UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION

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AND

WORLD METEOROLOGICAL ORGANIZATION

REPORT OF THE TYPHOON COMMITTEE

ON ITS THIRTY-SECOND SESSION

Seoul, Republic of Korea
23 - 29 November 1999

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I. ORGANIZATION OF THE SESSION (agenda item 1)

1. The thirty-second session of the ESCAP/WMO Typhoon Committee was held at the International Conference Room of the Korea Meteorological Administration in Seoul, Republic of Korea from 23 to 29 November 1999.

Attendance

2. The session was attended by participants, representing 10 (out of 14) Members of the Typhoon Committee, namely: China; Hong Kong, China; Japan; Macao; Malaysia; Philippines; Republic of Korea; Thailand, United States of America (U.S.A.) and Viet Nam.

3. The session was also attended by two observers from Brunei Darussalam and the International Federation of Red Cross and Red Crescent Societies (IFRCS). Seven from the World Meteorological Organization (WMO), Economic and Social Commission for Asia and the Pacific (ESCAP) also representing the IDNDR Secretariat and Typhoon Committee Secretariat (TCS) also attended the session. The list of participants is attached as Appendix I.

Opening of the Session

4. The opening ceremony commenced at 1400 hrs on Tuesday, 23 November 1999 at the Auditorium of the Korea Meteorological Administration.

5. In his welcome address, Dr Sung-Euii Moon, Administrator of Korea Meteorological Administration (KMA) extended a warm welcome to all the delegates and conveyed deep thanks to ESCAP and WMO for organizing the meeting. He mentioned that it was an honour to host the session for the second time in Seoul. He congratulated the Typhoon Committee for the outstanding achievements that had been made since its establishment in 1968. Dr Moon felt that there were many tasks to be undertaken in the future and to find effective ways to mitigate disasters caused by destructive typhoons. In this connection, he suggested that more scientific meetings be held as it would be one of the ways to bridge the critical gaps in knowledge among countries. He assured the Committee that KMA would actively participate in organizing such meetings. He wished the participants a comfortable and memorable stay in Seoul.

6. The representative of ESCAP, Mr Cengiz Ertuna, delivered the message of the Executive Secretary of ESCAP. He expressed sincere appreciation to the Government of the Republic of Korea for hosting the session and its role in the efforts to achieve the objectives of the

Committee. The Committee was informed that the ESCAP Commission at its fifty-fifth session in 1999 had noted with appreciation the extensive efforts by the Typhoon Committee in its coordination of the early warning and forecasting systems of its Members, increased disaster reduction and preparedness activities, and the progress it had so far achieved. The Commission reiterated the importance of natural disaster reduction for economic and social development in the twenty-first century and called on governments to attach priority to continuing national efforts in that field. He informed the Committee that the ESCAP Commission has endorsed the three common goals for regional cooperation in natural disaster reduction: (a) realistic reduction of damage (b) increased disaster awareness and (c) improvement of forecasting systems. ESCAP took particular note in the active collaboration among the Committee, WMO and ESCAP. The ESCAP Executive Secretary urged all those international institutions to continue to strengthen the linkage and translate it into a regional strategy towards a safer community in the new century. He assured the Committee that ESCAP would continue to undertake activities in support of the Typhoon Committee.

7. The representative of the WMO Secretariat, Mr Eisa H. Al-Majed, addressed the session on behalf of Professor G.O.P. Obasi, Secretary-General of WMO. He expressed the appreciation of WMO to the Government of the Republic of Korea for hosting the session. He thanked the Government of the Philippines for hosting the TCS and the Governments of Japan and the Republic of Korea for their support to the TCS and for seconding specialists. He congratulated KMA`s Administrator and staff on the new headquarter`s building. Mr Al-Majed recalled that the Thirteenth World Meteorological Congress urged the members to upgrade their capabilities where necessary to provide better tropical cyclone forecasts and warnings. This was an area of particular concern to WMO and should also be given greater attention by the Typhoon Committee. He mentioned that some issues such as globalization, rapid changes in technology, population pressure and human influences on the environment would pose considerable challenges to the nations of the world and in turn on the management and development of NMHSs. He concluded by assuring that WMO would continue making every effort to support the Typhoon Committee`s work, to the extent possible.

8. In his inaugural address, Honorable Dr Jung Uck Seo, Minister of Science and Technology, welcomed all participants to the session. He mentioned that the development of science and technology has a deep impact on our lives and there are many issues to be solved in the next century such as global warming, environmental contamination, food shortage, and energy depletion. He mentioned that Typhoons Yanni and Olga hit his country in 1998 and 1999 respectively, which claimed great lost

of lives and properties. The Minister was pleased to acknowledge the importance of meteorological services and said that it was his duty to ensure that KMA will develop into one of the world leaders with advanced meteorological services. Dr Seo highlighted the concern about climate change and global warming and called for more concerted actions worldwide. He encouraged the Typhoon Committee to continue to play its role in promoting international cooperation in meteorology and related fields and that its dedication, when combined with collective efforts by science communities, could help in reducing the adversary impacts of natural disasters. The Minister declared the thirty-second session of the Typhoon Committee open and wished it full success.

9. A short ceremony was held in the presence of the Chief Guest, the Honorable Minister of Science and Technology, where the ESCAP/WMO Typhoon Committee Natural Disaster Prevention Award was presented to Dr Sung-Euii Moon, Administrator of KMA, in recognition of his outstanding services as Administrator of KMA through the development of prompt forecasting and warning dissemination system, particularly, the expansion of automatic weather observation network and improvement of numerical weather prediction models, as well as the strengthening of public awareness.

II. ELECTION OF OFFICERS (agenda item 2)

10. Dr Sung-Euii Moon (Republic of Korea) was elected as the Chairman of the Typhoon Committee. Dr H.K. Lam (Hong Kong, China) and Dr Lim Joo Tick (Malaysia) were elected as Vice-Chairmen. Dr Leoncio A. Amadore (Philippines) was elected as the Chairman of the Drafting Committee.

III. ADOPTION OF THE AGENDA (agenda item 3)

11. The Committee adopted the Agenda shown in Appendix II.

IV. THE COMMITTEE'S ACTIVITIES DURING 1999 (agenda item 4)

12. The ESCAP Representative reported that the Commission at its fifty-fifth session held in Bangkok from 22 to 28 April 1999, noted with appreciation the progress achieved by the Typhoon Committee in 1998, including significant work undertaken under the meteorological, hydrological, disaster prevention and preparedness, training, and research components.

13. The Commission also noted the support provided by the ESCAP Secretariat to various activities of the Committee, especially those related to the hydrological and disaster preparedness component of its work. It also noted the continued valuable contribution of WMO to the work of the Committee through the years.

14. The TCS informed the session that:

- TCS organized, in cooperation and close coordination with WMO, the Workshop on the Impact of the El Niño Southern Oscillation (ENSO)/La Niña on Meteorology and Hydrology in the Typhoon Committee Area held in Macao from 29 June to 1 July 1999;

- TCS Meteorologist and Hydrologist attended the above-mentioned workshop;

- The Workshop on Doppler Radars to be held in Hefei, China from 7 to 10 December 1999 will be jointly organized by TCS and the Technical Support Unit in close cooperation and coordination with WMO; and

- TCS continued to manage the Typhoon Committee Foundation, Inc.

15. The WMO representative reported that the Thirteenth WMO Congress recalled the success of the Typhoon Operational Experiment (TOPEX) and the Special Experiment Concerning Typhoon Recurvature and Unusual Movement (SPECTRUM) of the Typhoon Committee; and recognized the importance of scientific research on various aspects of tropical cyclones, including genesis, intensity, structure and motion.

(a) Meteorological Component (agenda item 4.1)

16. The session reviewed the activities under the meteorological component of the Members of the Committee during the past year, as noted below, details of which are presented in Appendix III.

17. The delegate from China informed the Committee that the FY-1C was launched on 10 May 1999 and is now operational. Also in 1999, a Doppler radar, CINRAD, was installed in Hefei, Anhui province. Four other Doppler radars will be installed early next year. In order to be Y2K compliant, the China Meteorological Administration (CMA) in 1999 replaced 63 PC-1500 computers in their upper-air stations with advanced PII series computers. During the year, five foreign-made Automatic Weather Stations (AWS) were put into operation in five provinces while 60 locally made ones were set up

in 6 provinces. A newly developed AWS for National Reference Climate Stations is now under test process. In April 1999, an IBM SP parallel computer was installed in the National Meteorological Center for use in Numerical Weather Prediction (NWP).

18. The Committee was informed by the delegate from Hong Kong, China that a second Doppler weather radar was installed at Tai Mo Shan in April 1999. Radar observations from this radar (45009) are available through GTS when a tropical cyclone is within 500 km of Hong Kong. Combined with the radar at Tate`s Cairn, dual-Doppler winds are available operationally to forecasters. During the year, the Hong Kong Observatory's (HKO's) Operational Satellite Reception System was upgraded to meet Y2K compliance requirements and also to allow reception of high resolution cloud images from the FY-2 geostationary satellite of CMA. In October this year, a computer system, CRAY SV1, with an aggregate peak performance of 19.2 GFLOPS was commissioned for running a high resolution NWP model at the HKO. Starting from 1 April, 18UTC upper-air wind observations at Hong Kong have been made by wind profiler. Loran-C sondes were also used whenever possible to effect saving. In 1999, new features were added to HKO's homepage and a web-based Weather Information System was put into operation for government departments with automatic audio and visual alarms to alert users of warnings issued. Facilities at the Hong Kong International Airport were fully operational and include the Terminal Doppler Weather Radar, the Windshear and Turbulence Warning System, the Aviation Meteorological Data Processing System (METPS), the Aerodrome Meteorological Observing System and Reception System for the World Area Forecast System. In particular, during a recent Asia/Pacific regional meeting, the METPS gained the recognition of the International Civil Aviation Organization as a system enabling airlines to obtain relevant products for their operation ``with minimum investment in hardware, software and training``. The METPS is a web-based system to disseminate the latest aerodrome meteorological observations, forecasts and warnings, as well as flight documentation for all departing flights.

19. The delegate from Japan reported that the launch of the Multi-Transport SATellite (MTSAT) on 15 November 1999 ended in failure due to malfunction of an H-II rocket. Thus, the Japan Meteorological Agency (JMA) is now reconsidering future plans for the operations of GMS-5 and MTSAT and will prolong the operations of GMS-5 to ensure the continued provision of satellite image data to users in Asia and the Pacific region. On 1 November 1999, JMA started the operation of 2 new C-band radars in Nagano and Shizuoka and terminated the operation of an S-band radar in Fuji-san. In September 1999, JMA-95 type surface observing equipment were installed in 97 stations. As a contingency plan, JMA, now fully Y2K compliant, currently operates a Y2K GTS-back-up data server in addition to

the RSMC DSS server. JMA made a minor change in the tropical cyclone bogus-scheme of its Typhoon Model (TYM) in January 1999. In August 1999, JMA expanded the forecast area of its Storm Surge Model for the 24-hour prediction of storm surges associated with typhoons from the western part to the main island of Japan. It put into operation a new information services for domestic users called "Information Network for Disaster Prevention (INDiP) on 1 September 1999. The outlook information on El Niño with relevant oceanographic conditions such as monthly mean SSTs in the tropical Pacific and their anomalies will be provided for overseas users in 2000 through the Distributed Data Base (DDB) Web Server.

20. The delegate from Macao informed the Committee that in 1999 the VIS5D software which provided a display of the products from the JMA DSS server, ECMWF and MM5 was improved and is now in continuous operation. Also put into full operation during the year was an Intranet Weather Information Database System developed by SMG staff and a new satellite receiving system to receive FY-2 data. Upgraded in 1999 were the GTS circuit between Beijing and Macao and the access to JMA`s DSS using ISDN 64K file transfers TCP/IP protocol.

21. The delegate from Malaysia reported to the session that the Malaysian Meteorological Service (MMS) is in the process of acquiring 4 C-band radars which are planned to be installed in East Malaysia by middle of the year 2000. In addition, a new system to receive MTSAT data is being acquired for Kota Kinabalu, Sabah and another will be acquired for Kuching, Sarawak in the year 2000. In this respect, Malaysia viewed with concern the failed attempt to launch the MTSAT by Japan. MMS has placed a lot of emphasis in addressing the Y2K problem which would be expected to affect the observation and communication system. A contingency plan has been prepared and trial run will be carried out in late November or early December.

22. The delegate from the Philippines informed the Committee of the recent acquisition by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) of an MK II Brewer Spectrophotometer for the purpose of supplementary instrumentation in WMO's Ozone Network. Acquired also in 1999 is a Geo-stationary Meteorological Satellite Cloud Maps Access and Process-based Systems or CMAPPS. A World Area Forecast System (WAFS) acquired through VCP is to be installed soon. The reception and processing of grid point values (GPV) grib data from Tokyo RSMC has been made faster and more efficient with the acquisition of a Pentium III 450 mHz computer. PAGASA has already submitted its Y2K Contingency Plan to the Y2K Commission formed by the Philippine Government. Still to be achieved are third party validation and the readiness inspection by higher authorities. In connection with

PAGASA's plan to regionalize its forecasting centers, visualization software similar to the SYNERGIE workstation is being developed to answer the need for adaptability and portability for other regional stations.

23. The delegate from the Republic of Korea reported that a new satellite receiving system was installed in January 1999 which reduced analysis time of satellite data from 40 to 20 minutes. Acquired this year by KMA is a supercomputer, SX-5/NEC, which is capable of running a global model (T106 for 10 day forecast), a regional model (30 km, for 48hr forecast), and associated pre/post processes within an hour. A high resolution mesoscale model with 7 km resolution is also under test operation twice a day. Monthly ensemble forecasts with global model (T106) are regularly produced once a day with 8-12 members developed by time lagged approach. Ensemble typhoon track forecasts are made with 4 different models, GFDK (Geophysical Fluid Dynamics Korea) model, barotropic model, global model, and regional model during the typhoon season. Currently under test is the Advanced Regional Prediction System (ARPS) which was developed by the Center for Analysis and Prediction of Storms (CAPS) of the University of Oklahoma.

24. The Committee was informed by the delegate from Thailand the near completion of the installation of a new supercomputer which will be operational in 2000. This system consists of a supercomputer (IBM RS/6000 SP), 30 workstations, 70 briefing terminal, PCs and other peripherals. The supercomputer has 16 processors with 32 thin nodes and 6 wide nodes. The Automatic Aviation Broadcasting System Bangkok VOLMET and the Automatic Broadcasting System for shipping have been installed and has been operational since early 1999.

25. The delegate from U.S.A. reported that the National Weather Service has completed its modernization plan that focused on three high-tech systems: the Next Generation Weather Radar (NEXRAD), the Automated Surface Observing System (ASOS) and the Advanced Weather Interactive Processing System (AWIPS). Additional improvement at Weather Forecast Office (WFO) Guam during the year includes: images from polar orbiting satellites became available on a trial basis in June 1999 to supplement the hourly imagery provided by GMS-5; the NASA-sponsored Tropical Rainfall Measure Mission Satellite is now operational and provides imagery from its active microwave sensor; new communication lines between Hawaii and Guam were activated in December 1998; and ground breaking ceremonies for the new building to house the WFO Guam operations and the NWS Sub-regional Maintenance Depot took place on 25 January 1999.

26. The delegate from Viet Nam informed the Committee of the following that in 1999: a new digital meteorological radar was installed; the

installation of the WAFS system at the National Center for Hydro-meteorological Forecasting in Hanoi was completed in July; three upper-air radiosonde stations were upgraded; a VSAT communication system from the National Center to regional centers in Viet Nam was established; and the telecommunication system was upgraded.

27. The Committee reviewed and approved the proposed amendments to the Typhoon Operational Manual - Meteorological Component (TOM) as shown in Appendix IV. The proposed amendments were submitted by the Rapporteur, Mr Tatsuo Ueno (Japan) of JMA.

28. The Members of the Typhoon Committee expressed their gratitude for the services of the rapporteur in the past and proposed that JMA continue to provide the services of a rapporteur on TOM for the coming year as well. The WMO representative assured Members that a new edition of the Manual will be made available in early 2000.

29. The Committee expressed its gratitude to JMA for the exemplary work of the Regional Specialized Meteorological Center (RSMC) Tokyo-Typhoon Center and its continued provision of numerical weather products to other Members. The Members noted that these forecasts continue to be of great help to their operations. Its activities are contained in Appendix V.

30. The Committee expressed deep concern on the failure of the MTSAT`s launch and urged Japan to plan for countermeasures so as to ensure continuous satellite coverage of the Typhoon Committee area.

(b) <u>Hydrological Component</u> (agenda item 4.2)

31. Based on the programme for 1999, Members sustained their efforts in undertaking the programme of work under the hydrological component. A detailed summary of the reports of individual Members on their activities related to the hydrological component during 1999 is given in Appendix VI.

32. The delegate from China informed the Committee that after the great flood of 1998, state and local governments have made great investment in the renovation of the basic hydrological facilities which were destroyed in the flood. Over 0.2 billion RMB has been allocated to repair and update the basic hydrological and communication facilities. In 1999, another great flood was experienced in the Taihu Lake basin and along the middle and downstream of the Yangtze River. Owing to timely hydrological forecasts, damage due to flooding was limited. Some satellite earth stations have been established for some reservoirs and remote sensing telemetering has been successful. After evaluating the experiences from recent floods, hydrologists modified and amended some hydrological forecasting

techniques and schemes, and some workshops and training activities were undertaken. Currently, there is also a state flood control command system project in progress.

33. The delegate from Hong Kong, China informed the Committee that the rain gauge network was upgraded and expanded. A programme for upgrading the drainage system has been initiated, and drainage master plan studies have been commissioned. The Probable Maximum Precipitation for Hong Kong was reviewed and the old estimate was updated.

34. The delegate from Japan informed the Committee that for the improvement of hydrological observation facilities, measures are being taken with regard to flash flooding from small and medium rivers in the country through reduction of data renewal interval in observations of raingauges from 1 hour to 30 minutes and then to 10 minutes. Flood forecasting is being implemented in 84 river systems. Telemeter systems and radar rain gauges are being used to monitor rainfall, water levels, and other hydrological and meteorological conditions at each observation point in real time. Some of this information is available through Internet. Under the comprehensive flood loss prevention and management plan for the country, comprehensive flood control measures including appropriate land uses are being undertaken to achieve the required levels of flood safety.

35. The Committee was informed by the delegate from Macao that no new activities were initiated in 1999. The normal activities related to hydrology and drainage continued.

36. The delegate from Malaysia informed the Committee that the total number of telemetric stations reached 230 in 35 river basins. 137 manual river gauges and a few hundred flood gauges were installed in flood-prone areas, and local flood warning systems were established. A system is being developed to integrate and display through the internet the whole country`s real-time hydrological data for public flood warning. Seven river basins are provided with flood forecasting services. During the flood events at the end of 1998 and in 1999, flood forecasts and warnings were issued with lead times varying from 6 to 24 hours. Evaluation of the flood forecast accuracy was carried out to improve the model reliability. In addition, other non-structural and structural measures are being implemented under the comprehensive flood loss prevention and management, including basin studies, drainage master plans, structural flood mitigation projects, land use planning and control, resettlement of vulnerable population, preparation of a manual on storm water management, and education and public awareness programmes. Various research projects are being undertaken, and training activities being organized.

37. The delegate from the Philippines informed the Committee that four major river basins in the Luzon Island and to a limited extent some of other principal river systems in the country were continuously monitored and flood warning and other information were issued. Hydro-meteorological and hydrological analyses, investigations, and forecasting and prediction methods improvement were conducted, including derivation of PMP for major river basins in Luzon, flood forecasting models for gauged catchments, issuing of intensity-duration-frequency curves and conducting of comprehensive hydrological studies and post-flood survey for a major flood.

38. The delegate from the Republic of Korea informed the Committee that the number of rainfall and water level gauging stations continued to be increased. On-line flood forecasting systems for five major river basins have been continuously improved. Nine multi-purpose dams, with a total of 2.04 billion cubic metres were being operated, and there are plans for construction of six more dams, continuing the construction of levees throughout the country, extension of pumping schemes for inland drainage, and extension of flood warning systems. Research activities on development of measures to effectively reduce flood damages continued and workshops for flood forecasting and warning systems were regularly organized.

39. The delegate from Thailand reported that six hydrometeorological stations were completely established and operational throughout the country in order to improve the data collection network. MOFFS Version 2C has been replaced by MOFFS Version 3. Flood forecasting and warning systems in three designated basins, using three models, continued to be monitored on routine basis. Recently, budget of a new project was approved for covering the country with 150 telemetric stations to enhance the early warning and flooding disaster mitigation. It further informed the Committee that the implementation of His Majesty the King's project last year for the protection of flooding situations in urban areas was very successful.

40. The delegate from U.S.A. informed the Committee that some flooding, due to heavy rainfall on 30 July 1999, was experienced in Guam, however, there was no loss of life or serious injuries. Studies on climate change continued.

41. The delegate from Viet Nam informed the Committee that during the reporting period, 20 automatic water level and rainfall stations were installed and almost all of the 233 hydrological stations in the country were equipped with appropriate communication instruments. Comprehensive flood loss prevention and management programmes have been drawn up, including surveys and investigations on flood prone areas, magnitude and

corresponding frequency of floods, and preparation of flood risk maps. During the year, some areas of the country experienced record level flooding, however, mountainous areas in the north and north central part faced a drought situation. Forecasts with good accuracy on lead-time of 5 to 10 days were made for the Lower Mekong Delta area, and medium and long-term flood forecasting and warnings were made for the other main river basins in the country. Flood preparedness among the people living at flood-prone areas continued to be promoted. The Committee was informed of the severe flood that occurred in central Viet Nam in early November 1999.

42. The Typhoon Committee was pleased to note that within the framework of its programme of work, ESCAP continued to provide support to Members of the Committee within the hydrological component. This year`s activities had been focused on protection and rehabilitation of rivers, wastewater management, and development of a regional strategy for integrated water resources management. Advisory missions were fielded and TCDC exchanges were arranged. A publication entitled ``Regional Cooperation in the Twenty-first Century on Flood Control and Management in Asia and the Pacific`` was recently published and would be disseminated soon.

43. The WMO representative informed the session that with a view to further upgrading the capability of operational flood forecast and warning services at national and regional levels, great efforts were being made under the WMO RA II (Asia) and RA V (South-West Pacific) Working Groups on Hydrology in 1999.

Hydrologists Meeting

44. The annual pre-session meeting of the hydrologists took place on 22 November 1999, with participation of representatives from 9 Members, ESCAP, TCS, and the Local Organizing Committee. The hydrologists reviewed the implementation of recommendations made during the previous session of the Typhoon Committee. It was reported that the ``Workshop on the Impact of the El Nino Southern Oscillation (ENSO)/La Nina on Meteorology and Hydrology in the Typhoon Committee Area`` was held in Macao from 29 June – 1 July 1999. It was also reported that preparations were underway for the seminar on ``Development of Forecasting and Warning System for Typhoon-induced Sediment Disasters`` to be held in the Philippines in May 2000.

45. The hydrologists reviewed the recent water-related disasters experienced by the Members, problems encountered and mitigation measures taken. The Typhoon Committee Hydrologist, seconded from the Republic of Korea informed the meeting that his services would be

concluded by the end of May 2000. The meeting noted that the need for the services of the hydrologist at the TCS should be reviewed. It was agreed that a proposal together with a well-defined job description of the hydrologist should be prepared before making a request for the continuation of the services of a hydrologist at the TCS.

46. The report of the Hydrologists meetings with the list of participants is presented in Appendix VII. The meetings proposed a set of recommendations which were adopted by the Committee as reflected under Agenda item 7.

(c) Disaster Prevention and Preparedness Component (agenda item 4.3)

47. Typhoon Committee Members continued their sustained efforts in undertaking the programme of work under Disaster Prevention and Preparedness Component and also in line with the goals of the IDNDR. A summary of reports of the individual Members on their activities in the Disaster Prevention and Preparedness Component and IDNDR during 1999 is included in Appendix VIII.

48. The delegate from China reported that the ``International Workshop on Management of Natural Disasters``, jointly sponsored by the United Nations Development Programme and U.N. Department of Humanitarian Affairs, was held in Beijing from 10 – 12 June 1999. The main purpose of the Workshop was to discuss the prediction, early warning of disasters, theories and practices of disaster reduction, preparedness and post-disaster rehabilitation and reconstruction activities. China actively participated in the IDNDR Programme Forum organized by the IDNDR Secretariat in Geneva in July 1999. A climatic prediction system for typhoon activities was established and tested, and a list of names in Chinese was prepared for the tropical cyclones in the region. Meteorology Law of the People`s Republic of China was adopted for promoting the development of meteorology and the forecast of natural disasters in the country. China continued its assistance to other Members of the Typhoon Committee.

49. The delegate from Hong Kong, China informed the Committee that the use of new tropical cyclone names, effective 1 January 2000, was publicized and the media were provided with round-the-clock weather briefings during tropical cyclone situations. Operational procedures were set up to alert the public of the likelihood of severe rainstorms. Television episodes were produced on the work of the Hong Kong Observatory, and liaison continued with other government departments on disaster preparedness and prevention measures.

50. The delegate from Japan informed the Committee that in response to a severe tropical cyclone experienced between 19-24 September 1999, the government set up a coordination meeting of the ministries and agencies, dispatched a government survey team to the disaster sites, and the Disaster Relief Law was applied in various areas. The Asian Disaster Reduction Center (ADRC) was established in Kobe in July 1998, to facilitate exchange of disaster reduction experts, accumulate and provide disaster reduction information, and carry out research into multi-national disaster reduction cooperation. During the year (ADRC) disseminated disaster information from its database, formulated a network of member country counterparts, organized the First ADRC International Meeting from 16-18 February 1999, and prepared a schedule for disaster information dissemination. Japan will continue to promote active cooperation with other countries in the area of disaster reduction after the closure of the IDNDR.

51. The delegate from Macao informed the Committee that public awareness activities were continued. The Typhoon Contingency Plan was updated, revised and will be continued at the beginning of each year. Evacuation activities for schools and others were conducted, and other preventive measures were undertaken, including exercises.

52. The delegate from Malaysia reported that integrated programmes and activities related to enhancing the effectiveness of disaster management in the country continued to be implemented, including exercises at state level, acquisition of up-to-date and appropriate equipment and communication facilities, and undertaking of risk analyses. Between November 1998 – August 1999, over US$ 0.6 million was provided as disaster relief and assistance and various relief items were also distributed. Evacuation centres to accommodate nearly 1 million people were identified, and training activities were organized.

53. The delegate from the Philippines informed the Committee that the Office of Civil Defense continued the activities on disaster prevention and preparedness, with the Department of Public Works and Highways improving the conveyance capacities of water ways. PAGASA closely collaborated with NGOs in the training of trainors, and has provided assistance in the development of a community based flood forecasting system. Also, in coordination with the local government units and various government agencies and NGOs, flood hazard and vulnerability maps of different places in the Metro Manila area are being prepared. Other places in the country will subsequently be included in the mapping activities. During the reporting period, a number of activities related to El Nino and La Nina events were undertaken.

54. The Committee was informed by the delegate from the Republic of Korea that work was undertaken on inspection and maintenance of disaster prone areas, large-scale construction sites, disaster prevention facilities and equipment and facilities were secured for emergency countermeasures and funds were allocated for prevention and rehabilitation activities. Various activities on disaster prevention education, drills and public relations were undertaken. Implementation of the Basic Five-Year Disaster and the Yearly Disaster Prevention Plans continued. During the Fifth Basic Plan (1997-2001) the government would invest over US$ 26 billion for various disaster prevention measures, of which US$ 4 billion were invested in 1999. Risk assessment evaluation system of disaster impact activities continued. Under the implementation of the plans for improvement of disaster prone areas, a total of US$ 1.1 billion will be invested between 1998-2002. After the establishment of the National Institute for Disaster Prevention in 1997, the Korea Disaster Prevention Association was established in March 1999 to strengthen the nation`s capability to prevent disasters.

55. The delegate from Thailand informed the Committee that various activities on disaster prevention and preparedness were undertaken, including improvement of the National Defense Master plan, raising public awareness, publication and dissemination of disaster-related materials, and provision of various structural measures to reduce flooding. Seminars, meetings and training courses on various topics related to disaster preparedness and prevention were organized. Concerned personnel also attended international meetings. The Royal Irrigation Department held a seminar during the year on "Integrated Plans for Flood Mitigation in Chao Praya River Basin" for various agencies concerned.

56. The delegate from Viet Nam reported that during the period between 1 November 1998 – 30 September 1999, various water related disasters were experienced in many parts of the country. Four tropical cyclones, hails and tornadoes, general floods and flash floods caused a total of 537 dead and missing, hundreds injured and severely affected, and loss of US$ 143 million. Many activities at all levels were undertaken, such as strengthening the systems and improving the quality of warnings, improving flood control structures and flood combat forces, and stepping up public education and awareness activities. According to the available data, during the period from 1990 to 1999, the losses due to natural disasters were: 7,495 people dead or missing, 0.75 million ha. of paddy lost causing the loss of 2.3 million tons of food, 8,823 boats and ships sunk, 5.5 million houses destroyed and damaged, with a total loss figure of US$ 2 billion.

ESCAP

57. The Committee noted with appreciation that the Commission at its fifty fifth session endorsed the three common goals for regional cooperation in natural disaster reduction: realistic reduction of damage; increased disaster awareness; and improvement of forecasting systems. The Commission called on the governments of the region to attach priorities to natural disaster reduction activities and requested the ESCAP Secretariat to give priority to the development of integrated regional strategy in the coming century for better coordination of national and international efforts. ESCAP, in close collaboration with the IDNDR Secretariat, organized the ``IDNDR-ESCAP Meeting for Asia: Risk Reduction and Society in the 21st Century`` in Bangkok from 23 to 26 February 1999. ESCAP attended the IDNDR Programme Forum in Geneva in July 1999 and presented a paper entitled "The Asian Experience: Impacts of Recent Disasters. Responses and Bangkok Declaration." ESCAP also participated in the workshop in Macao and presented a paper "ENSO Impact Assessment and Disaster Preparedness: Challenges and Opportunities for Regional Cooperation in the Typhoon Committee Area." ESCAP organized an exhibition to commemorate the IDNDR Day on 13 October 1999.

IDNDR Secretariat

58. At the Typhoon Committee session, the IDNDR Secretariat was represented by the ESCAP representative.

59. The Committee noted that during the reporting period, the IDNDR Secretariat had organized a number of regional activities in different parts of the world, including the IDNDR-ESCAP Meeting for Asia, mentioned above. The IDNDR Secretariat also organized the IDNDR Programme Forum in Geneva in July 1999, which brought together disaster managers from different parts of the world. The Forum adopted a ``Strategy for a Safer World in the 21st Century: Disaster and Risk Reduction``, emphasizing the increasing vulnerabilities of societies to natural hazards and the importance of adopting preventive strategies and practical measures to reduce the potential loss of human lives resulting from natural disasters. The main objectives of the International Strategy for Disaster Reduction (ISDR) are (i) to enable communities to become resilient to the effects of natural, technological and environmental hazards , reducing the compound risk they pose to social and economic vulnerabilities within modern societies; and (ii) to proceed from protection against hazards to the management of risk, through the integration of risk prevention into sustainable development activities. The Strategy for a Safer World received the full support of the Secretary General, and the Economic and Social Council (ECOSOC) adopted Resolution 1999/63, entitled ``International Decade for Natural

Disaster Reduction: Successor Arrangements``, requesting the Secretary General to take into consideration the functional and organizational arrangements of the IDNDR when maintaining the Secretariat for disaster reduction in the next budget programme for the biennium 2000-2001.

60. The Secretary General has recently reported to the General Assembly that in line with the ECOSOC resolution, the IDNDR Secretariat will be replaced by the ISDR Secretariat to continue the work in this field towards building a culture of prevention with regard to natural and technological disasters. ISDR will be composed of Inter-Agency Secretariat and Inter-Agency Task Force. The Task Force will include, inter alia, six representatives from regional entities. The ISDR Secretariat will have its members drawn, as appropriate, from the international community of disaster reduction and other related experts to be seconded from competent United Nations organizations, governments and non-governmental organizations. The Secretariat will function under the direct authority of the Under-Secretary-General for Humanitarian Affairs from 1 January 2000.

WMO

61. The representative of the WMO Secretariat informed the session that the WMO Congress in May 1999 reaffirmed that WMO played a leading role as regards mitigation of and preparedness for natural disasters of meteorological and hydrological origin and had supported the IDNDR efforts through its major scientific and technical programmes, in particular the Tropical Cyclone, the Public Weather Services, and the Hydrology and Water Resources Programmes.

