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Intergovernmental Oceanographic Commission

Working Group 1
Tsunamis Risk, Community Awareness and Preparedness

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19th Meeting of ICG/IOTWMS Steering Group, Jakarta, 17-19 June 2025

Term of References (ToR) – WG 1

Liaise with other working group(s) and task team(s) within the ICG/IOTWMS and with working groups from the other ocean basins through the TOWS-WG to:

1. Assist, develop and strengthen the overall capacity and capability of Member States in **tsunami hazard, risk assessment and mitigation, community awareness and preparedness, including for tsunamis generated by non-seismic and complex sources and multi-hazard framework.**
2. Encourage Member States to **mainstream tsunami Disaster Risk Reduction into sustainable development to help achieve resilient communities in the region.**
3. Support **implementation of IOWave Exercises**.
4. Identify areas of priority for action following **assessments, exercises, and real tsunami events**.
5. Provide **advice on user requirements and utility of tsunami warning products and services.**
6. Provide advice to and collaborate with the UNESCO-IOC Indian Ocean TsunamiInformation Centre (IOTIC) on **education, awareness and preparedness including for nonseismic and complex sources.**
7. Provide special attention to **the needs of SIDS, LDCs, Africa in the work programme**.
8. Develop WG1 work plans in line with **the broad objectives of ODTP RDIP, Ocean Decade Challenge 6, EW4ALL**.
9. Promote collaboration among academia, research institutions and disaster management offices to encourage multidisciplinary and multi sectoral interaction in **ensuring tsunami risk knowledge are streamlined to risk reduction strategies.**

WG 1 Members (2024-2026)

Members (coming from 8 member states):

1. Dr. Weniza, M.Sc– Chair WG-1-Indonesia
2. Dr. Mahendra S. Ranganahalli – Vice-Chair WG-1-India
3. Dr. Gareth Davies – Australia
4. Mr. Luqman Al Zadjali – Oman
5. Mr. K.A.D.P.K. Kodippili – Sri Lanka
6. Mr. Ameer Haider Laghari – Pakistan
7. Mrs. Hidayanti.– Indonesia
8. Ms Trevi Jayanti Puspasari– Indonesia
9. Dr Khusnul Setia Wardani – Indonesia
10. Ms. Khazainani Salleh – Malaysia
11. Mr. Hadif Alshehhi - UAE
12. Mr. Ali Almehrzi - UAE
13. Mr. Khamis Alnaqbi - UAE

UNESCO-IOC

1. Dr. Srinivasa Kumar Tummala - IOTWMS Secretariat
2. Ms Nora GALE – IOTWMS Secretariat
3. Mr. Ardito M. KODIJAT – IOTIC

Invited Experts (suggested):

1. Mr. Harald Spahn – Germany
2. Prof Dilanthi Amaratunga – UK
3. Prof Richard Haigh – UK
4. Dr Aditya Gusman – Indonesia-GNS New Zealand
5. Dr. Irina Rafliana – Indonesia-Bonn Germany

ICG/IOTWMS-XIV Recommendation to WG 1

ICG/IOTWMS was held in Banten, November 2024 with recommendation to WG 1 as follow:

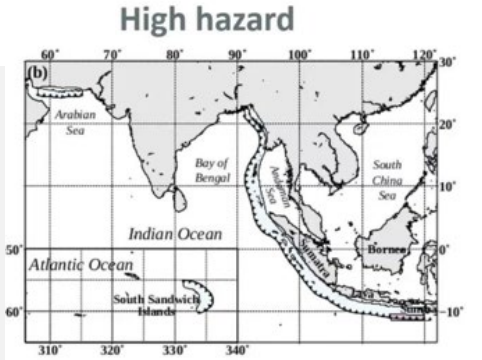
1. Develop guidelines for Tsunami Ready Critical Infrastructure in collaboration with WG3 and share with the TOWS-WG in their next meeting.
2. Probabilistic Tsunami Hazard Assessment for Indian Ocean including non-seismic sources.
3. Develop Inclusive People-Centered Early Warning DMO SOPs for near-field tsunamis.
4. Develop draft assessment tool for the downstream warning process.

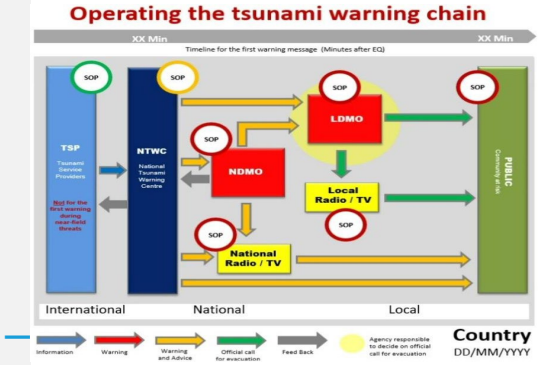
WG 1 Work Plan Discussion and Action 2024 - 2026

1. **PTHA Workshop (2025) --- PTHA Online: Updating Probabilistic Tsunami Hazard Assessment including Non- seismic Tsunami Hazard Assessment**
2. **Tsunami Warning Chains and Standard Operating Procedure Development in Indian Ocean Countries**
3. **Draft Assessment Tool for Downstream Warning Processes**

