UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION

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AND

WORLD METEOROLOGICAL ORGANIZATION

REPORT OF THE TYPHOON COMMITTEE

ON ITS THIRTY-FIRST SESSION

Quezon City, Philippines
1 – December 1998

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I. ORGANIZATION OF THE SESSION (agenda item 1)

1. The thirty-first session of the Typhoon Committee was held at Quezon City, Metro Manila, Philippines from 1 to 7 December 1998. The session was co-sponsored by the Economic and Social Commission for Asia and the Pacific (ESCAP) and the World Meteorological Organization (WMO).

Attendance

2. The session was attended by participants, representing 12 (out of 14) Members of the Typhoon Committee, namely: Cambodia; China; Hong Kong, China; Japan; Lao P.D.R.; Macau; 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 Papua New Guinea. In addition, two observers from the International Federation of Red Cross and Red Crescent Societies (IFRCS) and six from the WMO, ESCAP and the Typhoon Committee Secretariat (TCS) also attended the session. The list of participants is attached as Appendix I.

Opening of the Session

4. Dr. Roman L. Kintanar, Coordinator of TCS, welcomed all the participants to the thirty-first session of the Typhoon Committee and to Manila, Philippines. He noted that a lot of tropical cyclones visit the Philippines each year and that some are welcome as they bring rain and other benefits but the ones that come in with very strong winds and heavy rains, such as the super typhoons, bring havoc and destruction to the country. He added that the holding of this Typhoon Committee session in the Philippines was a reassurance to his people that they are not alone in their efforts to mitigate typhoon disasters.

5. The representative of ESCAP, Mr. Cengiz Ertuna, delivered the message of the Executive Secretary of ESCAP. He expressed appreciation to the Government of the Philippines for hosting the session and for playing a leading role in the efforts to achieve the objectives of the Committee. The Committee was informed that the Commission at its fifty-fourth session in 1998 had noted with appreciation the progress achieved in the implementation of the activities of the Typhoon Committee. The Commission had urged the United Nations Development Programme (UNDP), WMO and the ESCAP secretariat to continue their support to the Committee, and requested other donor countries and agencies to contribute to its activities. The ESCAP representative presented a brief account of ESCAP's activities related to hydrology and disaster prevention and preparedness in the past year and reiterated ESCAP's readiness to actively participate in the regional project "Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Area" in cooperation with WMO. He thanked the Government of the Philippines for hosting the TCS, and the other Members that have been supporting the activities of the Typhoon Committee, as well as WMO, the Office of Coordination of Humanitarian Affairs (OCHA), the International Decade for Natural Disaster Reduction (IDNDR) Secretariat, and the IFRCS, and acknowledged the significant contributions made by UNDP to the progress of the work of the Committee in the

past. The representative of ESCAP assured the Committee that ESCAP would continue to undertake activities in support of the Typhoon Committee within the framework of its own programme of work and available resources.

6. 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 Philippines for hosting the session and for the excellent facilities provided. He also thanked the Governments of Japan and the Republic of Korea for their support to the TCS and for seconding specialists. He mentioned that the accuracy of tropical cyclone track forecasts and the timeliness of warnings had been steadily improving, though not rapidly and the interaction between the national meteorological and hydrological services (NMHS) and the national agencies dealing with disaster prevention and preparedness had to be further strengthened in order to increase effectiveness of the warning system and the national disaster mitigation measures. He highlighted the importance of cooperation on regional initiatives and projects that can attract appropriate financial support. In this respect, WMO had been assisting the NMHSs in their development plans through, among others, the mobilization of resources for implementation of regional projects, particularly the project entitled "Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Areas". He encouraged the concerned directors of NMHSs to actively participate in the implementation of the project and to convince their national authorities of the need to support the project. He also expressed the appreciation of WMO to ESCAP for its continued close cooperation and support.

7. The Honorable Orlando S. Mercado, Secretary of National Defense and Chairman of the National Disaster Coordinating Council, welcomed all the participants to Philippines. He mentioned that about 20 typhoons hit his country each year and the economic development is always slowed down by the devastation of these typhoons. He highlighted the importance of regional and international cooperation, in particular, he commended the work done by the Typhoon Committee and international efforts on the part of countries that have so much concern in mitigating tropical cyclone effects on the environment and on the people. He mentioned that there was a serious environmental problem in Manila and his Government had launched a programme to clean up the environment. The Secretary of National Defense added that early warning was very critical in order to take necessary actions for mitigation and preparedness. He assured the Committee that the cooperation between the National Disaster Coordinating Council and the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) would be further strengthened and facilities and knowledge would be shared. He hoped that this session would enhance the good cooperation among the Typhoon Committee Members. He wished the participants a successful session and a pleasant stay in the Philippines. He then declared the session open.

II. ELECTION OF OFFICERS (agenda item 2)

8. Dr. Leoncio A. Amadore (Philippines) was elected as the Chairman of the Typhoon Committee. Dr. Sung-Euii Moon(Republic of Korea) and Dr. Patipat Patvivatsiri (Thailand) were elected as Vice-Chairmen. Ms. Elaine Koo (Hong Kong, China) was elected as the Chairperson of the Drafting Committee.

Application for Membership

9. The Committee was informed by the representative of ESCAP, that the Government of the United States of America had applied for Membership in the Typhoon Committee. In accordance with the established procedure, this application had been circulated to all Members of the Committee for their consideration. The Committee was also informed that no dissenting view had been received, and that many Members had expressed strong support for the Membership of the U.S.A..

10. The Typhoon Committee welcomed the U.S.A. as a Member effective 1 December 1998.

III. ADOPTION OF THE AGENDA (agenda item 3)

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

IV. THE COMMITTEE'S ACTIVITIES DURING 1998 (agenda item 4)

12. The ESCAP Representative reported that the Commission at its fifty- fourth session held in Bangkok from 16 to 22 April 1998 took note of the continuous support of Japan to the Committee especially the forecasting services of the Regional Specialized Meteorological Center (RSMC) in Tokyo.

13. The Commission also expressed its appreciation to the TCS Meteorologist for representing the Committee at the fifty-fourth ESCAP session which ensured a clear presentation of the achievements and future plans on the work of the Committee. The ESCAP representative proposed that a TCS representative continue to represent the Committee in the succeeding sessions of the Commission.

14. The TCS, on behalf of the Typhoon Committee, expressed its gratitude to Mr. Prasit Chamlongrath of the Thai Meteorological Department for representing the Committee at the Fifth session of the Special Body on Pacific Island Developing Countries, held in Bangkok on 14-15 April 1998.

15. The TCS informed the session that the:

- TCS Coordinator completed his WMO mission to Asian countries, from 31 March to 23 May 1998, in connection with the preparation of the regional project "Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Area."

- TCS Hydrologist completed consultations with the Members of the Committee in relation with the formulation of future activities under the Committee's hydrological component.

- TCS Meteorologist attended the "International Technical Conference for Female Senior Forecasters in Bangkok, Thailand, from 9-12 December 1997; the "Fourth WMO/ICSU International Workshop on Tropical Cyclones in Haikou, China, from 21-30 April 1998; the fifty fourth ESCAP session in Bangkok, from 16-22 April 1998; and the Typhoon Research Coordination Group (TRCG) meeting in Beijing, 3-6 August 1998. The TCS Meteorologist also visited the Democratic People's Republic of Korea and met with officials from the State Hydrometeorological Administration to assess their basic requirements related to their request for assistance in strengthening their national storm surge warning system.

- TCS continued managing the Typhoon Committee Foundation Inc.

(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 Cambodia informed the session that the response of the public to their forecasts and warnings has improved markedly during the past year due to intensive public information disseminated through the media.

18. The delegate from China reported that the FY-2 satellite which was launched on 10 June 1997 now operates 6-7 hours a day (daytime) and continues to provide good quality satellite images. The delegate also informed the Committee that China planned to launch its third polar-orbiting meteorological satellite, FY-1C on the first half of 1999.

19. The delegate from Hong Kong, China reported that a round-the-clock 'Information Enquiry System' was established in April 1998 to meet the public's increasing demand for weather and other geophysical information.

20. The delegate from Japan informed the session that his country will launch the Multifunctional Transport Satellite (MTSAT) in August 1999 and operation will start in March 2000. The MTSAT will take over the meteorological missions of the GMS-5 and provide digitized cloud imagery. Observational data and GPVs of NWP models are also provided through Low Rate Information Transmission (LRIT).

21. The delegate from Lao P.D.R. reported that it now receives meteorological data from Viet Nam by facsimile transmission.

22. The delegate from Macau informed the session that a new satellite system for receiving FY-2 data is now operational.

23. The delegate from Malaysia informed the session that the installation of new meteorological facilities at the Kuala Lumpur International Airport in Sepang was completed before June 1998.

24. The delegate from the Philippines informed the session that during the year a message switching system was installed which is capable of displaying numerical weather prediction products.

25. The delegate from the Republic of Korea reported that the Korea Meteorological Administration (KMA) had established the Meteorological Information Service System for Disaster Prevention, deployed one more buoy in the South Sea of the Korean Peninsula, continued to improve four operational dynamic typhoon models, and updated its radar data processing software in 1998.

26. The delegate from Thailand informed the session that the new computer system installed in late 1997 would be operational by mid-1999. The supercomputer of the new system has peak performance of 7 Giga FLOPS with a total of 4 GB of main memory and 280 GB hard disk.

27. The delegate from the U.S.A. informed the session that the new forecast office in Guam presently has a staff of 21 and that the construction of a new building had begun and would be completed in early 2000.

28. The delegate from Viet Nam reported that two new digital meteorological radars were installed in 1998.

29. 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. Yukio Takemura (Japan) and reported to the session by Mr. Koji Kuroiwa of the Japan Meteorological Agency (JMA).

30. The Members of the Typhoon Committee expressed their gratitude for the services of the rapporteur in the past and appreciated the offer of JMA for the continued services of a rapporteur on TOM for the coming year as well. The WMO representative assured Members that an amended copy of the Manual will be made available in early 1999.

31. 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.

(b) Hydrological Component (agenda item 4.2)

32. Based on the programme for 1998, 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 1998 is given in Appendix VI.

33. The delegate from Cambodia informed the Committee of the work on hydrology with respect to improvement of facilities, technical advancement,

flood forecasting and warning, and comprehensive flood loss prevention and management.

34. The delegate from China informed the Committee of the installation of seven satellite ground stations, and development of a new flood control consulting system based on Geographical Information Systems (GIS). He stated that the hydrological sectors issued about 12 thousand station/times of hydrological forecasting, and this accurate information and prediction enabled safe evacuation of 15 million person-times from flood areas and reduced damages in the order of RMB 80 billion. He also presented information on the research and training activities in various aspects of hydrology for technical advancement of staff and for achieving increased awareness.

35. The delegate from Hong Kong, China informed the Committee that issuing of early warnings for floods has started in specific areas and some engineering measures were being undertaken to protect low-lying areas, in addition to activities for improvement of existing storm-water drainage systems in flood-prone areas.

36. The delegate from Japan informed the Committee that in July 1998, information services using the Internet commenced and that various types of real-time information on some rivers were now being made available to the public on-line. He also informed that during a flooding episode along the Naka River located north of Tokyo, accurate flood forecasts enabled timely evacuation of 36,400 residents. He also reported on involvement of local residents in monitoring of sediment accumulation on slopes in order to strengthen warning and evacuation systems.

37. The delegate from the Lao P.D.R. provided information with regard to hydrological data collection and analysis, network extension and basinwide river surveys and inventory. He also reported on activities related to flood forecasting and warning and on flood control.

38. The delegate from Macau informed the Committee that three new raingauges were installed to enhance data collection for timely issuance of heavy rain warning.

39. The delegate from Malaysia informed the Committee that during the year, 21 new telemetric stations were installed, and data transmission via satellite was being implemented in two more river basins, in addition to the existing six stations. He reported that upgrading of the Kelang river basin flood forecasting and warning system was nearing completion. He also informed that the La Niña phenomenon was being studied and preparations were being made to mitigate the effects of expected floods and landslides, after having experienced a drought induced by El Niño.

40. The delegate from the Philippines informed the Committee of recent activities undertaken by PAGASA, including training, research and public information efforts. The Department of Public Works and Highways, in spite of financial difficulties, was still maintaining its 350 stations and continuing its

work on collection of water flow data, water sample and sediment sample analysis.

41. The delegate from the Republic of Korea informed the Committee of a plan to develop a flood warning system suitable for tributaries, especially for those located in the urban areas. He also presented information on the establishment of a radar rainfall system for the Imjin river basin and on flood warning systems for middle-sized river basins. He reported on various research activities being undertaken.

42. The delegate from Thailand informed the Committee that six new hydrometeorological stations were established in 1998. He also provided information on flood forecasting and warning systems in three designated river basins, and on the implementation of His Majesty the King's project for the mitigation of flooding situation in urban areas, particularly in Bangkok.

43. The delegate from the U.S.A. reported on the occurrence of flash floods and landslides in their area of responsibility in the Pacific and informed the Committee of their efforts for development of a flood forecasting system to remedy the situation.

44. The delegate from Viet Nam informed the Committee that although his country had experienced drought conditions from November 1997 to October 1998, heavy flooding was also experienced in November 1998. He reported that 11 automatic water level stations and 200 radio equipment had been installed. He also informed the Committee of a project on preparation of a feasibility study on setting up a flood forecasting and warning system for the whole country.

45. The Committee noted with appreciation the activities of ESCAP and WMO related to the hydrological component which are summarized in Appendix VII.

Hydrologists Meeting

46. Prior to the Typhoon Committee session, the pre-session meeting of the hydrologists took place on 30 November 1998. The second meeting of the hydrologists was held on 2 December 1998. The report of the Hydrologists meetings with the list of participants is presented in Appendix VIII. 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 1998 is included in Appendix IX.

48. The delegate from Cambodia provided information to the Committee on the damages caused by floods and drought in his country and reported that in

Cambodia, the National Committee for the National Disaster and Preparedness directed related activities.

49. The delegate from China presented information on the severe rainfall and resulting floods sustained during the summer of 1998. He reported that the Government had paid attention to the early predictions of the floods and efficiently organized disaster mitigation efforts and flood fighting activities, where the army played a critical role, thus minimizing casualties.

50. The delegate from Hong Kong, China informed the Committee of the increased public awareness on disaster prevention and preparedness. He reported on putting into operation a revised rainstorm warning system.

51. The delegate from Japan, referring to the "Yokohama Strategy", informed the Committee of the establishment of the Asian Disaster Reduction Center in July 1998, and presented brief information on the activities of the Center and the contributions it could provide to its members in the form of disaster information and studies on disaster reduction on various aspects of mitigation of natural disasters.

52. The delegate from Lao P.D.R. provided information on disaster prevention and preparedness at various levels. He informed the Committee that the Department of Meteorology and Hydrology provided real-time weather data to the public for various purposes.

53. The delegate from Macau informed the Committee that no serious damage had been sustained due to typhoons in the past five years. However, education in schools, distribution of leaflets and advertisements on television and radio were undertaken as ongoing preparedness measures.

54. The delegate from Malaysia informed the Committee that during the past year, droughts, forest and bush fires were experienced in many parts of the country. He reported that his Government had issued a directive providing guidelines to various agencies involved in disaster management to develop their own Standard Operating Procedures. He also informed the Committee that preparations were being undertaken in anticipation of the adverse effects of the impending La Niña phenomenon.

55. The delegate from the Philippines informed the Committee that its Contingency and Disaster Plan had been updated to include regional action plans on El Niño phenomenon. He reported that PAGASA had intensified the information, education and communication programme on hydrometeorological hazards to raise the awareness level of the general public on these issues through the news media and awareness campaigns.

56. The delegate from the Republic of Korea informed the Committee of various activities on disaster prevention and preparedness in his country. He reported that 42,984 staff members were trained, and drills and emergency practices had been carried out. He informed that as part of the 1997-2001 Disaster Prevention Plan, his Government invested $4,538 million in related activities and also spent additional amounts for other disaster mitigation

measures. He also informed the Committee that the Republic of Korea received two thirds of its annual mean rainfall during the period from 31 July to 18 August 1998 but the damage was relatively low.

57. The delegate from Thailand reported that in his country the annual rainfall amount during the year had been about 15 to 20 percent lower than average especially in the north and northeastern part. He informed of some recent undertakings on disaster prevention and preparedness, including development of the National Civil Defence Master Plan, public information campaigns, and some structural measures.

58. The delegate of U.S.A. informed the Committee that each forecast office was supplemented by someone who is responsible for working with local emergency management officials on disaster prevention and that Guam had revised its tropical cyclone preparedness systems. He reported on the public awareness campaigns and the provision of information on El Niño-Southern Oscillation (ENSO) impacts by the Pacific ENSO Application Centre, the University of Hawaii and the University of Guam.

59. The delegate of Viet Nam reported on a series of activities undertaken including management system for floods and storm control, improvement of dikes, organization of workshops and seminars on disaster management, and dissemination of information on disaster mitigation through mass media.

60. The observer from Brunei Darussalam informed the Committee that task forces had been established to mitigate the effects of El Niño and also for La Niña.

61. Some delegations expressed their concern that misinformation distributed through Internet by unofficial sources was having adverse effects, such as cancellation of tourist arrangements and misleading of public at large.

62. The observer from IFRCS reported to the Committee on various disaster preparedness and relief programmes of his organization in various countries of the region. He also informed that his organization had a clearly defined role with respect to the Governments in their disaster response and preparedness efforts.

63. The Committee noted with appreciation the activities of ESCAP and WMO related to the disaster prevention and preparedness component which are summarized in Appendix X.

(d) Training component (agenda item 4.4)

64. 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 XI.

65. The delegate from China informed the Committee that the International Training Course on Satellite Meteorology was held at the WMO Regional Meteorological Training Centre in Nanjing from 20 September to 19 October 1998. It had 27 participants, six of which came from Members of the Typhoon Committee.

66. The delegate from Japan reported that the International Training Seminar on Typhoon Monitoring and Forecasting in the Western North Pacific was held at the RSMC Tokyo - Typhoon Center from 12 to 30 January 1998. Five forecasters from Typhoon Committee Members attended the said seminar.

67. The delegate from the Republic of Korea informed the Committee that the Training Course on Weather Forecasting for Operational Meteorologists in the Asia/Pacific Region under financial support of the Korea International Cooperation Agency was being held at the KMA headquarters from 9 November to 6 December 1998. Eight meteorologists from Typhoon Committee Members attended the training course.

68. The delegate from the U.S.A. reported that they continue to maintain an active training program for the maintenance of current, and the development of future capabilities. In this regard, he noted the graduation of the first student from the Micronesian Meteorologist Training program. This graduate, after an internship at the Tiyan Forecast Office, will assume responsibility for the meteorological services for Yap State, Federated States of Micronesia.

(e) Research component (agenda item 4.5)

69. The Committee noted that the research work undertaken by the Members during the past year focused mainly on typhoon intensity prediction and typhoon structure. The summary of the reports of the individual Members in relation to the research component is given in Appendix XII.

70. The delegate from China informed the Committee that the Fourth International Workshop on Tropical Cyclones was successfully held in Haikou, Hainan Province of China from 21 to 30 April 1998. It was attended by 120 typhoon experts.

71. The representative from the Commission on Atmospheric Sciences (CAS) presented the Report of the Chairman of CAS. The report stated that at its February 1998 meeting, CAS confirmed that the Tropical Meteorological Research Programme will continue to provide support for international research and development activities with an emphasis on monsoons and tropical cyclones. The full text of the report is given in Appendix XIII.

72. As requested by the Joint Session of the Typhoon Committee and the Panel on Tropical Cyclones held in Phuket in early 1997, the statement on climate change and tropical cyclones, prepared by a committee of prominent scientists headed by Professor Ann Hederson-Sellers, was distributed. The full text of the statement is given in Appendix XIV.

V. REVIEW OF THE 1998 TYPHOON SEASON/ANNUAL PUBLICATIONS (agenda item 5)

Review of the 1998 Typhoon Season

73. The Members noted that in 1998, the number of tropical cyclones were significantly lower compared to previous years. This could be attributed to the El Niño phenomenon.

74. As in previous years, RSMC Tokyo-Typhoon Center provided the session with a review of the 1998 typhoon season contained in Appendix XV.

Annual Publications

75. The Members noted with satisfaction the publication of the 1997 Typhoon Committee Annual Review in November 1998 through the commendable efforts of the Chief Editor provided by the TCS and the National Editors provided by the Members.

76. The TCS published the 10th issue of the Typhoon Committee Newsletter in September 1998.

77. The RSMC Tokyo-Typhoon Center published the "Annual Report on Activities of the RSMC Tokyo-Typhoon Center in 1996" in February 1998 and the Technical Review (No. 2) entitled "Enhanced Accuracy of Typhoon Prediction of the Advanced Numerical Models at the Japan Meteorological Agency" in March 1998.

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

78. The consideration under this agenda item were based mainly upon the information contained in the twenty-fourth status report on the implementation of the WMO Tropical Cyclone Programme (TCP) and supplementary information, including detailed background information on the naming of tropical cyclones/hurricanes formulated by other TCP regional bodies, presented verbally at the session by the representative of WMO. The Committee expressed its appreciation for the detailed information provided on the implementation of the TCP.

79. The Committee was informed that a forthcoming WMO/National Oceanographic and Atmospheric Administration (NOAA) global Training Course on Tropical Meteorology and Tropical Cyclone Forecasting is being planned to be held in Florida in 2000.

80. The Committee reaffirmed the request of the 1997 Executive Council of WMO that Tropical Cyclone RSMCs should supply the first level of basic information covering the tropical cyclone's present and forecast movement and intensity to the international media, where a clearly defined source of reliable information was needed. Since the issuance of tropical cyclone warnings is the

responsibility of the NMHSs, the Committee reiterated on building the capacity of NMHSs to deliver accurate forecasts and timely warning services to the public, government agencies and local media effectively and efficiently.

81. The Committee noted with satisfaction that a summary of the TCP activities for 1998 as given in Appendix XVI would be incorporated in the WMO Annual Review, 1998.

VII. PROGRAMME FOR 1999 AND BEYOND (agenda item 7)

Regional Co-operation Programme Implementation Plan (RCPIP)

82. The Typhoon Committee reviewed and adopted the revised RCPIP which is contained in Appendix XVII.

83. 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 kindly offered to host a Regional Workshop on Doppler Radar in 1999.

