



**UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION**

**FOR ASIA AND THE PACIFIC**

**AND**

**WORLD METEOROLOGICAL ORGANIZATION**

**REPORT OF THE TYPHOON COMMITTEE  
ON ITS TWENTY-SIXTH SESSION**

**Quezon City, Philippines  
2 - 8 November 1993**

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## I. ORGANIZATION OF THE SESSION

1. The Twenty-sixth session of the Typhoon Committee was held at Quezon City, Philippines from 2 to 8 November 1993. The session was co-sponsored by the Economic and Social Commission for Asia and the Pacific (ESCAP) and the World Meteorological Organization (WMO), and was hosted by the Government of the Philippines.

### Attendance

2. The Session was attended by 58 participants and observers. They represented 9 (out of 12) Members of the Typhoon Committee, namely, China, Hong Kong, Japan, Macau, Malaysia, Philippines, the Republic of Korea, Thailand and Viet Nam. Two observers from the United States of America also attended the session. In addition, observers from the WMO Commission for Atmospheric Sciences (CAS), UNESCO and the International Federation of Red Cross and Red Crescent Societies were present. The list of participants is attached as Appendix I.

### Opening of the session (Agenda item 1)

3. Mr. Yan Hong, Chairman of the Committee, declared the meeting open. Dr. Roman L. Kintanar, Director of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) of the Philippines extended a very warm welcome to all the participants at the session. He mentioned briefly that the Tropical Cyclone Programme (TCP) of WMO was a direct result of the recommendations of the Typhoon Committee as a reaction to the destruction caused by a tropical cyclone that hit Bangladesh and another cyclone that hit the Philippines in 1970. He stated that the activities of the Committee had been recognized by WMO and other United Nations bodies even before the organization of the International Decade for Natural Disaster Reduction (IDNDR). He ended by wishing everyone a fruitful session and happy stay in the Philippines.

4. The representative of ESCAP delivered the statement of the Executive Secretary of ESCAP. The Executive Secretary in his statement expressed his appreciation to the Government of the Philippines for hosting the session and for hosting and providing excellent support to the Typhoon Committee Secretariat (TCS) over the years. The Committee was informed that ESCAP at its forty-ninth Commission session in 1993 had noted the considerable progress achieved in the implementation of activities of the Typhoon Committee. The Committee was also informed that the ESCAP Committee on Environment and Sustainable Development at its first session in 1993 had suggested that the natural disaster reduction activities should be combined with poverty alleviation efforts and that it had also adopted a set of recommendations for various aspects of natural disaster reduction. The Executive Secretary thanked those Members that had been supporting the activities of

the Typhoon Committee, as well as the World Meteorological Organization, the IDNDR Secretariat, and the International Federation of Red Cross and Red Crescent Societies, and acknowledged the significant contributions made by the Office of the United Nations Disaster Relief Coordinator and the United Nations Development Programme to the progress of the Committee in the past. He reviewed ESCAP's activities on natural disaster reduction in the past year and informed the Committee that the project on assessment of current preparedness programmes, forecasting systems and operational methods for water-related natural disaster reduction had been reactivated and that project documents had been drafted to solicit extra-budgetary funds for other disaster reduction activities. The Executive Secretary 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 that necessary efforts were being made to continue the substantive services that ESCAP had been rendering to its members in assisting them in the area of disaster reduction.

5. The representative of the WMO Secretariat, Mr. Katsuhiko Abe, addressed the meeting on behalf of the Secretary-General of WMO, Professor G.O.P. Obasi, and expressed the appreciation of WMO to the Government of the Republic of the Philippines and Dr. Roman L. Kintanar, Director of PAGASA, for hosting the meeting. He extended a warm welcome to all participants. He lauded Dr. Kintanar for his outstanding guidance and remarkable contributions to the Typhoon Committee since the inception of the establishment of the Typhoon Committee in 1968. He stated that Dr. Kintanar is considered to be the "Godfather" of the Typhoon Committee. He likewise informed the meeting of the Third Technical Conference on Special Experiment Concerning Typhoon Recurvature and Unusual Movement (SPECTRUM) organized by the China Meteorological Administration in close co-operation with WMO and TCS at the Shanghai Meteorological Bureau (Shanghai, China, 25-29 October 1993). He hoped that the Committee should consider effective measures in a realistic and cost-effective way to implement the Committee's Regional Cooperation Programme, in association with the IDNDR. He concluded by wishing the twenty-sixth session success and offering the assistance of the WMO Secretariat in completing its work.

6. The keynote speaker, Dr. Ricardo T. Gloria, Secretary of the Department of Science and Technology (DOST) was introduced by Dr. Amelia C. Ancog, Undersecretary of DOST. In his address, Dr. Gloria acknowledged the efforts being undertaken by the Typhoon Committee to minimize damage in the ESCAP region. He emphasized that through the concerted effort in finding ways and means to effectively prevent the detrimental effects of typhoons, developing countries like the Philippines can find strength and speedy economic development. He further stated that one incentive to pursue these activities is exemplified by the Natural Disaster Prevention Award given by the Typhoon Committee Foundation, Inc. Further, he expressed his appreciation to the endeavours of Members to hasten the pace of technology transfer in order to achieve socio-economic development. He ended his address by expressing his

hope for a fruitful session in terms of: establishing stronger regional cooperation in pursuance of the Committee's objectives for the maintenance and implementation of action programmes under the five components of the Committee; inspiring closer technical cooperation for human resources development; and improving the regional capability to respond effectively to the threats of typhoons and other natural hazards as the Committee's contribution to the socio-economic stability and progress in the region.

7. The meeting witnessed the awarding of the ESCAP/WMO Typhoon Committee Natural Disaster Prevention Award for 1993. The 1993 awards were given to the Core Shelter Project being implemented by the Department of Social Welfare and Development and to Mr. Rafael C. Yabut, both of the Philippines. The awards were presented by Dr. Roman L. Kintanar, Chairman of the Typhoon Committee Foundation, Inc. and assisted by Dr. Ricardo T. Gloria and Administrator Fortunato Dejas of the Office of Civil Defense of the Philippines. The award to the Core Shelter Project was accepted by Ms. Corazon Alma de Leon, Secretary of the Department of Social Welfare and Development. The citation of the award read:

*"In recognition of its outstanding services in the promotion of natural disaster prevention and preparedness through its efficient organization and management of low-cost house assistance program that has provided to typhoon-disaster victims nationwide thousands of typhoon-resistant core shelter units and the ability to rise above disaster under self-help basis."*

8. The citation of the award to Mr. Rafael C. Yabut read:

*"In recognition of his outstanding services in the promotion of natural disaster prevention and preparedness through his long-standing dedication and perseverance in popularizing weather forecasts and typhoon warnings through radio broadcasting, serving as vital link between the national disaster agencies and the people in enhancing public awareness of disaster threats posed by severe weather disturbances."*

#### Election of officers (Agenda item 2)

9. Mr. Fortunato M. Dejas (Philippines) and Dr. Patipat Patvivatsiri (Thailand) were unanimously elected as Chairman and Vice-chairman respectively. The Committee also elected Mr. P. Markandan (Malaysia) as the Chairman of the Drafting Committee.

#### Adoption of the agenda (Agenda item 3)

The session adopted the agenda as shown in Appendix II.

## II. THE COMMITTEE'S ACTIVITIES DURING 1993 (Agenda item 4)

10. The Committee reviewed and evaluated in detail its activities undertaken during 1993 under five components as elaborated below. The Committee was pleased to be informed that Members continued to maintain, with the assistance of the TCS, ESCAP and WMO, activities called for by its Regional Cooperation Programme.

### a) Meteorological Component (Agenda item 4(a))

11. The Committee noted that a new edition of the Typhoon Committee Operational Manual (TOM) - Meteorological Component had been published by WMO in May 1993 (Tropical Cyclone Programme Report No. TCP-23), and had incorporated all amendments made up to that date.

12. The Committee further considered the report of the rapporteur on the TOM, Mr. H. Ohnishi (Japan) who had developed further proposals for amendments to the TOM in collaboration with the focal points of the Members of the Typhoon Committee. The Committee expressed its appreciation for his excellent work and for the offer of Japan to continue providing the services of a rapporteur.

13. The Committee agreed that the changes provided by the rapporteur should be incorporated in the TOM and requested the WMO Secretariat to issue a new edition of the TOM in 1994.

14. A summary of the reports of the individual Members in relation to the meteorological component of its activities during 1993 is given in Appendix III.

### (b) Hydrological Component (Agenda item 4(b))

15. Based on the programme for 1993 as agreed upon during the last session of the Typhoon Committee the Members continued their sustained efforts in undertaking the programme of work under the hydrological component. A summary of the reports of the individual Members on their activities related to the hydrological component during 1993 is included in Appendix IV.

Due to the departure of the expert on hydrology the activities of the TCS had been limited in the field of hydrology.

### Activities of the Economic and Social Commission for Asia and the Pacific (ESCAP)

16. The Committee noted that ESCAP had continued to provide support to the Typhoon Committee Members in their endeavours on flood protection. The publication "Manual and Guidelines for Comprehensive Flood Loss Prevention and Management" has been reprinted twice. Considering the wishes of the Members of the

Panel on Tropical Cyclones another project has been prepared and received funding from Japan and roving seminars have already been fielded to Nepal, Myanmar, Iran, Pakistan and the Solomon Islands. In addition to providing advisory services on flood loss prevention and management it is planned to benefit from the experiences of participating countries and to revise the Manual and Guidelines accordingly. The project implementation is still continuing. Another project proposal, "Preparation of guidelines for storm surge mapping" has been prepared by ESCAP.

### Activities of the World Meteorological Organization (WMO)

17. The Committee recalled that at its twenty-fifth session (Zhuhai, December 1992), it had decided that the Management Overview of Flood Forecasting Systems (MOFFS) should be used within the region. Accordingly, the Committee urged Members who had not yet done so, and who are operating flood forecasting systems, to designate flood forecasting systems to be monitored using the MOFFS rating system.

### Hydrologists' Meeting

18. Prior to the Typhoon Committee Session the pre-session meeting of the hydrologists took place. The report of the hydrologists' meeting is presented in Appendix V. The hydrologists formulated 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(c))

19. 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 the reports of the individual Members on their activities related to the disaster prevention and preparedness component and the IDNDR during 1993 is included in Appendix VI.

### Activities of the Economic and Social Commission for Asia and the Pacific (ESCAP)

20. The ESCAP Secretariat has continued its work on disaster prevention and preparedness, and presented an issue paper on Natural Disaster Reduction to the ESCAP Committee on Environment and Sustainable Development at its first session in October 1993.

21. The project on "Assessment of current preparedness programmes, forecasting systems and operational methods for water-related natural disaster reduction in the ESCAP Region" has now been reactivated and seminars will be organized for the benefit of countries of the region frequently suffering from water-related natural disasters.

22. The publication "Natural Disaster Reduction in Asia and the Pacific: Launching the International Decade for Natural Disaster Reduction, Volume I" concerning water-related natural disasters in the region which had been published earlier has been widely disseminated.

23. ESCAP organized an exhibition for this year's International Day for Natural Disaster Reduction on 13 October 1993, in cooperation with a number of United Nations and ESCAP member government agencies.

24. In the proposed programme budget for 1994-1995 work programme "Natural Disaster Reduction" has been included as a sub-theme under the theme "Environment and Sustainable Development".

#### Activities of the World Meteorological Organization (WMO)

25. The Committee noted with satisfaction that WMO had continued to play a major role in the implementation of the IDNDR, including participation in sessions of the organs of the Decade: the inter-agency Working Group, the Steering Committee, and the Scientific and Technical Committee. The Committee recalled that the Executive Council of WMO at its forty-fifth session (Geneva, June 1993) had urged the Meteorological and Hydrological Services of Members to co-operate fully with their national IDNDR committees, where established. The Executive Council called on national Meteorological and Hydrological Services to take a lead in this view of the essential part played by these services in the reduction of natural disasters.

26. The Committee also recalled that the Executive Council had recognized a strong link between the objectives of the IDNDR and those of the WMO World Climate Programme (WCP) and had encouraged Members to foster such links at national level for the mutual benefit of both programmes and as a basis for joint submissions for funding, including that available from the Global Environment Facility (GEF).

27. The Committee was very pleased to learn of the detailed information on a preliminary plan of WMO for topical session D on "Warning Systems" at the World Conference on Natural Disaster Reduction (Yokohama, Japan, 23-27 May 1994). The results of the Conference will contribute to the mid-term review of the Decade in 1994 by the United Nations Economic and Social Council, as required by the General Assembly of the United Nations.

28. The Committee noted with pleasure that the following TCP related publications would be provided to participants in the above-mentioned World Conference on Natural Disaster Reduction:

- Fact sheet entitled "Will there be a tropical cyclone with your name?" (available in English, French, Russian and Spanish);

- Meteorological and Hydrological Risk Management (to be issued in the TCP series);
- Handbook on Natural Disaster Reduction in Tourist Areas (to be published by the World Tourism Organization (WTO) in co-operation with WMO) (English version; French, Spanish and Russian versions will be prepared in late 1994);
- ESCAP/WMO Typhoon Committee Annual Review for 1990 (special issue on "SPECTRUM");
- Disaster preparedness for meteorologists and hydrologists (tentative title, to be issued in the TCP series).

#### Other Discussions

29. The Committee noted that one of the greatest challenges in support of the disaster prevention and preparedness component is the education of the public on proper preparedness and response actions for natural hazards. Though there is a period following a disaster when interest on preparedness is high, most of the time it is difficult to capture the public's interest and willingness to become personally involved. This problem is further complicated by the capacity for individuals to deny that a serious natural hazard could affect them.

30. The Committee also noted that educating children in schools on natural hazard preparedness and having them bring the information home is one method of reaching a large segment of the population.

31. The observer from the United States reported that in his country the National Weather Service (NWS), the Federal Emergency Management Agency (FEMA), and the American Red Cross (ARC) have formed a partnership to share resources in the development and distribution of awareness and preparedness materials. By working as partners not only are costs reduced but each works to ensure that a consistent message is delivered to the public.

32. The representative of the Commission for Atmospheric Sciences (CAS) informed the Committee that the International Council of Scientific Unions (ICSU) and WMO have established a Tropical Cyclone Demonstration Project under the IDNDR with two major activities during the past year. A Symposium on Tropical Cyclones as Natural Disasters was held in Beijing in October 1992 with good attendance by leading scientists in a range of disciplines. The papers presented at this conference have been reviewed and published in a book "Tropical Cyclone Disasters".

33. The Committee noted that the Symposium also unanimously adopted the "Aerosonde" as the highest priority for development under the IDNDR. This is a small unmanned aircraft being developed for taking observations in remote regions, including tropical cyclone reconnaissance. The Aerosonde was subsequently approved by the Scientific and Technical Committee for the IDNDR at its meeting

in New Delhi in February 1993. The Typhoon Committee endorsed the IDNDR priority under the Tropical Cyclone Demonstration Project and supported development of this aircraft for typhoon reconnaissance in the western North Pacific.

(d) Training Component (Agenda item 4(d))

34. The Committee noted that Members continued to take every opportunity to further improve development of their human resources through the facilities available both inside and outside the region. They also took advantage of the various training events, such as symposia, workshops and training courses.

35. The Committee expressed its gratitude to various governments which have offered financial support and/or facilities to these workshops, training courses and symposia.

36. The Committee noted with appreciation that the Forty-fifth Session of the Executive Council of the WMO approved the designation of the Nanjing Institute of Meteorology, China, as a WMO Regional Meteorological Training Centre (RMTC). This Centre will provide a training course on Meteorological Satellite Application in 1994. All Members of the TC are welcome to participate.

37. A summary of the reports of the national activities in relation to the training component during 1993 is given in Appendix VII.

(e) Research Component (Agenda item 4(e))

38. Research work continued to be an integral part of the three major components of the Members' activities.

39. The Committee noted with satisfaction the progress being made in SPECTRUM by Members and the successful holding of the Third Technical Conference on SPECTRUM in Shanghai, China, 25-29 October 1993. Recent advances in the research work on the SPECTRUM were presented.

40. The Committee recognized the fine efforts of Mr. M. Ueno of JMA, Coordinator for research studies under cooperation of correspondents in meteorological component, for compiling and distributing research activities of the Members for the period from October 1992 to September 1993. One of the most important objective of this report is to encourage exchanges of views and research activities.

41. The Committee expressed its appreciation to TCM-90 for two recent publications on its research activities.

42. A summary of the reports of the individual Members in relation to the research component during 1993 is given in Appendix VIII.

Activities of the Commission for Atmospheric Sciences (CAS)

43. The Chairman of the CAS Group of Rapporteurs on Tropical Meteorology Research, Dr. G. Holland, representing CAS, expressed his appreciation to the Typhoon Committee for allowing him to attend as an observer and become familiar with the Committee's operations.

44. The Committee noted that over the past twelve months CAS has continued its very active role in tropical meteorology and tropical cyclone research activities. These activities have included organisation of symposia and conferences, formulation of the Global Guide to Tropical Cyclone Forecasting, and development of the Aerosonde.

45. The Committee also noted that, as mentioned under item 4(c), the highest priority project under the IDNDR Tropical Cyclone Demonstration Project is development of the Aerosonde.

46. The Committee was informed that a joint International Association for Meteorology and Atmospheric Sciences (IAMAS)/WMO/CAS Session on Monsoons and Tropical Cyclones was held in Yokohama in July 1993.

47. The International Workshop on Tropical Cyclones (IWTC) series is a major part of CAS activities, which in the past has produced several important recommendations and the text book "A Global View of Tropical Cyclones". IWTC-III will be co-sponsored by ICSU and is to be held in Mexico during late November 1993. In addition to the workshop activities, the text book will be completely revised in this meeting, and a symposium on climate change aspects of tropical cyclones will be undertaken. A joint ICSU/WMO statement on climate change is expected to be issued following this symposium.

48. Using material gathered in IWTC-I and II, CAS and the TCP have collaborated on producing "A Global Guide to Tropical Cyclone Forecasting", as a format guide to all aspects of tropical cyclone forecasting for which considerable care has been taken to provide the maximum amount of useful information in a readily accessible form. Fifteen-hundred copies have been printed by the TCP and the Guide is now being distributed to all tropical cyclone forecasting offices. It will be reviewed by the delegates at IWTC-III (see paragraph 61).

