UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-TEWS Hawaii)
TSUNAMI EARLY WARNING SYSTEMS
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME
15-26 September 2025, Honolulu, Hawaii

unesco
Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

UN Decade for Ocean Science for Sustainable Development

Dr. Laura Kong - Ardito Kodijat,
Indian Ocean Tsunami Information Centre (IOTIC)
International Tsunami Information Centre (ITIC)

Pacific Community
Communauté du Pacifique

Decade Challenge 6:
Increase community resilience to ocean hazards
(e.g., early warning)

Decade Challenge 7:
Expand the global ocean observing system

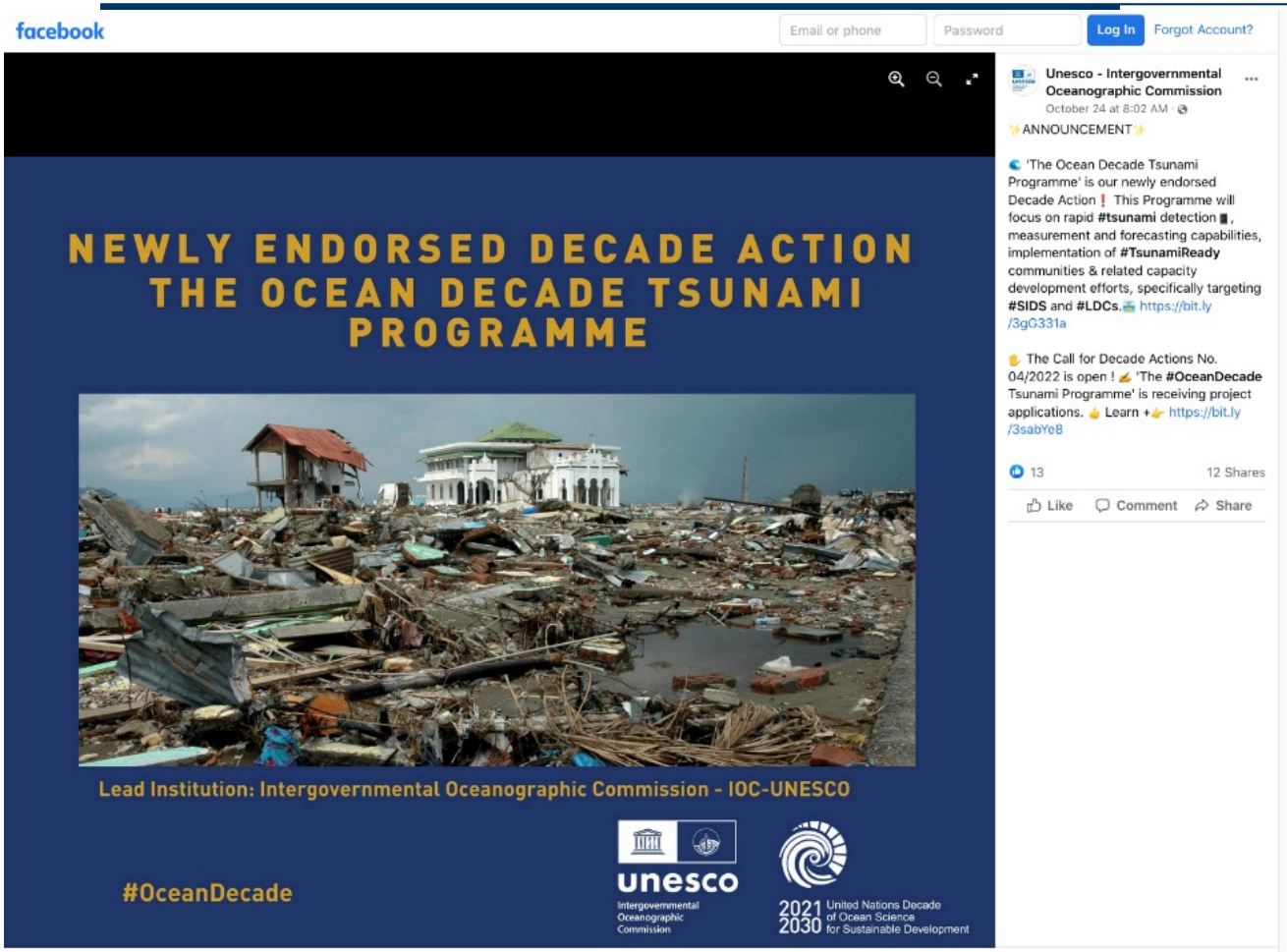
Societal Outcome 5:
Safe Ocean

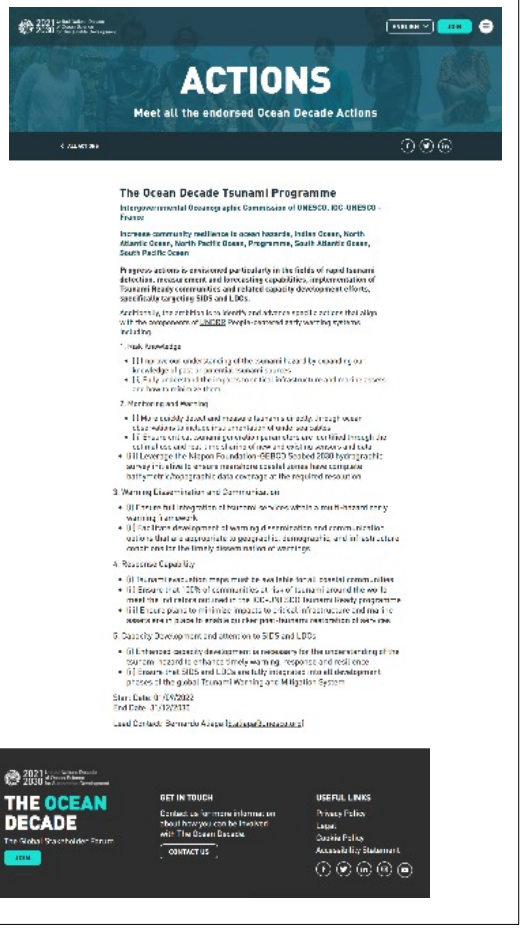
