ECONOMIC AND SOCIAL COMMISSION
FOR ASIA AND THE PACIFIC

AND

WORLD METEOROLOGICAL ORGANIZATION

REPORT OF THE TYPHOON COMMITTEE ON ITS THIRTIETH SESSION

Hong Kong, China,
(25 November - 1 December 1997)

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I. ORGANIZATION OF THE SESSION

1. The thirtieth session of the Typhoon Committee was held at Hong Kong, China from 25 November to 1 December 1997. 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 48 participants, representing twelve (out of 13) Members of the Typhoon Committee, namely: Cambodia; China; Hong Kong, China; Japan; Lao PDR; Macau; Malaysia; Philippines; Republic of Korea; Singapore; Thailand and Viet Nam.

3. The session was also attended by 5 observers from Brunei Darussalam and the United States of America. In addition, 4 observers from the International Civil Aviation Organization (ICAO), International Decade for Natural Disaster Reduction (IDNDR) Secretariat/Department of Humanitarian Affairs (DHA), WMO Commission for Atmospheric Sciences (CAS) and 7 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 (Agenda item 1)

4. Dr. H. K. Lam, Director of the Hong Kong Observatory, welcomed all participants to the thirtieth session of the Typhoon Committee and to Hong Kong, China. He expressed his appreciation for the support provided by ESCAP and WMO. He stated that Members of the Committee were benefiting from the free exchange of data and products, the use of new technology and by sharing of experiences among the Members. He added that, with thirty tropical cyclones on the average forming annually over the western North Pacific and South China Sea, the Typhoon Committee as a regional body, has achieved significant progress in the promotion and coordination of international efforts to mitigate damages caused by typhoons. He reaffirmed that Hong Kong, China would continue to play an active role in the Committee for the well-being of the peoples of the region.

5. The representative of ESCAP, Mr. Guangchang Shi, delivered the message of the Executive Secretary of ESCAP. He expressed appreciation to the Government of Hong Kong Special Administrative Region 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-third session in 1997 had noted with appreciation the progress achieved in the implementation of the activities of the Typhoon Committee. The Commission had welcomed Singapore as a new Member of the Typhoon Committee, urged the United Nations Development Programme (UNDP), WMO and ESCAP Secretariats 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 on natural disaster reduction in the past year, informed the Committee that project documents had been drafted to solicit extrabudgetary funds for further activities in this field, and expressed 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, when it receives funding. He thanked those Members that had been supporting the activities of the Typhoon Committee, as well as the WMO, the DHA, the IDNDR Secretariat, and the International Federation of Red Cross and Red Crescent Societies (IFRCS) and acknowledged the significant contribution 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, and invited the Committee Members to make more extensive use of the Technical Co-operation among Developing Countries (TCDC) programme for the exchange of expertise on various aspects of natural disaster reduction.

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 Hong Kong Special Administrative Region for hosting the session and for the excellent facilities provided. He complimented the Committee for thirty years of hard work since its establishment which had been rewarded by significant achievements and programmes. However, there was a need for more effective warnings with increased reliability and lead time, to allow for improved response by the public so as to further reduce the loss of life and property. Further, more effective disaster prevention and preparedness measures were needed, and closer interaction with the National Meteorological and Hydrological Services (NMHSs) and the national agencies concerned with disaster prevention and preparedness was an area that needed to be further strengthened. He assured the session that WMO would continue to support the Committee to the extent possible and through the Committee all the peoples of this region. He extended his thanks to all Members that have been providing support to the activities of the Committee. He also expressed the thanks of WMO to ESCAP for its continued close cooperation and support. In closing, he wished the participants a very successful session.

7. Mr. S.K. Ip, JP, Secretary for Economic Services, of the Government of the Hong Kong Special Administrative Region, welcomed all participants to Hong Kong on this spectacular year when Hong Kong became a Special Administrative Region of the People's Republic of China. He mentioned that 1997 also saw the wettest year ever recorded in Hong Kong and fortunately with good infrastructure and adequate emergency response, extensive casualties and damage had been avoided. He also mentioned that a new high-speed computer and a new weather radar were being acquired in Hong Kong. Mr. Ip then congratulated the Typhoon Committee for its achievements in coordinating the measures to minimize typhoon damages, of which Hong Kong, China had been proud to play a part and given its full support. He wished the participants a successful session and a pleasant stay in Hong Kong. He declared the session open.

8. The Committee witnessed the awarding of the ESCAP/WMO Typhoon Committee Natural Disaster Prevention Award for 1997 to Dr. Hung Kwan Lam, Director of the Hong Kong Observatory. The award was presented by Dr. Roman L. Kintanar, Chairman of the Typhoon Committee Foundation Incorporated (TCFI). The citation of the award read:

"In recognition of his meritorious service as Director of the Hong Kong Observatory, and of his invaluable contributions in the department's essential operational systems which have been associated with significant advances in technology

in remote sensing and computing, paving the way for the development of much more refined and diversified warning and forecasting services in Hong Kong. Given on the occasion of the Thirtieth Session of the Typhoon Committee in Hong Kong, China on 25 November 1997."

9. The Committee also witnessed the awarding of the ESCAP/WMO Typhoon Committee Natural Disaster Prevention Award for 1997 (honorable mention) to Mr. Bernard Lam Moon-Tim, Director of the Civil Engineering Department of Hong Kong, China. The citation of the award presented by Dr. Kintanar read:

"In recognition of his outstanding services as Director of the Civil Engineering Department, and of his distinctive contribution in the development of geotechnical control programme which has greatly reduced the annual loss of life and disruption to community due to landslides in Hong Kong. Given on the occasion of the Thirtieth Session of the Typhoon Committee in Hong Kong, China, on 25 November 1997."

II. ELECTION OF OFFICERS (Agenda item 2)

10. Dr. H.K. Lam (Hong Kong, China) and Dr. Lim Joo Tick (Malaysia) were unanimously elected as the Chairman and Vice-Chairman, respectively. Mr. Yuso Takigawa (Japan) was elected as the Chairman of the Drafting Committee.

III. ADOPTION OF THE AGENDA (Agenda item 3)

11. The Committee adopted the agenda as shown in Appendix II.

IV. THE COMMITTEE'S ACTIVITIES DURING 1997 (Agenda item 4)

12. The TCS, on behalf of the Typhoon Committee, expressed its gratitude to Mr. Pongkrit Saeneewong, Senior Meteorologist of the Thailand Meteorological Department, for representing the Committee in a consultative capacity at fifty-third session of the ESCAP held in Bangkok, 23-30 April 1997.

13. The TCS informed the session that the:

- TCS Coordinator attended as lecturer the Second Technical Conference on Management of Meteorological/Hydrometeorological Services in Regional Association II (Asia) held in Macau from 4 to 8 November 1997.

- TCS Meteorologist participated at the WMO Regional Training Seminar for National Instructors of Regional Associations II (Asia) and V (South-West Pacific) held in Quezon City, Philippines, from 10 to 21 November 1997.

- TCS continued managing the Typhoon Committee Foundation Inc.

(a) Meteorological Component (Agenda item 4.1)

14. 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.

15. The session was informed by the delegate from Cambodia that the country's Meteorological Service continued to suffer acutely due to deficiency of meteorological instruments and reiterated the appeal for assistance from Typhoon Committee Members and others.

16. The delegate from China informed the session of the successful launching of its first geostationary meteorological satellite FY-2 on 10 June 1997.

17. Japan's delegate informed the session of the upgrade of the Tokyo-Seoul telecommunication circuit from 9 600 bps to 64 kbps with X.25 protocol which took place in March 1997.

18. The delegate from Malaysia informed the session that the Malaysian Meteorological Service (MMS) had successfully upgraded their 8 upper air stations for Global Positioning System (GPS) sonde operations. Due to the steep increase in the cost of GPS sondes, Malaysia is finding it difficult to sustain the maintenance of the 8 upper air stations and would need to look into the possibility of reducing the size of its network. He also mentioned that the MMS had implemented a new warning system for strong wind and moderate to heavy rainfall, with or without the presence of tropical cyclones over land/sea areas of Malaysia, after the 1996 Tropical Storm Greg episode. He thanked other meteorological services in the region for their technical assistance in the formulation of the new system.

19. The Committee commended Malaysia for completing the conversion from Omega rawinsondes to Global Positioning Satellite (GPS) rawinsondes at all eight sites. These GPS rawinsondes are essential for accurate analyses of atmospheric weather systems in the region of the Typhoon Committee. In addition, these rawinsondes provide critical information for initial conditions of the regional and global model predictions and will contribute to detection of any global climate changes. In this connection, the Committee strongly urged Malaysia to maintain regular rawinsonde launches at all eight sites, and furthermore encouraged all Members to also make every effort to maintain regular rawinsondes that are essential to accurate analyses and weather predictions.

20. The delegate from the Philippines expressed his regret on the inability of the National Meteorological Service in his country to send a representative to this session. However, he covered the highlights of the Philippine meteorological activities in 1997 as found in the Philippine country report.

21. The delegate from the Republic of Korea, the newly designated Administrator of the Korea Meteorological Administration (KMA), reiterated his Government's continued support to the meteorological activities of the Committee and pledged more active participation in the future.

22. The delegate from Viet Nam informed the session of the upgrade of the Bangkok-Hanoi telecommunication circuit from 75 bps to 1200 bps during 1996.

23. The delegate from Hong Kong, China informed the Committee that a Terminal Doppler Weather Radar System and a boundary layer wind profiler had been installed near the new airport at Chek Lap Kok in 1997.

24. The delegate from Lao P.D.R. informed the Committee that two automatic weather stations were installed in 1997.

25. The delegate from Macau reported to the Committee that in 1997, the meteorological service started with preparations to develop a mesoscale meteorological prediction model.

26. The delegate from Singapore informed the Committee that the installation of an S-band Meteorological Doppler Radar would be completed by the end of 1997 which will replace and take over the weather watch function of the current radar system at Singapore's Changi Airport.

27. Thailand's delegate informed the Committee that the existing satellite receiving system (GSC-METPAK) at the head office is currently being upgraded. The Committee was also informed that the composited weather radar images which is linked via telecommunication satellite from 14 radar sites to the head office in Bangkok has been operational since September 1997.

28. The Committee reviewed and approved the proposed amendments to the Typhoon Operational Manual - Meteorological Component (TOM) shown in Appendix IV, submitted by the rapporteur, Mr. Yukio Takemura (Japan) and reported to the session by Mr. Yuso Takigawa of the Japan Meteorological Agency (JMA).

29. The Members of the Typhoon Committee expressed their gratitude for the services of a rapporteur and appreciation for the offer of JMA for the continued services of the rapporteur on TOM for the coming year as well.

30. The Committee expressed its gratitude to JMA on 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 Committee noted the highly improved accuracy of position forecasts issued by RSMC Tokyo-Typhoon Center up to 72 hours. The Committee also noted that such information was of great value to their operations.

(b) Hydrological Component (Agenda item 4.2)

31. Based on the programme for 1997, as agreed upon during the second joint session of the Typhoon Committee and the Panel on Tropical Cyclones, the Members continued their sustained efforts in undertaking the programme of work under the hydrological component. A detailed summary of the reports of the individual Members on their activities related to the hydrological component during 1997 is included in Appendix V.

32. The delegate from Cambodia informed the Committee of the work on hydrology related to the Mekong River Commission.

33. The delegate from China informed the Committee of the addition of 15 nodes to wide-area computer network of national hydrological information transmission. He also presented information on the application of network technology in hydrological information transmission in his country. He highlighted the flood forecasting and warning

and comprehensive flood loss prevention and management activities as well as the training courses held in China.

34. The delegate from Hong Kong, China informed the Committee that the Automatic Water-level Reporting System continued to provide real-time rainfall and river depth information. He also mentioned of the current plan to construct 70 km of new river channels at a total cost of HK$5 billion.

35. The delegate from Japan informed the Committee that considerable rainfall was experienced in 1997 in Japan. However, a mud flow had caused loss of considerable lives, rather than flooding. He also reported that measures were being taken to reduce data renewal interval in the observations of rain gauges as an improved warning measure against flash floods.

36. The delegate from the Philippines informed the Committee that the Flood Forecasting Branch of the Philippine Atmospheric Geophysical Atmospheric Services Administration (PAGASA) had made some new functional arrangements to strengthen its commitment to disaster preparedness and management programmes, particularly aiming at increasing the awareness of the population to natural hazards.

37. The delegate from Malaysia informed the Committee that during the year, 13 additional telemetric rainfall and river level stations were installed, and that data transmission via satellite was currently being tested at six remote radio based telemetric stations. He also gave some information on the flood forecasting and warning system for the Kelantan River.

38. The delegate from the Republic of Korea informed the Committee that flooding in 1997 was less severe than in the past years. He also reported that the plan to improve the hydrological data collection network for flood forecasting and warning system was continuing to be implemented.

39. The delegate from Thailand informed the Committee that three new hydrometeorological stations were established in early 1997, and that the MOFFS Version 2c has been replaced by MOFFS Version 3.

40. The delegate from Viet Nam informed the Committee that during the period between 1 November 1996 and 30 September 1997, Viet Nam was affected by very severe flooding from almost all of the rivers. Viet Nam has extensive plans to improve the facilities for hydrometeorological observations, flood forecasting and monitoring, however there was a serious need for technical and funding assistance.

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

42. TCS informed the session that in co-operation with Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), it met with a group of Japanese experts from the Foundation of River and Basin Integrated Communications (FRICS) on 10 February 1997. They discussed the present status, policy and planning of river information systems in the two countries including future plans and programmes of the FRICS Expert's conference which was held in Japan in 1996.

43. The session was also informed that the TCS Hydrologist participated in the Management Overview of Flood Forecasting Systems (MOFFS) Workshop held in Seoul, Republic of Korea from 19 to 21 March 1997 and the World River Conference in Gifu City, Japan, from 19 to 20 November 1997.

Hydrologists' meeting

44. Prior to the Typhoon Committee session, the pre-session meeting of the hydrologists took place on 24 November 1997. The report of the Hydrologists' meeting with the list of participants is presented in Appendix VII. The meeting 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)

45. Typhoon Committee Members continued their sustained efforts in undertaking the programme of work under the 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 related to the Disaster Prevention and Preparedness Component and IDNDR during 1997 is included in Appendix VIII.

46. The Committee was informed that the DHA/IDNDR Secretariat has recently been paying considerable attention to the El Niño phenomenon, and has established an inter-agency Task Force to deal with the scientific, socio-economic political and disaster preparedness aspects of El Niño. A series of meetings of the Task Force were being undertaken to tackle the problems associated with this problem. A draft resolution for consideration by the General Assembly has already been formulated. WMO has also formed a task team to provide scientific advice to the concerned NMHSs. The Committee was informed that the Asian Disaster Preparedness Centre (ADPC) was planning to organize a seminar on El Niño in Bangkok in January 1998. The Committee decided to take up the matter of El Niño again, for consideration for any possible action, under the Agenda item 7.

47. The delegate from Cambodia informed the Committee that although during the rainy season, the rainfall throughout the country was above the average, during the dry season, droughts were experienced in many areas of the country.

48. The delegate from Hong Kong, China informed the Committee of the rising popularity of the Hong Kong Observatory Homepage. He also reported that 1997 had been a record rainfall year, and that the natural disaster warning system in Hong Kong was being kept under review.

49. The delegate from China informed the Committee that four tropical cyclones had affected China in 1997, however owing to the effective measures taken, the number of casualties and economic losses had been greatly reduced.

50. The delegate from Japan, referring to the "Yokohama Strategy", developed as a result of the World Conference on Disaster Reduction in 1994, informed the Committee of the extensive cooperative activities undertaken by Japan, some of which also benefitted other countries.

51. The delegate from the Republic of Korea informed the Committee of Korea's disaster prevention and preparedness activities, which included designation of National Disaster Prevention Day, choice of the disaster prone areas and establishment of the National Institute for Disaster Prevention.

52. The delegate from Macau informed the Committee that damage due to typhoons had been minimal in 1997. He also informed that a number of education, training and public awareness activities were undertaken.

53. The delegate from Malaysia informed the Committee that, after a recent tropical storm induced disaster in Sabah, a major resettlement plan for vulnerable villages had been embarked upon. Also a new directive, encompassing management of natural, technological and environmental disasters had been approved.

54. The delegate from the Philippines informed the Committee on the continuing organization of disaster control units, and conduct of training courses throughout the country. New communication programmes were also being implemented and a computer network was being established. The Committee noted with appreciation that early warnings regarding the current El Niño event had been provided to the Government of Philippines in time so that all the prevention and preparedness measures were undertaken timely, minimizing the adverse social and economic effects of the current episode.

55. The delegate from Thailand informed the Committee that disaster exercises had been undertaken in 20 provinces in 1997, and that some public awareness activities were also undertaken. He also informed the Committee of the plans to establish a number of flood prevention projects. He further informed the Committee that one severe typhoon had hit Thailand in 1997. However, owing to the government's effective early warning measures and accurate forecasts, the number of casualties and economic losses had been greatly reduced.

56. The delegate from Viet Nam informed the Committee that during the reporting period, two-thirds of the provinces of Viet Nam had suffered various water related disasters. The Government had carried out various disaster prevention and preparedness activities, including strengthening the coordination mechanism, improvement of the quality of forecasts and warnings, reinforcement of structural measures, and accelerating public education and awareness activities.

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

(d) Training component (Agenda item 4.4)

58. The session reviewed the involvement of the Members in various education and training activities supported mainly by Members themselves, by WMO's Voluntary Cooperation Programme (VCP) and regular budget, and through TCDC arrangements details of which are given in Appendix X.

59. The session was informed by the delegate from Singapore that the course on Interpretation of Numerical Weather Prediction and Satellite Data for Meteorologists and

Weather Forecasters in the region was conducted in 1997 under Singapore's Colombo Plan Fellowship and that a similar course was planned for next year.

(e) Research component (Agenda item 4.5)

60. Research work continued to be an integral part of Members' activities in 1997 and a summary of the reports of the individual Members in relation to the research component is given in Appendix XI.

61. The CAS representative informed the session of the current activities of the CAS Tropical Meteorology Research Programme. He also mentioned that the Autonomous Aerosonde is reaching the capacity to undertake reconnaissance in a wide range of applications, including tropical cyclones, starting in 1998. Appendix XII contains his full report.

62. During the Second Joint Session of the Panel on Tropical Cyclones and Typhoon Committee held in Phuket, Thailand in February 1997, the session urged CAS/International Council of Scientific Unions/WMO to issue a formal position on climate change and tropical cyclones for Tropical Cyclone Programme (TCP) regional bodies. In response to this, the CAS mentioned that the formal position statement of the CAS on climate change has been approved by the CAS President. The Committee requested WMO to send to the Members by fax the said statement as soon as it is approved.

63. The CAS representative informed the session of the current status of the Autonomous Aerosonde Programme and encouraged the Members to endorse an international aerosonde facility.

V. REVIEW OF THE 1997 TYPHOON SEASON/ANNUAL PUBLICATIONS (Agenda item 5)

Review of the 1997 Typhoon Season

64. As in the past, RSMC Tokyo - Typhoon Center provided the session with a review of the 1997 typhoon season (Appendix XIII).

Annual Publications

65. The session noted with satisfaction the publication of the Typhoon Committee Annual Review 1996 in October this year through the commendable efforts of the Chief Editor provided by the TCS and the National Editors provided by the Members. The Committee agreed to the proposal that the TCS continue to publish the Annual Review for the time being.

66. The TCS published the 9th issue of the Typhoon Committee Newsletter in August 1997.

67. The TCS presented during the session a compilation of warnings/advisories issued by seven Members. The TCS Meteorologist reiterated the request to the rest of the Members to provide the Secretariat with their warnings/advisories for the compilation to be completed.

68. The Committee expressed its gratitude to the Secretariat for the 30th anniversary kit distributed during the session.

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

69. The considerations under this agenda item were based mainly upon the information contained in the twenty-third status report on the implementation of the WMO 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.

70. The Committee was informed that a biennial 10-week WMO/National Oceanographic and Atmospheric Administration (NOAA) global Training Course on Tropical Meteorology and Tropical Cyclone Forecasting, planned to be held in Miami and Tallahasee, Florida in 1998, might be postponed to 1999.

71. The Committee recalled that the second TCP RSMCs Technical Coordination Meeting held at the RSMC Miami - Hurricane Center in November 1996 had demonstrated significant accomplishment towards the coordination of activities within the programmes of the five TCP regional bodies. Among others, a number of recommendations of the meeting, the Committee endorsed 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 and that the centres should establish Internet access.

72. Since the issuance of tropical cyclone warnings is the responsibility of the NMHSs, the Committee was of the view that building the capacity of NMHSs to deliver accurate forecasts and timely warning services to the public, government agencies and local media effectively and efficiently, was one of the most fundamental ways of enhancing the visibility and status of NMHSs.

VII. PROGRAMME FOR 1998 AND BEYOND (Agenda item 7)

Regional Co-operation Programme Implementation Plan (RCPIP)

73. The Typhoon Committee reviewed and adopted the revised RCPIP which is contained in Appendix XIV.

Meteorological Component

(a) Future Activities of the RSMC Tokyo - Typhoon Center

74. The Committee took note of the future activities of the RSMC Tokyo - Typhoon Center which are contained in Appendix XV.

(b) A Proposal on naming tropical cyclones in the Western North Pacific

75. The Typhoon Committee endorsed the proposal to assign names to tropical cyclones in the Western North Pacific and South China Sea which should lead to the standardization of the usage of names for tropical cyclones by Members in the Typhoon Committee region. As a matter of urgency, it directed the Typhoon Research Coordinating Group (TRCG) to come up with a detailed proposal for discussion and possible concurrence at the next session of the Committee.

(c) Project Proposals for the Development of Lao PDR's and Cambodia's Typhoon Forecast and Warning Service

76. The TCS informed the session that the project proposals were submitted for funding consideration to the Asian Development Bank (ADB) in October 1997. The Committee requested that the TCS follow up this matter with the ADB.

(d) Proposal for provision of tropical cyclone passage report to other Typhoon Committee Members

77. The Committee agreed on the proposal of the TCS that each Member's tropical cyclone forecast center would compile reliable passage, landfall, near-buoy passage and near-ship passage data, tabulate that data and send it to the TCS a day after cyclone passage for distribution to other Members. It was also agreed that the task will be assigned to the focal point for the meteorological component of each Member.

El Niño Events

78. The Committee had a lengthy discussion on the possible link between El Niño and the extraordinary pattern and characteristics of typhoons in 1997. Features so far included: two exceptionally early typhoons striking Japan in June, very late start of typhoon season in China, much below normal typhoon activities in the Philippines and the South China Sea, and the rare event of a tropical cyclone hitting southern Viet Nam and southern Thailand in early November 1997. The low typhoon frequency in the Philippines led to drought conditions which were also observed in neighboring countries. Many of these features had also taken place during the previous El Niño event in 1982-83, which pointed towards a strong likelihood that the abnormal pattern of typhoon occurrence in 1997 was related to major shifts in the regional circulation associated with the on-going El Niño event.

79. The Committee noted with interest the actions taken by the National Meteorological Service in the Philippines to alert the government to the occurrence of El Niño and its associated impacts and commended the Philippine government for taking effective responsive actions to reduce damage and save lives.

80. Noting the considerable impact of the extraordinary typhoon season on the population in the region, the Committee urged Members to strengthen the routine monitoring of the state of the atmosphere, in particular upper-air ascents in the tropical region, so as to allow early detection of El Niño and associated circulation patterns and continuous monitoring of their evolution once El Niño has started. The Committee also attached great value to observations of rainfall and other hydrological parameters and

encouraged hydrological services in the region to contribute towards the detection and monitoring of El Niño condition.

81. The Committee urged NMHSs in the region to establish and strengthen their capability to advise their governments on national and regional climate impacts associated with El Niño and other phenomena of similar time and spatial scales including strong winds and rough seas. The Committee further encouraged Members to exchange speedily among themselves making use of telecommunication facilities like telephone, fax and e-mail, relevant meteorological and hydrological information once the occurrence of El Niño was detected or suspected. The Committee requested its network of focal points and correspondents to step up their liaison work in this connection. The highlights of information must be sent to the Members by fax in the first instance or as soon as possible.

82. Also in this connection, the Committee requested Members to step up their efforts in studying short-term climatic fluctuations associated with El Niño and in enhancing their capability and coordination in respect of the forecasts and warning of related disastrous weather conditions. On research, Members were encouraged to conduct statistical studies to evaluate the impact of El Niño in both meteorological and human-related terms, such as the changed regional typhoon pattern over a time scale of several months. Furthermore, the Committee felt that from the disaster prevention and preparedness point of view, much could be learnt from case studies of past El Niño events, particularly with regard to the response of governments and the community. Members were encouraged to locate such past studies if available, and make use of them.

83. The Committee considered it very important that NMHSs should make use of the best available data to establish a scientific assessment of the impact of El Niño, especially the disruption in the pattern of typhoon occurrence on their weather. The Committee emphasized that this assessment should be communicated to the public in clear layman terms.

84. The Committee pointed out that El Niño presented a new and challenging problem to NMHSs in the region and that the fulfillment of the new service requirements would require considerable input of resource. The Committee therefore called upon governments in the region to provide sufficient financial and organizational support to meteorological, hydrological and disaster management services and others concerned, so as to ensure that an adequate level of monitoring and research activity is maintained. International funding agencies were also invited to give positive consideration to requests for support from Members to strengthen their preparedness capability in this subject area.

Hydrological Component

85. The Committee adopted the following recommendations which had been proposed by the meeting of the hydrologists for implementation:

i) The Members were encouraged to establish a homepage of their national hydrological service similar to the homepage of National Meteorological Services of some Typhoon Committee Members.

ii) The TCS Hydrologist to evaluate the requirements of the Typhoon Committee Members as soon as possible and formulate proposals for future activities under the hydrological component.

iii) A project on debris flow and land-slide forecast and warning system in the Typhoon Committee area be formulated into a project document by ESCAP. The project document is to be submitted to WMO for consideration 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".

iv) To continue to seek the use of the TCTF to supplement TCDC funds for attendance at workshops and seminars in the region. In this regard, it was recommended that experts in hydrology should visit Viet Nam under a TCDC arrangement to assist in improving the country's hydrological service.

v) To continue sending promotional material to ESCAP and WMO for organization of the World Water Day and IDNDR Day (March and October, respectively, each year).

86. The Committee noted the interest given by the Members in expanding the Committee's hydrological activities beyond flood management to cover also the subject of water availability. This was considered to be very appropriate, in view of the importance of typhoons in the region as a major cause of rainfall. However, it should also be ensured that the Committee confined its activities within its mandate, and did not duplicate the activities which are already being undertaken in the region by other agencies.

87. The Committee noted with concern that climate change and the El Niño phenomenon could possibly affect the frequency and severity of typhoons. The Committee also noted the potentially devastating effect of a dramatic reduction in frequency in typhoons if this led to a major reduction in rainfall and hence availability of freshwater resources.

88. The Committee encouraged its Members to look into this matter and thus to provide what might be seen as a more balanced view of the role of typhoons in the life and economy of the region, and to make further benefit from the programmes and activities of WMO and ESCAP in this respect.

Disaster Prevention and Preparedness Component

89. The Committee was informed by the representative of ADPC of the Workshop for Asian Media (El Niño Emergency Management) which will be held in Bangkok, Thailand from 26 to 30 January 1998. The workshop will mainly be information sharing on the El Niño and will be attended by experts coming from various countries. This workshop is sponsored by ADPC in co-operation with NOAA. The Committee expressed its gratitude for the invitations which the ADPC will be sending out to Members.

Research Component

90. The Committee adopted the recommendations of the TRCG given in Appendix XVI.

91. The Chairman of the TRCG informed the session that the group will keep the research correspondents of the Typhoon Committee informed on the activities of the TRCG.

92. The Committee agreed on the suggestion of the WMO representative that the first meeting of the TRCG be held in conjunction with the Comparison of Mesoscale Prediction and Research Experiment (COMPARE) meeting scheduled in 2000 in Tokyo, Japan.

93. The Members of the Committee expressed their support to the South China Sea Monsoon Experiment (SCSMEX), the field phase of which is scheduled to take place in 1998. In this connection, the delegate from the Republic of Korea informed the session that the KMA would carry out an intensive monsoon experiment, namely Korea Monsoon Experiment, in association with the SCSMEX during the same period.

