



वार्षिक प्रतिवेदन ANNUAL REPORT 2010



भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
पृथ्वी विज्ञान मंत्रालय, भारत सरकार
Ministry of Earth Sciences, Govt. of India

ANNUAL REPORT 2010



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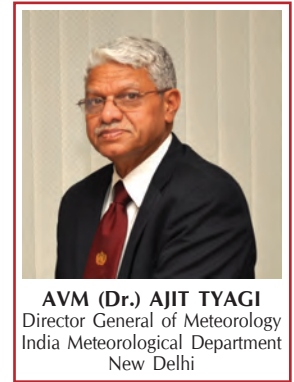
Gopi Chand

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FROM DESK OF DGM



AVM (Dr.) AJIT TYAGI
 Director General of Meteorology
 India Meteorological Department
 New Delhi

It gives me immense pleasure to bring out the Annual Report 2010. It highlights the activities of IMD during the year, in the backdrop of its past achievements and scope of future advancement. During celebration of the Department's 136th Foundation Day on 15th January 2010, the then Hon'ble Minister Shri Prithviraj Chavan had envisioned indigenous capability of weather prediction using numerical models. When this objective fructified later in the year, the Department entered the league of advanced nations in operationalizing NWP capability.

The Department has taken new strides towards modernization during this period with various projects undergoing successful completion or nearing completion. These include Automatic Weather Station (AWS), Automatic Rain Gauge (ARG), Doppler Weather Radar (DWR) etc, that have been installed at various stations in far-flung areas. IMD also took steps to benefit from the contributions of meteorological community within the country and abroad. The Department continued to work with openness, informality, intensity and dedication. "Modernization" has come to represent a fundamental change in terms of body and spirit.

This department successfully implemented a state-of-art system for providing venue specific weather predictions during Commonwealth Games 2010 held in Delhi. Location specific forecasts also received appreciation for its accuracy during Kailash-Mansarovar and Amarnath Yatra. The department organized several users' conferences, workshops, seminars and symposia to create awareness about the weather among the people. It provided an overview of the status of our services and future course of action on several frontier areas including radar, satellite meteorology, seismology, telecommunications and more importantly, weather and climate services.

The department fared well on the implementation of official language policy in popularizing the use of Hindi in day-to-day official work. This achievement was presented before Hon'ble Rajbhasha Parliamentary Committee during their visit at the HQ and other sub offices. Their guidelines shall inspire us to achieve greater use of Hindi language with more dedication.

Annual Report 2010

The collaboration in international forum with US (NOAA), Russia, U.K., China, Korea and Indonesia has opened a path ahead for technical and scientific cooperation under various exchange programmes. Important international events such as South Asian Climate Outlook Forum (SASCOF), meeting of Coordination Group of Meteorological Satellites (CGMS) and ESCAP Panel meeting on Tropical Cyclones were successfully conducted by the department.

Sadly 2010 was also marked by the demise of Dr. P. K. Das and Dr. R. P. Sarker, former Director Generals of Meteorology. Dr. P. K. Das was DGM during 1979-1983. He was a visionary and is widely considered as the Father of Indian NWP. The successful commissioning of IMD's NWP programs in 2010, based on the new HPCS, is a tribute to his pioneering efforts. Dr. R.P. Sarker served as DGM during 1986-88. He was among the earliest scientists to have studied the dynamics of orographic rain. Our upcoming programme on Mountain Meteorology would be a fructification of his ideas and thoughts.

In conclusion, I am availing of this opportunity to put on record the appreciation for dedication and hard work of IMD personnel in improving the efficiency of the department and in taking a lead role in the subject area of Earth & Atmospheric Sciences.

AJIT TYAGI
Director General of Meteorology

ORGANISATION

Ministry of Earth Sciences

Govt. of India

**Shri Pawan Kumar Bansal**

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Ministry of Earth Sciences and Ministry
of Parliamentary Affairs

**Shri Ashwani Kumar**

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Director General of Meteorology

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Head Agromet

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Shri A. K. Sharma, Scientist 'F'

(Satellite Meteorology)

Shri B. Mukhopadhyay, Scientist 'F'

(Environment Monitoring & Research Centre)

Dr. R. S. Dattatrayam, Scientist 'F'

(Seismology)

Shri N. Y. Apte, Scientist 'F'

(Hydrology)

Dr. S. K. Roy Bhowmik, Scientist 'F'

(Numerical Weather Prediction)

Shri Rajiv Sharma, DDGM

(Administration & Store)

Shri S. K. Kundu, Scientist 'F'

(Upper Air Instruments)

Shri A. K. Shukla, Scientist 'F'

(Earthquake Risk Evaluation Centre)

Shri B. K. Bandyopadhyay, Scientist 'F'

(Services)

Dr. A. B. Majumdar, Scientist 'F'

(Weather Forecasting)

Shri S. Krishniah, Scientist 'F'

(Surface Instruments)

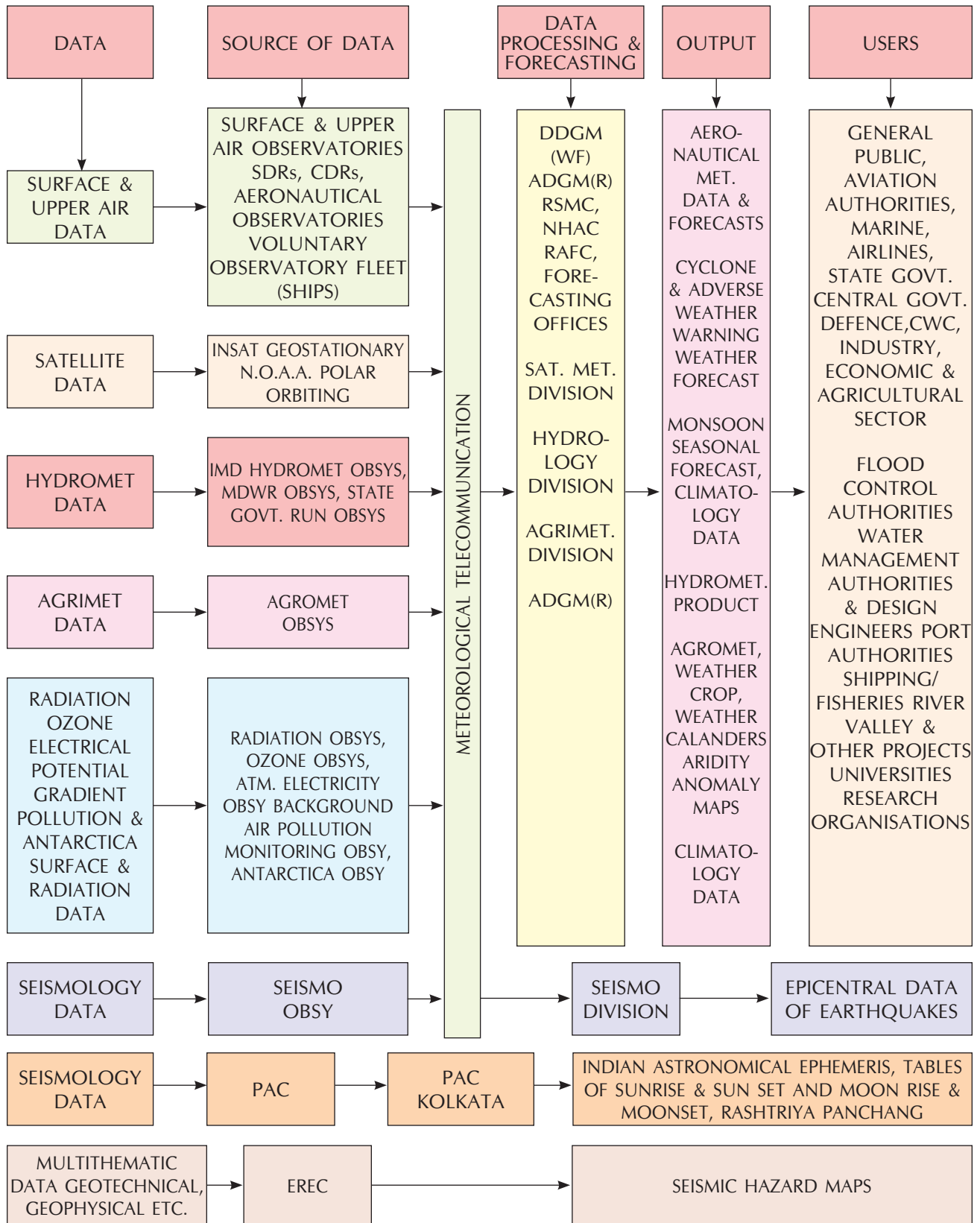
Shri R. P. Samui, Scientist 'F'

(Agriculture Meteorology)

Regional Administrative & Technical Heads

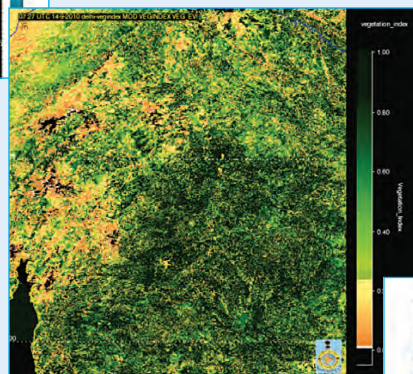
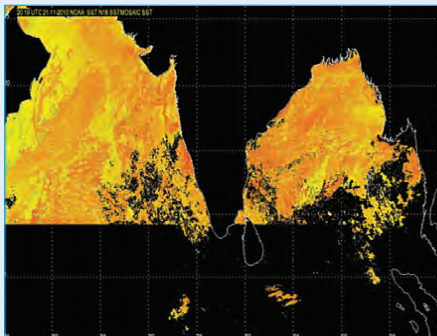
Dr. Y. E. A. Raj, DDGM (RMC, Chennai)**Dr. H. G. Pathak**, LACD DDGM (RMC, Guwahati)**Shri S. N. Roy**, DDGM (RMC, Kolkata)**Dr. R. V. Sharma**, DDGM (RMC, Mumbai)**Dr. Smt. Surinder Kaur**, DDGM (RMC, Nagpur)**Dr. O. P. Singh**, DDGM (RMC, New Delhi)

FUNCTIONAL SETUP



1

WEATHER SERVICES



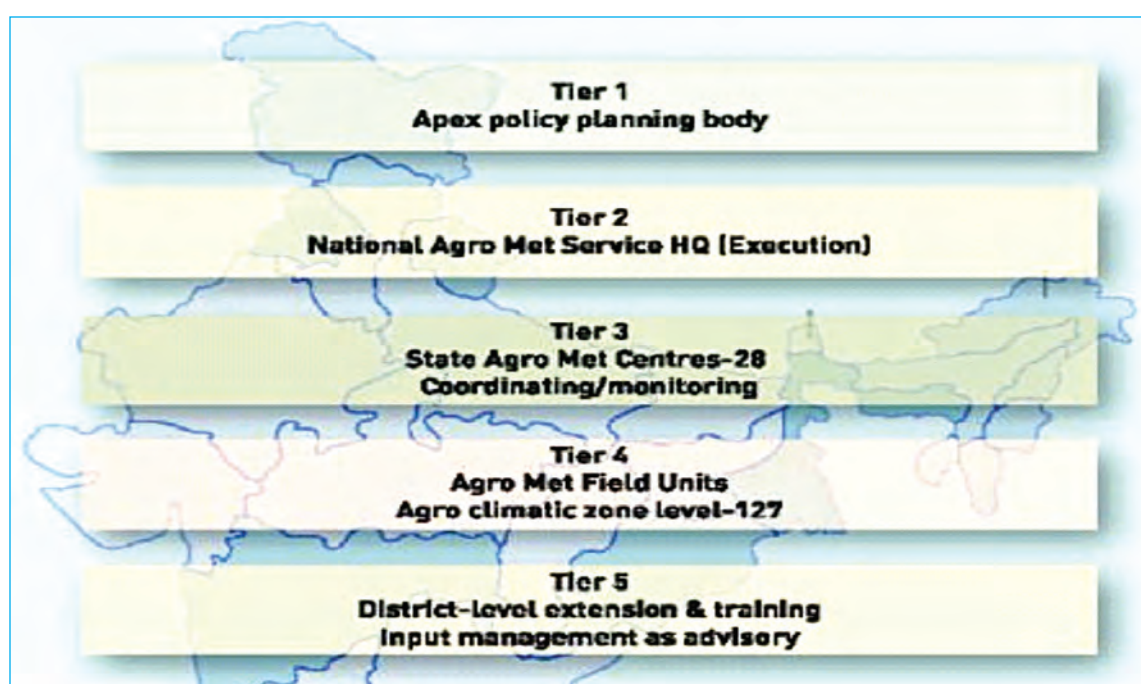
WEATHER SERVICES

1.1. AGROMETEOROLOGICAL SERVICES

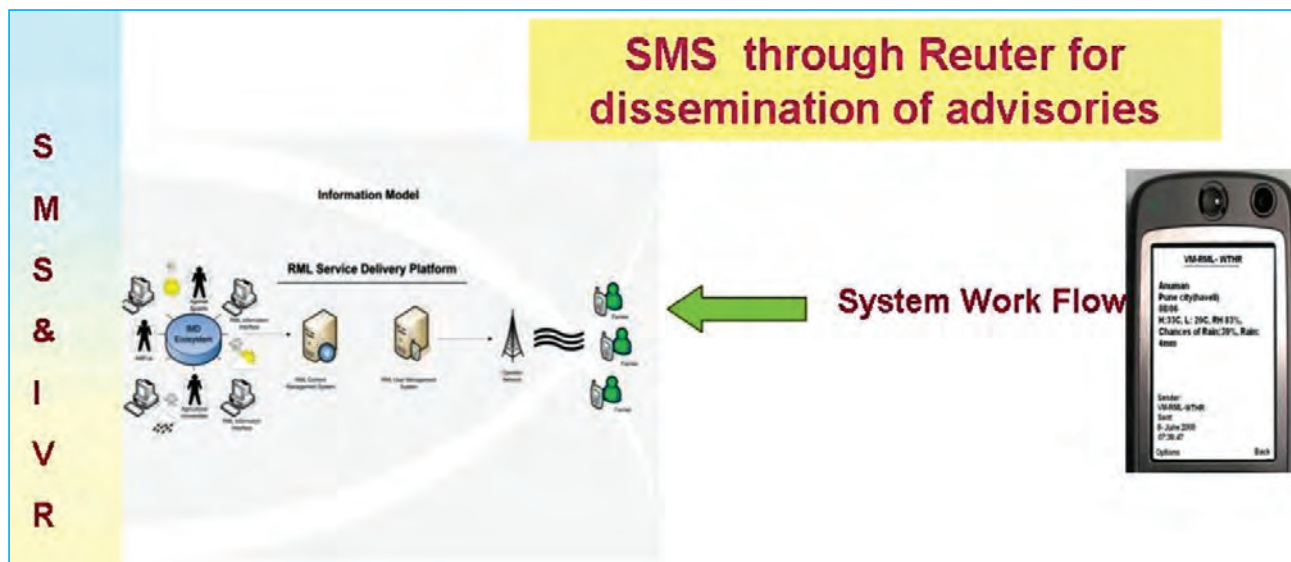
Agrometeorological Services are rendered to the State Governments and farmers by issuing weekly/bi-weekly Agro-met advisory bulletins at district, state and national levels to cater to the needs of farmers at local level to national level and include crop specific advisories including field crops, horticultural crops and livestock. At present these bulletins are issued for 539 districts of the country. These bulletins are jointly prepared by State Meteorological Centre of IMD and AMFUs and mainly used by State Government functionaries. These bulletins are useful to Fertilizer industry, Pesticide industry, Irrigation Department, Seed

Corporation, Transport and other organizations which provide inputs in agriculture. Presently, these bulletins are issued for all the states of the country. National Agromet Advisory Bulletins are prepared by National Agromet Advisory Service Centre, IMD, Pune. Ministry of Agriculture is prime user of these bulletins, which help to take important decisions in Crop Weather Watch Group (CWWG) meetings at national level. The bulletins are also used by a large number of other agencies including fertilizer, pesticide industries.

In addition, different multi-channel dissemination systems, are being used to disseminate advisories to the farming community in India through SMS and IVR (Interactive Voice Response Technology).



Five tier system under IAAS



SMS through Reuter for dissemination of advisories

Under the SMS system an information platform has been created which allows the existing Agromet Field Units (AMFUs) located at State Agriculture Universities (SAUs), institutes of Indian Council of Agriculture Research (ICAR), Indian Institute of Technology (IITs) etc. to provide the information in a convenient and timely manner. The advisories are crop and location specific and delivered within actionable time to the farmers.

A number of private firms namely Reuter Market Light, Handygo, Vritti Solution, IFFCO Kisan Sanchar Limited (IKSL) are disseminating the agromet advisories generated under IAAS through SMS and Interactive Voice. At present 16 states namely Delhi, Uttar Pradesh, Punjab, Haryana, Rajasthan, Madhya Pradesh, Orissa, West Bengal, Gujarat, Karnataka, Kerala, Tamilnadu, Andhra Pradesh, Bihar, Maharashtra and Himachal Pradesh have been covered under this service. Advisories are also disseminated through SMS to the farming community of Maharashtra in collaboration with the State Department of Agriculture, Government of Maharashtra.

Farmer’s Awareness Programme: Fifty Farmer’s Awareness Programmes were organized in various AMFUs during the year with an objective to make the farmers more reliant in dealing with weather and climate that affects agricultural production. This Division also participated in various

krishi melas organized in different Agricultural Universities. and other collaborative agencies by demonstrating the role of weather forecast in increasing overall preparedness of farmers, leading to substantially better outcomes overall. Besides this Division brought out agromet brochure highlighting the different services provided to the users in number of languages.

Implementation of FASAL programme: New initiatives were taken up to develop crop yield forecasting models for major crops of the country with greater accuracy in collaboration with Department of Space (DOS) and Department of Agriculture and Cooperation (DAC) under FASAL project (Forecasting Agricultural output using Space, Agrometeorology and Land based observations)

1.2. HYDROMETEOROLOGICAL SERVICES

IMD is providing the necessary technical and operational support to various Central/State Govt. Organisations and other agencies in the field of Hydromet design flood forecasting, water management and agricultural planning purposes. In the performance of these activities, this discipline carried out compilation of rainfall statistics, hydrometeorological analysis of different river

catchments for project authorities and provided meteorological support for flood warning and flood control operations to field units of Central Water Commission. Research Programmes in (a) Design Storm Analysis, (b) Rainfall Frequency Analysis and (c) Quantitative Precipitation Forecast are the ongoing hydrometeorological activities. The main activities of the Division are:

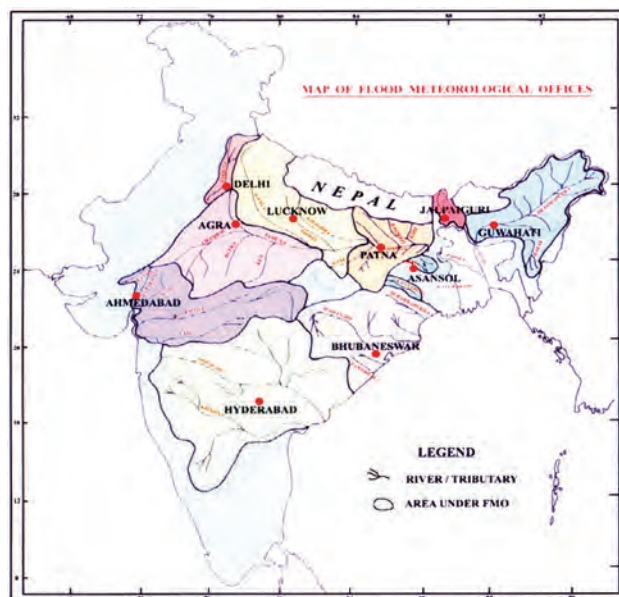
Rainfall Monitoring

Real time monitoring of districtwise daily rainfall is one of the important functions of IMD. A network comprising a large number of rain gauge stations is utilized under Districtwise Rainfall Monitoring Scheme (DRMS). Based on real time daily rainfall data, weekly districtwise, sub-divisionwise and statewise/seasonwise rainfall distribution summaries are prepared in the form of rainfall tables and maps. Districtwise and sub-divisionwise rainfall statistics provides important information useful to the agricultural scientists, planners and decision makers. The software used for preparation of districtwise rainfall summary has been modified to get outputs in Excel Format.

Preparation of weekly sub-divisionwise/districtwise/statewise rainfall reports including the statistics for the country as a whole as well for the four regions viz., North-West India, South Peninsula, Central India and North East India. During the Monsoon Season 2010 daily sub-division rainfall report (169 reports) were prepared and supplied to the Cabinet Secretary and other users. Districtwise reports for last 5 years were put up on IMD Website and creation of sub-divisional rainfall maps was automated.

Flood Meteorological Service

Flood Meteorological Service of IMD provides the inputs to Central Water Commission through their 10 FMO established in different parts of India for operational flood forecasting. This unit is mainly engaged in developing Quantitative Precipitation Forecast (QPF) model using different dynamical models for river basins during flood season. For this Mahanadi Basin is taken as pilot project for the flood seasons 2010 by using IMD's MME



Flood Meteorological Offices

forecast. IMD's WRF (9 km × 9 km) model was also partly utilized in the flood season 2010 with 48 hours lead time. During the Flood 2010, 15372 QPFs were issued by FMO's and supplied to Central Water Commission for flood forecasting purposes.

Design Storm Studies

Design Storm Studies are being conducted to evaluate design storm estimates (rainfall magnitude and time distribution) for various river catchments/projects in the country, for use as main input for design engineers in estimating design flood for hydraulic structures, irrigation projects, dams etc. on various rivers. This estimation of design values is required for safe and optimum design of storage and spillway capacity. On the request of Central Govt./State Govt. and Private Agencies, design storm values (Standard Project Storm, Probable Maximum Precipitation along with Time Distribution) are being provided for users as main input. For Govt. agencies, these studies are being carried out free of cost and for private/profit earning agencies on payment basis. The design storm studies for 36 projects have been completed and results communicated to the concerned project authority. The detailed project report are being sent in respect of the projects completed on payment basis. The work of preparation of PMP Atlas for Krishna Basin has been initiated.

1.3. METEOROLOGICAL SERVICES FOR AVIATION

Meteorological Services for aviation are provided for National and International flights for safe and efficient operations. These services are provided through a network of four Meteorological Watch Offices (MWOs) located at the four major international airports at Chennai, Kolkata, Mumbai and New Delhi and 68 other aviation meteorological offices located at the other airports in the country. A Tropical Cyclone Advisory Centre (TCAC) is also functioning at NHAC New Delhi to provide advisory information on tropical cyclones. The aviation meteorological offices provide airport specific current weather reports, various forecasts and warnings for safety, economy and efficiency of aircraft operations. Meteorological safety has assumed prime importance for aviation services in the country owing to massive expansion in air traffic. IMD prioritized its modernization programme to meet the immediate demands of the Aviation Sector.

New additional Transmissometers were installed at Lucknow, Jaipur, Chennai, Bangalore, Hyderabad, Amritsar and Runway 09 of Delhi airports for visibility and Runway Visual Range measurements to meet the upgraded category of Instrument Landing Systems at these airports.

Procurement for Integrated Automatic Aviation Met Systems (IAAMS) for forty two more airports is under process. Two new Airport Meteorological offices opened at Dharamshala and Nanded Airports. IMD make Digital Current Weather Systems installed at Kolkata and Bangalore International Airports. IMD make Digital Distant Indicating Wind Equipment (DIWE) was installed at Mangalore airport. IMD started receiving aircraft observed data (AMDAR) from Lufthansa Aircrafts visiting Indian airports w.e.f. 1st October 2010 under an agreement with European AMDAR panel.

1.4. MOUNTAIN METEOROLOGICAL SERVICES

The basic objective of integrated Himalayan project is to establish a mechanism by which

various departments and organizations working on the development of the Indian Himalayan belts could come together under a forum provided by the IMD to particularly exchange information on scientific meteorological aspects of Himalayan development with regards to weather, climate, hydrological, ecological and environmental aspects. Its aim is to improve and upgrade mountain weather and climate services over Himalayan region by establishing additional state-of-art surface and upper air observatories for real time observations. To integrate the observational network of neighbouring countries in the Himalayan region and also to consider possible linkage with regional partners, the department was entrusted to the development of appropriate system of early warning and timely dissemination for natural disaster management, taking into consideration the requirements of all users and sectors in the region. It may help to improve understanding of physical processes leading to heavy rainfall, heavy snowfall, and cloud burst etc.

The Himalayan region has a complex terrain which leads to modification of air flow as a result of which meso-scale systems form after interacting with synoptic scale systems. Due to formation of such meso-scale systems localized thunderstorms can be triggered which have Hydro-geological and socio-economical implications. High resolution state of art meso-scale models need to be run with variable grid size. It is felt that it would be necessary to run a 3 km resolution NWP model. It will require a surface observatory network of at least 50 km resolution or better. Therefore, there is a requirement of very dense network of observatories over the entire region with minimum 2-3 observatories at very high altitude in each zone.

An effort was initiated under project "PARWAT" for augmenting the observational network mainly to cater to the weather and avalanche forecasting requirements of Armed Forces. A network of 26 AWS and 3 upper-air stations was established in the Western Himalayan Region. The end user i.e., army has also appreciated the timely weather forecast and information provided by the IMD and found it useful for saving the lives of their people (operating in forward areas) from

the potentially hazardous weather situations. Considering the usefulness of the first phase of the Project, Government approved further extension of the project to cover central Himalayas in phase-II in May 2009. The project envisages further augmentation of the surface and upper air networks in Himachal Pradesh and Uttarakhand (15 Surface, 9 AWS, 19 ARG, 3 Upper air & 1 DWR and 4 VSAT's) which are planned to be integrated with over all modernization plan of IMD.

1.5 METROPOLITAN WEATHER INFORMATION AND FORECAST SERVICES

The above project has been undertaken by IMD to provide detailed Weather Information and Forecast for the NCR of Delhi including the services for CWG 2010. It is intended to be a long term permanent facility in IMD to serve the NCR of Delhi. The intended services for the CWG 2010 were provided by IMD utilising the existing infrastructure as detailed below.

1.5.1. Observational Systems utilized for the forecasts

An enhanced observing and monitoring network set up in and around Delhi under modernization of IMD, IITM and of the Indian Air Force (IAF) were utilized for the Games. This included 36 automatic weather stations (including 11 Air Quality-cum-automatic weather stations) in Delhi and its neighbourhood, a GPS based RS/RW station and a Doppler weather Radar. 10 manual surface observatories of IMD and the IAF in Delhi and neighbourhood recorded hourly observations; and 5 upper air observatories took observations every 6 hours. The data of ten surface observatory stations in and around Delhi were utilized to provide the forecast.

1.5.2. Doppler Weather Radar

To provide real-time coverage of significant severe weather systems upto 500 km range, the Doppler weather radar installed at the Indira Gandhi International Airport, Delhi was utilized.

For tracking weather systems during CWG-2010 (venues were within 40 km range from radar), scanning strategy marginally differed from those typically used for general weather operations.

1.5.3. Upper Air Sounding System

The monitoring of the atmospheric stability helps in nowcasting the evolution of thunderstorms and precipitation. A GPS based Radio Sonde – Radio Wind (RS/RW) upper air sounding system was installed at Ayanagar. Four ascents were taken every day and the data analyzed for atmospheric instability. In addition, the RS/RW stations around Delhi - Patiala, Jaipur and Lucknow also provided the upper air observations every 6 hours.

1.5.4. Satellite observations

The Satellite division of IMD had customized satellite images for covering the CWG-10 region. The domain is fixed between Latitude 26.0°N to 31.0°N and Longitude 75.0°E to 80.0°E.

1.5.5. Development of Numerical Weather Prediction Systems

In addition to its current operational products and in order to provide the best possible guidance and support for the CWG 2010, IMD developed the following experimental numerical weather prediction (NWP) systems for the CWG 2010 Games: (i) Advance Regional Prediction System (ARPS) Model, (ii) high-resolution Weather Research and Forecasting – Variational data assimilation system (WRF-VAR) down to 3km horizontal grid-spacing, (iii) Nowcast system Delhi PP and (iv) Warning Decision Support System – Integrated Information (II generation) (WDSS-II) (based on Delhi Radar data).

Outputs from Global and regional models of IMD and NCMRWF were used to provide 5 days forecasts for Delhi. The existing computational facilities of IMD were used for running the NWP models.

1.5.6. Current Weather Information

Under this, a GIS based application with Google map as the background for Delhi and adjoining

region was developed to graphically display the venues and AWS locations.

1.5.7. Details of Weather Forecasts provided for the CWG 2010

- Nowcasts for Temperature, Humidity, wind speed & direction and weather conditions at all the competition Venues for next 3 and 6 hours—updated every three hours.
- Temperature, Humidity, wind speed & direction and weather conditions forecasts for all the competition venues for the Forenoon/afternoon timings of next two days – updated twice daily. Daily weather Forecasts for Maximum/Minimum Temperature, Maximum/Minimum Humidity, wind speed & direction and weather conditions at all the competition venues for next two days – updated twice daily forecast for important tourist places in Delhi for next one day – updated twice daily.
- Weather forecast for Delhi as a whole for next 5 days – updated twice daily.
- Weather forecast for different districts in the NCR of Delhi next one day – updated twice daily.

All these forecasts were provided to the Commonwealth Games Organizing Committee directly through email and to the general public through IMD website. In addition to these, weekly weather outlooks for Delhi were provided to the Cabinet Secretariat twice every week (every Tuesday and Friday) for planning purposes.

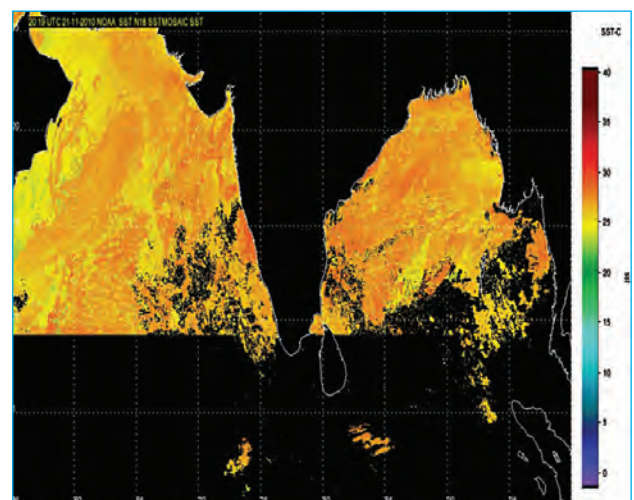
The commonwealth games organizing committee has appreciated the forecasts provided by IMD.

1.6. SATELLITE-METEOROLOGICAL SERVICES

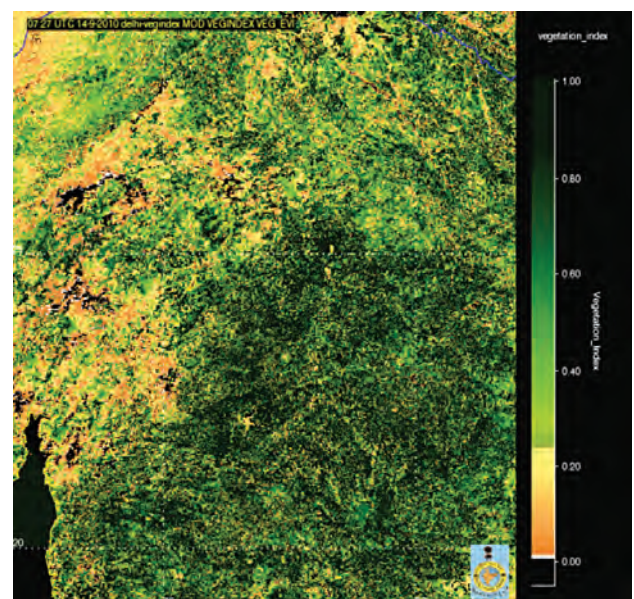
Satellite-Meteorology Division of IMD provides satellite images and products to the forecasters in improving weather forecasts. Its main functions

are receiving satellite meteorological data from INSAT satellites, its processing for generation of images in all channels and derivation of operational parameters for weather forecasting e.g. Cloud Top Temperature, Sea Surface Temperature, Atmospheric Motion Vectors, Outgoing Longwave Radiation etc. and their dissemination to the forecasters and various other users of the country. At present IMD is receiving and processing meteorological data from two Indian satellites namely Kalpana-1 and INSAT-3A.

Both Kalpana-1 and INSAT-3A have three channel Very High Resolution Radiometer (VHRR) for imaging the Earth in Visible (0.55-0.75 μm), Infra-



Sea Surface Temperature



Normalized Difference Vegetation Index (NDVI)

Red (10.5-12.5 μm) and Water vapour (5.7-7.1 μm) channels having resolution of 2 \times 2 kms in visible and 8 \times 8 kms in WV and IR channels. In addition the INSAT-3A has a three channel Charge Coupled Device payload for imaging the earth in Visible (0.62-0.69 μm), Near Infra Red (0.77-0.86 μm) and Short Wave Infra Red (1.55-1.77 μm) bands of Spectrum. The Resolution of CCD payload in all the three channels is 1 km \times 1 km. At present about 48 nos. of satellite images are taken daily from Kalpana-1 which is the main operational satellite and 9 images are taken from INSAT-3A. Imaging from CCD is done 5 times during daytime only. All the received data from the satellite is processed and archived in National Satellite Data Centre (NSDC), New Delhi.

During three Ground receiving and processing systems for NOAA/METOP and MODIS Polar orbiting satellites were installed at IMD New Delhi, RMC Chennai and at RMC Guwahati. Satellite Meteorological Geophysical products derived from these systems are useful in operational forecasting. The images of some of the products are given on pre-page.