Actions – Projects:

SMART will strengthen Tsunami Early Warning System

⇒ Faster Detection
⇒ Better Forecasts
⇒ Faster warning save lives

OCEAN DECADE TSUNAMI PROGRAMME





The Ocean Decade Tsunami Programme

Intergovernmental Oceanographic Commission of UNESCO, IOC-UNESCO - France

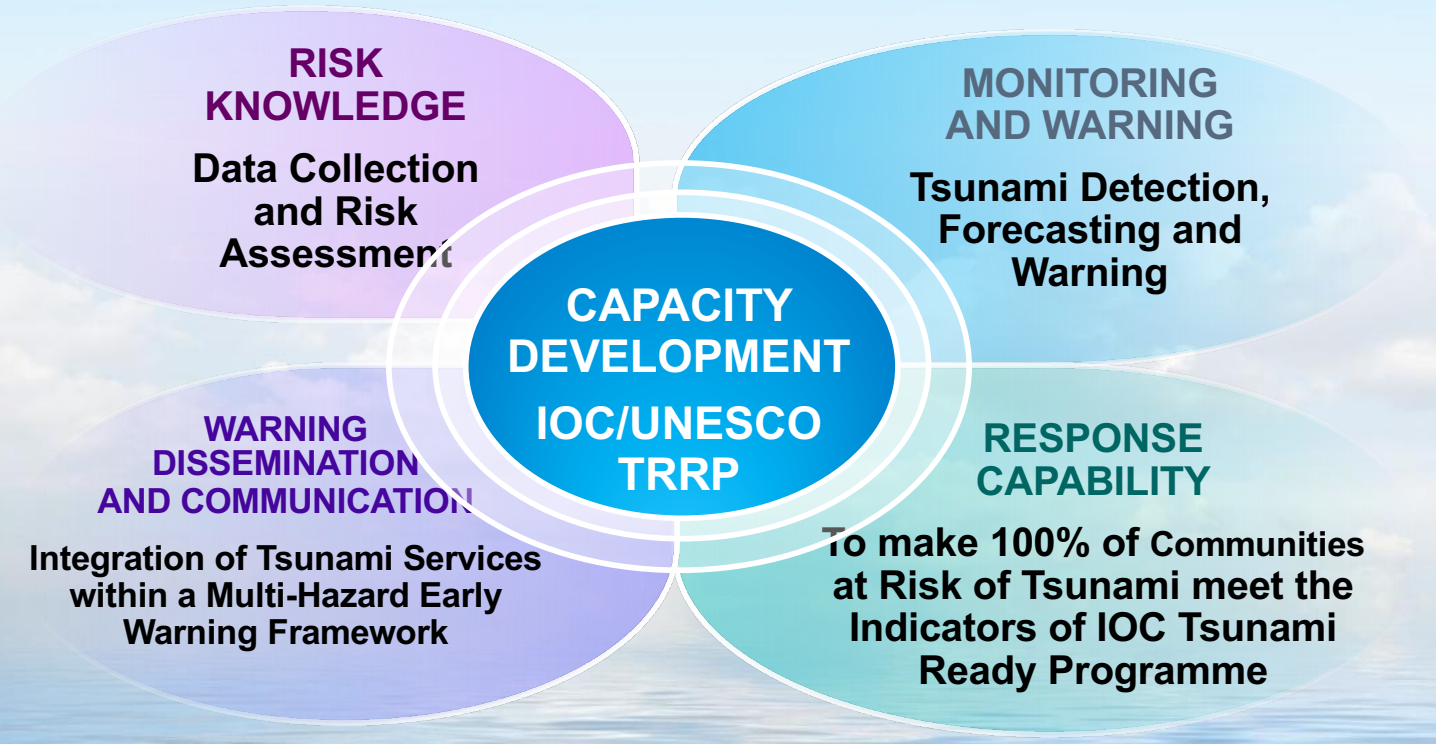
Increase community resilience to ocean hazards, Indian Ocean, North Atlantic Ocean, North Pacific Ocean, Programme, South Atlantic Ocean, South Pacific Ocean

Progress actions is envisioned particularly in the fields of rapid tsunami detection, measurement and forecasting capabilities, implementation of Tsunami Ready communities and related capacity development efforts, specifically targeting SIDS and LDCs.