84. The Committee reviewed the Report of the Typhoon Research Coordination Group (TRCG). 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.

85. The Committee also expressed its gratitude to the Government of China for hosting the meeting of the TRCG in Beijing, China, 3 - 6 August 1998.

Assignment of Names of Tropical Cyclones

86. The Committee after an in-depth discussion agreed on the method of assigning names to tropical cyclones in the Typhoon Committee Region, which will lead to the standardization of the usage of names with the following objectives:

(a) The Typhoon Committee list of names would be for use by the international press and for bulletins issued to international aviation and shipping. This would be the names to be used by Typhoon Committee Members when they issue bulletins intended for the international community.

(b) To facilitate the labeling of tropical cyclones when Members issue warnings in their vernacular language, if they so wish. This is expected to enhance people's alertness to an impending tropical cyclone hazard. The "international list" will serve as a source for adaptation into a "local list" in the vernacular language. Members will continue to use the four digit number to identify tropical cyclones as a matter of established practice.

87. The Committee further agreed on the following:

General Approach

(a) One single list will be used as it has the advantage of being simple to operate and easy to publicize to the international community.

(b) All Members of the Typhoon Committee and other WMO Members concerned (within the region) had been invited to contribute to the list.

(c) On the basis of a single list, it was agreed that:

(i) Equal number of names shall be contributed by each Member concerned.

(ii) The list shall be circular in nature, that is, tropical cyclones would be assigned names sequentially down the list until the last name is reached and then the first name will be used again.

(iii) The list shall consist of five columns, each containing two cycles of names listed in alphabetical order in terms of the contributors.

Choice of names

(a) On the choice of names, the following principles are to be followed:

(i) no more than nine alphabets;

(ii) easy to pronounce on radio and television;

(iii) no negative implication in the languages of contributors;

(iv) should not cause difficulties for any contributor;

(v) should not be commercial brand names.

(b) In the interest of harmony and cooperation, any name proposed should receive the support of all contributors and that objection from any contributor should be sufficient to veto a proposed name.

Presentation of the names

(a) The Committee adopted the list of names given in Appendix XVIII.

(b) Contributors may prepare the equivalent lists of names in their vernacular languages, if they wish to adopt the Typhoon Committee list for internal use. No rules will be set on how the translation should be done. This would give Members flexibility in choosing either the sound of the name or its meaning as the basis of finding an equivalent in the vernacular language.

(c) Further information on the meaning and/or origin of the names is contained in Appendix XIX.

Operational Procedures

(a) RSMC Tokyo-Typhoon Center will assign a name each time a 4-digit identification number is to be assigned. That is, names on the Typhoon Committee list will only be given to tropical cyclones of tropical storm strength or above. Each tropical cyclone should be identified by its name followed by the 4-digit number in brackets. The same names and numbers should also be used in bulletins issued by the Tokyo Tropical Cyclone Advisory Centre under the umbrella of the International Civil Aviation Organization (ICAO) as well as in bulletins for Meteorological Area (METAREA)-XI of the Global Maritime Distress and Safety System (GMDSS) issued by both China and Japan. This would contribute to the standardization of the usage of names of tropical cyclones as was desired by Typhoon Committee.

(b) The exchange of observational data should be promoted as much as possible in addition to what is already exchanged among the warning centres and the meteorological services in the region, to ensure that RSMC Tokyo-Typhoon Center would benefit from the best possible data and information needed for it to carry out its work.

(c) On the operation of the name list, the names will be assigned following the pre-determined order. The name would remain unchanged throughout the life history of the tropical cyclone. To avoid confusion, tropical cyclones given a name before crossing the Date Line and entering the western North Pacific should be assigned a number by RSMC Tokyo-Typhoon Center but should not be assigned a new name in the Typhoon Committee list. The US Central Pacific Hurricane Centre, the relevant body assigning names to tropical cyclones in the central North Pacific will continue the use of the tropical cyclone names assigned by RSMC Tokyo-Typhoon Center when tropical cyclones cross the Date Line from west to east.

(d) The names and numbers assigned by RSMC Tokyo-Typhoon Center will be used by all Typhoon Committee Members when issuing warning bulletins intended for the international community including the press, aviation and shipping.

(e) The Typhoon Committee, as the authority to maintain the list, shall review the list of names and its operation regularly at its annual sessions as the need arises.

(f) Members may request the retirement of a name from the list particularly in case of tropical cyclones causing extensive destruction or for other reasons. Such notification shall be made preferably within a year of the event. The decision to retire names should be

made at the regular review at annual sessions of the Typhoon Committee.

Implementation Programme

(a) The implementation of the tropical cyclone name list and related procedures, is to take place as of 1 January 2000.

(b) The user community and the public would be given one year advance notice about the new naming scheme.

(c) On publicity, the following actions would be undertaken:

(i) a brochure will be prepared on the list of names together with information on pronunciation (standard transcription scheme to be worked out), meaning, origin and other interesting annotation to be produced by TCS;

(ii) the list would be set up on the homepages of WMO, Typhoon Committee Secretariat and if possible on those of Members;

(iii) Members would publicize the new arrangements within their countries/areas/territories.

88. The Committee authorized the TRCG to assume responsibility for the implementation of the naming scheme in consultation with the Members and to convene another meeting of the TRCG for this purpose if necessary.

Hydrological Component

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

(a) Cooperation between meteorologists and hydrologists at the national or regional level to develop reliable Quantitative Precipitation Forecasting (QPF)s for the enhancement of flood forecasting.

(b) 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:

(i) A 3-day Experts Workshop on "The Impacts of El Niño and La Niña phenomena on Meteorology and Hydrology in the Typhoon Committee Area" in 1999 and to be supported by the Typhoon Committee Trust Fund (TCTF).

(ii) A 5-day training seminar on "Development of Forecasting and Warning System for Typhoon-Induced Sediment Disasters" for hydrologists in the Typhoon Committee area in 2000 and to be supported by the TCTF.

(c) Requesting the hydrologists of Typhoon Committee Members to participate actively in the activities under the hydrological component, including the attendance in the annual session of the Committee.

(d) Requesting the Government of Republic of Korea to continue to provide the service of a hydrologist in the Typhoon Committee Secretariat.

(e) Typhoon Committee Members are encouraged to seek advisory services from ESCAP as well as TCDC support.

Training Component

90. The delegate from China informed the Committee that as part of his government's TCDC program, the RMTC Nanjing, China will organize an International Training Course on Long Range Weather Forecasting from September to October 1999.

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

i) Arrangements for the Typhoon Committee Secretariat

91. 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 a part-time expert on disaster prevention and preparedness, and proposed that such arrangements continue.

92. 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.

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

94. The Committee expressed its appreciation to TCS for publishing the Typhoon Committee Newsletter and the ESCAP/WMO Typhoon Committee Annual Review.

95. 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 107).

ii) Technical cooperation

96. 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.

97. The Committee noted that there was some progress made in the Lao PDR Hydrometeorological Service. However, there are still a lot to be done in particular in the field of training of manpower and telecommunication. It further noted that Lao PDR and Thailand needed to establish a Very Small Aperture Terminal (VSAT) Global Telecommunication System (GTS) link between Vientiane and Bangkok. It encouraged the Lao Hydrometeorological Service and the Thai Meteorological Department to take necessary actions to implement the link with possible assistance from the Government of Japan as soon as possible. It further requested WMO to immediately coordinate with Japan and both countries in this matter.

98. The Committee noted that the Hydrometeorological Service of Cambodia required urgent upgrading and requested WMO, ESCAP and donor institutions to provide the necessary assistance to Cambodia.

99. Based on the report of the TCS Meteorologist who visited the Democratic People's Republic of Korea (see paragraph 15), the delegate from the Republic of Korea expressed deep interest on the request to provide the necessary assistance in strengthening the storm surge warning system of the State Hydrometeorological Administration.

100. The Committee was pleased to note that the ESCAP Commission in its last session urged UNDP, WMO and the ESCAP Secretariat to continue to provide support for the Typhoon Committee, and requested other donor agencies and countries to contribute to its activities. It also invited the Members of the Typhoon Committee to make more extensive use of the TCDC programme for the exchange of expertise on the various aspects of natural disaster reduction.

101. The Committee was pleased to note that the ESCAP would continue to undertake activities in support of the Typhoon Committee. These included undertaking of projects on substantive issues relating to mitigation of damage from typhoons, floods and droughts in Asia and the Pacific, which should be drawn up on close consultation with the Typhoon Committee, which also need to meet the criteria laid down by ESCAP. The TCS would be closely associated in the implementation of such projects within the work programme of ESCAP.

102. The Committee noted that ESCAP provided advisory services in the field of water resources planning and development including flood loss prevention through its regional adviser. Normally these services are provided for periods ranging from one to four weeks at any one time depending upon the terms of reference for the adviser. Typhoon Committee Members may wish to consider to make more use of the services of the ESCAP Regional Adviser on Water Resources.

iii. Typhoon Committee Trust Fund (TCTF)

103. 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.

104. The Committee reviewed and approved the financial report on the TCTF and the balance of the fund as of 23 October as shown in Appendix XX.

105. The delegates from Macau and the Republic of Korea informed the Committee that their Governments had already made their 1998 contributions to the TCTF. However, it was noted that this was not reflected in the financial report mentioned in the preceding paragraph.

106. 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.

107. The Committee after careful consideration agreed to the use of the TCTF for the following specific purposes from 1 January to 31 December 1999:

(i) Operating costs of TCS, including the support for the TCS Coordinator (approx. US$21,240).

(ii) Publishing the Typhoon Committee Newsletter No. 11 (400 copies) (approx. US$1,700).

(iii) Printing and distribution costs of the publication of Typhoon Committee Annual Review (TCAR) 98 (600 copies) (approx. US$5,900)

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

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

(vi) Support for attendance of participants to the Regional Workshop on Doppler Radars (China, 1999) (approx. US$21,000)

(vii) Printing and distribution of brochure on tropical cyclone names (approx. US$3000)

(viii) Support for the attendance of participants to the Workshop on the Impact of El Niño and La Niña Phenomena on Meteorology and Hydrology in the Typhoon Committee Area to be held in 1999. (approx. US$23,000)

(ix) Any other emergency case that can be justified for the use of the TCTF, such as the TRCG meeting if necessary but would require the concurrence of both the TCS Coordinator and the Typhoon Committee Chairman.

108. Total expenditures however are not to exceed the total contributions of the preceding year to the TCTF.

109. The per diem rates to be supported by the TCTF will be established in an ad hoc basis and whenever possible the most economic rates for air travel are to be applied.

iv. Other Activities

110. With regard to the Project Proposal "Integrated System for the Mitigation of Typhoon, Flood, and Environmental Disasters in the Western North Pacific Areas", the Committee took note of the progress and the conclusions and recommendations of the workshop on the Project which was held in Quezon City, Philippines, 30 November to 1 December 1998.

111. The Committee expressed its gratitude to WMO and welcomed the request of Lao PDR and Cambodia to be included in the Project.

112. The Committee strongly supported the project and requested WMO to keep the NMHSs informed on its development, in particular, its contacts with the funding agencies.

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

113. The Committee welcomed the offer of the Republic of Korea to hold the thirty-second session in Seoul, tentatively from 23 to 29 November 1999, to be preceded by the TC Hydrologists meeting on 22 November 1999.

114. The TCS suggested the following activities for a special annual session to commemorate the year 2000 which will be further discussed during the thirty-second session of the Committee:

(a) To hold a conference on networking and scientific exchange with other tropical cyclone regional bodies within Asia and the Pacific;

(b) To launch an expert exchange programme with other countries through bilateral agreement; and

(c) To conduct an intensive information drive by all Members about the work of the Typhoon Committee.

X. SCIENTIFIC LECTURES (agenda item 10)

115. The following scientific lectures were presented:

(a) Retrospective of the El Niño of 1997 - 1998
By: Dr. Aida M. Jose (Philippines)

(b) The Warning of Mesoscale Rainstorms in Hong Kong: Approach and Related Techniques Development
By: Dr. H.K. Lam (Hong Kong, China)

(c) Dissemination of Satellite Imagery and NWP Products via the Multifunctional Transport Satellite (MTSAT)
By: Mr. Koji Yamamoto (Japan)

(d) Study on the Drainage System Regulation for Controlling Rainfall Runoff in Korea
By: Mr. Heung-Soo Cheong (Republic of Korea)

(e) 1998 Unusual Flooding - Climate, Weather, Causes, Forecast and Services
By: Prof. Qiu Guo-qing (China)

116. The Ministry of Construction of Japan made available the following video tapes for presentation:

(a) "Flood Simulation in Tone River and Yodo River"

(b) "Countermeasures for Debris-flow in Yakedake and Urakawa"

117. The Committee expressed its thanks to the lecturers for their informative and useful lectures and to Mr. Toshio Okazumi for showing on television the video tapes he brought from Japan.

XI. ADOPTION OF THE REPORT (agenda item 11)

118. The Committee adopted the report of the session at 10:26 am on 7 December 1998.

XII. CLOSURE OF THE SESSION

119. The delegates from the Members of the Typhoon Committee, observers, and representatives of ESCAP and WMO expressed their thanks and appreciation to the Government of the Philippines and to the Typhoon Committee Secretariat for the successful hosting of the 31st session of the Typhoon Committee.

120. The session was closed by the Chairman at 11:10 am.

APPENDIX I

LIST OF PARTICIPANTS

31st Session ESCAP/WMO Typhoon Committee
Quezon City, Philippines
1 - 7 December 1998

MEMBERS OF THE TYPHOON COMMITTEE

CAMBODIA

Representative: **Ms Seth Vannareth**, Deputy Director, Department of Meteorology (DOM), General Directorate of Irrigation Meteorology and Hydrology (GDIMH), Cambodia

CHINA, PEOPLE'S REPUBLIC OF

Representative: **Prof Yan Hong**, Deputy Administrator, China Meteorological Administration (CMA), Beijing

Alternates: **Mr Qiu Guoqing**, Director-General, National Meteorological Center, CMA, Beijing

Mr Xin Xianhua, Division Director, International Cooperation Department, CMA, Beijing

Ms Tian Cuiying, Deputy Director, Division of Forecasting Operation, Department of Operational Development and Weather, CMA, Beijing

Ms Tang Huifang, Deputy Director, Forecasting Office, National Meteorological Center, CMA, Beijing

Mr Xu Yongke, Deputy Director, Forecasting Office, Guangdong, Meteorological Bureau, CMA, Guangdong

Mr Liu Zhiyu, Hydrologist, Water Resources Information Center, Ministry of Water Resources, Beijing

HONG KONG, CHINA

Representative: **Dr H K Lam**, Director, Hong Kong Observatory, Kowloon

Alternate: **Ms Elaine Koo**, Assistant Director, Hong Kong Observatory, Kowloon

JAPAN

Representative: **Mr Koji Yamamoto**, Director-General, Forecast Department, Japan Meteorological Agency (JMA), Tokyo

Alternates:

Mr Koji Kuroiwa, Senior Scientific Officer, National Typhoon Center, Forecast Division, Forecast Department, JMA, Tokyo

Mr Toshio Okazumi, Deputy Director, River Development Division, River Bureau, Ministry of Construction, Tokyo
Mr Kenji Tanaka, Section Chief, IDNDR Promotion Office, Disaster Prevention Coordination Division, Disaster Prevention Bureau, National Land Agency, Tokyo

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Representative:

Mr Thongpou Vongsiprasom, Director-General, Department of Meteorology and Hydrology, Ministry of Agriculture and Forestry, Vientiane

MACAU

Representative:

Mr Antonio Viseu, SubDirector, Macau Meteorological and Geophysical Service

Alternates:

Mr D.J. Dos Santos, Head, Disaster Prevention Center, Macau Security Force

Mr Hao I Pan, Chief, Meteorological Division, Macau Meteorological and Geophysical Service

Mr Iu Chong Hin, Assistant, Disaster Prevention Center, Macau Security Force

Ms Leong Ka Cheng, Chief, Weather Monitoring Center, Macau Meteorological and Geophysical Service

MALAYSIA

Representative:

Mr Yong Pok Wing, Deputy Director-General II, Malaysian Meteorological Service, Kuala Lumpur

Alternates:

Ir Chong Sun-Fatt, Senior Assistant Director, Hydrology Division, Department of Irrigation and Drainage, Kuala Lumpur

Ms Noormah bt Dato' A Rauf, Assistant Director (Rehabilitation Section), Social Welfare Department, Ministry of National Unity and Social Development, Kuala Lumpur

Mr Mohd Yassin bin Mustaffa, Assistant Director, Crisis and Disaster Management Unit, Division of National Security, Prime Minister's Department, Kuala Lumpur

PHILIPPINES

Representative:

Dr Leoncio A Amadore, Director, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) *and*

Permanent Representative of the Philippines to the WMO, PAGASA, Quezon City

Alternates:

Mr Cipriano C Ferraris, Deputy Director for Research and Development, PAGASA, Quezon City
Dr Bernardo M Soriano, Jr., Chief, Atmospheric, Geophysical and Space Sciences Branch, PAGASA, Quezon City

Dr Aida M Jose, Chief, Climatology and Agrometeorology Branch, PAGASA, Quezon City

Dr Rolu P Encarnacion, Chief, Flood Forecasting Branch, PAGASA, Quezon City

Dr Rosa T Perez, Officer-in-Charge, Natural Disaster Reduction Branch, PAGASA and Focal Person on Meteorology

Ms Margaret P Bautista, Senior Weather Specialist, Flood Forecasting Branch, PAGASA and Focal Person on Hydrology

Dr Melgabal Capistrano, Administrator, Office of the Civil Defense, Department of National Defense

Dr Judy F Sese, Chief, Research and Development Division, Bureau of Research and Standards, Department of Public Works and Highways (DPWH)

Mr Anacleto Espiritu, Engineer IV, Bureau of Research and Standard, DPWH, Quezon City

Ms Edna F Meñez, Engineer III, Bureau of Maintenance, DPWH, Port Area, Manila

REPUBLIC OF KOREA

Representative:

Dr Sung-Euii Moon, Administrator, Korea Meteorological Administration (KMA)

Alternates:

Mr Heung Soo Cheong, Director-General, Disaster Prevention and Preparedness Bureau, Ministry of Government Administration and Home Affairs, Seoul

Dr Kyung-Sup Shin, Director-General, Technical Development Department, KMA, Seoul

Mr Kwang-Joon Park, Senior Forecaster, KMA, Seoul

Mr Ok Joo Sohn, Deputy-Director, River Planning Division, Ministry of Construction and Transportation, Kyunggi Province

Mr Gye Jo Kim, Deputy Director, Disaster Prevention and Planning Division, Ministry of Government Administration and Home Affairs, Seoul

THAILAND

Representative: **Dr Patipat Patvivatsiri**, Deputy Director-General for Development, Meteorological Department, Ministry of Transport and Communication, Bangkok

Alternates: **Mr Pricha Rakskhid**, Deputy Director-General, Department of Local Administration, Ministry of Interior, Bangkok

Mr Weera Chaipimolpalin, Director, Civil Defense Division, Department of Local Administration, Ministry of Interior, Bangkok
Mr Nathapong Thitawuigran, Senior Governing of Officer, Department of Local Administration, Ministry of Interior, Bangkok

UNITED STATES OF AMERICA

Representative: **Mr Richard Hagemeyer**, Director, Pacific Region, National Weather Service

Mr John F Miller, Meteorologist in Charge, Weather Forecast Office, Tiyan, Guam, National Weather Service

VIET NAM

Representative: **Mr Nguyen Nhan Trung**, Deputy Director-General Hydrometeorological Service of Viet Nam

Alternates: **Mr Le Huynh Bac**, Deputy Director of National Center for Hydrometeorological Forecasting, Hydrometeorological Service of Viet Nam

Ms Duong Chau Lien, Deputy Chief, Short-Range Weather Forecast Division, National Center for Hydrometeorological Forecasting, Hydrometeorological Service of Viet Nam

OBSERVERS

OTHER STATES

BRUNEI DARUSSALAM

Representative: **Mr Haji Sidup Haji Sirabaha**, Metecrological Officer, Meteorological Service, Department of Civil Aviation

PAPUA NEW GUINEA

Representative: **Mr Graham John Ainui**, Head of Mission, Embassy of Papua New Guinea

International Federation of Red Cross and Red Crescent Societies (IFRCS)

Japan International Cooperation Agency (JICA)

WMO Commission for Atmospheric Sciences (CAS)

NON-GOVERNMENTAL ORGANIZATION

Dr Johan Schaar, Head, Regional Delegation, Kuala Lumpur

Mr James Y Sian, Manager, Disaster Management Service, Philippine Red Cross

Mr Junji Miwa, River Management Expert of PAGASA, JICA, Manila

Mr Kenji Suzuki, River Management Expert of PAGASA, JICA, Manila

Mr Yukihiko Sakatani, Sabo Engineering Expert of DPWH, JICA, Manila

Prof Yan Hong, Deputy Administrator, CMA, Beijing

SECRETARIATS

TYPHOON COMMITTEE SECRETARIAT (TCS)

Dr Roman L Kintanar, Coordinator, TCS, Manila

Ms Nanette C Lomarda, Meteorologist, TCS, Manila

Mr Han-Se Lee, Hydrologist, TCS, Manila

WORLD METEOROLOGICAL ORGANIZATION (WMO)

Mr Eisa H Al-Majed, Director, Regional Office for Asia and the South-West Pacific, WMO, Geneva

Mr Katsuhiro Abe, Chief, Tropical Cyclone Programme Division, World Weather Watch Department, WMO, Geneva

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC (ESCAP)

Mr Cengiz Ertuna, Officer-in-Charge, Environment and Natural Resources Development Division, ESCAP, Bangkok

LOCAL SECRETARIAT

Mr Edino Nonato L Nolasco, Weather Specialist I

Mr Jaime R Manlangit, Weather Observer III

Ms Marissa L Evangelista, Weather Observer II

Ms Rosemarie Z Anillo, Weather Observer I

Ms Bella U Mendoza, Weather Observer I

Mr Hannibal B Marayag, Clerk IV

Mr Roman O Mendoza, Weather Facilities Technician I

APPENDIX II

AGENDA

1. Opening of the session

   2.1 Election of officers

   2.2 Application for Membership

3. Adoption of the agenda

4. The Committee's activities during 1998:

   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 1998 typhoon season/annual publications

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

7. Programme for 1999 and beyond

8. Support required for the Committee's programme

9. Date and place of the thirty-second session

10. Scientific lectures

11. Adoption of the report

APPENDIX III

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

In **Cambodia,** the Department of Meteorology continued to devote considerable efforts to improve its pubic weather services through timely warning and intensive public information. Severe lack of resources, however, has hampered improvement of the meteorological service.

