WMO/ESCAP
Panel on Tropical Cyclones

Report for the Workshop on Standard Operating Procedures under the Project Synergized Standard Operating Procedures (SSOP) for Coastal Multi-Hazards Early Warning System

UN Conference Center (UNCC)
Bangkok, Thailand
May 8 – 9, 2013

Economic and Social Commission of Asia and Pacific (ESCAP)
ESCAP/World Meteorological Organization (WMO) Typhoon Committee (TC)
WMO/ESCAP Panel on Tropical Cyclones (PTC)
Thai Meteorological Department

Acknowledgments

This workshop was conducted as Activity 1.1 of Project Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System funded by the ESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and Southeast Asian Countries. The lead organizations for the project are the ESCAP/WMO Typhoon Committee and the WMO/ESCAP Panel on Tropical Cyclones in association with a wide cross section of partner agencies. Kind appreciation is expressed to the Thai Meteorological Department for their vital assistance as the Local Organizing Committee and hosting a welcoming reception and to ESCAP and the UN Conference Center for their support and contributions to the workshop.

Executive Summary

Project

Following the deadly and highly destructive tsunami on December 26, 2004, many of the countries surrounding the Indian Ocean as well as Southeast Asian countries developed Standard Operating Procedures (SOPs) for tsunami early warning systems (EWSs), many with the help of international agencies and other countries. However, many of them do not have operational experience in handling a tsunami with these SOPs. Also many do not have the same level of development of SOPs for other coastal hazard early warning systems or for multi-hazard early warning systems involving a tsunami and other coastal hazards. The challenge faced by warning providers, media, disaster managers, and coastal communities is an understanding the similarities and differences among different coastal hazards and the characteristics of the early warnings that are used.

The Economic and Social Commission of Asia and Pacific (ESCAP) / World Meteorological Organization (WMO) Typhoon Committee and the WMO/ESCAP Panel on Tropical Cyclones (PTC) in cooperation with the Asian Disaster Reduction Center (ADRC) and Intergovernmental Oceanographic Commission (IOC) of UNESCO recognized that there was a strong need to create synergies among different types of coastal hazard early warnings, including for tsunami, storm surge, high tide, high wave, strong wind, flood, and sediment disasters by reviewing existing SOPs. They believed these synergies can be achieved through identifying specific gaps and needs for making the existing EWSs fully operational for use in a multi-hazards context.

Thus, the ESCAP/WMO Typhoon Committee and the WMO/ESCAP Panel on Tropical Cyclones formulated, with the collaboration of other entities, and submitted the project Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System (SSOP) to ESCAP for funding through the ESCAP Multi-Donor Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and South East Asia. The Secretary of TC was authorized by the Chairperson of TC to sign the final version of the Letter of Agreement between ESCAP and TC, on behalf of the Committee, on the August 1, 2012. Unless otherwise agreed upon, the project termination date is July 31, 2014.

SSOP is the first project of Typhoon Committee to be funded by an international organizations like ESCAP. The longer term goal of the project is to promote community resilience to coastal multi-hazards, including impact from land-falling tropical cyclones, through having standard operating procedures for effective multi-hazards EWS which will lead to improvement of policy and institutional arrangements at national and community levels. This project will involve Typhoon Committee and Panel of Tropical Cyclones, several international/regional organizations, and thirteen beneficiary countries in TC and PTC region, and the designated target groups include National Meteorological and Hydrological Services, National Tsunami Warning Centres, and National Disaster Management Offices in TC and PTC Members.

The project will be mainly focused on the meteorological and hydrological services for affected areas which become more vulnerable to natural disasters after tsunami and other coastal disasters.

The synergized SOPs are intended to be easily understandable and interpretable for decision makers, forecasters, and dwellers, like fishermen.

Activity 1 under this project is to collect, review, analyze, and synergize the existing SOPs for coastal multi-hazard EWS in the Members of TC and PTC. Based upon the analysis and synergizing, the project will develop a Manual/Handbook of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning Systems. The first item, 1.1, under this activity was to conduct a workshop for collecting and exchanging the performance status of coastal multi-hazard EWS in the Members of TC and PTC at high risk. This workshop was held on May 8-9, 2013.

Workshop

ESCAP/WMO Typhoon Committee, the WMO/ESCAP Panel on Tropical Cyclones, the Thai Meteorological Department (TMD) with the kind collaboration of ESCAP jointly conducted a workshop on Standard Operating Procedures for Coastal Multi-hazards Early Warning System as part of the project Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System on May 8-9, 2013. The Workshop was held at the UN Conference Center (UNCC) in Bangkok, Thailand.

The main objectives of the Workshop were:

- Collect and exchange information on the performance status of coastal multi-hazard EWS in the 13 beneficiary countries of this project who are Members of TC and PTC.
- Share with the participants the experiences of experts on EWS from other agencies or organizations.

The associated outcome indicator for the workshop was the identification of needs and unmet gaps of current SOPs for EWS in the 13 beneficiary countries.

Presentations and Discussions

The presentations and discussions were a combination of items to ensure the main objectives of the workshop were met. At the opening ceremony, representatives from the TC, PTC, WMO, ESCAP, and TMD emphasized the importance of this workshop and pledged their full support to it. Following the opening ceremony, the Project Manager/Technical Advisor provided an introduction to the SSOP project and described the purpose of the workshop which provided a focus for the two day workshop.

To meet the objective of sharing with the participants the experiences of experts on EWS from other agencies or organizations, the following partners and collaborators made presentations: Asia-Pacific Broadcasting Union (ABU); Asian Disaster Preparedness Center (ADPC); ADRC; Global Alliance on AccessibleTechnologies and Environments (GAATES); IOC – UNESCO; Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES); and WMO. In addition, two presentations were made by non-beneficiary Members of the Typhoon Committee, Japan (RSMC Tokyo, JMA) and USA (RSMC Honolulu, NOAA NWS).

To meet the other objective of collecting and exchanging information on the performance status of coastal multi-hazard EWS in the 13 beneficiary countries, Bangladesh, China, India, Lao PDR, Malaysia, Maldives, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, and Viet Nam made presentations describing their multi-hazard risks and early warning systems. Cambodia was unable to attend.

The discussion at the end of the second day of the workshop was extremely valuable. Each country had an opportunity to make comments on the purpose, objectives, and plans for this project and their identified needs and gaps. This discussion helped the participants to refine the scope and intentions for the project.

Conclusions

Manual/Handbook of Synergized Standard Operating Procedures (SSOP).
During the discussions, three major themes were emphasized:

- There is a wide variety of cultures, governments, past experiences, relationships, risks, and people among countries and even within many countries. Therefore, the SSOPs must be flexible best practices, operational guidelines and recommendations that can be applied in a variety of situations. Most believed rigid, detailed, very precise SSOPs would not work and would not be used.
- Although the process and project is focused on the National Meteorological and Hydrological Services, the National Disaster Management Offices, and the National Tsunami Warning Centers, other agencies should and must be involved in detailed, integrated ways to make the end to end, cross-cutting early warning system work. One of the previously identified problem in some countries is inadequate government coordination and cooperation within and among national, regional, and local levels. In addition, various user sectors within government, businesses, and communities should be considered and addressed if possible. Therefore ways to possibly coordinate and cooperate this through SSOPs would have great value.
- For this approach to work, there should be encouragement to ensure there is a policy part of the development of SSOPs. Because of the different agencies, governments, etc., a policy framework would likely increase the probabilities for success.

Training.
A common need and gap identified was training and human capacity building. It was suggested that this training may be technical in nature for the NMHSs, but should also include many other types. For example, training the warning preparer how to communicate better with the media and training for the media on how to better understand the risks and potential impacts could produce significant benefits. In some countries, Disaster Management Offices, at all levels of government, have good awareness of risks, potential, and similarities and differences among coastal hazards and other do not. At the community level, increased awareness is needed or the meaning of warnings, risk, potential, actions needed, and methods to increase awareness when areas have not been significantly impacted for 20 -30 years.

Infrastructure Capacity Building
Although mostly out of the scope of this project, a number of issues were discussed concerning infrastructure improvements. For some, it was better bathymetrical data for storm surge and run up. For others it is better storm models, better observation tools, better numerical forecasting tools, etc. These are important parts of an effective early warning system which include: knowledge of the risks faced; monitoring and warning service; dissemination and communication; and response capability

Opportunity for Collaboration with Various Partners and Other Organizations.
Before and during the workshop, it was recognized that there is a tremendous opportunity for collaboration between this project and the two others managed by ADPC and ABU, both in association with GAATES, and funded by the ESCAP Trust Fund, ABU and ADPC both in association with GAATES. In addition, ADRC, RIMES, IOC-UNESCO, WMO, and ESCAP have all pledged to collaborate. Consultations will continue on the best method to proceed on this and to ensure the collaboration contributes to each other's projects and avoids unnecessary duplication. Finally, this is an opportunity for the TC and PTC to more closely collaborate and to achieve jointly some of their common goals. This collaboration concept has been discussed for several years, but it never had the resources or opportunities to work out the methodologies or details.

Recommendations

Based upon the outcome of this workshop, it is recommended that the project be continued because it has great potential and value to the 13 beneficiary countries and that the project planned actions should be completed.

Given the differences within the regions and within countries, it is recommended that the SSOPs have to be synergized in a way that can reflect the key concepts, basic principles and common strands behind the documents. Also, information peculiar to specific hazards or regions may need to be packaged in separate modules.

It was recommended that the activities contained in the project's plan be accomplished as listed. First by conducting in-country workshops in the three pilot countries (Philippines, Bangladesh, and Pakistan) by a team of experts to identify strengths, gaps, needs, and recommendations for EWS SOPs and recommendations for the content of the *Manual of Synergized SOPs for Coastal Multi-Hazards EWS.* Based upon the findings and reports of these pilot workshops, to then prepare an initial draft of the Manual. The draft reports and manual can be reviewed at PTC and TC workshops in late November and early December, respectively.

Table of Contents

1. INTRODUCTION

It has been pointed out in the 2011 *Report on Regional Unmet Needs for Early Warning Systems in the Indian Ocean and Southeast Asia* that the Asia-Pacific region is the most disaster prone region in the world which is seriously affected by many types of natural disasters. This coupled with the predicted effects of climate change, the potential for natural disasters may increase significantly. Also the report indicated that, an end-to-end disaster early warning system (EWS) should be a fundamental component of all nations' disaster risk reduction (DRR) strategies, enabling governments from the national to the local levels, as well as communities themselves, to take appropriate actions to reduce both the loss of lives and protect livelihoods in anticipation of a disaster.

Two of the five priorities of the Hyogo Framework for Action (HFA) 2005 – 2015 emphasized the importance of EWS and public awareness. The second HFA priority for action is to identify, assess, and monitor disaster risks and enhance early warning. Under this, there are four key components that should be addressed:

- Strengthening national and local risk assessments;
- Establishing institutional and community capacities for effective early warning;
- Developing and sustaining technical infrastructure and information management capacities for effective data collection and hazard analysis; and
- Building cooperation mechanisms for analyzing regional and emerging risks.

The third HFA priority for action is to use knowledge, innovation and education to build a culture of safety and resilience at all levels. Under this, there are four key components which should be addressed:

- Strengthening networks and mechanisms for information management and exchange;
- Promoting inclusion of risk reduction in school and community education and training;
- Furthering research into risk and hazard analysis and cost-benefit analysis for risk reduction actions; and
- Promoting public awareness to engage media and community interest.

Since the December 2004 Indian Ocean Tsunami, many countries in Asia, most of which are located in the region covered by the ESCAP/WMO TC and WMO/ESCAP PTC, especially southern countries, developed national tsunami warning systems supported by regional tsunami warning information services provided by Japan and the United States (Pacific Ocean) and Australia, India, and Indonesia (Indian Ocean) under the coordination of the IOC of UNESCO.

