

**SPECIALIZED CENTRES PROVIDE UP-TO-DATE TROPICAL  
CYCLONE, HURRICANE, TYPHOON ADVISORIES**

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**TROPICAL  
CYCLONE PROGRAMME**

**Report No. TCP-44**

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CYCLONE, HURRICANE, TYPHOON ADVISORIES**

SECRETARIAT OF THE WORLD METEOROLOGICAL ORGANIZATION - GENEVA - SWITZERLAND

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Cover: *top* Imagery by a NOAA (USA) meteorological satellite used in monitoring of a tropical cyclone (courtesy: RSMC La Réunion)

*bottom* Frequent tracks of tropical cyclones

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NOTE

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## INTRODUCTION

About 80 tropical cyclones form annually over warm tropical oceans. When they develop and attain an intensity with surface wind speed exceeding 118 km/h, they are called hurricanes in the western hemisphere, typhoons in the western North Pacific region and severe tropical cyclones, tropical cyclones or similar names in other regions.

Such tropical cyclones are among the most devastating of all natural hazards. Their potential for wrecking havoc caused by their violent winds, torrential rainfall and associated storm surges, floods, tornadoes and mud slides is exacerbated by the length and width of the areas they affect, their severity, frequency of occurrence and the vulnerability of the impacted areas. Every year several tropical cyclones cause sudden-onset disasters of varying harshness, with loss of life, human suffering, destruction of property, severe disruption of normal activities and set-back to social and economic advances.

However, a particularly important aspect of tropical cyclones, as distinct from most other natural hazards, is the availability of operational systems for monitoring, forecasting and warning of all tropical cyclones, everywhere in the world, as a basis for preparedness action and, hence, disaster mitigation.

As a result of international cooperation and coordination, and with the aid of meteorology and modern technology, such as satellites, weather radars and computers, all tropical cyclones around the globe are now being monitored from their early stages of formation and throughout their lifetime. Five centres designated by the World Meteorological Organization (WMO) as Regional Specialized Meteorological Centres (RSMCs) and located in La Réunion, Miami, Nadi (Fiji), New Delhi and Tokyo, as well as other centres of national Meteorological Services carry out these activities. These centres also provide forecasts on the behaviour of tropical cyclones, their movement and changes in intensity and on associated phenomena - principally storm surges and flash floods.

Timely official warnings for national territory are contained in releases issued by the national Meteorological Services for dissemination to all those who are threatened. The activities are coordinated at the global and regional levels by the WMO through its World Weather Watch and Tropical Cyclone Programmes.

## AVAILABILITY ON THE INTERNET OF ADVISORIES ON TROPICAL CYCLONES EVERYWHERE

Prior to the use of information on each server, the relevant disclaimer should be viewed.

### Latest advisories on current tropical cyclones/hurricanes/typhoons

The five tropical cyclone RSMCs, together with six tropical cyclone warning centres having regional responsibility, provide advisories and bulletins with up-to-date first-level basic meteorological information on all tropical cyclones, hurricanes and typhoons everywhere in the world. The first-level basic information comprises reliable information from a clearly defined source on the tropical cyclone's location and size and its present and forecast movement and intensity. Where available to the RSMC, summaries of the official **national warnings** may be included in their advisory.

For the convenience of those with access to the Internet, a central WMO website is linked to all these advisories, giving global coverage year round.

To obtain the latest advisory with first level basic meteorological information on tropical cyclones, hurricanes, typhoons anywhere in the world:

Go to: <http://www.wmo.ch/web/www/TCP/rsmcs.html>  
World Meteorological Organization  
World Weather Watch  
Tropical Cyclone Programme (TCP)

(diagram global network)

On the map, click on your area of interest or identify the name of the RSMC or the warning centre shown for that area and click on the listings below.