62. Congress requested the Secretary-General to continue his efforts to ensure that WMO takes a strong lead in activities to mitigate disasters of meteorological and hydrological origin with a potential of the Organization to become a coordinating focal point for such activities in the post-Decade era.

63. Congress urged the Secretary-General to continue its support of WMO training events that would contribute to capacity building needed for natural disaster reduction related to meteorological and hydrological hazards at the national and sub-national level. It agreed that improving the disaster warning capacity of Members and enhancing public awareness with an aim to saving lives and property of the public should continue as high priority activity within relevant WMO programmes, especially the Tropical Cyclone, Hydrology and Water Resources, and Public Weather Services Programmes.

64. WMO together with UNESCO convened a Sub-forum on Science and Technology in Support of Natural Disaster Reduction from 6 to 8 July 1999 in Geneva. The statement from the sub-forum is attached as Appendix IX of this report.

(d) Training component (agenda item 4.4)

65. The Committee reviewed the involvement of the Members in a number of education and training activities supported mainly by Members themselves, by WMO's Voluntary Cooperation Programme (VCP) and regular budget, and through Technical Cooperation among Developing Countries (TCDC) arrangements. The details are given in Appendix X.

66. The delegate from China informed the Committee that the 11th National Workshop on Tropical Cyclones will be held in Jiangsu Province of China by the end of 1999. The International Training Course on Long Range Weather Forecast jointly-sponsored by the Chinese Government and WMO was successfully organized in RMTC/Nanjing from 25 September to 24 October 1999. Computer replacement training workshops were held in Zhejiang province in April and September 1999. The second training course for the use of observing software was held in the Meteorological Bureau of Anhui Province during the year.

67. The delegate from Hong Kong, China reported that eight Observatory officers participated in four overseas training courses in 1999. The HKO organized eight in-house training courses from October 1998 to September 1999. A total of 100 Class I, II and III meteorological personnel from the HKO and 11 members of the Hong Kong Aviation Club attended the courses. Hong Kong, China also offered to provide training attachments through WMO's VCP.

68. The delegate from Japan reported JMA organized the second ``International Training Seminar on Typhoon Monitoring and Forecasting in the Western North Pacific`` at the RSMC Tokyo-Typhoon Center from 18 January to 5 February 1999. JMA sent five of its staff to provide expert services to two Members of the Committee while three KMA experts visited JMA. The Meteorological Satellite Center (MSC) developed CAL software for neph-analysis training. The software is designed to allow users to study neph-analysis including typhoon analysis by themselves through interactive procedures with a PC. Training is also being offered by the Ministry of Construction on various aspects of hydrology, to many trainees from foreign counterpart agencies.

69. The delegate from Macao informed the Committee that 68 SMG staff members attended eight in-house training courses while 63 staff members participated in 20 international training courses/seminars/workshops.

70. The delegate from Malaysia informed the Committee that MMS focused on training of its staff in Information Technology and PC utilization. MMS also took advantage of the opportunity available to send its staff to attend workshops, seminars and conferences organized by international scientific organizations, particularly, WMO.

71. The delegate from the Philippines reported to the Committee that 36 PAGASA personnel participated in 33 international training courses/seminars/workshops. It conducted 11 in-house training courses in 1999 and hosted three international workshops/conferences. Under the VCP, three foreign and 15 Filipino scholars are currently enrolled at the University of the Philippines, taking up post graduate course in Meteorology.

72. The delegate from the Republic of Korea informed the Committee that a total of 7 staff members attended 5 training courses in the USA and two in Japan.

73. The delegate from Thailand reported that 11 TMD staff members participated in 10 overseas training courses.

74. The delegate from the U.S.A., in addition to drawing attention to the comments on training in the country report, informed the Committee that the USA will begin, in mid-year 2000, the operation of a ``Training Desk`` at the Honolulu Forecast Office. This training, under the auspices of the WMO VCP program, will be focused on capacity building in the meteorological services of small island states.

75. The delegate from Viet Nam informed the Committee that 48 HMS personnel participated in in-house training courses, 2 attended post-graduate courses, 84 undertook short-term training courses and 32 joined study tours.

(e) Research component (agenda item 4.5)

76. The Committee noted that the research work undertaken by the Members during the past year focused this year on predicting typhoon movement and intensity. The summary of the reports of the individual Members in relation to the research component is given in Appendix XI.

77. The delegate from China informed the Committee that three research studies on tropical cyclones were undertaken in 1999. They are: Research on Typhoon Structure, Research on Typhoon Numerical Prediction and Research on Climate Characteristics of Tropical Cyclones.

78. The delegate from Hong Kong, China reported that four papers on tropical cyclones and rainstorms were presented at the 13th Guangdong-Hong Kong-Macao Seminar on Severe Weather held in Macao from 17-18 December 1998. A Guangdong-Hong Kong-Macao meeting on cooperation in mesoscale weather prediction and analysis was held on 15 July 1999 in Shenzhen, China. A study would be undertaken by the three sides to compare the performance of their mesoscale models on rainfall forecasts and tropical cyclone track prediction. Research work is also on-going on a variety of subjects including the impacts of El Niño/La Niña on tropical cyclone landfalling locations, short-term rainfall forecast using the Regional Spectral Model, and experimental long-range forecast of tropical cyclone activity and rainfall.

79. The delegate from Japan informed the Committee that JMA will host and ``International Workshop on Mesoscale Model Intercomparison of Typhoon Intensity Prediction (COMPARE Case III) in Tokyo from 13-15 December 1999 in cooperation with the Science and Technology Agency, the Japan International Science and Technology Exchange Center and WMO. The Meteorological Research Institute (MRI) of JMA started numerical experiments of typhoons using the MRI Mesoscale Non-hydrostatic Model (MRI-NHM) with high resolution. Preliminary results showed that the MRI-NHM represented well common features of the tropical cyclones such as an eyewall accompanied by heavy rainfall and spiral rain bands in the outer region. There are a wide range of research activities at national research institutes and universities aiming at reducing the flood damage by improving the accuracy of flood forecasting and flood damage estimation.

80. The delegate from Macao reported that studies on hazardous weather and three research papers were presented in Hazardous Weather Seminar held in Macao. A research paper on monsoon in collaboration with the Department of Atmospheric Science of Zhongshan University was presented in the 3rd GEWEX Meeting held in Beijing. A research study on a mesoscale meteorological model is in semi-operational run. This research study is a collaborative work of a team of SMG meteorologists and experts from the above mentioned University.

81. The delegate from Malaysia reported that MMS continues to pursue its research on the large-scale effects of tropical cyclones of the Northwestern Pacific basin on the Southeast Asian region in general and Malaysia in particular. Work had just begun to carry out analytical and dynamical studies by identifying tropical storm/typhoon cases in the last 10-20 years that entered into or developed within the South China Sea.

82. The delegate from the Philippines reported that seven research and development studies were completed during the period. Two of these dealt with tropical cyclones.

83. The delegate from the Republic of Korea informed the Committee that the following research studies on tropical cyclones were conducted in 1999: Statistical model to predict the tracks of typhoons, Dynamics of typhoons and effects of initial typhoon structure, Development of the Ensemble track forecast model, and Development of typhoon forecasting system using satellite data. Preliminary results from the ensemble models are encouraging.

84. The delegate from Thailand informed the Committee of three on-going research activities and the results of the study on the impact of ENSO phenomena in 1997-1999 on Thailand Climate.

85. The delegate from the U.S.A. informed the Committee that Mr Bill Ward, a Meteorologist with NWSO Guam, co-authored a technical paper with Dr Mark Lander of the University of Guam entitled ``Upper Tropospheric Outflow Patterns over some very intense tropical cyclones of the western north Pacific as revealed by soundings, Doppler radar and water vapor winds`` which was presented at the American Meteorological Society in January 1999. Mr O. Saka, a professor at the Kurume National College of Technology, Atmospheric Environmental Research Unit, conducted aerosol sampling experiment in Guam during the second week of August to determine the effect of the global transport of aerosols to the atmosphere.

86. The delegate from Viet Nam reported that four research studies on tropical cyclones were completed during the year.

V. REVIEW OF THE 1999 TYPHOON SEASON/PUBLICATIONS (agenda item 5)

Review of the 1999 Typhoon Season

87. The Members noted that in 1999, the number of tropical cyclones forming in higher latitudes were considerably more than in previous years. A review of the tropical cyclones affecting the Members are given in Appendix XIII.

88. As in previous years, RSMC Tokyo-Typhoon Center provided the session with a review of the 1999 typhoon season contained in Appendix XIV.

Publications

89. The Members noted with satisfaction the publication of the 1998 Typhoon Committee Annual Review (TCAR) in November 1999 through the commendable efforts of the Chief Editor provided by the TCS and the National Editors provided by the Members. The Committee proposed that the current Chief Editor continue with the editorial task.

90. The TCS published the 11th issue of the Typhoon Committee Newsletter in July 1999 and the brochure on the tropical cyclone names for the Typhoon Committee Region.

91. The RSMC Tokyo-Typhoon Center will publish the "Annual Report on Activities of the RSMC Tokyo-Typhoon Center in 1998" by the end of 1999 while the 1999 Annual Report will be published sometime in the year 2000.

VI. COORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME (agenda item 6)

92. The consideration under this agenda item was based upon the information contained in the twenty-fifth status report on the implementation of the WMO Tropical Cyclone Programme (TCP) and supplementary information, in particular, outcome of the Third TC RSMCs Technical Coordination Meeting (TTCM) (La Reunion, France, 5 to 11 November 1999), presented verbally at the session by the representative of the WMO Secretariat. The Committee noted its appreciation for the detailed information provided on the implementation of the TCP.

93. The Committee was informed that the TTCM reaffirmed that the "first level" information (i.e. basic information covering the tropical cyclone's present and forecast position, movement and intensity) should be provided by TC RSMCs and other Tropical Cyclone Warning Centres (Brisbane, Darwin, Perth, Wellington and Central Pacific Hurricane Center in Honolulu) in their areas of responsibility. With regard to the "second level" information (i.e. local forecasts, alert status, etc.), the TTCM affirmed that the provision of the "second level" information should remain the responsibility of the NMS concerned. The TTCM noted that there were some ocean basins that are not covered within the area of responsibility of a designated TC RSMC. It therefore recommended that WMO investigates the possibility of either assigning one or more new TC RSMCs to cover these basins, or to expand the areas of responsibility of existing TC RSMCs concerned.

94. The Committee was informed that NOAA, in cooperation with WMO was organizing the RA IV Workshop on Hurricane Forecasting and Warning

at the RSMC Miami-Hurricane Center, from 27 March to 11 April 2000. It noted with pleasure that seven candidates of Typhoon Committee Members would be able to attend the Workshop and will be provided financial assistance from the Typhoon Committee Trust Fund (TCTF).

95. The Committee noted a summary of the TCP activities for 1999 as given in Appendix XV.

VII. PROGRAMME FOR 2000 AND BEYOND (agenda item 7)

Regional Co-operation Programme Implementation Plan (RCPIP)

96. The Typhoon Committee reviewed and adopted the revised RCPIP which is contained in Appendix XVI.

97. The Committee, in reviewing the development of the implementation plan, noted that the plan was useful in the development of the national and regional activities and services. The Committee, considering the comments of a number of its Members, decided to establish a Working Group with the charge, while maintaining the basic structure of the RCPIP, to review generally Part A of the adopted RCPIP with the goal of eliminating duplication, deleting items no longer relevant to the Committee's activities, and suggesting to the Committee those items which should be actively pursued in the near term. The Working Group will be chaired by Mr Hagemeyer (U.S.A.) with experts from China; Hong Kong, China; Japan; Republic of Korea and Malaysia and will work through the process of correspondence. The report of the Working Group is to be distributed to the Committee Members by August 2000 for their comments. TCS is invited to distribute a document on the outcome of the Working Group to the Committee Members so that substantive discussions on this issue may be held at the thirty-third session of the Committee.

98. The Committee was informed by the delegate from China that in response to the request from the Coordinators of TCS of the Committee and the Technical Support Unit of the Panel on Tropical Cyclones, China will kindly host the Regional Workshop on Doppler Radar to be held in Hefei from 7 to 10 December 1999.

99. The delegate from the Republic of Korea informed the Committee that KMA plans to expand the overseas-aid programme organized by Korea International Cooperation Agency in the future. In this regard, it was suggested that the Members who wish to get aid from the Government of the Republic of Korea utilize the overseas-aid programme.

100. The Committee reviewed the Reports of the Typhoon Research Coordination Group (TRCG) as shown in Appendix XVII. The Committee expressed its deep appreciation to Mr C.Y. Lam (Hong Kong, China), Chairman of TRCG and the members of the group for their excellent work. The Committee recommended that Mr C.Y. Lam to continue to serve as the Chairman of the TRCG.

101. The Committee accepted the recommendation of the TRCG to establish a Typhoon Committee Research Fellowship Scheme. The Scheme would operate as follows:

(a) TRCG would establish at the beginning of each year through correspondence 2 to 3 priority research topics;
(b) TRCG would identify at the same time centres willing to receive researchers ("Typhoon Committee (TC) Research Fellows") from other Members to work on those topics for a period of time;
(c) With this information, TCS would circulate invitation to Members to solicit nominations;
(d) The host centres would decide on the selection of TC Research Fellows;
(e) Then TC Research Fellow would work on the chosen topic at the hosting centre, aiming at producing a scientific paper at the end of the fellowship for publication in a journal;
(f) The hosting centre would provide computing and other relevant facilities as well as a counterpart researcher to work alongside the TC Research Fellow;
(g) Part of the joint research work could be conducted by "correspondence", making use of present day information technology and telecommunication techniques.

102. The Committee proposed that the exchange programme should form part of the Typhoon Committee Research Fellowship Scheme proposed by the TRCG. The scheme was designed to provide an environment and facilities to enable joint researchers to achieve pre-defined objectives which would have operational applications.

103. Since the success of the scheme depended on centres willing to play host, researchers to work with partners from other Members, and funding to support the Research Fellows, the Committee urged Members to indicate through its member in the TRCG their intentions in these aspects.

104. The delegate from Hong Kong, China reported on behalf of the TRCG chairman, that voice recordings of the majority of tropical cyclone names were available on the webpage:

http://www.weather.gov.hk/infomtc/sound/tcname2000e.htm

Members are urged to send voice recordings of the names they proposed, pronounced in the original language, to the TRCG chairman for incorporation into the homepage as soon as possible if they have not already done so. The Committee re-affirmed the list of tropical cyclone names given in Appendix XVII "Report of the Typhoon Research Coordinating Group" submitted by the chairman of TRCG.

105. The Committee reviewed the report and recommendations of the Workshop on the Impact of the El Niño Southern Oscillation/La Niña on Meteorology and Hydrology in the Typhoon Committee Region as shown in Appendix XVIII.

106. Prof. Elsberry (U.S.A.) suggested that a number of national meteorological and climate groups are producing ENSO predictions that are available on web sites with likely impacts of El Niño on the area of Typhoon Committee Members. The recent East Asia and Western North Pacific Meteorology and Climate Conference in Hangzhou, China included many papers relating the 1998 flooding over China to the El Niño that will appear in a proceedings volume.

107. The delegate from Hong Kong, China commented that the recommendations of the workshop were useful but very general in nature. No specific action was proposed. In particular, with regard to the recommendation to establish a fully coordinated regional forecast and early warning system for ENSO events, he supported Prof. Elsberry's suggestion that since there are currently many sources of information available on ENSO and long-range forecast and these should be referenced as appropriate.

108. The Committee was informed by the delegate from Thailand in consultation with WMO that Thailand will host a Regional Technical Conference on Tropical Cyclones and Storm Surges to be held tentatively in November 2000 (see paragraphs 106 (iii) and 122 (viii)).

Hydrological Component

109. The following recommendations had been proposed during the meetings of the hydrologists for implementation:

- Requesting TCS to organize a thematic workshop or seminar with a view to promote greater information exchange and technology transfer among Typhoon Committee hydrologists. In this connection, the

following activities are proposed with budget estimate shown in Appendix VII:

(a) A 5-day training seminar on "Development of Forecasting and Warning System and Emergency Counter Measures for Typhoon-induced Sediment and Flood Disaster" to be held in the Philippines in May 2000 . The training seminar will be jointly organized by the Typhoon Committee Secretariat and the Japan International Cooperation Agency (JICA). (see paragraph 124 (vi))

(b) A 4-day expert workshop for TC hydrologists on "Evaluation and Improvement of Operational Flood Forecasting Models in the Typhoon Committee Area" to be held in Bangkok, Thailand sometime in the year 2001.

- The need for a hydrologist to serve the TC Members was carefully reviewed. A job description for the hydrologist was drawn up to facilitate the request (please refer to Annex 3 of Appendix VII). The request should be made through the TCS to the Government of the Republic of Korea and other potential donor Member to provide a hydrologist to serve after the term of the current TCS Hydrologist (mid-2000).

- ESCAP to take measures in alerting TC Members of ESCAP's projects on water resources and flood mitigation.

- Members should take advantage of TCDC arrangements by ESCAP for exchange visits of hydrologist.

Plans for special activities to commemorate the year 2000

110. The Committee reviewed and agreed on the plans proposed by TCS to commemorate the year 2000. The planned activities are the following:

(i) Conduct an intensive information drive by all the Members on the work of the Typhoon Committee

Proposed Tasks:

a. Members are enjoined to be collectively involved in conducting an intensive information drive mainly by arranging for press conferences or lectures to inform the public about the activities of the Typhoon Committee with emphasis on their countries involvement in the Committee.

b. The TCS will provide upon request information materials about the Typhoon Committee. The Committee further proposed that TCS should also provide soft copies of information on the Typhoon Committee to be included in Member's web sites.

(ii) To launch an expert exchange programme with other countries through bilateral agreement.

Proposed Tasks:

a. Identify during the 32nd session the countries that could possibly participate in this activity.
b. Members to make special effort to arrange for exchange of experts through TCDC.

(iii) To hold a technical conference on networking and scientific exchange with other tropical cyclone regional bodies within Asia-Pacific (see paragraph 124 (viii)).

Proposed Tasks:

a. Explore the possibility of holding technical conferences to coincide with an activity of RAII and RA V.
b. Seek the involvement of the Panel on Tropical Cyclones and the Tropical Cyclone Committee in the South Pacific and South East Indian Ocean.

(iv) Members to provide ESCAP with materials for the exhibition on the International Day for Natural Disaster Reduction (second Wednesday of October).

111. Prof. Elsberry (U.S.A.) suggested that Dr Greg Holland of Australia and Prof. Johnny Chan of City University of Hong Kong might be requested to adapt summaries of progress in tropical cyclone prediction that they have recently prepared to highlight the contributions of the Typhoon Committee. For example, the achievement of 72-hr track forecasts with equivalent accuracy of 48-hr forecasts just a decade ago is especially noteworthy. These individuals might be asked to give special lectures perhaps in conjunction with professional meteorological societies of Typhoon Committee Members.

Others

112. The Committee was informed that with effect from 20 December 1999, Macao will become a Special Administrative Region of the People's

Republic of China and will be listed as Macao, China. In consideration of the above, the membership of "Macao" in the ESCAP/WMO Typhoon Committee will be changed to "Macao, China" with effect from 20 December 1999.

VIII. SUPPORT REQUIRED FOR THE COMMITTEE'S PROGRAMME (agenda item 8)

i) Arrangements for the Typhoon Committee Secretariat (TCS)

113. The Committee expressed its gratitude to the Government of the Philippines for hosting the TCS and for providing a full-time meteorologist and support staff and proposed that such arrangements continue.

114. The Committee expressed its appreciation to the Government of the Republic of Korea for providing the services of a hydrological expert to the TCS and proposed that such arrangement continue.

115. The Committee expressed its gratitude to the dedication and continuous services extended by Dr Roman L. Kintanar in his capacity as TCS Coordinator.

116. The Committee expressed its appreciation to TCS for publishing the Typhoon Committee Newsletter, the ESCAP/WMO Typhoon Committee Annual Review and the brochure on tropical cyclone names for the Typhoon Committee Region.

117. The Committee approved the continuation of funding for the operating costs of TCS, including the support for the TCS Coordinator from the TCTF (see paragraph 124 (i)).

118. The Committee deliberated on the proposed revision of the honorarium of the TCS staff and approved an additional amount not exceeding US$5,000 per year on a differential scale basis (see paragraph 124 (i)).

ii) Technical cooperation

119. The Committee reviewed all the resources available to support the work programme of the Committee, including the contributions from Members themselves and external support from WMO/VCP, ESCAP, TCDC, TCTF, bilateral assistance and other potential donors.

iii). Typhoon Committee Trust Fund (TCTF)

120. The WMO Secretariat presented to the session a detailed breakdown of expenses of the TCTF. The Committee expressed its gratitude to WMO for submitting the financial report and requested WMO to continue doing so in the future.

121. The Committee reviewed and approved the financial report on the TCTF and the balance of the fund as of 30 September 1999 as shown in Appendix XIX.

122. The delegates from China and the Republic of Korea informed the Committee that their Governments had already made their 1999 contributions to the TCTF. However, it was noted that this was not reflected in the financial report mentioned in the preceding paragraph.

123. Members are urged to continue to enhance their contributions to the Trust Fund as a substantial support to the Committee's activities. The Committee was pleased to note that the Fund was being used for provision of institutional support and funding support to representatives of TC Members attending training events and conferences. The Committee expressed the view that a certain degree of self-reliance still has to be achieved. In this connection, the Committee urged its Members to continue to enhance their contributions to the Trust Fund as substantial support to the Committee's activities.

124. The Committee, after careful consideration, agreed to the use of the TCTF for the following specific purposes from 1 January to 31 December 2000:

(i) Operating costs of TCS, including the support for the TCS Coordinator (approx. US$ 26,220).

(ii) Publishing the Typhoon Committee Newsletter No. 12 [400 copies] (approx. US$ 1,700).

(iii) Printing and distribution costs of the publication of the 1999 Typhoon Committee Annual Review (TCAR) [600 copies] (approx. US$ 5,900).

(iv) Augmentation of travel funds for TCS staff mission, including attendance at the thirty-third session of the Typhoon Committee (approx. US$ 9,000).

(v) Printing and distribution costs of documents for the thirty-third session of the Committee (approx. US$ 1,700).

(vi) Support for the attendance of participants at a 5-day training seminar on "Development of Forecasting and Warning Systems and Emergency Counter Measures for Typhoon-induced Sediment and Flood Disaster" for hydrologists in the Typhoon Committee area in May 2000 (US$ 15,000).

(vii) Support for the attendance of seven (7) participants at a Workshop on Hurricane Forecasting and Warning, including topics related to Public Weather Services [Miami, USA, 27 March to 11 April 2000] (US$ 23,000).

(viii) Attendance of participants/lecturers at a Technical Conference on Tropical Cyclones and Storm Surges (Thailand, five days, tentatively November 2000) [for Typhoon Committee and Panel on Tropical Cyclones] (US$ 16,000).

(ix) Any other emergency case that can be justified for the use of the TCTF requiring the concurrence of both the TCS Coordinator and the Typhoon Committee Chairman.

125. The Committee decided that total expenditures for the year 2000 however are not to exceed US$ 100,000.

IX. DATE AND PLACE OF THE THIRTY-THIRD SESSION (agenda item 9)

126. The Committee welcomed the offer of the delegate from Macao to hold the thirty-third session in Macao, tentatively in November 2000, subject to the approval of the Government of Macao. The exact date of the session will be finalized in consultation with ESCAP, WMO, TCS and the host Member.

X. SCIENTIFIC LECTURES (agenda item 10)

127. The following scientific lectures were presented:

(a) Development of Typhoon Forecasting System Using Satellite Data
By: Dr Hyo-Sang Chung (Republic of Korea)

(b) Web-based Tool for Typhoon Analysis and Prediction
By: Dr H. Joe Kwon (Republic of Korea)

(c) Typhoon Intensity Prediction Experiments with statistical Regression and Neural Network Approaches
By: Dr Jong-Jin Baik (Republic of Korea)

(d) Computer and Communication Technology for Development of Meteorological Industry
By: Dr Chun-Pyo Hong (Republic of Korea)

(e) Introduction to the Korean Meteorological Society
By: Dr Sung-Nam Oh (Republic of Korea)

(f) Circulation Characteristics of the Development of Tropical Cyclones
By: Mr Li Huang (China)

(g) CAL software for neph-analysis training
By: Mr Tatsuo Ueno (Japan)

(h) Recent Tropical Cyclone Track Prediction Research at the Naval Postgraduate School
By: Prof. Russell Elsberry (U.S.A.)

(i) From PPI to Dual Doppler Images: 40 Years of Radar Observations at the Hong Kong Observatory
By: Mr Edwin W.L. Ginn (Hong Kong, China)

(j) Seasonal Forecast for Winter 1999
By: Dr Chung-Kyu Park (Republic of Korea)

128. The Ministry of Construction of Japan made available the video tape ``River, Water, Life" for presentation.

129. CMA made available the video tape ``Meteorological Services during the flood season in 1998" for presentation.

130. The Committee expressed its thanks to the lecturers for their informative and useful lectures and to Messrs Qui Guoqing, Edwin Ginn and Hisaya Sawano for the video tapes and CDRoms that were viewed during the session.

XI. ADOPTION OF THE REPORT (agenda item 11)

131. The Committee adopted the report of the session at 10:10am, 29 November 1999.

XII. CLOSURE OF THE SESSION

132. The delegates from the Members of the Typhoon Committee, observers, and representatives of ESCAP, WMO and TCS expressed their thanks and appreciation to the Government of the Republic of Korea and the Korea Meteorological Administration for the successful hosting of the 32nd session of the Typhoon Committee. They also expressed gratitude to Dr Sung-Euii Moon, Administrator of KMA and his staff for the warm hospitality and excellent arrangements made. Their thanks also goes to Taegu University for co-sponsoring this year's session.

133. The session was closed by the Chairman at 11:00am, 29 November 1999.

APPENDIX I

LIST OF PARTICIPANTS

32nd Session ESCAP/WMO Typhoon Committee
Seoul, Republic of Korea
23-29 November 1999

MEMBERS OF THE TYPHOON COMMITTEE

CHINA

Mr LI Huang	Deputy Administrator China Meteorological Administration
Mr WANG Caifang	Director-General International Cooperation Department China Meteorological Administration
Mr QIU Guoqing	Director-General, National Meteorological Center China Meteorological Administration
Ms TIAN Cuiying	Division Director Forecasting Services and Disaster Mitigation Department China Meteorological Administration
Mr ZHANG Jianxin	Engineer Water Resources Information Center Ministry of Water Resources

HONG KONG, CHINA

Dr H.K. LAM	Director Hong Kong Observatory
Ms Elaine KOO	Assistant Director Hong Kong Observatory
Mr Edwin W.L. GINN	Senior Scientific Officer Hong Kong Observatory

JAPAN

Mr Koji YAMAMOTO	Director-General Forecast Department Japan Meteorological Agency

Mr Tatsuo UENO	Head, National Typhoon Center(RSMC Tokyo-Typhoon Center) Forecast Division, Forecast Department Japan Meteorological Agency
Mr Masaharu OHIRA	Deputy Director Recovery and Reconstruction Division Disaster Prevention Bureau, National Land Agency
Mr Tsuyoshi KAJIYA	Deputy Director Disaster Prevention Coordination Division Disaster Prevention Bureau, National Land Agency
Mr Hisaya SAWANO	Deputy Director River Development Division, River Bureau, Ministry of Construction

MACAU

Mr Antonio VISEU	Subdirector Servicos Meteorologicos e Geofisicos
Mr Eurico Lopes FAZENDA	2 Commandant Macao Fire Services
Mr Americo de SOUZA MONTEIRO	Subintendente Do CPSPM Official of G C Seg.
Ms Ka Cheng LEONG	Chief of Meteorological Monitoring Centre Servicos Meteorologicos e Geofisicos

MALAYSIA

Dr LIM Joo Tick	Director-General Malaysian Meteorological Service
Mr CHONG Sun Fatt	Senior Assistant Director of Hydrology Hydrology Division Department of Irrigation and Drainage
Mr MOHAMAD Bin Haji Daud	Assistant Director Crisis and Disaster Management Unit Division for National Security Prime Minister's Department
Ms Noormah ABDUL RAUF	Assistant Director Social Welfare Department

PHILIPPINES

Dr Leoncio AMADORE	Director, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

REPUBLIC OF KOREA

Dr Sung-Euii MOON	Administrator Korea Meteorological Administration
Mr Jae-Sae Oh	Director General Ministry of Government Administration and Home Affairs
Mr Wang-Oo Rhee	Director General Water Resources Bureau Ministry of Construction and Transportation
Mr Soon-Kab CHUNG	Director Forecast Management Division Forecast Bureau Korea Meteorological Administration
Mr Kwang-Joon PARK	Senior Forecaster Forecast Bureau Korea Meteorological Administration
Dr Woo-Jin LEE	Director NWP Division, Forecast Bureau, Korea Meteorological Administration
Dr Myoung-Hwan AHN	Research Scientist Remote Sensing Research Laboratory Meteorological Research Institute Korea Meteorological Administration
Mr Jong-Soo Kim	Deputy Director Ministry of Government Administration and Home Affairs
Mr Ok-Joo Sohn	Deputy Director River Planning Division, Water Resources Bureau Ministry of Construction and Transportation
Mr Kyung-Taek Yum	Section Chief Water Resources Bureau Ministry of Construction and Transportation

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APPENDIX II

AGENDA

1. Opening of the session

2. Election of officers

3. Adoption of the agenda

4. The Committee's activities during 1999:

   4.1 Meteorological component
   4.2 Hydrological component
   4.3 Disaster prevention and preparedness component
   4.4 Training component
   4.5 Research component

5. Review of the 1999 typhoon season/publications

6. Coordination with other activities of the WMO Tropical Cyclone Programme

7. Programme for 2000 and beyond

8. Support required for the Committee's programme

9. Date and place of the thirty-third session

10. Scientific lectures

11. Adoption of the report

APPENDIX III

SUMMARY OF REPORTS OF THE TYPHOON COMMITTEE MEMBERS ON THEIR RELATED ACTIVITIES TO THE METEOROLOGICAL COMPONENT

In **China**, CMA's FY-1C was launched on 10 May 1999 and has been put into operational use. In 1999, a Doppler radar named CINRAD was installed in Hefei, Anhui Province. On 1 July, five imported Automatic Weather Stations (AWS) were put into operation while 60 locally made sets were deployed in six provinces. It is envisioned that all of these AWS will be operational by 1 January 2000. For its upper-air stations to be Y2K compliant, a total of 63 PC-1500 computers were replaced by advanced PII series computers. CMA's satellite-based telecommunication network was put into quasi-operation in 1999. In April 1999, an IBM SP Parallel computer was installed in CMA's National Meteorological Center for the purpose of operational NWP. The AWS developed by the Chinese Academy of Meteorological Sciences and used for National Reference Climate Station was put into operational test during the year. The national system for acquisition, processing and assessment of data on meteorological disasters was formally put into operation on 15 June 1999.

In **Hong Kong, China**, a Doppler weather radar was installed at Tai Mo Shan (45009) and put into full operation in April 1999. This radar together with another Doppler radar at Tate's Cairn provide enhanced radar products such as three-dimensional winds over Hong Kong, composite radar reflectivity images and three-dimensional radar images, automatic tracking, warning and forecasting of radar echoes. The Observatory's Operational Satellite Reception System was upgraded to meet Y2K compliance requirements and also to allow reception of high resolution cloud images from CMA's FY-2 geostationary satellite. A computer system, CRAY SV1, with 16 CPU's, an aggregate peak performance of 19.2 GFLOPS and a theoretical peak performance of 21,000 MTOPS was commissioned in October 1999 for running a high resolution numerical weather prediction model at the HKO. Starting from 1 April 1999, 18UTC upper-air wind observations have been made by wind profiler. In addition, radiosondes employing LORAN-C wind-finding technique have been used in place of GPS sondes whenever reception permits and thunderstorms are not in the vicinity. In 1999, the Observatory Homepage won "The Best Homepage among Government Departments" contest organized by a local newspaper. Added features during the year includes among others tracks of tropical cyclones passing Hong Kong, a network time server to provide a time-checking service, UV index, enhanced database on warning statistics, electronic publications, an educational resource page, an enhanced geophysical and time services page as well as real-time weather observations from various meteorological stations. The Observatory's Dial-a-Weather Service and the Information Enquiry System continues to be the

two most popular means for the public to access weather information. HKO also introduced a new fax-on-demand service into this system in 1999. A web-based Weather Information System was put into trial operation in May 1999 to provide tailor-made meteorological information to individual government departments so as to meet their operational needs. During the passage of Maggie on 07 June 1999, a number of terrain-induced windshear events were observed by the Terminal Doppler Weather Radar when strong southerly winds prevailed over Hong Kong. On-going developments are in hand to improve the success rate and reduce the false alarm rate of the Windshear and Turbulence Warning System. During a recent Asia/Pacific regional meeting, the Aviation Meteorological Data Processing System gained the recognition of the ICAO as a system enabling airlines to obtain relevant products for their operation "with minimum investment in hardware, software and training". The Aerodrome Meteorological Observing System was put into full operation to support dual runway use in August 1999. The workstations for receiving satellite broadcasts from the World Area Forecast Centres were upgraded in 1999 to make them Y2K compliant. A nested configuration of the Regional Spectral Model (adapted from JMA) with an inner domain of 20 km and 36 vertical levels was put on trial run in April 1999. Hourly rainfall based on the combined analysis of radar and rain-gauge data was also incorporated into the model through physical initialization. With the CRAY SV1 becoming operational, the RSM will be migrated before the end of 1999 to run on the new platform. To futher enhance the HKO's rainstorm nowcasting system SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems), attempts are being made to utilize technology such as neural networks, pattern recognition as well as satellite-estimated rainfall in conjunction with radar rain-gauge data.

