TC Newsletter

ESCAP/WMO TYPHOON COMMITTEE

No. 1 July 1989

Foreword

One of the activities recommended by the Typhoon Committee Technical Working Group on the Implementation of the Regional Co-operation Programme which convened at Kuala Lumpur in October 1988 is for the Typhoon Committee to undertake the publication of a regular newsletter, initially once a year. The Committee at its twenty-first session agreed and assigned the task to the Typhoon Committee Secretariat (TCS). It also provided a modest amount from the Typhoon Committee Trust Fund to cover the printing costs.

As envisioned, the TC Newsletter is intended to supplement but not supplant the Typhoon Committee Annual Review. It is meant to provide the latest information on events, activities, innovations, and developments that are pertinent to the goals and aspirations of the Committee. It is hoped that through its pages, Members can share their expertise and experiences with one another. It is also hoped that the occasional reader will be enlightened on how Governments mutually invest human, financial, scientific and technological resources for the mitigation of the disastrous effects of tropical cyclones.

TCS requests everyone concerned to send in their comments on and suggestions about this Newsletter. Happy reading.

ROMAN L. KINTANAR
Co-ordinator

ESCAP, WMO and the ESCAP/WMO Typhoon Committee

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

The Economic and Social Commission for Asia and the Pacific (ESCAP) aims to initiate and participate in measures for concerted action towards the development of Asia and the Pacific, including the social aspects of such development, with a view to raising the level of economic activity and standards of living and maintaining and strengthening the economic relations of countries and territories in the region, both among themselves and with other countries in the world.

The Commission also:

- provides substantive services, secretariats and documentation for the Commission and its subsidiary bodies;
- undertakes studies, investigations and other activities within the Commission's terms of reference;
- provides advisory services to Governments at their request;
- contributes to the planning and organization of programmes of technical co-operation and acts as executing agency for those regional projects decentralized to it.

WORLD METEOROLOGICAL ORGANIZATION (WMO)

The World Meteorological Organization (WMO) is a specialized agency of the United Nations. WMO was created:

- to facilitate international co-operation in the establishment of networks of stations and centres to provide meteorological and hydrological services and observations;
- to promote the establishment and maintenance of systems for the rapid exchange of meteorological and related information;
- to promote standardization of meteorological and related observations and ensure the uniform publication of observations and statistics;
- to further the application of meteorology to aviation, shipping, water problems, agriculture and other human activities;
- to promote activities in operational hydrology and to further close co-operation between Meteorological and Hydrological Services;
- to encourage research and training in meteorology and, as appropriate, in related fields.

THE ESCAP/WMO TYPHOON COMMITTEE

Under the auspices of ESCAP and WMO, the Typhoon Committee was constituted with a view to promoting and co-ordinating efforts for minimizing typhoon damage in the ESCAP region. The incipient stage of the Typhoon Committee dates back to 1964 when the United Nations Economic Commission for Asia and the Far East (ECAFE) at its twentieth session recommended that the Secretariat, in co-operation with WMO, studied the practical means of initiating joint programme of investigations of typhoons in the ECAFE region. Accordingly, a meeting of the Working Group of Experts on Typhoon was organized by ECAFE and WMO with financial assistance from the United Nations Development Programme (UNDP) in Manila in December 1965. Noting the extensive damage caused by tropical cyclones in the region, the meeting recommended that a Preparatory Mission on Typhoons be organized to visit the countries in the ECAFE region and neighbouring countries affected by tropical cyclones, in order to formulate an action programme to mitigate typhoon damage. It also recommended that a second meeting of experts be convened to examine the report of the Mission.

Consequently, the ECAFE/WMO Preparatory Mission on Typhoons was organized during the period from December 1966 to February 1967, with financial assistance from UNDP. Broadly, the report of the Mission provided recommendations to improve meteorological observing networks, telecommunication facilities, typhoon forecasting and arrangements for warnings. It also described requirements for the improvement or establishment of new pilot flood forecasting and warning systems on a key river basin in each of the countries visited. The establishment of a Regional Typhoon Centre was also dealt with in the report..

The second meeting of the Working Group of Experts on Typhoon, was held in Bangkok in October 1967 and the meeting endorsed the report of the Preparatory Mission and reiterated the need for early action to mitigate typhoon damage as a means of speeding economic development in the region. It also reaffirmed that national as well as joint efforts were necessary to combat effectively the detrimental effect of typhoons. Accordingly, the meeting recommended that

(Turn to page 2)

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a Typhoon Committee with a Regional Typhoon Centre as its executive body be established under the auspices of ECAFE in co-operation with WMO; and that the ECAFE and WMO secretariats draft jointly the statute and rules of procedure of the proposed Typhoon Committee and convene an ad hoc meeting of government representatives to consider and finalize the drafts.

The ad hoc meeting on the statute of the Typhoon Committee was held in Bangkok from 29 February to 2 March 1968. The meeting, besides finalizing and adopting the statute and rules of procedure of the Typhoon Committee, recommended that the statute of the Typhoon Committee be submitted to the twenty-fourth session of ECAFE and the appropriate body of WMO for consideration. It also recommended that ECAFE and WMO provide a small staff to undertake the preparatory work required for the implementation of the programme recommended by the Mission.

At its twenty-fourth session in April 1968, ECAFE endorsed the establishment of the Typhoon Committee in accordance with the statute as adopted by the ad hoc meeting. In a parallel action, the WMO Executive Committee, at its twentieth session in 1968, endorsed the establishment of the Typhoon Committee.

The inaugural session of the Typhoon Committee was convened in Bangkok in December 1968.

The Typhoon Committee is currently composed of 10 Members: China, Hong Kong, Japan, the Republic of Korea, Lao People's Democratic Republic, the Philippines, Thailand, Democratic Kampuchea, Malaysia and Viet Nam.

The functions of the Committee are to:

- review regularly the progress made in the various fields of typhoon damage prevention;
- recommend to the participating Governments concerned plans and measures for the improvement of meteorological and hydrological facilities needed for typhoon damage prevention:
- recommend to the participating Governments concerned plans and measures for the improvement of community preparedness and disaster prevention;
- promote the establishment of programmes and facilities for training personnel from countries of the region in typhoon forecasting and warning, flood hydrology and control within the region and arrange for training outside the region, as necessary;
- promote, prepare and submit to participating Governments and other interested organizations plans for co-ordination of research programmes and activities concerning typhoons;
- consider, upon request, possible sources of financial and technical support for such plans and programmes;
- prepare and submit, at the request and on behalf of the participating Governments, requests for technical, financial and other assistance offered under the UNDP and by other organizations and contributors.

In carrying out these functions, the Typhoon Committee maintains and implements action programmes under the five components of meteorology, hydrology, disaster prevention and preparedness, training and research with contributions by its Members and their co-operation and assistance provided by the UNDP, ESCAP, WMO and other agencies. (Typhoon Committee Annual Review)

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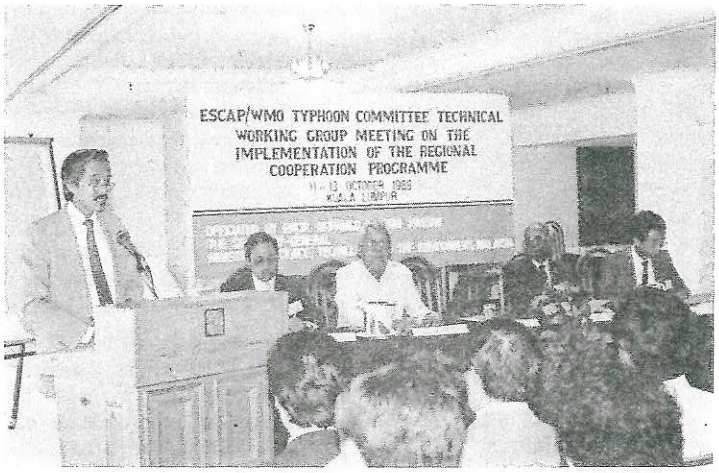
SPECIAL WORKING GROUP ON TYPHOON EXPERIMENT CONSTITUTED

The following scientists were nominated by their respective countries to the Typhoon Committee Special Working Group on Typhoon Experiments (TCSWGTX): Chen Shanmin (China), C.Y. Lam (Hong Kong), Teruo Muramatsu (Japan), Ooi See Hai (Malaysia), Ellaquim A. Adug (Philippines), Soon-kab Chung (Republic of Korea), and Patipat Patvivatsiri (Thailand).

The creation of the Working Group stemmed from an announcement of the US observer at the twentieth session of the Typhoon Committee at Bangkok, 1987 that the US Government was planning to undertake a field experiment in the Western North Pacific during the 1990 typhoon season to obtain a comprehensive data set that would be the basis for the study of tropical cyclone motion. The Committee considered the possibility of undertaking an activity similar to TOPEX to coincide with the US field experiment and established a Technical Working Group on the Implementation of the Regional Co-operation Programme (TCTWGIRCP) to study the matter, among others, and make appropriate recommendations.



Encik Mohamed Noordin Hassan, Secretary-General of the Malaysian Ministry of Science, Technology, and the Environment, delivers the principal address at the meeting of TCTWGIRCP. Seated from left to right facing camera are Mr. D.O. Vickers of WMO; Dr. R. L. Kintanar, TCS Co-ordinator; Mr. P. Markandan, Director General of Malaysian Meteorological Service; and, Mr. M. Kuriki, JICA Expert representing ESCAP.