(Insert map with Regions)

### List of tropical cyclone RSMCs

- I and II Caribbean Sea, Gulf of Mexico, North Atlantic and eastern North Pacific Oceans:  
**RSMC Miami - Hurricane Center**/NOAA/NWS National Hurricane Center, USA.  
<http://www.nhc.noaa.gov/products.html>
  
- IV Western North Pacific Ocean and South China Sea:  
**RSMC Tokyo - Typhoon Center**/Japan Meteorological Agency.  
<http://ddb.kishou.go.jp/typhoon/cyclone/cyclone.html>
  
- V Bay of Bengal and the Arabian Sea:  
**RSMC - tropical cyclones New Delhi**/India Meteorological Department.  
<http://www.imd.ernet.in/services/cyclone/cyclone-warning-services.htm>
  
- VI South-West Indian Ocean:  
**RSMC La Réunion - Tropical Cyclone Centre**/Météo-France.  
[http://www.meteo.fr/temps/dontom/reunion/cyclone\\_cart/sous\\_panneaux.html](http://www.meteo.fr/temps/dontom/reunion/cyclone_cart/sous_panneaux.html)
  
- XI South-West Pacific Ocean:  
**RSMC Nadi - Tropical Cyclone Centre**/Fiji Meteorological Service.  
<http://www.met.gov.fj/advisories.html>

*Typhoon forecasts are produced by a Global  
Spectral Model run on this super-computer  
(courtesy: JMA Japan)*

*RSMC Nadi forecast office*

*Tropical cyclone monitoring  
radar equipment  
(courtesy: RSMC New Delhi)*

**List of tropical cyclone warning centres with regional responsibility**

- III Central North Pacific Ocean:  
**Central Pacific Hurricane Center - Honolulu**/NOAA/NWS, USA.  
<http://www.nws.noaa.gov/pr/hnl/cphc/pages/cphc.shtml>
- VII South-East Indian Ocean:  
**TCWC - Perth**/Bureau of Meteorology (Western Australia region), Australia.  
<http://www.bom.gov.au/weather/wa>
- VIII Arafura Sea and the Gulf of Carpentaria:  
**TCWC - Darwin**/Bureau of Meteorology, Australia.  
<http://www.bom.gov.au/weather/nt/inside/cyclone/cyclone.shtml>
- IX Coral Sea:  
**TCWC - Brisbane**/Bureau of Meteorology, Australia.  
<http://www.bom.gov.au/weather/gld/cyclone.shtml>
- X Solomon Sea and Gulf of Papua:  
**TCWC - Port Moresby**/National Weather Service, Papua New Guinea.  
(to be established soon)
- XII Tasman Sea:  
**TCWC - Wellington**/Meteorological Service of New Zealand, Ltd.  
[http://www.metservice.co.nz/forecasts/high\\_seas.asp](http://www.metservice.co.nz/forecasts/high_seas.asp)

Tropical cyclones do not occur in other regions.

*GMS: geostationary meteorological satellite  
(courtesy: JMA Japan)*

### **Active national warnings of tropical cyclones/hurricanes/typhoons**

The national Meteorological Services (in some countries called the national Weather Services or similar titles) of countries affected by tropical cyclones provide advisories and bulletins with information and forecasts of current tropical cyclones which are threatening or could threaten the country. The advisories include, where applicable, official warnings of the impact of tropical cyclones on their national territory, local areas and coastal waters.

The central WMO website is linked to all official tropical cyclone warnings available on the Internet.

