Forecasting and Warning Systems for Cyclones in India

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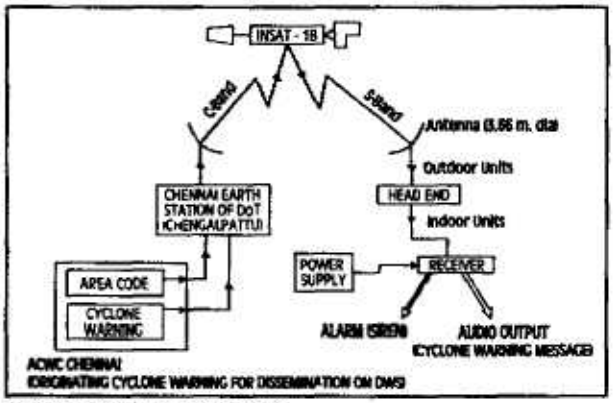
Abstract

Tropical cyclones are a national phenomenon, over the globe which cannot be prevented but its impacts could be minimised by understanding its regular behaviour, timely prediction and historically based damage assessment The impacts of tropical cyclones are not dependent on strength and frequency of occurance, but are more specific to location and time of occurance Advanced technologies like remote sensing, computers have made it possible to predict the size, intensity and path of the cyclones. It is the governments of the nations to evolve effective, short and long term mechanisms to utilise these predictions and forecasts for minimising loss of life and property over the period of time. India is one of the most well equipped countries in the world in terms of sophisticated technology and satellite in place. All that is required is to mobilise and train its taskforce for readiness and quick response to the forecasting, and communication system.

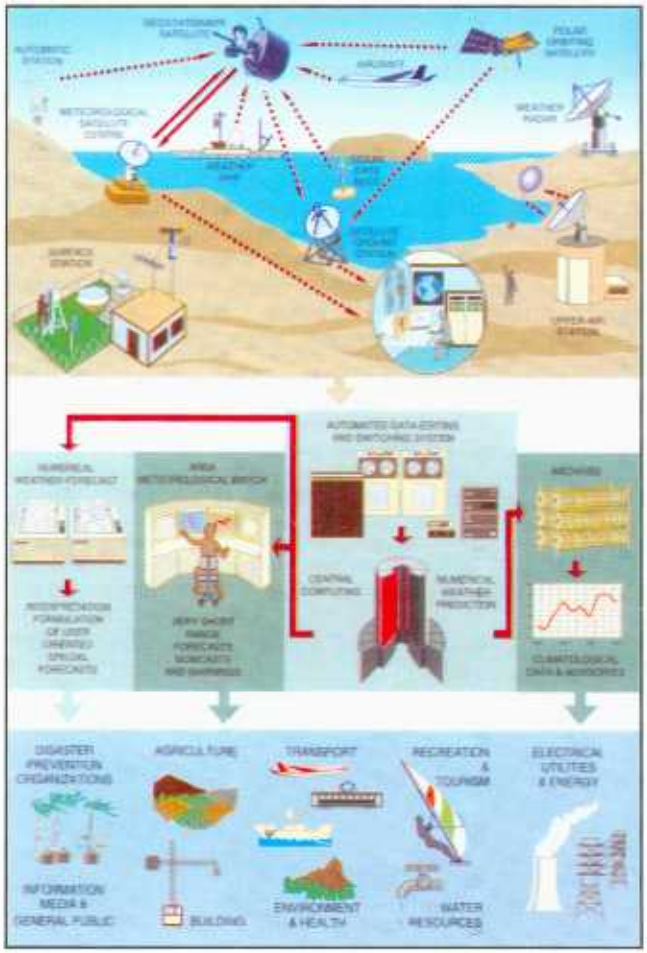
Cyclone Warning Systems in India

The Indian Meteorological Department (IMD) has a well established organizational set up for observing, detecting, tracking and forecasting cyclones and issuing cyclone warnings whenever a cyclone develops in the Bay of Bengal and the Arabian Sea. Cyclone warnings are provided through six cyclone warning centres located at Calcutta, Bhubaneshwar, Visakapatnam, Chennai, Mumbai and Ahmedabad These centres have distinct responsibilities areawise, covering both the east and west coasts of India and the oceanic areas of the Bay of Bengal and the Arabian Sea, including Andaman and Nicobar Islands and Lakshwadeep.