Subsequently, the TWGIRCP at its meeting at Kuala Lumpur in October 1988 endorsed to the Committee the conduct of a special experiment by the Typhoon Committee. It was felt that the data obtained, both on real and non-real time basis, aside from those expected to be exchanged with the US experiment, would be extremely important for operational and research purposes. It was also felt that whenever feasible, observation activities during the experiment be extended to the South China Sea region. The meeting as a consequence recommended the setting up of a special group that would formulate plans for the experiment and consider other ramifications evolving from the inter-relationship of both experiments.

At the twenty-first session of the Typhoon Committee at Manila in November 1988, the Committee agreed with the recommendation of the Technical Working Group to set up a special working group. The latter was further tasked with considering another development which is that the USSR has also planned to conduct a national typhoon experiment to study the formation mechanism of the tropical cyclone anomalous tracks in the same area at about the same time.

Consequently, the Special Working Group on Typhoon Experiment (TCSWGTX) was set up and is scheduled to meet at Seoul, Republic of Korea on 11-13 July 1989 at the kind invitation of the Republic of Korea.

WMO appointed one of the Group's members, C.Y. Lam of Hong Kong as seconded expert to the Working Group with the view of coming up with a comprehensive questionnaire for distribution to members on the nature of the experiment they would like the Committee to undertake. An Intensive Observational Programme (IOP) appears to be a major facet of the experiment as gleaned from initial reactions.

STUDY TOUR ON METEOROLOGICAL EQUIPMENT

China will conduct a study tour on meteorological instruments and equipment including radiosonde for personnel of the Thai and Philippine meteorological services from 21 August to 7 September 1989 under the Technical Cooperation among Developing Countries (TCDC) concept. The participants will visit factories and facilities at Beijing, Changchun, Shanghai and Guangzhou.

The nominees are Sunan Kanchana, Varesuan Chandraramya and Samchike Trangwanchirachai of Thailand and Cipriano C. Ferraris, Arnulfo Tayam and Ernesto Macabunga of the Philippines.

Under the TCDC scheme, China will assume the travel costs and subsistence of the prospective participants within China while WMO or other external sources will be asked to bear their travel costs to and from their countries of origin.

CHINA NATIONAL CONFERENCE ON TROPICAL CYCLONES

The 3rd national conference on tropical cyclones will be held in Shanghai, China in November 1989. Latest scientific treatises will be presented at the conference. As of May, 147 abstracts on tropical cyclones have been received. These contributions deal with a wide spectrum of subjects such as basic theory study, improvement of operational forecast models and their applications, numerical simulations, case analyses and others. (Shanghai Weather Bureau).

TELECOMMUNICATIONS CIRCUITS UPGRADED

Under the activity of the Typhoon Committee, WMO has provided funds for the Malaysian Meteorological Service and Thailand Meteorological Department to acquire modems for the upgrading of the Global Telecommunications System data circuit between Bangkok and Kuala Lumpur from 75 bauds to 1200 bps. The circuit was installed in mid-January 1989. Automated message switching is also under testing. The data circuit between Kuala Lumpur and Singapore was also upgraded from 75 bauds to 1200 bps in late February 1989. (MMS)

US INVITES MEMBERS TO TYPHOON EXPERIMENT WORKSHOP

The US Tropical Motion Project through its Technical Director, Dr. Russel Elsberry, invited participation of TC Members at its planning workshop, 19-21 May 1989 at San Diego, California immediately following the American Meteorological Society's 18th Conference on Hurricanes and Tropical Meteorology.

The Project met the transportation costs and per diem of the invited participants. The Typhoon Committee Secretariat was able to obtain two slots for Dr. T. Muramatsu of Japan and E.A. Adug of the Philippines who are both members of the TCSWGTX. Other TC attendees were from the Republic of Korea and Hong Kong. Observers from the USSR and Taiwan also attended the workshop.

CHINA SETS UP NATIONAL COMMITTEE ON IDNDR

The Permanent Representative of China with WMO and concurrently President of WMO, Prof. Zou Jingmeng, reported that a National Committee on the International Decade for Natural Disaster Reduction (IDNDR) has been set up in China. It is chaired by Vice-Premier Tian Jiyun. Mr. Lou Jibin, Deputy Administrator of the China Meteorological Administration (SMA) was appointed a member of the Committee. SMA is specifically tasked to deal with disasters caused by weather events.

The creation of the National Committee is a positive indication of the Chinese Government's support for UNDRO's proposed project for Public Education and Information for Disaster Prevention and Preparedness in the Typhoon Region. To complement the objectives of the Project, China will also conduct national and local workshops and seminars on the subject. It has appropriated the sum of US$1,315,000 for the project for the five year period 1989 to 1993.

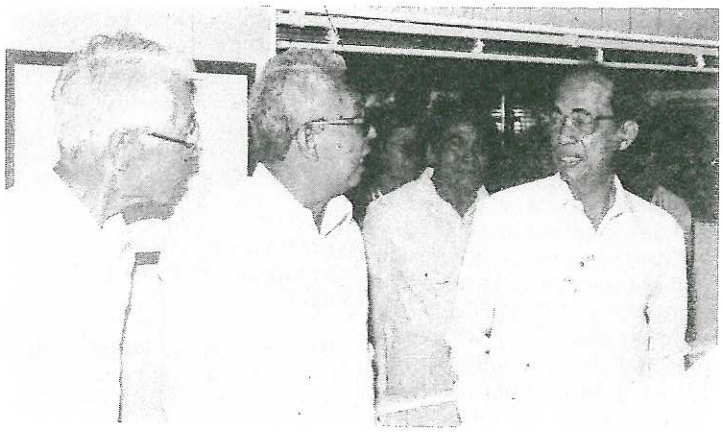
CONFERENCES

Second Expert Group Meeting on Comprehensive Flood Loss Prevention and Management
3-7 July 1989, Bangkok

Meeting of the TC Special Working Group on Typhoon Experiments
11-13 July 1989, Seoul

Twenty-second Session of the Typhoon Committee (TC.22)
October 30-November 6, 1989, Tokyo

Second International Workshop on Tropical Cyclones (IWTC-II)
27 November-8 December 1989, Manila



PAGASA Director R.L. Kintanar briefs Secretary of Science and Technology C.L. Follosco as JICA Resident Representative M. Miyamoto listens inside GMS monitoring room.

PHILIPPINES GETS NEW GMS SVISSR RECEIVER

The Japanese Government, through its Technical Assistance Program for the Philippines in Fiscal Year 1987, donated an NEC Satellite Data Utilization System (NESDUS-210 Semi-Standard Type) worth approximately US$400,000.00 to replace an older GMS receiver rendered obsolescent by the new data transmission system. This new system enables the PAGASA to obtain almost real-time transmission of data from the Geostationary Meteorological Satellite (GMS) Stretched VISSR (Visible and Infrared Spin Scan Radiometer). The reported cost did not cover installation/adjustment/operation costs which were provided separately, including the training of two PAGASA personnel in Japan, by the Japan International Cooperation Agency (JICA). Fourteen other PAGASA staff were provided on-the-job training by Japanese experts locally. PAGASA personnel started operating the new system on 29 April 1989.

A formal turn-over ceremony was held on site on 18 May 1989. Mr. Moriya Miyamoto, JICA Resident Representative to the Philippines turned over the equipment to Secretary Ceferino L. Follosco of the Department of Science and Technology before an audience headed by PAGASA Director Roman L. Kintanar.

It was noted that the system passed its first test with flying colors when it helped Philippine meteorologists in the early detection and tracking of Tropical Storm Brenda (8902) which passed south of Manila the night before the formal turn-over took place.

EL NIÑO AND TROPICAL CYCLONES

Preliminary findings by the Malaysian Meteorological Service indicate that tropical storms tend to recurve over the West Pacific before reaching the Philippines during the October month of El Niño years. On the contrary, during the October month of non-El Niño years tropical storms tend to cross the Philippines from the West Pacific. As such, plans are afoot to study the relationship of tropical storm occurrences in both the South China Sea and the West Pacific and the low-frequency oscillation of the northern hemisphere summer monsoon. (MMS)

CHINA ADOPTS TC CLASSIFICATION AND INTENSITY SCALES FOR TROPICAL CYCLONES

The classification and intensity scales of tropical cyclones as stipulated in the Typhoon Committee Operational Manual has been adopted by China beginning the year 1989.

In order to strengthen the coastal meteorological services and promote cooperation and exchange of knowhow in international meteorological science and technology, it was decided by the Chinese Government that the in-

(Turn to page 4)

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ternational classification and intensity scale of tropical cyclones would be put into use beginning 1 January 1989, and all information, forecasting and warning for domestic and international users from thereon would be broadcasted by the meteorological bureau and stations of all levels according to the stipulation.