Additionally, the ambition is to identify and advance specific actions that align with the components of UNDRR People-centered early warning systems including:

UN OCEAN DECADE TSUNAMI PROGRAMME

Components

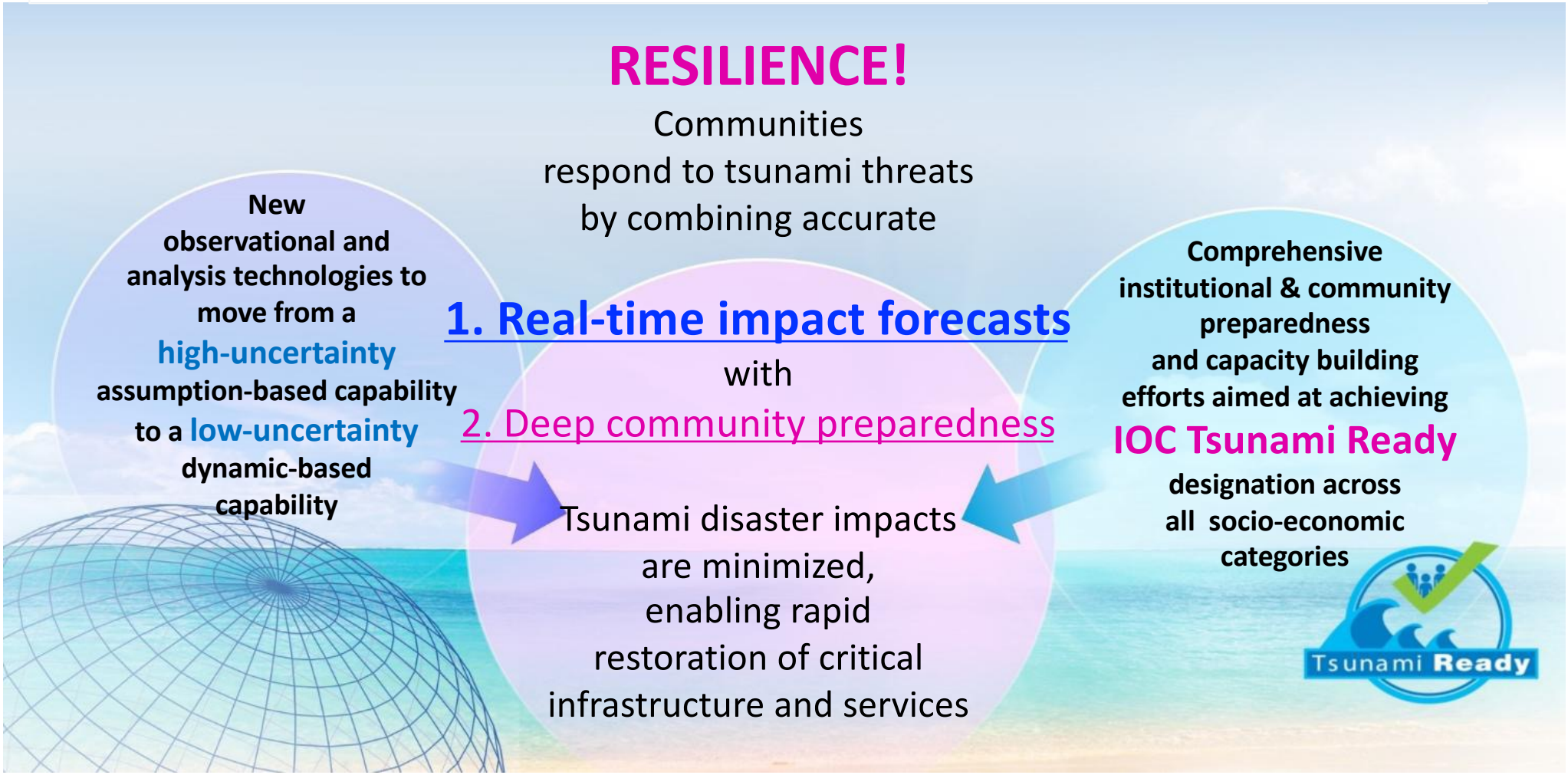


Annex 1 to IOC Circular letter, 2825
"Protecting Communities from the World's Most Dangerous Waves: A Framework for Action under the UN Decade of Ocean Science for Sustainable Development"
(6 January 2021)

Angove M et al (2019)
Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response. Front. Mar. Sci. 6:350. doi: 10.3389/fmars.2019.00350