Due to the low frequency of tsunami, however, there have been concerns over the continuity of stand-alone national level tsunami warning systems in less developed countries. In fact, except Indonesia and Japan, no country in the region has been significantly affected by a tsunami since the 2004 Sumatra Tsunami. Thus, many countries may not have been motivated to maintain an operational tsunami warning system. Therefore the concept was developed that an operational coastal multi-hazard warning system could be more sustainable for a longer time.

A more frequent coastal inundation is storm surge mainly caused by tropical cyclones. There are similarities and differences between storm surge and tsunami. Storm surges caused by tropical cyclones have a longer lead time in general than tsunami and the duration of inundation can be longer, especially for slow moving tropical cyclones. Because there is not an earthquake early warning system, inundation by tsunami is more difficult and less dependable than forecasting storm surges associated with tropical cyclones. Differences in the issuance of various warnings by providerswill need to be understood at the operational level. Any confusion or misunderstanding in this regard would be fatal.

In 2005, following the 2004 Indian Ocean Tsunami, ESCAP established the ESCAP Multi-Donor Trust Fund for Tsunami, Disaster and Climate Preparedness in Indian Ocean and South East Asia with the overall objective of building and enhancing tsunami early warning capacities. More recently, ESCAP has enlarged the scope of the Trust Fund and has made known through a Strategy Note issued in November 2011 that it was open to funding early warning capacities for other coastal hazards besides tsunamis. The Strategy Note mentioned that "mechanisms facilitated by ESCAP will be utilized, including the Panel on Tropical Cyclones, Typhoon Committee ...".

Based upon this expanded scope and identified need, the ESCAP/WMO TC and the WMO/ESCAP PTC formulated, with the collaboration of other entities, and submitted the project Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System (SSOP) to ESCAP for funding through the ESCAP Trust Fund.On behalf of the TC, the Secretary of TC was authorized by the Chairperson of TC to sign the final version of the Letter of Agreement between ESCAP and TC to fund this project on the August 1, 2012. Unless otherwise agreed upon, the project termination date is July 31, 2014.

2. PROJECT OVERVIEW

Purpose: The purpose of the project is to promote community resilience to coastal multi-hazards through standard operating procedures for effective multi-hazards early warning system which will lead to improvements in policy and institutional arrangements at national and community levels. It is focused mainly on the National Meteorological and Hydrological Services to meet the needs of diverse users, like disaster management offices, government and non-government decision makers, early warning issuers, media, researchers, operational agencies, public, including fisherman at community level.

SSOP is the first project of Typhoon Committee to be funded by an international organizations like ESCAP. This Project will involve:

- Two regional bodies of WMO Tropical Cyclone Programme – TC and PTC;
- Several international/regional organizations, such as ADRC, IOC of UNESCO, ESCAP, WMO,ABU, RIMES and ADPC as partners and potential cooperation entities;
- Thirteen beneficiary countries in TC and PTC regions including Bangladesh; Cambodia; China; India; Lao PDR; Malaysia; Maldives; Myanmar; Pakistan; Philippines; Sri Lanka; Thailand and Viet Nam;

- Target groups including National Meteorological and Hydrological Services (NMHSs), National Tsunami Warning Centres (NTWCs) and National Disaster Management Offices (NDMOs) in TC and PTC Members.

Because it is expected that this project will be comprehensive and complicate, the intent is to set SSOP as a cross-cutting project among working groups of the TC and PTC in order to effectively and efficiently implement the project and achieve its goals.

At a meeting of representatives of ESCAP, WMO, PTC, TC, ADRC with the Chairs of the WGs of TC on 25 November 2012 in Nanjing, the Terms of Reference of the Task Force and the Terms of Reference of the Project Manager of the SSOP project were drafted. At the 45th Session of the Typhoon Committee and the 40th Session of the Panel on Tropical Cyclones, the TC and PTC approved the Terms of Reference for the Task Force, Project Manager, and Steering Committee; the implementation plan of SSOP; and proposed budget.

Results Framework

Goal: The longer term goal of the Project is to promote the coastal community resilience to coastal multi-hazards through having standard operating procedures for effective multi-hazards EWS which will lead to improvement in policy and institutional arrangements at national and community levels.

Outcomes: The project has two expected outcomes with two associated activities and 5 sub-activities as shown below.

Expected Outcome 1: Integrated SOPs for coastal multi-hazard EWS for TC and PTC Members.

Support Activity 1: Reviewing and synergizing the existing SOPs for coastal multi-hazard EWS in the Members of TC and PTC areas and developing the *Manual of Synergized SOPs for Coastal Multi-Hazards EWS.*

Sub-Activity 1.1: Conduct workshop for collecting and exchanging information on the status of coastal multi-hazards EWS in the beneficiary countries.
Indicator: Needs and unmet gaps of SOPs for EWS in the beneficiary countries are identified.
Sub-Activity 1.2: Pilot SSOPs project in 3 selected countries, focusing on institutional capacity building at all levels from the national level to the local level with main emphasis on the meteorological, hydrological, and disaster management services.
Indicator: Two-three countries with multi-visits
Sub-Activity 1.3: Synergizing the existing SOPs to compile the *Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning Systems*, mainly focusing on the hydro-meteorological aspects, to meet the needs of diverse users, like decision makers, media, researchers, and public, for operational and personal actions. It is anticipated that partner agencies, other organizations, task force members, and others will assist in developing the different chapters.
Indicator: Distributed Manual to TC/PTC Members

Expected Outcome 2: Promoted capacity on performance of SOP for coastal multi-hazard EWS in Members of TC and PTC. Integrated Standard Operating Procedures (SOPs) for coastal Multi-hazard EWS for TC and PTC Members.

Support Activity 2: Enhancing the capacity building performance of SOPs for coastal multi-hazard EWS in Members of TC and PTC through SSOP.

Sub-Activity 2.1: Conduct training of users on the interpretation of EWS products for decision making, media, etc.
Indicator: Approximately 50 decision makers, disaster managers, media professionals and warning issuers from beneficiary countries are trained.
Sub-Activity 2.2: Conduct working meeting on cooperation between TC and PTC for coastal multi-hazard EW information sharing and technical transfer for beneficiary countries.
Indicator: Approximately 20 participants from the beneficiary countries as focal points of cooperation mechanism participate in the meeting.

Outputs.
Main Output 1: *Manual of Synergized Standard Operating Procedures for Coastal Multi-hazard Early Warning Systems*, mainly focusing on the hydro-meteorological aspects, to meet the needs of diverse users, like decision makers, early warning, media, researchers, operational, and public.
Main Output 2: Regular communications and cooperation between TC and PTC Members on coastal multi-hazard early warning, particularly in southern countries in the region.

The knowledge gained through this project will be disseminated through the manual listed above, TC and PTC workshops, training courses and websites in collaboration/coordination with partners, Asian Conference on Disaster Reduction sponsored by ADRC, ESCAP's meetings of the Committee on Disaster Risk Reduction, and several associated WMO meetings.

During and following the completion of the project, ESCAP will provide monitoring, evaluation, and auditing. The TCS must submit to ESCAP biannual progress reports, together with cumulative financial reports, by May 31 and November 30 each year within the duration of the project, following a progress reporting template provided by ESCAP. Independent end of term evaluation will be commissioned by the TCS in consultation with partners and ESCAP and a independent audit of the project funds at the end of the project will be performed.

The structure of the project is composed of a Steering Committee, Project Manager/Technical Advisor, and Task Force.

- The Steering Committee is composed of the Chairperson of Advisory Working Group of Typhoon Committee, Secretary of the Typhoon Committee, and Secretary of the Panel on Tropical Cyclones. Their terms of reference include the selection of consultant(s) and Project Manager; providing guidance to Task Force, Project Manager and consultant(s); and monitoring the progress of the SSOP project implementation. The Chairperson of the AWG of the TC will perform the functions of Head of the Steering Committee.
- The Project Manager/Technical Advisor terms of reference include the implementation of SSOP and coordinate related programmes or activities, taking part in the activities related to SSOP, maintaining progress of the implementation of the project and to prepare the progress

reports, and drafting the *Manual of Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System*.

- The Task Team is composed of chairpersons or their representatives of WGM, WGH, WGDRR, and TRCG of Typhoon Committee and the chairpersons or their representatives of the WGM, WGH, and WGDPP of Panel on Tropical Cyclones; representatives from TC and PTC Secretariats; consultants from potential cooperation organizations; focal points from beneficiary countries among Members of TC and PTC; and TC Secretary to perform the functions of Head of the Task Force. Their terms of reference include providing technical advisory and support to Project Manager in implementing the cross-cutting SSOP project, through: facilitating collection and exchange of information; facilitating compilation of good practices of SOP in TC and PTC; coordinating with other ongoing initiatives with similar objectives; reviewing and providing comments for the manual; offering support in the conduct of training courses in target countries; and building cooperation between TC and PTC.

3. PURPOSE OF THE WORKSHOP

The main objectives of the Workshop were to:

- Collect and exchange information on the performance status of coastal multi-hazard EWS in the 13 beneficiary countries of this project who are Members of TC and PTC.
- Share with the participants the experiences of experts on EWS from other agencies or organizations.

The associated outcome indicator for the workshop was the identification of needs and unmet gaps of current SOPs for EWS in the 13 beneficiary countries.

4. VENUE

ESCAP/WMO Typhoon Committee, the WMO/ESCAP Panel on Tropical Cyclones, the TMD with the kind collaboration of ESCAP jointly conducted a workshop on Standard Operating Procedures for Coastal Multi-hazards Early Warning System as part of the project Synergized Standard Operating Procedures for Coastal Multi-Hazards Early Warning System (SSOP) on May 8-9, 2013. The Workshop was held at the UN Conference Center (UNCC) in Bangkok, Thailand.

5. OPENING CEREMONY

The workshop began at 09:00 on May 8, 2013 with an opening ceremony. During the opening ceremony, valuable and insightful addresses were provided by representatives of the TC, PTC, WMO, ESCAP, and TMD.

5.1 Mr. Olavo Rasquinho, Secretary of the TC, stated that the SSOP project, together with the other three projects funded by the same ESCAP Trust Fund (one being implemented by ABU, another by ADPC, and a third project conducted by RIMES can greatly contribute as a whole to more resilient coastal communities in the Indian Ocean and Southeast Asia.

5.2 Mr. Arif Mahmood, Director General, Pakistan Meteorological Department and Secretary of PTC,stated that the TC and PTC regions comprise of diversified and complex topographic features and their long coastlines are fully exposed to the natural disasters like typhoons, tropical cyclones, storm surges, tsunami etc. One of the important factors which further aggravate this situation is the population density of the regions. In the changing climate scenarios, typhoons, tropical cyclones and their associated storm surges have become severe hydro-meteorological disasters in this part of the world, claiming precious lives and causing damages to property and infra-structure almost every year.

He presented a brief introduction of the PTC, its Member countries and organization of its sessions. He further added that with the adaptation of advanced technology, satellites data and imageries, and numerical prediction modeling can improve the prediction of severe weather events well in advance. There is no doubt that meteorological community of our region is fully aware of the challenges due to the typhoon, tropical cyclones and associated storm surges. Typhoon Committee and PTC with the assistance of ESCAP, WMO, IOC-UNESCO and their collaborative efforts, under agreed programmes of action, can further improve their forecasting and warning capabilities for the safety and prosperity of our peoples. He also stated that this workshop is an opportnity to strengthen new relationship between TC and PTC. He urged the TC and PTC Members to contribute maximum for developing long-term strategies to further improve the early warning systems and enhance cooperation among the Member countries to affectively address the hydrometeorological disaster risk reduction challenges in our region. Sharing the experiences of the experts on Early Warning Systems from other international organizations will be beneficial for driving the procedures for mitigating the disasters vulnerable to coastalines.

