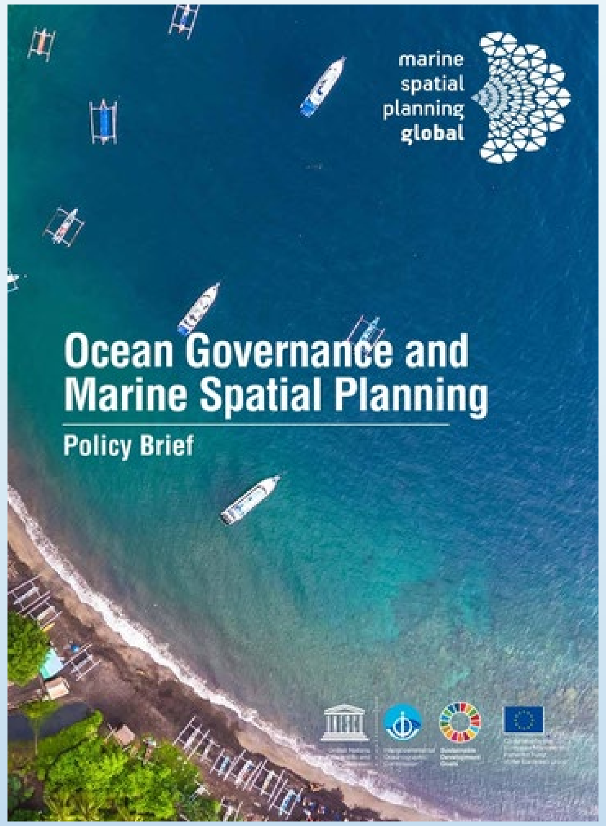


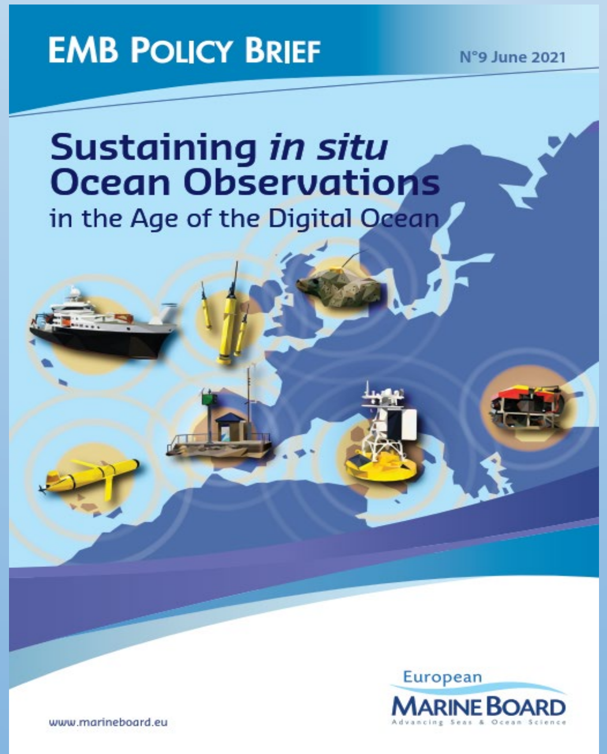
ACTIONS TO BUILD CAPACITY

- **Education and Awareness**

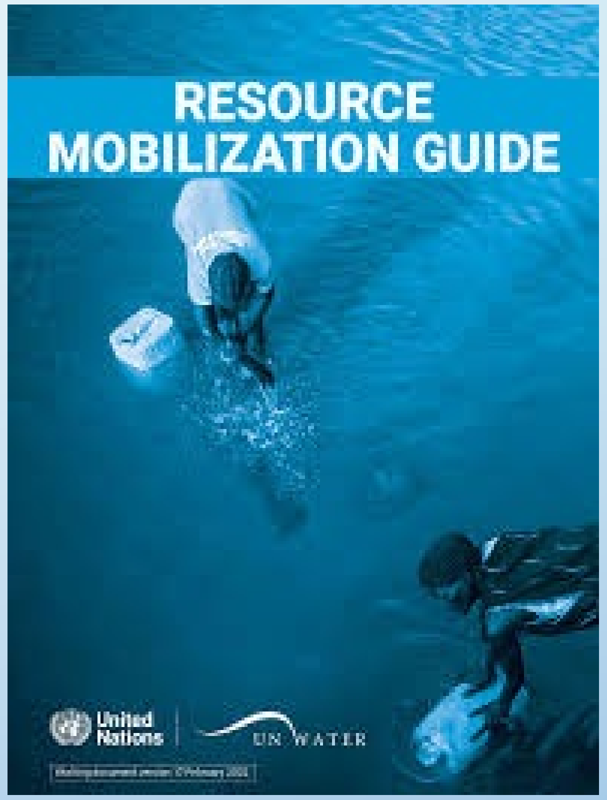


- **Policy and Governance**

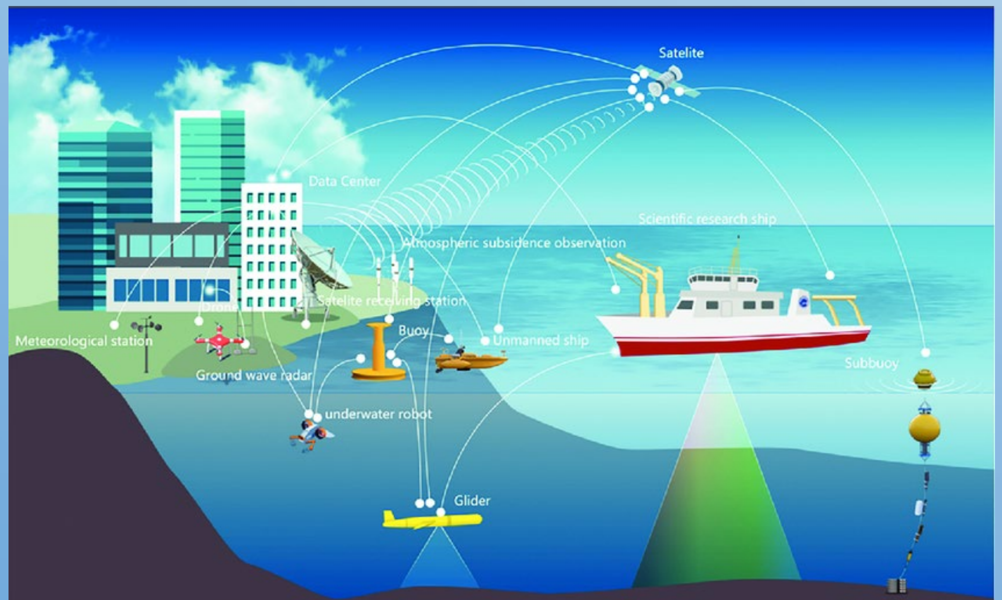


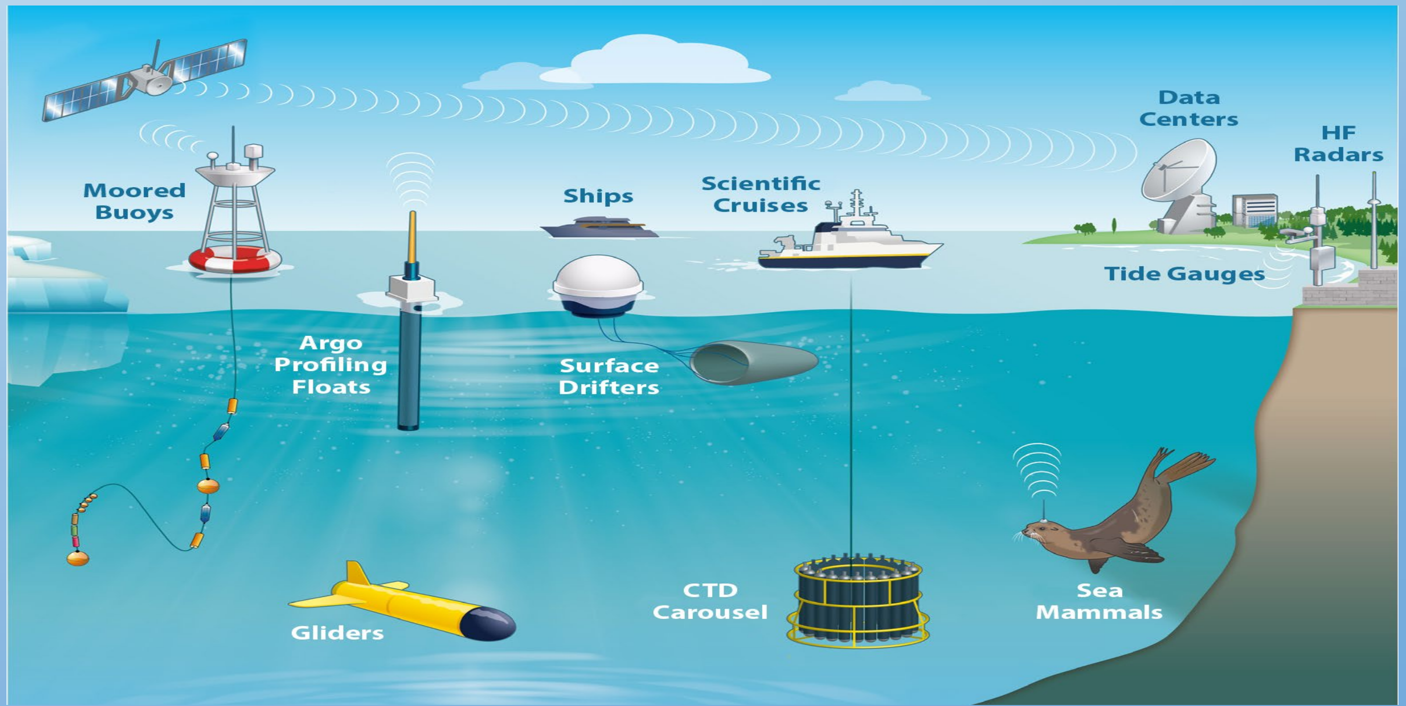


- **Funding and Resource Mobilization**