In **Japan,** GMS-5 continued to perform three major missions: VISSR observations, dissemination of cloud images and collection of meteorological data. With the failure of the launch of the Multifunctional Transport Satellite on 15 November 1999, Japan will prolong the operation of GMS-5 for continuous provision of satellite image data for users in Asia and the Pacific region. As of September 1999 there are 17 Medium-scale Data Utilization Stations, 52 Small-scale Data Utilization Stations and 61 Data Collection Platforms registered by Members of the Typhoon Committee. JMA as of 1999 has installed the REDIS-NEXT at three DMOs (Tokyo, Sendai and Sapporo). On 1 November 1999, JMA started the operation of two new C-band radars (Nagano and Shizuoka) and terminated the operation of the Fuji-san S-band radar. As of September 1999, JMA has installed the JMA-95 type surface observing equipment at 97 stations, thirteen of which are equipped with a visibility sensor for unmanned operation. JMA is currently operating 18 upper-air observing stations, six of which are GCOS Upper-Air Network stations. From November 1998 to September 1999, ten cruises were implemented by the 6 meteorological observing vessels of JMA in seas adjacent to Japan and in the western North Pacific. All of JMA's systems are now fully Y2K compliant. In operation from 10 November 1999 to 09 March 2000 is a Y2K GTS data server which will serve as back-up to the RSMC DSS

Server. In January 1999, JMA implemented a minor change in its Typhoon Model wherein the bogus tropical cyclone is constructed with the mean value of analyzed 30-kt wind radius instead of the minimum value which had been used in the model for the last 10 years. JMA in 1999 developed a coupled ocean-atmosphere model which was used in the prediction of sea surface temperatures in the equatorial Pacific which in turn was used to make dynamical predictions of El Niño events. Using its SST anomaly predictions, JMA started to issue outlook information on El Niño for domestic users in August 1999. In August 1999, JMA expanded the forecast area of its Storm Surge Model. On 1 September 1999, JMA put into operation the Information Network for Disaster Prevention (INDiP), a new information service for domestic users via the Internet.

In **Macao**, currently in operation at the SMG's Meteorological Monitoring Centre is the VIS5D software which displays the products generated from the JMA DSS server, ECMWF, and MM5 which proved very invaluable to forecasters day to day analysis work. Apart from the computer based weather briefing system, a task group made up of meteorologists and computer technicians had completed the development of an Intranet Weather Information Database System for SMG staff using the web-browser method. It can even be accessed by top level managerial staff in their homes. In operation is a new satellite receiving system able to receive FY-2 data. This is aside from the VCS HRPT satellite receiving system currently in operation. New stations were added to the AWS weather monitoring network with new software display of the AWS through Oracle database. A mass storage system for improving the archiving, processing and retrieval of meteorological, geophysical and air quality data is currently in operational status. Upgraded in 1999 is SMG's weather and air quality index telephone dissemination system (now with fax capability), SMG home page, leased line to access JMA DSS server (up to 64K), GTS circuit between Macao and Beijing (from 9600 bps to ISDN 64K file transfers using TCP/IP protocol.

In **Malaysia,** a new MTSAT receiving system is being acquired to replace the old resolution system in Kota Kinabalu, Sabah. Addressing the Y2K compliance issue was a major activity for the MMS during 1999 and currently almost all of its systems are compliant.

In the **Philippines,** PAGASA has recently acquired the MK II Brewer Spectrophotometer for the purpose of supplementary instrumentation in the World Ozone Network and for expansion of the agency's monitoring. Also in 1999, two equipment were procured and installed at PAGASA's Weather Branch. One is the Geostationary Meteorological Satellite Cloud Maps Access and Process-based Systems (CMAPPS) and the World Area Forecast System (WFS). The reception and processing of grid point values grib data from Tokyo RSMC has been made faster and more efficient with the acquisition of a Pentium III 450 mHz computer. The SYNERGIE/WEFAX system has proven to be very useful for operational weather forecasters and it was recently upgraded to be

Y2K compliant. In connection with PAGASA's plan to regionalize its forecasting centres, visualization software similar to the SYNERGIE workstation is being developed to answer the need for adaptability and portability for other regional stations.

In the **Republic of Korea,** a new satellite receiving system was installed in January 1999 The new system provides users satellite analysis data on real time and has thus greatly reduced analysis time (from 40 to 20 minutes). Currently on-going is the installation of Automated Surface Observing Systems (ASOS) across the country. It is envisioned that by the year 2000, observations in all manned stations will be automated. The SX-5/NEC (speed = 128 Gflops) was installed in 1999 and is currently operational. It is used to analyze huge amounts of meteorological data and operate fine-mesh numerical models. Running time of the Regional Model using this supercomputer is 48 minutes while that for the Severe Forecast Model is 53 minutes. The Advanced Regional Prediction System (ARPS) developed by the Center for Analysis and Prediction of Storms (CAPS) of the University of Oklahoma to predict the onset and development of storm scale weather phenomena have proved very useful to forecasters. Verification showed that ARPS provides a high degree of predictability for heavy rainfall over the Korean peninsula even is the observations network is not so dense as to describe small scale systems. An expert system called Typhoon Analysis and Prediction System (TAPS) was developed in 1999. It has been found to be very user-friendly and is a valuable aid to KMA forecasters.

In **Thailand,** a supercomputer, IBM RS/6000 SP, with peak performance of 7 GFLOPS is being installed and will be completed and in operation be 2000. Installed also in 1999 and is now operation are the Automatic Broadcasting System for Aviation and Shipping.

In the **U. S.A.**, the National Weather Service is nearing completion of its modernization plan that focuses on three of high-tech systems: the Next-Generation Weather Radar (NEXRAD), the Automated Surface Observing System (ASOS) and the Advanced Weather Interactive Processing System (AWIPS). Images from polar orbiting satellite became available on a trial basis in June 1999 to supplement the hourly imagery provided by GMS-5, which is the primary tool for the meteorological watch for Micronesia maintained by WFO Guam. The NASA-sponsored Tropical Rainfall Measurement Mission Satellite is operational and is providing imagery from its active microwave sensor. New communication lines were activated between Hawaii and Guam in December 1998. These included:

- T-1 (256 Kb) line from the Satellite Broadcast Network ground station in Hawaii for receipt of AWIPS data
- Wide Area Network (128 Kb) line to connect Guam's AWIPS with AWIPS at other locations within the U.S.

- Switched 56 Kb line to back up the AWIPS WAN and SBN
- Pacific Region WAN (192 Kb) line to obtain computer model data, Internet access and electronic mail

On 25 January 1999, ground breaking occurred for the new building to house the WFO Guam operations and the NWS Sub-regional Maintenance Depot. The new building is designed to survive typhoon-force winds and earthquakes, is environmentally sensitive and energy efficient. The expected completion date for the new facility is 27 January 2000. In recognition of the timely and accurate watches and warning issued for Super Typhoon Paka that struck the island of Guam on 16 December 1997, WFO Guam received two prestigious awards: the U.S. Department of Commerce Bronze Medal Award for Outstanding Public Service and the National Weather Association's Larry R. Johnson Special Award.

In **Viet Nam**, two new digital meteorological radars were installed in1998. The WAFS system at the National Center for Hydrometeorological Forecasting in Hanoi was fully installed in the latter part of January 1998. Three upper air radiosonde stations were upgraded from DiGiCORA-OMEGA RS80-15F to DiGiCORA-GTS RS80-15G in January 1998. Upgraded also was the HMS telecommunication system. A VSAT Communication system was established between the National Center for Hydro-Meteorological Forecasts (NCHMF) to regional centers within Viet Nam in 1999.

APPENDIX IV

PROPOSALS FOR THE UPGRADING OF THE TYPHOON COMMITTEE OPERATIONAL MANUAL METEOROLOGICAL COMPONENT (2000 EDITION)

Name of the Member **Democratic People's Republic of Korea**

Item	Method	Type of output
Name of the the method	**Barotropic model**	every 6 hours up to 48 hours
Description of the method	Basic equations : Non-divergent barotropic vorticity equation Domain: 90□E – 180 □E, 10□N – 65 □N Grid distance: 1□x 1□ Initial data: 500hPa grid point data from Northern Hemisphere objective analysis, 3-D multi- variance optimum interpolation is used. Frequency of forecast: twice a day (0, 12 UTC)	
Name of the the method	**East Asian area numerical weather forecast model**	every 6 hours up to 60 hours
Description of the method	Governing equations : Primitive equations Space discretization; Variable resolution, Arakawa C grid Time integration; Semi-Lagrange scheme Horizontal resolution; center area (homogeneous resolution); □x=□y= 50km Surroundings; x, y increas by 10% grids in center are 50 ×50 total grids 100 ×100 Vertical layer: 18 layers, □ coordinates 60□(latitude – longitude) Grid distance: regular grid size : 0.6□, the smallest grid size : 0.3□ Physics: □ large scale condensation, □ Kuo-type cumulus parameterization □ boundary layer parameterization by K model □ forecasting ground surface temperature from radiation process □ fourth order diffusion Frequency of forecast: four times a day (0, 12 UTC)	

Name of the Member **Republic of Korea**

Item	Method	Type of output
Name of the the method	**Korea Typhoon Model (KTM)**	every 6 hours up to 60 hours
Description of the method	Governing equations : Primitive equations Vertical resolution: 8 vertical□ levels with 50hPa at top Domain: 5400 × 5400 km area with a center set at median of expected typhoon track Transform grid distance: 50 km Lateral boundary: Prediction by GDAPS at T-6h initial Frequency of forecast: twice a day *(See Appendix 3-D 1.)*	
Name of the the method	**Geophysical Fluid Dynamic in Korea (GFDK) typhoon model**	every 6 hours up to 60 hours
Description of the method	Governing equations : Primitive equations Vertical resolution: 18 vertical□ levels Grid distance and Time step: (Multiple nested movable mesh) 1 deg. and 120 sec for Mesh 1 1/3 deg. and 40 sec for Mesh 2 1/6 deg. and 20 sec for Mesh 3 Lateral boundary: Prediction by GDAPS at T-6h initial Frequency of forecast: twice a day *(See Appendix 3-D 1.)*	
Name of the the method	**Barotropic Adaptive Typhoon System (BATS)**	every 6 hours up to 70 hours
Description of the method	Governing equations : Shallow water equations Domain: 60□ ×60□(latitude – longitude) Grid distance: regular grid size : 0.6□, the smallest grid size : 0.3□ Lateral boundary: Prediction by GDAPS at T-6h initial Frequency of forecast: four times a day *(See Appendix 3-D 2.)*	

Name of the Member **Viet Nam**

Item	Method	Type of output
Name of the the method	**Barotropic Model**	12h, 24h, 36h and 48h forecast tropical storm position
Description of the method	Governing equations : Equations of absolute vorticity conservation using solenoidal hypothesis. Domain: Area of 53 ×53 grid points from 72□E to 180□E. and from 20□S to 44□N with spatial increment of 2□ ×2□. Lateral boundary conditions: Northern and Southern boundaries are considered as rigid walls, but at the Eastern – Western boundaries there are eyelie conditions. Integration step: 900 seconds. Initial conditions: stream function field was calculated from the observed wind data objectively analyzed from wind sounding at upper-air stations network, using methods of successive correction. Frequency of forecast: one time a day when consisting of typhoons over the East Sea	

Name of the Member **Republic of Korea**

Item	Method	Type of output
Name of the the method	**Global Data Assimilation Prediction System (GDAPS)**	every 6 hours up to 60 hours
Description of the method	Governing equations : Primitive equation Vertical resolution: 21 level hybrid coordinate Horizontal representation: Spectral, with triangular truncation at wave number 106 Grid distance: 160 Gaussian latitudes and 320 longitudes Initial field: Global objective analysis Frequency of forecast: twice a day *(See Appendix 3-D 3.)*	
Name of the the method	**MM5/KMA**	every 6 hours up to 48 hours
Description of the method	A MM5/KMA, adapted from MM5, has been operated from 1999 for meso-scale forecasts. And also MM5/KMA produces its own typhoon track forecasts. - Frequency of Forecast : 2 times a day *(See Appendix 3-D 4.)*	

Name of the Member **USA**

Item	Method	Type of output
Name of the method	**Extrapolation method (XTRP)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Forecast speed and direction are computed by taking the difference between the current and 12-hour old positions of the tropical cyclone. - Frequency of Forecast : 4 times a day	
Name of the the method	**Climatology method (CLIM)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Employ time and location windows relative to the current position of the tropical cyclone to determine which historical storm will be used to compute the forecast. - The historical database is from 1945-1981 for the Northwest Pacific, and from 1900 to 1990 for the rest of JTWC's AOR. - Objective intensity forecasts are available from these databases. - Scatter diagrams of expected tropical cyclone motion at bifurcation points are also available from these databases. - Frequency of Forecast : 4 times a day	

Name of the Member **USA**

Item	Method	Type of output
Name of the method	**Analog method**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	A revised Typhoon Analog 1993 (TYAN93) picks the top matches with the basin Climatology of historical tropical cyclone best tracks. - Matches are based upon the differences between the direction and speed of the superimposed historical best track positions and the past direction and speed of the cyclone. - Forecast direction and speed are calculated from the 12-hour old position to the current position and the 24-hr old position to the current position. - Separate comparisons are made for climatology cyclone tracks classified as "straight," "recurver" and "other". There is also a "total" group, that includes the top matches without regard to classification of tracks. - The space window is +/- 35 days from the current position. - The space window is +/- 2.5 degrees latitude and +/- 5 degrees longitude from the current position. - Frequency of Forecast : 4 times a day	
Name of the the method	**Climatology and Persistence method (CLIPER or CLIP)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	A statistical regression technique based on climatology, current position, and 12-hour and 24-hour past movement. - Is the baseline against which forecast skill is measured. - Uses third-order regression equations, and is based on the work of Xu and Neumann (1985). - Frequency of Forecast : 4 times a day	

Name of the Member **USA**

Item	Method	Type of output
Name of the method	**Colorado State University model (CSUM)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	A statistical-dynamical technique based on the work of Matsumoto (1984). - Predictor parameters include the current and 24-hr old position of the storm, heights from the current and 24-hr old NOGAP 500-hPa analyses, and heights from the 24-hr and 48-hr NOGAPS 500-hPa prognoses. - Height values from 200-hPa fields are substituted for storms that have an intensity exceeding 90 kt and are located north of the subtropical ridge. - Three distinct sets of regression eqations are used depending on whether the storm's direction of motion falls into "below", "on", or "above" the subtropical ridge categories. - Frequency of forecast: 4 times a day	
Name of the the method	**JTWC92 or JT92**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	A statistical-dynamical model for the North West Pacific Ocean which uses the deep-layer mean height field derived from the NOGAPS forecast fields. - Deep-layer mean height fields are spectrally truncated to wave numbers 0 through 18 prior to use in JTWC92. - Separate forecasts are made for each position. - The 00Z and 12Z tropical forecasts are based upon the previous 12-hour old synoptic time NOGAPS forecasts. - The 06Z and 18Z tropical forecasts are based on the previous 00Z and 12Z NOGAPS forecasts, respectively. - Frequency of forecast: 4 times a day	

Name of the Member **USA**

Item	Method	Type of output
Name of the method	**NOGAPS Vortex Tracking Routine (NGPS/X)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Tropical cyclone vorticies are tracked in NOGAPS by converting the 1000-hPa u and v wind component fields into isogons. - The intersection og isogons are either the center of a cyclonic or anticyclonic circulation, or a col. - The tracking program starts at the last known location of the cyclone – a warning position. Based on this position and the last known speed and direction of movement, the program hunts for the next cyclonic center representing the tropical cyclone. - Frequency of forecast: 2 times a day	
Name of the the method	**Geophysical Fluid Dynamics Model – NAVY (GFDN/X)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	This model is an adaptation of the Geophysical Fluid Dynamics Model used by the National Center for Environmental Prediction (NCEP). - This model uses a triple-nested movable mesh with 18 sigma levels. - The outer mesh domain covers a 75 degrees x 75 degrees area with a horizontal resolution of 1 degree and is fixed for the duration of the model ru. - The 10 degrees x 10 degrees middle and a 5 degrees x 5 degrees inner (resolution 1/6 degrees) nested meshes move with thr cyclone. - Based on global analysis and an initialization message, the TC is removed from the global analysis, and replaced by a synthetic vortex which has an asymmetric (beta-advection) component added. - The model outputs TC track forecasts and maximum isotach swaths indicating the location of maximum winds in relation to the TC track. - Frequency of forecast: 2 times a day	

Item	Method	Type of output
Name of the method	**FNMOC Beta and Advection Model (FBAM)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	This model is an adaptation of the Beta and Advection model used by the National Center for Environmental Prediction (NCEP). - The forecast motion results from a calculation of environmental steering and an empirical correction for the observed vector difference between that steering and the 12-hour old storm motion. - The steering is computed from the NOGAPS Deep Layer Mean (DLM) wind Fields which are a weited average of the wind fields computed for the 1000-hPa to 100-hPa levels. - The difference between past storm motion and the DLM steering is treated as if the storm were a Rossby wave an "effective radius" propagating in response to the horizontal graient of the coriolis parameter, beta. - The forecast blends in a persistence bias for the first 12 hours. - Frequency of forecast: 4 times a day	
Name of the the method	**Medium Beta and Advection Model (MBAM)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Similar to FBAM, but the steering is computed from the NOGAPS wind fields which are a weighted average of the wind fields computed for the 850-hPa to 500-hPa levels. - Frequency of forecast: 4 times a day	
Name of the the method	**Shallow Beta and Advection Model (SBAM)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Similar to FBAM, but the steering is computed from the NOGAPS wind fields which are a weighted average of the wind fields computed for the 850-hPa to 700-hPa levels. Frequency of forecast: 4 times a day	

Name of the Member **USA**

Item	Method	Type of output
Name of the method	**Half Persistence and Climatology (HPAC)**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	Forecast positions generated by equally weighting the forecasts given by XTRP and CLIM. - Frequency of forecast: 4 times a day	
Name of the the method	**Dynamic Average**	12-, 24-, 36-, 48-, and 72-hr forecast positions
Description of the method	A simple average of all dynamic forecast aids: NOGAPS (NGPS), Bracknell (EGRR), JMA Typhoon Model (JTYM), JT92, FBAM, and CSUM. - Frequency of forecast: 4 times a day	

NAMES FOR TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC OCEAN AND SOUTH CHINA SEA

(Effective 01 January 2000)

The list in Table 1-A.1 contains the names prepared by the Typhoon Committee for identifying tropical cyclones with TS intensity or higher in the responsible area of the RSMC Tokyo-Typhoon Center (0 - 60N, 100E - 180E). The first name to be used in a year will be the one immediately following the last name used in the previous year. Subsequent name will be assigned in succession according to the list of names in Table 1-A.1. However, if a tropical cyclone acquires special notoriety because of strength, death tolls, damages or other special reasons, its name may be withdrawn at the request of any Member. The Typhoon Committee will decide if the name is to be withdrawn and provide a replacement for that name.

Table 1-A.1 Names for tropical cyclones

Column 1	Column 2	Column 3	Column 4	Column 5
Damrey	Kong-rey	Nakri	Krovanh	Sarika
Longwang	Yutu	Fengshen	Dujuan	Haima
Kirogi	Toraji	Kalmaegi	Maemi	Meari
Kai-tak	Man-yi	Fung-wong	Choi-wan	Ma-on
Tembin	Usagi	Kammuri	Koppu	Tokage
Bolaven	Pabuk	Phanfone	Ketsana	Nock-ten
Chanchu	Wutip	Vongfong	Parma	Muifa
Jelawat	Sepat	Rusa	Melor	Merbok
Ewiniar	Fitow	Sinlaku	Nepartak	Nanmadol
Bilis	Danas	Hagupit	Lupit	Talas
Kaemi	Nari	Changmi	Sudal	Noru
Prapiroon	Vipa	Megkhla	Nida	Kularb
Maria	Francisco	Higos	Omais	Roke
Saomai	Lekima	Bavi	Conson	Sonca
Bopha	Krosa	Maysak	Chanthu	Nesat
Wukong	Haiyan	Haishen	Dianmu	Haitang
Sonamu	Podul	Pongsona	Mindulle	Nalgae
Shanshan	Lingling	Yanyan	Tingting	Banyan
Yagi	Kajiki	Kujira	Kompasu	Washi
Xangsane	Faxai	Chan-hom	Namtheun	Matsa
Bebinca	Vamei	Linfa	Malou	Sanvu
Rumbia	Tapah	Nangka	Meranti	Mawar
Soulik	Mitag	Soudelor	Rananim	Guchol
Cimaron	Hagibis	Imbudo	Malakas	Talim
Chebi	Noguri	Koni	Megi	Nabi
Durian	Ramasoon	Hanuman	Chaba	Khanun
Utor	Chataan	Etau	Kodo	Vicente
Trami	Halong	Vamco	Songda	Saola

Notes:

1. Assign names in rotation, starting with (Damrey) for the first tropical cyclone with TS intensity or higher 2000. When the last name in Column 5 (Saola) has been used, the sequence will being again with the first name in Column 1 (Damrey).

2. Names for tropical cyclones reaching storm or hurricane intensity in the National Hurricane Center's area of responsibility or Central Pacific Hurricane Center's will be assigned from the lists published in the National Hurricane Operation Plan.

LIST OF STATIONS
FROM WHICH ENHANCED SURFACE OBSERVATIONS ARE AVAILABLE

The following stations will make hourly surface observations when they are within 300 km of the centre of a tropical cyclone of TS intensity or higher:

Cambodia

China

(54):	632,	753,	776,	836,	843,	857,	863,	938,	945	
(58):	040,	150,	238,	251,	265,	345,	362,	445,	457,	472,
	477,	556,	569,	646,	653,	659,	666,	754,	834,	847,
	911,	921,	927,	944						
(59):	636,	117,	134,	278,	287,	293,	316,	431,	456,	483,
	501,	632,	644,	658,	663,	673,	758,	838,	845,	855,
	948,	981								

Democratic People's Republic of Korea

(47):	003,	005,	008,	014,	016,	020,	022,	025,	028,	031,
	035,	037,	039,	041,	046,	050,	052,	055,	058,	060,
	061,	065,	067,	068,	069					

Hong Kong, China

(45):	004

Japan

(47):	401,	407,	409,	412,	417,	418,	420,	421,	423,	426,
	430,	570,	575,	582,	584,	585,	588,	590,	595,	598,
	600,	602,	604,	605,	607,	610,	615,	616,	618,	624,
	626,	629,	632,	636,	638,	648,	651,	655,	658,	662,
	663,	670,	672,	675,	678,	740,	741,	748,	747,	750,
	755,	759,	761,	762,	765,	768,	770,	772,	777,	778,
	780,	800,	807,	813,	815,	817,	819,	827,	830,	837,
	842,	843,	887,	891,	893,	895,	898,	898,	908,	912,
	913,	927,	936,	945,	971,	991				

Lao People's Democratic Republic

Macau

(45):	011

Malaysia

(48):	601,	615,	620,	647,	657,	665		
(96):	413,	421,	441,	449,	465,	471,	481,	491

Philippines

(69):	132,	133,	135,	222,	223,	232,	233,	324,	325,	328,
	329,	330,	333,	336,	425,	427,	428,	429,	430,	431,
	432,	434,	435,	437,	440,	444,	446,	447,	526,	531,
	538,	538,	543,	546,	548,	550,	555,	558,	618,	630,
	637,	642,	644,	646,	648,	653,	741,	746,	747,	748,
	751,	752,	753,	755,	836,	851				

Republic of Korea

(47):	090,	095,	100,	101,	105,	108,	112,	114,	115,	119,
	129,	130,	131,	133,	136,	138,	140,	143,	146,	152,
	155,	156,	159,	162,	165,	168,	170,	184,	185,	188,
	192									

Thailand

(48):	300,	303,	327,	328,	331,	353,	354,	356,	375,	378,
	379,	381,	400,	407,	431,	432,	456,	462,	465,	477,
	480,	500,	517,	532,	551,	565,	567,	568,	569,	583

USA

(91):	203,	212,	258,	317,	324,	334,	339,	348,	353,	356,
	366,	367,	369,	371,	376,	378,	408,	413,	425,	434,

Viet Nam

(48):	820,	826,	839,	845,	848,	855,	870,	877,	900,	914,
	917,	918,	920							

Note: Name, latitude, longitude and elevation of these stations are included in Weather Reporting, Volume A - Observing Stations (WMO Publication No.9).

LIST OF STATIONS
FROM WHICH ENHANCED UPPER-AIR OBSERVATIONS ARE AVAILABLE

The following stations will make six-hourly upper-air observations when they are within 300 km of the centre of a tropical cyclone of TS intensity or higher:

Cambodia

China

(54): 857
(57): 083, 494, 972
(58): 150, 457, 847
(59): 316, 758, 981

Democratic People's Republic of Korea

(47): 041, 058

Hong Kong, China

(45): 004

Japan

(47): 401, 412, 420, 582, 590, 600, 646, 678, 744, 778, 807, 827, 909, 918, 936, 945, 971* 991*
*: 06 UTC only

Lao People's Democratic Republic

Macau

Malaysia

(48): 601, 615, 647, 657
(96): 413, 441, 471, 481

Philippines

(98): 223, 444, 618, 646, 753

Republic of Korea

(47): 122, 138, 158, 185

Thailand

(48): 327, 407, 455, 480, 500, 551, 568

USA

(91): 212, 334, 348, 366, 376, 408, 413

Viet Nam

(48): 820, 855, 900

INFORMATION ON TRANSMISSION
OF THE STRETCHED VISSR DATA OF THE GMS

1. General

The Stretched VISSR (hereinafter, S.VISSR) data of the GMS is the digital image data originated by VISSR (Visible and Infrared Spin Scan Radiometer) on board GMS.

It is stretched on time bases, so that its data transmission rate is reduced at the ground station, and is retransmitted to Medium Scale Data Utilization Stations (hereinafter, MDUSs) through the GMS during the VISSR observation being made.

The concept of the S.VISSR transmission is shown in the attachment.

(1) VISSR image data in S.VISSR data format are assigned to three (3) sectors for three Infrared sensor's data and four (4) sectors for visible sensor's data.

(2) The data transmission rate is fixed regardless of the spin rate variation of the satellite.

(3) Gridding data which indicates information on longitude, latitude and coastline are not contained in image data words, however necessary parameters for mapping by users are inserted into the documentation words.

2. Link Characteristics

(1)	Transmitting frequency	1687.1 MHz
(2)	EIRP (Note 1)	54.5 dBm at a station having 20 degrees of elevation angle.
antenna		
(3)	Polarization	Linear
(4)	Type of modulation	2M-DPSK (NRZ-M) (Note 2)
(5)	Bit rate	660 Kbps
(6)	Necessary G/T at MDUS (Note 3)	Greater than 10.4 dB/EK (Antenna of 4m in
diameter		is recommended)
(7)	Required C/No (Note 4)	Less than 71.6 dB/Hz is expected

Note 1 Effective Isotropically Radiated power which is the power supplied to the antenna multiplied by the absolute gain of the antenna in a given direction.
Note 2 Bi-phase Differentially encoded Phase Shift Keying modulated by the bit stream of the form of Non Return Zero, Mark.
Note 3 The ratio of the absolute Gain of the antenna to System Noise Temperature of the receiver.
Note 4 The ratio of Carrier to Noise power in unit bandwidth for the required ratio of output signal to noise.

3. Data format

Format of the S.VISSR data is shown in Fig.2-F.4.

Transmission of the S.VISSR data is started when the satellite is set into the mode of the VISSR and Repeater simultaneous operation, and the VISSR demodulator and processor complete

PRESENT SCHEDULE OF GMS VISSR OBSERVATION AND WEFAX/DATA DISSEMINATION

The current schedule of VISSR observation and WEFAX dissemination is as follows:

(a) the full disk data are obtained hourly,

(b) cloud motion wind observation is performed four times a day for both hemispheres,

(c) the stretched VISSR digital data for all observations are disseminated in real time.

The detailed time schedule is shown in Fig. 2-F.1.

1 VISSR observation

The VISSR observation time is as follows:

(1) Regular observation
- Full disk image
  hourly basis
  and for wind derivation : 0530, 1130, 1730 and 2330 UTC

*(The observation starts at about 30 minutes before the respective observation time.)

(2) Additional observation for Typhoon wind derivation (WT)
- Half disk image covering the Northern Hemisphere
  15 minutes interval between 0330 and 0415 UTC

2 FAX dissemination via GMS

WEFAX
- 4-sectorized full disk
  Images A, B, C and D (IR1) : 00, 03, ... and 21 UTC
  Images K, L, M and N (IR3) : 00 and 12 UTC
  (Fig. 2-F.2)
- Polar stereographic projection
  Image H (IR1) : hourly
  Image I (VIS)
  or J (enhanced IR1) : hourly except for 05, 11, 17 and 23 UTC
  (Fig. 2-F.3)

the raw VISSR data signal acquisition. It is maintained as long as the satellite is in this mode. However the processor of MDUS should be able to recognize the effective scan lines to be acquired and processed by means of referring to the contents of the documentation words.

4. Contents of documentation information

The documentation data words consists of four blocks of information necessary for processing the image data at MDUS as follows.

4.1 Orbit and attitude block

This block contains the information about the orbit and attitude parameters of the satellite. These data may be used for mapping on the received image data. That is;

a. Epoch time
b. Orbital elements: semimajor axis, eccentricity, inclination, ascending node, argument of perigee and mean anomaly
c. Spin axis direction: right ascension and declination
d. Attitude state parameters: X, Y direction cosine, torque, VISSR, X, Y misalignment, beta-angle bias and spin rate.

4.2 Simplified mapping block

This block contains the information about the simplified mapping equation. These parameters may be used for mapping by relatively small scale computers (See Attachment for the detail).

a. Grid values : number of line and pixel at 5□ longitude and latitude interval in 60□N to 60□S and 80□E to 160□W.
b: Calculation constants : radius and the ratio of the circumference to the diameter of the Earth, satellite latitude, stepping and sampling angle, longitude/latitude and line/pixel number of the sub satellite point.

4.3 Observation information block

This block contains the necessary information about the operational status of the satellite and the ground facilities.

a. Date and time of observation of each line
b. Spacecraft name
c. Scanning status of VISSR
d. Quality data for data transmission and processing in the ground facilities
e. Transmission schedule and MANAM

4.4 Calibration information block

This block consists of calibration tables for VIS, IR1, IR2 and IR3, and calibration coefficients for IR1, IR2 and IR3. These tables and coefficients are used to extract brightness temperature and radiance from S.VISSR data.

CONCEPT OF THE STRETCHED VISSR DATA TRANSMISSION
(See, Fig.2-F.5)

When the satellite is set in the mode of the VISSR and the Repeater simultaneous operation, the on-board S-band transmitter is operated using time sharing method with the spin synchronous switch (K). The input of the transmitter will be the VISSR instrument RF output (A) during the scanning of the Earth, and the receiver RF output (D) during the rest of the spin (back-spin).

The VISSR Demodulator Processor (VDP) receives the raw VISSR data signal (B) and puts the processed data signal to the DPC and to the transmitter at the CDAS (C) so as to be relayed by the GMS. The VDP is designed to synchronize the satellite spin period and to give blank portions to the output data stream (Stretched VISSR data) as well as adjusting the value of time delay (approx. 0.3 seconds) caused by radio wave propagation on the two paths, so that the Stretched VISSR data signal can be relayed while the satellite is in the repeater period.

User's station (MDUS) could receive the GMS-relayed Stretched VISSR data signal (E) on almost real time basis with the VISSR observation.