94. The Committee encouraged the attendance of typhoon experts of the Typhoon Committee Members and TRCG members in the forthcoming International Workshop on Tropical Cyclones (IWTC-IV) to be held in Haikou, Hainan province, China from 21 to 29 April 1998.

95. The Committee expressed its appreciation to the representative of the National Hurricane Center (NHC), for the presentation on the impact of dropsonde data in numerical hurricane prediction modelling at the NHC.

Training Component

96. The TCS informed the Committee of the postponement of the proposed Regional Training Workshop on Doppler Tropical Cyclone Radars which was agreed upon during the Second Joint Session of the Panel on Tropical Cyclones and the Typhoon Committee held in Phuket, Thailand in February 1997. The proposed workshop was scheduled to be held in Hua Hin, Thailand from 14-17 April 1998. The Committee invited Thailand to consider the possibility of hosting the workshop in 1999.

97. The delegate from China informed the Committee that an International Training Course on Satellite Meteorology will be held in Regional Meteorological Training Centre (RMTC) Nanjing, China on September or October 1998. This activity is within the TCDC programme of China and thus the domestic costs will be provided by the host country, Typhoon Committee Members were encouraged to send participants to the forthcoming training course.

98. The delegate from Japan informed the Committee that the International Training Seminar on Tropical Cyclones will be held in Tokyo, Japan from 12 to 30 January 1998. Five participants will come from Typhoon Committee Members.

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

i) Arrangements for the Typhoon Committee Secretariat

99. The Committee expressed its gratitude to the Government of the Philippines for hosting the TCS and for providing a full-time meteorologist and a part-time expert on disaster prevention and preparedness.

100. The Committee expressed its gratitude to Dr. Roman L. Kintanar in his capacity as TCS Coordinator for the dedication and continued services extended by him.

101. The Committee also expressed its appreciation to the Government of the Republic of Korea for providing the services of a hydrological expert to the TCS.

102. The Committee approved the continuation of funding for operating costs of TCS, including the support for the TCS Coordinator from the TCTF (see paragraph 109 (a)).

ii) Technical Cooperation

WMO Voluntary Co-operation Programme

103. The Committee noted the status of the WMO Voluntary Cooperation Programme (VCP). The Members were encouraged to update their requests for VCP assistance to WMO.

ESCAP

104. The Committee was informed that, within the framework of its own programme of work, ESCAP would continue to undertake activities in support of the Typhoon Committee. These may include implementation of projects on substantive issues relating to mitigation of damage from typhoons, floods and droughts in Asia and the Pacific. The project proposal on flood loss reduction at large cities had already been formulated and submitted to potential donor countries for consideration for funding. The Committee appealed to donor countries and agencies to provide adequate extrabudgetary support to ESCAP for implementation of activities on natural disaster reduction.

105. The Committee was pleased to note that ESCAP had continued to provide advisory services in the field of water resources planning and development, including flood loss prevention, through its regional adviser. The Committee advised its Members to make more use of such services, which were rendered free of charge on request and also to take better advantage of the TCDC programme for the exchange of expertise on the various aspects of natural disaster reduction. In this regard, it was agreed by the Committee to approach ESCAP to utilize the TCDC funds for exchange of hydrologists between some developing countries among the Members of the Typhoon Committee and Viet Nam. In this regard, China and Malaysia kindly offered to provide the hydrological experts. Viet Nam should formally approach ESCAP for this purpose.

iii) TCTF

106. As requested during the last session, the WMO Secretariat presented to the session a more detailed breakdown of expenses of the TCTF. The Committee requested that the Secretariat continue to submit detailed financial reports in the future to ensure transparency in the use of the fund.

107. The Committee reviewed the financial report on the TCTF and the balance of the fund as of 31 August 1997 as shown in Appendix XVII.

108. The Committee was pleased to note that a certain degree of self-reliance had been achieved. The Committee urged its Members to continue to enhance their contributions to the Trust Fund as a substantial support to the Committee's activities.

109. The Committee after careful consideration agreed to the use of the TCTF for the following purposes from 1 January to 31 December 1998.

(a) Operating costs of TCS, including the support for the TCS Coordinator (total of about US$ 31,000);

(b) Publishing the Typhoon Committee Newsletter No. 10 (about US$ 1,400);

(c) Printing and distribution costs of the publication of Typhoon Committee Annual Review 97 (500 copies) (about US$ 5,000);

(d) Augmentation of travel funds for TCS staff mission, including attendance at the Thirty-first session of the Typhoon Committee (US$ 9,000);

(e) Support for attendance of typhoon experts and TCS Meteorologist at the Fourth WMO/ICSU International Workshop on Tropical Cyclones (Haikou, China, 21-29 April 1998) (US$ 19,000).

(f) Support for attendance of participants to the International Training Course on Satellite Meteorology (Nanjing, China, September or October 1998) (US$ 5,000).

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

110. Noting the current financial situation in the Typhoon Committee region and the financial difficulties in most of the Members, the Committee expressed its concern to optimize the use of the TCTF. It therefore requested the WMO Secretariat, in collaboration with the TCS to further explore ways and means to economize and increase the effective use of the TCTF.

iv) TCDC

111. The Committee noted the importance of TCDC as a means of promoting and strengthening collective self-reliance among developing countries through the exchange of experiences, pooling of resources, sharing of technical capabilities and development of

complementary capabilities. The Committee urged its Members to take an active part in this important activity.

112. The Korea Meteorological Administration expressed its readiness to share its development experiences with other Typhoon Committee Members. In this connection, the Korean delegation suggested utilizing the overseas-aid program organized by the Korea International Cooperation Agency (KOICA), in case there are Members which want to get aid from the Government of the Republic of Korea. KOICA has been carrying out the survey for implementation of aid projects through the Korean diplomatic offices abroad every year. They suggested Members to contact the Ministry of Foreign Affairs or Korean Embassy in their country.

v) Bilateral assistance

113. The Committee reiterated the great importance attached to the assistance from developed countries to the Committee's activities on a bilateral basis.

vi) International/Regional Funding Agencies

114. The Committee noted with appreciation WMO activities towards approval of the regional project proposal entitled "Integrated System for the Mitigation of Typhoon, Flood and Environmental Disasters in the Western North Pacific Area". The ESCAP representative expressed the readiness of ESCAP to actively participate in the project in cooperation with WMO.

IX. DATE AND PLACE OF THE THIRTY-FIRST SESSION

115. The Committee discussed the organization of a special annual session to commemorate the year 2000 or the start of the millennium and requested the TCS to report on the preparation for the event in the next session.

116. The Committee encouraged its Members to consider hosting the thirty-first session in November/December 1998. Since no offer for hosting of the thirty-first session has been received, the date and place of the thirty-first session will be decided at a later date.

X. SCIENTIFIC LECTURES (Agenda item 10)

117. The following scientific lectures were presented:

(a) Relations between El Niño and the tropical cyclones in Western North Pacific Area

By: Mr Yan Hong (China)

(b) Low-level Wind Shear in Tropical Cyclones

By: Mr C.M. Shun (Hong Kong, China)

(c) The Warning Aspects of Landslips in Hong Kong

By: Mr W.K. Pun (Hong Kong, China)

(d) Introduction of Sediment Disaster in Japan

By: Mr R. Kikuchi (Japan)

(e) Development of Numerical Storm Surge Prediction Model

By: Mr Yuso Takigawa (Japan)

(f) Observations made in Hong Kong during the passage of Typhoon Victor on 2 August 1997

By: Mr S.T. Lai (Hong Kong, China)

(g) Objective Diagnosis of Binary Tropical Cyclone Interaction

By: Prof Russell Elsberry (USA)

118. The Committee expressed its thanks to the lecturers for their informative and useful lectures.

XI. ADOPTION OF THE REPORT (Agenda item 11)

119. The Committee approved the press release of the 30th session as shown in Appendix XVIII.

120. The Committee adopted the report of the session at 11:55 am on 1 December 1997.

XII. CLOSURE OF THE SESSION

121. The delegates from the Typhoon Committee Members, observers, representatives of ESCAP, WMO and TCS expressed their thanks and appreciation to the Government of Hong Kong Special Administrative Region for hosting the session. They also thanked Dr. H.K. Lam, Director of Hong Kong Observatory and his staff, in particular the local secretariat, for the excellent arrangements, generosity and hospitality extended to the participants and for their tireless efforts during the course of the session.

122. The delegate from the Republic of Korea informed the Committee that his government is considering the hosting of the 32nd session of the Committee in 1999 in Seoul in commemoration of the completion of the new building of KMA.

123. The session was closed by the Chairman at 12:30 pm.

APPENDIX I

LIST OF PARTICIPANTS

30th Session ESCAP/WMO Typhoon Committee
Hong Kong, China
25 November - 1 December 1997

MEMBERS OF THE TYPHOON COMMITTEE

CAMBODIA

Ms Vannareth SETH	Deputy Director Department of Meteorology

CHINA

Mr YAN Hong	Deputy Administrator China Meteorological Administration (CMA)
Mr QIU Guoqing	Director-General National Meteorological Center China Meteorological Administration (CMA)
Mr XIN Xianhua	Division Director International Cooperation Department China Meteorological Administration (CMA)
Mr LIU Jinping	Deputy Division Chief Water Information Center Ministry of Water Resources
Mr LIU Ying	Deputy Director Forecasting Office Zhejiang Meteorological Bureau
Mr YU Bo	Deputy Director Forecasting Office Jiangsu Meteorological Bureau
Mr DUAN Yihong	Deputy Director Shanghai Typhoon Institute Shanghai Meteorological Bureau
Ms TIAN Cuiying	Deputy Division Director Department of Operational Development and Weather China Meteorological Administration (CMA)

HONG KONG, CHINA

Dr H K LAM	Director Hong Kong Observatory
Mr C Y LAM	Assistant Director Hong Kong Observatory
Dr B Y LEE	Senior Scientific Officer Hong Kong Observatory
Mr H G WAI	Senior Scientific Officer Hong Kong Observatory
Mr C C CHAN	Senior Scientific Officer Hong Kong Observatory
Mr S T LAI	Senior Scientific Officer Hong Kong Observatory
Mr LUK Wai-hung	Staff Officer Auxiliary Medical Service
Mr LAU Ting-leung	Senior Operations & Training Officer Auxiliary Medical Service
Mr HO Kam-tim	Senior Operations & Training Officer Auxiliary Medical Service
Dr Richard PANG	Government Geotechnical Engineer Geotechnical Engineering Office Civil Engineering Department
Mr W K PUN	Senior Geotechnical Engineer Geotechnical Engineering Office Civil Engineering Department
Mr John NG	Government Security Officer Security Bureau
Mr Simon TAM	Assistant Secretary Security Bureau
Ms Judy CHUNG	Home Affairs Department
Mr Y Y CHAN	Senior Engineer Drainage Services Department
Mr WONG Shut-yung	Principal Operations and Training Officer Civil Aid Service

JAPAN

Mr TAKIGAWA Yuso	Director-General of the Forecast Department Japan Meteorological Agency
Mr KIKUCHI Ryosuke	Deputy Director Disaster Management Division River Bureau, MOC
Mr HIMUKAI Hiromoto	Section Chief Disaster Prevention Coordination Division Disaster Prevention Bureau National Land Agency

LAO PEOPLE'S DEMOCRATIC REPUBLIC

Mr Thongphou VONGSIPRASOM	Director-General Meteorological and Hydrological Department Ministry of Agriculture and Forestry

MACAU

Mr FONG Soi Kun	Subdirector Servicos Meteorologicos e Geofisicos
Mr Antonio VISEU	Head of Meteorological Division Servicos Meteorologicos e Geofisicos
Mr Oscar Antonio GOMES DA SILVA	Secretary General Security Coordination Office
Mr LEONG Iok Sam	Security Coordination Office Assistant Security Coordination Office
Mr HAO I Pan	Meteorologist Servicos Meteorologicos e Geofisicos

MALAYSIA

Dr LIM Joo Tick	Director-General Malaysian Meteorological Service
Mr CHONG Sun Fatt	Assistant Director Hydrology Division Department of Irrigation and Drainage

PHILIPPINES

Mr Fortunato M DEJORAS	Administrator Office of Civil Defense and Executive Officer, National Disaster Coordinating Center

REPUBLIC OF KOREA

Dr MOON Sung Euii	Administrator Korea Meteorological Administration (KMA)
Mr PARK Kwang Joon	Senior Forecaster Korea Meteorological Administration (KMA)

SINGAPORE

Mr LAM Keng Gaik	Head Main Meteorological Office

THAILAND

Dr Patipat PATVIVATSIRI	Deputy Director-General Thai Meteorological Department
Mr Pricha RAKSKHID	Deputy Director-General Department of Local Administration
Mr Weera CHAIPIMOLPALIN	Directorof Civil Defence Division Department of Local Administration
Mr Chainarong VASANASOMSITHI	Chief of Civil Defence Planning Section Department of Local Administration

VIET NAM, SOCIALIST REPUBLIC OF

Dr NGUYEN Cong Thanh	Deputy Director-General Hydrometeorological Service of SR Viet Nam
Prof LE Bac Huynh	Deputy Director National Center for Hydrometeorological Forecasting Hydrometeorological Service of SR Viet Nam
Mr NGUYEN Dai Khanh	Senior Expert International Cooperation Department Hydrometeorological Service of SR Viet Nam
Dr DOAN Ngoc Dung	Deputy Chief of Planning Division Department of Dyke Management and Flood Control

OBSERVERS

BRUNEI DARUSSALAM

Mr ABD LATIF Haji Abdullah	Meteorological Technical and Coordinate Officer Brunei Meteorological Service Department of Civil Aviation
Mr KOO Chin Fah	Meteorological Officer Brunei Meteorological Service Department of Civil Aviation

UNITED STATES OF AMERICA

Mr Jerry D JARRELL	Acting Director National Hurricane Center National Weather Service National Oceanic and Atmospheric Administration (NOAA) Department of Commerce
Lt Col Mark J ANDREWS	Director Joint Typhoon Warning Center
Mr Frank H WELLS	Technical Advisor Joint Typhoon Warning Center

UNITED NATIONS BODIES

INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION (IDNDR) SECRETARIAT/DHA

Mr John William BARRETT, AFSM.	Executive Director Asian Disaster Preparedness Center (ADPC) c/o Asian Institute of Technology (AIT)

SPECIALIZED AGENCIES

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

Dr Edward P. LYSAKOV	Technical Officer, Meteorology ICAO Regional Office, Bangkok

OTHER ORGANIZATIONS

WMO COMMISSION FOR ATMOSPHERIC SCIENCES (CAS)

Dr Russell L ELSBERRY	Professor of Meteorology Naval Postgraduate School Department of Meteorology
Dr Greg HOLLAND	Bureau of Meteorology Research Centre, Melbourne

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

Mr Guangchang SHI	Director Environment and Natural Resources Management Division ENRMD, ESCAP
Mr Cengiz ERTUNA	Chief, Water Resources Section Environment and Natural Resources Management Division United Nations ESCAP

WORLD METEOROLOGICAL ORGANIZATION (WMO)

Mr Eisa Hussain AL-MAJED	Director Regional Office for Asia and the South-West Pacific
Mr Katsuhiro ABE	Chief, Tropical Cyclone Programme Division WWW Department, WMO

TYPHOON COMMITTEE SECRETARIAT (TCS)

Dr Roman L KINTANAR	Coordinator Typhoon Committee Secretariat
Ms Nanette C LOMARDA	Meteorologist Typhoon Committee Secretariat
Mr Han-Se LEE	Hydrologist Typhoon Committee Secretariat

LOCAL SECRETARIAT

Mrs Elaine KOO	Assistant Director Hong Kong Observatory
Dr W L CHANG	Senior Scientific Officer Hong Kong Observatory
Dr C M TAM	Senior Scientific Officer Hong Kong Observatory
Mr W K KWAN	Principal Experimental Officer Hong Kong Observatory
Mr Dickie CHAN	Scientific Officer Hong Kong Observatory
Mr David HUI	Scientific Officer Hong Kong Observatory
Mr H P CHAN	Senior Experimental Officer Hong Kong Observatory
Ms Joly HO	Senior Experimental Officer Hong Kong Observatory
Ms Karen SHUM	Experimental Officer Hong Kong Observatory
Ms Sara WONG	Experimental Officer Hong Kong Observatory
Ms Eliza CHAN	Experimental Officer Hong Kong Observatory
Ms Candy CHIU	Senior Scientific Assistant Hong Kong Observatory
Mr K M LEUNG	Senior Scientific Assistant Hong Kong Observatory
Mr M S CHAU	Scientific Assistant Hong Kong Observatory
Ms P Y YEUNG	Scientific Assistant Hong Kong Observatory

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APPENDIX II

AGENDA

1. Opening of the session.
2. Election of officers.
3. Adoption of the agenda.
4. The Committee's activities during 1997:
   (a) Meteorological component;
   (b) Hydrological component;
   (c) Disaster prevention and preparedness component;
   (d) Training component;
   (e) Research component.
5. Review of the 1997 typhoon season/annual publications.
6. Coordination with other activities of the WMO Tropical Cyclone Programme.
7. Programme for 1998 and beyond.
8. Support required for the Committee's programme.
9. Date and place of the thirty-first session.
10. Scientific lectures.
11. Adoption of the report.

APPENDIX III

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

In **CAMBODIA,** the Department of Meteorology in 1997 continued to devote considerable efforts to improve its public weather services through timely warning and intensive public information.

Currently, the government is unable to rehabilitate the weather service and neither are there any organization who had manifested interest in this sector which had hampered efforts to achieve and sustain socio-economic growth.

A ground meteorological satellite receiving station was installed by Tecnavia S.A. in 1997. The system was in full real-time operation for reception and display of SOUS and APT data from meteorological satellites by mid-year.

In **CHINA,** it's first geostationary meteorological satellite, FY-2 was launched on 10 June 1997. It had been located above the equator at 105°E since 17 June. The first visible image was received on 21 June while the first infrared and water vapor images were received on 13 July. The main payload of FY-2 is a Visible and Infrared Spin Scan Radiometer (VISSR) and a multi-functional communication subsystem. It is a spin-stabilized satellite rotating at 100 rpm. The FY-2 has the following functions:

- obtaining visible, infrared and water vapor cloud images by a radiometer on board. Sea surface temperature, cloud analysis chart, cloud parameters and wind vectors can be derived from these data.
- collecting and transmitting observed data from widely dispersed data collection platforms.
- broadcasting S-VISSR data, WEFAX and S-FAX
- monitoring space environmental from satellite

Since the characteristics of the FY-2 S-VISSR data signal are very close to those of the GMS S-VISSR data except for the frequency, the user stations receiving the latter data can receive the former by changing the antenna position and frequency of local oscillator. After being put into operation, FY-2 will take hourly observations from 00 min to 30 min while GMS from 30 min to 00 min. The functions of FY-2 includes S-VISSR and LR-FAX. The products derived by FY-2 such as cloud motion wind, SST, OLR and UTH will be transmitted through the GTS.

Two S-band Doppler weather radars (714SD) developed by China and which has been operational since 1996 in Shantou and Xiamen, continues to play a vital role in monitoring the formation, development and movement of tropical cyclones and provide scientific data for designing hydrotechnical projects and organizing flood control activities.

In 1997, more than 400 evaporating dishes were replaced by E-601 evaporation pans with diameters of 618 mm in the national basic stations of China. The third round of the operational testing of automatic weather stations was completed in March 1997 and results showed significant improvement in the quality and operation of the equipment developed by Chinese scientists.

The PC computer software for surface observations, developed by the Meteorological Bureau of Anhui Province, was likewise successfully tested in 1997.

On 1 July 1997, the Atmospheric Observing Experimental Base of the China Meteorological Administration (CMA) was established in the Beijing Meteorological Bureau which would serve as the laboratory for the operation, research and testing of equipment.

Also in 1997, a new C-band radar for upper-air sounding and wind-finding was installed and tested in Hohhot station and is now ready for operational use. Meanwhile, the project for developing an L-band radar and radiosonde system is in the process of inviting tenders.

Since 1996, about 97% of observations at the prefectural level throughout China have already established a computer information network system and about 72% of country stations are equipped with PC-computer terminals linked with the meteorological information service.

In order to support high speed data transmission among each meteorological service level, CMA is developing a dedicated nationwide satellite communication network. The entire system is composed of three subnetworks namely:

- satellite data network - works as a multi-port bridge, which connects the LAN computer of CMA's National Information Control Center with over 300 LAN's (regional, provincial and prefectural level) into a WAN.
- satellite voice network - whose topology is mesh. Any VSAT station can talk with other stations directly in the one-hop mode. The network uses DAMA/SCPC.
- satellite broadcast network - mainly used for grass root weather services and a variety of special weather stations to broadcast weather information. It is a one-way system with speeds varying from 9.6 kbps to 2048 kbps depending on the requirement of the weather services.

Once the whole network is established, the timeliness of weather information and the transmission capacity will be significantly raised and it is expected to provide meteorological services at different levels with much faster and more efficient information services.

In 1997, CMA established connection with the Internet via the China GoldBridge network and had built its homepage: HTTP://WWW.CMA.GO.CN.

In 1997, the National Meteorological Center (NMC) developed a high resolution (50 km interval) nested typhoon model, in which the complex physical processes (similar to Australia's TASP model) was employed. The new model's forecasting error was reduced by about 15% compared with the old one. Improvement was mainly due to the physical parameterization scheme.

In Guangzhou's Regional Meteorological Center, a new typhoon forecast system was also installed. A bogus typhoon vortex was merged in the model's initial field to improve the typhoon analysis over the data sparse ocean area. Currently, the system is able to forecast the tracks of tropical cyclones over the South China Sea and had proven to forecast some complicated tracks successfully.

Aside from a typhoon model, the Shanghai Typhoon Institute also developed a storm surge model to forecast the water level in the East China Sea.

The typhoon objective prediction techniques used in China had improved recently and were installed into a work station integrated with a warning system. This made the typhoon operational automated forecasting and warning system more systematic, platform-utilized and standardized than in previous years. The operational platforms were established in China's three levels (i.e. national, regional and provincial). A new typhoon positioning system was also established in China in 1997.

On 6 August, the NMC started issuing forecasts and warnings for Typhoon Winnie (9713) at least thrice daily through the Central Broadcasting Station and the CCTV. Updated forecasts were made available to the central and local government at various levels either through telephones or written messages.

The Guangdong Meteorological Bureau provided the Guangdong Broadcasting Station with typhoon forecasts and warning every 30 minutes before the landfall of Typhoon Zita (9715) in August.

To provide better public services and enhance public awareness and capabilities of typhoon preparedness and disaster prevention, the NMC opened a new daily weather forecast programme on tropical cyclones at 7:20am on 5 May.

Lastly, the CMA had further enhanced the capability of the meteorological information system of the State Council to better improve the decision making capability of its leaders in combating typhoons and disasters.

In the **DEMOCRATIC REPUBLIC OF KOREA,** the State Hydro-Meteorological Administration started in 1996 to reorganize the structure of the Central Forecast Institute (CFI) and established a new Numerical Weather Prediction (NWP) research team to improve NWP.

They had started on a research project to improve the short-range NWP model currently in use at the CFI and develop a new very short and medium-range NWP model which will be put into operation by 1999. At present, the area of the short-range forecast model is 4000~3000 km, grid interval is 100 km with 10 vertical levels.

Also in 1997, the CFI had succeeded in displaying forecast fields of some 20 physical quantities in animation every 3 hours.

The Maritime Forecast Laboratory of the CFI improved its two-dimensional NWP wave model and introduced it in its operational wave forecasting system in 1996. The area includes the West and East Seas of Korea and resolution is 100 km.

In **HONG KONG, CHINA,** the Observatory's Dial-a-Weather Service continued to enjoy tremendous popularity among the local public. The service was further enhanced in 1997 with the addition of 30 more telephone lines making a total of 155 lines altogether. The number of calls handled on a daily basis averages about 60,000 and the 12-month total up to end of September 1997 was about 22.1 million. A trial Putonghua channel was introduced in July.

In early 1997, a new wind finding system based on Global Positioning System (GPS) technology replaced the OMEGA based upper air sounding system. The new system gave a better capture rate particularly during adverse weather conditions.

After completion of system optimization in early 1997, a Terminal Doppler Weather Radar (TDWR) system was put into operations for the detection and warning of low-level wind shear associated with convective storms in the vicinity of the new airport at Chek Lap Kok.

An Aerodrome Meteorological Observing System (AMOS), an integrated system with meteorological sensors, data processors and displays was installed a the new airport in April 1997. Real-time data could be transmitted to forecasters, observers and air traffic controllers.

A second boundary layer wind profiler was installed at Sha Lo Wan near the new airport for detecting vertical winds and wind shear. The data collected was also found to be very useful for depicting winds associated with tropical cyclones and severe weather.

A Wind shear and Turbulence Warning System (WTWS) was developed for the detection of Terrain Induced Wind shear and Turbulence at the new airport.

An additional ground station for the reception of World Area Forecast System (WAFS) satellite broadcast from the World Area Forecast Centre at Kansas City (formerly at Washington) was being installed at the new airport.

An aviation Meteorological Data Processing System (METPS) was being installed at the new airport to facilitate dissemination of meteorological information to air traffic service units and airlines.

Planning for a new ground station for the reception of images from FY-2 had started.

In **LAO P.D.R.,** two automatic weather stations were installed in 1997 and plans are underway for the establishment of a telecommunication circuit between Hanoi and Vientiane.

Also in 1997, a satellite receiver which provides LRFAX was installed in the forecasting center in Vientiane through the VCP of WMO.

In **JAPAN,** the GMS-5, operational since 13 June 1995, continues to perform satisfactorily three major missions namely:

- VISSR observations producing 28 full-disk images per day
- dissemination of cloud images
- collection of meteorological data

With regard to data collection, 36 Data Collection Platforms of Typhoon Committee Members (other than Japan) are currently registered.

With the scheduled launching of a multi-purpose geostationary satellite (MTSAT) in the summer of 1999, the Japan Meteorological Agency (JMA) sent the specification of the High Resolution Imager Data (HiRID) and the Low Rate Information Transmission (LRIT) to Medium-scale Data Utilization stations/Small-scale Data Utilization stations users and relevant NMHSs on 1 September 1997. The present WEFAX service will be continued until the end of March 2003.

In February 1997, the operation of the RS2-91 radiosonde commenced at Ishigakijima (47918). The deployment program of the RS2-91 at 18 upper-air stations was completed at this commencement.

All of the 19 meteorological radars operated by JMA are now equipped with the Radar Echo Digitizing System (RESDIS). This system digitizes observed echoes and transmits them to the JMA Headquarters and to its local offices on a real-time basis.

JMA had started a program of installing a new system, REDIS-NEXT, at each of 5 District Meteorological Observatories (DMO). The REDIS-NEXT is an integrated system that enables each DMO to remotely control the radars in its responsible area and to monitor the radar-composite echo distributions at 5 vertical levels and of the vertically integrated liquid.

The Tokyo DMO was the first Observatory to install REDIS-NEXT: The Observatory started from March 1997 to remotely control four radars (Niigata/Yahikoyama (47572); Fukui/Tojombo (47705); Nagoya (47636) and Tokyo/Kashiwa (47695)). The next DMO to do this will be the Sendai DMO which will remotely control radars at Akita (47582) and Sendai (47590).

In 1997, JMA implemented 5 cruises in the typhoon-genesis area of the western North Pacific Ocean. The Ryofu Maru, the Keifu Maru and the Chofu Maru monitored seasonal-to-interannual variations of the oceanographic structure in the western tropical Pacific waters. The Keifu Maru made both marine meteorological and oceanographic observations of the sub-surface layer in the seas south of Okinawa in September.

JMA installed in March 1997 new tide gauges at 11 sites including Minamitorishima (47991). It is worthy of note that Minamitorishima is capable of monitoring the tsunami phenomena propagating from the central Pacific and detecting the sea level fluctuation that may be a result of climate change in the western North Pacific ocean basin.

JMA is currently making tidal observations at 84 tide stations. Tide gauges used are a float type for 73 stations, an acoustic type for 10 stations and a pressure type for one station.

The following GTS telecommunication circuits was strengthened in 1997:

- Tokyo-Seoul circuit (upgraded in March 1997) from 9600bps to 64kbps with X.25 protocol
- Tokyo-Beijing circuit (enhanced by end of 1997) from 9600bps to 64kbps with X.25 protocol
- Tokyo-Khabarovsk circuit (by end of 1997 will introduce a digital multiplexing scheme) with speed of 9600 bps with X.25 protocol
- Tokyo-Bangkok (upgraded by end of 1997) from 1200bps to 9600bps with X.25 protocol

With regard to typhoon forecasting, JMA is currently operating two models namely:

- Global Spectral Model (GMS) with a horizontal resolution of T213 (equivalent to 55 km grid) and 30 vertical levels. It conducts 84-hr and 192-hr predictions from 00 and 12UTC respectively.
- Typhoon Model (TYM) with 40 km horizontal grid and 15 vertical levels. It conducts 78-hr predictions from 06 and 18UTC.

