

Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies



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**Intergovernmental Coordination
Group for the Indian Ocean
Tsunami Warning and
Mitigation System
(ICG/IOTWMS)**

Inter-Sessional Meeting
23–24 November 2021 (online)

UNESCO

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Inter-Sessional Meeting
23–24 November 2021 (online)

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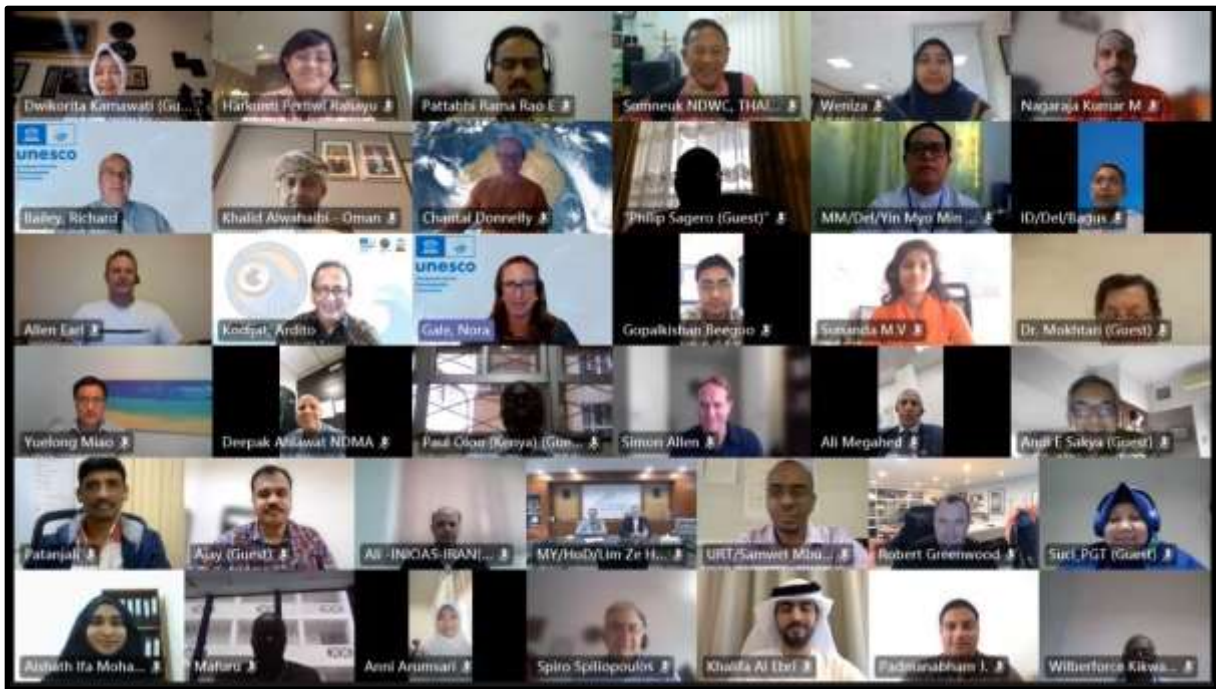


Photo 1: Some participants at Day-1 of the Intersessional Meeting of ICG/IOTWMS, 23 November 2021

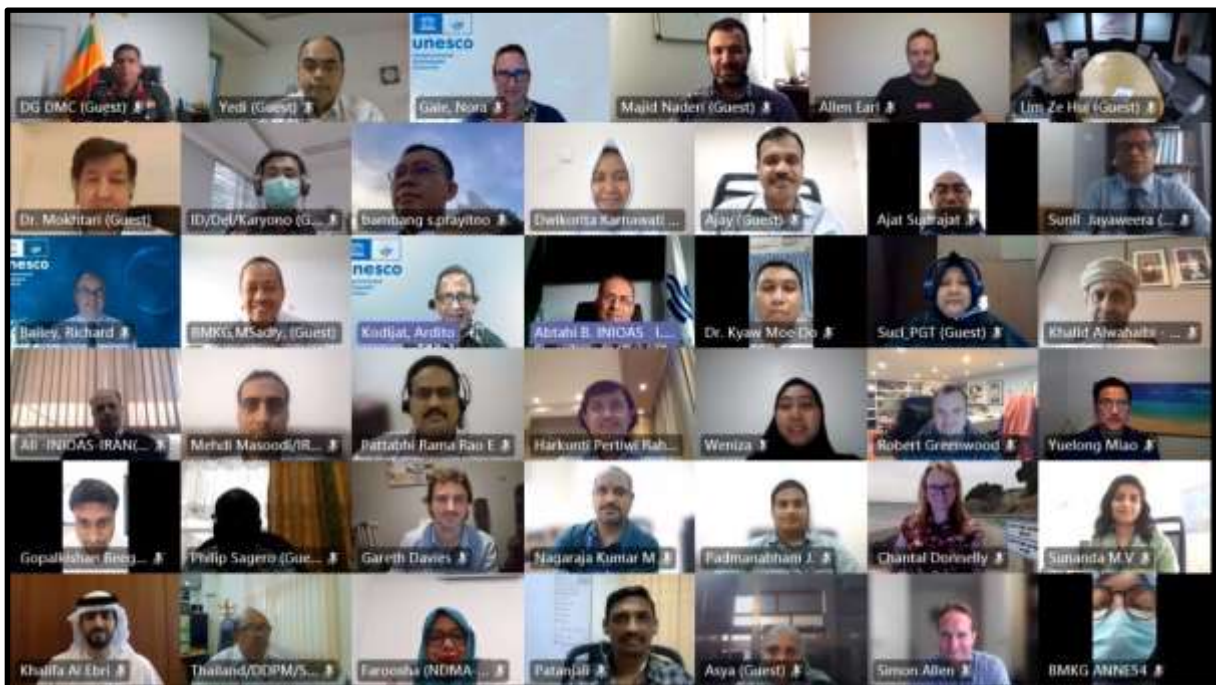


Photo 2: Some participants at Day-2 of the Intersessional Meeting of ICG/IOTWMS, 24 November 2021

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4. OPENING

1.1 WELCOME

1. The welcoming remarks were given by Mr Rick Bailey, Head of Secretariat for the UNESCO-IOC Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS). He welcomed all distinguished delegates and participants to the intersessional meeting of the ICG/IOTWMS.

2. Mr Bailey advised the group that the intersessional meeting is being held online due to the impacts of COVID-19 on scheduling and hosting face-to-face meetings of the ICG, especially due to restrictions placed on international travel. He noted that the purpose of this meeting is to provide progress reports to the Member States of the IOTWMS before the next formal session ICG/IOTWMS-XIII, when final reports will be tabled for Member State review and elections held as required.

3. Mr Bailey noted that one of the major outcomes of the United Nations Ocean Decade of Ocean Science for Sustainable Development 2021–2030, coordinated by the IOC, is a Safe Ocean. The ICG/IOTWMS will play a vital role in the Ocean Decade's Tsunami Programme in helping to meet this outcome, in particular to ensure the delivery of more timely and more accurate tsunami warnings to 100% of at-risk coastal communities who will be Tsunami Ready.

1.2 OPENING ADDRESS

4. The opening address was given by Professor Dwikorita Karnawati, Chair of the ICG/IOTWMS. Prof. Karnawati welcomed the distinguished participants, Chair of the ICG/IOTWMS, Heads of Delegations, Head of the UNESCO-IOC Tsunami Unit, Vice-Chairs of the ICG/IOTWMS, Head of the IOC Secretariat for the ICG/IOTWMS, and the Head of IOTIC to the intersessional meeting of ICG/IOTWMS.

5. Prof. Karnawati recalled that the ultimate goal of the IOTWMS is the safety of our at-risk communities against the terrible threat of tsunamis. All of our efforts need to be directed at enabling our national authorities to deliver more timely and more accurate tsunami warnings to all of our at-risk coastal communities, as we strive to make the communities Tsunami Ready. We need to utilise all opportunities, like the Tsunami Programme of the United Nations Decade of Ocean Science for Sustainable Development 2021–2030, to achieve this goal.

6. She noted that the intersessional meeting will review the work towards the three pillars underpinning the Indian Ocean Tsunami Warning System: 1) Hazard and Risk Assessment; 2) Detection, Warning & Dissemination; 3) Community Awareness and Preparedness. Reports will include support of these efforts by the IOC Secretariat, the Indian Ocean Tsunami Information Centre, Working Groups and Task Teams. Much progress has been made through the UNESCAP funded project "Strengthening Tsunami Warning in the North-West Indian Ocean through Regional Cooperation". The meeting will review our capacity, the performance of our Tsunami Service Providers, results from the last Indian Ocean Wave Exercise, and the impacts of COVID on our staff and systems. Importantly we will consider the challenges ahead and the opportunities to overcome them.

7. In conclusion, Prof. Karnawati thanked the ICG/IOTWMS Secretariat for supporting the online meeting in these challenging times of COVID. She declared the meeting officially open.

1.3 YOUTH VIDEO COMPETITION

8. Mr Ardito M. Kodijat, Head of the Indian Ocean Tsunami Information Center (IOTIC), presented the winners of the U-Inspire Tsunami Awareness Youth Video Competition, which attracted 79 video submissions from around the Indian Ocean. The winners for each region were:

Eastern Indian Ocean: 1) Little Sea in Tompe, Indonesia by Sarah Adilah; 2) Living with the Sea, Indonesia by Vania Qanita Damayanti, Adrian Muhammad Fikri Suni & Nur Amri Firmansyah; 3) Atypical Tsunami and Solution, Indonesia by Muhyiddin Aprizandy, Bobby Tegar Sanjaya & Muna Fauziah.

Indian Ocean Small Island States: 1) We Are Aware, Seychelles by Darius Ashvine Commettant, Shainarah Chandell Manisha Ragain & Ruth Abigail Nicole Henrie; 2) Public Tsunami Awareness, Maldives by Ahmed Yaeesh Shaheem; 3) Tsunami the Incoming Threat, Seychelles by Melchizedek Solin.

North-West Indian Ocean: 1) Surviving Tsunami, India by Vandita Sariya; 2) Let's Buck Against the Wave, Pakistan by Aneeqa Bibi, Humera Khan & Sania Mehmood; 3) Make Them Aware if You Care, Pakistan by Ayesha Nadeem.

Western Indian Ocean: 1) Good Wave Intentions, Kenya by Mahfudh Khamisi Omar; 2) Tsunami Exercise, Tanzania by Neema Tayai Mollel; 3) Do We Communicate Hazard and Risk of Tsunami, Tanzania by Yasin Ramadhan.

9. The ICG/IOTWMS expressed congratulations to the entrants of the competition noting the high quality and deeply meaningful messages of all the videos.

1.4 ORGANISATION OF THE MEETING

10. Ms Nora Gale of the UNESCO-IOC ICG/IOTWMS Secretariat introduced the organisation of the meeting, including the functionality of the MS Teams online meeting environment. She drew attention to the meeting website, <https://oceanexpert.org/event/3300>, which contains the agenda, documents, presentations, and participant list.

1.5 ADOPTION OF THE AGENDA

11. Prof. Karnawati presented the provisional agenda for adoption. The delegates adopted the agenda without modification and provided updates to the names of presenters. Refer to [Annex 1](#) for the agenda and timetable of the meeting.

5. ICG CHAIR REPORT

12. Prof. Karnawati reported on the inter-sessional activities of the ICG since its last meeting. She reviewed the development and governance of the ICG/IOTWMS, and its three pillars of (a) risk assessment; (b) tsunami detection, warning and dissemination; (c) and community awareness and preparedness. The IOC-UNESCO Tsunami Ready Programme, which is underpinned by 12 indicators of tsunami awareness and preparedness, is a current and ongoing focus of the ICG. Prof. Karnawati also reported on challenges including maintaining awareness and preparedness, responding to near-field and atypical tsunamis. Future opportunities include the UN Ocean Decade 2021-2030 Tsunami Programme, development of multi-hazard framework by WMO, and collaboration with other UN organisations (UNDRR, UNDP, etc.). In conclusion, Prof. Karnawati noted the national, regional and global commitments underpinning the effective functioning of the IOTWMS.

6. SECRETARIAT REPORT

13. Mr Rick Bailey presented a report focusing on the activities of the ICG/IOTWMS Secretariat since the last session of the ICG. He outlined the challenges tsunamis pose to our at-risk coastal communities, especially their short-fuse nature and the need to wherever possible enhance the timeliness and accuracies of tsunami warnings. Other challenges outlined included tsunamis caused by non-seismic or atypical sources, such as submarine landslides, volcano collapses, and certain atmospheric conditions. He described how COVID-19 has added to these challenges and the steps taken by the ICG/IOTWMS to help mitigate. Mr Bailey then described opportunities to address these challenges, including the Tsunami Programme of the UN Ocean Decade, continuing national, regional and global commitment and collaboration. He briefly reported on the implementation of ICG/IOTWMS decisions, recommendations and actions.

7. INDIAN OCEAN INFORMATION CENTRE REPORT

14. Mr Ardito Kodijat reported on activities at Indian Ocean Tsunami Information Centre (IOTIC)(<http://iotic.ioc-unesco.org/>) since the last session of the ICG. In particular, he advised of the outcomes from World Tsunami Awareness Day (WTAD) on 5th November and contributions made by the ICG/IOTWMS, including delivery of an online workshop on “International Cooperation Strategic Pathway for the Indian Ocean Tsunami Early Warning and Mitigation System Within the Context of UN Decade for Ocean Science”, 10 November 2021, a youth video competition, and the release of new tsunami awareness products such as a set of 14 animations describing Tsunami Ready. He also advised of the overall progress of the first phase of the UNESCAP funded project “Strengthening Tsunami Warning in the North-West Indian Ocean through Regional Cooperation” building a better understanding of the tsunami hazard in the Makran Region and strengthening national tsunami warning chains in the participating countries (Iran, India, Pakistan, Oman and UAE) to be able to respond and warn their at-risk coastal communities. It was advised a second phase of the project is to be supported by UNESCAP, starting in early 2022.

8. TSUNAMI AND OTHER HAZARDS RELATED TO SEA LEVEL WARNING AND MITIGATION SYSTEMS WORKING GROUP

15. Mr Rick Bailey informed the plenary of the two meetings of the Tsunami and Other Hazards Related to Sea level Warning and Mitigation Systems Working Group (TOWS-WG) that were held in the inter-sessional period. Meetings of both the TOWS-WG Task Team on Tsunami Watch Operations and the Task Team Disaster Management and Preparedness were also held back-to-back with these meetings.