49. The Committee noted that the CAS commended the SPECTRUM project for its organized approach to research activities in the region. The SPECTRUM Conference in Shanghai during late October 1993 had produced some excellent papers and recommendations for on-going activities, which CAS supported. CAS representative also announced that the COMPARE programme had agreed to utilize the SPECTRUM-90, TCM-90 and Typhoon-90 data sets to undertake a major intercomparison of regional numerical models in tropical cyclone conditions. The COMPARE programme resides under the Joint Steering Committee (JSC) and involves comparison of many limited area models

from major forecast and research centres around the world. Typhoon Committee Members with limited-area modelling capacity were invited to join in this intercomparison.

### III. REVIEW OF THE 1993 TYPHOON SEASON/ANNUAL PUBLICATIONS (Agenda item 5)

#### Review of the 1993 Typhoon Season

50. The Regional/Specialized Meteorological Center (RSMC) Tokyo Typhoon Center provided the session with the following summary of the 1993 season.

51. Tropical convection being characterized by El Niño event during the first half of the year, the 1993 typhoon season began late as in the previous year. In summer, however, the number of tropical cyclone occurrences increased remarkably to about 13 tropical cyclones of tropical storm intensity or stronger, as compared to an average of 14.7 towards the end of August.

52. The season's first tropical cyclone was Severe Tropical Storm (STS) Irma (9301), initially detected as a tropical depression in early March. No tropical cyclone attained tropical storm status until the middle of June when Typhoon (TY) Koryn (9302) formed, while tropical convections were anomalously enhanced in the vicinities of the International Date Line from April through May as sea surface temperature distributions assumed patterns typical of El Niño event. Koryn was one of the violent typhoons to hit the Philippines that peaked with maximum winds of 105 knots and claimed numbers of lives. It made another landfall over southern China afterwards causing serious damage in China and Hong Kong.

53. In early July, STS Lewis (9303) developed and took a course similar to Koryn's, affecting the Philippines, China, Viet Nam and Thailand along its track. However in late July, the subtropical ridge, which anomalously shifted to the south by roughly five degrees in latitude in its western section, guided three tropical cyclones towards the north to attack Japan; STS Nathan (9304), Tropical Storm (TS) Ofelia (9305) and STS Percy (9306) made landfall over Japan one after the other within a week and were responsible for a total of 15 deaths.

54. In August, tropical convection began to revert to normal conditions, which resulted in seven tropical cyclones to form this month. TY Robyn (9307), the first tropical cyclone of the month, also affected Japan in the aftermath of the preceding three tropical cyclones. By comparison, STS Steve (9308) and TY Tasha (9309) persisted in lower latitudes and never turned to the north, while TY Keoni (9310) moved highly erratically over the waters far east of Japan. In late August, Japan sustained again serious damage due to TY Vernon (9311), and further by TY Yancy (9313) at the beginning of September. During the passage of Yancy, 48 lives were lost.

#### Annual Publications

55. The Committee expressed its appreciation of the Typhoon Committee Annual Review (TCAR) 92 and the TC Newsletter. TCAR 92 marked the first time that camera-ready manuscripts were prepared in-house at the Hong Kong Royal Observatory while the WMO Secretariat coordinated the most economical strategy for printing and distribution with the use of Typhoon Committee Trust Fund. The Committee decided that the same measures should be taken for TCAR 93.

56. The Committee thanked the Chief Editor provided by Hong Kong and the national editors from other Members for their contributions to the publication of TCAR 92. It also thanked the WMO Secretariat for the prompt printing and distribution.

57. The Committee requested Hong Kong to continue to make available the services of the Chief Editor for the coming year. The delegation of Hong Kong assured the Committee that if no other Members would take the task, every effort would be made to meet the request. The Committee agreed that the publication of the TCAR and TC Newsletter should continue.

58. The Committee was informed that JMA will publish in December 1993 its Annual Report on 1992 activities of the RSMC Tokyo-Typhoon Center for eventual distribution to the Typhoon Committee Members.

### IV. CO-ORDINATION WITH OTHER ACTIVITIES OF THE WMO TROPICAL CYCLONE PROGRAMME (Agenda item 6)

59. The discussions under this agenda item were based mainly upon the information contained in the nineteenth status report on the implementation of the WMO Tropical Cyclone Programme (TCP) and supplementary information presented orally at the session by the WMO representative. The Typhoon Committee noted with satisfaction the efforts of the TCP towards placing further emphasis on collaboration at the regional and international levels and on the provision of assistance in the transfer of technology and methodology through the technical publications in the TCP series and the training of personnel.

60. The Committee was pleased to note that the third WMO/ICSU International Workshop on Tropical Cyclones (IWTC-III), scheduled to be held in Mexico from 22 November to 1 December 1993, would provide a useful forum for the interaction between forecasters and researchers which would encourage the application of research results to operational use. It further noted that an expert group meeting on Tropical Cyclone Related Numerical Weather Prediction (NWP) Products and their Guidance would take place in conjunction with IWTC-III.

61. The Committee expressed its great satisfaction to the WMO Secretariat for the implementation of TCP Project No. 16 "Global

Guide to Tropical Cyclone Forecasting", compiled by the Chief Editor, Dr. Greg Holland (Australia) and published as a WMO Technical Document in the TCP series. This project aimed at providing guidance and assistance to tropical cyclone forecasters in all tropical cyclone regions and basins. It is expected that the first review of the Guide will be carried out at the IWTC-III.

62. The Committee was informed that the sixth training course on tropical meteorology and tropical cyclone forecasting to be organized by National Oceanic and Atmospheric Administration (NOAA)/USA in co-operation with WMO would be held in Miami, Florida from 21 February to 29 April 1994. Invitations had been extended to all the WMO regional tropical cyclone bodies. The Committee was also informed that the Executive Council of WMO had suggested that efforts should be made to ensure greater opportunities for female meteorologists to attend the training course.

63. The Committee carried out a detailed review of the action sheet formulated at its twenty-fifth session (Zhuhai, China, December 1992). It noted with satisfaction the follow-up actions undertaken by the Secretariats (TCS, ESCAP and WMO).

#### V. REVIEW OF THE PROGRAMME FOR 1994 AND BEYOND (Agenda item 7)

##### Regional Cooperation Programme Implementation Plan

64. In reviewing the Regional Cooperation Programme Implementation Plan (RCPIP), the Committee agreed to a suggestion from the delegation of Hong Kong, that the list should be abbreviated so as to include only activities involving cooperation by at least two Members and those programmes involving the assistance of external resources.

65. The Committee agreed that in the 27th session, only those activities that are either in the nature of regional cooperation or getting support from external resources will be included in the report. TCS will prepare the revision in consultation and cooperation with the Members.

66. The Committee adopted the RCPIP which is contained in Appendix IX.

##### Meteorological Component

##### Future Activities of the RSMC Tokyo

67. The Committee took note of the future activities of the RSMC Tokyo which are contained in Appendix X.

##### SPECTRUM

68. The Committee noted with interest the report of the SPECTRUM Research Coordinating Group (SRCG) prepared by its Chairman and approved the recommendations that came out of the Third Technical Conference on SPECTRUM. See Appendix XI.

69. The CAS representative expressed the continued support and cooperation of CAS to the activities of SPECTRUM and cited as a long term objective of SRCG to pursue participation in the CAS programme for comparing various numerical models. The representative suggested that SPECTRUM research papers should be submitted for possible publication in international journals.

70. The Committee reiterated that non-participating Members to the 1990 field-experiment of SPECTRUM could nominate members, one each, to the SRCG.

##### Satellite-based Telecommunications System

71. The Committee deliberated at length on the working document on Simplex transmission/Retrieval of Regional Specialized Meteorological Centre (RSMC) Tokyo Grid Data via Geo-Stationary Meteorological Satellite (GMS). The Committee recognized that Grid Point Value (GPV) is vital and appealed to Japan to consider seriously its inclusion in the future plan of RSMC Tokyo.

72. The Committee recognized that further study by experts should be pursued on the subject and requested WMO to look at schedule of meetings that could also serve as an avenue for these experts to discuss the matter.

##### Regional Telecommunications Network

73. The Committee noted with interest the proposal of the Republic of Korea to the Democratic People's Republic of Korea to have a telecommunication link between Seoul and Pyongyang to speed up and increase the volume of data exchange that will benefit both Meteorological Services. The proposal includes the exchange of climate data and research results that would facilitate the understanding of the characteristics of local weather and climate over the Korean Peninsula.

74. The Committee supported the idea of facilitating the talks should the need arise.

##### Hydrological Component

75. The Committee adopted the following recommendations which had been formulated at the pre-session meeting of the hydrologists:

- A second consultative meeting to solicit participation of all Typhoon Committee Members in the MOFFS project.
- Exchange of information on flood forecasting models especially those which are being utilized by other Members.
- Exchange of river flow data particularly during flood season for international rivers among riparians based on mutual agreements.
- Exchange of experts through Technical Cooperation between Developing Countries (TCDC) or other means.

#### Training Component

76. The representative of China reported that, Nanjing Institute of Meteorology, as a WMO RMTC, will offer a training course on Meteorological Satellite Application in 1994. All Members of the Typhoon Committee are welcome to participate.

#### Research Component

77. The Committee endorsed the programme within the framework of IDNDR by ICSU and WMO on the development of the Aerosonde as a future observing system.

78. The Committee also accepted the invitation by the CAS representative for the development and field testing of the Aerosonde to be carried out in the western North Pacific region as a Typhoon Committee Project. The Committee noted the close relationship between this program and the SPECTRUM project, and that the end result was to provide an operational observing system. The Committee approved in principle the plans for a field programme, commencing with the first typhoon experiments in 1995. The Committee suggested that the CAS representative consult with the Committee Secretariat, individual countries in the region, and relevant funding agencies and prepare a detailed operational plan for consideration by the Twenty-seventh Session. This should specifically address all regulatory, legal and relevant safety aspects.

79. The Committee also requested that a demonstration flight of the Aerosonde be provided for the 27th session. The CAS representative agreed to arrange such a demonstration, provided that sufficient funds are obtained to maintain the engineering development programme and that the required permits could be obtained and physical plans made.

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

80. The Committee was informed on the current overall financial situation including information on the WMO Technical Cooperation Programme, which affects the availability of external assistance to the Committee's activities. The Committee noted with concern the reduction of UNDP resources and the de-emphasis on support to regional projects such as the Typhoon Committee.

81. Recognizing that the emphasis is on national execution and programme approach, the Committee requested its Members, particularly the senior officials of relevant institutions, to take the lead in seeking support to activities relevant to the objectives of the Typhoon Committee at the national level. In this connection, opportunities such as those offered by the follow-up to the U.N. Conference on Environment and Development (UNCED) and IDNDR should be made use of. The Committee recognized that the WMO publication on "Guidelines on the Role of National Meteorological and Hydrological Services in the Implementation of Agenda 21 and the Framework Convention on Climate Change" provides important relevant suggestions.

82. To mobilize resources for the Typhoon Committee and its activities the Committee recognized the need for the following:

- a. identification of the requirements
- b. establishment of priorities
- c. importance of emphasizing the products and services (deliverables) that the Committee's proposed projects provide
- d. underscoring capacity building
- e. drawing on the unique competence and comparative advantage of the Committee
- f. ensuring the incorporation in national development plans of the relevant areas of concern relating to the Committee's objectives and activities
- g. development of information and public affairs as well as resource mobilization capabilities.

83. The Committee requested TCS to study the matter further, propose specific recommendations, and undertake the necessary actions.

84. The Committee expressed its appreciation to the Government of the Philippines for hosting the TCS and for providing the services of a coordinator, a meteorologist and a part-time expert on disaster prevention and preparedness. The Committee was pleased to note that the Philippine Government would continue to facilitate the functioning of the TCS in Manila through a similar arrangement during the next intersessional period.

85. The Committee was especially grateful for the dedication and services extended by Dr. R.L. Kintanar in his capacity as the TCS Co-ordinator. The Committee was particularly pleased to note that

his services can still be tapped, after his retirement as Director of PAGASA in June 1994. The Committee requested ESCAP and WMO, in consultation with the Typhoon Committee Chairman, to make the necessary arrangements in connection with his continuing on as TCS Co-ordinator with support from the Trust Fund.

86. The Committee similarly expressed its appreciation to the Government of Japan for having provided the services of a full-time hydrologist in TCS, as well as for Japan's indication of supporting the post of hydrologist in the TCS for a term of two years. The representative of Japan informed that this shall be the last occasion that his government would provide the support and therefore requested the Committee to make provisions for counterpart experts.

87. The Committee was informed that in the framework of its own programme of work, ESCAP would continue to undertake activities in support of the Typhoon Committee. In this connection the Committee was pleased to note that ESCAP could provide advisory services on flood protection and drainage through its Regional Adviser on Water Resources and that TCDC funding could be made available to support exchange of experts among developing countries in the fields of hydrology and disaster preparedness and prevention.

88. The Committee requested ESCAP Commission to consider allocating necessary manpower and other resources for undertaking of activities on natural disaster reduction, and appealed to donor countries and agencies to provide adequate extrabudgetary support for implementation of such activities.

89. The Committee reviewed in depth the financial report on the Trust Fund (see Appendix XII). The Committee was pleased to note that a certain degree of self-reliance had been achieved through the establishment of the Trust Fund which provides for the financing of certain activities of the Committee. In view of the fact that no favourable response had so far been received from UNDP, the Committee urged its Members to continue and enhance their contributions to the Trust Fund. The Committee was pleased to note that several Members pledged their contributions to the Fund.

90. The Committee agreed to the use of the Trust Fund for the following purposes until the twenty-seventh session:

- (a) Augmentation of travel funds for TCS staff missions;
- (b) Support for organizing symposia, technical conferences and workshops related to typhoons;
- (c) Support for SPECTRUM Research Coordinating Group (SRCG);
- (d) Publishing the Typhoon Committee Newsletter periodically;
- (e) Support to the TCS, including representation and emergency expenses;
- (f) Printing cost of documents for the twenty-seventh session not exceeding US\$1300;
- (g) Support to the publication of TCAR 93;
- (h) Support to the attachment of typhoon experts to advanced Centres.

91. The Committee recognized the need to approach additional sources of support for its activities. It agreed that efforts should be made by the TCS, assisted by WMO and ESCAP to enlarge the number of contributors to the Trust Fund, by approaching other sources such as countries which are not members of the Committee as well as the private sector (e.g., oil companies). It also agreed to submit proposals to other possible sources such as the Asian Development Bank, Global Environment Facility and Capacity 21.

92. In addition, the enhancement of the use of TCDC was also called for by the Committee. Members were requested to provide TCS with their requirements as well as their offers in this connection.

93. The Committee reiterated the importance it attached to assistance on a bilateral basis from developed countries to its activities. In this connection, the Committee expressed its appreciation to the Government of Japan for its continuing support to developing countries in the TC region.

94. The Committee was informed on the status of the WMO Voluntary Co-operation Programme (VCP) Projects requested by Committee Members. Members were encouraged to update their requests for VCP assistance to WMO.

#### VII. AGENDA FOR THE TWENTY-SEVENTH SESSION (Agenda item 9)

95. The Committee requested TCS, in co-operation with ESCAP and WMO, to prepare the provisional agenda for the twenty-seventh session.

#### VIII. DATE AND PLACE OF THE TWENTY-SEVENTH SESSION (Agenda item 10)

96. The representative of Macau extended an official invitation to the Committee to hold its twenty-seventh session at Macau to be organized by the Meteorological and Geophysical Services in the first half of December 1994. The Committee in accepting the kind invitation, expressed its thanks and deep appreciation to the Government of Macau. The exact dates would be determined later based on consultations between Macau, TCS, ESCAP and WMO.

IX. SCIENTIFIC LECTURES (Agenda item 11)

97. The following scientific lectures were presented.

1. A Case Study of Synoptic Situations associated with Unusual Motion of Tropical Cyclones

by Mr. Eduardo M. Parong  
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2. Tropical Cyclone Motion Near Re-Curvature

by Dr. Greg Holland  
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3. Numerical Weather Prediction on Typhoons

by Mr. Toshiyuki Ono  
Director  
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98. The Committee expressed its thanks to the lecturers.

99. The Committee also expressed its thanks to Japan for showing a 20-minute video entitled "Protect Yourself from Storms and Floods", and to the Philippines for a video presentation entitled "Building New Homes ... New Lives" during the session of the Typhoon Committee.

X. ADOPTION OF THE REPORT (Agenda item 12)

100. The Committee adopted its report on 8 November 1993.

APPENDIX I

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## APPENDIX II

### AGENDA

1. Opening of the session
2. Election of officer
3. Adoption of the agenda
4. The Committee's activities during 1993
  - a) Meteorological component
  - b) Hydrological component
  - c) Disaster prevention and preparedness component
  - d) Training component
  - e) Research component
5. Review of the typhoon season/annual publications
6. Coordination with other activities of the Tropical Cyclone Programme of the World Meteorological Organization
7. Review of the programme for 1994 and beyond
8. Support required for the Committee's programme
9. Agenda for the twenty-seventh session
10. Date and venue of the twenty-seventh session
11. Scientific lectures
12. Adoption of the report

### APPENDIX III

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

In CHINA the National Meteorological Center of China is installing and testing the super computer, Galaxy-II, which is the first one of its type ever produced in China. The computer will provide a strong computing capability for improving the timeliness of medium range numerical weather prediction. Within a few years the useful medium range numerical weather forecast may reach 5-7 days.

The working group Meeting of Typhoon and Marine Meteorology was held in Haikou city of Hainan Province during December 17-19, 1992. Altogether 38 participants, including all the members of the working group and experts concerned, attended the meeting. The following subjects were reviewed in the meeting:

- \* Evaluation of tropical cyclone forecasting operations and service activities in 1992;
- \* Examination of best tracks for tropical cyclones in 1992;
- \* Assessment of benefits provided by tropical storm warning system and disaster evaluation studies;
- \* Major achievements of research projects and assessment of the SPECTRUM results as well as the preparations for the Third Technical Conference of SPECTRUM.

A Chinese Abnormal Typhoon Experiment (CATEX) was conducted in China from 26 June to 15 September 1993. During the experiment, three typhoons 9302 (Koryn), 9303 (Tasha) and 9315 (Abe) were chosen for experiment, and a large amount of valuable data was obtained including intensified surface and radar observations. In addition, upper air observations with increased density were also made at certain stations around typhoon centers. The data obtained has greatly facilitated the study of the physical mechanism of typhoon abnormal process.