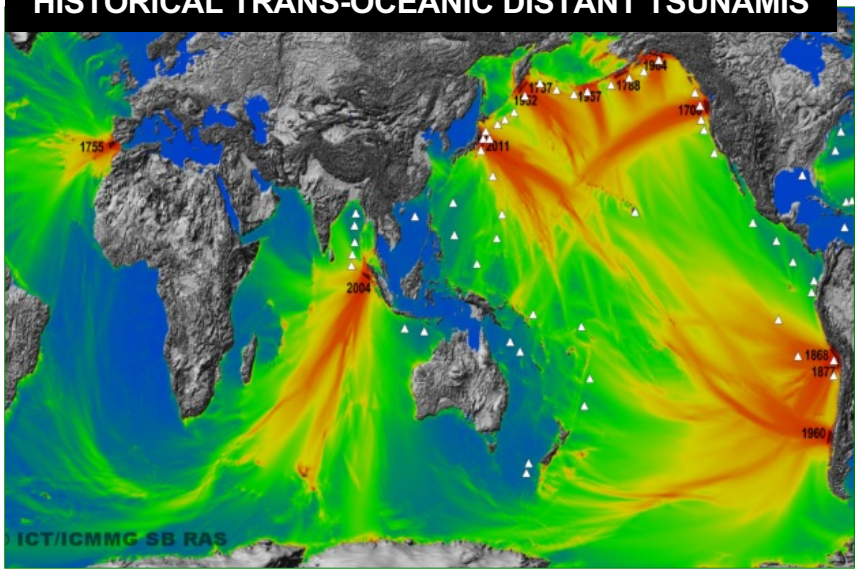
OCEAN DECADE TSUNAMI PROGRAMME

Seeking Major Advances in SCIENCE and PREPAREDNES

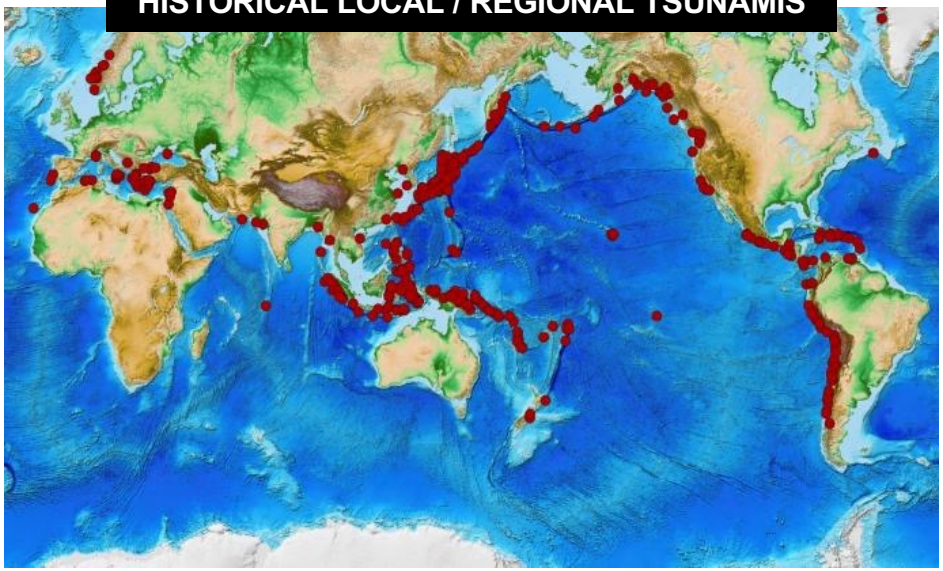


DEADLY TSUNAMIS – DISTANT to LOCAL

HISTORICAL TRANS-OCEANIC DISTANT TSUNAMIS



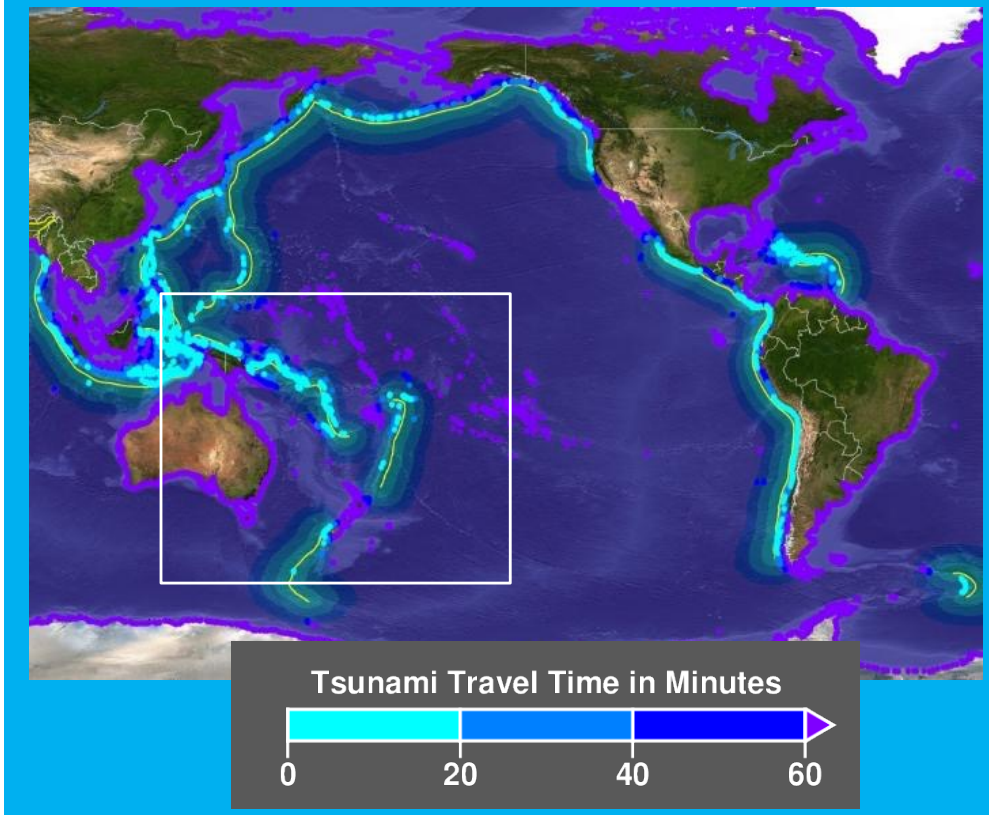
HISTORICAL LOCAL / REGIONAL TSUNAMIS



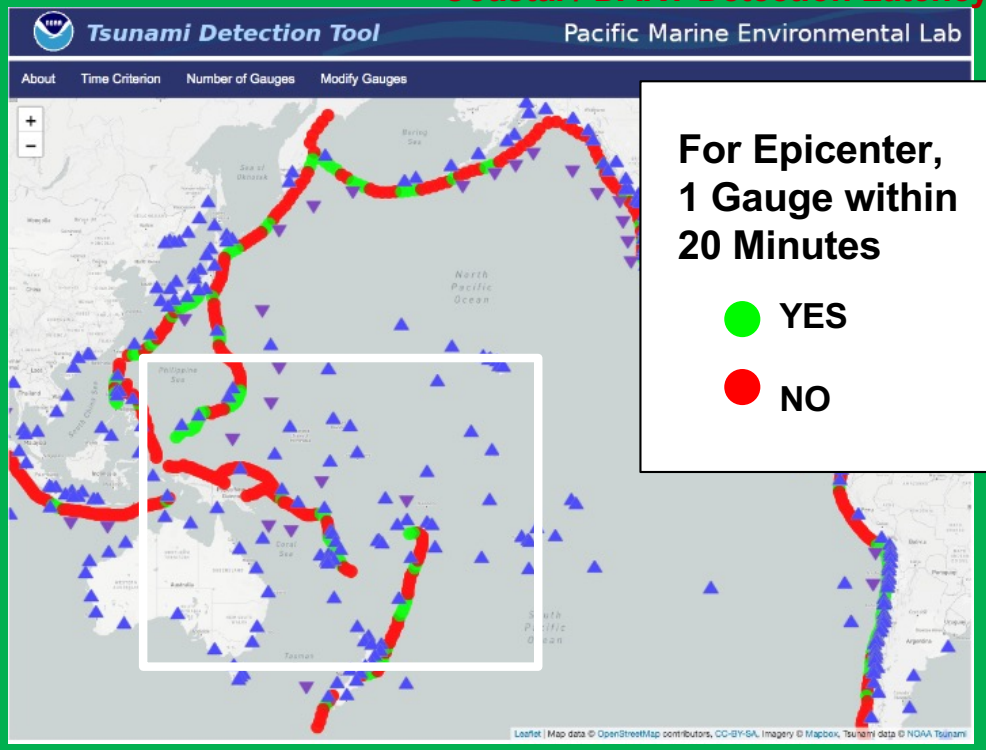