If you are concerned with safety of life and property in a specific area, and protection from the destructive impact of impending storms:

Select, from the list under national Weather Services, the country of interest (if shown on the list):

#### **National Weather Services of WMO Members affected by tropical cyclones and equipped with Web Servers**

Australia, Bureau of Meteorology, Melbourne, Victoria  
Canada, Meteorological Service of Canada  
China, The China Meteorological Administration  
Colombia, Institute of Hydrology, Meteorology and Environment Studies  
Costa Rica, Instituto Meteorológico Nacional  
Cuba, Instituto de Meteorología  
Fiji, Fiji Meteorological Service  
France, Météo-France, Toulouse  
Hong Kong, China, Hong Kong Observatory  
India, India Meteorological Department  
Indonesia, Indonesian Meteorological and Geophysical Agency  
Japan, Japan Meteorological Agency  
Republic of Korea, Korea Meteorological Administration  
Macao, China, Serviços Meteorológicos de Macau  
Malaysia, Malaysian Meteorological Service  
Mexico, Servicio Meteorológico Nacional  
New Zealand, Meteorological Service of New Zealand, Ltd., Wellington  
Oman, Department of Meteorology  
Pakistan, Pakistan Meteorological Department  
Panama, Hidro Meteorología, ETESA, República de Panamá  
Philippines, PAGASA (The Philippines Atmospheric Geophysical & Astronomical Services Adm.)  
Samoa, Ministry of Agriculture, Forestry and Meteorology  
Seychelles, Seychelles Meteorological Service  
Singapore, Meteorological Service Singapore  
Solomon Islands, Solomon Islands Meteorological Service  
South Africa, Weather Bureau, Pretoria  
Swaziland, Swaziland Meteorological Service  
Thailand, Meteorological Department of Thailand  
USA, National Weather Service, Silver Spring, Maryland  
Venezuela, Dirección de Hidrología y Meteorología  
Zimbabwe, Department of Meteorological Services

## **MONITORING, FORECASTING AND WARNING OF TROPICAL CYCLONES**

The monitoring, forecasting and warning of tropical cyclones are carried out within the framework of the WMO's World Weather Watch (WWW), which is a unique achievement in international cooperation. The operation of the Programme is based on the fundamental concept that each of the approximately 185 participating countries and territories, which are Members of WMO, undertakes according to its means, to meet certain responsibilities in the agreed global scheme so that all countries may benefit from the consolidated efforts. The main purpose of the WWW is to ensure that the national Meteorological Service of each Member has access to the information it needs to provide effective services.

The WWW has three main components: the Global Observing, Telecommunications and Data-processing Systems - GOS, GTS and GDPS. About 10,000 land-based stations, 8,000 ships and other marine stations, and in the order of 3,000 aircraft, together with 8 geostationary and polar-orbiting meteorological satellites of the composite GOS measure or observe the meteorological elements and provide the data needed for analyzing and forecasting the weather and meteorological phenomena.

The GTS, the arteries and veins of the WWW, is a worldwide system for the rapid exchange of these data and of processed information, including analyses and forecasts, which are produced by the GDPS. The latter component comprises a network of three World Meteorological Centres, WMCs, and 34 Regional Specialized Meteorological Centres, RSMCs, each with specified tasks and roles. These include the supplying of products and guidance for the third group of centres, the national Meteorological Services which have the responsibility for providing weather services, in particular severe weather warning, to meet operational needs.

Five of the RSMCs are directly concerned with tropical cyclones. These RSMCs carry out monitoring and forecasting of tropical cyclones and issue information for the international community including the international media, in addition to providing advisory information and guidance to national Meteorological Services. The provision of tropical cyclone warnings for national territory and coastal waters is, basically, a national responsibility. Such official warnings are contained in advisories issued by the national Meteorological Service.

There has been significant improvement in the monitoring and forecasting of tropical cyclones over the years resulting from developments of the WWW and advances in technology and related fields. Examples are:

- The network of geostationary and polar-orbiting meteorological satellites and other satellites providing meteorological information which enable improved and continuous monitoring, especially over data-sparse ocean areas, from the early stages of formation of the tropical cyclone;
- Advances in the capabilities of meteorological satellites, providing higher-resolution imagery, measurement of additional parameters such as water vapour, sea surface temperature and cloud motion vectors at various altitudes, and grid point values for ingestion in numerical prediction models;
- Satellite-based communications providing links with greater reliability and higher speed;
- Technological developments in super computers, other large computers and PCs (Personal Computers) capable of handling greater volumes of data at faster speeds and with improved affordability, as needed for many activities from numerical weather prediction - NWP, to more routine activities of the operational services;
- Scientific advances in the understanding and modelling (including NWP) of tropical cyclones and their environment;
- Technological advances in instruments and equipment such as Doppler cyclone monitoring radar which gives radar imagery and also the wind field in tropical cyclones;
- Hurricane reconnaissance aircraft.