5.3 On behalf of Mr. Michel Jarraud, Secretary-General of the WMO, Mr. Koji Kuroiwa, Chief of the Tropical Cyclone Programme (TCP), expressed the sincere appreciation of WMO to the Government of Thailand for hosting the Workshop on Standard Operating Procedures for Coastal Multi-hazards Early Warning System. Mr. Kuroiwa welcomed all the participants and emphasized the significance of the workshop as the first concrete step of the joint project of the Typhoon Committee and the Panel on Tropical Cyclones, both of which have 40 years of history in tropical cyclone warning services. In referring to the ceremony of the World Meteorological Day and the 40th session of the WMO Hurricane Committee which were both held in the previous month and focused on the effective early warning system, Mr. Kuroiwa demonstrated his belief that the SSOP project is a timely action for building resilience to the natural hazards in this world's most disaster prone area. Therefore, he expected that the workshop will facilitate the exchange of views needed to develop appropriate strategies and coordinated actions to achieve the goals of the project. He finally wished the participants constructive discussions during the workshop and fruitful outcomes.

5.4 Dr. Shamika Sirimanne, Director of ESCAP's Information and Communications Technology and Disaster Risk Reduction Division, reiterated ESCAP's strongsupport for the SSOP project. She stated that ESCAP saw the project as abridge between the PTC and the TC, with a view to an even closercollaboration in the future. Dr. Sirimanne also urged the workshopparticipants to explore potential partnerships aimed at transferring skillsand

sharing technology between countries, which could help build new capacities where they were greatly needed. Finally, Dr. Sirimanne noted that the ESCAP member States were increasingly concerned about natural disasters and their impact, and strongly encouraged closer regional collaboration in areas such as early warning, in order to strengthen resilience. As such, the SSOP project had the full support not only of the ESCAP Secretariat, but also of the governments across the region.

5.5 Dr. Songkran Agsorn, Deputy Director-General, TMD made an opening address for the session on behalf of Mr. Worapat Tiewthanom, Director-General, TMD. In his address, he warmly welcomed all distinguished guests and participants, reiterated the collaboration among members of TC, PTC, and all other international organizations partners participating in the SSOP with the main objective to promote the coastal community resilience to coastal multi-hazards through having standard operating procedures for effective multi-hazards early warning system and improving the policy and institutional arrangements at national and community levels.

He emphasized the need of standard operating procedures and experience to handle many kinds of coastal multi-hazards effectively for decreasing the losses of human lives and protection of property caused by such the disasters. He also express his most sincere appreciation to the TC, PTC, WMO, UNESCAP and other international organizations partners for joining together to implement the project. Finally, he wished the workshop conducted very success.

6. INTRODUCTION TO SSOP PROJECT

Mr. James Weyman, SSOP Project Manager/Technical Advisor, provided a 15 minute PowerPoint presentation to introduce the SSOP project and to describe the purpose of the workshop. The first part of the presentation included the purpose, the funding source, the time frame, the beneficiary countries, and target groups of the project. He went on to state that the project is intended to influence human resource capacity building; cooperation on multi-coastal hazard early warnings and risk between TC and PTC; and policies on emergency response, collaboration among multi-agencies, and data/ information sharing. He described the project's strategies and the results framework with associated goal, outcomes, activities and outputs discussed above.

Mr. Weyman emphasized the importance of close collaboration and coordination with other ESCAP funded projects by ADPC in association with GAATES for environment(Technical assistance for enhancing the capacity of end-to-end multi-hazard EWS for coastal hazards in Myanmar, Sri Lanka and Philippines); ABU (Disaster Risk Reduction Broadcast Media Initiative); and RIMES in cooperation with WMO(Reducing risks of tsunami, storm surges, large waves and other natural hazards in low elevation coastal zones). In addition, he stated it was important to closely collaborate and coordinate with many others, such as TC and PTC country focal points (NMHS and NDMO), ESCAP, TC, PTC, ADRC, IOC of UNESCO, ITIC, and Pacific Tsunami Warning Center (PTWC).

He completed his presentation with a description of the structure of the project which is composed of a Steering Committee, Project Manager/Technical Advisor, and Task Force and also provided a brief summary of the monitoring, evaluation, and auditing ESCAP will provide during and following the completion of the project.

7. KEYNOTE ADDRESSES

7.1 **"EW and DRR Media Campaign"**- Ms Natalia Ilieva (Asia-Pacific Broadcasting Union with Ms. Betty Dion and Mr. Aqeel Qureshi (Global Alliance on Accessible Technologies and Environments)

The overall objective of the ***ABU Disaster Risk Reduction Broadcast Media Initiative*** is to enhance the beneficiary countries' disaster risk reduction (DRR) and early warning (EW) capacities through utilization and in collaboration with the broadcast media. For achieving this objective the ABU would facilitate collaboration between broadcasters and the disaster warning centers (DWC) for specific hazards and relevant government national disaster management offices (DMOs). The facilitation would be channeled through establishing in the targeted countries of national ***EW/DRR Task Groups*** to help all parties to create or improve processes, procedures, structures, and mechanisms for the utilization of the broadcast media as an integral part of an effective national Early Warning Systems. The expected results are streamlining of the existing national SOPs for Early Warnings by improving coordination and shortening communication channels.The countries targeted by the project are India, Indonesia, Maldives, Myanmar, Pakistan, the Philippines, Sri Lanka and Thailand.

The project will develop several resource training tools: *Disaster Recovery Technical Manual*; **country and hazard specific** *Fact Sheets for Effective Early Warning for Costal Hazards*; a booklet *Good Practices in Reaching Women and Children in Early Warnings*; *Guide for Communicating with People with Disabilities in an Emergency*; *Lessons Learned: Strengths and Weaknesses of Emergency Warning Systems* and *Networks* book. The project will also develop a designated website to facilitate and support the regional network of nodal offices and broadcasters.

Important part of the project is sensitizing broadcasters, DWC and DMOs about the vulnerability of women, children, disable and elderly people to natural disasters and their specific needs when designing emergency warning messages and different communications channels to reach these groups in case of pending disasters. The project would identify the hardware and equipment that broadcasters need to reach these groups. For example deaf people can't be reached by radio sound alerts but if the sound alert is accompanied by light signal that increases the chances members of this group to receive adequate alert.

Ms. Betty Dion and Mr. Aqeel Qureshi stated that GAATES is pleased to be working with ABU and ADPC. Activities for the project include the identification of stakeholders, an environmental scan and interviews, the development of a bibliography, a Guideline Manual on Inclusive Disaster Risk Reduction and Early Warning Systems for persons with disabilities. The final activities will be the propagation of the guidelines and country-based workshop. GAATES is the leading international NGO dedicated to the promotion of accessibility of the built environment and information and communications technologies.

7.2 **"Strengthening the Multi-hazard Early Warning Systems for the Hazard Risk Reduction of Coastal Communities: Some experiences from the region"**-Mr. Atiq Kainan Ahmed, (Asian Disaster Preparedness Center)

ADPC was represented by Mr. Atiq Ahmed, Programme Specialist of ADPC (also the Project Manager for Trust Fund projects) who made a presentation on "Strengthening the Multi-hazard Early Warning Systems for the Hazard Risk Reduction of Coastal Communities: Some Experiences from the Region". The presentation shared some of the experiences and lessons that have emerged from ADPC working in the ESCAP countries. Mr. Ahmed mentioned that ADPC is one of the first partners of the UNESCAP Tsunami Trust Fund and their experiences of implementing various ADPC projects in both PTC and TC countries could be very helpful for the SSOP project as well. ADPC shared how they have moved ahead with the implementation arrangements of these national and sub-national level projects. They are implementing the projects in active collaboration with the NHMSs and NDMOs in respective countries. ADPC team is also conducting EWS gaps and needs assessment and the results would be coming out shortly. Initial results show that while much progress have also been made in the upstream scientific part of the EWS in various countries in past few years but still there are many gaps and weaknesses existing in the overall 'end-to-end EWS' with a clear demonstration of varied level and needs of capacity.

ADPC expressed that in future they are open to collaborate with TC and SSOP project and make synergies in implementing the Trust Fund projects in the region. At this point, under the current ESCAP Trust Fund project, ADPC is working in Sri Lanka, Myanmar and Philippines. In these countries, ADPC is also implementing some pilot demonstration that would demonstrate good practices of end-to-end coastal EWS. In terms of SOP development, ADPC is helping countries to develop 'local level EWS SOPs' that would enable local communities to understand, supplement, and coordinate with the national EWS procedures in the pilot countries. Mr. Ahmed mentioned that if SSOP project plans to cover a regional level synergies SOP then ADPC project experiences can help bring elements of local SOPs and connect that with the region SSOP. Apart from the current ADPC project under ESCAP Trust Fund, ADPC is also working in other ESCAP countries with various other sources of funding that includes Vietnam, Bangladesh, Pakistan, Cambodia, Indonesia, Timor Leste and others. Mr. Ahmed showed a proactive perspective from ADPC for future collaboration with TC/PTC, SSOP project and ESCAP for related works.

7.3 **"Case Studies of SOP in Japan and Asian Countries for Disaster Risk Reduction"**- Mr. Makoto IKEDA(Asian Disaster Reduction-ADRC)

Since the enactment of the Disaster Countermeasure Act in 1961, Japan has been continually enhancing and strengthening its disaster management system in light of the lessons learned from large scale natural disasters. The basic planning system for disaster management in prefectural and municipal level is comprised of the Local Disaster Management Plan which sets the framework for detailed SOPs. During the Keynote session, ADRC provided information on two examples of Local Disaster Management Plans, one for Hyogo Prefectural Government and one for Kobe City.

The Local Disaster Management Plan of Hyogo Prefectural Government and the Plan for Kobe City are separated into two chapters, one for tsunami and one for wind/water disaster. Specific emergency response activities are decided based on this Plan. Information including early warning and evacuation for citizens is provided by using amplifier stations such as antennas, radios and speakers. For better utilization of this plan, both authorities have been conducting many disaster prevention training events with experts, citizens, etc.

7.4 **"Standard Operating Procedures for Tsunami Warning and Emergency Response in the Indian Ocean and Southeast Asia Region"** - Mr. Tony Elliot (IOC-UNESCO)

Mr Elliott provided the background to the implementation of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS) and the establishment of its Intergovernmental Coordination Group (ICG) in 2005. The ICG comprises 28 Member States, with governance and secretariat support provided by the IOC of UNESCO. He explained IOC UNESCO's role in assisting member states to develop SOPs for tsunami warning and emergency response, which had been supported by a project under the UNESCAP Multi Donor Trust Fund for Tsunami, Disaster and Climate Preparedness. He noted that training in SOP development had been provided by IOC in partnership with the International Tsunami Information Center (ITIC) to over 25 countries in the Indian Ocean and Southeast Asia region. Globally, IOC and ITIC had also helped to develop SOPs in many countries in the Pacific Ocean and Caribbean regions.

Mr Elliott commented that it was vital to identify and coordinate all the key stakeholders in the warning chain and establish their roles and responsibilities. Written SOPs should be developed for routine and repetitive activities, and for procedures to be followed in an emergency with the goal of having the same quality every time. It is also essential to develop and test SOPs for communications links between all stakeholders in the warning chain to ensure that public safety messages are delivered in a timely manner to the end users. He noted that all warning centers require SOPs, but for tsunami events, rapid evaluation, warning and response are essential to save lives. He stressed that SOPs should be developed, practiced regularly and modified as and when necessary to ensure that they are effective and reliable.

7.5 **"Tsunami Risk Assessment for Enhancing Coastal Hazard Early Warning and Response"** - Dr. Patchanok Srivihok (RIMES)

Tsunami risk assessment at the local scale is important for generating information to enhance end-to-end early warning and response. A tsunami risk assessment would reveal communities that would be highly vulnerable to the hazard. This, however, entails detailed inundation modelling for a range of scenarios from most important source zones, and requires computational capability and good-quality near-shore bathymetric, topographic, and exposure datasets, which most countries in the region lack.

