



# 2nd UNESCO-IOC Global Tsunami Symposium

## Banda Aceh, 11-14 November 2024

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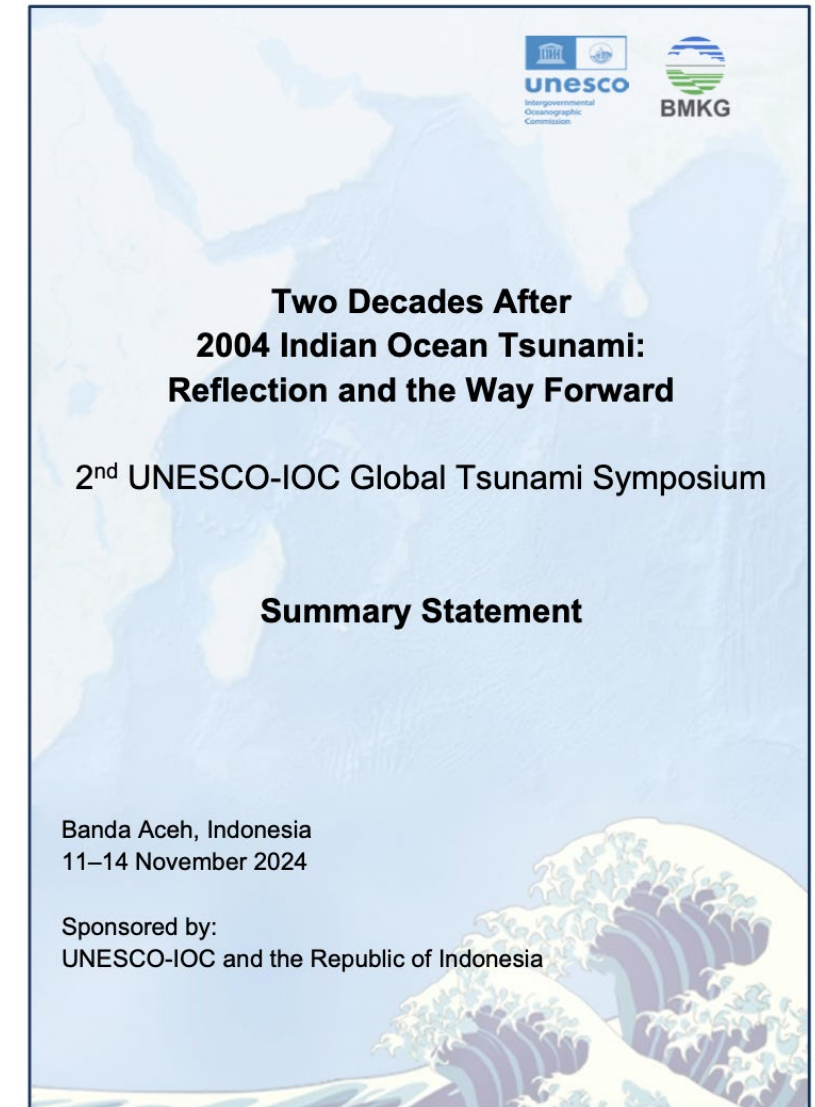
*19th Meeting of ICG/IOTWMS Steering Group, Jakarta, 17-19 June 2025*