*Geostationary and polar-orbiting meteorological satellites*

*Reconnaissance turbo-prop aircraft make  
low-altitude penetrations into hurricanes  
(courtesy: NOAA, USA)*

*The newest high-altitude jet aircraft measure the  
steering currents on the periphery of hurricanes  
(courtesy: NOAA, USA)*

## **TROPICAL CYCLONE RSMCs**

Five centres, each operated on a cooperative basis by its country's national Meteorological Service, and located in La Réunion, Miami, Nadi (Fiji), New Delhi and Tokyo, have been formally designated by the WMO as Regional Specialized Meteorological Centres (RSMCs) with activity specialization in tropical cyclone analysis, tracking and forecasting. They have specific assigned roles and international and regional responsibilities under the WWW and the Tropical Cyclone Programmes.

The WMO's Tropical Cyclone Programme (TCP) promotes the development of regionally coordinated systems to mitigate tropical cyclone disasters. The areas of activity range from the application of meteorology, based on the WWW, and hydrology, through promotion of risk evaluations, response to warnings and establishment of disaster prevention and preparedness measures. Emphasis is placed on the provision of reliable forecasts of tropical cyclone tracks and intensity, associated weather conditions and phenomena along with timely warnings, covering all tropical cyclone prone areas. In this latter connection, each of the five regional bodies of the TCP has drawn up an Operational Plan with the respective tropical cyclone RSMC as a core feature. The plans are designed to ensure full coordination and, taking advantage of the high level of cooperation which has been generated, to record the agreed comprehensive arrangements for operational meteorological services to support tropical cyclone disaster mitigation.

The tropical cyclone RSMCs were selected on the basis of the unanimous proposals of the TCP regional bodies, with participation of the Meteorological Services of all tropical cyclone-prone countries in the particular region, the evaluation and certification, under the WWW by experts in operational meteorology from many countries, of the facilities and capabilities of the centre to carry out its role and the formal approval of the WMO's Executive Council.

The specialized functions of the tropical cyclone RSMCs are, principally, the detection, monitoring and track and intensity forecasting of all tropical cyclones in its region, the provision of these first level basic information to the international community including the international media and the provision of real-time advisory information and guidance to the national Meteorological Services in its region. Their functions also include responsibility for deciding when to assign names to tropical cyclones, the training of tropical cyclone forecasters of the national Meteorological Services, preparing operational performance statistics and annual summaries of tropical cyclone seasons, a central role in tropical cyclone data archival, tropical cyclone research and involvement in activities for public awareness of tropical cyclones. In practical terms, the series of the TCP's "Tropical Cyclone RSMCs Technical Coordination Meetings" serves as an effective mechanism for inter-regional and overall technical coordination of the programme.

*Training of tropical cyclone forecasters from all tropical  
cyclone regions at RSMC Miami - Hurricane Center*

*Technical coordination meeting of the Directors of tropical cyclone RSMCs*

All the tropical cyclone RSMCs have been designated by the International Civil Aviation Organization as ICAO Tropical Cyclone Advisory Centres with the task of providing specialized tropical cyclone advisory services for the aviation community. These centres have also been assigned a key role in the provision of information and warnings of tropical cyclones, through the Global Maritime Distress and Safety System, for ships on the high seas and other marine interests in tropical cyclone prone areas.