In **China,** its first geostationary meteorological satellite (FY-2) which was launched on 10 June 1997 now operates 6-7 hours in the daytime and provides good quality images hourly. Also made operational during the year was a set of C band wind finding radar started in Hohhoot City, a WSR-88D radar in the Shanghai Meteorological Bureau and the Meteosat data receiving system in November 1998. CMA in 1998, started to upgrade it's computer system to process observational data. By the end of the year, 100 of the 700 computers had been replaced by more advanced systems. Also upgraded was the BABJ-EDZW circuit of CMA's Meteorological Telecommunication System. The year saw the completion of the installation of 330 VSAT bi-directional stations in both provincial and prefecture levels and was subsequently put into experimental operation. Completed also was the operational experiment for the Automatic Weather Stations installed nationwide. Set up during the year was the Dawning Tiao Chao 1000A High Performance Super Parallel Computer System in CMA's National Meteorological Center and the National Meteorological Disaster Information Collection, Processing and Assessment System which played a vital and effective role in CMA's systematic, comprehensive and timely delivery of services of forecasting severe, key and abrupt changing weather systems including typhoons.

In the **D.P.R. of Korea,** the Central Forecast Institute of the State Hydrological and Meteorological Administration (SHMA) in 1998: introduced the limited area model with variable resolution into operation for the purpose of very short range forecasting, upgraded it's NOAA and GMS satellite receiving equipment which was in operational status by August 1998, set up its computer network which established a communication link between its radar stations, one in the west coast and another in Pyongyang with the Central Forecast Research Institute, and established its hydro-meteorological data complex service system using a computer network for fast transmission of real time information and forecast products to major state agencies and the public.

In **Hong Kong, China,** the Observatory's Dial-a-Weather service was further enhanced in 1998 with the addition of 42 telephone lines bringing it to a total of 197 lines. The experimental Putonghua(Mandarin) channel which used to operate only from 8am to 5pm is now accessible during public holidays. In April 1998, a round-the-clock "Information Enquiry System" was installed to meet the public's increasing demand for weather and other geophysical information. The year also saw the continued enhancement of the Observatory's homepage, the smooth operation of terminal Doppler Weather Radar which was installed at the new airport on July 1998, installations of additional meteorological sensors along the second runway at the new airport in October 1998 which was integrated into AMOS to make it capable of providing real-time data from both runways to forecasters, observers and air-traffic controllers, and the smooth operation of the windshear and turbulence warning system since opening of the new airport. During the year, a ground station for the reception of World Area Forecast System (WAFS) satellite broadcast from the World

Area Forecast Centre(WAFC) Kansas and which serves as a back up to the ground receiving system for receiving broadcasts from WAFC London was put into operation while an aviation meteorological data processing system was installed at the new airport. Plans had started for the acquisition of a new ground reception system for receiving high resolution cloud images as well as meteorological data broadcast from Japan's MTSAT while installation of a new Doppler radar had begun at the highest peak on Tai Mo Shan. The Regional Spectral Model adopted from JMA, started semi-operational run on March 1998 to generate prognostic products with emphasis on mesoscale systems in the vicinity of Hong Kong and a prototype of the rainstorm nowcasting system SWIRLS (Short range Warning of Intense Rainstorms in Localized Systems) commenced real-time operation on a trial basis in July 1998.

In **Japan,** the GTS circuit between Bangkok and Tokyo was upgraded from 1200bpa to 9600bps with X.25 protocol in January 1998. In February, JMA and the Ministry of Construction increased the number of designated major rivers receiving flood forecast services from 130 to 146. In March, JMA's Sendai District Meteorological Observatory, started its remote operation of two radars with Radar Echo Digitizing and Disseminating System (REDIS-NEXT) while five JMA observing stations were made fully automated. In April, JMA introduced the third generation wave models for the global and Japan-area wave predictions, products of which were disseminated through the RSMC Data Serving System starting August 1998. In July 1998, JMA started to use sea surface wind data observed with the scatterometer of the European Remote Sensing satellite (ERS-2) in the Global Data Assimilation System which produces the initial data of the Global Spectral Model (GSM) and Typhoon Model (TYM), commenced operation of a dynamical storm surge model for the 24-hour prediction of storm surges associated with typhoons (the model covers the western part of Japan, is executed four times a day when a typhoon is approaching the country and its outputs are disseminated to local meteorological observatories to support storm surge advisories and warnings) and started to conduct a twice a month experiment to derive one-year predictions of sea-surface temperatures in the equatorial Pacific from a newly developed coupled ocean-atmosphere model. As of end of October, JMA's 95-type equipment had been installed in 68 observing stations. During the year, eight cruises were completed by JMA's meteorological observing vessels in the typhoon-genesis area of the western north Pacific Ocean.

In **Lao, P.D.R.,** the lack of observational equipment had markedly restricted the provision of forecasting services for the public by the Department of Meteorology-Hydrology, the planned upgrading of two synoptic stations and the rehabilitation of four climat stations.

In **Macau,** the Serviços Meteorológicos e Geofícicos (SMG) staff in 1998 developed a VIS5D display software showing the products from JMA's DSS server and ECMWF which has greatly improved the assimilation by forecasters of the trend of weather changes in 3D and variation in time, developed an Intranet Weather Information Database System, and installed a new satellite receiving system for receiving FY-2 data. Upgraded during the year were SMG's telephone weather dissemination system with fax capability, SMG's home page and their leased line to access JMA DSS server from 64K to 128K.

In **Malaysia,** the installation of new meteorological facilities at the Kuala Lumpur International Airport in Sepang which includes: Automated Weather Observation System/Automated Weather Station; GMS receiving system; SAtellite DIStribution (SADIS) system with VSAT equipment; Terminal Doppler Radar; and a Meteorological Data Processing System was completed in 1998. A new GMS S-VISSR ground system which was installed in December 1997 is now operational.

In the **Philippines,** supplemental works under the Japan-assisted Meteorological Telecommunications System Project which included enhancement of the HF radio transmission quality and reinforcement of the VHF antennae tower in Baguio's radar site and Tacloban weather station were carried out during the year. In 1998, a message switching system for displaying numerical weather prediction outputs was installed at PAGASA's Weather Branch. The PAGASA continued to issue information on the El Nino and La Nina to concerned government agencies and to the public.

In the **Republic of Korea,** KMA deployed a discus-type bouy in Keojedo in 1998 making up the total number of buoys around the Korean peninsula to four. From June 1998, KMA began testing the Meteorological Information Service System for Disaster Prevention (monitor severe weather in real time) aimed at providing web-based specific information to meet the requirements of related organizations through the Internet and dedicated line. Operation started in October 1998. Also during the year, KMA updated its radar data processing software which enabled the production of 20 new products, allowed the radar operator to modify the time interval for producing composite image from 5 minutes to 30 minutes and enabled volume scanning and automatic antenna control. In operational status is the video conferencing system which has the capabilities of bi-directional communication for voice, image and graphic information among six main offices of KMA (HQ and five Regional Meteorological Offices). Started in November 1998 is the broadcast of GTS codes from three new synoptic stations and four new buoy stations. Currently under test is the forecast performance of typhoon intensity using the Geophysical Fluid Dynamics Korea model of KMA.

In **Thailand,** still under installation (continued from late 1997) is a new computer system which consists of a supercomputer (IBM RS/6000 SP), workstations, PCs and other computer peripherals. Also installed in 1998 and now operational is the Automatic Aviation Broadcasting System (Bangkok VOLMET) and the Automatic Broadcasting System.

In the **U.S.A.,** administrative office space and operations were reorganized in 1998. Also during the year, the air conditioning and electrical wiring was upgraded in preparation for the arrival of five Hewlett-Packard work stations which are part of the Advanced Weather Interactive Processing System. A request was received in 1998 for an additional Terminal Aerodrome Forecast to be added to Tiyan's suite of forecast products issued to satisfy commercial airline requirements. Completed during the year was a total revision of Tiyan, Guam's tropical Cyclone Operation Procedures and forwarded for approval, the addition of the Area Synoptic Discussion (FXPQ60 PGUM) issued twice daily to the routine forecast product suite, replacement of the FOPN20 PGUM forecast for Micronesia by the Micronesian Coastal Marine Forecast (FZPQ50 PGUM) which lengthened the forecast by two additional forecast periods, installation of an antenna to directly ingest Japan's GMS imagery into NWS Tiyan, Guam's High-Resolution Picture Transmission Image Information Processing System, and installation of an Aeronautical Fixed Telecommunications Network throughout Micronesia. The upgrading of 20 automatic meteorological observing stations in Micronesia and contingency plans to alleviate possible Y2K problems was started in 1998.

In **Viet Nam,** the installation of a TSR-2730 digital radar at Phu Lien and a DWSR-93C at Tam Ky commenced in 1998. In July, completed was the installation of the WAFS system at the National Center for Hydrometeorological Forecasting (NCHMF) in Hanoi and the upgrading (since January 1998) of three upper-air radiosonde stations. Established during the year was a VSAT communication system from the NCHMF to its regional centers.

APPENDIX IV

PROPOSALS FOR UPGRADING OF THE TYPHOON COMMITTEE OPERATIONAL MANUAL - METEOROLOGICAL COMPONENT (1999 EDITION)

Page	Line	Present Description	Proposal for Amendment
CHAPTER 1			
7	7	100◦E and 180◦E	<< **CORRECT** the misprinting in the last Edition.>> 100°E and 180°E
CHAPTER 2			
8	29	the radiowind	the radiosonde/radiowind
8	31	Radiowind	Upper-air
8	31	affected by	within 300 km of the centre of
9	1	Additional	Enhanced
9	2	500	300
9	5	additional	enhanced
9	8	Additional hourly	Hourly
9	10	when they are	since April 1997.
9	12	Additional upper-air .... ships JBOA	<< **REPLACE** by the following sentence.>> Upper-air observations are usually made twice a day (00, 12 UTC), and radar observations are made 3-hourly on board the ships JBOA
CHAPTER 5			
21	5	Satellite, V.29, 9,600 bits 4,800 bits	Cable, 64 Kbit/s X.25 Level 3
21	6	(data) X.25 Level 3 + 4,800 bit/s (fax)	<< **DELETE** >>
21	8	Satellite, 1,200 bit/s	Cable, 9,600 bit/s X.25 Level 3
Appendix 2-A			
2	9		<< **INSERT** the following station numbers in this list.>> 98, 104, 117, 125, 126, 127, 128, 132, 167
Appendix 2-B			
1	3	500	300

Page	Line	Present Description	Proposal for Amendment
Appendix 2-F			
1	1	PRESENT	<< **DELETE** >>
1	3	current	<< **DELETE** >>
1	5	hemisphere	hemispheres
1	6	in addition to the WEFAX dissemination,	<< **DELETE** >>
1	11-15	(The observation starts .... (1) Regular observation - Full disk image hourly basis and for wind derivation : 0530, 1130, 1730 and 2330 UTC *(The actual observation starts at about 30 minutes before the respective observation time.)	<< **REPLACE** by the following sentences.>>
Appendix 2-G			
1	2	OF TYPHOON COMMITTEEE	AT TYPHOON COMMITTEEE
1	40-42	Pusan	<< **REPLACE** by the followings.>>

Seoul/METRI	(37.7° N, 127.0° E)	2
Seoul/Kimpo Intl Airport	(37.6° N, 126.8° E)	2
Pusan	(35.1° N, 129.0° E)	2
Kwangju	(35.2° N, 126.9° E)	2
Taejon	(36.4° N, 127.4° E)	2
Kangnung	(37.5° N, 130.9° E)	2
Cheju	(33.5° N, 126.5° E)	2
Taegu	(35.9° N, 128.6° E)	2
Taegu/Air Traffic	(35.9° N, 128.7° E)	2
Chonju	(35.8° N, 127.2° E)	2
Chongju	(36.6° N, 127.4° E)	2
Ullung-Do	(37.5° N, 130.9° E)	2
Mokpo	(34.8° N, 126.4° E)	2
Chunchon	(37.9° N, 127.7° E)	2
Masan	(35.2° N, 128.6° E)	2
Tongyong	(34.9° N, 128.4° E)	2
Inchon	(37.5° N, 126.6° E)	2
Huksando	(34.7° N, 125.5° E)	2
Suwon	(37.3° N, 127.0° E)	2
Sokcho	(38.3° N, 128.6° E)	2
Pohang	(36.0° N, 129.4° E)	2
Kunsan	(36.0° N, 126.7° E)	2

Page	Line	Present Description	Proposal for Amendment
Appendix 3-A			
1	8		<< **INSERT** the followings here.>> dynamic quality control considering temporal and spatial variabilities
1	8	(320 × 640)	(640 × 320)
1	11	a combination of	<< **DELETE** >>
1	35	bulk formulae ...	<< **DELETE** >>
1	35		<< **INSERT** the followings here.>> with evaporation of falling rain - Tiedtke (1985) –type shallow convection in the form of enhanced diffusion
2	6		<< **INSERT** the followings here.>> dynamic quality control considering temporal and spatial variabilities
2	6	(320 × 640)	(321 × 217)
2	9	a combination of	<< **DELETE** >>
2	11	asymmetric structure ...	<< **DELETE** >>
2	11		<< **INSERT** the followings here.>> asymmetric structure, whenever appropriate, derived from the last 12-hr prediction by TYM and tuned so that initial translation velocity better fits the latest analyzed track, otherwise, derived from the latest 6-hr prediction by GSM
2	22	while asymmetric component preserved	<< **DELETE** >>
2	27	None	<< **REPLACE** by the following sentences.>> Done through tuning of asymmetric components, whenever error of the latest 12-hr track prediction is within a range
2	32	(north of the equator,	0°N -- 60°N,
2	37	two per synoptic time	two for each synoptic time
2	42	each target tropical cyclone, fixed	each tropical cyclone (TC) and fixed
3	21		<< **INSERT** the followings here.>> (surface properties) fixed climatological mean values with seasonal changes
Appendix 3-B			
5	33	Latest position of current storm	Date, latest position of current storm

Page	Line	Present Description	Proposal for Amendment
Appendix 3-B			
15	15	12-, 24-, 36-	every 6 hours up to 60 hours
15	19	8-layer σ-coordinate	8 vertical σ levels with 50hPa at top
15	20	Periphery of typhoon (5400 × 5400 km)	5400 × 5400 km area with a center set at median of expected typhoon track
15	22	Time integration	<< **DELETE** >>
15	23	Value from the Global Spectral	Prediction by GDAPS at T-6h initial
15	last		<< **INSERT** the followings here.>>

(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 eqs.: Primitive equations Vertical resolution: 18 vertical σ 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 2.)	

Name of the the method	Barotropic Adaptive Typhoon System (BATS)	every 6 hours up to 60 hours
Description of the method	Governing eqs.: 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 3.)	

Name of the the method	Global Data Assimilation Prediction System (GDAPS)	every 6 hours up to 60 hours
Description of the method	Governing eqs.: 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 4.)	

Page	Line	Present Description	Proposal for Amendment
Appendix 3-C, Annex			
20	last		<< **INSERT Annex 3-D,p.1 – 4** after this page.>>
Appendix 4-C			
1	10	Tokyo, JMC 1-6, Western North Pacific	<< **DELETE** >>
Appendix 5-B			
1	8	WWWJP20 RJTD, WWWJP21 RJTD	<< **DELETE** >>
Appendix 5-C			
2	45		<< **INSERT** the followings here.>> FXPQ22 RJTD O TD TD TD TD TD BB BB FXPQ23 RJTD O TD TD TD TD TD BB BB FXPQ24 RJTD O TD TD TD TD TD BB BB FXPQ25 RJTD O TD TD TD TD TD BB BB
3	18	WWWJP20 RJTD	<< **DELETE** >>
3	19	WWWJP21 RJTD	<< **DELETE** >>
Appendix 6-B			
1	last		<< **INSERT** the following sentences.>> Members can also retrieve the data from the Internet server of JMA (ddb.kishou.go.jp) by using FTP. A password to connect the FTP server by using anonymous FTP is issued to Members in consultation with JMA.
Appendix 6-E			
1	Figure		<< **INSERT** an arc indicating ΔR length in the figure.>>
2	Figure		<< **INSERT** an arc indicating ΔR length in the figure.>>
Appendix 7-A			
1	1	PROCESSED TO BE	<< **DELETE** >>
1	15-18	Kinds of data ...	<< **REPLACE** by the followings.>> Kinds of data : either negative or positive imagery (for Microfilm data). : imagery and tabular form data (for CD-ROM data). Data form : Microfilm (Specification is given in the next page (Appendix 7-A, p.2)). : CD-ROM (Specification is given in Appendix 7-A, p.3).

Page	Line	Present Description	Proposal for Amendment
Appendix 7-A			
1	31	for level II -b and level III -a	<< **CORRECT** the misprinting in the last Edition.>> for level II -b
Appendix 7-A,Annex			
2	last		<< **INSERT Appendix 7-A, Annex, p.3** after this page.>>

□ Outline of KMA - Typhoon dynamic models

1. Korea Typhoon Model (KTM)

KMA has been operating the dynamic typhoon model (KTM) since 1994. KTM model was introduced from Japan Meteorological Agency (JMA).

1. Primitive equation model
2. 8 vertical σ levels with 50hPa at top
3. Horizontal Resolution

Representation	Spectral with circular truncation at wave number 70
Grid	109×109, The grid interval is about 50km.
Domain	Center of the domain is set at median of expected typhoon track, approximately 5400×5400km

4. Physics

Cumulus convection	Kuo cumulus parameterization
Boundary layer	simple K-theory
Surface layer	bulk method / analyzed SST / no heat flux over land

5. Boundary Conditions

Lateral	prediction by Global Data Assimilation Prediction System (GDAPS) at T-6h initial
Upper	σ = 0 at the top

6. Initial Field

Bogusing	Symmetric vortex generated by empirical formulas + asymmetry structure derived from first guess field
Initialization	NNMI

7. Forecast Time: 60 hours from 00, 12UTC
8. Products: location (lat./lon.), central pressure, and maximum tangential winds every 6 hours up to 60 hours in advance.

2. Geophysical Fluid Dynamic in Korea (GFDK) typhoon model

GFDK is the KMA version of the triply nested, movable mesh hurricane prediction system developed by NOAA's Geophysical Fluid Dynamics Laboratory (GFDL). The initial condition and lateral time-dependent boundary condition are provided by GDAPS. And boundary conditions such as SST are reevaluated for the far east Asia region.

1. Primitive equation model
2. 18 vertical σ levels
3. Multiple nested movable mesh

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

4. Physics
   - Diffusion
     Horizontal: Samagoriky nonlinear viscosity
     Vertical: 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
   - Radiation
     Infrared: Schwarzkopf-Fels scheme
     Solar: Lacis-Hansen schme
     effects of diurnal cycle and cloud variation considered
5. 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

6. Boundary Conditions
   Lateral prediction by GDAPS at T-6h initial
   Upper $\sigma = 0$ at the top
7. Time integration
   Two-step iterative integration scheme
   Wind direction-dependent boundary condition for limited domain
   Mesh-by-mesh integration using dynamical interface
8. Frequency of Forecast twice a day (06, 18UTC)
9. Products location (lat./lon.), central pressure, maximum tangential winds, and precipitation every 6 hours up to 60 hours in advance.

2.3 Barotronic Adaptive Typhoon System (BATS)

The barotropic typhoon track prediction has been developed in KMA in cooperation with department of atmospheric science at Gongju university in Korea, utilizing the continuous dynamic grid adaptation technique. This model has an advantage to represent the typhoon vortex in more detail.

1. Shallow water equations
2. Horizontal Resolution
   Grid system adaptive grid
   grid interval the regular grid size 0.6° and the smallest grid size 0.3° on the continuous dynamic grid adaptation
   number of grid 101×101
3. Coordinate
   Horizontal coordinate latitude-longitude
   Domain 60° ×60°
4. Initial Field
   Environmental fields from a GDAPS global analysis
   Specified vortex generated by empirical formulas
   Height field obtained by solving the balance equation
5. Boundary Conditions
   Lateral prediction by GDAPS at T-6h initial
6. Frequency of forecast four times a day (00, 06, 12, 18UTC)
7. Products location (lat./lon.) every 6 hours up to 60 hours in advance

4. Global Data Assimilation Prediction System (GDAPS)

The Global Data Assimilation Prediction System produces its own typhoon track forecasts since 1997.

1. Primitive equation
2. 21 level hybrid coordinate
3. Horizontal representation Spectral, with triangular truncation at wave number 106
4. Grid 160 Gaussian latitudes and 320 longitudes
5. Physics
   - Diffusion
     - Horizontal: $K\nabla^4$ (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
6. Initial Field.
   - Analysis global objective analysis (mandatory pressure levels, 1.875° resolution)
   - Bogusing Symmetric vortex generated by empirical formulas + asymmetry structure derived from first guess field
   - Initialization NNMI
6. Time integration
   - Semi-implicit with time filter
8. Frequency of Forecast twice a day (00, 12UTC)
9. Products location (lat./lon.), central pressure, maximum tangential winds, every 6 hours up to 60 hours in advance.

SPECIFICATION OF MONTHLY REPORT CD-ROM FOR GMS DATA

Recording format: ISO9660 standard

1) **Tabular form data**
   File format: ASCII code
   Content: Cloud Amount, Sea Surface Temperature, Cloud Motion Wind, Water Vapor Motion Wind, Equivalent Blackbody Temperature, Out-going Longwave Radiation (OLR), Solar Irradiation, Snow and Ice Index, GMS Attitude/Orbit Data, VISSR Image Data Catalog (CMT/Micro Film), TOVS Vertical Profile of Temperature and Precipitable Water and TOVS Total Ozone Amount

2) **GMS Full Disk Earth's Cloud Image**
   File format: Bitmap format available in Microsoft (R) Windows (R) operating system
   Size of image: 512 pixels by 512 lines and 256 levels
   Contents: Infrared (IR:11 μm) 6-hourly and 03UTC
   Visible (VS) 00, 03 and 06UTC
   Water Vapor (WV) 6-hourly and 03UTC

3) **GMS Cloud Image of Japan and its Vicinity**
   Covering area: 50N ~ 20N and 120E ~ 150E at every 0.06 degrees latitude by 0.06 degrees longitude box
   Size of image: 501 pixels by 501 lines and 256 levels
   Contents: Infrared (IR: 11 μm) hourly (24 images/day)
   Visible (VS) hourly from 21UTC to 09UTC (13 images/day)
   Water Vapor (WV) hourly (24 images/day)

*** (These images can be viewed by the Viewer contained in the CD-ROM.)**

Note : The Monthly Report CD-ROM has been issued every month since July 1996.