- Most tsunamis are local (< 1 hr) or regional (1-3 hrs)
- Globally, 90% of deaths from local or regional tsunamis

EARLY WARNING FOR LOCAL TSUNAMIS

How much time until wave arrives? < 20 min

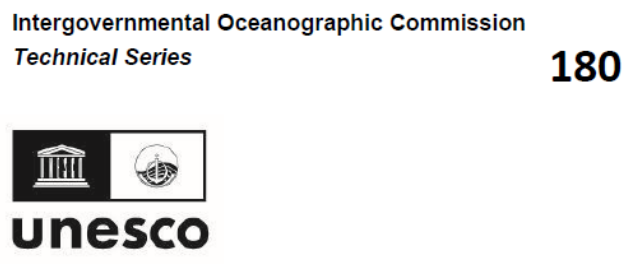


Coastal / DART Detection Latency



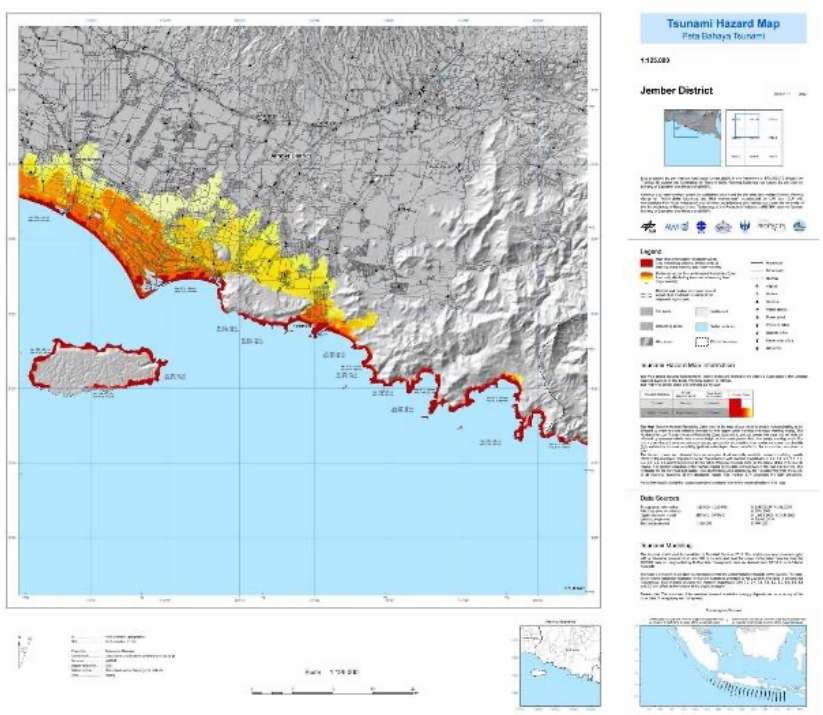
How fast you find out if wave is severe? < 20 min