1.7. CLIMATE MONITORING AND CLIMATE INFORMATION SERVICES

First meteorological observatory in India was established at Madras (now known as Chennai). Subsequently, observatory at Bombay (now known as Mumbai) in 1823 and Shimla in 1841 were established. With the gradual growth and expansion of observational network, varieties of data have been generated and accumulated in a span of many years. These data, initially kept in manuscript form are digitized and archived in the national data centre (NDC) at IMD Pune after its establishment in 1977. As on date more than 100 millions records are available in the archive and every year about 2.5 million records are added. Data collected at NDC are archived after following standard scrutiny and quality check. NDC of IMD supplies data for research and national building activities. IMD uses the data for preparation of Climate Normal as per

WMO guidelines and brings out state climate summary. The latest normal recently prepared is based on 1971-2000 period. An e-atlas of the cyclones and its track formed in the Indian Ocean was recently brought out. IMD also publishes a report entitled annual Disastrous Weather Events with maps. A long series of these publication help in identifying regions prone to a particular disastrous weather event.

1.7.1. Climatic information

Climatic information in form of seasonal prediction of summer monsoon rainfall was made available as early as in 1886. IMD has been issuing operational monsoon forecast regularly for the country since then. Present status of the seasonal prediction is as follows:

- SW Monsoon Season (June-September) rainfall for the country as a whole and four geographical regions (NW India, Central India, Northeast India and south Peninsula).
- July & August rainfall over country as a whole, date of monsoon onset over Kerala, 5-20 days of experimental forecast of OLR pattern over India, Winter (Jan - Mar) precipitation (issued in the end of December) over Northwest India, Northeast monsoon (October-December) rainfall over Southern Peninsula (issued in October).

1.7.2. Climate monitoring

National Climate Centre (NCC) at IMD Pune is functioning since 1995. India specific climate related activities like Climate Monitoring and Analysis, Climate Data Management, Climate Research and Climate Prediction (Seasonal Forecasts) are main functions of the centre. The centre prepares and publishes monthly, seasonal and annual climate diagnostic bulletins for Indian region regularly. NCC generates many climate data products for smaller spatial and temporal scales for the user community. These data products include high resolution daily gridded (1 $^{\circ}$ \times 1 $^{\circ}$) rainfall and temperature data over Indian region, district wise normal for various



Publication of National Climate Centre

surface parameters, marine climate summaries for Indian Ocean region etc. Some of publications of the NCC are shown below.

Monitoring of Agricultural drought conditions during Southwest and Northeast monsoons through Aridity Anomaly Maps is one of the important climate monitoring activities.

The major activities undertaken by NDC during the year 2010 are Climatological Data Rescue, Archival of Manual Weather charts into digital form and Installation of Climatological Data Management System (CLISYS). The main aim of the plan scheme, 'Climatological Data Rescue Scheme' is to digitize all available climatological data which are at present existing in paper form into easily accessible and presentable digital form. Under the plan scheme 'Archival of Manual Weather charts into digital form', IMD Pune has recently transferred about 4.5 lakhs of old analysed weather charts by digital photography

and uploaded on Network Array System (NAS) for access by remote user for research and reference purposes. During 2008-2009, the project was started and completed in March 2010. The charts are now available at URL <http://210.212.173.104> by registering with IMD.

In order to equip with large storage and network systems at NDC for a fast communication and better data management activities, a proposal under 'Modernization of IMD' has been evolved. CLISYS is being implemented at Pune as part of this 'Modernization of IMD' scheme. The installation of hardware and other peripherals is complete.

1.8. EARTHQUAKE MONITORING

India Meteorological Department (IMD), the nodal agency of Government of India for monitoring seismic activity in and around the country, has

rendered more than hundred eleven years of seismological service to the nation with the first seismological observatory of the country having been set up by the department at Kolkata in 1898. The operational task of the department is to quickly estimate the earthquake source parameters immediately on occurrence of an earthquake and disseminate the information to all the user agencies including the concerned State and Central Government agencies responsible for carrying out relief and rehabilitation measures. The information relating to under-sea earthquakes capable of generating tsunamis on the Indian coastal regions is also disseminated to concerned user agencies including the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad for issue of tsunami related messages and warnings. The earthquake information is transmitted to various user agencies including public information channels, press, media etc. using different modes of communication, such as SMS, fax, email, IVRS and also posted on IMD's Website.

Towards meeting the above objectives, IMD is maintaining a national network of seismological observatories consisting of 55 stations which includes 17-stations of the Real Time Seismic Monitoring Network (RTSMN) set up for early warning of tsunamis. IMD is also maintaining a 16-station, V-SAT based digital seismic telemetry system around National Capital Territory (NCT) of Delhi for close monitoring of seismic activity in the region.

Other major activities in Seismology include the National Seismological Network which is in successful operation and a total of 3524 earthquake events have been detected and located during the period January-November, 2010. The seismological data from all the network stations are being compiled, processed, analyzed and archived systematically at the National Seismological Database Centre (NSDC) on a regular basis. The Centre supplies earthquake data and seismicity reports of specific regions to insurance companies, industrial units, power houses, river valley projects etc. on payment

basis. Seismological data and earthquake related information are also supplied to various user agencies dealing with relief and rehabilitation measures, earthquake disaster mitigation and management related matters, seismic zoning, etc. Earthquake data is also being used by various scientific, academic and R&D institutions for research purposes.

Monthly National Seismological Bulletins containing the phase data and the processed information on source parameters of all earthquakes located by the Seismological Network of IMD are being prepared regularly. India is a permanent Member of the International Seismological Centre (ISC), UK. Seismological Bulletins of IMD are regularly supplied to International Seismological Centre (ISC), UK for incorporation in the ISC's Monthly Seismological Bulletins, which contain information on earthquakes occurring across the globe compiled using the data collected from global stations. Facilities for raster scanning, processing and vector digitization of old analog charts have been successfully established at Seismological Observatory, Kamla Nehru Ridge, Delhi under a plan scheme "Archival and digitization of seismic analog charts". The project is making good progress and so far more than 12,000 analog charts have been raster scanned and 20 scanned images vector digitized.

Towards further improvement of earthquake detection capabilities in the country, a project on "Optimum seismological network program" has been taken up. The project envisages deploying additional state-of-art seismic equipment in the existing/new observatories and integration of a few stations operated by other departments/agencies under MoES sponsored programs.

1.9 ENVIRONMENTAL MONITORING

1.9.1. Air Pollution

IMD set up a Background Air Pollution Monitoring Network (BAPMoN) programme in 1972 with the objective of documenting the long-term changes in composition of trace species of the atmosphere. The activity was brought under

Global Atmosphere Watch, (GAW) in 1989. The monitoring stations located at Allahabad, Jodhpur, Kodaikanal, Minicoy, Mohanbari, Nagpur, Port Blair, Pune, Srinagar and Vishakhapatnam continued to collect rain samples for chemical analyses and measurement of atmospheric turbidity. Wet precipitation samples, collected at GAW stations, are sent to Central Chemical laboratory at Pune where these are analysed for pH, conductivity, major cations (Ca, Mg, Na, K, NH₄) and major anions (SO₄, NO₃, Cl).

Atmospheric Turbidity Program: Atmospheric Turbidity which indicates the columnar aerosol load of the atmosphere is measured at:

- (i) 7 GAW stations (Allahabad, Jodhpur, Kodaikanal, Nagpur, Port-Blair, Srinagar & Pune) using Microtop-II multi-channel sunphotometer at 368, 500, 675, 778 & 1028 nm wavelength.
- (ii) Three GAW stations (Mohanbari, Minicoy, Visakhapatnam) using Volz's Sunphotometers at 500 nm wavelength.

These data from GAW stations provide reliable long-term observations of the chemical composition of the atmosphere and related parameters in order to improve our understanding of atmospheric chemistry leading to formulate environmental policy. Chemical composition of precipitation is useful in quantifying the level of pollution due to increasing anthropogenic activities.

1.9.2. Environmental Monitoring Unit

Environmental Monitoring Unit of IMD provides specific services to Ministry of Environment & Forests and other Govt. agencies in the assessment of air pollution impacts likely to arise from various types of Thermal Power Generation, Industries and

Mining activities. Atmospheric diffusion models developed for carrying out air quality impacts of multiple sources located in different climatic and geographical conditions are being utilized for siting of industries and adoption of air pollution control strategies.

The India Meteorological Department continued monitoring of meteorological parameters at Taj Mahal Agra to support air pollution abatement measures in the Taj Trapezium. The "Environmental Monitoring & Research" project aims at establishing a network of stations in India to generate on a long term basis primary data on GHGs and aerosols needed for Climate change studies and negotiations. Environmental Impact Assessment in respect of three hundred forty five (345) Thermal Power & Coal Mining, two hundred sixty three (263) Industrial and two hundred thirteen (213) Mining projects referred to this Department by the Ministry of Environment & Forests, New Delhi, was carried out. A consultative meeting on "Aerosol & Greenhouse gases Monitoring and Research" was also held on 6th December, 2010 at Mausam Bhawan, New Delhi.

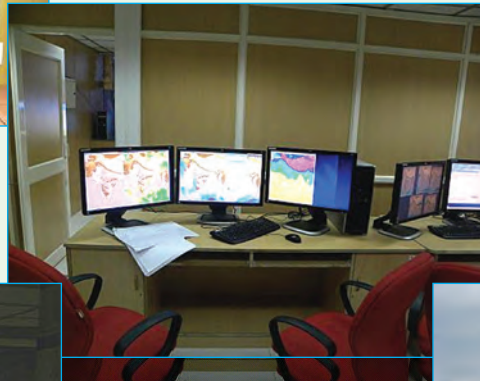
1.9.3. Ozone monitoring

The importance of Ozone as an environmental parameter stems from the fact that several industrial substances are considered to be destroyers of the natural ozone layer in the stratosphere, thus enabling higher dosages of Ultra violet radiation penetrating to the ground to the serious detriment of health factors. The global network of Total column ozone measurements has come up since late 1950s and India has been a pioneering country in this regard. The routine measurements have been carried out to monitor Total column Ozone, Vertical Ozone profiles and Surface Ozone.



2

DEPLOYMENT OF STATE-OF-THE-ART TECHNOLOGY



DEPLOYMENT OF STATE-OF-THE-ART TECHNOLOGY

2.1. MODERNIZATION OF IMD

A comprehensive upgradation of Observational and Forecasting infrastructure of IMD to enhance its capabilities in regard to meteorological services is in progress. Some of the activities that were taken up under ongoing programmes in the 1st Phase of upgradation are as follows:

- Installation of 550 Automatic Weather Stations (AWS) is in progress.
- Installation of 1350 Automatic Rain Gauges (ARGs) is in progress.
- Procurement of twelve Doppler Weather Radars is in progress.
- Development of indigenous Radiosonde for upper air observations has been initiated.
- Upper Air systems (10 stations).
- AMSS for Delhi HQ to serve as Regional Telecom Hub.
- Central Information and Processing system at IMD HQ.
- Synergie Forecasting Systems at 34 positions.
- CLISYS Climate Data Management System at Pune & IMD HQ.
- Public Weather Services Meteofactory at IMD HQ & RMCs Delhi & Kolkata.
- TV system at IMD HQ & TV station.

As on 15th Dec 2010, 400 AWSs and 356 ARGs

have been installed. It is planned to install at least one AWS and two Automatic Rain Gauge Stations in each district of India during Phase-I of the project. The ARG stations are also being setup on priority in flood prone river basins such as Brahmaputra, Ganga, Mahanadi, Tapi, Narmada, Godavari and Krishna. The data is available for users on the website: www.imdaws.com.

All 12 Doppler Weather Radars (DWR) have been received out of which two DWR have been commissioned at Hyderabad and Delhi. For the remaining DWRs buildings are at different stages of completion. Introduction of GPS radiosonde in the upper-air observation network at 10 places enabled to improve the data quality substantially and it has been acknowledged worldwide.

2.2. METEOROLOGICAL TELECOMMUNICATION NETWORK

The new Automatic Message Switching System 'TRANSMET' of RTH New Delhi was commissioned during the year. It is capable of exchanging 1 Tera Byte (1000 GB) of weather data and processed information every day. The system has easy browser based Graphical Interface for circuit configuration, circuit monitoring tool, data monitoring, audio-visual warning system for circuit failure and special message reception. The new RTH system has special features of data ingest and transmission through Email, SMS feature for warning messages, Fax transmission, file switching for files of different formats like satellite, RADAR, model etc. data file to predefined users, media file i.e., audio-visual files to RMC, MC etc through FTP, automatic conversion of the received SYNOP and Upper Air messages to BUFR and



New Automatic Message Switching System 'TRANSMET'



Three Screen 'Synergie' workstation at IMD HQ, New Delhi



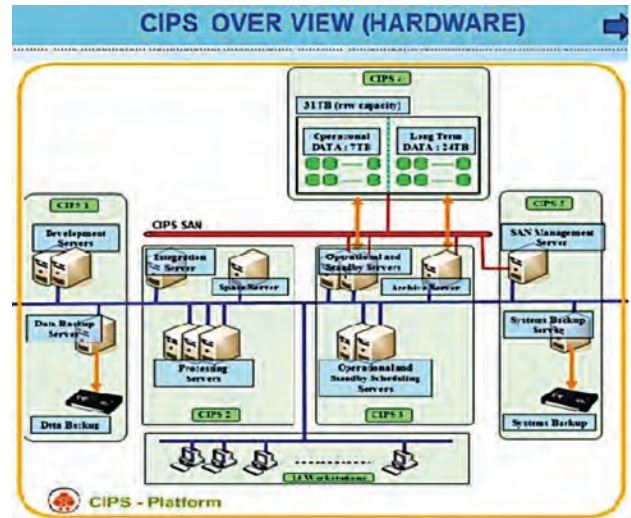
Public Weather Service System 'Meteofactory'

their transmission on GTS, message submission through web browser.

The new forecasting workstations "Synergie" have been installed at 34 location at different forecasting offices all over India. These have the capabilities to visualize multiple layers of observation and forecast overlaid on each other thus providing to the forecaster the capability to assimilate terabytes of information before issuing weather forecast.

A new Public Weather Service System called 'Meteofactory' is now operational at IMD HQ. New Delhi. It enables the forecaster to generate required customized presentation for the automatic delivery of products to the newspaper, TV, farmers, shipping etc.

A Central Information Processing System with a super-computer at the back-end was commissioned at IMD HQ in July 2010. Critical in the ongoing realization of the WMO Information System (WIS), Central Information and Processing System (CIPS) has given a paradigm shift in IMD's core activities from Observation Network Management towards integrated and connected Information Systems to provide effective services to the user community. It is equipped with latest state-of-the-art hardware and software to handle, manage, store, process and archive all data and products used operationally within IMD. It consists of 7 sub-systems comprising of data acquisition, data policy management, National Data Centre,



CIPS overview (Hardware)

Task Policy Management, Tasks Centre, Backup Policy Management and Backup. Working based on Linux Operating System, CIPS Data centre provide flexibility to ingest any kind of Meteorological data like satellite, radar etc. CIPS provide an in house task development platform for the programmers as per the need of users like forecasters, researchers etc. Two dedicated servers with modern development tools, scientific libraries, Scripting Languages and Compilers are available for the development jobs. Various products like colour composites, cropping, re-sampling, verifications etc. for satellite, NWP Models, Radars and Observations are running in CIPS for fulfilling the needs of forecasters at HQ and Regional levels like RMC's, MC's, MO's.

2.3. STRENGTHENING NETWORK OF SURFACE INSTRUMENTS

- Under the scheme "Upgradation of Standard Test Facility for Barometer and Thermometer", various calibration standards were procured and made operational, viz. Dead Weight Testers, Digital standard barometers (100 Nos), Thermoelectric Pyranometers (5 Nos) & Temperature Bath (2 Nos).
- Installation and commissioning of IAAMS at Chennai, Guwahati & Amritsar airports completed.

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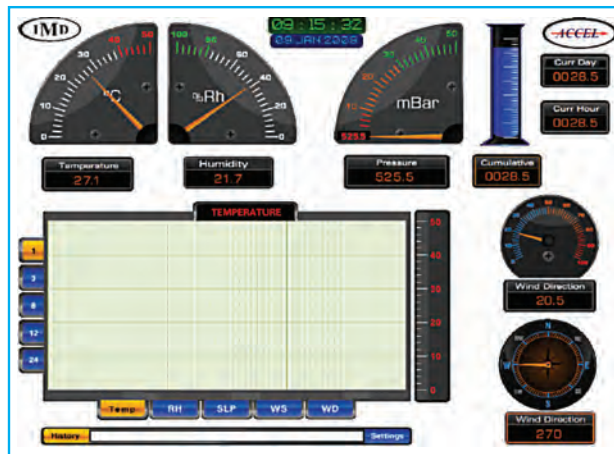
- Installation of additional transmissometers at New Delhi, Hyderabad, Bangalore, Jaipur and Lucknow airports.
- Drishti (Indigenous Transmissometer) installed and commissioned at Lucknow airport.
- Under the project "Commissioning of AWS Network/550 Nos." 200 AWSs have been installed in 2010 and progressive total of installation is 411.



Automatic Radiation Instrument

- Under the project "Commissioning of ARG Network- 1350 Nos." 188 ARGs have been installed in 2010 and progressive total of installation is 356.
- Supply of Digital Automatic Recording System for Antarctica.
- Installation of 4 DCWIS and 9 DDIWE at airports.

- QC software introduced for 125 PRBS type AWS.
- Automatic Radiation Station has been installed and commissioned at 45 stations.



- A state-of-the-art Digital Automatic Recording System (DARS) installed at M. C. Thiruvananthapuram on 07 February 2010 for the automatic measurement and recording of surface meteorological observations

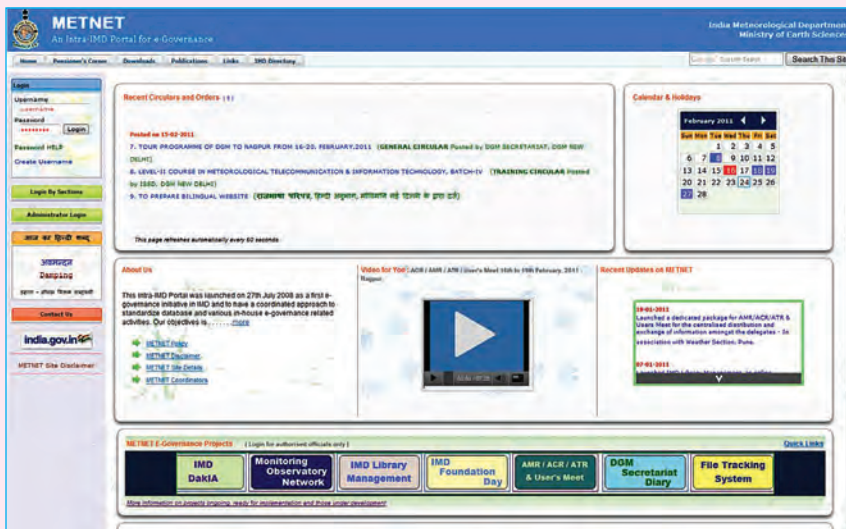
2.4. E-GRANTHALAYA

E-Granthalaya is a library automation software. This software has been installed at HQ Library (NMSDOC) by the National Informatics Centre (NIC) New Delhi. The software has the module for book with search through WebOPAC. Using this software the IMD library can automate in-house activities as well as user services. The software can be implemented either in stand-alone or in client-server mode where database and WebOPAC are installed on the server PC while the data entry program is installed on client PCs. The software provides LAN/Web based data entry solutions for a cluster of libraries where a common database can be created with Union Catalog output. The software provides Web OAPC interface to publish the library catalog over Internet/Intranet.



3

DIVISIONAL ACTIVITIES



DIVISIONAL ACTIVITIES

3.1. MARINE METEOROLOGY SERVICES

- The India Meteorological Department continued to maintain Voluntary Observing Fleet (IVOF), through six Port Met. Offices viz., Kolkata, Visakhapatnam, Chennai, Kochi, Goa and Mumbai. IVOF consists of ships of Merchant Navy, Indian Navy and Foreign ships. Meteorological Observations from the oceanic area are being collected on real time basis for operational forecasting. The ship weather logs are scrutinized in Marine Section and data is sent to Marine Climatological Section of the O/o ADGM(R) for archival.
- For Antarctica Expedition and Sagar Kanya Cruise, necessary training was given for recording and transmitting meteorological observations on High Seas. Data received from Sagar Kanya is scrutinized and sent to ADGM (R)'s office for archival.
- Excellent Award in the form of books and Certificate of Merit for meritorious meteorological work, were given to the ships' officers, who were involved in collecting routine as well as valuable Meteorological information from High Sea.
- IMD is also supporting various ongoing WMO programmes like Global Ocean Observing System (GOOS), Global Maritime Distress Safety System (GMDSS), Marine Pollution Emergency Responses Support System

(MPERSS) and Ships of Opportunity (SOT) etc.

- Meteorological observations are being recorded and transmitted by the Voluntary Observing Ships (VOS) on real time basis as well as in delayed mode.
- Lists of Selected, Supplementary and Auxiliary ships in XML (Extensible Markup Language) format were sent to WMO on a quarterly basis for inclusion in "WMO publication no. 47".

3.2. ANTARCTIC SCIENTIFIC PROGRAMME

IMD continues to operate its Meteorological Observatory at Maitri, Antarctica. Observational data and forecasts are regularly updated on IMD's website.

3.2.1. 29th InSEA

Two IMD team members of 29th InSEA S/Shri N. Chandrahas, Scientific Assistant from CWC Visakhapatnam (RMC Chennai) and Tushar V. Pawar, Scientific Assistant from AMO Mumbai (RMC Mumbai) have completed their one year expedition at Maitri and returned to India on 16th December 2010.

3.2.2. 30th InSEA

During this year IMD has selected two team members, namely S/Shri Shankar Prasad, Assistant Meteorologist Gr-II from DDGM(UI), New Delhi

and Ashok Khutwad, Scientific Assistant from DDGM (WF), Pune, for participating in the 30th Indian Scientific Expedition to Antarctica.

3.2.3. ORV Sagar Kanya Cruise No. SK277

S/Shri Gautam Roy Choudhury, SA from DDGM, RMC New Delhi and Brahum Paul, S.A. from MO Jammu were deputed onboard ship to participate in the Sagar Kanya Cruise No. SK277 under FDP cyclone from 22nd October 2010 to 18th November 2010. They have successfully completed collection of meteorological data in the region of Bay of Bengal.

3.3. POSITIONAL ASTRONOMY

Positional Astronomy Centre is the nodal office of the Govt. of India to generate data on Positional Astronomy and to publish the same in the form of annual publications viz. The Indian Astronomical Ephemeris. It has also assumed pivotal role in implementing the recommendations of two high power committees, one already mentioned earlier as Calendar Reform Committee and other one constituted later on and named as Peer Review Committee, through publication of Rashtriya Panchang in 14 languages. India is one of the 7 countries in the world having an ephemerides office like this centre and publishing the Indian Astronomical Ephemeris. As per mandate of the Government of India, the centre issues the following 16 publications annually.

- (i) The Indian Astronomical Ephemeris
- (ii) Tables of Sunrise, Sunset, Moonrise-Moonset
- (iii) Rashtriya Panchang in 14 languages namely- English, Hindi, Urdu, Sanskrit, Assamese, Bengali, Gujrati, Kannada, Malayalam, Marathi, Oriya, Punjabi, Tamil & Telegu.

As per mandate of the Government of India, the centre also fixes up dates of all India festivals

for all communities for declaration of holiday by Central & State Govt. The centre also acts as national agency for attending all matters concerning to calendars. This centre also provides five years advance accurate calendric data to many leading panchang makers of the country for preparation of their own Panchangs. This centre also takes observation on special astronomical events from time to time with the help of its portable telescopes at different places of the country.

The Indian Astronomical Ephemeris for the year 2011, an annual publication of Positional Astronomy Centre, which mainly contains positional data of the Sun, Moon and planets, basic data on yearly positions of fundamental stars, diary of celestial events, calendric data, eclipse data, explanatory text and other useful information on astronomy has been published in the month of September 2010. Fourteen language editions of Rashtriya Panchang of 1932 SE (2010-11 AD) and Sunrise-Sunset and Moonrise- Moonset tables for 2011 have been published during the year. These are important regular publications of the centre catering to daily need of users of almanac, Panchang makers and other users.

A pocket size calendar containing brief information on important celestial events during the year 2010 has been published for benefit of users. The centre has prepared monthly star charts and astronomical bulletins for 12 months during the year 2010 for giving useful guidance for watching celestial objects in the night sky. The bulletins contain brief texts explaining positions of objects in the sky and celestial diagrams showing positions for practical demonstrations.

3.4. WEATHER INFORMATION ON WEB

Two websites of IMD with URL <http://www.imd.gov.in> and <http://www.mausam.gov.in> are in operation. Both the websites contain static

and dynamic information. All observational data and products are uploaded. The new GIS based website <http://www.mausam.gov.in> was commissioned on 1st September 2010.

3.4.1. Intra-IMD Portal (METNET)

An e-governance Intra-IMD portal named METNET, completed two years on 27th July 2010. IMD Officials are accessing the site all over the country for numerous applications on office matters. All the development, implementation, management and routine updating of all the modules of METNET are done in-house. The METNET has brought all offices of IMD on a centralized and standardized e-governance platform (Table 3.1).

3.4.2. Weather Information Through Telephone

For public weather informations, Interactive Voice Response Systems (IVRSs), popularly known as

'Weather on Telephone' have been installed at 26 stations (mainly state capitals) throughout the country. One can access current weather and forecasts for major Indian cities by dialing a toll free number 1800 180 1717 or 1717.

3.5. PUBLICATION, LIBRARY & INFORMATION SERVICES

3.5.1. Research Journal "MAUSAM"

Publication Section at H.Q. publishes a departmental quarterly research journal "MAUSAM" since January 1950. It was originally called the "Indian Journal of Meteorology & Geophysics", then later called the "Indian Journal of Meteorology, Hydrology & Geophysics" and was finally named "MAUSAM" in 1979. MAUSAM is a renowned Indian Scientific Research Journal published in the field of Meteorology, Hydrology

Table 3.1

E-Governance Projects Implemented - 2010	
Biometric Attendance Record Updation	Biometric Attendance Records Updation is an application for uploading Biometric Attendance Records of the IMD Employees.
Pensioner's Corner	Pensioner's corner involves the details of registered retired users, their contact details, residential address, documents related to retirement and other useful links.
PROMAN Ver 2.0 (For Project Monitoring)	PROMAN Ver 2.0 is an online project monitoring Software.
MIMS Ver 1.0 (Met Instruments Monitoring System)	MIMS Ver 1.0 is an online met Instruments monitoring software.
APARNA Ver 1.0 (Annual Performance Appraisal Report Notation & Administration)	APARNA Ver 1.0 is an online package for Annual Performance Appraisal Report Notation and Administration.
IMD Monitoring Observatory Network	It is designed to monitor the reception of data from the different functional observatories of IMD on real-time.
METNET Instant Messenger	An Intra-IMD facility for IMD Officials to communicate and exchange documents among themselves related to the office matters.
IMD Centralized E-Administration Support System	This is an online e-Service Book application for management of personal records of the officials, generation of reports of all sorts of admin matters.
IMD DakIA	A Centralized Dak Inventory Application.
IMD AWAS	An Online Guest House Booking and Allotment System.

& Geophysics. The four issues appear in January, April, July & October every year. All the four quarterly issues of MAUSAM for the year 2010 have been brought out.

A Biennial Award Instituted by the Govt. of India in 1960, is aimed to encourage scientific research of high quality especially in the field of meteorology and allied subjects. So far, twenty

four distinguished contributions have been found worthy of this Award, now known as the Biennial MAUSAM Award. Presently, the award consists of a Citation and a sum of Rs.50,000/- (Rupees Fifty thousand only).

To encourage the use of Hindi language in writing scientific research paper on meteorology and allied subjects, another Biennial Award named



NMSDOC (H.Q. Library, New Delhi)

MAUSAM Shodh Puraskar was instituted by Govt. of India in 1993. Presently, the Award consists of a Citation and a sum of Rs.20,000/- (Rupees Twenty thousand only).

3.5.2. IMD NEWS and Annual Report

IMD has started publishing a quarterly Newsletter "IMD NEWS" highlighting the activities from January 2008 onwards. During 2010 all the four issues of quarterly newsletter "IMD News" have been brought out in time.

Annual Report is also being brought out by officers/staff of Publication Section of H.Q. New Delhi.

3.5.3. Library & Information Services

During this year 143 books in English, 136 in Hindi and other publications were added to the Library. 740 numbers of Journals were added to the Library. Reprographic services were provided

to 53 visitors. 518 journals were bound. Four Library Advisory Committee meetings were held during this year. 50 Foreign Journals and 25 Indian Journals were subscribed during the year. 2670 visitors visited the Library.

3.5.4. Library Facilities at Pune

The library at IMD Pune is one of the two main libraries of the IMD. It houses as many as 13,000 books, 38,000 bound serials and 5000 pamphlets, many of them are rare and of historical value. The library caters to the needs of employees of the department and also extends reference/reprographic services to researchers from other Govt. agencies like Central Water & Power Research Station, Pune, IITM scientists, research scholars and students etc. This library procures WMO publications directly from WMO, Geneva Switzerland as per standing order and distributes them to meteorological offices located in various parts of country and Air H.Q. Significant numbers

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of journals (Foreign and Indian) are subscribed by this library. Some journals (Foreign and Indian) are received on exchange basis.

The Library also treasures very old departmental publications/data like Meteorological Register kept at the East India Company's Observatory

at Madras dated back to 1822, Memoirs of IMD Vol. 1, (1876) to Vol. XXXII, IDWR from 1878 till date. Meteorological Monographs series, Climatology, Hydrology, Agro-meteorology, Synoptic Meteorology, Satellite Meteorology, Scientific Notes, Technical Notes, PPSRs etc.



WEATHER MONITORING

4.1. WINTER SEASON (JF)

Cold Wave Conditions

Cold wave conditions prevailed over the northern, northwestern, northeastern and central parts of the country on most of the days during January. Similar conditions also prevailed over the parts of peninsular India during the last week of January. However, temperatures were above normal over the northern/northeastern hilly regions during the month. During February, minimum temperatures were above normal by about 5 °C over some northern, northwestern and west-central parts of the country on some occasions during the first

ten days of the month and by about 1 to 3°C during rest of the month.

Rainfall Features

During the season, out of 36 meteorological subdivisions, 8 received excess rainfall, 4 received normal rainfall, 8 received deficient rainfall and remaining 16 sub-divisions received scanty rainfall (Fig. 4.1).

Rainfall activity over the country as a whole was subdued during the season. However, Jammu & Kashmir and many sub-divisions of peninsular India received excess/normal rainfall.

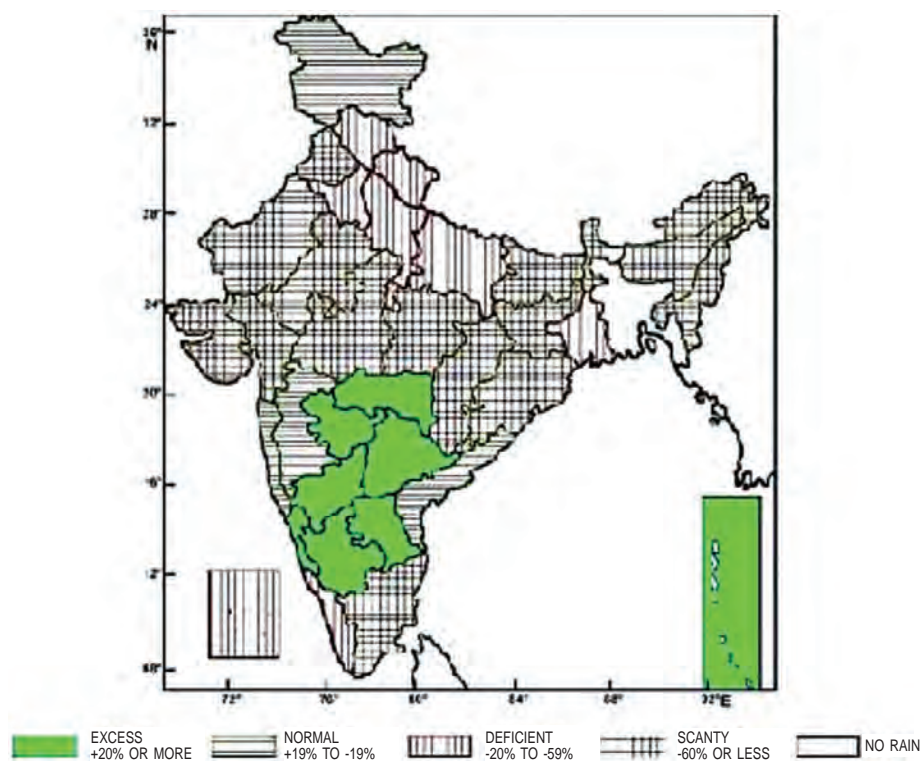
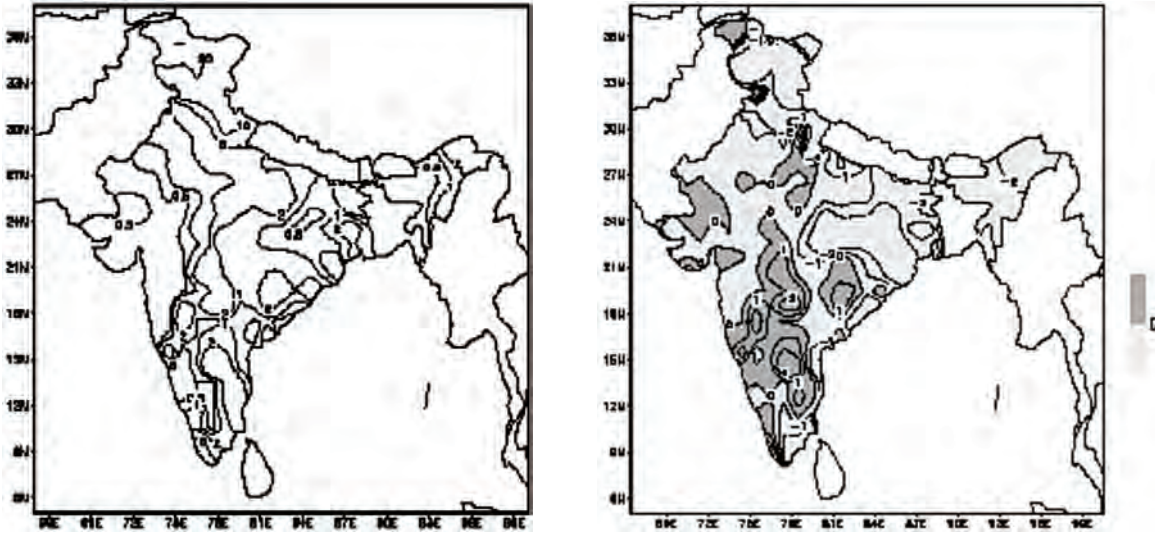


Fig. 4.1. Sub-divisionwise rainfall percentage departures for the winter season 2010

Fig. 4.2(a) shows the spatial pattern of rainfall (cm) received during the season. Parts of peninsula and eastern/northeastern region of the country received more than 2 cm of rainfall. Extreme northern parts of the country and extreme south peninsula received more than 5 cm of rainfall. Rainfall received by parts of Uttaranchal, Himachal Pradesh and Jammu & Kashmir was of the order of 10 to 20 cm.