In the D.P.R. OF KOREA, the monitoring of typhoons is conducted on the basis of information from satellites and neighboring countries if the typhoon occurs in the North-West Pacific Ocean. Forecasting of typhoons is done with different methods, the essential issue of which is the forecasting of typhoon course.

At present, the barotropic model is being introduced in operational work as numerical methods for the forecasting of typhoon course. The forecasting time is 48 hours and the scope of

the forecasting is 15°N-70°N, 90°E-170°E. The interval of node is 1°.

Besides, conditional probability forecasting on the basis of climatic persistence principle, the forecasting of typhoon course by MOS and simulation methods are introduced. The forecasting of precipitation by typhoons is proceeding through the synoptic-statistical method.

Wave and surge forecasting are both related to typhoons. The main method of surge forecasting is numerical. In the future, there are plans to focus and develop on modelling of region and considering detailed coastal conditions.

Marine forecasting issues are under the condition of understanding the movement of typhoon course and atmospheric pressure. At present, the forecasting duration is 2 days.

The observation work, communication equipment and analysis means are strengthened and renewed to intensify typhoon monitoring and take information on main parameters in rapidity and correctness.

At present, a satellite station is situated in Pyongyang. Satellite information is used in several units through network system. Several measures for strengthening the capacity on analysing of satellite data and its application are being taken.

In addition, satellite receiving devices will be installed in every local provincial observation. At present, two radars with 3.2 cm and 5.7 cm in wave length are installed in the West-Sea coastal region. The radar observation network will be established by installing a new radar in the East-Sea region in the future.

At present, about 200 meteorological observations are distributed in cities and other important areas. There are two upper-atmospheric observations in the country. The number of observations are increasing and the observed data are sent to the central unit whenever a typhoon passes.

The automatic observations will be established in the mountain areas inland and main river basins which are far from observations. With this, the collecting and analysing system will be formed to receive data quickly and correctly from general meteorological observations and automatic stations.

Typhoons 9305 (July 26), 9306 (July 28) and 9307 (August 3) have affected D.P.R. of Korea during summer of 1993, all passing the Korean Straits. In all cases, appropriate typhoon warnings were issued.

High-resolution GMS and NOAA receivers are being used operationally since 1988. New GMS and NOAA receivers were recently installed this 1993.

In HONG KONG, the standard of performance on hazardous weather warning is set by way of a performance pledge to the public and special uses. Targets on timeliness and accuracy are set with effective monitoring and reviews planned.

An upgraded local telecommunications network was installed in late 1993 to speed up the dissemination of forecasts and warnings to the public and other clients.

An integrated data display system, using custom-designed software running on UNIX workstations, was being procured. The system would greatly assist forecasters in assimilating diversified meteorological information to form an integrated depiction of the atmosphere.

Arrangements were being made with Beijing for the transmission of more digital facsimile weather charts to Hong Kong with a view to replacing present radio-facsimile transmissions.

A reception system was set up in January 1993 to monitor the meteorological forecasts and warnings prepared by the Royal Observatory and broadcast to the marine communities under the WMO Global Maritime Distress and Safety System.

A replacement upper-air sounding system was delivered, installed and put into operation on 20 July 1993. The old system which has been used since 1981 is now kept as a backup system.

Procurement of a replacement storm detecting radar system with Doppler capability is in progress. To be installed in year 1994, the system will replace the existing radar system which has been in use since 1983.

In JAPAN, the GMS-4 has been fully operated at 140°E above the equator during 1993. In addition to obtaining Earth imagery, it is relaying meteorological data from Data Collection Platforms (DCPs). By the end of 1993, the number of DCPs installed/to be installed in the area of Typhoon Committee Members except Japan will increase from 20 to 50.

Among the 20 meteorological radars operated by the Japan Meteorological Agency (JMA), 18 radars are equipped with the Radar Echo Digitizing and Disseminating Systems (REDIS) as of November 1993. Two radars at Miyakojima (47927) and at Ishigakijima (47918) are scheduled to be integrated into a new radar equipped with REDIS at a new site on Ishigakijima in early 1994. The new radar will contribute to expanding the area of typhoon detection over Ryukyu Islands. Consequently, the installation of REDIS to the meteorological radars of JMA will be completed and all the data from JMA's radars will begin to be digitized on 1 March 1994.

The automated upper-air observation systems, which have been successively introduced since 1986, will be installed at Wakkanai (47401), Kagoshima (47827), Chichijima (47971) and Minamitorishima (47991) by March 1994.

The new-type rawinsonde (RS2-91), which has been introduced since October 1992, will be installed in 15 out of 18 upper-air observation stations of JMA by March 1994. The remaining three stations, i.e. Fukuoka (479807), Ishigakijima (47918) and Minamidaitojima (47945) will also employ it by 1996.

The new-type radiowind (W92) was introduced in September and October 1993 at all the 16 stations which conduct radiowind observations.

In December 1992, the Kuo-scheme, which had been operationally used as convection scheme in the JMA's Typhoon Model (TYM), was replaced by a moist convective adjustment scheme. This replacement is expected to reduce mean error of 48-hour forecasts of typhoon center position by 30-40 km and by 50-60 km for 60-hour forecasts.

Since 1988 JMA has been expanding the service area of very-short-range forecast of precipitation up to three hours ahead. The start of digitation of the data from all the meteorological radar operated by JMA on 1 March 1994 will make it possible to compose radar echo all over Japan using computers. Consequently, the service area of very-short-range forecast of precipitation will expand to cover the whole of Japan.

JMA currently transmits 'Coastal Wave 24-hour Forecast Chart (FWJP)' and 'Coastal Wave Analysis Chart (AWJP)' for the coastal waters of Japan as well as 'Ocean Wave 24-hour Forecast Chart (FWPN)' and 'Ocean Wave Analysis Chart (AWPN)' for the western North Pacific once a day through broadcasts of the meteorological radio facsimile (JMH). To enhance ocean wave information related to typhoons, JMA plans to start providing FWJP twice a day in February 1994, in the event that a typhoon approaches Japan.

JMA dispatched the meteorological observation vessels Ryofu Maru and Keifu Maru in the western tropical Pacific four times in total in 1993. Furthermore, Keifu Maru made typhoon monitoring observation in the south of Japan in August and September.

In the framework of the (Monthly Mean) Marine Climatological Summaries Scheme (WMO), the Marine Climatological Charts of the North Pacific Ocean for 30-Year Period (1961-1990) was published and distributed to relevant organizations in March 1993.

MACAU Meteorological and Geophysical Service (SMG) has linked and upgraded the circuit speed to the Guangdong Meteorological Bureau of the State Meteorological Administration of P. R. China by using a 9600 bps telecommunication circuit on a 24-hour basis.

The weather forecasting services of SMG got a big boost with the access to the main computer of Guangdong Meteorological Bureau, through which we can obtain radar images of both ROHK and GMB, high resolution satellite images from GMS-4, European Centre Medium Range Weather Forecast's (ECMWF) six-day prognosis chart and other significant information for typhoon forecast.

For improving the automatic weather observation network, we set-up more stations to the network and add dew point temperatures sensor to each station as well.

Installation of new equipment, such as the plotter, enables us plotting surface and upper air charts, tephigram and getting other relevant information.

Having implemented an optical disk storage system, all charts of the historic archives coming from recorder instruments can be well-stored.

A new upper-air sounding system is equipped with capability to get automatically temperature, pressure, relative humidity and wind speed and direction.

On-going activity is to achieve a capability for computer to computer meteorological dissemination to general and specific users.

In MALAYSIA, the Malaysian Meteorological Service (MMS) has successfully installed and commissioned a new TIROS-N (NOAA) Satellite Data Acquisition and Processing System, in January 1993, to receive both NOAA-AVHRR imaging and sounding (TOVS) data as additional tool for weather analysis and forecasting. The AVHRR data are currently also used in the Agroclimatic Impact Assessment Programme for rice-yield prediction in the MADA rice field in Northern Peninsular Malaysia.

In keeping pace with the technological advancement in telecommunications, the Malaysian Meteorological Service (MMS) recently embarked on a 'telecomputerization program' to modernize its meteorological telecommunication services. The main objective of the program is to establish the basic meteorological network capable of supporting a fully computerized now-casting system. To facilitate implementation of the project, two phases of implementation were identified. In the first phase of the project, the existing teletype link between meteorological observation stations, Regional Forecast Offices and its National Meteorological Communication Centre would be replaced by computer to computer data links. This would enable plotting of meteorological maps at the Regional Forecast Office to become fully automated. This phase of the project is expected to be completed by mid 1994. The 2nd phase of the project would be implemented in 1994/1995. This would consist of further enhancing the hardware and software requirements of the computerized telecommunication network and the installation of a weather information display system at the National Meteorological Communication Centre. This weather information display system would initially be tailored for displaying the surface and upper-air observations and predicting maps. However, in later stages, it would be integrated with the radar and satellite display systems to form a forecaster's now-casting/short range prediction work station. In addition, the 2nd phase would encompass a more comprehensive archival system for meteorological data.

Under the development plan for 1993, 5 Upper Air Stations will be upgraded to fully automatic stations. These stations are located in Bayan Lepas, Kuching, Bintulu, Kota Kinabalu and Tawau. The new equipment are from Vaisala OY and are called DigiCora II Rawinsonde Set. All these 5 Automatic Upper Air Stations will be fully commissioned by the end of November 1993.

In the PHILIPPINES, the NOAA satellite tracking and data processing facility continued its operation. Software program for the computation of sea surface temperature, and the digitized stability fields of the TIROS Operational Vertical Sounder (TOVS) are in the process of upgrading since the start of data archiving on 02 February 1993. In this connection, three (3) PAGASA personnel underwent training on the Application of Satellite Data to Weather Forecasting in Australia from 16 January to 16 July 1993.

The eruptive activity of Mayon and Pinatubo volcanoes has proved to be a boon to research. Volcanic ash detection by the use of the NOAA AVHRR information was started. These data are being sent to the Bureau of Meteorology in Darwin, Australia where volcanic ash advisories for aviation purposes are being issued.

The Meteorological Telecommunication System Development Project (MTSDP) started full-scale construction on 29 June 1992. The construction phase is expected to be completed soon, while the installation of telecommunication equipment is due to commence in the last quarter of the current year.

On 17 September 1993, an Integrated Runway Meteorological Observations System (IRMOS) and a GMS-WEFAX satellite receiving station, both installed at Ninoy Aquino International Airport (NAIA), were formally turned over to PAGASA by the French Government. The two systems are part of the PAGASA project "Enhancement of Meteorological Delivery System to the Countryside" entered into in January 1989 with SOFREAVIA, a company owned by the French Government.

The project involves the acquisition of modern meteorological observation and communication equipment to augment, rehabilitate and upgrade existing facilities in field stations nationwide. Undoubtedly, the upgrading and augmentation of PAGASA's observation and communication facilities will result to timely, expanded and improved service products like forecasts and warning both for special clientele groups and the general public. Specifically, it will (1) improve observing and data acquisition systems; (2) improve daily weather forecasting and warning services; (3) speed up delivery of weather information to target beneficiaries; and, (4) improved linkages with multi-media groups as disseminators of weather information.

So far eighteen field stations and the NAIA meteorological aviation station have received and are now using new basic meteorological instruments. One complete automatic

agrometeorological facility including a processing station has been installed at the Science Garden (98430). Two GMS-WEFAX satellite receiving stations have been put up at NAIA (98429) and Mactan (98646) stations. Three back-up high frequency meteorological communication systems are now operational. Eighteen stations have received SSB Nardeaus AEL 2230 transceivers. Ten stations are now using multi-address telefax machine with memory. Thirteen 2.2 KVA diesel power generating sets have been installed in various stations. One IRMOS has been made operational at the NAIA.

The project implementation began in late 1992 when the equipment arrived in Manila and is expected to be finished in early 1994.

Regarding radars, only the Davao radar was in good operational status for the whole period. The Baler radar resumed operation only in June, while all others (Tanay, Daet, Virac, Guian, and Mactan) operated on and off due to equipment failure.

The upper-air stations at Laoag was operational for the whole period covering this report. Baguio and Davao stations were likewise in operational status although reports were sometimes hampered due to cloudiness and non-availability of supplies. The Legaspi, Mactan, and Puerto Princesa upper-air stations operated as the equipments warranted.

In the **REPUBLIC OF KOREA**, the Korea Meteorological Administration (KMA) continues to expand the number of automatic weather stations (AWSs) by setting 80 more in 1993, bringing it to a total of 328. Currently, the operational observations system in the KMA consists of 34 conventional systems at the meteorological stations, 38 AWSs at the weather observation stations and 282 AWSs at remote sites. The KMA will complete the project by setting 72 more in 1994 to a total of 400, which gives average spacing of 20 kilometers.

The AWS consists of tower, sensors, power supply unit (PSU), signal information processing unit (SIPU), and digital display unit (DDU). Several SIPUs are connected to Data Acquisition and Processing Unit (DAPU) at the meteorological stations by public telephone line. The DAPU collects observations and transmit them through meteorological telecommunication networks that nationwide weather watch is possible. The normal data acquisition is operated every hour. However, data for a single station or a certain region can be collected at any instant by manual operation.

The KMA is replacing its computer system for telecommunication. The new system consists of a TANDEM CM-1400 at Headquarters, and TANDEM S300 at the four Regional Meteorological Offices, workstations at the Meteorological Stations/The Weather Observation Stations, respectively. The new one emphasizes non-stop, fault-tolerant, on-line transaction, and real-time processing, and implements integrated communication of A/N, Graphics, Images, FAX, and binary data. Installation of the system will be completed by the end of 1993.

In addition to the operating climate/statistics typhoon track forecasting models, a numerical typhoon model is being tested at the KMA. The operational typhoon model at the JMA, TYM, is introduced to the KMA through the bi-lateral technical cooperation between the two organizations. The source code has been changed from HITAC to Cray version, and some technical assistance has been provided by the JMA. This model has been tested in 1993 typhoon season in Korea and will be in full operation in 1994.

The System Engineering Research Institute in Korea Institute of Science and Technology (SERI/KIST) has contracted new supercomputer, the Cray Y-MP C90/ 16512, in 31 March 1993 and a new one is being installed. The new supercomputer will start operation in November, and the current Cray-2S will retire at that time. New Cray has 16 CPU, 16 GFlops performance, 512 Mbytes memory, and 200 Gbytes disk space.

The KMA is sharing supercomputer with SERI to operate numerical weather prediction models. The KMA and SERI are linked by 56 Kbps direct line with Cyber-932 as a Front-End at KMA. The KMA currently operates three limited area models twice a day, the F-LAM (Fareast Limited Area Model), A-LAM (Asia Limited Area Model) and Ocean Forecast Model (OFM). In addition, a fine mesh model, the Korea Limited Area Model (K-LAM) and a Typhoon Model is in testing for next year operation.

In **THAILAND**, the S-band Doppler weather radar which was newly installed at Khon Kaen Province in the North-east and has been functioning since August 1993. There is a workplan for installing weather radar, by the year 1993, covering the following provinces:

- Ubon Ratchathani (North-eastern) Doppler C-Band
- Sakon Nakhon (North-eastern) Doppler C-Bank (substitute for the old C-Band)
- Surat Thani (Southern) Doppler S-Band
- Chiang Rai (Northern) Doppler C-Band
- S-Band Doppler weather radar is newly being purchased and will be installed at Hua Hin by 1994.

By the year 1996, radar imageries from 14 weather radar stations were planned to be transmitted to the center of radar network located at the Head Office.

Four new high resolution NOAA and GMS satellite receiving systems were purchased and hereunder is their current status.

- One was established at Chiang Mai Regional Meteorological Centre (RMC) in April 1993.

- Two sets are already installed at Songkla in August 1993 and Phuket-RMCs in July 1993, and both are functioning at present.
- Another one is planned to be established at Ubon Ratchathani RMC in 1994.

The existing satellite receiving system in the Headquarters is also planned to have its hardware as well as its software upgraded by 1995.

By mid August 1993, a center established at the Main Office began to retrieve all data from NOAA and GMS satellites received at three RMCs as mentioned above. A linkage workstation was also provided to Aeronautical Meteorology Division at Bangkok International Airport. This system will completely connect four RMCs in 1994, subsequent to the establishment of satellite receiver at Ubon Ratchathani.

Two Automatic Weather Observation System (AWOS) at Chiang Rai and Mae Hong Son Airports have been operated since October 1992. A set of mobile AWOS has been available at the Meteorological Department since December 1992. Three sets of AWOSs are being purchased for Lampang, Sakon, Nakhon and Ubon Ratchathani and will come into operation by 1995.

Wind Shear Alert System (WSAS) at Chiang Mai International Airport is now in operation. A set of WSAS is being purchased for Hat Yai International Airport and expected to be completely installed by 1995.

In telecommunications, a project on newly installing message switching system is expected to be implemented by the year 1994-1995. The accomplishment of this project will enable the upgrade of the Bangkok-Tokyo GTS medium speed circuit, as well as to establish the new Bangkok-Beijing GTS medium speed circuit.

Two GTS point to point circuit of low speed telegraph linked between Regional Telecommunication Hub (RTH) Bangkok-NMC Vientiane and RTH Bangkok-NMC Phnom Penh will be newly established. The implementation is under the consideration of both Lao PDR and Cambodia.

A project on newly installing domestic data collection system via satellite is expected to be implemented by the year 1994-1995. The accomplishment of this project will enable to gain more efficiency in collecting data from meteorological stations.

A new set of 10 Kw - HF transmitter of RTH radio broadcasts will be installed at RTH - Bangkok and will come into operation by the year 1993-1994. This will replace the existing one.

In VIET NAM, a local area network (LAN) of microcomputers has been established at the Central Forecast Department for improvement of data collection and processing.

One 10-cm weather radar was installed and put into operation in October 1993 at Meteorological station "VINH" (No. 48855), north Central Vietnam.

Seven old wind observational equipments at the stations located along the coastline have been replaced by the new wind recorders TAVID-87 for storm wind recording.

Two statistical models and one dynamical model are being used for computing operational forecasts of tropical cyclone tracks.

Three low resolution satellite ground receiving systems at the forecast centers in Hanoi, Danang, Ho Chi Minh city continued providing GMS hourly cloud pictures necessary to improve weather as well as tropical cyclone forecasts.

