



WMO

**WORLD METEOROLOGICAL ORGANIZATION
AND
ECONOMIC AND SOCIAL COMMISSION
FOR ASIA AND THE PACIFIC**



ESCAP

WMO/ESCAP PANEL ON TROPICAL CYCLONES

THIRTY-FOURTH SESSION

Male, Maldives

(25 February to 1 March 2007)

FINAL REPORT

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION

The thirty-fourth session of the WMO/ESCAP Panel on Tropical Cyclones hosted by the Republic of Maldives was held in Male, Maldives from 25 February to 1 March 2007.

Attendance

The session was attended by 27 participants from seven (out of eight) Members of the Panel on Tropical Cyclones, namely, Bangladesh, India, Maldives, Oman, Pakistan, Sri Lanka and Thailand. It was also attended by observers from China, Asian Disaster Reduction Center (ADRC), Indian Institute of Technology (IIT)-Kharagpur, International Civil Aviation Organization, (ICAO), International Federation of Red Cross and Red Crescent Societies (IFRC), United Nations Development Programme (UNDP) and representatives from WMO, UNESCAP and Technical Support Unit (TSU). The list of participants in the session as well as the capacities in which they attended is given in Appendix I.

OPENING OF THE SESSION (Agenda item 1)

1.1 The opening ceremony commenced at 08:00 a.m. on Sunday, 25 February 2007 at Nasandhura Palace Hotel.

1.2 The Honorable Ahmed Abdulla, Minister of Environment, Energy and Water delivered the inaugural address (see para 1.6) and declared the session open.

1.3 Mr Abdullahi Majeed, Deputy Minister of Environment, Energy and Water, and Permanent Representative of Maldives with WMO, in his welcome address, extended his warm welcome to the foreign participants to Maldives and gratefully appreciated the Chief Guest, Honorable Mr. Ahmed Abdullah, Minister of Environment, Energy & Water for gracing this historic occasion. Highlighting the responsibilities of the Panel he said, "The regions of Bay of Bengal and the Arabian Sea which are under the responsibility of this Panel are characterized with natural disasters. These disasters annually claim a high toll both in terms of human deaths and economic damage. Though only cyclones are emphasized by the Panel, other hydro-meteorological disasters like storm surges, floods, landslides, tornadoes, and rainstorms, to name a few, continue to ravage the countries of the Panel. It is, therefore, understandable why a disaster prevention and preparedness component always feature in the agenda of the Panel sessions". Speaking further about disasters, he noted that the average annual death toll caused by natural disasters still stand extremely high in Asia and the Pacific regions over the past 50 years and the annual economic damage has dramatically shot upward reaching US \$ 29 billion last 15 years! Mr. Abdullahi Majeed clearly emphasized that, something needs to be done and done quickly to defray the gloomy scenarios of damage incurred by natural calamities. He called upon WMO, UNESCAP, UNESCO and other competent international organizations in concert and cooperation with Members of the Panel to hasten pace to bring forth a multi hazard early warning system capable of providing timely, accurate and reliable information within the reach of the Members even with least resources in a not too distant future. Mr. Majeed concluded his speech here by expressing his wish to see the improvement and strengthening of the Technical Support Unit (TSU) of the Panel truly worthy of its name.

1.4 Speaking on behalf of Mr Michel Jarraud, Secretary-General of WMO, Dr Tokiyoshi Toya, Regional Director for Asia and the South-West Pacific, expressed his deep appreciation, and that of the World Meteorological Organization, to Mr Ahmed Abdulla, Minister of Environment, Energy and Water and the Government of the Republic of Maldives for hosting the thirty-fourth session. He extended his gratitude to Mr Abdullahi Majeed, Deputy Minister of Environment, Energy and Water, and Permanent Representative of

Maldives with WMO, and Mr Abdulla Algeen, Director of Department of Meteorology of Maldives and his staff for the warm welcome and for the excellent arrangements made to ensure the success of the session. With emphasis on the important role the Panel is playing in the international cooperation to mitigate tropical cyclone disasters in the Bay of Bengal and the Arabian Sea, he stressed that strengthening the capacities of NMHSs, in particular the improvement of forecasting capabilities, is indeed a priority, since this would enable the delivery of more accurate, timely and reliable warnings of severe events, and regional and national early warning systems would likewise be better equipped to provide communities with the information needed to activate emergency plans in time to protect life and minimize economic losses. He encouraged Panel Members to strengthen new partnerships and strategic alliances among the NMHSs and between the NMHSs and other partners at all levels, including the National Agencies concerned with disaster prevention and preparedness. In ensuring WMO's continued support to Panel's efforts to mitigate impacts and risks of tropical cyclone-related disasters, he wished the session every success.

1.5 The Executive Secretary of UNESCAP, in his message transmitted by Mr Ti Le-Huu as representative of UNESCAP, expressed his appreciation to the Government of Maldives for hosting the Thirty-fourth session. He noted that the Government of Maldives had been playing an active role in efforts to achieve the objectives of the Panel, particularly in promoting and coordinating the planning and implementation of measures and research activities required to minimize the loss of life and damage caused by cyclones. He highlighted the impressive achievements of the Panel Member countries during the past two decades in reducing the annual loss of lives, caused by cyclone-related disasters from about 18,200 people during the decade 1990-99 to about 2,100 people during the seven years, from 2000 to 2006. He also pointed out that the average annual economic damage caused by cyclone-related disasters in the member countries of the Panel has increased only slightly from about US\$2.25 billion during the decade 1990-99 to about US\$2.6 billion annually during the period from 2000 to 2006. In view of the tragic December-2004 Tsunami disaster, he invited the Panel to join hands with other international organizations, including UNESCAP, to develop a regional system on multi-hazard and tsunami early warning system for the Indian Ocean and South-East Asia. He expressed his sincere appreciation to the Government of Pakistan for its continuing support in hosting the Technical Support Unit of the Panel and to the Government of India for its continuing technical assistance in providing the services of the Regional Specialized Meteorological Centre - tropical cyclone New Delhi, which extended valuable support to all Members of the Panel.

1.6 In his inaugural address, the Honorable Ahmed Abdulla, Minister of Environment, Energy and Water focused on the main purpose of this meeting; that is to share, promote and coordinate our collective knowledge and experiences to raise awareness, enhance our capacity, empower people and strengthen our partnership to minimize the damage and loss arising from cyclones and related disasters. He also added; "cyclones and natural disasters are more frequent and stronger these days. We are all very worried and concerned about the changing weather patterns. In fact, last year was the hottest year recorded in recent history. This meeting is taking place at a very critical time in global environment and climate history. Global warming is indeed a global warning. We can't afford to waste any more time. In the Maldives, our government places highest priority on environment protection and sustainable development. Speaking on weather forecasting he said that efficient weather forecasting is an important means for taking preventive, preparatory and mitigation measures. It will facilitate emergency measures, minimizing loss of life and property. The honorable Minister felt that we must all exert more efforts to create awareness and forge a responsible partnership for optimum results and we must pool our knowledge and resources as much as possible to gather information about Tropical cyclones and other weather related disasters in our region.

1.7 The Honorable Chief Guest called upon the meeting that it must engage in more collaborative programmes and activities in the areas of prevention, early warning, emergency preparedness, mitigation, community empowerment and mobilization, resource mobilization,

capacity building and awareness creation, in addition to studying the meteorological and hydrological aspects of tropical cyclone warning systems. "All our countries are committed to doing and achieving our best in this Herculean task", the Minister said. He also thanked WMO, UNESCAP, TSU and the Panel members for visiting Maldives for this memorable occasion.

1.8 Mr Abdulla Algeen, Director, Department of Meteorology offered words of thanks to all the participants.

2. ELECTION OF THE CHAIRMAN AND VICE-CHAIRMAN (Agenda item 1.2)

Election of the Chairman and Vice-chairman of the Panel on Tropical Cyclones

2.1 Due to retirement of Mr Md. Akram Hossain (Bangladesh), Chairman of PTC for 2006, Mr Badar Al-Rumhi, Vice-chairman of the PTC, chaired the election for this year's Chairman and Vice-chairman. Mr Abdullahi Majeed (Maldives) and Mr Badar Al-Rumhi (Oman) were unanimously elected as Chairman and Vice-chairman of the Panel, respectively, to hold their posts until the next session.

Election of the Chairman of the Drafting Committee

2.2 Mr G.B. Samarasinghe (Sri Lanka) was elected as Chairman of the drafting committee.

3. ADOPTION OF THE AGENDA (Agenda item 3)

The Panel adopted the agenda as given in **Appendix II** with amendements of adding Agenda Item 8.8 "New Possible Joint Initiatives" and Agenda Item 13. "Special Session".

4. WORKING ARRANGEMENTS (Agenda item 4)

The Panel decided on its working hours and the arrangements for the session.

5. FOLLOW-UP ACTION ON PTC-33 (Agenda item 5)

5.1 A detailed review of the recommendations of the thirty-third session and their follow-up action taken was carried out based on the action sheet shown in Appendix III.

5.2 WMO Secretariat informed the session that the proposed expansion of the area of responsibility of RSMC New Delhi had been approved by the Regional Association I of WMO at its 14th session held in Burkina Faso in February 2007. The Panel was pleased to note that most of the items requiring action had been implemented while actions on on-going activities were continuing satisfactorily.

6. REVIEW OF THE 2006 CYCLONE SEASON (Agenda item 6)

6.1 The Director of RSMC New Delhi presented a review of the 2006 cyclone season on the basis of the comprehensive report entitled "REPORT ON CYCLONIC DISTURBANCES OVER NORTH INDIAN OCEAN DURING 2006" which was distributed during the session.

6.2 The Director of RSMC New Delhi informed the Panel that 2006 was a year of near normal activity over the north Indian Ocean. The basin witnessed the formation of twelve disturbances against a normal of fifteen cyclones. Out of the twelve, three (against a normal of five to six) intensified into cyclonic storms and three concentrated into deep depressions. There was one land depression during the year. The Arabian Sea was less active as compared to the Bay of Bengal. Only one cyclonic storm and one depression formed over the Arabian Sea, both of which dissipated over the sea itself. The Bay of Bengal was more

active with the formation of two cyclonic storms, two deep depressions and five depressions during the year 2006.

6.3 The representatives of the Panel Members reported to the session a review of the 2006 cyclone season of their respective countries, summaries of which are given in Appendix IV.

6.4 The Panel expressed its appreciation to the RSMC New Delhi for the continued valuable contribution it was making to its Members, and emphasized the importance of further strengthening the existing cooperation and collaboration between the national warning centres and RSMC New Delhi. In consideration of the usefulness of the RSMC advisories, some Members also expressed a hope for more frequent issuance of the advisories and a need to contact RSMC with telephone during tropical cyclone events.

7. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME (Agenda item 7)

7.1 The Panel expressed its appreciation for the comprehensive information provided by the WMO Secretariat on the implementation of the WMO Tropical Cyclone Programme (TCP). It noted with satisfaction the developments and progress made in both the general component and the regional component of the TCP since the thirty-third session of the WMO/ESCAP Panel on Tropical Cyclones (Dhaka, Bangladesh, 30 January to 4 February 2006).

7.2 The Panel was pleased to note that during 2006 the TCP had capacity building as its main priority to address the issue of sustainable development. A number of workshops, training courses and attachment of forecasters were organized especially for developing countries to achieve their sustainability. This is also in accordance with the programme's objective to facilitate the transfer of knowledge and technology to improve the institutional efficiency of the NMHSs leading to the provision of better tropical cyclone track and intensity forecasts and associated flood and storm surge forecasts.

7.3 The Panel noted with satisfaction that two storm surge experts from Bangladesh and Pakistan underwent training (7 to 18 August 2006) at the Indian Institute of Technology (Kharagpur) in the implementation and running of a PC-based high-resolution storm surge model. The Panel expressed its gratitude to Prof. Shishir Kumar Dube and to IIT Kharagpur for this valuable contribution to the Panel's activities.

7.4 The Panel was informed that the "Fourth Regional Workshop on Storm Surge and Wave Forecasting - A Hands-on Forecast Training Laboratory" was held in Manila, Philippines 11-15 September 2006. Twenty-nine trainees from Bangladesh, Fiji, India, Malaysia, Myanmar, Oman, Papua New Guinea, Philippines, Samoa, Sri Lanka, Vanuatu, and Viet Nam, attended the five-day workshop for a hands-on training in numerical forecasting of waves and storm surges associated with tropical cyclones.

7.5 The Panel noted with pleasure that TCP took an active involvement in the organization of the Sixth International Workshop of Tropical Cyclones (IWTC-VI) which was held in San José, Costa Rica from 21 to 30 November 2006. It provided assistance for the participation of operational tropical cyclone forecasters and ensured that all of the five TCP regional bodies are well represented in the workshop.

7.6 The Panel expressed its appreciation to WMO and RSMC New Delhi for arranging the attachment of three forecasters from Bangladesh, Myanmar and Sri Lanka (12 to 23 February 2007) for the on-the-job training at the RSMC on operational analysis and forecasting of tropical cyclone.

7.7 The Panel was pleased to note that steps are underway to include a one page executive summary of the study on suitable conversion factors between the WMO 10-minute standard average wind and 1 minute, 2 minute and 3-minute "sustained" winds in the Global Guide to Tropical Cyclone Forecasting and in the Operational Plans/Manual of the TC regional bodies in a suitable format. The study was undertaken by the Systems Engineering Australia Pty Ltd (SEA) and was reviewed during the Fifth TC RSMC/TCWC Technical Coordination Meeting (Honolulu, December 2005).

8. REVIEW OF THE COORDINATED TECHNICAL PLAN AND CONSIDERATION OF THE WORK PROGRAMME FOR THE NEXT FIVE YEARS (Agenda item 8)

The Panel was informed that Mr Ahmed Hamoud Mohamed Al-Harthy (Oman), Chairman of the Working Group on the Coordinated Technical Plan and Work Programme could not continue the chairmanship due to his heavy workload. Accordingly, the Panel re-established the Working Group during the session and appointed Mr Al-Ruhmi (Oman) as Chairman, and Dr Karmakar (Bangladesh) and Mr Samarasinghe (Sri Lanka) as Vice-chairmen of the Working Group. The terms of reference and membership of the Working Group are given in Appendix V. In endorsing the proposed Terms of Reference of the Working Group, the Panel requested the core group with the support of TSU, WMO and UNESCAP to hold a face-to-face meeting in late 2007 to prepare the new Coordinated Technical Plan and distribute it to the Members with findings and recommendations at least one month prior to the next session.

8.1 Meteorological component (agenda item 8.1)

8.1.1 Under this item, matters relating to the basic observational network, the telecommunication links and data-processing systems established in the region to fulfill the requirements of WMO's World Weather Watch Programme were given priority. The Panel Members were invited to present reports on the current progress in dealing with problems encountered and on programmes for the modernization of observing and telecommunication networks and forecasting systems, aiming at further improvements in tropical cyclone monitoring, forecasting and warning services. The Panel reviewed the activities under the meteorological component of the Members during the past year, details of which are presented in Appendix VI.

8.1.2 The Panel was informed that according to the results of the WWW Annual Global Monitoring (AGM) October 2006, the availability of SYNOP reports expected to be received from the RBSN of Members of Panel on Tropical Cyclones ranged from 63 to 100 per cent. The percentage of the reports received from India, Maldives and Pakistan has increased, while Thailand remained the highest in the region, constituting 100 per cent of expected reports. The availability of data from rest of the Member countries, Bangladesh, Myanmar, Oman and Sri Lanka showed a negative trend during this period.

8.1.3 The availability of TEMP reports during the same AGM period in October 2006 ranged from 0 to 97 per cent. The percentage of the reports received from Maldives was the highest, while the 5 upper-air stations in Myanmar continued to be silent similar to the past few years. Availability of reports from Pakistan and Thailand had showed a positive increase but Bangladesh, India, Oman and Thailand showed a decline during the intersessional period. As in previous years, no report was received from upper air stations in Sri Lanka during the AGM period.

8.1.4 The Panel noted that point-to-point GTS circuits in this region are effectively operated, including MTN New Delhi-Tokyo through data-communication network services and Bangkok -Tokyo through Frame Relay circuits, and several regional circuits being upgraded. It was also noted that TCP/IP migration for GTS circuits has made satisfactory progress in Region II with about 70 percent of the circuits operating on pure TCP/IP.

8.1.5 The Panel noted with satisfaction that, although there were still shortcomings in PTC Members such as NMCs Colombo and Yangon which were linked to RTHs New Delhi and/or Bangkok by low speed circuits (50 bauds) and NMC Male connected to RTH New Delhi via the Internet only, these GTS connections are being upgraded in the framework of the development of the Indian Ocean Tsunami Early Warning System and GTS support to multi-hazard early warning. .

8.1.6 WMO, in coordination with UN/ISDR, UNESCO/IOC, and NMHSs have actively promoted and taken action to ensure the most effective use of the GTS for the immediate support of the Interim Tsunami Advisory Information service as well as for the longer-term support of the Tsunami Warning System in this region. Within this framework, the GTS equipment at several NMCs is being upgraded (Bangladesh, Myanmar and Pakistan by WMO with UN/ISDR funding, Maldives and Sri Lanka by US-NWS with USA funding).

8.1.7 The Panel noted with pleasure that excellent progress on AMDAR continued to be made. Data counts show that a total of 220,000 automated aircraft reports were collected per day. Comparable numbers were around 10,000 in 1990, 50,000 in 1998, and 100,000 in 2001. In accordance with directions of Congress and the Executive Council, a migration of responsibility for the AMDAR Programme from the AeMP to the World Weather Watch is underway.

8.1.8 A significant new evolution of AMDAR was the development and testing of a new water vapour sensor that has been extensively tested in the US and is currently undergoing a performance evaluation in flight trials on Lufthansa aircraft in Europe. First results of this evaluation, after elimination of some technical problems, are very encouraging and show the potential to complement the existing upper air data, and possibly allow some considerable savings if the AMDAR data can replace part of conventional radiosonde ascents.

8.1.9 The Panel was pleased to note that capacity building was being enhanced in marine meteorology and oceanography. The Republic of Korea offered to host the First Scientific/Technical Storm Surge Symposium that would be held in Seoul, from 2 to 6 October 2007. In addition to addressing an important activity identified by JCOMM-II to enhance storm surge forecasting capability, the proposed scientific and technical Symposium would complement other international efforts, including the series of capacity building workshops on storm surge and wave forecasting organized by JCOMM, and the WMO Tropical Cyclone Programme, and JCOMM efforts in support of marine-related hazards warning systems. Moreover, an outline of a Guide to Storm Surge Forecasting has been prepared; the finalization of this Guide is a priority for 2007.

8.1.10 The Panel was informed that the current constellations of operational geostationary and polar-orbiting meteorological satellites will be enhanced by the new generation satellites which are expected to be launched in 2007, including the polar orbiting FY-3A by China, the polar-orbiting Meteor-M1 and the geostationary Electro-L1 by the Russian Federation, and the geostationary INSAT-3D by India.

8.1.11 The Integrated Global Data Dissemination Service (IGDDS) project is progressing. One objective of this project is to implement a quasi-global coverage of WMO Regions by multipurpose telecommunications satellite-based broadcasting services using the Digital Video Broadcast (DVB) which should provide the users with access to satellite data from different satellite operators through a single receiving device. Such a service is currently provided by EUMETSAT with its EUMETCAST service that currently covers Europe, Africa, the Americas, and the western part of Asia. An experimental system is implemented by China and there are plans from the Russian Federation. In addition to these dissemination services by telecommunications satellite, JMA has announced its plan to provide access to all MTSAT data in near-real time through the Internet as of April 2007.

8.2 Hydrological Component (agenda item 8.2)

8.2.1 Under the hydrological component, the Panel reviewed the activities of its Members, WMO and UNESCAP. The representatives of the Members reported the activities of their respective countries as reflected in Appendix VII. In 2006, several important improvements in the hydrological component had been made in the Panel Members, including flood forecasting techniques and modeling, real-time monitoring of water level and rainfall, risk mapping and participation of stakeholders in flood warning systems.

8.2.2 The Panel expressed its appreciation to the strong spirit of cooperation among the concerned Members of international river basins in the region on the exchange of hydrological data, especially for flood forecasting. The Panel took a special note of the report on the detailed programme of exchange of data and information on water level, rainfall and river forecasts between Bangladesh and India aiming at assisting the downstream authorities in improving flood forecasting operations. The Panel was informed that such a strong spirit of international cooperation in other international river basins could lead to not only saving lives, but also conducive environment for economic development and ultimately to building trust for major investment. The Panel was pleased to note the willingness of the delegations of Bangladesh and India to seek authorization from their respective Governments to organize a regional workshop to enable all the agencies involved in flood forecasting operations to discuss specific joint activities aiming at enhancing further the flood forecasting services for socio-economic development. The Panel called on UNESCAP, WMO and other international organizations to provide financial and technical assistance to organize such a regional workshop. In this connection, the Panel took note of the agreement of the delegations of Bangladesh and India to inform UNESCAP and WMO through the TSU of the decisions by their respective Governments within six weeks after the Session, for further arrangements.

8.2.3 As discussed at the thirty-third session, the Panel noted several common activities, such as the application of the Mike11 system for flood forecasting or application of radar systems to improve rainfall forecasting. The Panel pointed out the importance of sharing experiences on assessing socio-economic benefits of flood forecasting operations, such as explained by the delegation of Pakistan on the saving of about Rs 300 million with the extra volume of water that could be stored in the existing reservoirs based on accurate flood forecasting operations in Pakistan. The Panel recognized the benefits of regular and active exchange of experiences of these activities and called on international organizations to assist in facilitating the exchange of experiences, including organization of a regional workshop on detailed experiences in the application of the Mike-11 software package.

8.2.4 The Panel noted with concern of the increasing socio-economic impacts of stormed rainfalls in all Member countries of the Panel. It called for more regional cooperative efforts in dealing with these subjects and invited UNESCAP, WMO and other international organizations to assist in this increasing trend of water-related disasters.

Activities of UNESCAP

8.2.5 In 2006, UNESCAP continued to extend its technical support to the Panel on Tropical Cyclones' activities in its regular activities related to water resources management. In 2006, UNESCAP published a special publication on its experiences to assist countries in the region, including two members of the Panel, in their efforts to develop integrated water resources management (IWRM) plans, as recommended by the World Summit on Sustainable Development, held in Johannesburg in 2002, as part of the project on "Capacity-building in strategic planning and management of natural resources in Asia and the Pacific". The Panel was informed that the outcomes of this project and follow-up activities have been posted on a website jointly established by FAO and UNESCAP at www.spm-ap-water.net.

8.2.6 Also in 2006, UNESCAP joined the Japan Water Forum and the Asian Development Bank to organize a Regional Water Ministerial Meeting in Mexico City in March 2006 to initiate the establishment of the Asia-Pacific Water Forum. The Panel was informed that the Asia-Pacific Water Forum is now fully operational and efforts are being made to organize the first Asia-Pacific Water Summit in Japan in December 2007. As the Team Leader for Key Results Area 4 on Monitoring of Investment and Results and an active member of the Theme "Disaster Management" to prepare for the first Asia-Pacific Water Summit, UNESCAP invited the Panel Members to support its activities on these two areas of work.

8.2.7 The Panel Members were urged to make use of the advisory services which could be made available by UNESCAP to developing countries in the region on various aspects of water resources planning and management.

Activities of WMO

8.2.8 The Panel was informed that the next meeting of the RA II Working Group on Hydrology (WGH) is scheduled to take place in Beijing from 26 to 30 March 2007. Major issues for discussion will be the implementation of the work plans of the theme leaders, covering the areas of:

- Improving institutional capacity;
- Water resources assessment;
- Disaster mitigation – climate variability and hydrological aspects of drought
- Disaster mitigation – improvement to short duration (flash) flood forecasting capabilities in urban areas;
- Improved accuracy of flow measurements and estimation

The group will also discuss needs and requirements in hydrology and water resources in RA II in the next intersessional period 2008-2012.

8.2.9 As part of the WMO's Quality Management Framework, WMO's Commission for Hydrology (CHy) is preparing a series of Manuals. One such manual, the "Manual on Flood Forecasting and Warnings", is being compiled with contributions by experts from various WMO's regions and would be made available to Members when completed and the Members be supported with training courses on the application. Other manuals under preparation are a Manual on Low Flows and Prediction and a Manual on PMP.

8.2.10 The activities undertaken in the Flood Forecasting Initiative have the potential to go a long way in fulfilling the objectives of WMO by enhancing close cooperation between the NHS and NMS in countries. Eight regional workshops organized under it had gathered together meteorologists and hydrologists working in the countries to discuss and address flood forecasting issues jointly. A Synthesis Conference was held in Geneva in November 2006 and the "Strategy and Action Plan for the Enhancement of Cooperation between National Meteorological and Hydrological Services for Improved Flood Forecasting" was recommended for Congress adoption.

8.2.11 Three major regional components of WHYCOS had been developed in the past, namely the ARAL-HYCOS , Hindu Kush Himalaya-(HKH) HYCOS and the MEKONG-HYCOS . The ARAL-HYCOS project document was revised and has been endorsed during a regional meeting with the participating Central Asian States in December 2006. The HKH-HYCOS had been fully developed with the aim to establish a regional flood information system in the Brahmaputra – Ganges - Meghna basins, and a systems test had been undertaken in the monsoon period 2005. However, up to now, the project is not funded for full implementation. The MEKONG-HYCOS project is also aiming to establish a regional

flood information system. This project is now fully funded by France as the principal donor. A start-up meeting had taken place in Lao PDR in January 2007 and the project will be implemented over a period of 5 years.

8.3 Disaster Prevention and Preparedness (DPP) component (agenda item 8.3)

8.3.1 Under this agenda item, the Panel reviewed the activities of its Members and discussed the related activities of WMO, UNESCAP, IFRC and ADRC. The representatives of the Members reported the situations on disaster mitigation and related disaster management activities of their respective countries in the past year and the future plans. The Panel noted with appreciations the participation of the DPP experts from the host country. In view of the importance of DPP for effective impacts of the Panel's activities, the Panel urged Members to send their DPP experts to take part in future sessions. In this connection, it was decided to re-establish a Working Group on DPP and invited Thailand and Oman to nominate Chair and Vice-chair respectively to establish a detailed work plan aiming at enhancing cooperation among the Members on DPP, as well as to enforce the last mile for all activities of the Panel on meteorology and hydrology. Thailand and Oman agreed to inform the TSU, UNESCAP and WMO of their nominees in a six-week time. The Panel requested UNESCAP to assist the Chair and Vice Chair, then, in preparing the detailed work plan for circulation to all Members as soon as possible to enable the Working Group to take an active part in other international forums.

8.3.2 All the Panel Members report that they continue their efforts to provide training to stakeholders to enhance awareness and participation. Summary of DPP activities of Panel Members is given in Appendix VIII.

