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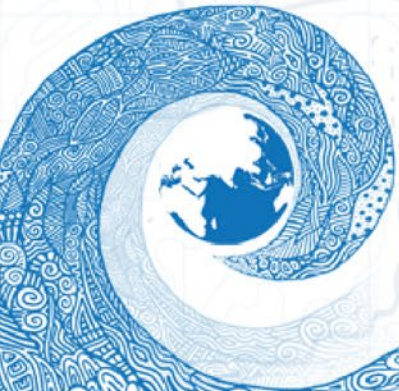


Intergovernmental
Oceanographic
Commission

TSP-India Status Report for *Intersessional Period*

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INCOIS, India



Intersessional Meeting of the ICG/IOTWMS November 2021



TSP India Activities during Intersessional Period

- Sustained the Observational Network and TSP Services
- Monitored 62 Tsunamigenic earthquakes and issued first bulletins for 46 events as per Service Definition
- Update in CFZs of India
- New DSS
- Event Database and KPI Generator for all 3 TSPs
- Probabilistic Tsunami Hazard Assessment for Makran Subduction Zone
- Participated in IOWAVE20 & IOTWMS Communications Test conducted during reporting period
- Implementation of CAP for National and TSP services for improving dissemination services
- TSP India Performance



Observation Network

➤ Seismic Network:

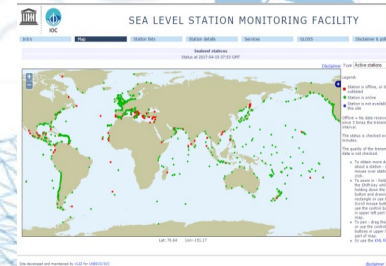
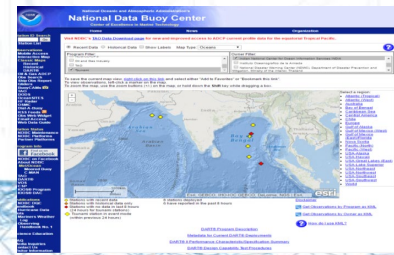
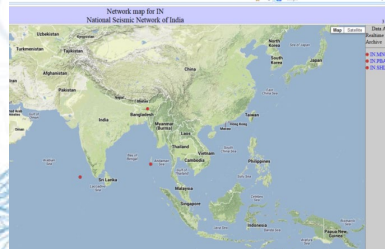
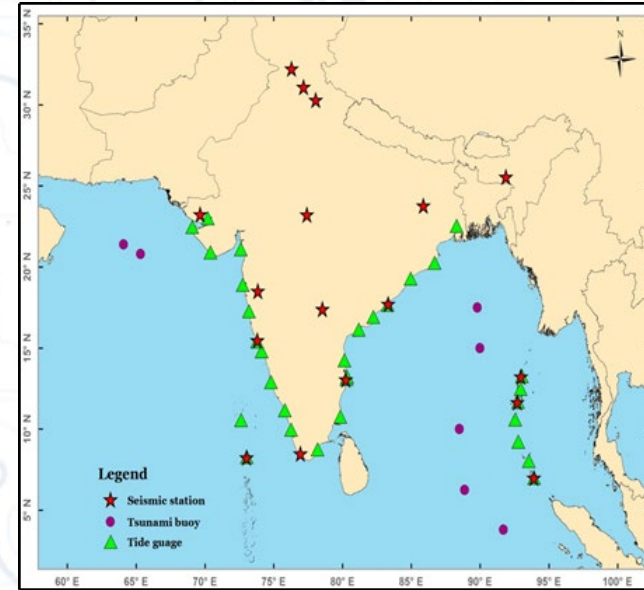
- Real-Time Seismic Network of 17 stations and ~400 international stations
- Currently, ITEWC is capable of estimating earthquake parameters less than 10 minutes after the event using SEISCOMP 4.0 (UPGRADED)
- Updated with W-Phase moment tensor module
- Shares data from 3 Indian stations

➤ Tsunami Buoy Network:

- INCOIS-NIOT Tsunami Buoys 3 (out of 7) are operational
- Receives data from ~ 50 international real-time tsunami buoys
- Shares data from 7 Indian stations

➤ Tide gauge Network:

- INCOIS established real-time network of 36 tide-gauge stations
- Receives data from 350 international real-time tide-gauge stations
- Shares data from 8 Indian stations



Impact of COVID-19 pandemic

➤ Immediate Impact

- **Observational components:**

- 1) Tide Gauge (Impact on 6 out of 36)
- 2) Tsunami Buoys (Impact on 2 out of 7)
- 3) No impact on Seismic network

- **Operations:** Due to national lockdown, ITEWC functioned with minimal manpower with longer duty hours and engaged operational staff in shifts who resides at campus

➤ Near-term Impact

- Observational components: Equipment maintenance activity got delayed due to lockdown and transport issues
- Operations: No impact. ITEWC planned according to the situation

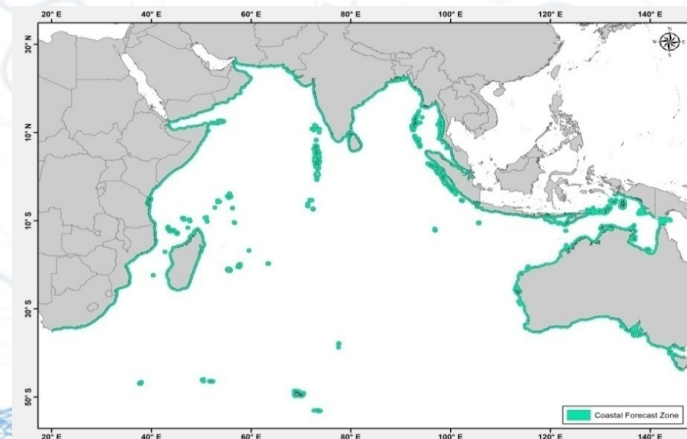
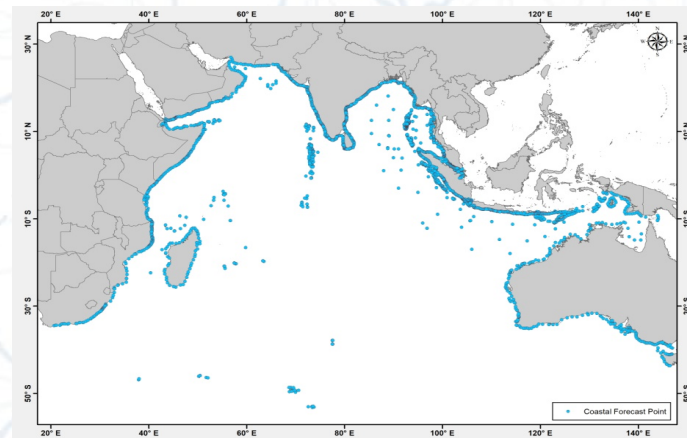
➤ Long-term Impact

- Observational components: No impact. ITEWC planned according to the situation
- Operations: No impact. ITEWC planned according to the situation