## APPENDIX IV

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

In CHINA, a meeting on hydrological operation management aimed at exchanging experiences was held in Changzhou City, Jiangsu Province, 20-25 March 1993. The participants included the leaders from the river basin administrations and hydrological agencies of various provinces (municipalities or autonomous regions) and the representatives from the concerned universities and scientific research institutions. At the meeting the participants had a discussion on how to further strengthen hydrology management, and especially on how to improve hydrological information and forecasting.

No serious floods occurred in the large river basins in China during the flood period of 1993. However, some medium and small river basins and tributaries of large rivers suffered from serious floods because of the concentrated rainstorms and lower level of flood control. In some areas, flood events even occurred several times. In June and July, the rain areas were mainly situated in the most of Guangdong Province, parts of Hunan and Jiangxi Provinces and the west of Guizhou and Sichuan Provinces in the Yangtze River Basin and south China. In the northern part of China, the rainfall concentrated in the lower reach of the Yellow River and the eastern part of Inner Mongolia Autonomous Region, which caused local flood events in Inner Mongolia and Jilin Province. In August, some local flood disasters occurred in Shandong, Jiangsu and Sichuan provinces. The government offices at various levels paid great attention to the flood control and did their best in strengthening management and post responsibility system, employing the measures for flood control and mobilizing the whole nation to combat natural disasters. In addition, the hydrological agencies provided timely and accurate flood forecasting and the flood control departments used the reservoirs to retard flood water and cut down flood peak, so that the disasters were minimized.

By the end of September 1993, 18 tropical storms and typhoons had been produced in the West Pacific Ocean, of which 6 landed on China. Typhoon Koryn landed on Guangdong Province on 27 June, tropical storm Lewis landed on Hainan Province on 11 July, and typhoon Becky landed on Guangdong Province on 17 September. Before the landing of typhoons, the flood control agencies issued urgent warnings and sent persons to the areas threatened by the typhoons for evacuating people and dealing with emergency matters so that losses were reduced.

The D.P.R. OF KOREA is making progress in flood forecasting by using flood course forecasting method on the basis of the unit course method and considering weather forecasting and hydrological conditions.

Barrages have been constructed on some of the main rivers of Korea and have contributed in preventing flood damages. Five barrages, including the West-Sea barrage which has a length of 8 km, were constructed on the Taedonggang river.

Comprehensive water control for these lock gates is being conducted by the Hydrological Forecasting Information Department of the Hydrological Research Institute in a unified way.

In HONG KONG, in cooperation with the Drainage Services Department and the Geotechnical Engineering Office, Civil Engineering Department of Hong Kong, several hydrological data acquisition networks have been expanded and the coverage improved. Data from these networks are integrated at the Royal Observatory and redistributed to the other two parties. It is now possible for weather forecasters as well as flood control personnel to have direct access to real time data from a total of 86 automatic rain gauges and 13 water level gauges installed at strategic locations within the Hong Kong territory.

In JAPAN, in order to protect life and property from floods, it is considered important to undertake not only structural measures, such as the construction of levees, flood walls, dams, and so on, but also non-structural measures, such as the establishment of systems for communicating information on flood forecasting and warning to local governments, the press and the residents for flood fighting and evacuation. The compilation of hazard maps concerning floods on rivers is one of those non-structural measures. Hazard maps related to river floods that have been compiled and published include Flood Protection Area Maps, Inundation Maps, and Inundation Hazard Area Maps.

- a. Flood Protection Area Maps show areas (e.g., alluvial plains) that can be inundated during floods on rivers at the design flood level. Flood Protection Area Maps have been compiled and published for all sections of the 109 class-A river systems throughout the country placed under the control of the Ministry of Construction.
- b. Inundation Maps show the actually inundated areas in the past floods along rapidly urbanized rivers. As of December 1992, Inundation Maps of 476 rivers have been compiled and published.
- c. Inundation Hazard Maps show areas that are likely to be inundated in the event of a rainfall exceeding a certain amount. Inundation Hazard Maps have been compiled and published for four rivers that are undergoing particularly marked urbanization, namely, the Shingashi, the Naka-Ayase, the Tsurumi, and the Ina.

In 1994, a new phase of the hazard mapping programme will begin in Japan. The above-mentioned maps will be improved and

expanded into new hazard maps incorporating the following information so that the new hazard maps will be more useful to local residents:

- evacuation zones and evacuation routes during flood
- places where flood information is displayed
- locations of flood-fighting organizations, and contacts
- locations of emergency medical institutions, and contacts
- locations of rain gauge stations and water gauge stations

MACAU has been undertaking implementation of an automatic weather observation network of digital rainfall gauges with which the rainfall amounts can be measured minute by minute. Also from radar images during approach of typhoons it is possible to pinpoint the location and the amount of precipitation associated with the outer rainband of the typhoon.

In MALAYSIA presently, 19 river basins have been equipped with telemetric systems for flood monitoring and/or forecasting purposes. 144 VHF radio stations have also been installed to provide additional meteo-hydrological and flood information. Plan is underway to establish telemetric systems to about 20 small river basins and dam areas. In 1993, establishment of 4 telemetric flood warning stations in the Muda River and Kedah River have been completed and are operational for the 1993/94 monsoon season. Establishment of 4 telemetric stations in the Timah-Tasoh dam area is in progress and is expected to be completed in early 1994.

The Tank Model and the Linear Transfer Function Model continued to be used in the real-time forecasting operation for Kelantan, Pahang, and Johor rivers during the 1992/93 monsoon season. The models performed satisfactorily. No serious floods occurred during this monsoon period. Development of a flood forecasting model for the Segamat River using Neural Computing Technique is in progress. Evaluation of the current forecasting models is being carried out with a view to improving their forecasting capability.

Malaysia continues to take part actively in the MOFFS programme under which the performance of the Kelantan river flood forecasting system for the 1992/93 flood season was evaluated. On 28 to 29 February 1992, Malaysia hosted the First Consultative Meeting on MOFFS in Kuala Lumpur which was participated in by Australia, Malaysia, Philippines, Thailand and a WMO expert. In May 1993, Malaysia was invited by WMO to participate in reviewing the MOFFS Draft Version 2C in Geneva.

In the PHILIPPINES, the flood operation procedures were enhanced due to the continuous rehabilitation of all the four telemeterized Flood Forecasting and Warning Systems (FFWS) in the country. During the period from November 1992 to October 31, 1993, a total of 101 flood information and flood warning bulletins were issued for the four river basins and dam target areas under monitoring. Major flooding occurred in the downstream of Agno/Sinocalan river basin on June 22-27, 1993 during the passage of the tropical cyclone Goring and the same river basins got flooded again during the passage of another tropical cyclone in August. A tropical cyclone caused major flooding in the downstream areas of three monitored river basins namely, Pampanga, Agno and Cagayan, in early October.

The considerable effects brought about by the eruption of Mount Pinatubo have greatly altered the hydrographic features of the river basins in Central Luzon especially the Pampanga river basin due to the deposition of lahar. In this connection, more extensive surveys and investigations were undertaken to update the rating equations and the assessment of water levels at all affected forecasting points. Installation of flood markers in strategic locations at the Pampanga, Cagayan and Bicol river basins have been completed.

In addition to the basin areas which were subjected to major flooding mentioned in the preceding paragraphs, five more post flood investigations were conducted in the river basins of southern Philippines, these were Agusan del Norte, Davao del Norte and General Santos City in Mindanao, southern Leyte in the Visayas and La Union in western section of Northern Luzon. Flash flooding in these areas occurred as a result of the oscillation of the intertropical convergence zone, the passage of a series of active easterly waves and tropical cyclone in the case of La Union province.

The Flood Forecasting Branch of PAGASA is presently undertaking research activities on the following:

- a) Flood Hazard Mapping of Ormoc City and Bicol River Basins using remote sensing technology
- b) Flood Risk Mapping of the Pampanga, Agno, Bicol and Cagayan River Basins
- c) Application of the Earth Radar Satellite-1 (ERS-1) Data on Flood Hazard Assessment in Fluvial Environment.

The rainfall forecasting model for selected stations in Metro Manila is still being tested and calibrated for its operationalization in the government inter-agency entitled: Effective Flood Control Operation System (EFCOS).

PAGASA's activities on the international linkage aspects is continuing with the submission of the final report on flash floods and their forecasting to the WMO. This report is in connection with

the 3rd session of the Working Group on Hydrology of the RA-V held in Indonesia. Moreover, the Ministry of Irrigation of Syria was provided a copy of the Philippines HOMS Component J04.1.06 entitled "Micro-Computer Based Flood Forecasting System". Same is also being requested by Malaysia and a copy will be sent soon. The PAGASA collaborated with the Institute of Hydrology of the United Kingdom in the development of a Regional Flood Frequency Analysis in order to come up with some estimates of flood magnitudes for long return periods for ungaged sites.

In the REPUBLIC OF KOREA the Ministry of Construction (MOC) is operating 316 telemetric rainfall and 302 telemetric river stage gauging stations. The MOC has now set to work to expand the modernized flood forecasting system to small basins of which catchment area is less than 2,000 km<sup>2</sup>. A preliminary study for two such basins has been carried out this year and installment of equipment will be commenced starting next year.

A long term plan for improvement of accuracy in flood forecasting was prepared this year. According to the plan, the following tasks will be carried during 1993 - 2002 (10 years) period:

- expansion of rainfall observation and discharge measurement network including arrangement of data base
- development of a runoff model adequate to meet the country's needs
- education and training for operating staff
- modernization of equipment
- study for effective operation of dams in a basin
- development of flood forecasting system for small basins.

Flood forecasting for the Han river is being given high priority because Seoul, the capital city of the country, is located downstream part of this river. The storage function method as runoff model has been in use but without yielding good accuracy because of the lack of physical parameters and the influence of tidal currents. Early this year, a study was started to improve the model to yield better results. Other studies are also being conducted for improved hydrologic information in the country, including such topics as:

- characteristics of floods in medium-small basins
- a method for estimation of peak discharge
- development of unit hydrographs in estimating flood discharge
- a manual for estimating flood discharge

In THAILAND The flood forecasting and warning system in the Pasak river has been monitored on a routine basis.

Bangkok Metropolitan Administration has already completed the installation of computerized telemetering system to monitor hydrological information gathering network including rainfall and water level gauges for flood protection as well as hydrological forecasting. The system consists of 26 stations located spread over about 600 sq.Km. of the Bangkok area.

Recently construction of flood protection systems at various industrial areas have been implemented. In addition, the study and design of drainage systems for areas outlying Bangkok and for the Chumporn Province in the southern part of the country have also been undertaken.

In VIET NAM, daily hydrological information and forecasts for effective operation of hydroelectric plants are provided at Hoabinh in the north and Triam in the south of the country. The Tank Model, the multivariable regression model and the unsteady flow equation model continue to be used for operational flood forecasts. Improvement of hydrological measurement network and data collection system is much needed at Central Viet Nam to ensure better quality data and their timely collection for running hydrological and flood forecasting models. Development and use of microcomputer software systems for hydrological data collection and processing are being undertaken in Viet Nam.

## APPENDIX V

### REPORT OF THE PRE-SESSION MEETING OF HYDROLOGISTS

#### A. INTRODUCTION

The Pre-Session Meeting on the hydrological component of the Typhoon Committee's Programme was convened by ESCAP in co-operation with TCS and WMO in Quezon City on the 1st of November 1993. This was attended by the representatives of the Typhoon Committee Member countries from Japan, Republic of Korea, Malaysia, Philippines, Thailand and Viet Nam. Dr. Rolu P. Encarnacion was elected Chairman while Ms. Margaret Bautista acted as the Rapporteur of this meeting.

#### B. 1993 HYDROLOGICAL EXPERIENCES OF THE TC MEMBERS

The PHILIPPINES, through the Flood Forecasting Branch of PAGASA, is continuously monitoring the existing four major river basins and four sub-basins downstream of Dams. Flood simulation is done through the use of some hydrological models, augmented by all available meteorological information. Two project proposals are being submitted to the National Economic Development Authority for approval, namely, Flood Risk Mapping for the existing telemeterized river basins, and The Application of the Earth Radar Satellite Data on Flood Hazard Assessment in Fluvial Environment. These activities will greatly enhance the efficiency of the Branch in meeting its various functions.

THAILAND, on the other hand, considers drought, not floods, as the national problem in 1993. It was expressed that most of the existing dams currently have water levels well below their normal levels and this condition will have an adverse effect on agriculture and other activities during the dry season. The session was informed that one solution to the problem is the diversion of water from other watersheds of the country. Also the possible utilization of international waters is being contemplated upon to provide the very much needed extra volume of water. Thus, the Government of Thailand is considering to undertake the necessary efforts in entering negotiations with concerned neighbouring countries.

As for MALAYSIA, no severe flooding was reported for the 1992-1993 monsoon season. Presently, 19 river basins have been equipped with telemetric systems for flood monitoring and/or forecasting purposes. Real-time flood forecasting is being carried out for 3 of the river basins. Real-time hydrometeorological data are also being collected and transmitted through a network of 144 VHF stations. A plan is underway to extend the telemetric system to many other river

basins and dam areas. Besides, flow simulation models are being developed for selected river basins already equipped with telemetric systems.

The Ministry of Construction (MOC) of the Republic of Korea undertakes flood forecasting activities on 5 major river basins which are equipped with modern flood forecasting systems. MOC has begun to expand flood forecasting to small basins. A preliminary study has been carried out in 1993 and the installation of equipment is scheduled next year. The Storage function model has been used for the flood forecasting for the Han River of which the downstream flows towards the center of Seoul. However, due to its inadequacy in considering tidal fluctuations, a study is now being made to modify it by the introduction of some physical parameters into the model. The Ministry's long term plan is geared towards the improvement in the accuracy of flood forecasting which include: expansion of observation stations, development of a runoff model to suit the country, undertake studies for effective operation of dams in a basin, education and training for operating staff, etc.

JAPAN has been very active in the field of hydrology. A wide variety of research activities are being conducted in this field, and regarding technical cooperation, it had conducted quite a number of training programmes and has been sending hydrologists to different countries on short and long term assignments. Most of Japan's major river systems are telemeterized. Radar rain gauges are also being installed to obtain more efficient hydrological forecasts. The major rivers are being monitored by the national government, while the small rivers are being monitored by the local government.

The hydrological warning and forecasting system in Viet Nam is operated by the Department of Meteorology and Hydrology for 16 flood-prone areas, i.e. 2 in the Northern region, 12 in the Central region and 2 in the Southern region. Forecasts issued for the lower Mekong River are made in coordination with the Mekong Secretariat. Runoff models, stage correlation and streamflow routing methods are used, aside from weather information, in the determination of flood forecasts.

#### C. RECOMMENDATIONS FOR REGIONAL COOPERATION OF TC MEMBERS

1. A second consultative meeting to solicit participation of all TC members in the MOFFS project.
2. Exchange of information of flood forecasting models especially those which are being utilized by other Members.

3. Exchange of river flow data particularly during flood season for international rivers among riparians based on mutual agreements.
4. Exchange of experts through Technical Cooperation between Developing Countries (TCDC) or other means.

## APPENDIX VI

### SUMMARY OF THE REPORTS OF THE TYPHOON COMMITTEE MEMBERS

#### ON THEIR ACTIVITIES RELATED TO THE DISASTER PREVENTION AND PREPAREDNESS COMPONENT

In CHINA, the fifth international conference for natural and man-induced disasters was convened in Qingdao, Shangdong Province from 30 August to 3 September 1993. The main subject of the conference was to discuss the causes of disasters which frequently hit various parts of the world such as flood, drought, storm, torrential rain, volcano, avalanche, earthquake, tsunami and storm surge etc. and their response strategies. About 200 experts and scholars in the fields of meteorology, seismology, oceanography, environmental science, agriculture and communication etc. attended the conference. They came from 29 countries and regions including China, Canada, U.S.A., U.K., Russia, Italy, Mexico, Japan and New Zealand. Mr. Zou Jingmeng, President of WMO and Administrator of the China Meteorological Administration, made a presentation on "Meteorological Modernization and Meteorological Disaster Prediction Service in China", presenting a vivid description of effective practices and successful cases in China in avoiding and reducing the losses brought about by natural meteorological disasters and making contributions to the development of national economy in response to the International Decade for Natural Disaster Reduction (IDNDR). The presentation was highly regarded at the conference. Many other papers were also presented and discussions were held on a wide range of issues covering the features of natural and man-made disaster occurrences, their monitoring methods and response strategies.

A symposium on flood and drought disasters in the Changjiang River and Huai River basin and on the response strategies was held at the end of 1992 in Huaiyin, Jiangsu Province, an area characterized by frequent occurrence of disasters. More than 80 experts in disaster reduction studies took part in the symposium. It was considered in the symposium that in a society unified and coordinated planning and development was necessary for effective prevention and reduction of disasters. Meanwhile disaster situation assessment was considered as an important basis for disaster reduction, therefore it was recommended that the disaster information collecting systems should be gradually improved.

A technical conference on disaster reduction for medium and large-size enterprises was convened in Shanghai. 180 participants coming from disaster administration departments of 19 provinces and municipalities as well as the medium and large-size enterprises attended the conference. Measures to prevent and reduce disasters for enterprises were discussed in the meeting.

Since September 1992, China has carried out "Art Activity Series for International Decade for Natural Disaster Reduction". In response to the International Decade for Natural Disaster

Reduction, public propaganda and education activities for disaster reduction were launched by the Chinese Society of Disaster Reduction and other institutions. 21 institutions which have joined activities, included Ministry of Water Resources, State Administration of Seismology, State Oceanic Administration, People's Insurance Company of China and so on. The purpose and objective of the Art Activity Series are organizing and coordinating the cultural and art personalities and organizations at home and abroad, who have been enthusiastic to the disaster reduction mission, so as to conduct literary and artistic creation, public performances and propaganda activities with disaster reduction as the main theme.

In the D.P.R. OF KOREA as in other Asian countries, the typhoon is regarded as the most important meteorological phenomenon which causes disasters. On the average two typhoons hit the D.P.R. of Korea each year. These typhoons weaken somewhat in intensity as they move up north towards the D.P.R. of Korea. Most of the typhoons that hit D.P.R. of Korea came from the direction of the Taiwan Island. Due to the typhoon recurvature and unusual movement with strong intensity and the difficulty in the forecasting of typhoons, research work on such typhoons is being given high importance.