SATELLITE IMAGERY RECEIVING FACILITIES OF TYPHOON COMMITTEE MEMBERS

Member	Station			GMS 1. M-DUS 2. S-DUS 3. Movie	NOAA 1. HRPT 2. APT
Cambodia					
China	Beijing	(39.9□N,	116.4□E)	1, 2	1, 2
	Shanghai	(31.1□N,	121.4□E)	1	2
	Shenyan	(41.8□N,	123.6□E)	1	
	Guangzhou	(23.1□N,	113.3□E)	1	
Democratic People's Republic of Korea					
Hong Kong, China	Kowloon	(22.3□N,	114.2□E)	1, 2, 3	
Japan	Sapporo	(43.1□N,	141.3□E)	2, 3	
	Hakodate	(41.8□N,	140.8□E)	2, 3	
	Sendai	(38.3□N,	140.9□E)	2, 3	
	Tokyo	(34.7□N,	139.5□E)	1, 2, 3	1
	Kobe	(34.7□N,	135.2□E)	2, 3	
	Narita	(35.8□N,	140.4□E)	2, 3	
	Haneda	(35.6□N,	139.8□E)	2, 3	
	Osaka	(34.7□N,	135.5□E)	2, 3	
	Niigata	(37.9□N,	138.1□E)	2, 3	
	Nagoya	(35.2□N,	137.0□E)	2, 3	
	Maizuru	(35.5□N,	135.3□E)	2, 3	
	Hiroshima	(34.4□N,	132.5□E)	2, 3	
	Takamatsu	(34.3□N,	134.1□E)	2, 3	
	Fukuoka	(33.6□N,	130.6□E)	2, 3	
	Nagasaki	(32.7□N,	129.8□E)	2, 3	
	Kagoshima	(31.6□N,	130.6□E)	2, 3	
	Naha	(26.2□N,	127.7□E)	2, 3	
Lao People's Democratic Republic					
Macau	Macau	(22.2□N,	113.6□E)	2, 3	2
Malaysia	Petaling Jaya	(3.1□N,	101.7□E)	1	1
	Kuching	(1.5□N,	110.3□E)	2	
	Kota Kinabalu	(5.9□N,	116.0□E)	2	
Philippines	Quezon City	(14.7□N,	121.0□E)	1, 3	1
Republic of Korea	Seoul	(37.5□N,	127.0□E)	1, 2, 3	1
	Pusan	(35.1□N,	129.0□E)	2	
	Kwangju	(35.2□N,	126.8□E)	2	
	Kangnung	(37.8□N,	128.8□E)	2	
Thailand	Bangkok	(13.7□N,	100.6□E)	1, 2	1, 2
Viet Nam	Hanoi	(21.0□N,	105.5□E)	2, 3	2
	Ho Chi Minh City	(10.5□N,	106.4□E)	2, 3	2
	Da Nang	(16.0□N	108.2□E)	2, 3	

SATELLITE IMAGERY RECEIVING FACILITIES AT TYPHOON COMMITTEE MEMBERS

Member	Station	GMS 1. M-DUS 2. S-DUS 3. Movie	NOAA 1. HRPT 2. APT
Cambodia			
China	Beijing (39.9□N,116.4□E)	1,2	1,2
	Shanghai (31.1□N,121.4□E)	1	2
	Shenyan (41.8□N,123.6□E)	1	
	Guangzhou (23.1□N,113.3□E)	1	
Democratic People's Republic of Korea		1,2,3	
Hong Kong, China		2,3	
Japan		2,3	
	Kowloon (22.3□N,114.2□E)	2,3	
		1,2,3	1
	Sapporo (43.1□N,141.3□E)	2,3	
	Hakodate (41.8□N,140.8□E)	2,3	
	Sendai (38.3□N,140.9□E)	2,3	
	Tokyo (34.7□N,139.5□E)	2,3	
	Kobe (34.7□N,135.2□E)	2,3	
	Narita (35.8□N,140.4□E)	2,3	
	Haneda (35.6□N,139.8□E)	2,3	
	Osaka (34.7□N,135.5□E)	2,3	
	Niigata (37.9□N,139.1□E)	2,3	
	Nagoya (35.2□N,137.0□E)	2,3	
	Maizuru (35.5□N,135.3□E)	2,3	
	Hiroshima (34.4□N,132.5□E)	2,3	
	Takamatsu (34.3□N,134.1□E)	2,3	
	Fukuoka (33.6□N,130.6□E)	2,3	
	Nagasaki (32.7□N,129.9□E)	2,3	
	Kagoshima (31.6□N,130.6□E)	2,3	
	Naha (26.2□N,127.7□E)	2,3	
Lao People's Democratic Republic			
Macau	Macau (22.2□N,113.5□E)		

Member	Station	GMS 1. M-DUS 2. S-DUS 3. Movie	NOAA 1. HRPT 2. APT
Malaysia	Petaling Jaya (3.1□N,101.7□E)	1	1
		2	
	Kuching (1.5□N,110.3□E)	2	
Philippines	Kota Kinabalu (5.9□N,116.0□E)	1,3	1
Republic of Korea		1,2,3	1
	Quezon City (14.7□N,121.0□E)	2,3	
		2,3	
	Seoul (37.6□N,127.0□E)	2,3	
	Seoul/METRI (37.6□N,127.0□E)	2,3	
	Seoul/Kimpo Intl.Airport (37.6□N,126.8□E)	2,3	
	Pusan (35.1□N,129.0□E)	2,3	
	Kwangju (35.2□N,126.9□E)	2,3	
	Taejon (36.4□N,127.4□E)	2,3	
	Kangnung (37.5□N,130.9□E)	2,3	
	Cheju (33.5□N,126.5□E)	2,3	
	Taegu (35.9□N,128.6□E)	2,3	
	Taegu/Air Traffic (35.9□N,128.7□E)	2,3	
Thailand	Chonju (35.8□N,127.2□E)	1,2	1,2
USA	Chongju (36.6□N,127.4□E)	1,2	1
Viet Nam	Ullung-Do (37.5□N,130.9□E)	2,3	2
	Mokpo (34.8□N,126.4□E)	2,3	2

	Chunchon (37.9□N,127.7□E) Masan (35.2□N,128.6□E) Tongyong (34.9□N,128.4□E) Inchon (37.5□N,126.6□E) Huksando (34.7□N,125.5□E) Suwon (37.3□N,127.0□E) Sokcho (38.3□N,128.6□E) Pohang (36.0□N,129.4□E) Kunsan (36.0□N,126.7□E) Bangkok (13.7□N,100.6□E) Guam (13.4□N,144.6□E) Hanoi (21.0□N,105.5□E) Ho Chi Minh City (10.5□N,106.4□E) Da Nang (16.0□N,108.2□E)		

OUTLINE OF KMA - Typhoon Dynamic MODELS

(1) □ Geophysical Fluid Dynamic in Korea (GFDK) Typhoon Model □

Initial field :

environmental fields from a GDAPS global analysis (Gaussian grid = 1°)
generation of a typhoon vortex by controlled spinup
replacement of a GDAPS analyzed vortex by the generated vortex

Operation :

(schedule)

twice (0600UTC, 1800UTC) daily

(integration time)

60 hr from 0000UTC, 1200UTC

Prediction model :

(dynamics)

primitive equations
18 vertical □ levels
multiple nested movable mesh :

Mesh	Grid resolution (deg.)	Longitude (deg.) (points)	Latitude (deg.) (points)	Time step (sec)
1	1	75 (75)	75 (75)	120
2	1/3	11 (33)	11 (33)	40
3	1/6	5 (30)	5 (30)	20

(physics)

horizontal diffusion : Samagoriky nonlinear viscosity
vertical diffusion : Mellor – Yamada turbulence closure scheme level 2
background mixing added
surface flux : Monin-Obukhov framework, interficial layer included
Ocean : SST (unchanged from the initial field)
Land : Land surface temperature prediction
Vegitation type-dependent roughness and wetness
cumulus convection : soft moist-convective adjustment scheme
entrainment effect considered, relation time assumed
infrared radiation : Schwarzkopf-Fels scheme
solar radiation : Lacis-Hansen scheme,
effect of diurnal cycle and cloud variation considered

Boundary conditions :

(lateral)

prediction by GDAPS at T-6h initial

(upper)

□= 0 at the top

Time integration :

two-step iterative integration scheme
wind direction-dependent boundary condition for limited domain
mesh-by-mesh integration using dynamical interface

Products :

location (lat./lon.), central pressure, maximum tangential winds, and precipitation every 6 hours up to 72 hours in advance

(2) □ Barotropic Adaptive Typhoon System (BATS) □

Initial field :

environmental fields from a GDAPS global analysis
specified vortex generated by empirical formulas
height field obtained by solving the balance equation

Operation :

(schedule)

four times (0000UTC, 0600UTC, 120000UTC, 1800UTC) a day

(integration time)

60 hr from 0000UTC, 0600UTC, 120000UTC, 1800UTC

Prediction model :

(dynamics)

- shallow water equations

(horizontal resolution)

- grid system : adaptive grid
- grid interval : the regular size 0.6° and the smallest grid size 0.3° on the continuous dynamic grid adaptation
- number of grid : 101 × 101

(coordinate)

- horizontal coordinate : latitude-longitude
- domain : 60° × 60°

Boundary conditions :

(lateral)

- prediction by GDAPS at T-6h initial

Products :

location (lat./lon.) every 6 hours up to 72 hours in advance

(3) □ Global Data Assimilation Prediction System (GDAPS) □

Initial field :

(analysis)

- global objective analysis (mandatory pressure levels, 1.875° resolution)

(bogusing)

- symmetric vortex generated by empirical formulas
  + asymmetric structure derived from first guess field

(initialization) NNMI

Operation :

(schedule)

twice (0000UTC, 120000UTC) daily

(integration time)

60 hr from 0000UTC, 120000UTC

Prediction model :

(dynamics)

- primitive equation

(vertical resolution)

- 21 level hybrid coordinate

(horizontal representation)

- spectral, with triangular truncation at wave number 106
- grid : 160 Gaussian latitudes and 320 longitudes

Time integration :

- semi-implicit with time filter

Physics :

(diffusion)

- horizontal : K□^{4} (linear)
- vertical : Mellor – Yamada turbulence closure scheme level 2

(surface flux)

- similarity function proposed by Louis

Ocean : SST (unchanged from the initial field)
Land : Soil temperature predicted, Simple Biosphere scheme

(cumulus convection)

- Kuo's scheme, entrainment effect considered

(radiation)

- long-wave cooling and solar heating with effects of diurnal cycle and cloud variation considered

Products :

location (lat./lon.), central pressure, maximum tangential winds, every 6 hours up to 72 hours in advance

(4) □ MM5/KMA □

Data assimilation :

(objective analysis)

- first guess field: GDAPS analysis
- using the mandatory data, non-mandatory level data and asynoptic data for data analysis

(bogusing of tropical cyclones)

- the same GDAPS bogusing method

(analysis nudging for four-dimensional data assimilation)

- upper level : 12-hr interval
- surface : 3-hr interval

Dynamics :
(basic equations)
primitive equations in terrain following coordinate
- horizontal resolution : 30 km on Lambert conformal projection
(domain)
Far-East region (191 x 171 grids)
(vertical levels)
33 levels

Physics :
(fourth order scheme for horizontal diffusion)
non local boundary scheme
(Kain-Frish scheme for cumulus parameterization)
(cloud microphysical parameterization including ice effect)
(radiation scheme for long wave and short wave interactions with explicit cloud and clear-air)
(5-layer soil model)

Boundary conditions :
(six-hourly predictions by GDAPS from initial time at T-00 hr)
(NOAA weekly mean SST)

Frequency of forecast : twice a day (00, 12 UTC)

Products :
location (lat./lon.), central pressure, and maximum tangential winds every 6 hours up to 48 hours in advance

ABBREVIATED HEADINGS FOR THE TROPICAL CYCLONE WARNINGS

Member	Abbreviated WMO Communication Headings
Cambodia	
China	WTPQ20 BABJ
Democratic People's Republic of Korea	
Hong Kong, China	WTPQ20 VHHH, WTSS20 VHHH
Japan	WTPQ20 RJTD, WTPQ21 RJTD, WTPQ22 RJTD, WTPQ23 RJTD, WTPQ24 RJTD, WTPQ25 RJTD
Lao People's Democratic Republic	
Macau	For domestic dissemination only and WTMU40 VMMC
Malaysia	For domestic dissemination only
Philippines	WTPH20 RPMM, WTPH21 RPMM
Republic of Korea	WTKO20 RKSL
Singapore	
Thailand	WTTH20 VTBB
USA	WTPQ31 – 35 PGUM
Viet Nam	WTVS20 VNNN

APPENDIX V

REPORT ON THE ACTIVITIES OF THE RSMC TOKYO TYPHOON CENTER

Table 1 Monthly and annual total numbers of products issued by the RSMC Tokyo - Typhoon Center in 1999 (as of 30 September 1999)

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	32	6	22	27	75	67	-	-	-	229
TCNA21	3	8	0	35	7	26	38	94	78	-	-	-	289
WTPQ20-25	3	9	0	37	7	25	42	103	86	-	-	-	312
WTPQ30-35	1	4	0	18	4	13	18	46	41	-	-	-	145
FXPQ20-25	3	8	0	36	6	26	39	86	80	-	-	-	284
FKPQ30-35	3	0	0	36	6	25	40	95	83	-	-	-	288
AXPQ20	7	0	0	0	0	2	1	0	6	-	-	-	16
AUXT85 AUXT20	62	56	62	60	62	60	62	62	60	-	-	-	546
FUXT852 FUXT854	62	56	62	60	62	60	62	62	60	-	-	-	546
FUXT202 FUXT204	62	56	62	60	62	60	62	62	60	-	-	-	546

Notes:

- via the GTS -

SAREP	TCNA20/21 RJTD
RSMC Tropical Cyclone Advisory	WTPQ20-25 RJTD
RSMC Prognostic Reasoning	WTPQ30-35 RJTD
RSMC Guidance for Forecast	FXPQ20-25 RJTD
Tropical Cyclone Advisory for SIGMET	FKPQ30-35 RJTD
RSMC Tropical Cyclone Best Track	AXPQ20 RJTD

- via the JMH Meteorological Radio Facsimile -

Analysis of 850 and 200 hPa Streamline	AUXT85/AUXT20
Prognosis of 850 hPa Streamline	FUXT852/FUXT854
Prognosis of 200 hPa Streamline	FUXT202/FUXT204

Table 2 Mean position errors of 24-, 48- and 72-hour operational forecasts for each cyclone with TS intensity or higher in 1999 (as of 30 September)

Tropical Cyclone			24-hour Forecast				48-hour Forecast				72-hour Forecast			
			Error Mean (km)	Number S.D. (km)	of Fcst.	EO/EP (%)	Error Mean (km)	Number S.D. (km)	of Fcst.	EO/EP (%)	Error Mean (km)	Number S.D. (km)	of Fcst.	
STS	9901	KATE	158	105	18	61	158	100	12	29	206	74	8	
STS	9902	LEO	146	105	14	57	220	135	8	38	322	139	4	
TY	9903	MAGGIE	190	66	22	85	287	112	14	63	410	61	10	
TS	9904		215	94	5	50	-	-	-	0	-	-	-	
STS	9905	NEIL	207	166	7	32	317	100	2	27	-	-	-	
TS	9906		-	-	-	0	-	-	-	0	-	-	-	
STS	9907	OLGA	142	104	17	51	259	146	11	63	509	164	7	
TS	9908	PAUL	266	120	11	46	420	81	3	47	-	-	-	
TS	9909	RACHEL	194	71	3	25	646	0	1	0	-	-	-	
STS	9910	SAM	174	67	12	87	416	51	7	105	802	124	3	
STS	9911	DORA	115	53	14	77	213	96	10	76	390	157	6	
STS	9912	TANYA	78	39	9	77	-	-	-	0	-	-	-	
STS	9913	VIRGIL	99	29	7	85	199	116	3	146	-	-	-	
TS	9914	WENDY	-	-	-	0	-	-	-	0	-	-	-	
STS	9915	YORK	125	77	15	69	361	92	7	97	822	174	3	
TS	9916	ZIA	-	-	-	0	-	-	-	0	-	-	-	
STS	9917	ANN	185	103	12	94	417	87	7	94	417	54	2	
TY	9918	BART	146	101	25	43	246	153	17	33	420	245	13	
TS	9919	CAM	183	18	4	104	-	-	-	0	-	-	-	
Annual Mean (Total)			160	100	195	61	274	142	101	53	430	224	56	

* All data after WENDY(9914) are preliminary.

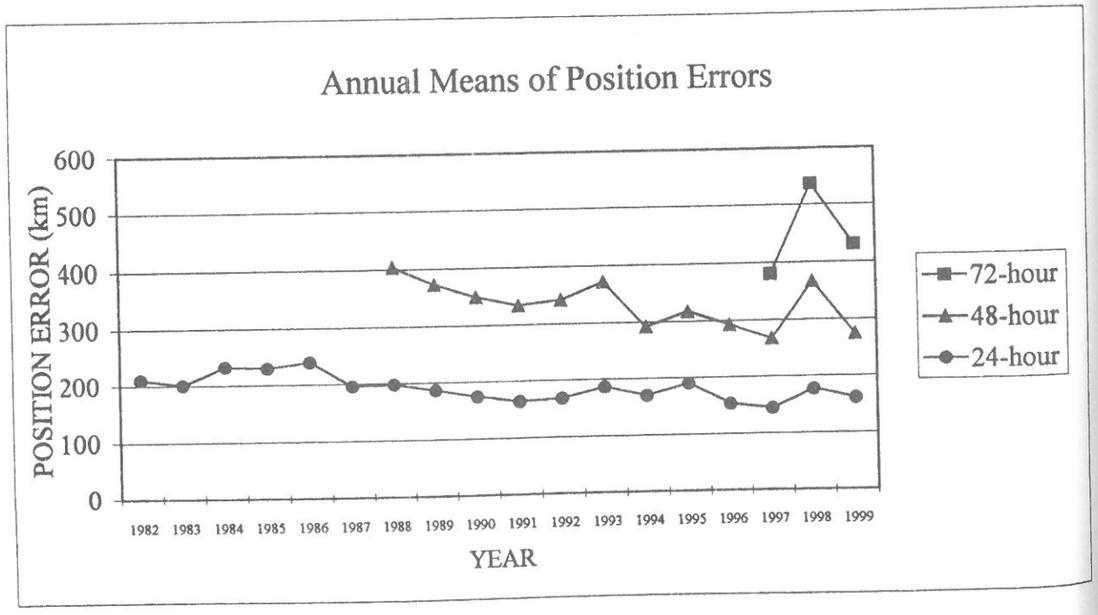


Figure 2 Annual mean position errors of 24-, 48-, 72-hour operational forecasts for tropical cyclones with TS intensity or higher (as of 30 September 1999)

Table 3 List of GPV products and other products and data on the RSMC Data Serving System (as of 30 September 1999)

List of GPV products on the RSMC Data Serving System

Area	20S-60N,80E-160W	20S-60N,60E-160W	global area	
Resolution	2.5×2.5 deg	1.25×1.25 deg	2.5×2.5 deg	
Level & Elements	surface(P,U,V,T,TTd,R) 850hPa(Z,U,V,T,TTd,□) 700hPa(Z,U,V,T,TTd,□) 500hPa(Z,U,V,T,TTd,□) 300hPa(Z,U,V,T) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T)	surface(P,U,V,T,TTd,R) 1000hPa(Z,U,V,T,TTd) 925hPa(Z,U,V,T,TTd,□) 850hPa(Z**,U**,V**,T**,TTd**,□,□,□) 700hPa(Z**,U**,V**,T**,TTd**,□) 500hPa(Z**,U**,V**,T**,TTd**,□) 400hPa(Z,U,V,T,TTd) 300hPa(Z,U,V,T,TTd) 250hPa(Z,U,V,T) 200hPa(Z**,U**,V**,T**,□,□) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T) 70hPa(Z,U,V,T) 50hPa(Z,U,V,T) 30hPa(Z,U,V,T) 20hPa(Z,U,V,T) 10hPa(Z,U,V,T)	surface(P,U,V,T,R) 850hPa(Z,U,V,T,TTd)* 700hPa(Z,U,V,T,TTd)* 500hPa(Z,U,V,T)* 300hPa(Z,U,V,T) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T)* 100hPa(Z,U,V,T)	surface(P,U,V,T,TTd) 1000hPa(Z,U,V,T,TTd) 850hPa(Z,U,V,T,TTd) 700hPa(Z,U,V,T,TTd) 500hPa(Z,U,V,T,TTd) 400hPa(Z,U,V,T,TTd) 300hPa(Z,U,V,T,TTd) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T) 70hPa(Z,U,V,T) 50hPa(Z,U,V,T) 30hPa(Z,U,V,T) 20hPa(Z,U,V,T) 10hPa(Z,U,V,T)
Forecast Hours	00,06,12,18,24,30,36,48,60,72	00,06,12,18,24,30,36,42,48,54,60,66,72 12UTC: Surface(P,U,V,T,TTd,R), from 78 to 192 hours, every 6 hours ** ; 96,120,144,168,192(12UTC only)	00UTC : 24,48,72 12UTC : 00,24,48,72,96,120 * ; 144,168,192(12UTC only)	00UTC : 00
Time/Day	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	

Note: □ : pressure reduced to MSL; □ : geopotential height; □ : relative vorticity
□ : u-component of wind; □ : v-component of wind; □ : stream function
□ : total precipitation; □ : temperature; □ : velocity potential
TTd : dew point depression; □ : vertical velocity

List of Other Products and Data on the RSMC Data Serving System

Products /Data	GMS Data	Typhoon Information	Global Wave Model (GRIB)	Observations Data
Contents	(a) Digital data (GRIB) •Cloud amount •Convective cloud amount •Equivalent blackbody temperature (b) Satellite-derived high density cloud motion vectors (BUFR)	Tropical cyclone related information (BUFR) □Position, etc.	•Wave height •Wave period •Prevailing wave direction Forecast Hours: 00,06,12,18,24,30,36, 42,48,54,60,72□(00&12UTC), 96,120,144,168,192□(12UTC)	(a) Surface data (SYNOP) (b) Upper air data (TEMP, Part A-D) (PILOT, Part A-D)
Frequency (initial time(s))	(a) 4 times (00, 06, 12 and 18UTC) a day (b) Once (04UTC) a day	4 times (00, 06, 12 and 18 UTC) a day	2 times (00 and 12 UTC) a day	(a) Mainly 4 times a day (b) Mainly 2 times a day

Table 3.2.1: Grid point value output products transmitted by RSMC Tokyo - Typhoon Center for regional purposes

Description of products	WMO headings	ii
Sea level pressure	HPDA$_2$ii RJTD	89
Geopotential height	HHDA$_2$ii RJTD	85,70,50,30,25,20,15,10
U-component of wind	HUDA$_2$ii RJTD	98,85,70,50,30,25,20,15,
V-component of wind	HVDA$_2$ii RJTD	98,85,70,50,30,25,20,15,
Temperature	HTDA$_2$ii RJTD	98,85,70,50,30,25,20,15,
Dew-point depression	HRDA$_2$ii RJTD	98,85,70,50
Total precipitation	HEDA$_2$ii RJTD	88
Vertical Velocity	HODA$_2$ii RJTD	85,70
Relative Vorticity	HZDA$_2$ii RJTD	50

A$_2$	Meaning
A	Analysis (Initial time)
B	6 hours forecast
C	12 hours forecast
D	18 hours forecast
E	24 hours forecast
F	30 hours forecast
G	36 hours forecast
I	48 hours forecast
J	60 hours forecast
K	72 hours forecast

ii	Meaning
98	Air properties for the Earth's surface
89	reduced to sea level
88	Ground or water properties for the Earth's surface
85	850 hPa
70	700 hPa
50	500 hPa
30	300 hPa
25	250 hPa
20	200 hPa
15	150 hPa
10	100 hPa

Area and Resolution: 80E - 160W, 20S - 60N, 2.5 x 2.5 deg
Observation time: 00 and 12 UTC
Format or Data: FM92-X Ext.-GRIB

Table 3.2.2: Grid point value output products transmitted by RSMC Tokyo - Typhoon Center for regional purposes

Description of products	WMO headings	ii
Sea level pressure	HPCA$_2$ii RJTD	89
Geopotential height	HHCA$_2$ii RJTD	99,92,85,70,50,40,30,25,20,15,10
U-component of wind	HUCA$_2$ii RJTD	98,99,92,85,70,50,40,30,25,20,15,1
V-component of wind	HVCA$_2$ii RJTD	98,99,92,85,70,50,40,30,25,20,15,1
Temperature	HTCA$_2$ii RJTD	98,99,92,85,70,50,40,30,25,20,15,1
Dew-point depression	HRCA$_2$ii RJTD	98,99,92,85,70,50,40,30
Total precipitation	HECA$_2$ii RJTD	88
Vertical Velocity	HOCA$_2$ii RJTD	92,85,70
Stream function	HXCA$_2$ii RJTD	85,20
Velocity potential	HYCA$_2$ii RJTD	85,20
Relative Vorticity	HZCA$_2$ii RJTD	50

A$_2$	Meaning
A	Analysis (Initial time)
B	6 hours forecast
C	12 hours forecast
D	18 hours forecast
E	24 hours forecast
F	30 hours forecast
G	36 hours forecast
H	42 hours forecast
I	48 hours forecast
Y	54 hours forecast
J	60 hours forecast
Z	66 hours forecast
K	72 hours forecast

ii	Meaning
98	Air properties for the Earth's surface
89	Reduced to sea level
88	Ground or water properties for the Earth's surface
99	1000 hPa
92	925 hPa
85	850 hPa
70	700 hPa
50	500 hPa
40	400 hPa
30	300 hPa
25	250 hPa
20	200 hPa
15	150 hPa
10	100 hPa

Area and Resolution: 60E - 160W, 20S - 60N, 1.25 x 1.25 deg
Observation time: 00 and 12 UTC
Format or Data: FM92-X Ext.-GRIB

Table 3.2.3: Grid point value output products transmitted by RSMC Tokyo - Typhoon Center for regional purposes

Description of products	WMO headings	ii
Sea level pressure	HPXA$_2$ii RJTD	89
Geopotential height	HHXA$_2$ii RJTD	85,70,50,30,25,20,10
U-component of wind	HUXA$_2$ii RJTD	98,85,70,50,30,25,20,10
V-component of wind	HVXA$_2$ii RJTD	98,85,70,50,30,25,20,10
Temperature	HTXA$_2$ii RJTD	98,85,70,50,30,25,20,10
Dew-point depression	HRXA$_2$ii RJTD	85,70
Total precipitation	HEXA$_2$ii RJTD	88

A_2	Meaning
A	Analysis (Initial time)
E	24 hours forecast
I	48 hours forecast
K	72 hours forecast
M	96 hours forecast (only 12 UTC)
O	120 hours forecast (only 12 UTC)

ii	Meaning
98	Air properties for the Earth's surface
89	Reduced to sea level
88	Ground or water properties for the Earth's surface
85	850 hPa
70	700 hPa
50	500 hPa
30	300 hPa
25	250 hPa
20	200 hPa
10	100 hPa

Area and Resolution: Northern hemisphere, 2.5 x 2.5 deg
Observation time: 00 and 12 UTC
Format or Data: FM92-X Ext.-GRIB

Table 3.2.4: Grid point value output products transmitted by RSMC Tokyo - Typhoon Center for regional purposes

Description of products	WMO headings	ii
Sea level pressure	HPYA$_2$ii RJTD	89
Geopotential height	HHYA$_2$ii RJTD	85,70,50,30,25,20,10
U-component of wind	HUYA$_2$ii RJTD	98,85,70,50,30,25,20,10
V-component of wind	HVYA$_2$ii RJTD	98,85,70,50,30,25,20,10
Temperature	HTYA$_2$ii RJTD	98,85,70,50,30,25,20,10
Dew-point depression	HRYA$_2$ii RJTD	85,70
Total precipitation	HEYA$_2$ii RJTD	88

A_2	Meaning
A	Analysis (Initial time)
E	24 hours forecast
I	48 hours forecast
K	72 hours forecast
M	96 hours forecast (only 12 UTC)
O	120 hours forecast (only 12 UTC)

ii	Meaning
98	Air properties for the Earth's surface
89	Reduced to sea level
88	Ground or water properties for the Earth's surface
85	850 hPa
70	700 hPa
50	500 hPa
30	300 hPa
25	250 hPa
20	200 hPa
10	100 hPa

Area and Resolution: Southern hemisphere, 2.5 x 2.5 deg
Observation time: 00 and 12 UTC
Format or Data: FM92-X Ext.-GRIB

Table 4 Implementation Plan of the RSMC Tokyo – Typhoon Center (1999 – 2003)

PRODUCT	###	###	###	###	###	REMARKS
Satellite Observation						
GMS S-VISSR	—	—	- - -	- - -	- - -	24 times/day (full-disk)
GMS/MTSAT WEFAX	—	—	- - -	- - -	- - -	8 times/day (4-sector), 24 times/day (Image H), 20 times/day (Image I or J)
Cloud motion wind	—	—	—	—	—	4 times/day
Analysis						
SAREP (for tropical cyclones)	—	—	—	—	—	4-8 times/day Dvorak intensity (estimation included)
Report of typhoon analysis*	—	—	—	—	—	4 times/day
Sea Surface Temperature	—	—	—	—	—	10-day mean and its anomaly
Objective analysis						
pressure pattern, etc	—	—	—	—	—	FAX
stream lines	—	—	—	—	—	FAX**
Cloud distribution	—	—	—	—	—	GPV**
Long-wave radiation	—	—	—	—	—	GPV**
Forecast						
RSMC Prognostic Reasoning	—	—	—	—	—	2 times/day
RSMC Guidance for Forecast	—	—	—	—	—	4 times/day GSM up to 84 hours TYM up to 78 hours
NWP products						
pressure pattern, etc	—	—	—	—	—	FAX, GPV (GSM)
stream line	—	—	—	—	—	FAX (GSM: 00,24,48 and 72 hrs)
RSMC Tropical Cyclone Advisory*	—	—	—	—	—	4 times/day up to 72 hrs
Others						
RSMC Tropical Cyclone Best Track	—	—	—	—	—	GTS
Annual Report	—	—	—	—	—	
Technical Note	—	—	—	—	—	

SUPPORTING ACTIVITY	###	###	###	###	###	REMARKS
Data archive	—	—	—	—	—	
Monitoring of data exchange	—	—	—	—	—	
Dissemination of products	—	—	—	—	—	RSMC Data Server

* "RSMC Tropical Cyclone Advisory" involves "Report of typhoon analysis"

** Some of these products will be disseminated within the capacity of traffic of the GTS and JMH.

APPENDIX VI

SUMMARY OF THE REPORTS OF THE TYPHOON COMMITTEE MEMBERS ON THEIR ACTIVITIES TO THE HYDROLOGICAL COMPONENT

In **China,** during the 1999 flood season, the Hydrology Bureau of Changjiang Water Resources Commission used two measuring cutters for patrol measuring water level at the Dongting Lake which ensured flow measuring under exceptional flood conditions. A microwave communication project was put into test operation on 12 September 1999 at the Sanjingkou area. During the year, the Water Resources Information Center (WRIC) updated the flood control consulting system, developed a precipitation and weather information system named "Eye 2000", a state flood forecasting system in 7 major basins and a flood information automatic mapping system. After the great flood of 1998, a hydrological forecasting technical training workshop was held by the WRIC at Hohai Unversity, Nanjing, participated by more than 40 trainees. Before the flood period of 1999, flood control maneuver and technical training were held in a number of hydrological departments all over the country.

In **Hong Kong, China,** the Civil Engineering Department's rain-gauge network was upgraded to meet Y2K compliance and expanded to include more than 80 rain-gauges aimed at improving the warning of landslides caused by heavy rain. A comprehensive programme for upgrading the drainage system in the urban areas was undertaken by the Drainage Services Department (DSD) in 1999, the first phase of which is scheduled for completion by 2003. Three of the seven Drainage Master Plan Studies commissioned by the DSD to review the condition and performance of the existing storm water drainage systems was completed during the year. As of 30 September, a total of 11 special announcements on flooding in northern new territories was issued, 8 of which were due to heavy rain associated with tropical cyclones. Following the recommendations of the review done in 1998 to evaluate probable land slip scenarios due to heavy rain, a Probable Maximum Precipitation (PMP) study for Hong Kong was conducted in 1999 and the 1968 PMP estimate was updated.