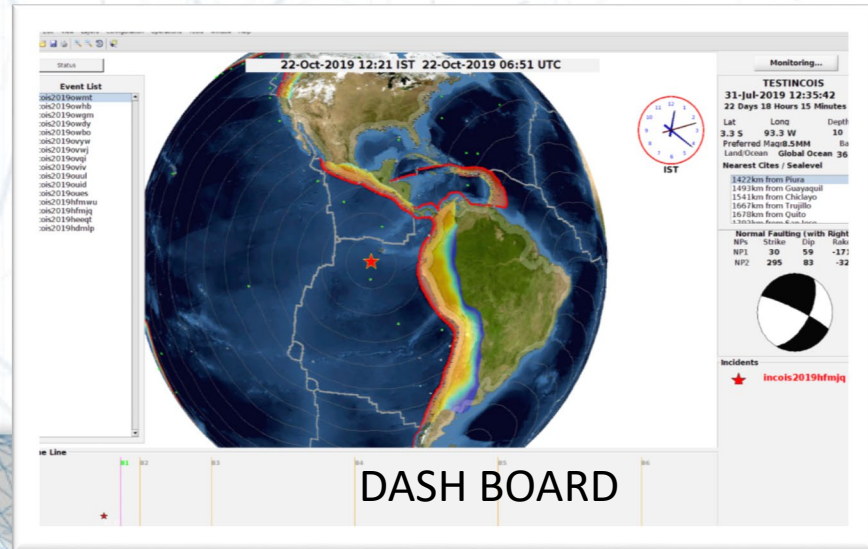
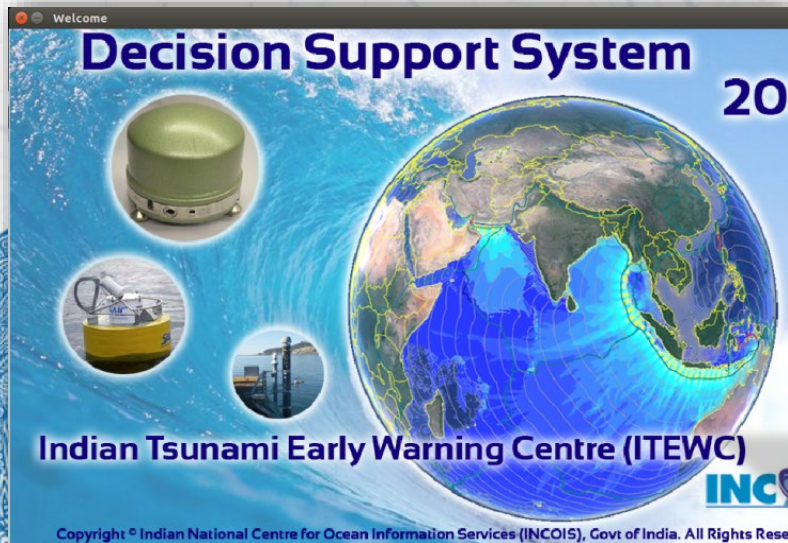
UPDATES In CFP and CFZ Version 2018 Mar 14

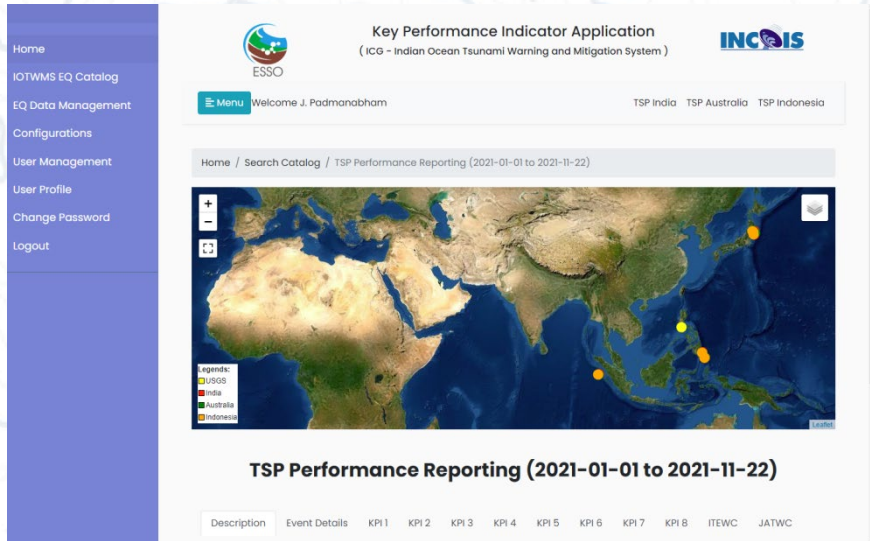
- ❑ CFZs : 581 and CFPs : 2251
- ❑ As part of NTWC SL III operational requirements, added 9 CFZs and modified 1 CFZ of India.
- ❑ Total **79** CFZ are identified for India and generated official list of Tsunami hazard districts approved by NDMA, India
- ❑ Linking CFZs With new GADM (Version 3.6).
- ❑ Verification of Place names, District, State/Province and Country names, naming standards against the ISO standard documents is under progress.
- ❑ CFZ files will be circulated to TSP Australia and Indonesia for comments and suggestions and will be released as a new version with approved date.