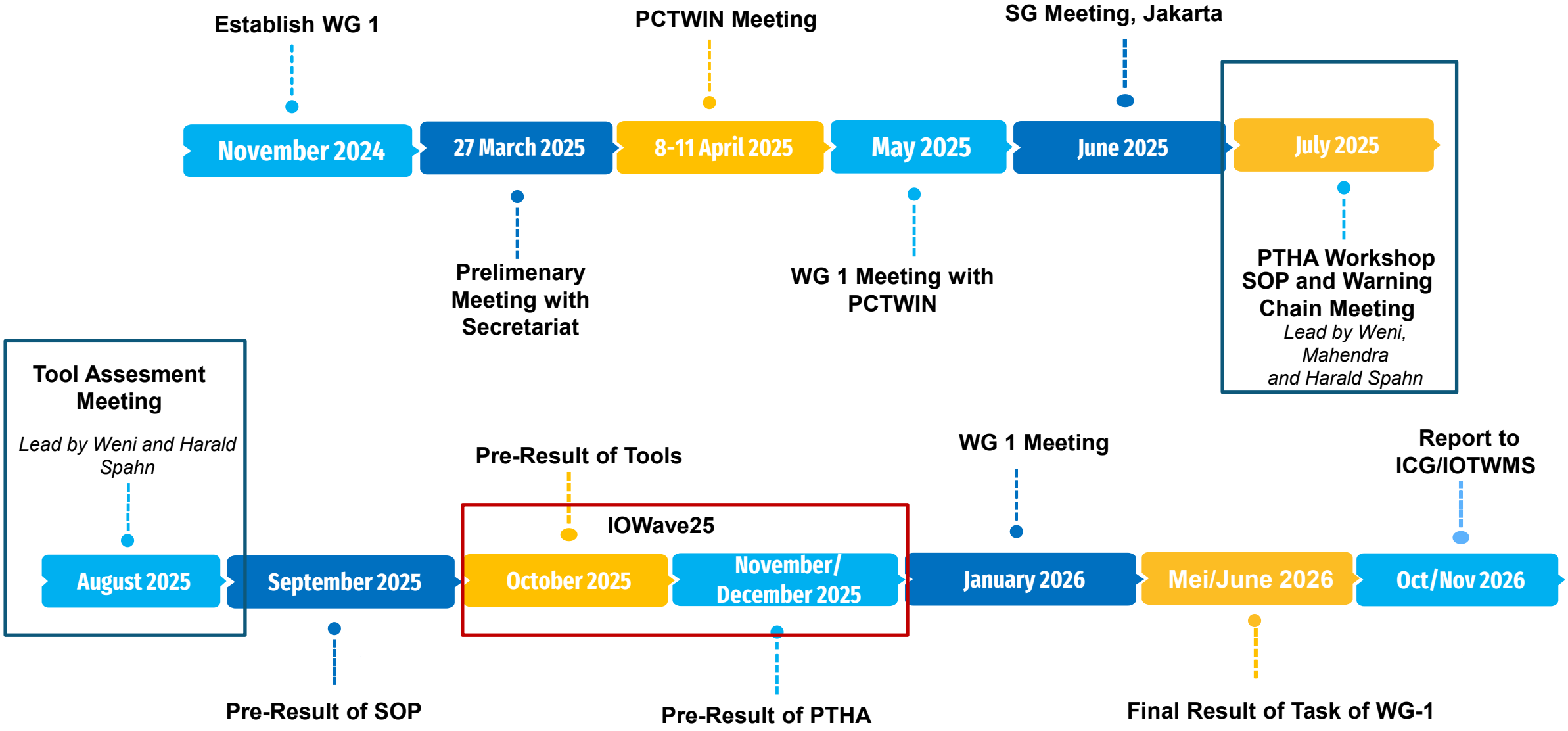
<u>Liaise Activities with other working group</u>

- Preserving Past Tsunamis in Collaboration with IOTIC (2025 & 2026) -- IOTIC
- TEMPP training in Collaboration with IOTIC and All Working Groups (Hyderabad, April 2025) – WG 3
- SOP Workshop in Collaboration with Working Group 2 (2026) – WG 2
- Inclusive People Center Early Warning System SOP in the Face of Near Field Tsunami Risk – has been recommended for further global guideline “UNESCO IOC guide”
- Capacity Develop guidelines for Tsunami Ready Critical Infrastructure – WG3





Timeline WG 1



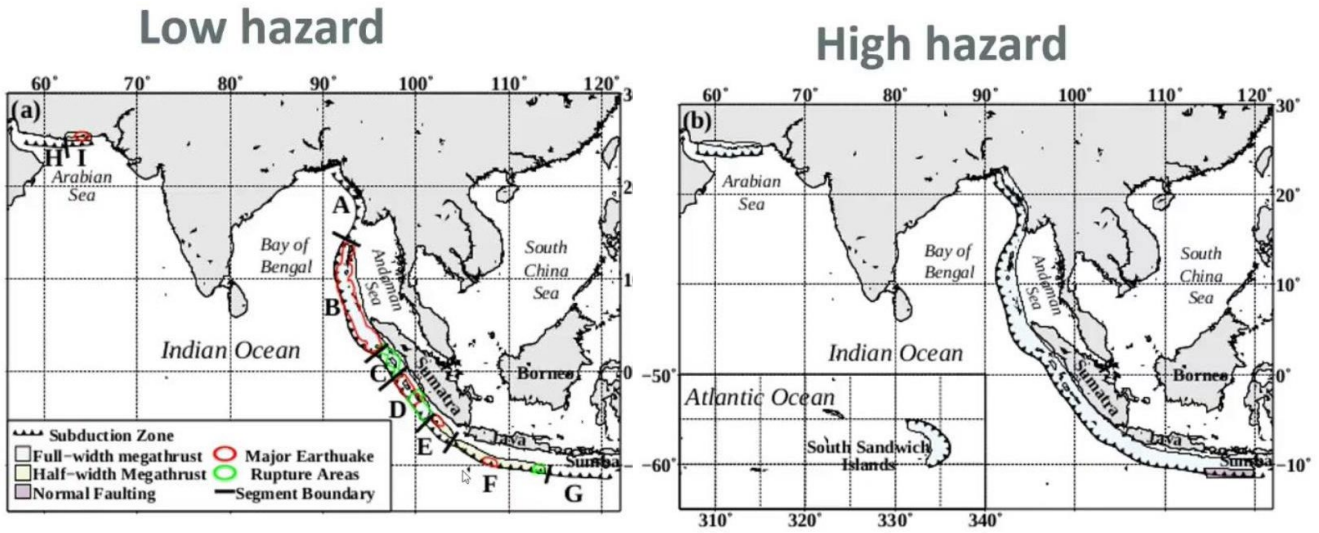
Objectives and Target Group of Meeting on Warning Chains

Online Meeting with members of WG 1 and TT IOWave25 to discuss working process on warning chains and integration into IOWave25

Topics:

- Revision and discussion of Status Report
- Specific feedback to Member States
- Process for continuous improvement of warning chains and SOPs
- Integration in the preparation, implementation and evaluation of IOWave25

1. Status of Probabilistic Tsunami Hazard Assessment (PTHA)



Alternative models of segmentation as illustrated in the 2009 Probabilistic Tsunami Hazard Assessment (PTHA) for the Indian Ocean

- In Western Australia, tsunami inundation mapping has been completed around the greater Perth area (Geraldton to Busselton). **Maps on how often areas are expected to be inundated and the uncertainties can be derived from this data.** Inundation products are being developed for use by the Emergency Services during tsunami responses through a collaboration between Geoscience Australia and the Department of Fire and Emergency Services.