An asymmetric bogus data serves as input to both models. A recent verification study made by WMO/CAS/JSC WGNE demonstrated that the performance of the typhoon predictions using global models in 1996 were almost the same among the three centers: ECMWF, UKMO and JMA with mean errors of central forecast positions of approximately 150km for 24-hr forecast, 250km for 48-hr forecast and 350km for the 72-hr forecast.

JMA had started to develop a method to incorporate satellite altimeter data into the Ocean Data Assimilation System, operational since 1995, to further improve the system. The system monitors El Niño events and generates initial conditions for El Niño predictions with a numerical model. A development of the coupled ocean-atmosphere model has continued during 1997 with emphasis on the study of its hindcast skill. The skill of the model for 25 hindcasts, for the period 1986 to 1992, were examined. The correlation coefficient between the predictions of sea surface temperature anomaly in the area of interest and the actual anomaly is around 0.6 for the 6-month predictions and above 0.5 for the 12-month predictions.

In **MACAU,** preparations for the development of a mesoscale prediction model commenced in 1997.

A powerful computer system was installed in the SMG's new headquarters on Taipa Island, on July 1997. The system includes an SGI 0200 server and an SGI 02 workstation. The SGI 0200 server has a dual CPU configuration, two 180Mhz R10000 MIPS CPU with 192Mb memory. The SGI 02 is a graphical workstation with 180Mhz R5000 MIPS CPU and 64Mb memory. The mesoscale prediction model is designed to run on the 0200 server while the 02 workstation will be used for the display of output data in graphical interface. Vis5D and GrADS were chosen to display the products.

Two graphics presentation applications to display and print ECMWF and JMA model products are currently in use at the Weather Monitoring Watch Centre.

The plans for acquiring the satellite images from FY-2 had started.

Currently being installed are the three Automatic Particulate Analysers for ISP ($d < 10\mu m$), which will be the first stage of the Macau Air Quality Monitoring Network.

In the process of upgrade is SMG's telephone weather information system which will involve the addition of a fax server for the acquisition of the latest weather information and the addition of 14 more telephone lines. With the upgrade, weather information will be available in three languages (Portuguese, English and Chinese (both in Cantonese and Mandarin).

A new version of the Computer Weather Dissemination System was developed during the year which will automatically update satellite images, radar echo images and warnings at 3 hourly intervals during adverse weather situations in the Macau region.

The SMG now has a homepage (http:www.smg.ctm.net) in the Internet which provides weather forecasts, climatological data, warnings, actual weather situations and some facts about Macau's meteorological services.

In **MALAYSIA,** the installation of the meteorological data processing facilities at the new Kuala Lumpur International Airport, Sepang, will be completed in November 1997. Meanwhile, the installation of the Terminal Doppler Weather Radar has been unduly delayed due to problems in land acquisition. The meteorological system is expected to be fully operational by March 1998 and will complement the existing forecasting capabilities of the Malaysian Meteorological Service.

In October 1997, all the 8 upper-air stations have been upgraded to handle GPS sondes.

In the light of the experience gained from Tropical Storm "Greg" (9627), a newly devised warning system for strong wind, moderate to heavy rainfall with or without the presence of tropical cyclones over land/sea areas of Malaysia is being implemented in the 1997/98 Northeast Monsoon.

In **PHILIPPINES,** the PAGASA, submitted on September 1997, to the country's senate body its 6-yr modernization plan with the objective to modernize the agency with inputs from state-of-the-art instruments, equipment and facilities and the application of new technologies to strengthen its capability in providing timely and reliable forecasting and warning services throughout the entire archipelago.

The major activities of the modernization program includes the following:

- equipment and technology development
- telecommunication development
- establishment of regional service centers
- human resource and training facilities and development
- expansion and enhancement of public information service
- organizational re-structuring associated with modernization

One of the top agenda of the modernization program is for the Agency's services to go into regionalization. The concept of regionalizing its services follows the principle of the devolution of government functions to the countryside. Five strategically located existing PAGASA stations have been identified as the core stations that will be transformed into regional service centers. These centers will develop their own weather forecasting methods that will inherently be applicable to their respective regions and will undertake regional activities relating to weather observations, analysis, forecasting and warning of natural hazards in their area of responsibility.

The Meteorological Service to the Countryside Project (EMDSC), under the 1992-94 Philippine-France Financial Protocol, had successfully completed its first phase and is now on its second phase. It highlights the installation of the following:

- a SYNERGIE forecaster's workstation and the map plotting system which automates weather map plotting analysis
- Integrated Runway Meteorological Observing System (IRMOS) for five domestic airports

The second phase of the project is expected to be completed in the year 2000.

A special task force was organized to address the effects on aviation of the smoke which resulted from the forest fires in Indonesia and which affected the southern part of the country in late September. It issued 5 special advisories on smoke which contained information on the current visibility condition of affected areas and an outlook for threatened and affected areas, updates regarding forest fires in Indonesia and identified smoke plumes moving towards the country.

The Agency has been closely monitoring the effects of drought in the country resulting from the El Niño phenomena. It issued and disseminated 10 Monthly Weather Situation Outlooks/Seasonal Climate Advisories/Drought Advisories. To fully address the problem, PAGASA became an active member of the following presidential task forces:

- Technical Working group on Water Resources Development & Management
- Presidential Task Force on the El Niño phenomenon

In the **REPUBLIC OF KOREA,** KMA deployed 3 discus-type buoys (diameter = 3km), two in the Yellow Sea and one in the sea south of the Korean peninsula, which transmits information on an hourly basis via Inmarsat or VHF communications.

KMA is promoting a plan to establish a video conferencing system using an ultra high-speed telecommunication network. This is to aid weather forecasting discussion among forecasters. The KMA entered into a purchasing contract with a manufacturing company on 9 August 1997 which will cost US$

877,778). Installation will begin mid-September 1997 and will be on operational test in October. Routine operation is expected to commence in November. The system will be established in 6 locations (i.e. 4 Regional Meteorological Offices, Cheju Meteorological Station and KMA headquarters). The images will consist of 30 fps and a bandwidth of 384 Kbps.

KMA's homepage (http://www.kma.go.kr) had more than 130,000 visitors from July 1996 to June 1997. There was a notable increase in the number of visits during the last days of June probably because of the bad weather brought about by Changma.

KMA currently maintains and operates 400 Automatic Weather Systems (AWS) which transmits data to the Local Acquisition Unit via a dedicated communication line equipped with modems (2400 bps). The data are then distributed to the Regional Offices and Meteorological stations as well as to the KMA headquarters. At present, the average acquisition rate of the AWS is about 92%. The analysis data are provided to the Internet as well as to the workstations. KMA is also developing plans to install a touch-screen terminal display of the analysis data at popular public places.

In addition to the existing dynamic typhoon model (KTM), two additional dynamic models have been implemented in 1997. These are the:

- Geophysical Fluid Dynamics Korea (GFDK) model
- Barotropic Adaptive grid Typhoon System (BATS).

KMA, also in 1997, developed a Typhoon Forecasting Graphic System (TFGS) which uses a SUN workstation and provides the forecaster with displays of numerical results produced by the dynamic models. The TFGS enables the forecaster to:

- view historical and real-time typhoon position
- plot forecast tracks for KTM, GFDK, BATS and GDAPS
- graphically construct maximum wind for 72-hr forecasts and deep layer wind at initial time for GFDK
- view accumulated precipitation for 72-hr forecast in Far East Asia or near the typhoon center for GFDK, every 12 hours
- view mean sea level pressure for GFDK, every 12 hours up to 72 hours.

In **SINGAPORE,** as part of the continuous effort to upgrade its services, the Singapore Meteorological Service (SMS), is in the process of acquiring a Boundary Layer Wind Profiler, which will be commissioned early next year. This is in effect a pulsed Doppler Radar, which uses the variation of the air's refractive index created by turbulence and water vapor content as tracers to determine the winds.

The installation of the SMS new S-band meteorological Doppler radar is in progress and should be completed by December 1997. It will replace and take over the weather watch functions of the current radar system at Singapore's Changi Airport. The new radar system is equipped with a klystrom transmitter tube capable of coherent pulses necessary for accurate velocity measurement. It would be able to provide low level wind shear and microburst information. In addition, with the long-range capability and powerful features, this radar will enable the SMS to monitor and forecast thunderstorms and mesoscale weather systems in the southern part of the South China Sea more effectively.

The SMS is currently implementing a Weather Information Dissemination System, which will integrate the existing Dial-A-Weather Forecast System (DAWF), METFAX Services and the aviation VOLMET Broadcast. There will be an overall improvement in efficiency and a better voice quality for the VOLMET and DAWF. The Public Weather Sub-System will include a voice and fax server which the public or other users can access to get the latest forecast products using telephone sets and facsimile machines.

Three atmospheric models and an ocean wave model are currently run operationally by the SMS. They are all adaptations of models from JMA. The average RMS MSL pressure errors for 1997 up to September for GSM were 2.8 hPa and 5.6 hPa for T+24 and T+48. Equivalent figures for the FLM were 2.8 hPa and 3.7 hPa respectively.

In **THAILAND,** the composited weather radar images which is linked via telecommunication satellite from 14 radar sites to the head office in Bangkok has been operational since September 1997.

The installation of an X-band Doppler weather radar will be completed by the end of 1997 at the Hat Yai International Airport.

The existing satellite receiving system (GSC-METPAK) at the TMD head office is currently being upgraded.

Under installation are 5 sets of Automatic Weather Observations Systems (AWOS) at five airfields (i.e. Nakhon Srithammarat, Krabi, Roi Et, Hua Hin and Narathiwat) in Thailand.

A project for a new broadcasting system for shipping is expected to be implemented by December 1997.

In the **SOCIALIST REPUBLIC OF VIET NAM,** 8 coastal stations were equipped with new anemometers in 1997. A network of 120 old wind observational instruments installed at islands and coastal stations were replaced by new digital anemometers (EL1) manufactured in China. Twenty digital pluviographs and 60 digital thermometers were installed during the year.

Three upper-air sounding systems were installed at Ho Chi Minh City (48900), Hanoi (48820) and Danang (48855) in 1997. The installation of a Doppler weather radar will be completed by the end of 1997 in Tamky Town in central Viet Nam.

The MDUS and HRPT receiving and processing system was successfully installed during the year at the National Center for Hydrometeorological Forecasting.

The Viet Nam HMS is planning to improve the data exchange between different departments especially the connection between the national center in Hanoi and 9 regional hydrometeorological centers.

APPENDIX IV

PROPOSALS FOR UPDATING OF THE TYPHOON COMMITTEE OPERATIONAL MANUAL - METEOROLOGICAL COMPONENT (1998 EDITION)

Proposal for Updating of the Typhoon Committee Operational Manual – Meteorological Component

Page	Line	Present Description	Proposal for Amendment
CHAPTER 1			
6	22	north of the equator	between 0°N and 60°N
CHAPTER 3			
12			<< REPLACE Table 3.1 by Annex A. >>
CHAPTER 5			
21		[Tokyo – Seoul] Cable, V.29 9600bit/s, 4800 bit/s (data) X.25 Level 3 +4800 bit/s (fax)	Cable, 64 kbit/s X.25 Level 3

<< The member name "Hong Kong" should be replaced by "Hong Kong, China" as follows. >>

Appendix 2–A p.1
Appendix 2–B
Appendix 2–E p.3
Appendix 2–G
Appendix 3–B p.5
Appendix 4–B p.5
Appendix 4–C p.1 (Member name)
Appendix 5–A p.1
Appendix 5–B

Appendix 2–A			
1	15	(45): 005	(45): 004
1	18		<< DELETE the station index number 47601.>>
Appendix 2–E			
4–6		[Member: Japan]	<< REPLACE each column of four stations as in Annex B. >>
Appendix 2–F			
1	4	the full disk data will be	the full disk data are
1	5	observation will be performed	observation is performed
1	8	observations will be disseminated	observations are disseminated
1	30	or (enhanced IR1)	or J (enhanced IR1)

Page	Line	Present Description	Proposal for Amendment
3		Fig.2-F.2 Four sectorized cloud images broadcast three hourly.	Fig.2-F.2 WEFAX IR four-sectorized image "A", "B", "C" and "D".
3			<< **INSERT** the followings. >> NOTE: "K", "L", "M" and "N" images are of the same size as IR four-sectorized image.
4		"I" and "J" images will be of	"I" and "J" images are of
Appendix 2-F, Annex			
1	9	data format will be assigned	data format are assigned
1	11	transmission rate will be fixed	transmission rate is fixed
1	14	will not be contained	are not contained
1	15	mapping by users will be inserted	mapping by users are inserted
1	16-17	(4) Detailed contents ... GMS system.	<< **DELETE** >>
1	20	56 dBm ±1.5 dB at a station	54.5 dBm at a station
2	2	Greater than 10.8 dB/°K	Greater than 10.4 dB/°K
2	4	Less than 72.9 dB/Hz	Less than 71.6 dB/Hz
2	16	S.VISSR data will be started	S.VISSR data is started
2	18	It will be maintained	It is maintained
Appendix 3-B			
1-4		[Member: China]	<< **REPLACE** the full description on p.1-4 by p.1-3 of **Annex C.** >>
17-18		[Member: unknown]	<< **DELETE** the full description on p.17-18 missing any connection. >>
Appendix 4-B		[Member: Hong Kong, China]	
5	Note	Royal Observatory	Hong Kong Observatory
Appendix 4-C		[Member: Hong Kong, China]	
1		VPS 1-2; VPS 8, VPS 35,60,80; VRN 35,60	VRX2, VRX8, VRX32, VRX62, VRX82

Page	Line	Present Description	Proposal for Amendment
Appendix 5-A			
1		[Member: China] Mr. Qiu Guoqing Director National Meteorological Centre China Meteorological Administration 46 Baishiqiao Load Western Suburb Beijing 100081	<< **REPLACE** by the followings. >> Telex: 222681 NMC CN Tel.: (+86) (10) 62172277 Ext.2615 Cable: 2894 Fax: (+86) (10) 62175928
1		[Member: Hong Kong, China] Public Weather Service Royal Observatory (Attn: B.Y. Lee)	 Central Forecasting Office Hong Kong Observatory Attn: B.Y. Lee
Appendix 7-A			
1	6	cloud mount (GMS).	cloud amount (GMS)
1	9	cloud mount:	cloud amount:
1	14	Microfilm (Datailed specification	Microfilm (Specification
1	20	Area covered by	Global area covered by
1	22-28	Surface : specific pressure levels (1000 – 10hPa): specific pressure levels (1000 – 300hPa):	<< **REPLACE** by the followings. >> sea surface pressure (Ps), temperature (Ts), dewpoint depression (Ts-Tds), wind (Us,Vs) geopotential height (Z), temperature (T), wind (U,V) dewpoint depression (T-Td)
1	29-30	for level II-b abd III-a are given	for level II-b are given
1			<< **INSERT** the followings here. >> Note : Level III-a data are available on CMT (36 TRK, IBM compatible). Details for data format are attatched on the CMT.
2			<< **REPLACE** by **Annex D.** >>
Appendix 7-A, Annex			
1	3	Level II-b and Level III-a are as	Level II-b are as
1	4	I) Level II-b data	<< **DELETE** >>
3-5			<< **DELETE** the full description on p.3-5. >>

Page	Line	Present Description	Proposal for Amendment
Appendix 7-B			
2	40-41	cards, diskettes, or magnetic tape.	diskettes.

Annex A

Table 3.1 Chart form output products transmitted by the RSMC Tokyo – Typhoon Center for regional purposes

(a) Analysis

Description of product		Observation time (UTC)
850 hPa	height	00, 12
	temperature	00, 12
	wet area (dew point depression)	00, 12
	streamline	00, 12
	wind arrow	00, 12
700 hPa	height	00, 12
	temperature	00, 12
	wet area (dew point depression)	00, 12
	pressure variation	00, 12
500 hPa	height	00, 12
	temperature	00, 12
	vorticity	00, 12
300 hPa	height	00
	temperature	00
	isotach	00
250 hPa	height	00, 12
	temperature	00, 12
	isotach	00, 12
200 hPa	height	00, 12
	temperature	00, 12
	isotach	00, 12
	streamline	00, 12
	jet stream axis	00, 12
tropopause		00, 12

(b) Forecast

Description of product		Forecast time
Surface	pressure	24, 36, 48, 72, 96, 120
Precipitation		24, 36, 48, 72, 96, 120
Surface wind arrow		24, 36
850 hPa	temperature	24, 36, 48, 72
	streamline	24, 48
	wind arrow	24, 36, 48, 72
700 hPa	wet area (dew point depression)	24, 36
	pressure variation	24, 36, 48, 72
500 hPa	height	24, 36, 48, 72
	temperature	24, 36, 72
	vorticity	24, 36, 48, 72
	isotach	24
250 hPa	height	24
	temperature	24
	isotach	24
200 hPa	streamline	24, 48

Some of them may be superimposed on one chart.

Annex B

Appendix 2-E, p.4 - p.6

Name of Member **Japan**

NAME OF STATION		Sapporo/ Kenashiyama	Sendai	Akita	Fukui/ Tojimbo
SPECIFICATIONS	Unit				
Index number		47415	47590	47582	47705
Location of station		43°08' N 141°01' E	38°16' N 140°54' E	39°43' N 140°06' E	36°14' N 139°09' E
Antenna elevation	m	**752.5**	99.4	56.8	107.0
Wave length	cm	5.65	5.67	**5.64**	**5.68**
Peak power of transmitter	kW	250	250	250	250
Pulse length	μs	**2.5**	**2.8**	2.6	**2.5**
Sensitivity minimum of receiver	dBm	**-111**	-113	-106	**-112**
Beam width (Width of over -3dB antenna gain of maximum)	deg	**1.07**(H) **1.10**(V)	1.3(H) 1.4(V)	1.4(H) 1.4(V)	**1.1**(H) **1.1**(V)
Detection range	km	300	300	300	300
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		2	2	2	2
DATA PROCESSING					
MTI processing 1. Yes, 2. No		1	1	1	1
Doppler processing 1. Yes, 2. No		2	2	2	2
Display 1. Digital, 2. Analog		1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		1	1	1	1
PRESENT STATUS 1. Operational 2. Not operational (for research etc.)		1	1	1	1

OPERATIONAL TYPHOON TRACK FORECAST METHODS USED BY TYPHOON COMMITTEE MEMBERS

Name of the Member **China**

Item	Method	Type of output
Name of the method	**Numerical Model of Typhoon Track Prediction (MTTP)**	12, 24, 36, 48, 60 and 72-hr forecast positions
Description of the method	a. Forecast domain of MTTP: 6.5625°N - 43.125°N, 101.25°E - 150.9375°E b. Vertical resolution: 15L(σ) c. Horizontal resolution: 0.46875°*0.46875° d. Differential scheme: Arakawa C-grid e. Time integration: Explicit scheme f. Physical processes: Large scale condensation Cumulus convection parameterzation (deep convection: Kuo-1974 scheme) (shallow convection: Tiedte(1987)) Radiation: Lacis et al(1974) Horizontal and vertical diffusion Modification of the moisture fields Surface physical processes Thermal conductivity under-ground g. Lateral boundaries: Davies scheme	

Name of the Member **China**

Item	Method	Type of output
Name of the Method Description of the Method	**Statistical dynamic method (SD-90)** a. Basic equations: $du/dt - fv = F_1$ $dv/dt + fu = F_2$ Where u and v are velocity components of typhoon centre; F_1, F_2 represent the mean effects of the pressure gradient and some other forces in the vortex area, given out by: $F_1 + b1^{(1)} + b2^{(1)}t + b3^{(1)}t^2$, $F_2 + b1^{(2)} + b2^{(2)}t + b3^{(2)}t^2$, Here $b\,i^{(j)}$ (i=1,2,3; j=1,2) represents 6 random variables, the 6 random variables in the basic equations are statistically obtained from samples over 30-year period (1961-1990). The 24-hr numerical forecast height values at 500 hPa are used as predictors. b. Domain: West of the Northwest Pacific area from 140°E c. Frequency of forecast: Twice a day 06Z, 18Z up to 72-hr	12, 24, 36, 48, 60 and 72-hr forecast positions

Name of the Member **China**

Item	Method	Type of output
Name of the method Description of the Method	**Consensus forecast method using the canonical correlation** a. Basic equations: $X = a_0 + \Sigma a_i x_i$ $Y = b_0 + \Sigma b_i y_i$ Where X and Y are longitude and latitude of forecast typhoon position, respectively. x_i and y_i (i = 1, 2, 3, 4) are forecast longitude and latitude obtained by four sub-models: Japanese numerical model, SD-85 method, CLIPER method and Shanghai Composite Statistical method. a_i and b_i (i=1,2,3,4) are regression coefficients obtained by canonical correlation method. b. Domain: West of the Northwest Pacific area from 140°E c. Frequency of forecast: Twice a day 06Z, 18Z up to 72-hr	12, 24, 36, 48 60 and 72-hr forecast positions

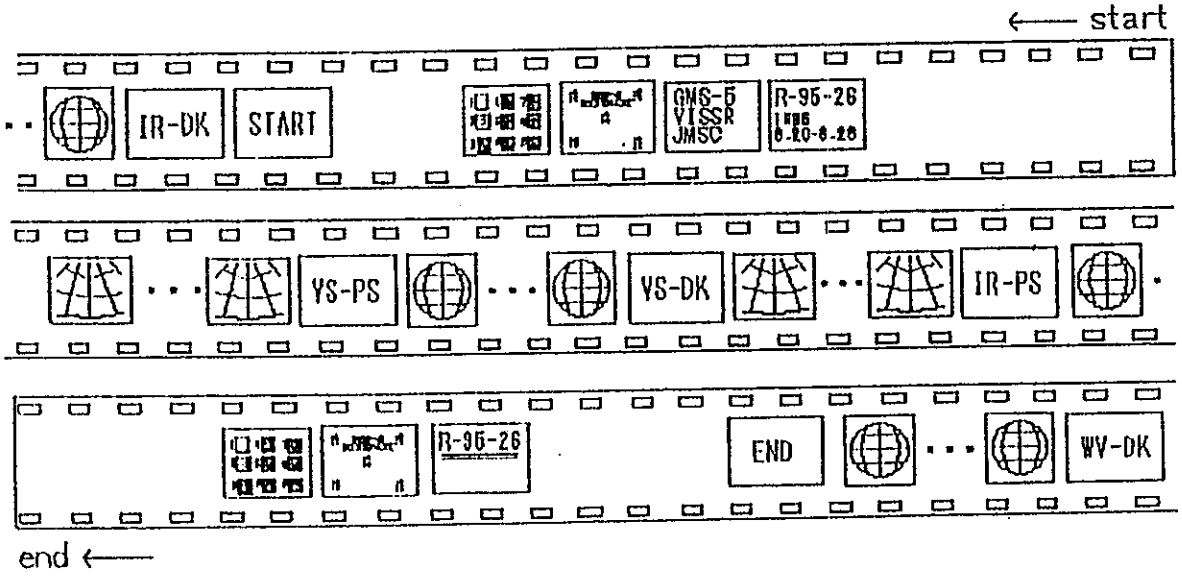
SPECIFICATION OF GMS IMAGE MICROFILM

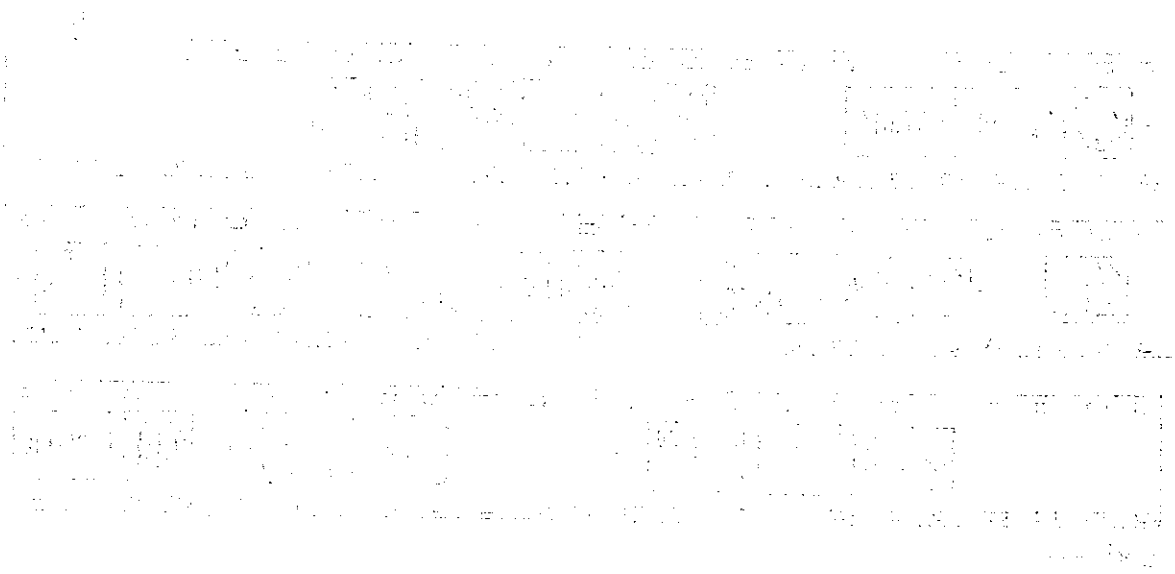
Form : 35mm perforated film

Image	: Full Disk (DK)	infrared (IR)	3-hourly
		visible (VIS)	00, 03, 06 UTC
		water vapor (WV)	hourly
	Polar-Stereographic projection of northern hemisphere (PS)	infrared (IR)	hourly
		visible (VIS)	00, 01, 02, 03, 04, 05, 06, 07, 08, 22, 23 UTC

Quantity : 7 days/volume

Format : below





APPENDIX V

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

In **CAMBODIA,** the DOH of the GDIMH continues to implement the project "Improvement of the Hydrological Network". The project which started in March 1996 is funded by the Government of Japan and is executed by the Mekong River Commission. The following activities have been completed during the year:

- 12 hydrological stations on the tributaries of the Tonle Sap Lake have been reinstalled and/or rehabilitated
- countrywide inspection of the existing hydrological stations
- equipment and materials (i.e. rubber boats, current meter set, recorder sets, etc.) were delivered for the project

No prevention measures have been implemented during the year in the Mekong River except for the rehabilitation of the older dikes around Phnom Penh.

In **CHINA,** the National Hydrological Information System in 1997, has finished the transfer from the Integrated Data Processing to the Distributed Data Processing and planned to replace the structure of Client/Server with the structure of Intranet.

Two VAX-11/785 computers, which have been used for 11 years, as water information receiving and processing computers were replaced by two Alpha server 4000 computers.

Fifteen more nodes were built on the wide-area computer network for national hydrological information transmission while the flood information monitoring computers were upgraded from PC486 to PC586 computers. To date, there are 42 nodes on the wide-area computer network.

Also in 1997, the observation and reporting facilities of all the hydrological stations in the country were modified.

During the 1997 flood season, the State Flood Control and Drought Relief headquarters received 207,000 telegrams of rainfall and water information through the wide-area computer network which amounts to 84% of the total 248,000 telegrams sent.

The Chinese hydrologists developed the flood information monitoring system, flood control consulting system and the water information retrieving system on notebook computers for ministry leaders.

In response to the development in computer technology and the needs of society and economy, the role of rainfall and water information telegram reporting was revised, reporting stations for drought season was increased and management files for reporting stations all over the country was established.

During the 1997 flood season, hydrologists in China developed a real-time hydrological forecasting system in more than 40 major sections of large river systems such as the Yangtze and Yellow Rivers, which played a very important role in flood forecasting and prediction. During the year, the Water Information Center under the Ministry of Water Resources (MWR) issued forecasts for about 30 larger flood events with high accuracy and lead-time of more than 24 hours and did 5 prediction analyses in large areas of the Yangtze River, Yellow River, Huai River and Hai River for the State Flood Control and Drought Relief Headquarters. These forecasts and predictions provided a very important foundation for flood control and proper operation of water structures.