R&D ODTP



1. Risk Knowledge
2. Detection, Analysis, and Forecasting of Tsunamis
3. Warning Dissemination and Communication
4. Preparedness and Response Capabilities
5. Capacity Development
6. Governance

1. Risk Knowledge



Tsunami Hazard

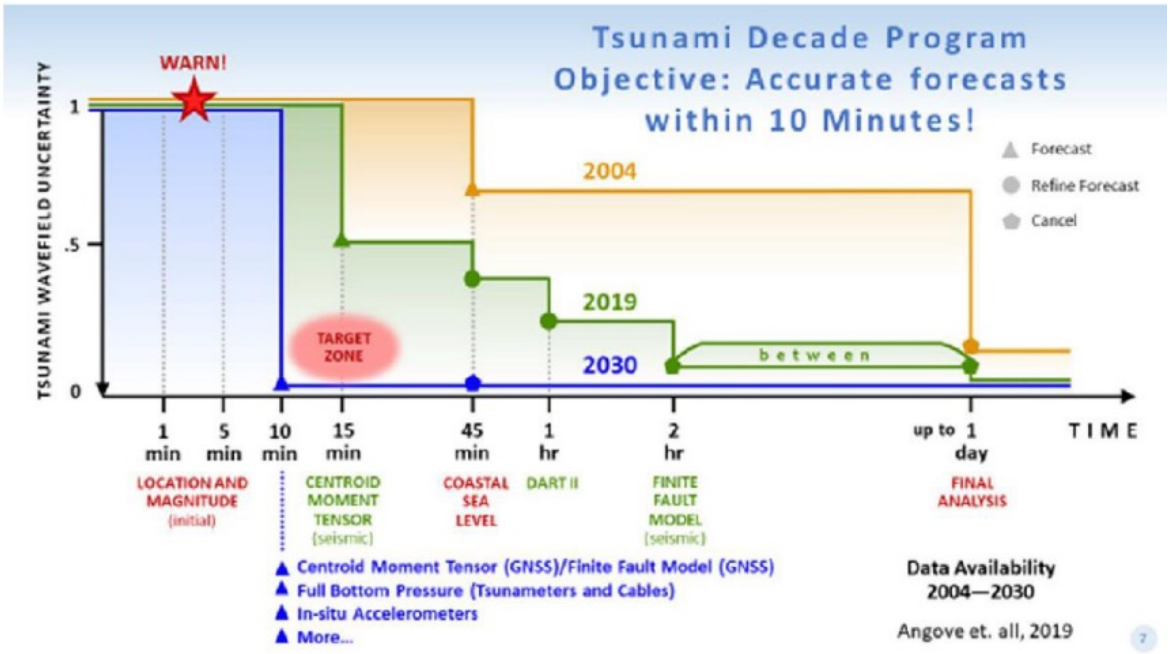
- **Probabilistic Tsunami Hazard Assessment**
- **Methodology to define Tsunami Parameters**
- **Data for Tsunami Hazard Assessment**

- **Quantitative and Qualitative Scenario Based Method**
- **Probabilistic and Deterministic Tsunami Risk Assessment Method**

Cascading Risk

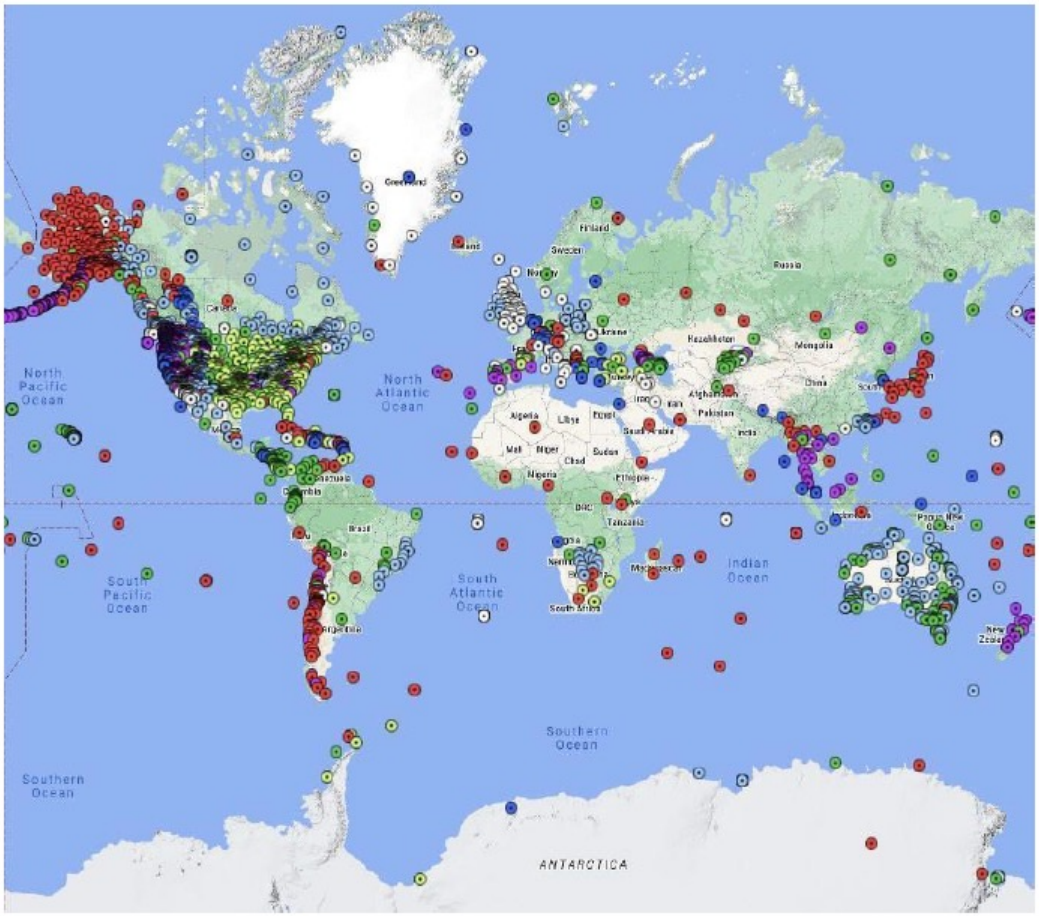
- **Physical Process that Caused Tsunami**
- **Tsunami that caused cascading risk**