Fig. 4.2(b) shows the spatial pattern of rainfall anomaly (cm) during the season. Rainfall anomalies were negative over most parts of the country, except over



Figs. 4.2(a&b). (a) Seasonal Rainfall (cm) (Interval : 0.5, 1, 2, 5,10, 20) and (b) Seasonal Rainfall Anomaly (cm) (Interval : -5, -2,-1, 0,1, 2) (Based on 1951-2000 Normals)

parts of peninsula and some western and northern region. Negative rainfall anomaly exceeded the normal by 2 cm over many parts of northeastern region and southern parts of Tamil Nadu and by 5 cm over parts of Jammu & Kashmir and Himachal Pradesh. Positive rainfall anomalies exceeded the normal by 1 to 2 cm over parts of Vidarbha, Marathwada, Telangana, Rayalaseema and northern parts of Karnataka. For the winter season 2010, rainfall for the country as a whole was 56% of its Long Period Average (LPA) value.

Pressure & Wind

Fig. 4.3 shows the mean sea level pressure anomalies. The pressure anomalies were positive almost throughout the country except some part of extreme northeastern region. The positive pressure anomalies exceeded the normal by 1 hPa over some central and northern/northeastern parts of the country.

Anomalous Cyclonic Circulation

At 850 hPa level, an anomalous cyclonic circulation over the northwest Bay of Bengal and another one over the east central Arabian Sea were observed. At 500 hPa level, an anomalous eastwest trough over the central parts of the country, extending from the centre of the circulation over the east central Arabian Sea, was

observed. This anomalous trough extended upto 200 hPa level also.

Outgoing Longwave Radiation (OLR)

OLR anomalies were negative over most parts of peninsula and adjoining Arabian sea and Bay of Bengal and some parts of Jammu & Kashmir. The negative OLR anomalies exceeded 10 W/m² over central parts of peninsula and adjoining eastcentral Arabian Sea. Fig. 4.4.

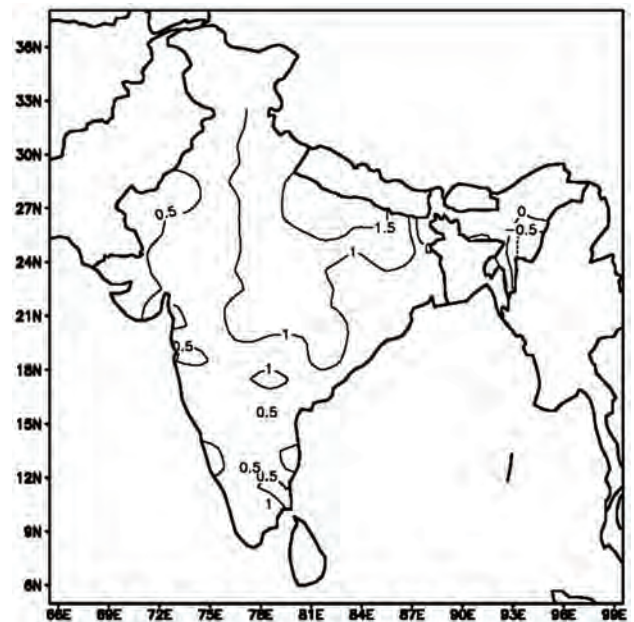


Fig. 4.3. Seasonal (Jan-Feb) pressure anomaly based on (1971-2000)

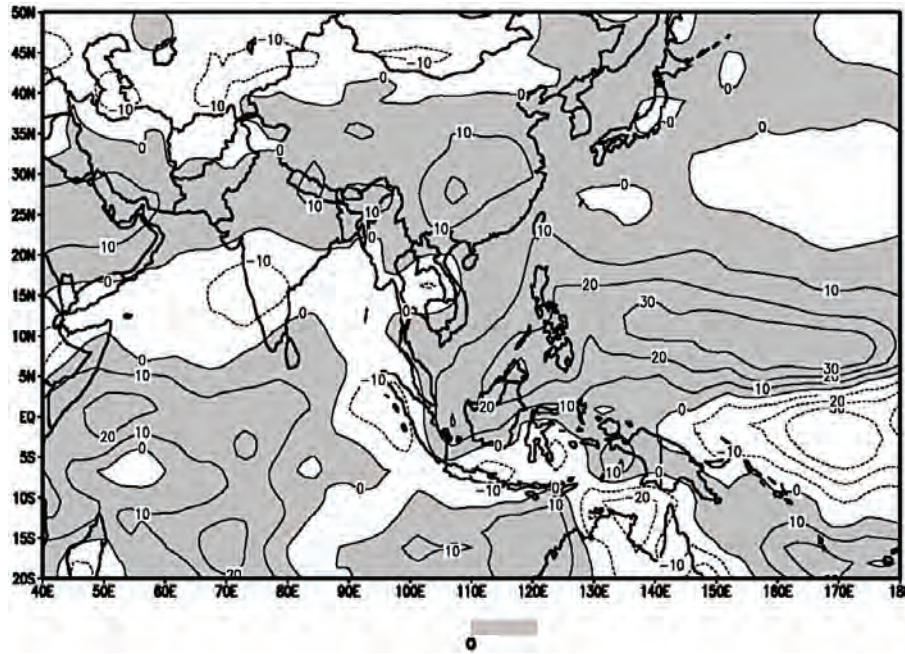


Fig. 4.4. OLR Anomalies (W/m^2) for Winter Season 2010 (Anomaly is based on 1968-96 climatology)

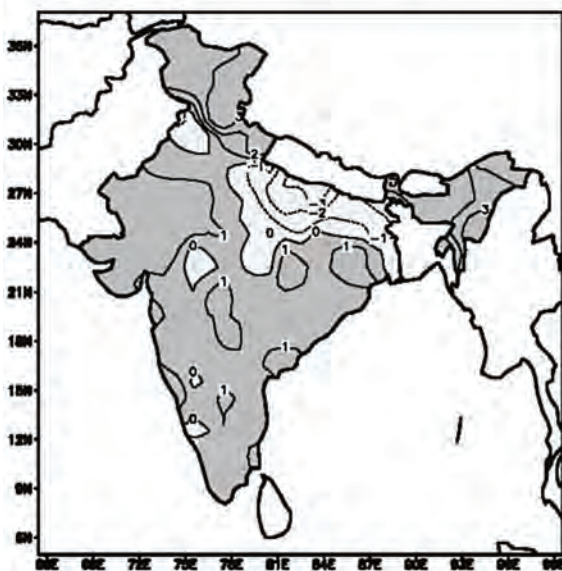
Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 4.5 (a&b). Maximum temperatures were below normal over most parts of Gangetic plains and some parts of Punjab, and were above normal elsewhere. Over the Gangetic plains, maximum temperatures were below normal by 1 to 3°C. These were above normal by nearly 1°C over the

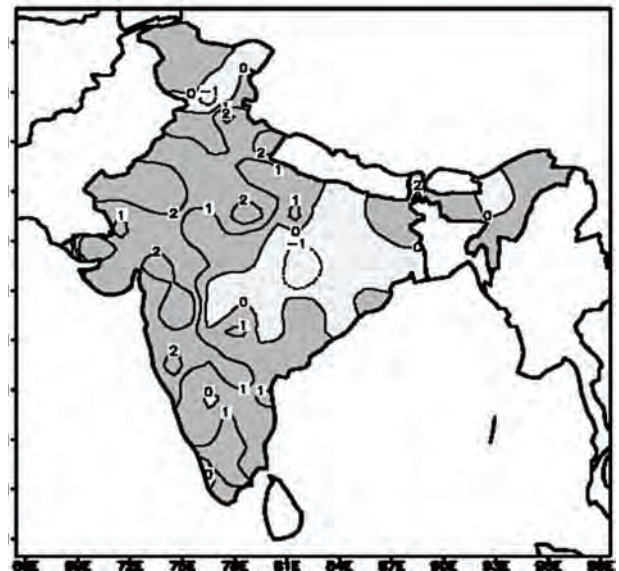
west central region and some parts of peninsula and by 2 to 3°C over extreme northern and northeastern region.

Minimum temperatures were above normal over many parts of the country except over the eastern and adjoining central region and some parts of extreme northern and northeastern region. Over most of the western parts of the country and some adjoining northern parts, the maximum

(a) MAXIMUM TEMPERATURE ANOMALY



(b) MINIMUM TEMPERATURE ANOMALY



Figs. 4.5(a&b). Mean seasonal temperature anomalies ($^{\circ}C$) (Based on 1971 - 2000 normals)

temperatures were above normal by 1 to 2°C. Over parts of Chattisgarh these were below normal by 1°C.

Low Pressure Systems

During the season, no low pressure system formed over the Indian seas.

4.2. PRE-MONSOON SEASON (MAM)

Heat Wave Conditions

Pre-monsoon season 2010 was the warmest pre-monsoon season since 1901. March and April months this year were the warmest since 1901, while May was the second warmest.

Severe heat wave/heat wave conditions prevailed over northern, northwestern and central parts of the country almost throughout the season from second fortnight of March to the end of May. Both maximum and minimum temperatures were above normal by over 5°C on many days over the northern half of the country during March and April. Some stations of these regions even reported record highest maximum temperature for the respective months during the season.

Severe heat wave/heat wave conditions also prevailed over the peninsular parts of the country during 2nd and last week of both April and May months and also over the northeastern parts of the country on some occasions during the second and third week of May.

Rainfall Features

During the season, out of 36 meteorological subdivisions, 4 received excess rainfall, 11 received normal rainfall, 8 received deficient rainfall and 12 received scanty rainfall. One subdivision (Gujarat Region) did not receive any rain (Fig. 4.6).

Meteorological sub-divisions of entire central and northwestern/northern parts of the country received deficient/scanty rainfall. However, some subdivisions of south peninsula and eastern/northeastern region received excess/normal rainfall. Coastal Andhra Pradesh received more than twice of its normal rainfall.

Figs. 4.7(a&b) show the spatial pattern of rainfall received during the season and its anomaly (cm) respectively. Rainfall activity was confined to south peninsula, eastern/northeastern region and extreme northern parts of the country. Rainfall

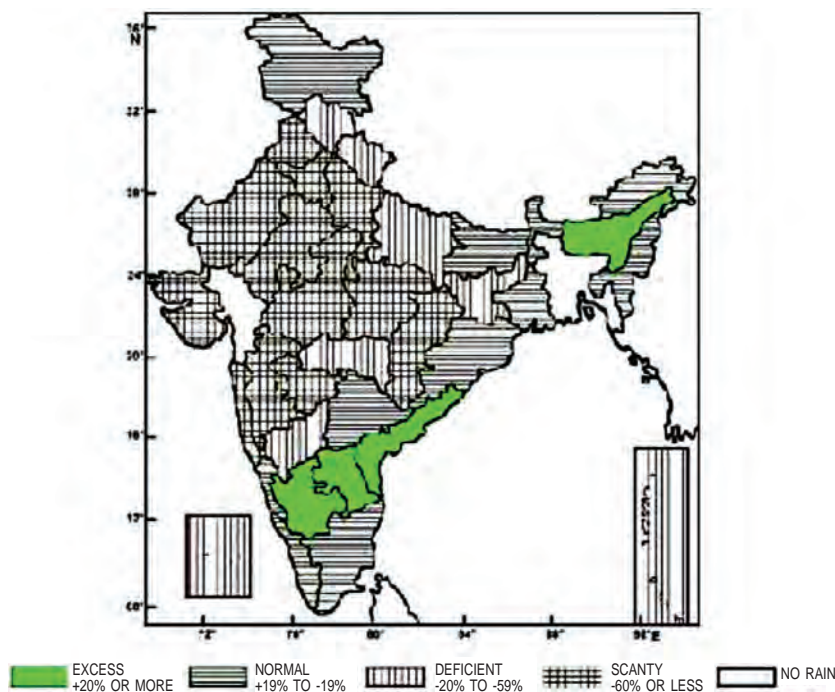
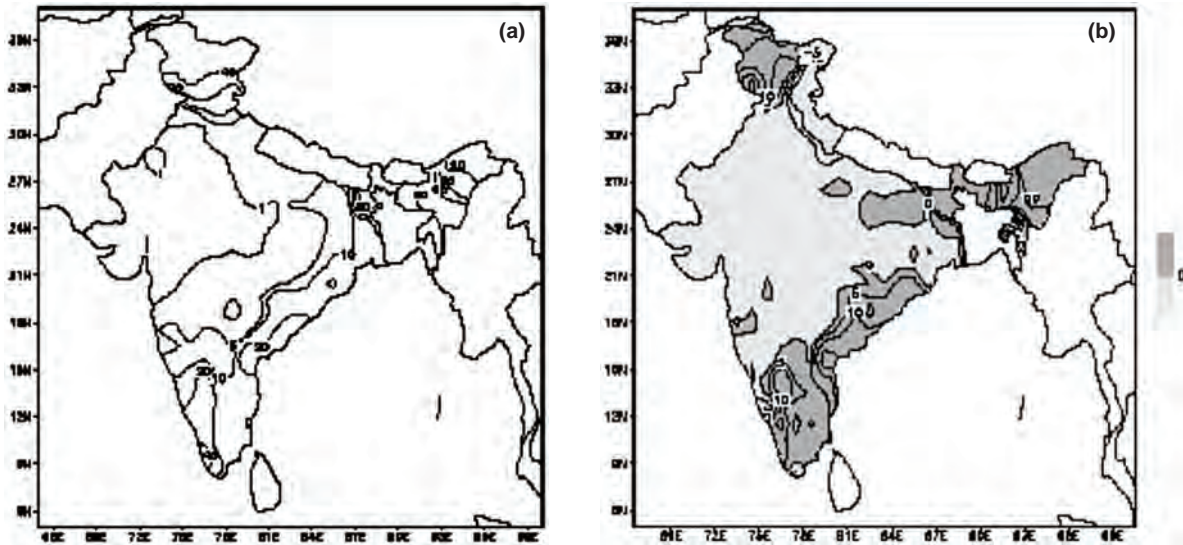


Fig. 4.6. Sub-divisionwise rainfall percentage departures for the pre-monsoon season 2010



Figs. 4.7(a&b). (a) Seasonal rainfall (cm) (Interval : 1, 5, 10, 20, 40, 60, 80, 120)
 (b). Seasonal rainfall anomaly (cm) (Interval : -10, -5, 0, 5, 10, 20) (Based on 1951-2000 normals)

over these regions generally exceeded 10 to 20 cm. Northern parts of Jammu & Kashmir and extreme northeastern region of the country received more than 40 cm of rainfall. Rainfall over parts of Sub-Himalayan West Bengal & Sikkim, Arunachal Pradesh and Assam & Meghalaya exceeded 80 cm.

Rainfall anomaly was positive over the south peninsula, eastern/northeastern region of the country and parts of Jammu & Kashmir, and was negative elsewhere. Over parts of Coastal Andhra Pradesh, South Interior Karnataka, Jammu & Kashmir and extreme northeastern region, the positive rainfall anomaly exceeded 10 cm. Rainfall deficiency over parts of Uttaranchal, Himachal Pradesh and eastern parts of Jammu & Kashmir exceeded 10 cm.

Pressure & Wind

The pressure anomalies were negative over most parts of the country except some parts of south peninsula and extreme northeastern region. The negative pressure anomalies increased northwards from 0.5 hPa over central parts of the country to more than 1.5 hPa over northwestern parts of the country (Fig. 4.8).

Anomalous Circulation

At 850 hPa level, anomalous anticyclonic circulations over the northern/northwestern region,

central parts of the country and Bay of Bengal were observed. The anomalous anticyclonic circulations over the northern/northwestern parts of the country and Bay of Bengal extended even upto 200 hPa level.

Outgoing Longwave Radiation (OLR)

OLR anomaly (W/m^2) over the Indian region and neighborhoods is shown in Fig. 4.9. OLR anomalies were negative over the peninsula,

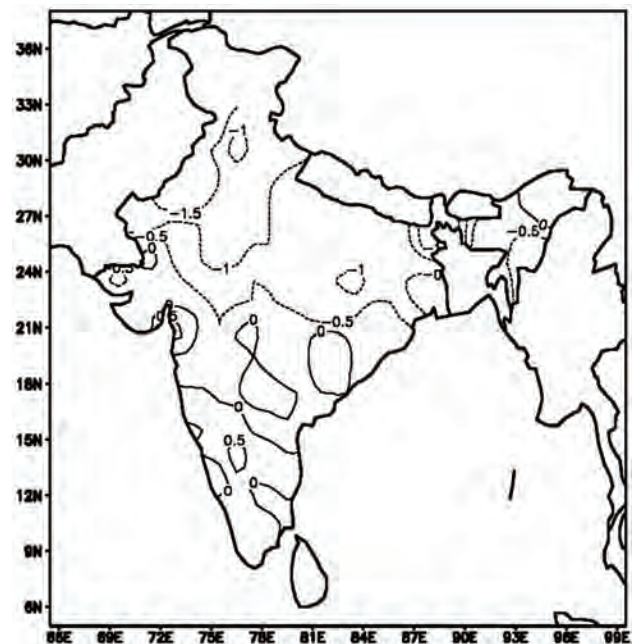


Fig. 4.8. Seasonal mean sea level pressure anomaly (hPa) (Based on 1971-2000 normal)

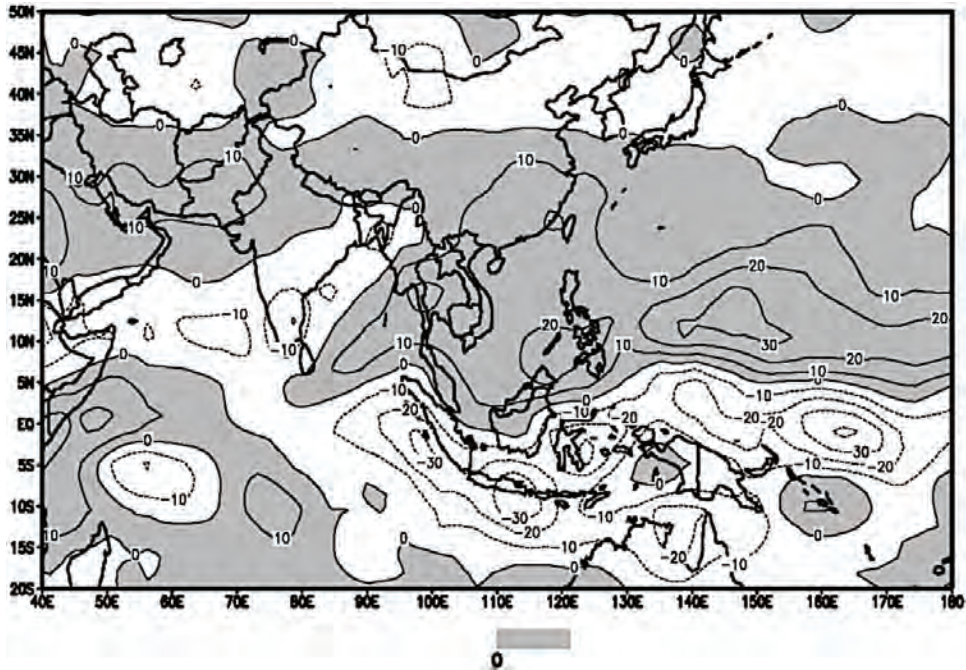


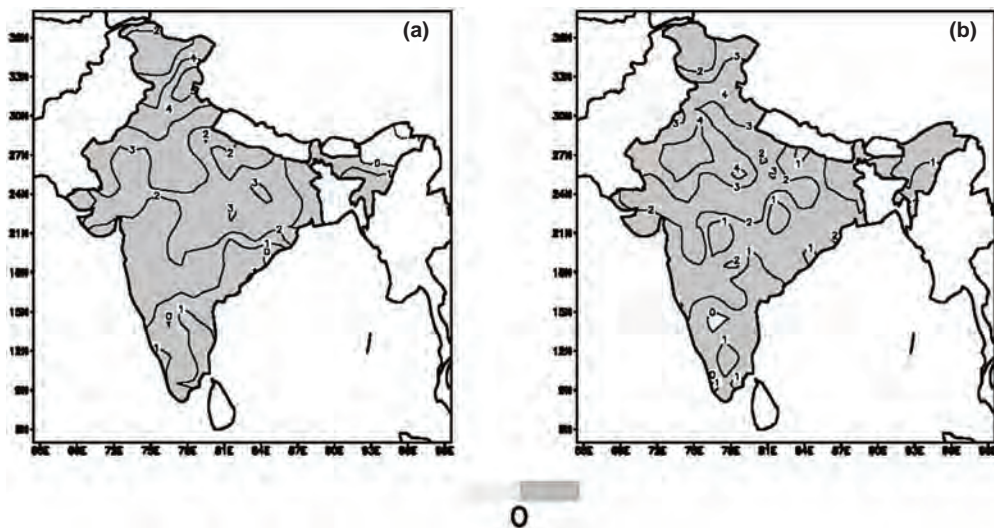
Fig. 4.9. OLR anomalies (W/m^2) for pre-monsoon season 2010 (Source : CDC/NOAA, USA)

eastern/northeastern parts of the country, central/south Arabian sea and western parts of Bay of Bengal, and were positive elsewhere. Over extreme south peninsula and part of south Arabian Sea, the negative OLR anomalies exceeded $10 W/m^2$.

Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 4.10 (a&b) respectively. Maximum temperatures were

above normal almost throughout the country except some parts of extreme northeastern region. These were above normal by about 1 to 2 °C over peninsula and some northeastern region, by about 2 to 4°C over central/western and extreme northern region and by more than 4 to 5°C over some northern/northwestern parts of the country viz. northern parts of Rajasthan, parts of Punjab, Haryana, Chandigarh & Delhi, Himachal Pradesh, Uttaranchal and Jammu & Kashmir. Minimum temperatures were above normal throughout the country. These were above normal by about



Figs. 4.10(a&b). Mean seasonal temperature anomalies (°C) (a) maximum (b) minimum (Based on 1971-2000 Normals)

1 to 2°C over peninsula and eastern/northeastern region, by about 2 to 4°C over northwestern and adjoining central/northern region of the country and by more than 4°C over central parts of Rajasthan.

Low Pressure Systems

During the season, a severe cyclonic storm (Laila) formed over the Bay of Bengal in the month of May. Apart from this cyclonic storm, a short-lived low pressure area also formed over the southwest Arabian Sea during May.

4.3. MONSOON SEASON (JJAS)

IMD issued weather forecasts and also precautionary warnings for hazardous weather like cyclonic storms, heavy rainfall, squalls etc. for the entire country so as to save human life, livelihood and property. Weather Central, Pune and Northern Hemispheric Analysis Centre, New Delhi are the two main forecasting Centres of the Department besides six Regional Meteorological Centres and Meteorological Centres at State headquarters. The weather reports were disseminated through media, passed on to all relevant Government agencies, hoisted on the Web and published in the Indian Daily Weather Report. Experiencing the normal variability of weather, the year 2010 did not witness any remarkable heat and cold wave or unexpectedly heavy rainfall except for a few cases of extreme weather which were successfully foreshadowed.

Monsoon monitoring

For the country as a whole, the rainfall for the season (June-September) was 102% of its long period average (LPA) of 89 cm. Seasonal rainfall was 112% of its LPA over Northwest India, 104% of its LPA over Central India, 118% of its LPA over south Peninsula and 82% of its LPA over Northeast (NE) India. Monthly rainfall over the country as a whole was 84% of LPA in June, 103% of LPA in July, 106% of LPA in August and 113% of LPA in September.

Out of 597 meteorological districts for which data are available, 173 districts (29%) received excess, 240 districts (40%) received normal, 173 districts (29%) received deficient and the remaining 11 districts (2%) received scanty rainfall during the season.

Southwest monsoon current advanced over the Andaman Sea on 17th May. The monsoon set in over Kerala on 31st May, one day earlier than its normal date of 1st June and covered the entire country by 6th July, 9 days earlier than its normal date of 15th July. The withdrawal of monsoon was delayed and it commenced from west Rajasthan only on 27th September compared to its normal date of 1st September.

Though there were two intense systems viz., the Severe Cyclonic Storm (LAILA, 16th - 21st May) over the Bay of Bengal and the Very Severe Cyclonic Storm (PHET, 31st May - 2nd June) over the Arabian Sea during the advance phase, the entire monsoon season was devoid of any monsoon depressions. Thus, 2010 has been the only year in the recorded history after 2002, to have no depressions during the entire season.

The forecast for monsoon onset over Kerala has been correct for the sixth consecutive year since its first issuance in 2005. Most of the operational long range forecasts issued for the 2010 southwest monsoon rainfall have been correct. The rainfall forecast for the country as a whole for the entire season, second half of the season and for the months of July, August & September have been accurate.

Onset of Southwest Monsoon

Southwest monsoon set in over Andaman Sea on 17th May, 3 days prior to normal date in association with a severe cyclonic storm (LAILA, 16th - 21st May 2010) over the Bay of Bengal. The southwest monsoon further advanced over parts of Comorin area and some more parts of Bay of Bengal on 21st May and thereafter there was a hiatus in the monsoon advance lasting for more than a week. However, monsoon set in over Kerala on 31st May, just one day before its normal onset date (1st June). The advance of

monsoon over northeastern parts of the country was earlier than normal date. But monsoon advance over most parts of Bihar and Jharkhand, interior Orissa, Chhattisgarh was delayed by 2-3 weeks than the normal.

Subsequent to the onset over Kerala, a very severe cyclonic storm (PHET, 31st May - 2nd June) formed over the Arabian Sea and it delayed further advancement of the monsoon across west coast by about one week. Around 6th June, monsoon got activated and by middle of June, it covered nearly half of the country. A prolonged hiatus was observed in the further advance till 30th June, due to weakening of monsoon current and prevalence of non-conducive conditions for the

formation of low pressure systems over the Bay of Bengal. As a result, over most parts of central and north India including Madhya Pradesh and Uttar Pradesh, monsoon advance was delayed by 2-3 weeks and 1-2 weeks respectively.

Associated with the formation of a low pressure area over the North Bay of Bengal and neighbourhood on 2nd July and its subsequent west-northwestward movement, the monsoon current advanced over most parts of the country, outside parts of west Rajasthan by 5th July itself. The southwest monsoon covered the entire country by 6th July, about 9 days earlier than its normal date of 15th July. The isochrones of advance of Southwest Monsoon-2010 is depicted in Fig. 4.11.

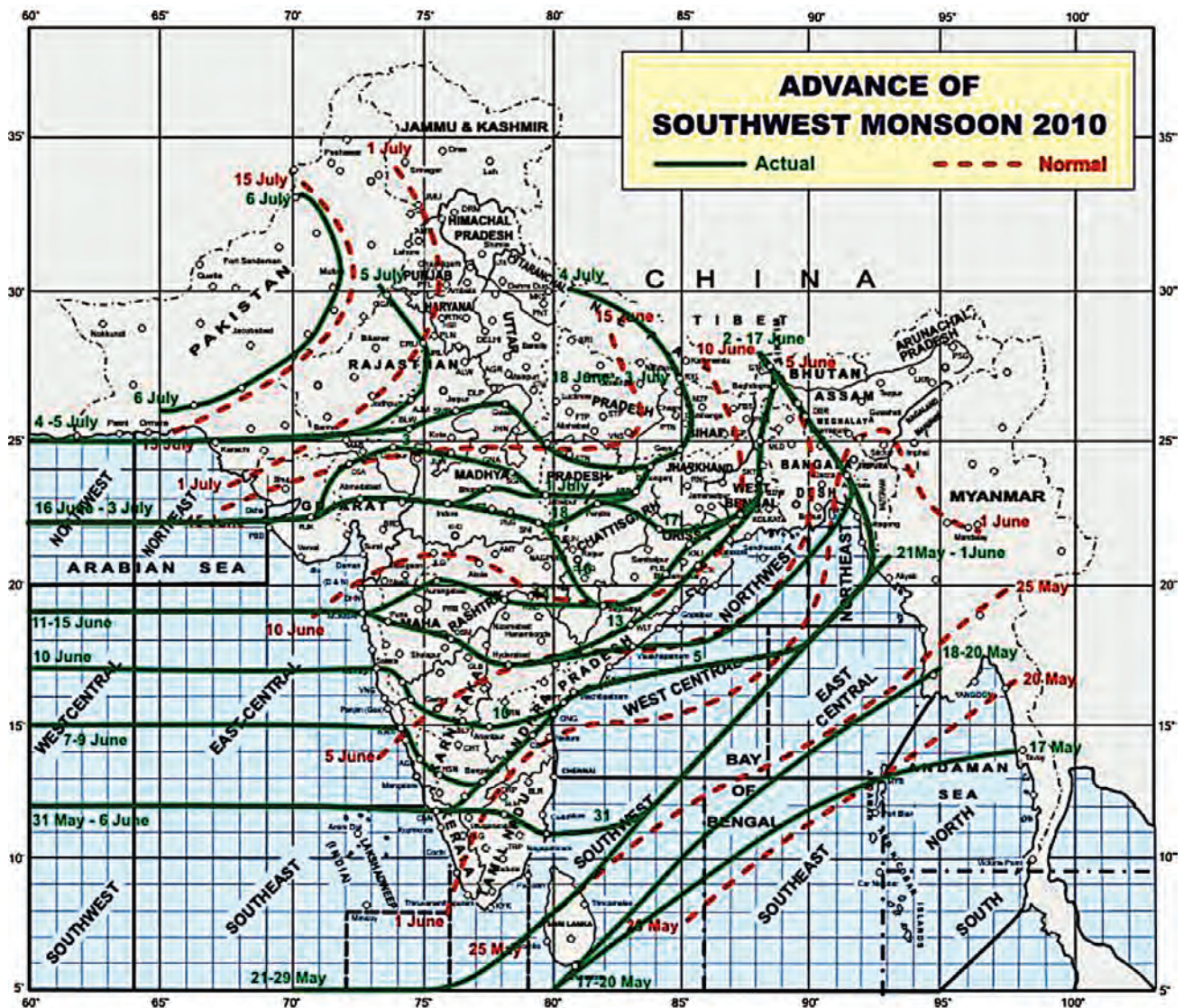


Fig. 4.11. Progress of Southwest Monsoon – 2010

Chief synoptic features

Weak cross equatorial flow prevailed during most parts of June and in the first fortnight of July. Though the monsoon trough, displayed rapid north-south oscillations, there had been active periods often in association with the low pressure areas and remnant cyclonic circulations embedded with the monsoon trough extending upto mid-tropospheric levels, and tilting southward with height.

Though there had been spells of subdued rainfall activity all through the season in different spatial and temporal scales, there was no all India break monsoon condition during this year.

Normally 4-6 monsoon depressions form per season (June - September). However, no depression formed over Indian monsoon region during this monsoon season.

Two low pressure areas formed over the northwest Bay of Bengal and neighbourhood in the month of June. One low pressure area (9th - 13th June) dissipated in-situ and the other low pressure area (24th - 26th June) was short lived and dissipated over Gangetic West Bengal and neighbourhood. Because of its very short trajectory, it could not revive the monsoon current which resulted in the prolonged hiatus during 19th - 30th June in further advance of southwest monsoon over the country, but it contributed to the active monsoon conditions over Orissa with very heavy rainfall.

Out of four low pressure areas that formed in the month of July over the Bay of Bengal, two low pressure areas formed during the first week and the other two in the last week of July. The first low pressure area (2nd - 6th July) formed over northwest Bay of Bengal became well marked, moved west-northwestwards across Orissa, Chhattisgarh and Madhya Pradesh and merged with the monsoon trough. This system was responsible for strengthening of monsoon current and rapid advance of the monsoon in the country. The second low pressure area (6th - 9th July) formed over northwest and adjoining west central Bay of Bengal off south Orissa & north Andhra coast, moved west-northwestwards and dissipated over north Madhya Pradesh and neighbourhood. These two systems gave good

rainfall over central India and Andhra Pradesh. The third low pressure area (24th - 27th July) formed over northwest Bay of Bengal, moved west-northwestwards along the monsoon trough and dissipated over south Rajasthan and adjoining Gujarat State. The fourth low pressure area (28th July - 2nd August) developed over northwest Bay of Bengal, moved west-northwestwards across south Orissa, Chhattisgarh and dissipated over Rajasthan on 3rd August.