In 1997, the MWR completed the construction of flood warning system in San-Hua region (downstream of the Yellow River), Xiaqinghe diversion area in Yongding River near Beijing, Honghu Lake Detention Basin in Yangtze River and Yishusi Water System in Huai River Basin which provided powerful assurance for flood control and water disaster reduction.

The hydrological departments in China provided a total of 500,000 water information for flood control and drought relief, issued about 1200 flood forecasts and water resources prediction analyses which was very important for loss prevention, disaster reduction and reasonable use of water resources which resulted to distinctive social and economic benefits.

To date, statistics showed that in 1997 about 6 million were evacuated from flood areas and 12 billion RMB Yuan of direct economic loss due to water-related natural disaster were prevented because of timely and accurate hydrological information, forecasts and warnings.

In the **DEMOCRATIC REPUBLIC OF KOREA,** the Hydro-Meteorological Institute of the State Hydro-Meteorological Administration (SHMA), continues to monitor the situations of 13 major reservoirs, 12 rivers and their branches across the country and forecasts flood. Data is received by radio, processed in real-time and is displayed.

The National Wind and Water Disaster Preparedness Committee, on the basis of the data supplied the SHMA asks the Ministry of Electrical Power Industry, the General Bureau of Barrages and the State Agricultural Commission to coordinate the lock gates under their control.

Taking into account the regional features, the NASH model and tank model are used for the Taedong River, the mountain and river models for the Chongchon and Ryesong Rivers and the regional division model for the Amnok and Tuman rivers.

In **HONG KONG, CHINA,** the automatic water-level reporting system continued to provide real-time rainfall and river depth information over the flood prone areas in the northern part of Hong Kong. Another 12 water-level gauges have also been installed on a trial basis to widen the coverage of the flood monitoring network.

A consultancy study on land drainage and flood control strategy for five major flood prone basins in Hong Kong was completed in 1993. The study identified and recommended major improvement to the primary drainage systems in these basins. The proposed works would cost around HK$6 billion and most of the works were either under construction or under detailed design stage. In addition, a series of 7 Drainage Master Plan Studies was being proceeded in stages to resolve secondary and local drainage problems in all flood prone areas in Hong Kong. This first study started in early 1996 and all the seven studies were targeted to be completed before the end of 1999.

In **LAO P.D.R.,** 25 additional rainfall stations were established in 1997 while 10 automatic water level recorders are currently being installed.

In **JAPAN,** inspite of excessive rainfall due to 4 typhoons and some frontal systems, serious damage such as dike breaks did not occur because the water level dropped relatively fast even though warning water level and design high water level were temporarily exceeded. As for sediment disasters, a large-scale mud flood occurred at the Kagoshima Prefecture in July which claimed 21 lives.

With regard to the improvement of observation facilities, measures are being taken against abrupt floods of small and medium rivers through reduction of data renewal interval in raingauge observation from 1 hour to 30 minutes and to 10 minutes. While automatic recording systems are introduced in most of the stations, data loggers will be installed for smooth execution of future data certification.

Currently, the transmission used in the river information system and the FRICS system are being updated using inter-LAN connection. Also, the standardization and building of a database for hydrological data including water quality was started with a plan to create a database in the next 3 to 5 years and make the information available via the Internet.

As of March 1997, 72 systems which determines the threshold for occurrence of mud flood from the rainfall statistics of the past and monitors whether the actual rainfall would reach this level has been introduced across the country. Also, as of end of March 1997, flood forecasting system had been implemented in 74 out of 109 river systems in Japan.

In **MALAYSIA,** the Department of Irrigation and Drainage (DID) during the year has installed 13 new telemetric stations (rainfall and river level) bringing the total number to 163 in 28 river basins in the country. Of these, 21 important VHF telemetric stations have also been equipped with telephonic telemetry (PSTN) as back up. A total of 191 VHF voice communication sets and 137 manual river gauges have been installed to provide additional hydrological and flood information especially during the flood season. As part of the local flood warning system, 60 flood warning boards and 56 flood warning sirens have been established in flood prone areas throughout the country.

Data transmission via satellite is currently being tested at 6 problematic remote radio based telemetric stations where telephonic infrastructure is not available. A system is being developed to transmit these telemetric data from the Master Station to the various users using the Internet. Of the 28 river basins which have been installed with telemetric stations, 8 river basins are equipped with real time flood forecasting models. These models are either operational at the respective states or at the National Flood Forecasting Centre (FFC) of the DID in Kuala Lumpur. At the FFC, Tank Model and Linear Transfer Function Model continued to be used by DID for real-time forecasting of the Kelantan and Pahang rivers respectively during the 1997 monsoon season. While the performance of Tank Model in terms of its forecast accuracy was satisfactory, the Linear Function Model did not perform as well and is currently being recalibrated with recent flood data. A new forecasting model incorporating hydrologic and hydraulic modules will be developed for the Batu Pahat river system (1944 km^2) in the Johore State.

For the past northeast monsoon season, the FFC carried out real-time flood forecasting operation from 15 October 1996 through 15 January 1997. Six-hourly forecasts of Kelantan river levels at Kuala Krai and Guillemard Bridge were prepared by FFC and transmitted to Kelantan DID office daily. Due to the relatively mild rainfall distribution, the Kelantan river level did not rise above the designated "danger level" during this monsoon season and no serious floodings were reported.

The performance of the flood forecasting system for the Kelantan River Basin is continuously being evaluated using MOFFS. The performance of the system for 1996 was found to be satisfactory. The forecast operation for the 1997/1998 Northeast Monsoon is being carried out from 15 October 1997 to 15 January 1998.

To date, there is still practically no structural measures being implemented with regard to the flooding problems of the Kelantan river basin due to technical and economic reasons. Currently, a comprehensive feasibility study on the possibility of implementing an integrated flood mitigation project is nearing completion.

In the **PHILIPPINES,** PAGASA's Flood Forecasting Branch (FFB) spearheaded the holding of a Participatory Rural Appraisal Workshop aimed an enhancing the Branch's public information drive for its flood forecasting services. Fourteen participants from the National Irrigation Administration, the National Power Corporation and PAGASA attended the said 5-day workshop.

To strengthen its commitment to disaster preparedness/management programs, the FFB entered into a Memorandum of Agreement with the Corporate Network for Disaster Response, a non-governmental network whose main function is to coordinate with the government, both in the provisional and municipal level, to come up with programs that will outline the appropriate disaster preparedness mechanisms to be adhered to by disaster-prone areas. Its objective is to increase the awareness of the population of disaster-prone localities to make them respond effectively to the threats and impacts of natural hazards.

The FFB is now embarking on the derivation of the Probable Maximum Precipitation (PMP) for tropical cyclone affected regions of the Philippines. The established PMP values will greatly assist water resources planners, especially in the structural design of major waterworks. The Depth-Area-Duration Analysis of major flood events for the monsoon-affected areas is one of the by-products that can be derived from this under-taking.

The importance of computer networking need not be overemphasized, especially its efficiency in the transfer of data and information between two points. To avail of its numerous advantages, the Branch initiated the installation of ethernet cards to its computers, linking the FFB to its subcenters located in Agno, Bicol and Cagayan River Basins.

In the **REPUBLIC OF KOREA,** the Ministry of Construction and Transportation (MOCT) continued to implement the short-term plan for the improvement of hydrologic data collection (1994-1998). To date, the present rainfall gauge network density is around 1/200 km^2-1/400 km^2. When the full plan is completed in 1998, the rainfall gauge network density will be improved to about 1/224 km^2 for the Han river basin and 1/194 km^2 for the Nakdong river basin, approaching the WMO recommended density of 1/150 km^2-1/250 km^2.

The MOCT constructed an on-line flood forecasting system in 5 major river flood control offices (FCO). At the Han river FCO, the Anseong-cheon flood control system was installed in 1996 and has been operational in 1997. The radar rainfall observation plan for the Imjin river basin will be completed by the end of 1997. At the Nakdong river FCO, the flood control system for Hyoungsan river basin is currently under installation and operation will start in 1998. At the Sumjin river FCO, the project of replacing and upgrading the hardware and software of the system has started.

The MOCT plans to establish flood forecasting and warning systems in 7 smaller basins: Ansung, Heungsan, Sapgwo, Dongjin, Mangeung, Tamjin and Taewha river basins. In the Ansung river basin, the system was established in September 1996 and has been in operation since then. In the Heungsan and Sapgwo river basins, the systems will be established by the end of 1997 and 1998 respectively. In the other four basins, the system will be established by the end of 1999.

Further, the MOCT has a plan to establish a flood forecasting and warning system in the Imjin river basin by the end of 1999. In this area, precipitation data will be collected with a radar which will be established in the beginning of 1998 and stream level data will be collected with a satellite communication system, scheduled to be established by the end of 1997.

Besides establishing these flood forecasting and warning systems, MOCT is constructing 7 new multipurpose dams and has built river embankments and the new pump stations to remove inland water.

In **THAILAND,** three new hydrometeorological stations namely Chawang station (Nakhon Si Thammarat province), Praseng station (Surat Thani province) and Kamalasai station (Kalasin province) were established in 1997.

During the year, the MOFFS Version 2 C was replaced by MOFFS Version 3.

The flood forecasting and warning systems in the designated Pasak, Prachin Buri and Nan river basins were monitored on a routine basis in 1997.

The computer hardware and software of flood modelling and forecasting technique using the Mike 11 modelling system is currently being tested.

In the **SOCIALIST REPUBLIC OF VIET NAM,** the HMS with the assistance from some overseas companies is currently developing a new flood warning and forecasting system based on PC-technology and remote stations. The first phase of the flood and flash flood warning and forecasting system based upon the ALERT-technology was implemented in the Sonia province in 1997.

During the 1996-1997 period the characteristics of the water information in Vietnam was investigated. This is the preliminary process in the development of an integrated hydrological information system.

Plans are underway to establish telemetric systems to selected river basins and dam areas.

During the year, the plan of forming an observation network that observes the water regime in the main rivers of Viet Nam was implemented. This network links the selected automated weather stations and water level stations located in Viet Nam. The network will transmit hydrolometeorological

information to the Regional Hydrometeorological Centres, and to the national Center HMF as well. With this network, the river information systems in the country will be improved and the flood warning and forecasting system will be upgraded.

Flood forecasts and warning were made for several rivers in northern and central Viet Nam (Red River, Da, Thao, Lo, Thai Binh, Ca, Ma, Thu Bon, Da Rang and Gianh rivers etc.) during the period from November 1996 to September 1997.

Channel modifications of various types were done before and during the 1997 flood season in several rivers. This includes lining the channel, raising or enlarging bridges and culverts which restrict flow, removing barriers that interferes with flow etc.

APPENDIX VI

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

Activities of ESCAP

ESCAP continued to provide support to Members in their endeavors on the hydrological component. The Commission at its last session noted that the Committee had decided to widen the scope of the Typhoon Committee hydrologists, so that they would not only cope with flood loss reduction but would also deal with the optimum use of the waters that became available. It was also noted that ESCAP organized a number of seminars on water resources management, in which some Members of the Committee participated. These include the seminar held in May 1997 in Macau on private sector participation in water supply and sanitation and the seminar on efficient use of water in Singapore in October 1997. The Secretariat also fielded advisory missions to Lao P.D.R., Thailand, Philippines and China on various aspects of water resources planning and management and arranged for several Technical Cooperation Among Developing Countries (TCDC) exchanges. ESCAP has also formulated a project proposal for donor funding, on regional co-operation in flood control and management for improvement of urban environment in Asia and the Pacific. The project aims at benefiting from experiences gained in Thailand and in other countries of the region, including some Members of the Typhoon Committee, which have major cities experiencing severe flooding.

Activities of WMO

A workshop on the Management Overview of Flood Forecasting Systems (MOFFS) was held in Seoul, Republic of Korea, from 19 to 21 March 1997, with the co-operation of the Ministry of Construction and Transportation and the Korea Water Resources Corporation and with the support of WMO and the TCTF. Together with the publication of WMO Technical Reports in Hydrology and Water Resources Nos. 51 and 55, this workshop brought to an end the development phase of the MOFFS. Report No. 51 describes MOFFS Version 3 and Report No. 55 summarizes past experience with the application of MOFFS and the potential for its wider use.

The participants discussed recent progress and applications of MOFFS, with the purpose of making a critical review of existing Flood Forecasting Systems (FFS) through the MOFFS scoring criteria, exchange experiences on flood forecasting using case studies from the countries represented and gain experience in the application and use of MOFFS for system management purposes. Participants also discussed the individual characteristics of their specific FFS and the applicability of MOFFS.

It was recommended by the participants that MOFFS Version 3 should be accepted as the standard version for international comparisons on representative basins and the individual countries should take the initiative in seeking to develop MOFFS-type scoring systems for addressing other problem areas.

Members have continued giving support to the activities related to flood forecasting in the region, including the application of MOFFS and the contribution of relevant components to the Hydrological Operational Multi-purpose System (HOMS). Updating of HOMS component is an on-going process overseen by the WMO's Commission for Hydrology and the WMO Secretariat. Countries were encouraged to contribute new components on flood forecast to HOMS.

APPENDIX VII

REPORT OF THE PRE-SESSION MEETING OF HYDROLOGISTS

REPORT OF THE MEETING OF HYDROLOGISTS FROM TYPHOON COMMITTEE MEMBERS

1. Introduction

The meeting of the hydrologists from the Typhoon Committee Members was convened on 24 November 1997 by the Typhoon Committee Secretariat and was attended by representatives of the Typhoon Committee members from: China; Hong Kong, China; Japan; Malaysia; Vietnam; and of ESCAP and WMO. Mr. Lee Boon Ying of the Hong Kong Observatory was elected to serve as the chairman of the meeting.

The hydrologists welcomed Mr. Lee Han-se, the new Typhoon Committee Secretariat Hydrologist, and expressed their gratitude to the Government of the Republic of Korea for making his service available. The hydrologists also expressed their thanks to the Government of the Philippines for assigning Ms. Margaret Bautista as part-time Hydrologist during the interim period.

2. Recent Activities of Each Typhoon Committee Member

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

ESCAP reported on their activities related to hydrology and water resources, particularly on the workshop on land use planning and practices for natural disaster reduction and increased crop production held in Bangkok in March 1997. The hydrologists were also informed that guidelines and manual on the subject were produced recently and would be made available to them.

3. Review of Recommendations Made During the Last Presession Meeting

i) As the Typhoon Committee Hydrologist took up his post only recently, it was not possible to make an evaluation of the requirements of Typhoon Committee members.

ii) ESCAP was in the process of starting a project on flood loss

reduction, particularly at urban areas. The project on flood risk analysis and mapping would be taken up in the future.

iii) Hydrologists were able to utilize the Typhoon Committee Trust Fund and TCDC funds to participate in workshops and seminars in the region.

iv) The scope of the activities of the Typhoon Committee hydrologists was widened so as not only to cope with flood loss reduction, but also for the optimal use of the water which became available.

v) ESCAP organized in Bangkok the World Water Day and the IDNDR Day (March 1997 and October 1997, respectively).

4. Recommendations from the Meeting of Hydrologists

The meeting deliberated on the problems concerning hydrologists. The El Nino phenomenon was briefly taken up, and it appeared that is has been causing significant reductions in rainfall at some areas of the region, whereas some other areas were experiencing record level rainfalls. It was decided to bring up the subject for consideration of discussion by the Typhoon Committee. Future activities were also discussed and a set of recommendations were made.

i) The meeting encouraged the establishment of a homepage of the national hydrological service similar to the homepage of national meterological service of some Typhoon Committee members.

ii) The meeting reiterated its recommendation that the Typhoon Committee Hydrologist should evaluate the requirements of the Typhoon Committee members as soon as possible and formulate proposals for future activities under the hydrological component.

iii) The hydrologists recommended a project on debris flow and land-slide forecast and warning system in the Typhoon Committee area, be formulated into a project document by ESCAP. The project document is to be submitted to WMO for consideration 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".

iv) The hydrologists recommended to continue to seek the use of Typhoon Committee Trust Fund to supplement TCDC funds for attendance at workshops and seminars in the region. In this regard, it was recommended that an expert on hydrology should visit Vietnam under a TCDC arrangement to assist in improving the country's hydrological service.

v) To continue sending promotional materials to ESCAP and WMO for organization of the World Water Day and IDNDR Day (March and October, respectively, each year).

7. Closing of the Meeting

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

25 November 1997

HYDROLOGISTS MEETING
List of Participants

Name	Country/Area/Organization
Liu Jinping	China
Lee Boon-ying	Hong Kong, China
Chan Yu-yuen	Hong Kong, China
Ryosuke Kikuchi	Japan
Chong Sun Fatt	Malaysia
Le Bac Huynh	Vietnam
Nanette C. Lomarda	TCS
Lee Han-se	TCS
Cengiz Ertuna	ESCAP
Katsuhiro Abe	WMO

APPENDIX VIII

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

In **CAMBODIA,** the National Committee for the National Disaster and Preparedness directed the Office of the National Committee for Disaster Management to implement counter measures to lessen the impact of floodings during the rainy season in 1997 and drought conditions in 14 provinces.

In **CHINA,** the government of different levels and the public made the best use of weather forecasts and warnings in order to do a better job in mitigating the damage caused by typhoons. There were 4 typhoons or severe tropical cyclones that affected the coastal provinces and municipalities in China in 1997.

Among them, Typhoon Winnie was the strongest and the affected area was the largest in the last two years. It made landfall over Wenling city, Zhejiang province at 13:30 UTC on August 18. The government at various levels attached great importance to typhoon preparedness and disaster prevention. State leaders like State Councilor Song Jian and Secretary-General of the State Council Luo Gan personally asked for first-hand information on the typhoon and gave their instructions to the disaster preparedness units. On August 19, the Ministry of Civil Affairs sent a working group to Zhejiang province to investigate and assess the losses caused by Typhoon Winnie and directed the disaster combat work. The Governor of the Shanghai Municipal Government went to the forecast office of the Shanghai Meteorological Bureau to get first hand information about the typhoon. His address mobilizing the people in Shanghai to prepare for the typhoon delivered from the forecast office was broadcast live by a TV station.

The government and people of Zhejiang, Jiangzi, Jiangsu, Anhui, Shandong, Hebei, Tianjin, Liaoning, Jilin and Heilongjiang provinces and municipalities made advanced preparations against the typhoon in accordance with the typhoon forecasts and warnings issued by the meteorological services. For example, the Zhejiang Provincial Government took effective measures to evacuate more than 1,300,000 people to safe places before the typhoon made landfall, thus greatly reducing the number of casualties. According to the weather forecast, the navigation, transportation and fishery operating agencies took shelter from the winds, thus greatly reducing economic losses and casualties as well. The government at various places also organized the people to reinforce the dikes and dams and dredge the rivers. These measures also contributed to the reduction of losses.

In the **DEMOCRATIC REPUBLIC OF KOREA,** vulnerable spots at main reservoirs were reinforced on a large scale before the rainy season in 1997 under the guidance of the National Wind and Water Disaster Preparedness Committee, the State Hydro-Meteorological Administration and the Ministry of Land and Environmental Protection. As in the past years, the state established the land and environmental protection months in spring and autumn and reinforced the river banks and planted trees on a nationwide scale to prevent floods. Dikes were built or reinforced at vulnerable spots along the Amnok, Chongchon, Taedong and Ryesong rivers and their branches.

In **HONG KONG, CHINA,** professional meteorologists from the Observatory maintained their presence in the TV weather programmes of the 3 major local TV networks. Weather programmes were produced in the Observatory's studio using special computer graphics. During the passage of tropical cyclones, centralized media briefings were held twice a day to ensure that warning messages were effectively disseminated and to alert the public on the need to take appropriate precautions.

The popularity of the Observatory's homepage continued to rise, with local public and overseas users acquiring real-time weather information from the site. The number of visits exceeded 10,000 per day on average, making it the most popular site among the government departments of Hong Kong, China. The homepage proved to be a very effective means to disseminate tropical cyclone warning

bulletins. During the close approach of Typhoon Victor on 2 August 1997, the number of visits reached 156,000 within one day.

Since the establishment of a public liaison group "Friends of the Observatory" in 1996, membership had risen to over 800 in 1997. Newsletters were published and meetings arranged on a quarterly basis. Science lectures on "Fog in Hong Kong" and "Tropical Cyclones" were organized during the year.

The natural disaster warning system in Hong Kong was kept under review. In the light of the severe rainstorm on 4 June 1997 and the subsequent public feedback, the rainstorm warning system will be re-examined to see if improvement to the system could be made.

In **LAO P.D.R.,** the Department of Hydrometeorology, Department of Irrigation and the Department of Communication and Transport worked towards strengthening the weather and flood forecasting systems, increasing the irrigation system and promoting disaster awareness and mobilizing the public during disaster situations, respectively.

In **JAPAN,** the Asian Disaster-reduction Cooperation Meeting was convened in Tokyo in June 1997. It was attended by senior officials in charge of disaster-reduction from 23 countries. The objective of the meeting was the consideration and discussion in greater detail of the establishment of a disaster-reduction center for the Asian region, the establishment of a secretariat and deepening ties and interaction among participating countries. The meeting agreed that the "Asian Disaster Reduction Center" should be established in Japan.

In **MACAU,** education and training meetings were held in 20 schools in 1997. These activities aimed to inform school's evacuation plan, which would help them to prepare their own plans. These plans will be analyzed by the Security Coordination Office and, if necessary, appropriate changes will be recommended.

An exercise on Disaster Prevention and Preparedness was held on 7 May 1997 with the participation of personnel from several departments (government and private) which are a part of the civil defense general organization and with the presence of the PR China (Guangdong) and Hong Kong, China observers.

A campaign on public awareness on tropical cyclones is currently in progress. This campaign, besides conducting training activities in several schools, also includes other activities in the following institutions:

- business associations
- neighbourhood associations
- students and juvenile associations

The same campaign also involved the following:

- Media Advertising
- Delivery of pamphlets giving instructions and advising about prevention and measures to be adopted.

In **MALAYSIA,** taking cognizance of rapid economic development and increasing vulnerability to natural or man-made hazard, Directive No. 20, dealing with the Policy and Mechanism for the National Disaster and Relief Management was approved by the Right Honourable Prime Minister of Malaysia on 11 May 1997. It replaces the Natural Disaster Management Guidelines which had been implemented since the 70's. This Directive gives specific tasking and spells out clearly the roles, functions and authority of various agencies which deal with search and rescue operation, relief and rehabilitation. Each agency could supplement and complement each other to avoid duplication of duties. The Disaster Management Committee has been expanded to cover all agencies dealing with the various types of emergencies. The first enforcement of this Directive occurred during the severe transboundary haze in September 1997 over Malaysia due to the forest fire in Sumatra and Kalimantan of Indonesia.

In the wake of disaster inflicted by Tropical Storm Greg killing 238 people on the riverbank of Sungai Pampang in Sabah, the government has embarked on a major resettlement plan for villages on river reserve to safer ground. Risk assessment has also been carried out to determine the degree of danger posed by floodings to river settlements in the country. Being aware of the fact that flood water could destroy hundreds of hectares of padi land and livestocks, the government has approved a monetary aid plan to animal husbandry and farmers so as to lighten their burden during such calamity.

In line with the IDNDR, the Department of Broadcasting and the Department of Information are intensifying their efforts in public awareness on disasters through press and electronic media. Brochures describing the important severe phenomena which include tropical cyclones, squall-lines, thunderstorms, monsoons and haze have been prepared by the Malaysian Meteorological Service and distributed to the public and various agencies concerned for purpose of information and education.

All National, State and District Disaster Management and Relief Communities had convened their annual meetings to be well versed with procedures and any actions needed to be taken during the coming northeast monsoon. The Department of Social Welfare has earmarked 3,417 schools and public community halls as centres to house any flood victims.

In the **PHILIPPINES,** the Office of Civil Defense (OCD) in coordination with concerned LGU's continued the organization of local disaster coordinating councils (DCCs). For the period November 1966 to September 1977, 1,523 DCCs and 796 Disaster Control Groups (DCG) were organized. During the same period, 358 disaster preparedness/management trainings and 273 public information drives were conducted while 5,845 manuals, 17,759 leaflets/poster/radio tapes were distributed.

In line with its communication capability program, OCD installed 2 VHF repeaters in Baguio and Tagaytay to service the VHF repeater stations of its regional centres. A digital PABX system and VSAT station were installed at the National Disaster Management Centre while the existing Trilon type antenna tower for VHF antenna system was rehabilitated.

The OCD facilitated the holding of 5 NDCC meetings and 11 NDCC Technical Working Group meetings. In coordination with DOST and UNESCO, PHIVOLCS and OCD co-chaired the earthquake mitigation and preparedness programme wherein a series of seminars had been conducted throughout the country.

Also during the year, PHP6.1 M was released for the establishment of a local area computer network aimed at improving the typhoon warning dissemination system with PAGASA as the service provider and 6 key agencies as clients. With the network, PAGASA can share weather image with the 6 agencies within the hour that PAGASA obtains the picture from the GMS weather satellite.

In compliance with a memorandum of the President, a 4-day workshop was conducted to review PD 1566 and other disaster-related issuances at Olongapo City. The OCD injected on the draft bill some recommendations aimed at enhancing the disaster management system of the country. The draft bill has been forwarded to the Chairman, NDCC for approval and endorsement to Congress thru the Office of the President.

Lastly, in support of the Social Reform Agenda of the government, determination and evaluation of resettlement sites throughout the country was undertaken.

In the **REPUBLIC OF KOREA,** in order to reduce the loss of life, property damage and economic disruption caused by natural disasters such as floods, windstorms, etc. during the rainy season, the government has annually designated the period from March to May as "Disaster Preparedness Period" and in 1997 performed the following activities:

- inspection and maintenance of 416 areas vulnerable to inundation, collapse, and isolation by typhoons and floods
- prepared the "Disaster Preparedness Plan" and assigned the persons in charge of maintaining 974 large-scale construction sites (i.e. subways, golf courses, dams, etc.)
- inspection and repair of 7,884 disaster prevention facilities (i.e. retaining walls, embankments, reservoirs, etc.)

- secured equipment and facilities for emergency countermeasures during the occurrence of disasters
- appropriated funds for natural disaster countermeasures

A total of 64,714 staff members were trained from 24 February to 25 April 1997 in disaster preparedness and prevention to enhance their ability to deal with natural disasters. The training programme included planning, managing critical situations, reporting damage, working on recovery plans and studying relevant laws.

Emergency drills and exercises were carried out during the period from 13 to 23 May 1997 to effectively cope with disaster situations. Local government units in each region had their own emergency drills on 15 May 1997.

On 23 May 1997 a comprehensive exercise on disaster prevention was carried out at the Kumkang river basin using the experience gained during the landfall of Gladys (9112) in 1991.

Government agencies also conducted exercises using computer-simulated earthquake conditions during the period 18 to 19 September 1997.

The main activities during the 25 May 1997 National Disaster Prevention Day included:

- inspection of disaster prevention facilities and equipment
- drill and campaign for disaster prevention
- photo display of disaster-struck areas and their recovery process
- disaster prevention poster making contests
- selection of one of the 5 major river basins and conduct of a comprehensive exercise for disaster prevention with the participation of responsible authorities.

Now on its first year of implementation, the government invested US$6,263 million in 22 key items of the Fifth Basic Disaster Prevention Plan (1997-2001). A total of US$117 million was in turn invested to improve 102 disaster prone areas based on the government's "Improvement of Disaster Prone Areas Project" which is now on its third year of implementation.

Since the Risk Assessment Evaluation System of Disaster Impact project was introduced on 21 October 1996, a total of 34 projects had been examined by the end of November 1997. The number of projects examined are as follows:

- 2 urban development projects
- 5 industrial complex development projects
- 13 tourist complex development projects
- 13 sports complex development projects
- 1 mountain development project

In 1997, 250 km of small rivers were refurbished at a cost of US$109 million.

The National Institute for Disaster Prevention (NIDP) opened on 2 September 1997 to provide a systematic and expert knowledge of disaster prevention and preparedness. The NIDP seeks to appropriate an institutional structure for disaster prevention and ways to promote international cooperation.

In **THAILAND,** the National Civil Defense System in 1997 had the following activities:

- assigned provincial authorities to risk areas to decide or improve construction of structures for flood prevention amounting to about 30 million baht.
- surveyed floodways and constructed flood control channels in the Chao Praya river basin.
- reinforced river banks along the Chao Praya river.
- reviewed drainage plans in the central region, southern region and Bangkok to ensure that new developments will not increase runoff, divert flows to other property or cause backwater to pond onto property.

