United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission

Organisation
des Nations Unies
pour l'éducation
la science et la culture

Commission
océanographique
intergouvernementale

Organización
de las Naciones Unidas
para la Educación
la Ciencia y la Cultura

Comisión
Oceanográfica
Intergubernamental

Организация
Объединенных Наций по
вопросам образования
науки и культуры

Межправительственная
океанографическая
комиссия

Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

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Acknowledgements: Dr. Thorkild Aarup and Ms. Nora Gale

The Intergovernmental Oceanographic Commission (IOC) Of UNESCO

- The only intergovernmental body of the UN system specializing in the **ocean science**, **services**, **observations**, **data exchange,** and **capacity development**

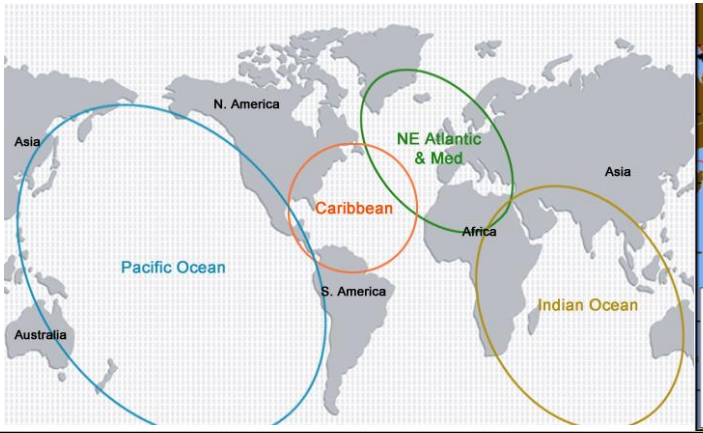
- Established 1960, **149** Member States

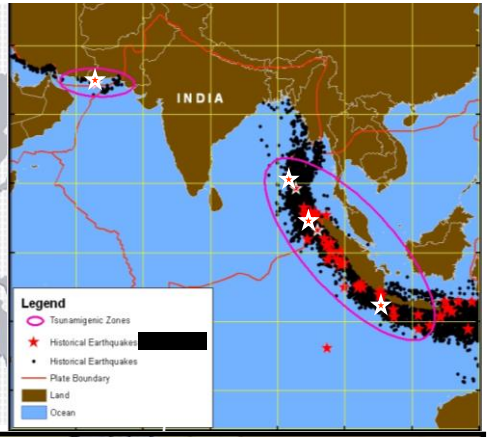
<u>High-Level Objectives 2014-2021:</u>

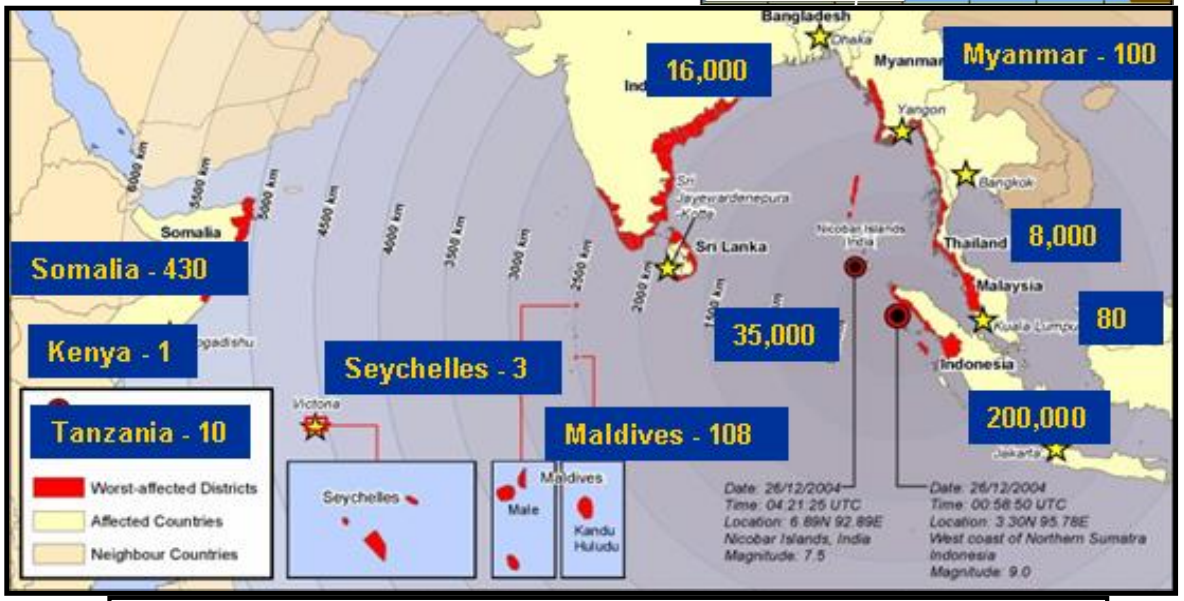
- Healthy ocean ecosystems;
- **Early warning systems (e.g. tsunami);**
- Resilience to climate change and variability by science-based services, adaptation and mitigation; and
- Emerging ocean science issues.

Tsunami Warning Systems

- Pacific since 1965
- 2004 tsunami in Indian Ocean illustrated need for more
- In 2005, the IOC was mandated to establish three more TWS
  - ICG IOTWMS
  - ICG CARIBE EWS
  - ICG NEAMTWS
- Java (M7.8) July 17, 2006 ~ 700 Causalities
- Mentawai (M7.7) 25 Oct 2010 ~ 400 Casualities

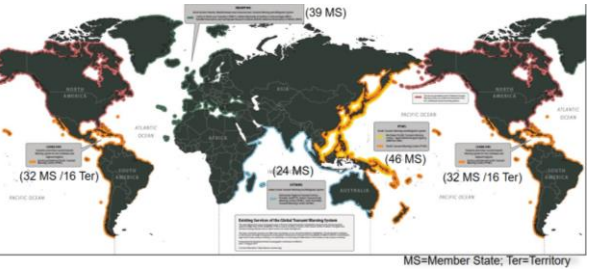






~230,000 Causalities
Over 1.6 people million displaced
Estimated economic losses of $14 billion

Governance



UNESCO/IOC
Assembly/Executive Council

WMO, IHO, IMO, UNISDR, UNDP…

Working Group for Tsunami & Other sea level related Warning & mitigation Systems (TOWS-WG)
[4x ICG Chairs, WMO, UNISDR, UNDP, IMO, IHO]

Task Team Tsunami Watch Operations

Task Team Disaster Management & Preparedness

ICG Caribbean & Adjacent Seas (CARIBE-EWS)

Intergovernmental Coordination Group
Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)
Chair: Dr. Andi Eka Saakya (Indonesia)
Vice Chairs: Dr. Sam Hettiarachchi (Sri Lanka)
Vice Chair: Dr. Juma Al Maskari (Oman)

Steering Group: Officers, WG Chairs/VCs

ICG Pacific Tsunami Warning & Mitigation System (PTWS)

ICG NE Atlantic & Mediterranean Seas (NEAMS-TWS

WG1 Tsunami Risk, Community Awareness and Preparedness - DMOs, Academia
Chair: Dr. Harkunti Rahayu (Indonesia)

WG2 Tsunami Detection, Warning & Dissemination – NHMSs
Chair: Mr. Peter Coburn (Australia)

1x Regional WG: NW Indian Ocean
Chair: Dr. Juma Al Maskari (Oman)

Task Team - IOWAVE18
Chair: Dr. Yuelong Miao (Australia)

Task Team - Capacity Assessment of Tsunami Preparedness
Chair: Dr. Harkunti Rahayu (Indonesia)

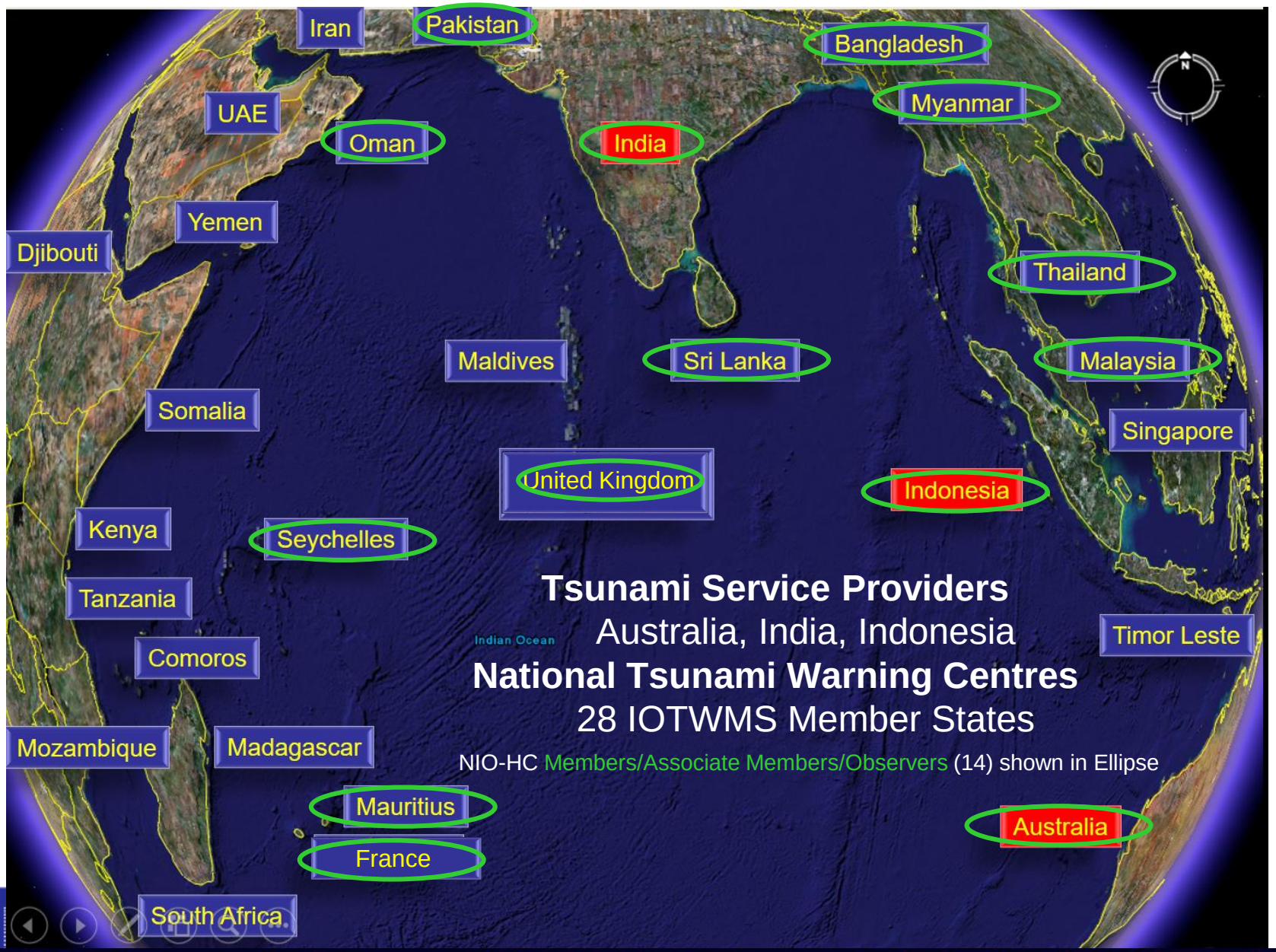
IOC Tsunami Unit (Paris)
Head: Thorkild Aarup

ICG/IOTWMS Secretariat (Perth)
Head: Srinivasa Kumar Tummala

Indian Ocean Tsunami Information Centre (Jakarta)
Head: Ardito Kodijat

IOC Secretariat, Tsunami Unit

ICG/IOTWMS Member States



IOTWMS - The Three Pillars

Risk Assessment and Reduction

Systematically collect data and undertake risk assessments

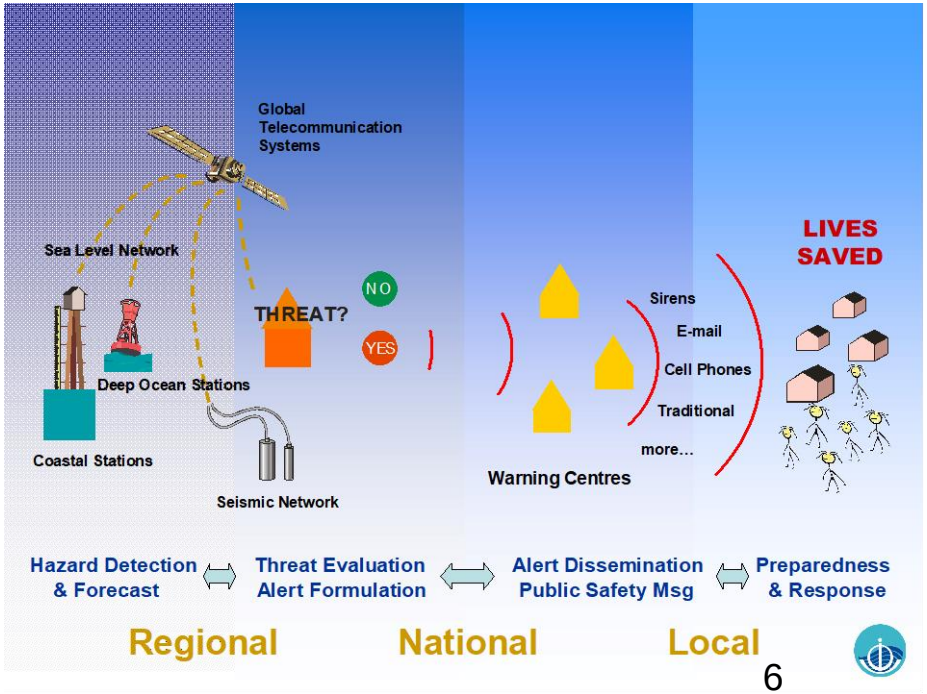
Detection Warning and Dissemination

Develop hazard detection, monitoring and early warning services

Communicate threat information and early warnings

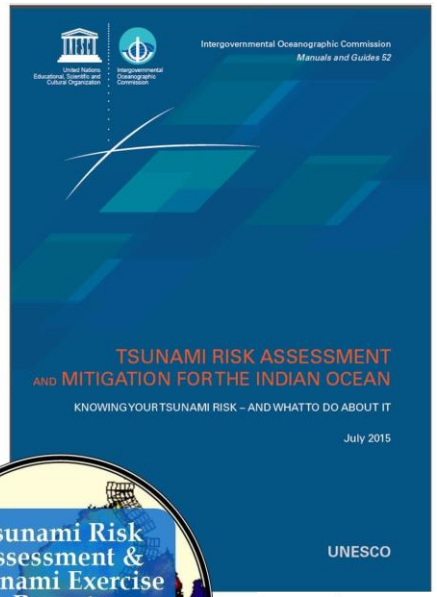
Awareness and Response

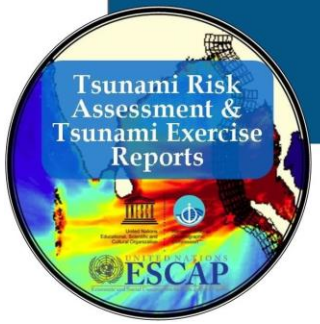
Build national and community response capabilities

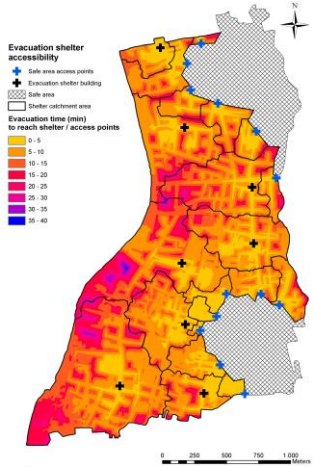


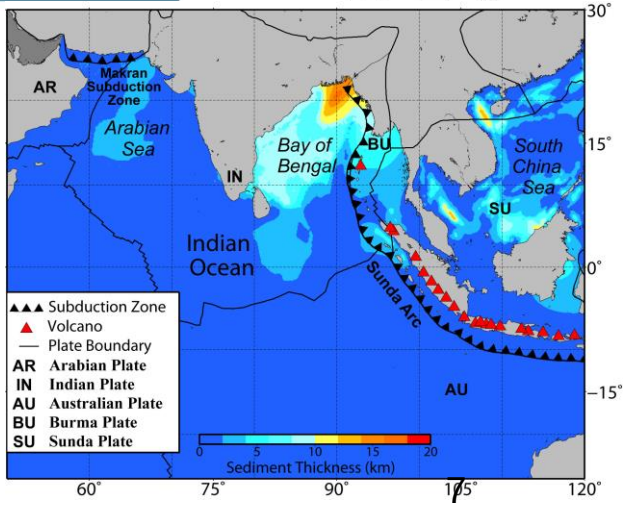
Pilar 1: Risk Assessment & Reduction

- Tools, Methods & Guidelines for Tsunami Risk Assessment published
- Indian Ocean Probabilistic Regional Tsunami Hazard Maps published
- Assessment and awareness of Makran tsunami hazards
- Regional Workshops on Tsunami Risk Assessment and Modelling
- Enhancing Tsunami Risk Assessment and Management, Strengthening Policy Support and Developing Guidelines for Tsunami Exercises in Indian Ocean Countries





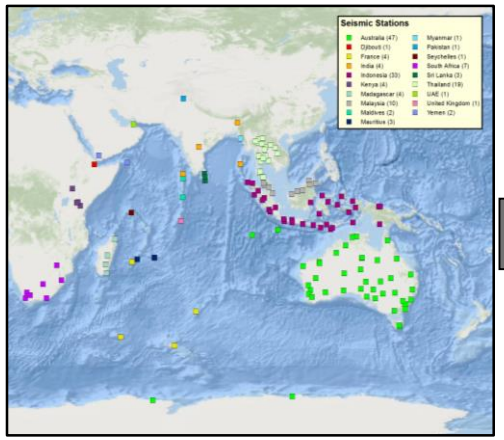


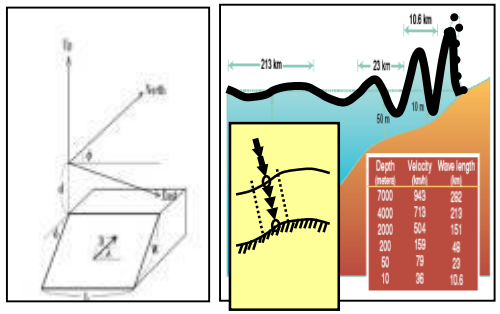


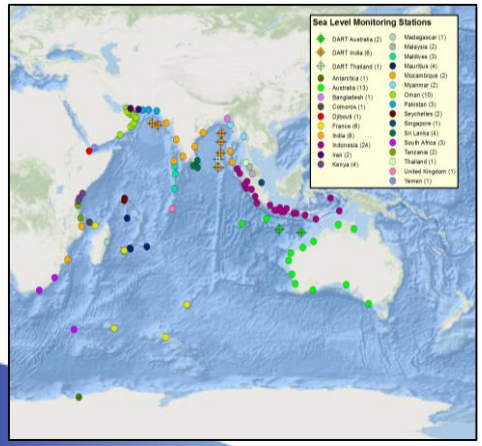
Pillar 2: Detection, Warning & Dissemination

- Service Definition: AoS, Stations, Products, Thresholds, CFZs, Formats
- Tsunami Service Framework
  - 3 inter-operable Tsunami Service Providers (Australia, India, Indonesia)
  - Network of NTWCs, TNCs, TWFPs
- Greatly expanded seismic and sea level monitoring networks
- Harmonised threat information by TSPs
- National warnings Sovereign responsibility of authorized national agencies
- Several Events handled
- Yearly performance assessments against Key Performance Indicators
- 6-monthly communications test to identify and fix any issues
- Interim Service – JMA, PTWC

Operational Elements of TSP Service







Seismological Data

Model Results

Sea level Data

TSP-1

TSP-n

Threat Information

Warning Status

NTWC1

NTWC2

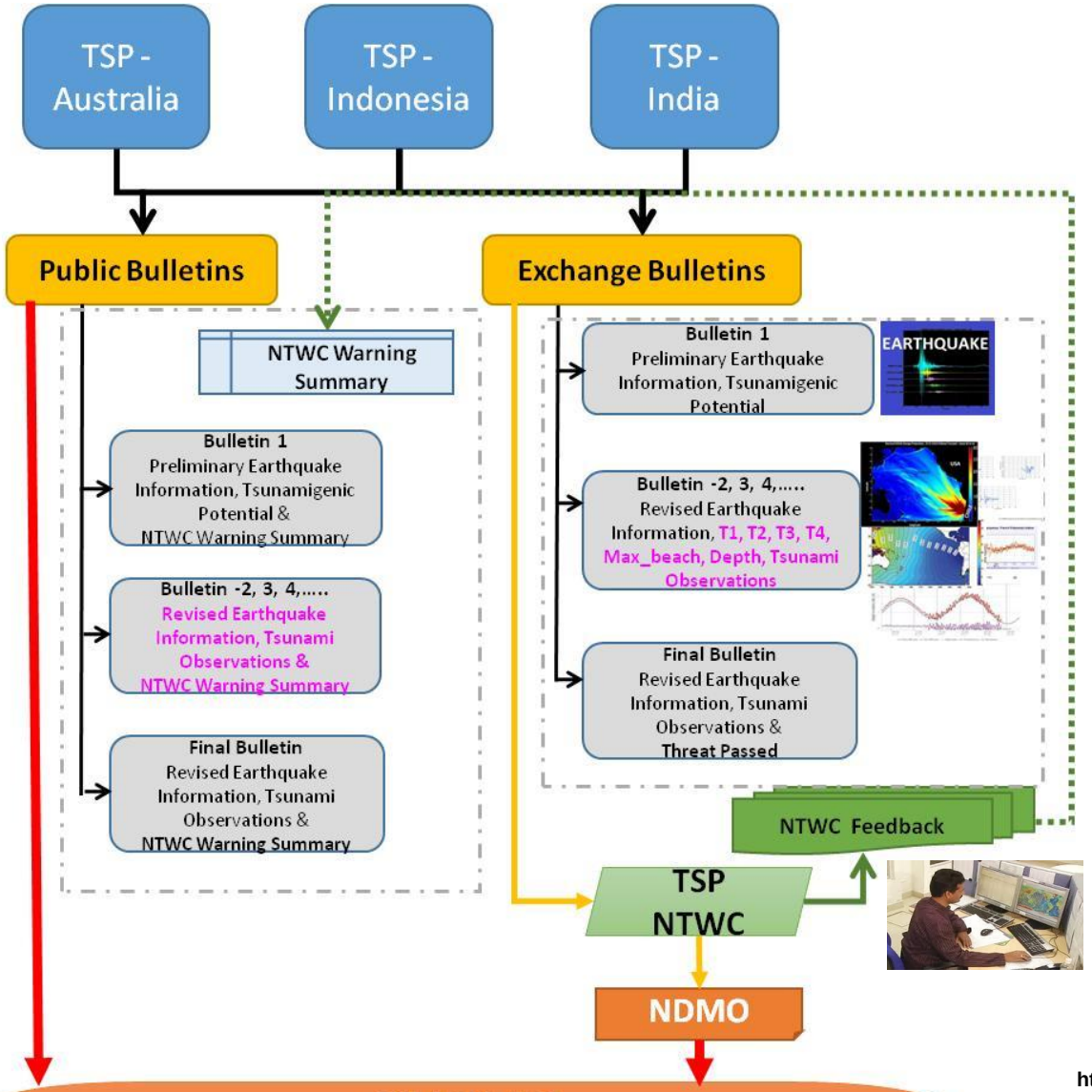
NTWCn

Warnings
NDMO
LDMO
Media
Public

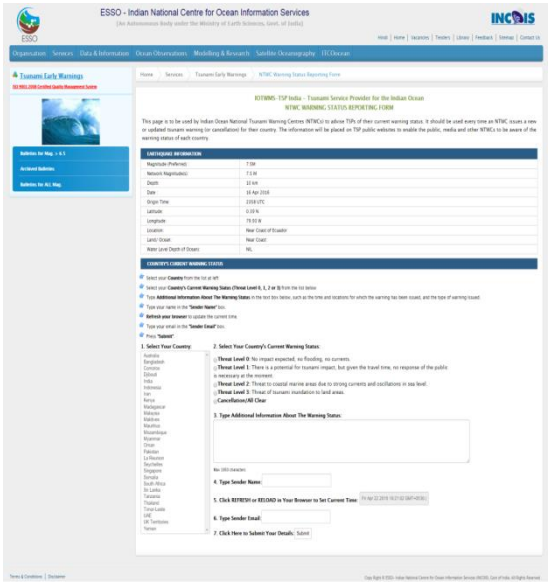
GTS
SMS
FAX
Email
Web

TV
Radio
SMS
Email
Web
SIRENS

Public & Exchange Products

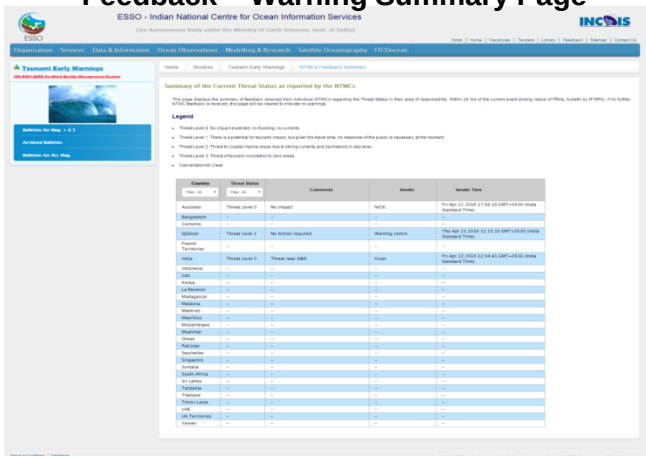


Feedback – Status Reporting Page



http://www.incois.gov.in/Incois/tsunami/NTWCReportingForm.jsp

Feedback – Warning Summary Page



http://www.incois.gov.in/Incois/tsunami/NTWCStatusSummary.jsp

Within 24 hours of the current event ending (issue of FINAL bulletin by TSPs), if no further NTWC feedback is received, this page will be cleared to indicate no warnings.

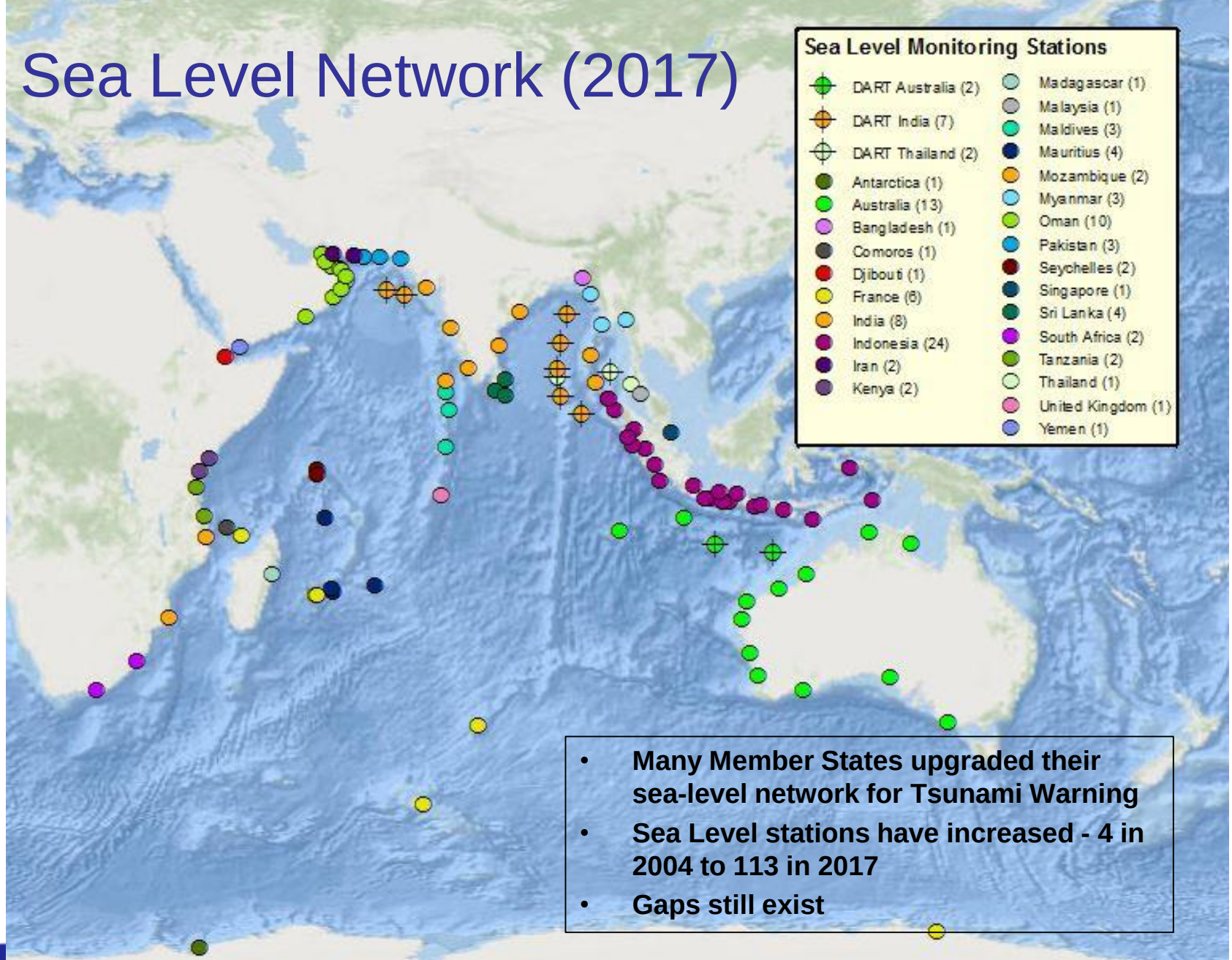
Alert Messages to the Shipping Community

- Tsunami amplification in harbours can cause damages that make them unusable
- Products describing Tsunami impacts on Harbours (Elevation / Drawdown / Currents ???) are needed for safe operations
- Formats
- Communication Channels

- Across four ICGs work continues with IHO/IMO/WMO Sub-Committee on the World-Wide Navigational Warning Service (WWNWS-SC) on the development of products by Tsunami Service Providers for use by the maritime communities.

- The TOWS-WG Task Team on Tsunami Watch Operations is developing draft messages for vessels at sea for TSPs based on the template in IHO Manual S53 for WWNWS-SC to review and provide feedback

Sea Level Network (2017)



- **Many Member States upgraded their sea-level network for Tsunami Warning**
- **Sea Level stations have increased - 4 in 2004 to 113 in 2017**
- **Gaps still exist**

Regional Networks: University of Hawaii Sea Level Network, GLOSS and IOC-UNESCO Sea Level Monitoring Network

Sea Level Network Operators in ICG/IOTWMS

Australia - Bureau of Meteorology (13)

France – ROSAME (3) & RONIM (3)

India – INCOIS (8)

Indonesia – BIG (24)

Malaysia – Department of Survey and Mapping (1)

Seychelles – UHSLN (2)

Sri Lanka – UHSLN (4)

Mauritius – UHSLN (4)

Myanmar – JICA (1) & UHSLN (2)

Oman – Meteorological Affairs (10)

United Kingdom – UHSLN (1)

Bangladesh Navy (1)

Pakistan Navy (3)

Thailand (1)

Possible Additional Stations ???

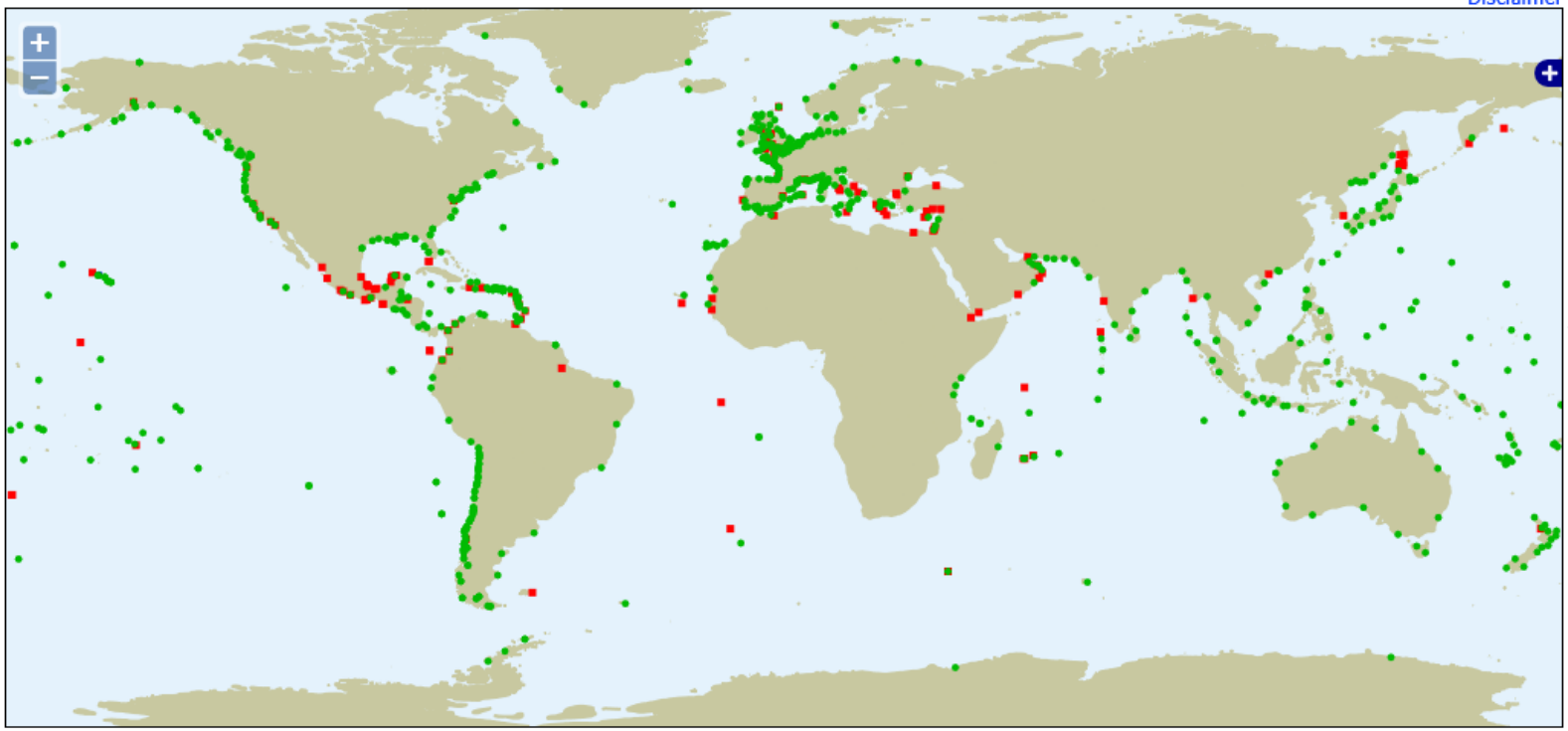
- France: SHOM (RONIM) - Ile de la Possession - Iles Crozet
- Pakistan Navy Hydrographic Department: Bin Qasim (IOC Sea Level Monitoring Network- Keti Bandar)

SEA LEVEL STATION MONITORING FACILITY

Intro | Map | Station lists | Station details | Services | GLOSS | Catalog

Sealevel stations

Status at 2018-04-11 02:06 GMT



Lat: Lon:

Disclaimer

Plot: Active stations

Show: Status

Legend:

- Station is offline, or data is outdated
- Station is online
- Station is not available at this site

Offline = No data received since 3 times the transmit interval.

The quality of the transmitted data is not checked.

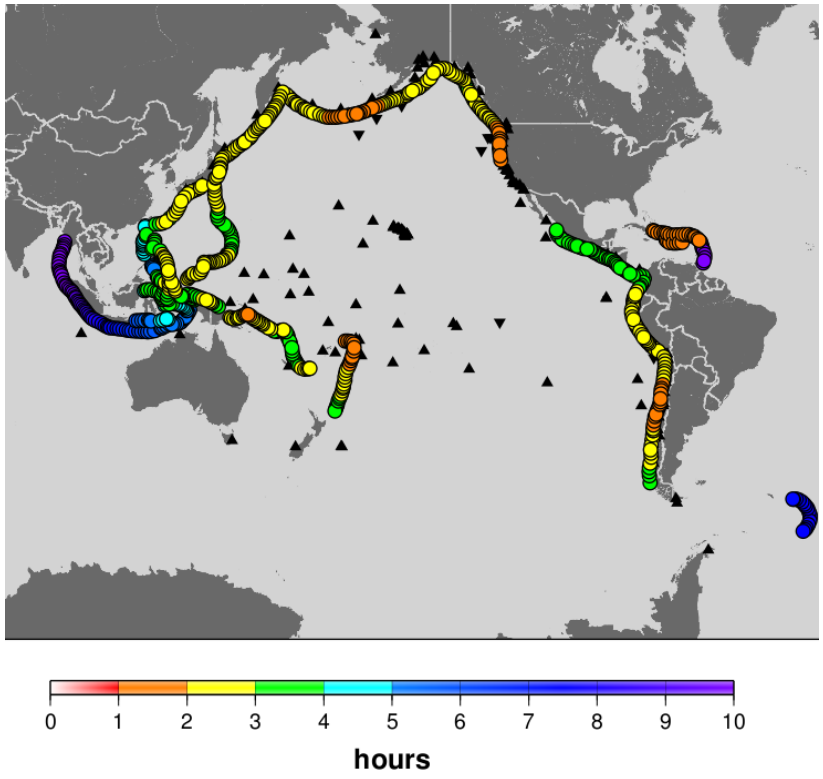
- To obtain more details about a station - move mouse over station and click.
- To zoom in - hold down the Shift-key while holding down the mouse button and drawing a rectangle or use the Scroll mouse button, or use the control buttons in upper left part of map.
- To pan - drag the map, or use the control buttons in upper left part of map.
- Or use the KML file.

Why are High Frequency Sea-Level Data Transmissions needed?

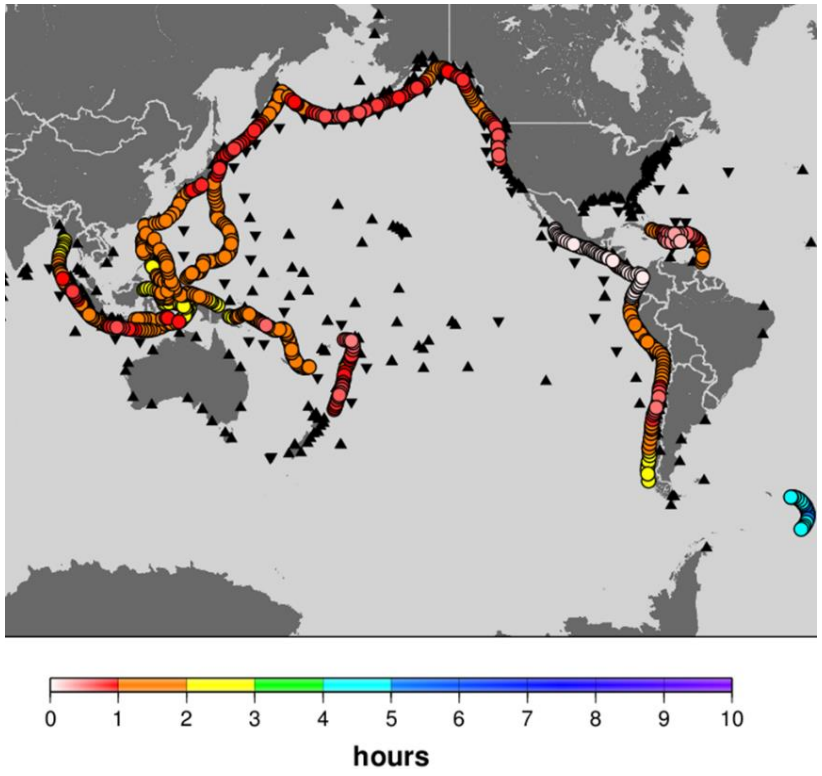
More frequent transmissions allow the TWC's to confirm the existence or non-existence of a destructive tsunami more quickly.

This is important because with every hour a tsunami warning remains in effect, any where from 500km to 1000km of additional coastline is placed in a warning depending upon where the earthquake occurred.

Tsunami Detection time at three Sea-Level Stations in 2005 and 2011



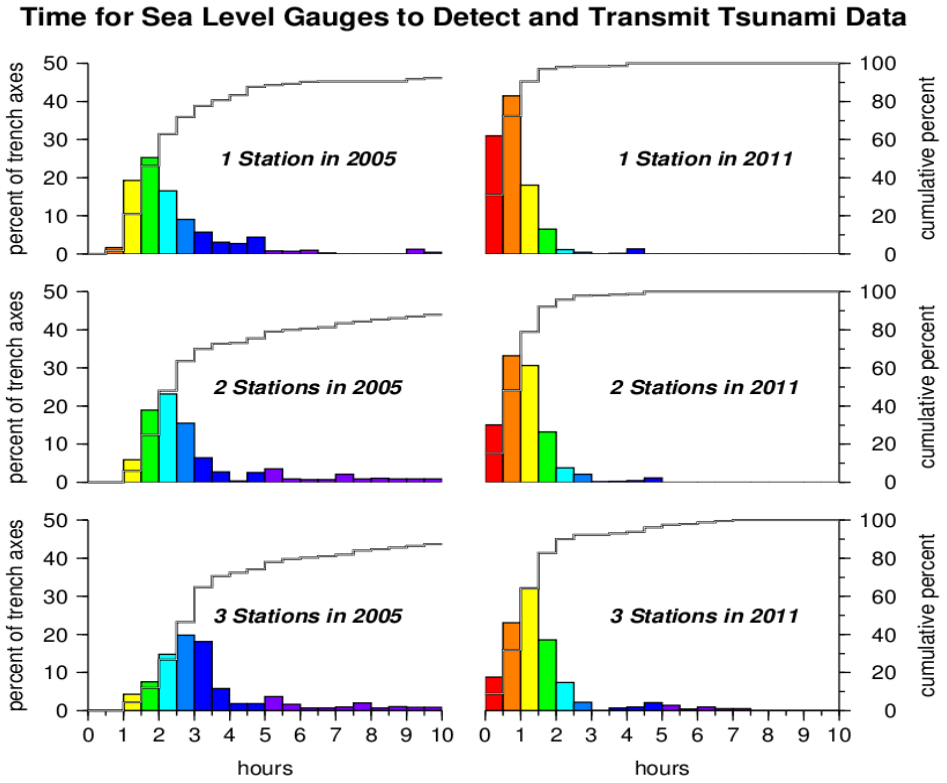
2005



2011

(Slide provided by N. Becker & S. Weinstein, PTWC, NOAA)

Tsunami Detection Time Histograms

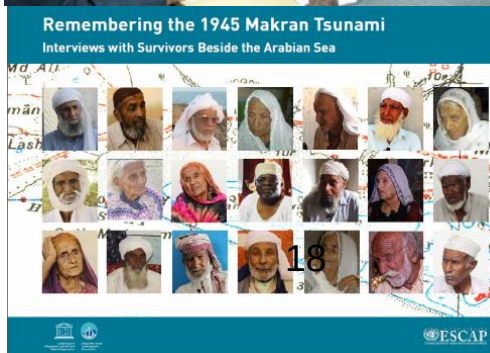


The increase in the number of stations and in the frequency of Data Transmissions over 6 years have decreased the wait time for three sea-level stations to report evidence of a tsunami to the extent that in 2011 the wait time in many cases is shorter than the wait time for just one station in 2005!

This is real progress! (Slide provided by N. Becker & S. Weinstein, PTWC, NOAA)

Pilar 3: Awareness & Response

- Education Material for NTWCs, emergency managers, communities, schools, tourism, etc in multiple languages including posters, booklets, videos, comics, stickers, guidebooks and leaflets.
- Over 100 capacity development workshops on Standard Operating Procedures for NTWC, DMO, staff and/or Media
- Indian Ocean Tsunami Information Center (IOTIC) in Jakarta hosted by BMKG
- 70th Anniversary of 1945 Makran tsunami commemorative events held in Iran, Pakistan, India and Oman
- Indian Ocean-wide (IOWave) exercises held every two years
- World Tsunami Awareness Day (WTAD)



Exercise Indian Ocean Wave 2018

- In the Indian Ocean, four IOWave Exercises have been conducted in 2009, 2011, 2014 and 2016.
- All 24 Indian Ocean Member States involved their NTWCs and 12 involved Communities in IOWave16 - 59,000 persons evacuated.
- IOWave18 on 04 - 05 September 2018
- NAVAREA Coordinators will be notified of the Exercise

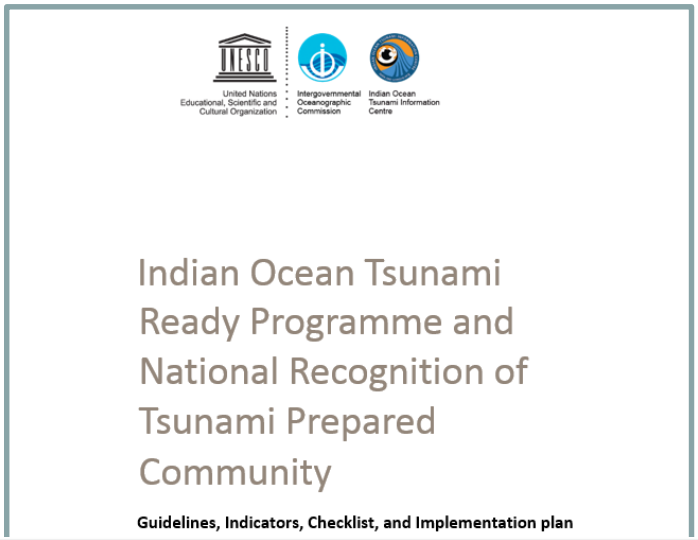
a) Indian school children preparing for Exercise Indian Ocean Wave 2016 in Odisha, India.

Scenario 1 – Makran Trench		Scenario 2 – Sunda Trench	
Date:	Tuesday 4 September 2018	Date:	Wednesday 5 September 2018
Time:	0600 UTC	Time:	0300 UTC
Magnitude:	9.0 Mw	Magnitude:	9.3 Mw
Depth:	10 km	Depth:	10 km
Latitude:	24.8 N	Latitude:	3.3 N
Longitude:	58.2 E	Longitude:	96.0 E
Location:	Off Coast of Iran	Location:	Northern Sumatra, Indonesia

IOWave18

Indian Ocean Tsunami Ready

Workshop - BMKG, Jakarta Indonesia
6-8 September 2017
18 Member States; 34 DMO Participants



Community Tsunami Ready Indicators	
CTRI 1	Have Community Tsunami Risk Reduction Plan
CTRI 2	Have designated and mapped tsunami hazard / inundation zones
CTRI 3	Have a public display of tsunami information
CTRI 4	Produce easily understood tsunami evacuation maps as determined to be appropriate by local authorities / collaboration with communities
CTRI 5	Develop and distribute outreach and public education materials
CTRI 6	Hold at least three outreach or educational activities annually
CTRI 7	Conduct an annual tsunami community exercise
CTRI 8	Address tsunami hazards in the community's Emergency Operations Plan (EOP)
CTRI 9	Commit to supporting the Emergency Operations Centre (EOC) during a tsunami incident, if an EOC is open and activated.
CTRI 10	Have redundant and reliable means for a 24-hour warning point (and EOC if activated) to receive official tsunami threats
CTRI 11	Have redundant and reliable means for a 24-hour warning point and/or EOC to disseminate official tsunami alerts to the public

What: A **community performance-based programme** that facilitates tsunami preparedness as an active collaboration of the public (community), community leaders, local and national emergency management agencies.

