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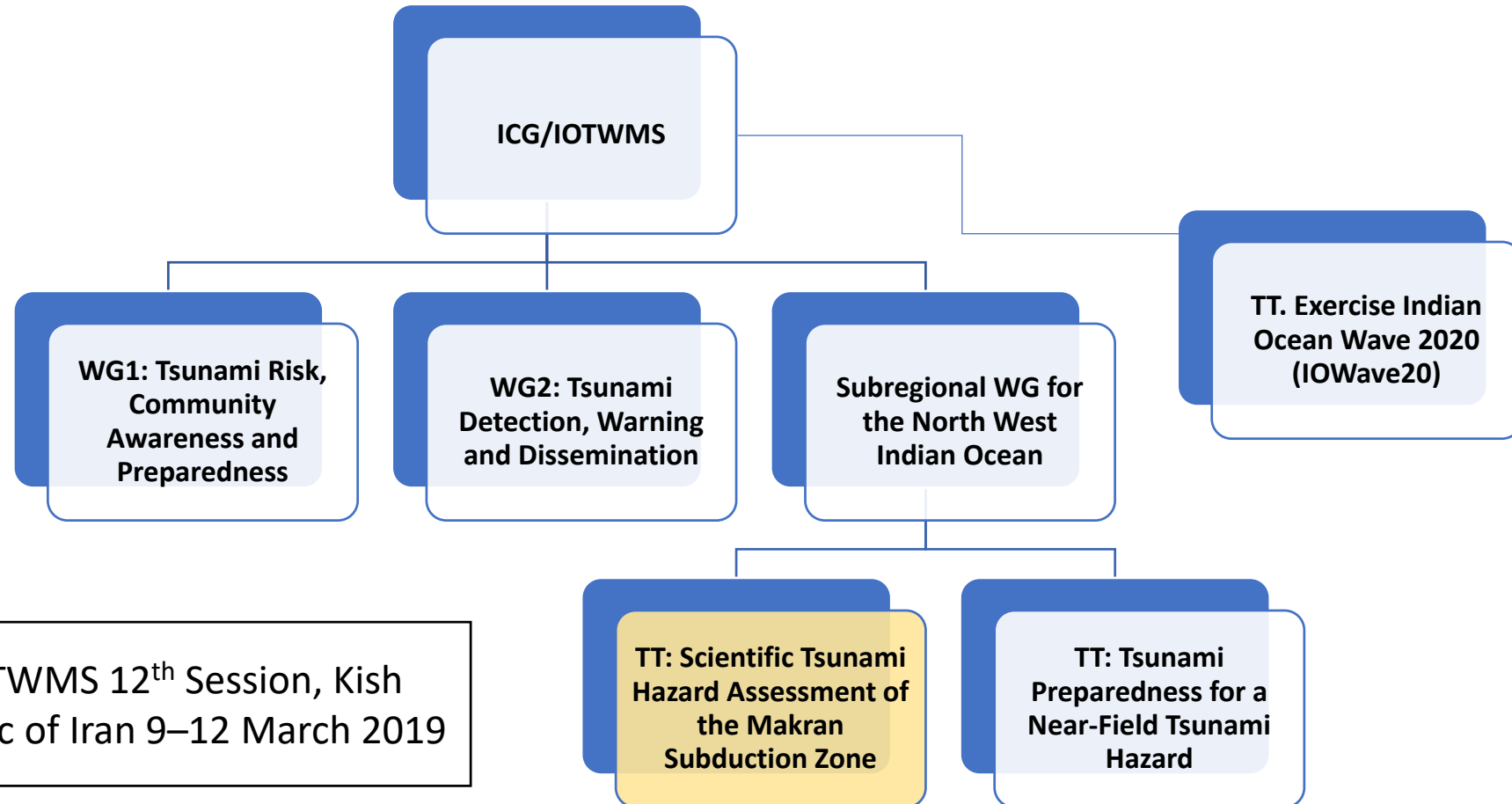
Intergovernmental
Oceanographic
Commission

***Task Team on Scientific
Tsunami Hazard of the
Makran Subduction Zone
Progress Report***

**Abdolmajid Naderi Beni
23-24 November 2021**

1. Progress on Activities

Task Team: Scientific Tsunami Hazard Assessment of the Makran Subduction Zone



1. Progress on Activities

Task Team Members

Chair: [Dr. Juma Said Al-Maskari](#) (Oman)

Vice-Chair: [Dr. Abdolmajid Naderi Beni](#) (Iran)