New– DSS Version (under Development & Testing)

- New Decision Support System is under development and Environment setup is under progress
- Access to SEISCOMP system for real-time Seismic information
- Integrated with International Sea level Data (Tsunami Buoys & Tide gauges), Scenario Database, **ADCIRC** real-time inundation modeling for Service Level –III, **TUNAMI-FF** for real-time modeling of Global Earthquakes $M \geq 8.0$,
- Dissemination Mechanism and Database for Web publishing
- **Integrated approach** including sea level inversion integration under progress





Home

JOTWMS EQ Catalog

EQ Data Management

Configurations

User Management

User Profile

Change Password

Logout

Key Performance Indicator Application
(ICG - Indian Ocean Tsunami Warning and Mitigation System)

ESSO

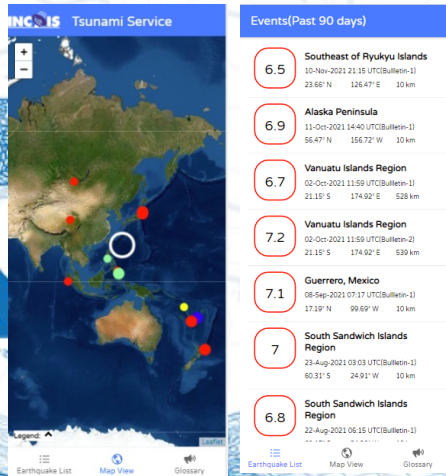
Menu Welcome J. Padmanabham

TSP India TSP Australia TSP Indonesia

Home / Search Catalog / TSP Performance Reporting (2021-01-01 to 2021-11-22)

TSP Performance Reporting (2021-01-01 to 2021-11-22)

Description Event Details KPI 1 KPI 2 KPI 3 KPI 4 KPI 5 KPI 6 KPI 7 KPI 8 ITEWC JATWC



ICG Tsunami Service

Events(Past 90 days)

6.5	Southeast of Ryukyu Islands	10-Nov-2021 21:15 UTC(Bulletin-1)	23.66° N 126.47° E 10 km
6.9	Alaska Peninsula	11-Oct-2021 14:40 UTC(Bulletin-1)	56.47° N 156.72° W 10 km
6.7	Vanuatu Islands Region	02-Oct-2021 11:59 UTC(Bulletin-1)	21.15° S 174.92° E 528 km
7.2	Vanuatu Islands Region	02-Oct-2021 11:59 UTC(Bulletin-2)	21.15° S 174.92° E 539 km
7.1	Guerrero, Mexico	08-Sep-2021 07:17 UTC(Bulletin-1)	17.19° N 99.69° W 10 km
7	South Sandwich Islands Region	23-Aug-2021 03:03 UTC(Bulletin-1)	60.31° S 24.91° W 10 km
6.8	South Sandwich Islands Region	22-Aug-2021 06:15 UTC(Bulletin-1)	60.31° S 24.91° W 10 km

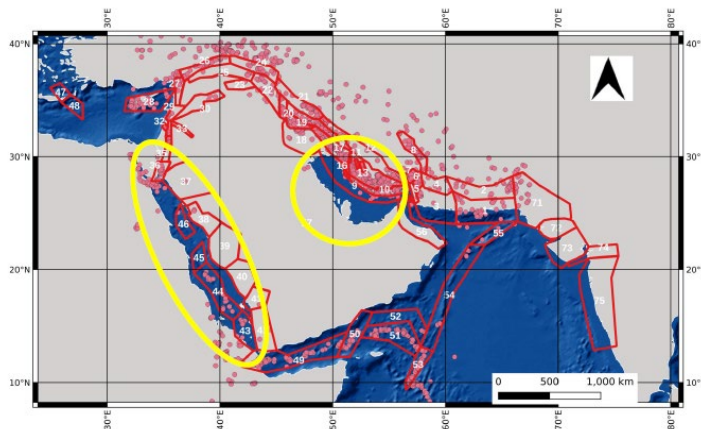
Earthquake List Map View Glossary

Event Database and KPI Generator & mobile App

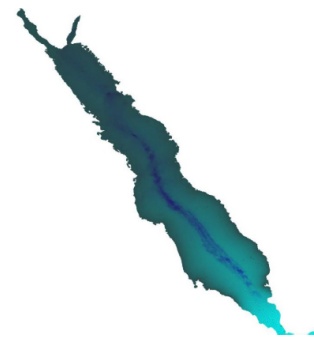
- TSP India has developed the Key Performance Indicator Application for ICG – IOTWMS.
- TSP India has developed the Mobile App