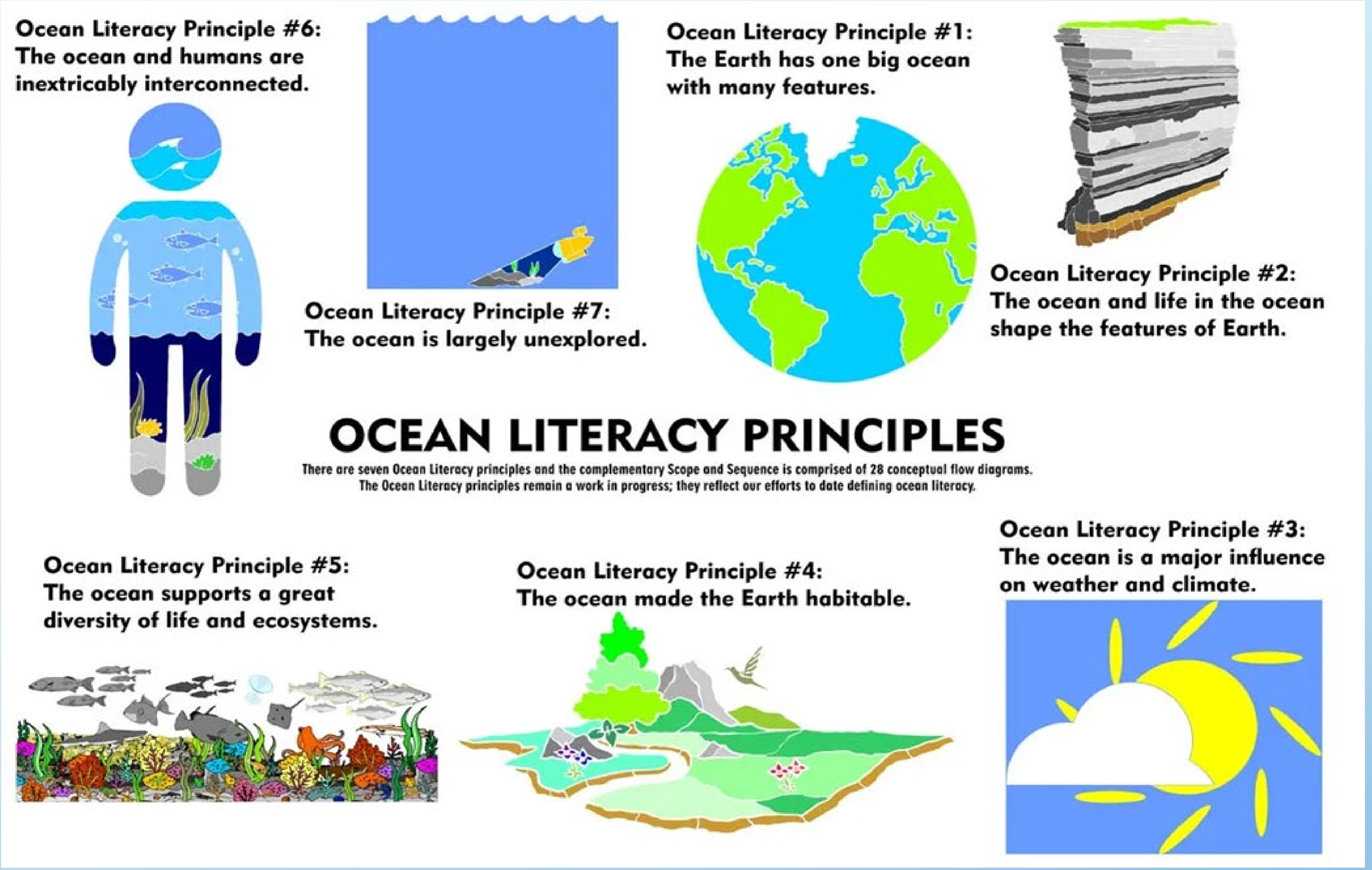


- **Research and Data Collection**





EDUCATION AND AWARENESS



Community Training Programs

- **Workshops and Seminars:** Conducting sessions to teach local communities about hazard preparedness, early warning systems, and emergency response.
- **Capacity Building for Local Leaders:** Training community leaders to act as resilience champions and first responders during emergencies.

Public Awareness Campaigns

- **Information Dissemination:** Using media (radio, TV, social media) to spread awareness about coastal hazards and resilience measures.
- **School Programs:** Integrating hazard education into school curricula to build awareness from a young age.