RIMES is now working on building tsunami risk assessment capacity through training, demonstration of tool application, and transfer of equipment, software, systems, and training manuals to the countries to facilitate replication/up-scaling. These tools are: a) low-cost, near-shore, bathymetric, topographic, and exposure survey methodologies; b) data processing tool to

generate high-resolution data required for tsunami risk assessment; and c) computer-based tsunami risk assessment and evacuation mapping.

7.6 "The Work of PWS Programme of WMO on Establishing MOUs and SOPs for an Effective EWS and the Related Experience of Hong Kong, China"–Mr. LEE Lap-shun, Hong Kong Observatory (in representation of WMO)

Mr. LEE Lap-shun of the Hong Kong Observatory, gave a talk in representation of a WMO Public Weather Services Expert Team on the guidelines for creating a MOU and a SOP between a National Meteorological or Hydro-meteorological Service (NHMS) and a partner agency. An MOU formalizes the relationship between the two parties and defines mutual roles and responsibilities. Its structure and content should be clear, unambiguous and easy to review and update. In some instances, an NHMS may wish to develop an agreement that focuses more upon operational or procedural matters than an MOU traditionally addresses. SOP could be agreed upon which describes in detail how the two agencies will routinely work together when certain defined conditions arise. It contains a written procedure of individual, often sequential, tasks that need to be undertaken, in the form of a checklist or other appropriate framework. It captures the most efficient and effective ways to perform an operation, helping an agency produce predictable, reproducible results and maintain the quality and consistency of its service.

Mr. LEE also gave a brief introduction of the application of Common Alerting Protocol (CAP) in warning services. CAP is a standard message format designed for all-hazards and all-media public alerting. It can replace single-purpose interfaces between alert sources and dissemination media, and serves as a kind of "universal adaptor" for alert messages. A key benefit of CAP is that the alert message sender can activate multiple warning systems with a single input, thus reducing the cost and complexity of notifying many warning systems. A further benefit of CAP for emergency managers is that standardized alerts from many sources can be compiled for situational awareness and pattern detection. Managers are then able to monitor at any one time the whole picture across all types of local, regional, and national alerts.

8 PRESENTATIONS BY REPRESENTATIVES OF BENEFICIARY COUNTRIES

8.1 Bangladesh.

Costal Multi-hazard EWS of Bangladesh by Taslima Imam, Senior Meteorologist.Ms. Taslima Imam opened her presentation with a short description of Bangladesh's profile and the possible hazards which can impact the coastal regions of the country. The coastal zone covers 47,201 km^2 which is 32 percent of the total landmass and 36 million people (28 % of total population) live in the coastal region. The coastal hazards Bangladesh experiences include, tropical cyclone and associated storm surge, monsoon depression, monsoon related heavy rain and wind driven surge, severe thunderstorms and possible tornados, floods, dense fog, tsunami, and riverbank erosion.

The Government of Bangladesh (GoB) has taken many steps to improve EWS process:

- Bangladesh Meteorological Department(BMD) has a network of five radars and out of these, three were updated as Doppler ones; satellite ground receiving stations for MTSAT,GMS and NOAA; increased capacity building for NWP; use of IIT-D model for storm surge forecasting; experimentally ran the MRI model, Wave model and WRF model; implemented PC clusters as training purpose; installed or in the process of being installed more than 60 AWS; maintained 35 Synoptic and 4 Seismic observation sites; and issued warnings in plain language format; and introduced graphical format for better, easier understanding by media reporters but more improvements are needed in the current graphical format.
- Infrastructure improvements were made including building more than 3000 storm shelters.
- The GoB improved the Disaster Management Regulative Framework and Disaster Management Planning Framework through the passage of the Disaster Management Act; the implementation of National Plan for Disaster Management and National Disaster management policy; establishment of Disaster Management Bureau (DMB) and the upgrading of DMB to Department of Disaster Management, Disaster Management Council, and Disaster Management Committees from national to field levels; and the Comprehensive Disaster Management Programme (CDMP) of DDM functioning to help upgrade capabilities for all disaster management agencies.
- Standing Orders on Disaster (SOD) were developed. SOD describes in detail the roles and responsibilities of all concerned ministries/divisions/departments/agencies at pre-, during, and post-disaster stages. The defined warning stages include Alert, Warning, Disaster, and Post Disaster/Rehabilitation Stages. BMD as well as all concerned organizations have their role in each stage.
- Dissemination of information was improved through more involvement of national and private radio and TV stations, mobile phones and internet; BMD meteorologists are presenting weather forecasts on national TV called Bangladesh Television(BTV); and a total of 49,365 Cyclone Preparedness Programme (CPP) volunteers were mobilized in all 13 coastal districts for dissemination of early warning and evacuation messages as well as assisted in the evacuation of the populations living along the coastal areas to safer place. Their goal is to warn coastal people in 15 minutes or less from the time of evacuation order.
- BMD's implementation of an active community awareness programme with brochures and animation cartoon film for school children; stakeholders seminars on all hazards; roving seminars with agriculture experts and farmers; and attempts to get hazard awareness/preparation sections into the national curriculum for school children.
- BMD is strengthening EWS through present and future initiatives: quality human resources; dedicated communication system with appropriate band width; stable power supply; large computing power; placing the NWP system under operations; ensuring TV broadcasting systems in BMD have visually attractive forecasts including real-time network with media; establishment of an additional GTS connection with another RTH for sustainable and broader utilization; enhancement of the seasonal forecasting capacity of BMD; and completion of Costal Inundation Forecasting Demonstration Project for the improvement of storm surge and inundation forecast.

8.2 Cambodia

The Cambodia representative was unable to attend the workshop, but Ms. Phalla PEOU, who was previously nominated, sent her presentation, which was delivered to the participants.

The presentation focused on four areas associated with the generation of location specific, early warning system for communities. First, the hazards identified as most threatening for the vulnerable coastal areas are thunderstorms, tropical cyclones, floods, especially flash floods, and drought. The monitoring and warning service was discussed next. It emphasized the importance of data acquisition, processing, and dissemination; numerical weather prediction (Cambodia uses the following models JMA (Japan), GFS (USA), Aperg (France), and ECMWF (European Union)); the various web sites to gather data and information (JMA, TMD, SWFDP- SEA (Severe Weather Forecasting Demonstration Project for Southeast Asia Webpage), Hong Kong Observatory, Tropical Cyclone Ensemble Forecast Information, and others).

The third item discussed was dissemination and communication through the use of the website, email, telefax, and phone and to whom information is sent. Fourth was response capability in which short range weather forecasts (nowcasting to 3 days), mid-range weather forecasts (4 to 6 days), extended range weather forecasts (7-10 days), seasonal weather forecasts, and severe weather warnings were listed.

8.3 China

Mr. Yerong Feng from CMA presented Weather-related Multi-hazards Early Warning System in Guangdong Province of China. In Guangdong province, China, 90% natural disasters are incurred by severe weathers or weather-related events. The talk covers current technologies and systems that deal with hazardous weather early warning in the province, in particular, focusing components which are critical: observation network, early warning system, dissemination and multi-hazards reduction.

The following gaps or needs on early warning are emphasized which need further strengthening: observations in remote area and off the coast; more accurate and timely forecast or nowcast for the severe weather; solution to the bottleneck of warning dissemination; roles played by different people and an effective SOP (including responsibilities of governors, mayors, and village chiefs; multi-agencies response, and community participation); and finally training people how to survive during severe weather.

8.4 India.

Dr. S.R. RAMANAN, Director (Area Cyclone Warning Center), Regional Meteorological Center, made the presentation for India on the status of their Early Warning System.

A list of the number of stations in surface network including automatic weather stations and hydro-meteorological stations was shown. Maps depicting the network of upper air stations, radars and data buoys were shown. The uses of numerical products were also discussed. Since the template suggested knowledge of the risk as a component of early warning system, he provided a few illustrations like use of hourly surface messages for fixing the land fall area and time of a cyclone; use of upper air data for computation of wind shear and its impact on the strength of cyclone period; and use of radar images prior to land fall were shown. Due to time constraints even though many numerical prognostic products are available, just two products

pertaining to genesis potential and ensemble of track forecast were shown. Certainly the improvements in numerical methods have helped them to improve the forecast and have given the forecasters more confidence.

Regarding the warnings and bulletins, India has four stage warning for cyclones with the director general issuing the first warning to the chief secretary of the concerned maritime state. The cyclone alert, the warning issued to coastal areas, post land-fall outlook (issued 12 hours prior to the time of land fall), and other warnings relevant to the maritime community like port and fisheries warning were discussed. The damage potential for different cyclonic disturbances are appended with the messages so as to enable the concerned to take required steps to face the same.

Dissemination of warnings is through fax to a select list of official agencies. Some people are contact through phone. The web page is frequently updated with warning bulletins and port and fisheries warning. IVRS facility (Interactive voice response system) for weather related information is available. Media (both print and electronic) plays a great role in dissemination. Once the cyclone comes within radar range and if radar can fix the centre with confidence, hourly bulletins are issued through All India Radio.

As far as response to the disasters, the national and state agencies (NDMA and SDMA) swing into action on receipt of the messages. District administration plays a great role in the disaster mitigation and the NDRF (National Disaster Response Force) assist them in the activity. The state disaster management agency and disaster management institutes take a proactive role with the concept that prevention is better than extensive response. Mock drills, table top exercises and disaster related lecture programmes are conducted to create awareness among the officials and general public.

More recently, human loss has come down. If the public really understands what forecasters' capabilities are and if the forecasting community can improve its services, the loss of life could be further reduced. In order to do this, user needs and outreach programmes are conducted. Before concluding his presentation, he related a successes story of a particular company using the forecast. The company said they were able to select "no regret options" for facing the situation based upon the forecast and suggested the need to work out solutions for a wide spectrum of events on an individual basis to reduce property loss.

8.5 Lao PDR

Mr. Vanhdy DOUANGMALA, Head of Weather Forecasting and Aeronautical Division, Department of Meteorology and Hydrology, provided Lao PDR's presentation on Cases of Effective Urban Flood Management in Lao PDR. The presentation focused on Historical Floods, Actual Features of Urban Floods, Cases of Recent Effective Flood Management, Flooding Responses Approaches and Mechanism, Recommendations, and Conclusions. In the area of historical floods, Lao PDR has experienced 8 years of major floods in 43 years (1966–2008).These large floods were caused by a combination of strong southwest monsoon from Bay Bengal/Gulf of Thailand and typhoons from South China Sea/east Pacific. Next, the actual features of urban floods are that the main urban cities are along the Mekong River/tributaries and urban residential areas are increasing each year. The third item was cases of recent effective

flood management. In mid-July 2008, flash floods occurred in northern and central Lao PDRcaused by monsoonal heavy rainfall and TS HAGUPIT. During the period 17 – 22 July 2008, some spots had over 500 mm of rain in the 6 day period. Then on 8 August TS KUMMURI produced widespread heavy rain over northern and central parts of Lao PDR. On 8-9 August, widespread monsoonal heavy rains, estimated at over 100-150 mm/day occurred upstream of Mekong River. In total, an estimated 77,000 hectares of agricultural land was inundated destroying stored harvests, field rice crops, and livestock. About 50,000 hectares had severely damaged agricultural infrastructure - irrigation systems and fish ponds; social amenities such as schools, hospitals and water wells were affected; transport infrastructure - bridges, roads and foot paths were damaged or destroyed; and thousands of commercial and personal houses were affected. Some 353,928 people were affected by the floods.