2. Detection, Analysis and Forecasting



- **Maximizing current capabilities and instrumentation**
- **Expansion of Supporting Capabilities**
- **Identifying capabilities that exist but are not currently applied to tsunami**
- **Identifying new capabilities that require development**

Maximizing current capabilities and instrumentation



Seismic Networks

Tsunameters Networks

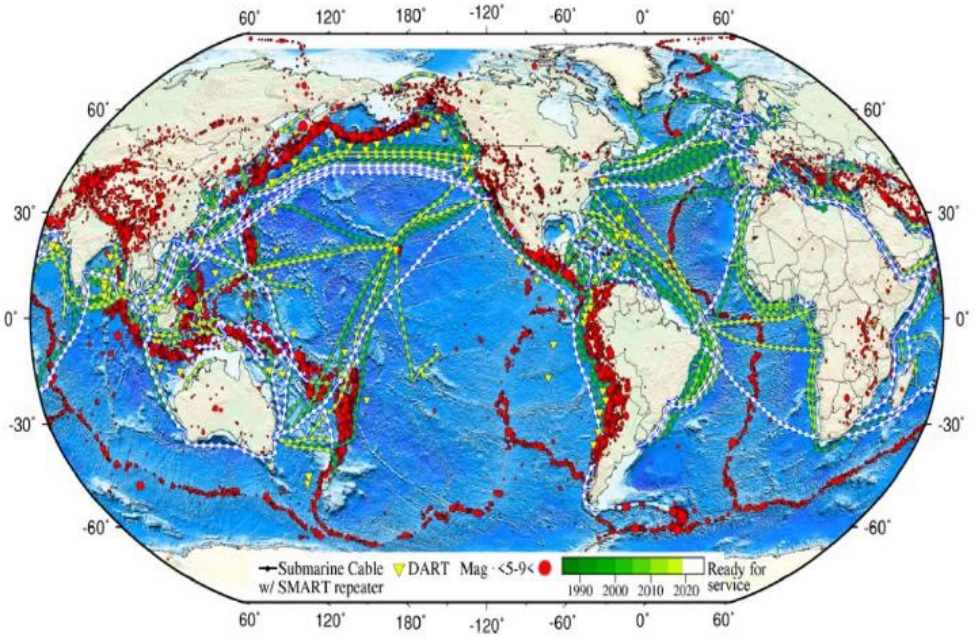
Coastal Sea Level Gauge Networks

Global Navigation Satellite System

Dedicated Tsunami Observatories

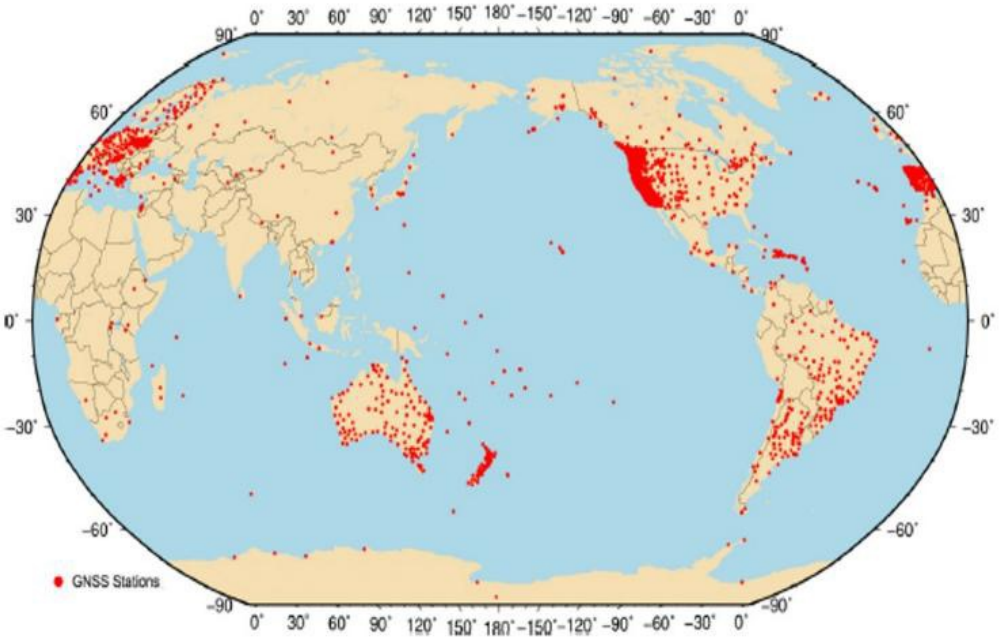
FASTER, BETTER EARTHQUAKE MONITORING:
UNDERSEA SMART CABLES, GNSS NETWORK

Historical seismicity (red), DART tsunami buoys (yellow triangles)
Current / planned (green/white) submarine cables
SMART repeaters shown every 300 km



Angove, M . et. al, 2019

Real-time GNSS stations (public networks, n=2,260)



Pacific Northwest Geodetic
Array/Central Washington University

Expansion of Supporting Capabilities

- Coastal Bathymetry
- Sensor Siting Analysis
- Global Digital Synthetic Database
- Comparison of Modelling codes
- Identification of potential tsunami sources
- The Science to Practice Challenges
- Training on Tsunami Warning Operations

Identifying capabilities that exist but are not currently applied to tsunami