Since it takes time for people to change their traditional ways and get used to new ones such as those concerning the classification and intensity scales of tropical cyclones, a great deal of publicity was carried out by means of radio and television broadcasting and print media. Officials from the State Meteorological Administration and the State Bureau of Technical Supervision spoke in a TV programme which was widely disseminated by the Chinese Central TV Station and TV stations of some coastal provinces. The programme proved highly successful. Moreover, a new publicity campaign will be launched as the tropical cyclone season approaches this year so as to effect positive reactions to the forecasting and warning of this year's tropical cyclones and to avoid confusion caused by the change in the classification. (SMA)

CHINA EMPLOYS NEW METEOROLOGICAL RADAR

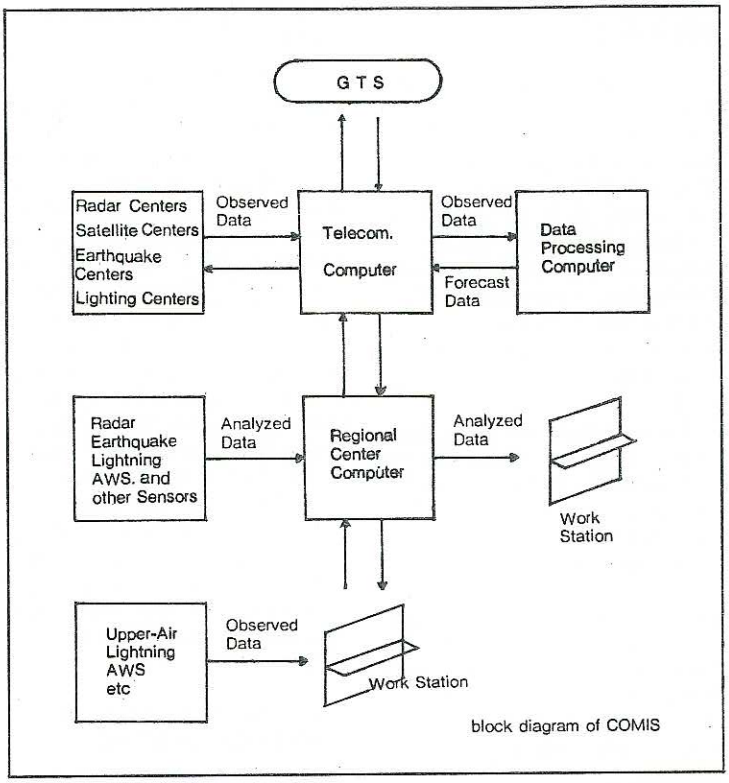
China has begun to replace the Model 843 meteorological radar with the newly developed Model 714, the purpose of which is to strengthen the monitoring of tropical cyclones along the coast of China. This kind of radar has already been installed at four stations: Xisha (59981), Fuzhou (58941), Shanghai (85367) and Shanton (59316). Another station, Dongtou (58760), is making some adjustments and expects to put it into operation in June 1989. The model 714 is a kind of digital radar of 10 cm wavelength with a sealed antenna cover that has proven to be accurate, stable and extremely effective in monitoring the location, intensity, direction and speed of the movement and the amount of precipitation of tropical cyclones. (SMA)

TECHNOLOGICAL DEVELOPMENTS IN THE REPUBLIC OF KOREA

MESDAS (Meteorological Satellite Data and Analysis System)

As part of a long term plan to upgrade its operations, the Korean Meteorological Service (KMS) has recently installed a major satellite receiving and processing facility in Seoul. The KMS system is designed for use in such areas as meteorology, hydrology, ocean science, and fisheries and will put many powerful tools into the hands of KMS forecasters and researchers.

The system will ingest data from a variety of sources, including the GMS and TIROS-N satellites, the KMS Tandem forecast computer, video and graphics digitizers, and computer tape. The most powerful aspect of the system is its tremendous analysis capability and potential. The raw processing power is fuelled by powerful VAX 8350 computer, assisted by an array processor and 4 Gigabytes of on-line disk storage. The software itself is organized and structured into several principal modules.



block diagram of COMIS

Supervisor software controls the overall system as well as handles the many peripherals. It also allows for a development environment for KMS staff to explore new ideas. Some of the functions of the application models include cloud analysis, TOVS, and ocean analysis. The application code also includes a full Meridian system with its powerful map analysis software.

COMIS (Combined Meteorological Information System)

In order to automatically and systematically collect, process and analyze various meteorological data and information transmitted from abroad as well as from within Korea, COMIS integrating meteorological observations, analyses, statistics and telecommunications into a single system, is currently under development. Under this system, various systems such as satellite data receiving system, the earthquake and lightning detection, radar and upper-air observation, and automatic weather observation will be simultaneously operated. For effective operation of COMIS, a basic computer network consisting of a host computer for meteorological analysis at KMS Headquarters, four mini-computers at DMS (District Meteorological Service), 100 terminals at WFO (Weather Forecast Office) and WOS (Weather Observation Station) will be installed.

The superimposition of meteorological image data and numerical analyzed data, and the enlargement, reduction and animation of imageries can be easily created with this System. (KMS)

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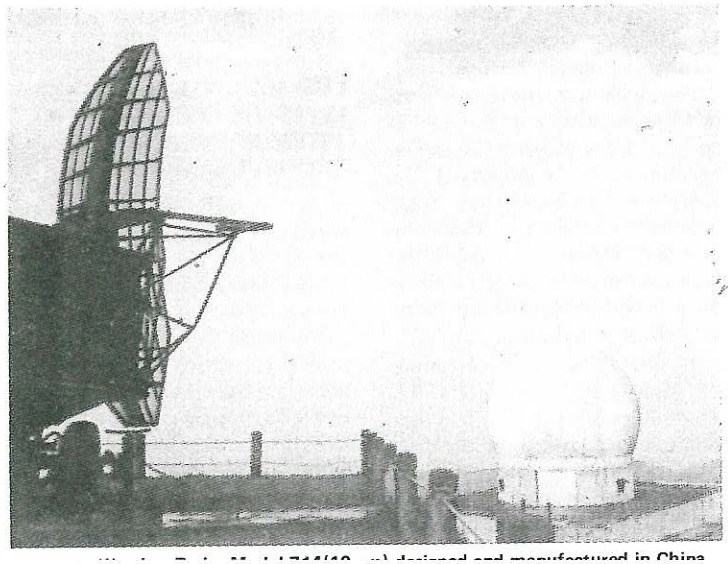


The TC Newsletter is published by the Typhoon Committee Secretariat, 1424 Quezon Avenue, Quezon City, Metro Manila, Philippines.

Opinions, scientific or otherwise, expressed herein do not necessarily reflect those of the Typhoon Committee. Contributors are requested to submit their manuscripts in English and to limit their length to not more than 1,500 words. The Editors reserve the right to edit and publish manuscripts for publication.

Twenty-Five Years of Satellite Meteorology in Hongkong

The Royal Observatory Hong Kong is one of the first institutions in Asia to install a ground station to receive hourly satellite pictures broadcast by the Geostationary Meteorological Satellite (GMS). The hourly images are broadcast in digital format and necessitates replacement of the high-resolution facsimile (HR-FAX) ground reception facilities which was in use since October 1979. Reception of the hourly pictures became operational from November 1988.

Satellite images of the earth and its cloud cover were first received at the Royal Observatory in December 1963 with equipment designed and constructed in house. The need to track typhoons prompted Hong Kong to enter into the field of satellite meteorology as soon as the first Automatic Picture Transmission System (APT) was flown onboard TIROS 8. Later on, APT signals from other polar orbiting satellites were also intercepted and reproduced on a photographic facsimile recorder. Two pictures were received everyday on a routine basis but the coverage depended much on the elevation of the satellite. Figure 1 shows a historical photograph of a duty watchman pointing a steerable helical antenna at pre-computed bearings to receive signals from the TIROS 8.

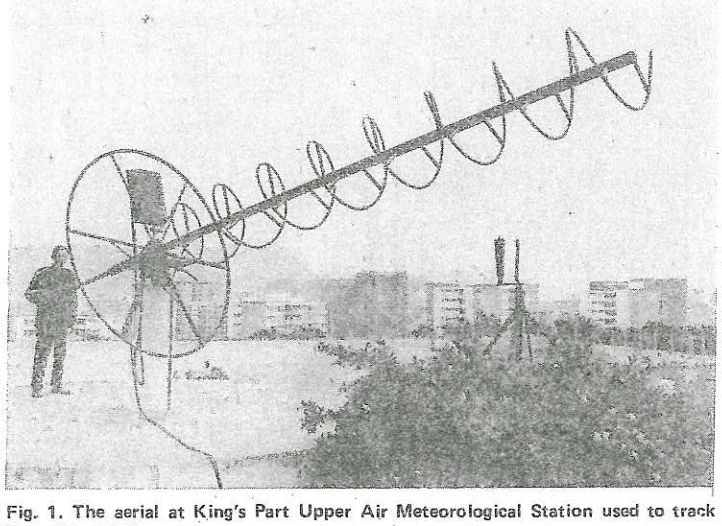


Fig. 1. The aerial at King's Part Upper Air Meteorological Station used to track Tiros 8 in 1963.

The big step forward for Hong Kong and other stations in the Far East and the Western Pacific regions came on 14 July 1977 when Japan launched the first of a very successful series of Geostationary Meteorological Satellites known as "Himawari" or "Sunflower". Stationed over the equator at 140°E it became operational on 1 April 1978. The satellite spins about an axis perpendicular to the equatorial plane so that radiometers (visible and infra-red) scan from east to west across the earth.

A dish aerial of 2 m diameter from an old Wind-finding radar, a pre-amplifier and a converter were assembled at the Royal Observatory to receive low-resolution (LR-FAX) images. Although these images had resolutions of about 4 km in visible and 7 km in IR and were available only once every three hours, they proved invaluable for tracking tropical cyclones and other hazardous weather systems.

In October 1979, a satellite ground reception system was installed at the Royal Observatory for the reception of high-resolution facsimile pictures (HR-FAX) from the GMS. The HR-FAX signals available every three hours were digitized, processed and stored on computer-compatible magnetic tapes. The processed images could be enlarged, colour enhanced to illustrate special meteorological features and presented as an animation sequence on a video display unit. Forecasters were able to make use of these facilities as a tool to monitor the movement and development of weather systems by their associated cloud pattern. The original data could be retrieved from magnetic tapes for further research.