Members

[Mr. Ch Patanjali Kumar](#) (India)

[Dr. Issa Elhussain](#) (Oman)

[Ms. Noura Al-Kaabi](#) (Oman)

[Mr. Ameer Hyder](#) (Pakistan)

[Mr. Tariq Ibrahim](#) (Pakistan)

[Mr. Khalifa Alebri](#) (UAE)

TSP-Australia Representative / Expert Modeller - tba

TSP-Indonesia Representative / Expert Modeller - tba

Representative of Yemen - tba

Invited Experts

[Dr. Stefano Lorito](#) (GMT)

[Dr. Andrey Babeyko](#) (GFZ)

Representative from UNESCAP - tba

1. Progress on Activities

Terms of Reference



- 1.** Draft an agreement document for real-time exchange between Member States of seismic/sea-level/GNSS data in the Makran Subduction Zone (MSZ)
- 2.** Specify optimal number and configuration of seismic/sea-level/GNSS and other observing networks needed for real-time tsunami warning in the MSZ
- 3.** Investigate and report on the credible maximum earthquake magnitude in the Makran Subduction Zone and define a strategy to develop a unified hazard map
- 4.** Investigate and report on the seismicity of the Makran subduction zone as well as the potential impact of tsunamis in the Red Sea and Persian Gulf with a view to including those zones in the IOTWMS Area of Service if there is a threat
- 5.** Review and report on the status of research into modeling of secondary non-seismic effects tsunamis in Makran for potential use in the IOTWMS

1. Progress on Activities

UNESCAP Proposal

- The TT decided To:
- Invite a team of expert modelers from Australia, Germany, India, Indonesia, Iran, Oman and Pakistan to:
- define a strategy for estimating the credible maximum earthquake magnitude
- developing a unified tsunami hazard map

The team of expert modelers are working under the UNESCAP Project

- Phase 1 of the Project was expected to finish by October 2021.
- The outcome of the Project will provide the required information for points 2-5 in the terms of reference for the TT-MSZ

Participants at the Expert Meeting for Establishment of a Regional Working Group and Working Process between North West Indian Ocean Countries on Risk Knowledge

3-6 September 2019, Muscat, Oman



Participants at the High Level Conference on Near-Field Tsunamis in the Makran Region

1-2 September 2019, Muscat, Oman



1. Progress on Activities

UNESCAP TTF-29 Project: Strengthening tsunami early warning in the North-West Indian Ocean region through regional cooperation



Timely delivery of national tsunami warnings to at-risk coastal communities who are prepared to respond effectively (*Tsunami Ready*)

Phase 1: Hazard and risk assessment (National tsunami warning chain development)

Phase 2: Inundation and evacuation mapping (capacity development)

Phase 3: At-risk coastal community preparedness

1. Progress on Activities

Phase 1

Project Funder: **ESCAP Tsunami Trust Fund**

Participating Member States: **India, Iran, Pakistan (+Oman and UAE self-funded)**

Target Groups: **National Tsunami Warning Centres (NTWCs), Disaster Management Organisations (DMOs), Communities, Response Agencies, Media**

Project Duration: **24 Months** (with extension)... ended 31st October, 2021

Objectives:

- **Better understanding of the risk knowledge to inform and underpin warning and mitigation systems in the NWIO to enable appropriate and effective community responses to the tsunami threat.**
- **Improvement of warning services at NTWC level and the organization of the national warning chains to assure timely warnings.**

1. Progress on Activities

Phase 1

Based on the recommendations of the RWG, it decided the following actions will be implemented in close association with the other relevant ICG/IOTWMS Working Groups and Task Teams:

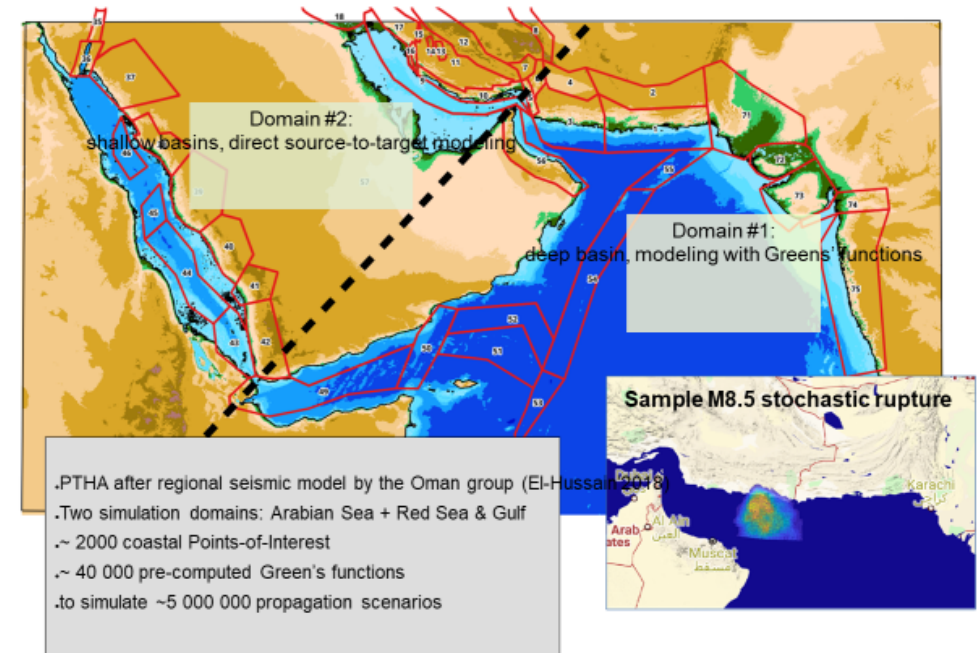
1. Teaming up leading by **Andrey Babeyko** to draft a framework for the development of a unified Probabilistic Tsunami Hazard Assessment (PTHA) for the Makran region (**by end of October 2019**).
2. **Expert Team 1** to jointly **develop a seismotectonic model** for the Makran region to be used for the unified PTHA. The main outcome should be a **catalogue of representative tsunamigenic scenarios** with recurrence rates. Principles of model construction will be defined (**by end of December 2019**).
3. **Expert Team 2** to consider and identify **tsunami propagation models**, existing and required data sets, amplification factors, etc., to be used for the **unified PTHA and future inundation modelling** (**by end of December 2019**).
4. **Expert Team 3** to provide guidance on inclusion of tsunamis generated by **non-seismic effects such as landslides**, mud volcanoes, etc. and **inclusion of Red Sea and Persian Gulf** in the proposed PTHA framework, or through other measures to inform risk assessments and decision makers (by end of May 2020).

1. Progress on Activities

Phase 1: Progress in 2019 and 2020

- Meeting of the Makran Probabilistic Tsunami Hazard Assessment (PTHA) team face-to-face: Hyderabad, India (December 2019)
- Virtual meetings of PTHA team due to COVID-19: May, June, & August 2020
- Initial benchmark PTHA model simulations run at INCOIS [India] with guidance from GFZ [Germany], INGV and University of Malaga (late 2020).

Probabilistic Tsunami Hazard Assessment
extended over the whole region and all earthquake sources

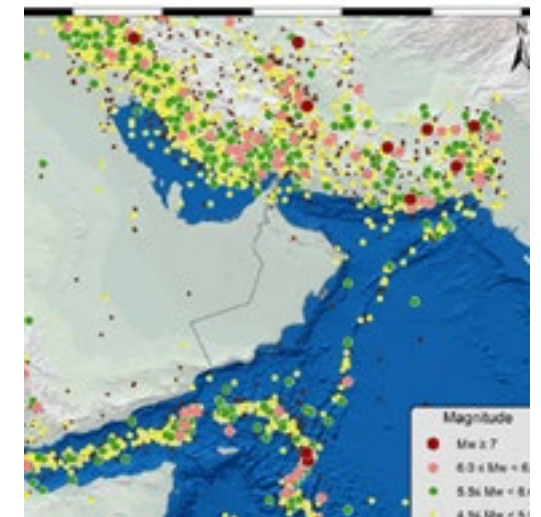
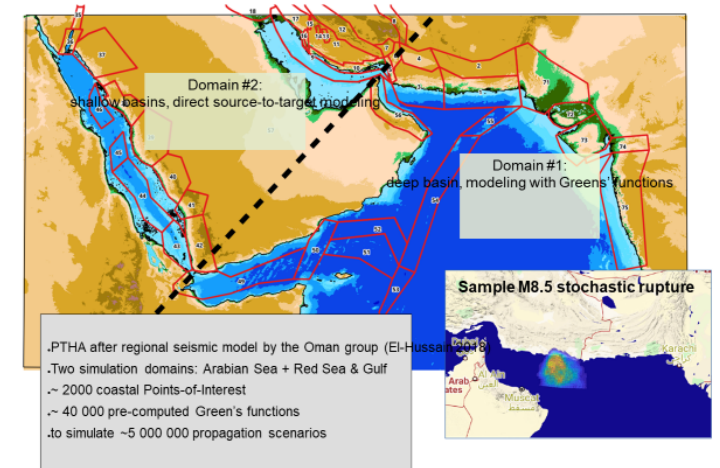