Probabilistic Tsunami Hazard Assessment

Source Zones

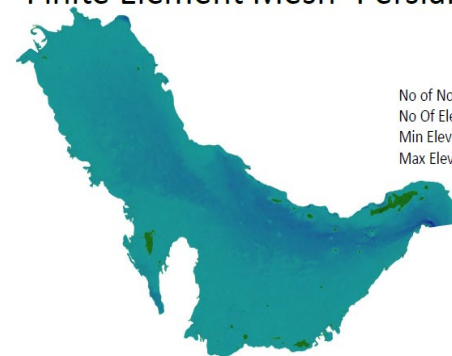


Finite Element Mesh - Red Sea



No of Nodes : 762592
No Of Elements: 1517276
Min Elevation : -2811.5 m
Max Elevation : 405.3 m

Finite Element Mesh - Persian Gulf



No of Nodes : 408106
No Of Elements: 810988
Min Elevation : -222.7 m
Max Elevation : 237.5 m

- Participating in UNESCAP project of PTHA for Makran Subduction Zone
- Initial benchmark PTHA model simulations run at INCOIS [India] with guidance from GFZ [Germany], INGV and University of Malaga.
- Examining the possibility of the tsunami threat in the neighbouring Persian Gulf and Red Sea.

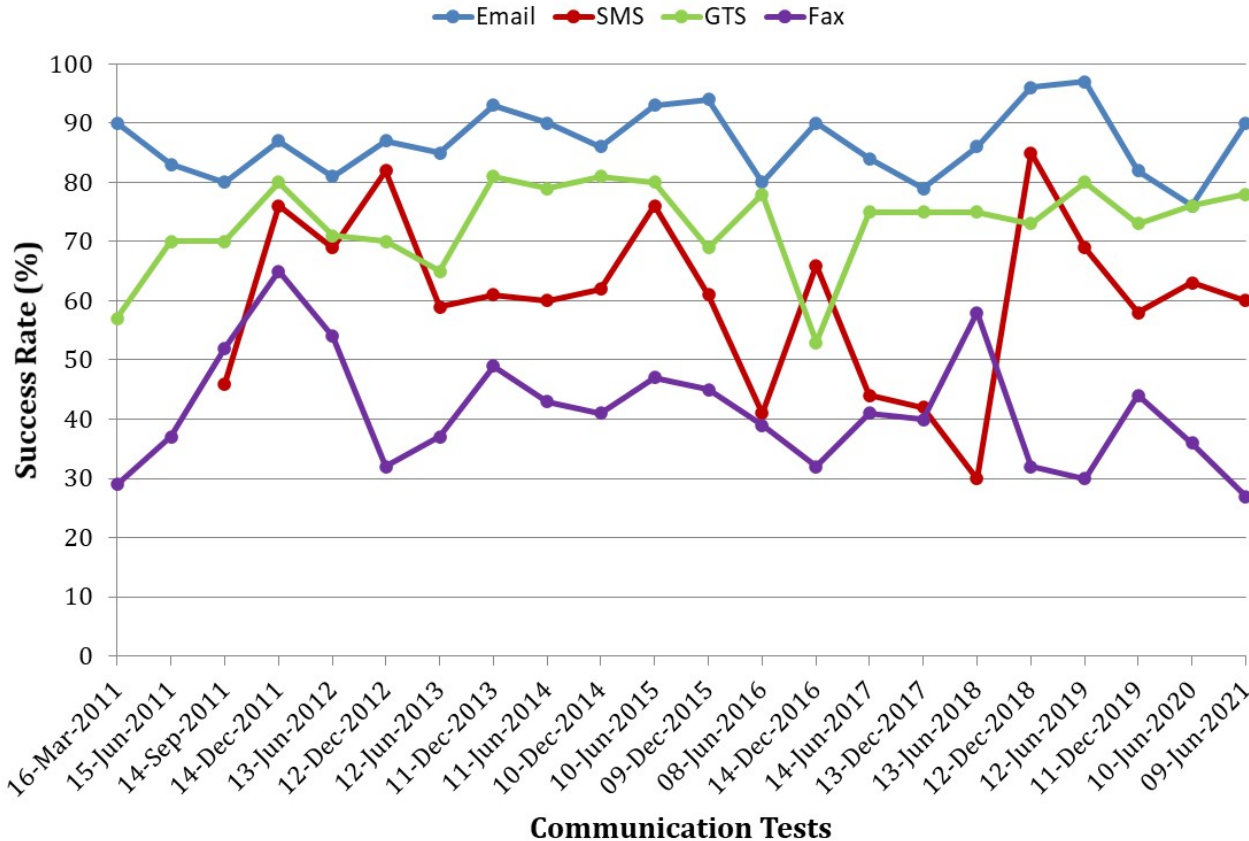
Tsunami Awareness & Response

- Participated in 4 Communication Tests (12 June 2019, 11 Dec 2019, 10 June 2020 and 09 June 2021)
- Participated in IOTWMS Pre and Post IOWave20 webinars during 28-30 September 2020 and 11-12 November 2020
- Participated in IOTWMS Regional SOP Workshop for Broadcasting Media and DMOs during 7-9 September 2021, 12-14 October 2021 and 26-28 October 2021



TSP-India Message delivery success in COMMs Test

TSP-India to NTWC Message Delivery Success Rates