In **Japan**, as of February 1999, an additional 15 rivers were designated for flood forecasts and warnings making a total of 165. As of October 1999 the status of the observation facilities for rainfall and water level are shown below:

Name of equipment	Number of observation stations(telemeter locations)
Radar rain gauge	26
Rain gauge	2,668 (2,064)
Water gauge	2,092 (1,682)
Sediment disaster	103

information processing unit	

With regard to the improvement of observation facilities, measures are being undertaken against abrupt floods of small and medium rivers through reduction of data renewal interval in the observation of rain gauge from 1 hour to 30 minutes to 10 minutes.

In 1999, the data for the Kanto area, undisclosed in previous FRICS versions are also made available for some rivers, with preparations in progress to provide access to the data for rivers omitted in the current version.

In **Malaysia**, during the current La Niña episode from September 1998 to November 1999, Malaysia experienced prolonged wet spell with a number of significant flood events which includes the following:

- Heavy rain associated with typhoon CHIPS (15-17 November 1998) causing widespread flooding to the northwestern states of Peninsular Malaysia
- Prolonged heavy rain due to the northeast monsoon resulted in moderate floods in the east coast of Peninsular Malaysia from 27 December 1998 to 4 January 1999.
- Typhoon HILDA brought heavy rain to Sabah state causing severe flooding and landslide occurrences leading to 6 deaths.
- Unusually heavy rain occurring on 23-25 October 1999 resulted in severe flooding of the northwestern states of Peninsular Malaysia, evacuation of a total of 15,000 people, 3 deaths and the highest flood levels ever recorded in several main rivers (Krian and Kurau rivers).

During the flood events mentioned above, flood forecasts and warnings were issued by the various Department of Irrigation and Drainage state offices with lead times varying from 6 to 24 hours. Evaluation of the flood forecast accuracy was carried out with a view to improve the model reliability.

To mitigate flood impacts, 16 river basin studies were completed with 8 on-going, and 28 town drainage master plans were prepared. Currently, 14 major structural flood mitigation projects are being implemented. A manual on storm water management is being prepared with a view to control at source the urban runoff quantity and quality. Other flood mitigation strategies included land use planning and control, resettlement of populations in flood prone areas, school education and public awareness programmes such as the "Love our River" campaign.

In the **Philippines**, during the year, PAGASA's Flood Forecasting Branch issued a total of 20 flood bulletins, flood situationers for Metro Manila and dam operation flood bulletin/warning information for two dams. The following are its

activities related to hydro-meteorological and hydrological analyses, investigations and forecasting and prediction methods improvement:

- On-going hydrological researches

  1. Derivation of the generalized probable maximum precipitation for the four major water resources regions of Luzon
  2. Flood forecasting models for gaged catchments

- Issued Intensity-Duration-Frequency (IDF) tables to consultants as primary information for their hydraulic structure design
- Conducted comprehensive hydrological studies in Bakun, Benguet as requested by Luzon Hydro, a private corporation involved in the installation of a mini dam in the said area.
- Conducted post-flood survey and investigation for the August major flood in Agno River Basin.
- Entered into contract with the Corporate Network for Disaster Response (CNDR), an NGO involved in disaster prevention, mitigation and preparedness.

In the **Republic of Korea**, to improve flood warning systems, 15 rainfall rain gauge stations and 8 river stage gauge stations were added for extended measurements of rainfall and water level. In 1999 the Geum River Flood Control completed the flood warning system for the Sapgyo river basin. Also during the year, the Youngsan River Flood Control Center improved the hardware and software of the system and installed the flood warning system for the Mankyung river basin for operation during the rainy season in 2000.

In **Thailand,** six new hydrometeorological stations were established by the Hydrometeorology Division during the year to improve the hydrological data collection for flood forecasting and warning system. The MOFFS Version 2 C was replaced by MOFFS Version 3.

In the **U.S.A.,** locally heavy rainfall on 30 July 1999 over southern Guam resulted in widespread flooding in the village of Merizo. Rainfall estimates from the NEXRAD weather radar on Guam indicated 4 to 6 inches of rain fell in just over an hour from a nearly stationary convective cell. Man-made obstructions in a diversion culvert (being constructed to reduce the impact of flooding in the area) were the primary reason the flood occurred. An overpass designed to allow cars to pass over the culvert became clogged with tons of debris from the Manell River. Runoff from the swollen stream overflowed the culvert, flooded 13 homes with standing water 2 to 4 feet deep and caused property damage amounting at over US$100,000.

In **Viet Nam**, during the period 1 November 1998 to 20 September 1999, 20 automatic water level and rainfall stations were successfully installed and

almost all the 233 hydrological stations across the country were equipped with SSB radios or telephones. With the assistance from international and UN agencies, the government has drawn up a comprehensive program for flood control with a view at reducing damage and human miseries. On-going is development of a software applicable to LAN for hydrological data collection, processing and timely transmission of hydrological information and forecasts to end-users.

APPENDIX VII

REPORT OF THE MEETINGS OF HYDROLOGISTS FROM TYPHOON COMMITTEE MEMBERS

1. Introduction

1.1 The pre-session meeting of hydrologists for the 32nd Session of the Typhoon Committee was held on 22 November 1999 at the International Conference Room, 4th floor of the Korea Meteorological Office (KMA). The meeting was attended by a total of 9 representatives from the following Typhoon Committee members: People's Republic of China; Hong Kong, China; Japan; Malaysia; Republic of Korea; and Thailand. Representatives from the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Typhoon Committee Secretariat (TCS) were also present. One member of the Local Organizing Committee (LOC) participated as observer. A list of participants is given in Annex 1.

1.2 The meeting on 22nd November 1999 elected Mr Chong Sun Fatt, Malaysia as the Chairman and Mr Edwin W L Ginn, Hong Kong, China as the Rapporteur.

1.3 The Government of the Republic of Korea's generous support in the provision of a full time hydrologist at the TCS was gratefully acknowledged by all present at the pre-session meeting. The meeting placed on record acknowledgement of the kind support provided by the KMA and the LOC for the meeting.

1.4 One additional meeting was held on 24th November 1999 and the discussions and decisions have been incorporated in this report.

2. Review of Recommendations Made During the Pre-session Meeting of Hydrologists of the 31st Session of the TC Meeting

2.1 Quantitative Precipitation Forecast for Flood Forecasting

The meeting noted that hydrologists from some TC members were using telemetered rainfall data and Numerical Weather Prediction (NWP) model output rainfall from their respective meteorological service to serve as guidance. However, QPF in the short term (from one to a few hours) in areas with short rivers and hilly terrain would require accuracy currently beyond the capabilities of NWP models. Both representatives from Hong Kong, China and Japan reported some success in QPF with lead time of

one to two hours using systems integrating real time rainfall data from a network of telemetry rain gauges with radar data.

2.2 TCS to hold Annual Thematic Workshop/Seminars to promote exchange of information and Technology Transfer

TCS reported that the 'Workshop on the Impact of the El Nino Southern Oscillation (ENSO) / La Nina on Meteorology and Hydrology in the Typhoon Committee Area' was held in Macau from 29 June to 1 July 1999. Apart from lectures and presentation on the subject, the workshop participants opined that not all climate/weather extremes or anomalies in an ENSO event could be attributed to the ENSO. It was further suggested that there was inter-relationship between typhoons activities and ENSO. The recommendations of the Workshop would be presented for discussion in the 32nd session of the TC meeting.

The representative from Japan reported that planning was underway for the 5-day training seminar on "Development of Forecasting and Warning System and Emergency Counter Measures for Typhoon-Induced Sediment Disaster" to be held in the Philippines in May 2000. Japan would provide three experts as lecturers for the seminar.

2.3 Hydrologists from TC members to participate actively in activities under the hydrological component

The meeting urged that encouragement for hydrologists to participate actively in various activities under the hydrological component including attendance in the annual session of the Committee should continue.

2.4 Requesting the Government of Republic of Korea to continue to provide the service of a hydrologist in the TCS

The meeting expressed its gratitude to the Government of Republic of Korea for extending the service of the hydrologist at TCS for one more year. Nevertheless, the meeting was also informed that the service of the hydrologist would expire by May 2000 and unlikely to be continued. The meeting noted that the need for the service of the hydrologist at TCS should be reviewed. A proposal together with a well-defined job description of the hydrologist was prepared and shown as Annex 3. This would facilitate making a request for the continuation of a hydrologist at the TCS.

2.5 Typhoon Committee Members to be encouraged to seek advisory service from ESCAP as well as TCDC Support

The representative from ESCAP informed the meeting that advisory services from ESCAP might not be available due to budgetary constraints next year. However, TCDC support would continue.

3. Hydrological activities of each TC Member in 1999

3.1 The meeting agreed that to avoid duplication, the reporting of hydrological activities of each member should be made at the main session.

Ms. Srisuporn informed that the Thai Hydrologist Assembly had been recently established in Thailand to promote technology transfer in hydrological science and engineering. She welcomed TC Members to join the organization and contribute technical papers.

4. Recent Water Related Disasters and Problems Encountered

4.1 Serious flooding again affected many members including China, Japan, Malaysia, Republic of Korea, Thailand and Viet Nam.

4.2 However, it was noted that in Bangkok although the rain was very heavy, the flooding was much less serious than before and also rather short-lived. This was the result of improvements in the drainage system as well as engineering measures to remove the floodwater.

4.3 The representative from Japan also noted that some of the water related disasters were man-made and could be attributed to urbanization.

4.4 The meeting noted that ESCAP's project on integrated flood management would also benefit other countries and should be suitably publicized.

4.5 The representative from Thailand voiced the need for an operational radar network for planning the release of water from dams for water management during the approach of sever storms.

4.6 The meeting also noted that warnings of water-related disaster to the public should be simple and easy to understand. Radio and TV should be the preferred medium for the dissemination of the warnings with the internet as an extra source for those who want more information.

5. Recommendations

After two active discussion sessions, the following recommendations and actions were agreed upon:

5.1 Requesting TCS to organize annual thematic workshop or seminar with a view to promote greater information exchange and technology transfer among Typhoon Committee hydrologists. In this connection, the following activities are proposed with budget estimate as shown in Annex 2.

a. A 5-day training seminar on "Development of Forecasting and Emergency Counter Measures and Warning System for Typhoon-induced Sediment Disaster" to be held in the Philippines in May 2000, jointly organized by TCS and Japanese International Cooperation Agency (JICA).

b. A 4-day expert workshop for TC hydrologists on "Evaluation and Improvement of Operational Flood Forecasting Models in the Typhoon Committee Area" to be organized in 2001 in Bangkok, Thailand.

5.2 The need for hydrologist to serve the TC Members was carefully reviewed. A job description for the hydrologist was drawn up (Annex 3) to facilitate the request. The request should be made through the TCS to the Government of the Republic of Korea and other potential donor members to provide a hydrologist after May 2000 to serve the TC Members.

5.3 ESCAP to take measures to inform Typhoon Committee members of ESCAP projects on water resources and flood mitigation.

5.4 Members should take advantage of TCDC arrangements by ESCAP for exchange visits of hydrologist.

LIST OF PARTICIPANTS OF THE PRE-SESSION MEETING OF HYDROLOGISTS OF THE 32nd SESSION OF THE ESCAP/WMO TYPHOON COMMITTEE ON 22 NOVEMBER 1999 AND THE SUBSEQUENT MEETING ON 24 NOVEMBER 1999

Participants

Zhang Jianxin, Ministry of Water Resources, People's Republic of China (22nd and 24th November 1999)

Mr Edwin W L Ginn, Hong Kong Observatory; Hong Kong, China (22nd and 24th November 1999)

Dr H K Lam, Hong Kong Observatory; Hong Kong, China (22nd November 1999)

Mr Hisaya Sawano, Ministry of Construction, Japan (22nd and 24th November 1999)

Mr Chong Sun Fatt, Department of Irrigation and Drainage, Malaysia (22nd and 24th November 1999)

Mr Sung Kim, Korea Institute of Construction Technology, Republic of Korea (22nd November 1999)

Mr Ok Joo Sohn, Ministry of Construction and Transportation, Republic of Korea (22nd and 24th November 1999)

Ms Srisuporn Srisuparb, Royal Irrigation Department, Thailand (22nd and 24th November 1999)

Mr Anant Thensathit, Meteorological Department, Thailand (22nd and 24th November 1999)

Mr John F Miller, National Weather Service, Guam, USA (24th November 1999)

Mr Bachuynh Le, Hydro-Meteorological Service, Viet Nam (24th November 1999)

Mr Cengiz Ertuna, ESCAP, Thailand (22nd and 24th November 1999)

Mr Han Se Lee, Hydrologist, TCS, Philippines (22nd and 24th November 1999)

Ms Nanette C Lomarda, TCS, Philippines (22nd November 1999)

Observer

Mr Joe Won Lee, Korean Meteorological Office, Republic of Korea (22nd November 1999)

BUDGET ESTIMATE FOR ACTIVITIES UNDER THE HYDROLOGICAL COMPONENT

Budget Estimate for a 5-day Training Seminar on 'Development of Forecasting and Warning System and Emergency Counter measures for Typhoon-Induced Sediment and Flood Disaster' in Manila, Philippines in May 2000

1.	Per diem for 13 participants:	13 x US$ 120 x 6 days	=	US$ 9,360
2.	Air travel for 13 participants:	13 x US$ 500	=	US$ 6,500
3.	Printing and local support:		=	US$ 3,000
		Total	=	US$ 18,860

Budget Estimate for a 4-day Expert Workshop for TC Hydrologists on 'Evaluation and Improvement of Operational Flood Forecasting Models in the Typhoon Committee Area' in Bangkok, Thailand, in the year 2001.

1.	Per diem for 13 participants:	13 x US$ 120 x 5 days	=	US$ 7,800
2.	Air travel for 13 participants:	13 x US$ 500	=	US$ 6,500
3.	Per diem and Air travel for 1 expert:		=	US$ 1,700
4.	Per diem and Air travel for 1 TCS Staff		=	US$ 1,700
5.	Printing and local support:		=	US$ 1,300
		Total	=	US$ 19,000

JOB DESCRIPTION FOR THE TC HYDROLOGIST

1. To formulate project proposals related to the work of the Typhoon Committee under the hydrological component and to seek funding from members and donors.

2. To formulate project proposals under the hydrological component for the consideration of the Typhoon Committee for approval of allocation from the Trust Fund.

3. Coordinate the implementation of the projects, service related meetings/ workshops/seminar and prepare the final reports or proceedings for dissemination.

4. Cooperate with the hydrologists of the TC Members for evaluation of the available capabilities and identification of assistance needs.

5. Provide advisory services to members if possible, under TCDC and/or TC Trust Fund.

6. Coordinate with ESCAP and WMO and whenever possible participate in their related regional activities.

7. Participate in and service the annual session of the Typhoon Committee.

APPENDIX VIII

SUMMARY OF REPORTS OF THE TYPHOON COMMITTEE MEMBERS ON THEIR ACTIVITIES RELATED TO THE DISASTER PREVENTION AND PREPAREDNESS COMPONENT

In **China,** initiated in Shandong province in 1999, is a strategy for mitigating oceanic disasters which involves the following:

- Enhance public awareness to mitigate disasters
- Invest more in scientific research
- Draw up relevant laws and regulations prohibiting large-scale destruction of the ecological environment
- Establish an integrated body at the provincial level to coordinate disaster mitigation activities

In **Hong Kong, China,** a press release was issued to publicize the use of new tropical cyclone names effective 1 January 2000. The press release was carried in many local newspapers. The list was also posted on the Hong Kong Observatory (HKO) Homepage and published in the Observatory's publicity brochures. Round the clock weather briefings by senior meteorologists to the media commenced on July 1999 to provide the public with authoritative and the most up-to-date weather information when tropical cyclones affect Hong Kong. In response to public demand for advance warning of imminent rainstorms, operational procedures were set up to alert the public to the likelihood of severe rainstorms before the criteria for issuing the rainstorm warning were actually met. In collaboration with Radio Television Hong Kong, a series of 8 television episodes was produced in 1999 on the work of the HKO. The series was broadcast on local television channels in August to November 1999 to promote public awareness of disaster prevention and preparedness.

In **Japan**, the Asian Disaster Reduction Center started to disseminate during the year, various disaster information to member countries and other disaster reduction organizations. The Center established a network made up of contact persons in member countries, advisory countries and an observer body. It's first meeting was held from 16-18 February 1999 which was attended by 19 Members, 2 Advisory Countries and ADPC.

In **Macao**, the Typhoon Contingency Plan was updated and revised and an exercise which involved 29 institutions was held in early May 1999. During the year, several activities were carried out related to public awareness which includes the conduct of training activities in evacuation of schools during dangerous situations and distribution of disaster prevention brochures.

In **Malaysia**, meetings were held between government agencies involved in disaster prevention and preparedness to enable them to discuss issues on disaster management as a whole as well as to determine their strategies and actions to be taken in disaster mitigation. For the year 1999-2000, the Social Welfare Department (SWD) has identified 3,639 evacuation centres which could accommodate 972,305 evacuees at any one time. A comprehensive exercise and workshop for disaster management were carried out by various state government agencies from November 1998 to May 1999 in collaboration with other NGOs. Talks on "Management Crisis and Disaster" by the Malaysian Royal Police were given to 60 officers of the SWD in the Headquarters and Klang Valley on 5 October 1999 as an exposure on the responsibilities of other related departments. At the end of 1998, the SWD had distributed to 5 states a total of 3600 blankets, 1400 mattresses, 280 torch lights and 500 sarongs as a preparedness measure in addition to those available in the states. In early 1999, the SWD at the headquarters level had secured 500 blankets, 400 mattresses, 25 loud speakers, 50 safety-vests and 50 raincoats as emergency counter-measures.

In the **Philippines**, as part of its public service, PAGASA has intensified its information, education and communications on hydro-meteorological hazards to uplift the awareness of the general public on these issues through lectures, exhibits and press releases. The collaboration between PAGASA and NGOs was highlighted this year in the conduct of Trainors Training/Workshop on post weather and flood investigation and assessment. A hydrologist from PAGASA's Flood Forecasting Branch will be temporarily assigned in selected barangays to provide in-house training workshop on operational hydrology aimed at providing assistance in the development of community-based flood forecasting system. Also, in coordination with local government units and NGOs, PAGASA is preparing flood hazard and vulnerability maps of different areas in Metro Manila.

In the **Republic of Korea**, to reduce the loss of life, property damage and economic disruption caused by natural disasters, the Korean government designated 1 March to 31 May 1999 as "Disaster Preparedness Period". Several action plans were effected during the period. This includes:

- Inspection and maintenance of disaster-prone areas
- Inspection and maintenance of large-scale construction sites
- Inspection and maintenance of disaster prevention facilities
- Securing equipment and facilities for emergency countermeasures
- Saving fund for Natural Disaster Countermeasures

Also during the year a number of disaster prevention seminars, drills and exercises were conducted. In 1999, the government invested more than US$4 billion in 22 key items of the Basic Five-Year Disaster Prevention Plan. The Korea Disaster Prevention Association was established on 9 March 1999 to

strengthen the nation's capability to prevent disasters and to stimulate exchange of information.

In **Thailand**, during the period 1 November 1998 to 30 September 1999 the following activities were implemented:

- Improvement of the National Civil Defense Master Plan for more efficiency and effectiveness
- Raised public awareness on typhoon and flood threats and promoted disaster preparedness coupled with studies of human response to warnings
- Published and disseminated disaster-related materials on typhoon for public information and education so as to increase public awareness.
- Constucted channels and reinforced riverbank dykes along the Chao Praya River to prevent the core cities from the impact of floods.
- Seminar on the Integrated Plan for Flood Mitigation in Chao Praya River Basin organized by the Royal Irrigation Department.

In the **U.S.A.,** a workshop was conducted for the Republic of Palau to address the issue of abnormal sea water heights affecting the Palau Islands. Guam's Warning Coordination Meteorologist (WCM) conducted training workshops with emergency management officials and Weather Service Office personnel in the Republic of Palau, Federated States of Micronesia (FSM) and Commonwealth of the Northern Mariana Islands. The Weather Forecast Office (WFO) Guam conducted typhoon preparedness exercises Stormy in conjunction with Guam Civil Defense and military interests on the Island. The WFO generated Tropical Cyclone Program Watch and Warning products depicting a typhoon overruning Guam. WFO Guam conducted its annual Tropical Cyclone Workshop for Guam CD, other local government agencies, military and media interests. Focus of the 1999 workshop was a review of WFO Guam's new Tropical Cyclone Program procedures and products. The WCM discussed increasing public education campaigns with emergency management personnel in Palau and FSM.

In **Viet Nam,** the National Committee for IDNDR carried out the following activities in 1998 to 1999:

- Strengthened the flood control plan at all levels
- Gradually improved the quality of storm and flood warnings, storm and flood forecasts
- Improved the quality of the dike system in the Red River Delta and in the northern section of Central Viet Nam, the quality of the dikes along the coastline from Mongcai to Hatien, the Day River diverting system, the reservoirs of Hoa Binh, Thac Ba and others.
- Strengthened flood combating force in all localities along the river banks from the provincial level down to the village level
- Stepped up public education to increase public awareness

- Endeavored to coordinate all measures both structural and non-structural in order to strengthen international cooperation and assistance in all fields.
- Basically completed the establishment of funds for flood and storm control in provinces and cities in Viet Nam.
- Established the government's policies on disaster prevention and mitigation.

APPENDIX IX

STATEMENT FROM THE WMO/UNESCO SUB-FORUM ON SCIENCE AND TECHNOLOGY IN SUPPORT OF NATURAL DISASTER REDUCTION

(Geneva, 6 - 8 July 1999)

One of the outstanding achievements of the International Decade for Natural Disaster Reduction (IDNDR) has been its major contribution to increased interaction and cooperation between the natural and social science communities working in disaster reduction and thence to enhanced application of science and technology to reducing the large and growing social and economic cost of natural disasters around the world.

Though science and technology have already contributed much to saving human life and reducing property loss and environmental damage from most forms of natural hazard of meteorological, hydrological, oceanographic and geological origin, their potential contribution over the next decade is even greater. But only if they are systematically and wisely applied within the broader social context of an integrated approach to natural disaster reduction which is the principal legacy and proudest achievement of the IDNDR.

In order to assist the global community to build most effectively on the foundation provided by the IDNDR, the World Meteorological Organization (WMO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), as the two principal United Nations (UN) agencies concerned with the scientific and technological aspects of disaster reduction, convened a "Sub-Forum on Science and Technology in Support of Natural Disaster Reduction" as a special contribution to the UN IDNDR Programme Forum 1999 "Partnerships for a Safer World in the 21st Century".

The Sub-Forum reviewed the various ways in which science and technology contribute to the disaster reduction process including, in particular, through:

- assessment of vulnerability and enhancement of community awareness of the nature of the risk;
- operation of integrated warning systems; and
- preparedness and education programs.

In its review, the Sub-Forum took stock of recent progress and future prospects in each of these three aspects of the application of science and

technology to reduction of the impacts of tropical cyclones, extra-tropical storms, storm surges, severe local storms and tornadoes, sand and dust storms, drought, extreme and persistent temperatures, fire weather, floods, landslides, avalanches, volcanoes, earthquakes and tsunamis. A synopsis of this review is contained in the Annex to this statement.

The participants in the Sub-Forum, who came from both the natural and social sciences and with both research and operational backgrounds in developing and developed countries, were concerned that more could have been achieved during the "decade" if the channels of communication and mutual trust that have now been achieved could have been established earlier. They were also concerned at the substantial gap that still exist between the disaster reduction capabilities of the developed and developing countries. They believe, however, that the achievements of the past decade have provided a sound foundation on which to build an effective global strategy for natural disaster reduction in the 21st century.

Major Achievements

Many of the most significant achievements in natural disaster reduction during the 1990s were largely a result of science and technology. Accuracy and timeliness of early warnings for many natural hazards have been improved. The ability to provide forecast time and location of landfall of tropical cyclones has been improved by 24 hours so that the accuracy of the 24-hour forecast in 1990 has been increased in 1999 to 48 hours in advance. The warning time for tornadoes in 1990 was around 8 or 9 minutes and this has nearly doubled to over 17 minutes by the end of the decade. During the "decade", information and understanding on specific natural hazards such as earthquakes and cyclones has, along with increased confidence of design engineers and insurance corporations, permitted improvements in building codes and standards in many parts of the world. A related achievement has been the significant increase of available maps of risk for many countries based on scientific studies and analyses of the climatology of natural hazards.

Perhaps the most visible achievement in the 1990s has been the creation of new disaster management bodies at all levels of government that now include scientists and engineers involved in the study and prediction of natural hazards. One of the major meteorological concerns of the 1990s has related to the longer time scales associated with seasonal to interannual climate variability and human-induced change. While the capacity to forecast these changes is still limited, the implications for natural disaster reduction are extremely significant with just a very small improvement in forecast skill likely to lead to major benefits for communities and national economies.

Another notable achievement of the decade has been the ability, through satellites, to detect, track and assess the intensity of tropical cyclones and major

storm systems. It is almost a certainty that all tropical cyclones can now be detected at or before their development as a natural hazard.

Significant improvements have been made during the decade in the global observations system of the World Weather Watch (WWW) and the Integrated Global Ocean Services System (IGOSS). For example, the polar and geostationary satellite systems have been enhanced and the experimental buoy network in the tropical Pacific Ocean has been made operational providing essential observations for early detection of intense El Nino and subsequent La Nina phenomena. This achievement permitted prediction of drought and above normal precipitation several months in advance in Eastern Africa, and prediction of heavy rain in California in the United States. These predictions also led to special preparedness actions resulting in significant reduction in the losses from the associated flooding.

Overall, the achievements in scientific understanding and its application during the 1990s have provided significant increases in evacuation times, better building standards, and improved risk assessment.

Vulnerability and Awareness

The Sub-Forum agreed that vulnerability assessment and reduction should form an integral part of the follow-up to the IDNDR. This should be achieved through use of advances in engineering as well as in the natural, social and human sciences.

Awareness raising on all types of natural disasters forms an essential element in early warning systems, particularly also where warning periods are short. It encompasses the affected population as well as the political authorities concerned. Therefore, education and training of communities at large, the involvement of media and continuous interaction between scientists, sociologists, technologists and decision-makers and governmental authorities are indispensable vehicles for effective implementation. The partnership of scientific and technical practitioners with those working in social and humanitarian fields is essential notably in urban areas, involving the local population as well as tourists.

In developed countries, it has been clearly demonstrated in recent years that the vulnerability of communities to natural hazards can be greatly reduced by the use of modern building standards in conjunction with risk zoning based on scientific and technical knowledge of the various hazards and their impact on the built environment. Indeed it is through such standards and risk zoning that much of the scientific and technical knowledge of the various hazard mitigation is applied in the community. In the building and construction area these standards are being developed by the International Standards Organization (ISO). These standards have the potential to greatly reduce community vulnerability to a

number of major hazards in the long term but this will require that the development of these new international standards be given higher priority than the revision and upgrading of their individual national standards.

A related, but separate need is the development of cost efficient means of reducing the vulnerability of existing buildings and infrastructure and the financing of activities. This is required to address the reduction of vulnerability in the short to medium term. A high level of technical skills will be required to determine economic means of reducing the vulnerability, and high level of scientific and engineering expertise will be required for the innovative methods of risk financing that will be needed to securitise the investment in reducing the vulnerability.

Integrated Warning Systems

Early warnings are an extremely important link in the chain of actions required to reduce the social and economic impact of natural hazards. Warnings of a natural hazard such as a flood delivered in a timely and clear manner to individuals or communities prepared to take action reduces the impact of the hazard.

All sectors must be involved in the warning process and serve population needs, environment and other national resources. Effective early warnings require unrestricted access to data that is freely available for exchange and they must emanate from a single officially designated authority.

Advances in science and technology during the last decade have demonstrated enhanced warning capabilities for many natural hazards in many parts of the world. For example, warnings of drought have been issued several months in advance which proved of great value for alleviating the impacts of the drought and food supplies. The forecast accuracy of tracks of tropical cyclones has shown significant improvement and average forecast lead times for tornadoes and flash floods have been substantially increased which reduces the loss of life.

Provided adequate assistance is available, many opportunities now exist to transfer these warning capabilities to all areas affected by the natural hazard especially in developing countries during the next decade.

The warning process is underpinned internationally by the World Weather Watch and IGOSS, the Tsunami Warning System and associated research particularly the World Weather Research Program. At the national level, this process includes local and regional observational systems such as coordinated hydrological networks and radar, data processing capability and most importantly it depends on well-trained meteorologists to prepare forecasts and warnings and interact with media and emergency management officials.

Preparedness and Education

A wide range of activities and bodies is encompassed by the terms "preparedness" and "education". They extend from the grass roots to the governmental level and involve individuals, families and communities at one extreme, and universities, ministries and government as a whole at the other. They take in classes, seminars, schools, links or various sorts such as between the forecasters and the audience for their forecasts; and they include research, not only into forecasting but also into their delivery and dissemination of forecasts and warnings and the responses, perception and reactions to them.

Developed and some developing countries have extended their preparedness and the meteorological, hydrological and other geoscience products supporting it into new areas during the "decade". They have forged closer dialogue between the scientific community and stakeholders in various areas of endeavour, such as agriculture, health and transport. They have made good progress with dialogue with social scientists, but this area still needs more attention. Catering for preparedness of the disadvantaged and disabled has also not progressed to the desired extent and greater use of plain and meaningful language is seen as highly advantageous in the better communication of forecasts and warnings. Indeed the language of preparedness measures and forecasts determine the way these messages are accepted. In many cases, the use of a dialect could improve effectiveness and credibility. Confirmation of such messages is also an important consideration. Using mobile phones and pagers to propagate these messages and means other than radio and television have distinct benefits. Education and training applied in the direction of those scientists building the preparedness measures as well as those they are designed for. Indian experience of workshops between forecasters and the users of their forecasts pointed to the value of such exchanges. However, there are differences when carrying the message to adults as opposed to children.

There are advantages attached to the education of school children in disaster preparedness - their parents benefit as well and this has been made evident during the IDNDR. Developing countries trying to build their preparedness face enormous costs and also the much greater costs of reconstruction in the wake of a disaster.

Future Actions

The Sub-Forum recognized that, as a result of population increase and concentration and other factors, our societies are becoming more and more vulnerable and that our protective systems are not necessarily adapted to cope.` Furthermore, considering that a disaster strategy which puts emphasis solely on relief and response is short-sighted and not cost-effective, the participants

agreed on the need for greater emphasis on prevention across the whole continuum of hazards faced by humanity.

The Sub-Forum recalled that the 1994 Yokohama World Conference on Natural Disaster Reduction called for a construction of a "Culture of Prevention" which should be based on improved short-term and long-term monitoring mechanisms. Mitigation, preparedness and prevention measures must be proactive rather than reactive; they must provide the correct treatment while there is still time. Prevention must be rooted ultimately in culture and education which finds its expression in our everyday social behaviour. Hence, the threat of potentially irreversible events includes an ethical dimension which should be reflected in training, organization and motivation of communities at risk.

Capacity building and education at all levels have an important role to play in the development of a culture of prevention by ensuring a two-way flow of information between decision-makers and communities at risk.

The Sub-Forum emphasized the need for capacity building in vulnerability and risk assessment, early warning of both short-lived natural disasters and long-term hazards associated with environmental change, improved preparedness, adaptation, mitigation of their adverse effects and the integration of disaster management into overall national socio-economic development planning.

The participants agreed that a focussed ongoing coordination structure is needed within the UN system in order to strengthen further the already close cooperation among intergovernmental and non-governmental scientific and technical bodies committed to natural disaster reduction. Such a mechanism is necessary to foster and sustain the vital international and national effort on the application of the natural and social sciences and technology in support of natural disaster reduction, particularly through the implementation of the relevant programmes of UNESCO and WMO.

APPENDIX X

SUMMARY OF REPORTS OF THE TYPHOON COMMITTEE MEMBERS ON THEIR RELATED ACTIVITIES TO THE TRAINING COMPONENT

In **China**, CMA organized the following training courses:

Number of Trainees	Title of Course	Venue	Period
26	International Training Course on Long Range Weather Forecast	RMTC Nanjing	From 25 Sep to 24 Oct 1999.
63	Computer replacement training workshops	Zhejiang Province	Apr and Sep 1999
40	2nd Training Course on the Use of Observation Software	Anhui Province	

In **Hong Kong, China**, the Observatory staff participated in the following overseas training:

Number of trainees	Title of Course	Institute	Period
5	Professional Training Course on Meteorology	Nanjing Institute of Meteorology, China	12 Oct – 24 Dec 1998
1	Meteorology Course for Graduates	UK Met Office College, UK	9 Nov 1998 – 26 Feb 1999
1	Advance Meteorology Training Course of ECMWF (Module 3)	ECMWF Headquarters, UK	4 –14 May 1999
1	Seminar on NWP Products for Aviation	ECMWF Headquarters, UK	12-16 Jul 1999

The HKO organized the following in-house training courses from October 1998 to September 1999 which was attended by a total of 100 Class I, II and III meteorological personnel from the HKO and 11 members of the Hong Kong Aviation Club:

Applied Meteorology Course for Forecasters (AMCF) Part II
Post-UK Training Programme for Scientific Officer
Pre-professional Training Programme for Scientific Officer
Training Course on back up operation of the Aviation Meteorological Office
Radar Software for Tai Mo Shan Weather Radar and Doppler Radar System

Workshop on Use of Weather Radar System
Training Course on the Forefront of Nowcasting
Training Course on Meteorological Observations at Sek Kong Airfield

In **Japan,** JMA organized the second "International Training seminar on Typhoon Monitoring and Forecasting in the Western North Pacific" at the RSMC Tokyo-Typhoon Center from 18 January to 05 February 1999.