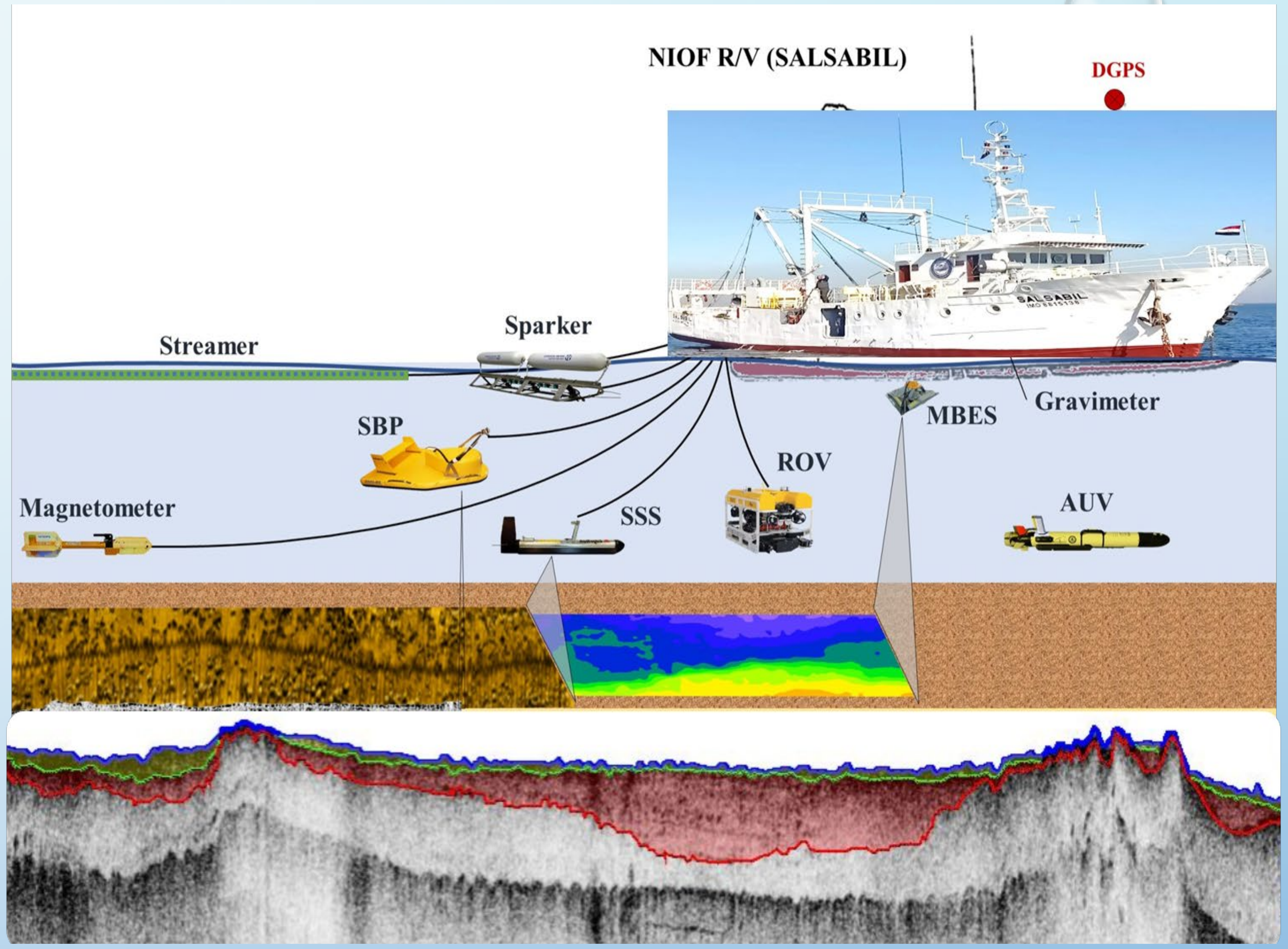
POLICY AND GOVERNANCE

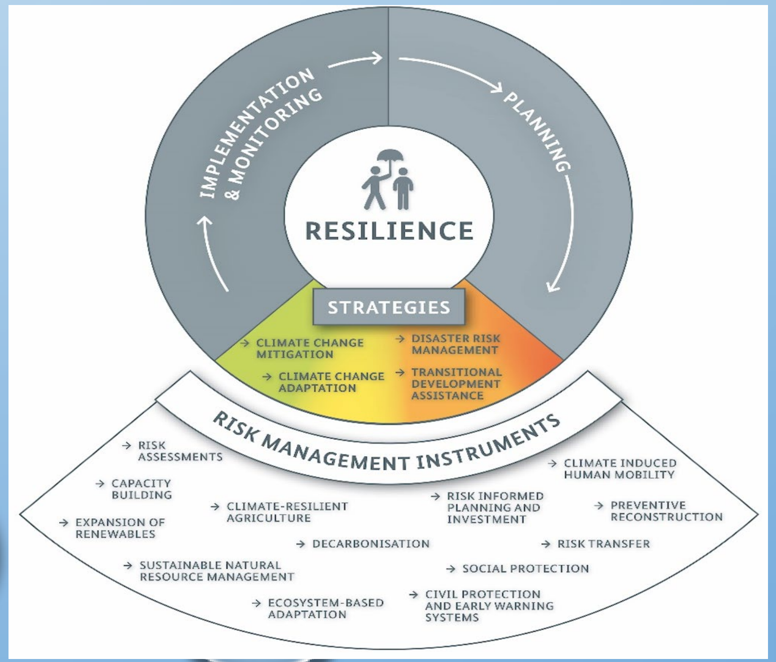
Strengthening Institutions

- **Capacity Building for Government Agencies:** Providing training and resources to local and national agencies responsible for coastal management and disaster response.
- **Decentralization:** Empowering local governments with the authority and resources to manage coastal hazards effectively.

Legislation and Policy Frameworks

- **Developing Comprehensive Policies:** Crafting policies that address climate change adaptation, disaster risk reduction, and sustainable coastal development.
- **Enforcing Regulations:** Ensuring compliance with building codes, zoning laws, and environmental regulations to reduce vulnerability.