16. Major outcomes were described from these important groups coordinating, harmonizing and further developing the global tsunami warning and mitigation system. This included the development of the UN Ocean Decade Tsunami Programme, which is a once-in-a-generation opportunity to address and potentially fill capability gaps by leveraging novel sensing platforms, techniques and/or infrastructure in order to more quickly detect, measure, forecast and warn for tsunamis, even from the near-instant they form, and to enhance the preparedness of coastal communities for tsunamis through the UNESCO/IOC Tsunami Ready Programme. The TWOS-WG endorsed the document “Protecting Communities from the World’s Most Dangerous Waves: A Framework for Action under the UN Decade of Ocean Science for Sustainable Development” (annex 1 to Circular Letter, [2825](#)) as a guiding document to develop a Draft 10-Year Research and Development and Implementation Plan that will be registered as an Ocean Decade Action called the Ocean Decade Tsunami Programme (the programme) and recommended a governance structure for the programme. A Science Committee is being established to develop the plan. A Tsunami Coalition is also to be established consisting of international, regional, and national stakeholders such

International Federation of Red Cross and Red Crescent (IFRC) Societies, UNDP, UNDR, ASEAN, etc. The goal of the Coalition is linked to the 'safe ocean' Societal Outcome of the Decade, "...whereby human communities are much better protected from ocean hazards and where the safety of operations at sea and on the coast is ensured...". In this context, the goal of the Coalition is to grow the number of Tsunami Ready communities as part of the Ocean Decade

9. UN OCEAN DECADE

17. Mr Bernardo Aliaga Rossel, Tsunami Unit Head (a.i.) provided an update on the definition of a dedicated Ocean Decade Tsunami Programme (the programme) under the UN Decade of Ocean Sciences for Sustainable Development (2021-2030). He reported that through [Decision A-31/3.4.1](#), the IOC Assembly at its 31th session approved the establishment of the programme and the establishment of a Scientific Committee (SC) to prepare the Draft 10-Year Research, Development and Implementation Plan for this programme. The programme is based on two over-arching aspects. The first aspect is to fully explore technological and observational advances that will allow us to move from a capability based largely on seismic assumptions and large uncertainties to one based on real-time dynamic assessment and low uncertainties. The second aspect will be to match these capability advancements with improved community preparedness efforts, including striving for 100% Tsunami Ready or comparable recognition of all at-risk coastlines. In this way—by combining scientific and technological advances with unprecedented levels of understanding and preparedness—we look to achieve true long-term tsunami resilience where communities have access to accurate real-time tsunami impact forecasts that enable them to minimize impacts on lives and maintain critical infrastructures and services, even under extreme circumstances.

10. STRATEGIC PATHWAY DEVELOPMENT

18. The outcomes from the World Tsunami Awareness Day (WTAD) online webinar held on 10th November 2021 on developing a strategic pathway for the IOTWMS within the context of UN Decade for Ocean Science were discussed with emphasis on future directions for the ICG/IOTWMS.

19. The WTAD webinar focused on developing a strategic pathway for the IOTWMS within the context of UN Decade for Ocean Science. Around 100 participants attended this event including ICG/IOTWMS Tsunami National Contacts, Steering Group, Working Group and Task Team Members, Secretariat, IOTIC, and Invited Experts. The group met in plenary, as well as two break-out sessions discussing: (1) Tsunami warning, detection and dissemination; and (2) Tsunami risk, community awareness and preparedness. Opportunities were explored in how to best utilise the Tsunami Decade Programme within the UN Decade of Ocean Science for Sustainable Development (2021–2030). Four strategic elements were discussed in terms of their implementation pathways and outcomes:

- 1 Expansion of existing and deployment of new technologies addressing observational gaps,
- 2 Wide expansion of real and near-real time data access and availability,
- 3 Strengthen the access to data, tools and communication platforms, protocols and training to timely and effectively warn coastal and maritime communities, and
- 4 Strengthen communities at risk of tsunami, by being prepared for and resilient to tsunami through the implementation of the UNESCO/IOC Tsunami Ready Programme.

20. To utilise these elements to achieve our goal of more timely warnings with reduced uncertainties delivered to at-risk communities that are 100% Tsunami Ready, the group made the following recommendations:

- Bridge the gaps between silos in tsunami early warning (i.e. upstream and downstream) by promoting multi-stakeholder collaboration.
- Link science and technology knowledge into training and policy.
- Include all levels of society in the tsunami warning and mitigation system.
- Integrate tsunami warning and mitigation into multi-hazard frameworks.
- Help build capacity in Small Island Developing States (SIDS) and Least Developed Countries (LDCs).

11. IOTWMS CAPACITY ASSESSMENT

21. Dr Harkunti Rahayu, Chair of ICG/IOTWMS Working Group-1 on Tsunami Risk, Awareness & Preparedness and former Chair of the Task Team on Capacity Assessment of Tsunami Preparedness, presented the results of the Capacity Assessment of Tsunami Preparedness in the Indian Ocean, Status Report, 2018. The report was published in 2020 as IOC Technical Series 143 (<https://unesdoc.unesco.org/ark:/48223/pf0000373680>). The full report is complemented by an Executive Summary.

22. The 2018 Capacity Assessment of Tsunami Preparedness in the Indian Ocean was a follow-up to the 2005 assessment of capacity building requirements in the Indian Ocean following the 2004 Indian Ocean Tsunami (IOT). The 2018 assessment provides a new baseline of the status of tsunami preparedness capacity in the region. The assessment addressed the status of: (a) policies, plans and guidelines; (b) risk assessment and reduction; 4) detection, warning and dissemination; and 5) public awareness, preparedness and response in Indian Ocean Member States. It identified considerable improvement across all components of the IOTWMS since 2005. It also identified specific gaps and capacity development requirements regional and national levels. Dr Rahayu reviewed the recommendations of the assessment, noting the endorsement by Working Groups 1 and 2.

Action: Working Groups to prioritise future Capacity Development requirement of IOTWMS Member States based on recommendations of the 2018 assessment.

12. TSUNAMI READY

23. The current status of the community-based IOC Tsunami Ready Programme was presented by Mr Ardito Kodijat, Head of IOTIC. Discussions revolved around implementing the programme in the Indian Ocean to reach the UN Ocean Decade goal of 100% of at-risk coastal communities being Tsunami Ready. The programme underpins the goals of the Sendai Framework for Disaster Risk Reduction 2015–2030, Sustainable Development Goals (SDG), and UN Ocean Decade. So far in the Indian Ocean two communities have been certified in Odisha, India (Venkatraipur and Noliashi). The 12 indicators required to be passed for certification were described. The process to become certified was outlined, including the key role of the National Tsunami Ready Board (NTRB). Some of the lessons learnt from Odisha included the importance of engagement of INCOIS the National Tsunami Warning Centre (NTWC), strong involvement of provincial DMO and the political leadership in Odisha, strong community ownership and opportunity to leverage financial resources.

Action: Steering Group to develop draft ToRs for a Tsunami Ready Working Group of the ICG/IOTWMS to be considered at ICG/IOTWMS XIII to lead and coordinate the implementation of the Tsunami Ready Programme in the Indian Ocean.

The Tsunami Ready Working Group shall work in conjunction and take technical advice from the other working groups and task teams of the ICG/IOTWMS Member States to nominate Tsunami Ready Focal Points and representatives from DMOs to the Tsunami Ready Working Group to promote increased participation of disaster managers in the work of the ICG/IOTWMS.

13. THE IMPACTS OF COVID

24. In 2020, the ICG/IOTWMS distributed Guidelines for Tsunami Warning Services, Evacuation, and Sheltering during COVID-19s (ICG/IOTWMS COVID-19 Guidelines) to its Member States. The document is aimed at Member State authorities responsible for the organisation of tsunami warning and emergency response. It clarifies the status of the regional tsunami services for the Indian Ocean and suggests best practices for national and local actions during the COVID-19 pandemic, such as management of evacuation centres.

25. UNESCO-IOC also requested monitoring network operators and TSPs operating within each regional tsunami warning and mitigation system to complete an assessment on the impact of COVID-19 on operations, data, procurement and risks. ICG/IOTWMS Working Group-2 on Tsunami Detection Warning and Dissemination (WG-2) analysed the responses submitted by the IOTWMS (Impacts of COVID on IOTWMS monitoring systems and TSPs) and found the IOTWMS did not have any major impediments for now. However, it was duly noted many operators are finding it increasingly difficult to undertake maintenance on assets, so interruptions to key observations may increase over time. Similarly, staffing levels at TSPs remain manageable, but may be impacted if COVID-19 infections increase.

26. Dr Harkunti Rahayu, Chair of WG-1, introduced the recent analysis on the impact of COVID-19 on tsunami preparedness and the uptake of these guidelines by Member States, which was conducted via an online survey with the help of the University of Huddersfield, UK. The survey was conducted to better understand current national, regional and local responses to COVID-19, which may differ depending upon a number of conditions, such as the phase of the pandemic, transmission in the community, demographics and response capabilities. The survey remains open and to date 26 responses have been received from authorities in ten countries. Survey responses will be further analysed by the University of Huddersfield, UK and Institute of Technology Bandung, Indonesia research teams, who will present the results to the next planned sessional meeting of the ICG Meeting in 2022.

14. TASK TEAM ON EXERCISE INDIAN OCEAN WAVE 2020 REPORT

27. Ms Weniza (Indonesia), Chair of the ICG/IOTWMS Task Team on Exercise Indian Ocean Wave 2020 (IOWave20), reported on the planning, conduct and outcomes of the IOWave20 exercise, which took place on 6–20 October 2020.

28. Six Indian Ocean Wave (IOWave) exercises have now taken place in 2009, 2011, 2014, 2016, 2018 and 2020. The most recent exercise, held in October 2020, was impacted by the ongoing COVID-19 pandemic. The exercise was successful with the three designated TSPs and 20 active Member States, with six Member States reporting community involvement but not necessarily evacuation. From this history of exercises, an article has been published in the UNESCO Magazine with the title “Evolution of Ocean Wide Exercise in the Indian Ocean”.

29. Due to COVID-19 pandemic effects, the task team decided to reduce the scale and objective of the exercise. The scale of exercise was reduced in comparison to previous exercises to reflect testing communication protocols, conducting a “virtual” table-top exercise, and updating organisational Standard Operating Procedures, plans and policies for tsunami warning and emergency response during a pandemic. There were three out of six objectives compared to previous exercises. The objectives of this exercise focused on validating the dissemination by TSPs of Tsunami Bulletin Notification Messages to NTWCs, the reception by NTWCs of the TSP messages, validation of the access by NTWCs to the tsunami bulletins and other products on the TSP websites, and the use of that information for the production of national warnings. This also included validation of the reporting by NTWCs of their National Tsunami Warning Status to the TSPs.

30. With regards to the pandemic effects and the ICG/IOTWMS published guidelines for tsunami response during the COVID-19 pandemic, five countries reported updating their tsunami response procedures during the pandemic. A further eleven countries reported that they have future plans to adjust their response procedures for a pandemic environment.

31. For the methodology of IOWave20 and following consultation, for the first time in Indian Ocean exercises three earthquake scenarios including the Java trench, Andaman trench, and Makran trench were held at one-week intervals on 6, 13 and 20 October. Each scenario was held in real time over a 1-hour duration. Furthermore, IOC-UNESCO conducted an online assessment that was coordinated in country by the IOWave20 National Contacts.

32. The draft report based on an online evaluation survey and post-IOWave20 workshop is available on the website for this ICG/IOTWMS Inter-Sessional Meeting. This report has been shared with TNC and national exercise contacts for approval, with the final feedback and input requested by end of November 2021 to enable publication by end of 2021 or early 2022.

33. Eight (8) ICG/IOTWMS Member States participated in the Java scenario, thirteen (13) participated in the Andaman scenario, and thirteen (13) participated in the Makran scenario. For those who participated, all nineteen countries (100%) involved National Tsunami Warning Centers (NTWCs); 17 countries (89%) involved National Disaster Management Organisations (NDMOs); 14 countries (74%) involved Local Disaster Management Organisations (LDMOs), 9 countries (47%) had media representatives participate; and 6 countries (32%) included communities. Out of the 19 reporting Member States, 10 (59%) conducted table-top exercises, 6 (35%) conducted orientation exercises, 6 (35%) conducted functional exercises, 3 (18%) conducted drills, and none conducted full scale exercises.

34. For Objective 1, which is to validate the dissemination by TSPs of Tsunami Bulletin Notification Messages to NTWCs via Tsunami Warning Focal Points (TWFPs) of Indian Ocean countries and the reception by NTWCs of the TSP messages, the notification messages issued by the TSPs from timeliest to least timely were: email, GTS, SMS and Fax. Very little difference in timeliness was observed between Email and GTS, which were approximately 80%. For assessing the success rate of NTWCs in receiving TSP notification messages for each delivery method, email was found to be the most effective method of communication to receive the TSP notification messages, followed closely by GTS and SMS, while Fax is the least effective out of all four communication methods.

35. For Objective 2 related to accessing each TSP website, which particular information or products was accessed and using TSP tsunami threat information in the production for national warnings, and which particular products were used, seventeen (89%) of participating countries were able to access the TSP websites. The most used information is the Predicted Max Wave Amplitudes, Coastal Forecast Zone Threat Levels, the first wave (T1) Predicted Arrival Time, and Tsunami Wave Observations. All of the reporting Member States (100%) accessed at least

one TSP website. This is the highest access rate achieved to date when compared to previous exercises and IOTWMS communication tests

36. For Objective 3 related with reporting by NTWCs to the TSPs of their National Tsunami Warning Status. The overall NTWC warning status reporting rate was 67% for any scenario during the entire exercise. This rate is slightly lower than previous exercise.

Recommendation: *The next Indian Ocean Wave Exercise to be held in 2023 to avoid overlap for some countries also involved in PAC WAVE Exercise planned for 2022.*

15. IOTWMS MEMBER STATE FUTURE PLANS AND ISSUES

37. Prof. Karnawati invited delegates to present on the status, future plans and issues with their national tsunami warning and mitigation systems. Thirteen Member States provided status reports to the meeting: Australia, Bangladesh, Comoros, India, Indonesia, Iran, Kenya, Malaysia, Maldives, Mauritius, Myanmar, Sri Lanka and Tanzania. Furthermore, Member States were invited to provide written statements on their national tsunami status, which are provided below.