1. Progress on Activities

Phase 1: Progress in 2021

- Model simulations have been run for all earthquake source scenarios and probabilistic calculations have produced the primary version of the PTHA
- Improve data exchange through MOUs
- Better understand the seismicity of the region to help improve future versions of the PTHA
- Consider hazard from atypical tsunamis from non-seismic sources (e.g. submarine landslides)
- Examine the possibility of the tsunami threat in the neighbouring Persian Gulf and Red Sea.

Probabilistic Tsunami Hazard Assessment
extended over the whole region and all earthquake sources



1. Progress on Activities

Phase 1: Improve data exchange through MOUs

ARRANGEMENT

BETWEEN

[ENTITY WITH THE AUTHORITY TO ALLOW [the] DATA TO BE SHARED INTERNATIONALLY]

AND

[IOC RECOGNISED (?) TSUNAMI WARNING CENTRE]

CONCERNING THE EXCHANGE OF [SEISMIC / SEA-LEVEL] DATA FOR TSUNAMI WARNING PURPOSES

[The authorising entity] authorises / permits [the data owner entity] to provide continuous, real-time [seismic and/or sea-level] data to the IOTWMS regional Tsunami Service Providers [or to the National Tsunami Warning Centre of [country]] for the purpose of tsunami warning.

[The data owner entity] is the acquirer / owner of the data and undertakes to provide the data, in real-time, on a best efforts basis.

[TSP/NTWC] is operated by [entity/entities] which is an agency of the [country] Government (or, as applicable...)

The parties listed above (or their respective governments?) will give effect to the following Arrangement concerning the use of [specified] data for tsunami warning purposes by [TSP/NTWC entity].

1. Framework cooperation

- 1.1. The purpose of this arrangement is to allow the provision of [specified] data to [TSP/NTWC], and to define the conditions related to this provision.
- 1.2. [Appendix I] to this Arrangement defines the data that will be provided.
- 1.3. The data are provided on a no exchange of funds basis[?]. The data provision is subject to the availability of funds of the [data owner/acquirer] to operate their data acquisition network and systems.

2. Confidentiality

- 2.1. [The NTWC/TSP] will use the data provided under this Arrangement for **tsunami warning purposes only**.
- 2.2. [The NTWC/TSP] will not pass on the data.
- 2.3. [The NTWC/TSP] will keep the data strictly confidential, albeit not to the exclusion of the issuance of tsunami warnings based on the data.
- 2.4. Scientific work on tsunamis, undertaken by [The NTWC/TSP] and shared with third parties, can disclose the data in recognizable form only with the express written permission of [the national authority / data owner?].
- 2.5. [The NTWC/TSP] will maintain confidentiality of the data even after the provision of the data under this Arrangement has ceased.

3. Duration

- 3.1. This arrangement will take effect upon signature by the Parties (all three or the two respective governments?), and will remain in effect until [when / what circumstances?]
- 3.2. This Arrangement will immediately end if UNESCO/IOC should withdraw its approval of [the TSP / NTWC] as a tsunami warning organization.
- 3.3. This Arrangement will end if either Party should make an indication to this effect with [3 months?] written notice.

4. Changes to the Arrangement

- 4.1. This Arrangement will be non-transferrable.
- 4.2. Any change to this Arrangement will be in writing, and signed by the authorized representatives of the Parties.

Useful information to collect from Members:

- (a) Who produces/acquires real-time seismic / sea-level data in your country? Is this separate from your NTWC?
- (b) Who owns the data (if different from (a))?
- (c) What arrangements exist *in-country* that allow your National Tsunami Warning Centre access to real-time data?
- (d) Who has the authority to permit that data to be shared with a foreign entity (if different from (a) and/or (b))?
- (e) What national stations are used by your National Tsunami Warning Center?