JMA's Meteorological Satellite Center in 1999 developed a CAL software for nephanalysis training. This software aside from presenting GMS imagery, analytic information of clouds, TBB and animation of cloud imagery also allows users to overlay NWP products and radar echoes on cloud pictures.

Expert Services:

Number of JMA expert/s	Agency/Service	Period
3 (satellite image analysis)	HMS of Viet Nam	16 Nov - 12 Dec 1999
1 (satellite image analysis)	Thai Met Dept	09 Nov 1998 - 15 Jan 1999
1 (NWP)	Thai Met Dept	04 - 15 Oct 1999
1 (typhoon forecasting)	Thai Met Dept	17 - 30 Oct 1999

Technical Visits:

Number of expert/s	From	Purpose	Period
1	KMA	Technical exchange of Global Spectral modeling	12 - 14 Apr 1999
2	KMA	Technical exchange of the operation of supercomputer for NWP	17 – 19 May 1999

In **Macao,** SMG staff members attended the following in-house training courses:

Title of Course	Period	Number of Trainees
Class II Met. Officer	6 months	3
Class III Met. Officer	3 months	5
Doppler Radar	2 weeks	18
Mesoscale Met Model	2months	12
Geomagnetism Observation	6 weeks	14
Aeronautical Observation & Information Class III	2 weeks	8
Air Pollution Class II & III Officer	2 weeks	8

Overseas Training Courses/Seminars/Workshops attended by SMG staff:

Title Course	Venue	Period	Number of Trainees
Typhoon Monitoring and Forecasting in the Western North Pacific	Tokyo	18 Jan-5 Feb 99	1
4th GD-HK-MC Meteorological Conference on Operational Cooperation	Conghau	14-15 Apr 99	2
3rd SCSMEX & SSC Joint Meeting	Macao	29-31 Mar 99	3
3rd GEWEX Meeting	Beijing	16-19 Jun 99	1
NWP	Shenzhen	15 Jul 99	2
ENSO Workshop	Macao	29 Jun-1 Jul 99	6
ISO 14001 EMS	Macao	40 hrs	1
Java Tech and Devt Course	Macau	25-29 Jan 99	1

In **Malaysia,** the MMS focused on training its staff in Information Technology and PC utilization. It also took advantage of the opportunity available to send its staff to attend international workshops, seminars and conferences abroad.

In the **Philippines,** 46 PAGASA staff members attended 36 training courses, seminars and workshops abroad while three international meetings were hosted by the agency. A number of PAGASA staff attended eight in-house training courses.

In the **Republic of Korea,** seven KMA staff members attended the following training courses in 1999:

Title of Course	Period	Venue	Number of Trainee
Experiments on severe weather events	17 Oct 98-24 Jan 99	USA	1
Training Seminar on typhoon Forecasting and training	17 Jan 99-6 Feb 99	Japan	1
Study on Medium Range Weather Forecasting	30 Nov 98-3 Mar 99	USA	1
Analysis on the results from ARPS/CAPS	31 Dec 98-4 Apr 90	USA	1
Study on the global spectral Modeling	11 Apr 99-15 Apr 99	Japan	1
Technical discussion on improving the data assimilation system in	8 Aug 99-22 Aug 99	USA	1

METRI with FSL			
Collaborating research on the Application of the MAS and RCSM	9 Aug 99-15 Aug 99	USA	1

In **Thailand,** training activities include the following:

Number of trainees	Title of Training Course	Venue	Period
1	Training on weather forecasting for Operational Meteorologists	Korea	5 Nov – 6 Dec 1998
1	Regional training workshop for Instrument Specialist (Class II & IV) of RA II	Japan	9 - 13 Nov 1998
1	Regional training seminar on GTS techniques and procedures to be implemented in RA II	China	7 – 10 Dec 1998
1	Training Course to develop National Inventories and strategies against Climate Change	Japan	11 Jan – 27 Feb 1999
1	Training Course in Ozone layer protection ad applicable technology	Japan	19 Jan – 6 Mar 1999
1	Training on Remote Sensing	Japan	8 – 12 Mar 1999
1	Training Seminar on the Application and Interpretation of NWP Products in Aviation	U.K.	12 –16 Jul 1999
1	On-site Inspection Training and Executive Programme (OSI TEP)	Vienna	2 – 6 August 1999
1	Training on Interpretation and Processing of NWP and Weather Satellite Data	Singapore	1 – 14 Sep 1999
1	Training Course on Land and Forest Fire Detection using NOAA Satellite Data	Singapore	20 – 22 Sep 1999

In the **U.S.A.**, the Joint NWS-FSM Meteorological Intern Trainee Program is making it possible for islanders to attend the University of Hawaii to work on a degree on Meteorology. The first graduate of this program will return to his home island of Yap in May 1999 and will become after additional administrative and technical on-the-job training at the local WSO, the first Meteorologist-In-Charge of a Micronesian WSO in December 1999. Currently, two more graduates of the program are in training with the WFO, Guam.

In **Viet Nam,** HMS personnel attended the following:

	Number of Participants	Number of Participants			
	Seminars & Workshop	Graduate	Post-Graduate	Short-term Training	Study-tours
1999	48	0	2	84	32

APPENDIX XI

SUMMARY OF REPORTS OF THE TYPHOON COMMITTEE MEMBERS ON THEIR ACTIVITIES RELATED TO THE RESEARCH COMPONENT

In **China**, research is being undertaken in CMA on the following:

- Typhoon Inner Structure
- Typhoon Numerical Prediction
- Climate Characteristics of Tropical Cyclone

The 11th National Workshop on Tropical Cyclones was held in Jiangsu Province, China in late 1999.

In **Hong Kong, China**, four papers on tropical cyclones and rainstorms were presented at the 13th Guangdong-Hong Kong-Macau Seminar on Severe Weather held in Macau on 17-18 December 1998. On 15 July 1999, a Guangdong-Hong Kong-Macau meeting on cooperation in mesoscale weather prediction and analysis was held in Shenzhen, China. Work is on-going on a variety of subjects which includes:

- Impacts of El Niño/La Niña on tropical cyclone landfalling locations
- Short-term rainfall forecast using the Regional Spectral Model
- Experimental long-range forecast of tropical cyclone activity and rainfall

The following tropical cyclone research projects are being undertaken at the City University of Hong Kong:

- Ensemble forecasting of tropical cyclone motion
- Tropical cyclone intensity change
- Non-barotropic processes of tropical cyclone motion
- Tropical cyclone size change
- Long-term variability of tropical cyclone activity

In **Japan**, the COMPARE Project is well underway with Typhoon 9019 (Flo) as the subject for Case III. JMA, the lead center of Case III hosted an "International Workshop on Mesoscale Model Intercomparison of Typhoon Intensity Prediction" in Tokyo from 13 to 15 December 1999. JMA's Meteorological Research Institute (MRI) started numerical experiments of typhoons using MRI's - Mesoscale Nonhydrostatic Model with high resolution. Results showed that the model gave a more precise simulation of the detailed structure of rain bands compared to the operational hydrostatic model of JMA.

In **Macao,** the following research papers were presented in the Seminar on Severe Weather held in Macao:

- Analysis of Typhoon Babs (9811)
- Analysis on rainstorm process in Macao on 24 May 1998
- Analysis on the anomaiies of subtropical high in western north Pacific during June to August 1998

A research paper entitled "Advance and Retreat of the Summer Monsoon in China, a joint effort of SMG and the Department of Atmospheric Physics of Zhongshan University was presented in the 3rd GEWEX Meeting held during the year in Beijing.

Currently in semi-operation run is a research project on a mesoscale meteorological model developed by a team of SMG Meteorologists and experts from a Chinese University.

In **Malaysia,** very much concerned about the large-scale effects of tropical storms and typhoons over the equatorial Southeast Asian region, MMS is currently working on dynamical and analytical studies on tropical storms/typhoon cases in the last 10-20 years that entered into or developed within the South China Sea. In hydrology some of the on-going research projects includes:

- Flood mapping for Kelantan river using Radarsat
- Urban hydrology study to determine runoff coefficient and concentration time

In the **Philippines**, several research and development studies were completed during the period. These includes the following:

- Hazard Mapping of Thunderstorm over Mindanao
- A Revised Analog Method of forecasting Tropical Cyclone Movement
- Rainfall Probability and Visibility Forecasting at Different Airport Stations in the Philippines
- Agroclimatic Zoning in the Western Visayas
- Climatology of three major ports of entry in the Philippines
- An Investigation of Physical Characteristic and Natural System Responses to Sea Level Changes in Selected Coastal Areas
- Theoretical Study of the Radial Distribution of Rainfall in Mature Tropical Cyclones

In the **Republic of Korea,** some of the research studies completed during the year includes the following:

- Statistical model to predict the tracks of typhoons
- Dynamics of typhoon and the effects of initial typhoon structure

- The development of the ensemble track forecast model
- Development of typhoon forecasting system using satellite data

In **Thailand**, some on-going research projects include the following:

- Environmental Zoning for Increasing efficiency of Soybean variety improvement (in-cooperation with Kasetsart University)
- Installation of global solarimeter (in-cooperation with Japanese scientists in GAME-T project)
- Crop simulation mode for Rice (in-cooperation with Suranese University of Technology)

In the **U.S.A.**, Mr. Bill Ward, Meteorologist (NWSO Guam), co-authored a technical paper with Dr. Mark Lander of the University of Guam entitled "Upper Tropospheric Outflow Patterns over some very intense tropical cyclones of the Western North Pacific as revealed by soundings, Doppler Radar and water-vapor winds" for presentation at the American Meteorological Society's conference in Dallas, Texas on January 1999. Mr. O. Saka, Professor (Department of Physics, Kurume National College of Technology, Atmospheric Research Unit) conducted aerosol sampling experiment on Guam during the second week of August to determine the effect of the global transport of aerosols to the atmosphere.

In **Viet Nam,** research activities in 1999 includes:

- Prediction of flood discharge and real-time reservoir operation in Hoa Binh, Thac Ba, Tri An, Dau Tieng Hydropower plants and for management of several water resource structures
- Development of inundation models and hydrological models for the flood forecasting in Mekong River Delta and in other principal river delta in Viet Nam

APPENDIX XII

TROPICAL CYCLONE ACTIVITIES IN THE WMO-CAS TROPICAL METEOROLOGY RESEARCH PROGRAM

Dr. Greg Holland
Chairman, WMO-CAS Working Group on Tropical Meteorology Research

1. SUMMARY

As outlined by the examples in this brief report, the CAS Tropical Meteorology Research Program has played an active role in supporting improvements to operations through workshops and support for research and development activities. At its February 1998 Meeting, CAS confirmed that the TMRP will continue to provide support for international research and development activities with an emphasis on monsoons and tropical cyclones.

Within the Working Group on Tropical Meteorology Research, we have an energetic Rapporteur on Tropical Cyclones, Professor Russell Elsberry, who has worked with the Tropical Cyclone Program over the past decade on several tropical cyclone programs. These have including the highly successful SPECTRUM/Typhoon 90/TCM-90, TCM-92 and TCM-93 series of field experiments and related research activities.

Highlights of current and recent activities include:

- The Fourth International Workshop on Tropical Cyclones held in China April 1998.

- A statement on Climate Change and Tropical Cyclones commissioned by CAS and published in the Bulletin of the American Meteorological Society.

- The autonomous Aerosonde has moved close to the capacity to undertake reconnaissance in a wide range of applications, including tropical cyclones.

- The TMRP collaboration with the newly established WWRP to conduct a major international program on Landfalling Tropical Cyclones.

2. ACTIVITIES

2.1 The International Workshop on Tropical Cyclone Series

There have been three of these quadrennial workshops, each dedicated to bringing researchers and forecasters together in a workshop environment to discuss mutual problems and potential solutions. A major outcome of each of the past workshops have been a reference book and a forecast manual. The Global View of Tropical Cyclones was written following IWTC-I, with Russ Elsberry as the editor, and subsequently substantially updated after IWTC-III. The Global Guide to Tropical Cyclone Forecasting was written following IWTC-II under the editorial direction of Greg Holland and with support from the TCP. All of these books have been distributed to forecast offices around the globe.

IWTC-IV was held in April 1998 in China under the capable chairmanship of Gary Foley. Significant amongst the substantial recommendations and meeting resolutions were the support for the WWRP initiative on Landfalling Tropical Cyclones, and the update to the Global Guide to Tropical Cyclone Forecasting, which will be issued in a web form as well as a printed copy. The initial move to the web for the Guide can be found at:

http://www.bom.gov.au/bmrc/meso/New/wmocas.html

A complete set of recommendations from the workshop have been recently published by WMO. It is important that these recommendations be taken up by TCP bodies as appropriate.

2.2 Support for Field Programs and Applied Research on Tropical Cyclones

The WGTMR has actively promoted research and development programs likely to help with forecast improvement.

One example is the Decade-long tropical cyclone research initiative supported by Typhoon Committee members, the United States and Australia that combined research and operations focussed in the Pacific region. This program provided the funding for the first Global View reference book, and has conducted joint international programs in the western Pacific.

Under this initiative, CAS co-sponsored the ICSU/WMO Tropical Cyclone Disasters Symposium in Beijing in 1992, which produced a book on the multi-disciplinary topics covered.

2.3 The Aerosonde Robotic Aircraft

A major initiative over the past several years has been the development of the Aerosonde, a small, autonomous aircraft designed to enable observations of a wide range of atmospheric systems at a very economical cost. The early support provided to the Aerosonde by WMO, by the New Delhi meeting of the IDNDR and the Beijing Tropical Cyclones as Natural Disasters Symposium was pivotal in the establishment of a development program that has lead to the first operations in 1999. The Aerosonde passed its operational trial conducted by the Australian Bureau of Meteorology in January and February 1998 and has since flown missions in Australia, the South China Sea, Canada, Alaska, West Virginia and Hawaii.

A major event was the recent successful flight across the North Atlantic Ocean, which placed the Aerosonde in the aviation record books for the first robotic aircraft to achieve this distinction.

The Australian Bureau of Meteorology has decided to move towards supporting a Global Reconnaissance facility based around the Aerosonde. This idea is receiving strong support from a wide range of countries in both hemispheres.

The remaining major step is for inclusion of the satellite communications system, which has been delayed by problems with the Motorola Iridium system. We are now considering use of Orbcom or Globalstar as alternatives.

Many information on the Aerosonde can be found at:

http://www.aerosonde.com

2.4 Statement on Climate Change and Tropical Cyclones

One outcome of IWTC-III was a community view on tropical cyclone aspects of climate change, developed under the leadership of Sir James Lighthill and published in the Bulletin of the American Meteorological Society. An updated and more detailed statement has since been prepared by a committee of prominent scientists headed by Professor Ann Henderson-Sellers. An article was also published in the Bulletin of the American Meteorological Society. The statement may be found at:

http://www.bom.gov.au/bmrc/meso/New/Gallery/People/Greg_Holland/TC_ClimChange/tropical.htm

Members are encouraged to utilize the statement in responding to questions on the likely consequences of global climate change on tropical cyclones.

2.5 The WWRP/TMRP Program on Landfalling Tropical Cyclones

The World Weather Research Programme (WWRP) is a recent development within the WMO Commission for Atmospheric Sciences, where it has grown out of an amalgamation of the former short and medium range prediction groups. The basic goals is to promote research and development activities that will have a significant benefit to weather forecasting.

The Tropical Cyclone Landfall Program has been formally approved by the TMRP at the meeting of the WGTMR in 1997 and by the WWRP at its October 1999 meeting in Innsbruck. The goals, which were discussed extensively at the IWTC-IV, are:

> *Improved specification of the rainfall and wind field occurring both at the coast and inland as a cyclone makes landfall. This will implicity require improved track forecasts and will lead to improvements in secondary parameters, such as storm surge estimation.*

It is expected that the focus will be on improved understanding and forecasting of the details of the tropical cyclone structure and rainfall at landfall, the impacts on vulnerable communities, and the methods of improving community response. Specific aspects of the cyclone structure will include the transient changes in wind and rain as a cyclone makes landfall, together with the associated effects of flooding and ocean impacts.

The procedure is to work through the entire problem, from research to forecasting as follows:

- Develop an international research program, aimed at improved understanding of the associated processes.

- Conduct associated field programs, both as a basis for the research and to provide indications of the likely data requirements for forecasting.

- Conduct 2-3 Forecast Demonstration Projects covering a range of forecast capacities for assessing the potential improvements in forecasting from application of the research and development findings and the improved observing systems.

The program will coordinate closely with existing national programs. In particular, the Hurricanes at Landfall program under the US Weather Research Program, and the Australian Tropical Cyclone Coastal Impacts Project are working closely with the WWRP and TMRP on the research and field program aspects.

The plan is to undertake a 3-4 year intensive research and development exercise, focussed on field trials being undertaken by the United States. This program will concentrate on improved observations, understanding and technique development related to the program goals. Next will be a series of forecast demonstration programs, conducted outside the United States, aimed at establishing methods of transferring the R&D outcome to forecasting. These programs will include upgrades to observing systems, forecast techniques and explicity address the cyclone impacts aspects.

TCP Members are strongly encouraged to support and work with this important international initiative. In particular, ideas and volunteers for forecast demonstration projects are needed.

GJH November 9, 1999

APPENDIX XIII

REVIEW OF TROPICAL CYCLONES IN 1999 AFFECTING TYPHOON COMMITTEE MEMBERS

TC NAME	RSMC NO.	MONTH	MEMBERS AFFECTED
HILDA		JAN	PHIL
IRIS		FEB	PHIL, USA
JACOB		APR	PHIL
KATE	9901	APR	PHIL
LEO	9902	APR	CHINA, HK, MACAO
MAGGIE	9903	JUN	CHINA, HK, MACAO, PHIL
NEIL	9905	JUL	JAPAN, PHIL., ROK
TS	9906	JUL	HK, MACAO,
OLGA	9907	JUL	PHIL, ROK, USA
PAUL	9908	AUG	JAPAN, ROK
SAM	9910	AUG	CHINA, HK, MACAO, PHIL
DORA	9911	AUG	USA
WENDY	9914	SEP	CHINA, HK, MACAO, PHIL
YORK	9915	SEP	CHINA, HK, MACAO
ZIA	9916	SEP	JAPAN
ANN	9917	SEP	ROK
BART	9918	SEP	JAPAN, ROK
CAM	9919	SEP	HK, MACAO
DAN	9920	OCT	CHINA, HK

APPENDIX XIV

SUMMARY OF 1999 TYPHOON SEASON

Summary (as of 30 September)

The tropical cyclone season began in late April about one month later than normal with the development of Severe Tropical Storm (STS) 9901 KATE. Although KATE was soon followed by Typhoon (TY) 9902 LEO, tropical cyclone activity of this year was rather quiet in the first stage with a single formation of TY 9903 MAGGIE during the two months of May and June. MAGGIE brushed the southern coast of China in early June where KATE reached and dissipated.

In late July, cyclogenesis became activated to generate four storms in total within the month, of which STS 9905 NEIL and TY 9907 OLGA took northward tracks over the East China Sea and affected the Korean Peninsula. Damage from OLGA in particular was so serious in the Peninsula.

Tropical cyclone formation continued to be active from August to September with more than normal frequencies; six storms formed in both of the months. Although no storm attained in TY intensity in August, STS 9910 SAM hit the southern coast of China just as KATE and MAGGIE and brought heavy damage to China. The damage from TY 9918 BART, this season's strongest storm that occurred in the middle of September, was also serious in western Japan.

As of the end of September, nineteen tropical cyclones of tropical storm (TS) intensity or higher were tracked in the area of responsibility of the Center. The total number is nearly normal as compared to 19.9, the thirty-year-average for 1961-90. However, there were only three storms (16% of the total) that reached typhoon intensity, which is roughly 1/3 of the average years.

Tropical cyclone activity 1999 was also featured by the spatial deviation of the tropical cyclone occurrence. During this season, storms tended to form in higher latitudes. Twelve storms out of 19 in total (63%) formed in latitudes higher than 20°N compared with 24% on average. In addition, no formation was observed in the seas west of the Northern Mariana (135° - 150°E and south of 20°N), one of the basins with the highest frequency.

STS 9901 KATE

A tropical depression (TD) formed just off the northeast coast of Mindanao on 21 April 1999. It reached TS intensity on 23 April. Moving northeastward, KATE reached STS intensity on 25 April. As it continued to the northeast, the

storm began to weaken. By 1200 UTC on 28 April, it became an extratropical cyclone about 600 km east-northeast of Hachijo Island, Japan.

TY 9902 LEO

A TD formed east of Viet Nam on 27 April 1999. It moved northward and reached TS intensity the following day. LEO appeared to make a loop off the coast of central Viet Nam and then took a northeastward track as it steadily intensified. Moving northeastward, LEO reached STS intensity at 1200 UTC on 29 April and TY intensity at 0000 UTC on 30 April when it was centered about 400 km south of Hong Kong. After reaching its peak intensity on 30 April, LEO weakened quite rapidly and lost TY intensity by 0000 UTC on 1 May. Only 30 hours later, it was downgraded to a TD centered about 80 km south of Hong Kong.

TY 9903 MAGGIE

A TD formed about 500 km east of Mindanao on 1 June and moved northwestward while increasing its intensity. It developed into a TS at 0600 UTC on 2 June. MAGGIE reached STS intensity at 0000 UTC on 3 June and TY intensity at 0000 UTC on 4 June. Reaching its mature stage on 5 June, it passed south of Taiwan and gradually turned west-northwestward. Weakening slowly, MAGGIE reached the southern coast of China about 200 km east of Hong Kong at 1200 UTC on 6 June. It turned slightly to the west-southwest and skimmed along the southern coast of China. With TS intensity it brushed north of Hong Kong on the day. It quickly turned northward and made landfall about 200 km west of Hong Kong. At 1800 UTC on 7 June, MAGGIE weakened to a TD and dissipated by 0600 UTC on 9 June.

TS 9904 NONAME

TS 9904 can be traced back to a tropical disturbance which was located around Marcus Island on 13 July. It became a TD at 0600 UTC on 14 July. On 15 July, the storm began to move northwestward. It reached TS intensity at 1800 UTC on 16 July and quickly weakened to a TD at 0000 UTC on 18 July. It then dissipated by 1800 UTC on 18 July in the waters about 200 km southeast of Hachijo Island.

STS 9905 NEIL

An area of convection located east of Luzon, moved westward slowly and became a TD at 0600 UTC on 22 July when it was located roughly 600 km east of Luzon. It began to turn to the northeast at 0000 UTC on 24 July and gradually intensified. It reached TS intensity at 0600 UTC on 25 July and STS at 1800 UTC on the day while turning to the north. NEIL passed Amami-ohshima Island, Japan, around 000 UTC on 26 July and continued to move northward. It passed

east of Cheju Island and the southwestern tip of the Korean Peninsula around 0900 UTC on 27 July. It was downgraded to a TD at 1800 UTC on the day. The weakening system brushed the western coast of the Peninsula and made landfall about 40 km southwest of Seoul around 0600 UTC on 28 July. NEIL dissipated by 1800 UTC on 28 July in the northwest of the Peninsula.

TS 9906 NO NAME

TS 9906 was a short-lived system, which formed in the northern South China Sea at 0000 UTC on 23 July. It moved northwestward slowly and began to turn to the northeast on 25 July. It reached TS intensity at 1800 UTC on 26 July about 200 km south of Hong Kong. It quickly made landfall in southeastern China, just east of Hong Kong. After the landfall, it moved north-northeastward over southeastern China and dissipated on 28 July.

TY 9907 OLGA

A TD formed about 900 km east-northeast of Mindanao at 0000 UTC on 29 July and moved north-northwestward. Persisting on the same course, it reached TS intensity on 30 July about 1100 km east of Luzon and STS the next day. OLGA reached TY intensity at 1200 UTC on 1 August. After passing Okinawa Island, it quickly weakened to an STS and turned more to the north while accelerating. It passed just west of Cheju Island around 0000 UTC on 3 August as it continued to weaken. OLGA passed near the southwestern tip of the Korean Peninsula and then rushed northward in the Yellow Sea off the western coast of the Peninsula. It made landfall on the northwest Peninsula and quickly lost tropical characteristics to become an extratropical cyclone by the next day.

TS 9908 PAUL

A TD formed in the waters about 400 km east-southeast of Okino-tori Island, Japan, at 0000 UTC on 3 August and began to move northwestward. It reached TS intensity at 12 000 UTC on 4 August about 400 km east of Minami-daito Island and became almost stationary for the next two days around waters northeast of the Island. After turning gradually to the north on 6 August, Paul moved toward the southern Kyushu. It passed just north of Tane Island around 1500 UTC on 6 August and skimmed up the western coast of Kyushu. It gradually weakened in the Yellow Sea and became an extratropical cyclone.

TS 9909 RACHEL

A TD formed around 150 km south of Hong Kong at 1800 UTC on 5 August and moved northeastward. It passed the central part of Taiwan and gradually intensified. It reached TS intensity 40 km north of Miyako Island at 0000 UTC on 8 August. RACHEL suddenly turned its course from northward to northwestward

in the next two days. It gradually weakened in the Yellow Sea and made landfall near Qingdao and quickly dissipated.

STS 9910 SAM

A TD formed about 400 km northeast of Mindanao at 1800 UTC on 17 August and moved northwestward. It gradually intensified and reached TS intensity at 0600 UTC on 19 August. SAM passed the northern tip of Luzon and moved into the South China Sea. It made landfall on the Southern China about 50 km west of Hong Kong and was downgraded to a TD. It passed over southern China on the northeasterly course. Then the TD passed the southern tip of the Korean Peninsula and dissipated in the Sea of Japan just west of Honshu.

TS 9911 DORA

A tropical cyclone generated in waters west of Mexico was named DORA. It passed the international date line on 19 August and moved to the western North Pacific. DORA continued to move northwestward and weakened to a TD at 0600 UTC on 23 August about 800 km north of Wake Island. Then it turned its course from northward to north-northeastward and dissipated by 0600 UTC on 26 August.

STS 9912 TANYA

A TD formed just east of the international date line at 0600 UTC 19 August and moved west-northwestward. It reached TS intensity about 800 km northeast of Wake Island at 0600 UTC on 20 August. TANYA turned the course to the north while weakening. It was downgraded to a TD at 0000 UTC on 23 August as it began to recurve. The TD moved back into the Western Hemisphere on 25 August.

STS 9913 VIRGIL

A TD formed about 200 km west of the Ogasawara Islands, Japan, at 0000 UTC on 23 August. It first moved southward on 23 August and then gradually turned to the northeast in the next three days and intensified. It reached TS intensity at 0600 UTC on 25 August and STS at 1500 UTC on the day. VIRGIL continued to move northeastward and was downgraded to a TD at 0600 UTC on 27 August. It gradually weakened on the easterly course and dissipated by 0000 UTC on 30 August.

TS 9914 WENDY

A TD formed about 300 km east of Luzon at 1800 UTC on 1 September and moved in the South China Sea on the northwesterly course. It gradually

intensified and reached TS intensity at 0600 UTC on 3 September. WENDY then weakened and made landfall on the southern China about 160 km east of Hong Kong as a TD at 1800 UTC on the day. The TD passed over the southern part of China and made landfall on the southern part of the Korean Peninsula again and dissipated in the Sea of Japan by 1200 UTC on 7 September.

STS 9915 YORK

A TD formed about 150 km east of Luzon at 1800 UTC on 9 September and moved westward. It made landfall on the northeastern coast of Luzon around 1200 UTC on 11 September and moved into the South China Sea where it re-intensified. It reached TS intensity at 1200 UTC on 13 September about 500 km south-southeast of Hong Kong. YORK moved northward about 80 km west of Hong Kong at 1000 UTC on 16 September. After the landfall, it quickly weakened and dissipated by 0000 UTC on 18 September.

TS 9916 ZIA

A TD formed in the waters northwest of the Mariana Islands and moved northwestward. It intensified to a TS just south of the southern tip of Kyushu and made landfall on the southern Kyushu two hours after the upgrade. ZIA passed over western Japan on 14 and 15 September. Then it weakened to a TD in the central Honshu at 0600 UTC on 15 September. ZIA moved in the Pacific and dissipated by 0000 UTC on 16 September.

STS 9917 ANN

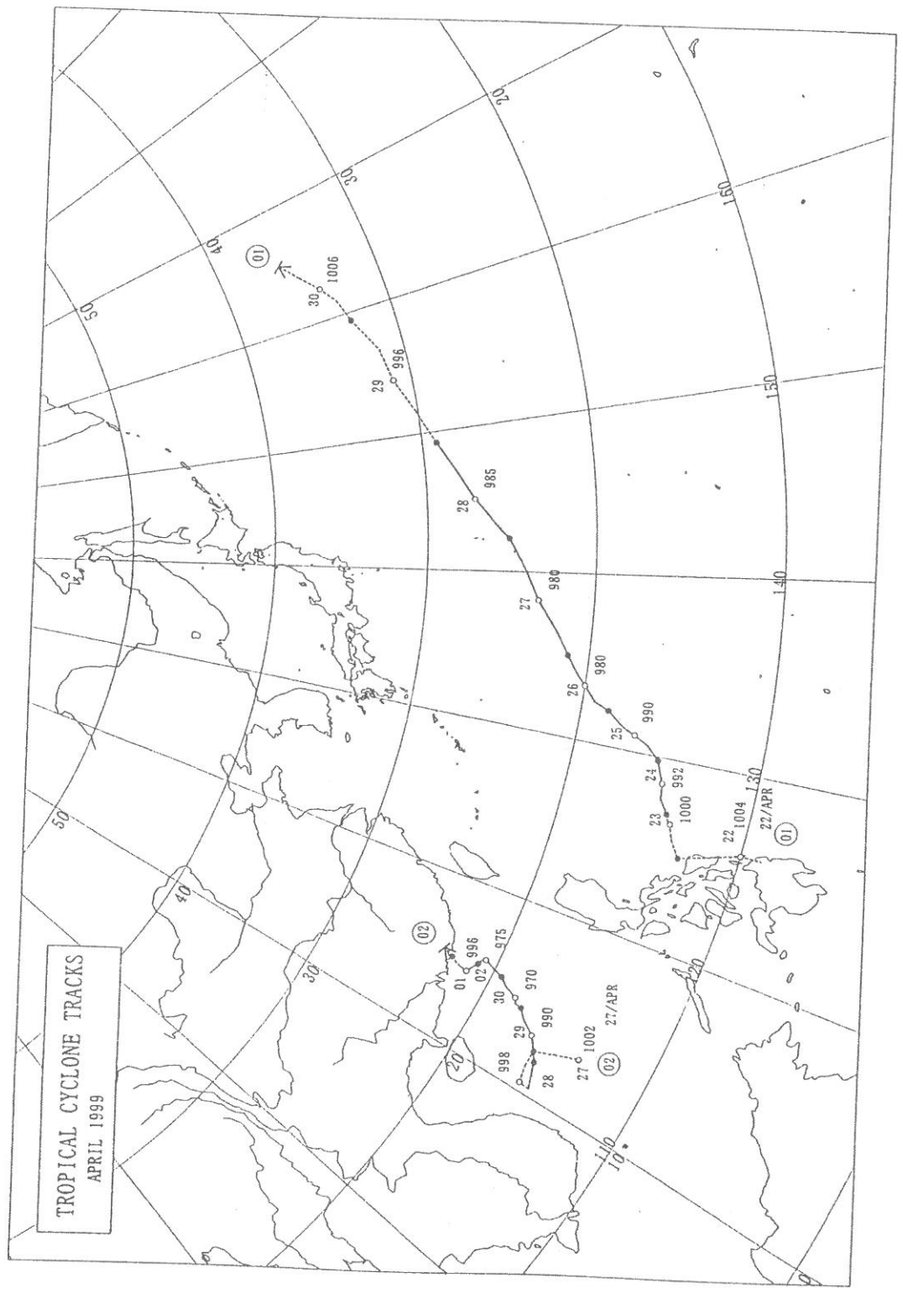
A TD formed about 100 km south of Okinawa Island at 1200 UTC on 14 September moving north-northeastward. It passed Amami-ohshima Island around 1800 UTC on the next day. It gradually turned to the northwest and moved in the Yellow Sea with intensifying. It reached TS intensity at 0000 UTC on 16 September and STS six hours later. ANN then turned eastward on 19 September and became an extratropical cyclone at 1800 UTC on the day just before making landfall on the southwestern Korean Peninsula.