The fourth area was Flooding Responses Approaches and Mechanism. In response to the extensive flooding in July-August 2008, the NDMC 2008 Disaster Preparedness Response Plan was developed. In early August, the Lao PDR government called all ministers (including NDMC) to a meeting to assign tasks and to coordinate the flood response which resulted in an efficient response in Vientiane Capital. Over 100,000 people deployed to place sandbags along the Mekong River banks; many vehicles, boats, trucks, helicopter, water pumps etc. deployed to the flood response; and this strengthened the Mekong River banks. The next item was recommendations to strengthen disaster response from lessons learned. These included: enhance the capacity of NDMC; clarify the roles and responsibilities of the various agencies and personnel; enhance the capacity of all players in disaster planning and preparedness; develop a comprehensive multi-sectorial national disaster management plan and legal frame work; sustained public education and community awareness on disaster management; and share information with mass media. He ended with the following conclusions and recommendations: the forecast and warning capabilities must be improved to assist government and public users to take preventive actions; further implementation of integrated water resources management is needed; early warning systems sharing of meteorological and hydrological information with mass media and concerned line agencies should be strengthened; and cooperation with regional and international organization in term of effective flood management and disaster prevention and mitigation should be improved.

8.6 Malaysia

Mr. Alui Bahari, Deputy Director General (Forecast), Malaysian Meteorological Department, presented Coastal Multihazard EWS which focused on Knowledge of the Risks Faced, Monitoring and Warning Service, Dissemination and Communication, and Response Capability. In the knowledge of risk area, he discussed 2 monsoon's season, the northeast monsoon (Nov – Mar) and southwest monsoon (May – Sept)both of which produced weather related hazards of floods, strong winds, rough seas, and tropical storms/typhoons. Northeast monsoon season is the major period of heavy rain activity over the east coast states of peninsular Malaysia and west Sarawak. Monsoon weather systems which develop in conjunction with cold air outbreaks from Siberia produce rains that last for days and often cause severe floods. The southwest monsoon is associated with a drier pattern and stable atmospheric condition in the equatorial region, except for state of Sabah. Sabah is wetter due to the tail effect of typhoons and tropical storms. Tropical Storm Greg occurred on Christmas night of 1996 and resulted in 182 deaths, 200-300

migrants missing, more than 4,000 houses destroyed, and some 3,000 people homeless. Tropical Storm Vamei developed on December 26, 2001 at 1.4° N in the South China Sea, strengthened quickly, and made landfall along extreme southeastern Malaysia. The system brought flooding and landslides to eastern Malaysia causing USD $3.6 million in damage and five deaths.

In the area of monitoring and warning service, Malaysia has 45 meteorological stations, 8 upper air stations, 18 coastal cameras, 12 radar stations,1 satellite ground receiving station, and 339 auxiliary stations (141 AWSs, 39 climatological stations, and 159 rainfall stations). Mr. Bahari then presented the criteria for heavy monsoonal rain and tropical cyclones of yellow, orange, and red and then the criteria for strong winds and rough seas of first, second, and third categories. For dissemination and communications, Malaysia uses SMS, TV broadcasts, radio broadcasts, facsimile (all disaster management agencies), mass media (print and electronic), web page, social media network, Facebook, Twitter, and Visual Strong Wind Warning System of red flags (5) and notice boards (7). Finally, for response capability, the National Security Council, routine and ad hoc meetings, SOPs, and awareness programme were discussed.

8.7 Maldives

Mr. Ali SHAREEF, Deputy Director General, Maldives Meteorological Service, gave the presentation for the Maldives. As background, the Maldives atolls encompass a territory spread over roughly 90,000 square km (99% Sea area) making the country one of the world's most geographically dispersed. Its population of 328,536 (2012) inhabits 192 of its 1,192 islands. The Maldives is the smallest Asian country in both population and land area. With an average ground level of 1.5 m (4 feet 11 inches) above sea level, it is the planet's lowest country. Thus delivering of warning messages to its public is very challenging.

The climate of Maldives is warm and humid and much of the weather is determined by the Indian Ocean monsoons. The average elevation of the islands is about 1 meters above mean sea level. In Maldives, hazardous weather and frequency include: flash flood, frequent with major events in 2004 and 2012; strong winds, frequent; thunderstorms, frequent; beach erosion, frequent; tidal or swell waves, frequent with major events in 1987 and 2007; storms sometimes, last major one in 1991; drought; and tsunami which occurred in 2004. 88 islands were severely affected by swell waves in May 2007 due to extra-tropical storm in southern hemisphere. Due to global warming, climate change and associated sea level rise, low lying Maldivian islands continue to be more vulnerable to the episodic flooding.

Preventive measures which the Maldives have taken include efficient drainage and conveyance systems in selected islands; sea walls to prevent tidal waves; coastal plantation in the absence of sea wall to prevent beach erosion; coral reef protection against direct impact of urbanization (waste management, avoid taking corals for building-blocks and other domestic usage). Forecasting in the Maldives is impacted by no real-time data facilities from ocean area and therefore MMS depends mostly on NWP on various websites. MMS is grateful to receive customized numerical products from INCOIS and RIMES. For preparedness and warning, the Maldives is planning a three phase approach to improve observation network involving the acquisition of Doppler weather radars, satellite receiving system, AWSs, seismometers, better service, and lightning detection system. To act upon any likely event of meteorological,

hydrological, tectonic and oceanographic disasters, the National Early Warning Centre prepared SOP which include 3 alert levels, white, yellow, and red, and green for cancellation. A description of each level and activities isincluded. Alerts are dispatched through cooperate SMS and hotlines to designated authorities as per SOP. Warnings are disseminated to public through stakeholders and media and MMS conducts briefings to sea travelers, fisherman, National Defense, Police, NDMC, and interviews for various media. Challenges and concerns include delivery of advisories and warnings to end users, widely dispersed population on many islands, lack of trained personnel in MMS and stakeholder agencies, lack of technical and financial support, no SOPs with stakeholders, and no safe shelters.

8.8 Myanmar

Mr. WIN MAW, Staff Officer, Department of Meteorology and Hydrology, Early Warning System in DMHprovided Myanmar's presentation. He discussed Introduction to the Roles and Responsibility of DMH; Warning, Forecast, Bulletin and News; Institutional Framework for Disaster Management; and Conclusion. First he listed the stations under DMH which included 63 Meteorological, 39 Meteorological & Hydrological, 30 Hydrological, 1 Pilot balloon, 17 Agro-meteorological, 2 Satellite receiving, 6 Aviation Met. Offices, and 6 Seismological sites. DMH's main responsibilities include observing meteorological, hydrological and seismological phenomena to provide necessary information for disaster prevention/mitigation and development of socio-economic activities, issuing information about forecasts and warnings, providing decision and policy makers with information through an early warning system. DMH issues warnings for cyclones, storm surge, flood, untimely rainfall, fog, heavy rain, aviation weather, low flow water level, tsunami, port, and strong wind. They provide general weather outlook and water level forecasts for monsoon season, seasonal weather and water level forecasts, monthly weather and water level forecasts, and 10 days weather and water level forecasts. In addition, they issue the following forecasts: aviation weather, marine weather, and special events. They issue bulletins for agro-meteorological, bay, special weather, significant water level, and low flow and finally news notifications for earthquakes, rainfall/temperature records and cyclones. Early Warning Dissemination in Myanmar is done via phone, fax, SSB, TV, Radio FM, web site, newspaper, NGO, and INGO.

Under Institutional Framework for Disaster Management, the Union government has given guidance to take proactive actions in relief, recovery and long-term prevention for potential disasters that may be caused unexpectedly by climate change. To improve the framework, Myanmar has reorganized Myanmar Disaster Preparedness Agency on 20 April 2011 and on the same day the Myanmar National Search and Rescue Committee was formed. The disaster response mechanism roles and responsibilities were depicted for Union Government, DMH Head Office, Myanmar Disaster Preparedness Agency. In conclusion, it was stated that DHM cooperates with local and international organizations and organize meetingsand workshops regarding natural disaster reduction in Myanmar.

8.9 Pakistan

Mr. Muhammad Touseef ALAM, Chief Met NSMC and EWC, PMD, provided the presentation regarding tsunami threat along Pakistan coast. PMD has established a National Seismic Monitoring and Tsunami Early Warning Centre at PMD Complex, Karachi (with a back centre at Islamabad) with the support by the Government of Pakistan and IOC UNESCO. The mission of this Centre (NTWC) is to provide timely and well understandable tsunami warnings.

The Tropical Cyclone Warning Centre and Marine Meteorology, Karachi conducts cyclone monitoring, tracking and prepares and issues cyclone advisories and warnings to general public at risk through National Disaster Management Authority (NDMA) and Provincial Disaster Management Authority (PDMA) and media (print and electronic), marine and shipping community, Pakistan Navy, Karachi sea port authorities and maritime security agency. Moreover forecasts for Met Area IX is the responsibility of PMD.PMD prepares the forecast for the area and passes it on-line to ships via INMARSAT Perth, Australia.

It is the responsibility of Tropical Cyclone Warning Centre, Karachi to detect cyclonic disturbances in the Arabian Sea and then assess disturbances' potential of strengthening into a cyclone. The TCWC issues pre-warning advisories 7 days before cyclone formation and then when a cyclone develops, they issues "Tropical Cyclone Warnings" containing cyclone current location, it's movement, CEP, maximum sustained winds, intensity and likely track for 3-4 days. Every one to three hours, they closely observe and monitor the central estimated pressure, winds, lower and upper-air anticyclone/steering factor, and the track of cyclone and issue updates/warnings every 3 to 6 hours as required.

The tracking of a tropical cyclone in Pakistan is done with the help of surface and upper air observations, different model outputs, data/output of high resolution regional model implemented at PMD, 5cm weather surveillance radar, meteorological satellites,10 AWS installed along Sindh and Makran coast, and SODAR.

8.10 Philippines

Ms. Susan ESPINUEVA, Chief, Hydrometeorology Division, Philippines Atmospheric, Geophysical andAstronomical Services Administration (PAGASA), DOST provided the presentation for the Philippines entitled Status of the Early Warning System (EWS) on Hydro-meteorological Hazards. The climate of the Philippines is influenced by the complex interactions of various factors such as Philippines geography and topography, ocean currents, semi-permanent cyclones and anti-cyclones (southwest/northeast monsoons and ITCZ), tropical cyclones, seasonal climatic conditions, and various weather patterns.

As background, the Philippines is composed of 7,100 islands, has a total land area of 300,000 km^2, a coastline of 36, 289 km, 64 coastal provinces, and a coastal population of 64.7 million. Two recent laws governing disaster risk reduction in the Philippines are Climate Change Act of 2009, mainstreaming climate change into government policy, and Philippine Disaster Risk Reduction and Management Act of 2010 (R.A. 10121) which strengthens the Philippine disaster risk reduction and management (DRRM) framework. Core functions in DRRM are disaster mitigation and prevention, disaster preparedness, disaster response, and disaster rehabilitation and recovery.