- Coastal Radars
- Passive/active Remote Sensing
- Infrasound

Identifying new capabilities that require development

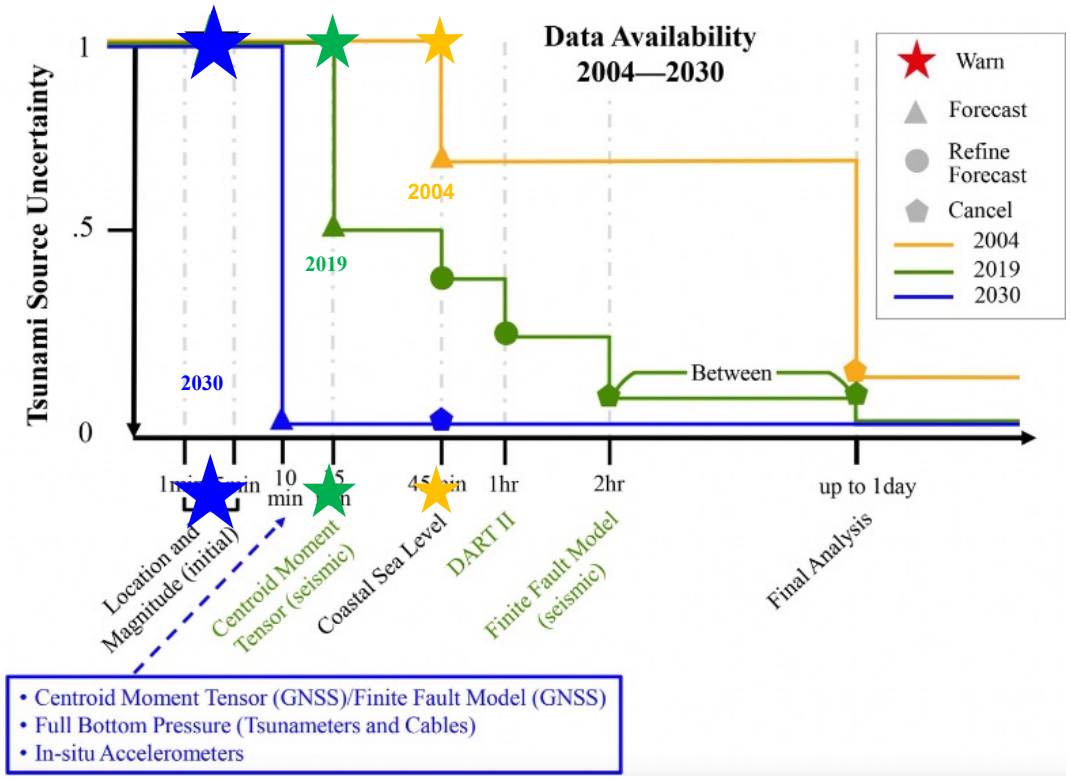
- Ship-based GNSS Observations
- Ionospheric Tomography
- Fibre Optic Application

- Global Threat Database
- Artificial Intelligence applications combined observations to potential outcomes and probabilistic tsunami forecasting
- Rapid Update Cycle Model

3. Waring Dissemination and Communication

- **Effective decision making to Warn**
- **Effective construction of warnings**
- **Effective dissemination and communication of warnings**

IMPROVEMENT IN EARLY WARNING (SMART, GNSS)



2021 2030 United Nations Decade of Ocean Science for Sustainable Development

OCEAN DECADE TSUNAMI PROGRAMME

A SAFE OCEAN

THE MAIN SOCIETAL OUTCOME

TO MAKE 100%

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

BY 2030

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

UN OCEAN DECADE TSUNAMI PROGRAMME:

100% AT-RISK COMMUNITIES 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 are held at least three times a year
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
- **GLOBAL MEASURE**

Standard Guidelines for the Tsunami Ready Recognition Program, UNESCO IOC TS 74, 21 Oct 2021 draft

Thank You