The month of August also witnessed formation of four low pressure areas over the Bay of Bengal. The first low pressure area (4th - 9th August) formed over northwest Bay of Bengal off Orissa coast and moved west-northwestwards across Orissa, Chhattisgarh and Madhya Pradesh and dissipated over Rajasthan. After the dissipation of this low pressure area, the monsoon trough shifted to north and monsoon activity remained subdued over major parts of the country outside northwest and western parts. The second low pressure area (12th - 14th August) formed over northwest and adjoining west central Bay of Bengal off south Orissa - north Andhra coast and dissipated over south Chhattisgarh and east Madhya Pradesh. After the dissipation of this low pressure area, the monsoon flow pattern in general resembled weak condition. With the formation of two more low pressure areas, one over west central Bay off Andhra coast during 23rd - 27th August and another over northwest Bay of Bengal during 30th - 31st August and their subsequent west-northwestward movement, active to vigorous monsoon conditions prevailed over major parts of south peninsula and central India in the last week of August.

Four low pressure areas formed in the month of September. Two formed over west central Bay of Bengal off north Andhra-south Orissa coast. One of these two (3rd - 6th September) weakened over Orissa and neighbourhood and second (17th - 20th September) weakened over north Madhya Pradesh. The third low pressure area (8th - 13th September) formed over Vidarbha and neighbourhood and weakened over northeast Rajasthan and adjoining Haryana. The fourth low pressure area formed over the southeast Arabian Sea on 29th and lay over the southeast and adjoining east central Arabian Sea on 30th September.

Considering season as a whole, 14 low pressure areas formed during the season including 13 over the Bay of Bengal and one over the Arabian Sea. Most of the low pressure areas formed over relatively southerly latitudes (over northwest and adjoining west central Bay) and moved west-northwestwards along the monsoon trough upto Rajasthan leading to a good rainfall activity over Central and Peninsular India. On the other hand, it caused deficient rainfall over many parts of east and northeast India including north Orissa, Gangetic West Bengal, Jharkhand, Bihar, east Uttar Pradesh and Assam & Meghalaya. The remnant of some of the low pressure areas interacted with the mid-latitude westerly systems and caused excess rainfall over northwest India. Frequent development of these lows in regular intervals led to frequent oscillation of monsoon trough and hence absence of prolonged all India weak monsoon conditions during this season. The year 2010 has been a normal year.

Withdrawal of southwest monsoon

The withdrawal started from west Rajasthan on 27th September with a delay of nearly 4 weeks as the normal date of withdrawal from extreme western parts of Rajasthan is 1st September. Subsequently, it withdrew from the entire northwest India and some parts of west Uttar Pradesh, west Madhya Pradesh and Gujarat State on 28th September and from most parts of Uttar Pradesh, some more parts of Madhya Pradesh and some parts of Bihar on 1st October.

Rainfall Distribution

The rainfall during monsoon season (June to September) for the country as a whole and the four broad geographical regions are as follows:

The seasonal rainfall is classified as normal when the actual rainfall is within $LPA \pm CV$. The CV for seasonal rainfall over various regions is given in the Table 4.1. Similarly, seasonal rainfall is classified as deficient when the actual rainfall is less than $(LPA - CV)$ and as excess when the actual rainfall is more than $(LPA + CV)$. Considering the above criteria, the monsoon seasonal rainfall over the country as a whole has been normal during 2010 (102% of LPA). Similarly, the seasonal rainfall has been normal over northwest and central India, excess over the Peninsular India and deficient over the northeast India.

The cumulative seasonal rainfall from 1st June to 30 September 2010 was excess in 14 meteorological sub-divisions (43% of the total area of the country) and normal in 17 meteorological sub-divisions (42% of the total area of the country) Five sub-divisions (East U.P., Bihar, Jharkhand, Gangetic W. B. and Assam & Meghalaya) constituting 15% of the country.

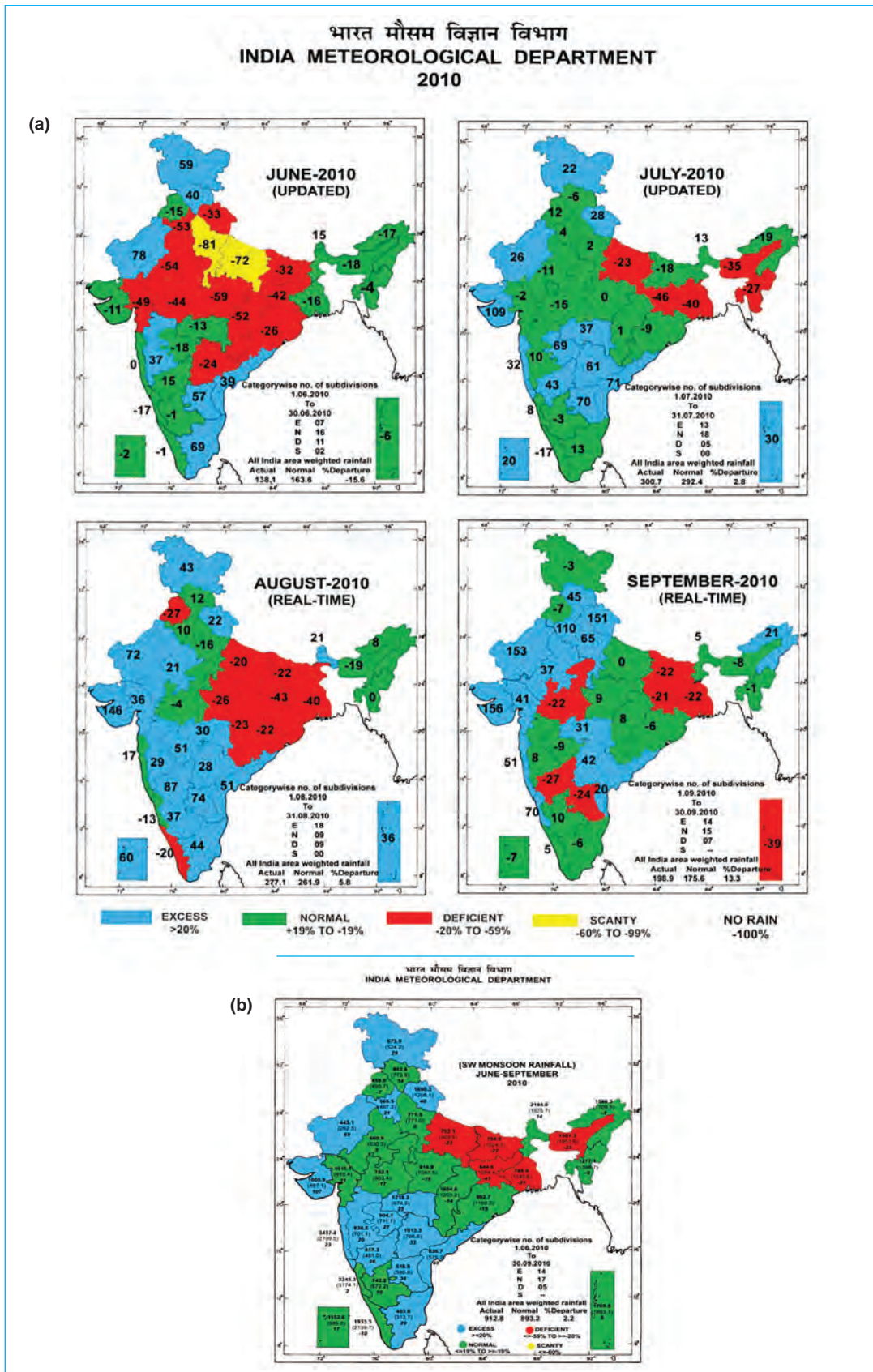
The monthly monsoon rainfall over the country as a whole was above the LPA, during all the months except June as shown below:

June	16% below LPA
July	3% above LPA
August	6% above LPA
September	13% above LPA

The spatial distribution of monthly rainfall is shown in Figs. 4.12 (a&b). In June, large rainfall deficiency was observed over many sub-divisions of central, northern and eastern parts of the country due to delayed monsoon advance over these regions. However, the rainfall situation over the country improved significantly during July, especially during second half of this month. Normal or excess rainfall

TABLE 4.1

Region	Actual (mm)	Long Period Average (LPA) (mm)	Actual % of LPA	Coefficient of Variation (CV) % of LPA
All-India	912.8	893.2	102	10
Northwest (NW) India	688.2	613	112	19
Central India	1027.9	991.5	104	14
South peninsula	853.6	722.9	118	15
Northeast (NE) India	1175.8	1436.2	82	8



Figs. 4.12(a&b). (a) Sub-division wise rainfall distribution over India during southwest monsoon season (June to September) - 2010 and (b) Sub-division wise monthly rainfall distribution over India during southwest monsoon season - 2010

was received over most of the sub-divisions except a few sub-divisions from eastern and northeastern parts of the country where the rainfall was deficient. Rainfall distribution over the country during August was more non-uniform than July, as number of sub-divisions with excess and deficient rainfall during August (excess 18 & deficient 9) was more than that during July (excess 13 & deficient 5). During August, most of the sub-divisions from northwest and Peninsular India received excess rainfall and most of the sub-divisions from eastern part of the country were deficient. However, sub-divisions from northeastern part received normal or excess rainfall.

Figures 4.13 and 4.14 depict the monsoon rainfall as received week by week and the cumulative rainfall during the season. The weekly rainfall was negative during all the weeks of June. In July, the weekly rainfall was positive during the first and last weeks and negative during the two weeks between them. During second and third weeks of August and last week of September the rainfall was deficient. Except for these three weeks, the weekly rainfall during the second half of the season (August-September) was positive. The cumulative rainfall distribution shows the large deficiency in rainfall during early part of the season. As a result, the cumulative weekly rainfall remained negative till end of August. In the first week of September only, the cumulative weekly rainfall became positive and remained so till the end of the season. The cumulative seasonal

rainfall deficiency by more than 10% prevailed from the week ending 23rd June to the week ending 21st July.

Long Range Forecast of Monsoon Rainfall

Based on an indigenously developed statistical model, it was predicted on 14th May 2010 that monsoon will set in over Kerala on 30th May with a model error of ± 4 days. The forecast came correct as the actual monsoon onset over Kerala took place on 31st May, one day later than the forecasted date. Thus this is the sixth consecutively correct operational forecast for the monsoon onset over Kerala since it was issued operationally in 2005.

As per the first stage long range forecast issued on 23rd April, the seasonal (June-September) rainfall for the country as a whole was expected to be $98\% \pm 5\%$ of LPA. In the updated forecast issued on 25th June, the forecast for the country as a whole was revised to a higher value of $102\% \pm 4\%$ of LPA. The updated forecast turned out to be very accurate as the actual area-weighted seasonal rainfall for the country as a whole was 102% of LPA. The forecast for the second half of the monsoon season (August-September) for the country as a whole issued in July was 107% with a model error of 7% of LPA. This forecast also became correct as the actual rainfall over the country as a whole during the second half of the season was 109% of LPA.

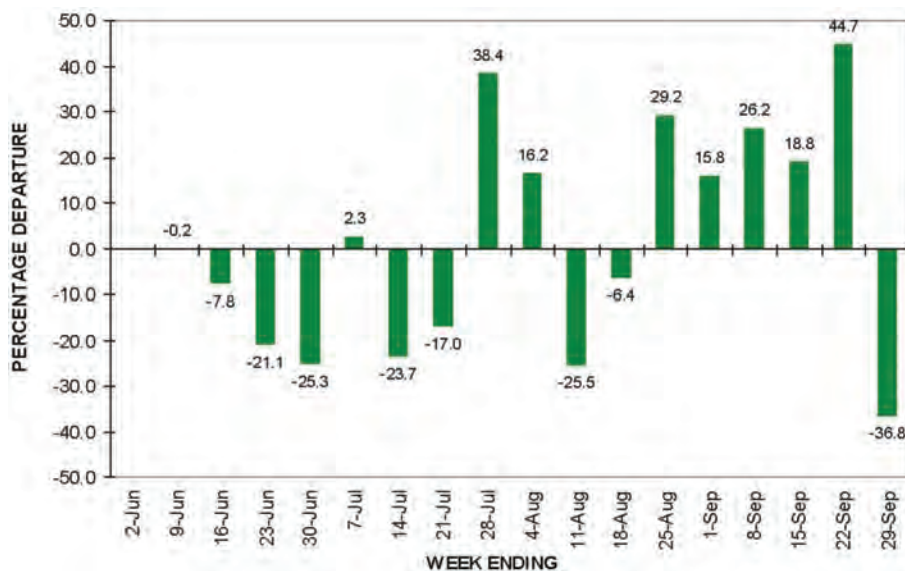


Fig. 4.13. Week-by-week progress of the monsoon rainfall - 2010

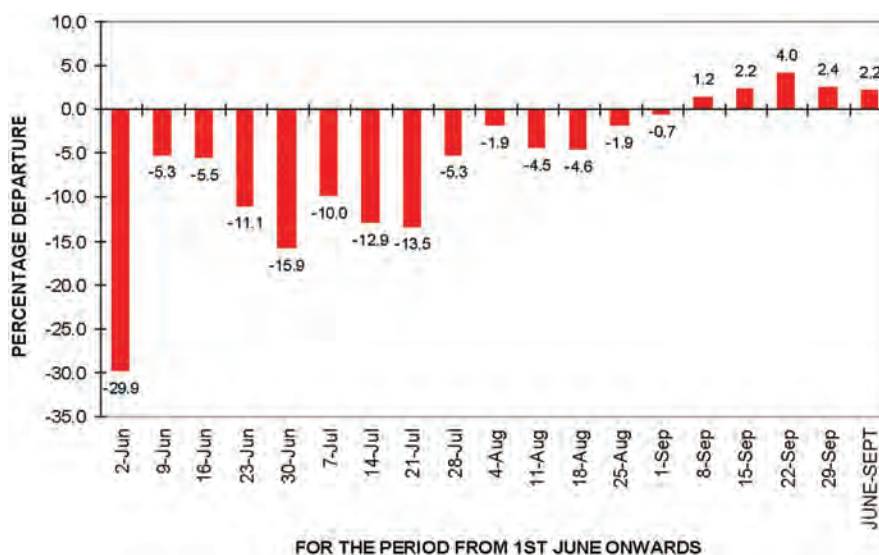


Fig. 4.14. Week-by-week progress of the monsoon rainfall-2010 (Cumulative)

The forecasts for monthly rainfall over the country as a whole for the months of July and August issued in June were 98% & 101% respectively with a model error of $\pm 9\%$ and that for September issued in August was 115% of LPA with a model error of $\pm 15\%$. All the monthly forecasts turned out to be correct as the actual rainfall were 103%, 106% and 113% of LPA respectively.

Considering 4 broad geographical regions of India, the seasonal rainfall was expected to be 102% of its LPA over northwest India, 99% of LPA over Central India, 103% of LPA over northeast India and 102% of LPA over South Peninsula, all with a model error of $\pm 8\%$. The actual rainfall

over northwest India, central India, northeast India and south Peninsula were 112%, 104%, 82% and 118% of the LPA respectively. Thus the actual seasonal rainfall over central India is within the forecast limit and that over northwest India is slightly above the forecast limit. However, the forecast for seasonal rainfall over northeast India and south Peninsula were not accurate as northeast India experienced deficient rainfall and south peninsula experienced excess rainfall against the normal rainfall predicted for both the regions.

The Table 4.2 gives the summary of the verification of the long range forecasts issued for Southwest monsoon 2010.

TABLE 4.2

Details of long range forecasts and rainfall

Region	Period	Date of issue	Forecast (% of LPA)	Actual rainfall (% of LPA)
All India	Jun to Sep	23 rd Apr	98 \pm 5	102
All India	Jun to Sep	25 th Jun	102 \pm 4	
Northwest India	Jun to Sep		102 \pm 8	112
Central India	Jun to Sep		99 \pm 8	104
Northwest India	Jun to Sep		103 \pm 8	82
South Peninsula	Jun to Sep		102 \pm 8	118
All India	Jul		98 \pm 9	103
All India	Aug		101 \pm 9	106
All India	Aug to Sep	30 th Jul	107 \pm 7	109
All India	Sep	27 th Aug	115 \pm 15	113

4.4. POST-MONSOON SEASON (OND)

Southwest monsoon withdrew from the entire country on 29 October and simultaneously the northeast monsoon rains commenced over the south peninsula.

Rainfall activity over the south peninsula (comprising of 5 subdivisions viz., Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu & Pondicherry, South Interior Karnataka and Kerala) during the season as a whole was good (155% of LPA). It was near normal during October (101% of LPA) and good during November and December (231% and 181% of LPA respectively). During the season, all the five sub-divisions of south peninsula received excess rainfall (nearly one and half times of their respective normal rainfall).

Both maximum and minimum temperatures were above normal by 3 to 4°C over different parts of the country on many days during October. November 2010 was the warmest month since 1901. This was mainly due to abnormally high minimum temperatures throughout the country. Minimum temperatures were above normal by over 5°C on many days over the central parts of the country and adjoining north peninsula during this month. The mean temperature for October was also the third highest since 1901.

Rainfall Features

During the season rainfall activity over the country as a whole was good. Many sub-divisions of peninsula, western/northwestern region of the country and the Indian Islands received excess rainfall. However, rainfall activity over the extreme northern and northeastern parts of the country was subdued.

During the season, out of 36 meteorological sub-divisions, 18 received excess rainfall, 7 received normal rainfall and 10 received deficient rainfall. Remaining one sub-division (East Uttar Pradesh) received scanty rainfall (Fig. 4.15). Rajasthan state received more than thrice of its normal rainfall. While, Saurashtra & Kutch, Konkan & Goa and Coastal Karnataka received more than twice of their respective normal rainfall.

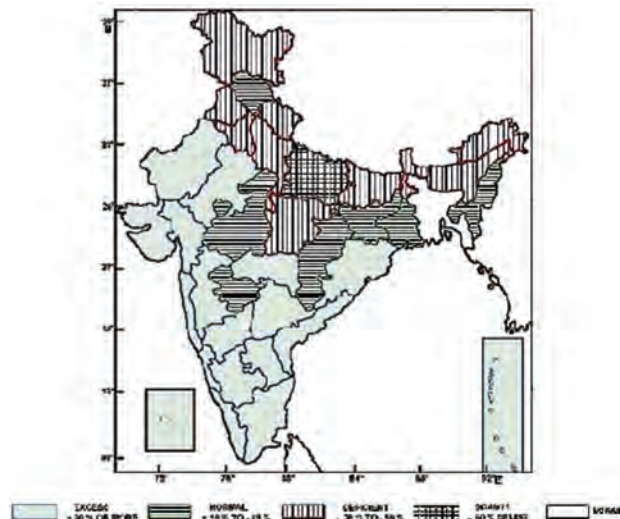


Fig. 4.15. Sub-divisionwise rainfall percentage departures for the post monsoon season 2010

Figs. 4.16 (a&b) show the spatial pattern of rainfall (cm) received during the season and its anomaly respectively. Peninsula, eastern/northeastern and extreme northern parts of the country received more than 10 cm of rainfall. Extreme South peninsula and parts of east coast received rainfall of the order of 40 to 60 cm. Rainfall over eastern parts of Tamil Nadu exceeded 80 cm. Rainfall anomaly was positive over most parts of the country, except some parts of eastern/northeastern region, parts of peninsula and Jammu & Kashmir. Positive rainfall anomaly exceeded 10 cm over parts of extreme south peninsula and parts of east and west coast. Over parts of Coastal Karnataka, Kerala, Tamil Nadu and Coastal Andhra Pradesh, positive rainfall anomaly exceeded the normal by 30 cm. Negative rainfall anomaly over parts of Jammu & Kashmir, Uttar Pradesh, Gangetic West Bengal and extreme northeastern region exceeded 5 cm.

Cumulative rainfall departure was negative till the first week of November. Thereafter it became positive and remained so till the end of the season. At the end of the post-monsoon season 2010, the rainfall for the country as a whole was 121% of its Long Period Average (LPA) value.

Fig. 4.17 shows the percentage departure of rainfall during the northeast monsoon season over the south peninsula for the period 1901-2010. The rainfall over the south peninsula for the season

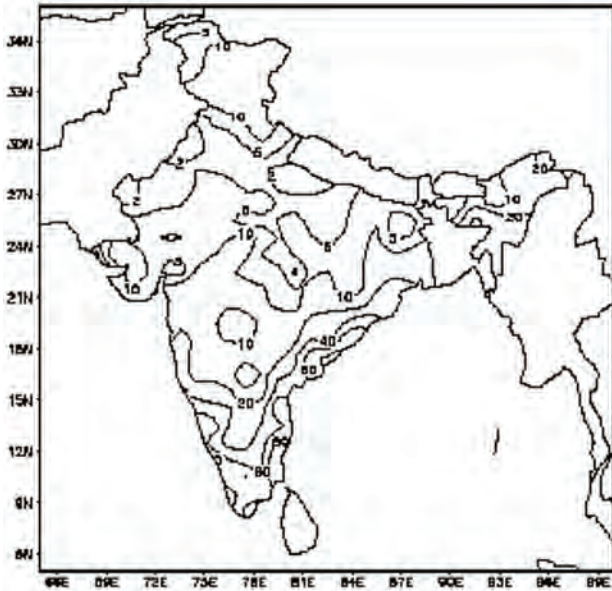


Fig. 4.16(a). Seasonal rainfall (cm) (Interval : 2, 5, 10, 20, 40, 60, 80)

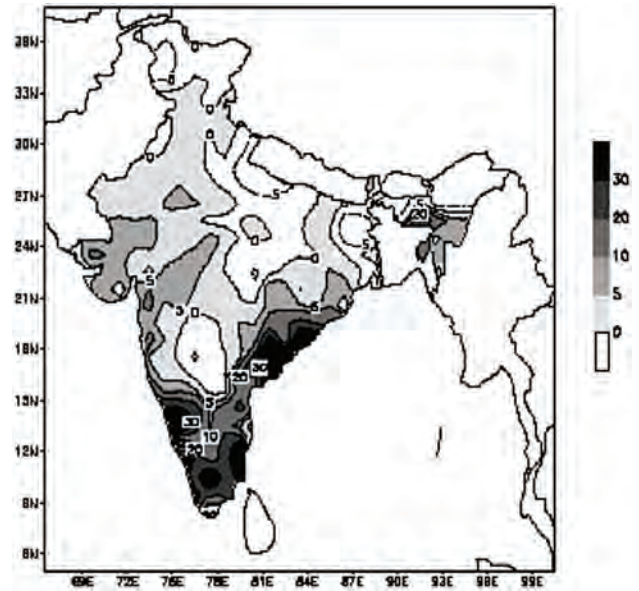


Fig. 4.16(b). Seasonal rainfall anomaly (cm) (Interval : -5, 0, 5, 10, 20, 30) (Based on 1951-2000 normals)

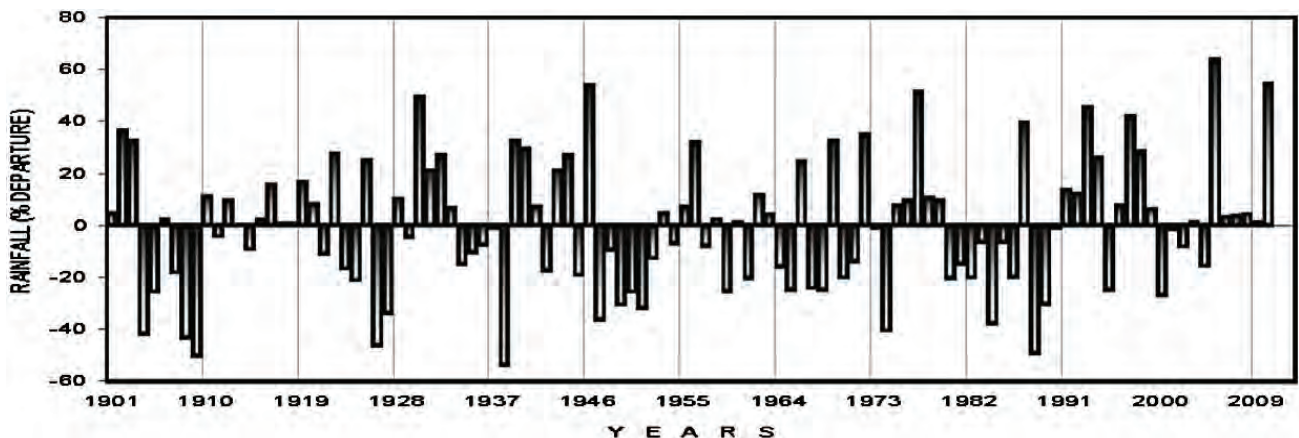


Fig. 4.17. Percentage departure of rainfall during north east monsoon season over the south peninsula (1901-2010)

this year was 155% of its LPA, which is the second highest since 1901 after 2005 (164%).

Pressure & Wind

The pressure anomalies were negative throughout the country and were generally of the order of -2 to -2.5 hPa.

Anomalous cyclonic circulation

At 850 hPa level, an anomalous cyclonic circulation over the northeast Arabian sea, while, anomalous westerlies prevailed over the south peninsula. Both these anomalous features were observed at 500 hPa level also. At 200 hPa, an

anomalous anticyclonic circulation was observed over the northern/northeastern parts of the country.

Outgoing Longwave Radiation (OLR)

OLR anomaly (W/m^2) over the Indian region and neighbourhood is shown in Fig. 4.18. Negative OLR anomalies were observed over the peninsula and adjoining central and eastern parts of the country and the Indian sea. Over parts of south peninsula & adjoining south and central Bay of Bengal and Arabian sea, the negative OLR anomalies exceeded 10 to 20 W/m^2 .

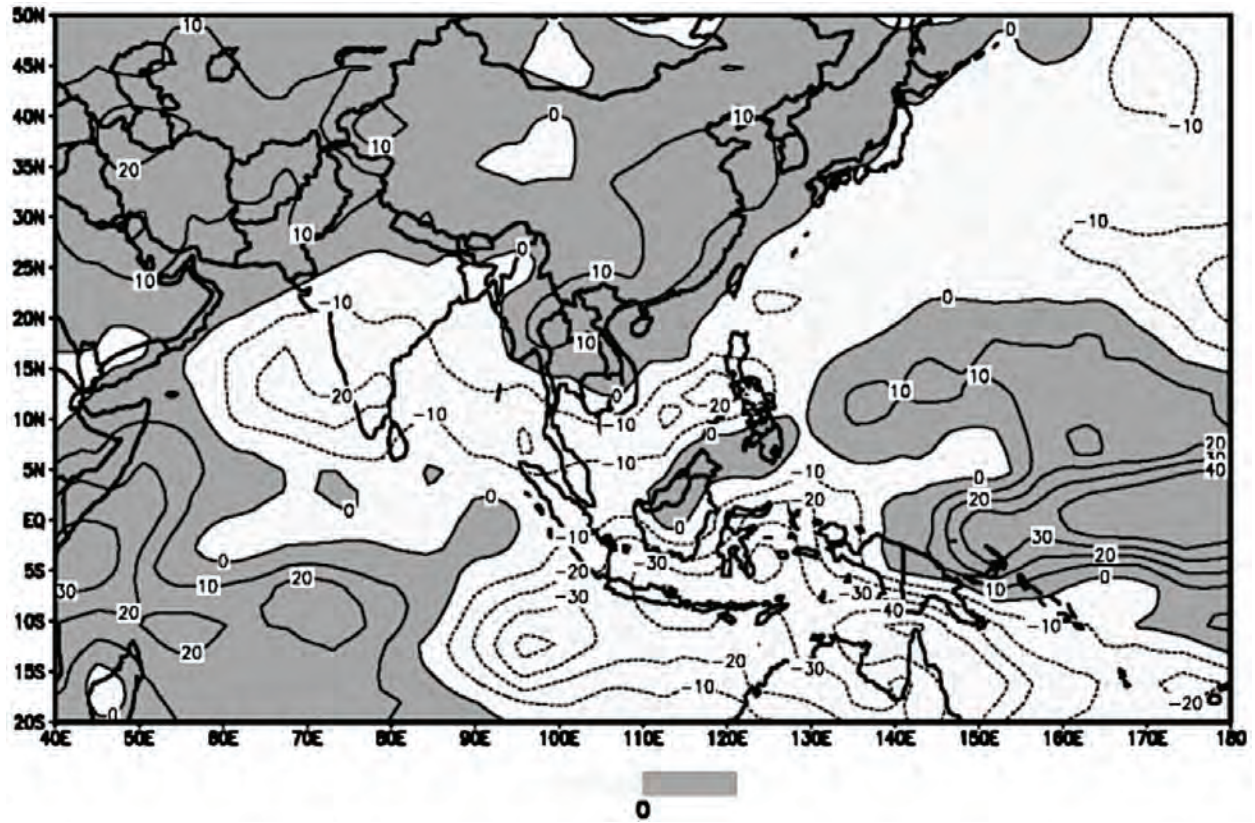
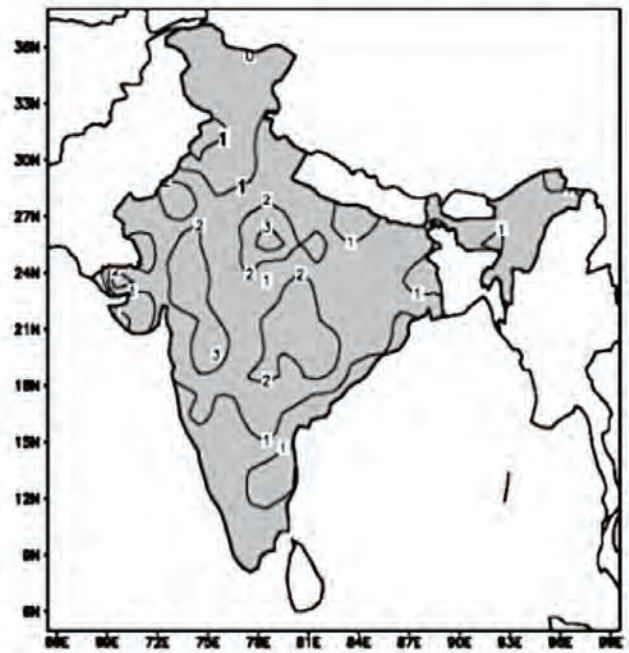
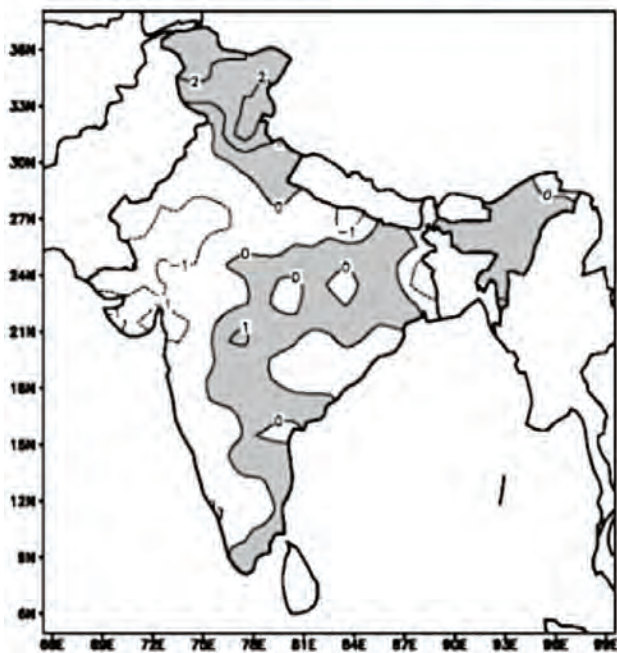


Fig. 4.18. OLR anomalies (Wm^2)

(a) MAXIMUM TEMPERATURE ANOMALY

(b) MINIMUM TEMPERATURE ANOMALY



Figs. 4.19(a&b). Mean seasonal temperature anomalies ($^{\circ}C$) (a) maximum (b) minimum

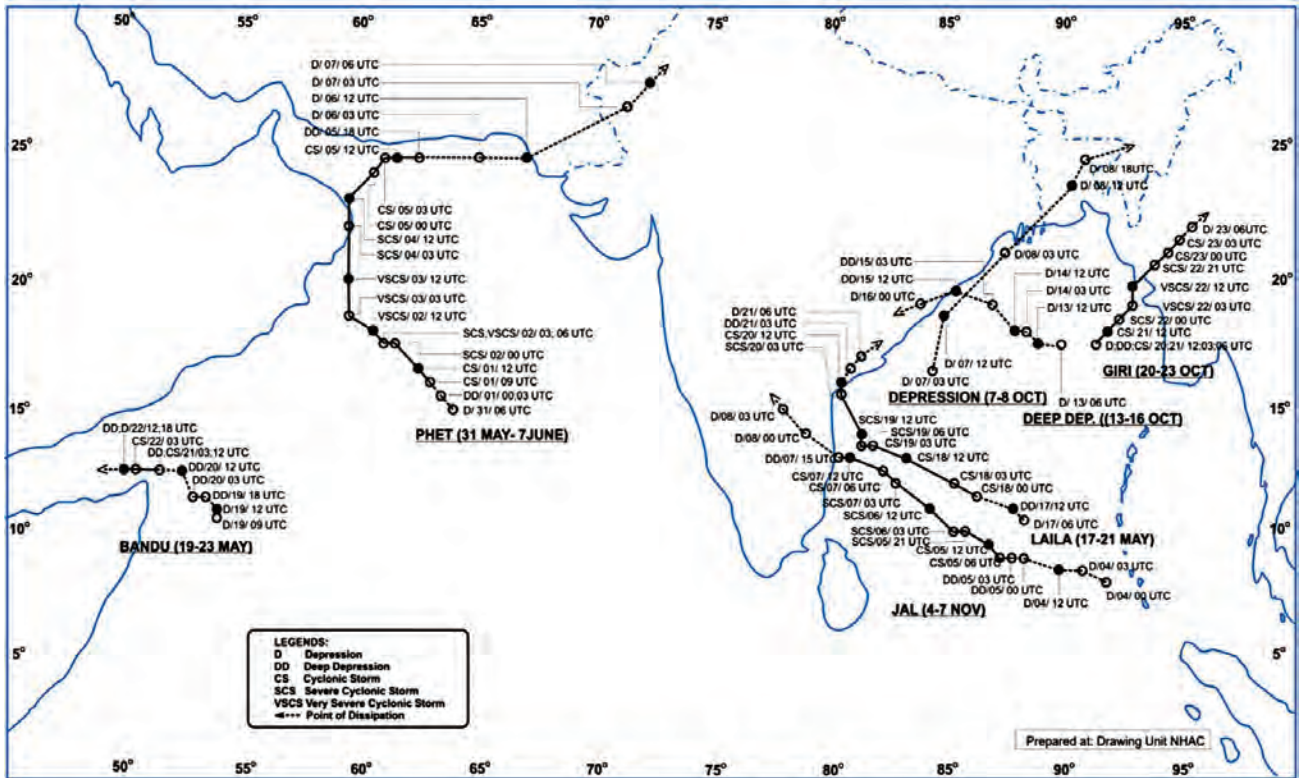


Fig. 4.20. Tracks of cyclonic disturbances during 2010

Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 4.19(a&b).