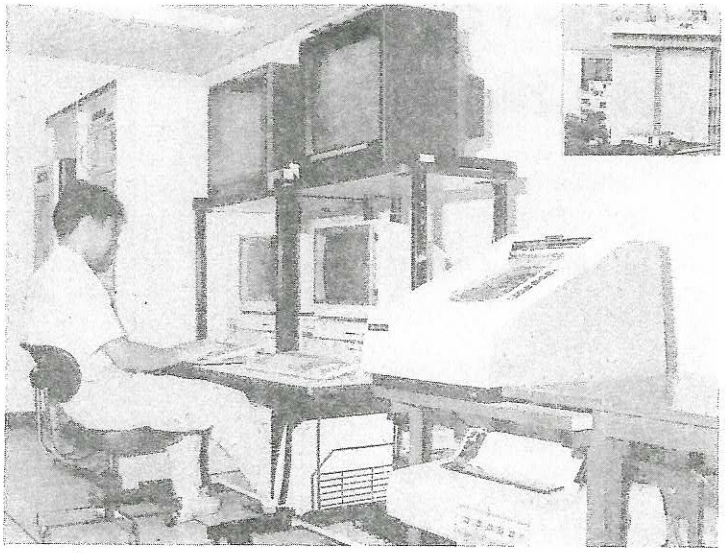


Fig. 2. The replacement GMS ground reception station in 1988. (The inset at upper right corner shows the reception aerial on top of the Royal Observatory Centenary Building).

In 1985, the Japan Meteorological Agency (JMA) announced the introduction of S-VISSR (Stretched Visible Infra-red Spin Scan Radiometer) broadcast in the middle of 1988 to replace the transmission of the HR-FAX. An International Seminar on the Advanced Utilization of Geostationary Meteorological Satellite Data was organized by the JMA in early 1987 to inform and familiarize user countries on the technical aspects of the new broadcast and the improvements S-VISSR transmission would bring.

The replacement system at the Royal Observatory was commissioned in November 1988, almost exactly 25 years after the first reception of satellite pictures in Hong Kong. The immediate benefit of the new system was the ability to receive hourly satellite pictures. The spatial resolution in the visible channel and the temperature resolution in the infra-red channel have been further improved to illustrate finer structures. The animation sequence of hourly satellite pictures gives a vivid impression to the forecaster for monitoring both the movement and life cycle of weather systems particularly the explosive development of convective activity over the tropical and equatorial regions. This enables the forecaster to respond promptly in quasi-nowcasting situations and in the timely issuance of warnings on tropical cyclones, thunderstorms, heavy rain, intense cold surges and other hazardous weather systems.

Figure 2 shows the replacement ground reception system installed at the Royal Observatory. In view of the cessation of reconnaissance flight from Guam, satellite pictures from the GMS is the only reliable method to identify and locate tropical cyclones over ocean areas, monitor their movement and development. The improved temperature resolution also gives a better estimation of their intensity in terms of wind strength.

The usefulness of information from GMS in providing more accurate weather forecasts cannot be overstated. In respect of minimizing damage and loss of lives from tropical cyclones and floods, satellite meteorology will continue to play a vital role in the years to come. (ROHK)

Hydrological Information And Forecasting In China

WANG JUEMOU and SUN GUIHUA
Hydrological Forecasting and
Water Control Center
Ministry of Water Resources, PRC

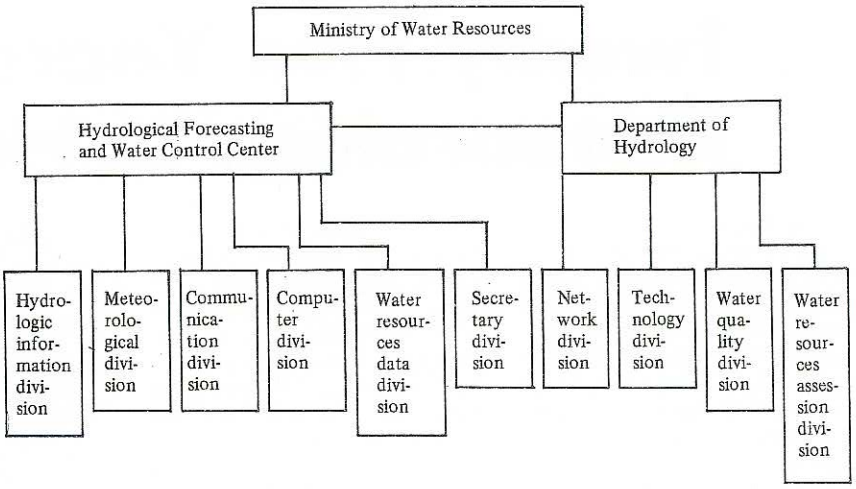


Fig. 1. Hydrology Agencies in the Ministry of Water Resources.

The history of flood information and forecasting in China goes back some 2,000 years. The agricultural law of the Qin Dynasty (221-206 BC) required localities to make rainfall reports. However it was not until 1573, during the Ming Dynasty, that the flood information system was institutionalized. Flood information was transmitted by couriers on horseback, from post to post set 30 km apart along the Yellow River was forcasted from the appearance or non-appearance of water bubbles, respectively. However, hydrological forecasting stood at a standstill for a long time. As late as 1949, there were only some 300 hydrological information stations, but no regular hydrological forecasting. Since then the Chinese Government has made great efforts to develop water project infrastructures and appropriate hydrological information and forecasting in order to minimize damages from flood and drought. In the early 1950's, a standard method for reporting hydrological information was made in the country and the number of stations increased to more than 8,500. Hydrological information and forecasting agencies were established in flood control departments at all levels, from the Central Government down to river basin authorities, provinces (municipalities, autonomous regions), prefectures, most counties and important water projects, to form a fairly thorough and organized system for carrying out hydrological information dissemination and forecasting, flood control and water management. The organization of hydrological information and forecasting systems are shown in Figs. 1, 2, 3 & 4.

In addition, a standard for period stage and degree for reporting hydrological information was developed. According to requirements of flood control and water resources management, hydrological station networks include stations that report the whole year round and stations that report only during flood periods. The daily number of reports are determined according to the characteristics of the river basin, the hydrological forecasting or monitoring function, and importance of hydrological information to flood control. In large river basins the hydrological forecasting stations report 4 times a day (i.e. every 6 hours); in medium- or small-sized river basins, 8-12 times a day. As for the monitoring stations, a standard increasing the number of reports according to water level, discharge or rainfall was determined. Usually, a report is sent each day or not at all. If the standard is exceeded, the frequency is increased. In an emergency, some stations report every hour or half hour. The content of the report includes water level, rainfall discharge (and observed discharge), sediment, ice regime, water temperature, water capacity, condition of gate working, dam-break, ice dam, etc.

Every hydrological station has its observers who, on receiving flood information, immediately send coded telegrams to county, prefecture and provincial authorities through the post and telecommunication departments. The Communication Ministry has ruled that hydrological information telegrams fall in the extra urgent category (R) — transmission should be completed in less than 90 minutes. In some

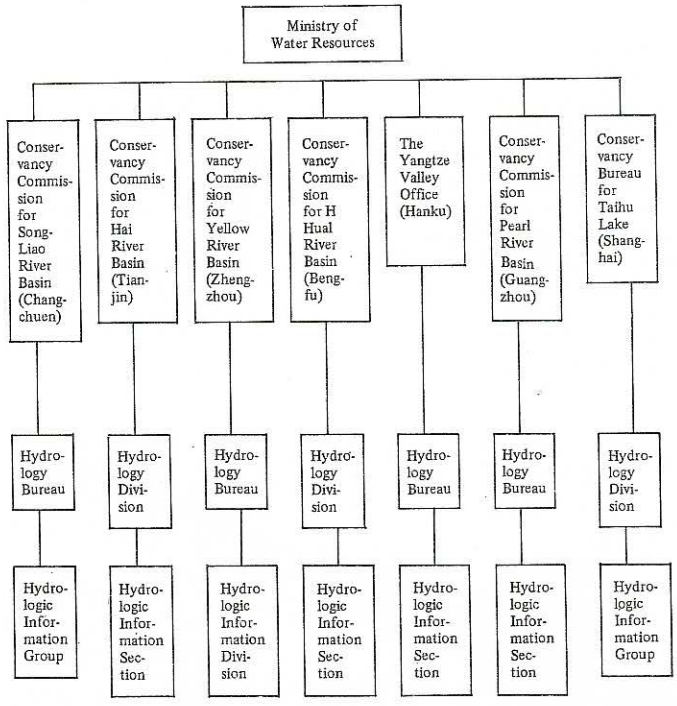


Fig. 2. River Basin Agencies under the Ministry of Water Resources.

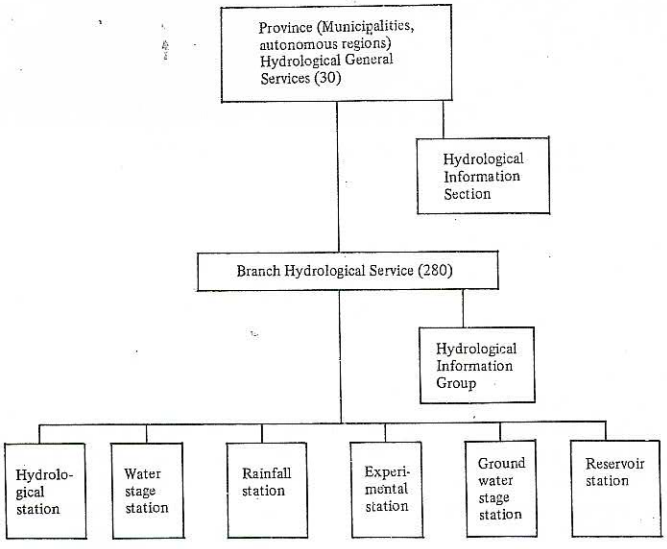


Fig. 3. Local Hydrological Agencies.