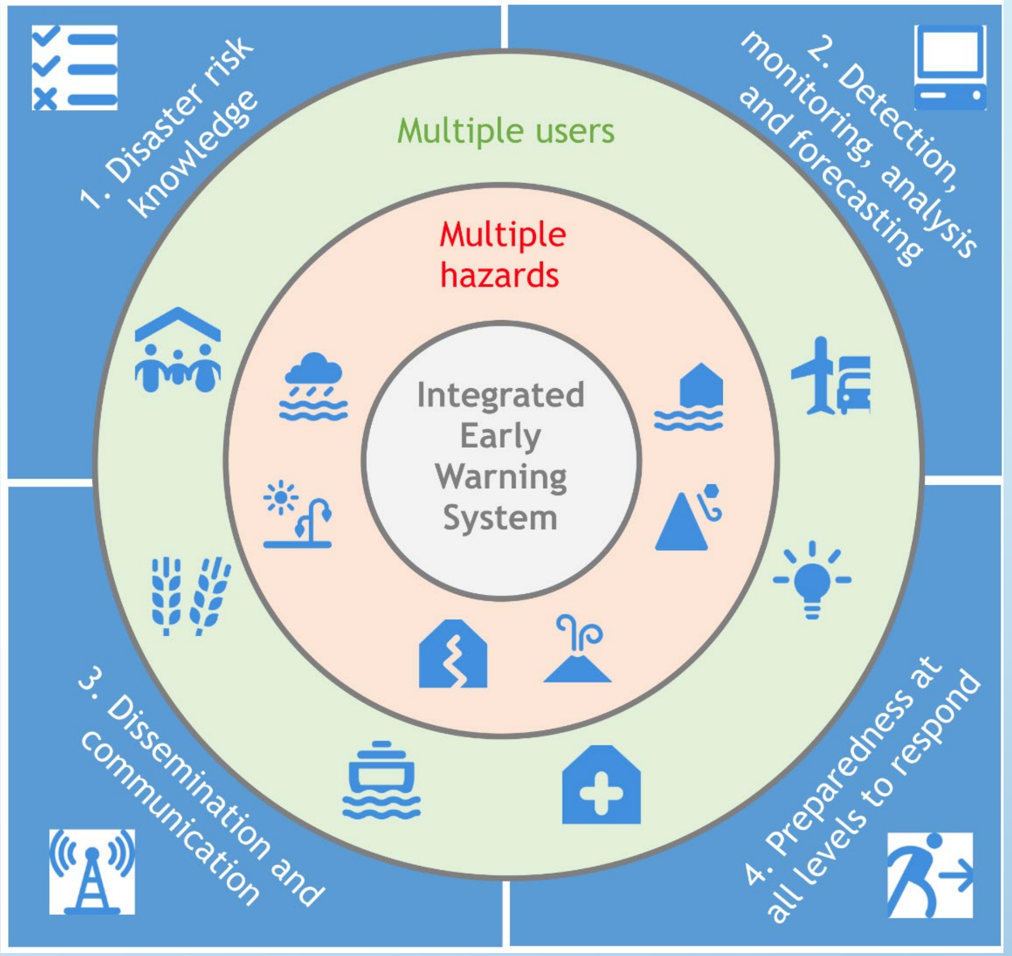




RESEARCH AND DATA COLLECTION

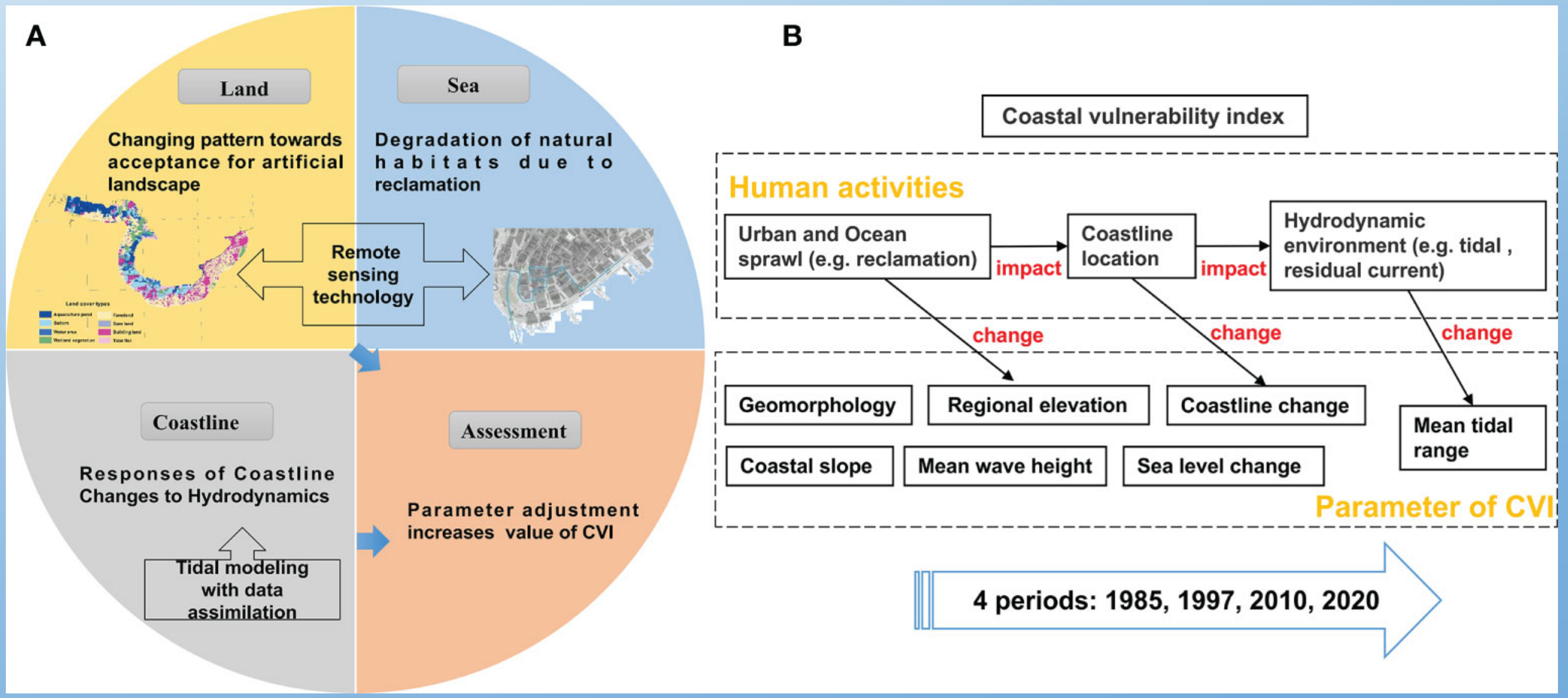
Hazard Mapping and Monitoring

- **Geospatial Technology**: Utilizing satellite imagery and GIS to map coastal hazards and vulnerable areas.
- **Early Warning Systems**: Implementing systems to monitor environmental indicators and provide timely alerts to communities.



Climate Research

- **Studying Climate Impacts**: Researching how climate change affects coastal dynamics and hazards in Africa.
- **Collaborative Research Projects**: Partnering with universities, research institutions, and international organizations to conduct comprehensive studies.



FUNDING AND RESOURCE MOBILIZATION

International Cooperation

- **Accessing Climate Funds:** Applying for grants and funding from international bodies like the Green Climate Fund, World Bank, and UN agencies.
- **Partnerships with NGOs and INGOs:** Collaborating with non-governmental organizations to implement resilience projects and leverage their expertise.

Public-Private Partnerships

- **Engaging Private Sector:** Encouraging businesses to invest in resilience infrastructure and initiatives through incentives and partnerships.
- **Corporate Social Responsibility (CSR):** Motivating companies to contribute to local resilience efforts as part of their CSR activities.

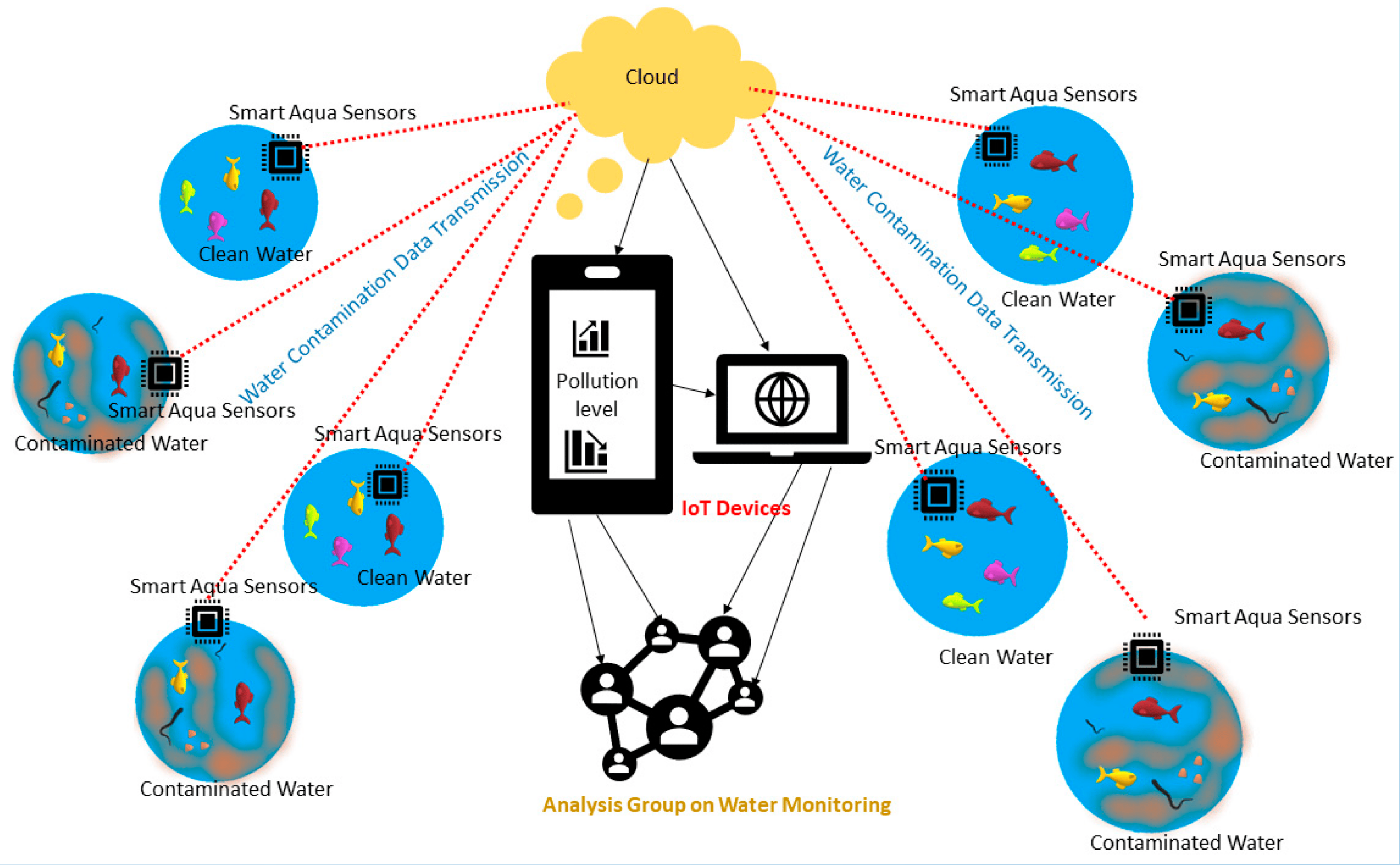
The GCF proposal development and approval process.
Source: GCF, www.greenclimate.fund

Building Resilient Infrastructure

- **Climate-Resilient Construction:** Promoting the use of materials and designs that withstand coastal hazards.
- **Upgrading Existing Infrastructure:** Retrofitting vulnerable structures to enhance their resilience.

Innovative Technologies

- **Smart Systems:** Implementing IoT and smart technologies for real-time monitoring and management of coastal zones.
- **Renewable Energy Projects:** Investing in solar, wind, and other renewable energy sources to power resilient infrastructure and reduce dependency on vulnerable power grids.