12.1 AUSTRALIA

38. Dr Chantal Donnelly, Head of the Australian Delegation, presented the status, future plans and issues with the national tsunami warning and mitigation system.

39. The Australian government has made significant changes to emergency management laws that enable the Federal Government to call a national emergency, creating a new role for national agencies' role in all phases of managing a natural disaster. This strengthens the role of Emergency Management Australia (EMA) in large emergencies and a new agency, the National Recovery and Resilience Agency (NRRRA), has been stood up to manage risk and resilience at the national level. The Australian Climate Service (ACS) has also been stood up to support these two federal entities for disaster response, resilience and recovery through a partnership between Geoscience Australia (GA), Bureau of Meteorology (Bureau), CSIRO, and Bureau of Statistics.

40. The Australian government continues its commitment to fund and host the Secretariat Office of the ICG/IOTWMS since 2005.

41. The Bureau of Meteorology tsunami warning system is now ISO 9001 certified as a quality managed tsunami warning system. The Joint Australian Tsunami Warning Centre (JATWC) responded effectively to the two Pacific tsunami events in February and March 2021 for Australia. Monthly tsunami exercises have been held since Jan 2021 between the two JATWC partners of Geoscience Australia (GA) and the Bureau of Meteorology (the Bureau). GA has commenced the development of the training and accreditation system for its JATWC front-line staff.

42. The State Emergency Services have been active in conducting tsunami inundation studies and developing evacuation maps. The states of Queensland and New South Wales have now published online tsunami evacuation maps for their entire coastlines. Queensland government rated tsunami in the top ten disaster risks and funded a program to assist local councils to address climate change related coastal hazard risks.

43. In the future, GA plans to integrate, test and operationalise seismic array processing as input to rapid earthquake detection and characterisation. The Bureau will uplift its tsunami warning decision support system. The Australian Tsunami Warning System (ATWS) will leverage off NRRRA and ACS to enhance Australian community tsunami readiness and capacity

development. The Australian Tsunami Warning System will adopt the tiered Australian Warning Management System. The GA developed PTHA2018 scenarios are and will continue to be used to inform local risk assessment across the country. The AusSeabed initiative is contributing to the Seabed 2030, with GA leading a project to develop a prototype platform to enable end-users to develop comprehensive bathymetric models based on multiple type of datasets.

44. The main issue raised by Australia is the lack of real-time seismic data sharing. This is severely limiting TSP Australia's ability to respond quickly to near-field threat, thus Australia reiterates its call for open, real-time data sharing.

12.2 BANGLADESH

45. Mr Momenul Islam, National Delegate of Bangladesh, presented the status, future plans and issues with the national tsunami warning and mitigation system.

46. Bangladesh is one of the most disaster prone countries of south Asia. Most of the area of this country is only a few feet above sea level because of its geographical location. The tectonic subduction structure of Bangladesh, Myanmar continues to Andaman island area and to Sumatra. That's why the possibility of local and distant tsunami strikes cannot be ignored. Tsunami Service Providers (TSP) products are very important for Bangladesh to provide national tsunami warnings. When Bangladesh Meteorological Department (BMD) receives the tsunami threat information from Tsunami Service Providers, it verifies the information, takes necessary action, and sends the messages to the Department of Disaster Management (DDM), National Disaster Risk Reduction Centre (NDRC), and Media to disseminate to the people who are at risk.

47. At present, BMD has installed 10 (ten) broadband seismometers in different places around the country for monitoring seismic activities. Government of Bangladesh wishes to expand seismic observatories within the existing networks. For proper monitoring, BMD needs capacity building in terms of its personnel. They need updated knowledge on seismology, seismic data analysis, hazard assessment, network maintenance, etc.

48. DDM and Armed Forces Division (AFD), arrange international programs like Disaster Response Exercise and Exchange (DREE) every year, but Bangladesh needs tsunami ready programs to enhance our capacity.

12.3 COMOROS

49. Mr Saifou-Dine submitted a national status presentation on behalf of Comoros.

50. Comoros thanked the ICG / IOTWMS and its Secretariat for the support they continue to provide to member countries, in particular the Union of Comoros. This meeting is the occasion to recall that a lot has been achieved towards the capacity building of countries. Also some of the support provided has aged and requires maintenance or replacement. At a time when focus is turning to climate change, Small Island Developing States (SIDS) are faced with a lack of budget for tsunami preparedness and mitigation. Only issues of climate change related to sea level rise, including waves, can benefit the tsunami program in SIDS. In this context, tsunami-specific issues may no longer be taken into account for low-income countries.

51. As a result, the Union of Comoros encourages the strengthening or establishment of a project or program in addition to communication and simulation exercises aimed at preserving the achievements of SIDS in the domain of tsunami warning and mitigation systems, so as not to be obliged to start all over again.

12.4 INDIA

52. Mr Ch. Patanjali Kumar, National Delegate of India, presented the status, future plans and issues with the national tsunami warning and mitigation system.

53. During the intersessional reporting period, ITEWC-India sustained the observational networks – seismic, sea level (BPR & Tide gauges) used for 24 X 7 tsunami monitoring services. In total, 62 tsunami-genic earthquakes were monitored globally and for all 62 events ITEWC-India issued first bulletins to national stakeholders as per the Service Definition of National Tsunami Warning Services. Currently, ITEWC is capable of estimating earthquake parameters less than 10 and recently upgraded to SEISCOMP 4.0 along with W-phase moment tensor module. The current COVID-19 pandemic has no immediate impact on the operational services, however due to national lockdown, ITEWC functioned with minimal manpower with longer duty hours and engaged operational staff in shifts who reside within the campus. Equipment maintenance activity (BPR 2 out of 7 and Tide gauges 6 out of 36) got delayed due to transport restrictions during lockdown.

54. Large Database of open ocean propagation scenarios (oops db) covering both Makran and Sunda Tsunami-genic Zones has been generated using Tohoku University's Numerical Analysis Model for Investigation of Far-field Tsunamis (TUNAMI FF) in spherical coordinates and migrated to new hardware as part of Tsunami Technology Refreshment program. The computational setup of real-time tsunami modelling for global tsunamigenic earthquakes on GPUs using TUNAMI FF - CUDA Version 2011 May 21 (tunamiff20110521) (<https://github.com/tunamiff2011cuda/tunamiff2011>) has been implemented on new hardware. Real-time tsunami modelling for propagation and inundation using ADCIRC model for coastal inundation estimates of Indian coastal regions has been successfully ported into the HPC environment. The ADCIRC model has been tested against the Dec 26, 2004 tsunami event and results are in good agreement. Initiated for BM tests for inundation modelling have been made against standard set of benchmark cases. WebGIS bulletins of Service Level – III for coastal inundation was made ready as Proof of Concept (POC).

55. New Decision Support System (DSS) is under development and the environment setup is under progress. An integrated approach with sea level inversion is being integrated into the DSS.

56. Technology Refreshment for National Tsunami Warning Centre infrastructure has been completed. An end-to-end tsunami applications porting, enhancement and migration on to the new Hardware (servers and storage) at both the Data Centres (at ITEWC, INCOIS and Disaster Recovery site (DR) at IITM, Pune locations) was completed and made operational on March 19, 2020. A new responsive website is made available for real-time tsunami bulletins access to both national and Indian Ocean rim countries.

57. ITEWC, INCOIS, participated in 4 Communication Tests (12 June 2019, 11 Dec. 2019, 10 June 2020 and 9 June 2021) as well as the UNESCAP Project Regional SOP Workshop for Broadcasting Media and DMOs held during 7–9 September 2021, 12–14 October 2021 and 26–28 October 2021. ITEWC Participated in IOWAVE20 & IOTWMS Communications Test conducted during the reporting period. INCOIS and NDMA are working towards implementation of the CAP service for dissemination of bulletins / warnings to all national stakeholders.

58. As part of the IOC-UNESCO Tsunami Ready Programme, India constituted a National Board under the Chairmanship of Director, INCOIS with members drawn from Ministry of Earth Sciences (MoES), National Disaster Management Authority (NDMA), Ministry of Home Affairs (MHA), Odisha State Disaster Management Authority (OSDMA), Andaman & Nicobar Islands Directorate of Disaster Management (DDM) and INCOIS. Odisha State Disaster Management

Authority, (OSDMA) Odisha implemented the Tsunami Ready programme on a pilot basis in 6 villages. National Board visited Venkatraipur of Ganjam district and Noliasahi of Jagatsinghpur district in December 2019 and recognized them nationally and recommended for UNESCO-IOC recognition. UNESCO-IOC conferred the Certificate of Recognitions to Venkatraipur and Noliasahi of Odisha as Tsunami Ready communities on 07 August 2020. India is the first country from the Indian Ocean region to successfully implement this Tsunami Ready programme. INCOIS is planning to extend the programme to other most vulnerable coastal regions of India in consultation with MHA, NDMA and coastal authorities.

59. As a key Member State in Sub-regional IOTWMS/NWIO group, ITEWC, INCOIS is participating in the UNESCAP project of PTHA for the Makran Subduction Zone. The Initial benchmark PTHA model simulations were carried out at INCOIS [India] with guidance from GFZ [Germany], INGV and University of Malaga. Currently INCOIS is examining the possibility of the tsunami threat in the neighbouring Persian Gulf and Red Sea.

60. As part of future plans, ITEWC, INCOIS is working towards utilization of real-time GNSS & SMA data for rupture characterization of tsunamigenic earthquakes, as well to work on Standard Operational Procedures (SOP) for atypical tsunami sources such as submarine landslides, volcanic eruption and meteoric sources. INCOIS will conduct national mock drills in coordination with MHA, NDMA and SDMOs as well Regular SOP Training Workshops for National stakeholders. INCOIS will finalize the SOP of DMOs and, Media in consultation with NDMA, SDMO and Media. INCOIS is planning to implement Tsunami Ready Programme. INCOIS will continue to participate in 6-monthly IOTWMS Communication Tests and biennial IOWave exercises.

12.5 INDONESIA

61. Dr Muhamad Sadly, Head of the Indonesian Delegation, presented the status, future plans and issues with the national tsunami warning and mitigation system.

62. The Indonesia Tsunami Early Warning System (InaTEWS) was established on November 11, 2008. At that time, the paradigm was to work hard in order to anticipate the earthquake and tsunami event. InaTEWS operational headquarters is located in Jakarta and InaTEWS backup is located in Bali.

63. The main product of InaTEWS is earthquake information and tsunami warning, which is disseminated within 5 minutes after the event. InaTEWS goal is to detect earthquake events accurately and disseminate the tsunami warning to the stakeholders, responsible institutions and communities. In order to achieve this goal, proper community response is needed to reduce and minimize the impacts of disaster.

64. To monitor earthquake activity, the Indonesian seismic monitoring network has 411 seismic stations, plus 200 overseas seismic stations. Indonesia has a strong-motion detection network of 594 accelerometer stations and 400 intensity-meter stations. Regarding tsunami monitoring, InaTEWS has several sea level monitoring networks such as: HF radar (2); Tide gauge stations (159) supported by Geospatial Information Agency (BIG); AWS-Water Level (25), Buoy (4), IDSL (4), CBT (1) and tsunami gauge (5) supported by Agency for the Assessment and Application of Technology (BPPT).

65. InaTEWS processing system consists of earthquake analysis (using SEISCOMP3) and Tsunami Observation and Simulation Terminal (using TOAST). Dissemination methods consist of multi-mode dissemination (e.g SMS, FAX, Email, Web, Warning Receiver System and WRS New Generation). Some innovated dissemination systems using mobile smart phone have been developed.

66. The aim of the capacity building activity is to develop the performance and ability of the researchers. Capacity building is obtained through training, internship and study. The aim of mitigation activities is to educate the community and stakeholders to achieve better knowledge about earthquake and tsunami in order to reduce and minimize the impacts of disaster. This are conducted through the Earthquake Field School (Sekolah Lapang Gempa) and BMKG school.

67. The future plans relate to the monitoring system, processing system and dissemination system as follows:

1 Monitoring System:

- Deploy additional 17 seismic stations until the end of 2021
- Deploy additional 92 seismic stations for 2022 (through the Indonesian Disaster Resilient Initiative Project with the World Bank)
- Deploy additional one hundred seismic stations over next 3 years
- Deploy additional sea level observations (InaBuoy, InaCBT, GPS/ GNSS) by related institutions.

2 Processing System:

- Establish National Earthquake and Tsunami Consortium to support development of InaTEWS
- Improve existing seismic processing with new additional packages/modules developed by Indonesian experts (National Seismic Processing System)
- New tsunami processing system developed by Indonesian experts
- New emerging technologies for earthquake and tsunami processing

3 Dissemination System:

- National standard of WRS (WRS New Generation)
- WRS for ASEAN Countries
- WRS for Indian Ocean countries
- New emerging technologies for dissemination

68. The current challenges in InaTEWS include: (a) Reliable dissemination; (b) Earthquake engineering mitigation; (c) Need of Non-Tectonic Tsunami processing system; (d) Atypical tsunami processing system; (e) Social Innovation Program for Earthquake and Tsunami Preparedness; and (f) Readiness culture campaign.

12.6 IRAN (ISLAMIC REPUBLIC OF)

69. Dr Ali Khoshkholgh, National Delegate of Iran, presented the status, future plans and issues with the national tsunami warning and mitigation system.

70. Iran's main activities and achievements regarding tsunami related activities were mentioned as follows:

- Forming a National Tsunami Committee consisting of local governors from Hormozgan and Sistan-&- Baluchestan Provinces which are in areas of tsunami risk.
- Holding briefing sessions, and technical and educational workshops in line with developing collaborations on strengthening the tsunami warning systems, and

raising awareness of the local officials and coastal communities of the mentioned provinces.

- Organization of an online workshop on "Tsunami Early Warning System", 15 Dec 2020.
- Organization of an online webinar on importance of awareness and preparedness for tsunami hazard in Makran area on the occasion of Tsunami Awareness Day, 2020.
- Holding workshops for school students in coastal vulnerable areas with the aim of informing the students of tsunami hazards, tsunami natural signs and precautions during a tsunami.
- Codification of the draft Iran Tsunami Warning Chain, as well as discussions and exchange of views with stakeholders for promoting it.
- Developing SOP for Tsunami Warning Center.
- Developing data bank of Makran tsunami scenarios, as well as developing inundation and evacuation maps for some scenarios.