APPENDIX V

REPORT ON THE ACTIVITIES OF RSMC TOKYO - TYPHOON CENTER

Activities of the RSMC Tokyo-Typhoon Center in 1998

1. Provision of RSMC Products

The RSMC Tokyo-Typhoon Center has been providing TC Members with various kinds of products on tropical cyclones in the western North Pacific via the GTS, HF broadcast, international SafetyNET service and others. Table 1 shows the total number of the products issued by the Center in 1998 (as of the end of October 1998).

2. Operational Typhoon Forecasts

Operational forecasts for tropical cyclones of TS intensity or higher in 1998 were verified against Best Track data prepared by the Center. Results of the verification of 24-, 48- and 72-hour forecasts for the tropical cyclones in 1998 are shown in Table 2 and Figure 1. Annual mean position errors are approximately 180 km for 24-hour forecast, 370 km for 48-hour forecast and 560 km for 72-hour forecast (as of the end of October 1998).

Figure 2 shows that the mean position errors of the operational forecasts in 1998 are much larger than those for the recent several years. The performance of numerical predictions with the Global Spectral Model (GSM) and the Typhoon Model (TYM) shows the same trend in track forecasts. For example, Typhoon 9804(REX) took unusual east-southeast courses in the seas south of Japan, and it was hard to forecast the courses accurately. Figure 3 shows 12 hourly observed positions of REX from 24 August to 7 September and its forecast tracks with GSM.

3. RSMC Data Serving System

JMA has been operating the RSMC Data Serving System that allows TC Members to retrieve NWP products (GPVs) and observational data through the Internet and Integrated Service Digital Network (ISDN) since 1995. Eight Members are registered for access to the system (as of the end of October 1998). The products and data being provided through the system are listed in Table 3.1 and Table 3.2. JMA added the following products and data to the system in 1998: 1) GPVs of the lower stratosphere, 2) digital GMS cloud data, 3) tropical cyclone information, and 4) products of the global wave model (see shaded items in Table 3.1 and Table 3.2).

4. Publication

The Center published:

1) Annual Report on Activities of the RSMC Tokyo-Typhoon Center in 1996 in February 1998; and
2) Technical Review (No. 2) that contains a paper entitled "Enhanced Accuracy of Typhoon Prediction of the Advanced Numerical Models at the Japan Meteorological Agency" in March 1998.

5. Training

The Center held the "International Training Seminar on Typhoon Monitoring and Forecasting in the Western North Pacific (12 to 30 January)" and the "Training Course for Use of Satellite Data for Typhoon Monitoring and Forecasting (19 January to 6 February)" (see paragraphs 5.1 and 5.2 of Meteorological Component of the Country Report of Japan).

6. Implementation Plan

The Implementation Plan of the RSMC Tokyo-Typhoon Center is shown in Table 4. As described in the paragraph 1.1 of Meteorological Component of the Country Report of Japan, the MTSAT LRIT and HiRID broadcasting systems will start in 2000 to replace the existing stretched VISSR and WEFAX (WEFAX will be continued until the end of March 2003). JMA plans to disseminate observational data, advisories on tropical cyclones and NWP products (GPVs) to TC Members for their own operational use via MTSAT LRIT from 2000. After implementation of the MTSAT LRIT data/products dissemination service, the RSMC Data Serving System will focus on distribution of large amount of data for purposes not covered with the LRIT service such as GPVs for boundary condition of the limited area model operation.

Table 1 Monthly and annual total numbers of products issued by the RSMC Tokyo-Typhoon Center in 1998 (as of 31 October 1998)

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	0	0	0	5	46	88	79	–	–	218
TCNA21	0	0	0	0	0	0	11	55	98	86	–	–	250
WTPQ20-25	0	0	0	0	0	0	13	63	102	89	–	–	267
WTPQ30-35	0	0	0	0	0	0	7	30	48	44	–	–	129
FXPQ20-25	0	0	0	0	0	0	11	60	94	86	–	–	251
FKPQ30-35	0	0	0	0	0	0	12	62	97	89	–	–	260
AXPQ20	2	0	0	0	0	0	0	0	0	4	–	–	6
AUXT85 AUXT20	62	56	62	60	62	60	62	62	60	62	–	–	608
FUXT852 FUXT854	62	56	62	60	62	60	62	62	60	62	–	–	608
FUXT202 FUXT204	62	56	62	60	62	60	62	62	60	62	–	–	608

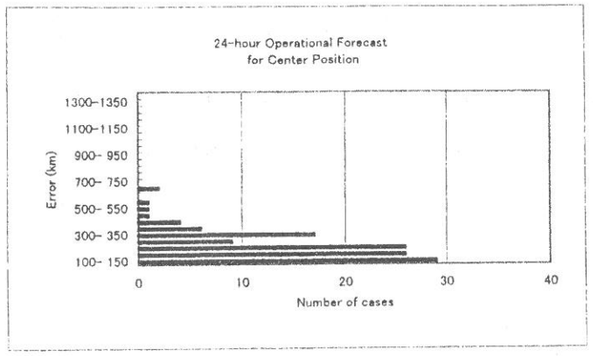
Notes:

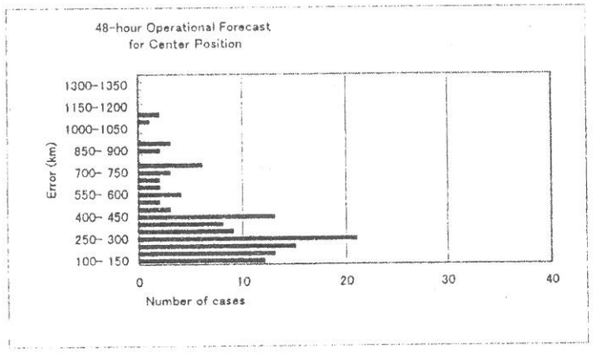
- via the GTS -

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 Meteorological Radio Facsimile (JMH) -

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





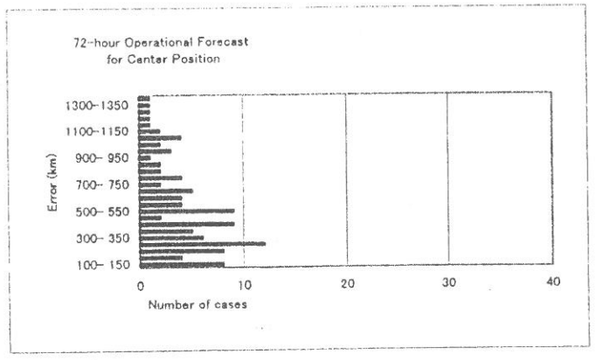


Figure 1 Error distribution of 24-, 48-, 72-hour forecast for center position of tropical cyclone with TS intensity or higher in 1998
(as of 31 October 1998)

Table 2 Mean position errors of 24-, 48- and 72-hour operational forecasts for each tropical cyclone with TS intensity or higher in 1998
(as of 31 October 1998)

Tropical Cyclone	24-hour Forecast				48-hour Forecast				72-hour Forecast			
	Error Mean (km)	Error S.D. (km)	Number of Fcst.	EO/EP (%)	Error Mean (km)	Error S.D. (km)	Number of Fcst.	EO/EP (%)	Error Mean (km)	Error S.D. (km)	Number of Fcst.	EO/EP (%)
TS 9801 NICHOLE	62	0	1	–	–	–	–	–	–	–	–	–
TY 9802 OTTO	200	126	5	91	646	0	1	–	–	–	–	–
STS 9803 PENNY	121	55	4	109	–	–	–	–	–	–	–	–
TY 9804 REX	174	90	48	86	375	186	43	81	612	321	40	85
STS 9805 STELLA	70	28	2	–	–	–	–	–	–	–	–	–
TY 9806 TODD	192	116	11	28	563	258	7	30	1074	244	3	36
TY 9807 VICKI	304	91	18	93	670	306	14	76	1148	442	10	56
TS 9808 WALDO	517	0	1	–	–	–	–	–	–	–	–	–
TY 9809 YANNI	331	54	6	84	924	18	2	–	–	–	–	–
TY 9810 ZEB	196	158	32	108	284	138	21	59	470	178	17	47
TY 9811 BABS	123	87	46	67	231	114	40	61	323	167	36	54
Annual Mean (Total)	184	124	174	77	368	239	128	65	555	367	106	63

* All data after STELLA(9805) are preliminary.

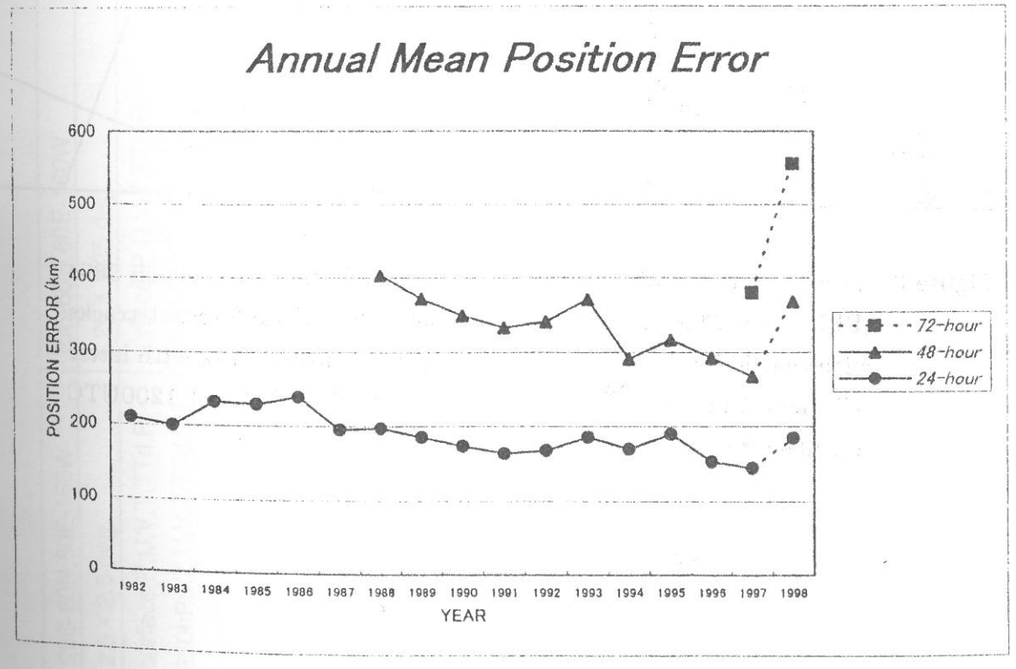


Figure 2 Annual mean position errors of 24-,48-,72-hour operational forecasts for tropical cyclones with TS intensity or higher
(as of 31 October 1998)

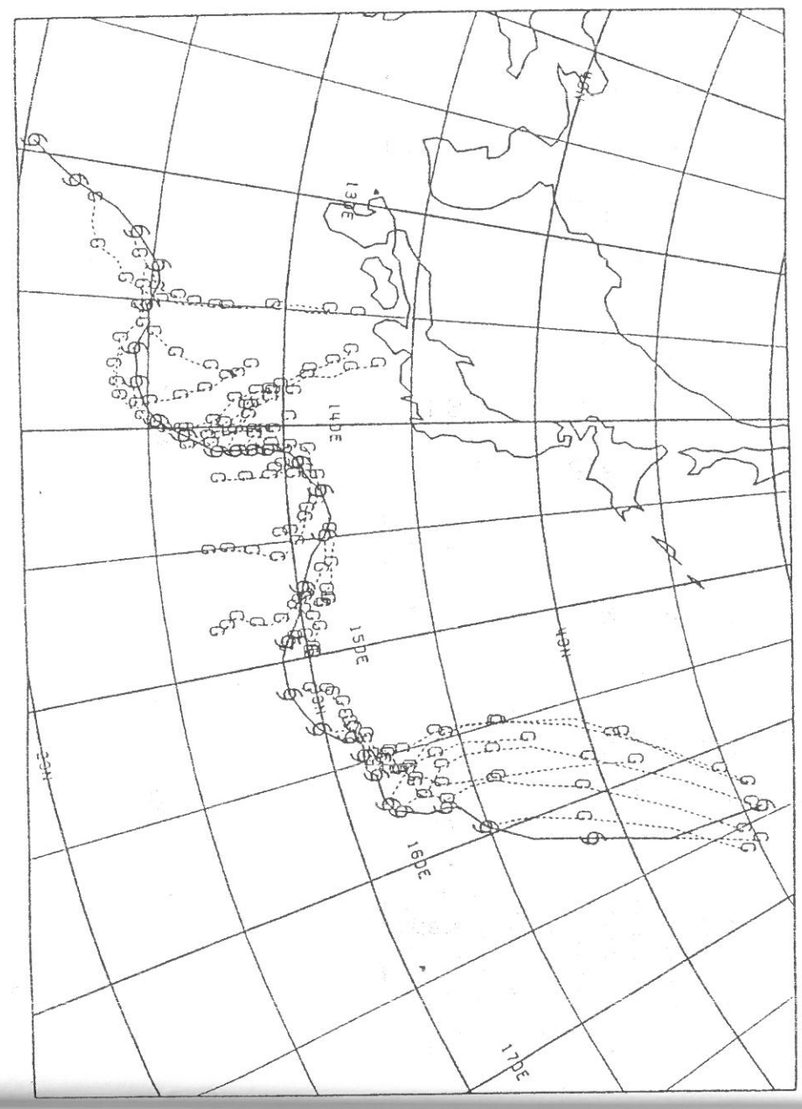


Figure 3 Twelve hourly analyzed positions (thick solid line) of typhoon 9804 (REX) from 24 August to 7 September 1998 and its forecast tracks with the JMA's Global Spectral Model. Thin dashed lines with letter "G" show 12-hourly predicted tracks from 0000UTC and 1200UTC initial each day.

Table 3.1 List of GPV products on the RSMC Data Serving System

31/October/1998

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,ω) 700hPa(Z,U,V,T,TTd,ω) 500hPa(Z,U,V,T,TTd,ζ) 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,ω) 850hPa(Z,U,V,T,TTd,ω,ψ,χ) 700hPa(Z,U,V,T,TTd,ω) 500hPa(Z,U,V,T,TTd,ζ) 400hPa(Z,U,V,T,TTd) 300hPa(Z,U,V,T,TTd) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T,ψ,χ) 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)
FCST 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	00UTC : 24,48,72 12UTC : 00,24,48,72,96,120	00UTC : 00
Time/Day	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	

Note: P : pressure reduced to MSL
U : u-component of wind
R : total precipitation
TTd : dew point depression
Z : geopotential height
V : v-component of wind
T : temperature
ω : vertical velocity
ζ : relative vorticity
ψ : stream function
χ : velocity potential

Table 3.2 List of Other Products and Data on the RSMC Data Serving System

31/October/1998

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) (c) Sea surface temperature (SATOB)	Tropical cyclone related information (BUFR) •Position, etc.	•Wave height •Wave period •Prevailing wave direction Forecast Times: Initial,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 (c) Every 5 days	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

PRODUCT	1998	1999	2000	2001	2002	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)
MTSAT LRIT						24 times/day (Image h, i/j)
MTSAT HiRID						24 times/day (full-disk)
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	1998	1999	2000	2001	2002	REMARKS
Data archive						
Monitoring of data exchange						
Dissemination of products						RSMC Data Server LRIT (MTSAT)

* "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.

Table 4 Implementation Plan of the RSMC Tokyo – Typhoon Center (1998 – 2002)

APPENDIX VI

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

In **Cambodia,** the Japan-funded Project on the Improvement of the Hydrological Network (basinwide) which commenced March 1996 resulted in the rehabilitation of 12 hydrological stations on the tributaries of the Tonle Sap Lake in 1998.

In **China,** completed in 1998 was the establishment of a wireless communication network between Administrations of Major River Reaches and Reservoirs at the county level and their branches which saw the setting up of 14 base stations and 585 user stations, installation of satellite ground receiving stations at the Ministry of Water Resources and six Water Resources Commissions of Yangtze River, Yellow River, Huaihe River, Haihe River, Pearl River and Song-Liao River, transmission of real-time hydrological information through the Wide Area Network, development of a new flood control consulting system based on GIS by the Water Resources Information Center and the establishment of a Hydrological Information and Flood Forecasting and Prediction Operational System in the Water Resources Information Center. The accurate and timely hydrological information and forecasting provided a scientific basis for flood control which resulted to tremendous social and economic benefits. Most notable was the accurate forecast provided by the Shashi station which helped decide contingency measures at the Jiangjiang flood retaining area in the middle stream of the Yangtze River.

In the **D.P.R. of Korea,** the State Hydrometeorological Administration in 1998 developed a flood process numerical forecast method (introducing an instantaneous unit hydrographic model and storage function method into the flood translation computation model), introduced the use of a rainfall excess computation method using an unsaturated rainfall model, provided timely and accurate forecasts to the State Flood Disaster Preparedness Commission so that reservoirs can be regulated which significantly reduced flood damage, and created a data base for flood forecasts and a system to provide concerned agencies with flood maps (i.e. inundation status of urban and arable land due to floods).

In **Hong Kong, China,** the Drainage Services Department in 1998 implemented village flood protection schemes in the New Territories in Hong Kong and commissioned seven studies under its Drainage Master Plan Scheme to review the condition and performance of the existing storm-water drainage systems in flood-prone areas. It also reviewed during the year, the existing estimate of the Probable Maximum Precipitation (PMP) for Hong Kong used to evaluate probable landslip scenarios due to heavy rain which established the necessity to update the current PMP.

In **Japan,** as a measure to guard against abrupt floods of small and medium rivers, the data renewal interval in the observation of rain gauges was reduced from 1 hour to 30 minutes and 10 minutes respectively. The river information system and FRICS system was upgraded in 1998 to the transmission method using inter-LAN connection. In July, information services using the Internet began and information on some rivers is now available on-line.

In **Lao P.D.R.,** hydrological observations of water level, discharge and sediment were made at the hydro stations in the Mekong River and its tributaries while for flood forecasting, the Mekong River Commission in cooperation with the Meteorological and

Hydrological Department issued daily forecasts of the water level in the Mekong River during the rainy season.

In **Malaysia,** the Department of Irrigation and Drainage (DID) in 1998 installed 21 new telemetric stations (rainfall and river level) bringing the total number to 184 in 32 river basins in the country. A total of 191 VHF voice communication sets and 137 manual river gauges were installed to provide additional hydrological and flood information especially during the flood season. As part of local flood warning systems, 60 flood warning boards and 73 flood warning sirens were established in flood prone area throughout the country. Real-time data transmission via the "Emarsat-C Satellite" tested during the year at six problematic radio-based remote stations in Kelantan and Pahang river basins were found to be very reliable. Similar systems were implemented for Padas River in Sabah. DID also tested the use of "Low Orbiting Satellites" for telemetric data transmission. Since the test on using internet infrastructure to transmit telemetric data between master station and users proved to be successful, the DID had installed a system to integrate all real-time telemetric data to be transmitted via the internet. Of the 28 river basins equipped with telemetric rainfall and water level stations, eight river basins were provided with flood forecasting models for which real-time flood forecasting operation was carried out by the respective state DID office. Efforts were made to calibrate new models to improve forecast accuracy.

In the **Philippines,** the Flood Forecasting Branch (FFB) of PAGASA issued appropriate flood warning bulletins to the different river basins affected by the passage of three tropical cyclones. PAGASA together with a number of concerned government agencies formulated non-structural measures for the mitigation of the effects of flooding in Mindanao, the second largest island in the country. This was in support of the national government's program to address the sustainability of the socio-economic development of Mindanao during the La Niña period. The FFB also completed during the year the installation of Ethernet cards to all its computers which made possible the availment of the numerous advantages of computer networking.

In the **Republic of Korea,** the Ministry of Construction and Transportation (MOCT) in 1998, continued to add new data collecting stations during the year and improved the on-line flood forecasting systems at five flood control centers at five major river basins which includes: the completion of the Hyoungsan River basin flood warning system in May 1998; completion of the Sapgyo Creek basin flood warning system in December 1998 and hardware and software improvements to the Seomjin River Flood Control Center in December 1998. On-going projects of the MOCT includes: increasing flood control capacity through the continued construction of seven additional multi-purpose dams, building of additional levees throughout the country; extending pumping stations for better inland drainage and adding more flood warning systems to middle or small river basins.

In **Thailand,** the Hydrometeorology Division of the Thai Meteorological Department established in 1998 six hydrometeorological stations and continued to improve its flood forecasting and warning system in three major river basins.

In the **U.S.A.,** in May and June 1998, a survey was conducted by the Alaska Regional Hydrologist and a Senior Service Hydrologist from Hawaii in line with initial efforts to establish a hydrology program in Micronesia.

In **Viet Nam,** completed during the year was the installation of additional VHF radio stations to provide hydro-meteorological and flood information for flood monitoring and forecasting purposes bringing the total to 185. With the assistance of international and U.N. agencies, the government in 1998, drew up comprehensive programs for flood control with a view at reducing property damage and loss of lives.

The Hydrometeorological Service also continued to provide timely flood forecasts and warnings to Viet Nam's main river basins and improve its measurement network and data collection system.

APPENDIX VII

SUMMARY OF ACTIVITIES OF ESCAP AND WMO RELATED TO THE HYDROLOGICAL COMPONENT

Activities of ESCAP

Background Information

The Economic and Social Commission for Asia and the Pacific (ESCAP), at its fifty-fourth session held at Bangkok from 16 to 22 April 1998 noted with appreciation the progress achieved by the Committee in the previous year, including important work undertaken in the meteorological and hydrological components, disaster prevention and preparedness, training and research.