Each of the tropical cyclone RSMCs is co-located with and forms part of their National Meteorological Centre, of Fiji, India and Japan, or the Regional Meteorological Service of Météo-France in La Réunion or the USA National Weather Service's Tropical Prediction Center. All are supported by their respective national Meteorological Service and have cooperative arrangements with other Services and Institutions such as, for example, meteorological research facilities. All these RSMCs have been upgrading their expertise, meteorological equipment, computer systems, scientific knowledge and techniques and other facilities towards improvement of their services. The rate of progress by RSMC Nadi was augmented by technical cooperation projects with Australia, Japan, New Zealand, USA and other Members of WMO or groups of Members. These RSMCs all have highly trained and well experienced staff and other facilities that have been described as state-of-the-art meteorological equipment and computer systems.

For example, all tropical cyclone RSMCs have high speed satellite links to the GTS, real time access to high resolution imagery and digital data from geostationary satellites and polar-orbiting meteorological satellites, 10 cm cyclone monitoring radars and receive model outputs and forecasts from numerical weather prediction models run on large high speed computers. All are highly computerized with software to process satellite data (calibration, navigation, zoom, enhancement, overlaying, etc.) and radar data (looping, merging, track analysis, rainfall quantification, etc.) message switching, data display and analysis, forecast preparation, product delivery and even for more routine functions. This allows automation and application of many techniques, speed and reliability in task performance and time for tropical cyclone specialist staff to concentrate on tasks requiring their knowledge and experience.

Each of the tropical cyclone RSMCs serves as a national tropical cyclone warning centre for their respective country. All are continuing to further enhance their facilities and capabilities and to provide more effective services to meet their national, regional and international commitments.

*WMO/TCP meeting to coordinate mitigation of tropical cyclone disasters in the South Pacific and South-East Indian Ocean regions, held at RSMC Nadi*

Some aspects related to the facilities and work of each of the tropical cyclone RSMCs are briefly mentioned below.

**RSMC La Réunion - Tropical Cyclone Centre**

The main circuit, an umbilical cord for the centre is its high speed satellite link with the Central Service of Météo-France in Toulouse. It permits access to all the databases of Météo-France and, in particular, to the French (ARPEGE) and ECMWF (European Centre for Medium-range Weather Forecasting) global models outputs.

The centre is equipped with MDD and DRS data reception station and system which allow reception of products from the meteorological centres in Bracknell, Rome, Toulouse and collection of data from numerous weather stations in its region. It receives real-time data from the European geostationary satellite METEOSAT, the USA's TIROS polar orbiting satellites and the European remote-sensing satellite.

Computer software, SYNERGIE, developed by Météo-France, facilitates the cross-analysis of all available meteorological information and supports the work of the forecaster in many ways.

Cyclone track and intensity forecasting rely to a great extent on the numerical models outputs, such as from the French ARPEGE series of global and limited area spectral models.

The centre provides training for cyclone forecasters in its region, including a biennial course for Southern Hemisphere forecasters.

*Classification of tropical cyclones in the South-West Indian Ocean  
(average 10 min and 1 min wind speed, gusts, surface pressure at the cyclone centre)  
(courtesy: RSMC La Réunion)*

## **RSMC Miami - Hurricane Center/USA National Hurricane Center**

The centre has been carrying out several of its current functions over the past many years, with continuing development of its facilities and improvement in its services, nationally and to the regions it serves. In some respects, it has been a pioneer and leader in these fields.

Technologies supporting hurricane detection, monitoring, forecasting and warning by the centre include:

- USA-NOAA geostationary meteorological satellites GOES-E and GOES-W parked normally over 75°W and 135°W, providing the RSMC with high-quality visible and infra-red imagery at standard operational intervals of 30 minutes and possibility of updates as frequently as every 5 minutes during hurricane warning situations;
- USA-TIROS polar orbiting satellites;
- Doppler radar network, most of which are installed by the USA National Weather Service over national territory;
- USA-aircraft reconnaissance of hurricanes in the Atlantic, Gulf of Mexico and Caribbean areas, including turbo-prop low altitude flights into hurricanes and the newer Gulfstream IV high-altitude jet for measuring the steering currents on the periphery;
- USA advanced computer/telecommunications weather interactive processing system, AWIPS, to help forecasters analyse storms and prepare and disseminate forecasts and warnings.