# Two Decades After 2004 Indian Ocean Tsunami: Reflection and the Way Forward

## Banda Aceh Statement

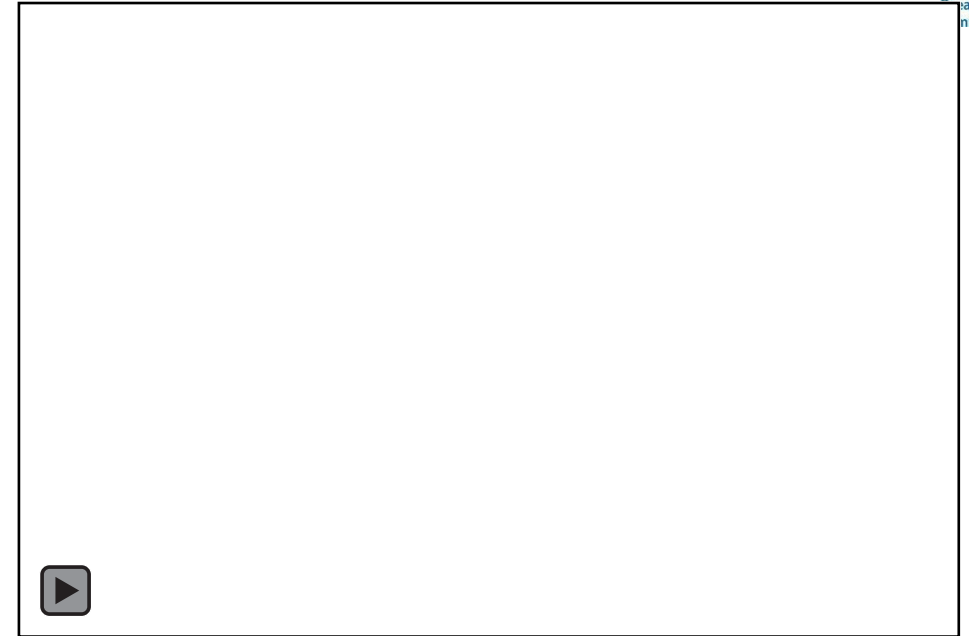
Global Tsunami Warning and Mitigation: Building Sustainability for the next decade through Transformation and Innovation.

UNESCO and its partners call on States and civil society to drastically step up their investments and efforts to strengthen Tsunami Early Warning Systems and achieve 100% of Tsunami Ready Communities across the world by 2030



# The Symposium 11-14 November 2024

- hosted by the Republic of Indonesia through BMKG in collaboration with UNESCO IOC and IUGG Join Commission
- attended by 702 in-person participants from 37 countries and 171 online participants, YouTube viewers
- representing: tsunami warning specialists, disaster managers, scientists, engineers, disaster risk reduction practitioners, and policymakers from around the world
- aims to discuss the status of tsunami warning and mitigation systems and the latest advances in tsunami science and technology to help globally enhance tsunami disaster preparedness and mitigation
- served as a global platform to review the contributions of each regional tsunami warning and mitigation system towards achieving the objectives of the UN Ocean Decade Tsunami Programme (ODTP) under the “Safe Ocean” outcome of the UN Decade of Ocean Science for Sustainable Development by 2030
- officially opened by Minister for Higher Education, Science and Technology of the Republic of Indonesia, Prof. Satryo Soemantri Brodjonegoro. He called for stronger cooperation of all stakeholders in protecting coastal communities from tsunamis and other coastal hazards.



- Mr Vidar Helgesen (Executive Secretary of IOC-UNESCO) emphasised the importance of intergovernmental processes in coordinating the development of the global tsunami early warning and mitigation system and called on Member States and stakeholders to leverage UN Ocean Decade as a platform for stronger collaboration to address future challenges.
- Prof. Dwikorita Karnawati (Head of BMKG and Chair ICG/IOTWMS) highlighted the progress made in establishing ICG/IOTWMS and importance of this symposium to define a roadmap for future.

# Objectives

1. Commemorate two decades after 2004 Indian Ocean Tsunami
2. Reflect what has been achieved in two decades
3. Identify gaps, challenges and priorities for tsunami early warning and mitigation
4. Identify synergy with global challenges and coherence with global commitments
5. Gather the global tsunami community





# Three Days Symposium in Seven Sessions

1. Session 1: Review of the Tsunami Warning and Mitigation Systems over the past 2 decades
  - Learning from Mega Tsunamis : 2004 Indian Ocean Tsunami and 2011 Tohoku Tsunami
  - Gaps, challenges, and priorities in tsunami risk, detection, warning and dissemination, awareness and preparedness for the Global Tsunami Warning and Mitigation System
  - History of IOTWMS
2. Session 2: Tsunami generated by non-seismic and complex sources
  - Progress, gaps and emerging challenges of detecting and warning for tsunamis generated by non-seismic and complex sources
  - Evaluating non-seismic generated tsunami modelling
3. Session 3: Tsunami Hazard and Risk Assessment
  - Evaluating seismic and non-seismic generated tsunami hazards
  - Identifying communities at-risk
  - Developing awareness and preparedness of communities for tsunamis generated by seismic, non-seismic and complex sources
4. Session 4: Tsunami Detection, Warning, Dissemination, and Response
  - Testimony for lessons to be learnt from past significant Tsunamis
  - How do we Enhance Timeliness and Accuracy of Tsunami Warnings?
  - How do we Ensure Tsunami Warnings Reach all in the community?
5. Session 5: “Achieving 100% Communities at Risk to be Prepared and Resilient to Tsunami by 2030”
  - UNESCO-IOC Tsunami Ready Recognition Programme in PTWS
  - UNESCO-IOC Tsunami Ready Recognition Programme in CARIBE-EWS and NEAMTWS
  - Synergising UNESCO-IOC Tsunami Ready with national programmes for tsunami preparedness in Indonesia
  - UNESCO-IOC Tsunami Ready Coalition
  - World Tsunami Awareness Day (WTAD)
6. Session 6: Other critical issues for building community resilience
  - Social and Human perspective in Tsunami Science and Tsunami Early Warning System
  - Critical infrastructure ready for tsunami: design, implementation, and maintenance

# Three Days Symposium in Seven Sessions

7. Session 7: Critical Contributions of TEWS to global initiatives
- MHEWS & EW4ALL
  - SDGs & COP28 & SFDRR
  - UN Ocean Decade
  - Synergies between the UNESCO IOC Tsunami Ready and the WMO Weather Ready Nations programs
  - MCR2030 (Mainstreaming DRR into Urban Planning)





# Field Trip



TR Communities Simulation



New TR Communities Recognition



## 2 Pre Conference Events

1. Two pre-events were organised before the conference centred around: (i) scientific advancements made since the 2004 Sumatra earthquake, with a focus on forecasting techniques, technological innovations, and understanding complex tsunami sources, and (ii) importance of building community preparedness and sustaining advancements in early warning systems and infrastructure.
2. These discussions brought together leading experts and stakeholders to address challenges, explore innovations, and outline priorities for future work in tsunami science and risk management.





# Conference Side Events

1. Three side events were organized during the conference that included (i) an exhibition, (ii) an ignite stage, and (iii) poster displays.
2. The exhibition featured 29 booths showcasing the latest innovations in tsunami mitigation and preparedness by international and national organizations. The UNESCO-IOC booth highlighted the Tsunami Early Warning System and Tsunami Ready, along with TIC educational and awareness materials. A game-based learning tool on tsunami evacuation, called “Runami,” was launched at both the exhibition and ignite stage.
3. The ignite stage hosted 32 presenters covering 27 different topics, and 70 posters were displayed during the three days. In addition to symposium participants, these side events attracted over 200 daily visitors from schools, universities, and the public.

## Key Take aways:

1. The side events provided researchers and participating organizations with the opportunity to share, update, and pitch their ideas on tsunami early warning, awareness, preparedness, and mitigation. These events also accommodated several related topics that were not covered in the main symposium.
2. While the symposium sessions might have been too technical for the general public and school children, the side events offered a valuable platform for them to engage with the overall event of the global tsunami symposium.
3. The side events were highly successful in attracting visitors, providing numerous awareness and educational materials that were shared and explained as part of public capacity building.

# Conclusion

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- The conference was regarded as highly successful in reviewing the status, identifying gaps and coming up with a robust roadmap for enhancing the end-to-end tsunami early warning and mitigation system.
- The conference adapted the Banda Aceh Statement:  
***“Global Tsunami Warning and Mitigation:  
Building Sustainability for the next decade  
through Transformation and Innovation.*”**

***UNESCO and its partners call on States and  
civil society to drastically step up their  
investments and efforts to strengthen Tsunami  
Early Warning Systems and achieve 100% of  
Tsunami Ready Communities across the world by 2030.***

# Session 1

## Review of the Tsunami Warning and Mitigation Systems over the past 2 decades

- **Chair:** Dr. Idwan Suhardi & Dr. Jorn Lauterjung
- **Rapporteur:** Ms. Nora Gale
- **10 Speakers :**

### Gaps (technological)

- Lack of adequate sea level data for tsunami detection and also monitoring infrastructure for early warning of non-seismic tsunamis (i.e., volcano, landslide, meteo-tsunami).
- Limited coverage in the availability of high-resolution shallow water bathymetry that is needed for more accurate tsunami forecasts, inundation modelling, and evacuation planning.
- Constraints in the extensive real-time sharing of freely available tsunami detection and forecasting data in order to improve timeliness and accuracy of tsunami forecasts.

### Future Priorities

- Monitoring and forecasting for non-seismic tsunamis.
- Integration of emerging technologies (i.e., GNSS, cable-based deep-ocean sensors, Deep Learning) into the existing monitoring systems.
- Increased accuracy and shorter dissemination times for tsunami threat information.
- Mainstreaming of the UNESCO-IOC Tsunami Ready Recognition Programme (or similar initiative) as a national priority and requirement implemented for all coastal communities at risk from tsunamis.



## Session 2

### *Tsunami generated by non-seismic and complex sources*

- **Chair:** Mr. Bernardo Aliaga
- **Rapporteur:** Srinivasa Kumar Tummala & Denis Chang Seng
- **5 Speakers :**

#### **Gaps (technological)**

- While several efforts are underway to develop warning protocols for tsunamis generated by non-seismic sources, such capabilities in the current regional tsunami warning systems are limited to a very few volcanoes.
- Observing, modelling, evaluating and early warning for non-seismic tsunamis, which often arise from volcanic eruptions or landslides, require distinct approaches, emphasizing the complexity and challenges they present.
- Volcanic- and landslide-induced tsunamis have diverse generation mechanisms, unlike seismic tsunamis, complicating forecasting and requiring specialized and dense monitoring and modelling.

#### **Future Priorities**

- Integrated standard operating procedures for operational warning of tsunamis generated by non-seismic sources including linkages and coordination with both volcanic and tsunami monitoring agencies.
- Development of optimal observing networks, numerical modelling, and scenario databases of non-seismic tsunamis to aid in hazard assessment and early warning capabilities.
- Strong international collaboration and global integration of multi-hazard warning systems is necessary for comprehensive tsunami risk management.

## Session 3

### *Tsunami Hazard and Risk Assessment*

- **Chair:** Dr. Srinivasa Kumar Tummala
- **Rapporteur:** Mr. Rick Bailey
- **8 Speakers :**

### **Gaps**

- Multi-hazards, coastal vulnerability, and tsunamis generated by non-seismic and complex sources are not included in most of the tsunami risk and/or hazard assessments.
- Local-level hazard and risk assessment and smaller impact scenarios (in addition to the largest impact scenarios) are needed to better inform communities.
- Reaching every individual and sector with the appropriate, useful, and timely information will always be a challenge.
- The catalogue of tsunami sources is limited and needs to extend further back in time, such as to the last Holocene period.
- There are few guidelines for tsunami risk and hazard assessments available leading to uncertainty on best practices.

### **Future Priorities**

- Extension of hazard and risk assessment to include tsunamis generated by non-seismic and complex sources (e.g., volcanoes, landslides, meteo-tsunami, splay faulting, etc.) is needed to enhance tsunami generation models.
- More high-resolution near-shore bathymetry and topography data should be acquired and made freely available for tsunami propagation and inundation models underpinning hazard and risk assessments.
- Paleo-tsunami studies to better inform tsunami hazard assessments should be undertaken along at-risk coastlines with preserved sedimentary deposits (i.e., North-West Indian Ocean).
- Preparedness needs to strive to address all individuals, the public and private sector, educational institutions, NGOs, and consider race and cultural, religious, and language diversity, and socioeconomic and demographic, geographical and migration status.
- Continued emphasis on early education as a foundational priority to sustain awareness and preparedness over generations, especially as tsunamis are infrequent and no-notice events.

## Session 4

### *Tsunami Detection, Warning, Dissemination, and Response*

- **Chair:** Prof. Nanang Puspito and Dr. Charles McCreery
- **Rapporteur:** Ms. Ocal Necmioglu
- **8 Speakers :**

#### **Gaps**

- Forecasting for tsunamis generated by non- seismic and near-source events remains a challenge.
- Determining accurate earthquake magnitudes immediately after the event remains challenging with magnitude estimates for large events generally increasing over time and initial assessments an underestimate.
- Ensuring tsunami warning and response is all inclusive is a necessary challenge to protect the lives of vulnerable communities.

#### **Future Priorities**

- Develop tsunami warning systems capable of issuing actionable and timely warnings from all sources to 100% of coasts at risk.
- Tsunami early warning systems should be people-centred and inclusive of all genders, children, elderly and people with disabilities.
- Maximise and extend existing tsunami monitoring technologies and identify emerging technologies for tsunami propagation modelling and forecasting.
- Design and install optimal global tsunami monitoring networks capable of detecting all tsunamis within ten minutes of generation.



## Session 5

# *“Achieving 100% Communities at Risk to be Prepared and Resilient to Tsunami by 2030”*

- **Chair:** Prof. Faisal Fathani and Mr. David Coetzee
- **Rapporteur:** Ms. Nora Gale
- **10 Speakers :**

### Gaps

- While there is progress in the implementation of the TRRP, the momentum is relatively slow and/or not equal across all regions and sub- regions. Capacity and funding gaps are particularly prevalent in SIDS.
- A significantly greater global implementation rate is required to achieve the ODTP aim of 100% communities at risk are prepared and resilient to tsunamis by 2030.
- To achieve the above aim, the collective support of the international community is required, including leveraging existing global and regional programmes and projects, and in successfully engaging new partners with resources.
- The Tsunami Ready Coalition has not yet been formed.

### Future Priorities

- Scale up the implementation of TRRP through establishment of a comprehensive TRRP implementation plan for each region, including identification of benefits, gaps and needs.
- Promote TRRP through relevant international and regional events and conferences.
- Identify funding for the TRRP in the regions, and/or opportunities for leveraging existing funding and programmes to advance Tsunami Ready.
- Establish an effective Tsunami Ready Coalition with the inclusion of traditional and non-traditional global and regional institutions to facilitate critical strategic and operational partnerships.

## Session 6

### *Other Critical issues for building community resilience*

- **Chair:** Mr. Ardito M. Kodijat and Dr. Ocal Necmioglu;
- **Rapporteur:** Dr. Laura Kong
- **10 Speakers :**

#### **Gaps**

- Existing tsunami education and preparedness efforts are often episodic and lack a structured, sustainable framework, while the inclusion of vulnerable groups, particularly women, in decision-making processes remains insufficient.
- There is a significant need for designing critical infrastructure facilities to cater to specific functions during tsunamis, as well as for improved collaboration between infrastructure management and communities for effective preparedness.
- There is a lack of effective frameworks to address the non-linear nature of systemic risks, alongside inadequate integration of technology resilience in emergency management systems, which may compromise detection and warning efforts during simultaneous hazard events.

#### **Future Priorities**

- There is a critical need to promote transdisciplinary collaboration in tsunami early warning systems to grasp the social complexities, empower women in disaster risk reduction efforts, and leverage higher education resources to build resilient communities through continuous awareness and preparedness initiatives.
- The goal is to promote implementation of tailored tsunami mitigation strategies for critical infrastructure facilities including conducting effective emergency drills, and implementing the UNESCO-IOC Tsunami Ready Recognition Programme for critical infrastructure
- To enhance preparedness and governance in this complex risk landscape, there is a need for probabilistic analyses, scenario-building techniques, and a community-level approach to resilience that focuses on capacity building and clarifies roles within a multi-agency governance structure.

## Session 7

### *Critical Contributions of TEWS to global initiatives:*

- **Chair:** Mr. Tony Elliott and Dr. Andi Eka Sakya
- **Rapporteur:** Prof. Richard Haigh
- **7 Speakers :**

### **Key Take Aways**

- There already is alignment and coherence across many global initiatives at the framework level. For example, EW4ALL was launched at COP 27, builds upon and synergises with existing initiatives. The UNESCO-IOC TRRP indicators mirror the EW4ALL pillars for tsunami.
- The global initiatives are not hazard-specific but are inclusive of tsunami. However, the Ocean Decade also provides an opportunity for dedicated actions that address specific challenges associated with tsunami.
- Coordination and partnership are crucial to achieving alignment in practice. It is also evident that the organisations leading EW4ALL pillars have many linkages and networks to facilitate building these partnerships. However, the specific mechanisms for coordination are less clear. The national roadmaps in EW4ALL are a way of facilitating coordination at the national level.
- A recurring theme of the session was about the global initiatives and Early Warning being meaningful at the community / local level, such as risk knowledge and early warning technology and messaging. Tsunami Ready and MCR2030 are vehicles for achieving this.
- An EW4All key priority, applicable for tsunamis, for enhancing risk knowledge is to improve impact-based forecasting and transmission of actionable warning messages. Several talks in earlier sections shared tools or evolving warnings to better meet customer needs, and for providing tools and global or regional community facilities for disaster risk reduction to ensure no one is left behind.
- Overall, partnership and coordination will be central to aligning tsunami with the global initiatives. However, further work is required to identify and / or establish the most suitable platforms to achieve this, especially at the sub- national level.





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# THANK YOU