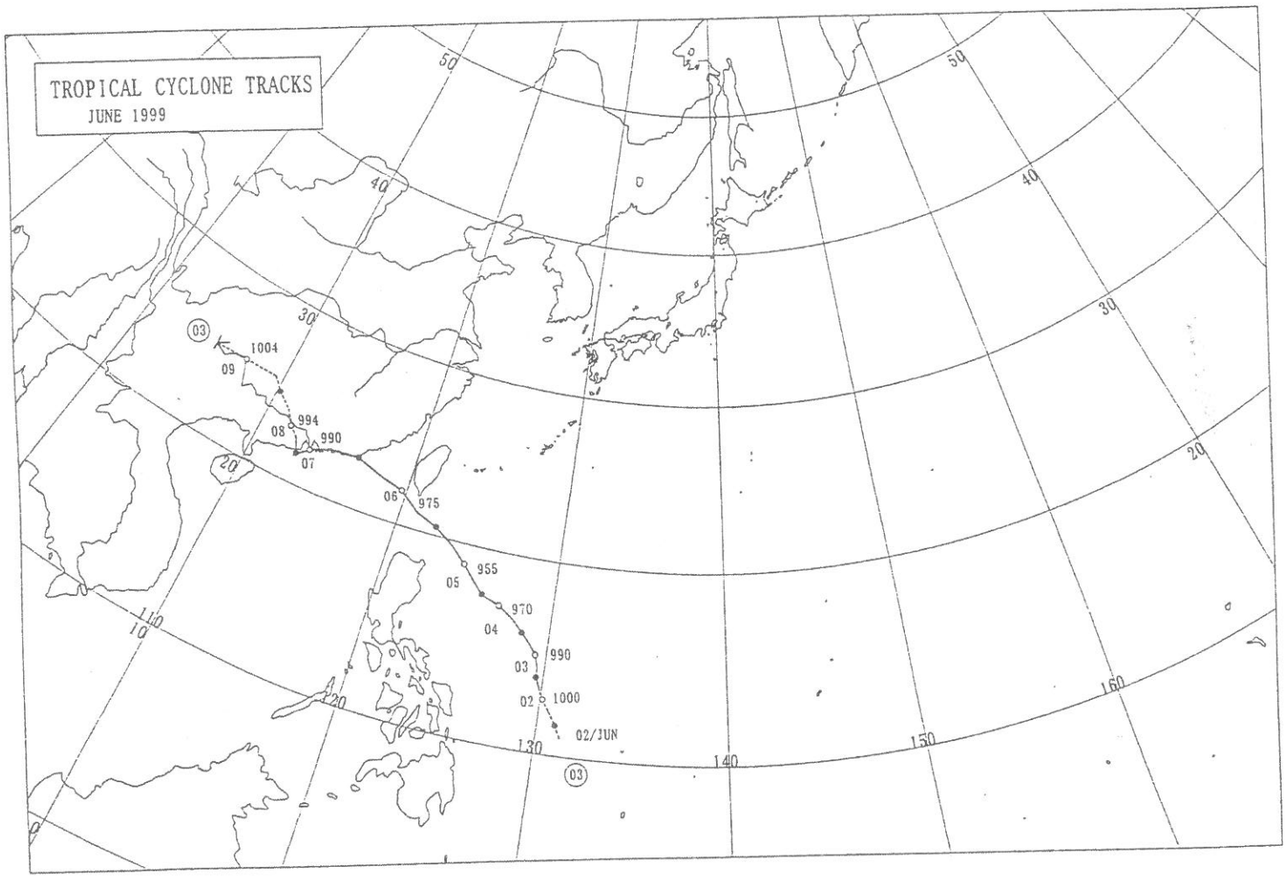
TY 9918 BART

A TD formed in the waters around 600 km south of Okinawa Island at 0000 UTC on 17 September. Moving toward the northwest, it reached TS intensity on 19 September and halted around 100 km south of Miyako Island on 20 September. BART steadily intensified to attain TY intensity on the day. On 21 September, BART began to move north-northeastward and made landfall on the northwestern Kyushu at 2100 UTC on 23 September with its peak intensity. BART then moved into the Sea of Japan with accelerating its speed. It made landfall on the western Hokkaido on 24 September and became an extratropical cyclone by 0300 UTC on 25 September.

TS 9919 CAM

A TD formed in the South China Sea at 1200 UTC on 22 September and moved northeastward. It reached TS intensity at 1200 UTC on the 24 September about 250 km south of Hong Kong and turned northward. CAM turned westward and made landfall about 30 km west of Hong Kong around 0200 UTC on 26 September. After the landfall, it quickly weakened to a TD and dissipated by 0000 UTC on 27 September.

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JUNE 1999
50
40
30
20
10
110
120
130
140
150
160
03
09
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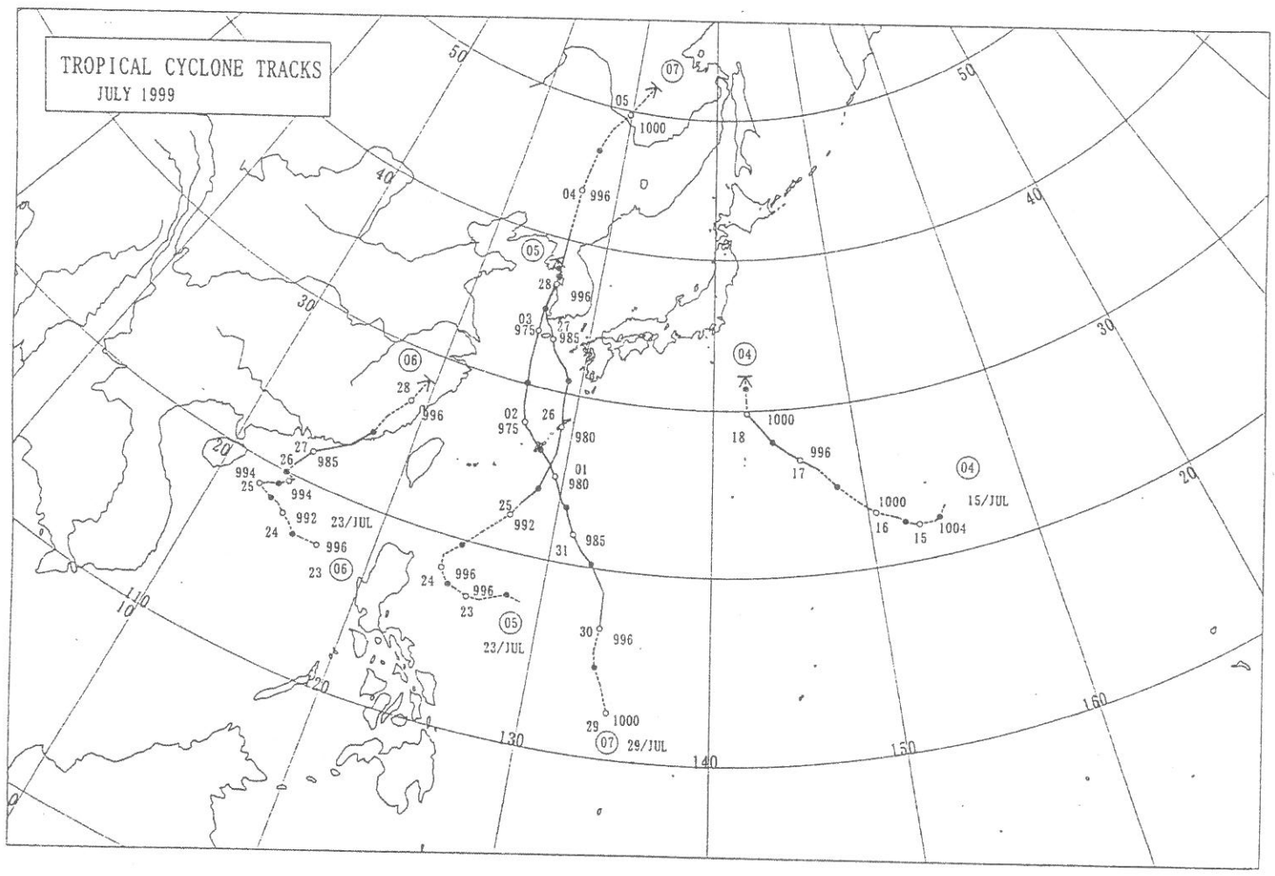
990
07
06
975
05
955
04
970
03
990
02
1000
02/JUN


TROPICAL CYCLONE TRACKS
JULY 1999
50
40
30
20
10
110
120
130
140
150
160
07
05
1000
04
996
05
28
996
03
975
27
985
06
28
996
02
975
26
980
01
980
25
992
31
985
30
996
29
1000
07
29/JUL
04
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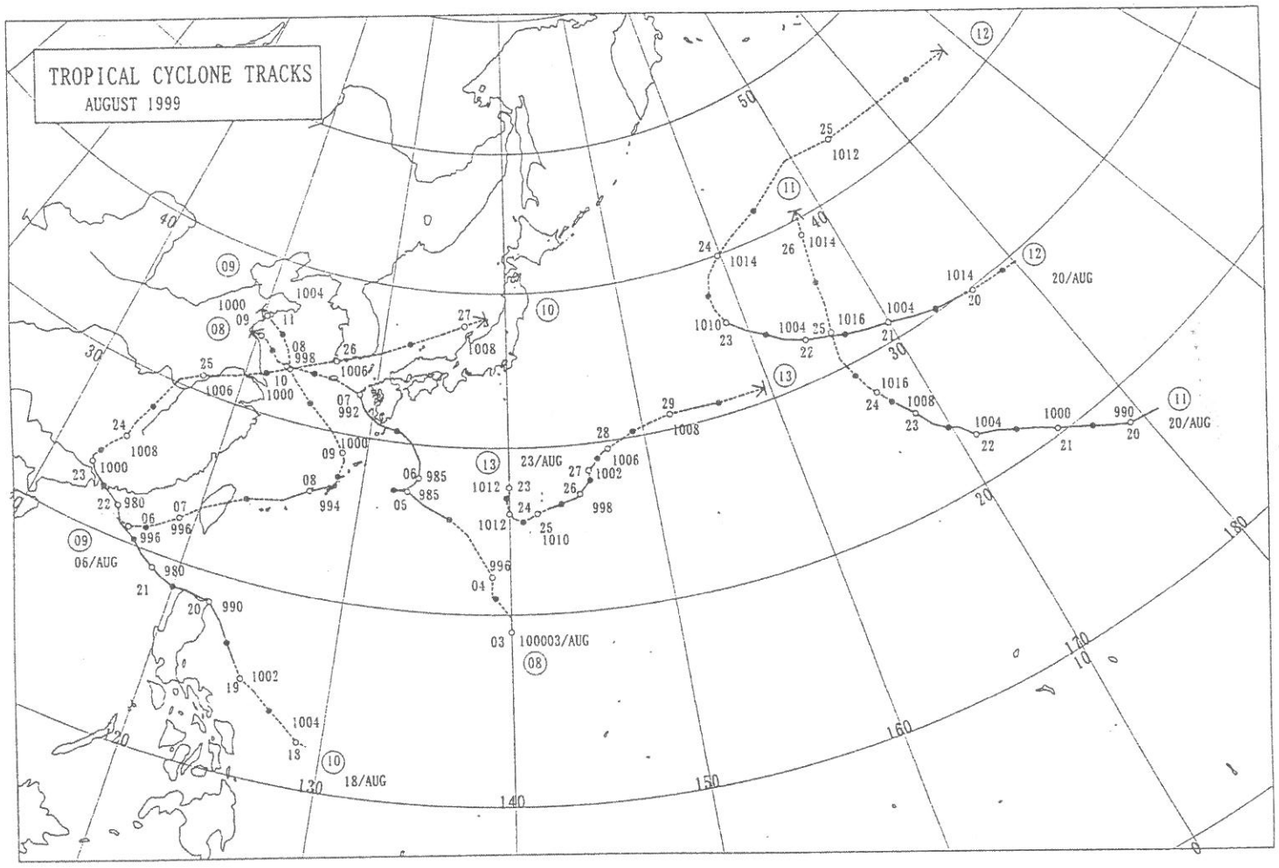
05
23/JUL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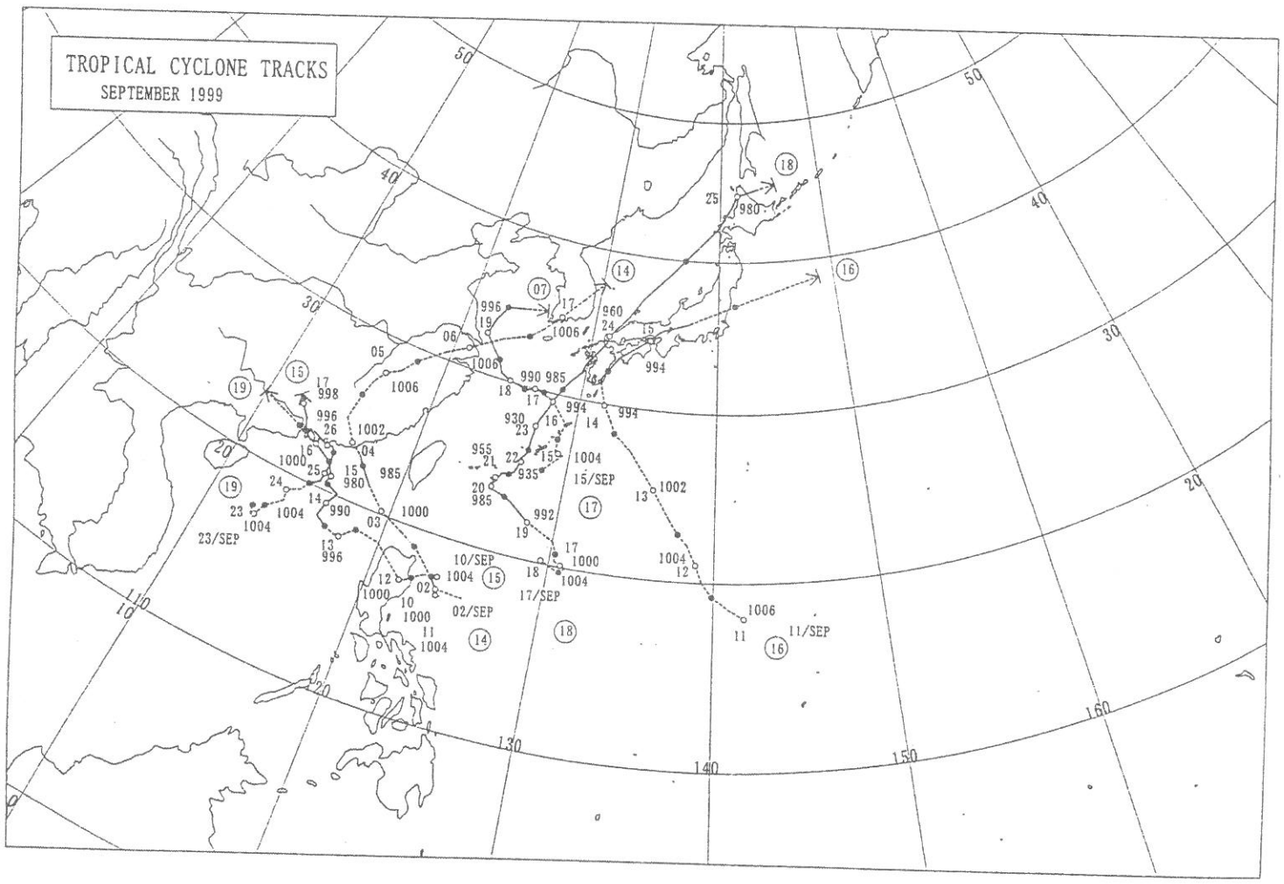
AUGUST 1999
06/AUG
18/AUG
23/AUG
20/AUG


TROPICAL CYCLONE TRACKS
SEPTEMBER 1999
23/SEP
02/SEP
10/SEP
11/SEP
15/SEP
17/SEP

APPENDIX XV

ACTIVITIES OF THE TROPICAL CYCLONE PROGRAMME (TCP)

In 1999, within the framework of the IDNDR and in the context of the Sustainable Development of Small Island Developing States, all five regional tropical cyclone bodies accelerated the implementation of their respective regional cooperation programmes, including the regionally coordinated plan for future development of services by the national Meteorological and Hydrological Services and the agencies involved in disaster prevention and preparedness. Each of the Tropical Cyclone RSMCs, i.e. Miami, Nadi, New Delhi, La Réunion and Tokyo, further strengthened their facilities and services to their respective regions. The Third RSMCs Technical Coordination Meeting, held in La Réunion in November, effectively coordinated and streamlined certain operational and technical aspects of tropical cyclone forecasting and advisory services across the various regions of the world.

Emphasis continued to be placed on the training of personnel, in particular forecasters, with a view to further promotion of capacity building through the development of human resources. Another in the series of RA IV Workshops on Hurricane Forecasting and Warning for Class I and Class II meteorologists took place at the RSMC Miami - Hurricane Center, in April. It was attended by 24 participants from 20 Members of the Hurricane Committee. The RA I Training Course on Tropical Cyclones for Members of the RA I Tropical Cyclone Committee for the South-West Indian Ocean, was held in La Réunion, in November. The Regional Workshop for Doppler Radars held in Hefei, China during December provided training for participants from Members of the Typhoon Committee and the Panel on Tropical Cyclones.

Coordination of the activities of the South Pacific Tropical Cyclone Warning Upgrade Project, funded by the European Union and of the RA V Tropical Cyclone Committee, with each carrying out work complementary to that of the other, was further enhanced, leading to accelerated progress in strengthening the warning systems in the South Pacific. These activities included a review of the functioning of the operational services in the Coral Sea sub-region by a jointly sponsored meeting held in Brisbane during November.

The Typhoon Committee adopted the use of Asian and Pacific names, in addition to a numbering system, to identify from the year 2000 onwards tropical cyclones in its region.

At the Twenty-sixth session of the Panel on Tropical Cyclones during March, the Maldives Meteorological Department was awarded the second annual Smith Tumsaroch Prize. This prize was instituted two years ago following on

receipt by Mr Tumsaroch of the 1997 Typhoon Committee Natural Disaster Prevention Award.

The TCP formulated the meteorological component and contributed to the disaster preparedness component of a project proposal on storm surge disaster reduction in the northern part of the Indian Ocean. Subsequently, the hydrological component of the project, including the interaction between storm surges and river flows and their combined effects were expanded, with input from Chy.

Two sub-projects were completed with the preparation and publication of reports on tropical cyclone-related NWP products and their guidance and estimating the amount of rainfall associated with tropical cyclones using satellite techniques. The reports will be widely distributed to Members and others concerned.

APPENDIX XVI

REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN (RCPIP)

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
1.	Meteorological Component	00	01	02	03			
1.1	***Support to Meteorological Observing Systems and Facilities***							
1.1.1	Expansion of observational programme: *With stress on radiosonde observations*	↔	↔	↔	↔	Members	National/External	Continuous activities
1.1.2	Maintaining services specified in the Operational Manual, including intensified observations (surface, upper-air and radars)	↔	↔	↔	↔	Members	National	Continuous activities
1.1.3	Provision of automated observation facilities and real-time telemetry of meteorological parameters, e.g., winds, rainfall, pressure, etc., by replacing with automatic instruments	↔	↔	↔	↔	Members	National	Continuous activities
1.1.4	Establishment of AMedas, ASDAR, anemometer, tide gauge and water recorder networks	↔	↔	↔	↔	Members	National	Continuous activities
1.1.5	Establishment/upgrading of satellite equipment (GMS/MTSAT/ TIROS-N/ FY2))					Members	National	The Multi-functional Transport Satellite (MTSAT) is to be put into operation in the next few years as the successor to the Geostationary Meteorological Satellite-5 (GMS-5)
1.1.6	Establishment of a WWW data user system for the reception of FAX and GPV data INTERNET or ISDN	↔	↔	↔	↔	Members	National	Continuous activities
1.1.7	Establishment/upgrading of weather radars	↔	↔	↔	↔	China	National	(CINRAD Implemented by 1999)
1.2	***Support to Meteorological Telecommunication Systems and Facilities***							
1.2.1	Establishment of a communication line to RSMC Data Serving System via Internet or ISDN for distribution of RSMC Tokyo grid point data	↔	↔	↔	↔	TC Members, WMO and ESCAP	National/External	Continuous activities. RSMC Data Serving System will be used for the distribution of large amount of data which are not transmitted for the time being

1. PART A. CONTINUING TASKS — Meteorological Component	TIME SCALE 00	01	02	03	BY WHOM	RESOURCES	REMARKS
1.2.2 Maintaining:							
Services and facilities for the real-time exchange of data and products	↔	↔	↔	↔	Members	National	Continuous activities
• Monitoring of data exchange	↔	↔	↔	↔	RTHs Bangkok, Beijing and Tokyo	Members concerned	Continuous activities
	↔	↔	↔	↔	RTH Bangkok, Vientiane-Hanoi	Members concerned	Continuous activities
1.2.3 Improvement of facilities and their operation as necessary for the rapid and reliable collection and distribution of the required observational and processed information	↔	↔	↔	↔	Members	National	Continuous activities
1.2.3.1 Improvement of data completeness and quality, including use of real-time and non real-time monitoring results for this purpose	↔	↔	↔	↔	Members	National	Continuous activity
1.2.3.2 Review of existing arrangements for dissemination of typhoon warnings with a view of introducing improvements where necessary	↔	↔	↔	↔	Members	National	Continuous activity
1.2.3.3 Improvement of national data collection and retransmission to associated RTHs	↔	↔	↔	↔	Member	National/External	
1.2.4 Expand U.S.A.'s EMWIN broadcast to cover TC area	↔	↔	↔	↔	U.S.A.	National	Commence in mid - 2000
1.2.5 Improvement in Member's capability in assessing information and knowledge via information and communication technologies (ICTs)	↔	↔	↔	↔	Members	National/External	Continuous activities
1.3 Requirements Specifically for Tropical Cyclone Forecasting and Warning							
1.3.1 Continuing provision and dissemination of processed information, advisories and other products needed by TC Members for	↔	↔	↔	↔	RSMC Tokyo-Typhoon Center	Japan	Continuous activity

1. PART A. CONTINUING TASKS — Meteorological Component	TIME SCALE 00	01	02	03	BY WHOM	RESOURCES	REMARKS
their forecasting and warning systems, archival of information on typhoon data in accordance with the TC Typhoon Operational Manual							
1.3.2 Exchange of forecasts including products of different objective methods in accordance with the TC Typhoon Operational Manual	↔	↔	↔	↔	Members	National	Continuous activity
1.3.3 Enhancement of cooperation in typhoon monitoring, forecasting and warning	↔	↔	↔	↔	Members	National	Continuous activity
1.3.4 Establishment of a regional computer network	↔	↔	↔	↔	Members	National and external assistance	
1.3.5 Installation of a computer processing system in view of integrating satellite, radar and rainfall data so as to provide spatial distribution of rainfall amount over a large region	↔	↔	↔	↔	Member	National and external assistance	TCDC, technical consultancy and assistance from external sources would be required
1.3.6 Setting up of electronic equipment maintenance and repair workshops	↔	↔	↔	↔	Members	National and external assistance including TCDC	Continuous activities
1.3.7 Promotion of development at the interface between the meteorological warning services and the users of warnings for increasing the impact and effectiveness of these services	↔	↔	↔	↔	Members	National and external assistance in conjunction with IDNDR	Continuous activities
1.3.8 Dissemination of observational data, advisories and grid point values of NWP models needed by TC Members for their forecasting and warning systems via the Multifunctional Transport Satellite (MTSAT)					RSMC Tokyo-Typhoon Center	Japan	The Japan Meteorological Agenc (JMA) will start to disseminate th above data and products with th Low Rate Information Transmissio (LRIT) of the MTSAT in the ne few years.

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
2.	Hydrological Component	00	01	02	03			
2.1	***Flood Forecasting and Warning***							
2.1.1	Installation and operation networks of observing stations required for flood forecasting systems	↔	↔	↔	↔	Members	National	Continuous activity
2.1.2	Establishment and operation of flood forecasting and warning system	↔	↔	↔	↔	Members	National	Continuous activity
2.1.3	Establishment of flood forecasting and warning systems for dam operations	↔	↔	↔	↔	Interested Members	National and external assistance	
2.1.4	Establishment of flood forecasting and warning systems for inundation from storm surges	↔	↔	↔	↔	Members concerned	Members concerned and external assistance including TCDC	Includes interaction of river floods and storm surges
2.1.5	Monitoring of/and reporting on performance of existing flood forecasting systems	↔	↔	↔	↔	Members	National and external assistance including TCDC and with support of TCS and WMO	Coordinated by WMO, using MOFFS
2.1.6	Further improvement of existing flood forecasting and warning systems, making use, where appropriate, of the results of TOPEX	↔	↔	↔	↔	Members	Members concerned and external assistance including TCDC	Includes catchment modeling
2.1.7	Implementation of recommendations of mission by experts to provide technical guidance on items 2.1.1 to 2.1.6	↔	↔	↔	↔	Members	External assistance, Missions to be organized by WMO and ESCAP	Using, where appropriate, technology available through HOMS
2.1.8	Exchange of technical visits among flood forecasters	↔	↔	↔	↔	Members	National and external assistance	Coordinated by WMO
2.1.9	Development and application of guidance on hydrological technology models for tropical cyclone regions	↔	↔	↔	↔	Members	External assistance with WMO	On the basis of OHP (HOMS)
2.1.10	Development and use of improved techniques for Quantitative Precipitation Forecast (QPF) taking advantage of data provided by satellite and radar	↔	↔	↔	↔	Members	National and external assistance	WMO to assist in development and promulgation of improved techniques

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
2.	Hydrological Component	00	01	02	03			
2.1.11	Improvement/expansion of existing flood forecasting and warning system	↔	↔	↔	↔	Members	National and external assistance	WMO to assist
2.1.12	Rehabilitation/upgrading of old/outmoded flood forecasting and warning system	↔	↔	↔	↔	Members	National and external assistance	WMO to assist
2.2	***Comprehensive Flood Loss Prevention and Management***							
2.2.1	Establishment of pilot area for comprehensive flood loss prevention and management	↔	↔	↔	↔	Members	Bilateral or multilateral support if available	Detailed programme will be established by respective Members
2.2.2	Investigation and survey including:					Members	National	ESCAP and WMO to assist in organizing investigations and surveys
	• Determination of flood-prone areas subject to heavy damages	↔	↔	↔	↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
	• Determination of magnitude and corresponding frequency of floods in each flood-prone area	↔	↔	↔	↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
	• Assessment of potential flood damage in each area for various flood magnitudes	↔	↔	↔	↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
	• Preparation of flood risk maps	↔	↔	↔	↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
2.2.3	Application of the manual and guidelines for/and dissemination of techniques for comprehensive flood loss prevention and management	↔	↔	↔	↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.4	Implementation of selected aspects of comprehensive flood loss prevention and management	↔	↔	↔	↔	Members	National and external assistance	With assistance of ESCAP and WMO

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
2.	Hydrological Component	00	01	02	03			
2.2.5	Mission of experts to provide technical guidance to Members on items 2.2.1 to 2.2.4 above	↔	↔	↔	↔	Members	UNDP, TCDC and bilateral, multi-lateral support if available	With assistance of ESCAP and WMO
2.2.6	Preparation and application of a manual and guidelines for integrated river system development and management with reference to comprehensive flood loss prevention and management	↔	↔	↔	↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.7	Preparation of guidelines for the formulation of a comprehensive master plan for urban flood loss prevention and mitigation	↔	↔	↔	↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.8	Storm surge prediction and risk analysis	↔	↔	↔	↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.9	Improvement of dam water release operation system	↔	↔	↔	↔	Members	National and external assistance	With assistance of TCS, ESCAP and WMO

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
3.	Disaster Prevention and Preparedness	00	01	02	03			
3.1	***Public Awareness***							
3.1.1	Improvement of public awareness on typhoon and flood threat and preparedness coupled with studies of human response to warnings	↔	↔	↔	↔	Members	National and external assistance in conjunction with IDNDR	With advice and assistance of OCHA/IFRC/WMO and other agencies concerned
3.1.2	Production of materials (audio-visual aids, pamphlets and book-lets) related to public information and education	↔	↔	↔	↔	Members	National and external assistance	Work under the WMO TCP projects 12 and 14 is also revenant
3.2	***Disaster Management***							
3.2.1	Establishment/upgrading of national disaster prevention and preparedness plans	↔	↔	↔	↔	Members	Bilateral or multilateral support if available	With advice, and if possible, support from ESCAP
3.2.2	Strengthening national coordination and cooperation between departments and agencies involved in DPP activities	↔	↔	↔	↔	Members	National	
3.2.3	Improvement in the timely dissemination of warnings of typhoons, floods and storm surges with particular attention to remote areas	↔	↔	↔	↔	Members	National	
3.2.4	Improvement of communication systems for warning dissemina-tion and relief operations	↔	↔	↔	↔	Members	Bilateral or multilateral support if available	
3.2.5	Improvement of damage assessment and reporting	↔	↔	↔	↔	Members	Multilateral support if available	With advice from ESCAP and OCHA
3.2.6	Development and exchange of information and guidance mater-ials on structural and non-structural measures for mitigation of disasters	↔	↔	↔	↔	Members	External assistance	With guidance from international agencies, such as, OCHA, IFRC, ESCAP and WMO
3.2.7	Conducting case studies of response to major disasters	↔	↔	↔	↔	Members	External assistance	With advice from OCHA, IFRC, and WMO
3.2.8	Compilation of annual information on loss of life and	↔	↔	↔	↔	Members	External assistance	With advice from OCHA in co-operation with ESCAP

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
3.	**Disaster Prevention and Preparedness**	00	01	02	03			
	damage caused by typhoons, floods and storm surges including damage to houses, public facilities, agricultural products, and so on							
3.2.9	Where appropriate, implementing the recommendations of joint missions and seminars to evaluate DPP procedures and to provide advice on local problems	↔	↔	↔	↔	Members	Bilateral or multilateral support if available	
3.2.10	Production of material related to public information and education on the Typhoon Committee activities, particularly storm warning and DPP	↔	↔	↔	↔	Members	External Assistance in conjunction with IDNDR	With support of ESCAP, WMO and TCS

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
4.	**Training Component**	00	01	02	03			
4.1	*Meteorology*							
4.1.1	Training on engineering application of tropical cyclone climatological data	↔	↔	↔	↔	Members	External assistance	Conferences, seminars and overseas training programmes, including roving missions and arrangements
4.1.2	Training on applications of radar and satellite data in tropical cyclone tracking, forecasting and very short-range precipitation forecasts	↔	↔	↔	↔	Members	External assistance	
4.1.3	Training in calibration, maintenance and repair of electronic meteorological instrumentation	↔	↔	↔	↔	Members	National and external assistance	Coordinated by WMO
4.1.4	Training on utilization of software for integrating satellite/radar/rainfall data	↔	↔	↔	↔	Members	Short-term fellowships with external support	Coordinated by WMO
4.1.5	Training of quantitative precipitation forecast (QPF) models					Members	Short-term fellowships with external support	Coordinated by WMO
4.1.6	Training of personnel through fellowships on tropical cyclone forecasting	↔	↔	↔	↔	Members	UNDP, WMO and other international organizations concerned	Coordinated by WMO
4.1.7	Other courses and seminars organized WMO and Members	↔	↔	↔	↔	Members	UNDP, WMO and other international organizations concerned	Coordinated by WMO
4.1.8/I	Group training courses in meteorology	↔	↔	↔	↔	Japan	JICA	Japan International Cooperation Agency
4.1.8/II	Group training workshop on hurricane forecasting and warning	↔		↔		USA/WMO	TCTF and WMO	Every two years for two weeks
4.1.9/I	Exchange of forecaster(s) between tropical cyclone forecasting and warning centers	↔	↔	↔	↔	Members	External assistance	Through TCDC arrangement
4.1.9/II	Attachment of operational forecast to RSMC Tokyo			↔	↔	Japan	TCTF and WMO	During typhoon high season