The centre relies on several techniques, mostly NWP, to prepare guidance to the forecasters and it cooperates with research and operational activities within and outside NOAA in the further development and testing of the models and techniques. It provides training for tropical cyclone forecasters from all the tropical cyclone-prone regions.

## **RSMC Nadi - Tropical Cyclone Centre**

One of the major features of the functions of the centre is the provision of not only information and advisory services for its region, but of full tropical cyclone forecast and warning services for eight countries and territories and special advisory services for two countries in its region.

Tropical cyclone alerts and warnings are issued in the form of Special Weather Bulletins at least every six hours and usually at three-hourly intervals for warnings, to the national Meteorological Services of the country under threat. Special Advisory Bulletins are issued to two countries at least every six hours during threat of a tropical cyclone, to assist their national Meteorological Services in preparing local warnings.

The centre receives high-resolution data in real-time from the Japanese GMS geostationary meteorological satellite, the USA GOES-W geostationary and NOAA polar-orbiting meteorological satellites.

The computer system installed, called Fiji Integrated Meteorological System, FIMS, is a complete meteorological system comprising from data collection through forecast preparation to product delivery. The communication network was the most recent available on the market in architecture and design at the time of its installation in 1998. There is a direct high-speed link with the WMC Melbourne and a planned direct link with WMC Washington.

The centre was moved into a new building in 1998 and has been utilizing the modernized meteorological equipment and facilities since then.

*Special product - hurricane track probability forecast  
(courtesy: RSMC Miami)*

*RSMC Nadi building*

### **RSMC - tropical cyclones New Delhi**

There are two peak periods for tropical cyclones in the Bay of Bengal and Arabian Sea areas, the post-monsoon and the pre-monsoon months.

A Regional Telecommunications Hub on the GTS is co-located with the RSMC New Delhi. In addition to meteorological data and products received on the GTS, the centre receives support from the application program satellite imagery from the Indian INSAT geostationary satellite located over the Indian Ocean. These data are used for the detection, analysis and tracking of tropical cyclones in the region and also to assist in forecasting their movement and intensity.

The center applies all the standard techniques in tropical cyclone forecasting. NWP forecasts are made using an advanced high-resolution multi-level primitive equation model run in operational mode on the India Meteorological Department's super-computer system. The numerical guidance provided by the model serves to enhance the degree of confidence in the synoptic forecasts.

Special attention is being given to storm surges associated with tropical cyclones in this region, which constitute one of the world's foremost natural hazards, due to the shallow bathymetry and the large range of the astronomical tide. The forecast track, size and intensity of the tropical cyclone itself are of vital importance, in conjunction with numerical storm surge model output and pre-computed nomograms for storm surge forecasting.

### **RSMC Tokyo - Typhoon Center**

A Regional Telecommunications Hub on the Main Telecommunications Network of the GTS is co-located with RSMC Tokyo.

The center operationally analyses the synoptic observations, data from the Japanese geostationary meteorological satellite, GMS, which provides excellent coverage of the region, other meteorological satellites and weather radars. Forecasts made operationally, particularly those for longer periods up to 72 hours, rely heavily on the products of NWP models at the Japan Meteorological Agency, JMA. The Typhoon Model (TYM) and the Global Spectral Model (GSM) are used for the prediction of tropical cyclones. These advanced models are nevertheless under constant revision. Forecast verification reveal a long-term trend of improving forecast and numerical guidance for forecasters in track forecasts and in storm surge prediction.

The synoptic field and sea surface temperature distribution are taken into account, especially for intensity forecasting. A new method of modifying numerical model output to get 48 hour and 72 hour intensity forecasts is planned for early implementation operationally.