Type of Station	Hydrological Station	Water Stage Station	Experimental Station	Rainfall Station
Station Number	3384	1420	63	16406

Terms of Observation	Discharge	Rainfall	Sediment	Evaporation	Ice Regime	Ground Water
Number of Terms	3384	20256	1583	1405	1260	2188

Fig. 4. National Network of Hydrological Stations.

important hydrological stations, many special shortwave radio transceivers were installed to increase the speed of hydrological information transmission. After the 1975 flood in the Huaihe River Basin, a radio communication network was partially established by the water resources agencies in order to raise the reliability and speed of information transmission. There are some 10,000 transceivers currently installed in the country. Automatic systems for flood forecasting and warning were gradually established in more than 30 important areas for flood control and important water conservation projects. They were put into operation in such places as the Puyangjiang River Basin in Zhejiang Province, in the Guanting Gorge at Beijing, in the Xizhijiang River Basin in the Guangdong Province, at the Danjiangkou Reservoir, the Luhuen Reservoir, Baishan and Fangman Hydropower Stations. More recently, experiments on flood information transmission were made with meteor bursts in the river basin above the Danjiang Reservoir and with satellite in the Three-Gorge of the Yangtze River. Tests in disseminating hydrological information at long distances via computers are being undertaken in some departments which have communication facilities such as the central agency, river basin authorities, province and prefecture hydrological agencies. In order to get hydrological information from larger ranges reception of rainfall information by radar was started. In some river basins, determination of the range of water surface fluctuation and rainfall distribution by remote sensing techniques were similarly started (Fig. 5).

Traditional hydrological information processing and transmission are dependent on manpower. By using computers, China developed a processing system for real-time hydrological information; receiving and translating hydrological information on real-time with VAX-11 computer and IBM-PC microcomputers. The system consists of data receiving, processing, storing, retrieving and usage, which is linked to a program library and a real-time base. By this system, a terminal user can, at any time, retrieve the hydrological and warning data from any hydrological station at any river basin. The user can retrieve the charts of rainfall distribution from various river basins, flood information distribution and water level-discharge hydrographs from the various hydrological stations, and various statistical and analyzed data. The data and charts can be displayed on large screens and can be printed out as bulletins of hydrological information and rainfall charts. The flow chart of real-time hydrological information processing is shown in Fig. 6. Computerization has vastly improved data processing and flood forecasting efficiency, has met the needs of various concerned departments, and has set a foundation for hydrological forecasting on real-time on line.

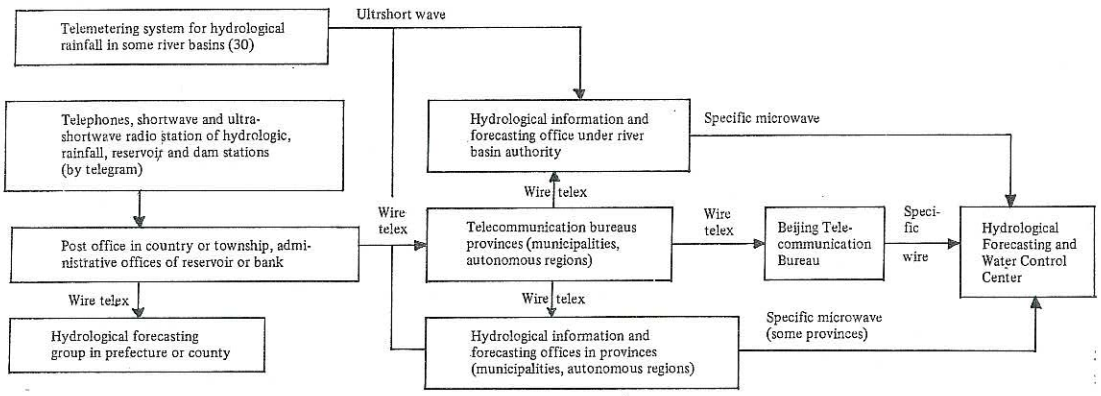


Fig. 5. Hydrological Information Transmission System.

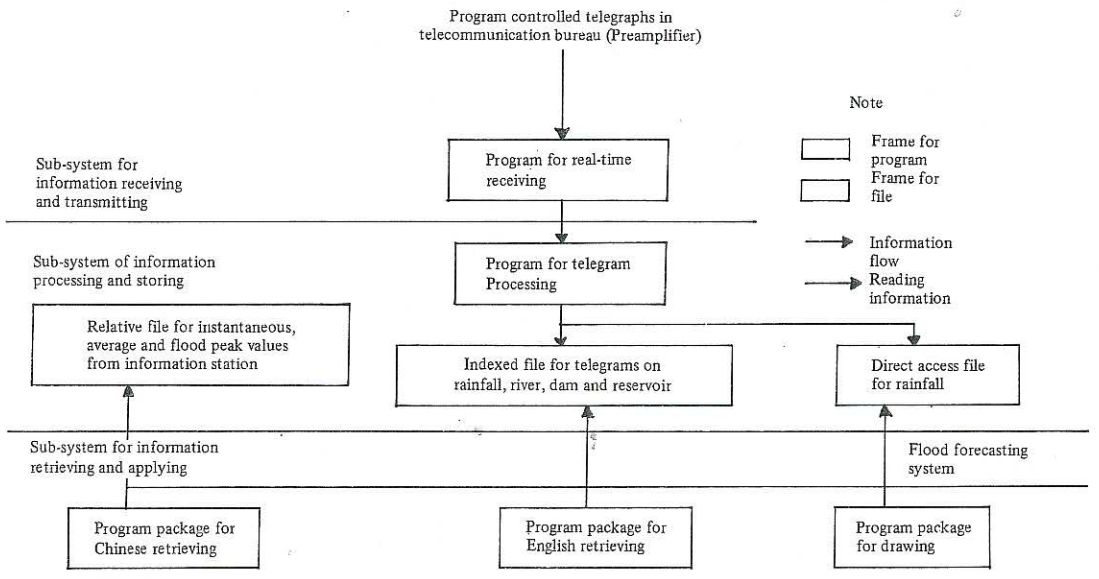


Fig. 6. The Automatic System for Real-Time Hydrological Information.

II.

Hydrological forecasting offices have been established in the flood control departments at all levels forming a fairly thorough system to carry out the work of hydrological forecasting. More than 1000 basic level hydrological stations issue local hydrological forecasts for rivers and reservoirs. Some water projects under construction and management units of large conservancy (hydroelectric) projects also carry out the work of hydrological forecasting. Hydrological forecasting has been extended from forecasting floods to forecasting low flow, ice regime, drought, sediment and water quality. Some hydrological agencies have undertaken research on medium- or long-period forecasting or prediction by combining hydrological forecasting with climate analysis and meteorological forecasting.

China has achieved great strides in hydrological forecasting. Chinese hydrologists have improved on the traditional methods of corresponding water level (or discharge), and Muskingum discharge routing through the physical characteristics of river flood wave movement such as continuous discharge routing, in separate sections, and non-linear solution according to the characteristics of the natural conditions and practical experience. This method enhances calculating precision and can be used in areas with no discharge data. To suit the characteristics of some rivers in China,

(Turn to page 10)

Geomorphological Classification Map for Flooding

The National Research Center for Disaster Prevention (NRCDP), Science and Technology Agency (STA) of Japan submitted the results of the research on geomorphological classification map for flooding of the Central Plain of Thailand and that of the Naka River basin in the Kanto Plain in Japan. The former was accomplished through the cooperative research works of NRCDP and the Remote Sensing Division of the National Research Council of Thailand funded by Special Coordination Funds for Promoting Science and Technology of STA. The latter was made by NRCDP in cooperation with Waseda University and the Remote Sensing and Image Research Center of Chiba University.

1. A Geomorphological Land Classification for the Flood-inundated Area in the Central Plain of Thailand Using Satellite Remote Sensing Technology
– Hiroshi Ohkura (NRCDP), Shiyeko Haruyama (Waceda U.) Masahiko Oya (Waceda U.), Suvit Vibulsresth, Rampin Simking and Rasamee Suwanwera Kamtorn (NRC-Thailand)

A geomorphological survey map of the Central Plain of Thailand showing the classification of inundated areas was delineated in order to develop a method of making this kind of map using satellite remote sensing technology. The scale of this map is 1:250,000 and the extent of the area is limited to 13°20'N–15°20'N, and 99°30'N–101°10'E.

The map shows microgeomorphological elements, such as natural levees and back marshes, etc., mainly on the low lying land of the alluvial plain. It indicates the relationship between the microgeomorphological elements and the conditions of inundation, and is useful not only for disaster prevention but also for rational land use planning.

In the map, land has been classified into geomorphological elements by utilizing satellite images and topographic maps. The satellite images were taken by Landsat 2, 4 and 5, while the topographic maps were made by the Royal Thai Survey in the scale of 1:250,000. The satellite images are quite useful because the area is almost 150km x 200km, allowing analysis of such a large area. In addition to this, the digital data of the satellite images is suitable for analysis and computation by computers.

The Central Plain of Thailand comprises the triangular-shaped plain from Chai Nat to the Gulf of Thailand. The Chao Phraya River is the biggest river in the plain and flows from north to south in the center. The other river basins are the Mae Klong, the Bang Pakong. The Chin and Suphan River basins.