Main goal

- To **improve coastal community preparedness** for tsunami emergencies and to minimise the loss of life and property.
- To ensure **structural and systematic approach** in building community preparedness

How

- Bringing the **ownership of preparedness to the community** ➔ Voluntary and Bottom Up.
- A collaborative effort to meet a level of tsunami preparedness through the achievement of fulfilling a set of established best practice guidelines and indicators.

Benefit of IOTR:

- Strengthens tsunami preparedness of coastal communities through structural and systematic approach
  - Improved assessments of Hazards, Risk, Inundation, and Evacuation
  - Improved early warning systems/warning chain, EOP, and EOC
  - Improved/Increases public awareness, understanding of tsunami threat, build preparedness, and ensures exercises.
- Improves community pre-planning
- **Strengthens preparedness for multihazards**
- Encourages a consistent and sustainable approach
- Contributes to the aims of the Sendai Framework 2015-2030 targets and priorities for action, i.e. Minimises' loss of life and property

Examples: CARIBE-EWS Tsunami Ready, US TsunamiReady

IOTWMS – Focus Areas

- Sustenance and Enhancement of the end-to-end system
- Greater emphasis on community awareness and preparedness → “Last Mile”
- Indian Ocean Tsunami Ready Piloting
- Regional cooperation for “Makran Subduction Zone”
- Capacity Assessment of Tsunami Preparedness
- Capacity Development

Calendar of Activities

- 2nd Integrated Meetings, June 26 – July 14 2018, India
  - Training on Tsunami Emergency Maps Plans and Procedures (TEMPP-2)
  - Training on Warning Centre Operations and SOPs
  - Working Group & Task Team Meetings
- Online Capacity Assessment of Tsunami Preparedness, June 2018
- Exercise IOWave 18, September 04 – 05, 2018
- Post-IOWave 18 Workshop, November-2018
- ICG/IOTWMS 13 SG Meeting, November 2018
- TEMPP-3, 2018, Indonesia
- Documenting the impacts of Ambon & Flores Tsunamis
- Awareness and Education Materials on Distant Tsunami in Indian Ocean
- TOWS-WG, February 2019, Paris
- ICG/IOTWMS XII, 3 – 6 March 2019, Iran

Requests to NIO-HC and Member States

- Densify sea level networks particularly nearby tsunamigenic sources
- Share sea level data relevant to tsunami detection
- Invite IOTWMS NAVAREA coordinators to participate in IOWave18 exercise (4 – 5 September 2018)
- Acknowledge the importance of high resolution bathymetry for Tsunami modelling and forecasting and encourage sharing of such data

UN Decade of Ocean Science for Sustainable Development

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

The UNGA-72 Omnibus Resolution on Ocean Affairs and Law of the Sea 6 December 2017

- **Proclaimed the UN Decade of Ocean Science for Sustainable Development 2021-2030, within existing structures and available resources, and calls upon the IOC to prepare an implementation plan for the Decade in consultation with (everyone)**

Objectives:

- **Knowledge of the ocean for Sustainable Development**
- **Cumulative stressors and ecosystem-based management**
- **Ocean-related hazards**
- **Oceanographic infrastructure, technology**
- **Scientific and technical capacity and education, ocean literacy**
- **Partnership, cooperation, coordination, and communication**

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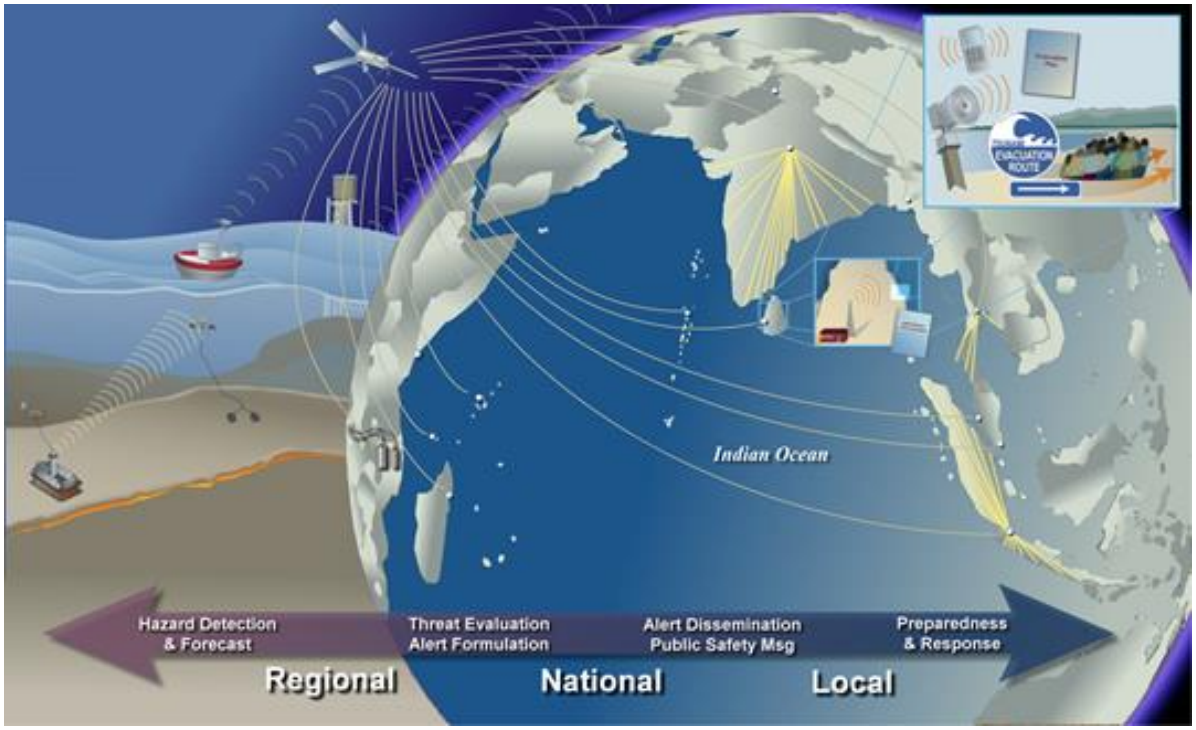

www.ioc-tsunami.org/iotwms