71. The Main challenges for tsunami national center of Iran, which will be considered in future plans are:

- Attracting the attention of government officials, especially the managers of the Disaster Management Organization of Iran, to the importance of the tsunami warning and mitigation programme. This will help ensuring it is part of the Development Plan of the Makran Coasts and in allocating budget for enhancing the tsunami warning system in Iran.
- Finalizing the tsunami warning chain in Iran and approving the role of each organization legally.
- Carrying out the Tsunami Ready Program as a pilot project in the Chabahar and Jask coasts.

12.7 KENYA

72. Dr Philip Sagero, National Delegate of Kenya, presented the status, future plans and issues with the national tsunami warning and mitigation system.

73. Kenya Meteorological Department, as the National Tsunami Warning Centre, has achieved some strides in tsunami awareness. Field surveys have been conducted along the Kenyan coastline to ascertain their awareness and preparedness for tsunami (Tsunami Ready). From the survey, most of the communities and local disaster managers are not Tsunami Ready. This has led to establishment of a partnership with communities through their CBOs, local disaster managers, NGOs especially Red Cross, and Local radio stations, to be trained on Tsunami Ready. From this establishment, we have planned several workshops beginning January 2022 to develop Standard Operating Procedures (SOPs), national to local warning chain, develop local language educational materials for community awareness, mapping of vulnerable areas and erecting of evacuation signs. So far as gaps, some observation equipments are not operational, and finally the main Challenges is lack of adequate funding for the Tsunami Ready activities.

12.8 MALAYSIA

74. Mr Zaidi Zainal Abidin, National Delegate of Malaysia, presented the status, future plans and issues with the national tsunami warning and mitigation system.

75. Prior to 2020, from 2006 to 2019, the Malaysian Meteorological Department (MMD) had been involved in 87 public awareness programmes/campaigns with the total participants of 20,172, as well as 19 tsunami drills/exercises with the total public participants of 19,776. In 2020, the MMD had suspended any public campaigns or tsunami drill/exercises in line with the NADMA's (National Disaster Management Agencies) prohibition of public gatherings. Although the physical campaign was suspended, MMD continues its campaign through its websites and social media using infographic content.

76. MMD's current infrastructure has 77 seismic stations, 53 network sirens and 17 tide gauge stations. Within the current year, it is expected to have more 3 seismic stations and 6 more stations between 2022 and 2025. During the early pandemic, there were many issues particularly regarding maintenance and operation. In the first issue, the main problem was that if any station was down or vandalised, especially across the South China Sea (i.e. Sabah and Sarawak), any repairs were delayed as the maintenance crew was in the Peninsula and any arrival from Peninsula was to be quarantined as per SOP. So, delays were inevitable until the restriction was lifted. For the second issue, we were fortunate to be able to operate as usual even during pandemic.

77. In addition, one of the issues that we missed out is the human capital development for intermediate and advanced training, as there was no travel abroad for that. However, we do hope that we will be able to do that in the foreseeable future.

12.9 MALDIVES

78. Ms Faroosha Ali Naseer, National Delegate of Maldives, presented the status, future plans and issues with the national tsunami warning and mitigation system.

79. Maldives, being a small island nation with extremely low elevations, is among the most vulnerable countries to the impacts of climate change. Apart from this, Maldives is also prone to hydro-meteorological hazards and geophysical hazards, including tsunami. Even though the risk of a tsunami is low, the deadliest disaster Maldives has ever faced was the 2004 Indian Ocean Tsunami and thus, it is vital for us to prepare for a possible future tsunami to reduce casualties, damage and destruction. NDMA along with our stakeholders, have been doing different activities both at national and local level from strengthening policies and guidelines to raising awareness. Due to COVID-19 pandemic, most of the activities has been conducted via social media through Twitter, Facebook, Club House and other online forums. With the hope of improved pandemic status, NDMA plans to continue and further strengthen the community preparedness projects including CBDRM (IDMP and CERT), school preparedness and awareness campaigns focused at different sectors. Given the context of working in a fluid pandemic phase with limited funding, NDMA have high hopes to implement DRR activities throughout the Maldives, where NDMA believes creating awareness will not only help to prioritize DRR but will also help in building resilient communities.

12.10 MAURITIUS

80. Mr Gopalkishan Beego, National Delegate of Mauritius, presented the status, future plans and issues with the national tsunami warning and mitigation system.

81. Mauritius Meteorological Services (MMS) is the Official Centre for Monitoring of Earthquakes and provides warnings in the Republic of Mauritius in case of tsunami generation. There is no separate or specialised unit responsible for tsunami monitoring.

82. The MMS is using USGS and CISN websites & RIMES network. An alarm system is activated in case of earthquake of magnitude ≥ 3.5 & if $5\text{km} > \text{epicentre depth} < 200\text{ km}$. Monitoring follows of tide gauges in Mauritius (Port-Louis harbour & Blue-Bay) and Rodrigues

(Port-Mathurin). At Agalega the tide gauge is under maintenance. Regarding the one and only seismometer at Vacoas, the software and hardware are being updated. The seismometer at Rodrigues is under the supervision of Globe de Paris, thus the data cannot be obtained in real time.

83. In the future, Mauritius plans to enhance its existing ocean networks by increasing the number of tide gauges. The MMS is looking forward to improving the staff capabilities by seeking opportunities for capacity building in the field of the ocean observation and research in physical oceanography and tsunamis. Efforts will be made to seek funds for the installation of Deep Ocean Tsunami Detection Buoys at Agalega, Rodrigues and Mauritius.

84. Identified gaps include the absence of a fully operational monitoring unit with fully qualified personnel. As there are insufficient seismometers to monitor earthquake data, it becomes imperative to install seismometers at Agalega, St-Brandon and Rodrigues. An additional seismometer is required in Mauritius. Currently, the inaccessibility of seismometer data from the network Globe de Paris in real time could be eliminated by sharing data from the existing seismometer at Rodrigues.

12.11 MYANMAR

85. Mr Oo Than, National Delegate of Myanmar, presented the status, future plans and issues with the national tsunami warning and mitigation system.

86. Myanmar expressed a need for more seismic stations to be installed in and around the country to improve the seismic network activities and research. They continue to monitor earthquakes 24/7 through their national seismic network and the international seismic network. Earthquake bulletins are issued based in accordance with their SOP. Tsunami warnings are based on the information issued by the TSPs.

87. Myanmar was involved in the IOWave09 functional exercise at Ayeyarwady Regions and Rakhine State. Furthermore, they have conducted communication tests two times per year since 2011.

88. Regarding gaps and issues, Myanmar only has three tide gauge stations and more are need for monitoring along their entire coastline. Budget limitations restrict involvement in all IOWave exercises and they have not had regular exercise participation. However, they do participate in all the tsunami communication tests.

89. Myanmar requires human resource capacity building, such as intermediate and advance training to develop the tsunami hazard maps and evolution route maps for our coastal zones, where is the danger area who lives in the hazard zone.

12.12 SRI LANKA

90. Mr Sunil Jayaweera, National Delegate of Sri Lanka, presented the status, future plans and issues with the national tsunami warning and mitigation system.

91. Sri Lanka has successfully organised several programmes and activities (e.g. drills, exercises, developing Tsunami Operational Plans, Standard Operating Procedures – Upstream and Downstream, commemoration events, fixing sign boards) at national and local level with the participation of key stakeholders, to create greater awareness among the public in fourteen (14) coastal districts. Participated at global forums and exercises carried out by international organisations such as IOTWMS, UN, BIMSTECH, SAARC etc. With the objective of obtaining the Tsunami Ready status or certification, future plans would be focused on setting up seismic stations, reviewing of Operational Plans, SOPs, local DRR, institutional disaster

management plans, business continuity plans etc., strengthening early warning (EW) mechanisms and creating greater community awareness and improving level of preparedness. Identified gaps include lack of resources, low level of hazardous risk among public unlike other disasters, lack of real time seismic and shared data, inadequate funding, lack of specialised human resources and expertise, and improper infrastructure development in the coastal zone.

92. Key areas of important progress in Sri Lanka include:

- 1 Indian Ocean wide tsunami warning and communications exercise (IOWave) conducted in 2018 and 2020 (i.e. Table Top Exercise (TTX); national and district level drills/ exercises);
- 2 Tsunami national drill in full scale done in 2016, 2017 and 2019;
- 3 Tsunami education, preparedness programmes and conducting evacuation drills at identified schools in selected coastal districts – 2017 and 2018;
- 4 Conducted tsunami preparedness and awareness programmes, including drills for selected hotels in the coastal belt;
- 5 Conducted tsunami drills for selected national hospitals in the coastal districts;
- 6 Tsunami Operational Plans prepared for all fourteen coastal districts in Sri Lanka – November 2021;
- 7 Preparation of Tsunami Standard Operating Procedures (SOPs) – upstream and downstream;
- 8 Installation of seventy-seven (77) Tsunami Early Warning towers in coastal districts (conversion from VHF to GSM ongoing);
- 9 Established, strengthened and continuously improved Early Warning dissemination mechanism – from national to local level with a 24 x7 call centre at Head Office (Colombo) and district 24x7 Emergency Operation Centres (EOCs);
- 10 Fixing/ erecting of tsunami sign boards and evacuation maps in identified coastal districts – ongoing;
- 11 IOTWMS communications test conducted on 9th June 2021;
- 12 Commemoration of Internal Day for Disaster Risk Reduction (IDDRR) on 13th October 2021 – national event (hybrid mode) organised by the Disaster Management Centre, Sri Lanka;
- 13 Commemoration of World Tsunami Awareness Day– national event (hybrid mode) held on 5th and 8th November 2021organised by the Disaster Management Centre, Sri Lanka; and
- 14 Commemoration of the 2004 Tsunami tragedy annually by organising the “National Safety Day” (26th December) in all fourteen coastal districts across the country to educate people on measures of disaster mitigation

93. Future plans in Sri Lanka include:

- 1 Formal launching of the documented Tsunami Standard Operating Procedures (SOPs) – downstream;
- 2 Review developed Tsunami Operational plans, evacuation and inundation maps for coastal districts;
- 3 Setting up of seismic stations in identified locations across the island;
- 4 Conduct community awareness programmes on EWs and EW systems;

- 5 Continue with drills for community evacuation and tsunami response upon engaging communities and first respondents;
- 6 Develop institutional DRR plans for coastal business establishments, hotels and SMEs, incorporating elements of tsunami;
- 7 Implement the Indian Ocean Tsunami Ready programme at local level; and
- 8 Tsunami Ready Hotel programme

94. Identified gaps in Sri Lanka include:

1. Inadequate resources (e.g. technical equipment/ items for EW);
2. Non-availability of an effective EW mechanism/ alert system during night time;
3. Lack of real-time seismic data sharing limiting Sri Lanka's ability to respond quickly to near-field threat;
4. Tsunami awareness remains low compared with other hazards;
5. Lack of access to shared data and better computer modelling;
6. Infrastructural development in coastal zone not planned properly considering tsunami risk;
7. Lack of backup service for EW systems, which could face power outages and interruption to telecommunication;
8. Inadequate funding of the tsunami activities;
9. Inadequate qualified and professional experts and personnel on tsunami related hazards; and
10. Current lack of public alertness due to current focus being on the COVID-19 pandemic and rising challenges due to imposed government restrictions and health guidelines.

12.13 TANZANIA (UNITED REPUBLIC OF)

95. Mr Samwel Mbuya, Head of the Tanzanian Delegation, presented the status, future plans and issues with the national tsunami warning and mitigation system.

96. Report on the status of the National Tsunami Warning System in Tanzania was provided to highlight the activities conducted and plans to sustain and contribute to the strengthening of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). As stipulated in the new legislation; The Tanzania Meteorological Authority Act No.2 of 2019, Tanzania Meteorological Authority (TMA) is the designated National Tsunami Warning Centre (NTWC).

97. The United Republic of Tanzania (URT) continued to participate in the operations of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). TMA Liaison with the Disaster Management Department under the Prime- Ministers office to ensure a coordinated tsunami warning system is functional at national level. As active Member State in IOC, URT through the NTWC issues tsunami warnings to communities based on the tsunami threat information provided by the three Tsunami Service Providers (TSPs): Australia, India and Indonesia. During the intersessional period, the NTWC Tanzania participated in activities of the tsunami warning system Working Group expert meetings, IOWAVE20 Exercise, Communication Tests and the World Tsunami Awareness Day activities. Key to the function of the tsunami warning system are the communication tests, which ensure message reception from the TSP are timely available at the NTWC.

98. The testing of communications indicated that the GTS, fax, email and SMS continued to be active with email being the most successfully medium of communication from the TSP followed by SMS messages were received via mobile phone, which is operational 24/7. GTS and fax didn't perform well during the June 2021 communication test. Summary of received messages (Start-up Messages and Bulletins) from Regional Tsunami Service Providers (RTSPs) during the communications test 09th June 2021 is indicated in Table 1.

Message Reception Media		India	Indonesia	Australia
FAX		0	0	0
GTS		0	0	0
SMS		0	4	4
EMAIL	cfo@meteo.go.tz	4	4	5
Website Message Accessed		4	4	4
Overall message arrival success level		8	12	13
Message arrival success level (%)		32%	48%	52%

Table 1: Message Receipt

99. Tanzania participated in the IOWVE20, whereby the scope was limited to tabletop exercise due to COVID-19 pandemic. As part of preparations for the IOWAVE20, we participated in the online pre-exercise that were conducted through webinars held from Monday to Wednesday, 28–30 September 2020. The webinar served as platform for representatives of NTWC, NDMO, LDMO, and Media to share and learn from each other on:

- (i) Prepare and plan for IOWave20 Exercise.
- (ii) Update and report on end-to-end National Tsunami Warning Chain.
- (iii) Update and report on end-to-end National Tsunami Early Warning (NTWC) and Emergency Response (DMO) SOPs.

100. Tanzania prepared a Swahili Version as a national guideline for the IOWAVE20 leading to the conduction of the IOWAVE20 Exercise.

101. The UN General Assembly designated 5 November as World Tsunami Awareness Day in December 2015. The World Tsunami Awareness Day calls on countries, international bodies and civil society to raise tsunami awareness and share innovative approaches to risk reduction. Customary, UN Disaster Risk Reduction (UNDRR) facilitates the observance of World Tsunami Awareness Day in collaboration with the rest of the United Nations system. This year 2021, Tanzania participated in the commemoration of this day through awareness campaigns conducted through digital media such as online TV, Tweeter, Blogs and WhatsApp.