- prepared comprehensive regional studies and analyses in the central region to identify locations and facilities that are presently or in the future will be at risk from natural disaster.

The Civil Defense Secretariat (CDS) of the Office of the Council of State and the Office of the National Economic and Social Development Board held a seminar on the "Implementation Problem in Disaster Action Plan" on 27 August 1997 at the Office of the Prime Minister.

The CDS recruited 152 defense volunteers to work on disaster reporting. It conducted exercises in 20 provinces, disseminated disaster management information and administered training activities on disaster and environment. In cooperation with the National Municipal League of Thailand, the CDS implemented the project on disaster prevention and relief performance evaluation in municipalities across the country.

In the **SOCIALIST REPUBLIC OF VIET NAM,** the National Committee for IDNDR carried out the following activities in 1996-1997:

- strengthened the directing and commanding apparatus for flood and storm control at all levels (central, provincial, district and village)
- gradually improved the quality of warning and forecasts of storms, floods and other kinds of disasters
- improved the quality of dike's systems in the Red River Delta and in north and central Viet Nam, the quality of dikes along the coast from Mongcai to Hatien, the Day river diverting system, the reservoirs like Hoa Binh, Thac Ba and others
- strengthened flood prevention and preparedness measures in all localities along the river banks from the provincial level (emphasis was placed on the village level)
- stepped up public education to increase awareness of the populace on tropical cyclones and floods, this included: organizing workshops and seminars on disaster management and disseminating information on disaster mitigation through the tri-media
- endeavored to coordinate all measures (both structural and non-structural) in order to strengthen international cooperation and assistance in all fields of disaster mitigation, disaster response, rehabilitation and reconstruction.
- basically completed the establishment of funds for flood and storm control in provinces and cities throughout the country.

APPENDIX IX

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

Activities of ESCAP

The ESCAP Commission at its fifty-third session in 1997, noted with appreciation the extensive efforts of the Typhoon Committee, including its coordination of the early warning and forecasting system of its Members, increased disaster reduction and preparedness activities, and related research and training work. In recognizing natural disaster reduction as an integral part of sustainable development in the region, the Commission recommended that further national and regional efforts should be directed towards enhancing preparedness and natural disaster reduction activities to support the national development programmes of its members and associate members.

The ESCAP Secretariat continued its work on disaster prevention and preparedness. Under a project funded by extrabudgetary resources, the Workshop on Guidelines and Manual on Land Use Planning and Practices in Watershed Management and Disaster Reduction was organized in Bangkok in March 1997. A number of Typhoon Committee Members attended it. The Workshop finalized the Guidelines Manual, which aims to reduce damage due to water-related disasters and to enhance productivity of land through watershed management. The Guidelines and Manual have just recently been published and is being disseminated for wide application.

ESCAP, as in the previous years, organized the IDNDR Day on 8 October 1997, at its headquarters in Bangkok, with an exhibition, which was made possible by contributions from other United Nations Agencies, as well as from its members, and from ADPC.

ESCAP continued its cooperation with IDNDR Secretariat in Geneva and with DHA.

Activities of WMO

The WMO Executive Council in 1997 noted with appreciation the report on activities and efforts to meet the goals of the IDNDR. The report underscored the close cooperation that existed between the WMO and IDNDR Secretariats. The Council paid particular attention to the closing events and proposals for continuing disaster reduction beyond the Decade.

The Council recalled the significant impact of natural disasters on the socio-economic development of countries. It, therefore, welcomed the leading role played by WMO in regard to the mitigation of natural disasters of meteorological and hydrological origin and endorsed the support provided to IDNDR efforts by the major scientific and technical programmes of WMO including four specific demonstration projects. As part of its active involvement in, and support for, the work of the bodies involved in the Decade, WMO had participated at sessions of the Scientific and Technical Committee and Inter-Agency Working Group.

WMO's long experience in coordination of global and regional programmes of meteorological and hydrological services, data and information would clearly serve as an excellent basis for continued efforts of the Organization in the promotion of disaster awareness, early warning capacity building for meteorological and hydrological and related disasters, and related research and development well beyond the end of the Decade. That should involve NMHSs and would require a well-developed infrastructure and recognition of the need, not only to issue warnings, but to assess the risk of hazards and ensure that such warnings reached and were understood by those communities that were vulnerable. Disaster warning capacity and public awareness should continue to be high priority activities within WMO Programmes and as a special focus for the Public Weather Services Programme. The major objective of that Programme was to save life and property through the provision of timely and accurate warnings and forecasts and public awareness of meteorological and hydrological disasters.

APPENDIX X

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

In **CAMBODIA,** there were no in-house meteorological and hydrological training courses held in 1997. However, some staff members attended the following trainings and seminars abroad:

Title	*Duration*	*Venue*	*No. of Participants*
Training Award of Japan International Cooperation Agency	13 Aug. - 20 Dec. 1997	Japan	1
Training on Satellite Meteorology	27 Sept. - 11 Oct. 1997	Iran	1
RA II Meteorological Technical Seminar	04 - 08 Nov. 1997	Macau	1
RA II & RA V Cyclone Training Seminar	10 - 21 Nov. 1997	Philippines	1
International Expert Meeting on Participation of Women in Meteorology and Hydrology	15 - 19 Dec. 1997	Thailand	1

Title	*Duration*	*Venue*	*Sponsor*	*No. of Participants*
1. Short term period				
Seminar on Integrated River Basin Development and Management	13 - 16 May 1997	Thailand	SIDA	1
2. Medium term period				
Training on Hydrology survey	10 Apr. - 12 Oct. 1997	Japan	JICA	1
Master Programs in Hydrology	12 Oct. 1997 - 12 Oct. 1998	Netherlands	FAO	1

In **CHINA,** entrusted by the government's IDNDR Committee and supported by the UNDP, CMA and the ADPC will jointly sponsor for the second year, an International Workshop on Disaster Prevention, in Bangkok, Thailand from 2 to 11 December 1997. The workshop whose main purpose is to further improve the management work of the CMA and other governmental agencies in disaster prevention and mitigation and strengthen international exchange and cooperation, has played a very important role in the past year's disaster management work in China. About 30 participants from the meteorological services of China, including the CMA, will attend the workshop.

The Regional Meteorological Training Center of Nanjing organized an International Training Course on Agrometeorology from 20 September to 19 October 1997. All domestic costs were covered by the government of China. Four participants to the training course were from Typhoon Committee Members.

In the **DEMOCRATIC REPUBLIC OF KOREA,** the State Hydro-Meteorological Administration is running a graduate course leading to a doctoral degree which consists of full-time;

correspondence and special studies. The course is open to meteorologists, hydrologists and oceanographers. Doctorate papers are prepared and published usually in 3-4 years' time, but in case of special courses, papers are available in a year's time.

In 1997, three persons graduated from the course and were awarded doctorate degrees.

In **HONG KONG, CHINA,** the Observatory's participation in overseas training includes:

Title	*Duration*	*Venue*	*No. of Participants*
Regional Spectral Model Phase II Training Attachment	7 Jan. - 5 Feb. 1997	Japan	2
Study Tour to CMA	3 - 21 Mar. 1997	China	2
Use and Interpretation of ECMWF Products	9 - 18 June 1997	U.K.	1
Application of NWP Products in Aviation and Dissemination through Satellite and Terrestrial Systems	30 Jun - 4 July 1997	U.K.	1
Training Seminar on Doppler Radar	7 - 18 July 1997	Macau	2

The Hong Kong Observatory organized several in-house meteorological courses in 1997. A total of 175 Class I, II and III meteorological personnel attended the courses:

a) Initial Training Course for Scientific Assistant (ITC)
b) Applied Meteorology Course for Forecasters (AMCF)
c) Training Course on Satellite Meteorology and its Application
d) Training Course on Forecasting of Tropical Cyclones
e) Training Course on World Area Forecast System Ground Receiving Station
f) Training Course on Aviation Meteorological Data Processing System (METPS)
g) Training Course on Terminal Doppler Weather Radar (TDWR) Operator
h) Meteorology Course for Aviation Forecasters (MCAF)
i) Training Course on Operational Wind Shear Warning System (OWWS) for forecasters
j) Training Course on Aerodrome Meteorological Observing System

In **LAO P.D.R.,** a one-month CLICOM training was held in Vientiane which was attended by six assistant technicians. A hydro-operational training course was organized at field stations and at the headquarters during the year with the participation of 15 observers. At the head office a seminar meeting of 17 chief hydrometeorological provincial personnel was held in 1997.

Eighteen staff members went to S.R. Viet Nam to train on computer and data processing, forecasting, equipment maintenance and telecommunication.

In **JAPAN,** during the period from November 1996 to November 1997, JMA provided four expert services, and these are:

a) Strengthening of Meteorological Services for Viet Nam (4 to 30 November 1996)
b) Satellite Data Utilization and Forecasting including NWP for Thailand (29 November to 24 December 1996
c) Date Processing for the Philippines (21 January to 22 March 1997)
d) Typhoon Prediction Model for the Republic of Korea (09 to 13 September 1997)

The Construction College, a training facility run by the Ministry of Construction continues to offer several courses related to hydrology such as River Planning Course, River Structure Design Course, River Environment Course and River Management Course. Expert training related to rivers are also

offered in the said college. These are Dam Course, Erosion Control Course, Coast Course and Disaster Prevention/Disaster Assessment Course.

Trainings related to rivers are also offered at respective local construction bureaus, municipal and public corporations for their employees. Government agencies like the Hokkaido Development Agency offers 35 courses and accepts 760 trainees. Municipal corporations offers 41 courses and accepts 1,700 participants while public corporations offers 2 courses with 30 trainees.

The National Construction Training Center Foundation, a school for completing the trainings offered by the Construction College, offers 10 courses related to rivers and accepts 360 trainees from the employees of the Ministry of Construction, the Hokkaido Development Agency, the Okinawa Development Agency, prefectural governments, ordinance designated municipal governments and public corporations.

The River and Dam Engineering Course II, a course which introduces the latest technology and knowledge concerning river and dam engineering in Japan to engineers that are involved in the administration of flood control and water resources development through lectures, exercises, discussions and field trips, is now on its fifth year. This particular course had trained 60 engineers from 22 countries from 1993 to 1997.

In **MACAU,** SMG staff members were trained in the following meteorological courses in 1997:

Title	*Duration*	*No. of Participants*
Class III Met. Officer	3 months	5
Aeronautical Obs. and Inf. for Class III Observers	2 months	5
Class II Met. Officer	6 months	3
Doppler Radar	2 weeks	18
Mesoscale Met. Model	2 months	12

Overseas and local training/Seminar/Workshop attended by SMG personnel:

Title	*Venue*	*Duration*	*No. of Participants*
International Course on Tropical Meteorology	Nanjing	09 Sept. - 08 Oct.	2
Study Tour for Typhoon Operational Forecaster TCM	China	08 - 19 Dec.	1
Regional Training Seminar on Use of GDPS Products and Presentation of Forecasters to the Public	Seoul	22 - 29 Oct.	2
Eleventh Seminar of Hazardous Weather	Guangzhou	17 - 19 Dec.	6
Factory Training on Met. Radar	Germany	10 days	5
Second GD-HK-MC Meteorological Conference on Operational Cooperation	Macau	14 - 15 Apr. 1997	24

In **MALAYSIA,** a total of 223 MMS staff underwent various training courses such as basic meteorological courses for meteorologists and meteorological assistants, basic and advanced courses on the use of microcomputer, basic Windows 95, electronic, statistics and meteorological instrument courses for meteorological assistants. Meanwhile, MMS personnel also attended the following:

Title	*Venue*	*Duration*	*No. of Participants*
Factory Training for Meteorological Data Processing System for KL Airport	USA	6 - 24 Jan. 1997	8
Workshop on Development of the Data and Information System for SEA START	Thailand	27 - 31 Jan. 1997	1
Factory Training for Terminal Doppler Radar	Japan	22 Jan. - 11 Mar. 1997	8
Factory Training for Automatic Meteorological Stations	U.K.	10 - 29 May 1997	4
Training Conference on the Operation of Geographical Information System (GIS)	USA	8 - 11 July 1997	2
Training Seminar on Environmental Response	Canada	6 - 10 Oct. 1997	1

Throughout the year, on-the-job trainings on the maintenance and repair of hydrological instruments were organized by the Hydrology Division of DID for the State Hydrology personnel. Besides, the Department had also organized or participated in the following:

Title	*Venue*	*Duration*	*No. of Participants*
Workshop on the "Management Overview of Flood Forecasting Systems (MOFFS)	Republic of Korea	19 - 21 Mar. 1997	1
7th International Workshop on "River Flow Forecasting"	Ireland	14 Apr. - 23 June 1997	1
WMO/NOAA Course on "Hydrological Flood Forecasting"	USA	7 July - 29 Aug. 1997	1
Applied Hydrology Course for Engineers	Malaysia	20 - 23 Oct. 1997	data not available

In the **PHILIPPINES,** as in the past, PAGASA provided a considerable number of in-house training courses in 1997 to equip the agency with an adequate pool of well-trained employees at all levels towards more effective and efficient operations. The following in-house training programs were conducted during the year:

a) TCP/WMO Practical Training Course in Weather Forecasting
b) Seminar/Workshop on Teaching Facilitation Methods and Techniques
c) OJT Computer Training of Agromet Personnel
d) Seminar/Workshop on Meteorological Services for Agriculture
e) Computer Concepts and Application Software for Support Services
f) Regional Flood Forecasting Course
g) Participatory Rural Appraisal for the Flood Forecasting Branch's Public Information drive enhancement

In addition, a number of personnel were offered scholarship grants under the MS and PhD programs of the Department of Meteorology, Civil Engineering (Water Resource), Agrometeorology, Statistics and other allied sciences of the University of the Philippines. This privilege extended to PAGASA personnel is also being availed of by 3 foreign students in the MS program in Meteorology, under the VCP of WMO.

In the **REPUBLIC OF KOREA,** a total of 6 staff members of KMA attended the following training courses in 1997:

Title	*Duration*	*Venue*	*Number of Trainee*
Development of Regional Numerical Weather Prediction Model in Far-East Asia	05/04/97 - 08/02/98	USA	one
Data Assimilation Techniques Used in Regional Weather Forecasting Systems	16/07/97 - 30/06/98	USA	one
Training on Short-range Numerical Model in Center for Analysis and Prediction of Storms	01/11/96 - 02/02/97	USA	one
Typhoon Model Development	18/05 - 27/05	USA	one
Medium-range Model for Severe Weather Phenomena	02/07 - 12/07	USA	one
Application of Physical Process to Regional Spectral Model	24/08 - 04/09	USA	one

In **SINGAPORE,** the SMS has been offering software training courses for meteorologists to other NMSs under the Singapore VCP Programme. Recently, it has revamped the training programme and began conducting a 2-week course on the *Interpretation of NWP and Weather Satellite Data* for meteorologists and weather forecasters in the region. The purpose was to foster greater technical collaboration with ASEAN member countries as well as other developing nations. A similar course is planned for next year. The latest course content included Model Output Statistics and weather satellite image processing techniques.

Seven Singapore-ASEAN and Singapore-Colombo Plan training fellowships were awarded to participants in the surrounding region under the Singapore-Cooperation Program.

In **THAILAND,** TMD personnel attended the following training courses in 1997:

No. of Participants	*Title*	*Venue*	*Duration*
1	Seismology and Earthquake Engineering II	Japan	25 Aug. 1997-26 July 1997
1	International Training Course on NWP and Weather Satellite data	Singapore	01 - 13 Sept. 1997
1	The Fifth Disaster Prevention and Mitigation Training Course on Seismic and Cyclone Hazards Mitigation	A.I.T.	21 Apr. - 16 May 1997

In the **SOCIALIST REPUBLIC OF VIET NAM,** 27 seminars/workshops were conducted in 1997 in Viet Nam's HMS. Sixty two staff members participated in study tours while 56 attended short-term training courses. Three HMS staff completed post-graduate courses during the year.

APPENDIX XI

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

In **CAMBODIA,** the following researches were undertaken in 1997:

a) study of forecast rainfall in Cambodia during the monsoon season
b) study of the synoptic situation during the southwest and northeast monsoon for forecasting the start and end of the monsoon season in Cambodia

In hydrology, two research activities were carried out under the framework of the "Improvement of the Hydrological Network" project:

a) hydrological study of the Tonle Sap Great Lake
b) update of the flood prediction model of the Cambodian Mekong delta

In **CHINA,** the following researches were completed in 1997:

a) Topography Impacts on Typhoon Motion

Typhoon motion is strongly influenced by the underlying topography, especially in the condition of weak environmental steering. A significant effect of island topography on typhoons is the formation and development of an induced cyclone in the Taiwan strait. The interaction between the typhoon and the induced low could affect the typhoon's structure and motion change while the typhoon is approaching the Taiwan Island. A series of numerical experiments suggest that an induced low would be formed over the Taiwan strait when a typhoon approaches Taiwan Island from the southeast direction under certain conditions. The induced low could further develop if it were coupling with the proper vorticity and divergence fields in the upper layer. The experiments have also shown some dynamic characteristics of typhoon's motion variation when typhoon moves towards or across the island.

b) Effect of Tropical Cyclone Asymmetry on Its Motion

The inner asymmetric structure of the typhoon has a strong influence on its motion, especially if the environmental steering flow is weak. The study also showed that the asymmetric distribution of the contours in a typhoon's circulation affects typhoon motion particularly deceleration and recurvature. Further, the inner convection asymmetry and the microscale vortexes in the ambient area of a storm also has a noticeable effect on typhoon motion. The study also indicated that typhoon motion can abruptly change under certain conditions due to the flow speed variation of the large-scale environmental steering flow.

c) Research on the Sudden Change of Typhoon Intensity

Recent studies showed that the sudden change of typhoon intensity is mainly due to the typhoon's strong convection heating in the typhoon's eyewall over warm sea surface. The divergent wind kinetic energy in typhoons is transformed to rotational wind kinetic energy which results to sudden intensification. Most of the divergent wind kinetic energy comes from the convective diabatic heating.

d) Research on Typhoon Torrential Rainfall

The latest studies related to typhoon torrential rainfall revealed that the following factors will enhance typhoon rainfall:

* the coupling mechanism between upper level jet and low level jet
* interaction between typhoon and westerly trough

* effect of the underlying topography

GMS satellite observation moisture data considerably improves the analysis in numerical models. It was shown that the simulated locations and amount of tropical cyclone rainfall are more accurate if satellite data is used. Good results were obtained for TC9413 and TC9414 tracks and rainfall distribution.

e) The Exchange of Research Achievements

The 10th National Workshop on Tropical Cyclones was held in Hangzhou in November 1996. The latest five-year achievements on tropical cyclone research including numerical model study, unusual motion, intensity and structure change, typhoon induced torrential rainfall and objective forecast method of typhoon were reported on the workshop. Some of the new achievements are being tested in different forecasting centers in order to improve the operational prediction techniques.

During the Ninth Five year Plan period, China is going to construct the "State Flood Control Commanding System Project" which includes 4 subsystems: flood control information collection subsystem, flood control telecommunication subsystem, computer network subsystem and policy-making supporting subsystem.

The Chinese Hydraulic Engineering Society, Department of Hydrology and the Water Information Centre are planning to organize the national hydrological forecasting modelling competition, which includes 3 components: modelling study, real-time forecasting and computer interface demonstration, from 9 to 16 December 1997 in Wuhan. Hydrological departments, universities, colleges and science study agencies all over the country will demonstrate their own forecasting models and methods which are fit for local regions. A total of 42 delegations will take part in the competition activity.

The National Command Automation System for State Flood Control and Drought Relief Headquarters funded by the Japan International Cooperation Agency (JICA) is currently being established.

In the **DEMOCRATIC REPUBLIC OF KOREA,** the following research projects were undertaken in the institutes under the State Hydro-Meteorological Administration:

a) Research for the development of very short-range, short-range and medium-range NWP models and improvement of technical processes

- Development of a meso-scale NWP model with a changeable resolution taking into account various physical quantities

- Conversion of the 10-layer regional NWP model into a spectrum model

- Development of a medium-range NWP model (T42L12) and establishment of a medium-range NWP system

b) Research for the improvement of a wave NWP model on eastern and west coasts of Korea

- Development of a wave field calculation formula taking into account the geographical and oceanographical features of the east and west seas of Korea and establishment of a forecast process

- Development of a method of round-the-clock wave NWP on coastal waters and ocean

c) Development of a flood process NWP model taking into account the intermediate inflow at the lowest reaches of the river Tuman

d) Research into factors of weather change in rainy season and application of statistical transformation method

- Confirmation of the forecast factors at the beginning and the end of the rainy season

- Classification of the features of weather change in rainy season

- Clarification of the features of simultaneous or preceding circulation

e) Establishment of the method of long-range forecast of oceanographic and meteorological factors on the West Sea of Korea and development of a compound numerical model of tide, wave and tidal wave.

f) Statistical analysis and numerical experiment research of relations between ENSO and the summer weather of Korea.

In **HONG KONG, CHINA,** the passage of Typhoon Victor on 2 August was studied in detail using data from a very dense network of automatic weather stations, Doppler radar and two wind profilers. preliminary findings are that the tilting of the tropical cyclone vortex tube is an indication of the cyclones' short term movement and could be used as a nowcasting tool. Using the Rankine model, structural parameters of the cyclone are derived from Doppler radar data. These parameters are used in studying the changes in cyclone structure as Victor moves from sea to land.

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

a) Ensemble forecasting of tropical cyclone motion
b) Dynamics of tropical cyclone recurvature
c) Tropical Cyclone size changes
d) Evaluation of the performance of the UK Meteorological Office global model in predicting tropical cyclone movement under various environmental conditions
e) Comparisons of the performance of different NWP models in predicting tropical cyclone movement
f) Seasonal forecasting of tropical cyclone activity for the western North Pacific and the South China Sea

In **LAO P.D.R.,** researches undertaken in 1997 includes seasonal weather forecasting, short and long-term flood forecasting, water quantity/quality and sediment analysis.

In **JAPAN,** the participants in the COMPARE project (under WMO-CAS/JSC-WGNE) has concurred with Japan's proposal that T9019 (Flo), a target of intense observations during SPECTRUM, be the third case study because it attained peak intensity and underwent explosive development during a period of relatively good data coverage. JMA will compile the results of the experiments by the spring of 1999.

Recent impact studies of NWP models used in JMA showed that the surface wind observations from the scatterometer (NSCAT) onboard the Advanced Earth Observing Satellite provided an improvement of forecast skill by 5% at seven forecast days. The NSCAT surface winds have been received by JMA from NESDIS since 17 April 1997 via the National Space Development Agency of Japan.

In hydrology, the research themes in 1997 includes the following:

a) Physics based distributed parameter hydrological model making use of GIS data for topography, land use, geology and soil type has been developed. The model can incorporate the spatial distribution of basin characteristics and its change. The 1 km mesh model, which is expected to utilize satellite remote sensing data and radar raingauge data, is to be applied to relatively big river systems in Japan ($A>3000$ km^2) for flood forecasting purpose.
b) Dual linear polarization radar raingauge system, as a next generation radar, is expected to improve the accuracy of areal precipitation measurement compared with conventional radar raingauge, was experimentally introduced in the field for evaluation purpose. The compared result to data shows an increased accuracy especially in high intensity rainfall (>50 mm/hr).
c) Flood hazard simulator based on a 2 dimensional flood analysis model was developed for evaluating the risk of inundation in case of flood and for making disaster prevention plan including the evacuation activity. A case study in the urban river basin in Japan was performed to evaluate the practicability and easiness of operation, the result of which was fed back to improve the system.

In **MACAU,** the following researches were completed in 1997:

a) analysis of cold surge in mid-February
b) analysis from the prognostic charts of ECMWF for an episode of heavy rainstorm
c) abnormal speed of Typhoon Sally (9615)

With the acquisition of an SGI server and the use of a mesoscale meteorological model, a research team composed of SMG Meteorologists and experts from a university in PR China started on a project to develop and implement a suitable numerical prediction model for the Macau area. Boundary conditions and other parameters are currently under consideration.

In **MALAYSIA,** in the aftermath of Tropical Storm Zita in August 1997, the MMS would continue to pursue studies on the indirect effects of tropical cyclones to the country's weather with the hope of gaining more physical insight for the purpose of improving weather forecasting.

In hydrological research, the DID with a few other agencies are embarking on a project (1997-1999) to evaluate the use of the GIS and remote sensing technology to monitor and evaluate floods. DID also leads an urban hydrology study (1995-1998) with an objective to determine experimentally the runoff coefficients and concentration times of different urban conditions.

In the **PHILIPPINES,** the researches conducted by PAGASA in 1997 focused on the improvement of meteorological and hydrological operation services, particularly on severe weather, tropical cyclones, flood forecasting and warning and these includes the following:

a) Rainfall Probability and Visibility Forecasting at Selected Stations
b) Impact of Long Duration Atmospheric Variability on Surface Water Supply
c) Correlation of Sea Surface Temperature with Sea Tide Occurrence
d) Study of Regional Weather Forecasting Using Statistical Techniques
e) Analysis of Storm Surge Potential of Various Landfalling Typhoons Originating from the Pacific Ocean
f) A Study of the Rainfall Estimates Based on Remote Sensing Applied to Hydrological Forecasting
g) Analysis of Heavy Rainfall Events Associated with Flash Floods
h) Storm Surge Prediction and Monitoring
i) Solar Radiation Mapping
j) Wave Forecasting for Philippine Seas
k) Slope Movement Associated with Heavy Rainfall
l) Heavy Rainfall and Flash Flood Forecasting in Metro Manila

In the **REPUBLIC OF KOREA,** a study on the detection of fog and low stratus clouds at night using Derived Dual Channel Difference (DCD) of NOAA/AVHRR data was completed in 1997. In this study, the property of different emissivity between channel 3 (3.7μm) and channel 4 (11μm) of NOAA/AVHRR was used. As a result of this study, empirically determined cut-off thresholds from DCD imagery are presented.

In hydrology, the MOCT is funding several researches to mitigate damage caused by floods. Currently, a comprehensive flood forecasting system is under development by the Han River FCO.

In **SINGAPORE,** the research section of the Singapore Meteorological Service is currently upgrading its NWP models to meet new requirements. In addition, it is customizing an atmospheric pollutant dispersion model for use in Singapore.

In **THAILAND,** a working group was established which worked in close coordination with scientists from various research institutes in the country to develop numerical weather prediction models.

In hydrology, currently under study are the water inflow and storage in dams (i.e. rainfall due to tropical cyclones passing across Thailand) and the use of the MIDE 11 Modelling system in flood forecasting.

In the **SOCIALIST REPUBLIC OF VIET NAM,** researches carried out in 1997 concerning tropical cyclones are as follows:

a) Echo structural characteristics of storm cloud field
b) Study of vertical structure variation of geopotential height and temperature field over Hanoi region under the influence of tropical cyclone landing at the northern part of the Viet Nam coastline
c) Analysis of the evaluation of 24-hour forecast of tropical cyclone tracks by making use of the vertically integrated steering flow model
d) Establishing a model for computing the wind fields of tropical cyclones over the east Viet Nam Sea area

In hydrology, a number of studies have dealt on evaluating 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. There were also a number of inundation and hydrologic models that were developed for flood forecasting in the Mekong river delta and in some principal river deltas in Viet Nam.

APPENDIX XII

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

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

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

Presented by Professor Russell Elsberry
WMO CAS TMRP Rapporteur on Tropical Cyclones

1. INTRODUCTION

The CAS Tropical Meteorology Research Program continues to strongly promote tropical cyclone research activities and applications, especially those that can help with operations. Within the Working Group on Tropical Meteorology Research we have an energetic Rapporteur on Tropical Cyclones, Professor Russell Elsberry, who has worked with the Tropical Cyclone Program over the past decade on several tropical cyclone programs and will be presenting this report. These programs have including the highly successful SPECTRUM/ Typhoon 90/TCM-90, TCM-92 and TCM-93 series of field experiments and related research activities. The next International Workshop on Tropical Cyclones is scheduled to be held in the TC region early in 1998 and the autonomous Aerosonde is reaching the capacity to undertake reconnaissance in a wide range of applications, including tropical cyclones, starting in 1998.

2. CURRENT ACTIVITIES

Current tropical cyclone activities within the TMRP are summarised below.

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.