The cyclone warning bulletins are issued to All India Radio and Doordarshan for broadcast/telecast in different languages. On an all India basis such warnings are issued to All India radio and Doordarshan, New Delhi from the Cyclone Warning Division at HQ office, New Delhi. IMD, through its HQ office at New Delhi provide cyclone information to the control room and Crisis Management Group set up in the Ministry Of Agriculture. Government of India, which is finally responsible to coordinate actions of various other central Government Agencies for taking effective disaster mitigation measures. Cyclone Warning Division at New Delhi also caters to the need of International requirements such as issue of Tropical Weather outlook and Cyclone Advisories to its neighbouring countries. **Considering the cyclone warning capabilities of India Meteorological Department, New Delhi has been designated as Regional Specialized Meteorological Centre (RSMC) by WMO which is one among the four such centers in the world trusted with the cyclone warning services for their area of responsibility.**



Disaster Warning System (DWS)



How a National Meterological Service Station works. Observation and data collection (top); data processing and preparation of forecasts, climatological data and advisories (centre); dissemination of forecasts and other, specifically user-oriented information(below).

Source . WMO - No. 799 (A Decade against Natural Disasters)

Cyclone Tracking

Whenever there is a cyclone in the sea areas adjacent to India, it is tracked with the help of INSAT satellite, powerful cyclone detection radars with a range of 400 km installed at (i) Calcutta, (ii) Paradip, (iii)Visakapatnam (iv) Machilipatanam, (v) Chennai, (vi) Karaikal on the east coast and (vii) Goa, (viii) Cochin, (ix) Mumbai and (x) Bhuj along the west coast and other conventional meteorological observations including ship's report. The cyclone detection radar network in India is shown in the figure. Facility also exists to monitor cloud patterns from Polar Orbiting meteorological satellites. The present

cyclone surveillance system in the country is such that no cyclone in the region can escape detection at any time in its life cycle. Three High Windspeed Recorders (HWSR) have been installed along the East Coast to record the wind upto 200 kts. Installation of more such recorders is in progress.

User Agencies

IMD provides warnings against tropical cyclones to the coastal regions of the country and for the high seas as per assigned area of responsibility. The main user organizations served by the department are Commercial Shipping and Indian Navy, (ii) Port Authorities, (iii) Fisheries Officials, (iv) Officials of the Central and State Governments, (v) Special warnees who are registered with IMD (Album Page Warnees), (vi) Commercial Aviation, (vii) Special Interest Groups and (viii) General Public.

Preparation of Forecasts

The important components of cyclone warnings are (a) the forecast of the future path, (b) intensity and (c) the associated destructive weather such as strong winds, heavy rainfall and associated storm surge For forecasting the path of cyclone and storm surges, advanced computer technology in addition to conventional techniques have contributed in relatively efficient and allenate results. For forecasting, intensity of disasters, satellite imageries and remote sensing techniques are more appropriate

Inspite of advancement in usage of sophisticated equipments errors of prediction of the path of the cyclones for 24,48 and 72 hours have been ranging to an extent of 220 kms, 430 kms and 730 kms, respectively. In India, these errors have ranged to 150 kms for 24 hour prior forecasts **Hence, authenticity of the prediction of path of the cyclone is normally considered only in case of 24 hours prior forecasts. Greater landfall errors due to earlier warnings require massive evacuation from larger areas, which sometimes are very impractical and uneconomical.** Therefore, cyclone warnings are not issued earlier than 24 hours all over the world. It is, therefore, important that taskforce of Government is well prepared for emerging situation of evacuation, safety and relief from the weather impacts of cyclones, within 24 hours of occurrence of cyclones..