Would we need more than one instrument to arrange data sharing? For example:

- (a) "National Authority" (e.g., Government authorisation for an in-country institution to make its data available to a foreign entity for tsunami warning purposes (e.g. to a NTWC or TSP)
- (b) In-country arrangement that recognises this relationship between the "National Authority" and the data owner (i.e., the data owner recognises arrangements made by the National Authority in respect of allowing data to be shared with a foreign NTWC or TSP?
- (c) One-to-one arrangements between the NTWC or TSP directly with (or without) pre-approval by "National Authority"?
- (d) Is there a role for the IOTWMS Secretariat to assist or coordinate agreements between the "National Authority" and/or "Data Owner" and the NTWC / TSP?

The first Letter of Agreement Between Iran and Oman in 2016 for Seismic Data Exchange

LETTER OF AGREEMENT BETWEEN SULTAN QABOOS UNIVERSITY, EARTHQUAKE MONITORING CENTER (SQU), OMAN AND UNIVERSITY OF TEHRAN INSTITUTE OF GEOPHYSICS, IRAN

1. Sultan Qaboos University and University of Tehran (UT) hereby agree to conduct a real-time seismic data exchange cooperation between Earthquake Monitoring Center (EMC) at Sultan Qaboos University, and Iranian Seismological Center (IRSC) at Institute of Geophysics, University of Tehran (IGUT) through internet IP control in furtherance of the advancement of learning and accurate earthquake location as stipulated below:
 - a. Conduct a real-time seismic data exchange of equal number of stations from one institution to the other for the purpose of obtaining timely earthquake parameters and location and utilizing in research.
 - b. Encourage visits by faculty/researchers from one institution to the other to foster the exchange of scholarly ideas, information, and research tools. Data and software will be exchanged subject to mutually agreed upon terms. Distribution of such materials to third parties is restricted unless there is a mutual agreement.
 - c. Facilitate publication of scientific papers jointly. Publication of data and/or analysis performed under this exchange Letter of Cooperation will be by mutual consent and acknowledgement or co-authorship unless agreed otherwise.
 - d. Promote other academic and research activities that enhance the above-mentioned goals.
2. Both institutions acknowledge that the visit by faculty from one institution to the other shall be subject to the entry and visa regulations of Oman and Iran, and shall comply with the regulations and policies of SQU and UT.