Updated of status of PTHA for the Indian Ocean

- In the Indian Ocean region, **the 2009 PTHA was developed for the Indian Ocean and has been in use in the years since**.
- In 2018, Australia published a global PTHA. The major Indian Ocean source include **the Sunda Arc, the Makran subduction zone, and the South Sandwich Islands**. This is open source and can be used by Member States in the Indian Ocean.
- The PTHA for **the Makran region is in progress with version 1.0 complete.** There are several alternative models, and the next step is consensus on the weighting of models. It is likely to be published in early 2025.
- While **deterministic tsunami hazard assessments involve a single or set of scenarios** PTHAs involve examining the likelihood of a set of scenarios including the uncertainties.
- Offshore **PTHAs contain many tsunami scenarios that are generally modelled in deep water and lack inundation impacts.** PTHAs can be combined with an inundation model to **determine local effects**.
- Identified Source → Indian Ocean, Sunda Arc, the Makran subduction zone, and the South Sandwich Islands → Multi Hazard framework

WP1 – Schematic overview

Task 1.1 – Long term post seismic deformation Andaman-Sumatra

Task 1.2 – Inventory of seismic source scenar

Task 1.3 – Inventory of landslide source scenarios

Task 1.4 – Probabilistic Tsunami hazard analysis

- Earthquake tsunamis
  - Regional hazard
  - Local hazard
- Landslide tsunamis

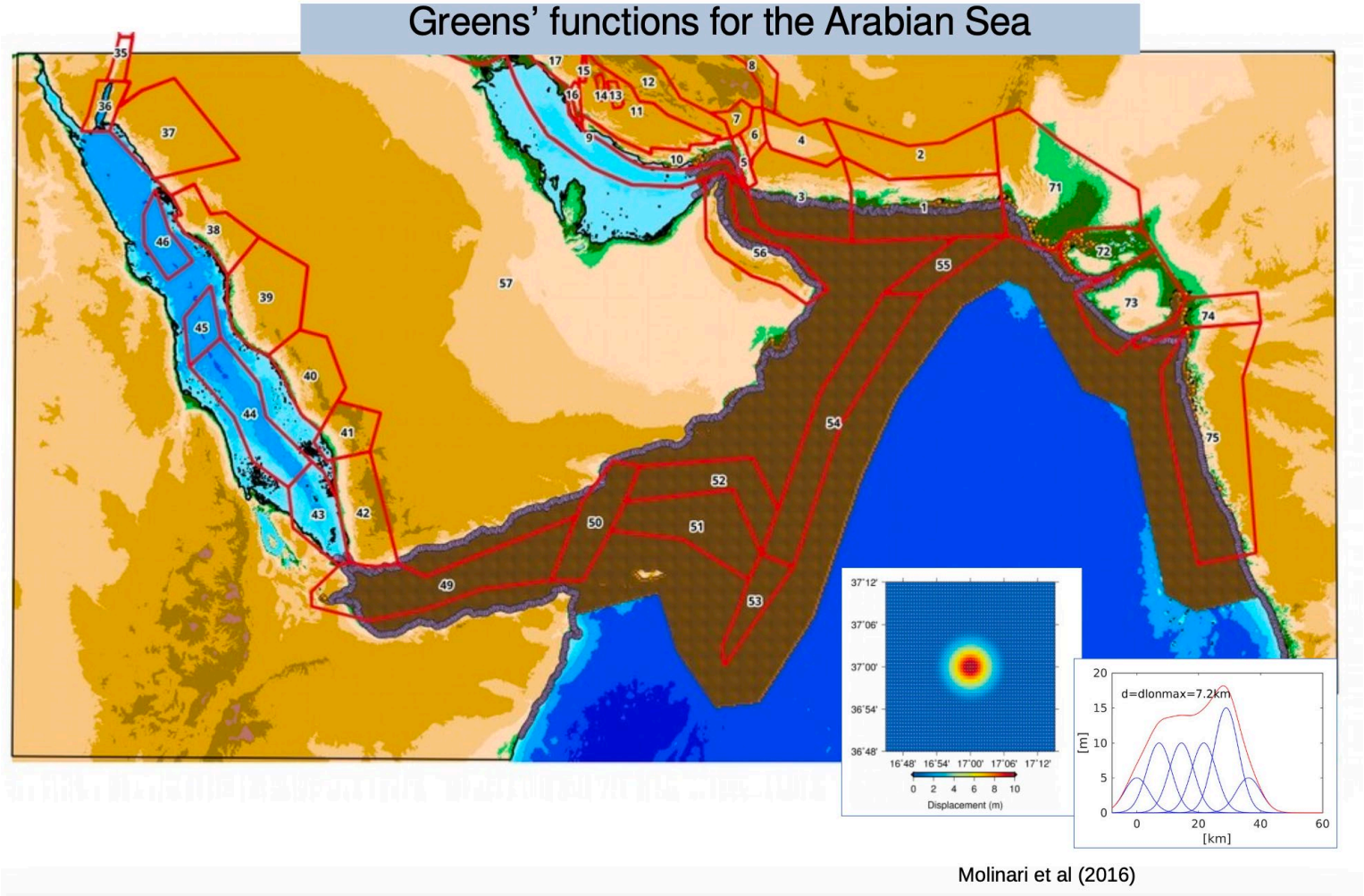
External input – Makran UNESCAP project

Task 1.5 – Exposure mapping

Task 1.6 – Probabilistic Tsunami Risk Analysis

Task 1.4 Probabilistic tsunami hazard analysis (INCOIS, ISR, NGI, UMA, GFZ, IOC-UNESCO)

- Develop national level PTHA maps for earthquake-induced tsunamis.
- High-resolution site-specific PTHA for pilot locations.
- In addition, prototypal conditional probability hazard maps for landslide tsunamis (without return periods).
- Strong interaction with T1.1 and T1.2



Molinari et al (2016)

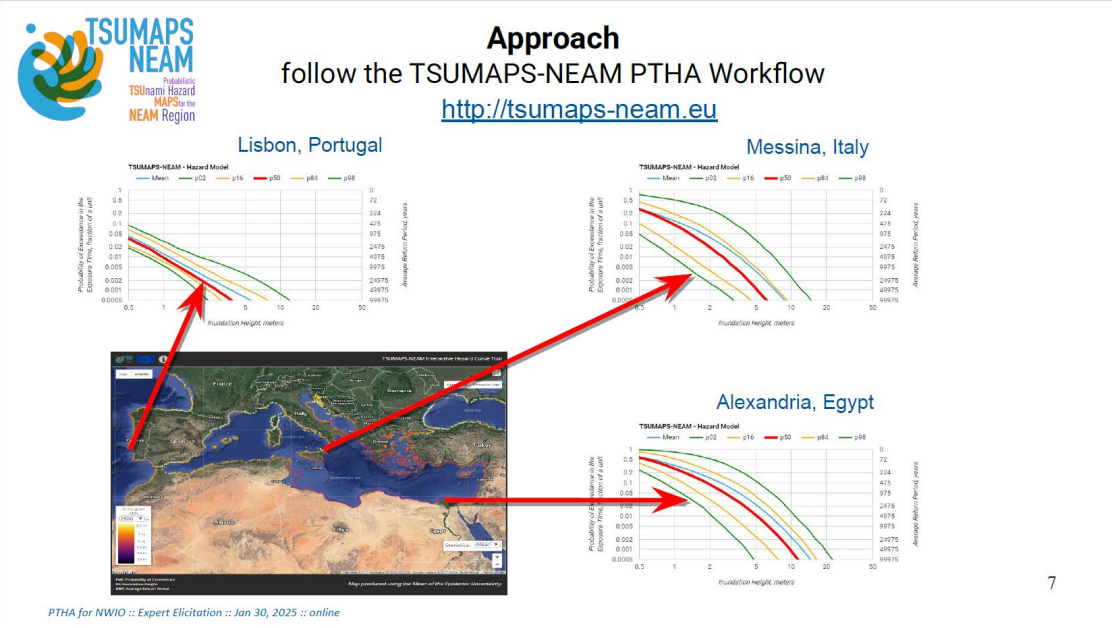
The Makran PTHA
Status and implications for PTCWIN

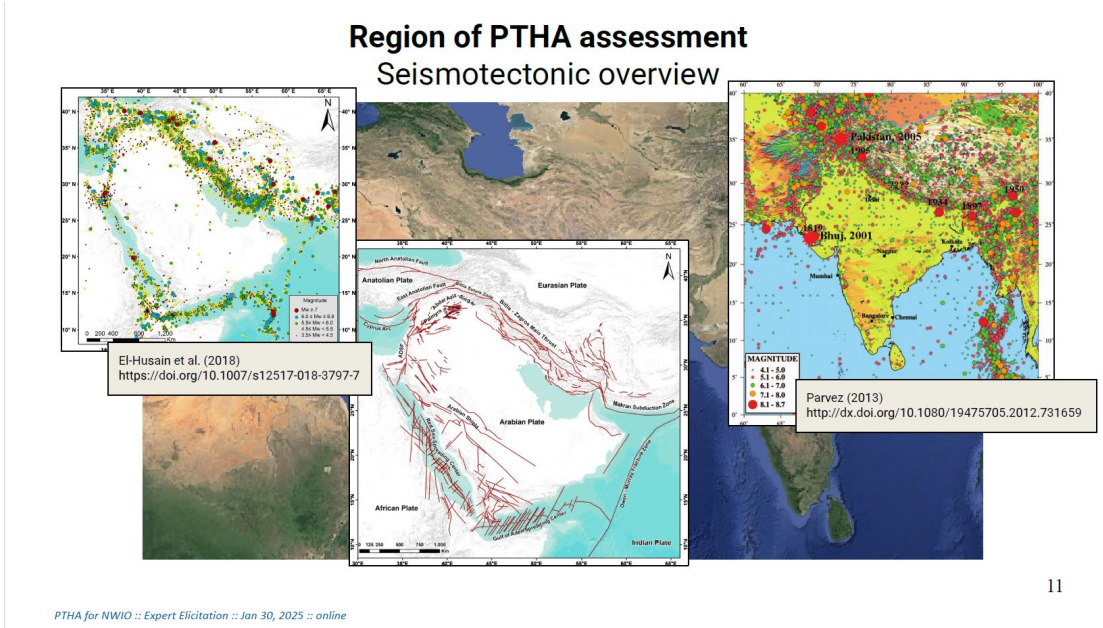
- Probabilistic tsunami hazard assessment for the Makran source zone and surrounding sources west of India
- Carried out for UNESCAP – endorsed by the Global Tsunami Model (GTM) as a community effort
- A large set of simulations done
- Seismic background info collected
- Possible need for some additional simulations
- Weighting of subjective probabilities
- **Template also for the other source regions**

Sunda Arc

Indian Craton

- More details in next presentation

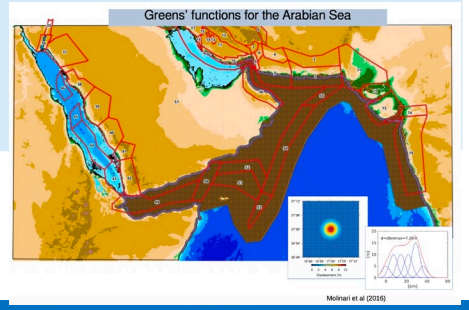




Roadmap for PTHA source

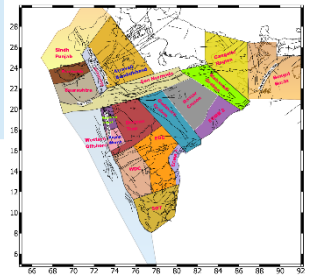
Arabian Sea roadmap

- UNESCAP project input
- Mainly Makran subduction zone (MSZ)
- Makran to be modelled as subduction zone
  - Finalize source quantification in Makran-PTHA
  - Inherit this source model for PCTWIN
- Other zones to be modelled as BS
- Will provide constraint to the two other source areas
- Main responsible – GFZ



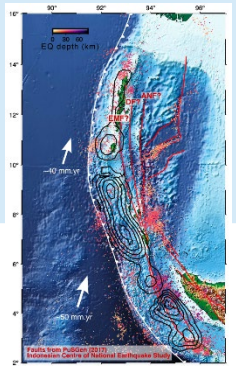
Indian Craton roadmap

- Seismic model – zonation, focal mechanism distribution, rates
- Main source zones with high magnitude potential
  - Gujarat region
  - Eastern India and Bangladesh
- Tsunami-tailored zonation of the Indian Craton
- Important note – emphasis on determining dominant focal mechanisms or faults in high magnitude potential regions – and possibly model them as PS sources
- Other regions can be estimated as BS
- Main responsible - ISR



Sunda Arc roadmap

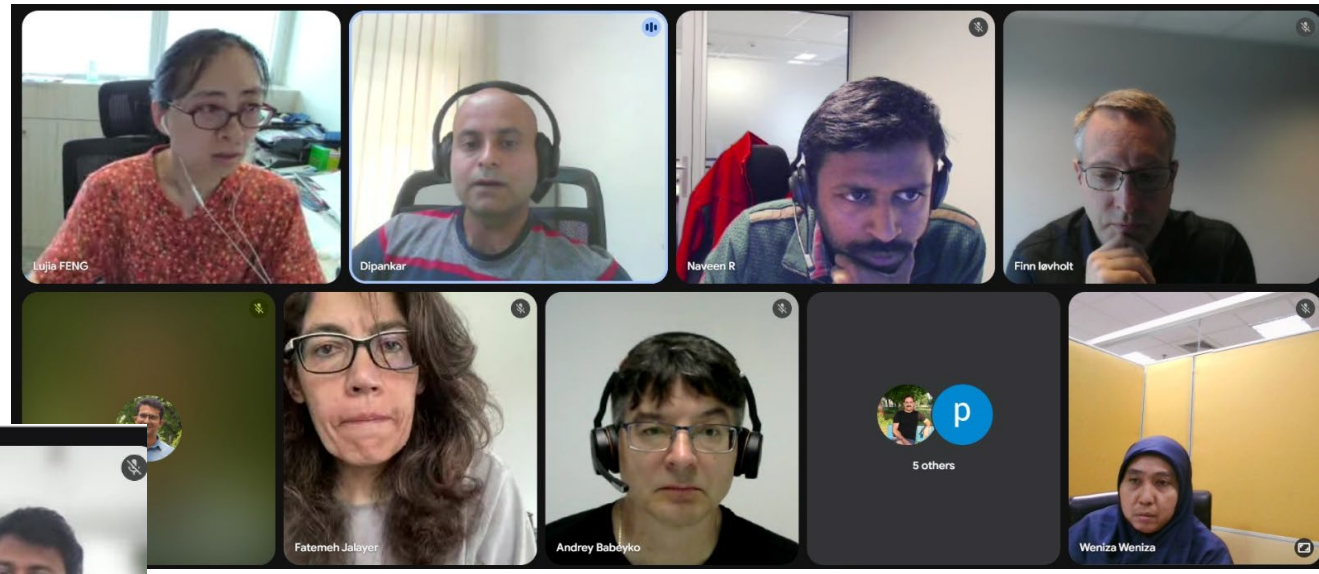
- Focus on segment from Southern Sumatra and northwards including Myanmar
- Build FEM model of subduction zone using Slab 2.0
- Generate synthetic stochastic slip scenarios
- Generate triangular unit source
- Apply wave filter to unit sources
- Provide database of initial conditions and simulate the wave propagation
- Main responsible – INCOIS, UE



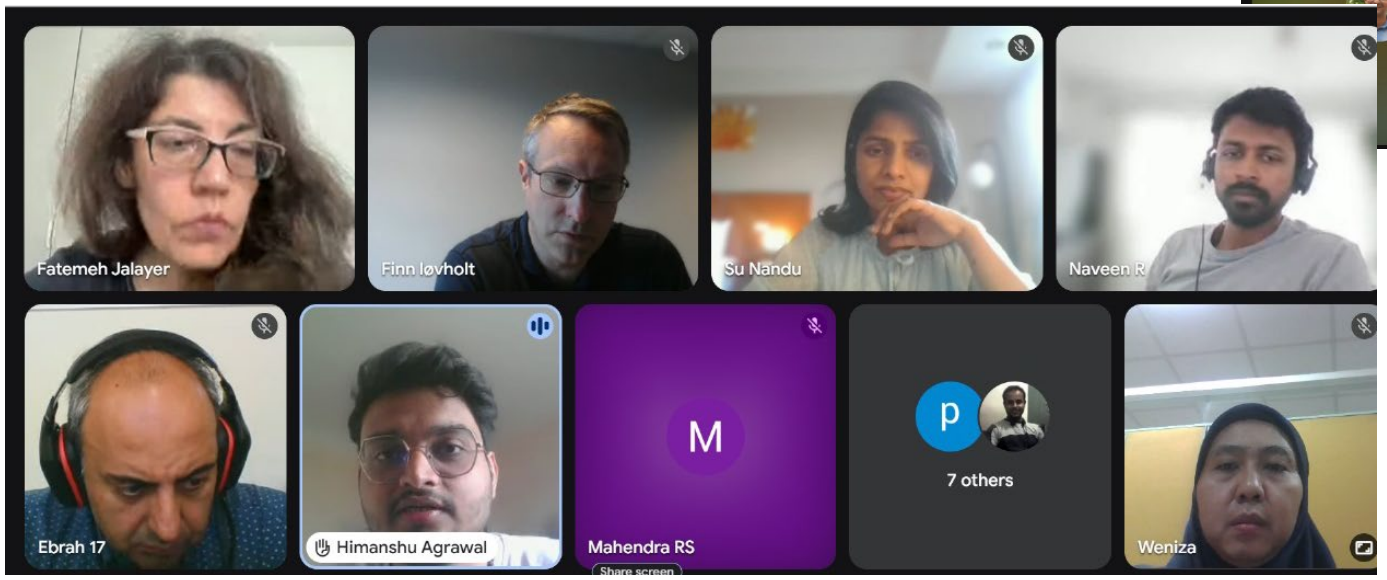
Collaboration – WG 1 and PCTWIN WG 1

WG 1 – PCTWIN WG 1 (UCL, INCOIS, GFZ)

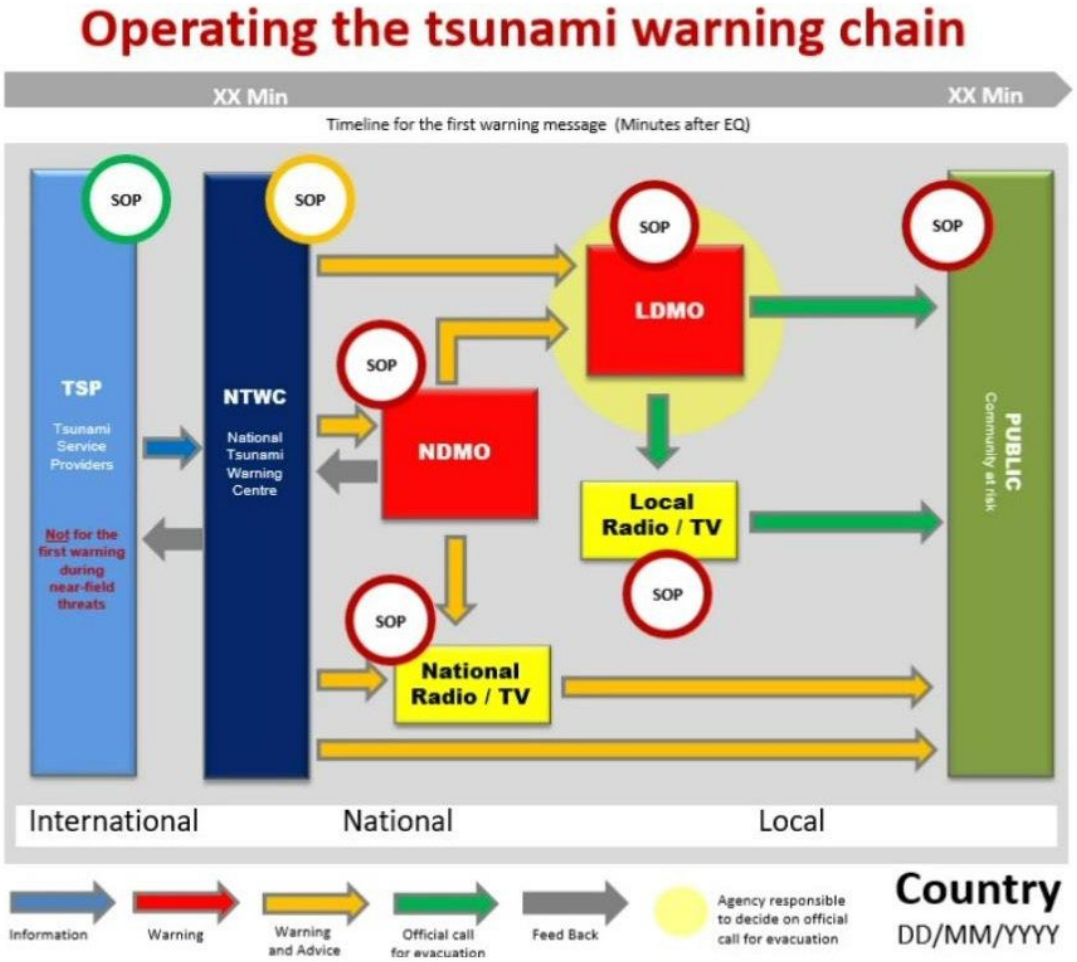
Monthly Meeting, 26 May 2025



Monthly Meeting, 16 June 2025



2. Tsunami Warning Chains and Standard Operating Procedure (SOP) Development in Indian Ocean Countries



Template of National Tsunami Warning Chains and SOPs

- Most national tsunami warning chains are solid and include redundancy. **Some countries need to add timelines aligned with the flow of information from the IOTWMS Tsunami Service Providers**. Warning chains and SOPs have so far been exclusively **for seismic tsunami scenarios**. Examination of the SOPs shared by Member States shows that the NTWC SOPs are well developed while **DMO SOPs require further work**.
- SOP Early Warning Chain, Publication, Methodology, Model

The recommendations include:

- Strengthening the framework conditions and multi-stakeholder processes for effective warnings through high-level political change;
- Strengthening regional cooperation (EIO, WIO, NWIO)
- Facilitate continuous and collective learning
- Focusing more strongly on the DMO SOPs
- Stronger focus on SOPs in IOWave exercises --- SOP Exercise
- Learning from experience: enhancement of the IOC Post-Tsunami Survey Guidelines by including assessment of downstream processes.
- SOP non seismic

3. Draft Assessment Tool for Downstream Warning Processes

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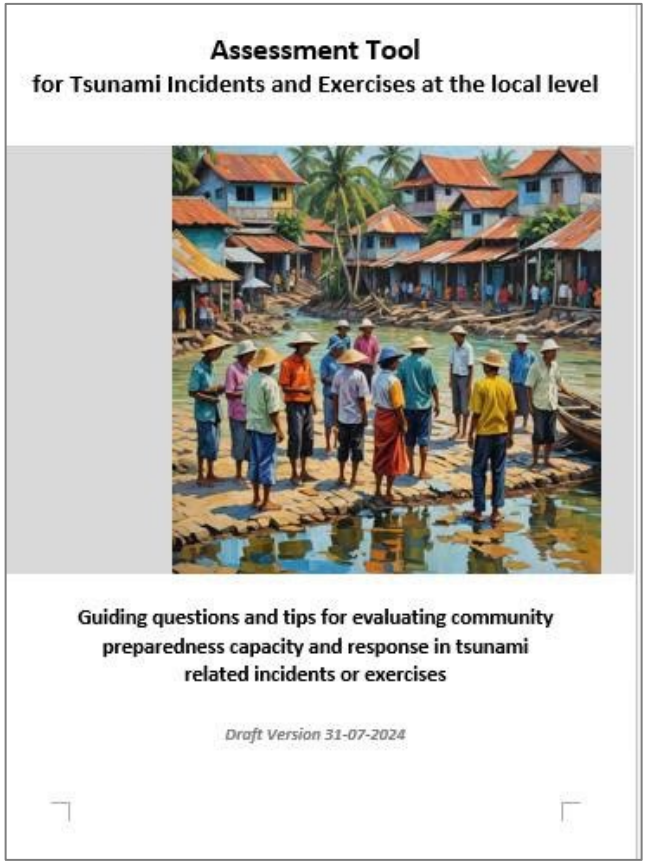
Assessment Tool

for evaluating community tsunami preparedness capacity and response

Rapid and participatory assessments immediately after tsunami related incidents are important for capturing experiences and drawing lessons that can be learnt from the local perspective to improve tsunami preparedness and end-to-end tsunami early warning. It can also be used to learn from community exercises

#Learning from local experiences
after tsunami incidents and exercises

The bigger picture



- This tool has been developed within the TsunamiRisk project and is derived from the analytical framework used in a meta-study of tsunami events in Indonesia between 2006 and 2021, and designed to guide the evaluation of community preparedness capacity and response in any type of tsunami related incidents or exercises.
- The tool contains a set of guiding questions that can be applied for a range of incidents that have posed a tsunami threat at the community level. This can include incidents where a tsunami was generated, but also incidents where an earthquake was strongly felt or a tsunami warning was issued, but ultimately no tsunami occurred.
- Rapid and participatory assessments immediately after tsunami related incidents are important for capturing experiences and drawing lessons that can be learnt from the local perspective to improve tsunami preparedness and end-to-end tsunami early warning.

The bigger picture

- The tool can be used for a variety of incidents where
  - a tsunami was generated
  - an earthquake was strongly felt in a coastal community
  - a tsunami warning was issued, but ultimately no tsunami occurred
  - It can also be used to learn from community exercises
- The section on **pre-existing capacities** cover all elements included in the set of indicators developed and applied by the **IOC Tsunami Ready Recognition Programme**.
- With its focus on the end-to-end warning chain and community response issues, it may complement the **IOC Post-Tsunami Survey Guidelines**, which look mainly at the impact of the tsunami after a destructive event.

The bigger picture

- Can be used either in an accompanied assessment process led by external experts or as a self-assessment tool for local stakeholder
- Preferably shortly after an incident or exercise in order to ensure that fresh impressions and detailed information can be captured
- Best in a **participatory** manner, **involving all main stakeholder**
- **Assessment methods** may include
  - interviews with relevant authorities,
  - focus group discussions with stakeholder groups,
  - field observations,
  - questionnaires to capture community reaction and
  - study of reference documents (hazard, risk and evacuation maps, SOPs, disseminated warning messages) as well as media reports.

Such an assessment always **focus on a specific geographical area that has been affected** or impacted by an incident. This may be a town, a district, a village or more than one of these.

Links

IOWave Survey
every 2 years

The tool can be used to assess downstream warning processes in **IOWave exercise** in a systematic way and the findings contribute to the IOWave Survey

TRRP
Tsunami-ready communities

The section of the tool on pre-existing capacities is aligned with **TRRP** indicators and can be used to assess state of community preparedness

Assessment Tool
to be applied after tsunami events or for exercises

ITST Survey
after destructive tsunamis

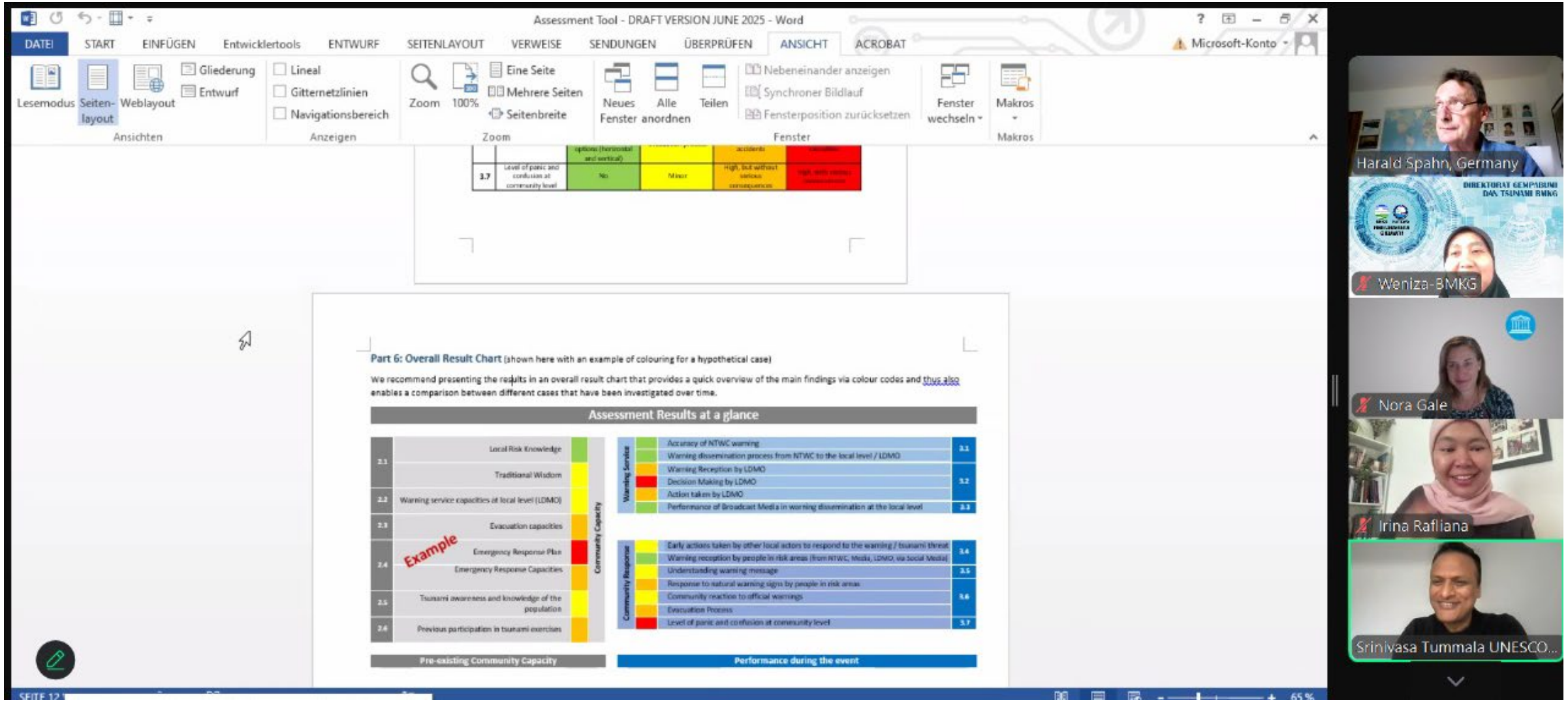
The tool can be used by **ITS** Teams to assess downstream processes in a structured and systematic way and findings can be integrated into survey report

Results from assessments carried out can inform **CATP** on existing capacities and challenges in the downstream part

CATP
every 6 years

The proposed tool to assess the warning chain in real events and in exercises is not intended to contradict but rather improving and filling gaps of current available tools to assess capacities and also including the IO Wave guidelines/Comms Tests.

Discussion WG-1 and Secretariat



1. Next Step : PTHA

- Developing/adopting a **tsunami vulnerability and risk assessment framework** with the help of experts and implement it in each member state.
- Conducting **PTHA workshop online** in order to identify source and running model exchange expertise.
- Collaborating in **UN ESCAP Project in Makran and the GTM**
- Facilitate adoption of PCTWIN knowledge and products (PTHA) for creating / updating guidelines and piloting them in IOTWMS member States
  - Risk Assessment (Guidelines, Products for pilot sites in Maldives, Sri Lanka, Mauritius, Seychelles, Timor Leste, etc, Early Warning Chain & SOPs)
- IOWave Exercises as an opportunity to observe and test new knowledge & products

2. Next Step : Tsunami Warning Chains and SOPs

1. Promotion and support of the continuous improvement of national tsunami warning chain and SOP development to address weak links and gaps. **Update the warning chain graphics on a regular basis as a tool to document the latest status and improvements.**
2. Use the **regular biannual IOWave exercises to revise, update, test and evaluate the status and functionality of the warning chains and related SOPs**. This requires more emphasis on the practical application of SOPs in the IOWave exercises (during preparation, implementation and evaluation of the exercise).
3. Setting a **particular focus on N/P/LDMO and Media SOPs and support the development such SOPs** *(through piloting, maybe as part of the 2026 support?)*. Share sound and proven SOPs among Member States
4. Continue **the joint learning in groups of Member States from geographical regions with similar tsunami threat and warning requirements** (EIO, WIO, NWIO)

2. Next Step: Tsunami Warning Chains and IOWave25

Preparation

- Reminding **Member States on joint working process** (preparation, training and evaluation after the exercise regarding warning chains and SOPs) around IOWave23
- Emphasize **the importance of IOWave25 exercises to revise, update, test and evaluate the status and functionality of the warning chains and related SOPs**. Explain that this requires the practical application of the existing SOPs during the IOWave exercise. While this has been widely practiced in the past at the NTWC level, special attention to the DMO SOPs is now important here.
- Encourage **Member States to revise and update their warning chains graphics and status of SOPs in preparation of IOWave25**. Emphasize the importance of regularly updating the warning chain graphics and SOP status as a way of keeping all stakeholders involved up to date with the latest status and improvements.
- Inform about **Consultancy Report and specific recommendations for each Member State, and that both will be made available after the meeting.**
- Ask **Member States to kindly share the latest versions of their warning chain graphics** with the ICG IOTWMS Secretariat before the start of IOWave25 exercise.

2. Next Step: Tsunami Warning Chains and IOWave25

After Preparation Meeting for IOWave25 with all Member States

Share consultancy report to all and provide the specific recommendations that have been drafted by the consultant after IOWave23 to each of the Member States separately. Also, attach the latest version of the respective national warning chain in the editable format that we have on file for reference

3. Next steps: further validation and improvement of the Tool

- The tool as such has not yet been comprehensively tested in practice.
- It is suggested to apply the tool in a **next tsunami related incident** that occurs in Indonesia or the Indian Ocean Region and during **IOWave25** in order to test it and gain further experience with its applicability.
- Such tests application should be accompanied and supervised by an expert team, with involvement of the team of authors, and preferably under the auspices of WG 1 ICG IOTWMS.
- Publish a **TEST-Version** by WG 1 ICG IOTWMS

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THANK YOU