In this study, the following facts were found:

i) Combinations of geomorphologic elements are as follows:
Chao Phraya River: N.L. + Upper D. + Lower D.
Bang Pakong River: f + n.l. + d.
Mae Klong River: F + n.l. + d.,
where, "F" means fan; "N.L.", natural levee; "D", delta; capital letters indicate major topography.

ii) Deltas are divided into two types, higher and lower areas. The former is situated in the upper reaches of Ayutthaya and the largest natural levees extend along the Chao Phraya River from Chai Nat to Ayutthaya. When flooding occurs, this area is first inundated and then the floodwater advances to the back marshes where it stagnates for a long period. The lower delta has small natural levee zones where floodwater is shallow but lasts longer than in the higher delta area. A large difference in flood runoff rate discharge is seen between this area and the headwaters' area where the downward movement of the floodwater from the upper to the lower reaches takes only several days while it takes roughly one to three months to get through the delta area.

iii) The delta area is never hit by storm surges but has a high possibility of land side water flooding, because the plain's gradient is gentle and its drainage is poor. At present Bangkok, having a large concentration of population, is highly susceptible to flooding.

2. Study on the Application of Satellite Data to Geomorphological Classification Map for Flooding: First report – S. Uehara, S. Kishi H. Ohkura, T. Morobashi, T. Sato, M. Oya, S. Haruyama, K. Tsuchiya, T. Miwa, T. Ishiyama.

This study delineated the geomorphological classification map for flooding of the Naka River basin by applying Landsat Thematic Mapper (TM) data to the geomorphological classification map for flooding of the Naka River basin by means of photo-interpretation of the satellite images and by analyzing Computer Compatible Tape (CCT) data.

The results obtained in this report are as follows:

i) Landsat TM data taken in winter are found to be most effective for geomorphological classification because it shows clear geomorphological features of land surface due to the atmospheric conditions and the smallest vegetation cover. Short wave infrared bands, Bands 5 and 7, are especially useful.

ii) In the case of photo-interpretation of satellite images, composite color images in the scales of 1/100,000 and 1/200,000, including Bands 5 and 7, are very effective, for example, composite color images with Bands 3(B) 5(G) and 7(R) from the viewpoin of clarity and detail of micro geomorphological features as wel as the whole area. Eleven categories of geomorphological features are classified and mapped.

iii) In the case of analyzin CCT data, the basic framework o geomorphological features whicl correspond to the ground height relating to flooding can be delineated by slicing the CCT count of Band 5 into four steps based o the spectral characteristics of the ground covers in reference to geomorphological features.

iv) These four classified geomorphological features were overlaid on topographical maps in the scales of 1:50,000 and 1/25,000 The maps indicate the precise geographical locations of the geomorphological features and the classified areas as the lowest ground height which coincides with the areas of the past maximum flooding.

v) However, there are stil various complicated problems o both methods of photo-interpretation and CCT data analysis as well as of the risk evaluation o flooding, in the urbanized areas in low lying lands.

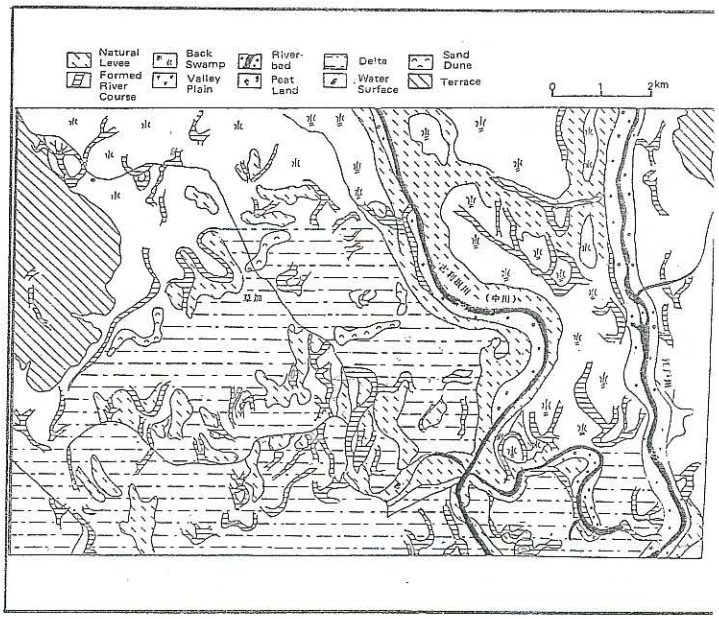
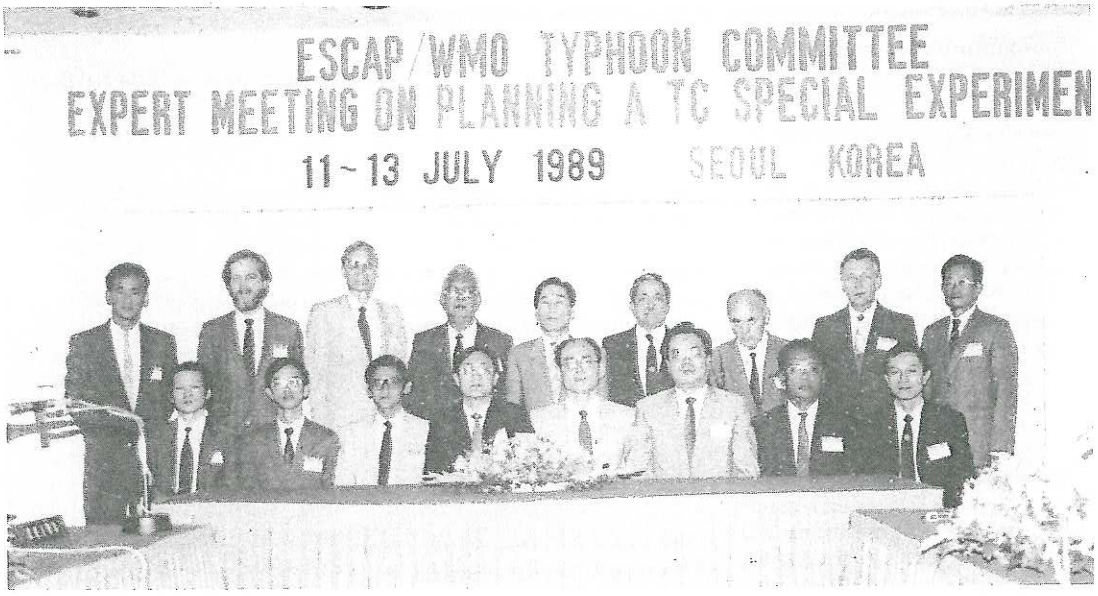


Fig. 3. Geomorphological classification map for flooding with 1/50,000 in scale of the vicinity area of Soka City made by photo-interpretation of TM composite image (print scale: 54%).

Typhoon Experiment Update



Front row seated: T. Muramatsu (Japan), C.Y. Lam (Hongkong), S.H. Ooi (Malaysia), S. Chen (China), Chairman S.K. Kim (ROK), E.A. Adug (Philippines) and P. Patipat (Thailand). Standing: A. Yoshii (TCS), G. Holland (CAS), R.L. Elsberry (USA), R.L. Kintanar (TCS), KMS Administrator Y.D. Park, D.O. Vickers (WMO), V.P. Teslenko (USSR), N.K. Vinnichenko (USSR), and J.E. Lucas (TCS).

The meeting of the Typhoon Committee Special Working Group on Typhoon Experiments (TCSWGTX), renamed Expert Meeting on Planning a Typhoon Committee Special Experiment to allow for expanded participation of other experts outside of the Working Group, was succesfully held 11-13 July 1989. The Korean Meteorological Service (KMS) which played host to the meeting, despite its protestations of hosting an international meeting for the first time, exceeded expectations of the participants in its hospitality and the efficiency and competence of its secretariat. The meeting was held at the New Seoul Hotel, a stone's throw from the Seoul City Hall.

The meeting defined the overall objective of the experiment as "To obtain enhanced meteorological observational data, required for study by Typhoon Committee Members, on the movement of tropical cyclones in the western North Pacific with a view to improving operational tropical cyclone forecasting". The scientific problems that would be addressed are: a) recurvature, b) westward movement in spite of weakness in the sub-tropical ridge, e) motion in weak environmental flow (very slow movement, looping, unusual movement, multiple tropical cyclones), and d) mutual interaction be-

(Turn to page 10)