Typhoon disasters in the D.P.R. of Korea occur as a result of heavy rain, storm surge and strong winds. Based on the investigation on the cause of heavy rain with more than 200 mm, it was concluded that 35 per cent of damage was caused by heavy rainfall due to typhoons. Heavy rain and strong wind also cause a big problem to the main crops of D.P.R. of Korea. Typhoons make it impossible for the fertilization of the crops and its flowering during the period from the end of July to August. Typhoons could also bring the coastal areas under water and houses along the coast and vessels are damaged by storm surges. In view hereof, the government is doubling its efforts to strengthen monitoring of typhoons and enhance the efficiency of typhoon forecasting.

A typhoon warning committee is formed when a typhoon moves northwards and threatens the D.P.R. of Korea. The research staff working in ultra-short, short, medium range, marine meteorology, satellite and communication sections with typhoon specialists make up the typhoon warning committee. The typhoon warning committee strengthens the monitoring of the typhoons while it issues forecasts, and serves as consultants on the results. Preliminary warning information is issued when the typhoon would reach and hit the D.P.R. of Korea within 2 days. The warning information is transmitted from central unit to final subordinate agencies by broadcasts, telephone, telefax, cable and telex.

In HONG KONG, an attractive booklet was printed to promote public awareness on weather hazards and to emphasize precautionary measures to be taken. This free and widely distributed publication covers warnings on tropical cyclones, rainstorms, landslides, floods and thunderstorms.

The present Dial-a-weather telephone system was expanded to 120 lines to allow easier direct access by the public. This is a free service with increasing popularity among the public interested in local weather conditions.

The International Day on Natural Disaster Reduction was commemorated on 13 October 1993 with an exhibition and a seminar. The dedicated theme on focus on schools was observed. All school principals were invited to this event. The seminar and exhibition emphasized on the meaning of severe warning systems, precautionary measures to be taken by schools and also gave an overview of territory-wide communication and relief facilities.

Weather presentations on the television by professionals increased in frequency during the year. The presentation style will be further improved with additional computerized graphics for portrayal of severe weather systems in radar and satellite sequences.

A Signal Light Remote Control and Monitoring System was developed and installed at the tropical cyclone signal station at Cheung Chau to enable remote controlling of the signal lights at the station from the Royal Observatory Headquarters.

In JAPAN, the Government Headquarters for the IDNDR was established in May 1989, and since then it has been vigorously promoting various activities for the Decade. To promote mutual exchange of knowledge in disaster reduction, several international conferences and seminars about disaster prevention have been organized, among which are: "IDNDR International Conference 1990 Japan", "IDNDR Summit Conference on Earthquake and Natural Disaster Countermeasures 1991 Japan", and "IDNDR Chiba Conference 1992 Japan".

This year, in the month of November, "IDNDR Nagoya Conference 1993 Japan" was held with the attendance of 1200 participants from 46 countries and regions as well as 6 international organizations concerned with natural disaster reduction, focusing on the disaster countermeasure in metropolitan areas.

In May 1994, Japan is going to hold "The World Conference on Natural Disaster Reduction", convened by the United Nations. The aim of the Conference includes undertaking a mid-term review of IDNDR activities around the world and an exchange of views on plans and priorities for the second half of the Decade, and promoting increased awareness on the progress of disaster reduction.

Japan has also been preparing new series of educational material to provide information to other disaster-prone countries on the past Japanese experiences of natural disasters and the countermeasures which have been taken.

The Civil Protection in MACAU is understood as an activity developed by the Public Administration of the Territory and by the citizens with the purpose of preventing collective risks inherent to the occurrence of a serious accident, calamity or catastrophe, and of attenuating its effects and of giving aid to exposed persons.

When a serious accident, calamity or catastrophe occurs, operations of the Civil Protection are unleashed in accordance with the programmes and the plans, previously elaborated and approved, to put in action to the effect, all the structure of Civil Protection: a Centre of Operations of Civil Protection (COCP), two Centres of Operations of Area, one in Taipa island (COAT) and another in the Coloane island (COAC), the Security Forces (Maritime and Customs Police, Public Security Police, Corps of Firemen and the entities between Public and Private Services). In the action of the Civil Protection during hazard situations, heavy equipment, ambulances, an emergency radio network and a civil network are employed.

In 1993, 2748 persons were sheltered in the Disaster Centre and other 3 improvised locations in Macau. Tropical cyclone Becky, the worst to hit Macau in the last 30 years, caused considerable damage and concern, however no lives were lost.

The Government of MALAYSIA, in conjunction with the International Decade for Natural Disaster Reduction (IDNDR), has established the National Committee at the National Security Council, Prime Minister's Department.

This year's IDNDR day, Wednesday October 13, 1993, was commemorated by undertaking various activities including broadcasts by the Government TV and radio stations and by other means of telecommunications, aimed at enhancing public awareness of the effects of natural disasters, and also through civic education and practical training on life saving technique for communities in the natural disaster prone areas. Presentations on saving lives during floods were made and pamphlets distributed in flood prone areas all over the country.

The main form of national disaster experienced in Malaysia is the flooding which occurs during the monsoon season. However, now and again, certain areas in the country experience flash flooding which occur after heavy rainfall. As such the measure normally undertaken usually is the preparation of relief and evacuation centres for flood victims. For this purpose the Department of Social Welfare was assigned to undertake the following three main functions, viz:-

- Locate, prepare and administer evacuation centres
- Prepare and forward food, clothings and other needs for the victims
- Responsibility for the rehabilitation of victims.

For the year 1992/1993, the Department of Social Welfare located and prepared 3,186 evacuation centres throughout the country which can provide accommodation for 781,352 evacuees. They are sited at strategic positions in flood-prone areas. Registration of victims is carried out at these centres. The Department has also prepared a total of 301 "forward bases" in remote areas where food and other essential items can be stored. In the event of any flood victim being stranded in isolated or "cut off" areas, the Royal Malaysian Air Force will air drop supplies on behalf of the Department. The Department also provides adequate food rations for the families on their leaving the evacuation centres to return home. A rehabilitation grant is given to those victims whose houses or businesses are destroyed by the disaster.

Food supplies are important relief items therefore the Welfare Department has close liaison with the Padi and Rice Board to ensure the adequate supply of rice. This is stock-piled by the Board and can be obtained at any time as required. The Department also has close liaison with the Ministry of Domestic Trade and Consumer Affairs in order to ensure the immediate supply of dry rations and canned food, mats, pillows, blankets and the like.

The Department has a standing arrangement with the Malaysian Red Crescent Society which runs a mobile kitchen service to prepare food provided by the said agency. In addition, the Department also enlists the assistance of other organizations such as the Civil Defense Corps, St. John Ambulance Brigade, and voluntary organizations to main evacuation centres and to provide essential facilities required by the victims. A register of those voluntary agencies and individuals are constantly reviewed and up-dated and these agencies and individuals can be called upon at anytime in the event of an emergency.

The preparations stated above are made long before the flood season starts which is normally between November to mid January each year. The annual project plans are submitted by the respective State Director of Social Welfare in August to enable the National Security Council which meets to deliberate and coordinate all activities before the flood season begins.

The amount of relief given out to the 6,249 flood victims for the year 1992 was RM 351,450. Late October 1993, there was minor flooding in some parts of Malaysia. Initial reports indicated that a few hundred persons were evacuated to evacuation centres. Relief items, such as food and other essentials were supplied to the evacuees. There was no loss of life or appreciable damage to property.

Malaysia, having the post of the Chairman of ASEAN Experts Group for Natural Disasters for 1993-1994, has taken over the task of publishing the 3 monthly issues of ASEAN Natural Disasters Information Network (ANDIN) newsletter. This task was assigned to the Malaysian Meteorological Service and the first issue is expected in November 1993.

The PHILIPPINES, frequently subjected to typhoons, floods and other calamities, has institutionalized disaster management mechanisms and at the same time persistently evolved workable strategies on disaster prevention and preparedness towards the attainment of disaster reduction. Among these initiatives are:

- a) Capability building of Local Government Units (LGUs): Republic Act 7160, known as the Local Autonomy Code provides for the devolution of disaster relief to the local government. With this responsibility, both the national government and the private sector have included in their thrusts the capability building of local government units.

For the private sector, the Philippine National Red Cross (PNRC) has conducted seven groups of volunteers training and one trainers training course. Also it is preparing the groundwork for implementation with the local government in 1994 to 1996 community-based disaster preparedness training in the pilot areas of Abra, Benguet, Eastern Samar and Surigao Norte. On the part of the national government, especially the Department of Social Welfare and Development (DSWD), technical assistance has been provided to the local government in the recruitment and training of volunteers with focus on the management of evacuation centres.

- b) Sustenance of Disaster Operations and Management Information Centers (DROMIC) at the DSWD national and field office levels which provide services for 24 hours during emergency operations and in 12 hours during ordinary or good weather. Its functions are to: (a) monitor effects of the disaster on the population, providing accounting on affected families/persons, casualties and damaged houses as well as the extent of relief operations; (b) coordinate the provision of augmentation support to meet emergency needs of victims, both food and non-food items; (c) maintain an "Inquiry Desk" where inquiries of relatives and friends of victims are answered; (d) produce daily quick facts on the disaster operations for the media, National Disaster Coordinating Council (NDCC), Office of the President, NGO's, private organizations and other data users.
- c) Maintenance of stockpile, especially food items at least good for one week ration of 100 families at the municipal/city level, one week ration for 200 families at the provincial level and good for one month at the field and central office levels. Tents, kitchenwares and water containers are also relevant non-food amenities for the stockpile.
- d) Organization and training of NGO communication group on disaster management. To date, 6 groups with about 600 members spread all over Luzon have been organized and trained.

- e) Risk mapping of floods is being undertaken by the Manila Observatory concentrating its activities in Regions I and VIII.
- f) Mitigation programmes on: prevention of soil erosion due to floods; prevention of losses in roads and bridges through the adoption of European standards in design and construction; and, prevention of damage to houses through social action for construction of typhoon resistant core shelter units.
- g) Integrated approach to evacuation, resettlement and barangay assimilation.

The flashfloods complicated by the lahar situation have put 6,500 families at risk in the three towns of Zambales (San Marcelino, San Antonio and Castillejos) who will have to be evacuated, resettled or assimilated to safer barangays. While the LGU's and Department of Environment and Natural Resources (DENR) are finalizing their plans on the sites and other evacuation requirements, the DSWD as chairman of the relief and rehabilitation committee of the NDCC has evolved with Communication Network for Disaster Relief (CNDR) and PNRC an integrated approach for evacuation initially 3,000 families from the affected barangays of the three evacuation centres identified. One centre shall be managed by DSWD and the other two by NGO's (CNDR and PNRC).

The planned package of evacuation emergency responses are: cash/food for work for 30 days worth P65 per family per day; shelter assistance (tents-semi-permanent); emergency livelihood support (small ad-hoc markets (talipapa)-3 months duration); support services such as medical, water stations, classes/day care centre.

In the Philippines, meteorological and hydrological disaster occurrences during the first six months of the year caused the total destruction of 36,152 houses, and the partial destruction of 72,297 others. Human casualties were minimal compared to other years, with 121 dead, and 20 persons missing. These incidents as a whole affected 220,288 families or 1,137,067 persons. Direct losses were estimated at US \$ 130 million.

In the Philippines, 1,424 local Disaster Coordinating Councils (DCC's) and 398 Disaster Control Groups (DCG's) were organized. These DCC's are the counterparts on the regional, provincial, city, municipal, and barangay levels of the National Disaster Coordinating Council (NDCC), the country's highest policy-making body for disasters and the body that exercises control and direction over all emergency operations. The DCG's, on the other hand, are responsible for the disaster management activities in establishments and institutions.

During the period, 11,202 DCC and DCG members and volunteer-workers were trained on disaster preparedness and prevention. Role-playing or simulated exposures to emergency situations formed part of the seminar-workshop.

The Office of Civil Defense (OCD) regional centers, in coordination with local DCC's and other concerned agencies, conducted 102 public information drives and 40 drills and exercises. These activities are geared towards preparing the people for any emergency, particularly those resulting from disasters due to natural hazards.

In the REPUBLIC OF KOREA, almost one and half billion U.S. dollars were spent for various structural measures in 1993 for the purpose of natural disaster mitigation. Some of the major structures included in the measures are:

- seven new dam projects
- 193 km of new embankments
- hydraulic structures in 270 places
- others (breakwaters, slope protection works, etc.)

Exercises and field training for natural disaster reduction were intensively carried on just before the beginning of the rainy season. A comprehensive public awareness plan was prepared and carried on for the rainy season including various media coverages.

June 28, 1993 was designated as a national day for disaster preparedness. During the day, hundreds of people and a total number of sixteen thousand heavy equipment of various kinds were mobilized and cleaning work was undertaken in rivers, floodplains, culverts etc. as well as various media coverages were also undertaken for the day.

As of October 4, 1993, in nineteen various disasters including Typhoon Robyn (9307) sixty five people were killed and over 13,000 were affected. The property damage was estimated as 246 million U.S. dollars, approximately half of the annual average for the same period.

The government prepared the "New Disaster Preparedness Plan" in this year. The basic idea of the plan is to undertake prevention and preparedness activities one step earlier than usual during the onset of typhoons and floods. The new plan brought some level of inconvenience to some people, but many believe they will be saved by the plan during disasters.

In the Republic of KOREA, population growth and the rapid urbanization in recent years significantly increased the potential of natural disaster damage. In order to meet the increasing demand for technological innovation in developing new disaster mitigation

measures, the country is in the process of forming a disaster research institute.

1992 Disaster Year Book, covering disaster statistics of 1992, including meteorological and hydrological records, damages and the recovery activities, was published. The book will play the role of a data bank in planning disaster mitigation programmes in the future.

Thirty one staff members, responsible for disaster prevention and preparedness across the country made a study tour to disaster related authorities/agencies in China, New Zealand and Australia for two weeks.

THAILAND strengthened the coordination between the relevant national government and non-government agencies as well as the cooperation with international agencies in various activities aimed at reducing the natural disasters.

Thailand and the Danish Hydraulic Institute implemented and coordinated Flood Modelling Programme in Thailand sponsored by Denmark. This will enhance the capability of forecasting and early warning on flooding.

The Red Cross Center namely, "Sirindhorn" was established at Nakhorn Si Thammarat, a disaster prone area in Southern Thailand. Action on stocking of the necessities for life was implemented in addition to regular responsibility of the Center on public health. The provision of efficient transportation and telecommunication system in emergency cases was also included in the preparedness measure.

Prof. Dr. Her Royal Highness Chulabhorn Mahidol, President of the Chulaborn Research Institute, upon the request of the Royal Thai Government, developed an integrated disaster prevention and preparedness programme, namely "Integrated Development and Environmental Management of the Southern Part of Thailand", which incorporated long-term sustainable development objectives to support community development in the flood-affected areas of Southern Thailand which were devastated in November 1988.

In various parts of the country, several measures on disaster prevention and preparedness were promoted and implemented by concerned agencies as follows:

a) Structural Measures:

- construction of flood protection system at Samut Prakarn, industrial areas, and
- study and design of drainage system for Nonthaburi, a province adjacent to Bangkok, and Chumporn in southern part of the country.

b) Non-Structural Measures:

- the disaster mitigation capability of local staff and volunteers was further enhanced by training and test exercises as well as the public awareness programmes was occasionally promoted in various vulnerable sites, and
- assessment and mapping of the disaster prone areas for the whole country.

During the last dry season, 68 provinces all over the country were supplied by soft loans, pumping wells and other water supplies to mitigate the impacts caused by drought.

In VIET NAM, the national law on natural disaster prevention and preparedness, approved by the Chairman of the National Assembly, has been put into force since March 1993. Based on this law all concerned ministries, organizations and other administrative levels have worked out their execution programmes.

The 1993 plan for disaster prevention and preparedness activities throughout the country was adopted in May 1993 by the National Committee for typhoon and flood control in coordination with the National Committee for IDNDR. During the typhoon and flood season close cooperation between organizations concerning disaster prevention and preparedness as well as relief activities has been achieved under the direction and guidance of the National Committee for typhoon and flood control. All forecasts and warnings of impending typhoons, floods, heavy rains were issued in time and transmitted in first priority to the public. This has contributed effectively to take appropriate emergency preparedness and relief measures to mitigate damages.

In 1993, the natural disaster phenomena over the Viet Nam such as whirlwinds, squalls, hailstorms, drought, torrential rains and floods, occurred more than their annual averages. During the year five tropical cyclones affected Viet Nam. They caused serious damages, especially at the provinces in the south of Central Viet Nam, where both drought and floods were recorded as extreme cases. The most disastrous situation was a flood and the accompanying inundation resulting from 3 days of continuous torrential rains over the southern part of Central Viet Nam from 3 to 5 October 1993. The maximum total rainfall of 3 days reached 1577 mm at station Sonhoa, and 1481 mm at station Cungson in the province of Phuyen. The resulting flood was recorded as the highest for the last 92 years. The preliminary figures of the total damages in the above-mentioned region for this event were reported as follows: 69 persons dead, 3822 houses and 364 class rooms destroyed, 53,800 ha of ricefields and 1150 ha of shrimp-breeding fields submerged, 1,321,200 cubic meters of stone for construction of reservoirs and roads were washed away, 49 bridges collapsed, 15 ships and boats sunk, etc.

APPENDIX VII

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

In CHINA, a training course on Artificial Intelligence forecast system was successfully held in April 1993 which covers the objective forecast technique for tropical cyclone location. More than 40 people from various local meteorological services of China attended the course.

The Hydrological Forecasting and Water Control Center, NWR has sent a man to Israel to attend the 1st International Post Graduate Course on Hydrometeorology.

From 23 November to 18 December 1992, Hydrological Forecasting and Water Control Center sent a person to Russia to attend the Training Course on New Methods for the Processing Analysis and Control of Hydrometeorological Data held by WMO.

The international training course for weather prediction, sponsored by the Ministry of Foreign Trade and Economic Cooperation, China and WMO, and organized by China Meteorological Administration, was opened on 21 September in Nanjing Institute of Meteorology. Thirty-four participants who are class I or II forecasters in their respective countries took part in the course. They were from 29 developing countries. This was the first training course held since EC-XLV of WMO adopted resolution to approve the Nanjing Institute of Meteorology as a Regional Training Center of WMO in June this year.