However, the forecasting techniques and equipment in IMD is equally sophisticated to any other in the world.

Two- Stage Warning System

The cyclone warnings are provided in two stages. In the first stage, a "Cyclone Alert" is issued 48 hr before the commencement of adverse weather along the coast. In the 2nd stage, a "Cyclone Warning" is issued 24 hour before the anticipated landfall. The ports and fisheries warnings start much earlier. Ports are warned day and night with specially designed Port Warning Signals. Informatory messages on cyclones are issued for broadcast to AIR as soon as a tropical cyclone is detected in the Bay of Bengal or in the Arabian Sea.

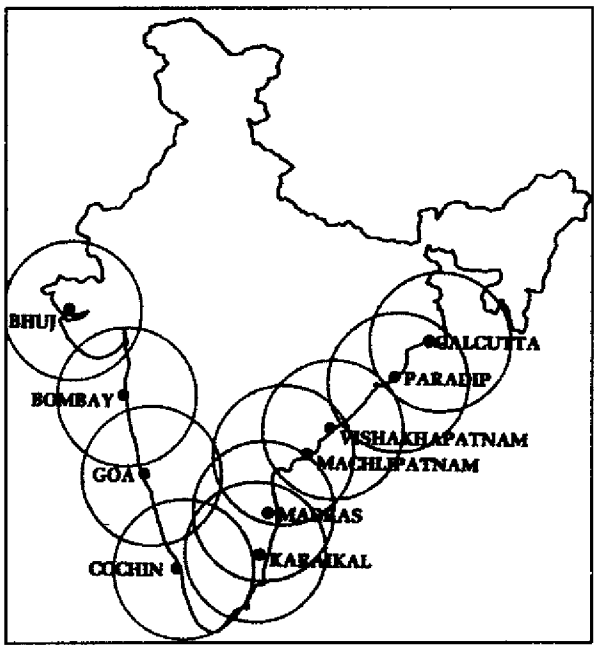
Dissemination of Cyclone Warnings

Cyclone warnings are disseminated by the following means: (i) Telegrams with the highest priority, (ii) Telecast through Doordarshan, (iii) Broadcast through AIR, (iv) Bulletins to the Press, (v) Broadcast through P&T's coastal radio stations for ships in the high seas and coastal areas and through INSAT based Disaster Warning Systems (DWS)

In addition to above, cyclone warnings are disseminated through teleprinters, telex, facsimile and telephones wherever such facilities exist with the recipient. The warning bulletins are issued normally at 3 –hourly intervals, but more frequently when needed. Areas threatened by cyclone, heavy rainfall, magnitude of destructive winds and their impact, storm surge elevation and coastal areas likely to be inundated are some of the elements included in the cyclone warning bulletins. On receipt of warnings, the government official and other authorities take appropriate measures to safeguard the life and property of coastal population, which includes evacuation of people from vulnerable areas to safer places.

Disaster Warning Systems (DWS)

Department of Telecommunication (DOT) telecommunication systems such as telegrams, telex and telephones are often among the first casualty during a cyclone situation and warning messages get delayed. To overcome this difficulty, a very dependable and unique communication system known as Disaster Warning System (DWS) has been developed in India. Through this system, rapid and direct dissemination of cyclone warnings are made through INSAT satellite to designated addresses at isolated places in local languages. Schematically this is shown in figure here below.



Cyclone Detection Radars

Presently, the disaster warning system is working along east and west coast of all maritime states where 250 DWS sets have been installed in small administrative units like Block Development Taluq Offices and Police Stations. Disaster warning sets are also located in the state and district level government headquarters in the above areas. The DWS has been successfully operated on occasions of cyclone during the past and has been found very effective.