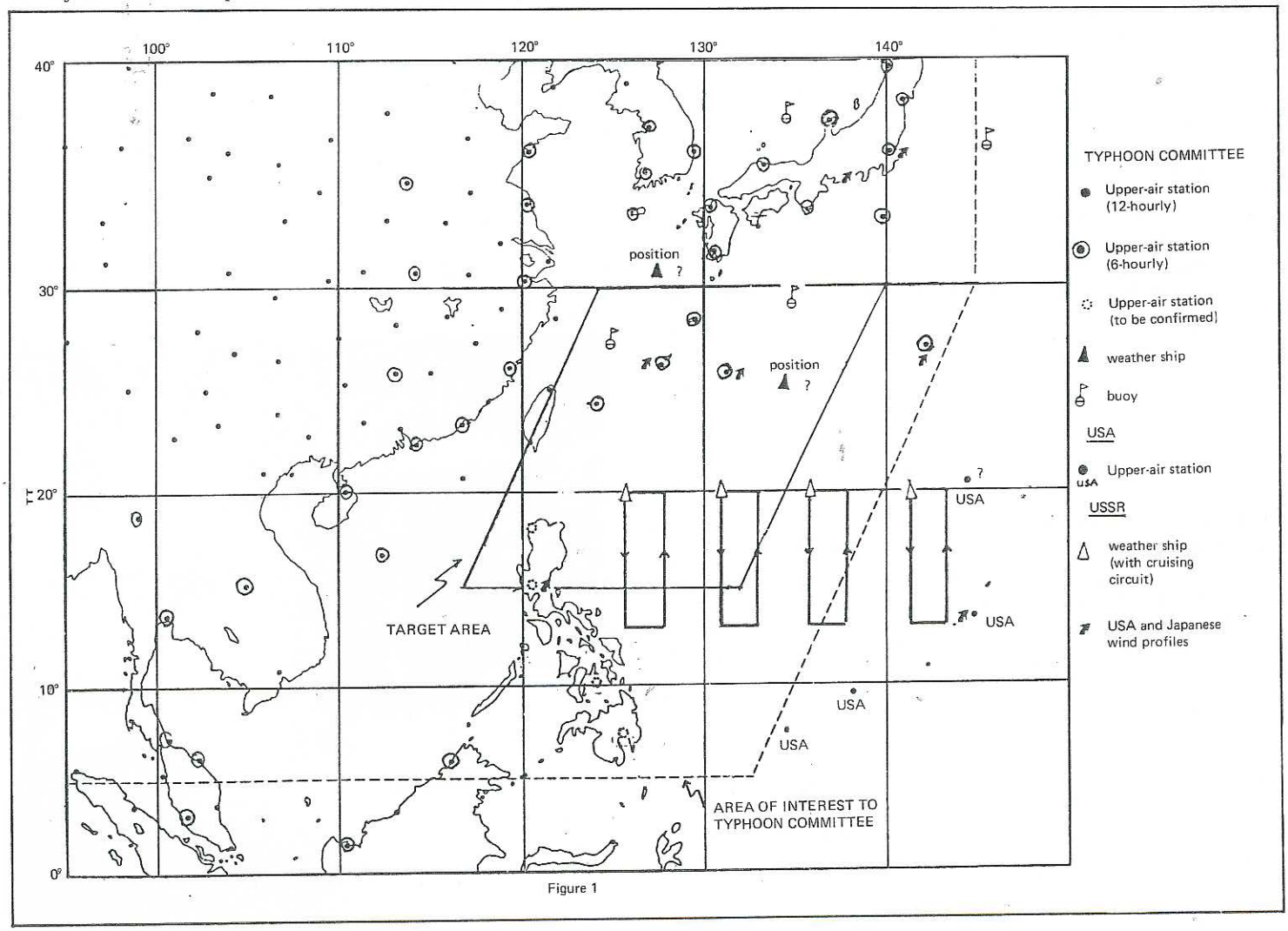


Figure 1

Typhoon Experiment . . .

(From page 9)

tween the large scale environment and tropical cyclone motion.

The decisions made at the meeting would be submitted to the twenty-second session of the Typhoon Committee at Tokyo in late 1989 in the form of recommendations. Salient points:

a) Co-ordination with other national experiments (US and USSR) to obtain optimum comprehensive data sets
b) RSMC Tokyo – Typhoon Center and its parent organization, Japan Meteorological Agency (JMA), will bear the brunt of the experiment including choice of the target tropical cyclones according to guidelines that will be enunciated by the Typhoon Committee
c) The experiment period is August and September 1990.
d) The key element in the enhanced observations will be 6-hourly upper-air observations to be supplemented by ship and aircraft reports. Irrespective of the location of the tropical cyclone, all Members must make upper-air observations.
e) Evaluation and follow-up activities (i.e. scientific conferences, review of research activities, provision of research grants and awards for outstanding research work, exchange visits of experts, annual reports, etc.) way into 1993 should be vigorously pursued.

Hydrological Forecasting . . .

(From page 7)

such as high sedimentation, it has developed a forecasting method for river reach flood suited to various conditions with more parameters considered and new methods of calculating concentration. As for forecasting rainfall runoff, it has established a natural storage model suited to the humid areas of China and is developing another model for arid areas. For calculation of watershed concentration, a hydrological model adapted to the river basins of China has been developed. The reliability of the basic assumptions involved in the unit hydrograph method has been studied. The accuracy of the method has been improved by treating the system as non-linear which can deal more accurately with the problems of uneven rainfall, different runoff resources, different flood regulating and storing functions, intervening area inflow and non-linear changing. Concept models and black-box models from other countries have been improved upon and adapted to conditions in China. In order to meet the need of forecasting and estimation at medium and small reservoirs some simple flood routing methods have been developed. Some other methods for ice regime, drought forecasts, groundwater, storm surges and medium- and long-period forecasting have been tried and have achieved good results. Some books on hydrological forecasting methods have also been published.

At present, Chinese hydrologists use the methods of corresponding water level (or discharge) and Muskingum method of successive routing in subreaches for large rivers, rainstorm-runoff relationships and unit hydrograph method for medium- and small-rivers and the inflow to reaches of large rivers. Meanwhile, the Zinanjiang, SCLS, Sacramento and Tank Models are used in some areas. In the 1950's and 1960's, the operation of hydrological forecasting had to be made manually. Hydrologists began formulating hydrological forecasting schemes and using computers for operational forecasting in early 1970's. China has since established a hydrological forecasting system (on PDP-11 or VAX-11 computers) which can be used by the central hydrological agency, river basin authorities and province (municipalities, autonomous regions) and other hydrological agencies as well as a hydrological forecasting system suited for important water projects on IBM-PC microcomputers. The systems are now widely used. Their characteristics are

– complete functions – calibrations of model, real-time forecasting, correction and consideration of various data sources such as quantitative rainfall forecasting;

– versatility – covering many models, suitable for any watershed and any region, high automation with processing, interpolation and correction of historical or real-time data, connection of forecasting models and connection of calibrating coefficients and real-time forecasting model;

– convenience of use – having united output and input file format; and

– speedy calculation – in a matter of minutes.

Based on experience in hydrological information and forecasting, the Ministry of Water Resources and Electric Power has produced the "Standard for Hydrological Information and Forecasting" which provides a good foundation for the further improvement of the quality of hydrological information and forecasting.

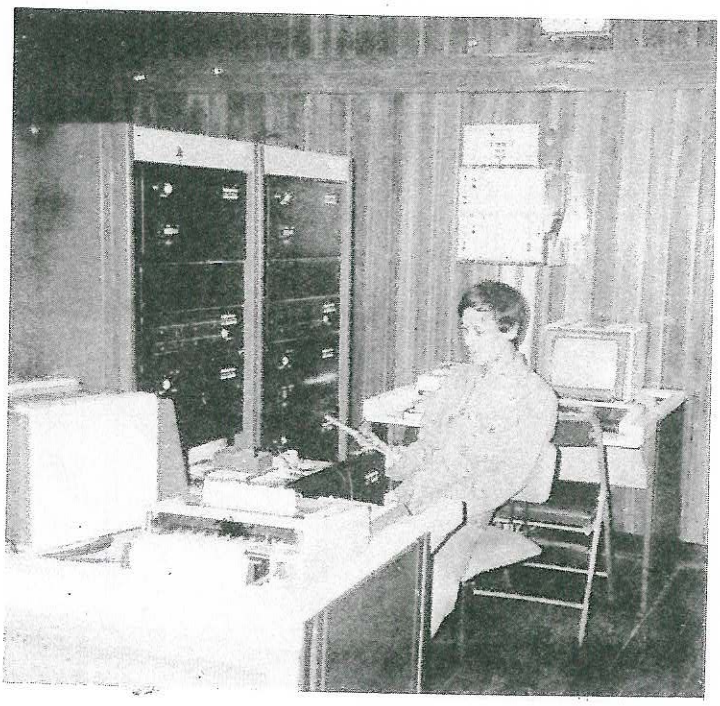
As a developing country, China is still backward in technology especially in hydrological information collection and processing and flood information communication, and can not deal with severe rainstorm flood (especially mountain flood and mudrock flow) adequately. Therefore, it seeks to learn from the experiences of advanced countries and also expand co-operation with America in the field of hydrology.

Study tour on . . .

(From page 4)

VIETNAM GETS MODERN EQUIPMENT

Through the UNDP/WMO Project VIE/80/051 "Strengthening the Hydrometeorological Services and Typhoon Forecasting", the Central Forecast Department of the Hydrometeorological Service (HMS) of the Socialist Republic of Vietnam was equipped with a new computerized automatic message switching system (CAMSS) and data processing and plotting (DPP) system from the ROBOTRON Company of the German Democratic Republic (GDR). The CAMMS is capable of handling 16 lines with speeds from 50B to 2.4KB (Fig. 1). The DPPS, on the other hand, comprises two mini-computers, 2 magnetic tape units, 2 line printers and two plotters. These systems have been put into operation on a daily basis since November 1988. They have increased dramatically the capability of HMS in the improvement of its hydrological and weather forecasts, especially typhoon and flood forecasts. They have also greatly facilitated regional and international data exchange. (VHMS)



RSMC TOKYO – TYPHOON CENTRE PRODUCTS ANNOUNCED

The Japan Meteorological Agency (JMA) announced the issuance of the following products by RSMC Tokyo – Typhoon Centre with effect from 1 July 1989:

1. Products for typhoons in the western North Pacific transmitted through the Global Telecommunication System (GTS) with the corresponding abbreviated headings ·
   (1) Typhoon analysis (WTPQ20 RJTD)
   (2) Typhoon forecast (WTPQ21 RJTD)
   (3) Output of numerical prediction model for typhoon movement (WTPQ23 RJTD)
2. Products to be broadcast on meteorological radio facsimile (JMH)
   Prognosis of the streamline field at the 850 hPa level

Further, the analysis scheme of tropical cyclone intensity in the Dvorak technique for GMS imageries were slightly modified.