Maximum temperatures were below normal over western half of the country and some eastern/northeastern region. Elsewhere, these were above normal. Maximum temperatures were below 0 normal by more than 1 °C over parts of Gujarat, Rajasthan, West Madhya Pradesh, East Uttar Pradesh and Gangetic West Bengal. Over parts of Jammu & Kashmir and Himachal Pradesh, these were above 0 normal by 1 to 2 °C.

Minimum temperatures were above normal throughout the country. These were above normal about 1 to 2 °C over most parts of the country except parts of south peninsula, east coast and extreme northern parts of the country.

Low Pressure Systems

Two severe cyclonic storms (Giri & Jal) and three depressions formed over the Bay of Bengal during the season.

4.5. CYCLONIC DISTURBANCES DURING 2010

The north Indian Ocean witnessed the formation of eight cyclonic disturbances during the period January – November, 2010. Out of eight disturbances six cyclonic disturbances formed over the Bay of Bengal and two over the Arabian Sea. Out of the six cyclonic disturbances over the Bay of Bengal, one intensified upto the stage of very severe cyclonic storm (GIRI), two upto the stage of severe cyclonic storm (LAILA & JAL) and one cyclonic disturbance upto the stage of deep depression and the rest two upto the stage of depression. Out of two cyclonic disturbances formed over the Arabian Sea, one intensified upto the stage of very severe cyclonic storm (PHET) and the other upto the stage of cyclonic storm (BANDU). Tracks of the cyclonic disturbances formed over the north Indian Ocean during the period are shown in Fig. 4.20.

The brief characteristics of the cyclonic storms are described below.

(a) Severe Cyclonic Storm, 'LAILA' (17th - 21st May, 2010)

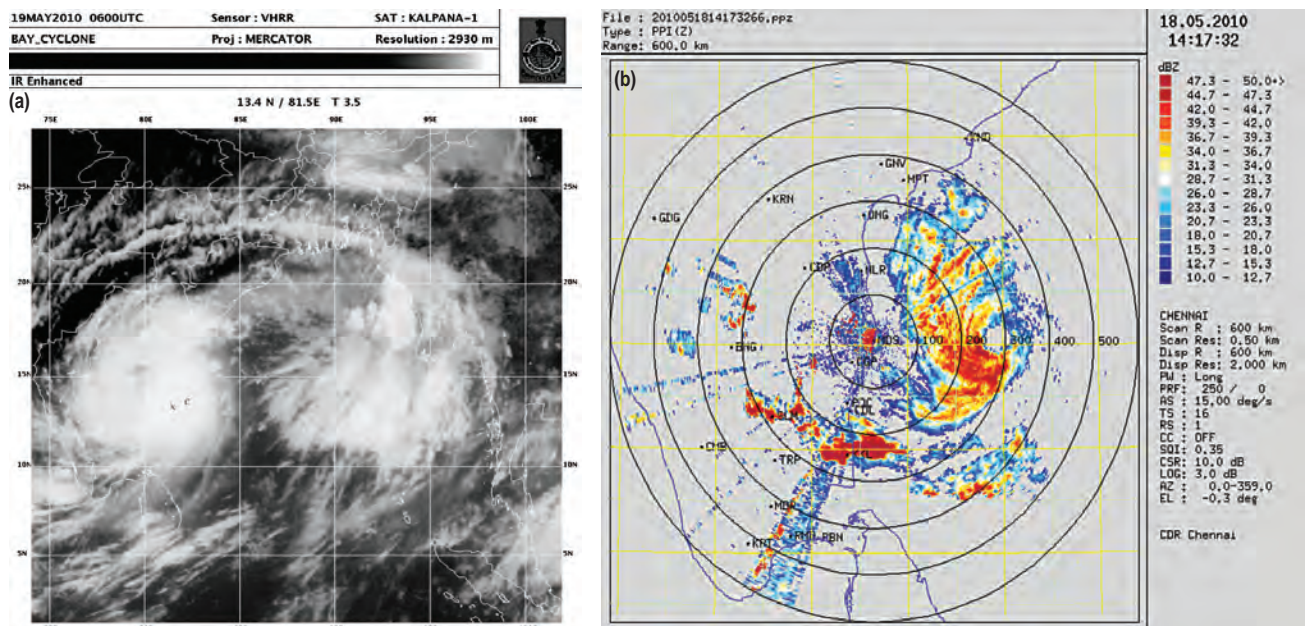
A severe cyclonic storm, 'LAILA' crossed Andhra Pradesh coast near Bapatla between 1630 and 1730 hrs (IST) of 20th May 2010. It caused wide spread rainfall with scattered heavy to very heavy falls and isolated extremely heavy falls over coastal Andhra Pradesh leading to flooding in low lying areas. Gale winds speed reaching 90-100 kmph were reported by the meteorological observatories in the coastal regions of Andhra Pradesh. The storm surge of 2 to 3 meters inundated the low lying areas of Guntur, Prakasham, West & East Godavari districts. It also caused isolated heavy to very heavy falls over Orissa. It caused loss of only six lives in Andhra Pradesh and extreme damage to property. This cyclone developed over southeast Bay of Bengal on 17th May, moved initially in a west-northwesterly direction towards south Andhra Pradesh and adjoining north Tamil Nadu coast till 19th morning and then moved in a northwesterly to northerly direction and crossed Andhra Pradesh coast near Bapatla (about 50 km southwest of Machilipatnam) on 20th evening. It then recurved north-northeastwards and weakened gradually. The satellite and Radar imagery of cyclone, Laila are shown in Figs. 4.21(a&b).

(b) Cyclonic Storm, 'BANDU' (19 - 21 May, 2010)

A cyclonic storm 'BANDU' formed over southwest Arabian Sea off Somalia coast on 19 May, 2010. Initially it moved in northwesterly direction and later in a westerly direction. Due to interaction with land surface and colder sea, it dissipated over Gulf of Aden. It caused heavy rain in Somalia and Yemen. The tropical cyclone advisory bulletins were issued to Somalia and Yemen in addition to WMO/ESCAP Panel member countries including Oman. The typical satellite imagery of cyclone, Bandu is shown in Fig. 4.22.

(c) Very Severe Cyclonic Storm, 'PHET' (31 May - 7 June, 2010)

A very severe cyclonic storm, 'PHET' developed from a low pressure area formed over the central Arabian Sea on 30 May 2010. The low pressure area concentrated into a depression over the same region on the forenoon of 31 May 2010. Moving initially in a northwesterly direction, the system intensified into a cyclonic storm, PHET in the afternoon of first June and attained maximum intensity of very severe cyclonic storm with maximum sustained wind speed of 85 kt in the evening of 2 June. It weakened gradually since 3 June morning, moved in a northerly direction



Figs. 4.21(a&b). (a) Kalpana-1 imagery of LAILA : 19 May 2010 (0600 UTC) and (b) DWR imagery of LAILA : 18 May 2010 (1417 UTC)

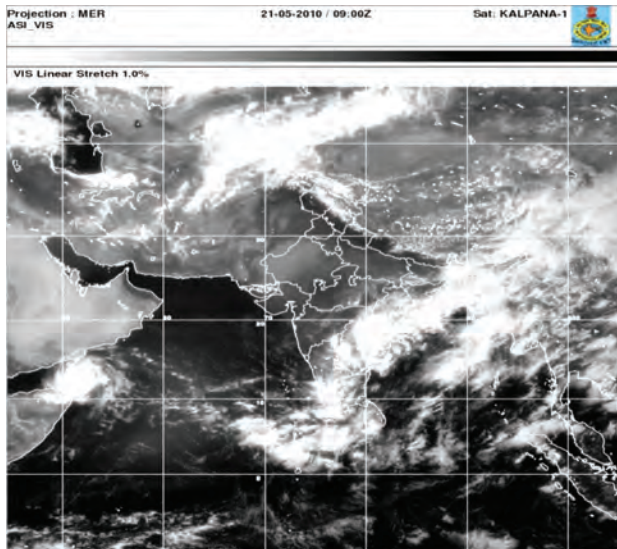


Fig. 4.22. Kalpana-1 imagery of BANDU : 21 May of 2010 (0900 UTC)

and crossed Oman coast as a severe cyclonic storm with the wind speed of about 125 kmph near latitude 21.5°N in the early morning of 4 June 2010. It then continued to move northwards, emerged into northwest Arabian Sea and then recurved eastwards and weakened gradually. It moved parallel to but close to Makaran coast and crossed Pakistan coast as a depression, close to south of Karachi in the evening of 6 June. It then moved east-northeastwards across south Pakistan and Rajasthan and weakened gradually into a well marked low pressure area over east Rajasthan and adjoining northwest Madhya Pradesh in the evening of 7 June. It was the rarest of the rare track in Arabian Sea as per the recorded history during 1877-2009. It was one of the longest tracks in recent years. The life period of the cyclone was also longer.

As a result of such unique track, the system affected three countries, viz., Oman, Pakistan and India (Gujarat and Rajasthan). There was heavy rain over Gujarat and Rajasthan. The typical satellite imagery of the cyclone 'Phet' is shown in Fig. 4.23.

(d) Very Severe Cyclonic Storm, GIRI (20 -23 October, 2010)

A low pressure area formed over the east central Bay of Bengal on 19th October. It concentrated

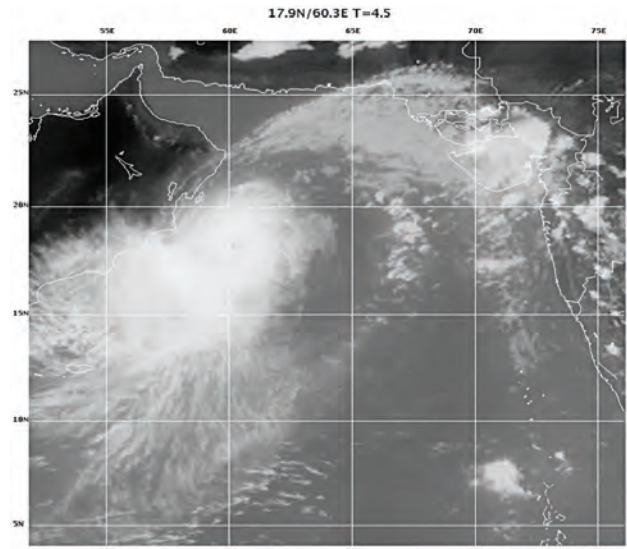


Fig. 4.23. Kalpana-1 imagery of PHET : 2 June 2010 (1000 UTC) showing eye of the cyclone

into a depression on 20th October evening over the same area. Remaining practically stationary, it intensified into a deep depression at 0830 hrs (IST) of 21 October and into a cyclonic storm, GIRI at 1130 hrs (IST) of the same day. It then moved slowly northeastwards and intensified into a severe cyclonic storm at 0830 hrs (IST) of 22nd October and into a very severe cyclonic storm at 1130 hrs (IST) of the same day. It then moved relatively faster in the same direction and crossed Myanmar coast between Sittwe and Kyakpyu around 1930 hrs (IST) of 22nd October 2010 with estimated sustained maximum wind speed of about 190 kmph (105 knots). The typical satellite imagery of the cyclone Giri is shown in Fig. 4.24.

(e) Severe Cyclonic Storm, JAL (04 - 08 November, 2010)

A severe cyclonic storm, JAL (4-8 November 2010) developed over the Bay of Bengal from the remnant of a depression which moved from northwest Pacific Ocean to the Bay of Bengal across southern Thailand. It moved west-northwestwards and intensified upto severe cyclonic storm on 6th November. However, as the severe cyclonic storm, JAL moved to the southwest Bay of Bengal closer to India coast, it entered into a region of lower ocean thermal energy and moderate to high vertical wind shear

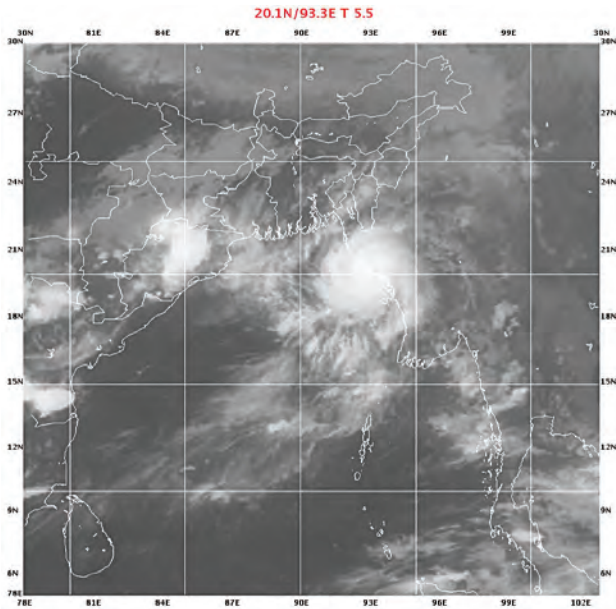


Fig. 4.24. Kalpana-1 imagery of cyclone GIRI on 22 October, 2010 CDO pattern of the system

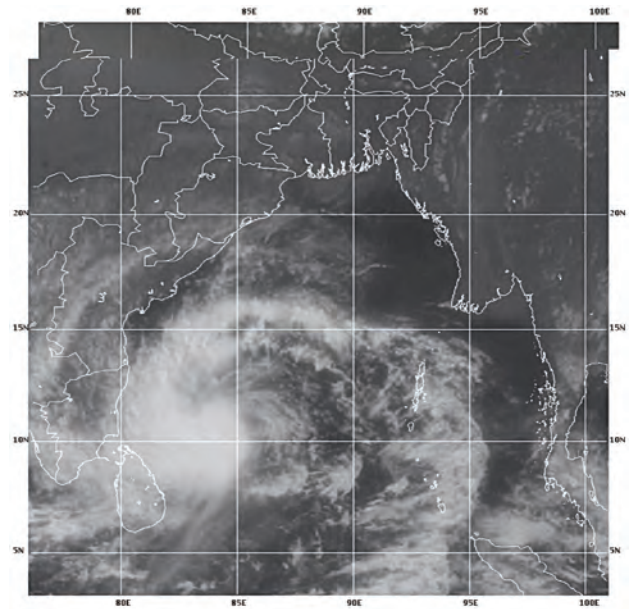


Fig. 4.25. Kalpana-1 imagery of cyclone 'JAL' on November 2010 at 0800 UTC showing the banding features of the system

in association with the strong easterlies in the upper tropospheric level. The high wind shear led to westward shearing of the convective clouds from the system centre and lower Ocean thermal energy led to unsustainability of convection over the region. Due to these two factors, the severe cyclonic storm, JAL weakened gradually into a deep depression and crossed north Tamilnadu – south Andhra Pradesh coast, close to the north of Chennai near 13.3°N and 80.3°E around 2130 hrs (IST) of 07th November 2010. It continued to move west-northwestwards and further weakened into a well marked low pressure area. As a low pressure area, it emerged into the east central Arabian Sea on 9th November. It then moved initially northwestwards towards Saurashtra & Kutch and adjoining Pakistan coast during 9-11th November. It then moved northeastwards across Saurashtra & Kutch and adjoining Pakistan and became less marked on 12th November 2010. The typical satellite imagery of the system are shown in Fig. 4.25.

The system caused scattered heavy to very heavy rainfall over north Tamilnadu, coastal Andhra Pradesh, Rayalseema, south interior Karnataka and coastal Karnataka. Maximum squally wind of about 33 KTs was reported by Ennore port of Tamilnadu in association with the system.

4.6. ANALYSIS AND PREDICTION OF CYCLONE

Various strategies were adopted for improvement of analysis and prediction of cyclone. The tropical cyclone analysis, prediction and decision-making process was made by blending scientifically based conceptual models, dynamical & statistical models, meteorological datasets, technology and expertise. Conventional observational network, automatic weather stations (AWS), buoy & ship observations, cyclone detection radars and satellites were used for this purpose. A new weather analysis and forecasting system in a digital environment was used to plot and analyse different weather parameters, satellite, Radar and numerical weather prediction (NWP) model products. An integrated fully automated forecasting environment facility was thus set up for this purpose.

The manual synoptic weather forecasting was replaced by hybrid systems in which synoptic method could be overlaid on NWP models supported by modern graphical and GIS applications to produce.

- High quality analyses

- Ensemble of forecasts from NWP models at different scales - global, regional and mesoscale
- Prediction of intensity and track of tropical cyclone

The major highlights of the strategies followed for monitoring and prediction of cyclone are shown in the Figure 4.26.

Introduction of MME technique for track prediction

WMO has suggested to introduce Multi-Model Ensemble (MME) technique for cyclone

track prediction. Development of Multi-Model Ensemble Prediction Scheme for cyclone track. technique. The tropical cyclone module installed in Synergie forecasting system at IMD, HQ has also the capability to provide MME prediction of tropical cyclone track based on available NWP statistical model forecast. It has been operational during 2010

Introduction of cyclone wind forecast

The forecast of maximum wind in four quadrants of a cyclone was commenced with effect from cyclone, GIRI during October 2010. In this forecast, the radius of 34, 50 and 64 knot winds

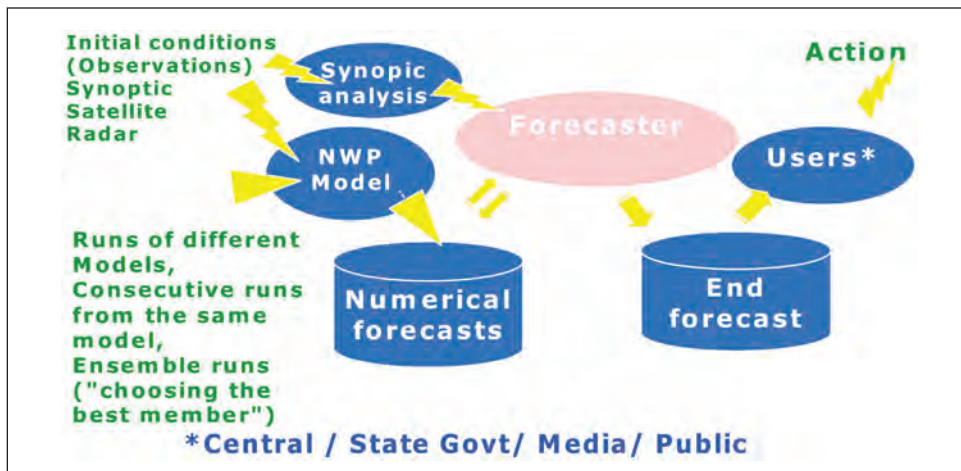


Fig. 4.26. Strategy adopted for cyclone analysis and forecasting

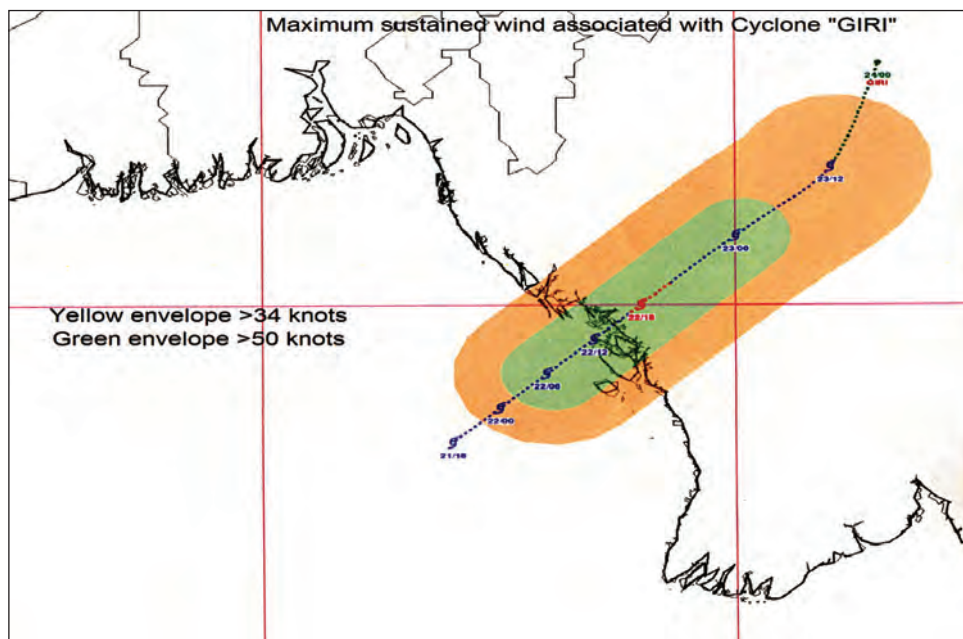


Fig. 4.27. A typical graphical presentation of cyclone wind forecast during cyclone, GIRI

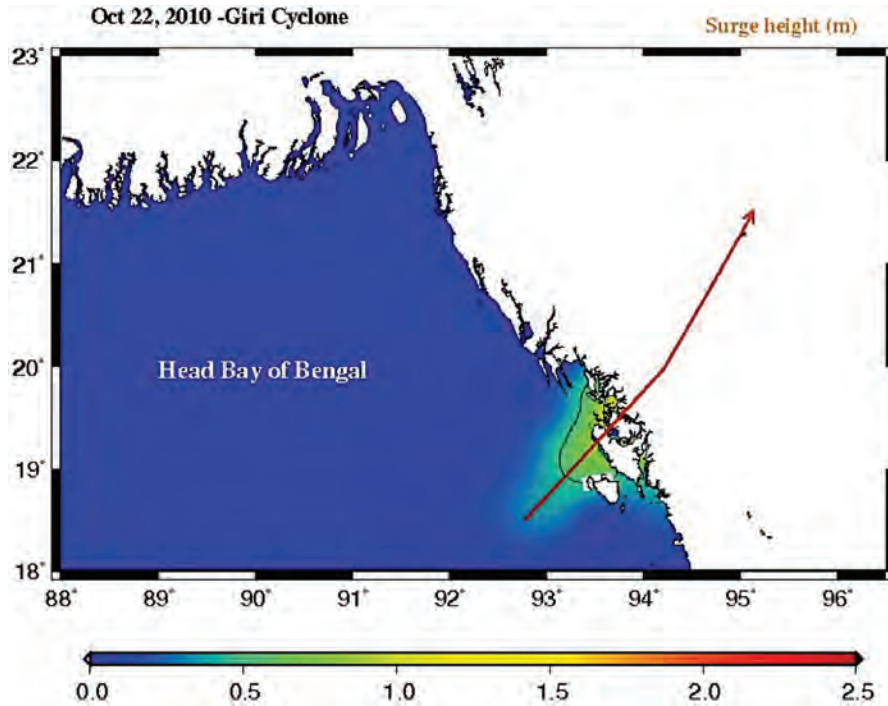


Fig. 4.28. A typical example of Storm Surge prediction by IIT Delhi Model adapted by IMD during cyclone, GIRI

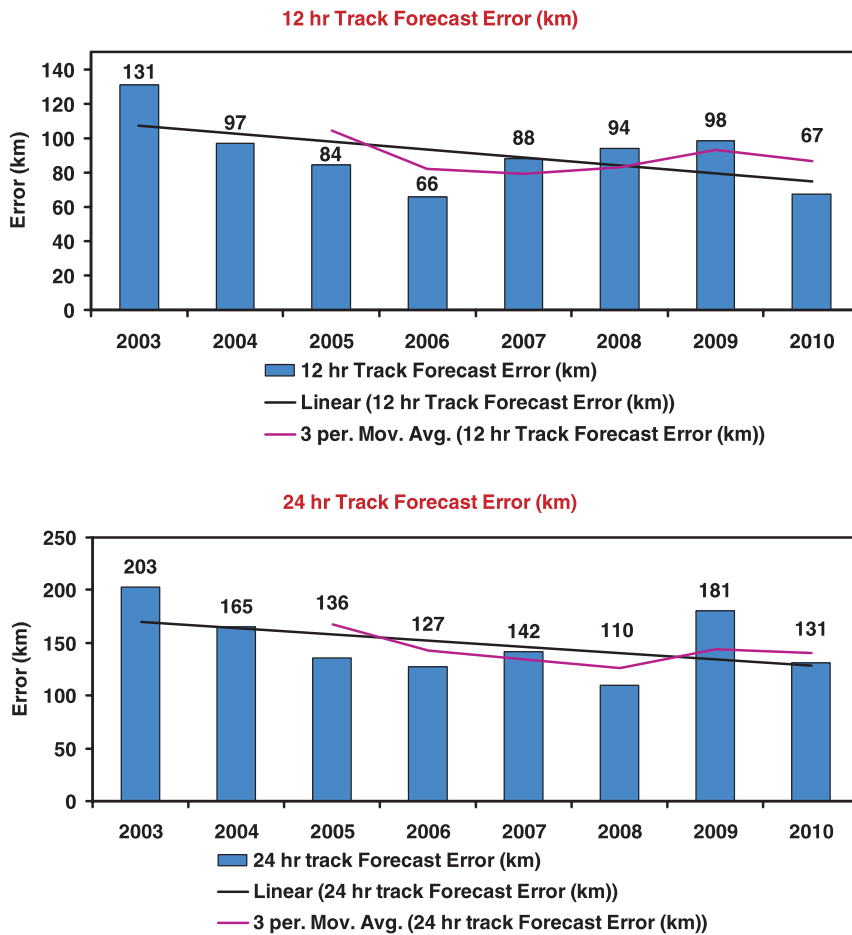


Fig. 4.29. 12 hr and 24 hr cyclone track forecast errors of IMD during 2003-2010. [Cyclone track forecast error (km)]

System	Lead Time (Hrs)					
	12	24	36	48	60	72
LAILA	84(12)	153(11)	228(9)	254(7)	372(5)	210(3)
BANDU	39(4)	78(2)	78(1)	-	-	-
PHET	82(20)	162(20)	215(16)	311(15)	410(14)	545(14)
GIRI	45(7)	73(5)	68(3)	117(1)	-	-
JAL	41(11)	78(9)	56(7)	83(5)	54(3)	54(01)
MEAN	66(54)	131(47)	167(36)	249(28)	330(22)	465(18)

Figures inside the brackets indicate number of forecasts verified based on 0000, 0600, 1200 and 1800 UTC

Skill score (%) of cyclone track forecast issued by IMD during 2010

System	Lead Time (Hrs)					
	12 hr	24hr	36hr	48hr	60hr	72hr
LAILA	17.9	17.9	25.4	51.2	68.0	68.0
BANDU	52.0	52.0	52.0	-	-	-
PHET	2.4	1.5	27.0	27.0	30.0	33.0
GIRI	15.1	57.1	78.8	82.1	-	-
JAL	43.0	32.0	45.0	43.0	69.0	77.0
MEAN	18.1	24.1	33.9	38.7	43.8	40.4

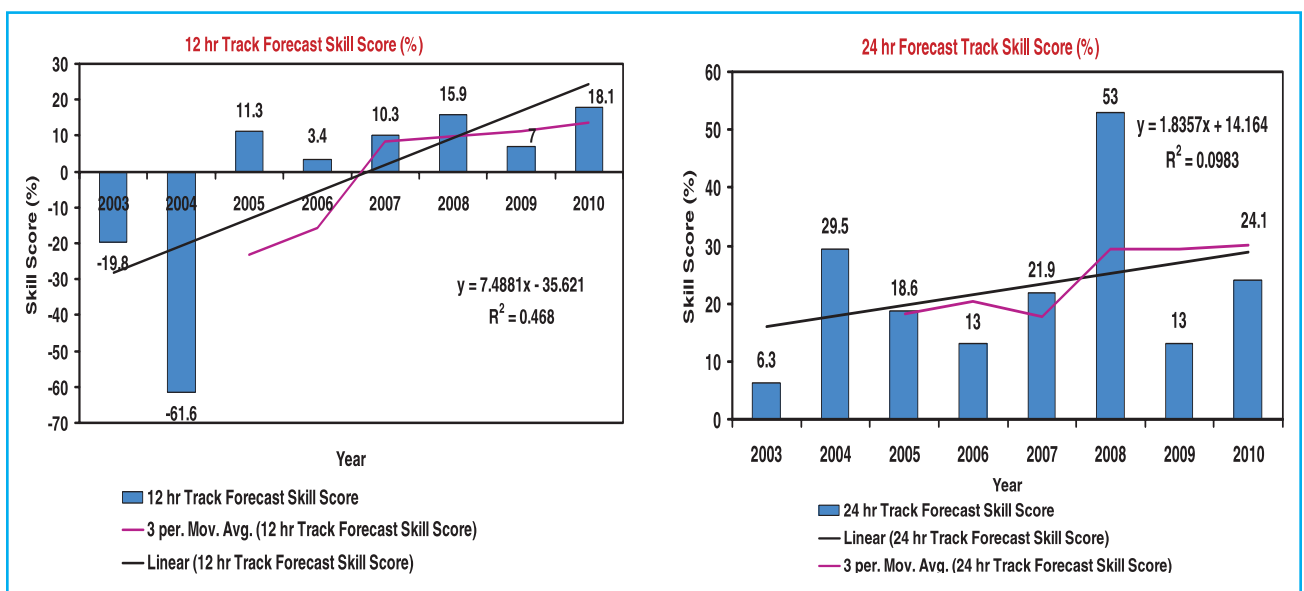


Fig. 4.30. 12 hr and 24 hr cyclone track forecast skill scores of IMD during 2003-2010

are given for various forecast periods like +06, +12, +18, +24, +36, +48, +60 and +72 hrs. A typical graphical presentation of this forecast is shown in Fig. 4.27.

Prediction of Storm surge due to cyclone

The high resolution storm surge model for different member countries, as developed by IIT, Delhi have been installed in Cyclone Warning Division of IMD, New Delhi. It was made operational during 2010. A typical example of Storm Surge prediction is shown in Fig. 4.28.

Reduction in average forecast error during 2010

The average landfall forecast error of cyclonic storms during 2010 based on the forecast issued by RSMC, New Delhi are given below. The landfall point and time forecast errors as well as track forecast errors have improved during 2010. There is also improvement in the skill score of the track forecast. For comparison, the 12 and 24 hr track forecast errors and the skill scores during 2003 to 2010 are shown in Fig. 4.29 and 4.30 respectively. The figures clearly indicate the gradual improvement in the cyclone forecast by

IMD, as the error has decreased and the skill has increased. The average landfall error was less than the long period average error for the land falling cyclones over the north Indian Ocean. Considering, the intensity forecast, the average 24 hrs wind forecast error has been about 10 knots for these cyclones.

The skill score has been calculated by comparing the IMD's forecast track errors with the forecast difficulty level. For this purpose, the IMD's forecast error has been compared with the CLIPER (climatology + persistence) model error, which is the international practice. The gain in skill in relation to CLIPER, is quantified in percentage terms by;

$$\text{Gain in Skill} = \frac{(\text{CLIPER DPE} - \text{DPE})}{\text{CLIPER DPE}} \times 100\%$$

Cyclone warning and advisory services

Cyclone warning/advisory bulletins issued by IMD during 2010

The Cyclone Warning Division/Regional Specialised Meteorological Centre (RSMC)-Tropical Cyclone, IMD, New Delhi mobilised

Landfall Point Forecast error (km)						
System	Lead Time (hours)					
	12	24	36	48	60	72
LAILA	55	55	115	115	122	207
BANDU	--	--	--	--	--	--
PHET	15/25	115/150	275/--	100/--	90/-	90/-
GIRI	55	55	55	--	--	--
JAL	35	25	33	44	22	101
MEAN	37	80	120	86	78	133

-- : No landfall as the system dissipated over the Sea

Landfall Time Forecast error (hrs)						
System	Lead Time (hours)					
	12	24	36	48	60	72
LAILA	1.5 D	1.5 D	3.5E	3.5E	2.5E	1.0E
BANDU	--	--	--	--	--	--
PHET	02E/0.5E	02E/2D	15D/-	01D/-	02E/-	1E/-
GIRI	4D	2E	2E	--	--	--
JAL	0.5 D	0.5D	0.5D	1.5E	1.5E	1.5E

D : Delay E : Early

all its resources for monitoring and prediction of cyclonic disturbances over the north Indian Ocean during 2010. It issued 3 hourly warning/advisory bulletins to national disaster management agencies. It issued forecast and warning bulletins to various national and international disaster management agencies including National Disaster Management (NDM), Ministry of Home Affairs (MHA), concerned state Govts and other users in regular intervals. It also issued advisories to World Meteorological Organisation (WMO)/ Economic and Social Cooperation for Asia and the Pacific (ESCAP) Panel member countries including Bangladesh, Myanmar, Thailand, Pakistan, Oman, Sri Lanka and Maldives during cyclone period. As tropical cyclone advisory centre (TCAC), it also issued tropical cyclone advisories with effect from the stage of cyclone for international civil aviation purpose as per the requirement of international civil aviation organization (ICAO). The following are the statistics of bulletins issued by IMD in association with the system.