102. Plans to further sustain and improve the tsunami warning system include possible contributions to the UN Ocean Decade. The URT through TMA is committed to support and maintains its national meteorological observing systems, data and information exchange to contribute to the ocean observations and research in the region. To ensure contribution to

continued development of the IOTWMS system from end-to-end, plans include infrastructure development, improving systematic and real-time data and information sharing (Table 2). Access to risk information is critical before and during emergency. Real time monitoring system for both meteorological and tsunami conditions need to be strengthened by installation of modern ocean observing systems.



Figure 1: Celebrating the World Tsunami Awareness' Day 2021 (WTAD) through the social media campaign in Tanzania.

S. No	Activities	Outcomes	Key Performance Indicators
1	Provision and installation of radar 3 HF Radar	Improved real-time monitoring of Ocean Surface Currents	Number of installed and operationalized HF Radar
2	Enhance the Safety of Life at Sea (SOLAS) Convention on meteorological requirements.	Compliance to SOLAS Convention and Improved capacity to deliver quality marine meteorological for safety at sea	Number of Tsunami & marine Warning bulletins issued Number of stations providing marine meteorological services
3	Acquisition and installation of tide gauges at Mtwara, Dar	Improved ocean level monitoring for early	Number of installed and operationalized tide gauges

S. No	Activities	Outcomes	Key Performance Indicators
	Es Salaam, Tanga, Pemba And Unguja	storm Surge detection and forecasting	
4	Acquisition and installation of Buoys (Drifting and fixed).	Improved marine weather observation and monitoring; Improved sea surface weather observation network	Number of installed and operationalized Buoys in the southwest Indian ocean along the Tanzanian coast
5	Acquisition and installation of ocean wave measuring and detection RADAR	Improved ocean wave observation and monitoring including Tsunami wave monitoring	Number of installed and operationalized wave RADAR over the Tanzanian coast
6	Real-time data monitoring and National and Global data exchange maintained	Improved Tsunami and marine weather observation and monitoring	Real-time Data monitoring reports

Table 2: Issues Facing the National Tsunami Warning & Mitigation Activities in Tanzania.

103. Despite the continued operational of the National Tsunami Warning Centre, there is a need to enhance staff skills and knowledge into application of different tools for preparation and computation of tsunami threats; modelling using models such as operationalization of the Commit Model for Tsunami; development of new risk knowledge (risk assessment and mapping). Furthermore, there is a need to develop risk scenarios at local and national scale for informing the emergency planning that should fully integrate Early Warnings and Action. This can include, conducting tsunami risk assessment, awareness, and community preparedness and developing evacuation plans. Overseen by Prime Minister's Office-Disaster Management Department, emergency plans should be designed taking into account specific local hazard, exposure and vulnerability, ideally through a participatory approach and shall integrate Early Warning and Action system for both slow and sudden disasters (Tsunami, floods, flash floods, droughts, etc.).

16. IOTWMS STATUS REPORTING

104. Mr Rick Bailey outlined plans to utilise and rationalise National Reports at future ICG meetings to enable routine monitoring of the status of the IOTWMS to continue. This will facilitate determinations and decisions by the ICG on the performance of the IOTWMS and inform decisions and recommendations. It will build on the Capacity Assessment of Tsunami Preparedness in the Indian Ocean, Status Report, 2018. An up to-date assessment is important to not only to monitor performance, but to also help identify gaps and demonstrate the extra resources required.

17. TSUNAMI SERVICE PROVIDER PROGRESS REPORTS

105. Representatives from the TSPs of Australia, India and Indonesia reported on their operational status, development and progress since the 12th Session of the ICG/IOTWMS

(ICG/IOTWMS-XII). They also reviewed their performance during the years 2019 and 2020 against the Performance Indicators established by the ICG/IOTWMS.

14.1 TSP-AUSTRALIA

106. The representative of TSP-Australia, Dr Robert Greenwood, reported on the TSP status and activities since ICG/IOTWMS-XII.

107. The Joint Australian Tsunami Warning Centre (JATWC) operates as an IOTWMS-TSP, as well as a National Tsunami Warning Centre. For the period Jan-Oct 2021, TSP Australia issued IOTWMS earthquake notification bulletins for a total of 37 events. Service level 2 bulletins were subsequently issued for six of those, made up of four (4) No Threat, one (1) Potential Threat, and one (1) Confirmed Threat. The JATWC responded to three threat level events in 2021 – two (2) in SW Pacific as an NTWC and one (1) in the South Atlantic as a TSP. COVID-19 has had minimal impact on TSP Australia's continued operations and no impact on service delivery. There have been several recent developments for TSP Australia, including: The commencement of monthly joint operations exercises; a new accreditation system for GA-JATWC front line staff; updates to the BoM-JATWC tsunami decision support tool; creation of an on-call roster for tsunami specialists; and ISO 9001:2015 reaccreditation of the BoM-JATWC Tsunami warning service. The Australian Bureau of Meteorology continued to host the IOC staff of the IOTWMS Secretariat in Perth. Future plans include: Updating the TSP service to match version 4 (2019) of the TSP Service Definition Document; upgrade seismic monitoring software to SeisComp4; test and operationalise seismic array processing; and continue work towards ISO 9001:2015 accreditation for GA-JATWC systems.

14.2 TSP-INDIA

108. The representative of TSP-India, Mr E. Pattabhi Rama Rao, reported on the TSP status and activities since ICG/IOTWMS-XII.

109. During the intersessional reporting period (October 2019 to November 2021), TSP-India sustained the observational network [seismic, sea level (BPR & tide gauges)]. TSP India detected and monitored 46 tsunamigenic earthquakes and issued bulletins as per the IOTWMS Service Definition Document (SDD).

110. TSP-India performed well during the reporting period against the Key Performance Indicators (KPIs). As per KPI-1, TSP-India issued 46 bulletins for the events Mw>6.5 (USGS final estimate) with an average elapsed time of 11.5 min. For KPI – 2, there are no events of M>6.8 in Indian Ocean. TSP-India closely monitored the event of tsunamigenic earthquake of 7.4 M South Sandwich Islands Region on 12 Aug 2021. Though the event has no threat for the Indian Ocean and since there could be wave activity as per TSP-Australia, TSP-India 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, this event was not considered for KPI-6 evaluation as per the SDD.

111. COVID-19 pandemic has had no immediate impact on the Indian Tsunami Early Warning Centre (ITEWC) in continuing and delivering the operational tsunami services. During the lockdown, ITEWC functioned with minimal manpower with extended duty hours by engaging the operational staff residing on the campus in shifts. However, observation network preventive maintenance activity was delayed due to lockdown.

112. ITEWC has carried out technology refreshment that includes the enhancement of end-to-end tsunami application software, porting, and migration onto the new hardware at INCOIS, and setup of a dedicated Disaster Recovery site (DR site) at another location. Both these systems can generate timely tsunami advisories for India and Indian Ocean rim countries. A

dedicated tsunami website (<https://tsunami.incois.gov.in>) was developed and operationalized with the latest responsive web technologies and mapping frameworks to deliver the tsunami advisories to a wide range of users, platforms, and devices at various resolutions. The earthquake detection software Seiscomp3 was upgraded with the latest version seiscomp4.0 along with W-phase moment tensor module.

113. Other major developments include the update of Coastal Forecast Zones (CFZs) for India and the verification is under progress. Initiated development of a new Decision Support System (DSS) that facilitates the integration of international sea level data (tsunami buoys and tide gauges), and scenario database. Real-time inundation modelling for Service Level –III, real-time modelling of Global Earthquakes ($M \geq 8.0$), sea level inversion, dissemination and database for web publishing will be key elements of the new DSS. TSP India developed a web-based application for the evaluation of Key Performance Indicators for IOTWMS Event data from other TSPs will be ingested into the KPI application and tested in consultation with other TSPs. TSP-India also developed a mobile application for tsunami services.

114. Key personnel in TSP-India participated in the UNESCAP project activity on Probabilistic Tsunami Hazard Assessment (PTHA) for Makran Subduction Zone. The initial benchmark PTHA model simulations were run at INCOIS with guidance from GFZ, INGV and the University of Malaga. Currently, INCOIS is examining the possibility of the tsunami threat in the neighbouring Persian Gulf and the Red Sea.

115. TSP-India participated in the IOWave20 exercise conducted by ICG/IOTWMS and provided required support for scenario selection, manual preparation, etc. TSP-India issued four bulletins for three scenarios of: (i) South of Java, Indonesia, (ii) Andaman Islands, India, (iii) Off Coast of Pakistan through email, fax, SMS, GTS and website on 6th, 13th & 20th October 2020. TSP-India participated in four IOTWMS Communication Tests (12 June 2019, 11 Dec 2019, 10 June 2020 and 09 June 2021), IOTWMS Pre and Post IOWave20 webinars during 28-30 September 2020 and 11-12 November 2020, as well UNESCAP Project Regional SOP Workshop for Broadcasting Media and DMOs during 7-9 September 2021, 12-14 October 2021 and 26-28 October 2021.

116. TSP-India committed to operationalizing the auto KPI system for IOTWMS TSP services, efforts on utilization of real-time GNSS & SMA data for rupture characterization of the tsunamigenic earthquakes, work on Standard Operational Procedures (SOP) for atypical tsunami sources. TSP-India will continue to contribute to IOTWMS activities in the next inter-session period, including the planning, conducting, and reporting of biennial IOWave exercises, 6-monthly Communication Tests, and active participation in ICG/IOTWMS Working Groups and Task Teams, as well in regular NTWC/DMO/Media SOP Training Workshops.

14.3 TSP INDONESIA

117. The representative of TSP-Indonesia, Mr Yedi Dermadi, reported on the TSP status and activities since ICG/IOTWMS-XII.

118. TSP Indonesia has improved the number of various sensors utilised in the monitoring system. Data sharing has become very important issue among the members. A new additional WRS dissemination mode was introduced and tested as an innovation. The KPI service performance so far runs as expected.

119. InaTEWS was awarded QMS ISO 9001:2015 on September 2021. Radio Broadcast to disseminate information was already implemented in 2021 for national purposes. TSP Indonesia is always active to participate in IOWave exercises and as well as in IOTWMS communication tests.

120. TSP Indonesia has many development plans. This year TSP Indonesia will start to work on inundation tsunami modelling and doing the first stage of GNSS data integration into the processing system. We plan to have a Sirens System Base Android (SIRITA). We also plan to start with the EEWS project for national purposes. We plan to develop InaTEWS impact base real-time system to handle both typical and atypical events. We will do a collaborative effort to augment tsunami meters on ships and rigs.

121. Capacity building is always the priority for future demands such as formal degrees and regular training. Outreach Activities (e.g. Indonesian Tsunami Ready) also become our priority as well as involvement in further international cooperation.

122. TSP Indonesia has an initiative to propose ISO 22328-3 Guidelines for the implementation of a community-based tsunami early warning system. This ISO is to empower individuals and communities who are vulnerable to hazards to act in sufficient time and appropriate ways in global perspective. This document also is to complement with the international standard for evidence-based community preparedness for tsunamis of the UNESCO-IOC Tsunami Ready program and indicators, and Guidelines for the Indian Ocean Tsunami Ready Program.

18. WORKING GROUP PROGRESS REPORTS

15.1 WORKING GROUP 1 ON TSUNAMI RISK, COMMUNITY AWARENESS AND PREPAREDNESS

123. The Chair of Working Group-1 on Tsunami Risk, Community Awareness and Preparedness (WG1), Dr Harkunti Rahayu (Indonesia), presented an update on the Group's activities.

124. WG1 progress against its work plan in the intersessional period included: Development of an IOC Technical Series document on governance of the upstream-downstream interface in tsunami early warning including a national self-assessment tool; Development of a concept note on mainstreaming disaster risk reduction into urban planning and resilience; Development of tools for upstream-downstream interface assessment; Developing and harmonizing local capacities for tsunami early warning. WG1 has also been actively engaged in improving COVID-19 and pandemic preparedness and response through the downstream of multi-hazard early warning systems.

125. A major issue receiving increasing focus is the mainstreaming of disaster risk reduction into urban planning and resilience. This will become a focus of WG1. She also provided an update on Tsunami Ready implementation globally and in the Indian Ocean, including the role and support by WG1 for IOTIC. In developing the IOTWMS Ocean Decade Strategic Pathway, WG1 led the related presentation and discussion at the WTAD Indian Ocean Webinar of 10 Oct 2021.

126. Challenges facing WG1 include the necessity for many WG1 engagements to be held online, several fieldwork related activities being delayed, Member States redirecting efforts onto COVID-19 response, and UK's withdrawal from EU Erasmus programme reducing funding support for initiatives such as the development of an online training programme.

15.2 WORKING GROUP 2 ON TSUNAMI DETECTION, WARNING AND DISSEMINATION

127. The Chair of Working Group 2 on Tsunami Detection Warning and Dissemination (WG2), Dr Yuelong Miao (Australia), presented an update on the Group's activities and progress against its work plan in the intersessional period.

128. Under the leadership of Dr Miao, Mr Patanjali Kumar Chodavarapu (Vice-Chair) and Dr Karyono (Vice-Chair), WG2 held three meetings in the intersessional period with the latest on 3–4 November 2021. It organised four (4) half-yearly communication tests and published the reports with findings and identified issues. It supported the IOWave20 tsunami exercise, the International Symposium and IORA Workshop on Lessons Learnt from the 2018 Tsunamis in Palu and Sunda Strait of 26-28 Sep 2019, the TOWS-WG and its Task Team Tsunami Watch Operations, the development of the Tsunami Concept Note for the Ocean Decade, and the global tsunami performance framework and measurement tools. To assess and manage the impact of the COVID-19 pandemic, WG2 conducted a survey of COVID impact on the observational networks and TSP operations, and support WG1 with the development of the tsunami evacuation guideline in COVID-19. In developing the IOTWMS Ocean Decade Strategic Pathway, WG2 led the related presentation and discussion at the WTAD Indian Ocean Webinar of 10 Oct 2021.

129. All eleven activities in the WG2's Workplan of 2019–2021 have progressed, from updating the TSP Service Definition Document with a few important improvements, to developing an Indian Ocean event database and KPI performance generation system at TSP India. The meeting noted the publication of a TOWS-WG agreed maritime community product by TSP Australia, the progress made in TSP India in developing the proof-of-concept coastal inundation service as a national service, the Warning Receiver System (WRS) developed at TSP Indonesia for auto-alerting the live TSP bulletins and its being successful tested in the June 2021 Communication Test by National Tsunami Warning Centres (NTWCs), and the formation of a small task team to develop a Common Alerting Protocol (CAP) guideline for NTWCs.