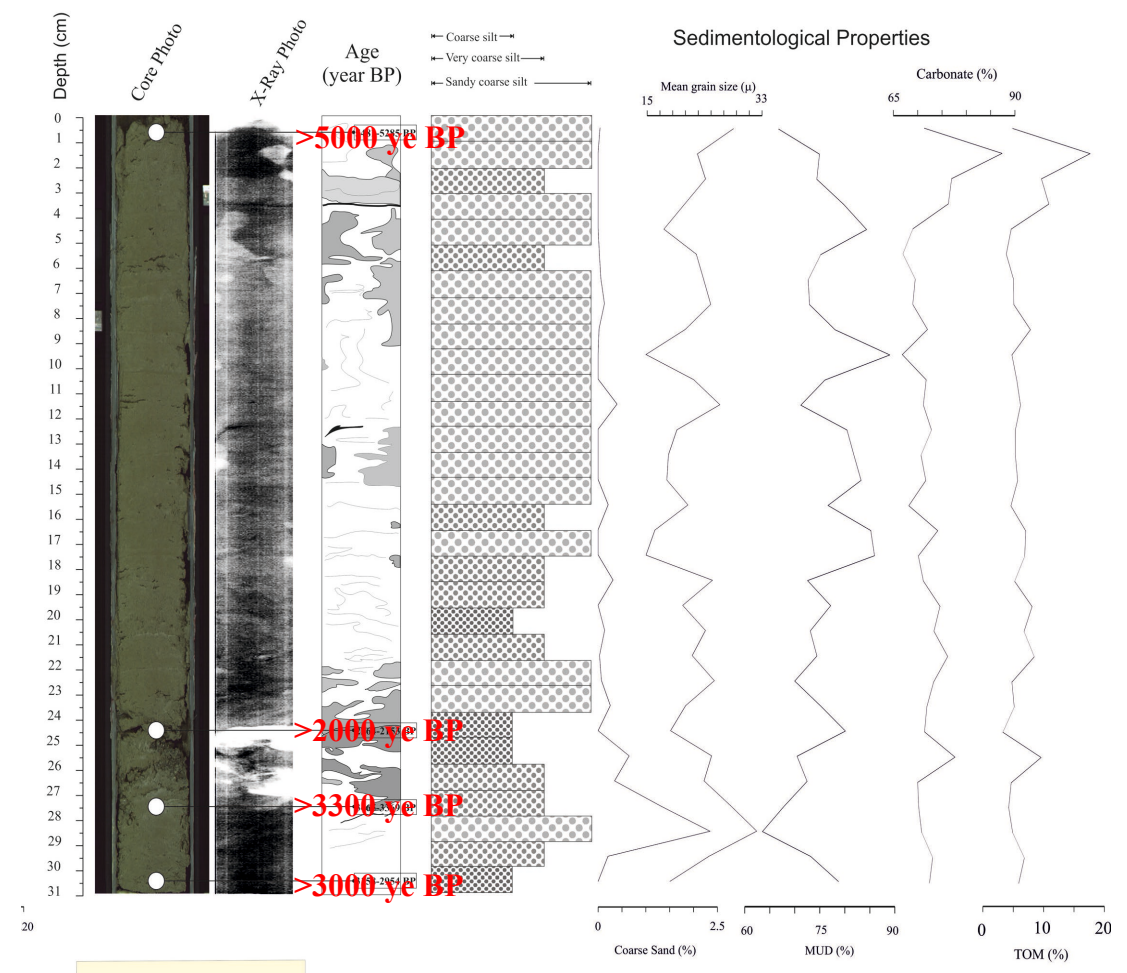
1. Progress on Activities

Phase 1: Possibility of tsunami threat in Persian Gulf and Red Sea

Meteo-tsunami in Dayer, Persian Gulf, 2017



Paleoseismicity reflected in bottom sediments of the Persian Gulf



2. Challenges

COVID-19

Run propagation scenarios for the PTHA to complete version one of the PTHA.

Exchange scientific staff between India and Germany/Italy for familiarisation with PTHA to enable hand over to the region

Hold (now virtual) Scientific Conference to share, exchange and discuss scientific results from the risk objective to review outcomes and broader uptake within each country

Hold 3rd and final SOP workshop for NTWCs, DMOs, and the Broadcast Media to further develop, and in some cases finalise and test SOPs for all links in the national tsunami warning chains

Time consuming paperwork to achieve agreement on data sharing

Bilateral MoUs have been signed between different countries and Oman but for multilateral agreement it needs more efforts.

3. Pathways Forward & Opportunities

Phase 2

Project Funder: **ESCAP Tsunami Trust Fund**

Participating Member States: **India, Iran, Pakistan (+Oman and UAE self-funded)**

Target Groups: **National Tsunami Warning Centres (NTWCs), Disaster Management Organisations (DMOs), Communities, Response Agencies**

Project Duration: **24 Months**

Objectives:

- **Finalization of some Phase-1 remaining activities in tsunami risk knowledge and strengthening of national tsunami warning chains (Phase 2a)**
- **Gap analysis and development of guidance on tsunami inundation mapping and evacuation planning in the NWIO region (Phase 2b)**
- **Inundation and evacuation mapping capacity development (Phase 2c)**



Phase 2a and 2b to be conducted in parallel for first 12 months



Phase 2c to be completed in second 12 months after Phase 2a and 2b

3. Pathways Forward & Opportunities

Finalization of some Phase-1 remaining activities in tsunami risk knowledge and strengthening of national tsunami warning chains (Phase 2a)

- Exchange of latest scientific results and studies from international studies on the tsunami hazard in the MSZ
Increased capacities and knowledge on tsunami modelling in the participating countries.
- Regional NTWC-DMO-Media SOP workshop
- Backstopping to National Working Groups

Gap analysis and development of guidance on tsunami inundation mapping and evacuation planning in the NWIO region (Phase 2b)

- Gap analysis and develop specifications for a unified approach for tsunami modelling and inundation mapping in the region
- Tsunami evacuation planning recommendations for the NWIO countries.

Inundation and evacuation mapping capacity development (Phase 2c)

- Training in development of tsunami inundation maps and evacuation plans to facilitate effective community responses to the threat from near-field tsunamis.
- Regional training on technical expertise for evacuation planning processes at local level
- Backstopping for evacuation planning in pilot communities

Recommendations and Comments

General recommendations to the ICG

The first version of the Probabilistic Tsunami Hazard Assessment (PTHA) for the NWIO region to be completed and utilized by Member States to guide awareness and response to the tsunami threat in the NWIO region

Comments for review by the Steering Group

- Paleoseismicity of the NWIO using the sea bottom sediments is recommended.
- The probability of atypical tsunami occurrence could increase in the NWIO under ongoing climatic changes. It is suggested to consider the impacts of climatic changes on increasing the potential of atypical tsunami occurrence in the region.



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Thank you for your attention