The Commission also noted the support provided by the secretariat to various activities of the Committee members and the valuable contribution of the World Meteorological Organization to the work of the Typhoon Committee.

ESCAP continued to provide support to Members in their endeavors on hydrological component.

The Ad Hoc Expert Group Meeting on the Integration of Water Resources Management into Economic and Social Development Plans was held at Bangkok in June 1998. It was attended by 11 experts from eight members of ESCAP, which included some Members of the Typhoon Committee, and also by other United Nations and international organizations. The Meeting reviewed the analysis of a survey conducted by the secretariat and noted the views expressed in case studies and other background documents and the experience presented in country papers. After vigorous discussions, the Group formulated a number of recommendations.

The Subregional Workshop on Private Sector Involvement in Water Supply and Sanitation was held in New Delhi in April 1998. The Workshop, which had been organized with extrabudgetary resources, provided a forum for constructive dialogue between the public and private sectors on greater partnership in the development and operation of water supply and sanitation infrastructure. It was attended by participants representing governments and the private sector, including senior managerial personnel from international water services providers. Private sector participation in the delivery of water supply and sanitation services is gaining momentum in the region, as shown by the long-term private sector concessions for the provision of water-related services recently given in Manila and Jakarta. The ESCAP activities on this issue have been found very timely and useful by governments, international water companies and other international agencies. The high demand for the *Guidebook on Private Sector Participation in Water* Supply and Sanitation (ST/ESCAP/1732) has led to the printing of an additional 300 copies.

A publication entitled *Towards Efficient Water Use in Urban Areas in Asia and the Pacific* (ST/ESCAP/1874) has been welcomed by readers. This publication was the final output of a project which was funded by Japan.

ESCAP secretariat had also continued to pivotal role in supporting cooperation between the United Nations and some regional agencies involved in work in the water resources field. On 4 June 1998, the secretariat convened forty-first session of the

RICAP Subcommittee on Water. Activities of Agencies were reviewed to avoid duplication, as well as to continue implementing inter-agency regional projects. An exhibition commemorating World Water Day was held on 20 March 1998, with contributions by the United Nations Children's Fund, the United Nations Environment Programme and the Ministry of Construction of Japan, various departments of the Government of Thailand and the Asian Institute of Technology. Cooperation with the Mekong River Commission (MRC) has also continued.

ESCAP secretariat has continued to publish its quarterly *Water Resources Journal* and the semi-annual *Confluence*, and also fielded advisory missions, including to Cambodia, Philippines, and Viet Nam on various aspects of water resources planning and management and arranged for several TCDC exchanges.

An expert group workshop will be held in Bangkok in November 1998 in order to review and adopt the guidelines and manual on the protection and rehabilitation of contaminated rivers in Asia and the Pacific. Under the previous phase of the project, a study on the sources and nature of water quality problems in selected rivers in Asia and the Pacific was carried out. The project is aimed at improving and protecting the quality of water in polluted rivers, increasing the availability of safe water supply, and affecting environmental technology transfer.

Activities of WMO

A more specific but nevertheless relevant event is the establishment of an Asia-Paficic FRIEND (Flow Regimes from International and Experimental Network Data), under the auspices of the UNESCO International Hydrological Programme (IHP). This initiative has resulted so far in the publication of two volumes of a river catalogue, and the preparation of plans for collaboration among a number of Asia-Pacific countries. Several members of the RA II (Asia)and RA V (South-West Pacific) Working Groups on Hydrology, and WMO Commission for Hydrology (Chy) have been involved in this initiative.

The most distinctive aspect of water resources management in the typhoon region is the widespread occurrence of flash flooding, particularly associated with tropical cyclones. Opportunities for reducing the water-related impacts of tropical cyclones include:

- Developing national capabilities to forecast tropical cyclones and their impacts;
- Improving QPFs and forecasts of storm surges;
- Capitalizing on new technology to develop flood forecasting systems that are more robust and better meet user needs;
- Enhancing cooperation and communication between hydrologists and meteorologists;
- Developing new approaches to hazard mitigation, for example involving local community leaders in interpreting and communicating warnings to the public.

The Executive Council at its fiftieth session in June 1998 recognized that the year 2000 problem could also have an impact on the hydrological community, in particular in relation to flood forecasting and warning systems. It welcomed the suggestion of the President of Chy that the HWR Department should take advantage of the excellent work undertaken within the WWW Programme to provide advice to the hydrological community as to the nature of the problem and how it might be addressed. The council took note of the renewed activities in the field of flood disaster reduction and the continuing cooperation between HWRP and the TCP.

APPENDIX VIII

REPORT OF THE MEETING OF HYDROLOGISTS FROM TYPHOON COMMITTEE MEMBERS

1. Introduction

The meetings of the hydrologists from the Typhoon Committee Members were convened on 30 November 1998 and 2 December 1998 by the Typhoon Committee Secretariat (TCS) and were attended by representatives of the Typhoon Committee members from: China, Japan, Malaysia, Philippines, Republic of Korea, Vietnam, ESCAP and WMO. Two JICA experts attended as observers. Mr. Chong Sun-Fatt of Malaysia was elected to serve as chairman of the meeting.

The hydrologists expressed their gratitude to the Government of the Republic of Korea for making available the service of a full time hydrologist at TCS.

2. Recent Activities of Each Typhoon Committee Member

The participating Typhoon Committee members briefly presented information on their recent activities which were covered in the country reports presented during the main session.

3. Review of Recommendations Made During the Last Pre-Session Meeting

(i) The meetings were informed that most of the national hydrological services of the participants have already established homepages respectively. Efforts would be continued to establish or upgrade the homepages.

(ii) The hydrologist of TCS has initiated some efforts to evaluate the requirements of TC members and he would continue to formulate proposals for future activities under the hydrological component.

(iii) The proposed project on "*The Establishment of Debris Flow and Landslide Forecasting and Warning System*" is to be considered for inclusion as a component in the main project "*Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Area*" at the stage of feasibility study.

(iv) The hydrologists noted that neither the Typhoon Committee Trust Fund nor the TCDC arrangement has been made use of for activities under the hydrological component in the last one year.

(v) Promotional materials on World Day for Water and IDNDR Day (22 March 1998 and 13 October 1998 respectively) had been sent by some of the national hydrological services to ESCAP and WMO. ESCAP has organized exhibitions on both occasions.

4. Recommendations from the Meeting of Hydrologists

The meetings deliberated on issues which were of general concern to the hydrologists. Such issues included: the need for reliable Quantitative Precipitation Forecasts (QPFs); debris flow and landslide disasters; as well as impacts of El Niño and La Niña phenomena. The meetings noted with concern the decreasing involvement of hydrologists in the works of Typhoon Committee at the regional level. Following which, future activities and support required were discussed and a set of recommendations were made as follows:

i. Cooperation between meteorologists and hydrologists at the national or regional level to develop reliable QPFs for the enhancement of flood forecasting.

ii. 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:

   (a) A workshop on "*The Impacts of El Niño and La Niña Phenomena on Meteorology and Hydrology in the Typhoon Committee Area*" in 1999 and to be supported by TC Trust Funds.

   (b) A 5-day training seminar on "*Development of Forecasting and Warning System for Typhoon-Induced Sediment Disasters*" for hydrologists in the Typhoon Committee Area in 1999 and to be supported by TC Trust Funds.

iii. Requesting the hydrologists of Typhoon Committee Members to participate actively in the activities under the hydrological component, including the attendance in the annual session of the Committee.

iv. Requesting the Government of Republic of Korea to continue to provide the service of a hydrologist in the Typhoon Committee Secretariat.

v. Typhoon Committee Members are encouraged to seek advisory services from ESCAP as well as TCDC support.

5. Closing of the Meeting

The Typhoon Committee hydrologists unanimously agreed on the proceedings, decisions and recommendations of the Meeting, as it was closed.

HYDROLOGISTS MEETING

List of Participants

Name	Country/Area/Organization
Liu Zhiyu	China
Okazumi Toshio	Japan
Chong Sun-Fatt	Malaysia
Margaret Bautista	Philippines
Ok Joo Sohn	Republic of Korea
Le Bac Huynh	Viet Nam
Lee Han-Se	TCS
Cengiz Ertuna	ESCAP
Katsuhiro Abe	WMO
Junji Miwa	JICA Expert (Observer)
Yukihiko Sakatani	JICA Expert (Observer)

Budget Estimate for a 3-day Workshop on *"The Impact of El Niño and La Niña Phenomena on Meteorology and Hydrology in the Typhoon Committee Area"* in _____ 1999

1.	Per diem for 14 participants*	=	14 x US$ 100 x 4 days	=	US$ 5,600
2.	Air travel for 14 participants	=	14 x US$ 400	=	5,600
3.	Printing, Stationary and logistic support			=	800
			Total	=	US$ 12,000

Budget Estimate for a 5-day Training Seminar on *"Forecasting and Warning System for Typhoon Induced Sediment Disasters"* in Manila, Philippines, 1999

1.	Per diem for 7 participants*	=	7 x US$ 100 x 6 days	=	US$ 4,200
2.	Air travel for 7 participants	=	7 x US$ 400	=	2,800
3.	Per diem and Air travel for 1 expert			=	500
4.	Printing and local support			=	500
			Total	=	US$ 8,000

* Cambodia, China, Malaysia, PDR of Korea, PDR of Laos, Thailand, Viet Nam

APPENDIX IX

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

In **China**, the precipitation in most parts of China during the summer of 1998 was distinctly more than the normal. The increased number of rainy days, frequent heavy or storm rainfall and steady rain belt brought about an abnormal rise of the water level in the tributaries and the successive appearance of flood peaks of the main river streams which resulted in the catastrophic flood topping all the previous records of the Nenjiang River and the Songhuajiang River. Fortunately, the timely and accurate flood warnings were made available to government planners which significantly reduced the damage caused by the severe flooding.

In the **D.P.R. of Korea**, the country was also severely affected by a number of abnormal climatic events in 1998 which included a cold surge in the eastern coastal region, flooding in five major farming regions and three storm surges. From 10 June to 20 September, the State Flood Disaster Prevention and Preparedness Commission was mobilized to undertake flood control and management, disaster prevention and preparedness for a more systematic mobilization of manpower and resources during times of natural calamities. Throughout the summer months, the Central Forecast Research Institute of SHMA issued 11 storm surge warnings which significantly reduced damage.

In **Hong Kong, China**, professional meteorologists from the Hong Kong Observatory continued to present TV weather programmes for the three major local networks, using special computer graphics and the chroma-key technique provided in the Observatory's studio. Furthermore, centralized media briefings were held twice a day during the passage of tropical cyclones. The Observatory's publicity video, which represents one of its on-going initiatives to increase the public's awareness of the meteorological and geophysical services it provides, was updated in 1998. The public liaison group "Friends of the Observatory", established in 1996, continued to grow with membership reaching 2000 in 1998. In response to the public demand for advance warnings, a revised Rainstorm Warning System was put into operation on 23 March 1998. The revised system, wherein an AMBER Rainstorm Warning Signal was introduced to alert the public that the RED and BLACK rainstorm warning signals may have to be issued, was well-received by the public and were useful to the economy.

In **Japan**, the Asian Disaster Reduction Center was established in July 1998 in Kobe, Hyoko Prefecture. The Center serves as the secretariat of the system composed of 23 Members which works for disaster reduction in the Asian region.

In **Lao, P.D.R.**, the Department of Meteorology and Hydrology and concerned government agencies worked hand in hand in1998 to reduce the disastrous effects of drought, forest fires and hot weather caused by the El Niño phenomenon.

In **Macau**, several public awareness campaigns which included distribution of information leaflets, television and radio ads, were carried out during the year. The government's Typhoon Contingency Plan was updated and revised and an exercise involving 29 institutions was held in May with the purpose of testing the communications system and readiness of all personnel to respond to emergency

situations. During the year the Security Coordinating Office evaluated Evacuation Plans submitted by 32 schools and conducted inspection of 90 schools .

In **Malaysia**, the Malaysian Meteorological Service introduced in July 1998 its own Standard Operating Procedures in dealing with imminent disasters. In view of the impending 1998/99 La Niña phenomenon which could result in enhanced northeast monsoon rainfall particularly over East Malaysia, the National Disaster Management and Relief Committee at district, state and national levels convened meetings in September and October 1998 to ensure that all agencies involved are geared and prepared to face any widespread heavy downpours and associated floods as well as damages. A total of 3535 relief/evacuation centres which can accommodate 926,850 evacuees and a total of 357 forward-supply bases were earmarked by the Department of Social Welfare for relief purposes.

In the **Philippines**, the National Disaster Coordinating Council through its Executive Secretariat, the Office of Civil Defense, updated the Contingency and Disaster Plan to include the regional action plans on El Niño Phenomenon. Also, it stepped up its public information and education campaign on earthquake precautionary measures. PAGASA, on its part, has intensified its information, education and communication program on hydro-meteorological hazards to uplift the awareness of the general public on these issues. Likewise, PAGASA coordinated with OCD/NDCC, other government organizations as well as non-governmental organizations through the assignment of resource persons in their Disaster Preparedness seminars, workshops or conferences. As part of the researches for natural disaster reduction, hazard and vulnerability mapping have been started on floods, thunderstorm occurrences and extreme winds.

In the **Republic of Korea**, in order to reduce the loss of life, property damage and economic disruption caused by natural disasters, the government designated the period from 1 March to 31 May in 1998 as "Disaster Preparedness Period". Activities during the period included inspection and maintenance of disaster prone area, large-scale construction sites and disaster prevention facilities; securing equipment and facilities for emergency countermeasures and saving fund for natural disaster countermeasures. During the said period, a total of 42,984 staff members were trained in dealing with natural disasters and a number of disaster prevention education and drills were conducted. According to the Fifth Basic Disaster Prevention Plan which commenced in 1996, the government has invested US$4,538 million on 22 key items as of 1998. In the implementation of the project to improve disaster prone areas, a total of US$ 59 million was invested in 1998 while for the improvement of small rivers US$69 million was used. The government installed during the year automatic rainfall warning systems in five areas at a cost of US$0.8 million.

In **Thailand**, the government in 1998:

- continued to strengthen national coordination and cooperation between departments and agencies involved in DPP activities;
- improved communication systems for warning dissemination and relief operations;
- defined the responsible agencies concerned in every aspect of disaster management;
- developed the capabilities of related organizations on disaster prevention preparedness and mitigation;
- strengthened cooperation between NGOs and the public with disaster mitigation;
- improved public awareness on typhoon and flood threat and preparedness coupled with studies of human response to warnings;
- improved the standard of fire prevention for high-rise building and also increased public awareness on this matter;

- published and disseminated materials related to public information and education on typhoons to increase public awareness;
- constructed flood control channels and reinforced river banks along the Chao Praya Main River to prevent flooding in the said river basin;
- conducted the "Integrated Plan for Flood Mitigation in the Chao Praya River Basin" seminar; and
- held the "National Civil Defense Master Plan" on 20-21 August 1998.

In the **U.S.A.**, in 1998, initial coordination was conducted with the Guam Civil Defense to incorporate NOAA Weather Radio into the Emergency Alert System greatly increasing the effectiveness of warnings. During the year, tropical cyclone procedures were revised to provide citizens and government officials with more frequent and timely information. El Niño briefings were given to the governments of Micronesia and U.S. Embassies in the Spring of 1997 and as a result the various governments took a variety of precautionary measures which resulted in no deaths during this El Niño episode unlike the last time. While the Federated States of Micronesia established a hot line for El Niño information, it was noted that the greatest number of requests were for the El Niño song. Prior to the typhoon season, as has been done through the years, the Tiyan, Guam Forecast Office conducted a Media Day where all the media, preparedness government officials and military were invited to the National Weather Service Office to review preparedness activities and coordinate activities. Tropical Cyclone Preparedness Brochures were translated into several local island languages. The Warning Coordination Meteorologist, assigned at the Tiyan Weather Forecast Office (WFO) with the responsibility of carrying out the WFO area-wide (Guam and Micronesia) public awareness program, conducted tropical cyclone preparedness training with emergency management, government officials and WFO weather personnel. Work continued during the year on a pilot project in Pohnpei to increase communications capabilities utilizing Pan-Pacific Education and Communications Experiments by Satellite.

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

- strengthened the directing and commanding apparatus for flood and storm control at all levels;
- step by step improved the quality of warning and forecasts of storms, floods and other kinds of disaster;
- improved the quality of dike's systems in the Red River Delta, in the North of Central Viet Nam, and along the coastal line from Mongcai to Hatien, the Day river diverting system, and the reservoirs of Hoa Binh, Thac Ba and others;
- strengthened the flood combating force in all localities along the river banks from provincial level donor, especially at the village level;
- stepped up public education to increase the awareness of tropical cyclone and flood by organizing workshops and seminars on disaster management; disseminating information on disaster mitigation through mass media;
- continued on its endeavor to coordinate all measures both structural and non-structural measures in order to strengthen international cooperation and assistance in all fields; and
- basically completed the establishment of funds for flood and storm control in provinces and cities in Viet Nam.

APPENDIX X

SUMMARY OF ACTIVITIES OF ESCAP AND WMO RELATED TO THE DISASTER PREVENTION AND PREPAREDNESS

Activities of ESCAP

The Commission expressed appreciation to the Committee for its significant work and for the excellent cooperation among its members in taking increased disaster reduction and preparedness measures against disasters through monitoring, forecasting and dissemination of information on typhoons and hydrological hazards. It also noted that the Typhoon Committee would be assigning Asian names to the tropical cyclones in the future in order to attract more public attention.

The ESCAP secretariat continued its work on disaster prevention and preparedness. Under a project funded by extrabudgetary resources, the Workshop on the Regional Cooperation in Flood Control and Management for Improvement of Urban Environment in Asia and the Pacific was held in Bangkok in October 1998. The Workshop was attended by participants from 13 members countries of ESCAP which included some members of the Committee, and several international organizations. The Workshop reviewed national experiences on flooding, flood control and management measures and processes employed in the participating countries as well as relevant experiences in selected basins in Europe and North America. The participants of the Workshop identified also priority needs for stronger regional cooperation in natural disaster reduction and adopted a number of recommendations for action at the national and regional levels. In particular, the Workshop recommended that efforts be focused on realistic integrated planning, enhancement of disaster preparedness, community participation, effective transfer of flood control and management technologies, and experience exchange on institutional arrangements for flood control and management.

The ESCAP secretariat mobilized the assistance in the study of the effects of El Niño phenomenon in the area, being undertaken by the IDNDR Secretariat, and as in the past, the June issue of the *Water Resources Journal* published a review of water-related disaster experiences in the region within the last year.

The IDNDR-ESCAP Regional Meeting for Asia: Risk Reduction and Society in the 21st Century is scheduled to be held in Bangkok from 23 to 26 February 1999, in particular for reviewing the progress and achievements of the Decade in Asia.

Activities of WMO

As a follow-up to the United Nations resolution on early warning, IDNDR Secretariat had set up five specific working groups, each convened by a principal collaborating organization, to determine early warning criteria and the areas for which improved coordination and/or effectiveness is required. WMO had convened the Working Group on Early Warning for Hydrometeorological Hazards (including drought).

The International IDNDR Conference on Early Warning Systems (EWC98) was held in Potsdam from 7-11 September 1998. Specific points included in the statement recognized that:

(1) "early warning requires unrestricted access to data that is freely available for exchange", and

(2) "warning information must be credible, and emanate fro a single officially designated authority",

At the tenth session of IDNDR Scientific and Technical Conference (STC) held in Washington in July 1998, it was agreed that the consolidation phase of IDNDR would include a series of events leading to a Programme Forum in mid 1999. The accomplishments of the IDNDR would be directly proportional to the extent of public and international policy recognition given to the importance of natural hazard awareness and mitigation. In this connection, the role of NMHSs in disaster reduction, particularly with respect to the preparation of weather and flood warnings and forecasts, including landslides, became even more apparent during the past year's experience with the use of seasonal forecasts of the El Niño event. WMO is playing a lead role, jointly with UNESCO, in convening a special forum from 5-7 July 1999 in Geneva, on the science, technology and services related to natural disaster reduction as part of an overall event which would contribute to the debate at the UN Economic and Social Council (ECOSOC), in 1999.

WMO's long experience in coordinating global and regional programmes of Meteorological and Hydrological Services would clearly serve as an excellent basis for continued efforts of the Organization in the promotion of disaster reduction activities beyond the Decade. Hazard assessment, disaster awareness and preparedness, early warning, research and technology development, political commitment and national planning, and shared technology and knowledge were vital to success in implementing the Yokohama Strategy Plan of Action over the remaining years of the Decade. The outcome of work on these major issues would form a basis for coherent strategies to be implemented into the twenty-first Century. Improving the disaster warning capacity of Members and enhancing public awareness with an aim to saving lives and property to the public should continue as high priority activities within WMO Programme and as a special focus for the Tropical Cyclone and Public Weather Services Programmes.

APPENDIX XI

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

In **Cambodia**, the training course on "Operational Hydrology, Data Processing and database management was held at the Mekong River Commission Secretariat in Phnom Penh from 26-30 October 1998. Aside from these, nine GDIMH personnel participated in the following:

- Basinwide Training on Hydrometry and Instrumentation (Vientiane from 23 March to 3 April 1998);
- Workshop on Flood Control and Management (Bangkok from 26 to 30 October 1998); and
- Training Course on Data Processing and Database Management (Phnom Penh from 26-30 October 1998).

In **China**, the WMO Regional Meteorological Training Center (RMTC) in Nanjing held an International Training Course on Satellite Meteorology from 20 September to 19 October 1998. The training course was sponsored by WMO and the Ministry of foreign trade of the People's Republic of China. A Regional Training Workshop on the Development on Meteorological Disaster Database and Application in Disaster Management sponsored by ESCAP and hosted by the National Satellite Meteorological Center of CMA, was held in Beijing from 26 to 30 October 1998.

A study tour in China aimed at promoting application of proven findings of tropical cyclone studies in the region to the operational tropical cyclone forecasts sponsored by WMO and CMA for the Members of the Panel on Tropical Cyclones was held from 23 March to 1 April. It was attended by seven participants from Panel members as well as representatives from TSU and WMO.