130. On the findings of all Communication Tests since 2011, the TSP to NTWC notification message delivery success rate was high for email, GTS and SMS while low to very low for Fax. This downward trend of fax's success rate is worth investigating for the need and value of this dissemination channel. About 90% NTWCs can access the TSP websites and about 60% of NTWCs have used the feedback form to report on what warnings each NTWC issued for their country.

131. On the TSP performance, WG2 discussed and proposed change to report only those earthquake events of Magnitude 6.8 or above in the IOTWMS Earthquake Source Zone. This rule should apply to all nine (9) KPIs covering Service Level 1 (KPIs 1 to 5), Service Level 2 (KPIs 6 to 8), and KPI-9 which reports how many times a TSP erroneously issued a bulletin. In order to provide a meaningful report for future improvement, a traffic light system will be formally introduced with the agreed thresholds in meeting target, nearly meeting target or missing target. Based on these newly agreed changes for TSP performance reporting, the 2021 performance of the three TSPs was evaluated. It was found that all TSPs performed reasonably well, meeting or nearly meeting the target in almost all KPIs. TSP Australia missed the KPI-9 target only due to its issuing bulletins for two events which later were assessed by USGS as below magnitude 6.2 (hence a false alarm).

132. WG2 listed the following challenges: the challenge to maintain fund for sustaining the existing observing networks and implementing new ones and for supporting R&D activities; the challenge with the lack of coherent coordination with many still working in silos within and between the upstream and downstream agencies in national tsunami warning chains; the challenge to integrate tsunami into the multi-hazard warning system; and the overarching challenge to substantially improve the timeliness and certainty of tsunami detection and warning particularly in the face of atypical tsunami sources.

133. WG2 proposed the pathways forwards in three focus areas: 1). Expansion of existing and deployment of new technologies addressing observational gaps; 2) Wide expansion of real and near-real time data exchange, access and availability; and 3). Access to data, tools

and communication platforms, protocols and training to timely and effectively warn coastal and maritime communities. A central theme for opportunity is the need to actively pursue strategic partnerships. On the first focus area, the SMART cable new detection technology demonstrated its potential as a game-changer with the recent good news of funds being granted to support the science and early warning aspects of the Vanuatu-New Caledonia cable as a pilot. On the second focus area, data sharing should be raised at the strategic level and all means should be explored including bilateral or multi-lateral MOUs. On the third focus area, it is important to engage and integrate with other agencies, institutions, organizations working on early warning as part of the multi-hazard approach. It also calls on pursuing partnerships with maritime authorities, community leaders, NGOs, WMO, IUGG, youth and young professional platforms

134. Dr Srinivas Tummala (India) enquired about the TSP response to the south Sandwich event and recalled events from outside of the Indian Ocean during the reporting period. A prescriptive and harmonious method should be agreed by the TSPs for such events. For example, estimated water levels for reporting could be less than 50 cm (PTWS has a 30 cm threshold). Dr Miao agreed that this should be addressed by WG-2.

135. Dr Tummala also asked about the plans for operationalising the maritime service. For instance, should TSPs be responsible for certain NAVAREAS or should all TSPs do this. Dr Miao replied that the current thinking is all TSPs will implement, noting Australia is ready to go live.

15.3 SUBREGIONAL WORKING GROUP FOR THE NORTH-WEST INDIAN OCEAN

136. The Chair of the Subregional Working Group for the North-West Indian Ocean (WG-NWIO), Dr Mohammad Mokhtari (Iran), presented an update on the Group's activities and progress against its work plan in the intersessional period, highlighting any issues.

137. In particular, he reported on general outcomes from the UNESCAP funded project "Strengthening Tsunami Warning in the North-West Indian Ocean through Regional Cooperation", especially the development of National Working Groups to help revise, manage, and enhance national tsunami warning chains. He also briefly discussed the enhanced scientific understanding of the tsunami hazard in the region.

138. The following are the main activities that have been concerned and planned to work on by the WG-NWIO:

- 1 identify all potential sources of tsunami in the Makran Subduction Zone and the earthquake source parameters (may need some extra funding).
- 2 Assess and mitigate local tsunami threat, maintaining effective national tsunami warning chains and integrating them with other multi-hazard frameworks. Strengthening tsunami awareness and preparedness especially for near-field threat, noting the local languages play an important rule and it is important to facilitate translations of important information and learning resources.
- 3 Need to further research the seismicity of the region and how to include features such as splay faulting in the PTHA, also include atypical tsunamis in the PTHA.
- 4 Optimal network design for data sharing seismic, GPS and tidal gauge data, and strengthening of observation network with advanced technologies (GNSS/SMART Cables/OBS etc.)
- 5 Phase 2 UNESCAP Project funded and to start late 21/early 22, this should be utilised by National Tsunami Working Groups established by UNESCAP Project to further coordinate, maintain and develop national tsunami warning chains. A new

chapter has been established in Iran to strengthen the local level SOP; this should be furthered.

- 6 Paleo-tsunami project in its phase one of "site selection" with the report being submitted to IGCP. It is a 5-year regional project (India, Pakistan, Oman and Iran). Source parameter investigation will need some further work/international funding, as now the national funding has become more difficult to obtain.
- 7 Utilize national and next IOWAVE exercises to test and enhance national/local tsunami warning chains and engage local communities in pilot areas identified by UNESCAP Project, to facilitate work on Tsunami Ready implementation.

19. TASK TEAM PROGRESS REPORTS

14.1 TASK TEAM ON SCIENTIFIC TSUNAMI HAZARD ASSESSMENT OF THE MAKRAN SUBDUCTION ZONE

139. Vice-Chair and Acting Chair of the Task Team on Scientific Tsunami Hazard Assessment of the Makran Subduction Zone, Dr Abdolmajid Naderi Beni (Iran), presented an update on the Task Team's activities and progress against its work plan in the intersessional period, highlighting any issues.

140. He reported on general outcomes from the UNESCAP funded project "Strengthening Tsunami Warning in the Northwest Indian Ocean through Regional Cooperation", especially the development of a Probabilistic Tsunami Hazard Assessment (PTHA) for the region with the help of international partners.

141. The Task Team was established during the 12th session of ICG/IOTWMS in Kish Island, Iran in March 2019. According to the scope of the Task Team, it was decided to gather a team of expert modellers from different countries in the framework of the UNESCAP Project on "Strengthening Tsunami Early Warning in the North-West Indian Ocean Region through Regional Cooperation". The first phase of the project finished in October 2021 and the main outcome of the first phase is:

- Hazard and risk assessment
- Improvement of warning services at NTWC level.

142. The second phase focuses on development of hazard and inundation maps by enhancing capacities on tsunami modelling and development of evacuation plans in line with the requirements of the threat by near-field tsunami.

143. According to the Terms and References of the Task Team, it is important to understand the potential impact of tsunamis in the Red Sea and Persian Gulf or any other atypical tsunami sources in these water bodies. Preliminary works show that it is possible for tsunami occurrence in Persian Gulf in terms of atypical sources, as it happened in 2017 in Dayyer in Persian Gulf and as it is mentioned in historical documents in Siraf. Moreover, evidence of sediment disturbances due to an abrupt event is evident in bottom sediments somewhere in the Persian Gulf.

144. According to the results of the UNESCAP project and according to the scientific works on possible sources of atypical tsunami in NWIO, the Task Team proposes:

- 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.

- The probability of atypical tsunami occurrence (such as submarine landslides and meteo-tsunami) could increase in the NWIO under ongoing climatic changes. It is suggested to consider the impacts of the ongoing climatic changes on increasing the potential of atypical tsunami occurrence in the region.

14.2 TASK TEAM ON TSUNAMI PREPAREDNESS FOR A NEAR-FIELD TSUNAMI HAZARD

145. The Chair of the Task Team on Tsunami Preparedness for a Near-Field Tsunami Hazard, Dr Mahmood Reza Akbarpour Jannat (Iran), presented an update on the Task Team's activities and progress against its work plan in the intersessional period, highlighting any issues.

146. He also reported on general outcomes from the UNESCAP funded project "Strengthening Tsunami Warning in the North-West Indian Ocean through Regional Cooperation", especially the development of national tsunami warning chains and associated timeline critical Standard Operating Procedures (SOPs) for National Tsunami Warning Centres (NTWCs) and National/Local Disaster Management Offices (N/LDMOs) where there is a near-field tsunami hazard. Given the rapid onset of near-field tsunami and arrival in minutes, communities need to educate on the risk and how to identify natural warning signs to facilitate effective response

20. PLANNING FOR ICG/IOTWMS-XIII

147. Prof. Karnawati recalled that in early 2021, following consultation with the ICG/IOTWMS Officers and Tsunami National Contacts (TNCs), it was decided to hold the thirteenth sessional meeting of the ICG/IOTWMS (ICG/IOTWMS-XIII) back-to-back with the seventh session of the UN Global Platform for Disaster Risk Reduction during May 2022 (GPDRR 2022) in Bali, Indonesia. This will enable ICG/IOTWMS-XIII participants to potentially attend both meetings and liaise with multi-hazard early warning and disaster management practitioners from around the world.

148. The intersessional meeting decided to hold ICG/IOTWMS-XIII during the week of 16th May as a precursor event to GPDRR 2022. The final session format (hybrid or in-person) will be confirmed at a later stage following a risk assessment and further consultation with all ICG/IOTWMS Member States.

149. Dr Donnelly (Australia) raised the concern that hybrid meetings are very difficult and can be ineffective. The Australia delegation may have concerns around traveling at this time.

150. Dr Mokhtari (Iran) noted that Bali attracts many tourists, which could be problematic with regards to accommodation. He suggested a hybrid meeting may be the way to proceed.

151. Dr Rahayu (Indonesia) reported that the organising committee for GPDRR 2022 is from BPBD and has ongoing preparation, including precautions if the pandemic worsens.

152. Delegates suggested potential agenda topics including UN Decade of Ocean Science, monitoring for atypical tsunamis, data sharing solutions, and the launch of innovation products.

Action: Secretariat to work with Indonesian hosts of ICG/IOTWMS to monitor COVID-19 situation and travel restrictions and advise ICG/IOTWMS when location and timing of the ICG/IOTWMS XIII is finalized.

21. REVIEW OF RECOMMENDATIONS

153. An update of existing and summary of new recommendations and actions can be found in [Annex 3](#).

22. CLOSING REMARKS

154. Mr Rick Bailey, Head of ICG/IOTWMS Secretariat and on behalf of IOC-UNESCO, thanked all attendees for their participation in the intersessional meeting of the ICG/IOTWMS. He also thanked all organisers for their contributions towards a successful event. Mr Bailey noted that the ICG will have a full and busy workplan in the lead-up to ICG/IOTWMS-XIII to be held in Bali during 2022.

155. The Chair of the ICG/IOTWMS, Professor Dwikorita Karnawati, thanked all of the participants and presenters for their contributions. She expressed gratitude to the organisers and support staff for their efforts in making the meeting a success. In conclusion, Prof. Karanawati welcomed and encouraged as many as possible delegates to attend ICG/IOTWMS-XIII, with representation of both warning and disaster management agencies and authorities from each Member State.

156. Prof. Karnawati officially closed the intersessional meeting of the ICG/IOTWMS at 10:00 UTC on 24 November 2021.

ANNEX 1: AGENDA & TIMETABLE

**Intergovernmental Coordination Group (ICG)
Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)
Inter-Sessional Meeting
23–24 November 2021**

Day #1: PROGRAMME AND STATUS REPORTING		
Time (UTC)	Agenda Item	Speaker/Lead
0600 <i>Moderator: Rick Bailey</i>	1. Welcome and Opening 1.1. Welcome by Head of Secretariat for IOC-UNESCO IOTWMS 1.2. Opening Address by Chair ICG/IOTWMS 1.3. Youth video competition winning videos 1.4. Organisation of the Meeting 1.5. Adoption of the Agenda	Mr Rick Bailey Professor Dwikorita Karnawati Mr Ardito Kodijat Ms Nora Gale Professor Dwikorita Karnawati
0630	2. ICG Chair Report	Professor Dwikorita Karnawati
0645	3. Secretariat Report	Mr Rick Bailey
0700	4. Indian Ocean Tsunami Information Centre Report	Mr Ardito M. Kodijat
0715	5. Tsunami and Other hazards related sea level Warning and mitigation Systems Working Group (TOWS-WG)	Mr Rick Bailey
0730	6. UN Ocean Decade	Mr Bernardo Aliaga
0745	7. Strategic Pathway Development	Mr Ardito Kodijat
0800	<i>Break... InaTEWS video</i>	
0815	8. IOTWMS Capacity Assessment	Dr Harkunti Rahayu
0830	9. Tsunami Ready	Mr Ardito Kodijat
0845	10. The impacts of COVID	Dr Harkunti Rahayu
0900	11. Progress report by ICG/IOTWMS Task Team on Exercise Indian Ocean Wave 2020	Ms Weniza
0930	12. IOTWMS Member State future plans and issues	National representatives
1015	13. IOTWMS status reporting	Mr Rick Bailey
1030	<i>Close of Day #1</i>	

DAY #2: ACTIVITY REPORTING AND PLANNING		
Time (UTC)	Agenda Item	Speaker/Lead
0600 0620 0640	14. Tsunami Service Provider progress reports 14.1. Australia 14.2. India 14.3. Indonesia	Mr Robert Greenwood Mr E Pattabhi Rama Rao Mr Yedi Dermad
0700 0720 0740	15. ICG/IOTWMS Working Group progress reports 15.1. Working Group1 – Tsunami Risk, Community Awareness and Preparedness 15.2. Working Group 2 – Tsunami Detection, Warning & Dissemination 15.3. Subregional WG North West Indian Ocean (NWIO)	Dr Harkunti Rahayu Dr Yuelong Miao Dr Mohammad Mokhtari
0800	Break... Tsunami Ready animation video	
0820 0840	16. ICG/IOTWMS Task Team progress reports 16.1. Task Team on Scientific Tsunami Hazard Assessment of the Makran Subduction Zone 16.2. Task Team on Tsunami Preparedness for a Near-Field Tsunami Hazard	Dr Abdolmajid Naderi Beni Dr Mahmood Reza Akbarpour Jannat
0900	17. Planning for Next ICG/IOTWMS-XIII	Professor Dwikorita Karnawati
0930	18. Review of recommendations	Mr Rick Bailey
0945	19. Closing remarks	Mr Rick Bailey Professor Dwikorita Karnawati
1000	Meeting close	