The next Workshop, IWTC-IV, is scheduled for April 1998 in China. The chairman of the International Program Committee, Gary Foley, has started the process of obtaining detailed reports from rapporteurs and chairmen of sessions to provide the extensive background information that has been a feature of the IWTC series. The first attachment outlines the draft programme for the workshop. A feature of this workshop will be the updating of the Global Guide to Tropical Cyclone Forecasting.

GJH November 26, 1997

More detailed information on IWTC-IV may be obtained from Gary Foley (g.foley@bom.gov.au).

2.2 SUPPORT FOR FIELD PROGRAMS AND APPLIED RESEARCH ON TROPICAL CYCLONES

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

One example is the Decade-long Tropical Cyclone research Initiative supported by the US Office of Naval Research and focussed in the western North Pacific. This program provided the funding for the first Global View reference book, and has conducted joint international programs in the western Pacific.

We have also strongly supported the series of SPECTRUM research meetings, organised under the Typhoon Committee, 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.

The data collected for Supertyphoon Flo in the TCM-90 experiment are being used as the basis for an intercomparison of regional model performance in forecasting tropical cyclones under the WMO WGNE COMPARE Program. The intercomparison is being coordinated by the JMA and the results are expected to be available for the next Typhoon Committee Meeting.

Under our monsoon components, we are active supporters of the South China Sea Monsoon Experiment, to be held in May June 1998. We are also involved in plans for a major programme lasting several years in the Indian Ocean. Whilst these programmes 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 and 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. An operational trial of the Aerosonde is scheduled for January and February 1998 from northwestern Australia.

Dr. Holland will present a detailed report on this progress and plans for 1998 at the meeting. Canvassing of support for an international reconnaissance facility to undertake Aerosonde missions on request has been discussed with TC members in

the past. This idea is now receiving strong support from a wide range of countries in both hemispheres.

2.4 STATEMENT ON CLIMATE CHANGE AND TROPICAL CYCLONES

One outcome of IWTC-III was a community view on tropical cyclone aspects of climate change, developed under the leadership of Sir James Lighthill and published in the Bulletin of the American Meteorological Society. A further detailed statement has now been prepared by a committee of prominent scientists headed by Professor Ann Henderson-Sellers. This statement will be confirmed at the next meeting of the WMO/CAS, but has been issued for debate and comment under the President's authority. The abstract of an article, which is at the accepted stage for the Bulletin of the American Meteorological Society, is included as the second attachment for information. The full statement may be found at:
http://www.bom.gov.au/bmrc/meso/Project

2.5 THE WWRP/TMRP PROGRAM ON LANDFALLING TROPICAL CYCLONES

The World Weather Research Programme (WWRP) is a recent development within the WMO Commission for Atmospheric Sciences, where it has grown out of an amalgamation of the former short and medium range prediction groups. The basic goal is to promote research and development activities that will have a significant benefit to weather forecasting. The formal establishment of the WWRP will be considered by CAS XII in February 1998.

The tropical cyclone landfall program is being developed by the WWRP in close collaboration with our TMRP. 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.

The goals and aspirations were developed at the first informal meeting of the WWRP in Cairns last October. Further consideration of plans has occurred at the recent meeting of the Landfalling Hurricanes Program of the US Weather Research Program. It is expected that the formal proposals will be finalised at the IWTC-IV for approval by the first formal meeting of the WWRP in October 1998. The focus will be on improved understanding and forecasting of the details of the tropical cyclone structure 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 and moves inland, together with the associated effects of flooding and ocean impacts.

3. SUMMARY

As outlined by the few examples in this brief report, the CAS Tropical Meteorology Research Program continues its active role in supporting improvements to operations through workshops and support for research and development activities.

The quadrennial meeting of the WMO/CAS Working Group on Tropical Meteorology Research in Jakarta last February confirmed our long-term commitment to improving tropical cyclone understanding and forecasting.

GJH November 26, 1997

ATTACHMENT 1
THE FOURTH INTERNATIONAL WORKSHOP ON TROPICAL CYCLONES, HAINAN, CHINA, APRIL 21-29 1998

1.0 TROPICAL CYCLONE LANDFALL PROCESSES

1.1 The WWRP/TMRP landfall program
1.2 Surface wind fields
1.3 Ocean processes
1.4 Modification of track at landfall
1.5 Rainfall
1.6 Decay after landfall

2.0 TROPICAL CYCLONE INTENSITY AND STRUCTURE

2.1 Air/sea interaction
2.2 Environmental interaction
2.3 Maximum potential intensity
2.4 Formation
2.5 Small scale interactions

3.0 TROPICAL CYCLONE MOTION

3.1 Environmental interaction
3.2 Baroclinic processes
3.3 Barotropic processes
3.4 Small scale interactions

4.0 TROPICAL CYCLONE PREDICTION

4.1 Observational issues
4.2 Analysis issues
4.3 Parametric wind fields
4.4 Track prediction techniques
4.5 Intensity prediction techniques
4.6 Seasonal prediction
4.7 Rainfall prediction
4.8 Upgrade to the Forecasters' Guide

5.0 TROPICAL CYCLONE IMPACTS

5.1 Economic aspects
5.2 Societal impacts
5.3 The warning process
5.4 Information issues

GJH November 26, 1997

ATTACHMENT 2

Tropical Cyclones and Global Climate Change: A Post-IPCC Assessment

A. Henderson-Sellers[1], H. Zhang[2], G. Berz[3], K. Emanuel[4], W. Gray[5], C. Landsea[6], G. Holland[2], J. Lighthill[7], S-L. Shieh[8], P. Webster[9] and K. McGuffie[2]

[1]Chancellory, Royal Melbourne Institute of Technology, Melbourne, Australia
[2]Mesoscale Meteorology Research Group, BMRC, Melbourne, Australia
[3]Reinsurance/Research and Development, Munich Reinsurance Company, Germany
[4]Center for Meteorology and Physical Oceanography, MIT, Cambridge, USA
[5]Department of Atmospheric Sciences, Colorado State University, Fort Collins, USA
[6]NOAA AOML/Hurricane Research Division, Miami, USA
[7]Department of Mathematics, University College London, London, UK
[8]National Taiwan University/Central Weather Bureau, Taiwan
[9]Program in Atmospheric and Oceanic Science, University of Colorado, Boulder, USA

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Address for Correspondence
Professor A. Henderson-Sellers
Deputy Vice-Chancellor (Research and Development)
Royal Melbourne Institute of Technology
PO Box 71, Bundoora
VIC 3083, Australia
Fax: +61 3 9466 9980
email: annhs@rmit.edu.au

Abstract

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. 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 a 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. 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.

APPENDIX XIII

SUMMARY OF THE 1997 TYPHOON SEASON

Submitted by the RSMC Tokyo - Typhoon Center

SUMMARY (as of 30 September 1997)

The sea surface temperature (SST) was warmer than the normal over the eastern and central tropical Pacific in the spring of 1997. Positive SST anomalies above 1.0°C were observed in the western waters of South America. Satellite imagery showed that the convective activity was less active than the normal over the waters from the eastern Indian Ocean to New Guinea and more active than the normal around the international date line. These features persisted during the summer of 1997: The area of positive SST anomalies over the eastern and central tropical Pacific extended to the west, and the area above 2.0°C reached 150° W. The positive SST anomalies in the western waters of South America were more than 4.0°C in July and August.

The mean sea level pressure (SLP) was higher than the normal around Indonesia and lower than the normal over the eastern and central tropical Pacific. This longitudinal seesaw pattern in SLP anomalies, which is a characteristic of El Niño, became evident from March 1997. The southern oscillation index (SOI) turned to negative in March and reached its negative peak from May to June. Although the negative SOI temporally weakened in July, it intensified again in autumn.

An SST pattern similar to La Niña which had persisted since the summer of 1995 over the tropical Pacific was replaced by an evident El Niño one in the beginning of 1997. The El Niño pattern further intensified in summer 1997. Positive SST anomalies in the Region B (4°S - 4°N, 150°W - 90°W) was greater than 3.0° C in August. This deviation was comparable to the maximum SST anomalies recorded in the significant El Niño 1982/1983.

The first tropical cyclone in 1997 formed on 13 April, slightly later than the normal. The number of tropical cyclones occurred by the end of September is 22, which is greater than the normal by two. Twelve of them (9701, 9702, 9703, 9705, 9706, 9710, 9713, 9714, 9718, 9719, 9720 and 9722) formed over the waters east of 140°E. Many of them took usual recurving tracks over the waters south or east of Japan. Tropical cyclone 9719 formed as a tropical depression in the western hemisphere and moved constantly to the west. It then recurved over the East China Sea and landed on the Japanese Islands. Since 1951, this is the first case of tropical cyclone which formed in the western hemisphere and hit the Japanese Islands.

Six tropical cyclones (9704, 9707, 9708, 9709, 9711 and 9716) formed over the waters east of the Philippines and west of 140° E. Three of them (9707, 9708 and 9709) moved directly to the north and landed on the Japanese Islands. Another tropical cyclone 9711 also moved northward and landed on the Korean peninsula. Tropical cyclone 9716 moved towards west-northwest passing the Taiwan Island and landed on the coast of China.

Four tropical cyclones (9712, 9715, 9717 and 9721) formed over the South China Sea. All of them occurred after late July and landed on the coast of China or Indochina Peninsula.

ISA (9701)

The first tropical cyclone in 1997 formed as a tropical depression (TD) at 00UTC on 12 April near Ponape (91348). Moving slowly to the north, it developed into a tropical storm (TS) named ISA (9701) at 00UTC on 13 April. During westward migration within southern periphery of a subtropical anticyclone along 15°N, it further intensified into a severe tropical storm (STS) at 06UTC on 15 April and then into a typhoon (TY) at 00UTC on 16 April southeast of Guam (91217). Retreat of the subtropical anticyclone from the Philippines led ISA to northward migration on 19 April. ISA reached its peak intensity with the maximum wind of 85 knots and the minimum pressure of 940 hPa at 00UTC on 20 April over the waters west of the Marianas. On late 21 April, ISA was on the southern periphery of westerlies and turned to northeast. It weakened into STS on 00UTC on 22 April near west of Iwojima (47981). On 23 April, it further weakened into TS at 00UTC and transformed into an extratropical cyclone at 18UTC over the waters east of Japan. It moved northeast and dissipated at 18UTC on 24 April.

JIMMY (9702)

A tropical depression formed over the waters between the Mariana and the Marshall Islands at 06UTC on 22 April. Within a subtropical anticyclone over the western North Pacific, it moved slowly along the ordinary recurving track. It acquired TS intensity and was named JIMMY (9702) at 18UTC on 23 April. The maximum wind of 35 knots and the minimum pressure of 994 hPa were estimated at 00UTC on 25. It weakened into TD at 00UTC on 26 April and dissipated at 18UTC of the day.

KELLY (9703)

KELLY (9703) formed as a tropical depression in the northern vicinity of Kwajalein (91366) at 18UTC on 6 May. Within weak steering flow along the southern periphery of a subtropical anticyclone along 20° N, it moved slowly to the northwest. It developed into TS with the maximum wind of 35 knots and the minimum pressure of 998 hPa at 06UTC on 8 May. KELLY weakened into TD at 12UTC on 10 May and dissipated in the northern waters of Enewetak (91250) at 00UTC on 11.

LEVI (9704)

A tropical depression formed in the western vicinity of Luzon at 00UTC on 26 May. It moved east across the Luzon Island within weak steering flow along the northwestern periphery of a subtropical anticyclone east of the Philippines.

Intensification of the subtropical anticyclone over these waters led the tropical depression to northward migration. At 00UTC on 28 May, it developed into TS LEVI (9704) and at 12UTC of the day, LEVI reached its peak intensity with the maximum wind of 40 knots and the minimum pressure of 992 hPa in the just south vicinity of the Ryukyu Islands. Then it moved northeast along the westerlies over the waters south of Japan. It weakened into TD at 09UTC on 29 May and degenerated into an extratropical cyclone at 00UTC on 31 May over the waters south of Japan.

MARIE (9705)

MARIE (9705) formed as a tropical depression at 18UTC on 27 May over the waters west of Enewetak (91250). It initially moved northward slowly toward a week trough in the subtropical anticyclone. During the northward migration, it intensified into TS at 00UTC on 29 and into STS at 06UTC on 30. MARIE further intensified into TY with its maximum wind of 65 knots and minimum pressure of 965 hPa at 00UTC on 31. As an upper trough of westerlies approached to the west of the typhoon, MARIE gradually turned its movement to the northeast. It weakened into STS at 18UTC on 31 and into TS at 12UTC on 1 June. Over the waters northwest of Midway (91066), it degenerated into an extratropical cyclone at 00UTC on 2 June and moved across the longitude of 180° into the western hemisphere at 12UTC of the day.

NESTOR (9706)

A tropical depression formed in the northern vicinity of Ponape (91348) at 00UTC on 5 June. It moved west in the southern periphery of a subtropical anticyclone along 20°N until 8 June, then turned northward as the ridge over the Marianas gradually retreated. It developed rapidly into TS NESTOR (9706) at 00UTC on 8, into STS at 12UTC of the day and into TY at 00UTC on 9 June over the waters east of Guam (91217). The subtropical anticyclone gradually developed over the Wake or Marshal Islands and NESTOR was led to move northwestward. During the northwestward migration, NESTOR reached its peak intensity with the maximum wind of 100 knots and the minimum pressure of 930 hPa at 06UTC on 10 June. On 13 June, the subtropical anticyclone over the Wake Island was at its maximum intensity and a significant westerly trough was approaching the Japanese Islands. NESTOR recurved to the northeast over the Ogasawara Islands. It weakened into STS at 18UTC on 13 June and transformed into an extratropical cyclone at 12UTC on 14 in the eastern waters of Japan. It further moved to the east and reached over the waters south of the Aleutian Islands across the longitude

of 180° into the western hemisphere at 18UTC on 16 June.

OPAL (9707)

OPAL (9707) formed as a tropical depression at 12UTC on 14 June about 1,000 km east of Luzon. It moved very slowly amidst the stagnant air of subtropical anticyclone and intensified into TS at 00UTC on 16. OPAL rapidly intensified into STS at 12UTC of the day and into TY at 06UTC on 17 June. During its developing period, the subtropical anticyclone over the Marianas also developed significantly and stretched northward covering the Ogasawara Islands. Another subtropical high developed over the southern China. As the result, a trough deepened over the western Japan and it began to move northward along the trough. OPAL reached its peak intensity with the maximum wind of 75 knots and the minimum pressure of 960 hPa at 00UTC on 18 June. As the subtropical anticyclone gradually retreated over the Ogasawara Islands, OPAL turned to the northeast decreasing its intensity into STS at 21UTC on 19 June. It landed on the southern coast of central Japan early on 20 June. Further weakening into TS at 12UTC of the day it left the Japanese Islands and degenerated into an extratropical cyclone at 00UTC on 21 June over the waters south of Hokkaido. It moved to the east and dissipated at 12UTC on 22 June over the southern waters of Kamchatka.

PETER (9708)

A tropical depression formed at 06UTC on 22 June about 1,000 km east of Luzon. It moved northwest along far periphery of the subtropical anticyclone over the Ogasawara Islands and developed into TS PETER (9708) at 06UTC on 24 June. The anticyclone again intensified over these waters, and PETER was hindered moving to the east. It kept northward migration developing into STS at 00UTC on 26. It further intensified into TY over the Eastern China Sea at 06UTC and gained its peak intensity on 27 June with the maximum wind of 65 knots and minimum pressure of 970 hPa. The subtropical anticyclone over the Ogasawara Islands was still intense. PETER moved northeast along the northern periphery of the ridge. After weakening into STS at 21UTC on 27, it landed on Kyushu, the western Japanese Islands. Crossing over Japan, it degenerated into an extratropical cyclone at 21UTC on 28 in the eastern waters of Japan. It temporally fell into stagnancy in the vicinity of the Kuril Islands, merging another low which had migrated over the Sea of Okhotsk from the Amur River basin. Then, moving to the east, it reached near the Aleutian Islands across the international dateline longitude of 180° into the western hemisphere at 00UTC on 4 July.

ROSIE (9709)

ROSIE (9609) formed as a tropical depression at 06UTC on 18 July in the northern vicinity of Yap (91413). It moved northwest along the western edge of a subtropical anticyclone centered in the vicinity of over the waters of Midway Island. It rapidly developed into TS at 00UTC on 20, into STS at 12UTC the same day and into TY at 12UTC on 21 July. The maximum wind of 100 knots and the minimum pressure of 920 hPa were expected at 00UTC on 23. Though ROSIE was located at the north of the subtropical anticyclone at the time, another anticyclone was significantly developing over the Mariana Islands and stretched northward for the Ogasawara Islands. ROSIE was prohibited its eastward migration and forced to move north directing the Japanese Islands. It landed on the coast of western Japan on 26 July and weakened into STS at 12UTC of the day. Leaving the Honshu Island of Japan, it further weakened into TS at 00UTC on 27 and into TD at 21UTC of the day over the Sea of Japan close to the coasts. The tropical depression again landed on the coast and moved across the central Honshu Island. ROSIE dissipated in the southern waters of Japan at 12UTC on 31 July.

SCOTT (9710)

A tropical depression formed just west of Marcus Island (47991) at 00UTC on 20 July. For a while it moved along the western periphery of a subtropical anticyclone centered over Midway. It reached to the north of 30°N on 24 July. As an upper cold trough approached over these waters and the anticyclone retreated, the tropical depression started swift migration to the southeast. It moved again to the southeastern waters of Marcus. There developed a significant anticyclone along 30°N to the north of the depression, and tropical depression was forced to be stagnant until 28 July. It intensified into TS SCOTT (9710) at 00UTC on 28 July. The subtropical anticyclone which extended to the north of SCOTT gradually retreated. SCOTT began northeastward migration. The maximum wind of 40 knots and the minimum pressure of 992 hPa were estimated at 18UTC on 28 July. Moving to the northeast, it weakened into TD at 12UTC on 2 August and degenerated into an extratropical cyclone at 00UTC on 3. The cyclone moved to the north across 180° longitude into the western hemisphere at 06UTC of the day.

TINA (9711)

TINA (9711) formed as a tropical depression over the waters about 1,000 km west of Guam at 00UTC on 29 July. It stayed there for four days amidst the stagnant air of inactive subtropical anticyclone around 15°N. During the stagnancy, it developed into TS at 06UTC on 31. As the subtropical anticyclone over the

Ogasawara and the Mariana Islands gradually intensified, TINA started to move to the west. It developed into STS at 00UTC on 2 August. To the north of TINA, there extended a significant ridge over the northern waters of the Philippine. TINA moved to the northwest, developing further into TY at 00UTC on 4. Gradual retreat of the subtropical anticyclone led TINA to northward migration. Moving across the Ryukyu Islands, peak intensity was reached at 00UTC on 7 August with the maximum wind of 75 knots and the minimum pressure of 955 hPa expected near the center of TINA. After weakening into STS at 12UTC on 8, it moved to the northeast along the mid-latitude westerlies. Moving across the Cheju Island and the Korean Peninsula, it weakened into TS at 03UTC on 9 August and degenerated into an extratropical cyclone at 09UTC of the day over the Sea of Japan. The cyclone passed over the northern Japan and dissipated at 00UTC on 11 August.

VICTOR (9712)

VICTOR (9712) formed as a tropical depression over the waters west of Luzon at 06UTC on 30 July. Moving slowly to the west, it developed into TS at 00UTC on 31 July. Then a subtropical anticyclone over the southern China gradually retreated and VICTOR started northward migration. It further intensified into STS at 00UTC on 1 August and gained its minimum pressure of 980 hPa and maximum wind of 60 knots at 12UTC of the day. VICTOR landed on the coast of the southern China and moved inland. It rapidly weakened into TS at 00UTC on 3 August and into TD at 03UTC of the day. It dissipated at 06UTC on 4 August in the central China.

WINNIE (9713)

A tropical depression formed over the waters of Marshall Islands to the south of Kwajalein (91366) at 06UTC on 6 August. It initially moved swiftly to the northwest along the significant flow around the subtropical high over the waters west of Midway Island. It reached over the eastern waters of the Mariana Islands where it developed into TS WINNIE (9713) at 12UTC on 9 August. The subtropical high over the Ogasawara Islands was at its mature stage at that time. WINNIE decelerated its swift migration to the northwest and slightly shifted its movement to the west-northwest. It developed into STS at 06UTC on 10 August and further into TY at 00UTC on 11. The minimum pressure of 915 hPa, the lowest of the year, and the maximum wind of 100 knots were expected at 12UTC on 12 August over the northern Mariana Islands. Though dominant subtropical anticyclone over the western North Pacific began to weaken, another significant anticyclone over the inland of China developed to the north of the typhoon. WINNIE continued to move

slowly until 18 August, then gradually recurved as an trough of northern westerlies approached. It landed on the coast of China late on 18 August and weakened into STS at 00UTC on 19 and into TS 12 hours later on its recurving track. Further weakening into TD at 00UTC on 20 August and degenerating into an extratropical cyclone at 12UTC of the day, it moved to the northeast across the Bohai Sea and the northeastern China. Gradually turning to the east it approached the Amur River. There formed a significant cutoff low of the mid-latitude westerlies over the eastern waters of the northern Japan. WINNIE was then within the southward flow on the western periphery of the trough. Moving slowly to the south, it dissipated over the Sea of Japan at 12UTC on 25 August.

YULE (9714)

Two tropical depressions formed, one at 06UTC on 16 August over the Marshall Islands and the other at 18UTC on 17 August over the Wake Islands. The former moved northward until it was controlled by mutual interaction of the adjacent cyclones. It spun twice along its looping track, i.e., on late 18 and on early 20 August. During this complicated migration, the former developed into TS YULE (9714) at 12UTC on 19 August. After the second spin in the near vicinity of Wake Island (91245), YULE merged the latter TD and intensified into STS at 12UTC on 20. The minimum pressure of 980 hPa and the maximum wind of 55 knots were estimated at 00UTC on 21 August. YULE was then amidst dominant northward flow within the eastern periphery of the significant cutoff low over the waters east of northern Japan. Moving rapidly to the north, it weakened into TS at 18UTC on 22 August. Then it merged the cutoff low and degenerated into an extratropical cyclone at 06UTC on 23 August. It traced a complicated track over the southeastern waters of Kamchatka and moved over the waters near the Aleutian Islands across the longitude of 180° into the western hemisphere at 18UTC on 28 August.

ZITA (9715)

ZITA (9715) formed as a tropical depression over the northwestern vicinity of Luzon at 06UTC on 20 August. After the passage of WINNIE (9713) across the subtropical anticyclone over the eastern China, there again formed a significant anticyclone along 30° N. Developing into TS at 00UTC 21 August and into STS at 18UTC of the day, it kept moving west-northwestward along the southern periphery of the anticyclone. The minimum pressure of 980 hPa and the maximum wind of 55 knots were expected near the Hainan Island at 06UTC on 22 August. After weakening into TS at 18UTC of the day, it landed on the coast of northern Viet Nam

and further weakened into TS at 06UTC on 23 August. It degenerated into TD in the inland of Indochina and dissipated at 06UTC on 24.

AMBER (9716)

A tropical depression formed over the waters east of the Philippines at 00UTC on 21 August. To the north of TD, there developed a significant subtropical anticyclone along the latitude of 25° N. It moved slowly to the northwest over the eastern waters of the Philippines. During erratic migration, it developed into TS AMBER (9716) at 00UTC on 22 August. It intensified into STS 12 hours later and further into TY at 12UTC on 23 August. The minimum pressure of 950 hPa and the maximum wind of 80 knots were estimated at 18UTC on 27 August. A temporary development of a cold trough over the central China led northwestward migration of AMBER. During the passage of Taiwan Island, it weakened into STS at 00UTC on 29 August. AMBER landed on the coast of the southern China around 12UTC of the day. Then it rapidly weakened into TS, and into TD at 21UTC on 29 August and dissipated at 12UTC on 31 over the inland of China.

CASS (9717)

CASS (9717) formed as a tropical depression at 06UTC on 27 August over the northern South China Sea. It initially drifted southward by mutual interaction with another typhoon AMBER (9716). As AMBER further migrated northward, CASS followed it. CASS developed into TS at 06UTC on 29. The minimum pressure of 992 hPa and the maximum wind of 45 knots were expected at 00UTC on 30 August over the Taiwan Straits. Shortly after landing on the coast of southern China, it weakened into TD at 09UTC of the day and dissipated at 00UTC on 31 August.

BING (9718)

A tropical depression formed over the waters west of Enewetak (91250) at 06UTC on 26 August. It initially moved along the easterlies within the southern periphery of the subtropical high over the waters of Marcus Island (47997). It moved in the very vicinity of Guam (91217) and developed into TS BING (9718) at 12UTC on 29 August. As the subtropical high over the northern waters of BING gradually retreated, it turned its movement to the north. BING developed into STS at 12UTC on 30 and into TY at 21UTC on 31 during its northward movement. Peak intensity was attained at 12UTC on 1 September as winds of 85 knots and pressure as low as 940 hPa were estimated near the center of BING. Restoration of the subtropical high over the waters of Marcus Island prohibited BING from

eastward migration. BING continued to move toward north until significant trough along the mid-latitude westerlies moved over the Japanese Island. On 3 September, a trough in the westerlies approached to the Japanese Islands and BING started its swift migration along northeastward steering flow of the westerlies. It weakened into STS at 12UTC on 4 September and degenerated into an extratropical cyclone at 18UTC of the day. It moved further to the northeast over the waters near the Aleutian Islands across the longitude of 180° at 00UTC on 6 September.

OLIWA (9719)

A tropical depression formed in the western hemisphere over the tropical Pacific migrated westward and developed into TS OLIWA (9719) at 00UTC on 4 September. It moved swiftly to the west in the southern periphery of significant subtropical anticyclone along 35°N. OLIWA acquired STS intensity at 12UTC on 6 September and TY intensity at 18UTC on 8 September. The maximum wind of 100 knot and the minimum pressure of 915 hPa were estimated at 18UTC on 10 September. As the ridge gradually retreated from the southern waters of the Japan Islands, OLIWA recurved the track northward. It made landfall on western Japan on late 15 September. Moving over the western Japan, it weakened rapidly into STS at 06UTC on 16 September and further into TS 6 hours later. OLIWA degenerated into an extratropical cyclone at 21UTC of the day. It moved to the northeast across the northern Japan and reached to the eastern waters of 180° longitude at 12UTC on 19 September.

DAVID (9620)

DAVID (9720) formed as a tropical depression over the Marshall Islands at 06UTC on 11 September. It initially moved northward along the western periphery of the subtropical high over the North Pacific. During the westward migration, DAVID developed into TS at 18UTC on 12 and into STS at 06UTC on 13. On 14 September, the subtropical anticyclone over these waters gradually retreated and DAVID shifted its movement northwestward migration in the southwestern periphery of the subtropical high to the north of Marcus Island (47991). It further intensified into TY at 12UTC on 14 September. The maximum wind of 85 knots and the minimum pressure of 945 hPa were expected at 12UTC on 15 September. It moved along the recurving track over the southeastern waters of the Japanese Islands. DAVID weakened into STS at 12UTC on 19 September over the eastern waters of the Islands and degenerated into an extratropical cyclone at 18UTC of the day. It moved further to the northeast and reached the western hemisphere across 180° longitude at 06UTC on 21 September.