In hydrology, a high-level technical training course on flood forecasting sponsored by the Water Resources Information Center and participated by 45 trainees was held at the Hohai University. A Technical Training Course on Reservoir Management and Flood Forecasting and Dispatching sponsored by the Office of the State Flood control and Drought Relief Headquarters and which had 40 participants was held in Changsha, Hunan Province. The Water Resources Information Center conducted a Technical Training Course of Emergence Feedback Communication System which was attended by 30 trainees in Dayong, Hunan Province.

In the **D.P.R. of Korea**, 50 personnel of the SHMA in 1998 attended a number of locally organized training courses for meteorological and hydrological forecasters while twelve trainees attended a WMO-organized working seminar on CLICOM in Pyongyang from 3-17 July.

In **Hong Kong, China**, Hong Kong Observatory's (HKO) participation in overseas trainings were:

- One officer undertook training attachment at the terminal Doppler Weather Radar Program Support Facility at Oklahoma City, USA from 15 October to 4 November 1997;

- Three officers attended the "Professional Training Course on Meteorology" at the Nanjing Institute of Meteorology, People's Republic of China from 3 November 1997 to 16 January 1998;
- Two officers undertook a study tour to the National Meteorological Centre and the National Satellite Meteorological Centre, CMA from 8 to 17 December 1997;
- One officer attended Module I of the "Graduate Diploma in Meteorology" Course at the Bureau of Meteorology, Australia from 2 February to 7 August 1998;
- One officer attended the "Advanced Meteorology Training Course of ECMWF (Module 1 & 2) at the ECMWF Headquarters, U.K. from 16 March to 3 April 1998;
- One officer attended the "Advanced Meteorology Training Course of ECMWF (Module 2) at the ECMWF Headquarters, U.K. from 24 March to 3 April 1998; and
- One officer attended the "Physical Initialization in the regional Spectral Model" training course at the Japan Meteorological Agency, Japan from 24 September to 8 October 1998.

The HKO organized the following in-house meteorological courses from November 1997 to September 1998:

- Initial Training Course for Scientific Assistants;
- Applied Meteorology Course for Forecasters Part II;
- Training Course on "Meteorological Data Processing System";
- Refresher Course on "Aerodrome Meteorological Observing System" (AMOS);
- Training course on "Windshear and Turbulence Warning System";
- Training course on "World Area Forecast System";
- A series of 3 training courses on "Terminal Doppler Weather Radar";
- A series of 3 operational training courses on "Chek Lap Kok Aviation Meteorological Office Systems;
- Two training courses on the extension of AMOS for northern runway for maintenance stay and system administrator;
- Training course on "Mesoscale Modelling and Recent Development of the Advanced Regional Prediction System";
- Training course on "Regional Spectral Model" conducted by Mr. Nishio and Mr. Goda of JMA;
- Training course on "Doppler Radar and Weather Observations" conducted by Professor Zrnic and Professor Doviak of NOAA and the University of Oklahoma; and
- Training programme on marine meteorology for four meteorological personnel from Oman.

A total of 258 Class I, II and III meteorological personnel from the HKO and 4 meteorological officers from overseas attended the above training courses.

In **Japan,** JMA held an International Training Seminar on Typhoon Monitoring and Forecasting in the Western North Pacific which was attended by forecasters from five TC Members at the RSMC Tokyo-Typhoon Center from 12 to 30 January 1998. The seminar aimed at supporting TC Members on enhancing the technique of typhoon monitoring and forecasting.

JMA in 1998 offered the following training courses related to the activities of the Typhoon Committee:

- Global Data Assimilation System (attended by one participant from KMA from 12 January to 25 June 1998);
- Use of Satellite Data for Typhoon Monitoring and Forecasting (attended by one participant from the Hydrometeorological Service of Viet Nam from 19 January to 6 February 1998); and
- Physical Initialization in the regional Spectral Model (attended by one participant from the Hong Kong Observatory from 24 September to 8 October 1998).

Expert Services provided by JMA included:

- two experts to the Hydrometeorological Service of Viet Nam for the technical exchange of weather forecasting and radar operation (23 February to 21 March 1998); and
- two experts to the Hong Kong Observatory for the technical exchange of the operation of Regional Spectral Model (8 to 14 March 1998).

JMA's Meteorological Satellite Center in 1998 developed a Computer Aided Learning software for training in satellite imagery.

In hydrology, the Construction College (CC) continued to provide river related training courses for the personnel of the Ministry of Construction (MOC). The Japan Construction Training Center continued to conduct training courses to complement the training courses offered by the CC. As in previous years, group training courses for overseas participants were administered by the River Bureau of the MOC. A total of 176 trainees were trained in various training courses during the period from April 1997 to November 1998. Seven International Conferences were held during the year in Japan while two were co-sponsored with France and China.

In **Macau,** 52 SMG personnel in 1998 attended five local training courses which included:

- training course for Class II Met. Officer (6 months duration);
- training course for Class III Met. Officer (3 months duration);
- training course on Doppler Radar (2 weeks duration);
- training course on Mesoscale Met Model (2 months duration); and
- training course on Geomagnetism observation (6 weeks duration).

Overseas and local training/seminar/workshop attended by SMG personnel included:

- 2nd Guangdong-Hong Kong-Macau Meteorological Conference on Operational Cooperation (Macau from 14 to 15 April 1997);
- The application of NWP products in aviation and dissemination through satellite and terrestrial system (Reading, U.K. from 30 June to 4 July 1997);
- Intergovernmental Panel on Climate Change, 13th Session (Maldives from 22 to 28 September 1997);
- IPCC Working Group II, 4th Session (Maldives from 23-24 September 1997);
- Applied Meteorology Course for Forecasters (Nanjing from 3 November 1997 to 16 January 1998;
- WMO Regional Training Seminar for National Instructors of RAII and RAV (Manila from 10-21 November 1997);
- International Expert Meeting on Participation of Women in Meteorology and Hydrology (Bangkok from 5 to 19 December 1997);
- The Application and Interpretation of NWP Products in Aviation (Reading, U.K. from 20 to 24 July 1998);
- Radar Meteorology Lectures (Hong Kong, China from 28 July to 3 August 1998);

- International Training Course on Satellite Meteorology (Nanjing from 20 September to 19 October 1998);
- Date Prediction Workshop on South China Sea Monsoon Onset in 1998 (Guangzhou from 6 to 7 April 1998); and
- Guangdong-Hong Kong-Macau Workshop on Meso-scale Weather Prediction and Analysis (Shengzhen from 10 to 11 August 1998).

In **Malaysia**, a total of 115 MMS staff underwent various local training courses as follows:

- basic meteorological courses for meteorologists and meteorological assistants;
- basic and advanced courses on the use of microcomputer, Windows '98 and web page creation; and
- basic electronic, statistics and meteorological instrument courses for meteorological assistants.

MMS personnel also attended the following international workshops and training seminar in 1998:

- International Training Seminar on Typhoon Monitoring and Forecasting in the Western North Pacific (Tokyo, Japan from 11 to 29 January 1998);
- 4th WMO/ICSU International Workshop on Tropical Cyclones (Haikou, China from 21-30 April 1998); and
- Regional Training Workshop on Development of Meteorological Disaster Database and Applications in Disaster Management (Beijing, China from 26-30 October 1998).

During the year, the Hydrology Division of the Department of Irrigation and Drainage (DID) organized a number of on-the-job trainings on the maintenance and repair of hydrological instruments and participated in the following activities:

- Training on the use of the "Guidelines for Risk Assessment of Natural Disasters in the Natives Settlement Areas" for five states in Peninsular Malaysia;
- Appraisal of the WMO/UNDP Project on "Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Area" in Kuala Lumpur from 31 March to 4 April 1998; and
- Advanced Course on "Stormwater Modelling" from 27 to 31 July 1998 in Kuala Lumpur.

In the **Philippines**, to promote continuous capacity building and human resource development, PAGASA personnel went overseas to attend twelve training courses, two conferences, three meetings and one study tour. PAGASA conducted seven local training courses.

In the **Republic of Korea**, four KMA staff members participated in the following training courses:

- Development of next generation limited area model in Far-East Asia (NCEP/NWS, USA from 5 April 1997 to 8 February 1998);
- Climate Prediction Technique for production of local climate simulation data in Korean Peninsula (NCEP/NWS, USA from 28 March to 31 May 1998);
- Development of data assimilation technique using local analysis and prediction system (FSL/NOAA, USA from 16 July 1997 to 30 June 1998); and
- Four-dimensional variational data assimilation and physical process of atmospheric boundary layer (BMRC, Australia from 20 September to 21 November 1998).

In hydrology, the flood control centers located at five major rivers held voluntary workshops for hydrographers during the year. The Korea Institute of Construction Technology (KICT) held a special workshop on management of vegetation in river channels.

In **Thailand**, TMD personnel attended the following:

- International Training Seminar on Typhoon Monitoring and Forecast in the Western North Pacific (Japan from 12-30 January 1998);
- 4th WMO/ICSU International Workshop on Tropical Cyclones (China from 21-30 April 1998); and
- International Training Course on Meteorological Satellite (China from 19 September to 19 October 1998).

In the **U.S.A.**, the Joint National Weather Service-Federated States of Micronesia (NWS-FSM) Micronesian Meteorological Intern Trainee Program recently saw its first student graduate from the University of Hawaii Department of Meteorology. The graduate will intern at Tiyan, Guam for nine months before returning to his home island of Yap to become the Meteorologist-In-Charge. Staff members of the Tiyan WFO attended the following courses: Systematic Approach to Tropical Cyclone Forecasting, Satellite Imagery Interpretation, UNIX System Training, AWIPS Centralized Users Training, and WSR 88-D Radar tropical cyclone position fix training. Three staff meteorologists have completed hydrology courses at the University of Guam.

In **Viet Nam**, 50 HMS personnel attended local training courses and workshops, 36 personnel went on overseas training, and 20 participated in study tours.

APPENDIX XII

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

In **Cambodia**, meteorological research activities undertaken during the year focused on monsoon rainfall while hydrological research studies included:

- hydrological study of the Tonle Sap Great Lake and
- Update of the flood prediction model of the Cambodian Mekong Delta.

In **China**, research studies in 1998 included:

- Interaction between Tropical Cyclones (TC) and Mid-latitude Circulations;
- Research on TC landfall problem; and
- Analyses on Late Genesis and Few Number of Tropical Cyclones over the Western North Pacific in 1998.

The fourth International Workshop on Tropical Cyclones (IWTC-IV) was successfully held in Haikou, Hainan Province of China from 21-30 April 1998 which was attended by about 120 research and forecast experts from China and other countries.

In hydrology, the Water Resources Information Center took the responsibility of the overall design of the "State Flood Control Commanding System Project" and brought it to success in 1998. The system includes four subsystems: flood control information collection subsystem, flood control telecommunication subsystem, flood control computer network subsystem, and decision-making supporting subsystem. In progress, is the development of the Chinese River Flow Forecasting System and three research projects namely: Technical Supporting System for Climatic Change on Hydrology and Water Resources in China, Operational Prediction Model and Water resources in China and the Operational Prediction Model of Climatic Abnormality on Water Resources and Water Cycle in China.

In the **D.P.R. of Korea**, research work in 1998 included:

- study on very short and short range numerical forecast model development and technical process improvement;
- study on quantitative process of satellite and radar data, numerical forecast data and determination of rainfall area;
- study on the synoptic climatological characteristics of disastrous weather phenomena which affects the country;
- study on the establishment of hydrological forecast method for the regional rivers and reservoirs; and
- study on making objective of intensive time and local forecast of heavy rain.

In **Hong Kong, China**, the following papers on tropical storms and rainstorms were presented at the 12th Guangdong-Hong Kong-Macau seminar on severe weather held in Hong Kong on 15-17 January 1998:

- Tropical cyclones in the Western North Pacific in El Niño years (in Chinese) - W.L. Chang, M.C. Woo, Y.W. Chan and C.H. Au;
- Rainfall in Hong Kong in El Niño years (in Chinese) - C.H. Au and W.L. Chang;
- Heavy rain over Hong Kong under northeast monsoon in autumn (in Chinese) - P.W. Chan and C.C. Fu; and
- Model simulation of the heavy rain events in early July 1997 (in Chinese) - K.L. Lee and W.M. Ma.

During the Guangdong-Hong Kong-Macau workshop on Mesoscale Weather Prediction and Analyses held in Shenzhen, China on 10-11 August 1998 the following research studies were presented:

- The status and outlook of mesoscale numerical prediction in Hong Kong Observatory (in Chinese) - H.K. Lam;
- Numerical simulation of rainstorms on 24 May and 9 June 1998 (in Chinese) - W.M. Ma and C.C. Lam; and
- Nowcasting of rainfall from radar echo movement (in Chinese) - W.K. Wong, S.T. Lai and P.W. Li.

The following papers were published in the ESCAP/WMO Typhoon Committee's Tropical Cyclone Annual Review 1997:

- Observational study of Typhoon Victor (9712) during its passage over Hong Kong - P.W. Li, H.T. Poon and S.T. Lai; and
- Statistical analysis of landfalling tropical cyclones in the western North Pacific in El Niño and non-El Niño years - Y.W. Chan and W.L. Chang.

While the research paper, "A localized heavy rain event in Hong Kong" by C.C. Fu and C.C. Chan was published in the August 1998 issue of Weather.

Aside from these, there is also on-going work at the Hong Kong Observatory on a variety of subjects including rainstorm nowcasting, further development of the Regional Spectral Model, and the characteristics of tropical cyclones in years when El Niño/La Niña is active.

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

- ensemble forecasting of tropical cyclone motion; and
- dynamic and climatological characteristics of tropical cyclone size and inter-annual and inter-decadal variability of tropical cyclone activity.

To evaluate probable landslip scenarios due to heavy rain, the existing estimate of the Probable Maximum Precipitation (PMP) for Hong Kong was reviewed in 1998. The review recommended that an updated PMP for Hong Kong would be desirable in view of the number of intense rainstorms that had occurred and the large amount of rainfall data that had been collected by the automatic rain-gauge system since the previous PMP study. This recommendation was taken up.

In **Japan,** hydrological research themes includes: Development of a physics-based distributed parameter hydrological model making use of GIS data for topography, land use, geology and soil type.

JMA continues to act as the lead center for Case III of the "Comparison of Mesoscale Prediction And Research Experiment (COMPARE)" project promoted by the CAS/JSC Working Group on Numerical Experimentation (WGNE). In the first stage of the project, 20-km mesh models of 11 organizations were run for the prediction of explosively developed Typhoon 9019 (FLO) to intercompare the performance of the models and to examine impacts of initial field of models on typhoon prediction. In the second stage, 10-km mesh runs are to be performed by mid-January 1999. Size and intensity predictions with TYM for 1997 typhoons were verified against the RSMC best track data. Results of the verification showed errors of the size and intensity predictions with TYM were still large.

The Meteorological Research Institute of JMA in 1998 analyzed meteorological conditions in the tropical oceans with the Special Sensor Microwave Imager (SSM/I) data of the US Defense Meteorological Satellite Program (DMSP) at the National Oceanic and Atmospheric Administration (NOAA). Retrieved data (precipitation, precipitable water, sea surface wind speed) from SSM/I and observational data such as SST were used for the analysis. There are wide range of research activities at the national research institutes and universities aiming at reducing the flood damage by improving the accuracy of flood forecasting and estimation of flood damage.

In **Macau,** studies on hazardous weather and three research papers were presented in the 12th Guangdong-Hong Kong-Macau Seminar on Severe Weather held in Hong Kong, China. Research on a mesoscale meteorological model with a team of SMG Meteorologists and experts from a university of PR China continued to work on developing and implementing a suitable regional numerical prediction model for South East Asian area.

In **Malaysia,** plans are underway to carry out dynamical studies by identifying tropical storm/typhoon cases in the last 10-20 years that entered into or developed within the South China Sea, collecting the associated large-scale dynamic and thermodynamic fields, rainfall, and other in-situ observations and analyzing such fields and observations in each category for the ultimate aim of making forecasting rules.

In Hydrology, the Department of Irrigation and Drainage together with other government agencies are conducting a three year research project to evaluate the use of GIS and remote sensing technology to monitor and evaluate floods. The DID also leads a four-year urban hydrology study with an objective to determine experimentally the runoff coefficients and concentration times of different urban conditions.

In the **Philippines,** two researches in hydrology were undertaken in 1998, one was the Derivation of the Probable Maximum Precipitation for four major water resources region in Luzon while the other dealt with the enhancement of the existing flood forecasting techniques through the application of several hydrological models. In meteorology, five researches on tropical cyclones, two on thunderstorm hazard mapping, a wave model and one for greenhouse emission inventory were completed during the year.

In the **Republic of Korea,** the Ministry of Construction and Transportation lends full support to related researches in this area as part of its efforts to effectively cope with and to cut losses from floods that take place in the country. Researches have also been carried out to improve the existing flood warning and forecasting systems. These included:

- the conversion from the current host-terminal system to client-server system for added user convenience and easier extension of the system at a later date;

- an attempt to modulize the system so that it can be generalized and system elements can be added or subtracted with ease; and
- the addition of a GIS application program in order to predict flood inundation and enhance the accuracy of flood forecasting system by applying the newly suggested hydraulic routing model (DWOPER).

Attempts were also made to further improve the performance of the Barotropic Adaptive-grid Typhoon Simulation model of KMA. It was found out that reinforcement of the steering current turns out to be very effective in reducing the forecast error.

In **Thailand,** on-going researches include:

- environmental zoning for increasing the efficiency of soybean variety improvement, (TMS in cooperation with Kasetsart University);
- installation of global solarimeter (in cooperation with Japanese scientists in GAME-T Project);
- Crop Simulation Model for rice (in cooperation with Suranaree University of Technology); and
- analyses of ENSO Phenomenon and its effect on Thailand's seasonal climate during the period of 1997-1998.

In the **U.S.A.,** a research paper on "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" by Mr. Bill Ward was submitted to the 1999 American Meteorological Society (AMS) meeting.

In **Viet Nam,** research concerning tropical cyclones carried out during the year includes:

- echo structural characteristics of storm cloud field;
- analysis of the test of 24-hour forecast of tropical cyclone tracks by making use of the vertically integrated steering flow model; and
- the influence of sea surface temperature on the intensity of tropical cyclones in the South China Sea.

In hydrology, researches dealt on the prediction of flood discharge and the real-time reservoir operation in Hoa Binh, Thac Ba, Tri An, Dau Tieng Hydropower plants, and for management of several water resource structures. Some inundation models and hydrological models were also developed for the flood forecasting in Mekong River Delta and in some principal river deltas in Viet Nam.

APPENDIX XIII

REPORT OF THE CHAIRMAN OF WMO'S COMMISSION ON ATMOSPHERIC SCIENCES WORKING GROUP ON TROPICAL METEOROLOGICAL RESEARCH

TROPICAL CYCLONE ACTIVITIES IN THE WMO-CAS TROPICAL METEOROLOGY RESEARCH PROGRAM: REPORT TO THE 1998 ESCAP/WMO TYPHOON COMMITTEE MEETING

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

Presented by Prof. Yan Hong
WMO-CAS Representative to ESCAP/WMO TC

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 Russel 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 activities include:

- *The recent Fourth International Workshop on Tropical Cyclones held in China, April 1988.*
- *A statement on Climate Change and Tropical Cyclones commissioned by CAS and published in the Bulletin of the American Meteorology Society.*
- *The autonomous Aerosonde 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. CURRENT 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 has 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. The Chairman of the International Program Committee, Gary Foley, reported on a range of activities that were undertaken there. 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

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 focused 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 strongly supported the series of SPECTRUM research meetings, and we co-sponsored the ICSU/WMO Tropical Cyclone Disasters Symposium in Beijing in 1992, which produced a book on the multi-disciplinary topics covered.

Under our monsoon components, we are active supporters of the South-China Sea Monsoon Experiment, which had its field phase in May-June 1998. We are also involved in plans for a major programme lasting several years in the Indian Ocean. Whilst these programs are not directly related to tropical cyclones, they provide substantial general benefits and will observe any tropical cyclones that to occur.

2.3 *THE AUTONOMOUS AEROSONDE*

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 is leading to the first operational system being available in 1998. The Aerosonde passed its operational trial conducted by the Australian Bureau of Meteorology in January and February 1998 and has since flown missions in the South China Sea and Canada.

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.

Dr. Holland is now seeking support and facilities for an international reconnaissance facility to undertake Aerosonde missions on request, as has been discussed with TC members in the past. This idea is receiving strong support from a wide range of countries in both hemispheres.

More 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 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 Meteorology Society. An updated and more detailed statement has since been prepared by a committee of prominent scientists headed by Professor Ann Hederson-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 Watch 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 goal 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 November 1998 meeting in Hong Kong. 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 implicitly 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.*
- *Specify 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. Typhoon Committee Members are strongly encouraged to support and work with this important international initiative. Ideas and volunteers for forecast demonstration projects are especially sought.

APPENDIX XIV

STATEMENT ON CLIMATE CHANGE AND TROPICAL CYCLONES

TROPICAL CYCLONES AND GLOBAL CLIMATE CHANGE: Report from the WMO/CAS/TMRP Committee on Climate Change Assessment (Project TC-2)

A. Henderson-Sellers and H. Zhang

(Final version completed on 14 February 1997)

Committee Members:

Professor A. Henderson-Sellers (Chairman); Dr G. Berz (Germany); Professor R. Elsberry (WMO/CAS/TMRP); Professor K. Emanuel (ICSU); Professor W.M. Gray (USA); Dr C. Landsea (USA); Dr G. Holland (Australia); Sir James Lighthill (ICSU); Professor S-L Shieh (Pacific Science Association); Professor P. Webster (WCRP/CLIVAR)

Rapporteur: *Dr H. Zhang (Australia)*

Executive Summary

This report is a synthesis of the objective scientific review from the WMO/CAS steering committee of our current capacity for predicting changes in tropical cyclone characteristics in a greenhouse-warmed world. It can be summarized as follows:

(1) **Observations:** The very limited instrumental record makes extensive analyses of the natural variability of global tropical cyclone activities difficult in most of the tropical cyclone basins. However, in the two regions where reasonably reliable records exist (the North Atlantic and the western North Pacific), substantial multidecadal variability (particularly for intense Atlantic hurricanes) is found, but no clear evidence of long-term trends. Efforts have been initiated to use geological and geomorphological records and analysis of oxygen isotope ratios in rainfall recorded in cave stalactites to establish a paleoclimate of tropical cyclones, but these have not yet produced definitive results.