ANNEX 2: PARTICIPANT LIST

**Intergovernmental Coordination Group (ICG)
Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)
Inter-Sessional Meeting
23–24 November 2021**

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ANNEX 3: RECOMMENDATIONS AND ACTIONS

ID#	Agenda Item	What	Who	When
<p>From 31st Session of the IOC Assembly 14–15 June 2021 IOC Decision A-31/3.4.1 Warning Mitigation Systems for Ocean Hazards</p>				
A1	5.0	IOC Assembly encourages MS to provide voluntary financial contributions to the IOC special account and in-kind contributions to support the Ocean Decade Tsunami Programme	Member States	Ongoing
A2	5.0 15.2	IOC Assembly encourages MS to densify sea level networks capable of tsunami detection as well as seismic network particularly nearby tsunamigenic sources	Member States	Ongoing
A3	5.0 15.2	IOC Assembly encourages MS to implement a sample rate of 1 sample/sec. or higher on sea level gauges in order to record and transmit tsunami wave-form data from all seismic and non-seismic sources	Member States	ICGXIII
A4	5.0 15.2	IOC Assembly encourages MS to register National Tsunami Warning Centres (NTWCs) and Tsunami Warning Focal Points (TWFPs) as alerting authorities in the “WMO Alerting Authority Register” via the WMO National Permanent Representative and in follow-up to WMO circular letters	Member States	ICGXIII
A5	5.0 9.0 15.1	IOC Assembly encourages MS to use best practices in engineering design and construction of evacuation shelters, especially where local tsunami hazards exist;	Member States	Ongoing
A6	4.0 5.0 9.0	IOC Assembly encourages MS to include the IOTIC compilation of school Disaster Risk Reduction and preparedness materials as a resource, and especially as part of Tsunami Ready pilots that include schools	Member States	ICGXIII
A7	3.0 4.0	IOC Assembly instructs MS to develop standardized trainings that can be delivered online or in person, in particular through the Ocean Teacher Global Academy (OTGA)	Member States Secretariat IOTIC	Ongoing
A8	9.0 16.2	IOC Assembly instructs MS to include local source tsunami Standard Operating Procedures as an important component of the UNESCO-IOC Tsunami Ready programme	Member States Secretariat IOTIC	Ongoing
<p>Inter-sessional Meeting of the ICG/IOTWMS 23–24 November 2021 – Recommendations and Actions</p>				
1	2.0 15.1	SG 15.06R Recommends all Member States to promote increased participation through broader nomination of DMO representatives to the Working Groups and Task Teams of the ICG/IOTWMS	Member States, Secretariat	ICG XIII 2022
2	4.0	Steering Group to advice and guide IOTIC on direction for the extension of IOTIC BMKG program for the next 5 years.	Steering Group, Secretariat, IOTIC	Jan 2022
3	4.0	IOTIC to consult, liaise, and initiate the discussion between UNESCO IOC and GOI (BMKG) on the extension of the partnership agreement	Steering Group, Secretariat,	Jan 2022

ID#	Agenda Item	What	Who	When
			IOTIC	
4	4.0	SG 15.05R Steering Group to review IOTIC Terms of Reference and make recommendations to the ICG for endorsement to help inform discussions on renewal of IOTIC under IOC-BMKG partnership in 2022	Steering Group, Secretariat	ICG XIII
5	7.0	SG 15.08R Steering Group to further develop a strategic pathway and implementation plan for the Indian Ocean Tsunami Warning and Mitigation System, within the Context of the UN Decade for Ocean Science, to enable more timely and accurate warnings to at-risk communities who are recognized as Tsunami Ready	Steering Group, Secretariat, IOTIC	ICG XIII
6	8.0	WG1 2020.1 ICG/IOTWMS notes the recommendations of the Capacity Assessment of Tsunami Preparedness [Status Report 2018] and requests WG1, WG2 and WG-NWIO to develop work plans to address identified issues	Steering Group WG1, WG2, NWIO-WG	ICG XIII
7	9.0	ICG 12.59 Steering Group to develop ToRs for a Task Team on Tsunamis and Critical Infrastructure to ensure covered under the Tsunami Ready Programme	Steering Group	ICG XIII
8	9.0	SG 15.06R Steering Group to develop draft ToRs for a Tsunami Ready Working Group of the ICG/IOTWMS to lead and coordinate the implementation of the Tsunami Ready Programme in the Indian Ocean.	Steering Group, Secretariat, IOTIC	ICG XIII
9	10.0	WG1 2020.3 Recommends all Member States to review their national tsunami warning and response procedures and protocols to take into account COVID-19	Member States	ICG XIII
10	10.0	WG1 to complete analysis of the survey "The Impacts of Covid19: Tsunami warning services, evacuation, and sheltering during COVID-19" and present draft report to ICG/IOTWMS X-III	WG1	ICG XIII
11	11.0	Task Team on Indian Ocean Wave 2020 to complete its report on IOWAVE 20, taking into account Member State feedback on the initial draft report, and present final draft to ICG-XIII for approval	TT IOWAVE 2020	ICG XIII
12	11.0	Decides next Indian Ocean Wave Exercise to be held in 2023 to avoid overlap for some countries also involved in PAC WAVE Exercise planned for 2022. Task Team on Indian Ocean Wave 2023 to be established, with same ToRs as Task Team on Indian Ocean WAVE 2020	Steering Group, Secretariat	ICG XIII
13	13.0	WG1 2019.02 Secretariat in conjunction with WG1 and WG2 to develop regular ICG/IOTWMS status assessments to be presented at each ICG meeting, using input from Member States and utilizing outcomes from the Capacity Assessment of Tsunami Preparedness [Status Report 2018] and the KPI Framework being developed by the TOWS-WG	Secretariat, WG1, WG2	ICG XIII
14	15.1	WG1 2019.07 Recommends TOWS-WG to develop an IOC Technical Series document on governance of the upstream-downstream interface in tsunami early warning, including development of a national self-assessment tool	Secretariat	Feb 2022 (TOWS-WG XV)
15	15.1	WG1 2019.12 Steering Group review WG1 ToRs to reflect its role in supporting the implementation of the IOC-UNESCO Tsunami Ready Programme in the Indian Ocean and present to ICG/IOTWMS for approval	Secretariat	ICG XIII

ID#	Agenda Item	What	Who	When
16	15.1	WG1 2019.15 WG1 in conjunction with IOTIC and the Secretariat to develop a communication plan to assist the WG1 ICG/IOTWMS meet its goals and objectives	WG1 Secretariat, IOTIC	ICG XIII
17	15.2	WG2 2019.01R WG2 to develop a discussion paper on whether TSPs should send actual threat information bulletins directly to NTWCs, and not just notifications to obtain information from registered TSP web sites, as per present practice	WG2	ICG XIII
18	15.2	WG2 2019.02R WG2 to update the ICG/IOTWMS Service Definition Document for Tsunami Service Providers (TSPs) and submit to ICG/IOTWMS for approval	WG2	ICG XIII
19	15.2	WG2 2019.07 WG2 to prepare advice and guidelines on how to monitor and warn for atypical tsunami events, taking into account the work of the TOWS-WG on Tsunami Watch Operations.	WG2	ICG XIII
20	15.2	WG2 2021 Secretariat in conjunction with IOTIC to implement two NTWC/DMO/Media SOP workshops in the 2 nd half of 2022 (western IO and eastern IO), taking into account lessons learnt from the UNESCAP project in the NWIO, and in lieu of fact next IOWAVE Exercise is 2023.	Secretariat IOTIC	Jul - Dec 2022
21	15.2	Secretariat to survey NTWCs on requirement and use of threat information disseminated by TSP via fax at significant cost to TSPs	Secretariat	Dec 2021
22	15.2	Recommends MS (and TSPs?) to explore use of multi-lateral, or at least bi-lateral MOUs to obtain greater access to real-time data	MS TSPs	ICG XIII
23	15.3	Lessons learnt from Phase 1 of the UNESCAP Project with regards to development and review of national tsunami warning chains and associated NTWC/DMO/Media SOPs to be utilised in the Indian Ocean wide SOP training programme	Secretariat IOTIC	Jul - Dec 2022
24	16.1	Recommends first version of the Probabilistic Tsunami Hazard Assessment (PTHA) for the NWIO region to be completed and utilised by Member States to guide awareness and response to the tsunami threat in the NWIO region	TT STHAMSZ	Dec 2022
24b	16.1	Recommends WG1 and TT STHAMSZ consider that the probability of atypical tsunami occurrence in the Indian Ocean could increase under ongoing climate change	TT STHAMSZ	Dec 2022
25	16.2	Decides lessons learnt from Phase 1 of the UNESCAP Project with regards to warning for near-field tsunamis in NWIO to be utilised in developing guidelines for all Member States with near-field tsunami threat	TT PNFTH	Jun 2022
25b	16.2	Recommends MS establish National Working Groups to oversee the agreement, maintenance and ongoing improvement of national tsunami warning chains with SOPs established for each link in the chain involving NTWCs, DMOs, and the broadcast media	MS	ICG XIII
26	17.0	Decides COVID-19 permitting ICG/IOTWMS XIII to be held face-to-face in Bali, Indonesia in May 2022 immediately before the Global Platform for Disaster Risk Reduction (GP2022) Meeting or at earliest possible date following	Secretariat Chair ICG	May 2022

In this Series	Languages
Reports of Governing and Major Subsidiary Bodies , which was initiated at the beginning of 1984, the reports of the following meetings have already been issued:	
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2. Seventeenth Session of the Executive Council	E, F, S, R, Ar
3. Fourth Session of the Working Committee for Training, Education and Mutual Assistance	E, F, S, R
4. Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S, R
5. First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
6. Third Session of the <i>ad hoc</i> Task team to Study the Implications, for the Commission, of the UN Convention on the Law of the Sea and the New Ocean Regime	E, F, S, R
7. First Session of the Programme Group on Ocean Processes and Climate	E, F, S, R
8. Eighteenth Session of the Executive Council	E, F, S, R, Ar
9. Thirteenth Session of the Assembly	E, F, S, R, Ar
10. Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific	
11. Nineteenth Session of the Executive Council, Paris, 1986	E, F, S, R, Ar
12. Sixth Session of the IOC Scientific Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S
13. Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange	E, F, S, R
14. Second Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Havana, 1986	E, F, S
15. First Session of the IOC Regional Committee for the Central Eastern Atlantic, Praia, 1987	E, F, S
16. Second Session of the IOC Programme Group on Ocean Processes and Climate	E, F, S
17. Twentieth Session of the Executive Council, Paris, 1987	E, F, S, R, Ar
18. Fourteenth Session of the Assembly, Paris, 1987	E, F, S, R, Ar
19. Fifth Session of the IOC Regional Committee for the Southern Ocean	E, F, S, R
20. Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Beijing, 1987	E, F, S, R
21. Second Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Arusha, 1987	E, F
22. Fourth Session of the IOC Regional Committee for the Western Pacific, Bangkok, 1987	E only
23. Twenty-first Session of the Executive Council, Paris, 1988	E, F, S, R
24. Twenty-second Session of the Executive Council, Paris, 1989	E, F, S, R
25. Fifteenth Session of the Assembly, Paris, 1989	E, F, S, R
26. Third Session of the IOC Committee on Ocean Processes and Climate, Paris, 1989	E, F, S, R
27. Twelfth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Novosibirski, 1989	E, F, S, R
28. Third Session of the Sub-Commission for the Caribbean and Adjacent Regions, Caracas, 1989	E, S
29. First Session of the IOC Sub-Commission for the Western Pacific, Hangzhou, 1990	E only
30. Fifth Session of the IOC Regional Committee for the Western Pacific, Hangzhou, 1990	E only
31. Twenty-third Session of the Executive Council, Paris, 1990	E, F, S, R
32. Thirteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, New York, 1990	E only
33. Seventh Session of the IOC Committee for the Global Investigation of Pollution in the Marine Environment, Paris, 1991	E, F, S, R
34. Fifth Session of the IOC Committee for Training, Education and Mutual Assistance in Marine Sciences, Paris, 1991	E, F, S, R
35. Fourth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1991	E, F, S, R
36. Twenty-fourth Session of the Executive Council, Paris, 1991	E, F, S, R
37. Sixteenth Session of the Assembly, Paris, 1991	E, F, S, R, Ar
38. Thirteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Baja California, 1991	E, F, S, R
39. Second Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1992	E only
40. Twenty-fifth Session of the Executive Council, Paris, 1992	E, F, S, R
41. Fifth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1992	E, F, S, R
42. Second Session of the IOC Regional Committee for the Central Eastern Atlantic, Lagos, 1990	E, F
43. First Session of the Joint IOC-UNEP Intergovernmental Panel for the Global Investigation of Pollution in the Marine Environment, Paris, 1992	E, F, S, R
44. First Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1992	E, F, S
45. Fourteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 1992	E, F, S, R
46. Third Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Vascoas, 1992	E, F
47. Second Session of the IOC Sub-Commission for the Western Pacific, Bangkok, 1993	E only
48. Fourth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Veracruz, 1992	E, S
49. Third Session of the IOC Regional Committee for the Central Eastern Atlantic, Dakar, 1993	E, F
50. First Session of the IOC Committee for the Global Ocean Observing System, Paris, 1993	E, F, S, R
51. Twenty-sixth Session of the Executive Council, Paris, 1993	E, F, S, R
52. Seventeenth Session of the Assembly, Paris, 1993	E, F, S, R
53. Fourteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Tokyo, 1993	E, F, S, R
54. Second Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1993	E, F, S
55. Twenty-seventh Session of the Executive Council, Paris, 1994	E, F, S, R
56. First Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Melbourne, 1994	E, F, S, R
57. Eighth Session of the IOC-UNEP-IMO Committee for the Global Investigation of Pollution in the Marine Environment, San José, Costa Rica, 1994	E, F, S
58. Twenty-eighth Session of the Executive Council, Paris, 1995	E, F, S, R
59. Eighteenth Session of the Assembly, Paris, 1995	E, F, S, R
60. Second Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E, F, S, R