A seminar on new techniques of numerical weather prediction, jointly organized by Numerical Weather Forecast Committee of the Chinese Meteorological Society, Department of Weather Forecast and Warning and Department of Scientific Research and Education of China Meteorological Administration, National Meteorological Center (NMC) and Beijing Institute of Meteorology, was held during 19-30 October 1993 in Beijing Institute of Meteorology. Twelve participants from various weather offices took part in the seminar. Lectures were given by well-known specialists and scholars which touched upon various latest achievements in numerical weather prediction and synoptic dynamics.

The Department of Weather Forecast and Warning, China Meteorological Administration and Beijing Institute of Meteorology jointly organized a training seminar on "Expert Nerve Network System" during 21-31 April 1993, in Guilin, Guangxi Autonomous Region in order to improve short range prediction of disastrous weather events and to accelerate the establishment of intelligent working station for weather forecast. Fifty persons from meteorological services of various provinces, autonomous regions and municipalities took part in the study.

The International Workshop on River Flow Forecasting was held by the Hydrological Forecasting and Water Control Center and University College Galway, Ireland during 17-28 September 1992. The trainees included 20 people from China and 8 people from other developing countries. The professors and experts from Italy, the Hydrology Department of UCG, Hydrology Department of Hehai University of China and the Ministry of Water Resources, PRC, gave the lectures. At the workshop, the trainees submitted their papers and exchanged their experience.

Hydrological Forecasting and Water Control Center sent its staff to Ireland attending the International Workshop on River Flow Forecasting held by UCG from 3 May to 28 June 1993.

Hydrological Forecasting and Water Control Center sent a person to USA attending the Training Course on River Flood Forecasting held by WMO and the National Weather Service from July to September 1993.

In HONG KONG, several local training courses covering new equipment operations, observational practices, meteorology and forecasting were run by the Royal Observatory. A total of around 240 participants/times from Class I, Class II and Class III meteorologists attended these courses. Two overseas participants from Brunei attended a meteorological training course at the Royal Observatory from 3 May to 13 August.

Nine meteorologists from Hong Kong were sent to various overseas institutions for advanced and special training.

JAPAN has been making continuous efforts to expand technical cooperation. Training events were offered to members of the Typhoon Committee on the subjects of NWP and telecom-munications as shown in Table 1. Expert services were provided in the fields given in Table 2.

**Table 1**  
Training implemented at the JMA related to activities on the Typhoon Committee since its twenty-fifth session

<i>Subject</i>	<i>Member(s) from</i>	<i>No. of Participants</i>	<i>Duration</i>
Initialization on numerical weather prediction	Republic of Korea	1	1.5 months from 15 February 1993
Introduction and operation of global models	- ditto -	1	3 months from 26 July 1993
Meteorology	China	1	4 months from 26 August 1993
Meteorological instruments	Thailand	2	10 days from 16 September 1993
Typhoon analysis	Republic of Korea	1	3 weeks from 5 October 1993

**Table 2**  
Expert service to the Typhoon Committee Members from the JMA since its twenty-fifth session

<i>Subject</i>	<i>Member(s) in service</i>	<i>No. of Experts</i>	<i>Duration</i>
Meteorological telecommunication	Philippines	1	one year from 14 July 1992
Meteorological data management system	Republic of Korea	1	2 weeks from 3 March 1993
Precipitation estimation using satellite data	- ditto -	1	10 days from 14 March 1993
Establishment of ASEAN Specialized Meteorological Centre	ASEAN	1	one week from 19 July 1993
- ditto -	- ditto -	1	3 days from 1 November 1993 (planned)

In MACAU, numbers of SMG staffs have been trained in the following meteorological course:

Course	Number of Participants
Class III Meteorological Officer	5

Overseas Training/Seminar/Workshop attended by SMG personnel in 1993.

Subject	Venue	Duration	No. of Participants
* Seminar for instructor	Seoul	6 DEC - 17 DEC	1
World Congress for Engineering and Environment	Beijing	11 OCT - 15 OCT	1
8th Seminar on Hazardous Weather	Guangdong	25 NOV - 27 NOV	4

\* Regional Training Seminar for National Instructor of RA II and RA IV.

In MALAYSIA, the training courses conducted by the Malaysian Meteorological Service (MMS) and those which were attended by MMS personnel are summarized in Tables 1 and 2, respectively.

Table 1				
Training Provided by the Malaysian Meteorological Service to Overseas Meteorological Personnel in 1991				
Date	Course	Duration	Country	No. of Participants
25 July - 07 August 1993	Basic Course for Marine Observers	14 days	Brunei Darussalam	1
04 - 23 October 1993	Basic Meteorological Instrument Course	20 days	Brunei Darussalam	4
06 - 11 December 1993	Operational Course in Agrometeorology*	6 days	Brunei Darussalam	3

\*(Tentative)

The following training activities were also undertaken in the field of hydrology:

- A Malaysian hydrologist participated in the Regional Workshop on Small Island Hydrology held on Batan Island, Indonesia from 16 to 19 February 1993.
- A Malaysian hydrologist attended the Tropical Cyclone Hydrology and Flood Forecasting Course in Davis, USA from July to August 1993.
- A Malaysian hydrologist shall participate in a symposium on forecasting of storm-related floods in Guangzhou, China from 22 to 25 November 1993.

Table 2			
Overseas Training/Seminar/Workshop Attended by Malaysian Meteorological Service Personnel in 1993			
Subject	Venue	Duration	No. of Participants
Workshop on Volcanic Ash Clouds	Darwin, Australia	16-17 February 1993	1
Exhibitions on the achievements of meteorological service and technology	Beijing, China	01-08 April 1993	1
Western Pacific Workshop on Seasonal to Interannual Climate Variability: Strategies for Improved Forecasting and Application for Social and Economic Sectors	Melbourne, Australia	01-03 June 1993	1
First International Conference on Computer-aided Learning (CAL) and Distance Learning in Meteorology, Hydrology and Oceanography	Boulder, Colorado, USA	05-09 July 1993	1
IAMAP/WMO Symposium on Monsoons and Tropical Cyclones	Yokohama, Japan	16-20 July 1993	1
Workshop on Global Warming Issues in Asia	Bangkok, Thailand	08-10 Sept 1993	1
International Seminar/Workshop for Port Meteorological Officers	London, UK	20-25 Sept 1993	1
3rd Technical Conference on SPECTRUM	Shanghai, China	25-29 Oct 1993	2
Training Course on Aeronautical Meteorology with Emphasis on Radar Applications	Tallahassee, USA	25 Oct - 05 Nov 1993	1

\*Tentative

# List of training in 1993 in the REPUBLIC OF KOREA:

Training of the KMA staffs in other countries in 1993 are summarized as follows:

Period (day/month)	Country (Organiza- tion)	Contents	Finan- cial Source
15/ 2 - 31/ 3	Japan (JMA)	Initialization of NWP	KMA
11/ 5 - 15/ 7	Japan	Remote sensing	JICA
14/ 7 - 27/ 7	Australia	Radiosonde observa- tion	KMA
26/ 7 - 26/10	Japan	Global Model	KMA
5/10 - 26/10	Japan	Typhoon Analysis	KMA

Two experts from JMA have visited the KMA in 1993. One came for computer system for meteorological service from March 3 to 16, and the other for satellite meteorology from March 14 to 24, 1993.

In the PHILIPPINES,

TRAININGS, WORKSHOPS, SEMINARS AND STUDY GRANTS

## I. Foreign Trainings and Seminars Attended - 19

Course/Field	No. of Participants	Place
Disaster Management	1	Thailand
Hydrology	2	Ireland/U.S.A.
Remote Sensing	4	Australia/Japan
Met. Telecommunica- tions	7	Japan
Other Meteorology Field	5	Japan/U.S.A. & Pakistan/U.K.

## II. Local Trainings

Course	Duration	No. of Participants
Port Marine Officers	23 - 29 November 1992	18
Meteorological Officers	18 May 1992 - 09 January 1993	24
Meteorological Observers (2 groups)	05 October 1992 - 16 April 1993	71
Meteorological Observers	16 January 1992 - 05 July 1993	32
Computer Data Entry and Quality Control	24 May - 04 June 1993	19

Co-Sponsorship with WMO

1) Training Seminar on Utilization of CLICOM 3.0; 23-27 August 1993; PAGASA, Quezon City - - - - 14 participants

2) Training Seminar on Interpretation of Climate Data and Products for Climatological Forecasting; 22-26 November 1993; PAGASA, Quezon City - - - - - 22 participants

RMTC Training and Fellowships

Graduates 1992-1993

Ph. D.	-	3 (Pakistan, Iran, Guinea)
M. Sc.	-	1) ) Philippines
Diploma	-	3)

WMO/VCP Fellowships 1993-1994

2	-	Viet Nam
1	-	Sri Lanka
1	-	PDR Yemen
1	-	Iraq
3	-	Iran Government

Local Trainings (participants)

MOC	-	17	MTC	-	36
MOTC	-	26			

In THAILAND,

No. of Participants	Title	Host	Duration
2	Workshop on Small Island Hydrology	Indonesia	16-19 Feb 1993
2	ASEAN Training Seminar on Regional Rain Acidification Studies	Malaysia	16-19 Feb 1993
1	Improving Cyclone Warning Response and Mitigation Workshop	Thailand (AIT)	29 Mar - 9 Apr '93
1	Western Pacific Workshop on Seasonal to Interannual Climate Variability	Australia	1-3 June 1993
2	Statistics in Agricultural Climatology	UK	7 July-14 Sep 1993
1	Software Development for Meteorology	Singapore	30 Aug-29 Oct 1993
1	Environmental Impact Assessment	Australia	12 Sep-11 Nov 1993
1	International Training Course on Weather Forecasting	China	20 Sep-15 Oct 1993

In VIET NAM, the workshop on natural disaster management was held in Hanoi, 5-11 October 1993 by the Viet Nam National Committee for IDNDR with assistance of UNDP and DMTP.

Two local training courses on observational methods and operation and maintenance of telecommunication equipments being used at stations were carried out respectively for the Meteorological and Hydrological observers.

In 1993, 8 specialists from the Hydrometeorological Service of Viet Nam were sent abroad to attend seminars, workshops and training courses on the following subjects:

- Tropical cyclone forecasting and research
- Improvement of tropical cyclone warning, response and mitigating measures
- Climatological data processing
- Computerized automatic data collection and processing.

APPENDIX VIII

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

In CHINA, the scientific research on SPECTRUM is continuing. Many scientists from the research institutions, forecasting centers and universities are involved in the research on the following subjects:

- The implication of asymmetric structure and scale-interaction on the movement of tropical cyclone.
- The studies on the environment conditions for typhoon recurvature and westward moving typhoon.
- Relations between meso-scale structure and the movement of typhoon.
- The mechanism analysis of the relations between typhoon movement and environment induced flow deviation.
- The implication of topography in Taiwan area on tropical cyclone movement and on its structure variation.

Parts of the results of the studies mentioned above will be presented at the Third Technical Conference on SPECTRUM.

Scientific research on tropical cyclones can be divided into two main efforts namely (1) the SPECTRUM research project, and (2) the national key research project which is supported financially by the government.

The goals of the SPECTRUM research project are to study the recurvature and unusual motions of target tropical cyclones using the intensive data set of SPECTRUM-90 integrated with TCM-90 aircraft observations within typhoons. Research topics focus on:

- The impact of asymmetric structure on typhoon motion;
- The causes of motion deviations from the environmental steering flow;
- The interactions of weather systems between different latitudes;
- The interactions between different motion scales.

Numerical simulations, diagnostic analyses, and observational studies were employed in this research. New findings were presented to the SPECTRUM second and third technical conferences.

The National key research project is being conducted with scientific field experiments and theoretical studies to:

- develop an operational typhoon numerical model to predict tropical cyclone motion;
- improve different statistical and statistical-dynamical models for tropical cyclone motion forecasting;
- conduct domestically the Chinese Abnormal Typhoon Experiment (CATEX).
- Target typhoons will be chosen for intensive observations according to the following criteria: 1) move into the target area of (off shore or inland) 2) sudden changes in track, intensity, or rainfall.
- Study the physical mechanisms of typhoons that exhibit sudden changes in track and intensity as well as torrential rains.

In the D.P.R. OF KOREA, research activities include:

- Develop and apply new numerical forecasting model and improve the quality of present forecasting methods.
- Integrate the forecasting results with various methods objectively on the basis of the characteristics of typhoons which passed Korea and physical parameters affected by the typhoon course.
- Enhance the objectivity level of wind by typhoon and forecasting of precipitation.
- Set-up measures enhancing effectiveness of typhoon forecasting and warning to help secure the national economy.
- Established the forecasting method on ultra-short heavy rain by radar, satellite data and medium-scale model.
- Research on the influence affecting sea water temperature and typhoon course and development by geographical condition.
- Solution of mechanism of typhoon in non-regular movement and rapid change of course.
- The modelling on the distribution of meteorological parameters of the typhoon with different stages of development.

The research work for the development and the improvement of typhoon numerical modelling are being carried out at the Atmospheric Circulation Laboratory of the Meteorological Research Institute. In particular, the new method of forecasting the typhoon movement by barotropic model was developed and it is being applied successfully in operational weather forecasting.

In HONG KONG, starting from June 1992, the Limited Area Model developed by the Florida State University was integrated into the operation cycle of the Royal Observatory numerical analysis-forecast system to generate better first guess field. In mid 1993, experiments to use the 12-hour forecast of JMA's global spectral model directly as first guess field were also made. Performances in the generation of analysis and short term (less than 3 days) forecasts based on the two approaches were being assessed and compared.

The following papers were published by Royal Observatory Hong Kong:

"A case study of heavy rain in Hong Kong using the Royal Observatory Limited Area Model"

"SPECTRUM: Scientific problems and research opportunities"

"Operational typhoon motion forecasting in Hong Kong - current possibilities and scientific problems"

"Comparison of different track scenarios for selected tropical cyclones during SPECTRUM - 90"

"Behaviour of SPECTRUM tropical cyclones in an operational limited area model"

"Use of numerical forecast products from global/regional models in operational forecast of winter monsoon in Hong Kong"

"Application of graphic display system to the monitoring of severe rainstorms"

"An observational study of the spiral rain bands of Typhoon Eli (9205)"

"The Royal Observatory synoptic analogue forecast system"

"Observational aspects of the 8 May 1992 rainstorm"

"The record-breaking rainstorm in Hong Kong on 8 May 1992"

In JAPAN, current operational models of the JMA utilized bogus typhoon data which are symmetric with respect to the typhoon central pivot. The impact of asymmetric components of bogus data was examined. It was found that the introduction of asymmetric components which are extracted from the first guess field for the objective analyses improved the typhoon track prediction.

Kuo's scheme is currently used in the JMA's operational Global Spectral Model (GSM) to express ensemble effect of cumulus convection which is crucial for tropical cyclone forecast. However, Kuo's scheme is known to give systematic errors, such as northward drifting bias error, in typhoon track forecasts of GSM.

Experiments revealed that introduction of the Arakawa-Schubert scheme decreased the systematic errors.

The Meteorological Research Institute (MRI) of JMA continued to conduct numerical prediction experiments on SPECTRUM typhoons using the triple nesting numerical model developed in MRI. For the time being, to examine the impact of initial value on the typhoon prediction, two different types of data, i.e. operational objective analysis data by JMA and re-analyzed data by the National Meteorological Center of the United States National Weather Service, are used as the initial values for the prediction experiment. According to the experiment, the typhoon movement and development deeply depend on conditional instability of the initial field, especially conditional instability over sea surface where the typhoons are formed. Because the initial field in data sparse area depends upon the first guess for the objective analysis, the improvement of numerical models for the objective analysis, as well as the improvement of typhoon prediction models, is indispensable to raise the accuracy of numerical prediction of typhoons.

Intraseasonal variation of convective activity with the period of 30-60 days over the tropical Indian Ocean and the western Pacific was analyzed by using infrared images of the geostationary satellites, GMS and INSAT. It has shown that the large-scale, NW-SE oriented convective zone associated with the intraseasonal variation extends from the Himalayas to the ITCZ region over the western Pacific. When the convective zone propagates over the western Pacific, tropical cyclones frequently occurred.

Water vapor data, sea surface temperature (SST) data and an index of convective activity were derived from the AVHRR split window data of the NOAA polar-orbiting satellite over the Indian Ocean and the western Pacific. It was found that the above three elements have intraseasonal variation with a period of 30-60 days east of the Philippines and that the warm SST precedes the active cumulus convection and moist field by about 20 days.

In MACAU, on-going studies about hazardous weather includes flood situation and typhoon.

In preparation are two research works entitled:

1. Qualitative Analysis of ECMWF model in forecasting the tropical cyclone trajectory in 1993.
2. Typhoon "Becky" and the highest tide (sea) level recorded in Macau.
3. A Protocol has been signed with the Macua University for research work.

The first results has been a research paper "Acid Rain over Macua" presented on the World Congress for Engineering and Environment (Beijing, October 1993).

We expect to have on the future the development of our research component with such collaboration.

Held for the first time in Macau, the Seventh Seminar on Hazardous Weather between Macau, Hong Kong and Guangdong for exchange of technical views and make contributions for further typhoon and flood research.

The Malaysian Meteorological Service is currently using the SPECTRUM and other data set to conduct studies on the interaction of typhoons with the large-scale environment especially the monsoon trough and its impact on the weather over the equatorial region.

In the PHILIPPINES, several researches on tropical cyclones were completed in 1993. These are:

A Statistical Method of Forecasting Tropical Cyclone Intensity for the Philippines

Rainfall Forecasting in Metro Manila: An Observational Case Study of Ten Tropical Cyclones

A Case Study of Synoptic Situations Associated with Unusual Motions of Tropical Cyclones

A Numerical Study of the Barotropic Model for Typhoon Track Prediction in the North Western Pacific

The Effects of El Niño on Tropical Cyclone Formation

Other researches on tropical cyclones which are currently being undertaken are the following:

A Statistical Method Using Synoptic Situation in Forecasting Tropical Cyclone Movement

Tropical Cyclone Rainfall Statistical Analysis for Five Weather Stations in the Philippines

Climatology of Maximum Wind Speed (MWS) Change of Tropical Cyclones in the Philippines

An Analysis of Recurvature and Non-Recurvature of Tropical Cyclones Affecting the Philippines in Relation to Surrounding Wind Height Field

In the REPUBLIC OF KOREA, several researches on typhoon were undertaken in 1992-1993. Three of them are on the performance of typhoon track forecasts by the dynamical models, one is on analysis of statistical characteristics of typhoons, and the last one is on center identification from satellite imagery. Their titles and some specifications are listed below.

Yoon, S.-C, and Y.-J. Kim, 1992: Forecasts of typhoons using Quasi-Lagrangian typhoon model, Part I: Model survey and test runs, J. Korea Met. Soc., 28, 347-378.

Kim, Y.-J., and S.-C. Yoon, 1992: Forecasts of typhoons using Quasi-Lagrangian typhoon model, Part II: Bogussing process taking serious view of mass field and comparison of the results, J. Korea Met. Soc., 28, 379-392.

Lee, D.-K., D.-E. Jang and T.-K. Wee, 1992: Typhoons approaching Korea, 1960-1989, Part I: Statistics and synoptic overview, J. Korea Met. Soc., 28, 133-147.

Lee, D.-K, Y.-C. Kwon and T.-K. Wee, 1992: Typhoons approaching Korea, 1960-1989, Part II: Prediction experiments on a mesoscale numerical model, J. Korea Met. Soc., 28, 149-163.

Suh, A.-S., K.-L. Kim, C.-K. Lee and M.-S. Lee, 1993: The location of the center of a typhoon from the satellite cloud images, J. Korea Met. Soc., 28, 333-346.

In THAILAND, some objective techniques for tropical cyclone prediction over Thailand and neighboring areas were further investigated and formulated. Further studies were done on the climatology of tropical cyclones over the Thailand area of responsibility.

The initialization schemes and boundary conditions for the primitive equation model applied for a limited region in the South China Sea and surrounding area are being studied. The formulation of cumulus parameterization and the large - scale release of latent heat are being investigated for the tropical atmosphere.

All NWP products received by GTS from ECMWF, KWBC (Washington), RJTD (Tokyo) and EGRR (Bracknell) are analyzed and graphically displayed by software developed on IBM-PC/AT; for purposes of research and operation of weather forecast.

TMD is establishing a working group that will closely coordinate with the scientists from various research institutes with the aim of developing Numerical Weather Prediction Models.

The existing 5-level limited area model is under study and modification for use over region of Thailand and neighboring areas.

Investigation is on-going on the impact caused by severe tropical storms in disaster prone areas. All relevant data would be further studied with the end in view of developing the effective measurements for reducing natural calamities.

Other tropical cyclones are further studied such as GAY (8929, 1-9 Nov. 1989) and ANGELA (9224, 15-31 Oct. 1992) on their peculiar movement in the area of the Gulf of Thailand. All concerning data were collected the most that is possible. Significant aspects of

the evolution and development of these disturbances and the related large-scale environment during the period of the occurrence are under analysis and investigation. The essential of and requirement for a limited area numerical model for forecasting purposes are on experiment and study as well as the model is under formulation with additional beneficial data utilization of Global Model from various Centres. Besides, research aspects of these severe tropical cyclones which originated in low latitudes over the tropical ocean are also attempted and being laid down for further implementation in combination with the available SPECTRUM data.

In VIET NAM, study of vortex initialization for a dynamical model predicting tropical cyclone tracks and study of predicting tropical cyclone intensity with use of satellite cloud images are continued.

Case study and survey of flash floods occurred recently in the north-western and central regions of Viet Nam.

Classification of synoptic situations related to heavy rains and development of statistical models for prediction of flood and inundation in the provinces of Central Viet Nam.

Application of a numerical model for computing storm surge.

Establishment of hydrometeorological data based specialized for study of typhoon and flood characteristics and their forecasts.

Fulfillment of the National research programme No. 06B on the measures mitigating damages caused by typhoons and floods, especially for the provinces in Central Viet Nam.

# APPENDIX IX

## TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

### 1 METEOROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
1.1 SUPPORT TO METEOROLOGICAL OBSERVING SYSTEMS AND FACILITIES							
1.1.1 Maintaining services specified in the Operational Manual, including intensified observations (surface, upper-air and radars)	—	—	—	—	Members	National	Continuous activities
1.1.2 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	
1.1.3 Establishment of AMedas, ASDAR, anemometer, tide gauge and water recorder networks	—	—	—	—	Members	National	
1.1.4 Expansion of observational programme:							
1.1.5 Replacement/Upgrading of old radars	—	—	—	—	Malaysia	National and external assistance	Continuing activity.
• Aparri (98232), Baier (98333), Guiuan (98558) and Virac (98447)	—	—	—	—	Philippines	National and external assistance	Continuing activity.
1.1.6 Establishment of new weather radars:							
• Da Nang (Viet Nam)	—	—	—	—	Viet Nam	National and external assistance	
• Vientiane, Lao PDR (Lao People's Democratic Republic)	—	—	—	—	Lao PDR	External assistance	
• Hua Hin (Thailand)	—	—	—	—	Thailand	National	Being purchased/installed in 1994.

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## TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

### 1 METEOROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
1.1 SUPPORT TO METEOROLOGICAL OBSERVING SYSTEMS AND FACILITIES (cont'd)							
1.1.6 Establishment of new weather radars: (cont'd)							
• Surat Thani (Thailand)	—	—	—	—	Thailand	National	
• Sakon Nakhon (Thailand)	—	—	—	—	Thailand	National	
• Ubon Ratchathani (Thailand)	—	—	—	—	Thailand	National	
• Chiang Rai (Thailand)	—	—	—	—	Thailand	National	
1.1.7 Establishment/upgrading of satellite equipment (GSM/TIROS-W)							
• Vientiane (Lao PDR)	—	—	—	—	Lao PDR	External assistance	
• Hanoi (Viet Nam)	—	—	—	—	Viet Nam	External assistance	
• Ubon Ratchathani RMC (Thailand)	—	—	—	—	Thailand	National	
1.1.8 Establishment of a WW data user system for the reception of FAX and GPV data via GMS	—	—	—	—	Members	National	Being planned.
1.1.9 Establishment of a dedicated GMS-based telecommunication system for a standardized and integrated distribution, reception (and local processing) of grid data from the RSMC-Tokyo, JMA.	—	—	—	—	Members with active participation of WHO, ESCAP and RSMC-Tokyo, JMA	National/External	

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**TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN**

**1 METEOROLOGICAL COMPONENT**

TASKS	TIME SCALE			BY WHOM	RESOURCES	REMARKS
	94	95	96	97		
<b>1.2 SUPPORT TO METEOROLOGICAL TELECOMMUNICATION SYSTEMS AND FACILITIES</b>						
<b>1.2.1 Maintaining:</b>						
• services and facilities for the real-time exchange of data and products				Members	National	Continuous activities
• Monitoring of data exchange				RTHs Bangkok, Beijing and Tokyo	Members concerned	Continuous activities
				RTHs Bangkok Vientiane-Hanoi Bangkok-Vientiane-Ho Chi Minh	Members concerned	Continuous activities
<b>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</b>				Members	National	Continuous activities
<b>1.2.2.1 Establishment of regional telecommunication links</b>						
• Bangkok-Cambodia				Thailand and Cambodia	National and external assistance	Under technical discussion
• Bangkok-Beijing				Thailand and China	National and external assistance	Under technical discussion
• Bangkok-Vientiane				Thailand and Lao PDR	External assistance	Under technical discussion
• Seoul-Pyongyang				ROK and DPRK	National	Depending on bilateral discussion

**TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN**

**1 METEOROLOGICAL COMPONENT**

TASKS	TIME SCALE			BY WHOM	RESOURCES	REMARKS
	94	95	96	97		
<b>1.2 SUPPORT TO METEOROLOGICAL TELECOMMUNICATION SYSTEMS AND FACILITIES (cont'd)</b>						
<b>1.2.2.2 Improvement of data completeness and quality, including use of real-time and non real-time monitoring results for this purpose</b>				Members	National	Continuous activities
<b>1.2.2.3 Review of existing arrangements for dissemination of typhoon warnings with a view of introducing improvements where necessary</b>				Members	National	Continuous activities
<b>1.2.2.4 Improvement of national data collection and retransmission to associated RTHs</b>						
• Lao PDR				Lao PDR	External assistance	Continuous activities
• Philippines				Philippines	National and bilateral support	Continuous activities
• Upgrading of telecommunication circuit linking Hanoi and Bangkok from 75 bauds to 100 or 200 bauds				Viet Nam	National and external assistance	Construction phase of civil and telecommunication works of the Meteorological Telecommunications System Development Program (MTSDP) will be completed by August 1994 to be followed by a 2-year contract on the Operation and Maintenance Guidance Phase of said program.
• Establishment of telecommunication circuit between Hanoi and Beijing with speed of 2400 bauds				Viet Nam	National and external assistance	Speed is under negotiation

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

1 METEOROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
1.3 REQUIREMENTS SPECIFICALLY FOR TROPICAL CYCLONE FORECASTING AND WARNING					RSMC Tokyo	Japan	Continuous activity
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					Members	National	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 and external assistance	Continuous activity
1.3.4 Establishment of a regional computer network					Members	National and external assistance	Continuous activity
1.3.5 Installation of a computer processing system with a view to integrating satellite, radar and rainfall data so as to provide spatial distribution of rainfall amount over a large region					Members	National and external assistance including TCDC	Continuous activity
1.3.6 Setting up of electronic equipment maintenance and repair workshops					Members	National and external assistance including TCDC	Continuous activity
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 JMWDR	Continuous activity

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
2.1 FLOOD FORECASTING AND WARNING					Members	National	Continuous activity
2.1.1 Installation and operation networks of observing stations required for flood forecasting systems					China	National	Continuous activity
• Installation of telemetering systems complemented by radar rain gauges and satellite systems for important cities and other densely populated areas prone to flash floods (China)					China	National	Continuous activity
• Integration and use of data from existing meteorological and hydrological observing stations operated by various agencies (China)					Thailand	National	Continuous activity
• Installation of two hydrometeorological observing stations, one each in the Chi river basin in the northeast and in the Tapi river basin in the South					Thailand	National	Continuous activity
• Installation of an on-line system for data transmission					Members	National	Continuous activity
2.1.2 Establishment and operation of flood forecasting and warning system					Leo PDR	National	Continuous activity
• Nam Ngum and Se Bang Hieng basins (Lao PDR)							Includes real-time data collection and hydrological modelling

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
2.1 FLOOD FORECASTING AND WARNING (cont'd)							
2.1.2 Establishment and operation of flood forecasting and warning systems: (cont'd)							
• One river basin (Viet Nam - to be selected by Viet Nam)	—	—	—	—	Viet Nam	National	In cooperation with ESCAP
• Application of computer-based mathematical models to study the hydrology of urban zones (Hong Kong)	—	—	—	—	Hong Kong	National	
• Extension of flood forecasting services to other basins subject to flooding especially in medium-scale catchment (Malaysia, Thailand)	—	—	—	—	Malaysia Thailand	National National and bilateral support	
• Use of radar rain gauge for providing QPF data	—	—	—	—	Philippines	National	Request for equipment fund is still in process
2.1.3 Establishment of flood forecasting and warning systems for dam operations	—	—	—	—	Interested Members	National and external assistance	Faulty dam operation aggravates flooding downstream. Though Project FFWSO II in the Philippines was completed in March 1992, some patch-up works in some basins continue, such as the rehabilitation of rainfall and water-level stations, along with the newly required change of telecommunications frequency.

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TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
2.1 FLOOD FORECASTING AND WARNING (cont'd)							
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 modelling
• Improvement of existing models and their application in catchments subject to floods (Malaysia, Philippines, Thailand)	—	—	—	—	Malaysia Philippines Thailand	National National National	Updating basin parameters forced by Mt. Pinatubo eruption still on-going.
• Development and establishment of flood forecasting systems which are appropriate for 5 small basins in Korea	—	—	—	—	Republic of Korea	National	
• Improvement of existing flood forecasting systems for the rivers Hong and Thai Binh using microcomputers	—	—	—	—	Viet Nam		

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TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
2.1 FLOOD FORECASTING AND WARNING (cont'd)							
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 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
• Development and application of QPF derived from radar rain gauges and satellites to issue flash flood warnings in densely populated small river basins (Malaysia)	■	■	■	■	Malaysia	National and external assistance	WMO to assist in development and promulgation of the techniques
• Development of QPF and its application to flood forecasting in central region (Viet Nam)	■	■	■	■	Viet Nam	National and external assistance	

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TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
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 & WMO to assist in organizing investigations and surveys
• Determination of flood-prone areas subject to heavy damages	■	■	■	■			
• Determination of magnitude and corresponding frequency of floods in each flood-prone area	■	■	■	■			
• Assessment of potential flood damage in each area for various flood magnitudes	■	■	■	■			
• Preparation of flood risk maps	■	■	■	■			
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 & WMO
2.2.4 Implementation of selected aspects of comprehensive flood loss prevention and management	■	■	■	■	Members	National and external assistance	With assistance of ESCAP & WMO

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TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

2 HYDROLOGICAL COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
2.2 COMPREHENSIVE FLOOD LOSS PREVENTION AND MANAGEMENT (cont'd)							
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 & bilateral, multilateral support if available	With assistance of ESCAP & WHO
2.2.6 Preparation and application of a manual and guidelines for integrated river system development and management with reference to comprehensive flood loss prevention and management					Members	National and external assistance	With assistance of ESCAP & WHO
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 & WHO
2.2.8 Storm surge prediction and risk analysis					Members	National and external assistance	With assistance of ESCAP & WHO
2.2.9 Improvement of dam water release operation system					Members	National and external assistance	With assistance of TCS, ESCAP and WHO

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

3 DISASTER PREVENTION AND PREPAREDNESS COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
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 UNDRO/IFRC/WHO and other agencies concerned
3.1.2 Production of materials (audio-visual aids, pamphlets and booklets) related to public information and education					Members	National and external assistance	Work under the WHO TCP projects 12 and 14 is also relevant

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

3 DISASTER PREVENTION AND PREPAREDNESS COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
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 operation	=====	=====	=====	=====	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 roving mission
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, UNDRO, IFRC, ESCAP and WMO
3.2.7 Conducting case studies of response to major disasters	=====	=====	=====	=====	Members	External assistance	With advice from UNDRO, 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 UNDRO in co-operation with ESCAP

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TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

3 DISASTER PREVENTION AND PREPAREDNESS COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
3.2 DISASTER MANAGEMENT (cont'd)							
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 Establishment of disaster research and training institute	=====	=====	=====	=====	Members	Bilateral or multilateral support if available	
3.2.11 <sup>1</sup> Production of material related to public information and education on the Typhoon Committee activities, particularly storm warning and DPP	=====	=====	=====	=====	Members	External assistance	With support of ESCAP, WMO and TCS
3.2.12 Establishment of a Philippine training and research center for disaster prevention and preparedness through consultancy services where appropriate	=====	=====	=====	=====	Philippines	External assistance (JICA)	No progress or action yet on the re-submitted proposal to the local National Economic and Development Authority (NEDA). This is initially a PAGASA project.

<sup>1</sup>External assistance in conjunction with IDNDR

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

4 TRAINING COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
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 on 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 Training on:					Members	UNDP, WMO and other international organizations concerned	Courses and seminars organized by WMO and Members
4.1.8 Continuation of group training courses					Japan	JICA	Japan International Cooperation Agency (JICA)

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

4 TRAINING COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
4.1 METEOROLOGY							
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	
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	For both meteorological and hydrological equipment

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

4 TRAINING COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
4.2 HYDROLOGY							
4.2.1 Training on repair and maintenance of electronic equipment used in flood forecasting and warning	=====	=====	=====	=====	Members	WHO, UNDP <sup>2</sup> and other sources	Roving seminars to be organized by WHO
4.2.2 Training on advanced techniques for flood forecasting and warning associated storms, including hardware and software	=====	=====	=====	=====	Members	WHO, UNDP <sup>2</sup> and other sources	Courses and seminars to be organized by WHO
4.2.3 Training in hydrology with emphasis on flood forecasting	=====	=====	=====	=====	Members	WHO, UNDP <sup>2</sup> and other sources	Courses and seminars to be organized by WHO
4.2.4 Training on personnel through fellowships on flood loss prevention	=====	=====	=====	=====	Members	WHO, UNDP <sup>2</sup> and other sources	Courses and seminars to be organized by WHO
4.2.5 Training on appropriate topics relating to flood loss prevention and management	=====	=====	=====	=====	Members	ESCAP, UNDP <sup>2</sup> 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	WHO, UNDP <sup>2</sup> and other sources	TCDC arrangements

<sup>2</sup>For next UNDP programme cycle.