(2) **Tropical cyclone intensity:** Recent thermodynamical estimation of the maximum potential intensities (MPI) of tropical cyclones shows good agreement with observations. Although there are some uncertainties in these MPI approaches such as their sensitivity to variations in parameters and failure to include some potentially important interactions such as ocean spray feedbacks, the response of upper-oceanic thermal structure, and eye and eyewall dynamics, they do appear to be an objective tool with which to predict present and future maxima of tropical cyclone intensity. Recent studies indicate the MPI of cyclones will remain the same or undergo modest increase of up to 10 - 20%. These predicted changes are small compared with the observed natural variations and fall within the uncertainty range in current studies. Furthermore, the known omissions (ocean spray, momentum restriction and possibly also surface to 300 hPa lapse rate changes) could all operate to mitigate the predicted intensification. A strong caveat must be placed on analysis of results from current GCM simulations of the 'tropical-cyclone like' vortices. Their realism, and hence prediction skill (and also that of "embedded" mesoscale models), is greatly limited by the coarse resolution of current GCMs and the failure to capture environmental factors that govern cyclone intensity. Little, therefore, can be said about the potential changes of the distribution of intensities as opposed to maximum achievable intensity.

(3) **Tropical cyclone genesis and frequency:** Current knowledge and available techniques are too rudimentary for quantitative indications of potential changes in tropical cyclone frequency. The broad geographic regions of cyclogenesis and therefore also the regions affected by tropical cyclones are not expected to change significantly. It is emphasized that the popular belief that the region of cyclogenesis will expand with the 26°C SST isotherm is a fallacy. The very modest available evidence points to an expectation of little or no change in global frequency. Regional and local frequencies could change substantially in either direction, because of the dependence of cyclone genesis and track on other phenomena (e.g. ENSO) that are not yet predictable. Greatly improved skills from coupled global ocean-atmosphere models are required before improved predictions are possible.

(4) **Tropical Cyclone structure:** There are insufficient data or understanding of the outer structure development and two-way air-sea interactions to allow a reasoned assessment of potential structure changes due to greenhouse warming.

(5) **Tropical cyclone impacts:** The impacts on society by tropical cyclones have been marked by a substantial decrease in deaths in the developed nations, but a rapid increase of economic damage and disruption of burgeoning coastal communities over the past few decades. The insurance industry in particular has experienced a rapid increase in losses from tropical cyclones disasters during the last decade. This has been caused, to a large extent, by increasing coastal populations, by increasing insured values in coastal areas and, perhaps, a rising sensitivity of modern societies to disruptions of infrastructure. However, the insurance industry is worried about the possibility of increasing frequencies and/or intensities of tropical cyclones in addition to the higher exposures in coastal areas. Until scientific predictions provide conclusive proof that these fears are unwarranted the industry has to prepare itself for extreme catastrophic losses by means of appropriate reserves and restrictive underwriting.

APPENDIX XV

SUMMARY OF 1998 TYPHOON SEASON

SUMMARY (as of 31 October 1998)

During the El Niño event that reached the mature phase in November 1997, anomalously cool sea surface temperatures (SSTs) prevailed from the last winter through spring in the tropical waters of the western North Pacific, from the east of the Philippines to the date line. As El Niño decayed, SSTs over these areas gradually increased and returned to normal by July 1998. Thus, the strong El Niño reached its final stage in the early summer of 1998 and SST anomalies reversed to be even positive partly around the Philippines.

Sea level pressures were above normal in the spring and the summer over the tropics in the central and western North Pacific, which suggests that the subtropical ridge extended anomalously to the south in this region. Accordingly, trade winds were enhanced to flow in part into the Southern Hemisphere across the equator. Convection was extremely weak in the western North Pacific through the spring and the summer, particularly in the seas east of the Philippines, in contrast to the Bay of Bengal where above-normal convection continued.

The anomalous conditions of SSTs and atmospheric circulation as described above led to notable features in the tropical cyclone activities in 1998.

Onset of 1998's typhoon season was significantly delayed. The first tropical cyclone of 1998 in the western North Pacific developed on 9 July to set the record of the latest occurrence of a year's first storm since 1951. The typhoon season continued to be suppressed for the first two months with less than normal frequencies; one in July and three in August (the monthly average is 4.2 and 5.5, respectively). Although tropical cyclone occurrence returned to near-normal in September with formations of five storms during the middle and late September, only two were generated in October as compared to the normal of 4.0. The total number of storms of TS intensity or more is eleven as of the end of October, less than half of the normal.

Another marked feature of the tropical cyclone activity in 1998 is that storms rarely formed in the seas east of the Philippines until September, the area with the maximum tropical cyclone frequency in the western North Pacific. Storms showed a tendency to form in higher latitudes; 6 out of 9 in total generated in latitudes higher than 20°N. Anomalous tracks were also characteristic. TS NICHOLE(9801) moved erratically off the west coast of Taiwan through its short life of 30 hours. TY REX(9804) took unusual east-southeast courses in the sea south of Japan. TY TODD(9806) moved eastwards initially, curved increasingly to the north and made a turn to the west eventually as opposed to an ordinary recurvature course in September. TY VICKI(9807), unlike average storms originated in the South China Sea, took a track across Luzon and moved to the northeast to reach Japan.

NICOLE(9801)

A tropical depression that formed on 8 July about 240 km southwest of Taiwan in the South China Sea was upgraded to Tropical Storm NICOLE at 0600 UTC on 9 July as the first tropical cyclone of 1998 in the western North Pacific. NICOLE remained a minimal tropical storm throughout its life. Drifting very slowly NICOLE turned its track from the north to the northeast and made landfall on the southwestern Taiwan at 0300 UTC on 10 July. NICOLE was downgraded to a tropical depression at 1200 UTC as it drifted westwards in the Taiwan Strait and dissipated by 1800 UTC on 10 July.

OTTO(9802)

OTTO was generated as a tropical depression east of Luzon at 1200 UTC on 1 August. It moved northwards and reached tropical storm intensity at 0000 UTC on 3 August. OTTO then continued to move north-northwestwards and intensified into a severe tropical storm at 1200 UTC on the 3rd. Peak intensity of 65 knots was reached at 0300 UTC on 4 August about 40 km east-southeast of Taiwan prior to landfall. About 6 hours later OTTO crossed central Taiwan and moved into the Taiwan Strait. Landfall on the southeastern Chin as a tropical storm was made later on the 4th. OTTO was soon downgraded to a tropical depression and dissipated by 18 UTC on 5 August.

PENNY(9803)

On the day after the dissipation of OTTO(9802), PENNY formed as a tropical depression in the sea southeast of Luzon. It tracked north-northwestwards initially and gradually curved to the west-northwest to cross northern Luzon on 8 August. Tropical storm intensity was reached at 0000 UTC on the 9th on a generally west-northwestwards track across the South China Sea. Further intensification into a severe tropical storm occurred at 0600 UTC on the 10th about 230 km south of Hong Kong before PENNY turned to the northwest. PENNY was downgraded to a tropical storm within 12 hours before it made landfall on southern China east of the Luichow Peninsula later on that day. Keeping tropical storm intensity, PENNY pushed further inland into southern China on 11 August. At 12 UTC on the 11th PENNY degenerated to a tropical depression and dissipated shortly.

REX(9804)

REX was the longest-lived and the most erratic tropical cyclone among those generated in 1998 as of the end of October. It originated as a tropical depression at 0000 UTC on 24 August about 670 km south-southeast of Okinawa. Moving slowly to the northeast, the storm acquired tropical storm intensity at 0000 UTC on the 25th. A significant meandering began as REX intensified quickly into a severe tropical storm at 1800 UTC on the 25th and a typhoon at 0600 UTC on the 26th. REX turned gradually to the east and then took a course to the east-southeast during 26 August and resumed a northeastwards track on the 27th. Peak intensity with maximum winds of 75 knots was reached on 29 August when REX was moving to the north about 140 km northwest of Chichijima Island. Later on the 30th the interaction with an upper cold low to the northeast steered REX to the northeast and to the east-southeast from 31 August to 2 September. REX then moved generally to the east-northeast while weakening and meandering slightly. On 5 September REX began to accelerate to the north-northeast. It became extratropical by 0000 UTC on 7 September and moved into the Western Hemisphere.

STELLA(9805)

STELLA, the first of the five tropical cyclones in September, generated as a tropical depression on the 12th over the water north of the Mariana Islands. On its northwestern track towards Japan, STELLA reached tropical storm intensity on the 13th and that of severe tropical storm on the 14th. Recurvature occurred around 30° N south of Honshu of Japan on 15 September before STELLA accelerated to the northeast. STELLA made landfall on Honshu about 140 km southwest of Tokyo during the day. It passed over the east coast of Honshu. STELLA made another landfall on Hokkaido on 16 September, where it was downgraded to an extratropical cyclone. The cyclone moved into the Sea of Okhotsk and dissipated on the 17th.

TODD(9806)

A tropical depression to form at 0000 UTC on 16 September about 670 km south-southeast of Okinawa was upgraded rapidly to Tropical Storm TODD at 0600 UTC that day on its eastwards track. Rapid development continued until TODD reached its peak intensity with maximum winds of 75 knots at 0600 UTC on 17 September as a typhoon, while it curved to the northeast and more to the north. TODD soon weakened under the influence of an upper cold low. TODD was downgraded to a severe tropical storm at 0300 UTC on 18 September shortly before it made a turn to the west about 120 km south of Kyushu. TODD then adopted a definite track to the west along the 30° N line across the East China Sea. At around 1500 UTC on 19 September TODD made a landfall on the southern China about 130 km south of Shanghai as a tropical storm and rapidly dissipated.

VICKI(9807)

VICKI was a rare example of a storm that made landfall on Japan with its origin in the South China Sea. It formed as a tropical depression about 120 km west of Luzon at 0600 UTC on 17 September. Drifting towards the southwest and then to the south, VICKI

attained tropical storm intensity at 1200 UTC during the day. Further intensification to a severe tropical storm occurred at 0600 UTC on 18 September after VICKI turned more to the east towards Luzon. VICKI made landfall on Luzon later on the 18th and took a track to the northeast. Downgraded to a tropical storm over Luzon VICKI reintensified on its track to the northeast on the seas east of the Ryukyu Islands and accelerated. VICKI reached typhoon intensity at 0600 UTC on 21 September and peaked with maximum winds of 75 knots at 1800 UTC that day about 350 km south of Shikoku. At 0400 UTC on 22 September, VICKI made landfall on the Kii Peninsula. VICKI maintained severe tropical storm intensity as it moved across Honshu at a speed of 75 km/h or more. After it moved into the sea southeast of Hokkaido, VICKI rapidly weakened and transitioned into an extratropoical cyclone shortly before dissipation.

WALDO(9808)

When VICKI(9807) was passing over Luzon on 19 September, a tropical depression formed at 0600 UTC that day about 700 km southwest of Chichijima Island. It moved towards the northeast initially and turned towards the northwest on 20 September. A sharp turn to the north took place at 0600 UTC on the 20th when the depression was upgraded to Tropical Storm WALDO. WALDO did not reach severe tropical storm intensity. It persisted on its track to the north and made landfall on the Kii Peninsula at around 0700 UTC on 21 September. WALDO's landfall was made about 21 hours prior to VICKI and about 50 km south-southeast of the VICKI's point of landfall. WALDO shortly degenerated to a tropical depression at 1200 UTC on 21 September as it moved rapidly across Honshu. It moved into the Sea of Japan and dissipated during the day.

YANNI(9809)

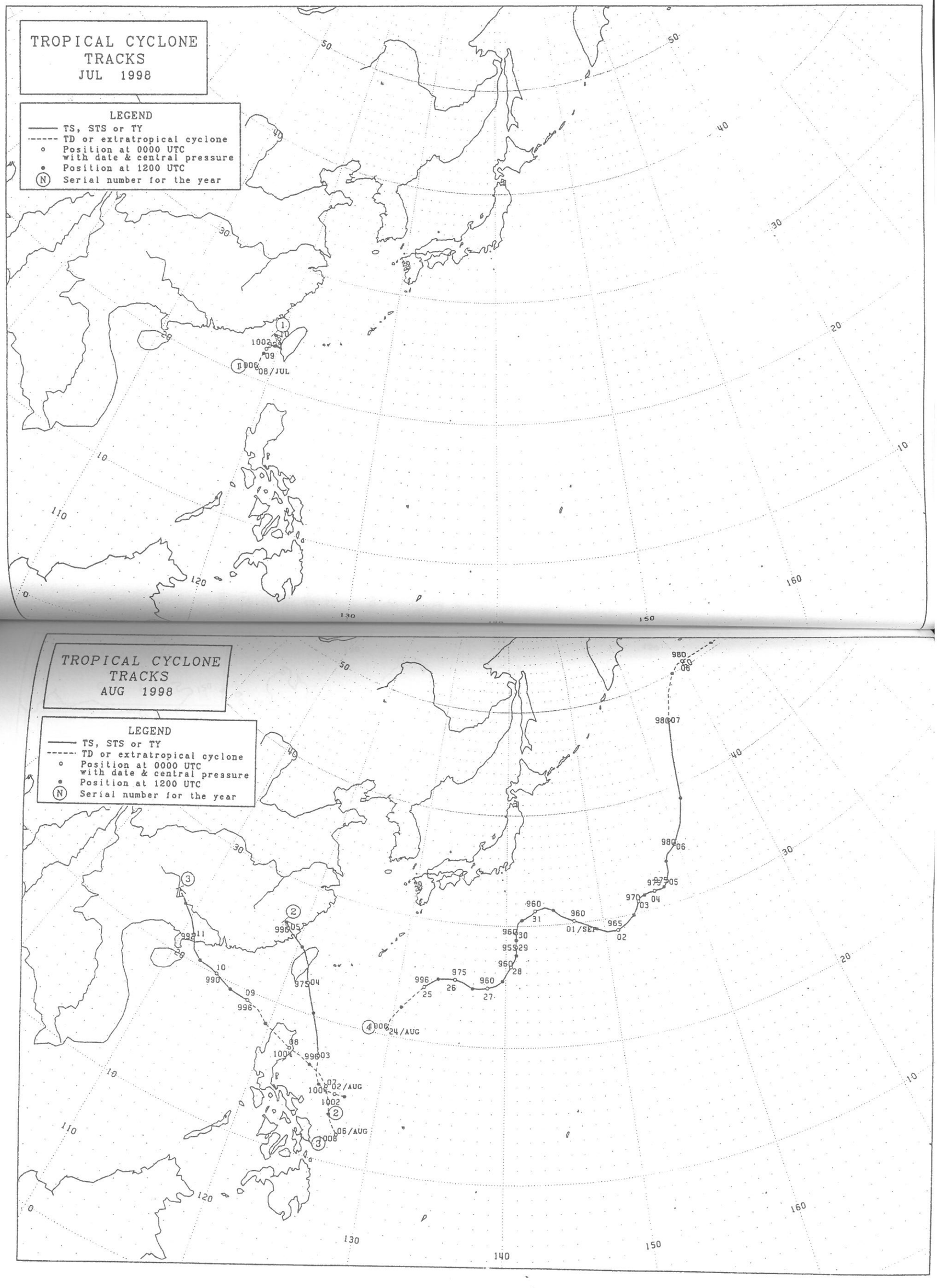
A tropical depression formed about 460 km east-northeast of Luzon at 1200 UTC on 26 September. It moved to the northwest towards Taiwan and became Tropical Storm YANNI at 0000 UTC on 28 September when it turned northwards east of Taiwan about 80 km off its coast. YANNI brushed the east coast of Taiwan and turned to the northeast. Intensifying and accelerating gradually, YANNI reached its peak intensity with maximum winds of 65 knots to become a typhoon at 1200 UTC on 29 September on its northeastwards track over the central East China Sea. YANNI then took the northwards track and passed just east of Cheju Island while weakening rapidly. Extratropical transition soon followed after YANNI made landfall on the Korean Peninsula at 0600 UTC on 30 September. YANNI then drifted southwards and dissipated shortly at 1200 UTC that day off the south coast of the Korean Peninsula.

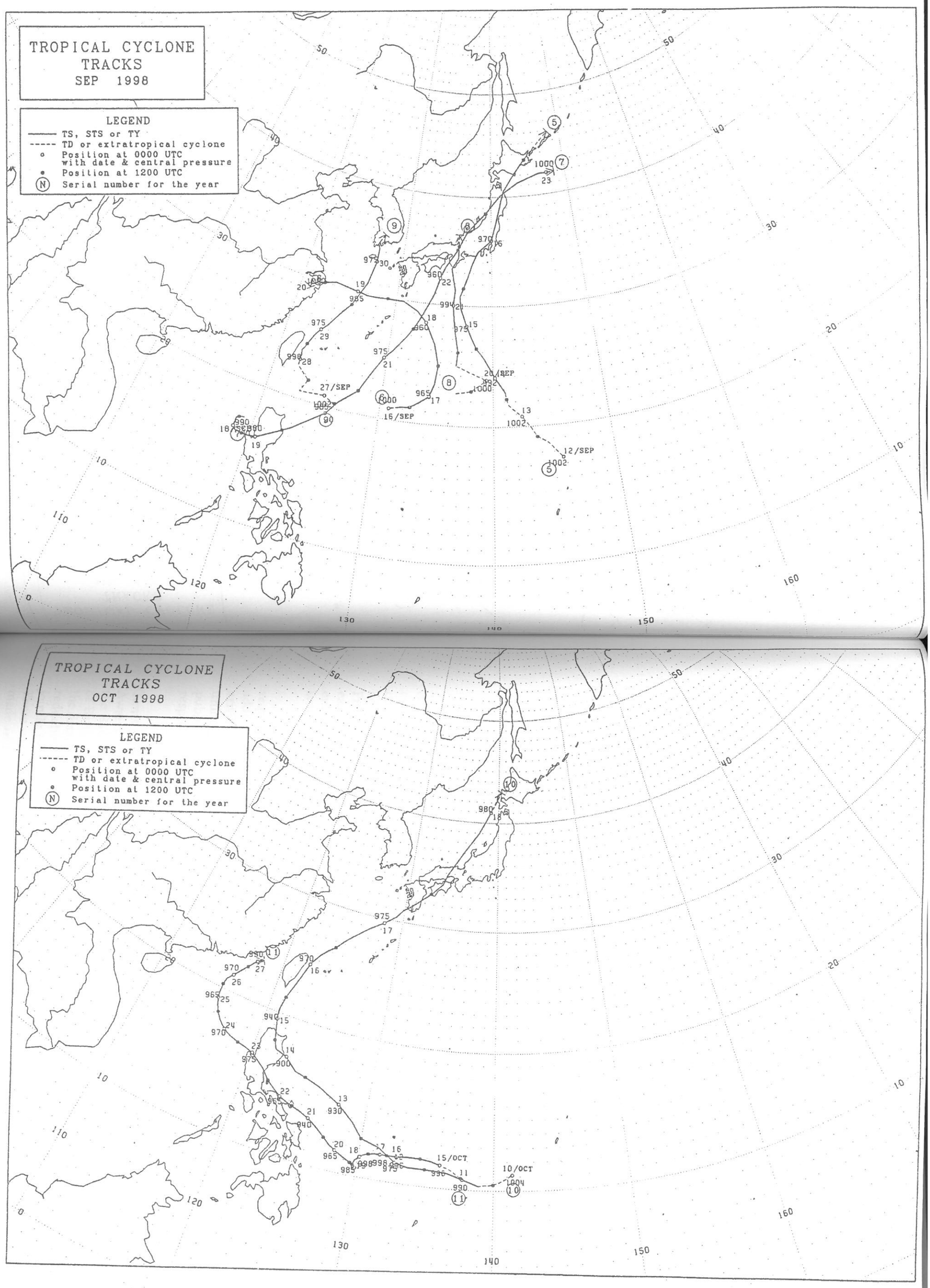
ZEB(9810)

On 10 October, ZEB formed as a tropical depression about 440 km southwest of Guam. It attained tropical storm intensity late that day on its track generally to the west. The storm strengthened rapidly, becoming a severe tropical storm on the 11th and a typhoon on the 12th. Turning gradually to the west-northwest, ZEB reached its peak intensity on the 13th about 150 km east of Luzon. Minimum central pressure was estimated at 900 hPa and maximum winds at 110 knots, which made ZEB the strongest typhoon of 1998 as of the end of October. ZEB made landfall on Luzon on early 14th and turned its track to the north-northwest. Weakening was steady as it turned further to the north-northeast to cross the Bashi Channel and passed off the east coast of Taiwan. ZEB was downgraded to a severe tropical storm on 16th, when it took the northwest course towards Japan. Keeping the severe tropical storm intensity, ZEB made landfall on Kyushu on 17 October. It passed across the western Japan during the day and moved into the Sea of Japan. ZEB degenerated to an extratropical cyclone on 18 October and shortly dissipated.

BABS(9811)

After four days from the formation of ZEB(9810), BABS occurred as a tropical depression southwest of Guam, in the vicinity of ZEB's genesis point. After attaining tropical storm intensity on 15 October, BABS drifted towards the west as a tropical storm for four days until it turned slightly to the south and became quasi-stationary on 18th. During the temporary halt, it rapidly intensified to a severe tropical storm and to a typhoon during 19 October. BABS started to move towards the northwest late 19th and reached its peak intensity on the 20th with maximum winds of 85 knots on its track towards the Philippines. During 21st and 22nd BABS passed over Luzon and moved into the South China Sea. Downgraded to a severe tropical storm temporarily on 23 October, BABS regained typhoon intensity within the day and started to recurve. ZEB turned increasingly to the northeast from 24 to 25 October as it approached southern China. It rapidly degenerated to a severe tropical storm on the 26th and to a tropical storm on the 27th. ZEB finally became extratropical on the 27th and shortly dissipated late that day before it moved into the Taiwan Strait.