Total number of bulletins issued during 2010

Bulletins for Indian coast	154
RSMC bulletin for WMO/ESCAP Panel member countries (Special Tropical Weather Outlook and Tropical Cyclone Advisory)	150
TCAC bulletin for international civil aviation	54

4.7. IMPACT OF WEATHER EVENTS DURING 2010

- An avalanche in the second week of February in Jammu Kashmir (northern parts of India) claimed lives of 17 soldiers.
- A cloud burst in early hours of 6 August in Leh (J&K) claimed more than 150 lives and more than 500 people were missing.
- A massive landslide due to heavy rainfall in Bageshwar (Uttarakhand, Northern India) on August 18 claimed lives of 18 school children.
- Northeastern states, sub-Himalayan West Bengal and Bihar experienced enhanced thunderstorm activity during pre-monsoon season, 2010.

- Death toll due to heavy rains/floods in different parts of the country, during the monsoon season, was more than 500 (mostly from northern and northwestern parts). Heavy rainfall events in November 2010 took a toll of more than 50 people from peninsular parts (AP, TN and Karnataka) of the country.
- Abnormally warm conditions (heat wave) prevailed over major parts of the country during March and April months. These heat wave conditions claimed more than 300 lives.
- Severe cold wave conditions prevailed over northern plains in January and during first fortnight of February. Maximum temperature over a number of stations over the northern plains was 5 to 10°C below normal on many occasions during January. Cold wave conditions claimed more than 600 lives.
- A Tornado like situation with strong winds estimated to be more than 100 kmph raged havoc in West Bengal and Bihar on 13 April, claiming more than 120 lives. More than 80000 houses were destroyed.

4.8. NUMERICAL WEATHER PREDICTION

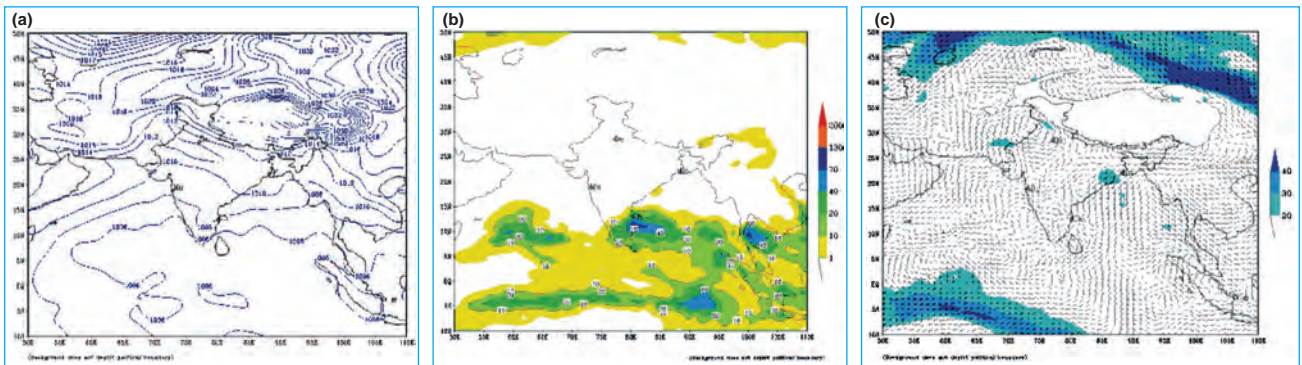
IMD has been in the process of expanding NWP activities to meet the growing operational need of multi-scale forecasts ranging from nowcast to medium range and extended range. NCEP GFS T-382 (including Global Data assimilation) was implemented at IMD in January 2010. NCAR mesoscale model WRF with 3 DVAR data assimilation was implemented at IMD with the resolution of 27 km, 9 km and 3 km in May 2010. Nowcast System and venue specific forecasts based on meso-scale model with the assimilation of Delhi Doppler Weather Radar Observation was implemented to support weather forecast system for Delhi Commonwealth Games 2010. Online GFS verification system & Location Specific Forecasts for major Airports based on WRF-VAR (9 km resolution was implemented w.e.f. October 2010 and November, 2010 respectively. Polar WRF for predicting weather conditions over Antarctica (Maitri) was implemented in October 2010.

With the commissioning of High Performance Computing System (HPCS), National Centre for Environmental Prediction (NCEP) based Global Forecast System (GFS T382) has been made operational at the H/Q of IMD, incorporating Global Statistical Interpolation (GSI) scheme as the global data assimilation for the forecast up to 7 days. Currently, it runs twice in a day (0000 UTC and 1200 UTC). In addition to this, the meso-scale forecast system WRF (ARW) with 3DVAR data assimilation is being operated daily twice, at 27 km, 9 km and 3 km horizontal resolutions for the forecast up to 3 days using initial and boundary conditions from the IMD GFS-382. At ten other regional centres, very high resolution mesoscale models (WRF at 3 km resolution) are made operational. NWP based objective forecast products are prepared to support cyclone warning service. Doppler weather and

mesoscale dynamical model based nowcast system was made operational for the national Capital of Delhi. Polar WRF is implemented to provide day to day short range (48 hours) weather forecast for the Maitri region over Antarctica. District Level Quantitative five days weather forecasts based on Multi-Model Ensemble (MME) system are being generated to support Agro-Meteorological Advisory Service of India, making use of model outputs of state of the art global models from the leading global NWP centres. All these NWP products are routinely made available on the IMD website www.imd.gov.in.

NWP Models during 2010

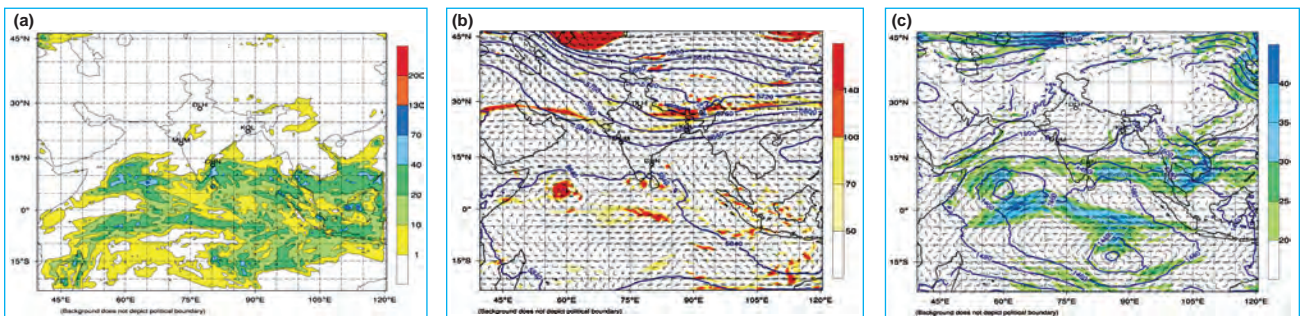
NCEP GFS T-382 (including Global Data assimilation) was implemented at IMD in January 2010.



Figs. 4.31(a-c). (a) IMD GFS (T382) MSL pressure (hPa) forecast (24 hr) based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010, (b) IMD GFS (T382) 24 hours rainfall (mm) forecast based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010 and (c) IMD GFS (T382) 700 hPa wind (kt) forecast (144 h) based on 12 UTC of 30.11.2010 valid for 12 UTC of 06.12.2010

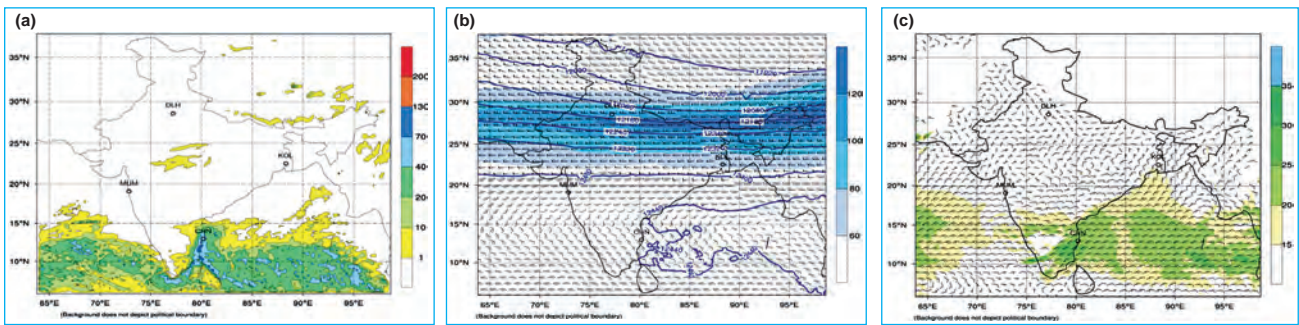
- NCAR mesoscale model WRF with 3 DVAR data assimilation was implemented at IMD with the resolution of 27 km, 9 km and 3 km in May 2010.

WRF-VAR - 27 km Resolution



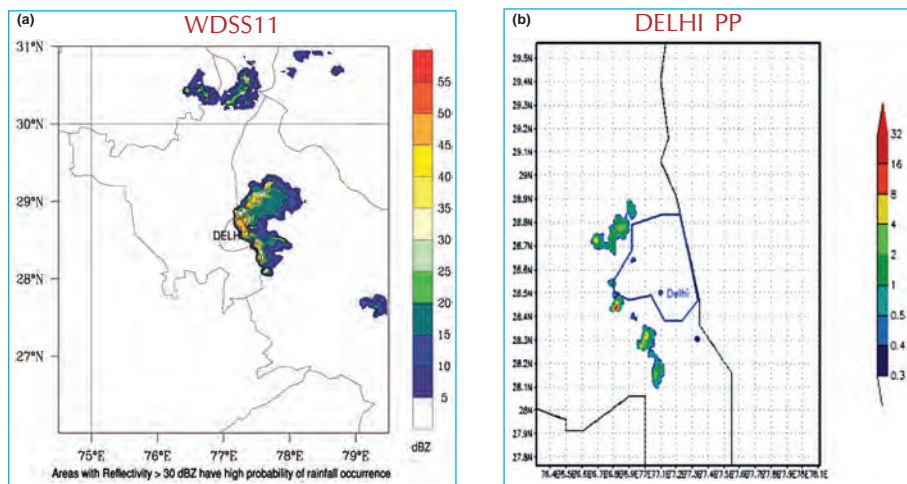
Figs. 4.32(a-c). (a) IMD New Delhi WRF (27 km) rainfall (mm) forecast (24 hr) Based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010 (b) IMD New Delhi 500 hPa WRF (27 km) forecast (72 hr) Geop. Height(m), wind (kt) & vorticity ($10^{-5}s^{-1}$) based on 12 UTC of 30.11.2010 valid for 12 UTC of 03.12.2010 and (c) IMD New Delhi 850 hPa WRF (27 km) (48 hrs) Geop. height (m), wind (kt) & isotach based on 12 UTC of 30.11.2010 valid for 12 UTC of 02.12.2010

WRF-VAR - 09 km Resolution

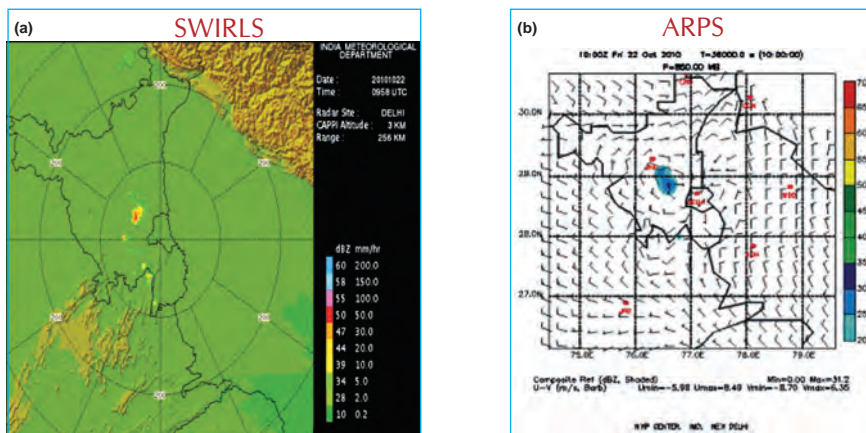


Figs. 4.33(a-c). (a) IMD New Delhi WRF (09 km) rainfall (mm) forecast (48 hr) based on 12 UTC of 30.11.2010 valid for 12 UTC of 02.12.2010, (b) IMD New Delhi 200 hPa WRF (09 km) forecast (72 hr) Geop. height (m), Wind (kt) & Isotach based on 12 UTC of 30.11.2010 valid for 12 UTC of 03.12.2010 and (c) IMD New Delhi 925 hPa WRF (09km) forecast (24 hr) wind (kt) & Isotach based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010

- Nowcast System and venue specific forecasts based on meso-scale model with the assimilation of Delhi Doppler Weather Radar Observation was implemented to support weather forecast system for Delhi Commonwealth Games 2010.

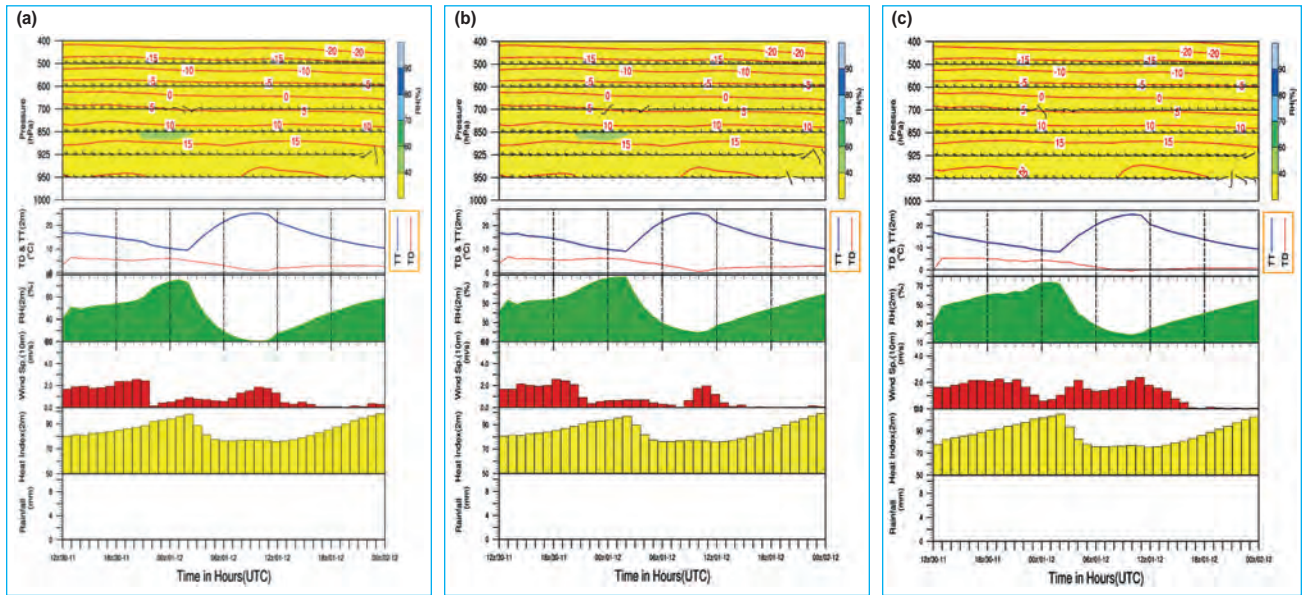


Figs. 4.34(a&b). (a) IMD WDS11 60 min reflectivity forecast for Delhi and neighbourhood based on 22.10.2010 at 1618 IST [Adopted from NSSL, USA (Based on Delhi radar data)]. (b) IMD nowcast (Delhi PP) 0000 min precipitation rate (mm/hr) valid for 22.10.2010 at 1040 UTC



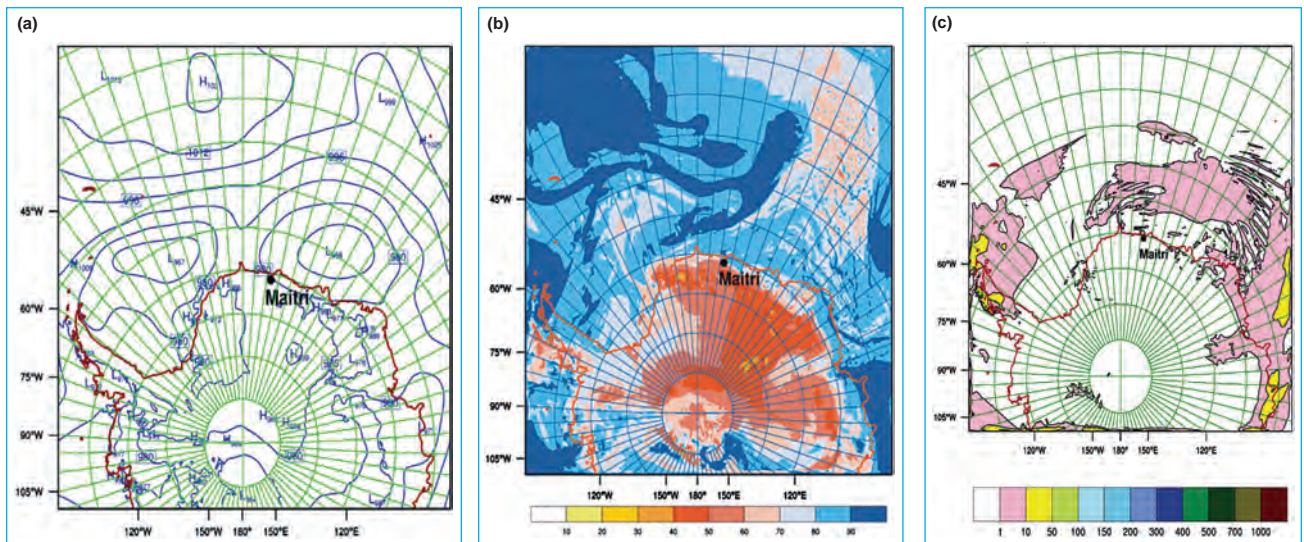
Figs. 4.35(a&b). (a) SWIRLS (b) Next update at 1700 IST IMD ARPS 850 hPa wind (kts) & reflectivity (dBZ) forecast based on 1530 IST valid for next three hours

Meteograms CWG Venues & Location Specific
WRF-VAD-3km resolution

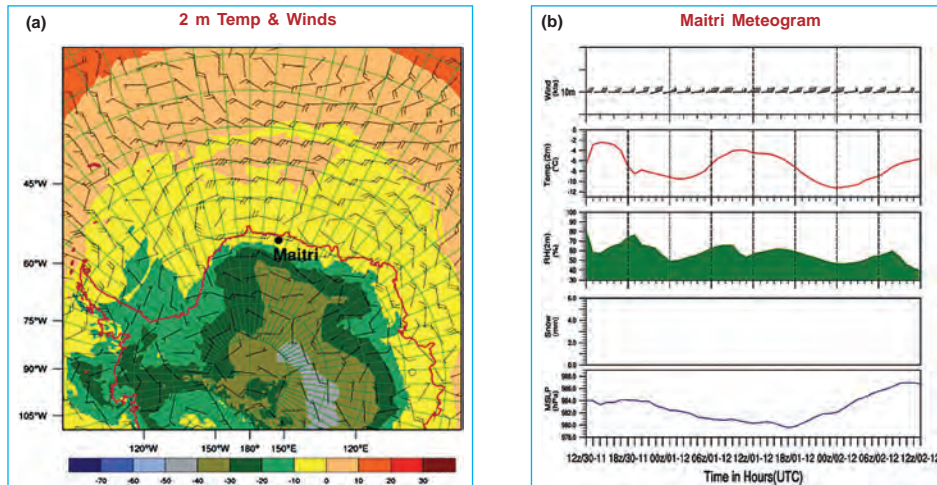


Figs. 4.36(a-c). (a) JLN Stadium 12 UTC/30.11.2010 (b) IG Stadium 12 UTC/30.11.2010 (c) Rohtak 12 UTC/30.11.2010

- Polar WRF for predicting weather conditions over Antarctica (Maitri) was implemented in October 2010

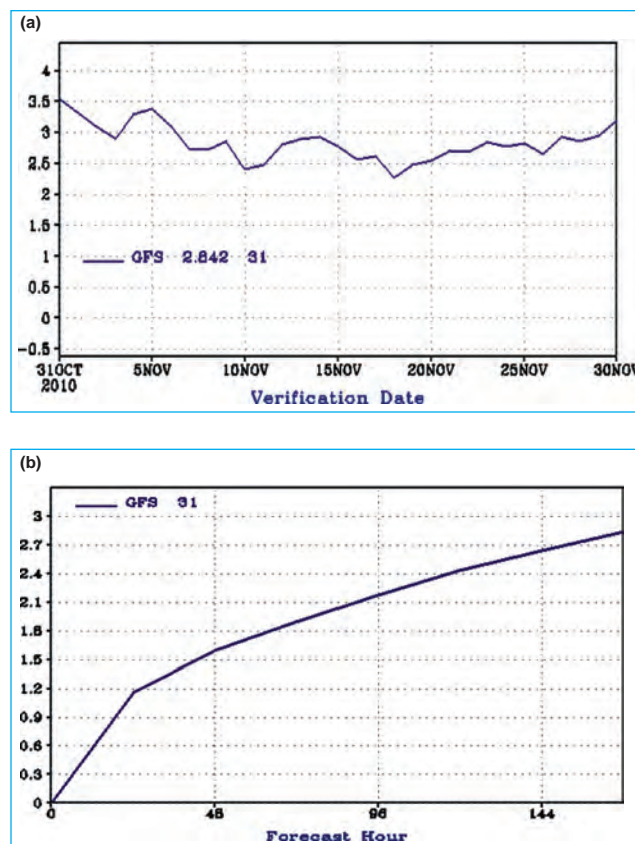


Figs. 4.37(a-c). (a) IMD New Delhi polar WRF (15 km) Analysis mean sea level pressure (hPa) at 12 UTC of 30.11.2010 (b) IMD New Delhi polar WRF (15 km) forecast (24 hr) 2 m relative humidity (%) based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010 (c) IMD New Delhi Polar WRF (15 km) forecast (48 hr) snow (mm) based on 12 UTC of 30.11.2010 valid for 12 UTC of 02.12.2010.



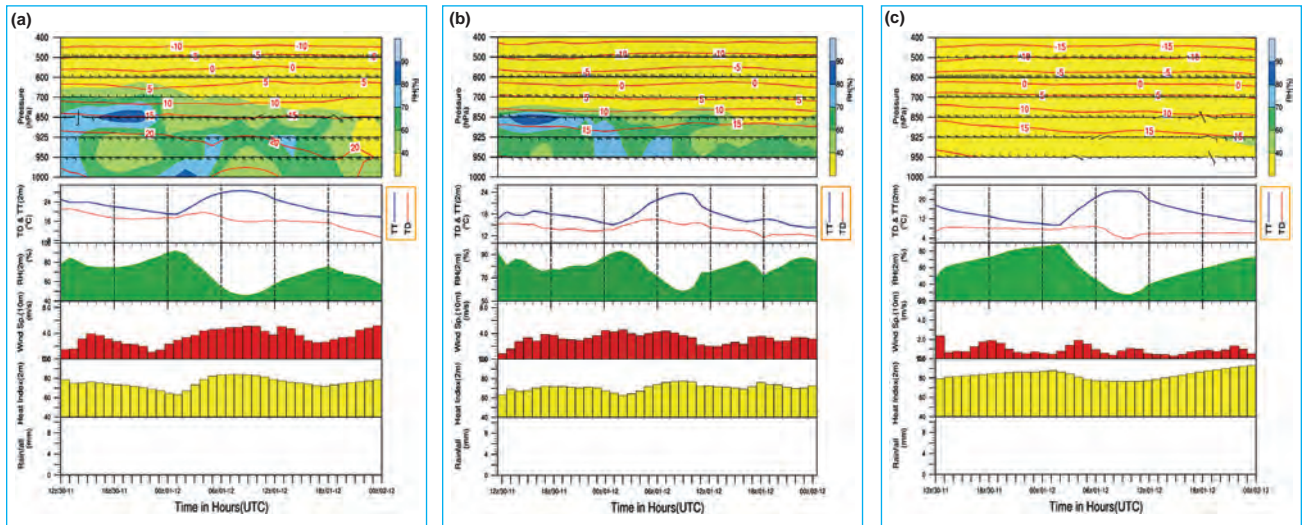
Figs. 4.38(a&b). (a) IMD New Delhi Polar WRF (15 km) forecast (24 hr) 10 m wind (kts) & 2 m Temp. (°C) based on 12 UTC of 30.11.2010 valid for 12 UTC of 01.12.2010 and (b) Maitri (Lat. 70°45'S Lon. 11°44'E) Meteogram 12 UTC of 30.11.2010

- Online GFS verification system is implemented in October 2010



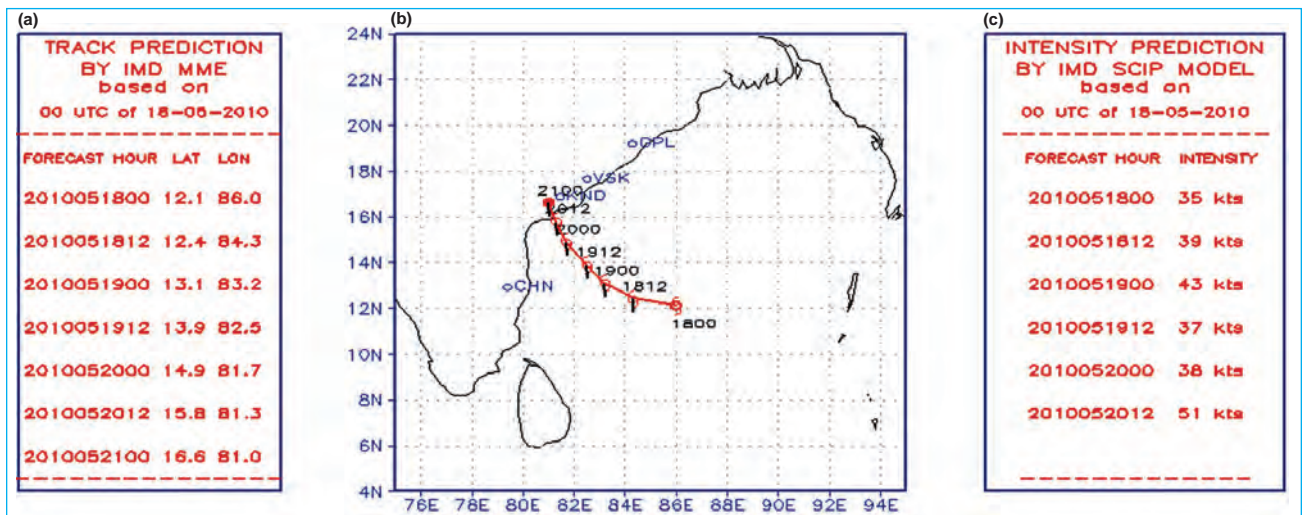
Figs. 4.39(a&b). (a) RMS Err: U P1000 G2/RSM 00 UTC, Day 7 and (b) Mean RMS Err: U P1000 G2/RSM 00 UTC. 31.10.2010-30.11.2010

- Location Specific Forecasts for major Airports based on WRF-VAR (9 km resolution) was implemented in November, 2010



Figs. 4.40(a-c). Meteorgrams (a) Bhubaneswar 12 UTC/30.11.2010, (b) Guwahati 12 UTC/30.11.2010 and (c) Lucknow 12 UTC/30.11.2010

- Track forecasts for the Bay Cyclone Laila of May 2010 by multimodel ensemble approach



Figs. 4.41(a-c). Track prediction by IMD multimodel ensemble (MME) based on 00 UTC of 18.05.2010

4.9. FOG MONITORING & FORECASTING FOR WINTER (DEC-JAN) 2010-2011

Though IGI Airport had no dense fog during December 2009, but beginning month January 2010 had experienced total of 172 hours of dense fog. Visibility reduced less than 200m, an unusual highest hours for any January since 1960. It disrupted the aviation service at IGI Airport severely causing diversion of around two

hundred seventeen flights and cancellation of nearly thousand flights.

Dense fog spell during 2010-2011 was developed very late and was first observed over small pocket covering extreme North Rajasthan and adjoining region of Punjab and Haryana. It was then advected to NCR Delhi and parts of west Uttar Pradesh during 24-27 Dec, 2010. The fog conditions further intensified and covered whole Indo-Gangetic plains including east Uttar Pradesh, Bihar and West Bengal by 1st week of January due to fairly widespread rain/snow over North

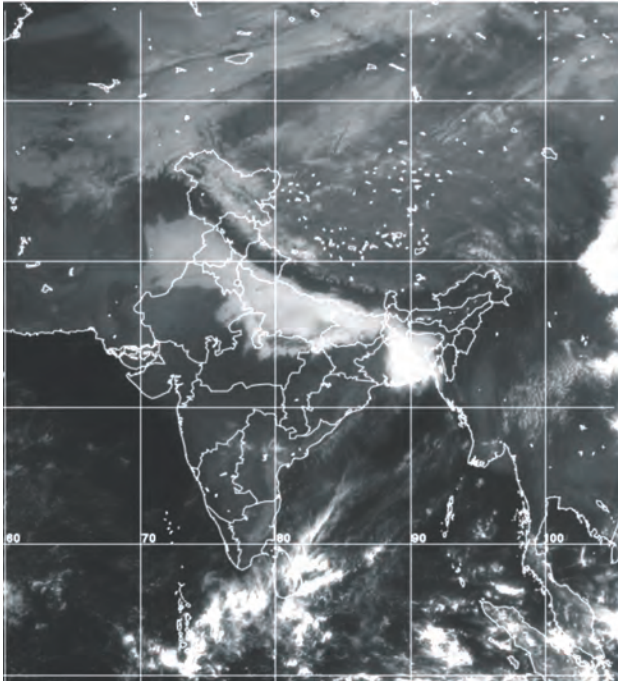


Fig. 4.42. Kalpana – 1 VIS Imagery (18th Jan 2010)

India during 28-31 Dec when an active western disturbance affected the region during the period. The whole Indo-Gangetic plains remained under the thick blanket of dense fog during 1-10 January. IGI airport alone had diversion of nearly seventy flights and cancellation and delay of hundreds. Thereafter, it started receding from western part including Delhi and then from eastern part by 13 Jan 2011 and completely dissipated on 15 Jan. By the time large-scale fog dissipated from the Northern plains of the country.

Afterwards, just on the last day of January, a case of freak dense fog was observed only at IGI airport of Delhi on 31 Jan morning. On real time basis it has been able to forecast this particular freak dense fog case 10-hours well in advance. It was only radiation fog as air temp was fallen below 7 deg C from 1200 UTC to 2100 UTC with wind speed from 8 knots to calm. In totality,

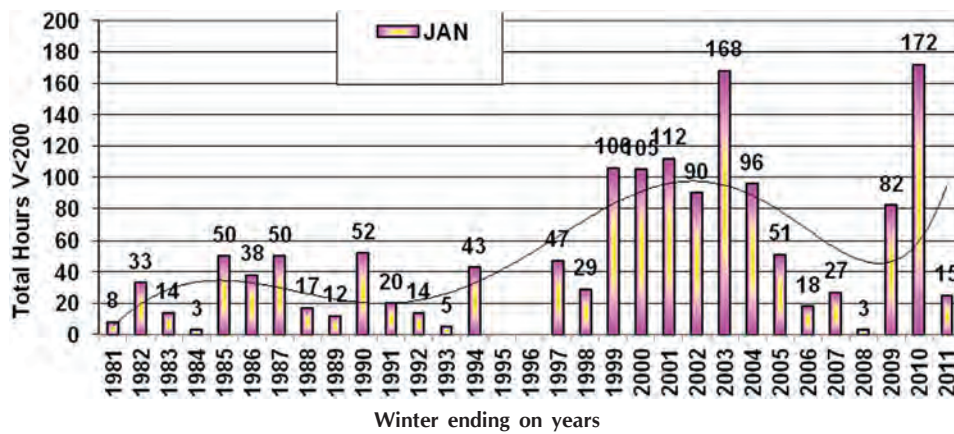


Fig. 4.43. Frequency of total duration of fog for January (vis. <200m)

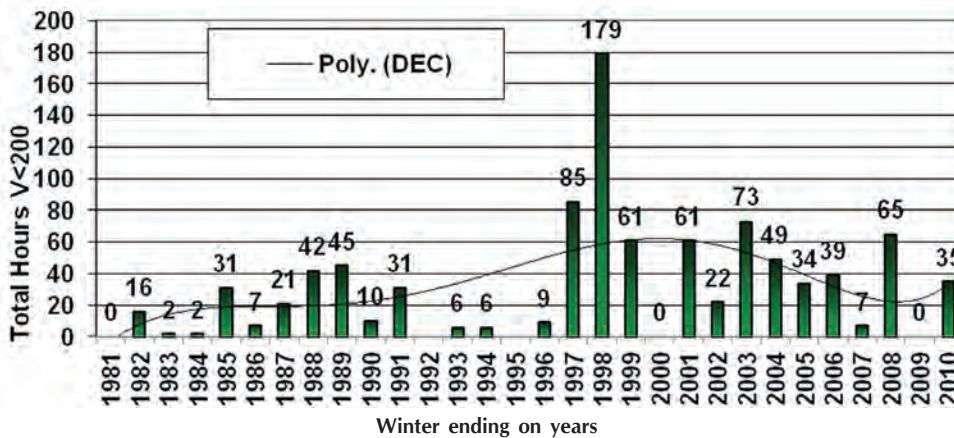


Fig. 4.44. Frequency of total duration of fog for December (vis. <200m)

this peak fog season ended in 55 hours of CAT-III dense fog. This has been the third lowest season of CAT-III dense fog if fog records of IGI Delhi is considered with data since 1996. The lowest was 2007-2008 with 10 hours and 2nd lowest was 2005-2007 with 52 hours.