FRITZ (9721)

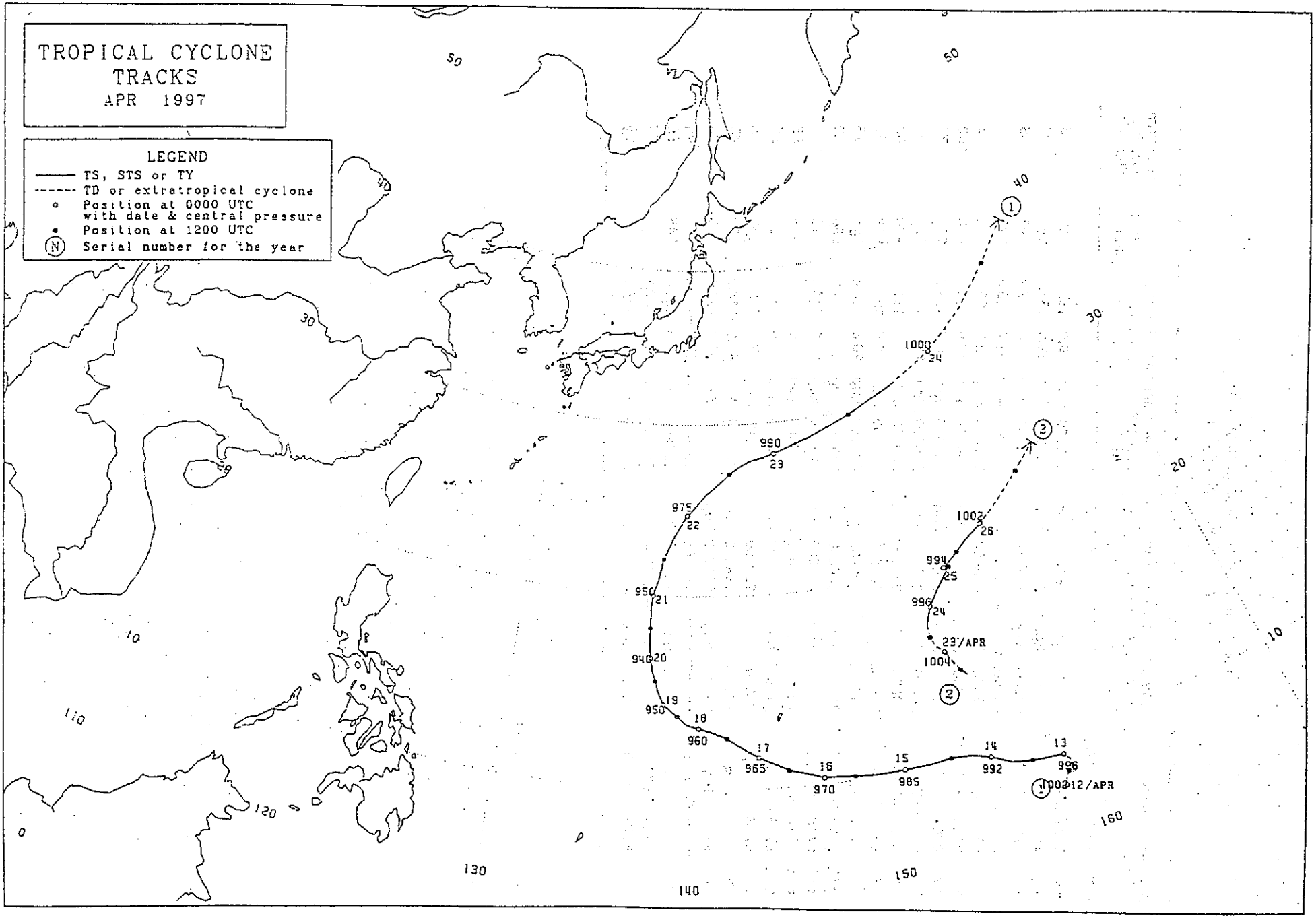
A tropical depression formed over the South China Sea near the coast of Viet Nam at 06UTC on 21 September. It initially moved slowly to the east amidst stagnant air of the subtropical anticyclone over these waters. It developed into TS FRITZ (9721) at 12UTC on 23 and into STS at 12UTC on 24. The maximum wind of 55 knots and the minimum pressure of 980 hPa were estimated at 18UTC on 24. As the subtropical anticyclone east and north of FRITZ intensified, it turned its movement to the west and made landfall on the coast of Viet Nam on 25 September. It weakened into TS at 06UTC of the day. Moving into inland of the Indochina Peninsula, it further weakened into TD at 00UTC on 26 September and dissipated at 06UTC on 27.

GINGER (9722)

GINGER (9722) formed as a tropical depression over the Marshall Islands at 00UTC on 23 September. It moved to the northwest in the southwestern periphery of significant subtropical high over the waters near Midway (91066). It developed into TS at 12UTC on 24 September and into STS at 06UTC on 25 September. Then temporary intensification of the subtropical anticyclone around the latitude of 25°N to the north of GINGER led it to decelerate. Migrating slowly to the northwest, GINGER developed into TY at 00UTC on 26 September. The maximum wind of 95 knot and the minimum pressure of 925 hPa were expected at 12UTC on 27 September. On 28 September, GINGER was on the southern periphery of dominant westerlies in the mid-latitudes. Northwards movement of GINGER was accelerated and reached the waters east of the Kuril Islands, where it weakened into STS at 00UTC on 30 September. Moving rapidly to the northeast, it degenerated into an extratropical cyclone at 12UTC on 30 and entered the western hemisphere across 180° longitude at 18UTC of the day.

List of tropical cyclones generated in 1997
(as of 30 September)

Tropical Cyclone	Duration of TS intensity or higher (UTC)	Minimum Central Pressure Date/Time (UTC)	Location (°N)	(°E)	Pressure (hPa)	Maximum Sustained Wind (kt)
TY 9701 ISA	130000 Apr - 231800 Apr	200000 Apr	16.6	137.7	940	85
TS 9702 JIMMY	231800 Apr - 260000 Apr	250000 Apr	19.9	155.2	994	35
TS 9703 KELLY	080600 May - 101200 May	080600 May	11.5	167.2	998	35
TS 9704 LEVI	280000 May - 290900 May	281200 May	21.7	126.6	992	40
TY 9705 MARIE	290000 May - 020000 Jun	310000 May	22.0	160.3	965	65
TY 9706 NESTOR	080000 Jun - 141200 Jun	100600 Jun	17.8	148.0	930	100
TY 9707 OPAL	160000 Jun - 210000 Jun	180000 Jun	20.7	133.6	960	75
TY 9708 PETER	240600 Jun - 282100 Jun	270600 Jun	28.4	126.5	970	65
TY 9709 ROSIE	200000 Jul - 272100 Jul	230000 Jul	19.1	131.9	920	100
TS 9710 SCOTT	280000 Jul - 021200 Aug	290600 Jul	25.5	155.9	992	40
TY 9711 TINA	310600 Jul - 090900 Aug	070000 Aug	26.8	126.4	955	75
STS 9712 VICTOR	310000 Jul - 030300 Aug	011200 Aug	18.7	114.0	980	60
TY 9713 WINNIE	091200 Aug - 200000 Aug	121200 Aug	18.1	144.9	915	100
STS 9714 YULE	191200 Aug - 230600 Aug	210000 Aug	22.0	168.1	980	55
STS 9715 ZITA	210000 Aug - 230600 Aug	220600 Aug	21.0	110.0	980	55
TY 9716 AMBER	220000 Aug - 292100 Aug	250000 Aug	17.5	128.6	955	75
TS 9717 CASS	290600 Aug - 300900 Aug	300000 Aug	22.2	118.2	992	45
TY 9718 BING	291200 Aug - 041800 Sep	011200 Sep	25.1	139.1	940	85
TY 9719 OLIWA	040000 Sep - 162100 Sep	101800 Sep	19.2	148.2	915	100
TY 9720 DAVID	121800 Sep - 191800 Sep	151200 Sep	22.6	156.4	945	85
STS 9721 FRITZ	231200 Sep - 260000 Sep	241800 Sep	15.6	109.2	980	55
TY 9722 GINGER	241200 Sep - 301200 Sep	271200 Sep	22.9	158.2	925	95


TROPICAL CYCLONE TRACKS
APR 1997
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
1000 24
990 23
975 22
950 21
940 20
950 19
960 18
965 17
970 16
985 15
992 14
996 13
1002 12/APR
1002 26
994 25
996 24
23/APR 1004
50
40
30
20
10
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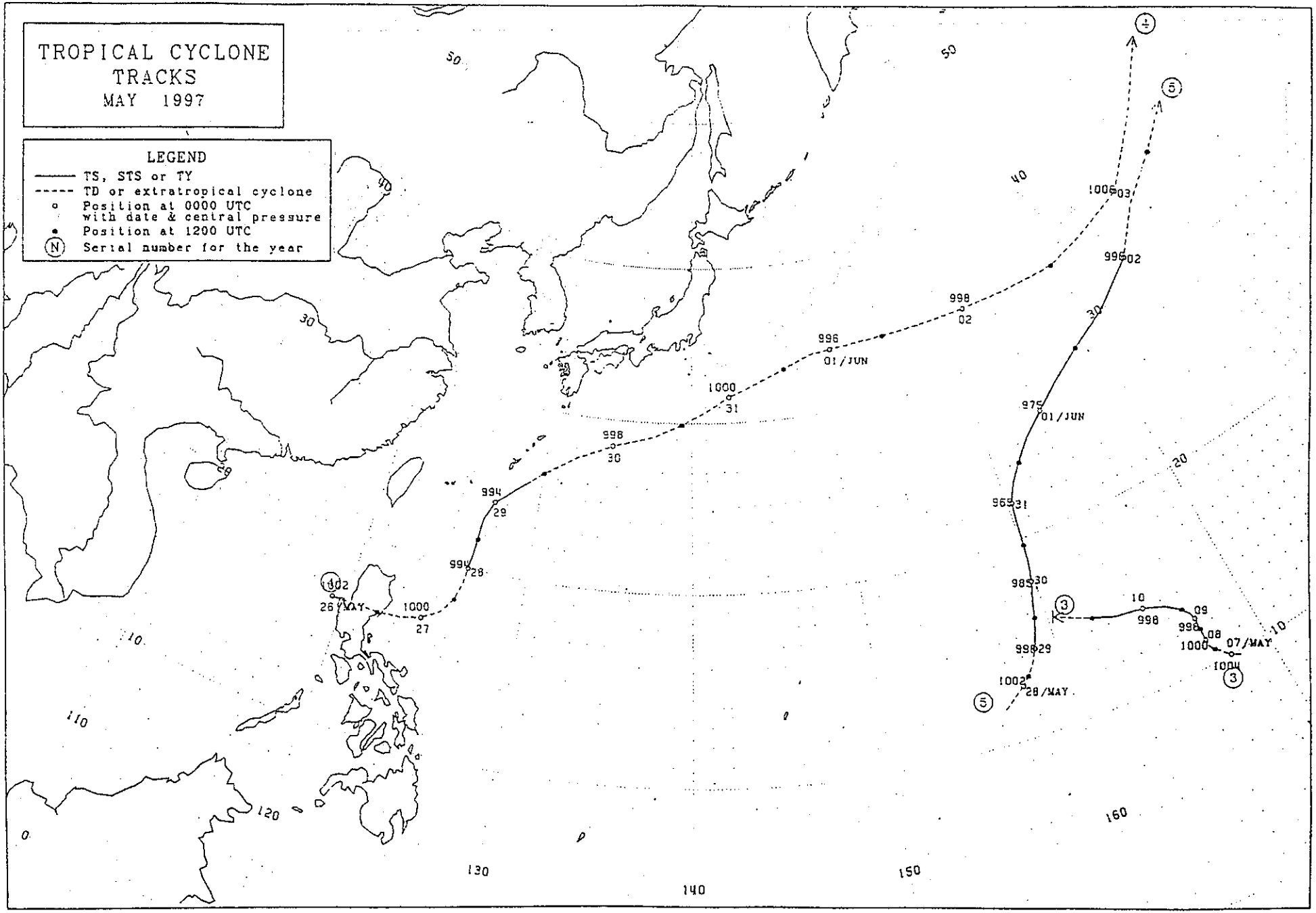
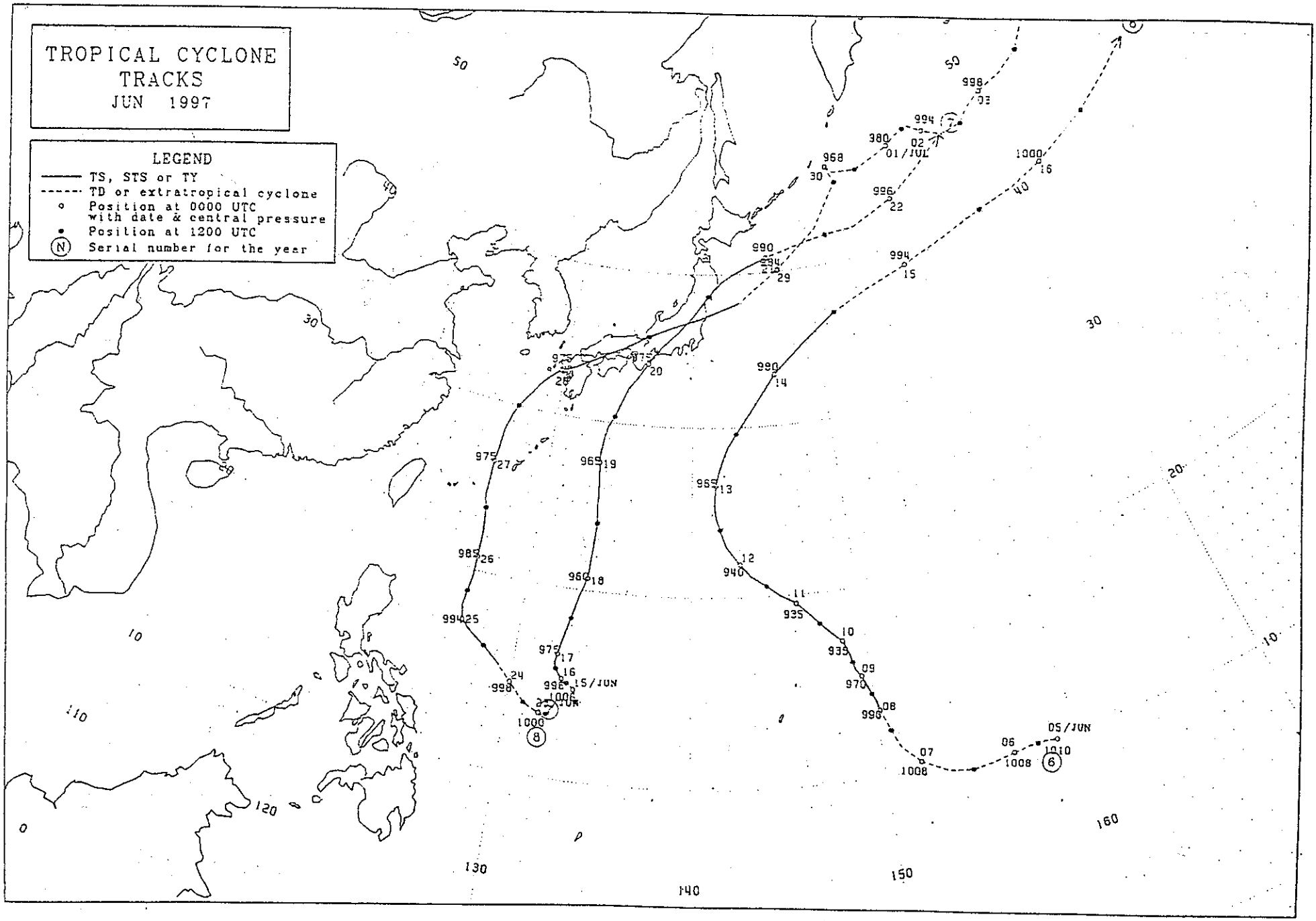
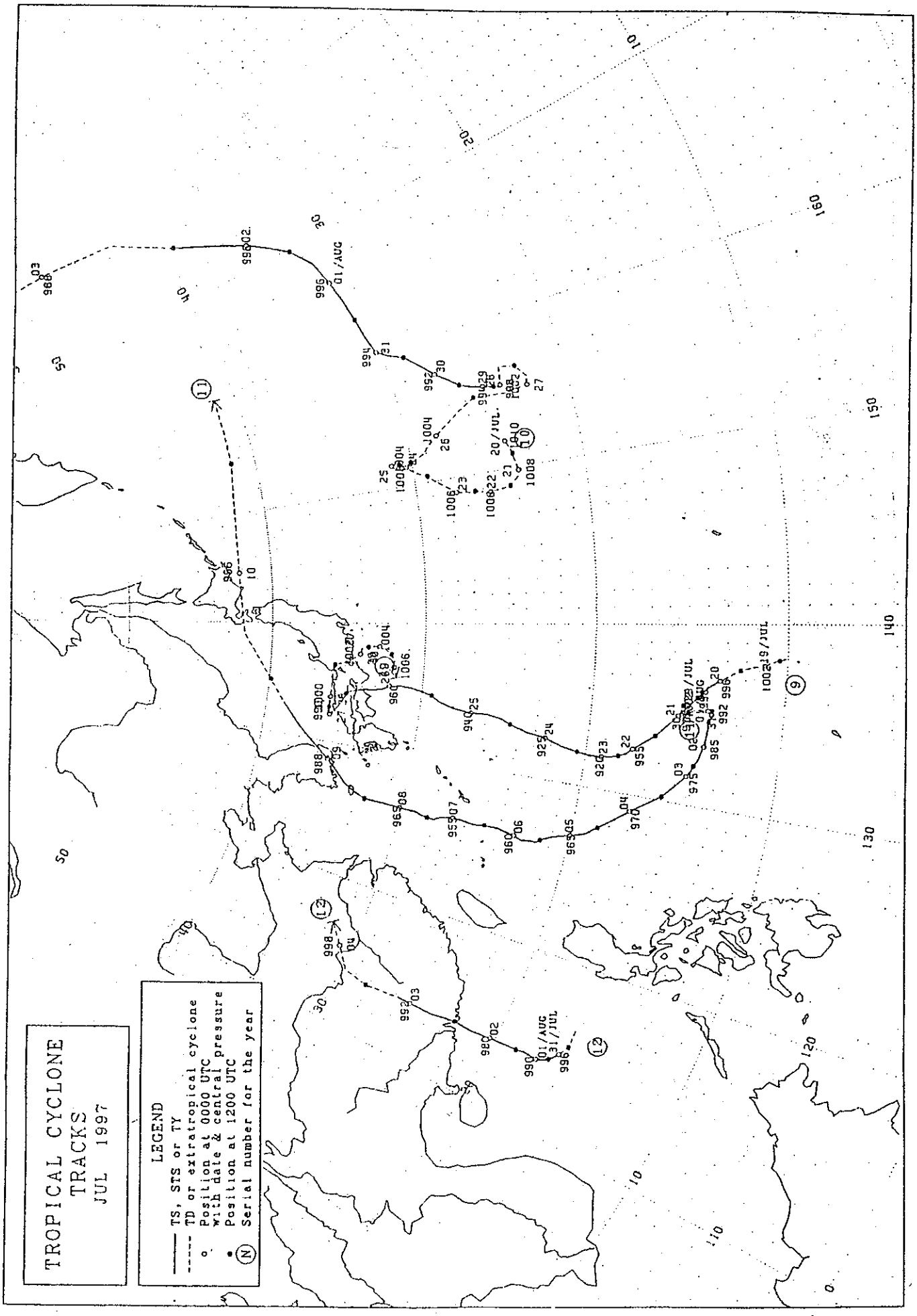
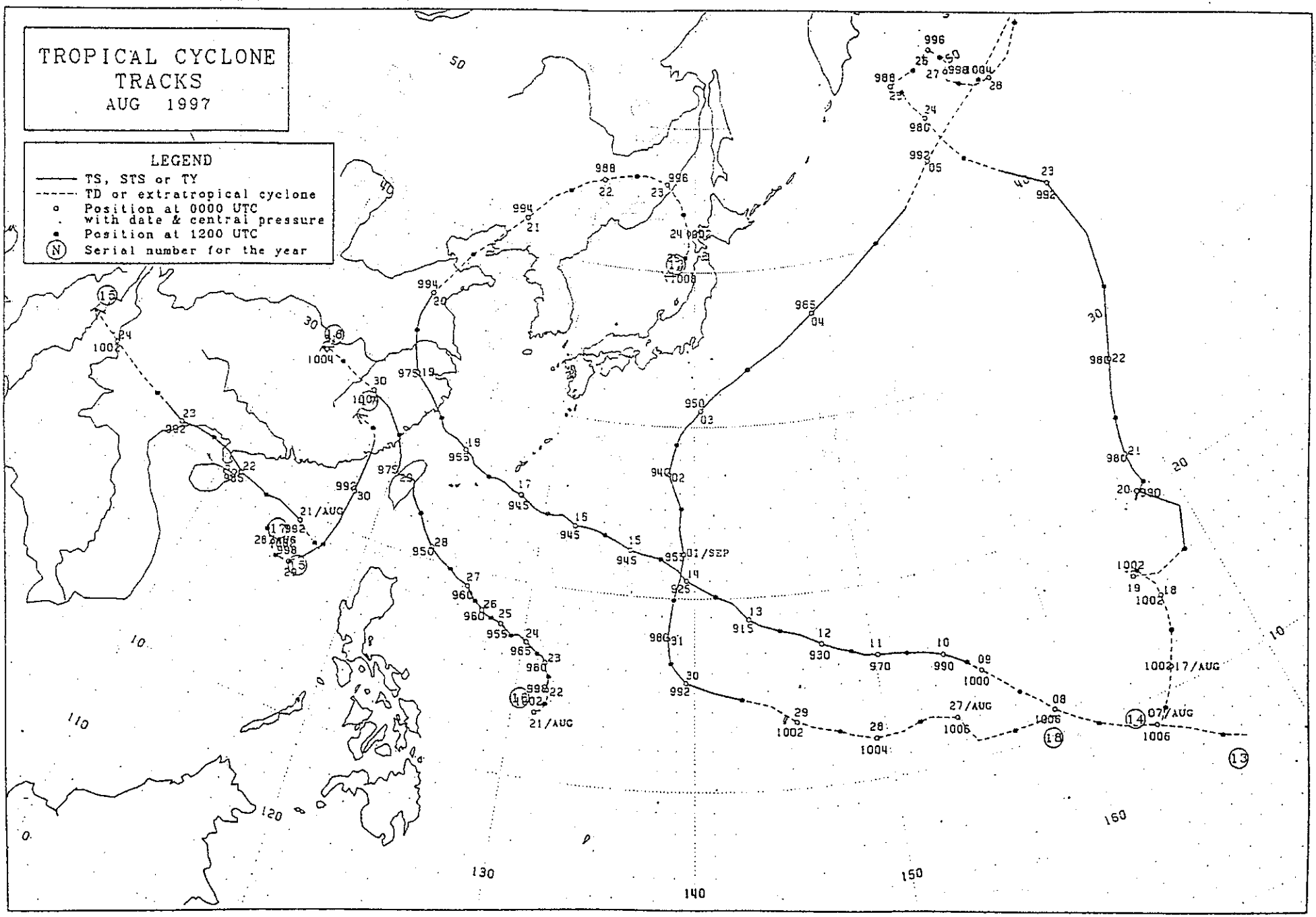
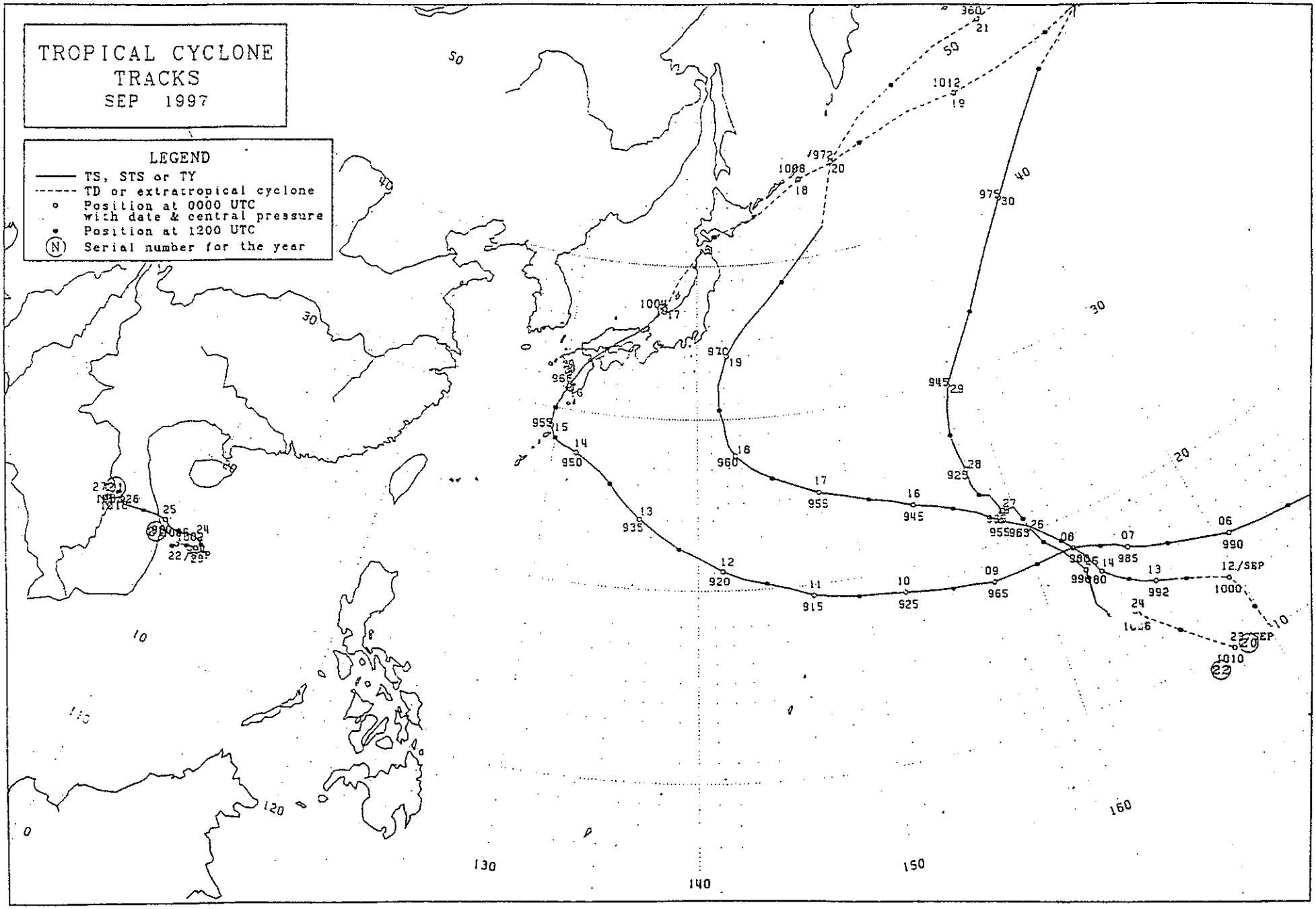
110
120
130
140
150
160


TROPICAL CYCLONE
TRACKS
MAY 1997
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
(N) Serial number for the year
50
40
30
20
10
0
110
120
130
140
150
160
1002
26/MAY
1000
27
994
28
994
29
998
30
1000
31
996
01/JUN
998
02
1000
03
996
02
30
975
01/JUN
20
965
31
985
30
10
998
09
998
08
1000
07/MAY
10
998
29
1002
28/MAY


TROPICAL CYCLONE
TRACKS
JUN 1997
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
01/JUL
05/JUN
15/JUN
25/JUN


TROPICAL CYCLONE
TRACKS
JUL 1997
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
(N) Serial number for the year


TROPICAL CYCLONE
TRACKS
AUG 1997
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
(N) Serial number for the year
50
40
30
20
10
0
110
120
130
140
150
160
21/AUG
01/SEP
27/AUG
17/AUG
07/AUG


TROPICAL CYCLONE
TRACKS
SEP 1997
LEGEND
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
(N) Serial number for the year
50
40
30
20
10
0
110
120
130
140
150
160
360
1012
1008
1004
1000
995
990
985
980
975
970
965
960
955
950
945
940
935
930
925
920
915
910
905
12/SEP
23/SEP

APPENDIX XIV

REGIONAL COOPERATION PROGRAMME IMPLEMENTATION PLAN (RCPIP)

PART A. CONTINUING TASKS 1. Meteorological Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
1.1 *Support to Meteorological Observing Systems and Facilities*				
1.1.1 Establishment of a communication line to RSMC data system via Internet or ISDN for distribution of RSMC Tokyo grid point data	↔ ↔ ↔ ↔	TC Members, WMO and ESCAP	National/External	Continuous activities
1.1.2 Expansion of observational programme: *With stress on radiosonde observations*	↔ ↔ ↔ ↔	Members	National/External	Continuous activities
1.1.3 Maintaining services specified in the Operational Manual, including intensified observations (surface, upper-air and radars)	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.1.4 Provision of automated observation facilities and real-time telemetry of meteorological parameters, e.g., winds, rainfall, pressure, etc., by replacing with automatic instruments	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.1.5 Establishment of AMedas, ASDAR, anemometer, tide gauge and water recorder networks	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.1.6 Establishment/upgrading of satellite equipment (GMS/TIROS-N/FY2))	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.1.7 Establishment of a WWW data user system for the reception of FAX and GPV data INTERNET or ISDN	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.1.8 Establishment/upgrading of weather radars	↔ ↔ ↔ ↔	Members	National	Continuous activities
1.2 *Support to Meteorological Telecommunication Systems and Facilities*				
1.2.1 Maintaining: • Services and facilities for the real-time exchange of data and products	↔ ↔ ↔ ↔	Members	National	Continuous activities