TROPICAL CYCLONE TRACKS
JUL 1998
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
Serial number for the year
1002
09
1008
08/JUL
TROPICAL CYCLONE TRACKS
AUG 1998
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
Serial number for the year
980
980
980
07
980
06
975
05
970
04
970
03
960
31
960
960
01/SEP
965
02
960
30
955
29
960
28
996
25
975
26
960
27
1006
24/AUG
998
11
10
990
09
996
08
1004
996
03
1004
02/AUG
1002
2
06/AUG
1008
3
996
05
975
04
50
40
30
20
10
0
110
120
130
140
150
160


TROPICAL CYCLONE
TRACKS
SEP 1998
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
Serial number for the year
TROPICAL CYCLONE
TRACKS
OCT 1998
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
Serial number for the year

APPENDIX XVI

TROPICAL CYCLONE PROGRAMME (TCP)

For most of the ocean basins concerned, the numbers of tropical cyclones which formed during the year were widely different from the long-term averages, most notably the comparatively low number in each of the western North Pacific and the South-West Indian Ocean. In the South-West Pacific and the North Atlantic and Caribbean regions there were above average numbers of tropical cyclones, one of which, hurricane Mitch, attained near record breaking severity. The operational plans/manual of the five regional tropical cyclone bodies under the TCP were revised and updated or new editions were issued. Each of the five RSMCs with activity specialization in tropical cyclones i.e. in Miami, Nadi, New Delhi, La Réunion and Tokyo, which are at the core of the plans/manual, further strengthened their facilities and advisory services to their respective region. These plans/manual performed well during the year.

Lesotho and the USA joined the RA I Tropical Cyclone Committee and the ESCAP/WMO Typhoon Committee to become the thirteenth and fourteenth Members respectively and to bring to seventy-three the number of Members of the TCP regional bodies. Further progress was made in implementation of each of the coordinated technical plans formulated and monitored by the TCP regional bodies for the future development of comprehensive services for tropical cyclone disaster mitigation.

Australia organized the third Southern Hemisphere Training Course on Tropical Cyclones in cooperation with WMO, in Melbourne. In support of the sustainable development of small island developing states, ten participants from small island countries of the South Pacific and South-West Indian Ocean regions joined their counterparts from Australian Tropical Cyclone Warning Centres on the course. The coordination of the activities of the South Pacific Tropical Cyclone Warning Upgrade Project, funded by the European Union, and the RA V Tropical Cyclone Committee, each of which is carrying out work complementary to that of the other, was further enhanced, leading to accelerated progress in the strengthening of the tropical cyclone warning system for the South Pacific region.

The Typhoon Committee agreed on plans formulated earlier in the year, at its request, by its Research Coordinating Group, for the use of Asian and Pacific names, in addition to a numbering system, to identify tropical cyclones in its region. This arrangement, to be brought into force after one year of publicity, will not only provide unique identification of typhoons in real time and historically, but will also strengthen public awareness of the dangers posed by typhoons and strengthen and promote response to the warnings provided by the NMSs in the region.

The Smith Tumsaroch Prize was instituted, following on the receipt by Mr. Tumsaroch (Thailand) of the 1997 Typhoon Committee Natural Disaster Prevention Award. The recipients of the first annual award of the prize, in February 1998, were the Bangladesh Meteorological Department and the Cyclone Preparedness Programme of Bangladesh. The TCP formulated the meteorological component and contributed to the disaster preparedness component of a draft project proposal on storm surge disaster reduction in the northern part of the Indian Ocean. The project is being developed jointly by IOC and the International Hydrological Programme of UNESCO and WMO. These components were endorsed by the Panel on Tropical Cyclones. Plans are being made in response to comments by EC-L, for expansion of the hydrological component

of the project, including the interaction between storm surges and river flows and their combined effects, with inputs from the work of Chy.

The TCP cooperated in the organization of the Fourth International Workshop on Tropical Cyclones held in Haikou, China, during April as a forum for interaction between tropical cyclone forecasters and researchers. To help the tourism industry around the world to cope with tropical cyclone and other natural disasters, the World Tourism Organization and WMO jointly published a Handbook on Natural Disaster Reduction in Tourist Areas. This manual, which has been widely distributed to tourist professionals and others concerned, will educate and guide the industry on tropical cyclones and other natural hazards, the dangers they pose and on clear step-by-step procedures for disaster prevention and preparedness, to minimize their impact on the industry and on tourists.

Purpose and scope

The purpose of the Tropical Cyclone Programme (TCP) is to assist Members, through an internationally coordinated programme, in their efforts to mitigate tropical cyclone disasters. Its purposes therefore include facilitating WMO's role in the implementation of follow-on activities to the IDNDR (post-Decade) and helping Members to obtain the humanitarian, social and economic benefits of effective tropical cyclone disaster mitigation and to achieve sustainable development.

Main long-term objectives

The main long-term objective of the TCP is to assist Members in upgrading the capabilities of national Meteorological and Hydrological Services (NMHSs) to provide better tropical cyclone, related flood and storm surge forecasts and more effective warning through regionally coordinated systems, and to encourage Members to establish national disaster prevention and preparedness measures.

Implementation for the period 2000 - 2003

Implementation components will include:

(a) Coordination of the further development and implementation of the comprehensive regional cooperation programme, comprising a tropical cyclone operational plan/manual and a technical plan, formulated by each of five tropical cyclone regional bodies; (two inter-governmental bodies, established under the joint auspices of WMO and ESCAP and three working groups of Regional Associations I, IV and V and the provision of institutional support to these five tropical cyclone regional bodies.

(b) Facilitating the transfer of technology, through monitoring relevant developments, promoting and providing advice on methodology and transfer of appropriate technology to NMHSs, to modernize and upgrade their operational capabilities, with substantial improvements at the interface with the users, and through the transfer of relevant meteorological research results to operational usage. Publication and wide distribution of reports providing technical and scientific information and advice also will be supported.

(c) Monitoring and evaluation of the performance of the coordinated warning systems centred on the role of the RSMCs with activity specialization in tropical cyclones, in providing specialized advisories and other products and services.

(d) Assessment of the evolving TCP requirements as related to the overall implementation of the WWW.

(e) Upgrading, promoting and coordinating implementation of regional computer networks and storm surge projects, including application of PC-based workstations and improved storm surge simulation and forecasting.

(f) Coordinating activities relating to flood risk assessment and flood forecasting in tropical cyclone regions between various bodies of WMO concerned.

(g) Promotion, in cooperation with other bodies concerned, of the strengthening of programmes relating to tropical cyclone disaster mitigation including, tropical cyclone hazard assessment, collection of historical and post-storm tropical cyclone, storm surge and flood data, public awareness, response to warnings and dissemination of warnings.

(h) Capacity building in NMHSs through workshops, seminars and co-sponsored training courses, particularly for tropical cyclone forecasters, and identification of the needs for technical cooperation activities and human resources development.

(i) Involvement and assisting in planning and implementation of follow-on activities to the IDNDR related to TCP.

APPENDIX XVII

REGIONAL COOPERATION PROGRAMME IMPLEMENTATION PLAN (RCPIP)

PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
I. Meteorological Component	99	00	01	02			
I.1 Support to Meteorological Observing Systems and Facilities							
I.1.1 Expansion of observational programme: *With stress on radiosonde observations*	↔	↔	↔	↔	Members	National/External	Continuous activities
I.1.2 Maintaining services specified in the Operational Manual, including intensified observations (surface, upper-air and radars)	↔	↔	↔	↔	Members	National	Continuous activities
I.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
I.1.4 Establishment of AMedas, ASDAR, anemometer, tide gauge and water recorder networks	↔	↔	↔	↔	Members	National	Continuous activities
I.1.5 Establishment/upgrading of satellite equipment (GMS/TIROS-N/FY2))	↔	↔	↔	↔	Members	National	Continuous activities
I.1.6 Establishment of a WWW data user system for the reception of FAX and GPV data INTERNET or ISDN	↔	↔	↔	↔	Members	National	Continuous activities
I.1.7 Establishment/upgrading of weather radars	↔	↔	↔	↔	Members	National	Continuous activities
I.2 Support to Meteorological Telecommunication Systems and Facilities							
I.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 via MTSAT from 2000
Maintaining:							
Services and facilities for the real-time exchange of data and products	↔	↔	↔	↔	Members	National	Continuous activities

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	Meteorological Component	99	00	01	02			
	• Monitoring of data exchange	↔	↔	↔	↔	RTHs Bangkok, Beijing and Tokyo	Members concerned	Continuous activities
		↔	↔	↔	↔	RTH Bangkok, Vientiane-Hanoi	Members concerned	Continuous activities
.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
1.2.2.1	Improvement of data completeness and quality, including use of real-time and non real-time monitoring results for this purpose	↔	↔	↔	↔	Members	National	Continuous activity
1.2.2.2	Review of existing arrangements for dissemination of typhoon warnings with a view of introducing improvements where necessary	↔	↔	↔	↔	Members	National	Continuous activity
1.2.2.3	Improvement of national data collection and retransmission to associated RTHs	↔	↔	↔	↔	Member	National/External	
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 their forecasting and warning systems, archival of information on typhoon data in accordance with the TC Typhoon Operational Manual	↔	↔	↔	↔	RSMC Tokyo-Typhoon Center	Japan	Continuous activity
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

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
1.	**Meteorological Component**	99	00	01	02			
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 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	From 2000

PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	99	00	01	02			
Hydrological Component							
Flood Forecasting and Warning							
1.1 Installation and operation networks of observing stations required for flood forecasting systems	↔	↔	↔	↔	Members	National	Continuous activity
1.2 Establishment and operation of flood forecasting and warning system	↔	↔	↔	↔	Members	National	Continuous activity
1.3 Establishment of flood forecasting and warning systems for dam operations	↔	↔	↔	↔	Interested Members	National and external assistance	
.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	99	00	01	02			
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
.2.3 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
2.4 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
	99	00	01	02			
Hydrological Component							
.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
!.2.6 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

PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	99	00	01	02			
3. **Disaster Prevention and Preparedness**							
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 damage caused by typhoons, floods and storm surges including	↔	↔	↔	↔	Members	External assistance	With advice from OCHA in co-operation with ESCAP

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
5.	**Disaster Prevention and Preparedness**	99	00	01	02			
	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**	99	00	01	02			
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	Group training courses in meteorology	↔	↔	↔	↔	Japan	JICA	Japan International Cooperation Agency
4.1.9	Exchange of forecaster(s) between tropical cyclone forecasting and warning centers	↔	↔	↔	↔	Members	External assistance	Through TCDC arrangement
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	

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	Training Component	99	00	01	02			
.1.12	Training on storm surge and wave prediction	↔	↔	↔	↔	Members	Short-term fellowships with external support	
.1.13	Training in message-switching, wave forecasting, numerical weather prediction and cloud physics, through attachments	↔	↔	↔	↔	Members	External assistance	TCDC arrangements
4.1.14	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
4.2.7	Group training courses on river 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

	PART A. CONTINUING TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
4.	**Training Component**	99	00	01	02			
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 courses on technology for disaster prevention	↔	↔	↔	↔	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		TIME SCALE				BY WHOM	RESOURCES	REMARKS
5.	**Research Component**	99	00	01	02			
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		TIME SCALE				BY WHOM	RESOURCES	REMARKS
5.	**Research Component**	99	00	01	02			
.1.2.6	Study on climatology of precipitation extremes	↔	↔	↔	↔	Members	National	Counts on discussion
.1.2.7	Encourage participation in the works of the CAS working group	↔	↔	↔	↔	Members	National	
.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	
2	*Hydrology*							
2.1	Application of meteorological inputs to flood forecasting	↔	↔	↔	↔	National or regionally coordinated programmes	National	In cooperation with ESCAP
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
2.3	Research on hydrological aspects of El Niño phenomena	↔	↔	↔	↔	Members	National and external resources	In cooperation with ESCAP, WMO, OCHA and other concerned agencies
2.4	Study on model of flood process variation	↔	↔	↔	↔	National or regionally coordinated programmes	National and external resources	In cooperation with ESCAP, WMO, and other concerned agencies
	Disaster Prevention and Preparedness							
.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
2	Vulnerability and risk assessment of disaster-prone areas	↔	↔	↔	↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
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
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**	99	00	01	02			
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 El Niño	↔	↔	↔	↔	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**	99	00	01	02			
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	↔	↔	↔	↔	Possible Regional Consortium/Individual countries	Base facilities, cost of UAV, staff training	Subject to successful trials in 1997
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	
	• 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 bauds to 2400 bauds - 9600 bauds	↔	↔	↔	↔	Vietnam	National and external assistance	Continuous activity
	• Establishment of telecommunication circuit between Hanoi and Beijing with speed of 2400 bauds					Vietnam	National and external assistance	Speed is under negotiation

PART B. SPECIFIC TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	99	00	01	02			
2. Training Component							
2.1 Meteorology							
2.1.1 Satellite meteorology	↔				China	China	Training course organized 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
2.1.3 International Training Seminar on Tropical Cyclones	↔				Japan	Japan	Includes on-the-job training and study tour
2.1.4 Training of Class II meteorologists in Applied Meteorology	↔	↔	↔	↔	Hong Kong, China	TC members may be waive of tuition subject to availability of space	
2.1.5 Attachment of operational forecasters to NMC or RSMC	↔	↔	↔	↔	China	China and Members concerned	One month attachment to NMC or RSMC during the peak of the typhoon

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

PART B. SPECIFIC TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	99	00	01	02			
3. Research Component							
3.1 Meteorology							
3.1.1 Encourage members to participate in the "model-inter comparison experiment for typhoon in research project COMPARE under WGNE of CAS	↔				Members	National Assistance and/or external assistance	Participation by TRCG members encouraged

APPENDIX XVIII

LIST OF NAMES FOR TROPICAL CYCLONES ADOPTED BY THE TYPHOON COMMITTEE

Contributed by	I	II	III	IV	V
	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
HK, 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
HK, 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

APPENDIX XIX

LIST OF NAMES FOR TROPICAL CYCLONES CONTRIBUTED BY MEMBERS TOGETHER WITH FURTHER INFORMATION ON THE MEANING AND/OR ORIGIN OF THE NAMES

CAMBODIA

1.	Nakri	=	A kind of flower
2.	Krovanh	=	A kind of tree
3.	Maysak	=	A kind of tree
4.	Krosa	=	Crane
5.	Sarika	=	Singing bird
6.	Bopha	=	Flower/The name of little girl
7.	Damrey	=	Elephant
8.	Nesat	=	Fisherman
9.	Kong-rey	=	Pretty girl in Khmer legend/The name of mountain
10.	Chanthu	=	A kind of flower

CHINA

1.	Yutu	=	Rabbit in Chinese story
2.	Wukong	=	Famous hero in Chinese story
3.	Dujuan	=	Azelea
4.	Longwang	=	Dragon king
5.	Haishen	=	Sea god
6.	Dianmu	=	Mother of lightning
7.	Fengshen	=	Wind god
8.	Haima	=	Sea horse
9.	Haiyan	=	Petrel
10.	Haitang	=	Chinese flowering crabapple

D.P.R. KOREA

1.	Maemi	=	In summer season Maemi (Cicada) chirps, when Typhoon attacks Korea
2.	Sonamu	=	The looks of Sonamu (Pine tree) resembles the nature of Korea for its growing green throughout the year, standing strong enrooted even in the rocks
3.	Podul	=	Tree usually found in the towns and countries. In the sultry weather people have a rest under shadow of Podul (Willow) enjoying chatting
4.	Toraji	=	Beautiful flower bloom unnoticed, usually found in deep mountains of Korea for its usefulness as food and medicine
5.	Nalgae	=	It (Wing) means flying, and dynamic and free motion

6.	Kalmaegi	=	Bird (Sea gul) usually found wherever in the sea, which is an emblem of sea
7.	Kirogi	=	Migrating bird (Wild goose), the flock of which comes in Autumn to our country and fly away in early spring towards far North. Their appearance in our country every year resembles Typhoon habit
8.	Meari	=	It (Echo) means that once Typhoon occurs, the Typhoon Committee notification echoes over to its members
9.	Pongsona	=	Beautiful flower (Touch-me-not or balsam) specially loved by Korean women from ancient time for its fairy shyness and tender feeling
10.	Mindulle	=	Small and yellow flower (Dandelion) bloom in the field when spring comes, almost in the same time, which represents simple and gentle minds of Korean women

HONG KONG, CHINA

1.	Fung-wong	=	Phoenix (name of a peak)
2.	Ma-on	=	Horse saddle (name of a peak)
3.	Shanshan	=	Name of young girl
4.	Yanyan	=	Name of young girl
5.	Lingling	=	Name of young girl
6.	Banyan	=	A kind of tree
7.	Man-yi	=	Name of a strait, now a reservoir
8.	Kai-tak	=	Name of old airport
9.	Choi-wan	=	Colourful cloud
10.	Tingting	=	Name of young girl

JAPAN

1.	Tembin	=	Libra
2.	Yagi	=	Capricorn
3.	Usagi	=	Lepus
4.	Kajiki	=	Dorado
5.	Kammuri	=	Corona Berealis
6.	Kujira	=	Cetus
7.	Koppu	=	Crater
8.	Kompasu	=	Circinus
9.	Tokage	=	Lacerta
10.	Washi	=	Aquira

LAO P.D.R.

1.	Xangsane	=	Elephant
2.	Pabuk	=	Big fresh water fish
3.	Chan-hom	=	A kind of tree
4.	Nock-ten	=	Bird
5.	Phanfone	=	Animal
6.	Faxai	=	Lady name
7.	Bolaven	=	Plateau
8.	Ketsana	=	A kind of tree
9.	Namtheun	=	River
10.	Matsa	=	Lady fish

MACAU

1.	Linfa	=	Lotus
2.	Muifa	=	Plum blossom
3.	Vamei	=	Laughing Thrush (a kind of bird)
4.	Chanchu	=	Pearl
5.	Sanvu	=	Coral
6.	Malou	=	Agate
7.	Wutip	=	Butterfly
8.	Vongfong	=	Wasp
9.	Parma	=	Macanese cuisine (ham with liver and mushroom)
10.	Bebinca	=	Macanese milk pudding

MALAYSIA

1.	Jelawat	=	A fresh water fish
2.	Mawar	=	Rose
3.	Melor	=	Jasmine flower
4.	Meranti	=	A type of tree
5.	Merbok	=	A type of bird
6.	Nangka	=	A type of fruit
7.	Rumbia	=	A palm tree that yields ago
8.	Rusa	=	Deer
9.	Sepat	=	A fresh water fish with small climbing perch
10.	Tapah	=	A fresh water fish

MICRONESIA, FEDERATED STATES OF

1.	Sinlaku	=	Kosrae legendary goddes
2.	Nepartak	=	Famous Kosrae warrior
3.	Soudelor	=	Legendary Pohnpei chief
4.	Ewiniar	=	Chuuk traditional storm god
5.	Fitow	=	Yapese name for a beautiful fragnant flower
6.	Mitag	=	Yap women's name
7.	Soulik	=	Traditional Pohnpei chief's title
8.	Nanmadol	=	A famous Pohnpei ruin
9.	Rananim	=	Chuukese for "Hello"
10.	Guchol	=	Yapese word for the spice Tumeric

PHILIPPINES

1.	Bilis	=	Speed
2.	Cimaron	=	Philippine wild ox
3.	Danas	=	To experience
4.	Hagibis	=	Swift; fast
5.	Hagupit	=	Lash; flog
6.	Imbudo	=	Funnel
7.	Lupit	=	Cruel
8.	Malakas	=	Strong; powerful
9.	Talas	=	Sharpness; acuteness
10.	Talim	=	Sharp edge

REPUBLIC OF KOREA

1.	Chebi	=	Swallow
2.	Noguri	=	Racoon dog
3.	Kaemi	=	Ant
4.	Koni	=	Whistling swan
5.	Megi	=	Fish
6.	Nabi	=	Butterfly
7.	Nari	=	Flower
8.	Noru	=	Roe deer
9.	Changmi	=	Rose
10.	Sudal	=	Otter

THAILAND

1.	Kularb	=	Rose
2.	Prapiroon	=	God of rain
3.	Khanun	=	Thai fruit (Jackfruit)
4.	Durian	=	Favourite fruit of Thai people *(Durio zibethinus)*
5.	Megkhla	=	Angel of thunder
6.	Chaba	=	Tropical flower (the shoeflower, genus *Hibicus*)
7.	Hanuman	=	Dramatic monkey
8.	Vipa	=	Name of woman
9.	Nida	=	Name of woman
10.	Ramasoon	=	God of thunder

USA

1.	Utor	=	Marshalese name for squall line
2.	Kodo	=	Marshalese name for cloud
3.	Chataan	=	Chamorro word for rain
4.	Omais	=	Palauan word meaning wandering around
5.	Etau	=	Palauan word for storm cloud
6.	Higos	=	Chamarro word for fig
7.	Roke	=	Chamarro men's name
8.	Francisco	=	Chamarro men's name
9.	Maria	=	Chamarro women's name
10.	Vicente	=	Chamarro women's name

VIET NAM

1.	Saola	=	An animal recently found in Viet Nam
2.	Sonca	=	A singing bird
3.	Trami	=	A kind of flower
4.	Saomai	=	Name of star Venus
5.	Lekima	=	A kind of fruit
6.	Bavi	=	A mountain in northern Viet Nam
7.	Conson	=	A historical place
8.	Songda	=	A river in northwestern Viet Nam
9.	Vamco	=	A river in southern Viet Nam
10.	Halong	=	A beautiful bay in Viet Nam

APPENDIX XX

ESCAP/WMO TYPHOON COMMITTEE TRUST FUND
INTERIM STATEMENT OF ACCOUNT
as at 23 October 1998

				$	$
Balance of fund at 1 January 1998				364'484	
Advances received				84'000	
Other income				14'236	
Exchange difference				-22	
Total revenue					462'698
Less: Expenditure	Liquidated	Unliquidated	Total		
Administration Costs - Local	13'738	8'581	22'319		
4th International Workshop on T/C Haikou, China	12'054	1'781	13'835		
TRCG Meeting, Beijing	13'859	7'716	21'575		
International Trng. on Satellite Met., Nanjing, China	-	5'468	5'468		
Publications and Reports	433	7'995	8'428		
Missions	634	-	634		
Total expenditure					72'259
Balance at 23 October 1998					$ 390'439

Represented by:		
Cash in Bank		422'977
Less: Unliquidated Obligations		32'538
		$ 390'439

Contributions Received

	1998	Total
China	12'000	12'000
Hong Kong, China	12'000	12'000
Japan	12'000	12'000
Malaysia	12'000	12'000
Singapore	12'000	12'000
Thailand	12'000	12'000
Viet Nam	12'000	12'000
Total	84'000	84'000