Besides providing instantaneous RVR of IGI through its website, IMD has implemented a further improved and efficient on-line Fog monitoring system this season by making on-line availability of current weather of nearly fifty airports of India updated at each 10-30-minutes (<http://121.241.116.157/Palam1.php>) and hundreds of synoptic stations at each three hours analysed through Synergie Forecast work stations imported from France under modernization which was also complemented with space based INSAT satellite day time fog detection at each 30-minutes and a new technology night time fog detection at real time from MODIS of USA developed by SATMET division of IMD(http://www.imd.gov.in/section/satmet/dynamic/fog_modis). IMD fog forecast system at IGI Airport for 2010-2011 have also captured successfully both at short ranges and medium very well with forecast accuracy

of IGI short fog forecast system at time scale of 18 hours in advance this time reached as high as 94% for December, 2010 and 97% for Jan 2011. The frequency of total duration of fog when visibility came down less than 200M wef 1981 as recorded at AMO IGI Airport Palam is presented in Figs 4.43 & 4.44.

4.10. WEATHER AT MAITRI, ANTARCTICA DURING 2010

Synoptic data collected at Maitri (Fig. 4.45), Antarctica every three hours including visibility, sky condition, wind speed and direction, pressure, temperature, weather conditions and snowfall, if any. Aerosol optical thickness observations are also regularly taken. Radiation parameters, global radiation and diffuse radiation were continuously recorded. Synoptic charts and satellite pictures were also collected regularly. IMD lab was provided with Internet connection which enabled timely transmission of synoptic messages from Maitri and real time transmission of Main Synoptic Hours Observation, AWS data, collection of weather data and information

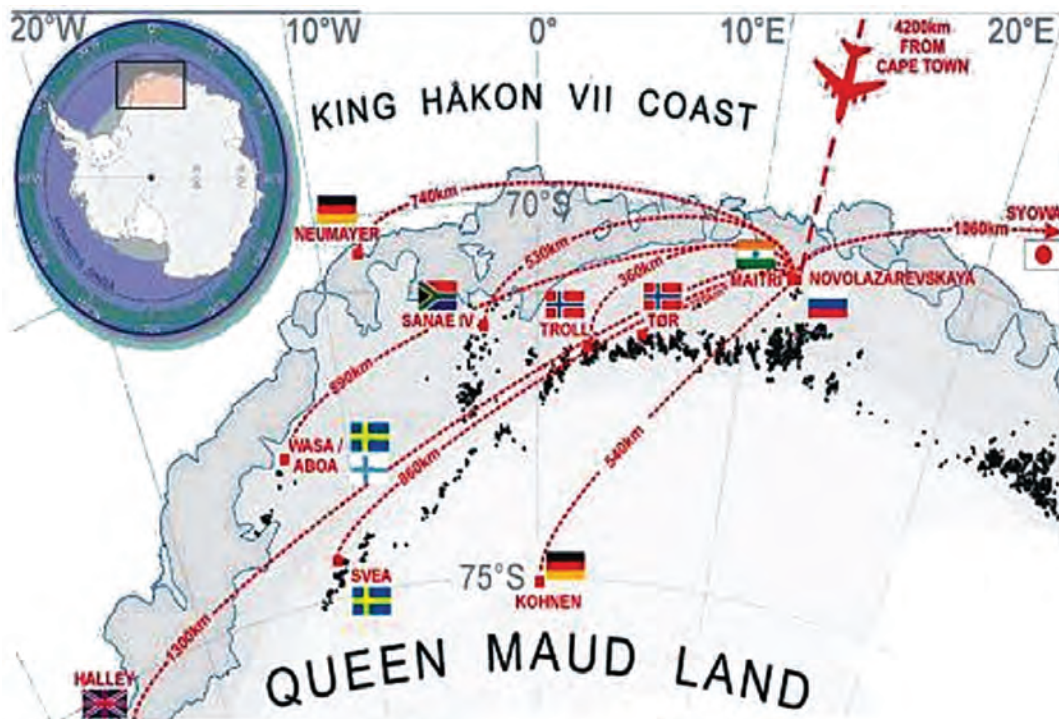


Fig. 4.45. Map showing location of Maitri at Antarctica

The extreme values of meteorological parameters of the year 2010		
1.	Lowest Temperature recorded	-31.6°C on 7.7.2010
2.	Highest Temperature recorded	+07.7 on 23.01.2010
3.	Maximum gust	92 knots on 17.04.2010
4.	Number of Blizzards	10
5.	Lengthiest Blizzard	30 hours (20 to 21 Jul 2010)
6.	Total Snowfall	048.2 mm

Mean Monthly Average of Meteorological Parameters recorded during 2010												
	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10
Avg MSL	0992.0	0989.7	0986.2	0986.6	0990.2	0982.8	0980.5	0980.9	0985.7	0981.7	0981.1	0991.0
Highest MSL	0998.1	1005.2	1001.6	1007.6	1024.1	0995.5	0999.8	0999.3	1006.9	0999.9	1005.4	1007.8
Lowest MSL	0971.4	0967.1	0970.9	0965.8	0955.6	0972.7	0959.4	0960.3	0959.1	0936.2	0966.5	0979.6
Avg Temp	01.3	-01.7	-07.0	-11.4	-15.9	-18.7	-19.8	-19.9	-16.2	-13.5	-05.5	-01.1
Max Temp	07.7	05.0	-01.8	-03.5	-06.6	-10.6	-07.0	-06.9	-03.2	-02.5	04.4	06.1
Min Temp	-03.9	-10.3	-14.4	-20.8	-26.8	-27.6	-31.9	-30.0	-28.2	-23.2	-12.6	-09.7
Avg Max	03.9	00.7	-04.5	-09.0	-12.5	-15.6	-16.7	-16.5	-12.5	-10.2	-02.3	02.0
Avg Min	-01.9	-03.6	-09.3	-14.3	-18.3	-21.9	-23.1	-23.7	-21.0	-17.4	-08.9	-03.5
Avg kts	14.0	16.0	20.0	16.0	08.0	09.0	12.0	11.0	11.0	12.0	12.0	14.0
Xgust	53.0	64.0	64.0	92.0	66.0	70.0	88.0	88.0	72.0	90.0	66.0	80.0
No of > 23 kts	28.0	22.0	22.0	15.0	08.0	08.0	17.0	13.0	14.0	11.0	13.0	06.0
No.of Blizzards	0	0	1	2	2	1	3	1	0	0	0	00.0
No. of days with pptn	7	6	6	5	9	3	7	1	2	4	8	01.0

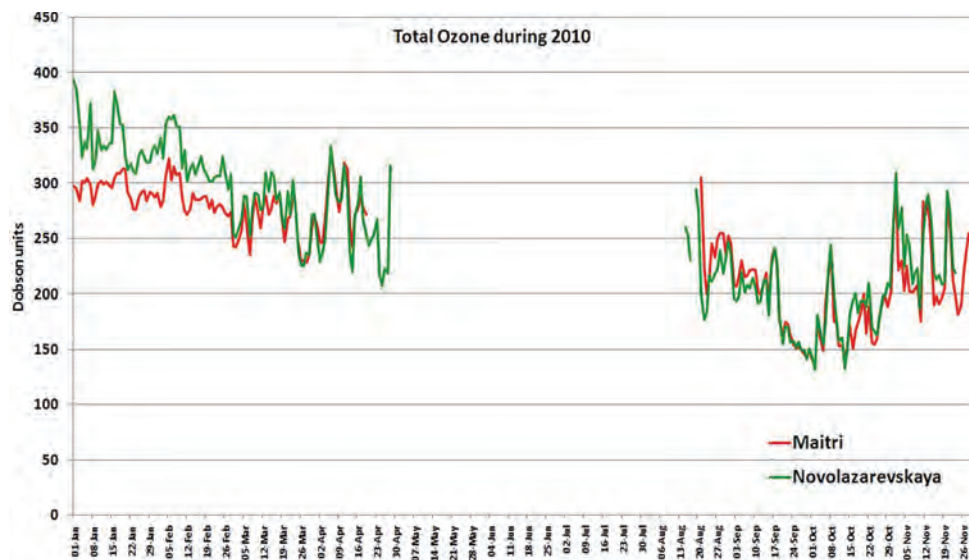


Fig. 4.46. Total Ozone during 2010



Fig. 4.47. *Blizzard at Maitri*

like satellite images etc. A brief meteorological parameters as recorded at Maitri are mentioned in Table on prepage.

Measurement of Total Ozone

Since Brewer spectrophotometer was back loaded for servicing, total column ozone data was obtained from NASA- TOMS website and also total ozone data exchanged with Russian station Novolazarevskaya. These two values, one measured from ground based equipment at Novolazarevskaya station and another over Maitri station from TOMS (Total Ozone Mapping System) from satellite are very much matching and the variations in the total ozone concentration are also very well matching. Fig. 4.46.

Blizzards during 2010

Blizzards are a typical Antarctic phenomenon occurring when drift snow is picked up and blown along the surface by the violent winds. Blinding conditions can result in which objects less than 3 feet away may be invisible Fig. 4.47. Localized blizzards are caused when the surface wind sweeps up any loose snow, even if the

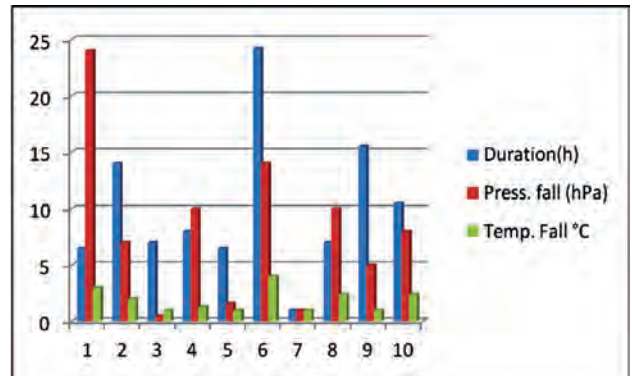


Fig. 4.48 *Intensity of each Blizzard*

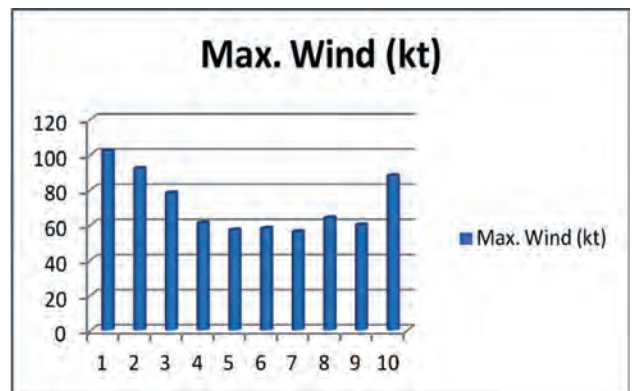


Fig. 4.49 *Max. Wind Gust during Blizzard*

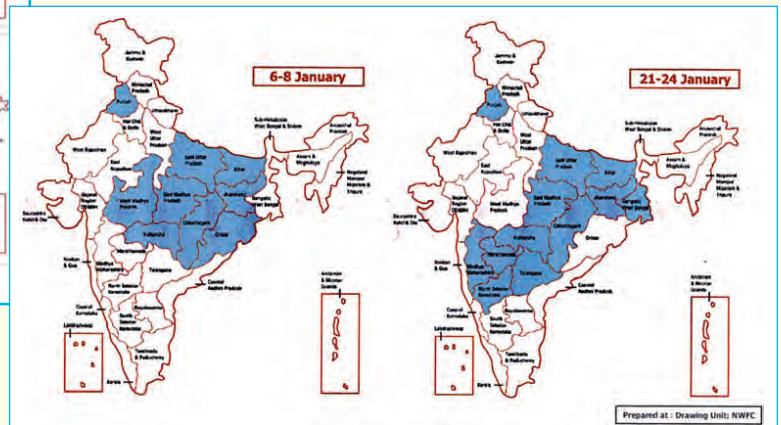
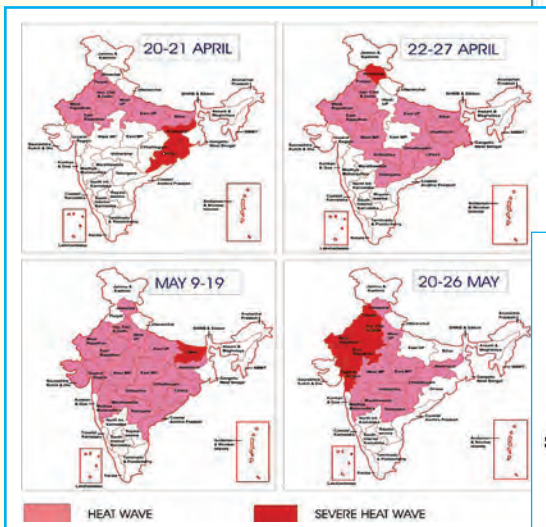
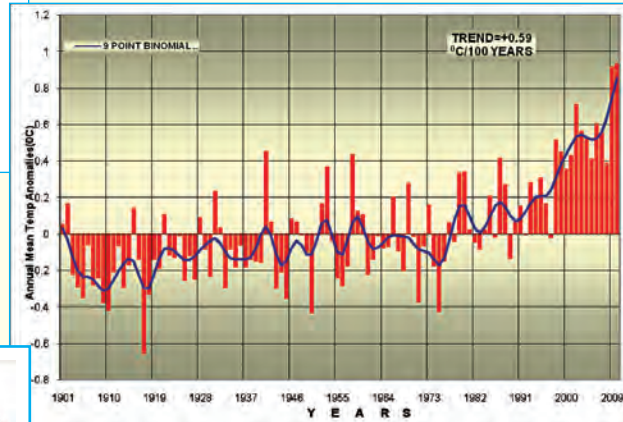
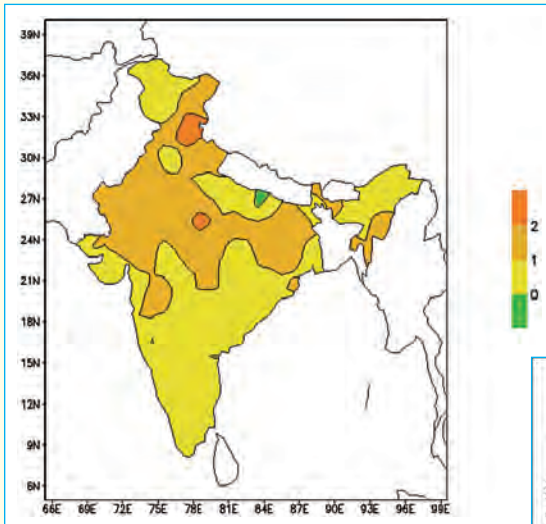
skies above are clear and no snow is falling. A severe blizzard may last for a week at a time with winds blasting at over 100 miles per hour. Eight to ten blizzards a year are not uncommon to coastal areas, and they bring any human outdoor activity to a standstill.

During the year 2010 ten blizzards have occurred, longest duration of blizzard occurred in June which is the peak winter month at Maitri. This year maximum wind gust 102 kts reported in the month of March whereas maximum number of blizzard day was experienced in July. This year was very unusual year as no blizzard was reported during Jan, Feb, Sep, Oct, Nov & Dec. History of each blizzards are presented graphically (Figs. 4.48 & 4.49).



5

CLIMATE SCENARIO



CLIMATE SCENARIO

Climate Scenario : Is India Warming

Mean annual temperature for the country as a whole during 2010 was $+0.93^{\circ}\text{C}$ above the 1961-1990 average. It was slightly higher than that of the year 2009, thus making the year 2010 as the warmest year on record since 1901. Considering different seasons, Pre-monsoon season (March-May) in 2010 was the warmest since 1901 with mean temperature being 1.8°C above normal. The Characteristic features of temperature and salient weather conditions over India during 2010 are described below.

Temperature

Annual Mean Temperature

In 2010, annual mean temperature averaged over the country as a whole was $+0.93^{\circ}\text{C}$ above the 1961-1990 average (Fig. 5.1). The year 2010 was the warmest year on record since 1901. The other warmer years on record in order are 2009 (0.92), 2002(0.71), 2006(0.6), 2003(0.560), 2007 (0.553),

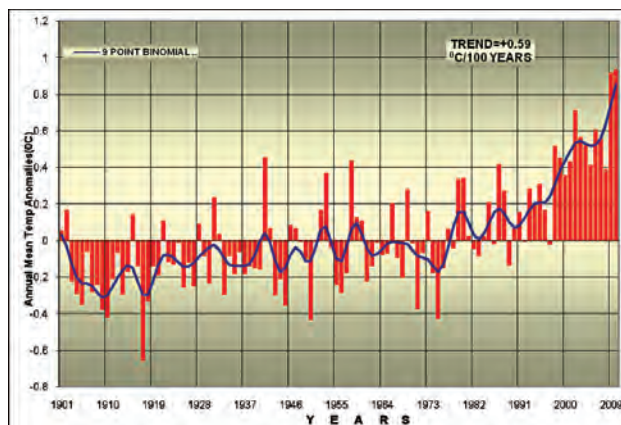


Fig. 5.1. Annual mean temperature anomaly (Departure from normal)

2004 (0.515), 1998 (0.514), 1941 (0.448), 1999 (0.445), 1958 (0.435), 2001 (0.429) and 1987 (0.413). Details are given in Table 5.1. Spatial pattern of annual mean temperature anomaly and annual mean max. & min temperature anomalies over India during 2010 (Fig. 5.2. & 5.3).

TABLE 5.1. Temperature ranking 2001-2010			
	Year	Temperature ($^{\circ}\text{C}$)	Anomaly ($^{\circ}\text{C}$)
Warmest	2010	25.8023	0.9319
2	2009	25.7876	0.9172
3	2002	25.7366	0.7084
4	2006	25.5024	0.6016
5	2003	25.4720	0.5600
6	2007	25.4430	0.5528
7	2004	25.4232	0.5143
8	2001	25.3848	0.4292
9	2005	25.2800	0.4096
Coldest	2008	25.2562	0.3857

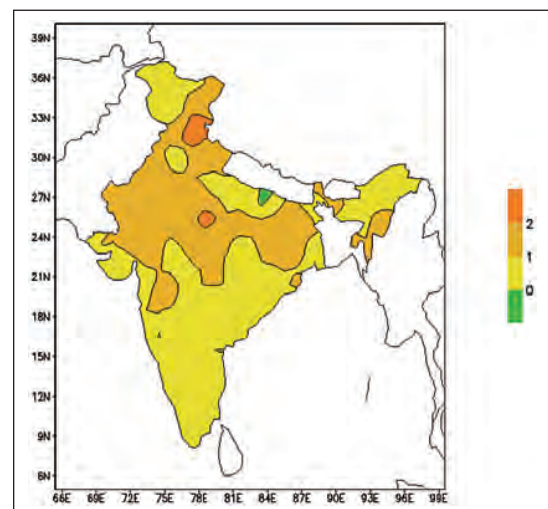
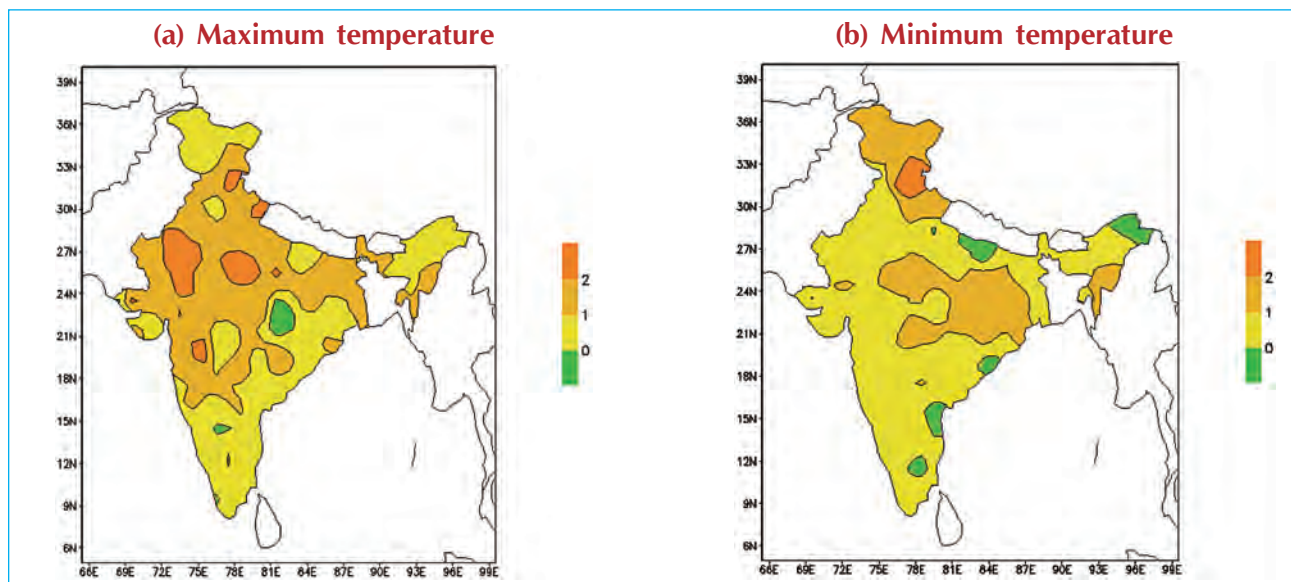
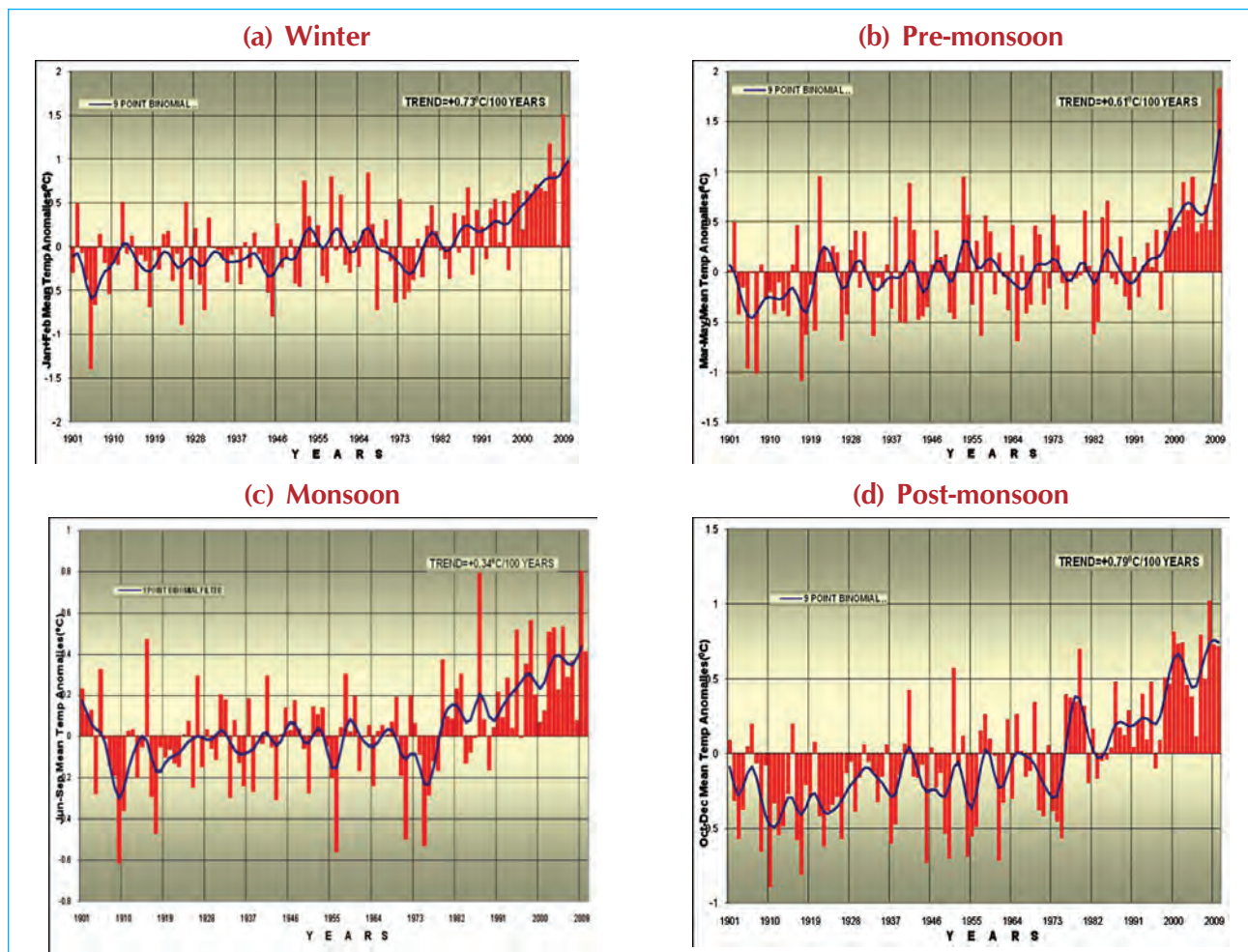


Fig. 5.2. Spatial pattern of annual mean temperature anomaly



Figs. 5.3(a&b). Annual mean (a) maximum and (b) minimum temperature anomalies (Departure from normal) over India during 2010



Figs. 5.4(a-d). Mean temperature anomaly (Departure from normal) of India during (a) winter and (b) pre-monsoon season (c) monsoon and (d) post-monsoon season

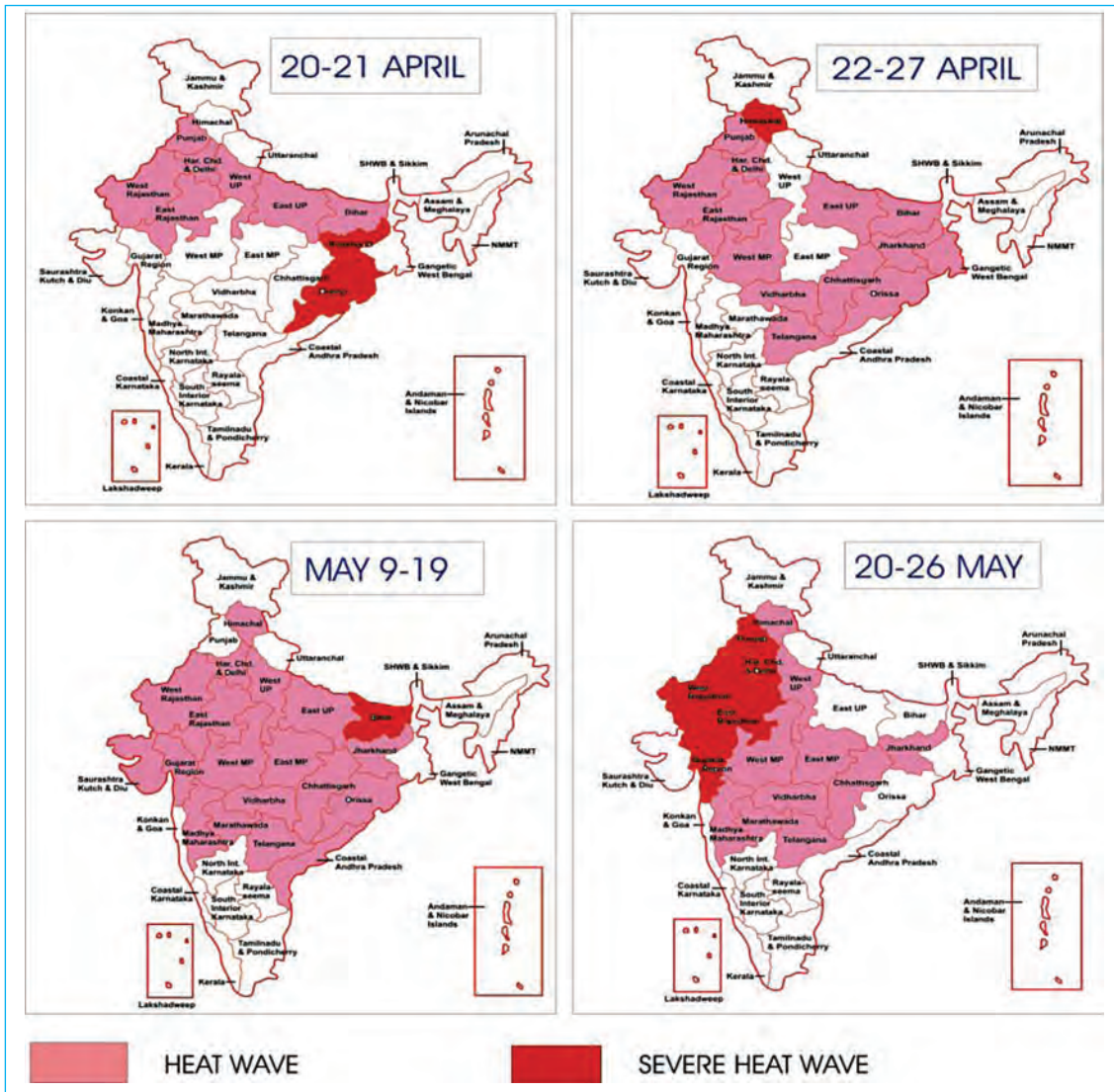


Fig. 5.5. Significant heat wave conditions over India during April and May 2010

Seasonal Mean Temperature

Trends in mean temperature for different seasons viz., winter (Jan to Feb), pre-monsoon (Mar to May), monsoon (June to Sep) and post-monsoon (Oct to Dec) seasons are shown in (Fig. 5.4). Pre-monsoon season in 2010 was the warmest since 1901 with mean temperature being 1.8° C above normal.

Monthly Mean Temperature

Mean monthly temperature over the country as a whole was the highest since 1901 for March (2.27° C), April (2.02° C) and November (1.17° C) 2010 and the second highest for May 2010

(1.17° C). Abnormal warm conditions (minimum temperature exceeding the normal by 5° C on many days) prevailed over the peninsular/central parts during November making it record warmest since 1901.

Both maximum and minimum temperatures contributed to record warming of March, April and May months, while above normal minimum temperatures were apparently responsible for record high temperature in November.

The mean temperature during this decade i.e. 1901-2010 has been the warmest decade with a temperature anomaly of 0.4°C.

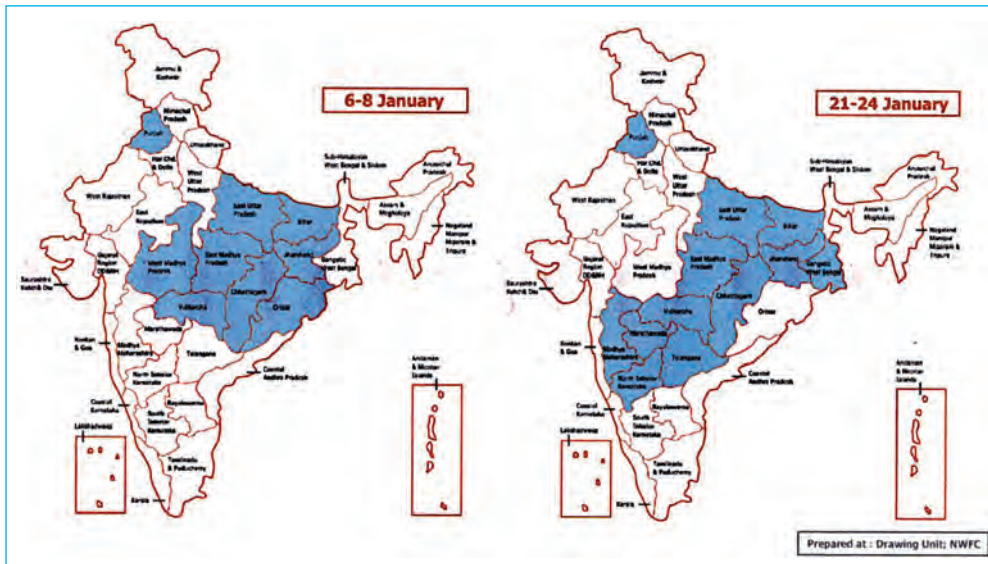


Fig. 5.6. Significant cold wave spells during January 2010

Heat Wave

Abnormally warm conditions (heat wave) prevailed over major parts of the country during pre monsoon months. Temperature over northwestern/Northern and central parts of the country was 3 to 5°C above normal in the second fortnight of March and in April. During May, mean temperature over northwestern/Northern and central parts of the country was 4 to 6°C above normal. These heat wave conditions claimed more than 300 lives. Significant heat wave spells are shown in Fig. 5.5.

Cold Wave

Severe cold wave conditions prevailed over northern plains in January and during first fortnight of February. Maximum temperature over a number of stations over the northern plains was 5 to 10°C below normal on many occasions during January. Cold wave conditions claimed more than 600 lives.

Significant cold wave spells during January 2010 are shown in Fig. 5.6.

Climate Change Reflection

Analysis of data for the period 1901-2005 suggests that annual mean temperature for the country as a whole has risen to 0.51° C over the period. It

may be mentioned that annual mean temperature has been consistently above normal (normal based on period, 1961-1990) since 1993. This warming is primarily due to rise in maximum temperature across the country, over a larger parts of the data set. However, since 1990, minimum temperature is steadily rising and rate of its rise is slightly more than that of maximum temperature.

Spatial pattern of trends in the mean annual temperature shows significant positive (increasing) trend over most parts of the country except over parts of Rajasthan, Gujarat and Bihar, where significant negative (decreasing) trends were observed.

Season-wise, maximum rise in mean temperature was observed during the Post-monsoon season (0.7°C) followed by Winter season (0.67°C), Pre-monsoon season (0.50°C) and Monsoon season (0.30°C). During the winter season, since 1991, rise in minimum temperature is appreciably higher than that of maximum temperature over northern plains. This may be due to pollution leading to frequent occurrences of fog.

Upper air temperatures have shown an increasing trend in the lower troposphere, and this trend is significant at 850 hPa level, while decreasing trend (not significant) was observed in the upper troposphere.



6

ACTIVITIES



ACTIVITIES

CELEBRATION OF IMD FOUNDATION DAY

In the history of India Meteorological Department, 15th January 1875 is a momentous day, as on this day Mr. H.F. Blanford took charge as the Meteorological Reporter to the Govt. of India. IMD considered 15th January as an opportune moment to highlight its achievements and pathway for future development.

