Indian Ocean Tsunami Warning and Mitigation System

Pattabhi Rama Rao Eluri
Vice-Chair, ICG/IOTWMS

On behalf of

Prof. Dwikorita Karnawati
Chair, ICG/IOTWMS
ICG/IOTWMS Member States

Tsunami Service Providers
Australia, India, Indonesia

National Tsunami Warning Centres
/Tsunami Warning Focal Points /
Tsunami National Contacts of
IOTWMS Member States
Governance

UNESCO/IOC Assembly/Executive Council

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

Task Team Disaster Management & Preparedness

Task Team Tsunami Watch Operations

Intergovernmental Coordination Group
Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)
Chair: Prof. Dwikorita Karnawati (Indonesia)
Vice Chairs: Dr. Behrouz Abtahi (Iran)
Vice Chair: Mr. Pattabhi Rama Rao (India)
Steering Group: Officers, WG Chairs/VCs

Task Team – IOWAVE20
Chair: Mrs. Weniza (Indonesia)

Task Team – Scientific Tsunami Hazard Assessment for Makran
Chair: Dr. Juma Al-Maskari (Oman)

Task Team – Tsunami Preparedness for near-field tsunami hazard
Chair: Dr. Akbarpour Jannat (Iran)

ICG Caribbean & Adjacent Seas (CARIBE-EWS)

ICG Pacific Tsunami Warning & Mitigation System (PTWS)

ICG NE Atlantic & Mediterranean Seas (NEAMS-TWS)

IOC Secretariat, Tsunami Unit

IOC Tsunami Unit (Paris)
Head: Thorkild Aarup

IOTWMS Secretariat (Perth)
hosted by Australia (BoM)
Head: Srinivasa Kumar Tummala

IOTIC (Jakarta)
hosted by Indonesia (BMKG)
Head: Ardito Kodijat
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
Pillar 1: Risk Assessment & Reduction

- Tools, Methods & Guidelines for Tsunami Risk Assessment published
- Indian Ocean Probabilistic Regional Tsunami Hazard Maps published
- 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
- Assessment and awareness of Makran tsunami hazards
- Expert Consultation on Tsunami Hazard Assessment of the MSZ
- Capacity Assessment of Tsunami Preparedness of IOTWMS Member States – Status Report 2019
Pillar 2: Detection, Warning & Dissemination

- Tsunami Service Framework
  - 3 inter-operable Tsunami Service Providers (Australia, India, Indonesia)
  - Network of NTWCs, TNCs, TWFPs

- Service Definition: AoS, ESZ, CFZs, Thresholds, Products (Public / Exchange), Formats, Dissemination Methods

- Greatly expanded seismic and sea level monitoring networks

- Harmonised threat information by TSPs

- National warnings Sovereign responsibility of authorized national agencies

- Yearly performance assessments against Key Performance Indicators

- 6-monthly communications test to identify and fix any issues

- Interim Service – JMA, PTWC
IOTWMS Area of Coverage
Indian Ocean Tsunami Warning and Mitigation System urge all countries and institutions to adopt and practice open data policies for real-time seismic, GNSS and sea-level data.
Operational Elements of Tsunami Warning

Seismological Data → TSP-1 → NTWC1

Model Results → TSP-n → NTWC2

Sea level Data → TSP-n → NTWCn

IOTWMS KPIs:
- EQ Info: 10 Min
- Tsunami Threat Info: 20 Min

Warnings
- NDMO
- LDMO
- Media
- Public

Threat Information
- GTS
- SMS
- FAX
- Email
- Web

TV
- Radio
- SMS
- Email
- Web

SIRENS
Performance of the IOTWMS COMMs Tests

TSP to NTWC Message Delivery Success Rates

NTWC Web Access and Reporting Rates
## Performance of the IOTWMS

### TSP KPIs 2019 (Jan – Dec)

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Target: 10 mins (% met)</td>
<td>100%</td>
<td>0.11 (100%)</td>
<td>18.6 (71.9%)</td>
<td>20.5 (75.0%)</td>
<td>23 min (33.3%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>15.8 min (16.1%)</td>
<td>100%</td>
<td>0.11 (100%)</td>
<td>18.6 (71.9%)</td>
<td>20.5 (75.0%)</td>
<td>23 min (33.3%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>10.2 min (58.8%)</td>
<td>100%</td>
<td>0.09 (100.0%)</td>
<td>20.0 (82.4%)</td>
<td>21.7 (88.3%)</td>
<td>26.6 min (50.0%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Target: 10 mins (% met)</td>
<td>100%</td>
<td>0.19 (91.3%)</td>
<td>17.9 (82.6%)</td>
<td>19.2 (86.9%)</td>
<td>17.3 min (100%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>10.1 min (69.6%)</td>
<td>100%</td>
<td>0.19 (91.3%)</td>
<td>17.9 (82.6%)</td>
<td>19.2 (86.9%)</td>
<td>17.3 min (100%)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
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### NOTES
- KPI 1: Australia issued 3 events where the initial EQ estimate was <M6.5 which add 2.8s to the average response time.
- KPI 6: Australia issued 3 No Threat Bulletin.
- India issued 1 Potential Threat Bulletins and 1 No Threat Bulletin.
- Indonesia issued 3 No Threat Bulletin.
- KPI 7,8: No events caused threat-level tsunami waves.
Pillar 3: Awareness & Response