61.	Third Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1995	E only
62.	Fifteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Papete, 1995	E, F, S, R
63.	Third Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1995	E, F, S
64.	Fifteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange	E, F, S, R
65.	Second Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E only
66.	Third Session of the IOC Sub-Commission for the Western Pacific, Tokyo, 1996	E only
67.	Fifth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Christ Church, 1995	E, S
68.	Intergovernmental Meeting on the IOC Black Sea Regional Programme in Marine Sciences and Services	E, R
69.	Fourth Session of the IOC Regional Committee for the Central Eastern Atlantic, Las Palmas, 1995	E, F, S
70.	Twenty-ninth Session of the Executive Council, Paris, 1996	E, F, S, R
71.	Sixth Session for the IOC Regional Committee for the Southern Ocean and the First Southern Ocean Forum, Bremerhaven, 1996	E, F, S,
72.	IOC Black Sea Regional Committee, First Session, Varna, 1996	E, R
73.	IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Fourth Session, Mombasa, 1997	E, F
74.	Nineteenth Session of the Assembly, Paris, 1997	E, F, S, R
75.	Third Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1997	E, F, S, R
76.	Thirtieth Session of the Executive Council, Paris, 1997	E, F, S, R
77.	Second Session of the IOC Regional Committee for the Central Indian Ocean, Goa, 1996	E only
78.	Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Lima, 1997	E, F, S, R
79.	Thirty-first Session of the Executive Council, Paris, 1998	E, F, S, R
80.	Thirty-second Session of the Executive Council, Paris, 1999	E, F, S, R
81.	Second Session of the IOC Black Sea Regional Committee, Istanbul, 1999	E only
82.	Twentieth Session of the Assembly, Paris, 1999	E, F, S, R
83.	Fourth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1999	E, F, S, R
84.	Seventeenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Seoul, 1999	E, F, S, R
85.	Fourth Session of the IOC Sub-Commission for the Western Pacific, Seoul, 1999	E only
86.	Thirty-third Session of the Executive Council, Paris, 2000	E, F, S, R
87.	Thirty-fourth Session of the Executive Council, Paris, 2001	E, F, S, R
88.	Extraordinary Session of the Executive Council, Paris, 2001	E, F, S, R
89.	Sixth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, San José, 1999	E only
90.	Twenty-first Session of the Assembly, Paris, 2001	E, F, S, R
91.	Thirty-fifth Session of the Executive Council, Paris, 2002	E, F, S, R
92.	Sixteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Lisbon, 2000	E, F, S, R
93.	Eighteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Cartagena, 2001	E, F, S, R
94.	Fifth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2001	E, F, S, R
95.	Seventh Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Mexico, 2002	E, S
96.	Fifth Session of the IOC Sub-Commission for the Western Pacific, Australia, 2002	E only
97.	Thirty-sixth Session of the Executive Council, Paris, 2003	E, F, S, R
98.	Twenty-second Session of the Assembly, Paris, 2003	E, F, S, R
99.	Fifth Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Kenya, 2002 (* Executive Summary available separately in E, F, S & R)	E*
100.	Sixth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, St. Petersburg (USA), 2002 (* Executive Summary available separately in E, F, S & R)	E*
101.	Seventeenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
102.	Sixth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
103.	Nineteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Wellington, New Zealand, 2003 (* Executive Summary available separately in E, F, S & R)	E*
104.	Third Session of the IOC Regional Committee for the Central Indian Ocean, Tehran, Islamic Republic of Iran, 21-23 February 2000	E only
105.	Thirty-seventh Session of the Executive Council, Paris, 2004	E, F, S, R
106.	Seventh Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2005 (* Executive Summary available separately in E, F, S & R); and Extraordinary Session, Paris, 20 June 2005	E*
107.	First Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Perth, Australia, 3-5 August 2005	E only
108.	Twentieth Session of the Intergovernmental Coordination Group for the Tsunami Warning System in the Pacific, Viña del Mar, Chile, 3-7 October 2005 (* Executive Summary available separately in E, F, S & R)	E*
109.	Twenty-Third Session of the Assembly, Paris, 21-30 June 2005	E, F, S, R
110.	First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Rome, Italy, 21-22 November 2005	E only
111.	Eighth Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Recife, Brazil, 14-17 April 2004 (* Executive Summary available separately in E, F, S & R)	E*
112.	First Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS), Bridgetown, Barbados, 10-12 January 2006	E only
113.	Ninth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Cartagena de Indias, Colombia, 19-22 April 2006 (* Executive Summary available separately in E, F, S & R)	E S*

114.	Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14–16 December 2005	E only
115.	Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19–27 September 2005 (Abridged final report with resolutions and recommendations)	E, F, R, S
116.	Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2–4 November 2005 (* Executive Summary available separately in E, F, S & R)	E*
117.	Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8–10 December 2005 (* Executive Summary available separately in E, F, S & R)	E*
118.	Thirty-eighth Session of the Executive Council, Paris, 20 June 2005 (Electronic copy only)	E, F, R, S
119.	Thirty-ninth Session of the Executive Council, Paris, 21–28 June 2006	E, F, R, S
120.	Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July–2 August 2006 (*Executive Summary available separately in E,F,S & R)	E*
121.	Second Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Nice, France, 22–24 May 2006	E only
122.	Seventh Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 16–18 March 2005 (* Executive Summary available separately in E, F, S & R)	E*
123.	Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IV), Mombasa, Kenya, 30 February-2 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
124.	Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Trieste, Italy, 12–16 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
125.	Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Bonn, Germany, 7–9 February 2007 (* Executive Summary available separately in E, F, S & R)	E*
126.	Second Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Cumaná, Venezuela, 15–19 January 2007 (* Executive Summary available separately in E, F, S & R)	E*
127.	Twenty-first Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Melbourne, Australia, 3–5 May 2006 (* Executive Summary available separately in E, F, S & R)	E*
128.	Twenty-fourth Session of the Assembly, Paris, 19–28 June 2007	E, F, S, R
129.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Lisbon, Portugal, 21–23 November 2007 (* Executive Summary available separately in E, F, S & R)	E*
130.	Twenty-second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Guayaquil, Ecuador, 17–21 September 2007 (* Executive Summary available in E, F, S & R included)	E*
131.	Forty-first Session of the Executive Council, Paris, 24 June–1 July 2008	E, F, R, S
132.	Third Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Panama City, Panama, 12–14 March 2008 (* Executive Summary available separately in E, F, S & R)	E*
133.	Eighth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 17–20 April 2007 (* Executive Summary available separately in E, F, S & R)	E*
134.	Twenty-third Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Apia, Samoa, 16–18 February 2009 (*Executive Summary available separately in E, F, S & R)	E*
135.	Twentieth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Beijing, China, 4–8 May 2009 (*Executive Summary available separately in E, F, S & R)	E*
136.	Tenth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Puerto La Cruz, Bolivarian Republic of Venezuela, 22–25 October 2008 (*Executive Summary available separately in E, F, S & R)	E, S*
137.	Seventh Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VII), Sabah, Malaysia, 26–29 May 2008 (*Executive Summary available separately in E, F, S & R)	E*
138.	Ninth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, France, 10–12 June 2009 (* Executive Summary available separately in E, F, S & R);	E*
139.	Fifth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Athens, Greece, 3–5 November 2008 (* Executive Summary available separately in E, F, S & R)	E*
140.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Fort-de-France, Martinique, France, 2–4 June 2009 (* Executive Summary available separately in E, F, S & R)	E*
141.	Twenty-fifth Session of the Assembly, Paris, 16–25 June 2009	E, F, R, S
142.	Third Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, Marrakesh, Morocco, 4–11 November 2009	E, F, R, S
143.	Ninth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 22–24 April 2009 (* Executive Summary available separately in E, F, S & R)	E*
144.	Fifth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Managua, Nicaragua, 15–17 March 2010 (* Executive Summary available in E, F, S & R)	E*
145.	Sixth Session of the IOC Regional Committee for the Central and Eastern Atlantic Ocean, Accra, Ghana, 28–30 March 2010 (* Executive Summary available in E, F, S & R)	E*
146.	Forty-second Session of the Executive Council; Paris, 15, 19 & 20 June 2009	E, F, R, S
147.	Forty-third Session of the Executive Council; Paris, 8–16 June 2010	E, F, R, S
148.	Sixth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Istanbul, Turkey, 11–13 November 2009 (* Executive Summary available separately in Ar, E, F, S & R)	E*
149.	Seventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Paris, France, 23–25 November 2010 (* Executive Summary available separately in Ar, E, F, S & R)	E*
150.	Sixth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Santo Domingo, Dominican Republic, 26–29 April 2011 (* Executive Summary available in E, F, S & R)	E*

151.	Twenty-fourth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Beijing, China, 24–27 May 2011 (*Executive Summary in E, F, S & R included)	E*
152.	Twenty-first Session of the IOC Committee on International Oceanographic Data and Information Exchange, Liège, Belgium, 23–26 March 2011 (*Executive Summary available separately in E, F, S & R)	E*
153.	Eighth Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VIII), Bali, Indonesia, 10–13 May 2010 (*Executive Summary available separately in E, F, S & R)	E*
154.	Tenth IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 12–14 April 2011 (* Executive Summary available separately in E, F, S & R)	E*
155.	Forty-fifth Session of the Executive Council, Paris, 26–28 June 2012 (* Decisions available in E, F, S & R)	E*
156.	Seventh Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Willemstad, Curacao, 2–4 April 2012 (*Executive Summary available in E, F, S & R)	E*
157.	Eleventh Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Miami, USA, 17–20 May 2011 (*Executive Summary available separately in E & S)	E, S*
158.	Eight Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-VIII), Trinidad & Tobago, 29 April–1 May 2013 (*Executive Summary available in E, F, S & R)	E*
159.	Twenty-seventh Session of the Assembly, Paris, 26 June–5 July 2013 and Forty-sixth Session of the Executive Council, Paris, 25 June 2013	E, F, R, S
160.	Twenty-fifth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), Vladivostok, Russian Federation, 9–11 September 2013 (*Executive Summary in E, F & R)	E*
161.	Ninth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, US Virgin Islands, 13-15 May 2014 (*Executive Summary available in E, F, S & R)	E*
162.	Forty-seventh Session of the Executive Council, Paris, 1–4 July 2014 (* Decisions available in E, F, S & R)	E*
163.	Ninth Session of the IOC Sub-Commission of the Western Pacific (WESTPAC-IX), Busan, Republic of Korea, 9–12 May 2012	E
164.	Eleventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, 12–14 November 2014, Nicosia, Cyprus (*Executive Summary available in E, F, S & R)	E*
165.	Twenty-sixth Session of the Intergovernmental Coordination Group for the for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVI), Hawaii, USA, 22–24 April 2015 (*Executive Summary available in E, F, S & R)	E*
166.	Tenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), Philipsburg, Sint Maarten, Kingdom of the Netherlands, 19–21 May 2015 (*Executive Summary available in E, F, S & R)	E*
167.	Tenth Session of the IOC Sub-Commission of the Western Pacific (WESTPAC-X), Phuket, Thailand, 12–15 May 2015	E
168.	Twenty-eighth Session of the Assembly, Paris, 18–25 June 2015	
169.	Twelfth 12th Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS-XII), Dublin, Ireland, 16-18 November 2015 (*Executive Summary available in E, F, S & R)	E*
170.	Eleventh Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XI), Cartagena, Colombia, 5-7 April 2016 (*Executive Summary available in E, F, S & R)	E*
171.	Tenth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Muscat, Oman, 24–26 March 2015	E*
172.	Forty-ninth Session of the Executive Council, Paris, 7–10 June 2016 (* Decisions available in E, F, S & R)	E*
173.	Thirteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, Bucharest, Romania, 26–28 September 2016 (*Executive Summary available in E, F, S & R)	E*
174.	Twenty-seventh Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVII), Tahiti, France, 28-31 March 2017 (*Executive Summary available in E, F, S & R)	E*
175.	Twelfth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), Puntarenas, Costa Rica, 10–12 May 2017 (*Executive Summary available in E, F, S & R)	E*
176.	Eleventh Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), Putrajaya, Malaysia, 18–20 April 2017 (*Executive Summary available in E, F, S & R)	E*
177.	Fourteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS), Lisbon, Portugal, 21–23 November 2017 (*Executive Summary available in E, F, S & R)	E*
178.	Twenty-ninth Session of the Assembly, Paris, 21–29 June 2017 and Fiftieth Session of the Executive Council, Paris, 20 June 2017 (*Executive Summary available in E, F, S & R)	E*
179.	Thirteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XIII), Curaçao, 23–27 April 2018 (*Executive Summary available in E, F, S & R)	E*
180.	Twenty-fifth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Tokyo, 2019 (* Executive Summary available separately in E, F, S & R)	E*
181.	Fifteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Paris, France, 26–28 November 2018 (*Executive Summary available in E, F, S & R)	E*
182.	Twelfth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), Kish, Islamic Republic of Iran, 9–12 March 2019 (*Executive Summary available in E, F, S, R)	E*
183.	Twenty-eighth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVIII), Montelimar, Nicaragua, 2–5 April 2019 (*Executive Summary available in E, F, S & R)	E*
184.	Fourteenth session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-XIV/3), Punta Leona, Costa Rica, 8–11 April 2019 (*Executive Summary available in E, F, S & R)	E*
185.	Fifth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-V/3), Putrajaya, Malaysia, 8–10 April 2008	E

186.	Sixth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-VI/3), Hyderabad, India, 7–9 April 2009	E
187.	Eighth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-VIII/3), Melbourne, Australia, 3–6 May 2011	E
188.	Fifty-first Session of the Executive Council, Paris, 3–6 July 2018 (* Decisions available in E, F, S & R)	E*
189.	Sixteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Cannes, France, 2-4 December 2019 (* Executive Summary available in E, F, S & R)	E*
190.	Fifteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XV), 27–29 April 2021 (online) (* Executive Summary available in E, F, S & R)	E*
191.	Twenty-ninth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIX), Online, 1–2 and 7–8 December 2021 (*Executive Summary available in E, F, S & R)	E*
192.	Thirtieth Session of the IOC Assembly, Paris, 26 June–4 July 2019 and Fifty-second session of the IOC Executive Council, Paris, 25 June 2019 (*Summary report available in E, F, S & R)	E*
193.	Fifty-third Session of the Executive Council, Online, 3–9 February 2021 (* Decisions available in E, F, S & R)	E*
194.	Thirty-first Session of the IOC Assembly, Online, 14–25 June-2021	E F S R
195.	Tenth Session of the International Co-ordinating Group for the Tsunami Warning System in the Pacific, Sydney, Canada, 1–3 August 1985	E
196.	Inter-Sessional Meeting of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), online, 23–24 November 2021	E