During 135 year of its existence, IMD has contributed immensely for the development of Science of Meteorology over the sub-continent.

The department has served the cause of safety and well being of Indian population against weather related hazards and to economic development of the country. Shri Prithviraj Chavan, the then Hon'ble Minister of Science & Technology and Earth Sciences was Chief Guest of the function. On this occasion Shri Chavan inaugurated the High Power Computing System (HPCS) installed at NHAC, New Delhi.



Dr Shailesh Nayak, Secretary, MoES addressing the audience

Dr. Shailesh Nayak, Secretary, MoES enumerated the achievements of IMD. He also emphasized that efforts should be made to bring the best brains to IMD. Dr. R. R. Kelkar stressed the need for self assessment and development of indigenous numerical models instead of dependency on foreign models.



AVM (Dr.) Ajit Tyagi, DGM briefing Media about HPCS

AVM (Dr.) Ajit Tyagi, DG, IMD extended his gratitude for seniors of the department and highlighted important landmarks of completion of modernization Phase-1 programme to improve forecasting as well as computational capability. The system is capable of running high resolution global, regional and local numerical weather prediction Models on 24 × 7 basis which will further lead to improved weather & climate services from very short range to long range scale for the country.

EXHIBITIONS

Indian Science Congress

The 97th Indian Science Congress (ISC) 2010 Science Exhibition was held at University of Kerala, Karyavattom Campus, Thiruvananthapuram from January 3-7, 2010. Under the guidance of Shri K. Santhosh, Director, Met. Centre, Thiruvananthapuram made all arrangements for the display of exhibits from India Meteorological Department in the pavilion of Ministry of Earth Sciences, which was inaugurated by the then Hon'ble Minister Shri Prithviraj Chavan. The visitors were explained in details about the exhibition. Shri Bhullar, AM-II participated from DDGM(UI) Office, New Delhi. About 2,00,000 people visited the pavilion during the five days and MoES was one of the major exhibitors.



Hon'ble Minister Shri Prithviraj Chavan, Secretary MoES and Dr. G. Madhavan Nair, Former Chairman of ISRO

Science Exhibition

Northern India International Trade Fair (NIITF 10)

IMD participated in Northern India International Trade Fair (NIITF 10) from 19th to 26th January, 2010 at Kanpur (U.P.), "Science & Rural Technology Expo-2010" 1st Destination Rajasthan 2010 from 12th to 14th February & in "Oceantex, Ener Tech, Shipping Marine & Ports World Expo 2010" from 3rd to 6th March 2010.

Tropmet 2010

During the Seminar 'TROPMET 2010' organized by IMS from 19-21 May 2010, a Science Exhibition was also organized at Kolkata Information Centre. Several manufacturing companies, IT sectors, other



Exhibition at Kolkata Information Centre

corporate houses and Government organizations participated in this Exhibition and displayed their products, information, posters etc.

8th Infra Educa 2010

Shri J. P. S. Bhullar, A.M.-II of ITC participated in "8th Infra Educa - 2010" organized by Friendz Exhibition & Promotions Pvt. Ltd., New Delhi on 29 to 30 May 2010 at Pragati Maidan, New Delhi.

Exhibition at Shimla

An Exhibition was conducted at Reckong Peo, District Kinnur for Awareness of Bharat Nirman Jan Suchna Abhian organized by the Govt of India, PTI, Shimla from 12th to 15th July 2010. An exhibition was installed in the "State Level Children Congress-2010" at Senior Secondary School, Hamirpur (HP) from 14th to 17th November 2010.



*Oceanex Ener TECH, Shipping Marine & Ports
World Expo 2010*



Exhibition at Shimla

Projects Evaluation

Three hundred sixty six (366) Thermal Power & Coal, Three hundred twenty two (322) Industrial and Five hundred thirty six (536) Mining projects referred to this Department by the Ministry of Environment & Forests, New Delhi were evaluated by EMRC.

APEC Unit also evaluated scientific Project Proposals received from DST. In this year nine Scientific Research Project Reports have been evaluated by IMD scientists.

India Meteorological Department

SPORTS

Inter Ministerial Bridge Tournament

IMD Bridge Team won the winners trophy of team championship and also won the winners/ runners trophy of pair event in Inter-Ministry Bridge Tournament 2009-10 conducted by Central Civil Services Cultural and Sports Board during 13-14 March 2010.

Inter Ministerial Cultural Competition

Five Members IMD Team lead by Team Manager, Smt. Jiga Kaul participated in inter ministry music, dance & short play competition 2009-10 held from 22-25 February at Mavlankar Auditorium, New Delhi conducted by Central Civil Services Cultural and Sports Board. The IMD team stood up runner.



DG, IMD with Cultural Team Members

M. B. More Memorial Tournament

M. B. More memorial tournament was held from 22nd to 26th March 2010 in Pune. Six teams of



IMD officers with Trophies

IMD consisting of about 96 players from different corners of India participated in this Tournament. The Opening ceremony was held on 22nd March. Dr. H. R. Hatwar, ADGM(R) and all other Head of the offices of IMD Pune were also present on this occasion. The Ammunition Factory, Kirkee, Pune was declared Winner whereas IMD Pune was runners up during the Tournament.

संसदीय राजभाषा समिति द्वारा निरीक्षण

मौसम विज्ञान विभाग (मुख्यालय) का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 8 अप्रैल 2010 को भारत मौसम विज्ञान विभाग (मुख्यालय) का निरीक्षण किया गया जिसमें ए. वी. एम. (डॉ.) अजित त्यागी, महानिदेशक, श्री ए. के. भटनागर, मौ.वि.अ.म.नि., श्री राजीव शर्मा, मौ.वि.उ.म.नि. (प्र. एवं भंडार) तथा अन्य अधिकारीगण उपस्थित थे। संसदीय राजभाषा समिति के सभी प्रश्नों के यथोचित एवं संतुष्टकारक उत्तर दिए गए। उपसमिति के संयोजक डॉ. प्रसन्न कुमार पाटसाणी, संसद सदस्य, ने धन्यवाद देते हुए आशा व्यक्त की कि महानिदेशक डॉ. अजित त्यागी के कुशल नेतृत्व में राजभाषा प्रयोग की गति उत्तरोत्तर अग्रसर रहेगी।

कोडईकेनाल का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा मौसम कार्यालय कोडईकेनाल का निरीक्षण दिनांक 8 जुलाई 2010 को किया गया। श्री ए. के. भटनागर, डॉ. एल. एस. राठोर, श्री वाई. ई. ए. राज, श्रीमती मंजुला मेहता, सु.श्री रेवा शर्मा और अनुराधा राव ने उक्त बैठक में भाग लिया।

मौसम कार्यालय, पालम का निरीक्षण

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 1 अक्टूबर 2010 को मौसम कार्यालय, पालम तथा दिनांक 1 नवंबर 2010 को मौसम कार्यालय सफदरजंग का निरीक्षण किया गया। महानिदेशक महोदय ए.वी.एम. डॉ. अजित त्यागी और सुश्री रेवा शर्मा, वरिष्ठ हिन्दी अधिकारी समिति के निरीक्षण के दौरान उपस्थित रहे। निरीक्षण के दौरान मौसम कार्यालय सफदरजंग की हिन्दी में अधिकतर कार्य करने के लिए सराहना की गई।

हिन्दी पखवाड़ा का आयोजन

भारत मौसम विज्ञान विभाग, मुख्यालय में यह समारोह 14 सितम्बर 2010 को मुख्यालय के सेमिनार हाल में आयोजित किया गया। समारोह की अध्यक्षता



संसदीय राजभाषा समिति के सदस्य एवं भारत मौसम विज्ञान विभाग के महानिदेशक के साथ अन्य अधिकारीगण

मौसम विज्ञान के महानिदेशक ए.वी.एम. डॉ. अजित त्यागी ने की। समारोह में सर्वप्रथम वरिष्ठ हिन्दी अधिकारी सुश्री रेवा शर्मा, ने अध्यक्ष महोदय तथा सभी वरिष्ठ अधिकारियों एवं सभागार में उपस्थित सभी कार्मिकों का स्वागत किया। दीप प्रज्ज्वलित करने के पश्चात् विभाग के कार्मिकों ने सरस्वती वन्दना प्रस्तुत की। राजभाषा विभाग गृह मंत्रालय से प्राप्त माननीय गृह मंत्री श्री पी. चिदंबरम जी का संदेश सुश्री रेवा शर्मा, वरिष्ठ हिन्दी अधिकारी ने पढ़ा। स्वागत भाषण के पश्चात् विभाग के कार्मिकों ने शिक्षाप्रद झलकियां, हास्य झलकियां, गीत एवं संगीत का रंगारंग कार्यक्रम प्रस्तुत किया।

हिन्दी में सर्वाधिक पत्राचार करने वाले कार्यालय प्रादेशिक मौसम केन्द्र, नई दिल्ली को राजभाषा चलशील्ड प्रदान की गई, जिसे अध्यक्ष महोदय द्वारा मौसम विज्ञान के उपमहानिदेशक (प्रा. मौ.के.), नई दिल्ली को दिया गया। हिन्दी पखवाड़ा 2010 के दौरान हिन्दी निबन्ध, हिन्दी टिप्पण और मसौदा लेखन, स्वरचित हिन्दी कविता पाठ, हिन्दी वाद विवाद, हिन्दी स्लोगन और कार्टून प्रतियोगिताओं का आयोजन किया गया। इस अवसर पर हिन्दी पत्रिका 'मौसम मंजूषा', अंक 15, 2010 का भी विमोचन किया गया। हिन्दी पखवाड़ा के दौरान विभिन्न प्रतियोगिताओं के विजेताओं को प्रमाण पत्र और नकद पुरस्कार प्रदान किए गए। हिन्दी दिवस समारोह में अखिल भारतीय विभागीय हिन्दी निबन्ध प्रतियोगिता 2010 के विजेताओं को भी प्रमाण पत्र प्रदान किए गए। अपने अध्यक्षीय भाषण में ए.वी.एम. डॉ. अजित त्यागी ने विभाग के सभी कार्मिकों को कार्यालय का काम हिन्दी में करने की सलाह दी तथा राजभाषा के प्रचार-प्रसार में अपना अमूल्य योगदान देने पर भी जोर दिया।

क्षेत्रीय कार्यालयों में हिन्दी पखवाड़ा/हिन्दी दिवस का आयोजन

भारत मौसम विज्ञान विभाग के अंतर्गत आने वाले सभी उप कार्यालयों में हिन्दी दिवस समारोह/हिन्दी पखवाड़ा का आयोजन भी किया गया। एम. सी. थीरुवनन्थापुरम में हिन्दी सप्ताह का आयोजन 7 सितम्बर से 14 सितम्बर तक किया गया जिसमें 6 प्रतियोगिताएं रखी गई थीं। 27 सितम्बर

को प्रमाण पत्र एवं पुरस्कार दिए गए। एम. सी. अहमदाबाद में 1-15 सितम्बर तक हिन्दी पखवाड़ा का आयोजन किया गया। एम. सी. बंगलूरु एवं पी. ए. सी. कोलकता में भी हिन्दी दिवस का आयोजन क्रमशः 15 एवं 20 सितम्बर को किया गया जिसमें हिन्दी निबन्ध, काव्य पाठ एवं सांस्कृतिक कार्यक्रम का आयोजन किया गया।

AWARDS

Certificate of Merit

On occasion of IMD foundation day, mementos and Certificate of Merits were distributed to the veteran weather scientists and young students



Dr. Y.E.A. Raj receiving Certificate of Merit of best RMC, Chennai



DGM with the recipients of certificate of merit award



Shri A.K. Sharma receiving Awards from Dr. Swati Basu

of various schools for best performance in quiz competition. Dr. N. Sen Roy, Ex DGM was presented a shawl as an honour by the Hon'ble Minister. Dr. Y.E.A. Raj, DDGM, Chennai was honoured with the best RMC award for excellent work. Met. Centre, Bhopal has been selected best Met Centre.

On occasion of MoES foundation day 2010, Dr. D. S. Pai, Shri B. P. Yadav and Dr. S. D. Kotal were awarded Certificate of Merit for their outstanding contribution in the field of Atmospheric Sciences. Smt. M.V. Kamble, Scientific Asstt., O/o DDGM(Agrimet.), Pune Shri S. Mondal, Radio Mechanic, RMC, Kolkata, Shri Ram Bahadur Singh, M.A. IMD, New Delhi were conferred best employees award for the year 2010.

Vigyan Bhushan Award

Dr. D.P. Dubey, Scientist 'E' Director, M. C. Bhopal was awarded "Vigyan Bhushan" on 28th November 2010. The award was given by Science Centre, Gwalior (M.P.) on account of contribution in popularization of Science, achievement in Science communication, contribution towards children and community for knowledge of Science.

First Prize for Presentation

Shri Anand Kumar Sharma, Scientist 'E', M. C., Dehradun participated in the national seminar organized by Ministry of Earth Sciences, Government of India, New Delhi and made a presentation on "Effect of weather and climate on Agriculture" on 10th December 2010 and was awarded first prize for the presentation.

Honour of Uttarakhand

Shri Anand Kumar Sharma, Director-in-Charge, Meteorological Centre Dehradun was awarded "Honour of Uttarakhand" for his contribution to society by Forum for Emotional Intelligence learning, Dehradun Chapter at Doon School on 08 June 2010. The programme was funded by Uttarakhand Council for Science and Technology (U-COST) Dehradun.

Awards for excellence to Ship Officers

Awards for excellence in the form of scientific books for 37 Ships Officers of Indian volunteers observing fleet were sent to Directorate of Naval Oceanography and Meteorology, Ministry of Defence, New Delhi and 8 Ship certificates/37 ships officers certificates and 3 citations handed over to Shipping Corporation of India Ltd., Mumbai by DDGM(WF), Pune.



MEMORABLE MOMENTS



Ex-Senior Officers with IMD officials



Hon'ble Minister at IMD Exhibition



Cultural programme by School Children



Release of Mausam Manjusha



Cultural programme by IMD staff



DG, IMD presenting Hindi Typing Award



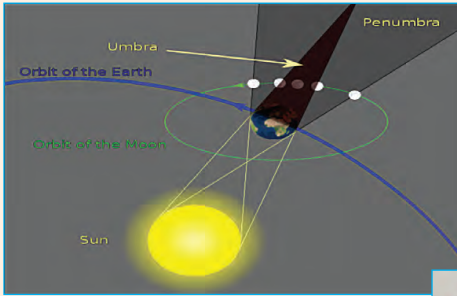
Vigyan Bhushan Award to Dr. D.P. Dubey



DG, IMD and Bridge Team with Trophy

7

EVENTS



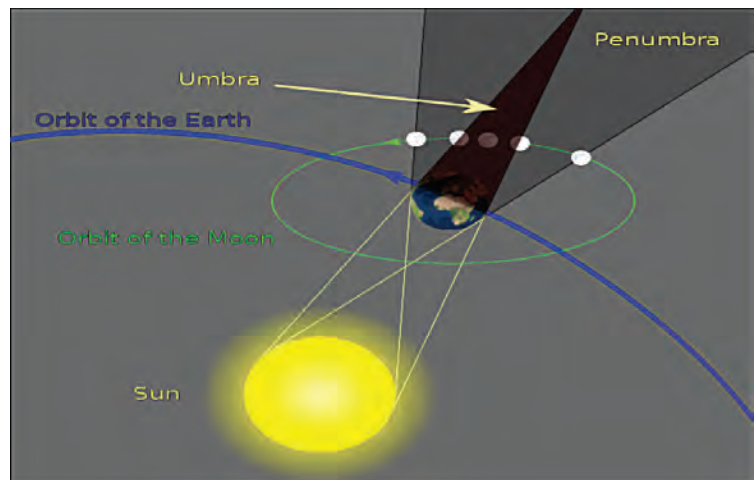
EVENTS

ECLIPSES

Solar and lunar eclipses are among nature's most fascinating spectacles. A solar eclipse occurs when the Moon passes between Earth and the Sun, thereby totally or partially obscuring the image of the Sun for a viewer on Earth. During the year 2010 mainly two solar eclipses and Lunar Eclipse occurred. They were Annular Solar Eclipse, January 15, Partial Lunar Eclipse June, 26, Total Solar Eclipse July 11, and Total Lunar Eclipse December, 21. The month January 2010 witnessed three eclipses - 1st January, 15th January and 26th January.

Partial Eclipse of the Moon 1st January

The Partial Eclipse of Moon on 1st January 2010 occurred in the early hours. In this eclipse, only a very small part of the Moon was under the Earth's umbral shadow. The eclipse was visible throughout India.



Lunar Eclipse

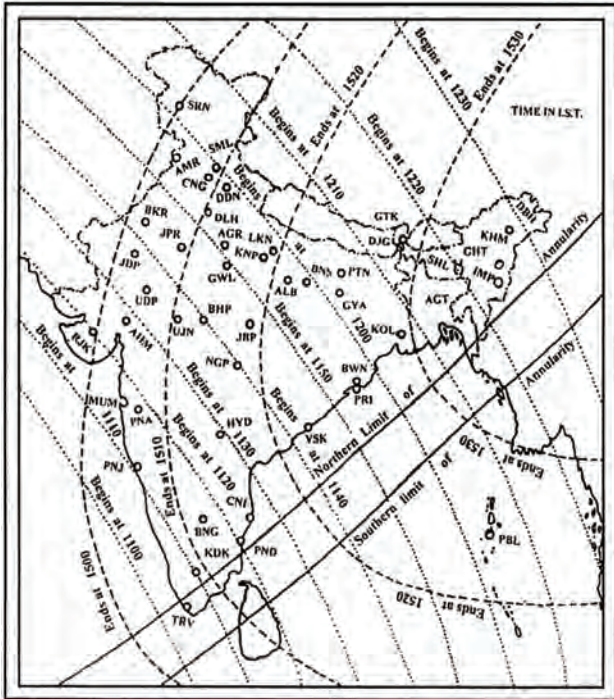
Annular Solar Eclipse

An annular solar eclipse occurs when the Moon's apparent diameter is smaller than the Sun, causing the sun to look like an annulus (ring), blocking most of the Sun's light. An annular eclipse appears as a partial eclipse over a region thousands of kilometres wide. The annular solar eclipse on

January 15, 2010, was the longest solar eclipse since 1992 which lasted for about 11 minutes and eight seconds. This eclipse was visible from across central Africa, the Indian Ocean and eastern Asia. The path of annularity passed through southern tip of India. The eclipse was seen as partial Solar Eclipse from rest of the country. Observation of the partial phase of the eclipse was carried out from the roof top of the building of Positional Astronomy Centre at Salt Lake, Kolkata.



Annular Solar Eclipse



Path of the Annular Solar Eclipse over India

In Trivandrum, the annular eclipse or the ring of fire, was visible for nearly 8 minutes – from 13:10:35 hrs to 13:18:08 hrs. The ring of fire was visible for a similar duration at Dhanushkodi, Rameshwaram, Kanyakumari and other nearby regions.

A talk in Tamil by Kum. B. Amudha, Met. Gr.-I, RMC Chennai on the celestial event “Annular Solar Eclipse on 15 January 2010”, was telecast on 13 January 2010 at 0830 hrs (IST) on AIR Chennai ‘A’ channel.

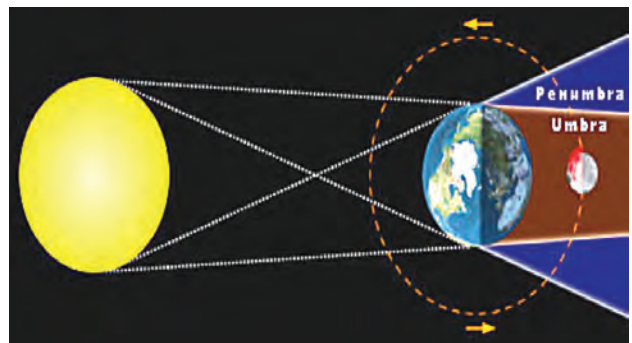
Partial Eclipse of Moon 26th June 2010

A Partial Eclipse of Moon occurred on 26th June 2010. The beginning of umbral phase was visible from central south America, north east USA, Central Canada and part of Arctic Ocean. Ending of the umbral phase was visible from some part of the Indian Ocean, northeast India, Middle China, Mangolia and north east part of Russia.

The Total Solar Eclipse of July 11 and Total Lunar eclipse December 21st was not visible in India.



Annular solar eclipse observation on 15 January, 2010 at PAC Kolkata



Partial Eclipse of Moon

National Science Day

The day is celebrated to honour Nobel laureate Sir C.V. Raman for his invention of the ‘Raman effect’ on 28th February 1928. IMD celebrated National Science Day. This occasion attracts many young minds and creates awareness about Meteorology.



Dr. H. R. Hatwar inaugurating National Science Day

The celebrations of this day include showcasing IMD competence in the field of Meteorology as an overwhelming response from public.

Celebration of Republic Day

The Republic Day of India is celebrated to mark the adoption of the Constitution of India and the transition of India from a British Dominion to a republic on January 26, 1950. AVM (Dr.) Ajit Tyagi, Director General of Meteorology hoisted the flag in the office premises on this 61st Republic Day of India. The Republic Day Celebrations were also held in all MCs & MOs, where the concerned officers unfurled the National flag.

World Meteorological Day



DG, IMD Presenting Memento to Prof. S. Kumar

Each year on 23rd March, the WMO and Meteorological community of all its 189 member states celebrate the day as World Meteorological Day with a chosen theme. The day 23rd March commemorates the convention held on this date in 1950 to create WMO. As a result it came into existence in 1951, as a specialized agency of United Nations System.

WMO emerged on solid pillar laid by the International Meteorological Organization which was functioning

since 1873. WMO took appropriate initiatives on various issues. The most recent concern was on environmental issue as a challenge for the benefit of mankind and society. This year the theme was “60 Years of Service for your Safety and Well-Being”.

Celebration of World Meteorological Day was organized by this department all over India. Prof. Santosh Kumar from National Institute of Disaster Management delivered a lecture at H.Q., New Delhi to mark the theme. A live talk of DGM was broadcast on Doordarshan on the day.

Also, Dr. S. Balachandran, Director gave a talk in Tamil at AIR Chennai. The IMD offices throughout the country were kept open to the General Public. School children visited the various offices of IMD and they were briefed about divisional activities. An exhibition on the activities of IMD, balloons and banners of WM Day 2010 were displayed for visitors.

119th Birth Anniversary of Dr. B. R. Ambedkar

14th April, the Birth Anniversary of Dr B.R. Ambedkar, is celebrated to honour that special person, who taught world the lesson of self confidence. He was the chief architect of the Indian Constitution and is fondly called the Father of the Indian Constitution. SC/ST



School Children at Ahmedabad observatory

Annual Report 2010

Association of IMD celebrated this year 119th Birth Anniversary of Dr. B. R. Ambedkar on 28th April 2010. DG, IMD, and other officials were also present during the function. All Unions representatives expressed their views on this occasion.

Vigilance Awareness Week

Vigilance Awareness Week was observed from 25th October, 2010 to 1st Nov, 2010, in India Meteorological Department. Vigilance Awareness period was observed as "Generation of Awareness and Publicity against Corruption". Emphasis was laid on spreading awareness against the harmful effect of corruption. DGM administered an oath on this occasion. It was emphasized that the corruption is eroding the basic values of life. It has not only a negative effect in social



AVM (Dr.) Ajit Tyagi, DG, IMD administering oath to Officers & Staff of IMD

dynamics but also erodes the value system. It is important that each one plays a pivotal role in the development of the country and needs to be educated to fight against such unethical practices.



Shri Anand Kumar Sharma participating in Clean Environment Programme

Clean Environment

Shri Anand Kumar Sharma, Director, Meteorological Centre, Dehradun actively took part in the polythene removal campaign from Gandhi Park, Dehradun, as a part of the clean earth campaign. The programme was organized by the Indian Society of Remote Sensing, Dehradun Chapter (ISRS-DC). The programme was sponsored by Ministry of Earth Sciences (MoES), Government of India.





FOREIGN VISITS



FOREIGN VISITS

Ms Soma Sen Roy, Met.-I and **Dr. S. D. Kotal**, Met.-I were deputed for training in Now-casting system and regional Unified Model of UKMO for 4 weeks period from 4-31 January.

Shri A. K. Bhatnagar and **Dr. R. S. Dattatrayam** presented a paper entitled, "Real time earthquake monitoring for early warning of tsunamis at the meeting of the WG-1 of Indian Ocean Tsunami Warning System (IOTWS), held in Jakarta, Indonesia, on 25th January, 2010.

Shri S. Venkateswarlu, Director, CWC Visakhapatnam and **Shri Y. K. Reddy**, Director, MC Hyderabad were on tour to China for the Factory Acceptance Test (FAT) of 6 numbers of Beijing Metstar Radars from 05 January to 24 January 2010.

Dr. A. K. Singh, Met.-I deputed to Bhutan to attend planning meeting for installation of AWS and GPS Sonde during 23-24 January.

Dr. M. Mohapatra, Director attended Forecasting Demonstration Project (SWFDP) (Vietnam) from 2nd to 5th February, 2010 and the WMO workshop on Severe Weather Development for Southeast Asia at Hanoi.

Shri M. K. Bhatnagar, Scientist "E" & Director Aviation Services attended the 14th session of WMO Commission for Aeronautical Meteorology (CAeM) held in Hong Kong, China from 3rd to 7th February 2010. During this period he visited the Hong Kong Observatory and Hong Kong Airport Meteorological Office also.

Dr. A. L. Koppar, DDGM(C) was on deputation to Antalya, Turkey during 14th to 26th February

2010 for attending 'Technical Conference on Changing Climate & Demands for Climate Services for Sustainable Development' and XV Session of the Commission for Climatology of WMO.

Shri B. K. Bandyopadhyay, DDGM (Services) attended the 37th Session of WMO/ESCAP panel meeting on Tropical Cyclone held at Phuket, Thailand from 15th to 19th February, 2010.

Shri L. R. Meena, DDGM(ISSD) was deputed to Seoul (Korea), to participate in Inter Commission coordination group on WMO information system during the period 22-26 February.

Dr. V. Rajeswara Rao, Director and **Shri D. K. Malik**, Director were deputed to Australia during 24-28 March 2010 for Factory Acceptance Test of Ground Receiving and processing system to be installed at New Delhi, Chennai and Guwahati to receive data from NOAA, METOP and MODIS Satellites.



Shri M. K. Bhatnagar with Mr. C. M. Chun, President of CAeM at Tai Lam Chung, Hong Kong

Shri A. K. Srivastava, Director attended Sixth Session of the Forum on Regional Climate Monitoring Assessment and Prediction for Asia (FOCRA II) at Beijing, China from 6th to 8th April 2010.

Dr. R. S. Dattatrayam, Scientist, "F" was deputed to Banda Aceh, Indonesia from 14-16 April 2010 to attend the 7th Session of Inter-Governmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System.

Shri A. K. Jaswal, Director attended first CBS meeting of Inter Panel Expert Team on Metadata and Data Interoperability held at Geneva, Switzerland from 27th to 29th April 2010.

Shri A. D. Tathe, Meteorologist-I was deputed to participate in the programme 'ICT for Meteorological Services for SAARC Countries' during 01-30 May 2010 at Seoul, Korea. The programme was organised by KOICA under Official Development Assistance programme of the Government.



Participants of ICT for Meteorological Services Programme

Shri Satish Bhatia, Director was deputed to Kathmandu, Nepal to attend Planning Meeting for site selection for installation of AWS, GPS Sonde and Doppler Weather Radar under SAARC Storm Programme from 24-26 May 2010.

Dr. Jayanta Sarkar, Director attended the WMO/UNISDR Expert Group Meeting on Agricultural Drought Indices, held at Murcia, Spain from 2- 4 June 2010.

S/Shri A. K. Mitra, R. K. Giri, P. Naryanaswamy, Met.-I, were deputed to USA to participate in training course in INSAT 3D Project at University

of Wisconsin, Modisow, USA w.e.f. 6th June to 5th October, 2010.

13 Officers were deputed for twelve week training under Modernization programs on Operation and Maintenance of Doppler Weather Radar at Beijing, China during period from 21st June to 12th September 2010.



Group of trained officers in DWR with DG, IMD

Shri S. Krishnaiah, Scientist "F", was deputed to Geneva, Switzerland to attend 6th Session of Expert Team on requirement and Implementation of AWS Platform from 22-25 June 2010.

Shri J. L. Gautam, Director was on deputation to the Institute of Physics of the Earth (IPE), Russian Academy of Sciences (RAS), Moscow during 19th July - 10th August, 2010 as part of implementation of a project, under the Integrated Long Term Programme (ILTP) of Cooperation in Science & Technology.

Dr. R. Suresh, Scientist 'E' represented IMD and participated in the 14th meeting of the Asia Pacific Air Navigation Planning Implementation Regional Group [APANPIRG], CNS/MET subgroups of ICAO Bangkok held at Jakarta, Indonesia from 19th to 22nd July and presented two working papers.

Shri M. K. Gupta, Scientist 'E' was deputed to Tokyo, Japan to attend JMA/WMO workshop on Quality Management in surface, climate and upper air observations in RAIL (Asia) during the period 27-30 July 2010.

Shri Satish Bhatia, Scientist 'E' was deputed to Dhaka, Bangladesh to attend the meeting of International Programme Committee (IPC) of the SAARC STORM Programme during the period 1-2 August 2010.

Shri A. K. Srivastava, Scientist 'E', was deputed to Trieste, Italy to attend Target Training Activity (TTA), Statistical methods in seasonal prediction during the period 2-13 August 2010.

Dr. Jayanta Sarkar, Scientist 'E', was deputed to Kabul, Afghanistan to attend SAARC Regional Workshop on Drought Risk Management during the period 8-9 August 2010.

Shri Bikram Singh, Director was deputed to Bangkok, Thailand to attend the Panel on Tropical Cyclone Working Group on DPP meeting to finalize the annual operation plan 2000 and training on preparation of the Disaster Management and Crises Management Drill during the period 18-20 August 2010.

Shri Gajendra Kumar, Met-I, was deputed to attend WMO Technical Conference on Instruments and Methods of Observation (TECO-2010) during 30th August 2010 to 1st September 2010 at Helsinki, Finland. He also presented the paper entitled "Upgradation of Indian Radiosonde Network: Performance & Future Plans".

Shri K. C. Sai Krishnan, Scientist 'E' was deputed to attend the 15th session of the WMO Commission for Instruments and Methods of Observation (CIMO-XV) and Technical Conference on Instruments and Methods of Observation (TECO-2010) during 30th August – 8th September 2010 at Helsinki, Finland. He also presented the poster presentation "Modernisation of Observational Network of India Meteorological Department".



S/Shri Gajendra Kumar and K. C. Sai Krishnan – participants of CIMO-XV

Dr. Siddhartha Singh, Met-I and **Shri Vijay Kumar Soni**, Met-I, were deputed to Tokyo, Japan to attend the Factory Training in Sun Sky Radio Meter System during the period 29th August to 10th September 2010.

Shri. R.K. Sharma, Director participated in International Pyrheliometer Comparison - XI at World Radiation Centre, Devos, Switzerland from 25th September to 15th October 2010 for Inter-comparison of one of the radiation Standard Absolute Cavity Radiometer.

Dr. P. Guhathakurta, Scientist 'E' was on deputation to GFDL/NOAA, Princeton, U.S.A. from 30th September to 21st November under MoES/NOAA collaborative research project on "Seasonal Rainfall Prediction using Statistical Downscaling of GCM outputs".

Dr. (Mrs.) Surinder Kaur, Scientist 'F' attended the 7th meeting of the GEOSS Asia Water Cycle Initiative (AWCI) International Coordination Group (ICG) in Tokyo, Japan from 05 to 06 October 2010.

Shri M. K. Bhatnagar, Scientist 'E' was deputed to Geneva to attend the 13th CBS Expert Team on AMDAR during the period from 5-7th October 2010.

Shri A. P. Pandey, Met. Gr.-I. was deputed to Taipei, Taiwan to attend South Asia Prominent Youth Study Camp during the period 18-27 October 2010.

Dr. R. P. Samui, DDGM (Agrimet)/Scientist F attended the Cochran fellowship training programme on "Weather Modeling for Crop Forecasting" organized by the U.S. Department of Agriculture, Washington D.C. during 18 – 30 October, 2010.

Shri Sanjay Bist, Met. Gr.-I, was deputed to attend the Global Atmospheric Water Training and Edu. Centre (GAW TEC) in Germany during the period 19-30 October 2010.

Dr. L. S. Rathore, Head, Agromet, as a resource person and **Shri A. K. Das**, Met. Gr.-I, were deputed to Dhaka, Bangladesh to attend the workshop during the period 24-25 October, 2010.

Shri S. I. M. Rizvi, Met.-I. was deputed to Indonesia to participate in the Eleventh WMO Symposium and Training (SYMET-XI) during the period 25-29 October 2010.

Shri I. K. Sachdeva, Asstt. Met. was deputed to Nanjing, China to attend WMO International Training Seminar on South - South Cooperation on Weather and Climate during the period 8-12th November 2010.

Dr. O. P. Singh, Scientist 'F' visited Moscow as a member of Indian delegation during 8-13 November, 2010 in connection with Indo - Russian collaboration in Science and Technology. An MOU between India and Russia was signed in which Atmospheric Science is an important component for collaboration between India and Russia.

Shri L. R. Meena, Scientist 'F', was deputed to Namibia to attend Extra ordinary session of WMO Commission of Basic Systems during the period 17-24 November, 2010.

Dr. Y. E. A. Raj, DDGM, RMC Chennai attended 5th Technical Conference on the management of NMHSs in RA-II (Asia) held at Daegu, South Korea during 29 November to 3 December 2010.



Dr. Y.E.A. Raj standing extreme left with the delegates

Shri A. K. Srivastava, