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Intergovernmental
Oceanographic
Commission



2021 United Nations Decade
of Ocean Science
2030 for Sustainable Development

Ocean Decade Tsunami Program (ODTP)

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Global Tsunami Warning and Mitigation System

Significant 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

Ocean Decade Tsunami Programme (ODTP)

- UN Ocean Decade (2021-2030): 10-year framework initiative to identify, generate and use critical ocean knowledge to manage the ocean sustainably
- For Tsunamis: Once-in-a-generation opportunity to achieve “transformational gains” in tsunami warning and mitigation system by addressing gaps in tsunami warning and enhancing community preparedness.
- IOC Assembly 31 in June 2021 (Dec. A-31/3.4.1) established the “Ocean Decade Tsunami Programme” and “Scientific Committee” to Develop Research, Development & Implementation Plan
 - Technological & Observational Advances to reduce uncertainties in tsunami warning
 - 100 % at risk communities prepared & resilient to tsunamis by 2030 (Tsunami Ready, etc.)



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development

UN Decade of Ocean Science for Sustainable Development IOC Ocean Decade Tsunami Programme



2021 United Nations Decade
2030 of Ocean Science
for Sustainable Development



UN Ocean Decade Tsunami Programme Scientific Committee 2024-2025



**Srinivasa Kumar
Tummala**
Chairperson



**Christa von
Hillebrandt**



Maria Ana Baptista



**Harkunti Pertiwi
Rahayu**



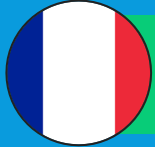
**David
Coetzee**



Silvia Chacon



**Srinivasa
Kumar
Tummala**



Helene Hebert



Yutaka Hayashi

Michael Angove

Sergio Barrientos

Alexander Rabinovich

RESILIENCE!

New observational and analysis technologies to move from a **high-uncertainty** assumption-based capability to a **low-uncertainty** dynamic-based capability

1. Real-time impact forecasts

with

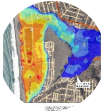
2. Deep community preparedness

Tsunami disaster impacts are minimized, enabling rapid restoration of critical infrastructure and services

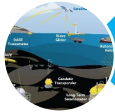
Comprehensive institutional & community preparedness and capacity building efforts aimed at achieving **IOC Tsunami Ready** designation across all socio-economic categories



Key Elements of the Research, Development & Implementation Plan



1. Tsunami Risk Knowledge : Identify and prioritise at-risk communities



2. Tsunami Detection, Analysis and Forecasting : Expand existing, and deploy new observing technologies and warning systems



3. Warning, Dissemination and Communication : Access to data, tools, communication platforms, protocols and training to effectively warn coastal and maritime communities



4. Preparedness and Response Capabilities : To build tsunami-resilient communities



5. Capacity Development, SIDS and LDCs, Multi-hazard Framework : Underpinning elements



6. Governance and Pathways to Implementation

1. Tsunami Risk Knowledge - Goals



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

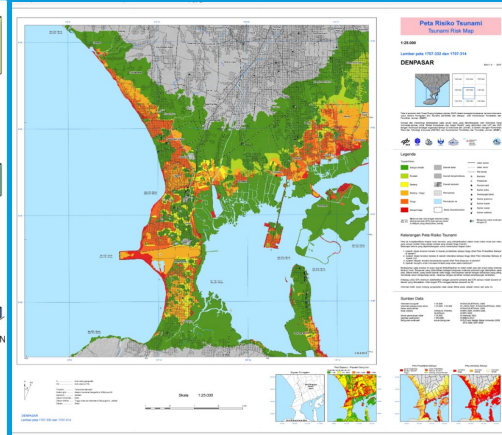
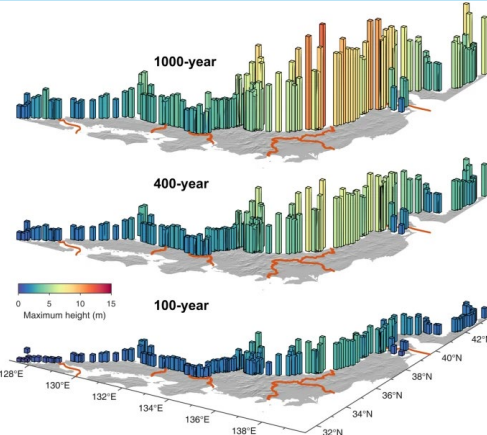
Definition of methodology to calculate risk