From last COMMs Test (9 Jun 2021)

- Fax messages not received by Australia, Bangladesh, Comoros, France, Indonesia, Kenya, Madagascar, Mozambique, Pakistan, Seychelles, South Africa, Sri Lanka, United Arab Emirates, Yemen
- E-mail messages not received by Malaysia, Yemen
- SMS messages not received by Indonesia, Oman, Pakistan, Sri Lanka, Thailand, United Arab Emirates, Yemen

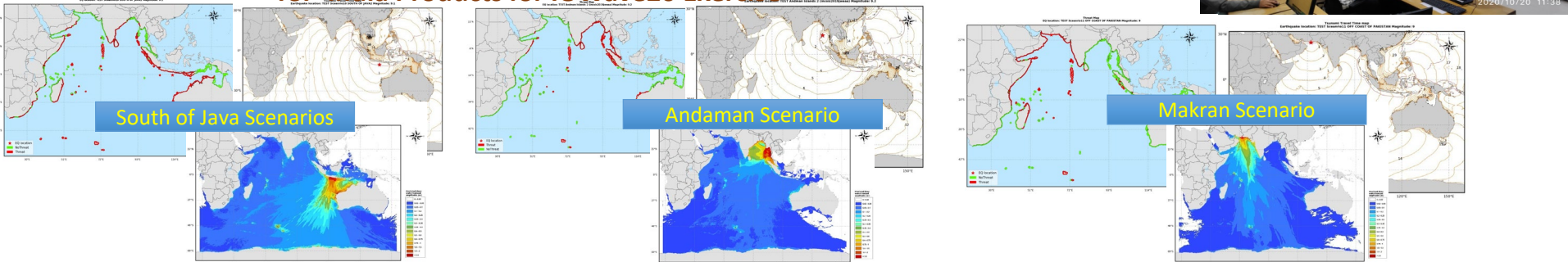
IOWave20 Exercise

- IOWave20 Exercise conducted by ICG/IOTWMS on 6th, 13th and 20th October 2020
- ITEWC issued bulletins to all NTCs in Indian Ocean Region on 3 days of exercises as a Tsunami Service Provider (TSP)
- TSP-India issued 4 bulletins (Type-I, II, III & IV) for each scenario
- Bulletins issued through Email, Fax, SMS, GTS and Website
- At National level, India participated the exercise on 13th and 20th October 2020

Event No	Date	Origin Time	Latitude	Longitude	Depth	Magnitude	Region Name
1	6-October-2020	0300 UTC	10.40S	112.80E	10km	9.1	South of Java, Indonesia
2	13-October-2020	0400 UTC	12.65N	93.50E	10km	9.2	Andaman Islands, India
3	20-October-2020	0600 UTC	24.80N	62.20E	10km	9.0	Off Coast of Pakistan



TSP-India Products for IOWave20 Exercise



TSP India Performance

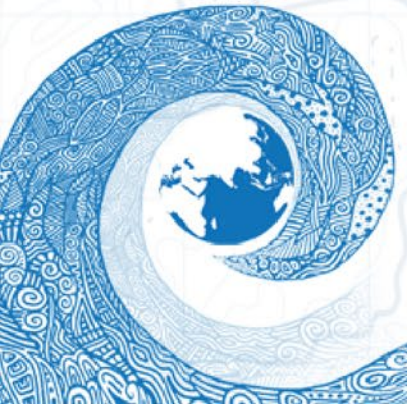
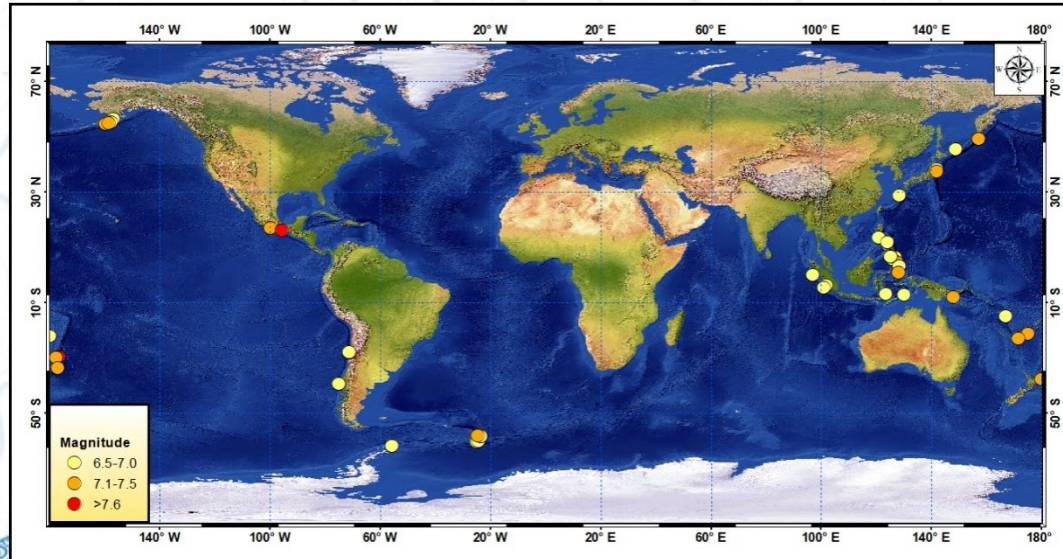
KPI 1: Elapsed Time of Issuing First Earthquake Bulletin after Earthquake – Target 10 minutes

Reporting Period October 01, 2019 to November 22, 2021

Total Number of Global Earthquakes M≥6.5	62#
Number of TSP INDIA events those crossed the USGS final M≥6.5	46@
Number of events those issued first bulletin by TSP INDIA	46
Average Elapsed Time to issue first Bulletin	11.5 min

USGS final magnitudes ≥ 6.5 were located in IOTWMS Earthquake Source Zone

@ for non-issue of earthquake bulletin for these events is because the initial magnitude was less than 6.5



TSP India Performance

KPI 2-Probability of Detection of Indian Ocean Earthquakes with Magnitude 6.8 or above – Target 100%

Reporting Period October 01, 2019 to November 22, 2021	
Total Number of Indian Ocean Earthquakes $M \geq 6.8$ (USGS)	NA
Number of Indian Ocean Events detected by TSP INDIA	NA
Number of events those issued first bulletin	NA

Target = 100%; Result = NA

There are no events with Magnitude 6.8 M or above with in Indian Ocean region



TSP India Performance

KPI 3: Accuracy of Earthquake Magnitude (Target 0.3)

KPI4: Accuracy of earthquake hypocenter Depth (Target 30km)

KPI 5: Accuracy of earthquake hypocenter Location (Target 30km)

Reporting Period October 01, 2019 to November 22, 2021

Total Number of Global Earthquakes $M \geq 6.5$

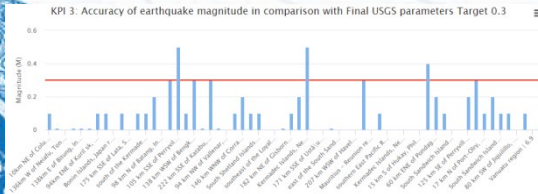
62#

Number of events those issued first bulletin

46*

USGS final magnitudes ≥ 6.5 were located in IOTWMS Earthquake Source Zone
(Indian Ocean, Pacific Ocean, South Atlantic)

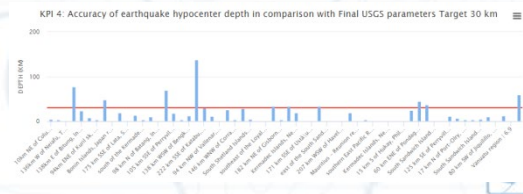
* for non-issue of earthquake bulletin for these events is because the initial magnitude
was less than 6.5



**Magnitude
difference: 0.15**



**Location difference:
25.4 km**



**Focal Depth difference:
35.3 km**

TSP India Performance

KPI 6: Elapsed Time of Issuing First Tsunami Threat Assessment Bulletin after Earthquake – Target 20 min

Reporting Period October 01, 2019 to November 22, 2021	
As per USGS final magnitude Number of Events Threat Assessment Bulletin need to be issued	2
Number of Events Threat Assessment Bulletin issued	2#
Number of Events for which "THREAT" Bulletin issued	0
Number of Events for which "NO THREAT" Bulletin issued	2
Average Elapsed Time for all Events	27 min

7.4 M South Sandwich Islands Region on 12 Aug 2021 : Though this event has no threat for the Indian Ocean, since there could be a wave activity as per TSP- Australia, TSP-India had also monitored this event closely and issued the type-II No threat Bulletin and Type=-IV Final bulletin with recorded sea-level observations.

Since the 7.4 magnitude is below the threshold of 8.0, hence, this event may not be considered for the KPI6 evaluation as per the SDD.

Event	Elapsed Time of First EQ Bulletin (min)	Elapsed Time of First Threat Assessment Bulletin (min)	Threat Assessment Threat Zones and Countries	No of Bulletins	Threat Cancel Time (mins)
M6.5 Southern Sumatra, Indonesia On 18 August 2020	09	25	-	2	No Threat Issued
M6.6 Off West Coast of Northern Sumatra On 14 May 2021	09	29	-	2	No Threat Issued

TSP India Performance

KPI 7: Probability of detection of tsunamis above threat threshold - Target: 100%

Reporting Period October 01, 2019 to November 22, 2021

Number of events those generated above threat threshold waves (> 50 cm) **None**

KPI 8: Accuracy of tsunami wave height predictions - Target: factor of 2

Event	Elapsed Time of First EQ Bulletin (min)	Elapsed Time of First Threat Assessment Bulletin (min)	Threat Assessment		Number of Bulletins Issued	Threat Cancel Time (mins)
			Threat Zones and Countries	Highest Predicted Wave Amplitude		
NA	NA	NA	NA	NA	NA	NA

TSP India Performance

Summary of Performance Indicators during the reporting period

S. No	Performance Indicator	Target	TSP India Performance
PI 1	Elapsed time of issuing first earthquake bulletin after earthquake	10 min	11.5 min
PI 2	Probability of Detection of IO EQ with Mw >= 6.5	100 %	100%
Accuracy of Earthquake Parameters, in comparison with final estimates from USGS			
PI 3	Magnitude	0.3	0.15
PI 4	Depth	30 km	35.3 km
PI 5	Location	30 km	25.4 km
PI 6	Elapsed time of issuing first tsunami threat assessment bulletin after earthquake	20 min	27 min
PI 7	Probability of detection tsunamis above threat threshold	100%	NA
PI 8	Accuracy of tsunami wave height predictions	Factor of 2	NA

Future Plans

- ❑ Operationalize the auto KPI system.
- ❑ Work on [Operational procedures \(SOP\)](#) for [atypical tsunami](#) sources such as Submarine landslides, Volcanic eruption and meteoric sources.
- ❑ Utilization of [real-time GNSS & SMA data](#) for rupture characterization of the tsunamigenic earthquakes.
- ❑ Mounting efforts on Integrated inversions for tsunami source characterisation
- ❑ Support IOTWMS MS to adopt CAP in their NTWC Services
- ❑ Continue to contribute strongly to IOTWMS activities in the next intersessional period, including:
 - The planning, conduct and reporting of biennial IOWave exercises
 - The planning, conduct and reporting of 6-monthly Communication Tests
 - Regular NTWC/DMO/Media SOP Training Workshops
 - ICG/IOTWMS Working Groups and Task Teams



THANK YOU