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

4 TRAINING COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
4.3 DISASTER PREVENTION AND PREPAREDNESS							
4.3.1 Training of disaster managers and volunteer leaders	=====	=====	=====	=====	Members	National and external assistance	With advice from international agencies
4.3.2 Test exercises	=====	=====	=====	=====	Members	National and external assistance	With advice from international agencies
4.3.3 Training in DPP	=====	=====	=====	=====	Members	External assistance	Regional seminars organized by TCS with help of UNDR0, IFRC, ESCAP and WHO
4.3.4 Exchange of information on the socio-economic impact of disaster	=====	=====	=====	=====	Members	UNDR0, IFRC	Seminars organized by UNDR0, IFRC and WHO
4.3.5 Training on disaster vulnerability and risk assessment	=====	=====	=====	=====	Members	UNDR0, IFRC	Courses and seminars organized by UNDR0, IFRC and ESCAP
4.3.6 Group training courses on technology for disaster prevention	=====	=====	=====	=====	Japan	JICA	Continuation
4.3.7 Exchange of DPP personnel	=====	=====	=====	=====	UNDR0, IFRC, TCS and ESCAP	UNDR0, IFRC, ESCAP and other sources	TCDC arrangement organized by UNDR0, IFRC, TCS and ESCAP
4.3.8 Emergency health management after natural disasters (Thailand)	=====	=====	=====	=====	Thailand IFRC	National	Organized by relief organizations and Thai Red Cross
4.3.9 First aid training and disaster preparedness (Thailand)	=====	=====	=====	=====	Thailand IFRC	National	Organized by relief organizations and Thai Red Cross

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

5 RESEARCH COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
5.1 METEOROLOGY							
5.1.1 General studies on:					Members or regionally coordinated programme	National	
5.1.1.1 Methods of typhoon location and accuracy					Members or regionally coordinated programme	National	
5.1.1.2 Typhoon development mechanism and forecasting					Members or regionally coordinated programme	National	
5.1.1.3 Disastrous weather associated with typhoons					Members or regionally coordinated programme	National	
5.1.1.4 Forecasting of precipitation by use of new approaches or techniques, such as, interactive techniques for integrating satellite, radar and other information					Members or regionally coordinated programme	National	
5.1.1.5 Influences of meso- and micro-scale systems on typhoon characteristics					Members or regionally coordinated programme	National	
5.1.1.6 Interaction between typhoons and the environmental circulation					Members or regionally coordinated programme	National	
5.1.1.7 Possibility of extended track forecasting methods					Members or regionally coordinated programme	National	
5.1.1.8 Evaluation and improvement of present objective forecasting methods					Members or regionally coordinated programme	National	
5.1.1.9 Sensitivity of objective methods to initial data distribution and quality					Members or regionally coordinated programme	National	
5.1.1.10 Typhoon Climatology in relation with anomalies in regional circulation					Members or regionally coordinated programme	National	

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

5 RESEARCH COMPONENT

TASKS	TIME SCALE				BY WHOM	RESOURCES	REMARKS
	94	95	96	97			
5.1 METEOROLOGY (cont'd)							
5.1.1 General studies on: (cont'd)							
5.1.1.1 Forecasting storm surge and heavy rainfall (see also 5.2.1.6)					Members or regionally coordinated programme	National	Need for short-term attachment of experts to advanced centers in the typhoon region
5.1.2 Utilization of TOPEX data set and those of SPECTRUM, TOPEX-90 AND TYPHOON-90 data set (radar, satellite, upper-air soundings, etc.) 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	
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	
5.1.2.6 Exchange of climate data & research reports					ROK & DPRK	National	Counts on bilateral discussion

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

5 RESEARCH COMPONENT

TASKS	TIME SCALE			BY WHOM	RESOURCES	REMARKS
	94	95	96	97		
5.2 HYDROLOGY						
5.2.1 Studies for development or improving techniques for:						
5.2.1.1 Comprehensive flood loss prevention and management					National	In cooperation with ESCAP
5.2.1.2 Flood risk analysis, including flood risk mapping					National	In cooperation with ESCAP
5.2.1.3 Flood run-off models appropriate for the region					National	In cooperation with ESCAP
5.2.1.4 Application of meteorological inputs to flood forecasting					National	In cooperation with ESCAP
5.2.1.5 Comparison of the performance of the different models, using the post-TOPEX data set					National	In cooperation with ESCAP
5.2.1.6 Forecasting floods caused by the combined effects of storm surges, heavy rainfall and stream flow (see also 5.1.1.11)					National	In cooperation with ESCAP
5.2.1.7 Flash flood forecasting					Members	
5.2.1.8 Study of effects of deforestation, urbanization and changing land use on the hydrology of the catchment and on the intensity of floods (In China, Malaysia, Philippines)					China, Malaysia, Philippines	In cooperation with ESCAP. On-going.
5.2.1.9 Study and evaluation of the economic and social benefits of hydrological forecasting					National	In cooperation with ESCAP

TYPHOON COMMITTEE'S REGIONAL CO-OPERATION PROGRAMME IMPLEMENTATION PLAN

5 RESEARCH COMPONENT

TASKS	TIME SCALE			BY WHOM	RESOURCES	REMARKS
	94	95	96	97		
5.3 DISASTER PREVENTION AND PREPAREDNESS						
5.3.1 Studies on the socio-economic impact of typhoon and flood disasters					Members	With advice and possible support of UNDR0, IFRC, ESCAP, and WHO
5.3.2 Vulnerability and risk assessment of disaster-prone areas					Members	With advice and possible support of UNDR0, IFRC, ESCAP, and WHO
5.3.3 Socio-economic implication of availability and quality of typhoon and flood forecasts and warnings					Members	With advice and possible support of UNDR0, IFRC, ESCAP, and WHO
5.3.4 Disaster impact modelling					Members	With advice and possible support of UNDR0, IFRC, ESCAP, and WHO
5.3.5 Vulnerability and risk assessment of lahar-prone areas in Central Luzon (debris flow)					Philippines	In connection with Mt. Pinatubo volcano eruption. Relief operations being conducted by the local Disaster Coordinating Center Relief Service Committee are still continuing.

## APPENDIX X

### CURRENT ACTIVITIES AND FUTURE PLANS OF THE RSMC TOKYO-TYPHOON CENTER

1. Major activities of the RSMC Tokyo-Typhoon Center in 1993 (after the twenty-fifth session of the Typhoon Committee) were:

- a. Replacement of cumulus parameterization scheme of the Typhoon Model (TYM)

On 15 December 1992, Kuo's cumulus parametrization scheme, which had been employed in the numerical TYM operated by the RSMC Tokyo-Typhoon Center was replaced by a moist convective adjustment scheme. Revised TYM was used for STS Irma (9301) for the first time with the initial time of 00 UTC 13 March 1993. Revised TYM is expected to reduce northward drifting bias error of typhoon track prediction.

- b. Addition of information on intensity forecast by the TYM

One of the products of the RSMC, "Guidance for Forecast by Numerical Typhoon Model" delivered through the Global Telecommunications System (GTS), was enhanced to include dynamically forecasted amount of change of the central pressure and of the maximum wind speed in addition to the center position forecast as of 1 July 1993. This product gives a guidance upon the tendency of intensification or decay of the tropical cyclone concerned. An example of the new bulletin is given below.

FXPQ21 RJTD 071200  
RSMC GUIDANCE FOR FORECAST  
NAME TS 9320 FLO (9320)  
PSTN 071200UTC 24.5N 129.5E  
PRES 990HPA  
MXWD 45KT  
FORECAST BY TYPHOON MODEL (TYM)

TIME	PSTN	PRES	MXWD (CHANGE FROM T-0)
T=12	29.4N 133.8E	-001HPA	+004KT
T=24	35.1N 142.7E	-009HPA	+016KT
T=36	40.3N 152.3E	-019HPA	+001KT
T=48	46.0N 161.0E	-038HPA	+013KT
T=60	47.9N 163.9E	-057HPA	+023KT

- c. Ocean Waves

The RSMC broadcasts the following products regarding ocean waves made available to the public through the meteorological radio facsimile (JMH) once a day:

'Ocean Wave Analysis Charts (AWPN)' for the western North Pacific

'Ocean Wave 24-hour Forecast Charts (FWPN) for the western North Pacific

The wave forecast is based on products of numerical wave models.

- d. Sea surface temperature

The RSMC provides prognostic charts of ten-day mean sea surface temperature and its anomaly as well as their analysis charts through broadcasts of JMH.

- e. Number of the disseminated RSMC products

The RSMC Tokyo-Typhoon Center disseminated the following numbers of the products to the Typhoon Committee Members from 1 January through 30 September in 1993.

via the GTS -

. Satellite Reporting (SAREP) reports	TPPW20 RJTD	322
	TPPW21 RJTD	379
. Tropical cyclone advisory	WTPQ20-25 RJTD	444
. Prognostic reasoning	WTPQ30-35 RJTD	205
. Guidance for forecast by numerical typhoon model	FXPQ20,21 RJTD	191
. Best track information	AXPQ20 RJTD	14

via the JMH (meteorological radio facsimile) -

. Prognosis of 850 hect pascal (hpa) streamline	FUXT852, FUXT854	273
	(once a day)	

On 4 November 1993, the abbreviated headings of SAREP reports, TPPW20 RJTD and TPPW21 RJTD are scheduled to be changed to TCNA20 RJTD and TCNA21 RJTD, respectively, according to the revision of the Manual on the Global Telecommunications System-Volume I, Part II.

- f. Evaluation of tropical cyclone forecasts

For the period from 1 January through 30 September 1993, nineteen tropical cyclones were observed in the western North Pacific. Results of evaluation of these tropical cyclone forecasts were issued by the RSMC. Furthermore, annual mean forecast errors of tropical cyclone positions in 24- and 48-hour forecasts from 1982 through 1991 were also determined.

g. Publication

In December 1993, the Center will publish "Annual Report on Activities of the RSMC Tokyo-Typhoon Center 1992".

h. Monitoring of data exchange

The regular monitoring of exchange of observation data associated with typhoons is being carried out by the Center for two appropriate periods selected from the year from 1 November 1992 through 31 October 1993. The results will be forwarded to all the Typhoon Committee Members in December 1993.

2. Future plans for the activities of the RSMC Tokyo-Typhoon Center

Since the establishment of the RSMC Tokyo-Typhoon Center, the Japan Meteorological Agency has continuously made efforts to expand its functions and capabilities to serve as the center for tropical cyclone analysis, tracking and forecasting in East Asia region. As one of the important products for tropical cyclone forecasting, the RSMC broadcasts 24- and 48-hour prognostic charts of 850 hPa streamline based on the predicted winds by the Global Spectral Model of JMA with initial time at 12 Universal Time Coordinated (UTC) everyday by the meteorological radio facsimile, JMH. On 1 February 1994, the Center will start to broadcast an analysis chart of 850 hPa streamline, and analysis and 24- and 48-hour prognostic charts of 200 hPa streamline. These analysis and prognostic charts will be broadcast twice a day, for initial time at 00 and 12 UTC. The proposed JMH schedule as of 1 February 1994 is given in Table 3.

In the attached table, the implementation plan of the RSMC for the year 1993 through 1996 is summarized.

Implementation Plan of the RSMC Tokyo - Typhoon Center

PRODUCT	93	94	95	96	REMARKS
<b>GMS Observation</b>					
GMS S-VISSR					28 times/day (full-disk)
WEFAX					8 times/day (4-sector), 24 times/day (Image H), 20 times/day (Image I/J)
Cloud motion wind					4 times/day
<b>Analysis</b>					
SAREP (for tropical cyclone)					8 times/day (Dvorak estimation included : 4 times/day)
Ocean waves					FAX, once/day
Sea surface temperature					FAX, 10-day mean and its anomaly
Objective analysis					
conventional					FAX
stream line					FAX
Cloud distribution					GPV*
Long-wave radiation					GPV*
<b>Forecast</b>					
NWP products					
conventional					FAX, GPV (Global Model)
stream line					FAX (Global Model: 24 & 48 hrs)
Ocean waves					FAX, once/day
Sea surface temperature					FAX, 10-day mean and its anomaly
<b>Advisory</b>					
Tropical Cyclone Advisories					4 times/day (up to 48 hrs)
Prognostic Reasoning					2 times/day
Output of numerical prediction model					4 times/day (up to 60 hrs)
<b>Others</b>					
Best Track					GTS
Annual Report					
Technical note					

SUPPORTING ACTIVITY	93	94	95	96	REMARKS
Data archive					
Monitoring of data exchange					
Product dissemination via GMS					subject to budgetary allocation*

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

## APPENDIX XI

### REPORT OF THE SPECTRUM RESEARCH COORDINATING GROUP

#### 1. Progressive Developments Relating to the SPECTRUM

The proceedings of the ICSU/WMO International Symposium on Tropical Cyclone Disasters held from 12 to 18 October 1992 in Beijing, China, was published under the title of "Tropical Cyclone Disasters" by the Peking University Press in August 1993. Many contributions from the members participating in the SPECTRUM are compiled in this book.

The Joint International Meeting of IAMAP/IAHS was held from 11 to 23 July 1993 in Yokohama, Japan. A symposium on monsoons and tropical cyclones was held under the auspices of WMO during the Joint Meeting. Several topics were presented by the participants from the Typhoon Committee Members at the symposium.

The fruitful results from research activities related to the SPECTRUM in the past three years are summarized at the Third Technical Conference on SPECTRUM held in Shanghai, China, 25-29 October 1993. Another opportunity to promote the communication between researchers and operational forecasters will be the Third International Workshop on Tropical Cyclone (IWTC-III) to be held from 22 November to 1 December 1993 in Santa Cruz, Mexico.

#### 2. Activities of the SRCG in 1993

Since the informal meeting held on 28 November 1991 during the Second Technical Conference on SPECTRUM in Guangzhou, China, SRCG has functioned by correspondence between the members. The main activities of the SRCG in 1993 were delivery of additional TCM-90 data and consultation to solve many problems that arose in the data processing. The SRCG also compiled the research activity status of the members of the Group, which are summarized below.

##### HONG KONG:

Using SPECTRUM and other data, the contrasting weather scenarios during the dissipating stages of Yancy (9012) and Dot (9017) are being investigated.

The following papers relating to SPECTRUM were published by the Royal Observatory of Hong Kong:

- (1) Behavior of SPECTRUM tropical cyclones in an operational limited-area model;
- (2) A brief synoptic discussion of SPECTRUM tropical cyclones.

Tropical cyclone researches using SPECTRUM and TCM-90 data are also undertaken at the City Polytechnic of Hong Kong. Topics studied include asymmetric flow associated with tropical cyclone motion, upper level influences on movements and intensity changes, steering flow and tropical cyclone motion based on vorticity advection, and binary interaction between tropical cyclones.

##### JAPAN:

Many researches are being undertaken at the Numerical Prediction Division and the Forecast Division of Forecast Department and the Meteorological Research Institute of JMA using SPECTRUM and TCM-90 datasets.

Several forecasting experiments using operational and research models initialized by the TCM-90 reanalyzed fields were executed and the results were compared with those started from the operational analyses of JMA to investigate the cause of northward bias error, which is dominant in typhoon track forecasts by the JMA's models.

Impacts of refinements in the bogussing method and cumulus parameterization were also studied with SPECTRUM typhoons. Introduction of real observational data near the tropical cyclone center into the bogussing procedure improved the track forecasts. Replacement of the Kuo's cumulus parameterization scheme by a moist convective adjustment scheme reduced northward bias errors. The operational models were upgraded based on these studies.

An analytical case study was done to clarify the mechanism that induced concentrated heavy rainfall associated with Typhoon Flo (9019).

##### REPUBLIC OF KOREA:

The SPECTRUM data were used to evaluate the performance of two typhoon models. The data will also be utilized in the future plan of investigating the scale interactions and the internal structure of typhoon.

##### THAILAND:

The peculiar movement of the tropical cyclones such as GAY (8929, 1-9 November 1989) and ANGELA (9224, 14-31 October 1992) in the area of the Gulf of Thailand is studied with all the available data. Significant aspects of the evolution and development of these disturbances and related large-scale environment during the period of their occurrences are under analysis and investigation.

Experiments and studies are conducted to assess the requirements of a limited area numerical model for the forecasting. The model is under formulation to incorporate the global model

output from various centres. Researches are planned on the severe tropical cyclones which originated over the tropical ocean with the available SPECTRUM data.

The status reports of other participating members will be presented at the twenty-sixth Session of the Typhoon Committee in Quezon City, Philippines.

### 3. Remarks on the Data Exchange Media

Technical difficulties were experienced in processing the data of SPECTRUM exchanged on tapes due to a wide variety in the method of recording data on magnetic tapes. The SRCG will conduct a study on the best approach to solve this problem in order to facilitate the exchange of the data between the Members.

### 4. Short and Long-term Research Objectives

It is recognized that the concept on the short and long-term research objectives of the Typhoon Committee stated in Appendix X to the Report of the Typhoon Committee on its Twenty-fifth Session is still valid.

The Group has come out with the following recommendations for the coming twenty-sixth session of the Typhoon Committee in Quezon City.

#### Recommendations

The SPECTRUM Research Coordinating Group (SRCG) recommended that:

- (a) In principle, the Fourth Technical Conference on SPECTRUM be organized possibly in 1995. However, the exact dates and venue should be decided, taking into account the progress of Members' SPECTRUM-related studies and of the programmes for the attachment of typhoon experts;
- (b) WMO publishes the articles presented at the Third Technical Conference on SPECTRUM (Shanghai, 25-29 October 1993) in the TCP series. The authors are urged to submit their articles in camera-ready form according to the prescribed format of 10 pages or less including figures and references, and to reach WMO Secretariat by 15 January 1994;
- (c) In recognition of valuable preliminary findings from SPECTRUM-related research, and the need to coordinate and integrate all research efforts for meeting fully the SPECTRUM scientific objectives, members of SRCG are urged to submit a comprehensive list of research topics containing pertinent items of objectives and their methodologies to the Chairman of SRCG by 31 January 1994 for circulation to the members;

- (d) The Typhoon Committee seeks financial support to the SRCG for its activities, e.g., setting up of coordinated medium-range research goals and development programmes to realize the benefits of the SPECTRUM datasets, and distribution of additional TCAR to researchers with an interest in SPECTRUM-related research;
- (e) WMO and Typhoon Committee are invited to explore financial support such as WMO fellowship fund and the Typhoon Committee Trust Fund, where needed, for attachment of typhoon experts of participating members to advanced centres at mutually convenient times to carry out studies which could not otherwise be conducted owing to the limitation of computing facilities, etc.;
- (f) In considering support to the request for attachment of typhoon experts to advanced centres, the Chairman of the SRCG, after consultation with members concerned, makes recommendations to TCS for financial and logistic arrangements;
- (g) Noting that the input of TCM-90s, TYPHOON-90 and CAS is valuable for the future research activities of SPECTRUM, communication between SPECTRUM and representatives of these entities should be maintained;
- (h) WMO and Typhoon Committee are invited to explore financial support for coordinating SPECTRUM-related research with other bodies, such as attendance of meteorologists and researchers at tropical cyclone related conferences of these bodies.

APPENDIX XII

ESCAP/WMO TYPHOON COMMITTEE TRUST FUND

Interim Account for the Biennium 1992/1993

As at 30 September 1993

	\$	\$	\$
Balance of fund as at 1 January 1992		134,025	
Adjustment for cancellation of prior period obligations		9,580	143,605
		-----	
Advances received	96,000		
Other income	9,716		105,716
		-----	
<u>Total revenue</u>			249,321
Less: Expenditure			
Joint Session TC and Panel	1,841		
Administration Costs - Local	10,606		
Administration Costs - WMO	4,892		
Bank Charges	36		
Spectrum Technical Conference	(250)		
Support Spectrum Steering Group	973		
Support Seminar Forecasting - Nanjing	8,573		
Publications and Reports	10,508		
Missions	5,341		
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Total Expenditure			42,520
			-----
Balance at 30 September 1993	\$		206,801
			-----
Represented by:			
Cash at Bank			215,477
Less: Unliquidated obligation			8,676
			-----
	\$		206,801

Contributions received	1992	1993	Total
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Malaysia	12,000	12,000	24,000
Thailand	12,000	12,000	24,000
China	12,000	12,000	24,000
Korea Rep. of	12,000		12,000
Japan	12,000		12,000
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Total	60,000	36,000	96,000
	=====	=====	