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

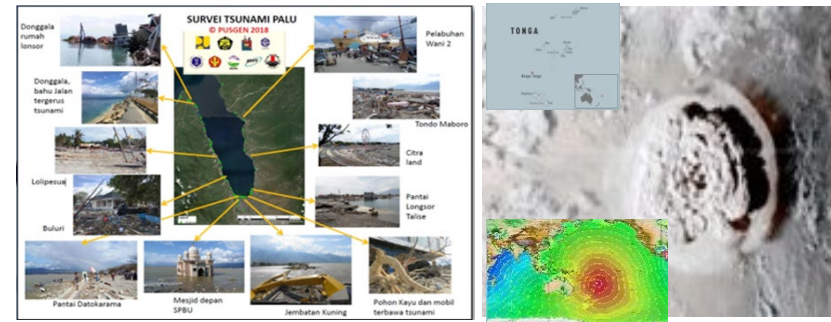
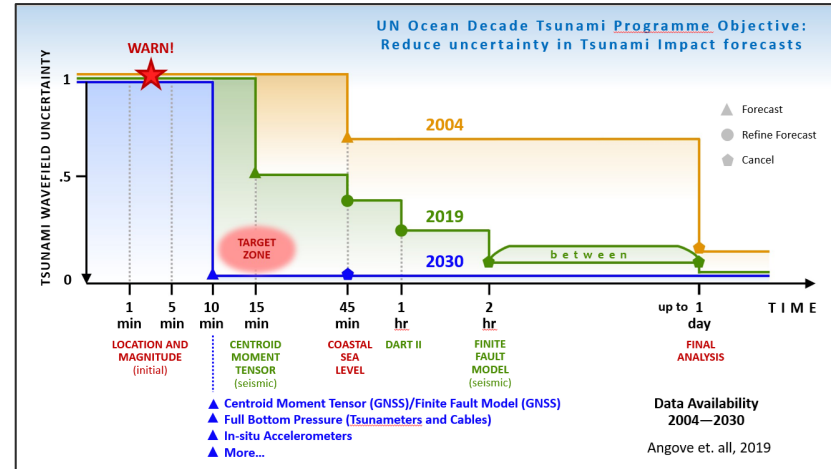
- Performed TRA studies



2. Tsunami Detection, Analysis And Forecasting - Goals

- Tsunami Threat Life Cycle : Initial indicators, confirmation, forecasting, validation and cancellation
- Throughout the threat life cycle it is possible to provide information on the potential threat
- Initial indicators based on seismic proxy provide necessary timelines but can be inaccurate
- Additional challenges with non-seismic and near-source tsunamis

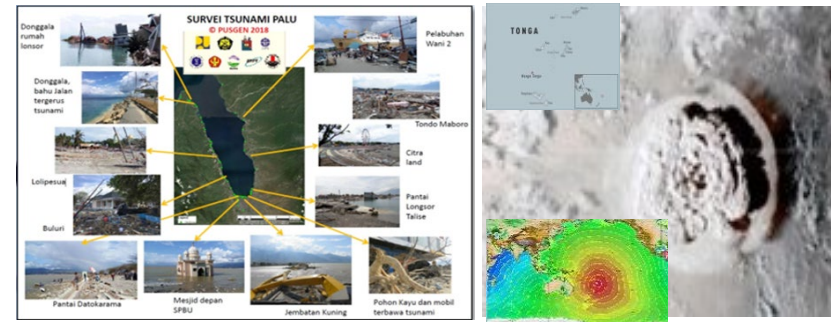
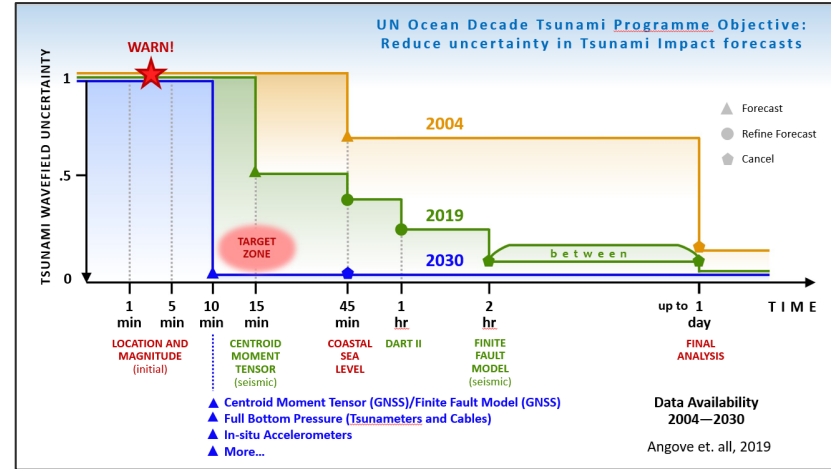
- Greatly expand international cooperation in tsunami warning and mitigation, to improve capability to directly detect and measure tsunamis and reduce reliance on seismic proxy relationships in terms of projecting impacts
- To develop the warning systems' capability to issue actionable and timely tsunami warnings for tsunamis from all identified sources to 100% of coasts at risk
- Most urgently, the ODTP will aim to provide tsunami confirmation within 10 minutes or less of origin for the most at-risk coastlines



2. Tsunami Detection, Analysis And Forecasting - Goals

Tsunami Source	Initial indicators (time after origin)	Tsunami detected (time after origin)	Tsunami constrained (time after origin)
Earthquake	3 min	10 min	45 mins
Non-earthquake (known)	10 mins	45 mins	60 mins
Non-earthquake (unknown)	60 mins	90 mins	120 mins

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2. Tsunami Detection, Analysis And Forecasting

Detection and Measurement

- **Maximize and expand current capabilities**
 - Seismic networks, Tsunameters, Coastal sea level gauges, GNSS, Dedicated observatories
 - Supporting capabilities: Coastal bathymetry, Sensor siting analysis, Global digital synthetic database, Model codes, Potential tsunami sources including non-seismic, Science to practice, Training on tsunami warning operations
- **Implementation of existing capabilities not being applied to tsunami operations**
 - Coastal RADARs
 - Passive/Active Remote Sensing
 - Infrasound
- **Identification of new candidate capabilities**
 - Ionospheric tomography TEC
 - FibreOptic Applications- Distributed acoustic sensing

Characterization and Forecasting

- **Research on nature of tsunamis, source mechanisms and characterisation**
- **Probabilistic Tsunami Forecasting Techniques**
- **New Forecast methods**
 - Database Applications and matching Schema for updated Global Threat Database including non-seismic sources
 - AI – ML to relate, discrete or combine observations to potential outcomes
 - Dynamic Characterization using Rapid update cycle models

- **Optimal notional global network design in all ICGs**
 - Mix of observational platforms for tsunami operations in terms of locations, sensors, telemetry, data format etc
 - New Technologies for Communication, Sensors, Repeaters,
 - New use cases for Data (multi-hazard, climate, science)
 - Collaboration with Scientific Groups, International Organisations, Industry, etc. for expansion of networks, R&D of new systems, Operationalisation
- **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 all TSPs**
- **Access to data, tools and communication platforms in all TWCs**



Rethinking Ocean Observations:
Reducing Uncertainty in Global Tsunami Forecasts

2. Tsunami Detection, Analysis And Forecasting

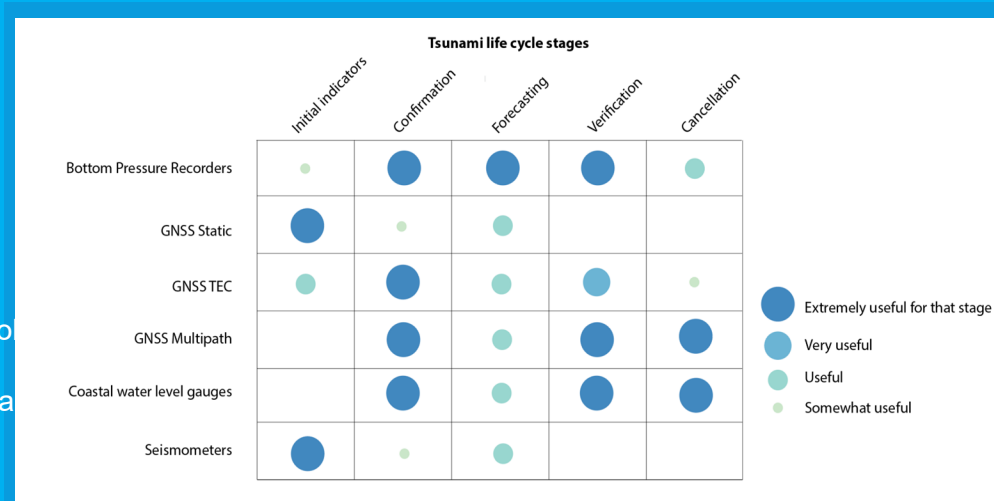
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Global Array: Climate, Oceans, Sea Level, Earthquakes,

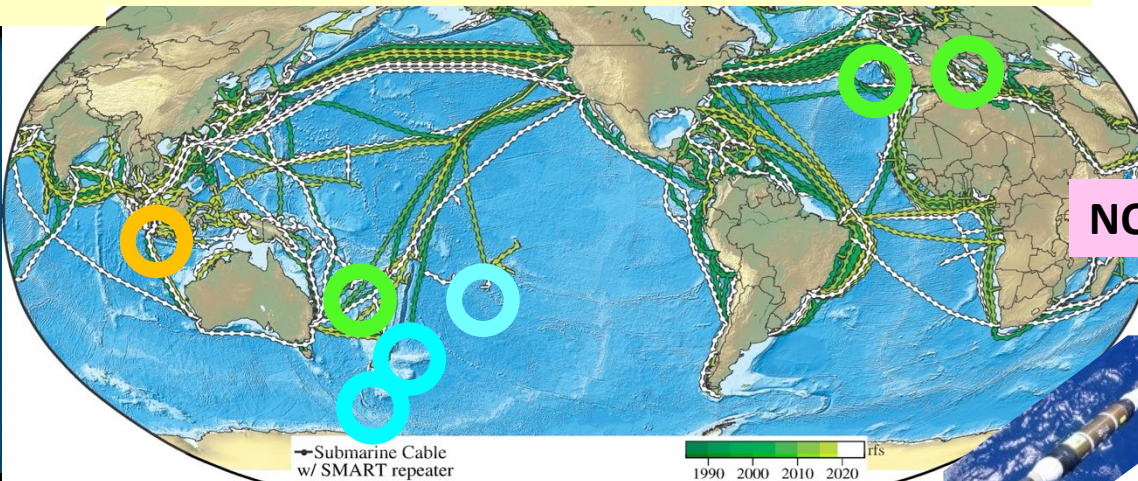
- *Create Planetary Sensor, power, Internet network*
- *1st order addition to Ocean-Earth observing system*

*Share submarine cable infrastructure
Telecom + science*

NO Interference ↓ €\$

1.2+ Gm
~20,000
repeaters

20 year refresh



SMART:
UN Decade for Ocean Science Project

CAM: 3700 km, Gov't, install 2025 → SMART

Continent/Lisbon-Azores-Madeira ring

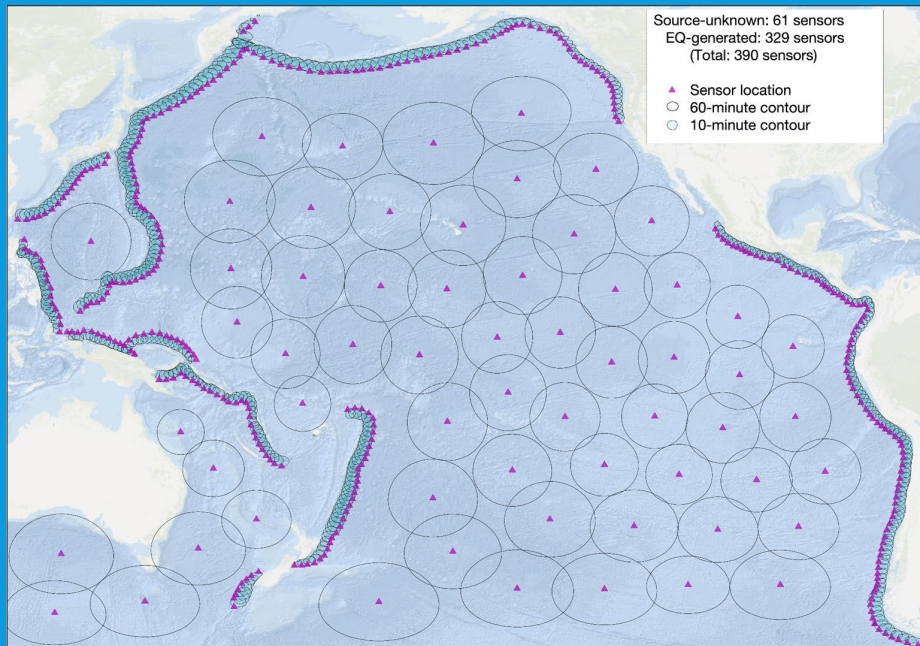
1755 Lisbon - Seismic, tsunami, ocean, environment

3700 km, 50 SMART repeaters, €120M

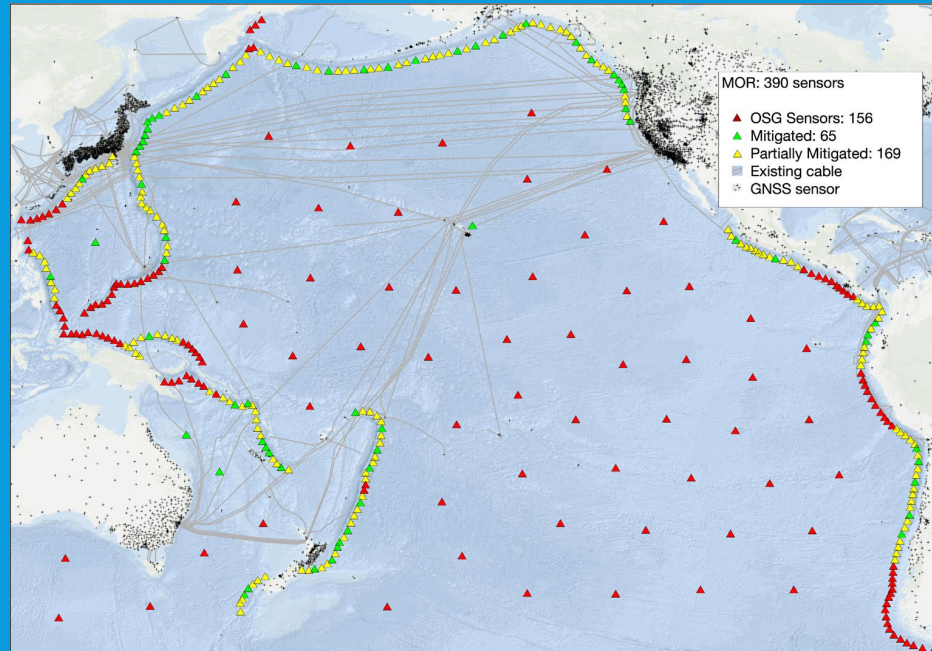
1st Sensors: Bottom temperature, pressure, seismic acceleration



Developing an Optimised Sensing Grid To Achieve UNODTP Goals (Pacific Example)



Minimum Observations Required: 390 (new)



Optimised with new technologies: 156 (new)

3. Tsunami Warning, Dissemination and Communication – Goals

The ODTF goal is that by 2030 there will be 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**)



4. Preparedness and Response Capabilities - Goals

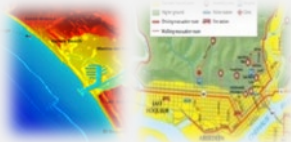
Aspirational social outcome of the Ocean Decade Tsunami Programme is that 100% of communities at risk from tsunamis are prepared for and resilient to tsunamis by 2030 through efforts like the IOC-UNESCO Tsunami Ready Recognition Programme

Key elements 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, multi-hazard, 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



UN OCEAN DECADE TSUNAMI PROGRAMME: 100% AT-RISK COMMUNITIES PREPARED FOR AND RESILIENT TO TSUNAMIS THROUGH EFFORTS LIKE TSUNAMI READY



UNESCO IOC TSUNAMI READY INDICATORS

I ASSESSMENT (ASSESS)	
1	ASSESS-1. Tsunami hazard zones are mapped and designated
2	ASSESS-2. The number of people at risk in the tsunami hazard zone is estimated
3	ASSESS-3. Economic, infrastructural, political, and social resources are identified
II PREPAREDNESS (PREP)	
4	PREP-1. Easily understood tsunami evacuation maps are approved
5	PREP-2. Tsunami information is publicly displayed
6	PREP-2. Outreach and public awareness and education resources are available and distributed
7	PREP-3. Outreach or educational activities <u>are held at least three times a year</u>
8	PREP-4. A community tsunami exercise is conducted at least every two years
III RESPONSE (RESP)	
9	RESP-1. A community tsunami emergency response plan (ERP) is approved
10	RESP-2. The capacity to manage emergency response operations during a tsunami is in place
11	RESP-3. Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place
12	RESP-4. Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place

- ❑ **STRATEGY:**
Be Aware, Be Prepared
- ❑ **FRAMEWORK:**
 - Harmonized global guidelines UNESCO IOC Tsunami Ready
 - Performance-based Community Recognition
- ❑ **ACTION:**
National programs empower Communities, Communities empower National programs
- ❑ **GLOBAL MEASURE**

OCEAN DECADE TSUNAMI PROGRAMME

A SAFE OCEAN

THE MAIN SOCIETAL OUTCOME

TO MAKE
100%

OF COMMUNITIES AT RISK
TSUNAMI PREPARED FOR
RESILIENT TO TSUNAMIS

OF
AND

BY
2030

- **Tsunami Coalition:** collaborative with critical UN stakeholders, civil protection, others ==> Raise profile. Facilitate resourcing
- **Capacity Development:** “Tsunami Ready” training, augmented by online IOC Ocean Teacher Global Academy (OTGA) ==> Global reach, deep curricula

CHAIR is LAURA KONG

Tsunami Ready Communities Caribbean, Central America, Mexico and Adjacent Regions



Legend (As of November 2023)

● UNESCO/IOC Tsunami Ready Recognition

5. Capacity Development - Goals

- 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



6. 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 should endeavour to dovetail their national tsunami warning system 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 commitment by targeting the objectives most important to advancing Member State capabilities

Thank you very much!

<https://tsunami.ioc.unesco.org/en>