IMPROVED ANALYSIS SCHEME OF TROPICAL CYCLONE INTENSITY IN A LANDFALL

The Meteorological Satellite Center (MSC),

The Japan Meteorological Agency (JMA)

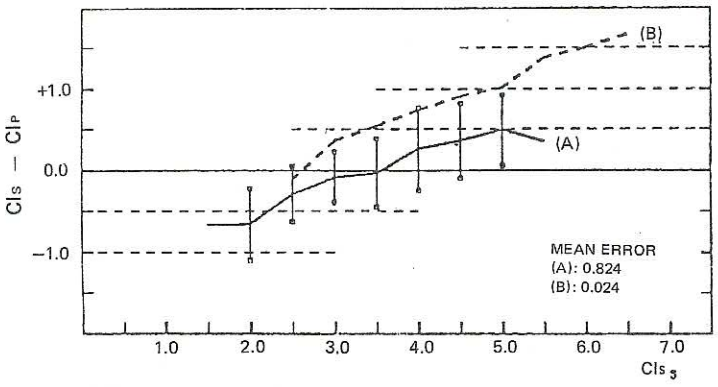
The MSC issues 6-hourly on the SAREP code tropical cyclone intensity reports analyzed according to the Enhanced Infrared Satellite Imagery Analysis Diagram proposed by Dvorak. This diagram includes twelve-hour time lag in determining CI (Current Intensity) number when T (Tropical) number decreases. Although this criterion works well in ordinary cases, there can often be found a discrepancy, that is, tropical cyclone intensity is often overestimated when it rapidly weakens after a landfall.

The MSC has been making efforts to reduce this difficulty by amending the criteria as mentioned below.

(a) CI No. be equal to T No. shows a rapid decrease owing to a landfall.

(b) The amount of decrease in CI No. be equal to that of T No. when a tropical cyclone makes a landfall within the time lag (12 hours) after it passes the extremum (peak) stage and begins to decay.

(c) when a tropical cyclone begins to re-develop after a criterion (a) or (b) is satisfied, CI No. be determined following the criteria originally proposed by Dvorak.



CI numbers (Group B) derived for 13 tropical cyclones landing the Philippine Islands by applying the criteria mentioned above and CI numbers (Group A) derived in routine operations are compared respectively with the post-analyzed central pressure values.

The total mean difference between CI numbers in Group B and the central pressure values is smaller than that between Group A and the central pressure values, and the mean difference between CI numbers and central pressure values for Group B is some 0.5 in each level, which proves that the additional criteria mentioned above improve the accuracy of CI No. for landing tropical cyclones.

The level difference between the CI No. (CIs) and the central pressure value (CIs) of the tropical cyclones passing the Philippine Islands, where.

CI_p indicates equivalent CI number converted by the CI/(central pressure)·conversion table proposed by Dvorak from the post-analyzed central pressure value.

Group A indicates CIs's determined by original criteria proposed by Dvorak, and Group B the CIs's amended as mentioned in this report.

The vertical bars attached on data in Group B indicate the standard deviation.

1. STATUTE OF THE TYPHOON COMMITTEE

ESTABLISHMENT

Article 1

The Typhoon Committee (hereinafter referred to as the Committee) is established by the Governments of regional ESCAP member countries affected by typhoons (hereinafter referred to as the participating Governments) under the auspices of the United Nations Economic and Social Commission for Asia and the Pacific (hereinafter referred to as the Commission) in cooperation with the World Meteorological Organization with a view to promoting and co-ordinating efforts to minimize typhoon damage in the ESCAP region.

MEMBERSHIP COMPOSITION AND ORGANIZATION

Article 2

The Committee shall be composed of a representative from each of the participating Governments desiring to participate in co-operative efforts to minimize typhoon damage in the ESCAP region. The Executive Secretary of ESCAP and the Secretary-General of WMO or their representatives shall be ex-officio members of the Committee.

Article 3

The Committee shall have a technical secretary and a secretariat which will serve as its executive body. The functions and duties of the Typhoon Committee Secretariat shall be determined by the Committee.

Article 4

The Committee shall be assisted, when necessary, by an Advisory Group consisting of qualified experts from within and outside the region.

CO-OPERATION WITH THE SECRETARIATS OF THE COMMISSION (ESCAP) AND THE WORLD METEOROLOGICAL ORGANIZATION (WMO)

Article 5

The Secretariat of the Commission and the Secretariat of the World Meteorological Organization shall co-operate with the Committee in the performance of the latter's functions.

FUNCTIONS

Article 6

The functions of the Committee are to promote and to co-ordinate the planning and implementation of measures required for minimizing typhoon damage in the ESCAP region. It shall, to this end:

(a) Review regularly the progress made in the various fields of typhoon damage prevention;

(b) Recommend to the participating Governments concerned plans and measures for the improvement of meteorological and hydrological facilities needed for typhoon damage prevention;

(c) Recommend to the participating Governments concerned plans and measures for the improvement of community preparedness and disaster prevention;

(Turn to page 12)

(d) Promote the establishment of programmes and facilities for training personnel from countries of the region in typhoon forecasting and warning, flood hydrology and control within the region and arrange for training outside the region, as necessary;

(e) Promote, prepare and submit to participating Governments and other interested organizations plans for co-ordinations of research programmes and activities concerning typhoons;

(f) Consider, upon request, possible sources of financial and technical support for such plans and programmes;

(g) Prepare and submit, at the request and on behalf of the participating Governments, requests for technical, financial and other assistance offered under the United Nations Development Programme and by other organizations and contributors.

In carrying out these functions, the Committee will ensure that the plans adopted by the appropriate bodies of WMO, including the implementation programme established by WMO as part of the World Weather Watch plan, are fully respected at all times.

GENERAL PROVISIONS

Article 7

The Committee shall adopt its own rules of procedure.

Article 8

The Committee shall take no action in respect of any country without the agreement of the Government of that country.

Article 9

The Committee shall have authority, subject to established United Nations procedures and practice, to invite representatives of Governments, the United Nations specialized agencies, other United Nations bodies and recognized governmental and non-governmental organizations to attend specific meetings of the Committee in the capacity of observers or in a consultative capacity.

Article 10

The Committee shall submit annual reports to participating Governments, the Commission and the World Meteorological Organization. Such reports, or summaries thereof, may be made available to other Governments, the United Nations specialized agencies, other United Nations bodies and recognized governmental and non-governmental organizations on the recommendation of the Committee.

Article 11

Amendments to the present statute which may be proposed by any participating Government shall be examined by the Committee and shall take effect when approved by all participating Governments.

2. RULES OF PROCEDURE OF THE TYPHOON COMMITTEE

Rule 1

The Committee shall hold at least one session annually. The venues and dates of its sessions shall be decided by the Committee.

Rule 2

The Executive Secretary of ESCAP shall, in consultation with the Secretary-General of WMO and the Chairman of the Committee, issue a notice convening each session of the Committee, together with copies of the provisional agenda, at least six weeks before the commencement of the session.

Rule 3

The Executive Secretary of ESCAP, in co-operation with the Secretary-General of WMO, shall provide the necessary servicing of the Committee's meetings.

Rule 4

All meetings shall be held in private unless the Committee shall decide otherwise.

Rule 5

English shall be the working language of the Committee.

Rule 6

The Committee shall, at its first meeting of the year, elect from among its representatives a chairman and a vice-chairman, who shall hold office until their successors are elected. They shall be eligible for re-election.

Rule 7

A simple majority of the Government members of the Committee shall constitute a quorum.

Rule 8

Decisions of the Committee shall be made by a majority of the government members present and voting.

Rule 9

In the event of any matter arising which has not been foreseen by the present Rules, the pertinent rules of the United Nations Economic and Social Commission for Asia and the Pacific shall be applied.

3. FUNCTIONS AND DUTIES OF THE TYPHOON COMMITTEE SECRETARIAT

The secretariat will be the executive arm of the Typhoon Committee and through the Committee, as may be appropriate, will advise the participating countries on the technical and administrative co-ordination of plans for the implementation of improved meteorological, hydrological and other facilities needed for the prevention of typhoon damage. It will assist the Committee by carrying out the day-to-day co-ordination of all related activities undertaken at the request of the Committee by the United Nations and specialized agencies, as well as under bilateral or multilateral programmes. The secretariat will report to the Committee at regular intervals on the progress of the work. In the performance of these duties, the secretariat will maintain close liaison with the ESCAP and WMO secretariats. Specifically its functions will be as follows:

(a) to advise and assist countries in the international exchange of meteorological and hydrological data, distribution of typhoon forecasts and warnings;

(b) to advise and assist countries in the operation and improvement of meteorological observing networks, telecommunication systems and facilities as required for typhoon forecasting and warning, including storm surge forecasting;

(c) to advise and assist countries in the operation and improvement of existing and new hydrological stations required for flood forecasts and warnings;

(d) to advise countries on arrangements for the most effective means of disseminating typhoon and flood warnings within the country and to assist in organizing measures for the improvement of community preparedness and disaster prevention;

(e) to advise and assist countries in organizing their programmes of training and research in typhoon forecasting and warning, flood hydrology and flood control measures;

(f) to keep under constant review and circulate information on the progress achieved in the latest research studies relating to typhoons, storm surge and flood forecasting;

(g) to encourage and to promote co-operation in research activity aimed at gaining a better understanding of typhoons and, hence, at improving forecasting methods;

(h) to conduct, under specific instructions from the Typhoon Committee, studies on such specific problems concerning typhoons as would facilitate carrying out more effectively the advisory functions stipulated under (a) to (e) with a view to supporting the action programme;

(i) to assist the countries, on request, in the preparation of applications for technical, financial and other assistance for typhoon damage control.

In carrying out its responsibilities under (a), (b) and (c) above, the secretariat will ensure that the plans adopted by the appropriate bodies of WMO, including the implementation programme established by the WMO Congress as part of the World Weather Watch plan, are fully respected at all times.