The status of the EWS on hydro-meteorological hazards in the four components are: 1) knowledge of the risks faced as evident by the available meteorological and hydrological hazard and vulnerability mapping; planned flood risk mapping undertaken and piloted in Metro Manila; along with presentations, drills, and signage for public awareness; 2) monitoring and warning service in the Philippines is provided by PAGASA. The Philippines has 156 AWS, 187 automated rain gages, 2 meteorological buoys, 8 Doppler radars with 8 more planned by 2015, 8 upper air stations, 58 synoptic stations, 4 satellite receiving facilities, and high power integrated computing facility that runs the NWP model (WRF). The House of Representatives has approved PAGASA's Modernization Plan to upgrade existing monitoring stations and acquisition of new monitoring equipment. In weather forecast and tropical cyclone services, PAGASA provides public weather forecasts, severe weather bulletins, shipping forecasts, tropical cyclone warning for shipping, gale warning information, airways and terminal forecasts, METAR, TAFOR, forecast for selected Philippine cities/municipalities, and information on the onset/termination of monsoon. For hydro-meteorological service, PAGASA prepares flood bulletins for monitored major river basins and reservoirs/dams, general flood advisories for non-telemetered river basins, hydrological forecasts during non-flood watch, establishment of community-based flood EWS, flood hazard maps, rainfall-intensity-duration frequency analysis, flood/flash flood susceptibility maps, flood risk maps, and storm surge maps. For climatological and farm weather services, daily farm weather forecast and advisories, 10-day regional agro-climatic weather and advisories, monthly weather situation and outlook, El Nino/La Nina advisories, annual seasonal forecasts, Philippine agro-climatic review and outlook, Philippine agro-weather forecast, climate impact assessment bulletin for agriculture, and climate change scenarios are provided. Innovation by PAGASA's warning service have included rainfall warning system for metro manila (advisory, alert, emergency), thunderstorm warning system (information, watch, warning) and National Operational Assessment of Hazards (NOAH) Program; and 3) for dissemination and communication, PAGASA uses NDRRMC, media, internet, SMS, dial-a weather, auto-fax, on-line, and web site. The fourth component and the summary provided are included in section 10 under Gaps and Challenges.

8.11 Sri Lanka

Mr. Malavige Don Dayananda, Director, Dept of Meteorology, Sri Lanka made the presentation for Sri Lanka on their Early Warning System. As background, Mr. Dayananda stated that Sri Lanka has a Land Area of 65,525 km^2, a coast line of 1, 760 km, population of 20 million, has a highland massif surrounded by vast area of lowlands, with average rainfall of 1815 mm but ranges from 900 to 5000+.

Climate seasons in Sri Lanka are composed of first intermonsoon, March-April; southwest monsoon May – September; second intermonsoon, October-November; and the northeast monsoon December-February. Rainfall is spread evenly across the four periods except the first intermonsoon period has about one half as much as the other three. Hydro-meteorological hazards consist of heavy rains and strong winds withearth slips at the onset of SW monsoon in the hilly areas; storm surges in the eastern coastal areas; floods mainly in the low lying areas with the onset of southwest monsoon and second intermonsoon period; tropical cyclones usually during October, November and December with 17 crossing the Island from 1901 to 2000 with

great impacts; and tornados, specially during the intermonsoon periods. Recent extreme events during the southwest monsoon were: on 4 June 1992 due to a disturbance formed in the SW bay of Bengal, 492mm of rainfall was recorded in Colombo and most of the roads, low lying areas (even the parliament) were under water; on 17 May 2003 due to a cyclone in the central Bay of Bengal, very heavy rainy conditions experienced over the Sabaragamuwa and Galle and Matara districts and along the southwestern slopes of the central hills. Willie estate (Deniaya) reported 734 mm of rainfall, floods and landslides caused more than 250 casualties and massive property damages; and on 2 May 2007 due to formation of low pressure area in the east Bay of Bengal, very heavy rain experienced in Galle district and in Western province. On 2-3 May Colombo received 121.8mm and 111.3mm of rainfall respectively. There was floods in the Colombo, Gampaha, Kalutara and Galle districts. During depression/cyclonic storm situation, the Department of Meteorology issues general information bulletin when a system is 600 km from coast; cyclone alert/warning bulletin indicating distance of storm, centre from the coast, speed and direction of movement, maximum surface wind speed every 6 hours when the system is 550 km off the coast; bulletin every 3 hours with additional information on point of landfall and likely areas affected when it is 300 km from coast; and bulletin every hour when 250 km off coast and landfall is expected.

Department of Meteorology issues tsunami warnings/advisories after the occurrence of the Indian Ocean tsunami on 26 December 2004. The agency receives earthquakes and tsunami information via CISN and from RTSP India/Indonesia/Australia and RIMES through GTS, E-mail and Fax. Watches and Warnings (as needed) are issued for earthquakes greater than 7.0 and Tsunami Information Bulletins for earthquakes below 7.0 if the earthquake occurs in the sea area and depth less than 100 km. Normally daily weather forecasts are disseminated via media (radio and television) and Internet. However, during the period of severe weather conditions or Tsunami alerts, disaster warnings are disseminated to other important agencies such as Disaster Management Center, district secretaries, and local police stations.

8.12 Thailand

Mr. Maytee MAHAYOSANANTA, Director, Central Weather Forecast Division, Weather Forecast Bureau, TMD gave the presentation for Thailand. He discussed TMD' mission and structure, standard of procedures in TMD, and dissemination. TMD's vision is "*Aspiring to the excellence in meteorology at the international level*" and TMD's missions have been designed to carry on meteorological administrations and managements for the sakes of 2 vital aims: the best economic, social, agricultural, and industrial benefits as well as protection of human lives and properties possessed by public members; private sectors; and governmental units against natural disasters. In this role, it has been authorized to perform the following 5 duties:

- To supply weather forecasts for the entire country and publicize disaster warnings to fulfill the requirement from administration and management in natural disaster mitigation;
- To build the people's awareness toward natural disasters which will enable them to perform correct survival practices and reduce impacts from natural disasters by using modern technologies together with IT services;
- To become the meteorological IT data and service center at the national level for users in any ventures;
- To improve and develop the Department's research works; and

- To strengthen the Department's roles in international cooperation concerning meteorology and environment with the purpose of profound comprehension on changing world situation.

TMD's structure consists of a Director General and 3 Deputy Director Generals for Administration, Operations, and for Technical Services. Under the Deputy Director General for Operations are: Weather Watch and Warning Bureau, the Northern Meteorological Center, the Northeastern Meteorological Center, Southern Meteorological Center (East Coast), and Southern Meteorological Center (West Coast). Under the Deputy Director General for Administration are: Meteorological Instrument Division and Meteorological Telecommunication and Information Division. Under the Deputy Director General for Technical Services are: Weather Forecast Bureau, Meteorological Development Bureau, and Bureau of Meteorology for Transportation.

For the Standard of Procedures in TMD, in the warning process, there are 4 steps: monitoring, early warning, warning, and evacuation and operations. Observations are very important to the monitoring process. TMD has many observations sites comprised of meteorological, marine measurement, and seismic sites. TMD has 14 weather radars and many upper air sites. TMD uses extensive satellite data, NWP data, and IT systems to display these data. TMD forecasts on various time scales extending from a few minutes, to hours, days, 6-10 days, 8-14 days, months, seasons, and years covered by products (warnings and alerts, watches and updates, forecasts, multi-day outlooks, seasonal outlooks, and climate normal) corresponding to the time scales. The Bureau of Meteorology warning responsibilities include Central Weather Forecast, Marine Meteorological Center, and surveillance and monitoring of the earthquake and tsunami.

TMD has a multi-faceted dissemination system to send information to government agencies such as National Disaster Warning Center, Department of Disaster Prevention and Mitigation, Department of Fisheries, and Marine Department, local officials, radio and television, newspapers, and the public. They use short message service (there are over 20 million mobile phones in Thailand), fax (using 16 ports), email, call center 192, government radio station, and Government Information Network and use INMARSAT D+ to disseminate information to the 328 warning towers, 654 small towers, 1590 special radios at chief of village locations, 271 local governments in risk areas, 180 provinces city halls, and 180 provinces radio stations.

In summary, Mr. Maytee Mahayosananta, discussed: public network; cooperation between agencies, both domestic and international; PWS and met-alarm for Southeast and South Asia; and NWP including typhoon model with storm surge model. He then discussed future plans to: expand public network, upgrade automatic answering machine (1182), Weather Channel, and changes to NWP.

8.13 Viet Nam

Dr. NGUYEN Dai Khanh, Director, Science Technology and International Cooperation Department, National Hydro-Meteorological Service of Viet Nam (NHMS) gave Viet Nam's presentation on the Status of Early Warning System in Viet Nam. Dr. Nguyen first gave a brief introduction of disasters in Viet Nam and then provided the status of early warning system through a discussion of the knowledge of the risk, monitoring and warning service, dissemination and communication, and response capacity. As background, Viet Nam consists of

329,560 km^2 of land space, greater than 3400 km of coastline, mountainous area, highlands in the north and west, 2 large deltas in the South (Mekong) and Red river delta. Its population is 86 million with about 27% urban. Vietnam is located in the tropical monsoon area with clear difference between the North and South (Latitude 16). In the north, there are four seasons, whereas, in the South, there are only two (rainy and dry). Disaster relative frequency in Viet Nam can be classified as follows: high – flood, inundation, tropical depression, typhoon, flash flood, tornado, drought; medium – hail, landslides, forest fires, drought, salt water intrusion; and low – earthquake, accident (technology), and frost. There are about 10-12 tropical cyclones per year with 5-6 affecting land with most occurring from June to December. Flood season is also from June to December with flood and inundation lasting for 7-15 days in the north, 1-7 days in the central and 3-4 months in the south (Mekong River).Drought is the third largest impact after TC and floods. From 2005 to 2011, approximately 3,000 people have lost their lives and approximately 9.0 trillion VND ($4.3 billion USD) has been lost due to natural disasters.

For the status of EWS, knowledge of hazards have gradually improved at the national level with laws on water resources and dykes and the National Strategy on Disaster Prevention, Response and Mitigation (for north, central and south regions) and at the commune level with the national programme on Common but Differentiated Responsibilities (CBDR), Committee for Flood Control, Search and Rescue, and Plan for Disaster Prevention and Preparedness. The presenter noted that disasters seem to be more frequent, more severe and difficult to predict with climate variability and climate change. In the area of monitoring and warning services, national hydro-meteorological service: is a state operational institution under Ministry of Natural Resources and Environment (MONRE); has the functions to assist the Minister in managing, exploiting the national hydro-meteorological station networks (including meteorological and hydrological basic investigations, forecasts, documentation); take observations on air and water environment to serve disaster prevention and preparedness, socio-economic development; and ensures security and defense in the country. NHMS's local units consist of the: 1) Central Hydro-meteorological Forecasting Center which completes typhoon analysis and forecast, daily, medium- and long-term weather forecasts, flood forecast, forecasts of heavy rain, cold surge, hot and dry weather, and warnings of severe weather phenomena; 2) Regional hydro-meteorological forecasting centers which prepare weather and hydrological short- and long-term forecasts for a region; and 3) 54 Provincial hydro-meteorological forecasting centerswhich complete weather and hydrological short- and long-term forecasts for a province. The NHMS observation station network consists of hydro-meteorological data collection stations (174 surface meteorological stations, 764 rain gauge sites, and 27 radiation sites); aero-meteorological observation network (6 radiosonde stations, 8 wind gauge locations, 3 ozone and UV sites and 7 weather radars), and 17 marine meteorological stations. In addition, they have satellite receiving and processing stations for geostationary satellites and polar-orbiting satellites and use microwave satellite data from the internet. They have made computing capability improvements and maintain a specialized hydro-meteorological communication system. Several projects to improve flood forecasting were also discussed.

For dissemination and communications, the NHMS uses telephone, fax, GTS, coastal broadcasting radio, alert signals, towers, and internal hydro-met radio to communicate with the 1)

decision makers such as Office of Party, Office of Government, Ministry of Defense, MARD, Ministry of Communication, Ministry of Transport, Ministry of Industry and Commerce, and Provincial People's Committees and relevant agencies; 2) to the mass media such as VOV, VTV, newspapers, coast broadcasting radio, provincial TV, radio, newspaper, border guard, VNPT, and others; and 3) to implementing bodies such as Central Committee for Flood and Storm Control (CCFSC) and National Centre for Scientific Research (NCSR) who then communicate with the Provincial Committee for Flood Control (FC) and Scientific Research (SR), then to District Committee for FC and SR, then to Commune Committee for FC and SR, and then to the people. In the response capabilities area, Viet Nam has structural measures for flood protection and a legal framework for flood control which includes: Law on Water Resources; Law on Dykes; SOP on broadcasting tropical depression, tropical storm and flood (2011);SOP on reservoir management; Resolution 04/2011/NĐ-CP on cancellation of use of flood retardation and cutting structures in Red River system; Resolution 14/2010/NĐ-CP on organization, tasks, functions and coordination mechanism of CCFSC, local CFSC and SRs; National Strategy of Disaster Prevention and Mitigation up to 2020; and decisions related to financial mechanism and post-disaster recovery. For the institutional arrangement, the CCFSC provides overall direction with the Provincial People's Committees play a key role. The presentation concluded with a discussion on improving the existing SOPs, improving quality of forecasts and warnings, strengthening relationship with DRR managers and mass media, improving communication means to ensure everyone can receive warning in time and respond properly, implementing education and training, and avoiding from duplication.