Activities of WMO

8.3.3 In 2006, WMO conducted a country-level disaster prevention and mitigation survey (Country-Level DPM Survey) to map and benchmark national disaster risk reduction governance and organizational structures, relevant hazards, NMHSs' capabilities and partnerships, as well as their major gaps and needs to support disaster risk reduction decision processes. In this survey, most Members at risk to tropical cyclones have indicated that they could benefit from strengthening the integration of the warnings issued by the NMHSs into emergency preparedness and operations and indicated that they would benefit from advice and support in this area. Those countries are seeking assistance of WMO in this regard.

8.3.4 There are a number of good practices in which warnings of tropical cyclone and related hazards issued by NMHSs are integrated into emergency preparedness and response planning and operations, supported by governance, legislation and organisational mechanisms, from local to national levels. Through the tropical cyclone regional bodies, these good practices may be identified and documented with assistance of the WMO Natural Disaster Prevention and Mitigation Programme, and shared among all NMHSs in the countries at risk to tropical cyclones and related hazards.

8.3.5 Warnings of tropical cyclone, storm surge, coastal floods and tides usually are decentralised, falling on responsibilities of different agencies at national level. The decentralisation of information presents significant challenges to decision-makers to assess risks associated with situations where tropical cyclone lead to storm surge, tides and coastal flooding. To this end, in some countries, NMHSs, together with other technical agencies (e.g. hydrological services, ocean services), have combined their information into information portals to facilitate access by the decision-makers and emergency operators. Based on lessons learned through those good practices, close collaboration among these agencies could be strengthened to ensure that information is available, authoritative, timely, understandable, and easily accessible for emergency operators and decision makers.

8.3.6 Currently, many of the international humanitarian agencies (e.g. OCHA) are not directly linked to the network of NMHSs (i.e. access to official warnings) and RSMCs (i.e. access to specialised forecasts and bulletins). In many cases, they primarily rely on information sources such as international media and miscellaneous academic websites to develop their risk scenarios and contingency plans. Through strengthened partnerships with NMHSs and RSMCs, regional and international humanitarian agencies could systematically benefit from more timely and reliable information from the WMO Tropical Cyclone Programme network. Furthermore, through proactive participation of these agencies in the tropical cyclone regional bodies, regional operational plans in support of humanitarian contingency planning and response could be considered based on better understanding of these agencies' requirements.

8.3.7 In many countries where tropical cyclone warnings have been effectively integrated in emergency preparedness and response operations, interdisciplinary training curricula between operational forecasters of NMHSs and operational response staff have been developed. Through the Country-Level DPM Survey, many NMHSs indicated that they could benefit from these curricula to enhance their partnerships with emergency response and planning structures. Tropical cyclone regional bodies could assist WMO with compilation of these curricula and development of training programmes which could benefit those Members of WMO through interdisciplinary training workshops and activities.

Activities of UNESCAP

8.3.8 Since the December-2004 Tsunami, UNESCAP has intensified its activities on DPP on top of its ongoing and regular activities in its regional programme on water-related disasters reduction. The regular and ongoing activities of UNESCAP included the following:

- a. UNESCAP in cooperation with the Asian Disaster Preparedness Centre (ADPC), the Secretariat of the United Nations International Strategy for Disaster Reduction [ISDR], and the Asian Disaster Reduction Center [ADRC] organized on 11 October 2006 the Annual Forum on Disaster Reduction to commemorate the International Day for Disaster Reduction. In this year event, other members of the ISDR Asia Partnership (IAP) participated in the commemoration.
- b. In cooperation with ADPC, UNESCAP implemented and completed the third phase of the project on Partnership for Disaster Reduction in South-East Asia from 1 February 2005 to 30 April 2006 to assist five developing countries in South-East Asia. The main focus of this phase is to assist the target countries in their efforts to institutionalize community-based disaster risk management (CBDRM) and to promote efforts to create a conducive environment in the region for these efforts. At the national level, the project has assisted respective national disaster management offices in establishing their strategic plans to institutionalize CBDRM and in developing partnership with the media and possibly the private sector. At the regional level, efforts have been made to establish a regional database on CBDRM with relevant information on the target countries, to promote the integration of CBDRM into the policies and programmes of donors on disaster risk management, and to encourage synergy among inter-governmental organizations working in the region on this subject.
- c. UNESCAP in cooperation with UNDP and ECLAC extended their joint project aiming at enhancing capacity of the countries in region on applying the ECLAC methodology to carry out routine assessment of socio-economic impacts of hydro-meteorological disasters. Representatives of several Panel Members were invited to participate in the Regional Workshop on Application of UNESCAP Template for Assessment of Socio-Economic Impacts of Natural Disasters, held in Bangkok in November 2006. The findings of the Regional Workshop and subsequent applications will be disseminated to all Panel Members for future reference.

- d. The ISDR Asia Partnership (IAP) has reiterated its intention to undertake its joint efforts to assist developing countries in the region in the formulation of their respective strategic national action plans on the implementation of the Hyogo Framework for Action (HFA). It is expected that several Members of the Panel would be included as priority targets for implementation. UNESCAP has been requested to assist in the implementation of this joint programme.

8.3.9 Extra activities generated by the Tsunami included the following:

- e. Government of the Republic of Korea has provided a trust fund up to US\$ 1 million to UNESCAP to implement pilot projects related to tsunami and other disaster preparedness to the tsunami-affected countries. Under this trust fund, a pilot community-based multi-hazard early warning system is being implemented in Sri Lanka, started in May 2006. The project involved the construction of a pilot early warning system consisting of a central control system and three terminals to serve three main ethnic groups: Sinhala, Tamil and the Muslim. The system will be supported by a series of studies on socio-economic conditions of the selected communities for effective integration of the early warning system into the development process. Two terminals have been completed and the first multi-hazard early warning tower of Sri Lanka was inaugurated on 26 December 2006 to commemorate the second anniversary of the tragic 2004 Tsunami Disaster. The first survey was also completed by the International Water Management Institute for the project with financial assistance of ISDR and the first national workshop was organized on 27 December 2006. UNESCAP expects that the experience of Sri Lanka would be shared and transferred to other Members of the Panel.
- f. A regional multi-donor trust fund has been established with an initial contribution of US\$ 10 million by Thailand and subsequently with another contribution of US\$2.5 million by Sweden to support regional efforts in the establishment of multi-hazard early warning systems for the Indian Ocean and South China Sea. This trust fund is being administered by UNESCAP. Efforts are being made to enable the Panel on Tropical Cyclones to make use of the Trust Fund to support its activities related to reduction of socio-economic impacts of tsunami and other natural disasters in the Indian Ocean and South-East Asia.

Activities of other International Organizations

International Federation of the Red Cross and Red Crescent (IFRC)

8.3.10 The representative of IFRC, Ms. Elizabeth Loeber, Regional Advocacy Delegate, briefly informed the Panel of its activities relevant to the work of the Panel on DPP, including those related to risk management at the community level. She highlighted the successful joint efforts made by the Government of Bangladesh, as elaborated by the delegation of Bangladesh, and IFRC in promoting cyclone-preparedness through the Cyclone Preparedness Programme in Bangladesh for more than 30 years. She congratulated the initiative of the Panel to establish a working group on DPP to enhance the socio-economic benefits of the current services of the Panel on meteorology and hydrology and expressed interest in collaborating with the Panel in this area of its work.

Asian Disaster Reduction Center (ADRC)

8.3.11 On behalf of ADRC, Dr. Kenpei Kojika informed the Panel of its various activities on disaster risk management in the Panel countries. ADRC has been making its effort to promote disaster reduction through multi-national cooperation in Asia region since its establishment. In October 2006, Japan Aerospace Exploration Agency (JAXA) and ADRC have announced the operation of Sentinel Asia, an internet-based Web-GIS platform developed under the cooperation among Asia-Pacific Regional Space Agency Forum

(APRSAF), JAXA, ADRC, Digital Asia and international organizations based on the best-efforts and voluntary initiatives, providing integrated disaster information for the Asia-Pacific region and accepts emergency disaster observation to the ADRC member countries as well as the space agencies of the Joint Project Team (JPT) of Sentinel Asia after a large-scale disaster. It could serve as a useful tool for the disaster management especially when it is combined with the local detailed GIS, social and economic information.

8.4 Training component (agenda item 8.4)

8.4.1 The Panel reviewed the involvement of its Members in various education and training activities supported under WMO Voluntary Cooperation Programme (VCP), regular budget (RB), UNDP and TCDC arrangements.

8.4.2 The Panel noted the number of training events and workshops, which were organized in 2006 for the benefit of its Members. Since its last session, the Panel had benefited from WMO's education and training activities, relating to the award of fellowships, relevant training courses, workshops, seminars, the preparation of training publications, and the provision of advice and assistance to Members.

8.4.3 The Panel noted that WMO fellowships for long-term and short-term training continued to be granted to the Member countries of the Panel under various WMO programmes.

8.4.4 The Panel noted the recent development of the ETRP web site and the current initiatives to facilitate online access to worldwide training resources, as well as exchange of meteorological case studies and related documentation between advanced and less advanced training institutions.

8.4.5 The Panel expressed appreciation to the Member countries, which offered their national training facilities to other Members under bilateral arrangements. These cooperative efforts by the Panel Members have been found by the recipient countries to be very useful, and the Panel strongly recommended that such endeavours should continue in the future and be strengthened. The Panel urged its Members to make maximum use of such training facilities.

8.4.6 The Panel was pleased to note that the attachment of tropical cyclone forecasters at the RSMC New Delhi and the attachment of storm surge experts at IIT Kharagpur were successfully conducted (see para 7.3 and 7.6). The Panel expressed appreciation to RSMC New Delhi and IIT Kharagpur for indicating that the agencies will organize the attachment in 2007. RSMC New Delhi and IIT Kharagpur expressed their willingness to accommodate more trainees. The Panel requested IIT Kharagpur to include the training on tsunami propagation model in the curriculum in addition to storm surge model.

8.4.7 The Panel Members were invited to attend the fourth EUMETSAT satellite application course which is planned to be held at the Muscat Center of Excellence during February 2008, by requesting the WMO Secretariat for financial assistance as necessary.

8.4.8 A summary report on the 2006 training activities and future plan of Members is given in Appendix IX.

8.5 Research component (agenda item 8.5)

8.5.1 The Panel was informed that the Sixth WMO International Workshop on Tropical Cyclone (IWTC-VI) was successfully held in San José, Costa Rica from 21 to 30 November 2006. It was attended by 125 tropical cyclone experts from 34 WMO Members with the Panel being represented by Dr Samarendra Karmakar (Bangladesh), Dr Omprakash Singh (India) and Mr G.B. Samarasinghe (Sri Lanka). Three tropical cyclone research

experts from the Region also attended the workshop. The proceedings of the workshop are currently being finalized and will subsequently be distributed to the participants and to Panel Members. Included in the proceedings are a number of very important and useful recommendations, formulated by the participants and addressed to the WMO Secretariat, to NMHSs and to the research community. Towards the conclusion of the workshop, the participants adopted the Statement on Tropical Cyclones and Climate Change which is available online at: <http://www.wmo.int/arep/arep-home.html>.

8.5.2 The Panel was pleased to note that steps are underway to organize a meeting of the WMO/CAS Working Group on Tropical Meteorology Research in Guangzhou, China, from 22 to 24 March 2007. The meeting will review the recent developments on tropical meteorology research and discuss future strategies of the working group. Invited to the meeting are members of the said working group, which includes Dr H.R. Hatwar (India) with the support of TCP, and representatives of the WMO Monsoon Activity Centres.

8.5.3 WMO's World Weather Research Programme (WWRP) is organizing an International Training Workshop on Tropical Cyclone Disaster Reduction which will also be held in Guangzhou, China, from 26 to 31 March 2007. The training workshop is aimed at providing training and experience on new knowledge gained from recent advances on tropical cyclone research and how best to apply these to operational prediction activities in order to enhance the accuracy and usefulness of tropical cyclone forecasts and warnings. The workshop will also enable participants to be aware of the issues associated with disaster mitigation, such as factors contributing to human and economic losses, conveying forecasting and warning information to stakeholders, users and the general public, evaluating the effectiveness of warning systems, mitigation strategies and community capacity building for disaster reduction.

8.5.4 The Panel endorsed that all NMHSs promote research and development, not only by research scientists but also by operational personnel. In view of that the Panel expressed appreciation to Pakistan that offered to invite one or two scientists from each Member country to Pakistan for initiating/carrying out joint research work in the mutually agreed fields of meteorology and related sciences. This visit must not be less than four months in view of the concrete achievement of the research work.

8.5.5 A summary report on the 2006 research activities and the future research activities of the Panel Members is given in Appendix X.

8.6 Storm Surge Project (agenda item 8.6)

8.6.1 In view of the effectiveness in implementation of the Storm Surge Project, the Panel unanimously agreed to reformulate this project to be included in the New Possible Joint Initiatives (Agenda Item 8.8) as a separate entity with the same project name (Storm Surge Project).

8.7 Publications (agenda item 8.7)

Publications issued under the programmes of the Panel fall into two categories (a) Panel News, and (b) the Annual Review of the Tropical Cyclones affecting the Bay of Bengal and the Arabian Sea. Information on the current status of each is presented below:

(a) Panel News

Panel News No.22 was published in March 2006 and No. 23 in February 2007. Members were requested to provide information on their recent development to TSU through their correspondents more actively to avoid any delay in the publication of Panel News.

(b) Annual Review

The Panel on Tropical Cyclones Annual Review for the year 2006 which was consolidated and finalized by the Chief Editor, Mr A. K. Bhatnagar (India) with contributions from the National Editors will be submitted to WMO in March 2007 for publication as soon as possible. In this regard, the Panel expressed its appreciation to the Chief Editor and the National Editors of the Review. The Editorial Board for the 2006 annual review is given in Appendix XI.

8.8 New Possible Joint Initiatives (agenda item 8.8)

8.8.1 Upon the recommendation of the Deputy Minister of Environment, Energy and Water in his opening statement of the Session to establish a regional multi-hazard early warning system for the PTC Area, the Panel noted ongoing efforts of all PTC Members to integrate the need of establishing a tsunami early warning system into existing framework of early warning operations such as tropical cyclones, floods and storm surges. On the basis of ongoing national initiatives and activities, the Panel considered necessary to integrate ongoing efforts of PTC into a multi-hazard early warning system so as to obtain endorsement of the respective Governments for more effective regional cooperation to support socio-economic development. The Panel requested UNESCAP to present ideas on possible framework for the establishment of a regional multi-hazard early warning system for discussion.

8.8.2 A framework for development of a regional multi-hazard early warning system was proposed to take into account the following developments in the region: (i) increasing socio-economic impacts of cyclone-related disasters; (ii) strong interest in building regional tsunami early warning system for the Indian Ocean; (iii) strong interest in enhanced subregional cooperation on disaster risk management (SAARC and others); and (iv) high potential for more effective cooperation among PTC Members to support socio-economic development. In addition, it was suggested to adopt an approach to build on the regional trends (i) to meet the increasing needs for more effective early warnings; (ii) to build on the strong interest in Tsunami early warning to multi-hazard early warnings, including cyclone-related disasters; (iii) to support policy and decision-making in socio-economic development process; (iv) to implement the Hyogo Framework for Action to ensure community resilience; and (v) to build on the strengths and priorities of PTC cooperation.

8.8.3 It was also considered necessary for the programme to develop a regional multi-hazard early warning system of the Panel to include the following components: (1) Expansion of Cyclone EWS to cover other hazards, (2) Integrated EWS at the national level, (3) Hazard mapping, (4) Promotion of community based disaster reduction management and its institutionalization, and (5) Harmonization of methodologies to assess socio-economic impacts of cyclone-related disasters.

8.8.4 The Panel agreed in principle the proposed concept to enhance regional cooperation suggested above to support ongoing efforts of all the Members in developing their respective multi-hazard early warning systems. The Panel considered necessary to obtain authorization by all the Governments before proceeding with further action. In this context, the Panel recommended that a detailed concept paper be prepared to outline the objectives, expected outcomes as well as key components and identification of potential donors. The Panel requested UNESCAP with assistance of TSU and WMO to draw up such a concept paper and submit it to all the Members by May 2007 for consideration by the respective Governments.

8.8.5 The Panel also recognized the fact that its annual sessions have been functioned as a regional forum to exchange information and achievements in disaster risk management as well as multi-hazard early warnings. It encouraged existing collaborating organizations, such as ICAO, IFRC, ADRC, UNDP and ISDR, to provide important achievements made

during the preceding year in the Panel Area for reference. It therefore urged these collaborating organizations to submit their respective reports of achievements at the 35th session.

8.8.6 In view of the important achievements of the Storm Surge project in the recent years in mobilizing authorization and support of several Governments of the Panel, it considered essential to include the Storm Surge Project as one of the main component of the proposed programme on the development of a regional multi-hazard early warning system in the Panel Area. It also encouraged Members and donors to proceed with the implementation of the Storm Surge project on the basis of current level of support by the respective Governments.

8.8.7 The Panel considered necessary to establish a Task Force for the development of an implementation strategy and programme for this new joint initiative and decided to appoint such a Task Force after obtaining approval by all the Governments.

9. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN (Agenda item 9)

9.1 The basic purpose of the operational plan is to facilitate the most effective tropical cyclone warning system for the region with existing facilities. In doing so the plan defines the sharing of responsibilities among Panel countries for the various segments of the system and records the coordination and cooperation achieved. The plan contains the agreed arrangements for standardization of operational procedures, efficient exchange of various data related to tropical cyclone warnings, archival of data and issuance of tropical weather outlook for the benefit of the region, from a central location having the required facilities for this purpose(i.e. RSMC New Delhi), as agreed upon by the Panel.

9.2 The operational plan contains an explicit formulation of the procedures adopted in the Bay of Bengal and the Arabian Sea region for the preparation, distribution and exchange of information and warnings pertaining to tropical cyclones. Experience has shown that it is a great advantage to have an explicit statement of the regional procedures to be followed in the event of a cyclone and this document is designed to serve as a valuable source of information to be readily available for reference by the forecaster and other users..

9.3 The representative of the International Civil Aviation Organization (ICAO), Mr Dimitar H. Ivanov, presented to the Panel the new Amendment 74 to ICAO Annex 3, Meteorological Service for International Air Navigation, which will become applicable on 7 November 2007. Changes to the Annex 3 provisions on the format and content of the tropical cyclone advisories (TCA) and SIGMET were presented in detail. These changes will require corresponding amendment to Chapter II, p. 2.7 of the Operational Plan. The Panel was informed that ICAO will submit the draft changes to the Operational Plan in due course for inclusion in the 2007 edition. In addition, some amendemnts to Chapter V(Communications, of the Plan) were also proposed in order to give the Panel Members clearer instructions regarding the dissemination of the TCAs and TC SIGMET. Mr. Ivanov informed the Session about the actions undertaken by ICAO to eliminate the safety related deficiencies in the field of aeronautical meteorology. Panel Members were invited to improve their participation in the regional SIGMET tests and to consider sending their experts to the Regional SIGMET Seminar to be held in the ICAO Regional Office, Bangkok from 11 to 13 July 2007.

9.4 The Panel noted that many changes have to be incorporated to the text of the Operational Plan. For the early issuance of the 2007 Edition of the Operational Plan, the Panel urged the Members to communicate their amendments, if any, by 31 March 2007 to Dr. Samarendra Karmakar, Director of Bangladesh Meteorological Department, who kindly agreed to finalize the 2007 Edition of the Operational Plan.

9.5 The Panel invited WMO to issue the 2007 Edition as early as possible.

10. Technical Support Unit (Agenda item 10)

10.1 The Panel expressed its gratitude to the Government of Pakistan for hosting the Technical Support Unit (TSU) and appreciated the services being rendered by Dr Qamar-uz-Zaman Chaudhry, Director-General of Pakistan Meteorological Department (PMD) in his capacity as TSU Coordinator. The Panel welcomed Mr Ata Hussain as the new TSU Meteorologist and wished him success in his assignment.

10.2 The Panel was briefed by Mr Hussain on the activities of TSU during the intersessional period. The Panel expressed its satisfaction with the work of the TSU.

10.3 The Panel was informed that the 23rd issue of the Panel News is currently being distributed to the Members.

10.4 The Panel would like TSU to take a major role in the management of joint projects of the Panel. In this connection, the Panel requested TSU in cooperation with WMO and UNESCAP to review the current status of the legal and institutional framework of TSU and report to all the Members as soon as possible report the findings and recommendation for further action.

10.5 TSU provided the Panel with a detailed breakdown of its expenses incurred during the Inter-sessional period (see Appendix XII).

11. SUPPORT FOR THE PANEL'S PROGRAMME (Agenda item 11)

11.1 The Panel was informed of the technical cooperation activities of WMO and ESCAP in support of the programmes of the Panel carried out in 2006, including the Voluntary Cooperation Programme (VCP), Trust Fund arrangements, Emergency Assistance Fund scheme and Technical Cooperation among Developing Countries (TCDC) activities, and expressed its appreciation to WMO, ESCAP and collaborating partners for providing assistance to the Panel Members..

11.2 The Panel noted that, in 2006, Maldives and Pakistan made cash contributions to the Voluntary Cooperation Fund (VCP(F)). Four VCP project requests were submitted by four Members of the Panel. The Meteorological Information Comprehensive Analysis Process System (MICAPS) is being provided to Bangladesh, Maldives and Myanmar by China. Myanmar also received support from MEISEI Electric Co. Ltd, Japan for the provision of an Automatic Weather Stations (AWSs) in 2006. In view of the VCP potential in support of activities of the Panel, the Panel urged Members to further actively participate in the VCP activities.

11.3 The panel was informed of the progress of the on-going Trust Fund project for Oman and UNDP project for Maldives. It also noted with satisfaction the progress of a coordinated project for the upgrading of the Global Telecommunication System (GTS) for Bangladesh, Myanmar and Pakistan with the funds from UN/ISDR Flash Appeal. The system, composed of a Local Area Network, Communication System, Visualization System and additional PCs and accessories, is expected to be installed in early 2007 in NMC Dhaka by Oriental Electronics, Inc., Japan; in NMC Yangon by NetSys, South Africa; and in NMC Islamabad by COROBOR, France. The Panel welcomed the initiation of the GTS upgrade projects for Maldives and Sri Lanka with the support of USA, as well as a proposed Trust Fund project for the installation of a Doppler weather radar in Sri Lanka.

11.4 The Panel also noted the recent emergency assistance provided under the Emergency Assistance Fund scheme to WMO Members affected by natural disasters, including Bangladesh and Sri Lanka, and those emerging from conflict. Affected Members who need emergency assistance were advised to utilize this scheme, and all Members were requested to consider possible support to the affected NMHSs. The Panel was further

informed on the major outcome of the expert mission to Timor-Leste carried out in end-January 2007 for the establishment of its Meteorological Service with the participation of Australia; Indonesia; Macao, China; Portugal and WMO as well as UNISDR and IOC/UNESCO.

11.5 Within the framework of the TCDC, China organized the WMO Symposium on Strengthening Cooperation among NMHSs and WMO followed by a 2006 Study Tour in China from 4 to 13 September 2006 for 22 participants, mainly International Advisors, from 21 Members of WMO. None of the Panel Members participated in the Symposium and the Study Tour in 2006.

11.6 In view of the successful implementation of training activities among the Members within the framework of TCDC, those Members who offered training opportunities were requested to provide the WMO Secretariat with the information on their activities.

11.7 In light of enhancing the regional cooperation in expert services, the Panel agreed that TSU develop an inventory of experts in the fields of maintenance of meteorological equipment, ICT, and other relevant fields with inputs from Members, and also develop a funding support mechanism and procedures to facilitate the proposed expert services.

11.8 The Panel further noted the outcomes of the Fourth Technical Conference on Management of Meteorological and Hydrological Services in Asia (Islamabad, 5-9 February), and a series of national and regional workshops on social and economic benefits of weather, climate and water services, carried out in 2005-2006 towards the Madrid International Conference (March 2007) and the usefulness of the evaluation of socio-economic benefits.

11.9 The Panel noted with appreciation that WMO and UNESCAP would continue to undertake activities in support of the Panel on Tropical Cyclones.

Panel on Tropical Cyclones Trust Fund (PTCTF)

11.10 The establishment of the Panel on Tropical Cyclones Trust Fund (PTCTF) indicated a step towards achieving self-reliance of the Panel. At the moment, the Fund is being used not only for the provision of institutional support but also as funding support to the representatives of Panel Members attending training events and conferences.

11.11 Members were urged to continue to enhance their contributions to the Trust Fund as a substantial support for the Panel's activities.

11.12 The Panel endorsed the use of the Trust Fund for 2007 for the following specific purpose:

- Supplemental support for the attendance of members of the Working Group on the Coordinated Technical Plan at its first meeting to be held in late 2007. (US\$ 4,000)
- Support to TSU for its operating expenses including those for printing Panel News and running TSU-website. (US\$ 4,500)

Any other emergency expenditure that can be justified for the use of the PTCTF requires the concurrence of both the TSU Coordinator and the Panel on Tropical Cyclones Chairman.

11.13 A detailed financial report on the Trust Fund as of 31 December 2006 was submitted to the Thirty-fourth session of the Panel (see Appendix XIII).

12. SCIENTIFIC LECTURES (Agenda item 12)

12.1 The Panel devoted a session for the presentation of lectures and technical discussions. The list of presentations is as follows:

- (a) Storm Surge Mitigation in the Bay of Bengal & Arabian Sea – Prof Shishir Kumar Dube (IIT Kharagpur);
- (b) Quality Management in the Provision of Meteorological Services to Aviation – Mr Dimitar H. Ivanov (ICAO);
- (c) Possible application of UNESCAP Disaster Impact Calculator to support PTC cooperation – Mr Ti Le-Huu (UNESCAP)

12.2 The Panel expressed its deep appreciation to the above lecturers for their informative and excellent presentations.

12.3 The Panel welcomed and expressed its appreciation for the participation and contributions of Prof. Shishir Kumar Dube (IIT) and Mr Dimitar H. Ivanov (ICAO) to this session. It encouraged the continued participation of IIT and ICAO in the work of the Panel.

13. SPECIAL SESSION (Agenda item 13)

On the final day of the thirty-fourth session, the Panel invited secondary school students of Male to the session with a view to promoting better understanding of the young generation about the disaster prevention and preparedness for tropical cyclones. About 50 students attended the special session and the Panel participants delivered lectures on various topics related to tropical cyclone and the activities of the Panel and collaborating organizations.

14. DATE AND PLACE OF THE THIRTY- FIFTH SESSION (Agenda item 14)

14.1 The representative of Oman informed the session of their willingness to host the next session in 2008 subject to the Government's approval.

14.2 The Panel expressed its deep appreciation to the Sultanate of Oman for considering to host the Panel's session in 2008.

14.3 The exact dates and venue of the next session would be determined based on consultation between WMO, UNESCAP, the host, Chairman of the Panel and TSU Coordinator.

15. ADOPTION OF THE REPORT (Agenda item 13)

The report of the thirty-fourth session was adopted at 1300 hours on 1 March 2007.

16. CLOSURE OF THE SESSION

16.1 The Panel expressed its sincere appreciation to the Government of Maldives, the host country, for providing the excellent facilities, the venue, other arrangements and its warm hospitality. The Panel also expressed its deep appreciation to Mr Abdullahi Majeed, Chairman of the Panel, Mr Badar Al-Rumhi, Vice-chairman of the Panel as well as Mr G.B. Samarasinghe, Chairman of the Drafting Committee, for their successful conduct of the session. The Panel wished to express its gratitude to Mr Ali Shareef (Chairman, Local Organizing Committee) and staff of Department of Meteorology for their hard work in organizing the session, assistance provided to the participants, for producing a session

report, and for providing a copy of the presentations and photos in CD-ROMs to all the participants.

16.2 The thirty-fourth session of the Panel was concluded on 1 March 2007 at 1310 hours.

LIST OF APPENDICES

Appendix I	List of Participants
Appendix II	Agenda
Appendix III	PTC-33 Action Sheet
Appendix IV	2006 Cyclone Season Summary
Appendix V	Terms of Reference and Membership of the Working Group on the Coordinated Technical Plan (CTP)
Appendix VI	Summary of the Meteorological Activities of the Members
Appendix VII	Summary of the Hydrological Activities of the Members
Appendix VIII	Summary of DPP Activities of the Members
Appendix IX	Summary Report on Training Activities of the Members
Appendix X	Summary Report on Research Activities of the Members
Appendix XI	Editorial Board for the 2006 Annual Review
Appendix XII	Statement of TSU Accounts
Appendix XIII	Interim Statement of Account of the Panel's Trust Fund

APPENDIX I

LIST OF PARTICIPANTS

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APPENDIX I, p. 2

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APPENDIX I, p. 3

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APPENDIX I, p. 4

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APPENDIX II

AGENDA

1. OPENING OF THE SESSION
 2. ELECTION OF THE CHAIRMAN AND VICE-CHAIRMAN
 3. ADOPTION OF THE AGENDA
 4. WORKING ARRANGEMENTS
 5. FOLLOW-UP ACTION ON PTC-33
 6. REVIEW OF THE 2006 CYCLONE SEASON
 7. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME
 8. REVIEW OF THE COORDINATED TECHNICAL PLAN AND CONSIDERATION OF THE WORK PROGRAMME FOR THE NEXT FIVE YEARS
 - 8.1 Meteorological component
 - 8.2 Hydrological component
 - 8.3 Disaster prevention and preparedness component
 - 8.4 Training component
 - 8.5 Research component
 - 8.6 Storm Surge Project
 - 8.7 Publications
 - 8.8 New Possible Joint Initiatives
 9. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN
 10. TECHNICAL SUPPORT UNIT
 11. SUPPORT FOR THE PANEL'S PROGRAMME
 12. SCIENTIFIC LECTURES
 13. SPECIAL SESSION
 14. DATE AND PLACE OF THE THIRTY- FIFTH SESSION
 15. ADOPTION OF THE REPORT
 16. CLOSURE OF THE SESSION
-

APPENDIX III

ACTION SHEET

THIRTY-THIRD SESSION OF THE WMO/ESCAP PANEL ON TROPICAL CYCLONES

(Dhaka, Bangladesh, 30 January to 4 February 2006)

Para. No.	Subject	Action Required	Responsible	Deadline	Remarks
1	Hosting of the session	Letter of appreciation to Bangladesh.	WMO (TCP)	ASAP	
6.5	RSMC New Delhi	Pursue for approval the proposed change of the RSMC New Delhi forecast area of responsibility during the next session of WMO's Regional Association I (tentative early 2007).	WMO (TCP)	RA I XXIV	
8 (a)	Working Group on CTP	Mr Al-Harthy to continue as Chairman of working group.	TSU	ASAP	Check with Mr Al-Harthy
8 (c)	Survey on CTP	Make consolidated report of survey and submit next session.	TSU	PTC XXXIV	

Para. No.	Subject	Action Required	Responsible	Deadline	Remarks
7.3	Training on Storm Surge Model in the India Institute of Technology (IIT) Kharagpur	Arrange attachment of 2 forecasters, one from Pakistan and one from Bangladesh to IIT for training in implementing and running a storm surge model.	WMO (TCP)	Aug 2006	
8.1.5	GTS upgrade	Implementation of the GTS upgrade in Panel Members such as Bangladesh, Maldives, Sri Lanka and Thailand so as to address requirements for tsunami-related information exchange in the Indian Ocean Rim.	WMO (WWW)	ASAP	
6.1.15	Cox's Bazar and Khepurara radars	Look into possible replacement.	WMO (TCO)	ASAP	
8.4.4	WMO Training Library (TLB) and Virtual Training Library (VTL)	Make use of TLB and VTL whenever possible.	Members		Continuous activity
8.4.5	Attachment of tropical cyclone forecasters	Arrange for the attachment of tropical cyclone forecasters to RSMC New Delhi during the cyclone season.	WMO (TCP) RSMC New Delhi	Before cyclone season	

Para. No.	Subject	Action Required	Responsible	Deadline	Remarks
9.6	Tropical Cyclone Operational Plan for the Bay and the Arabian Sea (WMO/TD-No. 84)	Finalize 2006 edition. Issue updated Operational Plan (2006 edition).	Director, RSMC New Delhi WMO (TCP)	ASAP ASAP	
13.2	Thirty-fourth Panel session	Send to WMO early confirmation of the hosting.	Maldives/ Sultanate of Oman	ASAP	

APPENDIX IV

2006 CYCLONE SEASON SUMMARY

Cyclonic activities over north Indian Ocean during 2006

The year-2006 was a year of near normal cyclonic activity over north Indian Ocean. The basin witnessed the formation of twelve disturbances against a normal of fifteen (Table 2.1). Out of twelve disturbances, three (against a normal of five to six) intensified into cyclonic storms and three concentrated into deep depressions. There was one land depression during the year. Tracks of the systems are shown in Fig. 2.1.

As usual, the Arabian Sea was less active as compared to the Bay of Bengal. Only one cyclonic storm and one depression formed over the Arabian Sea, which dissipated over the sea itself. The Bay of Bengal was more active with formation of two cyclonic storms, two deep depressions and five depressions during the year 2006.

MALA: The very severe cyclonic storm "MALA" developed over southeast Bay of Bengal as a low-pressure area and intensified into a depression in the morning of 25 April 2006. It was located about 350 km southwest of Port Blair. Moving initially in a westerly direction, it intensified into a deep depression in the afternoon and into a cyclonic storm in the evening. The cyclonic storm continued to move in a northerly direction for some time and thereafter in a northeasterly direction and intensified into a severe cyclonic storm in the forenoon of 27 April. It further intensified into a very severe cyclonic storm and continued to move in a northeasterly direction and crossed Arakan coast about 100 km south of Sandoway, Myanmar around noon of 29 April 2006 as a very severe cyclonic storm. After landfall, the system weakened gradually.

MUKDA: The severe cyclonic storm "MUKDA" developed over east central Arabian Sea as a depression and it lay centered at 0300 UTC of 21 September 2006 about 450 kms southwest of Porbandar. It intensified into a cyclonic storm over eastcentral Arabian Sea at 0000 UTC of September 22 and lay centred about 400 km southwest of Porbandar. It remained practically stationary upto 0900 UTC of 22 and then moved slightly northeastwards and intensified into a severe cyclonic storm and lay centered at 1500 UTC of Sept 22 about 350 kms southwest of Porbandar. The system remained over the same area about 36 hours and dissipated around midnight of September 24, 2006 over sea itself.

OGNI: The third cyclonic storm "OGNI" developed over west central Bay of Bengal as a low pressure area off Andhra Pradesh coast in the evening of October 28, 2006. It intensified into a depression and lay centred about 50 km east of Nellore in the morning of October 29. Moving slowly in a northerly direction it further intensified into a deep depression in the afternoon and cyclonic storm in the evening of same day and lay centred about 50 km east of Kavali. The system slightly moved northwards till the morning of October 30. The movement of the system was very slow and it was about 30 km east of Kavali. Doppler Weather Radars at Machilipatnam showed band features with small core. The cyclonic storm, moving northwestwards, weakened into a deep depression and crossed the coast near Bapatla around noon of October 30, 2006, and then to a depression in the afternoon of same day. The depression further weakened into a well-marked low pressure over north Andhra Pradesh and adjoining areas in the evening of October 30, 2006.

Comprehensive information on tropical cyclone activity over the north Indian Ocean for last ten years is given in Table 2.2.

Some of the characteristic features of these cyclonic disturbances are given in Table 2.3. The statistical data pertaining to the monthly frequencies, total life time (days), frequency distribution (intensity-wise and basin-wise) are given in Table 2.4.

RSMC, New Delhi mobilized all its resources, both technical and human, to track these tropical disturbances that formed over the north Indian Ocean and issued timely advisories to WMO / ESCAP Panel countries.

Table 2.1

List of cyclonic disturbances formed over north Indian Ocean during 2006

1.	Deep depression over the Arabian Sea, January 13-15
2.	Very severe cyclonic storm over Bay of Bengal, " MALA " April 25-29
3.	Deep depression over the Bay of Bengal, July 02- 05
4.	Deep depression over the Bay of Bengal, August 02-05
5.	Depression over the Bay of Bengal, August 12-13
6.	Depression over the Bay of Bengal, August 16-18
7.	Depression over the Bay of Bengal, August 29- September 01
8.	Depression over the Bay of Bengal, September 03-05
9.	Land depression, September 21-24
10.	Severe cyclonic storm " MUKDA " over the Arabian Sea, September 21-24
11.	Depression over the Bay of Bengal, September 28-30
12.	Cyclonic storm " OGNI " over the Bay of Bengal, October 29-30

Table 2.2

**Cyclonic disturbances formed over north Indian Ocean
and adjoining region during 1997-2006**

Year		D	DD	CS	SCS	VSCS	Total
1997	BOB	1	4	1	1	1	8
	ARB	1					1
1998	BOB		3		1	2	6
	ARB		1	1	1	1	4
1999	BOB	1	3	1		2	7
	ARB					1	1
2000	BOB	1	--	3	--	2	6
	ARB	--	--	--	--	--	-
2001	BOB	2	--	1	--	--	3
	ARB	--	--	2	--	1	3
2002	BOB	1	1	2	1	--	5
	ARB	--	--	1	--	--	1
2003	BOB	2	2	--	1	1	6
	ARB	--	--	--	1	--	1
2004	BOB	2	--	--	--	1	3
	ARB	--	2	--	3	--	5
	LAND	2	--	--	--	--	2
2005	BOB	2	3	4	--	--	9
	ARB	2	--	--	--	--	2
	LAND	1	--	--	--	--	1
2006	BOB	5	2	1	--	1	9
	ARB	--	1		1	--	2
	LAND	1	--	--	--	--	1

D: Depression **DD:** Deep Depression, **CS:** Cyclonic Storm
SCS: Severe Cyclonic Storm **VSCS:** Very Severe Cyclonic Storm
BOB: Bay of Bengal **ARB:** Arabian Sea

Table 2.3
Some Characteristic features of cyclonic disturbances formed
over north Indian Ocean and adjoining region during 2006

Cyclonic Storm / Depression	Date, Time (UTC) & Lat. ^o N / Long. ^o E of genesis	Date, Time (UTC) place of landfall/ dissipation	Estimated lowest central pressure, Date & Time (UTC) & lat. ^o N / long. ^o E	Estimated Maximum wind speed (kt), Date & Time	Max. T. No. Attained
<i>Deep depression over Arabian Sea, January 13-14</i>	January 13, 1200 UTC near 5.0/77.0	<i>Weakened over Arabian Sea at 03 UTC of January 15</i>	1004 hPa at 0900 UTC of January 14 near 7.0/73.0	30 kt at 0300 UTC of January 14	T 2.0
Very severe cyclonic storm "MALA" over Bay of Bengal April 25-29	April 25, 0300 UTC near 9.5/90.5	Crossed the Arakan Coast 100 Km south of Sandoway around 0700 UTC of April 29 as Very Severe Cyclonic Storm	954 hPa at 0900 UTC of April 28 near 15.3/92.3)	100 kt at 0900 UTC of April 28	T 5.5
Deep depression over Bay of Bengal July 02-05	July 02, 0000 UTC near 20.0 / 89.5	Crossed Orissa coast between Paradip and Chandbali around 1500 UTC of July 02	982 hPa at 0300 UTC of July 02 near 20.5/87.0	30 kt at 0300 UTC of July 02	T 2.0
Deep depression over Bay of Bengal August 02-05	August 02, 0300 UTC near 20.5 / 87.5	Crossed Orissa coast between Puri and Gopalpur around 0300 UTC of August 03	986 hPa at 1200 UTC of August 02 near 20.0/86.5	30 kt at 0900 UTC of August 02	T 2.0
Depression over Bay of Bengal, August 12-13	August 12, 0300 UTC near 21.0 / 88.0	Crossed Orissa coast near Balasore around 15 UTC of August 12	992 hPa at 0300 UTC of August 12 Near 21.0/88.0	25 kt at 0300 UTC of August 12	1.5
Depression over Bay of Bengal August 16-18	August 16, 0300 UTC near 20.5/ 88.0	Crossed north Orissa coast near Chandbali around 1430 UTC of August 16	988 hPa at 1500 UTC of August 16 Near 20.5/86.5	25 kt at 0300 UTC of August 16	T 1.5
Depression over Bay of Bengal, August 29 to September 01	August 29 0300 UTC near 20.5 / 87.5	Crossed north Orissa coast near Paradip around noon of August 29	990 hPa at 1200 UTC of August 29 Near 21.0/85.0	25 kt at 0300 UTC of August 29	T 1.5
Depression over Bay of Bengal September 03-04	September 03, 1200 UTC near 20.5/88.5	Crossed north Orissa coast near Chandbali around 01 UTC of September 04	992 hPa at 1200 UTC of September 03, Near 20.5/88.5	25 kt at 0300 UTC of September 03	T 1.5
Land depression September 21-24	September 21, 0300 UTC near 23.0/ 86.5	-----	996 hPa at 0000 UTC of September 21 Near 23.0/86.5	25 kt at 0300 UTC of September 21	
<i>Severe Cyclonic Storm, "MUKDA" over Arabian Sea September 21-24</i>	September 21, 0300 UTC near 19.5/66.0	<i>Weakened over the east-central Arabian Sea around mid-night of September 24</i>	988 hPa at 2100 UTC of September 22, Near 20.5/66.5	55 kt at 1500 UTC of September 23	T 3.5
Depression over Bay of Bengal September 28-30	September 28, 0900 UTC near 18.0/89.0	Crossed Orissa coast close to Gopalpur around 12 UTC of September 29	1002 hPa at 0900 UTC of September 28, Near 18.0/89.0	25 kt at 0900 UTC of September 28	T 1.5
<i>Cyclonic storm "OGNI" over Bay of Bengal October 29 to 30</i>	October 29, 0300 UTC near 14.5/80.5	<i>Crossed Andhra Pradesh coast close to Bapatla around 0730 UTC of October 30</i>	988 hPa at 1200 UTC of October 29, near 15.0/80.5	45 kt at 1200 UTC of October 29,	T 2.5

Table 2.4

**Statistical data relating to cyclonic disturbances
over the north Indian Ocean during 2006**

A) Monthly frequencies and total lifetime of cyclonic disturbances (CI \geq 1.5)

S.No	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Life Time in (Days)
1.	D								↔↔↔ ↔	↔↔↔ ↔*				15.75
2.	DD	↔						↔	↔					6.25
3.	CS										↔			3.38
4.	SCS									↔				2.00
5.	VSCS				↔									1.96
6.	SuCS													---

* Land depression

B) Frequency distribution of cyclonic disturbances of different intensities based on satellite assessment.

CI No.	≥ 1.5	≥ 2.0	≥ 2.5	≥ 3.0	≥ 4.0	≥ 5.0	≥ 6.0	≥ 7.0
No. of disturbances	12	6	3	2	1	1	-	-

C) Basin-wise distribution of cyclonic disturbances

Bay of Bengal	9
Arabian Sea	2
Land depression	1

APPENDIX V

TERMS OF REFERENCE AND MEMBERSHIP OF THE WORKING GROUP ON THE COORDINATED TECHNICAL PLAN (CTP)

OVERALL FRAMEWORK OF THE CTP (2006-2010)

Visions of the Panel

The Panel adopted the following visions:

- a. To provide high quality tropical cyclone forecasts and warnings by highly trained professionals using the best available technology to mitigate the effects of tropical cyclone disasters
- b. To obtain through effective tropical cyclone disaster mitigation and water resource management for humanitarian, social, and economic benefits to achieve maximum sustainable development and
- c. To derive maximum benefits to provide the high quality forecasts and warnings and effective mitigation actions through combining resources, sharing of meteorological and hydrological data, sharing of experiences in disaster prevention and preparedness and cooperative and collaborative research and training.

Emerging prioritized overall goal

To establish an effective integrated regional early warning system for hydro-meteorological disasters in the Panel's Area covering all the five components of the WMO/ESCAP Panel on Tropical cyclones.

Specific objectives

To develop an effective mechanism and subsequently a regional project for the establishment of an integrated regional early warning system for hydro-meteorological disasters in the Panel's Area.

To mobilize resources for an early implementation of the above objectives

1. METEOROLOGY

Broad Goal

To establish an efficient EXPANDED observational network, to provide accurate and timely forecasts and warnings and to reduce loss of lives and properties that may be caused by tropical cyclones and associated phenomena. These goals are expected to be achieved through the latest technology, improved exchange of data and development of skills of personnel of the panel through national, bilateral and regional programs.

Specific objectives

1.1 To improve and expand the observing system of surface, upper-air, ship, buoy, aircraft, radar and satellite observations in all the Panel Countries by at least 10 percent in the next two years (2005-2006) and by 20 percent during the five year period (2006-2010).

1.2 To improve through national, bilateral and regional programs the telecommunication systems by upgrading the existing point to point teleprinter circuits at least to 64 kbps digital TCP/IP operation in the next two years (2005-2006), by internet email, ftp , VPN and mobile wireless technology and augmenting the above with the regional satellite broadcast receiving systems. To organize training of personnel in the operation and maintenance of the telecommunication system in the panel countries also on high priority and whenever necessary.

1.3 To upgrade the computing facility of RSMC New Delhi (2006-2007) so as to facilitate efficient data processing and data assimilation from different observing systems / platforms to run high-resolution global, regional and mesoscale numerical models and ensemble prediction system for generating products - their retrieval, display and compositing to suit the needs of the NMHSs in the region.

1.4 To develop regional plans for utilization of these NWP products for their integrated developments of storm surge prediction models.

1.5 To promote exchange of information among the Panel Members to enhance regional cooperation in meteorology.

Priority projects

1.1 Upgrading of observational network in member countries, wherever necessary.

1.2 Upgrading of computing facility at RSMC New Delhi to generate improved NWP products for use by all Panel Members.

1.3 Strengthening regional cooperation mechanism on data and information exchange among the Members.

2. HYDROLOGY

Broad Goal: To formulate accurate and timely forecasts and warnings on floods and other water related hazards with a view to support preparedness and response mechanisms among the member countries.

Specific Objectives:

To improve regional cooperation in real time monitoring and exchange of relevant data and information and technical expertise related to all hydrological hazards by Developing and implementing regional information exchange strategy during 2005-06.

Organizing regional workshops on data transmission mechanisms with special reference to water related hazards and sharing information through PTC web site.

Collaborating with Commission for Hydrology (CHy).

To improve flood forecasts and warnings particularly in deltaic and coastal areas by coupling meteorological storm surge forecasts with river flow forecasting by developing delta hydraulic models for river forecasting by coupling MIKE 11 (or any other model being used in the countries) with the storm surge forecasts for at least one river delta in each country during the next five years.

Organizing workshops for enhancing the capabilities of the countries to meet above objectives. and

Collaborating with CHy in the preparation of flood forecasting manual.

To enhance regional capabilities relating to flood hazard mapping in delta and coastal regions through continued interaction with the user agencies by undertaking flood hazard mapping at least in one major delta/coastal area in each country during the next five years.

Organizing workshops for capacity building.

Collaborating and sharing experiences with Typhoon Committee.

Priority projects

- 2.1 Improved flood forecasting services and capacity building
- 2.2 Priority cooperation area on flash flood forecasting
- 2.3 Pilot projects on flood inundation and hazard mapping

DISASTER PREVENTION AND PREPAREDNESS

Broad Goal

To improve disaster prevention and preparedness in the region including enhanced public awareness, establishment of institutional and legal framework and participation of stakeholders for more effective disaster management. These are expected to be achieved through improvement in standard procedures on DPP and exchange of national and international experiences and information on disaster management among the Panel Members.

Specific objectives

3.1 To improve regional cooperation in policies and strategies on DPP, especially those related to tropical cyclones by

3.1.1 Establishing a regional information system to support development of policies and strategies on DPP at the regional level as well as at the national level by creating a regional database on disaster information and best practices on DPP from 2006 onward.

3.1.2 Improving public awareness of the impacts of tropical cyclones and possible mitigation and response actions through effective communication with the media prior to, during, and after tropical cyclone occurrences.

3.1.3 Improving coordination and interaction between meteorological/hydrological services on the one hand and emergency management/disaster response agencies on the other through integrated emergency management, disaster response and preparedness programs.

3.2 Strengthening regional cooperation on DPP information exchange through networking by making available disaster preparedness and mitigation information through Internet web sites and other means.

3.3 Improving disaster risk management, especially those related to cyclone-related disaster preparedness by developing and implementing national pilot projects on multi-hazard disaster risk management programmes into the development plan of the Panel Members in the next five years.

3.4 Facilitating improved awareness through video programmes on tropical cyclone preparedness.

Priority projects

3.1 Improved community-based disaster risk management.

3.2 Implementation of the Hyogo Framework for Action in the Subregion of the Panel on Tropical Cyclones.

3.3 Regional cooperation on mainstreaming disaster risk reduction in the education curriculum.

4. TRAINING

Broad Goal

To enhance capacity building through strengthening skills of personnel engaged in various aspects of cyclone-related disaster management through regular training programmes including organization of workshops, seminars etc.

Specific objectives

Arrange training programmes on the use of NWP model products, Doppler Weather Radar products and their application in cyclone forecasting (track and intensity) and storm surge prediction.

Media coordination during disasters and their effectiveness on “human response”

Arrange exchange visits of faculty members among Member countries to share their experiences and expertise on cyclone & related disaster management aspects.

Introduction of “Disaster Management” in the High School curricula.

Priority projects

4.1 Training on the use of NWP model products, Doppler Weather Radar products and their application in cyclone forecasting (track and intensity) and storm surge prediction.

4.2 Exchange visits of faculty members among Member countries to share their experiences and expertise on cyclone & related disaster management aspects.

4.3 Institutionalization of training on modeling of storm surge and tsunami propagation.

4.4 Training on hydraulic modeling of extreme events including dam break.

5. RESEARCH

Broad Goal

To collaborate on research activities related to updating forecasting technologies, including NWP, storm surge and flood forecasting models.

Specific objectives

To take up as a pilot R&D project on coupling of storm surge and flood forecast model over a specific river Basin (say Mahanadi) for coastal inundation and river flood forecast.

Updating of vulnerability maps for various parameters like wind force /peak storm surge etc. based on latest available database.

APPENDIX VI

SUMMARY OF THE METEOROLOGICAL ACTIVITIES OF THE MEMBERS

BANGLADESH

Observations and Basic observing networks

A total of 35 synoptic stations are in operation in Bangladesh. BMD has also 10 Pilot Balloon stations and 3 Rawinsonde stations. All observed data are received and gathered at the National Meteorological Communication Centre, Dhaka and transmitted through GTS to RSMC New Delhi.

Dhaka Rawinsonde station has only one observation at 0000 UTC in a day. The Rawinsonde equipment in Dhaka, which has been provided under WMO/VCP project, became operational in December 1993 and was upgraded to GPS system in 1998. BMD has installed a new RS system at Chittagong in 2006 and planning to replace the old RS system at Bogra.

At present one observation at 0000 UTC is made at Dhaka and Chittagong. Bangladesh is facing difficulties in maintaining these observations due to financial constraints. During the tropical cyclone formation, rawinsonde observations are important to determine the steering current for the prediction of cyclone track. In this regard, BMD should have four stations in total at Dhaka, Chittagong, Barisal and Bogra. Assistance from WMO or any donor agency is essential to replace equipment at Bogra and establishment of a new station at Barisal.

Two high-gust anemometers are in operation over the country. The instrument including that at Cox's Bazar was installed in May 1992 with funds from the UNDP/WMO regional project.

Four 10 cm S-band radars with modern facilities are operated at very strategic points at Dhaka, Khepupara, Cox's Bazar and Rangpur each with a scanning radius of 400 km. Among them the Radars at Khepupara and Cox's Bazar were provided for storm warning purposes. These two radars at Cox's Bazar radar are being replaced with Doppler facilities by JICA Assistance. Communication link is also upgraded with the connection of VSAT link. Up gradation of Khepupara radar with Doppler facilities is expected to be completed in March 2008.

For real time weather monitoring, a dedicated network between SWC and observatories of BMD is in final stage under the assistance of Comprehensive Disaster Management Programme (CDMP) and likely to be completed within June 2007.

SWC receives Numerical Weather Prediction (NWP) and World's Area Forecast (WAFS) products from Bracknell, UK and also from NCMRWF, India through Internet.

Network of meteorological observations in BMD:

Type of station	No. of station	Remarks
Synoptic <ul style="list-style-type: none"> • RBSN-SYNOP • RBSN-CLIMATE • RBSN-TEMP 	35 35 35 03	The network gives and average density of a synoptic station per 4,100 km ² .
Upper-air <ul style="list-style-type: none"> • Rawinsonde stations • Pilot balloon stations 	03 10	Three Rawinsonde stations, but two stations are in operation now and take one observation at 0000 UTC a day. Other one is obsolete. Ten pilot balloon stations carrying out observations four times a day. Because of the establishment of the Hydrogen Plant in BMD, the gas production is regular and uninterrupted. As a result, the regularity of pilot balloon observations has become uninterrupted.
Weather radar	04	10 cm S-band radars at Dhaka and Rangpur are in full operation. The replacement of Cox's Bazar radar with Doppler facilities is going on with Doppler facilities. The replacement of Khepupara radar is expected to complete within June 2008. For flood monitoring establishment of a new Doppler Radar at Moulavi Bazar (north eastern part of the country) is in process and likely to complete within 2007.
AWS	02	Operating in ZIA International Airport Kurmitola, Dhaka and Shah Amanat International Airport at Patenga, Chittagong.
Agrometeorological stations	12	Are in operation.
Climatological stations	35	Are in operation.
Rainfall stations	35	Are in operation.
Aeronautical stations	09	Are in operation.
Evaporation stations	12	Are in operation.
Marine meteorological station <ul style="list-style-type: none"> • Ship 	01 03	Working at Chittagong Sea Port
Satellite receiving station	03	Establishment of MTSAT ground receiving station is completed and testing working going on. NOAA ground receiving station is not working due to problem antenna system. Experts are trying to solve the problem and hopefully it will solve immediately. INSAT ground receiving station is not functional as it has not been upgraded from analog to digital mode.
Others Seismological stations	01	Establishment of three new Seismological Observatories at Dhaka, Rangpur, Sylhet and the modernization of the existing one at Chittagong and networking between them are in final stage and are likely to be completed by 2007.

Telecommunication Systems

Automation of telecommunication system.

- National telecommunication networks.

35 BMD Stations are connected to the Dhaka NMCC.

Data from RTH New Delhi and 10 synoptic observatories of BMD are exchanged on routine basis through WMO's GTS. All the 35 observatories of BMD have been connected with NMCC Dhaka either by TP or Telephone and single sideband (SSB) etc. or by all the three systems. The communication between Radar Station at Cox's Bazar and Storm Warning Centre (SWC) has been upgraded with **VSAT link** and the same between Radar Station at Khepupara will also be upgraded with **VSAT link**. NMCC uses MSS software obtained from WMO/UNDP Regional Computer Network programme for reception and transmission of all meteorological data.

GTS circuits

Dhaka is linked with New Delhi through a circuit of speed of 2400 bps. The circuit is now operational through HP Computer Hardware/Software supplied by Bureau of Meteorology, Australia under Japan Grant Aid Assistance.

Status of implementation of GTS circuits

Circuits Dhaka	Type of GTS	Status of implementation	Future plan
New Delhi	Regional circuit	2400 bps.	64 kbps to be completed in June 2007

The existing speed of GTS is only 2400 bps and should be upgraded up to 64 kbps. In this respect, BMD requested WMO to take initiative and accordingly WMO sent an Expert Team to assess the existing GTS and also Tsunami Warning.

WMO has taken the necessary steps for the up-gradation of the GTS-link up to 64 kbps as an aid and the project is supposed to be completed this financial year.

Establishment of three new Seismological Observatories at Dhaka, Rangpur, Sylhet and the modernization of the existing one at Chittagong and networking between them is in final stage and is likely to be completed June by 2007.

Weather Forecasting

Weather forecasting services

The Storm Warning Centre of BMD issues routine day-to-day weather forecasts and tropical cyclone warnings. Two Main Meteorological Offices carry out aviation weather forecasting; one is at ZIA International Airport, Kurmitola, Dhaka and the other at Shah Amanat International Airport at Patenga, Chittagong.

Except aviation weather forecasts, which are issued by Meteorological Offices at Zia International Airport at Dhaka and eight other airports, major weather forecasts are issued by the Storm Warning Centre. Cyclone bulletins for national and international users in various sectors are issued at frequent intervals whenever cyclones develop in the Bay of Bengal and there has been so far much achievement in reducing human loss and properties in this way. BMD is going to simplify signal system in relation to cyclone intensity and location for further easy understanding of the public. However, due to issuance of timely and accurate forecasts and warnings by BMD and the preparedness and mitigation measures by CPP and the Government of Bangladesh, it has now been possible to reduce the loss of lives and damage to properties significantly.

Dissemination of Cyclone Forecasts and Warnings

The dissemination of cyclone information such as cyclone forecasts and warnings is an important task of disaster preparedness in Bangladesh. BMD plays an important role by initiating the warnings related to the formation of tropical disturbances in the Bay of Bengal and transmitting the warnings to Cyclone Preparedness Programme (CPP) as per **Standing Orders on Disaster**. When the CPP control room in Dhaka receives special weather bulletins for tropical cyclones from the Storm Warning Centre of BMD, they transmit them without delay to the local authorities through the wireless network. The warnings and special weather bulletins are also disseminated to the Disaster Management Bureau, important Govt. Organizations, BTV, Radio, mass media, etc. Special weather bulletins are telecast and broadcast through national and private televisions and radio. All the organizations work as per **Standing Orders of Bangladesh Government** during disasters.

National dailies publish weather bulletins regularly, which in turn help increase public awareness.

There are nearly 2300 cyclone shelters but the country needs 2500 shelters or more along its 710 km coastal belt.

NWP activities

Government of Bangladesh has approved the project of Numerical Weather Prediction (NWP) with own money. Construction work for NWP system has been completed. Work about appointment of consultant is going on. It is expected that establishment of NWP system is likely to complete by 2007.

Climatological Services

Computerized system for climate data management

CLICOM system has not yet been installed in BMD. BMD requested WMO for assistance in the last WMO Congress. Afterwards action is not known.

Data storage and climatological publications

Data storage and archiving are regular in Bangladesh Meteorological Department. BMD supplies the Meteorological Data to the end users and also for research purposes with minimum charge. The system needs upgrading.

Climate change-related activities

Climate change related activity is limited. Bangladesh Meteorological Department (BMD), Bangladesh University of Engineering and Technology (BUET), Space Research and Remote Sensing Organization (SPARRSO) and Department of Environment (DOE) have jointly work on Climate Change in Bangladesh by using PRECIS Model of Hadley Centre, U.K. BMD has already received the model with computer facility through DOE and the work is in progress.

The climate change related activities and participation in IPCC meeting have been hampered because of the indecision about the designation of BMD as Focal Point. The Department of Environment (DOE) has been claiming to be the Focal Point in Bangladesh. The DOE may be the Signatory of UNFCCC, which is completely different from IPCC. Since IPCC is intimately connected with climate change activities to which the NMSs are related, the Heads of the National Meteorological Services including BMD should be the Focal Point of IPCC. In this regard, suitable recommendation may be made.

Meteorological Satellites

INSAT MDD Receiving System was installed at Storm Warning Centre, Dhaka and the System was fully operational for reception of Satellite image, Cloud Motion Vector (CMV) and Outgoing Longwave Radiation (OLR) charts along with GTS and aviation data (METAR, SPECI etc.). But because of the change of INSAT from analogue to digital system, INSAT Ground Receiving System (MDD) at BMD can not receive INSAT images nor can it receive GTS and other mentioned data and charts. The system needs to be upgraded into digital System. In this regards, BMD contacted with PEC Ltd., Nitel India and IMD. Recently PEC Ltd. has sent an offer to BMD for upgradation of the INSAT MDD system.

BMD has NOAA and GMS Satellite Receiving Stations, but because of the lack of alignment of its GPS system and for launching of new MTSAT by Japan due to expiry of GMS, BMD does not receive any cloud imageries from NOAA and GMS.

Establishment of MTSAT ground receiving station is completed and testing work is going on. NOAA ground receiving station is not working due to problem in antenna system. Experts are trying to solve the problem and hopefully it will be solved immediately.

Chinese FY-series of geostationary satellite over about 110° E longitude is nearerto the Bay of Bengal and so its imageries are obviously of better use to the meteorologists of Bangladesh. FY satellite receiving system can be installed at BMD for monitoring Tropical Cyclones in a better way. BMD has received PC VSAT System from China under VCP programme in July 2006, but it awaitng for commissioning due to the arrival of experts from China. Correspondences between BMD and CMA are going on.

BMD has also SADIS system for receiving ECMWF NWP Forecast charts, WAFS charts and upper air charts through VSAT. It has become inoperative due to fault developed with the receiver. Assistance is required in this respect.

Tropical Cyclone Names

BMD is practicing naming convention of Tropical Cyclones formed in the Bay of Bengal since the cyclone season of 2006.

BMD feels that the Tropical Cyclones formed in the Bay of Bengal and the Arabian Sea should be named as practised in other tropical basins.

ICAO: Aeronautical Meteorological Services in Bangladesh

The Bangladesh Meteorological Department operates nine Aeronautical Meteorological Offices (one at Dhaka International Airport and eight at other airports) for supporting aviation. Bangladesh Meteorological Department provides all sorts of meteorological information to the Civil Aviation Authority. BMD follows all the rules and regulations. Civil Aviation Authority may be requested to provide necessary assistance for updating, maintaining and replacement of equipments.

Development Plans of BMD:

To equip BMD with the latest technicalities and attain advancement in forecasting as well as other fields of Meteorology, a number of projects have been taken up:

On-going Projects:

- Improvement of Seismological Services.
- Establishment of Numerical Weather Prediction System.
- Improvement of Meteorological Radar System at Cox's Bazar & Khepupara.
- Meteorological cum Hydrological S-Band Doppler Radar at Moulvi Bazar Radar.

Long-term Development Plans:

- Upgradation of BMD's Data Collection and Processing System with Automation and Networking.
- Upgradation of GTS Link from 2,400 bps to 64 kbps at National Meteorological Communication Centre (NMCC) at Dhaka.
- Modernization of Data Processing and Archiving System of Climate Division of BMD Head Office. Suitable climatological software for climate data processing (input, retrieval etc.) will be required. In this respect, BMD need assistance from WMO/any Donor agency.
- Upgradation of the Training Institute and Research & Development Cell. Higher Training Courses on Electronic, Communication and mechanical Engineering and Meteorology need to be introduced. One consultant should be appointed in this respect to evaluate the needs for the upgradation of Meteorological Training Institute and the R & D Cell established in the Institute.
- Human capacity building on operational weather analysis & forecasting and relevant technical issues.

Assistance is required for upgradation of the Meteorological Training Institute and the R & D Cell of BMD as well as for the capacity building with higher training/degree in Meteorology.

INDIA

1. Meteorology

- 1) A newly designed DIWE system will also be installed at the stations where HWSRs are installed in due course.
- 2) Installation of 125 AWS received from M/s Sutron, USA and M/s Astra is in progress.
- 3) Procurement of 500 Automatic Raining Stations (ARS) to replace all DRMS sites by ARS is in final stage.
- 4) In addition, it is planned to procure 900 AWS & 4000 ARS within the next few years to upgrade all part time observatories by AWS and DRMS stations by ARS. The Department is planning for more DWRs.
- 5) Radiosonde MK–III introduced in the network in early 70's, is being further improved. Both the Lithium Chloride and Baroswitches for the Radiosonde are manufactured indigenously.
- 6) A new Radiosonde IMD MK–IV with automatic acquisition and processing system has been installed for improved performance, with baroswitch, thermistor and carbon Hygristor sensors. Further improvement of Radiosonde is under progress.
- 7) The proposals of replacing conventional RADARs by latest state of art S–band imported DWR at Mumbai and Paradip and with indigenous DWRs at Bhuj and Kochi respectively are being approved. Indigenous RADARs are expected to be installed at Bhuj and Kochi by March, 2008..
- 8) The IMD is contemplating installation of wind profilers to get reliable wind data in future.
- 9) Action is in progress for upgradation of MDD into Digital type.
- 10) Procurement of DCWDS is in progress to replace the existing CWDS and to add fifty more into the network.
- 11) About 40 Digital MDD stations will be installed by 2007.
- 12) INSAT–3D is scheduled to be launched in the last quarter of 2007, which will have 6 channel imager and 19 channel sounder as meteorological pay–load.
- 13) AODT technique will be introduced in INSAT–3D to give centre and intensity of Tropical Cyclone automatically.
- 14) Fifty low cost meteorological Buoys are planned in the Bay of Bengal and Arabian Sea before September 2007.

1.2 IMD maintains an extensive Telecommunication network with a central hub in Mausam Bhavan, New Delhi. The Regional Telecommunication Hub (RTH), New Delhi, located on the Main Trunk Network (MTN) is the core network of GTS. RTH New Delhi is directly connected with World Meteorological Center (WMC) Moscow (Frame relay), RTH Tokyo (Frame relay) and RTH Cairo on the MTN. RTH New Delhi is also directly connected with RTH Beijing (Frame Relay), RTH Jeddah and WMC Melbourne located on the MTN, RTHs Bangkok and Tehran and National Meteorological Centers (NMCs) Colombo, Dhaka, Karachi, Kathmandu, Male, Muscat and Yangon in the Regional Meteorological Telecommunication Networks

(RMTNs). Present status of circuits in the GTS connected with RTH New Delhi is given at Attachment I.

The National Meteorological Telecommunication network consists of 10 high speed (64 Kbps), 2 medium speed (2400 bps), 34 slow speed teleprinter links, 10 Satellite based data reception system by using M/s. World Space Technology, 4 integrated data reception and analysis system, 73 Telefax facilities, 67 stations having HF/RT facility, 47 stations with VHF (including Walkie- Talkie) facility, 51 Internet stations, 14 VSAT (Micro-Earth Stations), 5 Stations with Automatic Message System (AMSS) and 4 PC based Current Weather Display System.

Meteorological Data and processed products containing 3 hourly INSAT imageries, surface and upper air data, aerodrome forecast, Wx. Charts and model outputs, etc. exchanged over GTS are broadcast using World Space "Asia Star" Satellite. The broadcast covers large areas of Middle- East and South- East Asia.

IMD's website (<http://www.imd.ernet.in>) is operational since 1st June, 2000. All the forecasting products like Charts, Warnings, Satellite Imageries, Rainfall information are placed and timely updated in IMD's website. Another website <http://www.imd.gov.in> is also operational. The Regional Meteorological Centers are also having their own websites and many stations have been provided with internet facility. On account of increasing demand of public to view IMD's website and to avoid choking of these links, Telecom Division has already upgraded these links through service providers by increasing bandwidth from 128 Kbps to 2 Mbps for the website ernet.in and from 2 Mbps to 4 Mbps for the website gov.in.

Popularly known as "Weather on phone", the Interactive Voice Response System (IVRS) is functioning with effect from July, 2000. One can access current weather and forecast for major Indian cities by dialing Toll free number 1800 180 1717. More cities are likely to be covered in future with this facility.

A receive only Satellite Data Dissemination System (SADIS) is in operation at New Delhi to receive aeronautical meteorological information from International Civil Aviation organization (ICAO) centers which are routed to four International Airports of India for National and International flight briefing and for providing data in GRIB/ BUFR format for wind/ temperature and sig. Wx. Charts.

Under the new marine meteorological broadcast system GMDSS (Global Maritime Distress Safety System) of WMO/ IMO, IMD Bulletins are broadcast through INMARSAT Safety Net System.

A network of 14 VSATs have been installed at selected seismological observatories, Cyclone Detection Radar Stations, Cyclone Warning Centers and Meteorological Centers for reception of observational data utilizing communication transponder of INSAT.

Ongoing projects for modernization of IMD's communication facilities:-

Following are the ongoing projects for modernisation of IMD's Communication facilities.

- (1) IVRS at 26 observatories
- (2) High Speed (64 Kbps) Data terminals at 27 observatories + 6 IAF stations.
- (3) VSAT stations at observatories (26 Stations)
- (4) Establishment of Data Terminal at 64 observatories.
- (5) Upgradation of RTH New Delhi, Replacement of AMSS at Gauhati and installation of AMSS at Nagpur.

ATTACHMENT - 1**Present Status and future plans of Circuits in the GTS connected with RTH, New Delhi**

Circuit	Present operational status	Future plans and Status of upgradation
New Delhi-Moscow	*FR 64 KBPS	
New Delhi-Tokyo	*FR 64 KBPS	
New Delhi-Beijing	*FR 64 KBPS	
New Delhi-Jeddah	64 KBPS	
New Delhi-Cairo	100 baud	
New Delhi-Bangkok	200 baud	
New Delhi-Melbourne	Internet	
New Delhi-Male	Internet	-
New Delhi-Karachi	64 KBPS	-
New Delhi-Muscat	Internet	
New Delhi-Dhaka	9.6 KBPS	Upgradation to 64 Kbps is under progress.
New Delhi-Yangon	50 baud	Yangon informed that they are getting through satellite broadcast via Beijing. Introduction of GTS TCP/IP for 64 Kbps with New Delhi depends on WMO assistance under WMO/IOC projects.
New Delhi-Tehran	75 baud	
New Delhi-Colombo	50 baud	RTH New Delhi is ready to upgrade the circuit to 64 Kbps. Colombo informed that USTDA is trying to help upgradation under Tsunami Disaster Theme.
New Delhi-Kathmandu	50 baud	The matter is under consideration with Met. Kathmandu Adminsitration.

* Frame Relay (FR) links connecting New Delhi with Moscow, Tokyo and Beijing are using one 64 KBPS link and shared among these three circuits. The transmission speed is variable with a minimum of 16 KBPS for alphanumeric data

and 16 KBPS for binary data on New Delhi-Tokyo/Tokyo-New Delhi circuit; 8 KBPS for alphanumeric data/binary data on New Delhi-Moscow/Moscow-New Delhi and also New Delhi-Beijing/Beijing-New Delhi circuits.

RTH New Delhi has plans to use VPN circuits (64 Kbps) as replacement of leased circuits with National centres.

NWP activities of IMD

At present, IMD operates regional models (namely, LAM, MM5 and QLM) using two computer servers (Altix-350 and Origin 200). A 12 CPU computer system has been under process and expected to be available by March 2007. Recently following modifications have been made in the NWP system of IMD:

(a) The Quasi-Lagrangian Model (QLM) which has been used (at the resolution of $0.4^{\circ} \times 0.4^{\circ}$ Lat./Long.) for cyclone track prediction for the forecast up to 72 hours has been modified to receive inputs from the Global forecast System (GFS) of NCEP readily available on the Internet at the resolution of $0.1^{\circ} \times 0.1^{\circ}$ Lat./Long. and to delink the model from the spectral form of T-80 (NCMRWF) inputs with which the original version of the model was tied up in IMD.

(b) The Limited Area Model (LAM) is further modified increasing the horizontal resolution from $0.75^{\circ} \times 0.75^{\circ}$ Lat./Long. to $0.5^{\circ} \times 0.5^{\circ}$ Lat./Long. and vertical resolution from 16 sigma levels to 18 sigma levels. The code is made flexible to prepare initial and boundary conditions from the outputs of Global Forecast System (GFS) of NCEP readily available on the Internet at the resolution of $1^{\circ} \times 1^{\circ}$ Lat./Long. and to delink the model from the T-80 (NCMRWF) inputs with which the original version of the model was tied up. The forecast period is extended from 48 hours to 72 hours. The upgraded model has been run in test mode during monsoon 2006 and IMD plans to implement the model for operational forecasting during monsoon 2007. The meso-scale model WRF has been implemented in the experimental mode. IMD plans to run the WRF model for operational use by June 2007. A four members multi-model ensemble technique has been implemented in test mode for rainfall prediction during monsoon 2006. IMD plans to implement the technique for operational forecasting during monsoon 2007.

IMD plans to implement the latest cyclone prediction model namely Hurricane WRF in collaboration with NCEP by September 2007. The output of the model Hurricane WRF have the potential to provide inputs to the storm surge model.

A report entitled "Probable maximum storm surge heights for the maritime districts of India" has been under finalization and is expected to be available soon as a published report of IMD. The report present the Probable Maximum Storm Surge (PMSS) values for each coastal district of the Indian maritime states.

Under the modernization programme of IMD work has been in progress to acquire a High Performance Computing System, which is expected to be available at IMD in an year's time. This will give thrust to the NWP activities at IMD, as IMD plans to implement an advanced NWP system consisting of Global Spectral model and high resolution mesoscale models.

Work has been in progress for acquiring a 12 CPU Computer Server which is expected to be available by April 2007. Following NWP activities are in progress at RSMC New Delhi:

- (a) The mesoscale model **Weather Research and Forecasting** (WRF) has been implemented in the experimental mode. IMD plans to run the WRF model for operational use by June 2007.
- (b) A four number multimodel ensemble technique has been implemented in test mode for rainfall prediction during monsoon 2006. IMD plans to implement the technique for operational forecasting during monsoon 2007.
- (c) IMD plans to implement the latest cyclone prediction model namely Hurricane WRF in collaboration with NCEP by September 2007. The outputs of the model Hurricane WRF have the potential to provide inputs to the storm surge model.

A Surface Observatory Network:

(i) High Wind Speed Recorders

This office has installed 10 sets of High Wind Speed Recording Systems (Ultrasonic type) at East and West coast stations of India as per recommendations of ACR meeting during Oct. 2000 - May 2001. Also, 10 more systems of HWSR, procured under World Bank Project were installed at West Bengal, Orissa, Andhra Pradesh and Tamil Nadu Coast. In addition, a newly designed DIWE system will also be installed at these stations in due course.

(ii) AWS Network

Under the scheme "Replacement of old and obsolete DCPs with the state of art Automatic Weather Station", 100 SUTRON make AWS systems and 25 ASTRA make AWS systems have been installed and 23 out of 100 SUTRON make AWS systems have been installed till date. One AWS data receiving Earth Station in redundant mode has been installed in INSAT-AWS Laboratory, Pashan, Pune in July 2006. Real time AWS data from 53 AWS sites are being received at Pune Receiving Earth Station. From Pune Receiving Earth Station, hourly data is being sent to AMSS Mumbai through dedicated lease line for onward transmission through GTS to different users. Quality of AWS data from new AWS stations is under evaluation.

Scheme of establishing 500 numbers of satellites linked Automatic Raingauge (ARG) Stations is in advance stage of procurement.

Future Plans:

Several developmental schemes/plans are under way at different stages. Some of these are:

- 1) Installation of 125 AWS received from M/s Sutron, USA and M/s Astra is in progress.
- 2) Procurement of 500 Automatic Raingauges Stations (ARS) to replace all DRMS sites by ARS is in final stage.
- 3) In addition, it is planned to procure 900 AWS & 4000 ARS within the next few years to upgrade all part time observatories by AWS and DRMS stations by ARS.

4) Modernization of Voluntary Observing Fleets (50 nos). Scheme has been forwarded to HQ for approval.

5) Construction of 'Test and Evaluation laboratory' and Seismo Observatory and Extension of AWS building.

B Upper Air Network:

a) RS/RW stations and Pilot Balloon observatories:

There are 39 observatories, which perform twice daily the Radiosonde ascents and provide PTU data and wind data, while two observatories at Kochi and Jaipur provide only RS data and not the wind data. In addition to this there are 62 Pilot Balloon observatories. The network has been expanded and being updated gradually for use in operational work of weather analysis and forecasting as per WMO standard. The ground reception system used in the network is of mixed type such as 1680 MHz, IMS – 1500 Radioteodolite and indigenously developed 401 MHz SAMEER tracking theodolites. In other stations Radiosonde Ground Equipments (RSGES) are used in association with wind finding RADARS.

Radiosonde MK–III introduced in the network in early 70's, is being further improved. Both the Lithium Chloride and Baroswitches for the Radiosonde are manufactured indigenously.

A new Radiosonde IMD MK–IV with automatic acquisition and processing system has been installed for improved performance, with baroswitch, thermistor and carbon Hygistor sensors. Further improvement of Radiosonde is under progress in collaboration with SAMEER Mumbai, SCL Chandigarh and GATEC Hyderabad.

b) Cyclone Detection RADAR:

There are 11 nos. of S–band CDR stations out of which 6 are using conventional RADARs, 4 stations viz. Chennai, Kolkata, Machilipatnam and Visakhapatnam have DWRs imported from M/s. Gematronik, Germany and one station SHAR, Sriharikota has indigenous DWR developed by ISRO. DWR at Visakhapatnam became operational with effect from 27th July 2006.

Future Plans:

There is a proposal to expand the Upper Air Network.

The proposals of replacing conventional RADARs by latest state of art S–band imported DWR at Mumbai and Paradip and with indigenous DWRs at Bhuj and Kochi respectively have been approved in C.M.A S. The supply order for indigenous RADAR have been placed on 29.03.2006 on M/s. BEL, Bangalore and the RADARs are expected to be installed at Bhuj and Kochi by March, 2008. The EFC proposal for the imported RADARs has been approved by MoES and is presently with Planning Commission for further approval in principal.

There is no approved scheme for upgradation of RS Kochi to RS/RW station. The IMD is contemplating installation of wind profilers to get reliable wind data in future.

However exact numbers and site of installation is yet to be finalised.

C Meteorological Satellites:

a) Analog Cyclone Warning Dissemination System (CWDS):

For speedy dissemination of Cyclone Warnings in the East & West Coast areas of India 250 Nos. of Cyclone Warning Dissemination System (CWDS) working through INSAT were installed by IMD during the period 1985-95. These are very useful for quick and timely dissemination of Cyclone Warning messages to the concerned State Govt. Authorities in maritime states. All these analogue receivers shall be replaced with Digital CWDS in next 2 years.

b) Digital Cyclone Warning Dissemination System (DCWDS)

IMD has also procured 100 Nos. of Digital Cyclone Warning Dissemination system with state of art technology in Andhra Pradesh coast during 2002-2003 under the world bank funded project of Andhra Pradesh Hazard Mitigation & Emergency Cyclone Recovery Project (APHM & ECR Project). One more DCWDS station has been commissioned in Kavarati Lakshadweep Island in May 2005.

c) INSAT – Automatic Weather Station/ Automatic Rain gauge system (INSAT-AWS/ ARGs)

Hundred Data Collection platforms (INSAT-DCP) were established during 1984-85 by IMD all over India in order to provide Meteorological data from remote inaccessible field stations. The system has since outlived their useful life and it is under replacement soon by increasing the number to 125. Fifty INSAT-AWS systems are functional as on date in the field units and remaining 75 are under process of installation. The performance of these systems has been found to be very satisfactory. These systems have built-in memory for storing 6 to 8 months data, which could be retrieved on a laptop or PCMCIA card. The quality of data from these systems have also been found to be satisfactory within WMO specified accuracy limits. However there is a need to improve the rainfall sensor (TBRG) which needs frequent visits due to its inherent electro-mechanical design. Efforts are being made to redesign the sensor so that it could work at least for six months without any visit to the station.

The commissioning of all 125 INSAT–AWS is expected to be completed by March, 2007.

d) Meteorological Data Dissemination (MDD)

The processed INSAT clouds imageries are broadcast through INSAT using S–band broadcast capability of the satellite, in analog mode every three hours during normal weather and every hourly during cyclones in the Arabian sea & the Bay of Bengal. Meteorological data i.e. SDUC satellite cloud imageries & T/P data (conventional Meteorological Data) are transmitted to various field stations through MDD network. At present there are 33 MDD stations in India and one each in Maldives and Sri Lanka. During cyclone situations, actual position of system and its intensity and related forecast are also being transmitted to field stations every hour. MDD units have also been provided with work stations for detailed analysis of cloud imageries. Action is in progress for upgradation of these into Digital type.

Future Plans:

i) To replace the existing CWDS to improved DCWDS and additional 50 stations to expand the existing network to 300. Procurement process is already in progress.

- ii) About 40 Digital MDD stations will be installed by 2007.
- iii) INSAT-3D is scheduled to be launched in the last quarter of 2007, which will have 6 channel imager and 19 channels sounder as meteorological payload.
- iv) AODT technique will be introduced in INSAT-3D to give centre and intensity of Tropical Cyclone automatically.

OMAN

1 Meteorological Facilities

1.1 Upper Air Observation

The Sultanate of Oman operates two upper air-observing stations, viz. Muscat (41256) and Salalah (41316). Both these are equipped with Vaisala's Digicora GPS wind finding system. The radiosonde was up graded to Visalla RS92 equipment. One flight is launched from each of these stations in a day.

1.2 Ship Weather Reports

Weather Reports from Ships are received through GTS as well as from Muscat Coastal Radio Station. In addition Ship reports are also received from the Royal Oman Navy.

1.3 Wave Measurements

One wave radar measurement station was installed offshore of Qalhat (Sur)- Oman liquid Gas Company- an other wave measurement station located offshore of Sohar and the collected data is inserted on the GTS every three hours. Two more stations will be repaired and or replaced at Muscat and Salalah.

1.4 Synoptic Land Stations

The number of Synoptic Land Stations being inserted into the GTS still remained at 30 stations. Additional station will soon be included in the RBSN also.

1.5 Telecommunication

All the meteorological stations operated by the Meteorological Department are connected to the MSS computer located at the Central Forecasting Office at Seeb International Airport by a reliable dial-up telephone link.

The MSS is connected to the RTH Jeddah by a dedicated link at 64 kbps based on TCP/IP protocol.

In addition a 512 kbs Internet leased line has been established as well as an e-mail and FTP Server. All these are protected by a firewall.

A bilateral Internet Circuit, which was established between New Delhi and Muscat for the exchange of meteorological data, has proved to be very effective and useful. Another bilateral Internet circuit link was also established between Abu Dhabi and Muscat for the exchange of meteorological data.

1.6 Satellite reception

1.6.1 The Department installed Second Generation Satellite ground receiving station and the ground-receiving stations for intercepting High Resolution images from Polar Orbiting satellites operated by NOAA as well as from geostationary satellites operated by EUMETSAT.

1.6.2 After the third EUMETSAT Satellite Application course Feb 2007 and the opening Ceremony of the Centre of Excellence for training satellite meteorology in Muscat Oman during February 2006. The Panel Members are invited to attend the fourth EUMETSAT Satellite Application course which is planned to occur at the Panel 35th Session in Muscat Oman during February 2008.

1.7 Computer Workstations:

1.7.1 Data Processing System

Numerical Weather Products are received via MDD, GTS and Internet from Bracknell, Toulouse, Offenbach and Washington. A Local Oman Regional Model (ORM) was established with the kind cooperation of the National Weather Service of Germany (DWD). We run three model versions as follows:-

a] The ORM_28 covers the region 30.0 E, 07.0 N (Lower left corner) to 78.0 E, 35.25N (Upper right corner) with a mesh size of 0.25 degree (approx. 28km). There are 193 x 114 grid points and 40 layers. The model gives a 78-h forecast in the 12 processor E 4500 Sun Machine.

b] The ORM_07 covers the region 51.0E, 16.5N(lower left corner) to 61.0E, 26.5N (Upper right corner) with a mesh size of 0.0625 degree (approx. 7KM). There are 161x161 grid points and 40 layers. The model gives a 78-h forecast in a] 12 Processor E4500 Sun machine.

c] A WAM based wave Model was established with the kind cooperation of GKSS of Germany, which covers the Arabian Sea, Gulf of Oman and Arabian Gulf.

d] A SWAN Wave Model for shallow water and at high resolution.

e] A Tsunami Model for the Gulf of Oman.

1.7.2 Module Output Statistics (MOS)

The Department successfully established a MOS which is generated with each Model run. MOS is an approach to incorporate NWP forecasts information into statistical weather forecast. After installing MOS we noted improvement in Temperature and wind forecast. In addition we were able to get a probability forecast for thunderstorms and fog.

1.7.3 Verification Package

The Department managed successfully to develop its own verification package which was led by Computer Scientist Sultan Al Yahyai. The developed system verifies the continuous weather parameters such as T_2m, TD_2m and for the categorical weather parameters such as Total precipitation. The system generates different statistical scores such as Hit rate with a margin of error, Bias, Root Mean Squared Error (RMSE). The package provides a friendly UGI to allow the user to select different choices (Model type,

stations list, observation time, weather element and statistical score) to be verified. This system will help find the systematic errors in the Model output, which can be tuned.

The package is being in several countries. Panel Members may get a copy also if they request Oman's P.R.

2. Aeronautical Services

In order to meet ICAO recommended practices and to fulfill the requirements for Aviation the Department installed a SADIS workstation as early as 1996. Effective Last year the Department started to pay to the UK Met Office the annual contributions for obtaining SADIS data and Products. In addition all the SADIS data and products are also received thru an FTP Server from UK as a back up.

A new service was also established for the provision of en-route flight folders for all Airlines operating in the sultanate to be accessed on our web site.

SRI LANKA

METEOROLOGICAL COMPONENT

Synoptic Observations: Data from the 20-station network was very good reaching 90%, except from Trincomalee (43418), Vavuniya (43415) and Jaffna (43404) where the observations were disrupted due to security reasons. Trincomalee had to be withdrawn by August 2006. Meteorological observations at Trincomalee are presently carried out by the Sri Lanka Navy.

Meteorological data exchange via RTH New Delhi was extremely good except for a few isolated short interruptions. MDD system is still non-operational pending up-gradation by the IMD.

Upper-air Observations: No Radar observations at Colombo were possible due to the defective equipment at the beginning of the year. Repaired by the local Technician, radar wind observations resumed in June and continued very satisfactorily except for some gap in August. Nevertheless, Radiosonde observations were not possible due to non-availability of consumables. But observations at all Pilot wind stations Hambantota, Puttalam and Trincomalee continued at 0000, 0600 and 1200 UTC satisfactorily, until Trincomalee was withdrawn in August.

Meteorological Satellites: HRPT receiver of NOAA imageries was defective and in dire need of replacement, and considered as a priority in the next (2008) State Financial year, as no alternate funding was available.

Ships and Aircraft Reports: Ship Reports are still not received at Colombo radio shore station, as latest INMARSAT capabilities are not present in Colombo but many are received through RTH. AIREPs reception at Airport Meteorological office is poor but whatever received is transmitted to WAFS centers regularly.

Improvement of Facilities/ Technical Advancements

Up-gradation of software and hardware of SADIS WAFS data system to second generation (GOSL funding) was completed by the end of year and commissioned in January 2007.

Upgrading of GTS system with VCP assistance from USAID is in progress. The collaborative work with the IMD is appreciated.

KOICA sponsored NWP technique MM5 model in a PC cluster environment is effectively used as an operational tool in daily forecasting.

An AWS donated by the Government of China is to be set up at the SLMD Head Office premises awaiting lightning protection device.

A JICA grant project to establish communication between proposed AWS stations, regional offices and SLMD is in progress with basic study conducted in late 2006. This is expected to launch by March 2007. As the Component 2 of this project, establishment of communication network between Disaster Management Centre and stakeholders is envisaged.

SLMD is involved in another World Bank Project, NAWAM (National Water Assessment and Management) to establish a Data-base capable of handling AWS as well as GTS data.

SLMD is pleased to record that WMO assistance in procuring a Doppler Weather Radar from GOSL funding is in progress with the MOU between the WMO and GOSL/SLMD being processed presently.

Building construction at synoptic observation station Pottuvil (43475) that was completely washed-away due to the Tsunami waves is completed as the first Tsunami shelter in Sri Lanka in mid 2006 but constructions at Mannar (43413) is yet to be completed. Re-location of synoptic observation station Badulla (43479) due to increasing environmental changes and possible unrealistic values is still in progress.

Observing and Telecommunications: The Internet server speed is upgraded to 256Kbps.

The Government of Sri Lanka wishes to thank KOIKA, JICA, Govt. of China, WMO and other Institutions for their keenness in assistance to improve capabilities at SLMD.

THAILAND

METEOROLOGICAL COMPONENT

a. Improvement of facilities

- + Bangkok – Singapore GTS circuit has been upgraded from X.25, speed 2,400 bps to TCP/IP Frame Relay, speed 16 Kbps (CIR).
- + Regarding – Phnom Penh GTS circuit, TMD's facility is ready for the connection.
- + Bangkok – New Delhi GTS circuit will be upgraded very soon to support the Tsunami Warning System in the Indian Ocean.
- + TMD's website development : The TMD's website under a new design which is easier for the public members to access is expected to be available by December 2006.

- + Two new C-band Doppler Radars have been installed at Khao Khiew and Krabi in order to enhance the capacity in monitoring heavy rainfalls in the lower part of Northeastern Thailand and the Southern part of the country.
- + All observation stations in Thailand have been installed with either 512K ADSL (in urban areas) or 256K Ipstar (at remote sites). In addition, 4 regional forecasting centers have communicated with the safer VRN circuits. While the Internet can be easily used via ISP, the TMD's Intranet was developed for more information/ data to be accessed by TMD staffs.

b. Technical advancement

- + A numerical weather model for storm surges forecasts has been developed from one provided by Mr. Masakazu Higaki (Japan Meteorological Agency, Japan) and Prof. Shishir K. Dube (The Indian Institute of Technology, Kharagpur, India). The equations in the developed model have been modified to suit the coastal lines conditions of Thailand. The data of sea surface level are used to check the accuracy of such model.
- + To change the forecasting capacity, the weather forecasts from other forecasting centers have been taken into considerations and incorporated into TMD weather forecasts, in both medium and long ranges.

APPENDIX VII

SUMMARY OF THE HYDROLOGICAL ACTIVITIES OF THE MEMBERS

BANGLADESH

Hydrological Component

BMD provides all sorts of data, information and weather forecast to the Flood Forecasting & Warning Centre (FF&WC) of Bangladesh Water Development Board (BWDB).

Bangladesh lies in between 20° 30'- 26° 40' North and 88°. 03'-92° 40' East occupying an area of 147570 Sq. km. Continuous setting of hydrological process is going on in this area having Bay of Bengal in the south and Great Himalayas in the North. Three major river systems Meghna-Ganges–Brahmaputra are flashing the country every year with an average volume of 14 Billion-m³ of water. It enjoys Sub-tropical monsoon climate and experiences annual average 2300 mm precipitation varying 1100-5000 mm evaporation.

Floods continue to be a major hazard in Bangladesh. Floods in 1987, 1988, 1998 and 2004 caused widespread damage in rural and urban areas and set back the country's efforts to alleviate poverty. For the flood protection both structural and non-structural measures are often taken. Bangladesh started National flood Forecasting and Warning Services in its FFWC (Flood Forecasting and Warning Centre) since 1972. FFWC is using MIKE-11 model of Denmark for flood forecasting services. WMO has taken up Pilot project for Flash flood in Northeastern portion of the country. Rain estimation by Satellite technology has been adapted to increase the Lead-time. The regional forum ICIMOD has extended this technology. Improved inundation maps based on topographic and latest information on structures are issued from the FFWC. Bangladesh is also enjoying the regional hydro-metrological information flow from upper countries, India, Nepal and China. This will enhance the flood forecasting Lead-time.

In 2006, it was a normal flooding season. In comparison to the earlier devastating floods, 2006 flood have been shown in different scenarios in table-I, II, III, IV below:

Table –I: Comparison of Water Level of the Current Year 2006 and Historical Events of 1988 & 1998 of Some Important Stations in Brahmaputra Basin.

Sl.No	River	Station	Recorded Maximum (m)	Danger Level (m)	Peak of the year (m)			Days above Danger level		
					06	98	88	06	98	88
1	Dharla	Kurigram	27.50	26.50	27.06	27.22	27.25	-	30	16
2	Teesta	Dalia	52.97	52.25	52.41	52.20	52.89	8	-	8
3	Teesta	Kaunia	30.52	30.00	28.8	29.91	30.43	-	-	38
4	Brahmaputra	Noonkhawa	28.10	27.89	26.23	27.35	NA	-	-	NA
5	Brahmaputra	Chilmari	25.06	24.00	23.53	24.77	25.04	-	22	15
6	Jamuna	Bahadurabad	20.62	19.50	19.51	20.37	20.62	-	66	27
7	Jamuna	Serajganj	15.12	13.75	13.3	14.76	15.12	-	48	44
8	Jamuna	Aricha	10.58	9.14	9.72	10.76	10.58	-	68	31
9	Old Br.putra	Jamalpur	18.00	17.00	15.56	17.47	17.83	-	31	8
10	Old Br.putra	Mymensingh	14.02	12.50	11.7	13.04	13.69	-	33	10
11	Buriganga	Dhaka	7.58	6.00	5.36	7.24	7.58	-	57	23
12	Lakhya	Narayanganj	6.71	5.50	5.76	6.93	6.71	-	71	36
13	Turag	Mirpur	8.35	5.94	5.54	7.97	NA	-	70	NA
14	Tongi Khal	Tongi	7.84	6.08	5.46	7.54	NA	-	66	NA
15	Kaliganga	Taraghat	10.39	8.38	8.6	10.21	10.39	-	66	65

APPENDIX VII, p. 2

Table –II: Comparison of Water Level of the Current Year 2006 and Historical Events of 1988 & 1998 of Some Important Stations in Ganges Basin.

Sl. No	River	Station	Recorded Maximum (m)	Danger Level (m)	Peak of the year (m)			Days above Danger level (m)		
					06	98	88	06	98	88
1	Punarbhaba	Dinajpur	34.40	33.50	31.56	34.09	34.25	-	3	4
2	Padma	Pankha	22.97	21.50	20.65	24.14	NA	-	66	NA
3	Padma	Rajshahi	20.00	18.50	17.13	19.68	19.00	-	28	24
4	Padma	Hardinge Bridge	15.04	14.25	13.34	15.19	14.87	-	27	23
5	Padma	Goalundo	9.83	8.50	8.64	10.21	9.83	4	68	41
6	Padma	Bhagyakul	7.58	6.00	5.98	7.50	7.43	-	72	47
7	Gorai	Gorai Rly Bridge	13.65	12.75	11.57	13.45	13.65	-	25	25

Table –III: Comparison of Water Level of the Current Year 2006 and Historical Events of 1988 & 1998 of Some Important Stations in Meghna Basin.

Sl. No	River	Station	Recorded Maximum (m)	Danger Level (m)	Peak of the year (m)			Days above Danger level m)		
					06	98	88	06	98	88
1	Surma	Kanaighat	15.26	13.20	14.79	15.00	15.10	26	73	75
2	Surma	Sylhet	11.95	11.25	11.60	11.72	11.95	10	14	21
3	Surma	Sunamganj	9.46	8.25	8.75	8.90	9.03	14	56	62
4	Kushiyara	Amalshid	18.28	15.85	17.66	17.60	17.50	17	54	65
5	Kushiyara	Sheola	14.33	13.50	14.31	14.14	14.09	14	37	80
6	Manu	Manu Rly Br	20.42	17.07	18.97	18.63	18.95	7	6	66
7	Manu	Moulvi Bazar	15.50	11.75	12.13	11.68	13.01	3	-	25
8	Khowai	Habiganj	11.75	9.50	10.71	11.44	11.00	4	8	14
9	Someswari	Durgapur	15.15	13.00	13.27	13.92	14.31	1	7	30
10	Upper Meghna	Bhairab Bazar	7.66	6.25	5.41	7.33	7.66	-	68	68
11	Gumti	Comilla	13.56	10.38	10.79	12.79	11.80	-	17	17

Table -IV Comparison of Water Level of the Current Year 2006 and Historical Events of 1988 and 1998 of Some Important Station in South Eastern Hill Basin.

Sl.No	River	Station	Recorded Maximum (m)	Danger Level (m)	Peak of the year (m)			Days above Danger level (m)		
					06	98	88	06	98	88
1	Muhuri	Parshuram	15.03	15.03	12.8	14.60	12.42	2	9	48
2	Halda	Narayanhat	18.05	14.63	16.1	16.57	NA	5	21	NA
3	Halda	Panchpukuria	11.55	9.50	9.4	10.44	10.05	-	4	6
4	Sangu	Bandarban	20.38	15.25	12.5	15.25	16.80	-	1	3
5	Sangu	Dohazari	9.05	7.00	6.05	7.42	NA	-	2	NA
6	Matamuhuri	Lama	15.45	12.25	12.30	13.05	12.18	-	2	-
7	Matamuhuri	Chiringa	6.83	5.75	6.4	6.85	NA	6	5	NA
8	Feni	Ramgarh	21.41	17.37	15.81	17.50	NA	-	1	NA

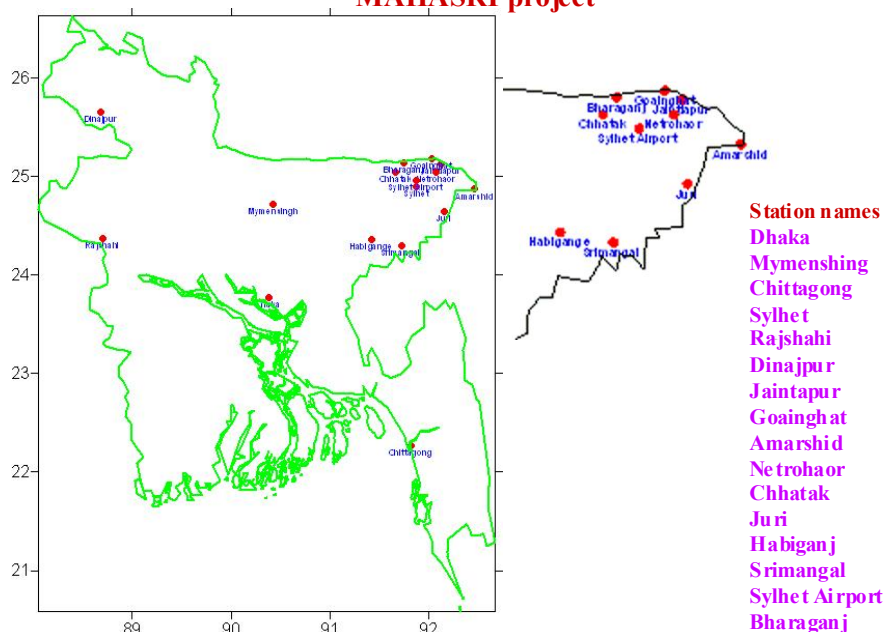
Table-V: Recorded Highest Water Level with Date

Sl. No.	River	Station	Danger level (m)	Recorded highest Water level (m) before 2006 flood with date	Water level and date Exceeding previous Highest water level(m)
1	Dharla	Kurigram	26.50	27.66 (14.07.96)	-
2	Teesta	Dalia	52.25	52.97 (29.07.72)	-
3	Teesta	Kaunia	30.00	30.52 (06.01.68)	-
4	Brahmaputra	Noonkhawa	27.89	28.10	-
5	Brahmaputra	Chilmari	24.00	25.07 (23.08.54)	-
6	Jamuna	Bahadurabad	19.50	20.62 (30.08.88)	-
7	Jamuna	Serajganj	13.75	15.12 (30.08.88)	-
8	Jamuna	Aricha	9.14	10.76 (02.09.88)	-
9	Old Br.putra	Jalpur	17.00	18.00 (31.07.54)	-
10	Old Br.putra	Mymensingh	12.50	14.02	-
11	Buriganga	Dhaka	6.00	7.58 (04.09.68)	-
12	Lakhya	Narayanganj	5.50	6.93 (10.09.98)	-
13	Turag	Mirpur	5.94	8.35 (10.09.88)	-
14	Tongi Khal	Tongi	6.08	7.84 (01.09.62)	-
15	Kaliganga	Taraghat	8.38	10.39	-
16	Punarbhaba	Dinajpur	33.50	34.40	-
17	Padma	Pankha	21.50	24.14 (07.09.97)	-
18	Padma	Rajshahi	18.50	20.00 (13.09.1910)	-
19	Padma	H- Bridge	14.25	15.19 (10.09.98)	-
20	Padma	Goalundo	8.50	9.83	-
21	Padma	Bhagyakul	6.00	7.58	-
22	Gorai	Gorai Rly Br	12.75	13.65 (02.09.98)	-
23	Surma	Kanaighat	13.20	15.26	-
24	Surma	Sylhet	11.25	12.44(19.07.04)	-
25	Surma	Sunamganj	8.25	9.75 (20.07.04)	-
26	Kushiyara	Amalshid	15.85	18.28 (08.06.74)	-
27	Kushiyara	Sheola	13.50	14.46 (20.07.04)	-
28	Manu	Manu Rly Br	17.07	20.42 (23.05.02)	-
29	Manu	Moulvi Bazar	11.75	15.50	-
30	Khowai	Habiganj	9.50	11.82 (23.07.02)	-
31	Someswari	Durgapur	13.00	15.50 (11.07.97)	-
32	Upper Meghna	Bhairab Bazar	6.25	7.33 (06.09.98)	-
33	Gumti	Comilla	10.38	13.56 (23.07.93)	-
34	Muhuri	Parshuram	15.03	15.30	-
35	Halda	Narayanhat	14.63	18.05	-
36	Halda	Panchpukuria	9.50	11.55	-
37	Sangu	Bandarban	15.25	20.7 (12.09.97)	-
38	Sangu	Dohazari	7.00	9.05	-
39	Matamuhuri	Lama	12.25	15.45	-
40	Matamuhuri	Chiringa	5.75	7.03 (10.07.97)	-
41	Feni	Ramgarh	17.37	21.42 (11.07.68)	-

GEOSS/MAHASRI/ASIAN Water Cycle Initiative Project in Bangladesh

Under this project, 10 Automatic rain-gauge stations have been set up near Meghna Basin in Sylhet region under the supervision of BMD (with the help of Prof. T. Hyashi of Kyoto University). The data obtained from these stations will be used to calibrate the model for flash floods in Bangladesh. Besides, five other stations have been established at Dhaka, Mymensingh, Dinajpur, Rajshahi and Chittagong. The stations are shown in the figure below:

Automatic rain-gauge Stations over Northeastern Bangladesh under MAHASRI project



BMD provides all sorts of data, information and weather forecast to the Flood Forecasting & Warning Centre (FF&WC) of Bangladesh Water Development Board (BWDB). Representative from Flood Forecasting and Warning Centre of BWDB is requested to speak on the hydrological aspects of Bangladesh.

INDIA

HYDROLOGY

1. Procurement of 100 A W S has been completed and their installation is in progress. Action for procurement of 500 A R Gs is in advance stage.
2. There is a proposal to install 20 A W S and 200 A R Gs under Hydrology Project-II during 2006 – 2011 in a phased manner in the states of Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Pondicherry, Punjab, Tamilnadu.
3. The participation of IMD in Asia Water Cycle Initiative is in active consideration of Government of India for management of water resources in Asian region.

4. The updated Hydrological Programme and Implementation Plan of facilities and sources concerning Flood Forecasting system in the rivers falling in the Bay of Bengal & Arabian Sea is given in **Annexure-I**.
During the monsoon season of 2006 total 6666 flood forecasts were issued for 28 inflow-forecasting stations and 147 stage-forecasting stations with an overall accuracy of 95.8%.

Annexure-I

In the Mahanadi & adjoining east flowing rivers in the state of Orissa during the years 2003 & 2004, ten new sites viz., Pubansa (seasonal), Indupur (seasonal), Marshaighai (seasonal), Kanas (seasonal), Khandapara Bridge, Padmavati, Arampur, Deogam, Gopalpur and Mahulpalli were established in Orissa. No additional site was established during the year 2005 & 2006. Under telemetry system, rainfall and water level sensors are under installation at eight sites viz. Alipingal, Nimapara, Khandapara Bridge, Padmavati, Arampur, Deogam, Gopalpur and Mahulpalli and likely to be completed before April 2007.

In the Krishna and Godavari river basins, comprehensive telemetry system consisting of data sensors, transmitter etc. is under installation by the Central Water Commission and the work will be completed before April 2007.

The total No. of stations proposed under telemetry in the Krishna and Godavari basin is under.

Sr. No.	Sensor Type	Krishna Basin	Godavari Basin	Total
1.	Rainfall sensor (Type 1)	17	1	18
2.	Rainfall & water level sensor (Type 2)	24	62	86
Total		41	63	104

The data bank for the storage of hourly gauge as well as rainfall data collected in real time over the past several years was prepared in Central Water Commission where the data of part of southern rivers like Krishna, Godavari, Pennar etc. were included. In addition the data of some reservoirs maintained by various state Governments and other agencies were included in the data bank. The objective is to modernize the flood forecasting methodology by using enhanced and advanced software likely MIKE 11 in respective jurisdiction in phased manner.

It is now proposed to issue inundation maps also of the area likely to be flooded for which the topographical data of major flood prone basins are being digitized. Under Ministry of Home Affairs USAID project on climate forecasting, a team of Indian engineers interacted with USGS/ USWB expert to study models being used abroad for flood forecasting and to develop appropriate models for Mahanadi Basin as a pilot project wherein it is also proposed to forecast the areas likely to be flooded in addition to river stage and inflow forecasts.

5. The details of sites & type of data being transmitted to Bangladesh by India are enclosed as **Annexure-II**, Efforts are being made for better flood management.

Details of sites & type of data being transmitted to Bangladesh by India

Sr. No.	River	Name of site	Particulars of data being transmitted	Frequency transmission	Mode of Transmission	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(i) By Patna Centre						
1.	Ganga	Farakka	1. Actual Water Level (W.L.) 2. Forecast Level (F/C) 3. Observed Discharge (Q) 4. Weather Report	1. W.L. of 21-24 hrs. of previous day & 03, 06 hrs. of the day of report transmitted at 0800 hrs. 2. W.L. of 09, 12, 15 & 18 hrs. of the day of report, transmitted at 2000 hrs. Which contains observed 'Q' only, F/C, and weather report, if specially issued by FMO (IMD) for Bangladesh.	MGD-V, Patna transmit to Met. Centre at Air Port, Patna which pass it to met. centre, Dum Dum, Kolkata which in turn transmit it to IMD, Delhi and from where it is transmitted to Flood Warning Centre and Storm Warning Centre, Dhaka, Bangladesh.	1. Effective from 15 th June to 15 th October. 2. Data is transmitted only if W.L. is at or above warning level.
3.	Brahmaputra	Goalpara	1. Actual Water Level (W.L.) 2. Forecast Level (F/C) 3. Weather Report	- do -	- do -	- do -

APPENDIX VII, p. 8

1	2	3	4	5	6	7
4.	Brahmaputra	Dhubri	1. Actual Water Level (W.L.) 2. Forecasting Level (F/C) 3. Weather Report	1. W. L. of 21–24 hrs of previous day & 03, 06 hrs of the day of report, transmitted at 0800 hrs. 2. W.L. of 09, 12, 15 & 18 hrs of the day of report, transmitted at 2000 hrs. which contains observed 'Q' only F/C weather report, of specially issued by FMO (IMD) for Bangladesh.	MBD(CWC), Guwahati transmit to RMC, Guwahati which in turn transmit to IMD, New Delhi and from where it is transmitted to Flood Warning Centre and storm Warning Centre, Dhaka, Bangladesh.	1. Effective from 15 th May to 15 th October 2. Data is transmitted only if W.L. is at or above warning level.
5.	Barak	Silchar	1. Actual Water Level (W.L.) 2. Forecasting Level (F/C) 3. Weather Report	– do –	– do –	– do –
6.	Tissa	Damohani	1. Actual Water Level (W.L.) 2. Forecasting Level (F/C) 3. Observed Discharge (Q) 4. Weather Report	– do –	– do –	– do –

APPENDIX VII, p. 9

7.	Brahmaputra	1. Jalpaiguri 2. Cooch Behar 3. Dhubri 4. Goalpara 5. Silchar 6. Tura (Not functional) 7. Siliguri 8. Agartala	continuous rainfall data for all the stations except for Silchar in respect of which rainfall is given only when amount of rainfall exceeds 50 mm	At 0800 hrs	– do –	Effective from 15 th May to 15 th October.
8.	Manu	Kailashahar	Actual water level	Thrice a day, at 09, 13 and 18 hrs throughout flood season	From Kailashahar to Moulvi Bazar (Bangladesh)	Point to point communication by MBD, Guwahati.
9.	Gumti	Amarpur	– do –	– do –	From Amarpur to Comilla (Bangladesh)	– do –
10.	Barak	Badarpurghat	– do –	– do –	From Badarpurghat to Sylhet (Bangladesh)	– do –
11.	Tista	Damohani	Actual water level & forecast level (F/C)	– do –	From Damohani to Dalia (Bangladesh)	Point to Point communication by LBD, Jalpaiguri
12.	Tista	Gajoldoba	Actual water level	– do –	From Gajoldoba to Dalia (Bangladesh)	– do –
13.	Jaldhaka (Dharla)	NH–31	– do –	– do –	From NH–31 to Kurigram (Bangladesh)	– do –
14.	Tarsa (Dudkhkumar)	Ghughumari	– do –	– do –	From Ghughumari to Kurigram (Bangladesh)	– do –

6. Central Water Commission has taken up modernization of flood forecasting activities by developing mathematical model using MIKE-1 software. The models are at various stages of development at a few chosen sites in Central and Southern India and likely to be tested & deployed in a couple of years time. A model for forecasting of flood events for Delhi on the Yamuna river has already been developed and tested for the year 2006 and is likely to be deployed in 2007. In the next five-year period it is planned that flood forecasting for all major cities inhabited by the side of any major river would be done by using mathematical model. The MIKE-11 software has been used for other purposes also including flood management of river basin, effects of embankments etc.
7. In respect of flood forecasting the CWC issues level forecast of major rivers of the country as soon as the river goes above the warning level. The users of this flood forecast wants that for every stage of river (above the danger level), the extent of area likely to be inundated should also be made available to State Government agencies and public are to be informed. Efforts will be made to develop the inundation model of the areas, which are the most floods prone. This will help the civil authorities to plan and undertake rescue and relief measures in more comprehensive ways. The development of FF model would enable CWC to increase advance-warning time, minimize individual's input in formulation of forecast.

One committee will be set up very soon to revise the existing guidelines on flood forecasting.

8. CWC is developing area flood inundation maps. They are also modifying MIKE-II model for flood forecasting in different basins.

MALDIVES

Hydrological Component

There are only a few lakes in the Maldives and Ministry of Environment, Energy and Water look after them; otherwise no much hydrological issues exist here.

SRI LANKA

Hydrological Component

The Hydrology Division of the Irrigation Department collects hydrological data that enables quantification of surface water hydrology analyse and archive these data as the only such institution concerned with surface water measurements in the island.

At present this division is collecting surface water levels hourly at 69 Hydrometric stations and calculating daily average river discharges from 40 stream gauging stations located at 17 major river basins, and it covers over 60% of the total basin area of the island. The Hydrological data thus collected is made available for water resources development, planning and research work. In addition to the above work Hydrological Division collects daily rainfall records from 135 rain gauges out of which 30 gauges are established in stream gauging stations. This division maintains 10 evaporation pans also to collect daily evaporation records and maintains one weather station.

Improvement of Facilities

A study is carried out to upgrade the existing standing orders to safeguard city of Colombo from floods of Kelani Ganga (river), and also to establish standing orders to safeguard Ratnapura and Kalutara Districts from floods of Kalu Ganga and to prepare a Drainage Management Plan for Bolgoda Basin under IHP/UNESCO.

Technical Advancements, Flood Forecasting and Warning

Hydrology Division of the Irrigation Department operates flood warning system for Kelani Ganga to safeguard the city of Colombo from floods of Kelani Ganga and operates flood warning system for Kalu Ganga , Gin Ganga , Nilwala Ganga, Deduru Oya and Mahaweli Ganga.

The following computer packages are used for water resources planning, Hydrological Modeling and data processing.

1. MIKE II Hydraulic Model
2. HEC HMS
3. HEC RAS
4. HEC DSS Vue
- 5 .Mike BASIN

In addition to above, Monitoring and measuring high flood levels, discharge measurements during floods and flood mapping of most of the main river basins are carried out by this division.

THAILAND

Hydrological Component

a. Improvement of facilities :

- + The telemetering system project under the TMD's responsibility has been established in 12 river basins. There are 161 automatic rainguage/hydrometeorological stations altogether so far. The project has been carried out in 3 phases :
 - The first phase had been established during 1999 – 2001. There are 50 rainguage stations in Bangkok and 18 hydrological stations in 8 river basins : Yom, Nan, Pasak, Chi, Mun, Prachinburi, Tapi and Klong U Ta Pao.
 - The second phase had been set up during 2002 – 2003. There are 40 rainguage/hydrological stations in 3 river basins : Phetchaburi, Prachaup Kiri Kun and Tapee.
 - The third phase has been being carried out during 2004–2006. There are 53 rainguage/hydrological stations in 5 river basins : Kok, Upper Nan, Upper Pasak, Prachinburi and Thachin. This phase is expected to be complete by the end of December 2006.

APPENDIX VII, p. 12

- + From the telemetering project, the TMD will have real-time data, covering Bangkok Metropolitan areas and 12 principal river basins capable of continuously monitoring changes in weather conditions at each station. It is expected to enable the TMD's staffs to immediately give more efficient warning information to the concerning governmental units as well as the public members and allow them to have enough time for preparedness, protection and for relief of possible damages caused by future flash floods.
- + After the end of last year, the Royal Irrigation Department still continues its three ongoing telemetering projects in the Ping, Lam Pao and Chantaburi river basins. The real-time in situ and remotely-sensed data collection was planned to be received on the hourly basis while some certain data have just been collected this year. These projects are on test run and expected to finish next year.
- + For Department of Water Resources, it has cooperated with MRCS and other Mekong River Countries (Lao's PDR, Cambodia and Vietnam) to improve the hydro-meteorological monitoring network in Mekong Mainstream under the appropriate Hydrological Network Improvement Project (AHNIP), Basin Development Plan, Water Utilization Program, Environment Program, Flood Mitigation Management Program and start up drought management program.
- + Department of Water Resources continued to develop and set up a flood and landslide warning system in mountain and upland area cover 64 villages, dealing with system alerts activated heavy rainfall and rising of river levels to monitor at appropriated site, early warning signal were sent to subscribers and communities in real time in advance of the impact of disasters which provide time for people to take response actions.

b. Technical Advancement :

- + In TMD Telemetering project, the Mike11 Model will be implemented to simulate the hydrological behaviors for forecasting and warning floods in 5 river basins : Tapee, Kok, Nan, Pasak and Prachinburi.
- + The Ping telemetering project, under the responsibility of the Royal Irrigation Department, starts collecting some rainfall and runoff data and analyses them. The model needs more data to calibrate before issues good warning.
- + At this moment, the forecasted results from other finished telemetering projects, implemented by the Royal Irrigation Department, are disseminated to the concerned agency and warning is via internet, radio and television. Part of data collected from ongoing project also gives good support to flood warning in the command areas.
- + The Royal Irrigation Department has three telemetering systems under installment and planed to be complete next year. Some data has been collected and applied in the command area this year. The model gives reasonable result but still needs more data to calibrate. In case of Department of Water Resources, it has developed and improvement in the hydrological and meteorological monitoring network in Penninsula-East Coast. And telemetering hydro-meteorological stations was established in Upper Mun and Chi river basin for Flood forecasting and management.

APPENDIX VIII

SUMMARY OF THE DPP ACTIVITIES OF THE MEMBERS

BANGLADESH

5.3 Disaster Prevention and Preparedness (DPP) Component (Agenda item 8.3)

5.3.1 Cyclone Preparedness Programme

The Cyclone Preparedness Programme (CPP) of Bangladesh Red Crescent Society (BDRCS) came into being in 1977 to minimize loss of lives and properties of the community people in cyclonic disaster. Since 1973, the programme is being implemented jointly by the BDRCS and the Government of Bangladesh. The Government of Bangladesh accepted the programme responsibilities for recurring expenses while the International Federation of Red Cross and Red Crescent Society provide the administrative and operational cost.

5.3.1.1 Working Area

The programme covers 32 Upazilas under 11 coastal districts and is aided by 42,675 volunteers including 14,225 female in 2845 units (village). Recently numbers of female volunteers has been increased.

5.3.1.2 Objectives

- Disseminate cyclone warning signals issued by the Bangladesh Meteorological Department (BMD) to every nook and corner of the cyclone prone area.
- Assist people in taking shelter.
- Rescue distressed people affected by a cyclone.
- Provide First aid to the people injured by a cyclone.
- Assist in relief and rehabilitation operations.
- Assist in the implementation of the BDRCS disaster preparedness plan.

5.3.1.3 Cyclone Preparedness during 2006

A total of 13-monsoon depression formed in the Bay of Bengal on 25 April. 1, 6, 16, 28 July; 1, 11, 16, 21, 29 August; 2, 19 September and 6 October 2006. Hopefully all the depressions moved towards north/north westerly direction and gradually weakened, though the depression which was formed on 19 September turned into serious and under it's influence sea became rough causing damage of fishing trawlers and boats. The CPP volunteers were alerted and kept ready for rescuing the victims from the capsized fishing trawlers in the sea.

5.3.1.4 Training

- ◆ Arranged dissemination meeting with the students of 116 educational institutions of 29 Upazila under CPP command area. A total of 32,480 students participated in the meeting. The ultimate result of arranging this meeting is very much positive and significant.
- ◆ Arranged orientation on Cyclone Preparedness, self-preparedness & guideline for the fishermen in 29 centers. A total of 1450 fishermen participated in the orientation Programme.

- ◆ The community trainers (TOT holding volunteers) and local CPP officers under took short training of RC/RC principles, movements, basic DM, role of volunteers, cyclone warning signal etc. with the volunteers attending in their regular unit and union committee meetings.
- ◆ Arranged refresher training on DM, HR, First Aid tracing and rescue among 2340 volunteers in 39 centers under CPP command area.
- ◆ Arranged three days long (TOT) and refresher TOT on DM first Aid tracing, search and rescue for CPP officer's and community trainers from 28-30 November, at Barishal and 3-5 December 2006 at Nokhali and Cox's Bazar. 68 Participants from 31 Upazala under CPP Command area participated in the training courses. The respective Zonal officer's and youth volunteers of RC unit conducted the training while Director (operation), CPP, BDRCS to monitors /evaluate training.
- ◆ Arranged VHF operator's refresher training at Cox's Bazar from 24 December 2006. A total of 29 participants attended in the training, which was conducted by Radio Engineer and concerning zonal officer.

5.3.1.5 Awareness Raising Activities

- Volunteers of Tajunuddin and Pathargatha arragned two separate cyclone field demonstration in their respective Upazala. About 10,300 community people, local clites, Govt. officials NGOs and students of educational institution witnessed the demonstration, which reflected the potential impact of cyclone awareness, preparedness and mitigation issues.
- 13 October 2006, the International Disaster Reductions Day (IDRD) was observed by the Bangladesh Red Crescent Society in a befitting manner. With the spontaneous participation BDRCS officials a colourful rally and a discussion meeting was arranged to mark the day. In collaboration with the local administration all CPP field level offices observed the day.

5.3.1.6 Wireless Network

- There are 3 radio workshops in the programme. In view of repair and maintenance of the wireless networks the following warning equipment and wireless sets have been repaired in those workshops and in the field by the concern radio engineer and technician.

Name of equipments	Quantity
HF wireless	22
VHF wireless	34
Radio	21
Megaphone	83
Solar panel cage pointing	52
Re-installation VHF center	01
Re-installation of VHF sets	05
Re-installation of HF Antenna	07
Torch light	24
Hand siren	28
Antenna mast painting	53

- 50 new VHF sets and 26 dip cycle battery received from International Federation of Red Cross & Red Crescent (IFRC) for strengthening the wireless network.
- 7,100 big size and 33,320 medium size battery procured and sent to the CPP field stations for to be used in the equipment lying with the warning group volunteers.

5.3.1.7 Organizational Activities

As a continuous process, 3,289 units, 466 unions and 110 Upazilas committee meeting were conducted with the volunteers in the stipulated year.

5.3.1.8 Activities of DMB

BMD disseminates the Tropical Cyclone Warnings and other adverse weather warnings as per Standing Orders on Disaster to the Disaster Management Bureau (DMB) and Ministry of Food and Disaster Management (MOFDM) in time. The MOFDM and DMB take necessary steps for Disaster Prevention and Preparedness (DPP) in Bangladesh during the impending tropical cyclone.

INDIA

1. DISASTER PREVENTION AND PREPAREDNESS

1. Hon'ble Minister for Science & Technology and Ocean Development launched the Natural Disaster Information System (NDIS) from Bangalore through video conference in February 2006.
2. Natural Calamities meeting was held on 4.9.2006 at the Commissioner's office Chennai to discuss about the precautionary measures to be taken during the floods.
3. An Integrated Operation Centre(IOC) has been set up in the Ministry of Home Affairs to handle disaster Situations on a 24x7 basis. The Standard Operating Procedure (SOP) for issuing Alerts through Electronic Messaging System in the event of disasters to the PMO, Cabinet Secretary and other specified officers of NDMA, MHA and other concerned ministries /Departments/ Organisation and agencies has been formulated. IMD has recently started including colour code in the cyclone warning bulletins which were issued to National Disaster Management and other organisations w.e.f 21 Sept. 2006(Cyclonic Storm, Mukda) as per SOP viz., Cyclone Alert – Yellow; Cyclone Warning – Orange; Post Landfall Outlook – Red.
4. A project-CDSTAT on 'Generation of comprehensive database of statistics of Depression, Cyclonic Storm and Severe Cyclonic Storm over North Indian Ocean' was completed. This project consisting of several programs which can generate any type of statistics on formation, dissipation and coastal crossings of Depression, Cyclonic storm and Severe Cyclonic storm over North Indian Ocean for the period 1891-2005.
5. Digitisation of IMD's cyclone track Atlas was taken up. The whole project will be completed during 2007.

6. The Cyclone Manual published by IMD is a very exhaustive and detailed document providing substantial information on cyclone climatology of India, methods of cyclone forecasting, storm surge etc., besides describing all the guidelines required for the preparation and dissemination of cyclone warning messages. The same has been brought out in a CD form for easy distribution to concerned agencies.
7. Early Tsunami Warning System may be operational by 2007 end.
8. The use of INTERNET to share the information with panel member countries has already been started by IMD. The CWD is using INTERNET and other means of communication to strengthen the regional cooperation on DPP.
9. Ministry of Home Affairs Govt. of India is planning to launch a Cyclone Risk Mitigation Project with World Bank support.

Workshops/Seminars/talks:

Workshops

1. Shri.S.Sridharan,DDGM,RMC Chennai attended the workshop on Disaster Management convened by National Institute of Disaster Management (NIDM), NewDelhi at Anna Institute of Management. Chennai and delivered an invited talk on “Cyclones-Vulnerability and preparedness, on 15th February 2006.
2. Shri S.B.Thampi, Director attended the Safety Awareness Campaign organized by Chennai Port Trust and delivered a lecture on “Tropical Cyclones” on 24th February 2006.
3. Dr. M. Satyakumar & Shr G.Sudhakar Rao Directors attended a workshop on Disaster Management jointly organized by National Disaster Management and Dr. Marri Cheen Reddy Human Resources & Development Institute of AP at Hyderabad during 24-25 March 2006. They also attended a workshop on Disaster Management at AARD, Rajendra Nagar, Hyderabad on 18th September 2006 and delivered a lecture on ‘Disaster Management’.
4. Shri. R. Muralikrishna,AM-1 attended a workshop jointly organised by Govt of Andhra Pradesh and CARE INDIA on Disaster preparedness at collectors office, Visakhapatnam on 18th April 2006.
5. Shri S.Sridharan DDGM attended the National Workshop organized by the National Disaster Management Authority, New Delhi at Dr. MCR HRD Institute, Hyderabad on 27.10.2006.
10. Shri.Ramanan, Director attended various meetings on Disaster Management and Mitigation conducted by Govt. of Tamil Nadu on 9th March 2006, 21st April 2006, 21st May 2006, 20th August 2006 and 4th September 2006. He also attended the “UNDP project INDISDATA” project implementation in TamilNadu– constitution meeting convened by Anna Institute of Management, Chennai on 29th March 2006.
11. Dr.M. Satya Kumar and G.Sudhakar Rao,Directors attended the State Level High Power Committe meetings on Disaster preparedness held on 26th April 2006,21st & 27th August 2006 and 31st August 2006 and on 18th September 2006.
12. Dr.P.C.S.Rao, Meteorologist attended the consultative meeting on “Disaster Management-Early Warning System “convened jointly by UNDP and Disaster Management and Mitigation, Govt. of Tamil Nadu at Anna institute of Management on 21st April 2006.
13. Shri. K.Santhosh, Director, attended a meeting on preparation of department level Disaster Management Plan at faculty of Disaster Management, Institute of Land Management, PTP Nagar on 5th May 2006.
14. Under the joint auspices of IMS, Chennai Chapter and RMC Chennai the following two scientific talks were organized during March 2006. 1.Shri.K. Suresh ,IAS, Chairman, Chennai Port Trust delivered a talk on the WMO theme ‘Preventing & Mitigating Natural Disasters’ and 2. Prof. P.C.Kesavan, M.S.Swaminathan Research Foundation, Chennai delivered a talk on “ Post Disaster Relief Operation”.
15. Shri.S.R.Kalsi ADGM(S) attended 9th Peer Group meeting for updating and revision of Vulnerability Atlas of India organized by Building Materials and Technology Promotion Council, at IHC, New Delhi during June 2006.

16. Dr. Y.E.A.Raj Director attended the meeting convened by the Chief Secretary, Govt. of Tamilnadu at the Secretariat to review the Disaster Management for heavy rainfall over Tamilnadu on 29.10.2006.

6. Shri Y.K.Reddy, Director attended one day Workshop on 'Cyclone Disaster Management' at Noble College Machilipatnam on 9.10.2006.

Seminars/Symposiums

Under the joint auspices of IMS, Chennai Chapter and RMC Chennai the following two scientific talks were organized:

- i) Shri.K. Suresh ,IAS,Chairman, Chennai Port Trust delivered a talk on the WMO theme – 'Preventing and Mitigating Natural disasters' and
- ii) Prof. P.C.Kesavan of M.S.Swaminathan Research Foundation, Chennai delivered a talk on " Post Disaster Relief Operation" during March 2006.

Shri S.Sridharan DDGM convened a Seminar 'Public Weather Services and Disaster Management' at RMC Chennai jointly organized by ISRO & IMS Chennai Chapter in May 2006.

Dr. V. Subramanyam, Director, attended the National seminar on "Cyclones, Earquakes, Tsunami and Disaster Management" at St. Terasa College, Eluru, Andhra Pradesh during 31st July –1st August 2006.

Dr.V.Subramaniam, Director attended a Seminar on Indian coast and Natural Disasters conducted by Department for studies on Bay of Bengal, Andhra University during 18th-19th May 2006 and delivered a lecture and submitted a paper on Cyclones.

He also delivered an invited talk on "Cyclones-Disaster Management-Role of IMD" in National Seminar on "Cyclones, Earthquakes,Tsunami and Disaster Management"at St.Terasa College at Eluru,Andhra Pradesh during 31st July –1st August 2006.

S/Shri. S.R. Ramanan, Director, delivered a talk on "Early warning for Cyclone"at the Seminar as a part of Project for strengthening multi –hazard early warning system in Coastal Districts of Tamil Nadu under Joint auspices of The Revenue Dept of Tamil Nadu and the UNDP on 13th July 2006.

Talks

1. Dr. R.Suresh, Director participated in a panel discussion in connection with introducing a new M.Sc course in Remote Sensing and Disaster management at S.V. University on 27th February2006.

2. On ten occasions Officers from RMC Chennai delivered lectures on "Role of IMD in Flood and Cyclone Management" for the trainees from Anna Institute of Management, Chennai during 2006.

3. Dr. M. Satyakumar,Director, delivered a lectures on "IMD role in early warning, Characteristics and monitoring of Cyclones" and "IMD role in Managing Disasters Cyclones, Floods and Drought" in connection with training programmes arranged by Andhra Pradesh Academy of Rural Development Programme at Rajendranagar on 7th and 28th August 2006.

3.1.1 Action is in progress:

- a) A project-CDSTAT on 'Generation of comprehensive database of statistics of Depression, Cyclonic Storm and Severe Cyclonic Storm over North Indian Ocean' was completed. This project consisting of several programs which can generate any type of statistics on formation, dissipation and coastal crossings of Depression, Cyclonic storm and Severe Cyclonic storm over North Indian Ocean for the period 1891-2005.
- b) Digitisation of IMD's cyclone track Atlas was taken up. The digitised database containing various statistics /feature of cyclone tracks for 115 years storms and depressions were generated. The project has been handed over to a software developer for developing an electronic version of IMD's cyclone Atlas. The whole project will be completed during 2007. Once the software is developed CDs can be distributed / sold to the member countries of WMO/ESCAP panel.
- c) The Cyclone Manual published by IMD is a very exhaustive and detailed document providing substantial information on cyclone climatology of India, methods of cyclone forecasting, storm surge etc., besides describing all the guidelines required for the preparation and dissemination of cyclone warning messages. The same has been brought out in a CD form for easy distribution to concerned agencies.

3.1.2: Efforts are on to further improve the public awareness through media and disaster managers.

Anna Institute of Management periodically conducts training programs for personnel of Government / NGO/ other organizers in Disaster Mitigation and Managements. In fourteen occasions about 520 trainees sponsored by the Anna Institute of Management visited RMC Chennai and they were given familiarization in various aspects in forecasting and warning procedures followed by IMD in the disaster mitigation and lectures were given to the trainees on the Role of IMD in disaster Management by IMD Officers.

Early Tsunami warning system is being implemented by September 2007.

Reliable Communication Facility for dissemination of output of DWR Products is being implemented.

IMD has taken up the task of upgrading the analog CWDS receivers to digital in a phased manner. Modernisation of a new version of CDWDS which can remove the present deficiency in the old version of CDWDS is being finalised.

World Bank Hydrology project –II is being implemented after the successful completion of World Bank project -I. This project is being implemented in collaboration with IMD ,Central Water Commissions, and other State Government Hydrological Service Agencies, water bodies, Flood management and equitable distribution of water to the various users.

A proposal to make arrangement to open two more NAVTEX in the East coast –one in South Tamilnadu coast near Ramanathapuram and another in North Andhra coast near Visakhapatnam and two in the West coast – one in Karnataka near Mangalore and another in Kerala near Kochi was agreed to and suitable action is being initiated.

3.1.3: Continued efforts are being made to improve the co-ordination between meteorological/Hydrological services and emergency management of Disaster response agencies.

Central Water Board and IMD interact and issue suitable warning measures for Flood forecast in the various river basins of India.

Activities related to Hydrology Project:

1. Dr.(Mrs) N.Jayanthi, DDGM (WF) attended 1st meeting of State level Steering Committee (SLSL) under Hydrology Project at Mantralaya, Mumbai during June 2006.

2. Shri.B.R.Loe, DDGM(H) and Shri. N.Y.Apte, Director (H) attended the organization of active session under HP-II and CWC, R.K. Puram and at Goa to interact with States of Punjab, Himachal Pradesh, Goa and Pondicherry regarding implementation of Hydromet Component under the Project during June 2006.

3. Snri.B.R.Loe,DDGM (H) and N.Y.Apte, Director(H) attended meeting on:

- i. Identification of activities related to Hydrology Project Phase –II need clearance from HISC.
- ii. “Flood Disaster Management- Strategies Guidelines and Action Plan” under vice-chairman, NDMA at New Delhi during July 2006.
- iii. The first meeting of Hydrological Information System Management Group during July 2006.

4. Dr. Y.E.A. Raj Director attended the following meetings held at PWD office Chepauk, Chennai in May 2006.

- i) the Coordination Committee meeting of the State Hydrological Information System Coordination Committee; and
- ii) the first State Level Steering Committee Meeting of the State Hydrological Information System Coordination Committee of World Bank aided Hydrological Project Phase II.

5. Shri K.Santhosh Director attended a review meeting on overall status of Flood preparedness in the state at the Chamber of Additional Chief Secretary, Disaster Management Thiruvananthapuram in July 2006.

6. Dr.Y.E.A Raj Director and alongwith other officials visited the Office of the Chief Engineer (SG & SWRDC) Taramani and discussed about Hydrology Project Phase II and explaining format of sending rainfall data to IMD in July 2006.

7. Dr. M.Satyakumar Director and Shri D.Visweshwar Rao Meteorologist attended the first meeting of State Hydrological Information System Co-ordination Committee (SHISCC) of Hydrology Project Phase II held in the Chambers of Superintending Engineer, H.P.Circle Hyderabad in July 2006.

8. Shri.S.K.Subramanian,DDGM(CW) attended a Seminar on “Hydrological, Climatic Disasters-Floods,Cyclones,Rains etc held at Dehradun convened by Army HQ, Uttranchal, Sub Area, Dehradun during June 2006.

9. The following papers were forwarded to the Organizers of the National Seminar on Hydrology held at University of Madras for presentation;

1. 'Physical conditions responsible for unusual excess rainfall over east coast of India during northeast monsoon season of 2005' by S/Shri S.Sridharan DDGM and A.Muthuchami, Meteorologist.
2. 'An analysis of maximum temperature in Tamilnadu' by S/Shri A.Muthuchami, P.S.Kannan Meteorologists and S.Sridharan DDGM.

10. Shri G.Sudhakar Rao Director delivered a lecture on 'Role of IMD in Flood Management' in connection with training programme on Flood – computation & Management' at Engineering Staff College of India in January 2006.

11. Dr. P.C.S Rao Met and Shri R.Nallaswamy AM gave lectures on Seismology & Tsunami at Dept of Fisheries Govt of Tamilnadu Chennai in June 2006.

3.2: The use of INTERNET to share the information with panel member countries has already been started by IMD. The CWD is using INTERNET and other means of communication to strengthen the regional cooperation on DPP.

INTERNET facilities are available at all the cyclone forecasting centres, satellite imageries from other satellites such as Meteostat etc., are readily accessed. In addition to the routine communication about the existence and forecast of Cyclonic storm, IMD WEB site provides Satellite imageries, DWR output, information about movement, likely place of landfall, Warnings on Damaging features in case occurrence of Cyclonic storms, the intensity of Rainfall associated with it and the storm surge likely to occur.

The website also provides climatological aspects of cyclones and other weather events which will be useful for pre-planning design of DPP measure.

Cyclone forecasting outputs based on NWP models from NCMRWF, ECMWF, GUAM centers are taken into consideration while preparing IMD's forecast.

3.3: Action is in progress.

Ministry of Home Affairs Govt. of India is planning to launch a Cyclone Risk Mitigation Project with World Bank support at an estimated cost of 1642.50 crores out of which the World Bank would meet Rs.1350 crores. For example the Government has implemented the scheme of the project in Kerala and the resource allocation to Kerala is Rs.26 crores. The State Government of Kerala requested issue of proposals covering the relevant components as per the guidelines. In this connection Suitable Guidelines / advices are being supplied to the Govt. of Kerala.

3.4: Action is in progress.

Priority projects : No comments.

MALDIVES

Disaster Prevention and Preparedness Component

Warnings and advisories

The Department of Meteorology, Maldives (DoM) issued timely and accurate severe weather warnings and disseminated them to the public through mass media and web-page. Apart from severe weather or tropical cyclone warnings, tsunami warning reports received through GTS were also dispatched satisfactorily in time.

In addition to the 3 existing hotlines between the National Meteorological Centre and Television Maldives, Voice of Maldives, Coast Guard, DoM installed a new hotline between Ministry of National Defense Force (MNDF) for quick dissemination of the warnings.

The warnings/ advisories (*more than 40 issued last year*) helped immensely to minimize the damages to property and loss of life due to floods/ landslides, risks to fishing vessels or passenger boats encountering stormy weather in the open seas.

OMAN

Disaster Prevention and Preparedness

Disaster Prevention and Preparedness

Disaster Prevention and Preparedness operates under the Directorate General of Civil Defense of the Royal Oman Police. On yearly basis, they run awareness programs, roving workshops, rehabilitation programs, etc.

The Public Relation Office of the Royal Oman Police issues warnings and Advisories to the public through different Media channels.

There is a very good coordination and cooperation between this entity and the Meteorological Department.

Earthquake Monitoring Center

The Sultan Qaboos University established a Center for Earthquake Monitoring in order to fulfill its mandate on a national program for the assessment and mitigation of earthquake hazard in the country. The Director of Meteorology is one of the members in the coordination technical committee.

Disaster Preparedness Plan

A new Natural Disaster Management Plan is drawn up by Directorate General of Civil Aviation and Meteorology – Department of Meteorology- in coordinating with the National Civil Defense as a part of the National Natural Disaster Plan.

PAKISTAN

Disaster Prevention and Preparedness (DPP) Component

(i) Pakistan's National Disaster Management Programme: Establishment of National Disaster Management Commission

Realizing the importance of disaster risk reduction for sustainable social, economic and environmental development, the Government of Pakistan has established a National Disaster Management Commission (NDMC) for making disaster risk reduction and preparedness policies, systems and capacities. A National Disaster Management Authority (NDMA) has also been established. NDMA would serve as the Secretariat to the NDMC.

The NDMC would be responsible to ensure coordination for disaster risk reduction management in its broader sense including all hazards approach to mitigate; prevention, preparedness, response and recovery; to oversee the integration of disaster risk management issues in to sectoral development plans; and to oversee the implementation of this policy through the NDMA. Prime Minister of Pakistan is the Chairman of NDMC.

In this connection, PMD also organizes a two days National workshop on Hazard / Vulnerability Mapping for Pakistan from 09-10 January, 2007 in Islamabad, in collaboration with UNDP. Representatives of many government and non-government organizations attend the workshop.

(ii) National Plan: "Strengthening National Capacities for Multihazard Early Warning and Response System (Phase-I)"

Like other South Asian countries, Pakistan continues to suffer from a plethora of natural hazards and disasters like floods, earthquakes, landslides, cyclones that threaten to affect the lives and livelihood of its citizens. For this a National Plan: "Strengthening National Capacities for Multihazard Early Warning and Response System (Phase-I)" was prepared by PMD. Phase-I of the National Plan has been submitted to the United Nation's International Strategy for Disaster Reduction (UN-ISDR) Consortium for seeking funding / donor support in response to President Clinton's initiative. The cost of first phase of National Plan for Establishment of Multi Hazard Early Warning and Response System is estimated about US\$ 28 million. It includes eight integral components dealing with all major disasters generally experienced in Pakistan.

(iii) Cooperation with Regional Organizations: Drafting of MoU between ADPC & PMD

On the invitation of Asian Disaster Preparedness Centre (ADPC), Thailand, PMD has initiated the process of cooperation with ADPC. At first stage, a draft of Memorandum of Understanding (MoU) for Cooperation on Early Warning Arrangements Mitigation of Natural Hazards between ADPC & PMD has been submitted to the Government of Pakistan for seeking Govt. approval.

SRI LANKA**Disaster Prevention and Preparedness (DPP) Component**

Disaster Management Centre (DMC) with the SLMD, playing a major role in early warning is considered a monitoring, coordinating and early warning Agency while, National Disaster Management Centre (NDMC) takes up preparation and implementation of awareness projects and response, relief and recovery work.

(a) DPP Activities by National Disaster Management Centre (NDMC)

Floods, landslides and droughts are among major disasters that occurred during 2006, with floods claiming the highest proportion of financial allocation (~ 62%); droughts claimed for 07% as the next. Fire, man-made disasters like civil conflicts and accidents were also among the other disasters.

(i) Assistance for Relief, Rehabilitation and Reconstruction Activities- 2006

Type of Disaster	Allocation (Rs)	Percentage of Total Allocation
Accidents	406,567.00	0.17
Civil Conflicts	44,583,731.07	19.18
Cyclones	10,236,932.00	4.40
Development	25,400.00	0.01
Drought and Drought Mitigation	16,693,828.25	7.18
Relief Assistance for Fishery	379,080.00	0.16
Fire	20,084.62	0.01
Floods	143,711,728.75	61.82
Funeral expenses for Disaster Victims	5,650,655.00	2.43
Landslides	4,635,605.54	1.99
Publications	307,618.00	0.13
Sea Erosion	120,000.00	0.05
Training and Education	1,279,071.02	0.55
Other	4,404,230.87	1.88
Total Allocation	232,454,532.12	100%

(ii) Database of Disaster Information

The NDMC with the assistance of UNDP has prepared a database of disaster information and DesInventar and DesConsultar computer software have been used to disseminate and accumulate information on floods, landslides, fire, tsunami situations and accidents that affect Sri Lanka. This information includes disasters that affected Sri Lanka during the period 1974 to 2006, analytical reports, charts and maps. In the final stages, the district officers will be provided with facilities to join the main database through the Internet.

(iii) Emergency Relief Assistance Programme

Immediate action to provide relief assistance to victims of natural and man made disasters such as sudden fires, internally displaced people (Cooked meals, dry rations, food items and kitchen utensils temporary residential facilities, mats, lanterns, sanitary equipment, water tanks and clothes were among the items distributed).

(iv) Programmes for Mitigation of Disasters

Reducing the impact of Droughts: Allocation for the supply of potable water, 255 water tanks for providing drinking water to the people affected by drought.

Rain Water Tanks Project: For people of drought affected areas, particularly low-income groups to overcome grit, dirt and turbidity problems. Under Drought Impact Reduction Programme, 80 families out of total of 192 families (960 members) in tiny village of Kuda Oya have been selected as beneficiaries for rain water tanks.

Suriyawewa Drinking Water Project: To relieve people from drinking water shortage and water-induced health hazards. Full contribution of the villagers by way of labour, the contribution of the local organizations and the dedication and commitment of the government officials are praise-worthy.

Introduction of Sprinkler Irrigation System donated by the Chinese Government: Introduced among farmer community affected by severe shortage of water, this exercise will help to educate the farmers on effective use of water in agriculture and to enhance the economy of the poor farmer families.

Mapping areas vulnerable to floods: In order to reduce socio-economic impact due to areas getting inundated as an annual phenomenon. The community was apprised of this pilot project which helped them to adjust their living standards through flood risk assessment. (Introduction of flood resistant housing construction programmes etc.)

Mapping of Areas Devastated by Tsunami: Mapping of Tsunami affected areas was done through GPS and GIS (scale 1:10000 base map) and it will help to launch awareness programmes and find out what course of action should be taken in the event of another tsunami situation.

(v) Educational and Training Programmes on Disaster Management

The main objective of this programme is to provide effective contribution for Sustainable Development through main factors of disaster management, namely awareness creation, preparedness, mitigation, relief operation, recovery, rehabilitation and reconstruction. The National Disaster management Centre conducts educational and training programmes from the national level to the community level.

National Certificate Course: To create awareness among government officers and leaders of voluntary organizations. Two, six day residential courses were held in Colombo.

One day and Three day Training Workshops: These workshops are being held for public officers and community leaders in every Divisional Secretariats in the country. The main objective of these workshops is the formulation of disaster management strategies after identifying probable natural as well as man made disasters at Divisional level.

Training was given to 75 public officers and NGO officials in the Puttalam district and for 75 volunteer organization officials in the Ratnapura district and for 80 government officers and officials of volunteer organizations in Kegalle district.

Educational and Training workshops for School Children: The prime objective of these workshops was to educate school children on disaster management covering all Divisional Secretariat divisions in the Island.

Accordingly, one day educational training workshop was conducted for 500 school children in Matara district.

(vi) Setting up of Voluntary Disaster Search and Rescue Operation Teams in every Divisional Secretariat Division.

Action has been taken to train a district group of 110, selecting 10 from each Divisional Secretariat Division of Hambantota District as a pilot project.

(vii) Establishment of Resources Centre for Disasters

A resource centre was set-up for Ratnapura District in District Secretariat to be activated to provide relief to the people affected by disasters in the area. More centers to be set up in Matara, Nuwara Eliya, Kalutara and Batticaloa districts.

(viii) Publication of a quarterly newspaper and magazine on disaster management.

(b) DPP Activities by Disaster Management Centre (DMC)

(i) At National Level

- Implementation of 8 workshop in Colombo, Gampaha, Puttalam, Kalutara, Galle, Matara, Hambantota & Trincomalee for Govt officials Department Heads, INGO & NGOs.
- Establishment of National Technical Advisory Committee, Emergency Response Committee, Colombo Flood Committee, Technical Committee on DVI, Technical Committee for developing building guidelines in disaster prone areas
- Lidar Survey – Undertaken by the Italian Government as an outright grant has been completed with handing over ceremony in December.
- National Safety Day Activities are implemented on 26th December in Galle where the effect of Tsunami was outstanding.
- Initiated development of Sri Lanka Disaster Resource Network (SLDRN)
- Established networks / agreements with a number of key partners such as (a) Youth Services Council (b) Samurdhi Movement for poverty alleviation (c) Practical Action (d) Dialog GSM of telephones
- Started establishment of SMS and cell broadcast system

- Established first of 03 Tsunami EW Towers with UN-ESCAP, at Hikkaduwa in Southern province on 26 December.
- Establishment of ICS in Sri Lanka. Several workshops have been conducted by US Forest Services. This is a programme funded by the USAID under the Indian Ocean Tsunami Early Warning System.
- National Emergency Response coordination in the districts of Puttalam, Gampaha, Colombo and Kalutara with Joint Damage Assessment, during October 2006 floods.
- Implementation of Flood Mitigation Programmes for Colombo and other districts with arrangements made to handover equipments such as boats, catamarans, generators, life jackets, tents etc. to districts and provincial councils.

(ii) Local level Activities

Following activities have been conducted in the districts of Puttalam, Gampaha, Colombo, Kalutara, Galle, Matara, Hambantota, Ampara, and Ratnapura;

- Establishment of Disaster Management Committees and sub committees at District, Divisional and Village Levels and initiating Disaster Preparedness & Response Plans at District, Divisional and GN levels
- Capacity building of village level volunteers on First Aids, SAR, Life Saving, Swimming, Fire Fighting Programmes, Emergency Evacuations etc
- Awareness programmes for General public, Schools, Government & Non-Governmental Organizations, Hoteliers / Private sector etc
- Evacuation Drills/ Rehearsals & warning systems, coordinating the dredging of channels as a Flood mitigation activity, other mitigation activities such as Tree Planting, and Community Based Hazard Mapping, and coordination of recent Oil Spill in Galle and Floods in October 2006 as an Emergency Response activity at local level

(iii) Preparedness Planning

Preparation of disaster preparedness plans for Districts, Divisional Secretary Divisions and Grama Niladari Divisions are coordinated by the District Disaster Management Coordinators (DDMC) of the District Disaster Management Units (DDMU) established in District Secretary's office under the supervision of the DMC. At present DDMUs are functioning in eight districts, Colombo, Gampaha, Kalutara, Galle, Matara, Hambantota, Ampara and Puttalam. Preparation of District and Divisional preparedness plans are in progress in these Districts and selected Divisional Secretary Divisions.

The preparation of preparedness plans is in different stages, viz., Awareness programme, Establishment of disaster management committees, Data collection and draft plan preparation, Discussion on the draft plan and, Finalisation of the plan.

Position of preparation of preparedness plans during year 2006

District	No. of Divisional Secretary Divisions selected for preparation of Divisional Plan
Colombo	13
Gampaha	2
Kalutara	2
Galle	2
Matara	2
Hambantota	2
Ampara	12
Batticaloa	12
Puttalam	2

(iv) Mitigation and Technology

- Provided boats with engines and ferries (Conterminous) to strengthen the preparedness and response capacity of District Secretary Ratnapura
- Two fibreglass boats with 15hp capacity outboard motors, and 15 Anguls were purchased and handed over to Ratnapura District Secretary o 12th October.
- **Rehabilitation of Drainage canal in Kolonnawa:** Dredging of Kithampahuwa Canal is in progress. Sri Lanka Land Reclamation and Development Corporation have completed nearly 50% of the dredging work. Ministry has appointed a Committee to study the problem of flooding in Colombo District and made recommendation to mitigate the threat of flood in most part of Colombo City and greater Colombo area. Ownership of canal is being established at present.
- **Establishment of Rainwater harvesting facility to minimize the effect of drought:** Beneficiary communities in Yodakandiya, Tissamaharama and Hanguranketa are identified. Construction of tanks is undertaken through Divisional Secretary Tissamaharama and Hadabima Authority. Community contracts awarded.
- **Establishment of Natural Barrier along the coast:** Work has commenced in Moratuwa. Unauthorized structures on a coastal stretch of 500m cleared and prepared for planting trees. Plants are purchased from Department of Forest. Coconut Board and other nurseries. Planting of trees has commenced. More than 60% of the work is completed, in Gampaha District Plants were purchased and preparation of land are in progress and 30% of the work has been completed.
In Matara District work is in progress. UDA and NGO are assisting District Secretary to impellent the project. About 30% work completed.
- **Project to Mitigate Land Subsidence in Matale District:** NBRO has commenced the study to determine the reasons for land subsidence at Matale and recommend mitigation activities. Survey of 2500 houses in the Matale area was completed and analysing the data is in progress. Houses in critical conditions were identified and occupants were provided with temporary houses with the assistance of a NGO. More than 50% of the work is completed.

▪ ***Project to Study the effect of Landslides around Kotmale reservoir and recommend activities to mitigate:*** Study was handed over to NBRO and Project office will be opened from 1st November 2006. A group of professionals from university of Peradeniya, Institute of fundamental Studies, NBRO, Irrigation Dept. and Mahaweli Authority of Sri Lanka visited the area and had identified the main direction of the study. About 10% of the work is completed.

• **Other Projects**

- Technical Advisory Committees to formulating guidelines for:
 - Construction in landslide prone areas
 - Designing of buildings against cyclones and strong winds
 - Design guidelines for earth quake resistant buildings
- Project for improving the capacity for flood forecasting and early warning with JICA assistance. Contract agreement signed and Consultants have commenced work. Project will complete in Feb 2009
- In NAWAM Project implemented by MASL, discussion with consultants to include dam safety component identified in the Road Map, is in progress.

(v) Training and Public Awareness

- District Disaster Management Coordinators (DDMCs), Assistant Coordinators and Staff attached to District Disaster Management Coordination Units (DDMCUs) were trained adequately in Disaster Management approaches and Participatory approaches to work at community level. (around 240 personnel).
- They were also trained on how to conduct Tsunami evacuation drills at community level. A video programme of a model drill was compiled and disseminated to all coastal districts with DDMCUs.
- Conducted communication skills training for UNVs and District Coordinators and Assistant Coordinators to develop effective communication ability with stakeholders.
- Contributed with resource inputs, to a multitude of awareness creation activities at various institutions and schools across the country.
- Conducted a pilot programme to create awareness for elected members of local governments (300 personnel) within the Central Province under the auspices of the Governor. This will be replicated in all Provinces.
- Conducted an awareness programme for OICs of Police Stations in the Galle District (40 personnel) as a pilot project. This will be replicated in all districts.
- Conducted community training for five selected communities in Ratnapura on response to early warning of landslides.
- Facilitated the development of a draft MOU for collaboration with National Youth Council as well as Samurdhi for disaster management work at village level using their widely spread networks.

- Translated two manuals, one on School Preparedness and the other on House-hold First Aid into Sinhalese and Tamil. Currently getting ready to print and disseminate them.
- Five posters to create awareness on Tsunami, Floods, Landslides, Lightning and Cyclones were designed and printed for distribution
- Island wide awareness campaign on the National Safety Day (26th December) as well as Media Awards for Excellence in Disaster Reporting and School Essay and Arts competitions accomplished.

(vi) Emergency Operations Centre

- The role and task of the Emergency Operations Centre is to collect and collate data during an Emergency Situation, to provide necessary relief assistance through Government and Non Government Organizations, in liaison with the District Disaster Management Coordinators.
- An officer from the Emergency Operations section along with a District Disaster Management coordinator got involved in settling an unrest situation that was developing to the stage of a communal conflict in Pambegama Estate in Kegalle District. On 29th June 2006 the aforesaid DMC officials visited the estate and established a peace committee and brought the situation back to normal. The DMC officials met the Chief Minister Sabaragamuwa, other political party representatives and the government official during this visit.
- Roofing sheets were provided to the occupants of the houses that got damaged due strong winds in the Central province in July 2006. The sheets were donated by the International Organization for Migration (IOM).
- A daily situation report on Manmade or Natural disasters is forwarded to the Hon Minister of Disaster Management and Human Rights.
- In August – September 2006, District Disaster Management coordinators of Puttalam and Kalutara were attached to Kantale to coordinate matters related to relief activities at the IDP centres in Trincomalee district, following terrorist attacks in Sampur and Muttur. An officer from the Emergency Operations section visited Kantale to check on the activities carried out by the attached DMC staff.
- On 29th September 2006 a Bangladesh oil tanker was sunk in Koggala – Habaraduwa area in Galle district. The District Disaster Management Unit Galle established a temporary Operations Centre in the area and got involved in clearing activities to minimize the damage to the environment due to oil spill.
- The Emergency Operations Centre was activated full time (24 hours operation) during floods October 2006. Monitoring of Kelani river water level and island wide weather, collection of data and passing information to media to educate the general public on the situation and coordination with District Secretariats and Government and non government organizations for relief activities were successfully handled by the Emergency Operation Centre.
- The Emergency Operations Centre in close coordination with all the District Secretariats monitors the IDP state in respective IDP centre. Further, complaints made by affected persons are forwarded to respective authorities for relief assistance.

THAILAND

DISASTER PREVENTION AND PREPAREDNESS (DPP) COMPONENT

a. DPP Activities :

+ Department of Water Resources has implemented the work plans set forth in the national water policy, one of them is the accelerate preparation of plans for flood and drought protection. In 2006, completed and ongoing projects are supported as follow:

1. The Integrated of Flood Mitigation in Chiang Rai Province Project including the construction of 21 reservoirs.
2. Flood Mitigation in the North Project including construction of 21 reservoirs, Check Dam and improving the village water supply in respond to the Royal Initiative.
3. Flood and Landslide Early Warning System.
4. The Establishment of War Room phase II Project to cope with water crisis focusing on the flood, drought and water pollution monitoring and assessment.
5. The Telemetering of Hydrological Network and regional center for Flood forecasting in Chi and Mun Basin.

+ Project on “Advisory Assistance to DDPM in Disaster Risk Management”

“Advisory Assistance to DDPM in Disaster Risk Management” project, with the support from Deutsche Gesellschaft Für Technische Zusammenarbeit (Germany’s GTZ), is conducted with the main aim to reduce the loss of lives and properties from future disaster. This project is also targeted to strengthen the community awareness in disaster prevention and mitigation. Two pilot areas in tsunami and flooding in two provinces were selected for the field study. Trainers from Department of Disaster Prevention and Mitigation (DDPM) and Deutsche Gesellschaft für Technische Zusammenarbeit (Germany’s GTZ) introduced the Community-Based Disaster Risk Management (CBDRM) practices, followed by the handover of needed equipment to both villages. Evacuation exercises were conducted in both selected communities to ensure the better understanding of the local residents of how to prevent and mitigate the consequences of the disasters by themselves.

+ OTOS Project

DDPM has envisioned to have a search and rescue team in every tambon of Thailand or “One Tambon One SAR : OTOS”. Each OTOS team will be saving not only the lives of those who face road accident but also those who are hit by any type of disaster.

The objectives of the OTOS include : a) to bring the life safety to the people b) to ensure rapid and efficient search and rescue operation though 5 days extensive training and c) to setup of SAR teams in every tambon (Thailand has 7,255 tambons). The target group of OTOS programme is government officials in provincial and local government who work in the disaster management field. Volunteers working in similar environment are also welcome to join the OTOS.

+ The new “Mr. Warning” project

Department of Disaster Prevention and Mitigation (DDPM) launched a new project called “Mr. Warning” in July 2006. This project was jointly implemented by various government agencies related to landslide disasters, i.e Department of Provincial Administration, the Meteorological Department, Department of Mineral Resources, National Park, Wildlife and Plant Conservation Department and National Disaster Warning Center. At the initial stage the mentioned agencies jointly drafted the training course in order to review the policies from July 31st - Aug 1st, 2006 at Department of Disaster Prevention and Mitigation. Furthermore, the trainers were dispatched to train the 2 selected villagers in the flood and mudslide prone areas and assigned them as Mr. Warning. Their responsibilities are to keep close watch at water level situation, the amount of rainfalls and to report emergency by using telecommunication utilities to alert and warn people to evacuate to the safe areas immediately. The training courses were launched in the north of Thailand from August 7th, 2006 as first priority.

+ Civil Defense Volunteers (CDVs)

CDVs play an important role in disaster management in Thailand. Authorized by the Civil Defense Act 1979 and MOI’s Civil Defense Regulations 2005, Local governments can recruit local residents with age over 18 years to have 5-days trainings and then grant them the CDV status. Roles of CDVs can be found in disaster response, relief, recovery, prevention, mitigation and preparedness. In other words, all activities in disaster management have been involved by the volunteers. CDVs have been also engaged in general activities organized by government agencies at national, provincial and local level. Normally, CDVs are not paid by the governments. They work on a voluntary basis. At present, there are around 835,000 CDVs in the country (about 1.3% of the total population). But due to the increase in number, scale and complexity of disaster, MOI has planed to increase the number of CDV to 2 millions (2% of the population) within the year 2007.

+ The Royal Irrigation Department (RID) has introduced the implementation plan for flood management during the rainy season. The plan is divided into 3 stages namely : before flooding, during flooding and after flooding. RID has also completed two other projects in the rivers of Pa Sak Lower Chao Phaya .

APPENDIX IX

SUMMARY OF THE TRAINING ACTIVITIES OF THE MEMBERS

BANGLADESH

5.4 Training Component (Agenda item 8.4)

5.4.1 Foreign Training attended by BMD during 2006

Except the participation in different Workshop, Seminar and Conference, officers of BMD underwent foreign training in different countries as follows:

Participants	Training Title	Funding	Host Country	Duration
Md. Sazzad Hossain	Regional Seminar on Tsunami Early Warning System	Japan	Japan	22 January-11 February, 2006
Mr. Md. Akram Hossain	Asian Conference on Disaster Reduction	WMO	Korea	15-17 March 2006
Mr. Murad Ahmed	International and Communication Technologies for Meteorological Services	Korea	Korea	02-29 April, 2006
Mr. Md. Shah Alam	Second Session of the Forum of Regional Climate Monitoring Assessment Prediction for Asia (FOCRA-II)	China	China	06-08 April 2006
Mrs. Jinnatun Nessa	Application of Satellite Rainfall Estimation in the Hindu Kush Himalayan Region.	ICIMOD	Nepal	03-07 July 2006
Mr. S. M. Quamrul Hassan	Training Workshop on Emission inventory, Preparation and Integrated Assessment Modelling	UNEP	Thailand	03-08 July 2006
Mr. Md. Shah Alam	Regional Workshop on Disaster Preparedness Plans for Natural Hazards	ICIMOD	Nepal	07-09 August 2006
Md. Akram Hossain	Meeting on Regional Cooperation on Early Warning for preparedness and mitigation of Natural Hazards	WMO	Thailand	12-14 July 2006
Mr. Sayeed Ahmed Chowdhury	Fourth Regional Workshop on Storm Surge and Wave Forecasting	WMO	Manila, Philippines	11-15 September 2006

Participants	Training Title	Funding	Host Country	Duration
Ayesha Khatun	Training in different aspects of Storm Surge model and its familiarization	WMO	India	07-18 August 2006
Mr. S. M. Quamrul Hassan	Group Training Course on Meteorology	JICA, Japan	Japan	12 September-16 December 2006
Mr. B. N. Poddar, Mr. Ahmed Arif Rashid and Mr. Munshi Mahmudul Hassan	JICA's Counterpart Training Course	JICA	Japan	18 September-14 October 2006
Mr. Md. Sanaul Hoque Mondal	Regional Training Seminar on the use of Environmental Satellite data in meteorological application for RA-II region.	WMO	Nanjing, China	16-27 October 2006
Mr. Md. Akram Hossain	International Task Team (ITT) Working Session and Capacity Building Workshop entitled Earth Observation in the Service of Water Management		Thailand	25 September
Mrs. Arjumand Habib	Tender related activities of the project "Improvement of Meteorological Radar System at Cox's Bazar and Khepupara"	Japan	Japan	22-30 October 2006
Mr. Nur Mohammad Mia	International Workshop on Agrometeorological Risk Management, Challenges and Opportunities	WMO	India	25-27 October 2006
Dr. Samarendra Karmakar	Sixth WMO International Workshop on Tropical Cyclone (IWTC-VI)	WMO	San Jose Costa Rica	21-30 November 2006

5.4.2 METEOROLOGICAL TRAINING INSTITUTE OF BMD

5.4.2.1 ACTIVITIES

This institute imparts in-service training to the BMD's officers and staffs as per syllabi of the scheduled courses approved by WMO. It conducts and coordinates research and investigations on various meteorological problems particularly relating to Bangladesh and the region. The training courses include both theoretical and practical aspects. The practical courses include weather observation at the surface and upper levels, recording, data analysis and issue of forecasts. Besides the departmental employees, this institute also conducts special training courses on meteorology for other organizations too. Meteorological instruments and meteorological communication system are also imparted to the students of

various educational institutions. This institute also guides the M. Sc. /M.S. /Ph. D students of various universities, who are doing their theses in the field of Meteorology. In every training course, clear conceptions about disaster preparedness and management and related Standing Orders are also imparted. This institute also conducts and co-ordinates research and investigations on various meteorological problems particularly relating to Bangladesh and the region. So far the institute conducted 2-3 courses in an average every year.

5.4.2.2 Regular Courses

The regular scheduled courses are:

- i. Class-II Forecaster's Course for Class-I Officers.
- ii. Class-III Assistant's Course.
- iii. Class-IV Observer's Course
- iv. Class-II Forecaster's Refresher Course for Class-I Officers.

5.4.2.3 Areas of Training and Training Method

- i) Science and Meteorology,
- ii) Observation of weather phenomena,
- iii) Transmission and exchange of weather data,
- iv) Analysis of weather elements and charts,
- v) Forecasting & monitoring of the all types of weather & natural disasters
- vi) Recording and monitoring of Earthquake,
- vii) Satellite & Radar Meteorology,
- viii) Electronic and communication,
- ix) Research on Meteorology,
- x) Seminars and workshops in the disaster prone areas,
- xi) Practical training on Storm Surge Model (Dube Model) with two hours training everyday for two months.

Training Institute imparts training to all Meteorological personnel on the above-mentioned fields through theoretical and practical classes as per the syllabi approved by World Meteorological Organization.

Training Programmes Conducted by BMD in 2006

1. Class-IV Observer's Course, Batch 28/2006 during 19 February – 03 August 2006, No. of participants =14: 12 participants from BMD and 2 participants from Bangladesh Navy.
2. Basic Computer Course during 03 September – 20 November 2006, No. of participants = 05, all are from BMD.
3. Class-III Course for the Technicians, Course duration is 35 weeks, Batch No. 01/2006. The Course started on 10 September 2006. No. of participants-10, all are from BMD. Course is going on.
4. Class-III Assistants' Course, Batch No. 24/2006, Course duration is 35 weeks, Batch No. 01/2006 Course started on 10 July 2006. No. of participants-10, 09 participants from BMD and 1 participant from SMRC.

5. Industrial Attachment Course for Bangladesh-German Technical Training Centre, Course duration is 08 weeks, Course started on 03 April 2006-28 May 2006. No. of participants-17.
6. Industrial Attachment Course for Mirpur Karigori Proshikhan Kendra, Mirpur, Course duration is 08 weeks, Course started on 03 April 2006-28 May 2006. No. of participants-28.
7. Industrial Attachment Course for Bangladesh-German Technical Training Centre, Course duration is 08 weeks, Course started on 12 December 2006-05 February 2007. No. of participants-15.
8. Industrial Attachment Course for Mirpur Karigori Proshikhan Kendra, Mirpur, Course duration is 08 weeks, Course started on 11 December 2006-04 February 2007. No. of participants-14.

5.4.2.4 Monitoring Evaluation

Training has been conducted according to the standard syllabi approved by WMO. The standard of trainees have been selected and classified through interim, final, practical and viva-voce examination (lowest pass marks is 50%) on different subjects of each course.

The Meteorological Training Institute of BMD needs to be upgraded by introducing new courses on Advanced Meteorology, Communication, Electronics and Equipment. It is essential to introduce Class I Forecaster's Course for officers (Forecasters). It is also necessary to introduce computer courses for trainees of different levels. In this respect, **assistance is necessary.**

INDIA

4. Training

Broad Goal

Anna Institute of Management, Chennai periodically conducts training programs for NGO/ other organizers in Disaster Mitigation and Managements. In fourteen occasions about 520 trainees sponsored by the Anna Institute of Management visited RMC Chennai and they were given familiarization in various aspect in forecasting and warning procedures followed by IMD in the disaster mitigation. IMD Officers delivered lectures on the 'Role of IMD in disaster Management' to the trainees.

In AP also IMD officers deliver lectures on disaster weather events in particular to the state Govt./NGO and other organisers under the training programs organized by the state government in DPP.

Shri Y.K. Reddy Director participated as a resource person in the training program organized by CRASA Machilipatnam and gave orientation training on early warning dissemination and preparedness to school teachers in August 2006.

Eight Postgraduate students from various colleges have undergone projects, Internship programme on different topics on disaster events associated with Tropical cyclones.

Five M.Sc (Physics) students and one Senior Observer from RMC Chennai who has enrolled for Postgraduate course in Disaster Mitigation are presently undergoing projects on various topics.

About 40 students from different Engineering colleges in Tamilnadu were given Inplant training.

4.1

- A two week training workshop was conducted at IIT Delhi in February 2006 on the use of WRF model where young meteorologists and research scientists of India took part.
- A two week training workshop was conducted at IIT Delhi in January 2007 on the use of Hurricane WRF model in the cyclone prediction where young meteorologists and research scientists of India were trained.
- A Multi stakeholders workshop-cum-seminar on “Communicating Meteorology” was organised by IMD together with Centre for Environment Education”, Pune (CEE) at Central Training Institute, Pune during 26-27 Sept. 2006.
- Two officers were on deputation to SAARC Meteorological Research Centre, Dhaka, Bangladesh, under the Joint Collaboration Project on Development of “Cyclone Track prediction Model” during June 2006.
- Under the INDO-USAID collaborative programme, fifteen scientists of IMD are being trained in USA in different components of NWP and another scientist was trained in precipitation downscaling technique for flood forecasting.
- One scientist from IMD attended the 6th WMO International Workshop on Tropical cyclones (IWTC–VI) held at San Jose, Costa Rica during 21–30 November, 2006. The IWTC–VI emphasized that the maximum impact zone in terms of maximum winds and heaviest precipitation need to be conveyed to the affected people in coastal areas and concerned authorities in addition to the conventional landfall location and time.
- During August 2006, Two meteorologists from Bangladesh and Pakistan were attached to IIT Kharagpur for training on storm surge forecasting. During the period of attachment they were given intensive training on the numerical modelling of storm surge. The location specific high resolution operational storm surge forecasting models for Bangladesh and Pakistan was used by the Meteorologists to simulate the past storm surges and validation. The models together with operating and relevant graphics software were transferred to these experts for implementation in Bangladesh and Pakistan.
- DDGM(UI), New Delhi imparts training on Doppler Weather RADAR products in Advance Instrumental Training course.
- IMD in collaboration with SAARC Meteorological Research Centre organized a two week training workshop at IMD New Delhi in February-March 2006 where Meteorologists of SAARC countries were trained on the use of MM5 model and interpretation of NWP products for operational forecasting.

4.2 Dr.Y.V.Rama Rao, Director and Dr. S. K. Roy Bhowmik, Director (NWP) were on deputation to SAARC Meteorological Research Centre, Dhaka, Bangladesh, under the Joint Collaboration Project on Development of “Cyclone Track prediction Model” during June 2006.

IMD has proposed the following in the core group on "College and University Education" during the workshop-cum-seminar on "Communicating Meteorology":

1. Exchange of Faculty
2. Students project and internship
3. Web based interface
4. EDUSAT
5. Resource (Material and Services) exchange
6. IMD personnel may be involved in University and college teaching
7. Outreach Cell
8. Consultation with UGC/All Universities Professional courses, Agriculture, Management, some branches of Engineering, Journalism, Arts, Commerce and Science Colleges and Open Universities.

Regular training courses in the advanced, intermediate, basic levels and modular training courses are being imparted to departmental officers, Indian Navy, Coast Guard, IITM and Foreign countries of Southeast Asia like Sri Lanka, Maldives, Ethiopia, Uganda, Malaysia, Vietnam, Myanmar etc.

The following courses are proposed to be held during 2007 at CTI, Pune:

1. Refresher course for Salt Commission Officials
2. Refresher course for Officers and staff working in FMO
3. Hydromet. Supervisors course
4. Basic observers Hydromet. course
5. Refresher course on ASTRONOMY
6. SASE observers course at MMC Srinagar
7. Specialised Proficiency course in Meteorology for SASE for SASE/ Army personnel
8. Senior Level Refresher course.

Courses planned during 2008-2010

Year : 2008

Mapping and analysis of Long Range transport of air pollution and its relation with Air quality
Sea and swell wave monitoring and its prediction

Year : 2009

Mid tropospheric cyclones and weather
operational NWP models
Stratospheric meteorology

Year : 2010

Special refresher course for operational aviation weather forecaster

Priority Projects

4.1: A study for estimating the Probable Maximum Storm Surge (PMSS) for Indian coasts for the preparation of a Met Monograph on Probable Maximum Storm Surge. Initially, PMSS values for various Indian coasts and the PMSS values separately for Gujarat, Maharashtra and Tamilnadu coasts were worked out, all the required data for the computation of PMSS for maritime districts of India and subsequently carried out all the computations for the derivations of PMSS had been collected and a draft Manuscript.

The above results will be published as Met monograph and will also be included in the Vulnerability Atlas of India being brought out by the Ministry of Urban Development.

The project on the development of storm surge model is being undertaken in CWRC, RMC Chennai.

A paper on 'Modelling and tracking of severe weather systems using Remote Sensing Technology' by Dr. R Suresh, Director has been published in ISG News letter.

4.2: Under consideration.

4.3: IIT, Delhi is conducting the training programme on storm surge modeling in regular intervals for WMO/ESCAP Panel member countries according to their requirements.

4.4: Under consideration.

MALDIVES**Report on staff training for the 34th WMO/ESCAP Panel on Tropical Cyclones**

Short come of trained staffs has always been a problem to the department. By the end of year 2006, the department has given training in various sectors. Following are the details of the short term trainings given.

	Name of Training Programmes	Country	Duration	No of Participants
1	Training workshop on familiarization and use of mm5 model	India	18 days	2
2	Marine information management training	Belgium	12 days	1
3	International training course on territorial planning with emphasis on natural risks in coastal zone	Belgium	11 days	1
4	Marine data management course	Belgium	13 days	1
5	UNESCO/IOC International training course on Tsunami numerical modeling course	Malaysia	12 days	2
6	Study tour on familiarization in operational Oceanographic observation system	India	3 days	2
7	Intermediate training course in general Meteorology WMO class III	India	4 months	4
8	Advance Training course on General Meteorology	India	10 months	1
9	International Training School on Atmospheric Brown cloud	Bangkok	5 days	2

Most of these trainings are funded by the UNDP, WMO and the Maldives government.

In addition to this, the department has sent 2 staffs to be trained at graduate level and 1 at post graduate level. These candidates are funded by the department's regular budget. Lot of other items in the budget has been sacrificed to fund for these candidates. The details are as follows:

APPENDIX IX, p. 9

	Name of Training Programmes	Country	Duration	Participants
1	Master of Science in Computer Systems Applications	India	2 Years	1
2	Bachelor of Science in Physics	India	3 Years	1
3	Bachelor of Science in Geological Sciences	India	3 Years	1

Moreover, with the recent introduction of two other disciplines; Oceanography and Geological sciences, the department is expanding its network by introducing various equipments in these fields. To fully utilize these equipments the department needs to gear-up the staffs in these areas. Furthermore, the department will look forward to continue its training in 2007 and the following has been proposed.

	Name of Training Programmes	Country	Duration	Participants
1	Bachelor of Science in Oceanography	India	3 Years	1
2	Bachelor of Science in Meteorology	India	3 Years	1
3	Bachelor of Science in Geology	India	3 Years	1
4	Bachelor of Science in Atmospheric Chemistry	India	3 Years	1
5	MSc in Telecommunications Engineering	Malaysia	2 Years	1
6	Advance Training course on General Meteorology	India	10 months	3

Assistance is required in the following areas:

NWP

- MM5 or WRF
- Storm surge models
- Tsunami propagation models
- Air pollution models
- Climate models

Data Processing and Analysis

In addition to these, the department will be participating in workshops and seminars held at national and international levels.

SRI LANKA

TRAINING ACTIVITIES

During the year eleven meteorologists, one engineer and two technical officers from the SLMD attended conferences/seminars/workshops/trainings sponsored by WMO.

1. Thirty Third Session of the WMO/ESCAP Panel on Tropical Cyclones. Dhaka, Bangladesh
2. Expert Group Meeting on Formulation of a Comprehensive Framework on Disaster Management, Dhaka, Bangladesh
3. Asian Conference on Disaster Reduction. Seoul, Korea
4. Training Workshop on ICT for Meteorological Personnel. Seoul, Korea
5. 25th Session of IPCC, Mauritius
6. Symposium on Multi-hazard Early Warning Systems for Integrated Disaster Risk Management, Geneva
7. 3rd Session of the ICG for the IOTW and Mitigation System, Bali, Indonesia
8. 4th Regional Workshop on Storm Surge and Wave Forecasting, Manila, Philippines
9. Regional Training Seminar on the Use of Environmental satellite data in Meteorological Applications. Nanjing, China
10. Sixth WMO International Workshop on Tropical Cyclones, San Jose, Costa Rica.

Two technical officers from the SLMD successfully participated in Intermediate Training Course in Meteorological Instrumentation and Intermediate Training Course in General Meteorology in India Meteorological Department.

Sri Lanka would like to express its sincere thanks to the WMO for providing the Met. Staff with opportunities to participate in these events during the year. Furthermore, we would like to express our gratitude to other International Organizations and Governments for providing assistance leading to human resource training.

SLMD especially seeks assistance from the IMD and the PMD in training our Meteorological Observers. No personnel could be trained during 2006 and we kindly request at least one place each allocated and funded from these Institutions, as it has been as a continuous programme.

THAILAND

a. Meteorology

Local Training

Since 1 October 2005 till 30 September 2006, TMD has provided training courses to its staffs on the regularly basis with the hope to be able to enhance their potentials in order to prepare them to cope with the advanced technology and concerned recent academic development. There are

13 training courses provided by the TMD for its staffs. For example, training course on basic meteorology, training course on weather forecast techniques, training course on capacity enhancement in earthquake monitoring, etc.

Overseas Training

During 1 October 2005 – 30 September 2006, the staffs of the TMD had joined overseas training as shown in Table 1.

Table 1 : The overseas training courses which the staffs of the TMD had joined.

No.	Course Title (s)	Duration	Country	No. of participant(s)
1.	Training on Evaluation of the model performance in Typhoon prediction in the high-resolution global of KMA	1 Aug. – 30 Oct. 2005	Korea	1
2.	First Combined Modeling and Data Management Training Workshop	4 - 10 Sep. 2005	Belgium	1
3.	Specially designed Disaster Communications Management Training	9 Oct. – 2 Nov. 2005	USA	2
4.	Training on Operational Tropical Cyclone Forecasting at RSMC tropical cyclones	17 – 28 Oct. 2005	India	1
5.	The Training on Establishment of Integrated Emergency Management System and Early Warning System	24 Oct. – 5 Nov. 2005	Korea	2
6.	10 th GAWTEC Training Course	7 - 18 Nov. 2005	Germany	1
7.	Training on Satellite Applications	12 Nov. – 10 Dec. 2005	France	1
8.	Training on Tropical Cyclone Modeling	1 Dec. 2005 – 30 May. 2006	Japan	1
9.	Training Course on Design and Operation Meteorological Warning Systems	5 – 9 Dec. 2005	China	1
10.	Training Course on Aeronautical Meteorology	12 – 20 Dec. 2005	China	1
11.	Training programme on Seismic data acquisition system "Seiscom P"	27 – 29 Mar. 2006	Indonesia	1
12.	Training under Master Program on Space Technology and Application	Jul. 2006 – Mar.2007	China	1
13.	RANET Introductory Technical Training Workshop (RITT)	8 – 12 May 2006	USA	1
14.	The 5 th Postgraduate Course in Satellite Meteorology and Global Climate	1 Aug. 2006 – 30 Apr. 2007	India	2
15.	Training Course on Tsunami Disaster Mitigation	29 Sep. 2006 – 17 Sep. 2007	Japan	1
16.	Training on Disaster Management System	27 Sep. – 4 Oct. 2006	Japan	1

b. Hydrology

- + The training in flood forecasting has been carried out in the regional centers of the Royal Irrigation Department. The staffs at some certain centers have been able to carry out the forecasts although they need to be trained again. Therefore, the training was planned to launch out again in the future.
- + Department of Water Resources, had provided 4 training projects for its staffs as shown below :
 - Workshop on Hi-tech in Meteorological and Hydrological data, 24 Feb 2006, Bangkok;
 - National Workshop on Increasing Efficiency in Integrated Water Resources Management, 4-5 May 2006, Nakhon Pathom;
 - Workshop on Water Resources Management Strategy in Thailand, 21-22 June 2006, Bangkok;
 - Training for Trainer on the Integrated Water Resources Management, 12-14 July 2006, Bangkok.

c. DPP

- + 62 Tsunami Warning Towers have been completed its installation along the coastal areas of Ranong, Phuket, Phangna, Trang, Krabi, Stun and 48 stations around the gulf of Thailand.
- + The Meteorological Department has provided its cooperation to other governmental units of which responsibility is natural disaster prevention and mitigation under the "Mr. Warning" Project. The goal of this project is to educate the local staffs about natural disasters and concerning preventivemeasures.
- + *The continuation of Community-Based Disaster Risk Management Project*

In the fiscal year 2006, Department of Disaster Prevention and Mitigation has conducted the Community Based Disaster Risk Management training course for people in local communities in order to enhance their disaster risk reduction capacity.
- + OTOS training is implemented in three different levels; sub-district, district and provincial level. The implementation in sub-district level involves the selection of participants by local governments and district government. Then the Provincial DDPM office will then conduct the training. DDPM's Disaster Prevention and Mitigation Academy and its six campuses across Thailand also the training venue and facilities for OTOS members upon request from the provincial governments.

The followings are the sample list of OTOS training subjects:

 - Incident command system
 - Search technique and safe zoning
 - Operation of rescue equipment
 - Role of forensic science in the search of disaster victims
 - First aid treatment
 - Live saving system
 - Search and rescue exercise
 - Evaluation of the exercise and training course etc.

It is projected that OTOS programme will be completed in 2008. The goal of this project is that after the year 2008 every tambon will be equipped with a reliable and efficient SAR team.

- + Many DDPM officials have attended the workshops, meetings and conferences in a number of countries in Asia, Europe and elsewhere.
- + The DDPM has sent their staffs to attend the "Disaster Management" training course in such as chemical disaster prevention and Disaster Management by Thai government fund and foreign countries.
- + DDPM's Disaster Prevention and Mitigation Academy (DPMA) has conducted a number of disaster management training courses for DDPM officials, local government staffs and volunteers.

APPENDIX X

SUMMARY OF THE RESEARCH ACTIVITIES OF THE MEMBERS

BANGLADESH

Research

A Research and Development Cell (R&D Cell) has been established in the Meteorological Training Institute of BMD for undertaking research in Meteorology. Every division of the department is requested to involve in doing research work in the cell. They have shown their keen interest to do research in the cell. For the development of the R&D cell computers, broadband Internet connection has been set up by using own money. It is trying to install soft wares of different models. BMD has already started research activity. But assistance is necessary for infrastructural development and facilities of R&D Cell.

INDIA

Research

1. The following research works are in progress.
 1. Asymmetry in OLR distribution in the field of severe cyclonic storm occurring over North Indian Ocean.
 2. Diurnal Variation of northeast monsoon rainfall over coastal Tamilnadu and Andhrapradesh during October to January'
 3. Probable causes of intensification and weakening of cyclonic storms emerging from NW Pacific to North Indian Ocean.
 4. A study on northward transportation of energy and momentum flux over Indian landmass and North Indian Ocean in northward and westward moving storms.
 5. Estimation of cyclone Risk Index based on Met. Parameters and the Socio-economic conditions in different coastal belt.
2. The following research works have been initiated;
 1. Unusual features of the cyclonic storm OGNI of 28-31 October 2006.
 2. CLIPER model for forecasting / Severe Cyclonic storm over Indian region based on data for the period 1971-2005.

Under Ministry of Home Affairs USAID project on climate forecasting, a team of Indian Engineers interacted with USGS/USWB expert to study various models being used abroad for flood forecasting and develop appropriate models for Mahanadi Basin as a pilot project wherein it is also proposed to forecast area likely to be flooded in addition to river stage and inflow forecasts

Specific Objectives: Hydrology division of IMD has already undertaken this project. A Vulnerability Atlas has been prepared by Building Material and Technology Promotion Council (BMTPC) for Indian Maritime Districts.
3. Various research studies are being carried out on Tropical Cyclone. A report entitled " Probable maximum storm surge heights for the maritime districts of India" has been under finalization and is expected to be available soon as a published report of IMD. The report presents the Probable Maximum Storm Surge (PMSS) values for each coastal district of the Indian maritime states

The estimated values of PMSS are likely to be included in the Vulnerability Atlas of India which is being brought out by the Ministry of Urban Development.

4. (a) The mesoscale model WRF has been implemented in the experimental mode. IMD plans to run the WRF model for operational use by June 2007.
- (b) A four members multimodel ensemble technique has been implemented in test mode for rainfall prediction during monsoon 2006. IMD plans to implement the technique for operational forecasting during monsoon 2007.
- (c) IMD plans to implement the latest cyclone prediction model namely Hurricane WRF in collaboration with NCEP by September 2007. The outputs of the model Hurricane WRF have the potential to provide inputs to the storm surge model.

Publications

A paper entitled "Some salient features of Arabian Sea Severe Cyclonic Storm of 5-10 May 2004" is being published in Mausam.

Storm Surge Project and Tsunami

Govt. of India initiated a project for setting of National Early Warning System for Tsunami and Storm surge with participation of India Meteorological Department (IMD), Indian National Centre for Ocean Information Service (INCOIS), National Institute of Ocean Technology (NIOT), CSIR and other institutions. IMD is to monitor all earthquakes, which are likely to generate Tsunamis that may affect Indian coasts. The Ocean bottom sensors are being developed and deployed by NIOT, while INCOIS Hyderabad will do data processing and warning generation. The system is expected to be operational by September 2007.

WMO is considering to upgrade its GTS Network for exchange of Data, Warnings and Information in the region.

An inter-Governmental Coordination Group has been set-up under Intergovernmental Oceanographic Commission (IOC) for Indian Ocean Tsunami Warning and Mitigation System. There are six working group set-up for implementation of various components viz. Seismic Data Collection and Exchange, Sea level data collection and exchange, Risk assessment, Modelling, Forecast and Scenario development, Inter-operable advisories and warning centres and Mitigation and preparedness & response. India has participated in various meetings of the working group.

The Dept of Ocean Development and Integrated Coastal and Marine Area Management Project Directorate, Chennai carried out preliminary Assessment of Impact of Tsunami in December 2004. The studies include various aspects due to Tsunami – like its intensity to affect the coastal topography, salination, seawater inundation, change in vegetation field etc.

MALDIVES

Research

Research projects on air-pollution were carried-out in the Climate Observatory of Hanimaadhoo.

Maldives Climate Observatory

Location: Island called Hanimaadhoo ($\approx 6N$, $\approx 73 E$).

Major purpose: Monitoring Transboundary Air pollution.

Measurement Techniques: Remote sensing mainly Passive, In situ Technique Passive.

Equipments: Microtops and Cimel Sun photometer for Aerosol optical depth and for Ozone, Condensation Particle Counter (CPC) to measure number of particles, Sample mobility Particle Seizer (SMPS) to measure particle size, Aethelometer for Black carbon, Nephelometer for Scattering.

DATA shows the country experience high concentration of Aerosols in North east Monsoon compare to South West Monsoon.

SRI LANKA

RESEARCH ACTIVITIES

(a) **Meteorology**

Predicting Storm Surges Along Sri Lankan Coasts for 1964, 1978, 1992 Cyclones
Evaluation of Sensitivity of Pressure Drop, Rmax, Vmax, etc on Storm Surges.

(b) **DPP**

Analysis of Recent Drought in Anuradhapura, Kurunegala And Hambantota Districts
Using SPI (Standardized Precipitation Index).

THAILAND

RESEARCH ACTIVITIES

a. **Meteorology**

+ To support disasters warning activities, and to be the centre of meteorological knowledge in Thailand, a number of researches have been done by the TMD's meteorologists as listed below :

- The implication of SST in Development of Tropical Cyclone using TRMM.
- Rainfall Intensity-Duration-Frequency Relationship in Southern Region of Thailand.
- Analysis of the Relation between the Atmospheric Stability and Hail Occurrence.
- Prediction of Droughts in Thailand Using SPI Model.
- Daily Minimum Temperature Forecast in the Upper Part of Northeastern Thailand.
- Correlation between the Northeast Monsoon and Rainfalls along the Eastern Coast of Southern Thailand.
- Rainfall Forecast in Thailand based on the Monsoon Indices Using Time Series Analysis.
- A Study of Daily Rainfalls in Upper Thailand during the Southwest Monsoon Period using Wave Analysis.
- Precipitation Patterns for Aviation activities in the lower Part of Southern Thailand using Radar Data.

APPENDIX X, p. 4

- Correlation between Run-up of Tsunami and Coastal Characteristics.
- Analysis of the Cause of Earthquake and Tsunami on 26 December 2004.

b. Hydrology

- + In 2006, a research on Utapao river basin, with a catchment size of 1,740 sq. km., in the southern part of Thailand had been conducted by both TMD and the Royal Irrigation Department. The derived unit hydrograph was derived from last year flood and then will be applied to compute flood hydrograph this year. The progress will be reported next year.
- + At Department of Water Resources, 3 researches had been done as listed below :
 - The Study on Antecedent Precipitation index for Flood and Landslide Early Warning System.
 - The Study on the Impact of Tsunami on Inland Water Resources.
 - The Study in the Data Linkage system and the spatial Analysis on Flood Forecast and Early warning system in Upper Ping River Basin.

c. DPP

- + DDPM has planned to implement a research program on landslide and mudslide in collaboration with Chiang Mai University. It is projected that the project can be launched in the fiscal year 2007.

APPENDIX XI

EDITORIAL BOARD FOR THE 2006 ANNUAL REVIEW

Chief Editor

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APPENDIX XII

**STATEMENT OF TSU ACCOUNTS
(2006 - 2007)**

1.	Balance after 33rd Session	Pak. Rs. 213,640.00
2.	Receipts during the inter-sessional period	NIL
	Total	Pak. Rs. 213,640.00

EXPENDITURE

1.	Running cost of TSU website for one year	Pak. Rs. 6,000.00
2.	Honorarium to TSU-Meteorologist and Technical staff	Pak. Rs. 77,000.00
3.	Purchase of Toner (black only) for Colour Laser Printer	Pak. Rs. 7,000.00
4.	Expenses incurred on the printing of 23rd Issue of the Panel News	Pak. Rs. 30,000.00
5. (a)	Purchase of stationery for TSU use	Pak. Rs. 2,500.00
(b)	Expenditure on postage etc.	Pak. Rs. 5,000.00
	Total	Pak. Rs. 127,500.00
	Balance in hand	Pak. Rs. 86,140.00

APPENDIX XIII

PANEL ON TROPICAL CYCLONE TRUST FUND

Statement of Account as at 31 December 2006

	USD	USD
Balance of fund at 1 January 2006	58,947	
Contributions	12,000	
Interest	1,093	
Total revenue	<u>72,040</u>	72,040
Less: Expenditure		
Contribution towards Fourth Regional Workshop on Storm Surge and Wave Forecasting, 11-15 September 2006	1,639	
Support costs (13%)	213	
	<u>213</u>	213
Balance at 31 December 2006		<u><u>71,827</u></u>
Represented by:		
Cash in Bank		<u><u>71,827</u></u>

Country	Contributions		
	2005	2006	Total
India		2,000	2,000
Maldives		2,000	2,000
Pakistan	2,000	2,000	4,000
Sri Lanka		2,000	2,000
Thailand		2,000	2,000
Total		<u>12,000</u>	<u><u>12,000</u></u>