PART A. CONTINUING TASKS 1. Meteorological Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
• Monitoring of data exchange	↔ ↔ ↔ ↔	RTHs Bangkok, Beijing and Tokyo	Members concerned	Continuous activities
	↔ ↔ ↔ ↔	RTH Bangkok, Vientiane-Hanoi	Members concerned	Continuous activities
	↔ ↔ ↔ ↔	Bangkok-Vientiane-Ho Chi Minh		
1.2.2 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	Continuous activity
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	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 1. Meteorological Component	TIME SCALE 98	 99	 00	 01	BY WHOM	RESOURCES	REMARKS
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

PART A. CONTINUING TASKS		TIME SCALE				BY WHOM	RESOURCES	REMARKS
2.	Hydrological Component	98	99	00	01			
2.1	*Flood Forecasting and Warning*							
2.1.1	Installation and operation networks of observing stations required for flood forecasting systems	↔	↔	↔	↔	Members	National	Continuous activity
2.1.2	Establishment and operation of flood forecasting and warning system	↔	↔	↔	↔	Members	National	Continuous activity
2.1.3	Establishment of flood forecasting and warning systems for dam operations	↔	↔	↔	↔	Interested Members	National and external assistance	
2.1.4	Establishment of flood forecasting and warning systems for inundation from storm surges	↔	↔	↔	↔	Members concerned	Members concerned and external assistance including TCDC	Includes interaction of river floods and storm surges
2.1.5	Monitoring of/and reporting on performance of existing flood forecasting systems	↔	↔	↔	↔	Members	National and external assistance including TCDC and with support of TCS and WMO	Coordinated by WMO, using MOFFS
2.1.6	Further improvement of existing flood forecasting and warning systems, making use, where appropriate, of the results of TOPEX	↔	↔	↔	↔	Members	Members concerned and external assistance including TCDC	Includes catchment modeling
2.1.7	Implementation of recommendations of mission by experts to provide technical guidance on items 2.1.1 to 2.1.6	↔	↔	↔	↔	Members	External assistance, Missions to be organized by WMO and ESCAP	Using, where appropriate, technology available through HOMS
2.1.8	Exchange of technical visits among flood forecasters	↔	↔	↔	↔	Members	National and external assistance	Coordinated by WMO
2.1.9	Development and application of guidance on hydrological technology models for tropical cyclone regions	↔	↔	↔	↔	Members	External assistance with WMO	On the basis of OHP (HOMS)
2.1.10	Development and use of improved techniques for Quantitative Precipitation Forecast (QPF) taking advantage of data provided by satellite and radar	↔	↔	↔	↔	Members	National and external assistance	WMO to assist in development and promulgation of improved techniques

PART A. CONTINUING TASKS 2. Hydrological Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
2.2 *Comprehensive Flood Loss Prevention and Management*				
2.2.1 Establishment of pilot area for comprehensive flood loss prevention and management	↔ ↔ ↔ ↔	Members	Bilateral or multilateral support if available	Detailed programme will be established by respective Members
2.2.2 Investigation and survey including:		Members	National	ESCAP and WMO to assist in organizing investigations and surveys
• Determination of flood-prone areas subject to heavy damages	↔ ↔ ↔ ↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
• Determination of magnitude and corresponding frequency of floods in each flood-prone area	↔ ↔ ↔ ↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
• Assessment of potential flood damage in each area for various flood magnitudes	↔ ↔ ↔ ↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
• Preparation of flood risk maps	↔ ↔ ↔ ↔	Members	National	ESCAP and WMO to assist in organizing investigations and surveys
2.2.3 Application of the manual and guidelines for/and dissemination of techniques for comprehensive flood loss prevention and management	↔ ↔ ↔ ↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.4 Implementation of selected aspects of comprehensive flood loss prevention and management	↔ ↔ ↔ ↔	Members	National and external assistance	With assistance of ESCAP and WMO
2.2.5 Mission of experts to provide technical guidance to Members on items 2.2.1 to 2.2.4 above	↔ ↔ ↔ ↔	Members	UNDP, TCDC and bilateral, multi-lateral support if available	With assistance of ESCAP and WMO
2.2.6 Preparation and application of a manual and guidelines for integrated river system development and management with	↔ ↔ ↔ ↔	Members	National and external assistance	With assistance of ESCAP and WMO

PART A. CONTINUING TASKS 2. Hydrological Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
reference to comprehensive flood loss prevention and management				
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 3. Disaster Prevention and Preparedness	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
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 DHA/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 dissemination 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 DHA
3.2.6 Development and exchange of information and guidance materials on structural and non-structural measures for mitigation of disasters	↔ ↔ ↔ ↔	Members	External assistance	With guidance from international agencies, such as, DHA, IFRC, ESCAP and WMO
3.2.7 Conducting case studies of response to major disasters	↔ ↔ ↔ ↔	Members	External Assistance	With advice from DHA, IFRC, and WMO
3.2.8 Compilation of annual information on loss of life and damage caused by typhoons, floods and storm surges including damage to houses, public facilities, agricultural products, and so on	↔ ↔ ↔ ↔	Members	External Assistance	With advice from DHA in co-operation with ESCAP

PART A. CONTINUING TASKS 3. Disaster Prevention and Preparedness	TIME SCALE 98 | 99 | 00 | 01				BY WHOM	RESOURCES	REMARKS
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 4. Training Component	TIME SCALE 98 | 99 | 00 | 01				BY WHOM	RESOURCES	REMARKS
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 4. Training Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
4.1.12 Training on storm surge and wave prediction	↔ ↔ ↔ ↔	Members	Short-term fellowships with external support	
4.1.13 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 Group training courses on river engineering	↔ ↔ ↔ ↔	Japan	Japan International Cooperation Agency (JICA)	At the request of TC
4.2.7 Exchange of flood forecasting experts	↔ ↔ ↔ ↔	Members	WMO, ESCAP, UNDP and other sources	TCDC requirements
4.3 *Disaster Prevention and Preparedness*				
4.3.1 Training of disaster managers and volunteer leaders	↔ ↔ ↔ ↔	Members	National and external assistance	With advice from international agencies

PART A. CONTINUING TASKS 4. Training Component	TIME SCALE 98	 99	 00	 01	BY WHOM	RESOURCES	REMARKS
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 DHA, IFRC, ESCAP and WMO
4.3.4 Exchange of information on the socio-economic impact of disaster	↔	↔	↔	↔	Members	DHA, IFRC	Seminars organized by DHA, IFRC and WMO
4.3.5 Training on disaster vulnerability and risk assessment	↔	↔	↔	↔	Members	DHA, IFRC	Courses and seminars organized by DHA, 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	DHA, IFRC, ESCAP and other sources	TCDC arrangement organized by DHA, IFRC, TCS and ESCAP

PART A. CONTINUING TASKS 5. Research Component	TIME SCALE 96 | 99 | 00 | 01				BY WHOM	RESOURCES	REMARKS
5.1 *Meteorology*							
5.1.1 General studies on:							
5.1.1.1 Interaction between typhoons and the environmental circulation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.2 Typhoon climatology in relation with anomalies in regional circulation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.3 Forecasting storm surge and heavy rainfall	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.1.4 Tropical cyclone related rainfall and intensity rates aimed at detection of possible relationship to global climate change	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2 Utilization of TOPEX, SPECTRUM, TCM-90 and TYPHOON-90 data set in tropical cyclone numerical and physical modeling, with the aim of improving existing methods of predicting formation, development and steering	↔	↔	↔	↔	Members or regionally coordinated programme	National	Need for short-term attachment of experts to advanced centers in the typhoon region
5.1.2.1 Establishment and operation of a tropical cyclone data bank for the northwestern Pacific and East Asia with software exchanges between Members	↔	↔	↔	↔	RSMC Tokyo	Japan	According to the procedure described in TOM
5.1.2.2 Development of an operational NWP model for typhoon movement and development	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.3 Irregular tropical cyclone behavior, such as, sudden turning of tracks, sudden increase/decrease of intensity, rainfall and storm surge	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.4 Air-sea interactions associated with the occurrence of typhoons, with emphasis on wave and storm surge generation	↔	↔	↔	↔	Members or regionally coordinated programme	National	
5.1.2.5 Study on typhoon-related wind climatology					Members	National	

PART A. CONTINUING TASKS 5. Research Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
5.1.2.6 Study on climatology of precipitation extremes	↔ ↔ ↔ ↔	Members	National	Counts on discussion
5.1.2.7 Encourage participation in the works of the CAS working group	↔ ↔ ↔ ↔	Member	National	
5.1.2.8 Encourage members to provide the CAS Committee on Climate Change Aspects of Tropical Cyclones relevant data sets for their consideration	↔ ↔ ↔ ↔	Members	National	
5.2 *Hydrology*				
5.2.1 Application of meteorological inputs to flood forecasting	↔ ↔ ↔ ↔	National or regionally coordinated programmes	National	In cooperation with ESCAP
5.2.2 Study of effects of deforestation, urbanization and changing land use on the hydrology of the catchment and on the intensity of floods	↔ ↔ ↔ ↔	Members	National	In cooperation with ESCAP
5.2.3 Research on hydrological aspects of El-Niño phenomena	↔ ↔ ↔ ↔	Members	National and external resources	In cooperation with ESCAP, WMO, DHA and other concerned agencies
5.3 *Disaster Prevention and Preparedness*				
5.3.1 Studies on the socio-economic impact of typhoon and flood disasters	↔ ↔ ↔ ↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.2 Vulnerability and risk assessment of disaster-prone areas	↔ ↔ ↔ ↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.3 Socio-economic implication of availability and quality of typhoon and flood forecasts and warnings	↔ ↔ ↔ ↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
5.3.4 Disaster impact modelling	↔ ↔ ↔ ↔	Members	National	With advice and possible support of UNDP, IFRC, ESCAP and WMO
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

PART A. CONTINUING TASKS 5. Research Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
5.3.6 Preparedness for social and economic aspects of El Niño	↔ ↔ ↔ ↔	Members	National	With advice and possible support of DHA, ESCAP, WMO and other concerned agencies

PART B. SPECIFIC TASKS 1. Meteorological Component	TIME SCALE 98 | 99 | 00 | 01				BY WHOM	RESOURCES	REMARKS
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	↔	↔	↔	↔	Thailand and 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 and Thailand	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 2. Training Component	TIME SCALE 98 | 99 | 00 | 01				BY WHOM	RESOURCES	REMARKS
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		↔			Thailand	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

PART B. SPECIFIC TASKS 3. Research Component	TIME SCALE 98 | 99 | 00 | 01	BY WHOM	RESOURCES	REMARKS
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 XV

ACTIVITIES OF THE RSMC TOKYO-TYPHOON CENTER

The RSMC Tokyo-Typhoon Center is disseminating operational products on tropical cyclones within the responsible areas. Table 1 shows the total number of products disseminated by the RSMC Tokyo-Typhoon Center to Typhoon Committee Members from 1 January through 30 September 1997. The Implementation Plan of the RSMC Tokyo-Typhoon Center from 1997 to 2001 is shown in Table 2.

With regard to the accuracy of typhoon forecasts issued by forecasters, Fig. 1 shows error distribution of 24-hour, 48-hour, and 72 hour forecast of the center position of tropical cyclones with Tropical Storm intensity or more. Figure 2 shows an improving accuracy. In 1997, mean errors are approximately 150 km for 24-hour forecast, 270 km for 48-hour forecast, and 400 km for 72-hour forecast. The accuracy of 72-hour forecast in 1997 is nearly equal to that of 48-hour forecast about ten years ago.

RSMC DATA SERVING SYSTEM

JMA, started in March 1996, to provide Members of the Typhoon Committee (TC), through the RSMC Data Serving System, with grid point values (GPVs) and observations. Eight Members were registered for the access to the system as of September 1997. As of November 1997, the system provided TC Members with the data shown in Table 3. Shadings on the variables in Table 3 indicate that these variables were newly added for distribution in 1997. GPVs with 1.25° x 1.25° horizontal resolution are expected to be used as initial values and lateral boundary values of limited area NWP models. In order to further support NWP activities among TC Members, we will add GPVs to the system of the lower stratosphere with 1.25° x 1.25° horizontal resolution in early 1998.

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	53	27	70	51	161	130	–	–	–	492
TCNA21	0	0	0	57	28	80	62	179	143	–	–	–	549
WTPQ20-25	0	0	0	58	31	83	63	185	149	–	–	–	569
WTPQ30-35	0	0	0	28	16	39	31	91	74	–	–	–	279
FXPQ20/21	0	0	0	57	30	79	63	151	130	–	–	–	510
FKPQ30-35	0	0	0	58	31	83	63	185	149	–	–	–	569
AXPQ20	1	0	0	0	2	1	3	2	4	–	–	–	13
AUXT85 AUXT20	62	56	62	60	62	60	62	62	60	–	–	–	546
FUXT852 FUXT854	62	56	62	60	62	60	62	62	60	–	–	–	546
FUXT202 FUXT204	62	56	62	60	62	60	62	62	60	–	–	–	546

Notes:

– via the GTS –

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

– via the JMH Meteorological Radio Facsimile –

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

Table 1 Monthly and annual total numbers of products issued by the RSMC Tokyo - Typhoon Center in 1997 (as of 30 September)

Implementation Plan of the RSMC Tokyo – Typhoon Center (1997–2001)

PRODUCT	1997	1998	1999	2000	2001	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						
MTSAT HIRID						
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 78 hours
						TYM up to 84 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 48 hrs
						up to 72 hrs
Others						
RSMC Tropical Cyclone Best Track						GTS
"Annual Report"						
"Technical Note"						

SUPPORTING ACTIVITY	1997	1998	1999	2000	2001	REMARKS
Data archive						
Monitoring of data exchange						
Dissemination of products						RSMC Data Server
						LRIT (MTSAT)

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

Table 2 Implementation Plan of the RSMC Tokyo - Typhoon Center (1997-2001)

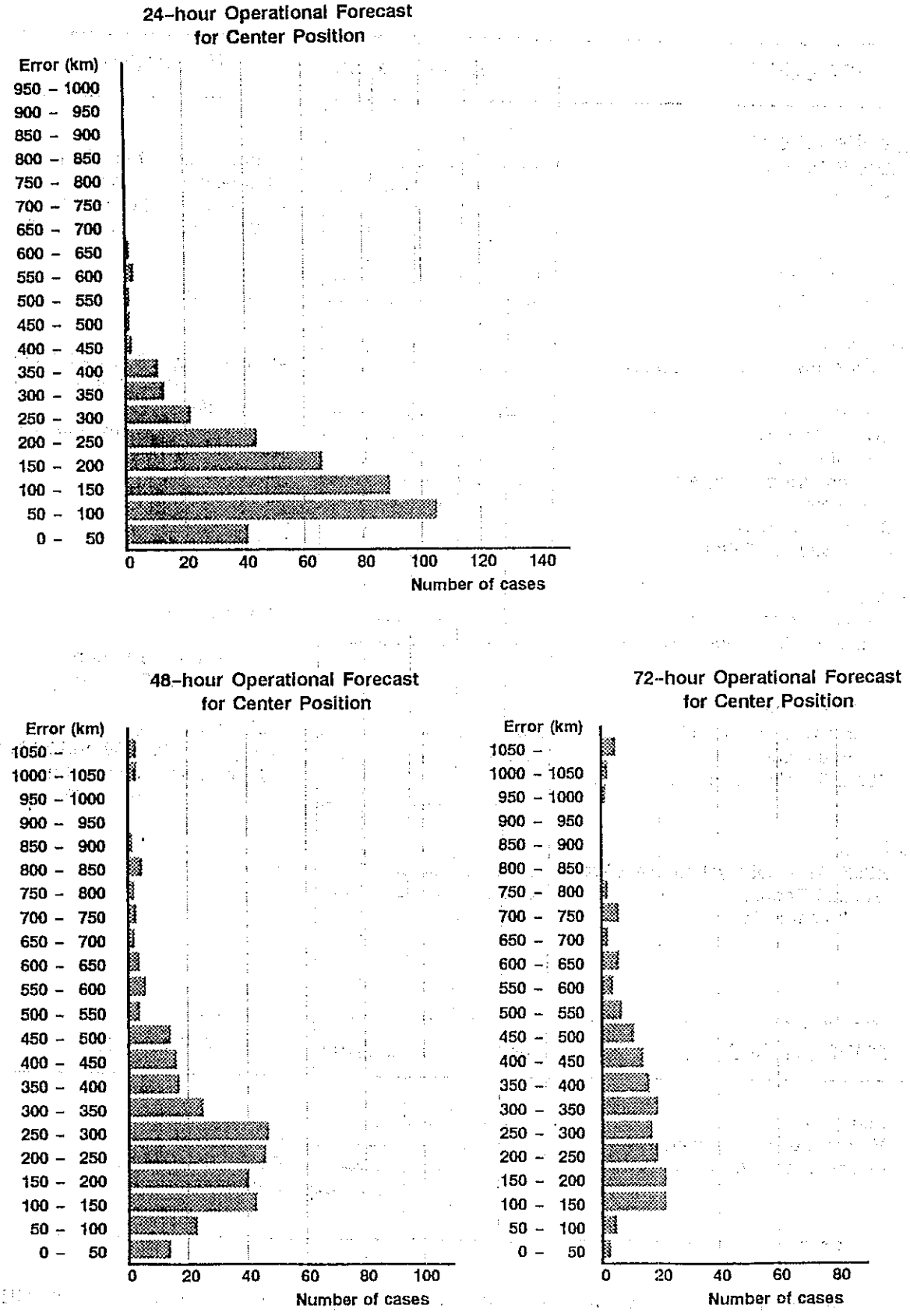


Figure 1 Error distribution of 24-, 48- and 72- hour forecast for center position of tropical cyclone with TS intensity or more in 1997 (as of 30 September)

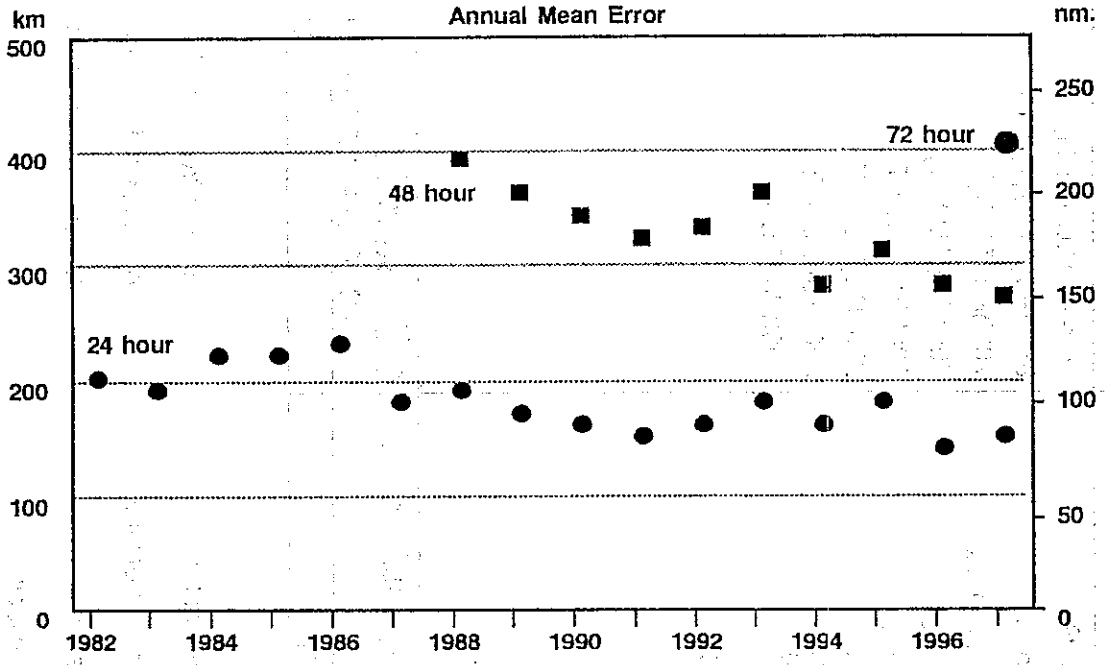


Figure 2 Annual mean errors in the forecast positions.

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,ξ) 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) 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,ξ) 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)	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,R) 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	00,06,12,18,24,30,36,42,48,54,60,72	00UTC : 00,24,48,72 12UTC : 00,24,48,72,96,120	00UTC : 00
Time/Day	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	2 time (00 and 12 UTC)	

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

Table 3 List of GPV products on the RSMC Data Serving System

APPENDIX XVI

REPORT OF THE TYPHOON RESEARCH COORDINATING GROUP

Submitted by the Chairman, Typhoon Research Coordinating Group

1. Introduction

1.1 The idea of a Typhoon Research Coordinating Group (TRCG) was first discussed in the 4th Technical Conference on SPECTRUM held in Tsukuba, Japan in November 1995. The proposal was subsequently endorsed by the Typhoon Committee at its 28th session held in Kuala Lumpur in December 1995. The agreed terms of reference for the TRCG are given in Appendix 1.

1.2 Nomination of representatives to the TRCG by Typhoon Committee members was carried out in 1996. The formation of TRCG was formally declared by the Typhoon Committee Secretariat on 5 December 1996.

1.3 The composition of TRCG is:

Chairman	:	Mr. C. Y. Lam	Hong Kong, China
Members	:	Ms. Seth Vannareth	Cambodia
		Ms. Tian Cuiying	China
		Mr. Yukio Takemura	Japan
		Mr. Thongphou Vongsyprasom	Lao PDR
		Mr. Hao I Pan	Macau
		Mr. Ooi See Hai	Malaysia
		Dr. Rosa T. Perez	Philippines
		Dr. Woo-jin Lee	Republic of Korea
		Dr. Patipat Patvivatsiri	Thailand
		Ms. Nguyen Thi Minh Phuong	Viet Nam
Ex-officio	:	Dr. Masashi Nagata	Japan

2. Activities in 1997

2.1 The Chairman sent a letter to members in January to solicit views and ideas regarding the functions and activities of the TRCG. A visit to RSMC Tokyo - Typhoon Centre was also made in June to discuss TCRG-related matters with Mr. Takemura and Dr. Nagata.

2.2 Based on members' returns, areas identified as requiring research are summarized in Appendix 2.

2.3 Continuing efforts and liaison are being made to facilitate members' utilization of the SPECTRUM and TCM-90 dataset.

3. Outlook for TRCG in 1998 and beyond

3.1 TRCG members will be encouraged to develop research projects within their respective countries under the five major topics listed in Appendix 2.

3.2 Consultation among members will be conducted on the feasibility of setting up a TRCG homepage on the Internet for researchers to exchange data, information, analysis tools, results, opinions and experience.

3.3 Means will be explored to facilitate cooperative research efforts among centres in the region, such as the identification of specialized research centres in the region for topics listed in Appendix 2 and arrangements for research attachments. Research resources from outside the region may also be considered.

4. Recommendations

4.1 To maximize the coordination efforts, the merging of the roles of Typhoon Committee research correspondents and membership of the TRCG may be considered.

4.2 Subject to availability of resource, it is recommended that the TRCG meets once every four years in conjunction with a regional technical conference on tropical cyclones to discuss latest scientific and technical developments and how they impact on operational analysis and forecasting of tropical cyclones in the region. It would provide an opportunity to review regional cooperative research initiatives, existing and planned. A possible time slot would appear to be the year 2000, that is, in between the regular International Workshop on Tropical Cyclones also held at 4-year intervals.

TYPHOON RESEARCH COORDINATING GROUP

Terms of Reference:

1. To further strengthen efforts using SPECTRUM, TCM-90 and Typhoon-90 data with extended aspects on rainfall, strong winds and storm surges as well as NWP comparison studies geared towards operational typhoon forecasting.

2. To identify scientific and technical problems in the operational analysis and forecasting of tropical cyclones, and to suggest key research projects at certain periods for Typhoon Committee consideration.

3. To maintain communication with other related international research communities and to promote research addressing common scientific and technical problems.

4. To coordinate the organization of a "Regional Technical Conference on Typhoon" with WMO and the TCS at the request of the Typhoon Committee so as to keep abreast of scientific and technical findings and of the developments relating to the operational analysis and forecasting of tropical cyclones and related impacts to each Member.

5. To report to the Typhoon Committee Session on the recent developments in research activities associated with operational analysis and forecasting of tropical cyclones.

Typhoon Research Coordinating Group
Research Topics and Related Activities

Topic 1 - Tropical Cyclone Forecasting

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

Topic 2 - Hazards associated with Tropical Cyclones

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

Topic 3 - Observations and Operational Aspects

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

Topic 4 - NWP Aspects

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

Topic 5 - Large-scale effects and Long Term Changes

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

ESCAP/WMO TYPHOON COMMITTEE TRUST FUND

Interim Account for the Biennium 1996/1997

As at 31 August 1997

			$	$	$
	Balance of fund as at 1 January 1996			323,800	
	Adjustment for cancellation of prior period obligations			358	
					324,158
	Advances received			156,000	
	Other income			27,180	
	Exchange difference			(105)	
					183,075
	Total revenue				507,233
	Less: Expenditure				
			Liquidated	Unliquidated	Total
(I)	Sessions of Committee		356	5,644	6,000
(II)	Administration Costs - Local		53,018	17,935	70,953
	Administration Costs - WMO				0
(III)	Consultative Meeting on Cambodia in Manila*		13,786		13,786
(IV)	Support Study Tour in China		10,747	982	11,729
	Spectrum technical Conference		50		50
(V)	MOFFS Seoul		6,392	1,614	8,006
(VI)	Expert Meeting Female Senior Forecasters			18,553	18,553
(VII)	Publications and Reports		1,389	7,995	9,384
(VIII)	Missions		31,706		31,706
	Total Expenditure				170,167
	Balance at 31 December 1997			$	337,066

Represented by:

Cash at Bank		389,789
Less: Unliquidated Obligations		52,723
	$	337,066

Contributions received

	1,996	1,997
China	12,000	
Hong Kong	12,000	12,000
Japan	12,000	12,000
Korea Rep. of	12,000	
Macau	12,000	12,000
Malaysia	12,000	12,000
Singapore		12,000
Thailand	12,000	12,000
Total	84,000	72,000

* including émission to Laos PDR (see Attachment III -(ii))

30th Session
ESCAP/WMO Typhoon Committee
Hong Kong, China
25 November - 1 December 1997

PRESS RELEASE

(Monday, 1 December 1997)

Asian Names for Typhoons in the Future

The ESCAP/WMO Typhoon Committee has decided at its 30th Session in Hong Kong, China from 25 November to 1 December 1997, to work towards using Asian names for typhoons in the western North Pacific.

Currently, press and the electronic media in a number of places in the region uses names given by the U.S. military Joint Typhoon Warning Center located at Guam.

For many years, the Typhoon Committee has been using a numbering system to label the typhoons. The Committee, with Members* from almost all the places affected by typhoons, thought that a regionally agreed naming system should be set up for use in this region. As typhoons refer to tropical cyclones affecting many places in East Asia, it is believed that the use of Asian names would enhance the alertness of the people to approaching typhoons, making warnings more effective.

A special group has been assigned the task of looking into the details of implementation of this idea. The group will report back to the Typhoon Committee in the next session, when the implementation of the new naming system, tentatively in the year 2000, will be further discussed.

El Niño and Abnormal Typhoon Behaviour

At the same session, the Typhoon Committee noted that the typhoon season in 1997 had been exceptional in many ways, including early arrival of typhoons in Japan, late start of typhoon season in China, much below normal typhoon activities in the South China Sea, and yet the peculiar event of a severe typhoon hitting southern Thailand and Viet Nam in early November. The Philippines also saw much fewer than normal visits by typhoons and consequently faced drought conditions of a serious degree.

The Committee observed that there were many similarities between this year and the 1982-83 period, both of which were El Niño years. In this connection, the Committee commended the Philippine government for taking the timely advice of its weather service and responding by effective measures to minimize loss and damage in the country.

Members of the Committee pledged to step up their cooperative efforts to monitor atmospheric and hydrological conditions in the region and to exchange speedily information among themselves, so as to be in a better position to advise their respective governments about the regional impacts of El Niño and any other phenomena of similar time and space scales in the future.

* Members of the ESCAP/WMO Typhoon Committee include: Cambodia; China; Democratic People's Republic of Korea; Hong Kong, China; Japan; Lao People's Democratic Republic; Macau; Malaysia; Philippines; Republic of Korea; Singapore; Thailand; Viet Nam.