9 PRESENTATION BY EXPERTS FROM NON-BENEFICIARY COUNTRIES (MEMBERS OF PTC OR TC)

9.1 "JMA's Response to Great East Japan Earthquake on March 11, 2011" Mr. Naohisa KOIDE, RSMC Tokyo, JMA, Japan

The Japan Meteorological Agency (JMA) introduced its response to the Great East Japan Earthquake on 11 March 2011. After the earthquake, the Agency adjusted criteria for sediment disaster, flood, and storm surge warnings/advisories for the affected area in East Japan in response to the increased risks of coastal meteorological/hydrological hazards, such as slope failures/debris flows, river floods, and tidal inundation. Special products tailored for affected coastal regions such as tidal level and precipitation forecast maps, tide level calendars and extreme high temperature forecasts, were also provided to support recovery and reconstruction activity.

JMA stressed the importance of development of criteria for disaster-specific warnings/advisories, through close coordination with relevant disaster management authorities to make its warnings/advisories incorporated into their disaster management operational plans accordingly.

9.2 "Weather-Ready Nation: Early Warning and Decision Risk Reduction Outreach of the US National Weather Service" Mr. Raymond Tanabe, RSMC Honolulu, USNWS, USA

Hazardous weather events have major economic and health safety impacts in the U.S. NOAA is the sole U.S. government authority for issuing official weather and water warnings for life-threatening events, in partnership with the Weather Enterprise (private weather companies), and holds a key role in the nation's disaster response plan. The benefits of NOAA's forecast and warning services are tremendous. For example, their forecasts, warnings, and the associated emergency responses result in a $3 billion savings in a typical hurricane season. However, despite the thousands of warnings NWS forecasters will issue this year, nearly 600Americans will lose their lives in a weather-related catastrophe. NOAA must continue to improve in the forecasting of high impact events to meet the demands of an increasingly sophisticated society, in terms of their expectations for information content, flow, and delivery.

The devastating impacts of extreme events such as 2012's Hurricane Sandy can be reduced through improved readiness. NOAA's National Weather Service is transforming its operations to help America respond. NOAA's Next Generation Strategic Plan establishes a long-term goal of a "Weather-Ready Nation," (WRN) as part of a broader vision of resilient ecosystems, communities, and economies. *Weather-Ready Nation* is about building community resilience in the face of increasing vulnerability to extreme weather and water events. In the end, emergency managers, first responders, government officials, businesses, and the public will be empowered to make faster, smarter decisions to save lives and protect livelihoods.

10 PANEL DISCUSSION

Gaps and Challenges in End to End Early Warning System

10.1 Bangladesh

a) Establishment of SOP:

SOPs must clearly explain/focus on the minimum establishment of observation facilities, forecasting tools, and forecaster's educational background, skills, forecast quality, standard warning system and language, dissemination system, forecast delivery, media coverage, public awareness, community response, over all disaster management plans and policies, etc. Considering these, there are many gaps and challenges that must be overcome for significant improvement of the end to end EWS:

b) For forecasting purpose BMD needs the following improvements:

1. Build up the medium range seasonal forecasting capability.
2. Enhance the capacity building in numerical weather prediction system and place it under operation.
3. Incorporate tools for cyclone track prediction and generation of high-resolution storm surge, area specific inundation, and wave forecasts at coast.
4. Improve the 35 existing weather observatories and monitoring system.
5. Establish an effective now casting system.
6. Expert support/assistance to enhance forecasters' abilities to make use of new generation forecasting tools and research.
7. Establish a facility to operate the radars round the clock and to calibrate these data.
8. Incorporate into operational use all 64 AWS (some newly installed and some being installed) and calibrate these data.

9. Assimilate radar, synoptic and upper air data into common system.
10. Establish automatic seismic analysis system with real-time tide gauge network.
11. Establish a standard tsunami warning signal system and guideline.

c) For forecast delivery and quick dissemination:

1. Implement easy and clearly understandable area specific weather information with time andexpected impacts.
2. Implement easily understandable graphical and visually attractive forecasts for all users.
3. Establish Common Alerting Protocol (CAP).

d) For proper disaster management the following steps are required:

1. Dialogue with stakeholders at national and local levels to identify and assess users' forecast gaps and needs.
2. Conduct hazard, risk, vulnerability and local level potential impact assessment and prepare corresponding maps.
3. Establish quicker dissemination system for risk communities.
4. Conduct additional public awareness/education and training.
5. Investigate and analyze community response to establish community based EWS.
6. Consider risks from all hazards.

10.2 Cambodia

In the area of gaps, the warning system is functioning in emergencies due to the government's Emergency Alert System which has delivered to emergency management a powerful asset in the effort to protect life and property. This system has already been effectively used many times. However, the system is not providing the needed urgent notification and required responses in the valley disaster areas. Warnings issued via Emergency Alert System may take many hours to reach the intended people and they sometimes arrive after the fact. The Department of Meteorology does have a current warning system in effect. It appears that the failure to warn is caused by the lack ofa well-defined and a dedicated early warning system that would include situational awareness and direct communications with local emergency management. An Emergency Alert System does not by itself constitute an early warning system.

For challenges, it was pointed out that the early warning system should be improved and should include procedures and utilize network technology for the urgent need to communication directly with the local communities. The Severe Weather and Rainfall Alert should be produced for specific locations, and Pre-Alerts should be issued to the public in vulnerable locations on days of high threat.

10.3 Lao PDR

With regard to the SOP for Flood Early Warning System, there exist various gaps, such as:

- Risk knowledge has not been fully assessed for the entire country and various sectors;
- Monitoring network does not cover all vulnerable communities;
- Forecast and early warning generating capability needs to be strengthened;
- EWS dissemination system and mechanism needs to be strengthened and modernized;
- Multi-sector oral coordination and governance needs to be strengthened; and
- Public awareness and education are key aspects which needs additional focused.

Besides gaps, there are also various challenges to be overcome, such as:

- Technical know-how of EWS-generating personnel needs to be up-graded;
- Describe roles of DMOs' and local authorities' in SOPs and exercised through many training sessions and workshops;
- Improve response plan as well as exercise or conduct mock drills involving people participation; and
- Practice taking actions by different concerned agencies in innovative ways without the requirement for a large amount of effort and budget.

10.4 Malaysia

Accurate day-to-day forecasts are real challenges to meteorologist over equatorial region including Malaysia. Short lived and localized thunderstorms are difficult to predict especially defining its location and time. Thunderstorms are often accompanied with strong gusting winds. Over the recent years, the occurrence of extreme weather events has increased and more extreme events such as heavy rain episodes (floods), severe thunderstorms, and strong winds have become more prevalent in Malaysia.

For dissemination and communication, MMD has a comprehensive system to inform the public regarding warnings issued by the department. But in some cases, the warning was issued during the night and it was very difficult to reach the public especially inland areas. Nevertheless, the most important item is the accuracy of the warning. If there is a good dissemination system, but the warning issued is not accurate, the information received by public will not be appreciated and acted upon.

10.5 Maldives

As discussed above, the Maldives is one of the world's most geographically dispersed countries with a population of 328,536 (2012) living on 192 of its 1,192 islands. The Maldives is the smallest Asian country in both population and land area. With an average ground level of 1.5 m (4 feet 11 inches) above sea level, it is the planet's lowest country. Thus the delivery of warning messages to the public is very challenging.

The major challenges and issues in the smooth operation of an end to end multi-hazard early warning system in Maldives are: inadequately trained personnel in Maldives Meteorological Service and stakeholder agencies; insufficient technical and financial resources; incomplete/not available SOPs for important stakeholders; and no safe shelters in country.

10.6 Myanmar

Department of Meteorology and Hydrology (DMH) is the only authorized department for multi-hazard early warning system in Myanmar. DMH's main responsibilities include observing meteorological and hydrological information; issuing warnings, bulletins and news; and providing decision makers, policy makers and local communities with the required information. DMH has many gaps and challenges in an end to end early warning system.
Gaps

1. DMH's meteorological and hydrological observatories are usually equipped with conventional instruments and data handling and assessment are carried out manually.
2. Real time meteorological, hydrological and seismological data collection from the stations is done manually by telephone and single side band (SSB)radio and then quality controlled manually.
3. In DMH, flood forecasting techniques use single and multiple linear regression model(by Microsoft Excel) and do not use advance flood forecasting methods.
4. Inadequate communication links (slow Internet connection, power failures, etc.).
5. Public does not understand the technical terms.

Challenges

1. Improve installation of new modernized instruments (e.g., AWOS, Automatic Water Level Gauges, etc.).
2. Install automatic telemetric hydro-met stations.
3. Improve data storage system (e.g., super computer for data bank, data base software).
4. Improve advanced and effective weather and flood forecasting techniques.
5. Strengthen human resource development.
6. Cooperate closely with national, international and regional institutions.

10.7 Pakistan

Because of the language technicality/particularity of the warnings, alerts and messages, the people at grass-root village level sometimes do not absorb the gravity of the message and hence do not translate it into actions required. Thus it is believed that there is a public awareness deficiency which requires constant public awareness campaigns launched at grass-root level particularly in vulnerable areas. In addition, some of the gaps identified were: failure of communication modes in emergency; disruption of infrastructure; warnings and messages sometime being generic and not precisely specific to a particular area (or area at risk); special public weather advisor engagement; and social and security concerns.

Although outside of this project's scope, Pakistan identified various equipment gaps which included 2 Doppler radars to cover the entire coastal belt, 3 radars, 10 AWSs, 2 vertical wind profiler, 3 tide gauges, 2 ocean data buoys, an alarm system, local volunteers from masses of the area, and some fool-proof dissemination and communication channels.

10.8 Philippines

Challenges

a. To simplify the forecasts/advisories/tropical cyclone bulletins and to make them public-friendly by considering:
   - Developing "laymanized" versions focusing on specific and clear information on rain, wind, and flood situations which delineate specific provinces that will be affected, the timeline and the expected impacts to meet the needs ofLocal Government Units (LGUs);
   - Avoiding the use of highly-technical terminologies and describe clearly the typhoon path, where it will pass and the specific timelines. Add visual forms of forecasts to show rainfall and wind maps in different time-scales (hourly) requested by LGUs;
   - Highlighting specific areas covered by gale warning; and

- Including the extent and height of inundation (visually plotted in a map using GIS) for flood forecasts and warnings also requested by LGUs.
- Provide more frequent issuance of updates on weather, flood, rainfall and TC tracks

b. General perception on disaster risk reduction is skewed towards recovery and post disaster activities.

Gaps and needs

c. Update existing SOPs on weather and flood EWS to incorporate current technological advances.
d. Warnings on storm surges are general statements that are incorporated in severe weather bulletins and no SOPs are established.
e. Inadequate dissemination of warnings and actions taken, especially during emergency situations due to:
    - Response capability of LGUs and the communities varies. Communities that have experienced major water-related disasters are more receptive and appreciative of the warnings;
    - Inadequate understanding of hazard/risk maps and interpretation of the warnings with the associated possible impacts of the hazard forecasted;
    - Inadequate rainfall forecasts and warning for many areas. Local chief executives/community appreciate the Rainfall Warning Signals for Metro Manila and real-time access of inundation maps

10.9 Sri Lanka

Gaps

1. Existing SOPs are for Tsunami only. Comprehensive SOPs for all weather related hazards need to be prepared.
2. Inadequate dissemination of warnings
3. Other related agencies like Disaster Management Centre, Fisheries Department, Police and other forces have their own SOPs for hazard events, but these SOPs are not inter-connected. There is a need to exchange views among these agencies to improve the SOPs and continue the relationship to synergize SOPs effectively.
4. No color code or weather symbols for forecasts/warnings.
5. Improvement in developing a good relationship with media is needed.
6. Insufficient visually attractive forecasts for TV broadcasting systems.
7. Inadequately trained personnel.

Challenges

1. Difficulties in forecasting extreme events such as strong winds, down draft and tornado.
2. No legal safety for the department when forecasts are inaccurate.

10.10 Thailand

Gaps

Numerical Weather Prediction (NWP)

1. TMD super computer older than 15 years
2. Ineffective use of NWP data
3. Ambiguous interpretation of product

4. Requirement to downscale of specific area

Network

1. Global cooperation: Research with Asian countries for providing warning product development
2. National cooperation: Public and privacy issues in risk areas; public perception, rapidity of dissemination, ownership of forecast; public support and knowledge of information transmitted and public'sself-perception, self-protection and self-solution.

SOPs

No SOPs for severe storm and disaster along the coast, except for work manual of each agency regarding Standing Order on Disaster.

Challenges

NWP

1. Hardware upgrade with high efficient computer.
2. Software operations to accurately use various models. (To use models such as WRF or unified model, to downscale for specific areas quickly, such as areas prone to disaster.)

Forecasting

1. Short and simple language to understand quickly.
2. Weather news class, such as, for public, shipping, fishing, coastal areas, or storm information.
3. News levels, such as, level 1 equal to advising; level 2, warning; level 3, alerting
4. Forecast scale analysis, such as, southeast region, south Asian country, or specific area

GIS Risk Map

1. Mapping areas prone to risk in south Asia or southeast Asia
2. Owning long-lasting risk map of each country to define, for example, threatened storms

11 SUMMARY OF THE OUTCOME OF THE WORKSHOP

During the two day workshop, the main objectives of the workshop were achieved. Through presentations, panel discussions, and general discussions, the workshop enabled the participants to:

- Collect and exchange information on the performance status of coastal multi-hazard EWS in the 13 beneficiary countries of this project who are Members of TC and PTC and
- Share with the participants the experiences of experts on EWS from other agencies and organizations.
- Identify needs and unmet gaps of current SOPs for EWS in the 13 beneficiary countries.

In addition, the three pilot countries, Philippines, Bangladesh, and Pakistan, were selected and tentative plans were made to make pilot in-country visits to each of these.

12 CONCLUSIONS

During the workshop, many ideas, best practices, needs, unmet gaps, and challenges were identified. Some of these fell within the scope of this project and some did not, but a list of all

was kept as a complete documentation of users' needs related to EWS. The first three: Handbook of Synergized Standard Operating Procedures (SSOP), Training, and Opportunity for Collaboration with Various Partners and Other Organizations are within the scope of the project and will be reviewed and analyzed further, while Infrastructure Capacity Building is outside of the scope and is listed for completeness of the workshop's conclusions.

Handbook of Synergized Standard Operating Procedures (SSOP).
During the discussions, three major themes were emphasized:

- There is a wide variety of cultures, governments, past experiences, relationships, risks, and people among countries and even within many countries. Therefore, the SSOPs must be flexible best practices, operational guidelines and recommendations that can be applied in a variety of situations. Most believed proposed rigid, detailed, very precise SSOPs would not work and would not be used.
- Although the process and project is focused on the National Meteorological and Hydrological Services, the National Disaster Management Offices, and the National Tsunami Warning Centers, other agencies should and must be involved in detailed, integrated ways to make the end to end, cross-cutting early warning system work. One of the previously identified problem in some countries is inadequate government coordination and cooperation within and among national, regional, and local levels. In addition, various user sectors within government, businesses, and communities should be considered and addressed if possible. Therefore ways to possibly improve this through SSOPs would have great value.
- For this approach to work, there should be encouragement to ensure there is a policy part of this development. Because of the different agencies, governments, etc., a policy framework would likely increase the probabilities for success.

Training.
A common need and gap identified is training and human capacity building. It was suggested that this training may be technical in nature for the NMHSs, but also many other types. For example, training the warning preparer how to communicate better with the media and training for the media on how to better understand the risks and potential impacts. In some countries, Disaster Management Offices, at all levels of government, have good awareness of risks, potential, and similarities and differences among coastal hazards and other do not. At the community level, in some areas increased awareness is needed or the meaning of warnings, risk, potential, actions needed, and methods to increase awareness when areas have not been significantly impacted for 20 -30 years.

Opportunity for Collaboration with Various Partners and Other Organizations.
Before and during the workshop, it was recognized that there is a tremendous opportunity for collaboration with this project and the two others funded by the ESCAP Trust Fund, ABU and ADPC both in association with GAATES. In addition, ADRC, RIMES, IOC-UNESCO, WMO, and ESCAP have all pledged to collaborate. Consultations will continue on the best method to proceed on this and to ensure the collaboration contributes to each other's projects and avoids unnecessary duplication. Finally, this is an opportunity for the TC and PTC to more closely collaborate and to achieve some of their common goals together. An idea that has been discussed for several years, but never had the resources or opportunities to work out the methodologies or details.

Infrastructure Capacity Building

Although mostly out of the scope of this project a number of issues were discussed concerning infrastructure improvements. For some it was better bathymetrical data for storm surge and run up, others it is better storm models, better observation tools, better numerical forecasting tools, etc. These are all important parts of an effective early warning system: knowledge of the risks faced; monitoring and warning service; dissemination and communication; and response capability

13 RECOMMENDATIONS

Based upon the outcome of this workshop, it is recommended that the project be continued because it has great potential and value to the 13 beneficiary countries and that the project planned actions should be completed.

13.1 General SSOP Development Strategy

Many of the Members already have some form of SOPs developed in their countries. But given the whole range of hazards the countries are facing and the very different social and economic situations in different parts of the region, it would be unrealistic to develop one set of SOPs in an integrated fashion that would be meaningful to all. Therefore it is recommended that the SSOPs have to be synergized in a way that can reflect the key concepts, basic principles and common strands behind the documents. Also, information peculiar to specific hazards or regions may need to be packaged in modules that can be readily fitted in as required into a so-called SSOP framework.

13.2 Future Actions

In following the project plan, it is recommended that the actions below be accomplished:

a. Complete Support Activity 1 which is to review and synergize the existing SOPs for coastal multi-hazard EWS in the Members of TC and PTC areas and to develop the *Manual of Synergized SOPs for Coastal Multi-Hazards EWS.*
   - First by conducting in-country workshops in the three pilot countries (Philippines, Bangladesh, and Pakistan) by a team of experts focusing on institutional capacity building at all levels from the national level to the local level with main emphasis on the meteorological, hydrological, and disaster management services by identifying strengths, gaps, needs, and recommendations for EWS SOPs and recommendations for the content of the *Manual of Synergized SOPs for Coastal Multi-Hazards EWS.*
   - These visits should be conducted in late September or early October 2013, so the information can be reviewed by TC and PTC at their planned workshops in late November (PTC) an early December (TC).
   - After completing the visits, 3 detailed reports should be written, one for each pilot country, and also a summary report of all three visits on the results of the workshops.
   - These reports can then be reviewed and comments provided at the PTC and TC workshops.

- An outline or general format of *Manual of Synergized SOPs for Coastal Multi-Hazards EWS* can be developed and then can be the foundation for initial discussions of the content and format of the manual.
- The project's progress and results should be briefed at the annual Sessions of the Typhoon Committee and the Panel on Tropical Cyclones.

b. Start the planning process for the training of users on the interpretation of EWS products and processes for decision making, media, etc. as identified as part of Support Activity 2 of the project.

ESCAP/WMO Typhoon Committee

WMO ESCAP Panel on Tropical Cyclones for the Bay of Bengal & the Arabian Sea

Workshop on Standard Operating Procedures for Coastal Multi-hazards Early Warning System
Bangkok, Thailand
8-9 May 2013
Programme

Convener: Head of Steering Committee of SSOP

Time	Programme	Note
	Day 1, Wednesday, 8 May 2013	
08:30 – 09:00	Registration	
09:00 – 09:30	**Opening ceremony** - Address: representative of TC - Address: representative of PTC - Address: representative of WMO - Address: representative of ESCAP - Address: representative of TMD	
09:30-09:50	**Introduction** to SSOP project and Purpose of the Workshop	Project Manager/ Technical Advisor
09:50-10:20	**Group Photo** followed by **Coffee break**	
10:20 – 12:30	**Keynote addresses** (20 min each) · **"EW and DRR Media Campaign"**- Ms Natalia Ilieva (AsiaPacific Broadcasting Union-ABU) · **"Strengthening the Multi-hazard Early Warning Systems for the Hazard Risk Reduction of Coastal Communities: Some experiences from the region"**-Mr. Atiq Kainan Ahmed, (Asian Disaster Preparedness Center-ADPC) · **"Case Studies of SOP in Japan and Asian Countries for Disaster Risk Reduction"**- Mr. Makoto IKEDA(Asian Disaster Reduction-ADRC) · **"Standard Operating Procedures for Tsunami Warning and Emergency Response in the Indian Ocean and Southeast Asia Region"** - Mr. Tony Elliot (IOC-UNESCO) · **"Tsunami Risk Assessment for Enhancing Coastal Hazard Early Warning and Response" -** Dr. Patchanok Srivihok (RIMES) · **"The work of PWS Programme of WMO on establishing MOUs and SOPs for an effective EWS and the related experience of Hong Kong, China"**–Mr. LEE Lap-shun, Hong Kong Observatory (in representation of WMO)	

Time	Programme	Note
12:30 – 14:00	Lunch	
14:00 – 15:40	**Presentations by representatives of beneficiary countries** (15min each + 5 min for Q&A each) · Participant from Bangladesh · Participant from Cambodia · Participant from China · Participant from India · Participant from Lao PDR	
15:40 – 16:00	Coffee break	
16:00 – 17:00	**Presentations by representatives of beneficiary countries(cont.)** · Participant from Malaysia · Participant from Maldives · Participant from Myanmar	
17:00 - 18:00	Coach leaves from UNESCAP	LOC
18:00 - 21:30	**Welcome reception** Siam Niramit, the must-see show of Thailand	Hosted by TMD
21:30 - 22:30	Coach arrives at UNESCAP	LOC
Day 2, Thursday, 9 May 2013		
09:00-10:20	**Presentations by representatives of beneficiary countries (cont.)** · Participant from Pakistan · Participant from Philippines · Participant from Sri Lanka · Participant from Thailand	
10:20-10:40	Coffee break	
10:40-12:00	· Participant from Viet Nam **Presentations by experts from non-beneficiary countries (Members of PTC or TC)** · **"JMA's Response to Great East Japan Earthquake on March 11, 2011"**– Mr. Naohisa KOIDE, RSMC-Tokyo, JMA, Japan · **"Weather-Ready Nation: Early Warning and Decision Risk Reduction Outreach of the US National Weather Service"–**Mr. Raymond Tanabe (Central Pacific Hurricane Center)	
12:00 –13:30	Lunch	

Time	Programme	Note
13:30 – 15:10	**Panel Discussion on** · Cooperation between TC and PTC · Cooperation and support from partners · Commitment from Beneficiary Countries · Implementation plan (piloting, training…) · Preparation of a roadmap based on the discussion and its adoption.	
15:10 – 15:30	Coffee break	
15:30 – 16:30	**Summary of the outcome of the Workshop**	Project Manager/ Technical Advisor