Public Awareness Activities in Cyclone Disaster Prevention and Preparedness

Finally the success of a good cyclone warning system depends on community reaction to the warnings. Individual response to the warnings depends on many factors, such as educational background, cultural background, age, family situation, ownership of assets and previous experience of similar hazardous conditions A good community preparedness committee can, however,

plan and carry out an intensive educational program to ensure that all people living in cyclone prone areas know what to do and how to take protective measures in the case of a threat from a tropical cyclone Permanent Cyclone Preparedness Committees (CPC) can also prepare model cyclone plans indicating the risk areas and suggesting building codes and structural designs for cyclone shelters for such areas. Such committees can also advise on construction of embankments and dykes in vulnerable areas and creation of coastal forestry (with specific varieties of bushy plants) in the risk zones to serve as windbreakers

IMD, along with the state governments, evolved a well orchestrated information dissemination campaign to enhance public awareness among Government officials, voluntary organisations and the community at large through seminars, workshops, popular talks, publicity materials etc in Indian languages on characteristics of cyclone hazard, and benefits of preparedness and mitigation measures.

Every year to review the performance of cyclone warning system a Cyclone Review Committee meets in one of the Cyclone Warning Centers by rotation, to discuss all the aspects of cyclone warning including its failure and rectification measures needed in the future. These meetings are chaired by the Director General Of Meteorology and are attended by all the senior officers concerned with the cyclone warning works. As a part of pre cyclone exercises pre cyclone circulars are sent to all concerned Central and State Government officials before the pre monsoon and post monsoon cyclone season

Keeping pace with the development of science and technology the cyclone warning system in India has been modernised and today, it is one among the advanced cyclone warning system in the world. Due to reliable cyclone warnings and adequate timely steps taken by the concerned State and Central Government authorities as well as affected public in general, the loss (specially the human lives) due to tropical cyclones has reduced significantly during recent times.

Desirable for the Future Improvements

Tropical cyclones spend most of their life period over the ocean from where wind observations are difficult. On the other hand wind observations from the cyclone field over the ocean by direct measurements or through remote sensing are important in deciding the cyclone's intensity as well as identifying the oceanic areas under high wind speed. Such information is also required for providing initial input to track and surge forecasting models. The ships carrying meteorological instruments passing through the cyclone field can measure surface winds over the ocean. Actual measurements of meteorological parameters at different heights over the oceans can also be obtained by probing cyclones with the help of specially instrumented aircrafts known as **Cyclone Reconnaissance Aircraft**. However with the improvement of cyclone warnings the ships started avoiding the areas affected by tropical cyclone. As such, presently, ship observations from the inner core regions of cyclone are generally not available. Due to high operational costs the facilities for cyclone probing by reconnaissance aircraft are only available with the United States. Ocean buoys (anchored or drifting) are other sources of wind observation from the ocean, whose numbers over the Indian seas are insignificant As such, direct wind observations from the cyclone field are generally not available for the Indian seas.

Surface winds over the ocean can also be estimated with the help of remote sensing techniques using Doppler radar and satellites with scatterometer on board. India Meteorological Department has a plan to replace the present CDR network by Doppler radar in a phased manner (first phase starting very soon) Ocean SAT currently in orbit is carrying the scatterometer on board. It is expected that soon surface wind observations over the ocean through this instrument would be made available to the meteorological community. These efforts will finally reduce the gap of non-availability of wind information from the cyclone field over the ocean considerably.

Present wind measuring instruments available along the coast are not capable of recording high wind speed generally associated with tropical cyclones. As such, present effort of installation of very high wind speed recorder had to be strengthened. Measurement of storm surges is another gap area, which needs attention. At present 48 and 72 hour forecast errors of cyclone's position even by most advanced techniques, are quite large This is however a problem common to all the nations effected by tropical cyclones and there is already a very concerted and coordinated efforts continuing throughout the globe to reduce the forecast errors.