CASE STUDIES AND SUCCESS STORIES

- **CoastWAVE Project-UNESCO/IOC**

Strengthening the Resilience of Coastal Communities in the North East Atlantic, Mediterranean Region to the Impact of Tsunamis and Other Sea Level-Related Coastal Hazards

- **West African Coastal Areas Management Program (WACA)**

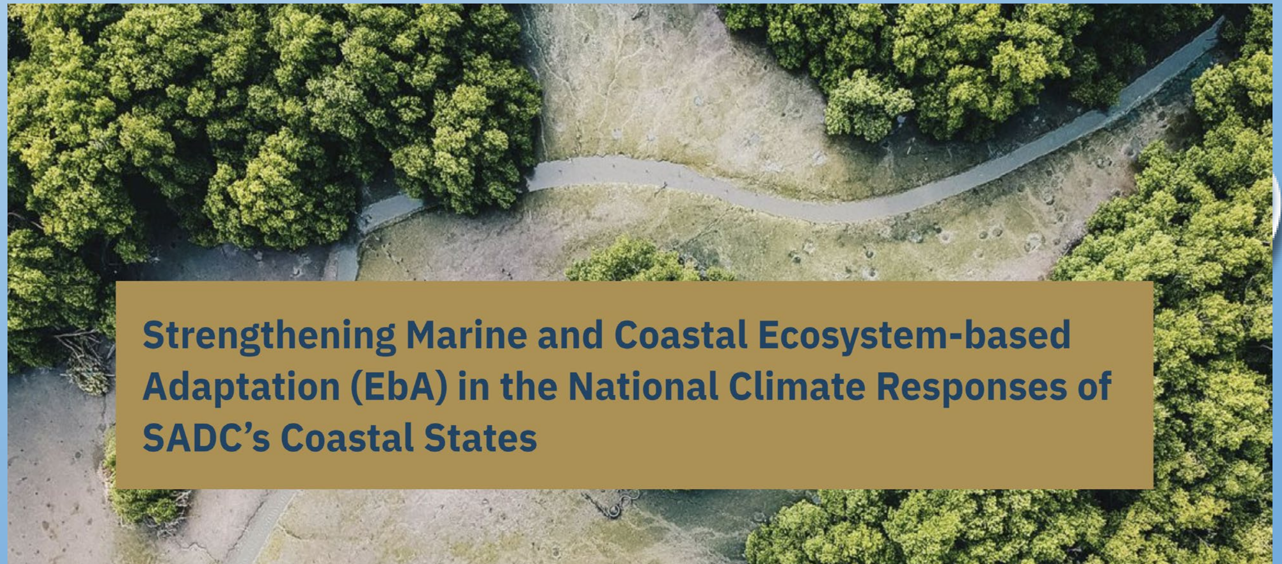
  Focuses on sustainable coastal development and resilience.

  Example projects: Mangrove restoration, infrastructure strengthening.

- **South African Coastal Adaptation Projects**

  Implementing ICZM and EbA str

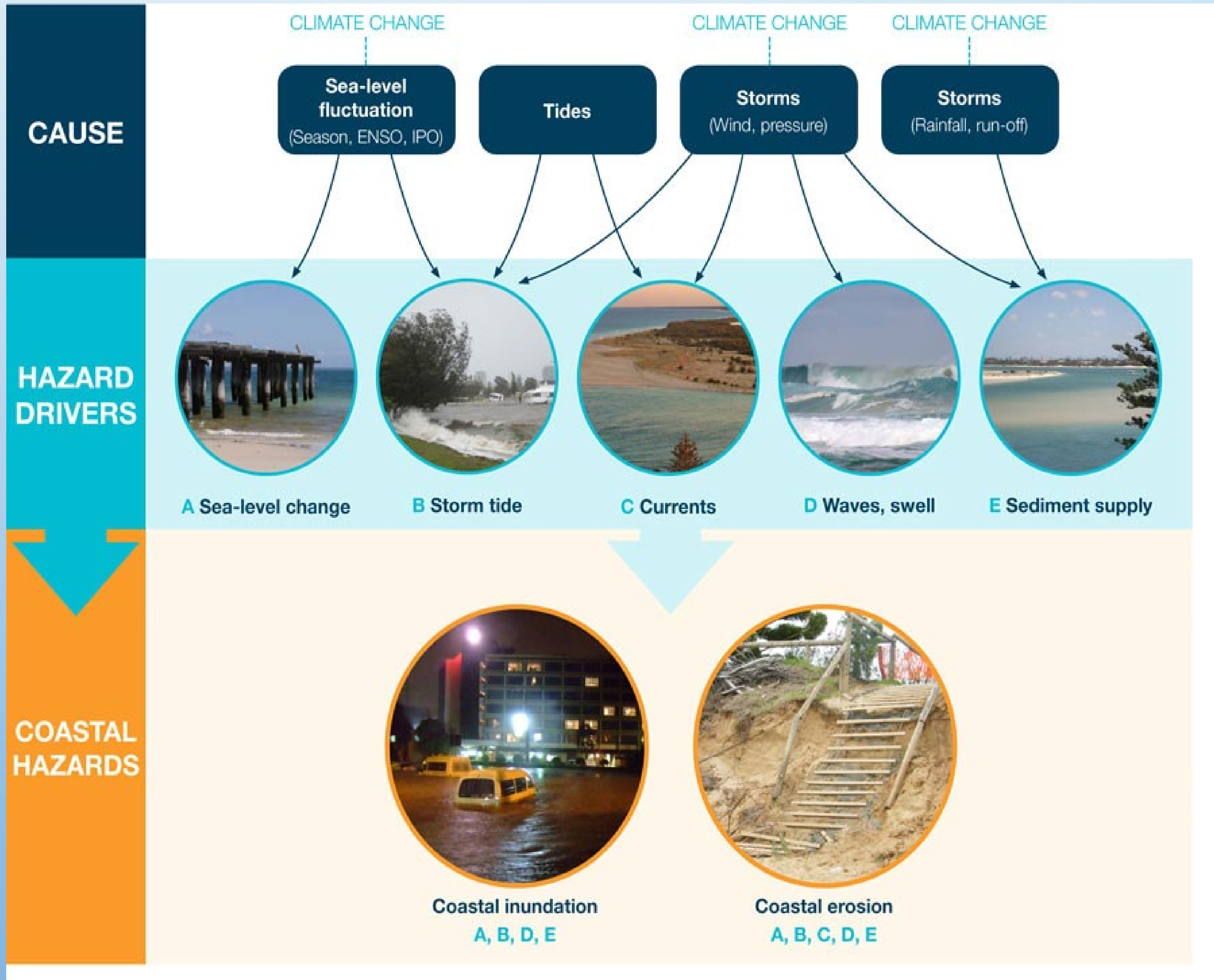
  Successful community engagement and adaptation measures.