- Education Material for NTWCs, emergency managers, communities, schools, tourism, etc in multiple languages
- Indian Ocean-wide (IOWave) Exercises held every two years
- Piloting of Indian Ocean Tsunami Ready (IOTR) Programme
- 3 Trainings on Tsunami Emergency Maps, Plans and Procedures (TEMPP) for NTWC and DMO staff
- Over 100 capacity development workshops on Standard Operating Procedures for NTWC, DMO, staff and/or Media
- CABARET & INTERFACE Projects – Warning Chains, SOPs
- Documenting the impacts of past Tsunamis - Makran, Ambon, Flores, East Java
- 70th Anniversary of 1945 Makran Tsunami commemorative events
- World Tsunami Awareness Day (WTAD) – 05 November
- Indian Ocean Tsunami Information Center (IOTIC) supported by BMKG, Indonesia (2017-2022)
In the Indian Ocean, five IOWave Exercises have been conducted in 2009, 2011, 2014, 2016 and 2018.

- **IOWave18 during Sep 2018** - All 24 Indian Ocean Member States involved their NTWCs and 11 involved Communities in IOWave18.
- Approximately 116,000 persons evacuated.
- India and Oman evaluated their community preparedness against Indian Ocean Tsunami Ready Indicators.
- **International Observers** in Iran (APDIM-UNESCAP) and Sri Lanka (Univ. of Huddersfield).
- **TSP Australia launched a public website** to display the summary of national tsunami warnings issued by countries in the Indian Ocean was launched during the Exercise.
- **IOC-UNESCO conducted an online assessment** that was co-ordinated in-country by the IOWave18 National Contacts.

### Member State Evacuations (# of persons)

<table>
<thead>
<tr>
<th>Member State</th>
<th>Evacuations (# of persons)</th>
</tr>
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<tbody>
<tr>
<td>India</td>
<td>104,326</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>4,147</td>
</tr>
<tr>
<td>Oman</td>
<td>3,225</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,941</td>
</tr>
<tr>
<td>Mauritius</td>
<td>553</td>
</tr>
<tr>
<td>Tanzania</td>
<td>300</td>
</tr>
<tr>
<td>Thailand</td>
<td>300</td>
</tr>
<tr>
<td>Kenya</td>
<td>200</td>
</tr>
<tr>
<td>Iran</td>
<td>200</td>
</tr>
<tr>
<td>Pakistan</td>
<td>55</td>
</tr>
<tr>
<td>Seychelles</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>115,959</strong></td>
</tr>
</tbody>
</table>
India
- Piloted in 6 villages of Odisha
- OSDMA plans to implement in all 328 tsunami prone communities in Odisha
- National Board set up by INCOIS for implementing IOTR in India
- 2 Villages of Odisha submitted application for regional recognition by IOC
- International recognition by IOC UNESCO will help mobilise resources for implementing in rest of the communities.

Oman
- Piloted IOTR in AlSawadi village
- First time conducted the tsunami exercise at the community level
- Challenge in community interest
- To continue piloting IOTR taking advantage of IOWave exercises
- To establish National Committee for Tsunami Ready
- Adoption of indicators (Community – LDMO)

Indian Ocean Tsunami Ready (IOTR)

- Finalised Indian Ocean Tsunami Ready Guidelines and pilot implementation plan
- India and Oman piloted IOTR indicators in 7 communities during IOWave18

Tsunami Ready Indicators

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

Current Status

- The National Board along with IOTWMS & IOTIC delegates visited two Tsunami Ready piloted villages of Boxipalli (Venkatraipur) of Ganjam district and Noliasahi of Jagatsinghpur district in Odisha during 13-14 December 2019 and evaluated the Indicators.

- After the verification of implementation of the Tsunami Ready indicators at those villages, the National Board decided to recognize them nationally and forwarded the applications to ICG/IOTWMS Secretariat for UNESCO-IOC recognition.

- India will be the first country and the communities in Odisha to implement UNESCO-IOC Tsunami Ready programme in the Indian Ocean region.

National Board and IOTWMS delegates Visit Photos Boxipalli (Venkatraipur) and Noliasahi villages
## Detection Warning and Dissemination

- **Tsunami Risk Assessment, Awareness & Response**
  - Review Warning Chains/SOPs and enhance Community Preparedness for near-field tsunamis with emphasis on self-evacuation
  - Emphasise role of DMOs in strengthening Warning Chains and importance of their participation in tsunami governance and technical forums
  - Continue piloting of Indian Ocean Tsunami Ready (IOTR) in vulnerable communities, with IOC-UNESCO recognition

- **North-West Indian Ocean Region**
  - Strengthen end-to-end TEWS in the NWIO – Hazard Assessment, Observing Networks, near-field Warning Chains
  - Implement recommendations of the MSZ Expert Consultation (8 March 2019)
  - Implement UNESCAP project on “Strengthening tsunami early warning in the NWIO region through regional cooperation”

## Capacity development

- **Organise** Indian Ocean Tsunami Exercise in late-2020 (IOWave20)
- **Continue to conduct** NTWC/DMO/Media regional trainings on Standard Operating Procedures
- **Organise** in-country trainings of Tsunami Evacuation Maps, Plans and Procedures (TEMPP)
- **Organise** Palu & Sunda Strait Lessons Learnt Workshop in 2019 and post-IOWave20 Workshop in 2020
- Prioritise future CD activities based on results of the survey on Capacity Assessment of Tsunami Preparedness

## Tsunami Risk Assessment, Awareness & Response

- **Seismic & Sea level networks** – determine optimal networks, enhance station density, promote data sharing and adopt new technologies (GNSS, Under-sea cables, etc),
- **Importance of Coastal Bathymetry & Topography data** for accurate modelling and forecasting of tsunamis
- **Continuing issues with Vandalism of Tsunami Buoys**

## Governance

- **Continue existing Working Groups** on
  - Tsunami Risk, Community Awareness and Preparedness
  - Tsunami Detection, Warning and Dissemination
  - Sub-Regional Working Group for the North West Indian Ocean
- **Three new inter-sessional Task Teams** on
  - Tsunami Preparedness for a near-field Tsunami Hazard
  - Scientific Tsunami Hazard Assessment of the MSZ
  - Exercise Indian Ocean Wave 2020
- **Adopted the Medium Term Strategy (2019 – 24), Status Report, Service Definition Document and NTWC User Guide**
**Recent Activities**

**Strengthening Tsunami Warning in the North West Indian Ocean**

- Project funded by UNESCAP Tsunami Trust Fund, being implemented by IOC in India, Iran, Pakistan and Oman
- Project initiation meetings hosted by DGMET, Muscat, Oman, 01 to 06 Sep 2019
  - High Level Conference on near-field tsunamis in the Makran
  - Expert Meeting for establishment of a working group and working process on Risk Knowledge
- 62 participants from NTWCs, DMOs, Seismologists and Modellers from the region and international experts
- Working process established for enhancing national tsunami warning chains to suit near-field tsunami threat
- Initiated development of a unified PTHA for the Makran region

**Palu and Sunda Strait Lessons Learnt Symposium**

BMKG, Jakarta, Indonesia, 26 to 28 Sep 2019

- 270 participants/experts from 24 Countries
- Tsunamis from Near-field, atypical sources complex from early warning perspective
- Need for new observation technologies and more “real-time” data sharing
- Need to revise national dissemination mechanisms and SOPs for near-field threat
- Importance of community preparedness to respond to both official warning and natural signs
- Importance of UNESCO IOC Tsunami Ready
- Launch of publication on Limitations & Challenges of Early Warning Systems
Recent Activities

Regional Workshop on strengthening tsunami warning chain to critical infrastructure
BMKG, Jakarta, Indonesia, 20 – 22 Nov 2019
- 40 participants from NTWCs, Ports, Harbours, Coastal airports
- Commemoration of 15 years of Indian Ocean Tsunami and WTAD-2019
- Identified gaps and priorities for tsunami hazard assessments and warning chains for critical infrastructure

Training on UNESCO - IOC Tsunami Ready
INCOIS, Hyderabad and OSDMA, Odisha, India, 10 – 14 Dec 2019

Meeting of the Expert Teams on PTHA for the Makran
INCOIS, Hyderabad, India, 02 – 04 Dec 2019

ICG/IOTWMS Intersessional Meetings
BMKG, Jakarta, Indonesia, 29 Sep to 02 Oct 2019
- 40 participants/experts from 9 Member States
- 14th Meeting of the Steering Group
- Meeting of the Working Group 1 on Tsunami Risk, Community Awareness and Preparedness
- Meeting of the Working Group 2 on Tsunami Detection, Warning and Dissemination
- Meeting of the Task Team on Tsunami Preparedness for near-field tsunami hazard
- Meeting of the Task Team on IOWave20

Important Activities for 2020
- NTWC/DMO/Media SOP Workshops
  - Pakistan: 20 – 24 February 2020
  - Iran: May 2020
  - India: August 2020
- PTHA Expert Team Meeting: May / Aug 2020
- IOwave20: 7, 13, 20 Oct 2020
- WTAD-20 Regional Workshop: Nov 2020
- Makran Scientific Symposium and IOTWMS Integrated meetings : Nov / Dec 2020
- Support National Trainings on Tsunami Ready
Thank you for your attention