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
4.	**Training Component**	00	01	02	03			
4.1.10	Training on observing technology	↔	↔	↔	↔	Members	External support	Seminars
4.1.11	Exchange of meteorological experts between Members other than 4.1.9 above	↔	↔	↔	↔	Members	Bilateral or TCDC arrangements	
4.1.12	Training course on weather forecasting	↔	↔			Republic of Korea	KOICA	
4.1.13	Training on storm surge and wave prediction	↔	↔	↔	↔	Members	Short-term fellowships with external support	
4.1.14	Training in message-switching, wave forecasting, numerical weather prediction and cloud physics, through attachments	↔	↔	↔	↔	Members	External assistance	TCDC arrangements
4.1.15	Training personnel through fellowships on maintenance of electronic meteorological and hydrological equipment	↔	↔	↔	↔	Members	External assistance	
4.2	***Hydrology***							
4.2.1	Training on repair and maintenance of electronic equipment used in flood forecasting and warning	↔	↔	↔	↔	Members	WMO, UNDP and other sources	Roving seminars to be organized by WMO
4.2.2	Training on advanced techniques for flood forecasting and warning associated storms, including hardware and software	↔	↔	↔	↔	Members	WMO, UNDP and other sources	Courses and seminars to be organized by WMO
4.2.3	Training in hydrology with emphasis on flood forecasting	↔	↔	↔	↔	Members	WMO, UNDP and other sources	Courses and seminars to be organized by WMO
4.2.4	Training on personnel through fellowships on flood loss prevention	↔	↔	↔	↔	Members	WMO, UNDP and other sources	Courses and seminars to be organized by WMO
4.2.5	Training on appropriate topics relating to flood loss prevention and management	↔	↔	↔	↔	Members	ESCAP, UNDP and other sources	Seminar to be organized by ESCAP
4.2.6	Training on observation techniques	↔	↔	↔	↔	Members	WMO, UNDP and other sources	Courses and seminars to be organized by WMO

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
4.	**Training Component**	00	01	02	03			
4.2.7	Group training course on river and dam engineering	↔	↔	↔	↔	Japan	Japan International Cooperation Agenic (JICA)	At the request of TC
4.2.8	Exchange of flood forecasting experts	↔	↔	↔	↔	Members	WMO, ESCAP, UNDP and other sources	TCDC requirements
4.3	***Disaster Prevention and Preparedness***							
4.3.1	Training of disaster managers and volunteer leaders	↔	↔	↔	↔	Members	National and external assistance	With advice from international agencies
4.3.2	Test exercises	↔	↔	↔	↔	Members	National and external assistance	With advice from international agencies
4.3.3	Training in Disaster Prevention and Preparedness (DPP)	↔	↔	↔	↔	Members	External assistance	Regional seminars organized by TCS with help of OCHA, IFRC, ESCAP and WMO
4.3.4	Exchange of information on the socio-economic impact of disaster	↔	↔	↔	↔	Members	OCHA, IFRC	Seminars organized by OCHA, IFRC and WMO
4.3.5	Training on disaster vulnerability and risk assessment	↔	↔	↔	↔	Members	OCHA, IFRC	Courses and seminars organized by OCHA, IFRC and ESCAP
4.3.6	Group training course on disaster mitigation and restoration system for infrastructure	↔	↔	↔	↔	Japan	JICA	At the request of TC
4.3.7	Exchange of DPP personnel	↔	↔	↔	↔	DHA, IFRC, TCS and ESCAP	OCHA, IFRC, ESCAP and other sources	TCDC arrangement organized by OCHA, IFRC, TCS and ESCAP

PART A. CONTINUING TASKS 5. Research Component	TIME SCALE 00	 01	 02	 03	BY WHOM	RESOURCES	REMARKS
5.1 Meteorology							
5.1.1 General studies on:							
5.1.1.1 Interaction between typhoons and the environmental circulation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.2 Typhoon climatology in relation with anomalies in regional circulation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.3 Forecasting storm surge and heavy rainfall	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.4 Tropical cyclone related rainfall and intensity rates aimed at detection of possible relationship to global climate change	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2 Utilization of TOPEX, SPECTRUM, TCM-90 and TYPHOON-90 data set in tropical cyclone numerical and physical modeling, with the aim of improving existing methods of predicting formation, development and steering	↔	↔	↔	↔	Members or regionally coordinated programme	National	Need for short-term attachment of experts to advanced centers in the typhoon region
5.1.2.1 Establishment and operation of a tropical cyclone data bank for the northwestern Pacific and East Asia with software exchanges between Members	↔	↔	↔	↔	RSMC Tokyo	Japan	According to the procedure described in TOM
5.1.2.2 Development of an operational NWP model for typhoon movement and development	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.3 Irregular tropical cyclone behavior, such as, sudden turning of tracks, sudden increase/decrease of intensity, rainfall and storm surge	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.4 Air-sea interactions associated with the occurrence of typhoons, with emphasis on wave and storm surge generation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.5 Study on typhoon-related wind climatology	↔	↔	↔	↔	Members	National	

PART A. CONTINUING TASKS 5. Research Component	TIME SCALE 00	 01	 02	 03	BY WHOM	RESOURCES	REMARKS
5.1.2.6 Study on climatology of precipitation extremes	↔	↔	↔	↔	Members	National	
5.1.2.7 Encourage participation in the works of the CAS working group	↔	↔	↔	↔	Members	National	
5.1.2.8 Encourage members to provide the CAS Committee on Climate Change Aspects of Tropical Cyclones relevant data sets for their consideration	↔	↔	↔	↔	Member	National	
5.2 Hydrology							
5.2.1 Application of meteorological inputs to flood forecasting	↔	↔	↔	↔	National or regionally coordinated programmes	National	In cooperation with ESCAP
5.2.2 Study of effects of deforestation, urbanization and changing land use on the hydrology of the catchment and on the intensity of floods	↔	↔	↔	↔	Members	National	In cooperation with ESCAP
5.2.3 Research on hydrological aspects of ENSO phenomena	↔	↔	↔	↔	Members	National and external resources	In cooperation with ESCAP, WMO, OCHA and other concerned agencies
5.2.4 Study on physically-based flood simulation models	↔	↔	↔	↔	National or regionally coordinated programmes	National and external resources	In cooperation with ESCAP, WMO, and other concerned agencies
5.3 Disaster Prevention and Preparedness							
5.3.1 Studies on the socio-economic impact of typhoon and flood disasters	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.2 Vulnerability and risk assessment of disaster-prone areas	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.3 Socio-economic implication of availability and quality of typhoon and flood forecasts and warnings	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.4 Disaster impact modelling	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
5.	Research Component	00	01	02	03			
5.3.5	Natural Disaster Insurance System	↔	↔	↔	↔	National or Regionally Coordinated Programme	National	With advice and possible support of UNDP, WMO and other international organizations concerned
5.3.6	Study on Flood Control Method for disaster prevention	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, WMO and other international organizations concerned
5.3.7	Preparedness for social and economic aspects of ENSO	↔	↔	↔	↔	Members	National	With advice and possible support of OCHA, ESCAP, WMO and other concerned agencies

PART B. SPECIFIC TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
1.	Meteorological Component	00	01	02	03			
1.1	***Support to Meteorological Observing Systems and Facilities***							
1.1.1	CAS aerosonde field development and testing (typhoon reconnaissance by unmanned aerial vehicles) in the western North Pacific region as a Typhoon Committee Project	↔	↔	↔	↔	CAS	Possible Regional Consortium/Individual countries	Field experiment in 2000
1.2	***Support to Meteorological Telecommunication Systems and Facilities***							
1.2.1.1	Establishment of regional telecommunication links							
	• Bangkok - Cambodia					Thailand and Cambodia	National and external assistance	Need donors
	• Bangkok - Vientiane	↔	↔	↔	↔	Lao DPR	External assistance	
	• Seoul - Pyongyang					ROK and DPRK	National	Depending on bilateral discussion
1.2.1.2	• Upgrading of telecommunication circuit linking Hanoi and Bangkok from 1200 bps to 2400 bps - 9600 bps	↔	↔	↔	↔	Vietnam	National and external assistance	Continuous activity
	• Upgrading of telecommunication circuit between Hanoi and Beijing with speed of 2400 - 9600 bps					Vietnam	National and external assistance	Speed is under negotiation

	PART B. SPECIFIC TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
		00	01	02	03			
2.	**Training Component**							
2.1	***Meteorology***							
2.1.1	Satellite meteorology	↔				China	China	Training course recently completed in 1998
2.1.2	Regional Workshop on Doppler Tropical Cyclone Radars	↔				China	Thailand and external	Organized by TCS and TSU in cooperation with WMO during 7-10 December 1999
2.1.3	Short training attachment on specific subjects			↔	↔	Hong Kong, China		
	Training of Class II meteorologists in Applied Meteorology	↔	↔	↔	↔	Hong Kong, China	TC members may be waive of tuition subject to availability of space	
2.1.4	Training course on weather forecasting for operational meteorologists in the Asia-Pacific region (~ 3 weeks)	↔	↔	↔	↔	Republic of Korea	Republic of Korea	Under VCP
2.1.5	Attachment of operational forecasters to NMC or RSMC	↔	↔	↔	↔	China	Members concerned	One month attachment to NMC or RSMC during the peak of the typhoon season

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

	PART B. SPECIFIC TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
		00	01	02	03			
3.	**Research Component**							
3.1	***Meteorology***							
3.1.1	Set-up TC Research Fellowship Scheme					Members	Members and other sources	TRCG to assist

APPENDIX XVII

REPORTS OF TYPHOON RESEARCH COORDINATING GROUP (TRCG)

Introduction

1. The TRCG completed its involvement in the development of the list of tropical cyclone names (see WRD/TC.32/5).

2. According to its terms of reference, the TRCG is required among other things to identify problems in the operational analysis and forecasting of tropical cyclones, to report on recent developments in related research activities, to promote research addressing common problems, and to suggest key research projects for Typhoon Committee consideration. Development in these areas is summarized in Annex 1.

REPORT OF TYPHOON RESEARCH COORDINATION GROUP, 1999

Identification of Problems

1. The TRCG presented to the 30th session of Typhoon Committee a list of areas requiring research (see Annex). Consultation with TRCG members indicates that the list still reflect the current situation in the region. Based on returns from members, the following areas are either receiving priority attention or considered to be particularly challenging:

   (a) unusual movement of tropical cyclones

   (b) forecasting of gusts and heavy rain

   (c) forecasting of intensity change

   (d) relationship with El Niñno and monsoon

   (e) weather effect of distant tropical cyclones

Recent Research Activities of Members

2. On unusual movement, research in the region shows that inner asymmetric structure in terms of both wind and mesoscale deep connective systems are significant factors. Both hydrostatic and non-hydrostatic models are being applied to simulate the detailed structure of tropical cyclones. Work is being done to introduce asymmetric tropical cyclones as bogus data in order to improve track forecasting. Experiments with ocean models coupled to tropical cyclone models are being conducted in the region.

3. On the forecasting of heavy rain, different groups have independently identified the interaction between tropical cyclones and mid-latitude frontal systems as a situation conducive to severe rainstorms. Research is being conducted through both observational and modelling studies. Other groups have chosen to attack the problem of heavy rain as a "nowcasting" issue and developed radar-based quantitative precipitation forecasting systems.

4. On intensity forecasting, numerical modelling is beginning to show some promise and operational guidance is emerging. However, there is still much room for improvement.

5. Typhoon Committee Members reported their work on the relationship between El Nino and tropical cyclones as well as flood and drought at the Typhoon Committee Workshop on the Impact of the El Niño-Southern Oscillation - La Niña Phenomena on Meteorology and Hydrology in the Typhoon Committee Area held in Macau, 29 June to 1 July 1999 (detailed report in WRD/TC.32/7). The overall picture from the presentations is that El Niño is linked to suppressed tropical

cyclone activity in the western North Pacific and to a higher probability of individual tropical cyclones impacting Members at low latitudes. Furthermore, El Nino is linked to drought in Thailand, Philippines and areas further south while it is thought to be related to floods in China like what happened in the summer of 1998. Further north in the region, El Niño is linked to warmer winter and spring but the signal in terms of rain is less clear. Generally speaking, El Niño is seen as a significant factor influencing the region's weather in the seasonal time scale.

6. On the relation between tropical cyclones and the monsoon, research indicates that the strength of the Meiyu in China (also known as Baiu in Japan) and tropical cyclone activity is negatively correlated.

7. On the basis of such studies on tropical cyclone activity in relation to large-scale, long-term phenomena, experimental prediction of tropical cyclone activity on a seasonal scale has begun in the region. It is based on a combination of conceptual models with physical basis as well as statistical methods and dynamical model products.

8. On climate change and tropical cyclone occurrence, there are as yet no conclusive results. Some global circulation model studies suggest that global warming will bring about fewer tropical cyclones, each bringing more rain. But other groups have shown different results. Further work has to be done to solve the problem.

9. Studies by Members located in the lower latitudes have repeatedly showed that distant tropical cyclones could be associated with strengthened monsoon winds, giving rise to heavy rain and associated devastation. This is therefore an area deserving attention.

Promoting Research

10. Through correspondence, TRCG has explored among its members what might be done to promote research. An idea about cooperative research among Members has been floated. For the sake of convenience, the idea is labeled tentatively as Typhoon Committee Research Fellowship Scheme and is outlined below :

    (a) TRCG would establish at the beginning of each year through correspondence 2 to 3 priority research topics;

    (b) TRCG would identify at the same time centres willing to receive researchers ("Typhoon Committee Research Fellows") from other Members to work on those topics for a period of time;

    (c) With this information, Typhoon Committee Secretariat would circulate invitation to Members to solicit nominations;

    (d) The host centres would decidé on the selection of TC Research Fellows;

    (e) Then TC Research Fellow would work on the chosen topic at the hosting centre, aiming at producing a scientific paper at the end of the fellowship for publication in a journal;

(f) The hosting centre would provide computing and other relevant facilities as well as a counterpart researcher to work alongside the TC Research Fellow;

(g) Part of the joint research work could be conducted by "correspondence", making use of present day information technology and telecommunication techniques.

11. The proposed scheme is expected to strengthen the exchange of experience and expertise among Members as well as to contribute towards the solution of problems common to Members. The hosting centre will benefit from fresh ideas and new perspectives from the visitor. The visiting researcher will benefit from the opportunity of being able to concentrate his effort on a specific problem in an environment supportive of this effort. The region as a whole will benefit from the building up of the spirit of cooperative research and the synergy of different skills and experience scattered around the region.

12. The success of the proposed idea will depend on centres willing to play host and researchers willing to work with partners from other Members, either as TC Research Fellow or as counterpart researcher at the hosting centre. It will also depend on funding to support the Research Fellows.

13. It is understood that some Members have begun adopting the concept of "open laboratories", which provide opportunities for the proposed TC Research Fellowship Scheme to be implemented. On funding, potential sources are VCP and sponsorship by the host Member or nominating Member.

14. Before the idea could be developed further, the Typhoon Committee is invited to give guidance in respect of feasibility and institutional arrangements.

Other Suggestions

15. TRCG members have made other suggestions viz.:

(a) establishing a uniform historical data archive for tropical cyclones in the Typhoon Committee area;

(b) producing annually a CD containing observational data and gridded analysis data related to tropical cyclones affecting Members.

Annex: Typhoon Research Coordinating Group - Research Topics and Related Activities

TYPHOON RESEARCH COORDINATING GROUP
RESEARCH TOPICS AND RELATED ACTIVITIES

Topic 1 - Tropical Cyclone Forecasting

Unusual motion
Sudden intensity changes
Landfall forecast (48-hour lead time)
Core structure
Interaction with the environment
Low-latitude tropical cyclones

Topic 2 - Hazards associated with Tropical Cyclones

Wind field assessment
Gusts and squalls
Heavy rain (include QPF)
Storm surge
Ocean waves
Risk assessment

Topic 3 - Observations and Operational Aspects

Solution for areas with scanty conventional data
New observation platforms (wind profilers, Doppler radar, dropsonde, water vapour channel, satellite winds) - sharing of data and applications
Position fix (integration of diverse data to get position and intensity)
Standardization of data and warning format
supplementary objective tools for correction of model bias

Topic 4 - NWP Aspects

Numerical traits
Track bias
Intensity forecast
Interpretation of prognostic products, including local topographic effects
Incorporation of non-conventional data in NWP models
Bogussing techniques

Topic 5 - Large-scale effects and Long Term Changes

Relationship with SST and El Niño and possible mechanism
Interannual variability
Relationship with monsoon variability (and SCSMEX)
Climate change and tropical cyclones

TROPICAL CYCLONE NAMING SCHEME FOR THE WESTERN NORTH PACIFIC AND SOUTH CHINA SEA

Introduction

1. Following the adoption of the new naming scheme by Typhoon Committee at its 31st session at Quezon City (1-7 December 1998), TRCG collated information on the meaning and/or origin of the names as well as their pronunciation, and communicated it to the Typhoon Committee Secretariat (TCS) for the production of relevant publicity material.

2. Requests for minor spelling changes for a few names from the originating Members were received. TCS coordinated consultation with Members for endorsement. The final list is given in Annex 3.

3. For ready reference by TRCG members and other interested parties, a web page was created and hosted by the Hong Kong Observatory :

   http://www.weather.gov.hk/informtc/sound/tcname2000e.htm

   The pronunciation of the names in the original language, where available from the Member concerned, is provided in voice in the web page to help the international broadcasting community.

4. Representatives from China; Hong Kong, China; and Macao met in Beijing (31 March – 1 April 1999) and developed a common Chinese translation of the list of names. This will ensure uniformity of practice and to avoid confusion to Chinese-speaking travellers in the region.

Action Proposed

The Committee is invited to :

(a) note the list of names for implementation in 2000 (Annex 3)

(b) discuss any proposal which Members might wish to make on changes to the list for implementation in 2001 and beyond

(c) discuss how the naming scheme might be further publicized

Appendix: List of Tropical Cyclone Names

TROPICAL CYCLONE NAMES IN THE
WESTERN NORTH PACIFIC AND SOUTH CHINA SEA
(WITH EFFECT FROM 1 JANUARY 2000)

	I	II	III	IV	V
Contributed by	Name	Name	Name	Name	Name
Cambodia	Damrey	Kong-rey	Nakri	Krovanh	Sarika
China	Longwang	Yutu	Fengshen	Dujuan	Haima
DPR Korea	Kirogi	Toraji	Kalmaegi	Maemi	Meari
Hong Kong, China	Kai-tak	Man-yi	Fung-wong	Choi-wan	Ma-on
Japan	Tembin*	Usagi	Kammuri*	Koppu	Tokage
Lao PDR	Bolaven	Pabuk	Phanfone	Ketsana	Nock-ten
Macau	Chanchu	Wutip	Vongfong	Parma	Muifa
Malaysia	Jelawat	Sepat	Rusa	Melor	Merbok
Micronesia	Ewiniar*	Fitow	Sinlaku	Nepartak	Nanmadol
Philippines	Bilis	Danas	Hagupit	Lupit	Talas
RO Korea	Kaemi*	Nari	Changmi	Sudal	Noru
Thailand	Prapiroon	Vipa	Megkhla	Nida	Kularb
U.S.A.	Maria	Francisco	Higos	Omais	Roke
Viet Nam	Saomai	Lekima	Bavi	Conson	Sonca
Cambodia	Bopha	Krosa	Maysak	Chanthu	Nesat
China	Wukong	Haiyan	Haishen	Dianmu	Haitang
DPR Korea	Sonamu	Podul	Pongsona	Mindulle	Nalgae
Hong Kong, China	Shanshan	Lingling	Yanyan	Tingting	Banyan
Japan	Yagi	Kajiki*	Kujira*	Kompasu	Washi
Lao PDR	Xangsane	Faxai	Chan-hom	Namtheun	Matsa
Macau	Bebinca	Vamei	Linfa	Malou	Sanvu
Malaysia	Rumbia	Tapah	Nangka	Meranti	Mawar
Micronesia	Soulik	Mitag	Soudelor	Rananim	Guchol
Philippines	Cimaron	Hagibis	Imbudo	Malakas	Talim
RO Korea	Chebi	Noguri	Koni	Megi	Nabi
Thailand	Durian	Ramasoon	Hanuman	Chaba	Khanun
U.S.A.	Utor	Chataan	Etau	Kodo	Vicente
Viet Nam	Trami	Halong	Vamco	Songda	Saola

*Spelling slightly modified at the request of the originating Member

APPENDIX XVIII

REPORT AND RECOMMENDATIONS OF THE WORKSHOP ON THE EL NINO SOUTHERN OSCILLATION (ENSO)/ LA NINA IMPACT ON METEOROLOGY AND HYDROLOGY IN THE TYPHOON COMMITTEE AREA 29 JUNE – 01 JULY 1999, MACAO

At the kind invitation of the Government of Macao, the Workshop on the Impact of the El Niño Southern Oscillation (ENSO)/La Niña on Meteorology and Hydrology in the Typhoon Committee Area was held in Macao from 29 June to 01 July 1999. The workshop was attended by 26 participants, an invited lecturer and 2 observers.

The workshop reviewed the impact of El Niño and La Niña events on Typhoon Committee Members. A number of scientific and technical lecturers were presented as well as reports on national experiences.

The focus of the workshop was on the following subjects:

- Climate situation and weather anomalies
- Social and economic impacts of recent ENSO events
- Water resources status and its planning and management
- ENSO-tropical cyclone relationship
- Early warning systems

Session 1: OPENING OF THE WORKSHOP

The opening was addressed by representatives of the host Government, Economic and Social Commission for Asia and the Pacific (ESCAP) and World Meteorological Organization (WMO). Eng. Jose Alves de Paula, Undersecretary for Transportation and Public Works of Macao, welcomed all participants. The representative of ESCAP delivered the message of the Executive Secretary of ESCAP of the United Nations while the representative of WMO delivered the statement on behalf of the Secretary-General of WMO.

Election of Officers

Dr. Wen Lam Chang (Hong Kong, China) was unanimously elected as Workshop Chairman and Dr. Chew Kian-Hoe (Singapore) as the Vice-Chairman. Ms. Sandy Song (Hong Kong, China) was elected as Workshop Rapporteur.

Adoption of the Agenda

The workshop adopted the agenda as shown in Annex I of this Appendix.

Major Agenda items

Session 2: EVOLUTION IN THE PERCEPTION OF THE ENSO PHENOMENON IN THE CONTEXT OF THE ECONOMIC AND SOCIAL DEVELOPMENT PROCESS IN THE TYPHOON COMMITTEE AREA AND RELATED INTERNATIONAL EXPERIENCES AND TRENDS

Dr. Neville Nicholls delivered a lecture on the El Niño/Southern Oscillation: Aftermath of the 1997/1998 event in Australia and prediction of future events.

Session 3: ASSESSMENT OF ENSO IMPACTS ON HYDROLOGY AND METEOROLOGY IN THE TYPHOON COMMITTEE AREA AND TRESHOLDS IN APPLICATIONS TO WATER RESOURCES MANAGEMENT AND DISASTER PREPAREDNESS AND MANAGEMENT

The following lectures were also presented:

1. Impact Assessment and Disaster Preparedness: Challenges and Opportunities for Regional Cooperation in the Typhoon Committee Area by Mr. Cengiz ERTUNA (ENRMD, ESCAP)
2. Impacts of ENSO on Hydrology and Meteorology in China by Ms. TIAN Cuiying (CHINA)
3. The Impact of El Niño on Floods and Typhoons in China by Mr. LIU Jinping (China)
4. Some impacts of El Niño and La Niña on the Climate of Hong Kong by Dr. Wen Lam CHANG (Hong Kong, China)
5. Suppressed Tropical Cyclone Formation in 1998 by Dr. Tetsuo NAKAZAWA (Japan)
6. Retrospective of the 1997-1998 ENSO Event (in the Philippines) by Dr. Aida JOSE (Philippines)
7. Overview of Regional Climate over East Asia during the 1997-1998 ENSO by Dr. Chung-Kyu PARK (Republic of Korea)
8. Impact of ENSO phenomena in 1997-1999 on Thailand Climate by Ms. Muntana BRIKSHAVANA (Thailand)

Session 4: NATIONAL EXPERIENCES IN ASSESSMENT OF ENSO TELE-CONNECTIONS, ECONOMIC AND SOCIAL IMPACTS, USES OF INFORMATION AND ENHANCEMENT OF PUBLIC AWARENESS IN THE TYPHOON COMMITTEE AREA

The following participants presented country reports:

1.	Hong Kong, China	:	Ms. Sandy Man Kuen SONG
2.	Japan	:	Mr. Makoto KANEKI
3.	Lao PDR	:	Mr. Pheng PIENGPANYA

4.	Macao	:	Mr. TONG Si Man
5.	Malaysia	:	Mr. LOW Koon-Sing
6.	Philippines	:	Ms. Susan ESPINUEVA
7.	Republic of Korea	:	Mr. Yong-Sik JUNG
8.	Singapore	:	Dr. CHEW Kian Hoe
9.	Thailand	:	Mr. Srisuporn SRISUPARB
10.	Viet Nam	:	Ms. Pham Thi THANH HUONG

Secretariat:

TCS:	Ms. Nanette C. Lomarda, Meteorologist
	Mr. Han-Se Lee, Hydrologist
ESCAP:	Mr. Cengiz Ertuna, Director, ENRDD
WMO:	Mr. Don Vickers, Scientific Officer, TCP

Section 5: RECOMMENDATIONS

The workshop formulated a set of recommendations (see Annex 2) to be presented to the Typhoon Committee in the forthcoming thirty-second session to be held in Seoul, Republic of Korea, 23 – 29 November 1999.

The workshop participants agreed that not all climate/weather extremes or anomalies in an ENSO episode can be blamed on the ENSO.

Section 6: ADOPTION OF THE REPORT

The workshop examined the draft report and adopted it.

Section 7: CLOSURE OF THE WORKSHOP

The workshop expressed sincere gratitude to the Macao government and the Macao Meteorological and Geophysical Service for successfully hosting the workshop and thanked Dr. Neville Nicholls of the Bureau of Meteorology Research Centre (BMRC) for sharing his expertise with the participants. The Workshop on the Impact of the El Niño Southern Oscillation (ENSO))/La Niña on Meteorology and Hydrology in the Typhoon Committee area closed at 11:45 am on 01 July 1999.

Annex 1

TYPHOON COMMITTEE
Workshop on the Impact of the El Nino Southern Oscillations (ENSO)/
La Niña on Meteorology and Hydrology in the Typhoon Committee Area
Macau, 29 June - 1 July 1999

PROVISIONAL AGENDA

1. Opening of the workshop.
2. Election of officers.
3. Adoption of the agenda.
4. Evolution in the perception of the ENSO phenomenon in the context of the economic and social development process in the Typhoon Committee Area and related international experiences and trends.
5. Assessment of ENSO impacts on hydrology and meteorology in the Typhoon Committee Area and thresholds in applications to water resources management and disaster preparedness and management.
6. National experiences in assessment of ENSO teleconnections, economic and social impacts, uses of information and enhancement of public awareness in the Typhoon Committee Area.
7. Recommendations on priority needs in strengthening national capabilities and opportunities in enhancing regional cooperation in mitigation of ENSO adverse impacts.
9. Other matters.
10. Adoption of the report.

Annex 2

WORKSHOP ON THE IMPACT OF THE EL NINO SOUTHERN OSCILLATION (ENSO)/LA NINA ON METEOROLOGY AND HYDROLOGY IN THE TYPHOON COMMITTEE AREA

*** RECOMMENDATIONS ***

The Workshop concluded that there is an inter-relationship between typhoons and ENSO and recommended the following:

1. That Typhoon Committee Members incorporate in their sustainable development programmes, at the national, regional and international levels, strategies to prevent, mitigate and rehabilitate the damage caused by natural disasters, including those caused by typhoons and the ENSO phenomena.
2. The Members integrate contingency planning into their development plans at local, national and regional levels in order to deal with ENSO related crisis aiming at affecting significant reduction of their impacts.
3. That the Typhoon Committee urges its Members and appeal to international agencies, donors and others involved in natural disaster reduction to participate actively in the financial and technical support and in increased levels of cooperation for mitigation of disasters caused by typhoons and ENSO. This support may be in the form of technical and financial assistance, including national capacity building, and in fostering and upgrading of global and regional observation systems and research, including the dissemination of warnings and forecasts of typhoons and ENSO to prevent, mitigate and redress the adverse effects of these phenomena.
4. That a framework be established between the Typhoon Committee Members, and also with other concerned countries, to promote exchange of information and national experiences related to the monitoring of the ENSO phenomenon as well as strategies for the reduction of its adverse impacts.
5. Frameworks be established and/or strengthened so that important data and other scientific information which become available can be adequately translated into early warning systems and forecasts of ENSO, so that protective action can be taken by concerned authorities well in advance.
6. A fully coordinated regional forecast and early warning system for ENSO events be established.
7. That the Members establish and/or strengthen early warning, education and long-term public awareness and information programmes related to natural hazards, including those induced by ENSO which would also be integrated into comprehensive national disaster management programmes focussing on preventive strategies for risk reduction and disaster prevention. These warning and public awareness programmes should be an integral part of the Members' national social and economic development plans.

8. Appreciating the great importance of early warning on the preparedness measures for mitigation of the effects of the ENSO events, the following goals and activities which are among the recommendations made by the Asian Regional Meeting on El Niño Related Crisis, organized by the Asian Disaster Preparedness Center and National Oceanic and Atmospheric Administration of the United States, in Bangkok in February 1998: were also recommended by the Workshop for consideration by Members of the Typhoon Committee.

- Improved forecast accuracy, detail, and tailored for decision makers in specific sectors;
- Forecaster training programmes and educational opportunities that cross political and sectoral boundaries including international workshops and seminars;
- Establishment of uniform criteria for forecast skill and validation techniques;
- Continued updates (ideally consensus forecasts) of the state of the climate for the upcoming season;
- Continued interaction between forecast users and producers to create the best and most applicable forecasts for given sectors; and
- Pilot demonstration projects designed to establish a framework for responding to climate forecast information for users such as agriculture and food security, water resource management, public health, and forestry.

9. Members undertake impact assessments after ENSO events and assess the lessons learned in order to be better prepared for such events in the future.

10. That Members implement continued development and practical use of commonly accepted standards for data acquisition, management and exchange as well as research to improve prediction capabilities and other methods which can reduce the consequences of ENSO events.

11. That Members are urged to conduct researches specifically on the relationship between tropical cyclones and ENSO.

12. That Members are encouraged to utilize all available forecasts and information on ENSO including those from CLIPS in their tropical cyclone disaster mitigation systems and social and economic benefits as well.

13. That the Members are encouraged to conduct climate model simulation studies to determine the cause of East Asian climate anomalies in summer 1998. It is also urged that the Typhoon Committee request CLIVAR to assist in these studies.

14. That the Typhoon Committee request CLIPS to develop a single comprehensive Regional description of ENSO impacts including the hydrologic cycle over the Typhoon Committee region.

15. That the Typhoon Committee encourage CLIVAR to conduct studies to determine if climate change or enhanced global warming is altering the typhoon activity and the impacts of ENSO on regional climate.

16. That ESCAP/WMO is requested to consider the organization of a training workshop for meteorologists and hydrologists on ENSO modeling, seasonal forecasts and interpretation of seasonal guidance information.

APPENDIX XIX

ESCAP/WMO TYPHOON COMMITTEE TRUST FUND

INTERIM STATEMENT OF ACCOUNT
as at 30 September 1999

			US$	US$
Balance of fund at 1 January 1998				364,484
Contributions received				191,978
Other income				29,757
Exchange difference				-96
Total revenue				586,123
Less: Expenditure	Liquidated	Unliquidated	Total	
Administration Costs - Local	38,280	10,767	49,047	
4th International Workshop on T/C Haikou,China	12,054	1,793	13,847	
TRGC Meeting Beijing	20,992	683	21,675	
W/S El Nino/La Nina Impact Typhoon Area	13,418	813	14,231	
Publications and Reports	7,195	11,833	19,028	
Missions	634	-	634	
Expenditures before WMO support costs	92,573	25,889	118,462	
Add WMO support costs: 1996-1997	23,403		23,403	
: 1998-1999	15,400		15,400	
Total expenditure	131,376	25,889	157,265	157,265
Balance at 30 September 1999				428,858
Represented by:				
Cash in Bank				455,654
Less: Unliquidated Obligations				26,796
				428,858

Contributions Received	1998	1999	Total
China	12,000	*	12,000
Hong Kong, China	12,000	12,000	24,000
Japan	12,000	12,000	24,000
Korea, Republic	12,000	-	12,000
Macau	-	23,978	23,978
Malaysia	12,000	12,000	24,000
Singapore	12,000	12,000	24,000
Thailand	12,000	12,000	24,000
USA	-	12,000	12,000
Vietnam	12,000	-	12,000
Total	96,000	95,978	191,978

12,000 received in early October 1999