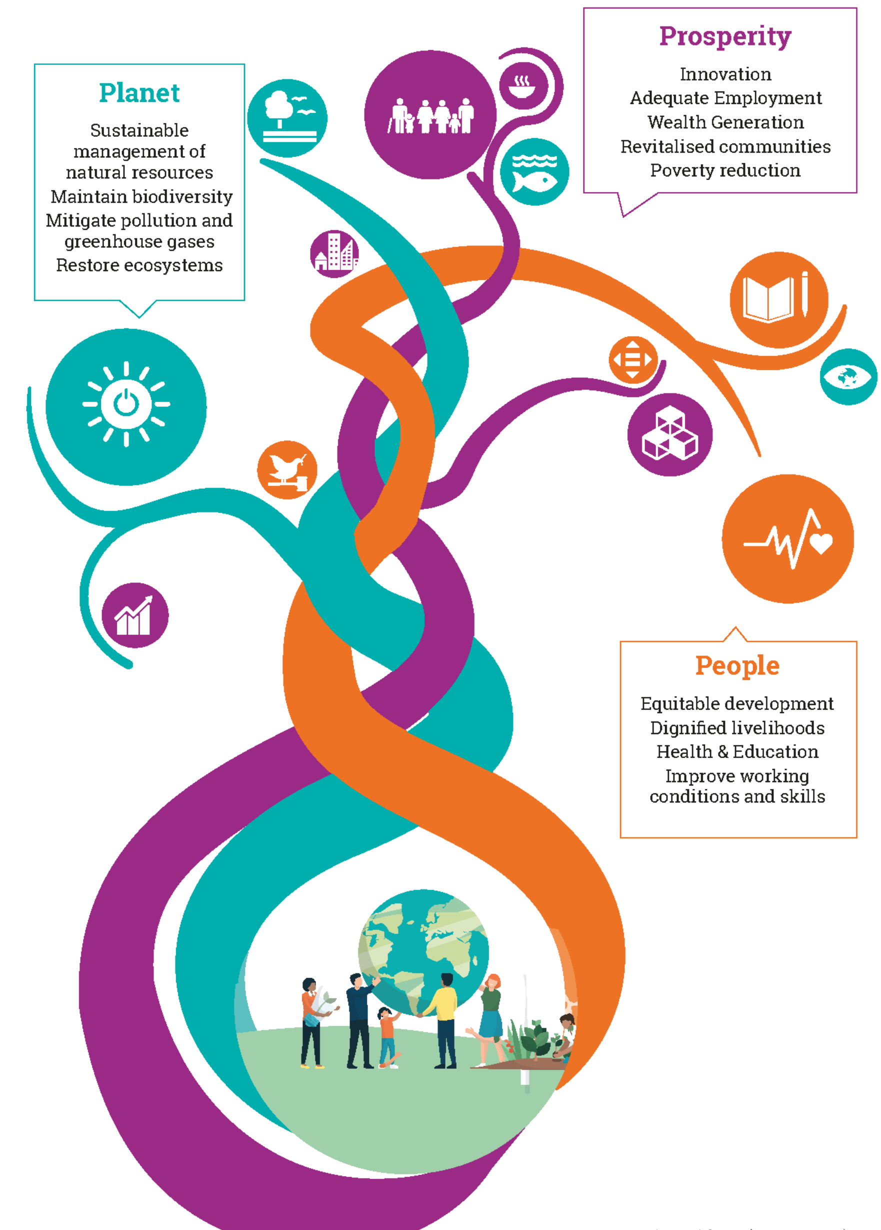


Conclusion

Building capacity for resilience to coastal hazards in Africa requires **a multifaceted approach involving education, policy, research, funding, infrastructure development, community participation, and ecosystem management.** Collaborative efforts from governments, communities, the private sector, and international partners are essential to create sustainable and resilient coastal zones.

- **Holistic Approach is Essential**
  - Combining various pathways and actions is crucial for building resilience.
- **Continued Effort and Collaboration**
  - Ongoing commitment from all stakeholders is necessary to address the evolving nature of coastal hazards.





Source: Adapted from (IPBES, 2021)


Thank You

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Q & R and Discussion