RSMC Tokyo staff members serve as resource persons in international training seminars on typhoon monitoring and forecasting, hosted by JMA for the benefit of other national Meteorological Services in the typhoon region.

*Training of typhoon  
forecasters  
(courtesy: RSMC Tokyo)*



(insert maps p. 17 to 22)











## **TROPICAL CYCLONE WARNING CENTRES WITH REGIONAL RESPONSIBILITY**

The tropical cyclone warning centres with regional responsibility are operated by and are part of the USA-NOAA National Weather Service's facility in Honolulu, Hawaii, the Australian Bureau of Meteorology, the National Weather Service of Papua New Guinea and the Meteorological Service of New Zealand Ltd. Their functions include the detection, monitoring and track and intensity forecasting of all tropical cyclones in their respective region and the provision of these first level basic information to the international community, in addition to provision of local warnings to meet their national responsibilities. Their functions also include assigning names to tropical cyclones forming within their region. TCWC Port Moresby has responsibility for a comparatively small region in which only a few tropical cyclones form, and for activities as outlined above, primarily the provision of local warning services. The three Australian centres and the Honolulu centre are directly linked to WMC Melbourne and WMC Washington respectively and are fully supported by their national Meteorological Service. The Wellington centre is also fully supported by its national Meteorological Service. They provide, additionally, information and warning for marine interests in their regions. TCWC Brisbane has been designated as an ICAO Tropical Cyclone Advisory Centre and provides specialized tropical cyclone advisory services for the aviation community.

*Radar imagery of a tropical cyclone  
(courtesy: BOM, Australia)*

## NATIONAL METEOROLOGICAL SERVICES

The provision of warnings of tropical cyclones and associated phenomena for national territory and its coastal waters is, basically, a national responsibility.

The national Meteorological Services of countries affected by tropical cyclones provide advisories and bulletins with information and forecasts of current tropical cyclones that are threatening or could threaten their country. The advisories include, where applicable, official warnings of the impact of tropical cyclones and of associated phenomena on national territory, including local areas, communities and coastal waters.

The facilities, equipment and staff of national Meteorological Services vary widely from country to country. Some have a wide range of modern and sophisticated facilities and highly trained and experienced personnel, some others do not. Nearly all the Services are connected to the GTS and receive at least a significant amount of data from the GOS and products from the GDPS. All the Services of these Members that are affected by tropical cyclones receive information, advice and guidance from the relevant tropical cyclone RSMC. Very nearly all of the Services have facilities to enable reception of information directly from meteorological satellites, at least limited low-resolution data.

In the few exceptional cases where so needed, tropical cyclone warnings for a country or territory are issued under special arrangements by the relevant RSMC or by a neighbouring national Meteorological Service.

Thus tropical cyclone warning services are being provided for all countries and territories which are affected.

The official warnings are included in advisories and bulletins which are issued, in general, by the National Meteorological Centre. In the cases of a few large countries, such as Australia, China, India and USA, they are issued by area tropical cyclone warning centres of the national Meteorological Service.

The detailed arrangements and form of the warning services vary from country to country. Often an "alert" is raised about 48 hours ahead of the onset of the tropical cyclone and a specific warning phase usually commences in time to give about 24 hours advance notice.

Up-to-date reliable information on current tropical cyclones, forecasts of their tracks and intensities, and warnings of the impact of these cyclones and associated phenomena, form together the foundation of a disaster mitigation system. Combined with effective response by all concerned and the appropriate pre-arranged disaster prevention and preparedness measures, such as tested evacuation plans, they can and do save numerous lives and substantially reduce the devastation that could be caused by tropical cyclones around the globe every year.

Widespread dissemination of these information and warnings in real-time, in which the media and particularly the electronic media play an important role, to a population which is aware of the dangers posed by these natural hazards and of the protection systems make invaluable contributions to the integrated tropical cyclone disaster mitigation system.

\* \* \* \* \*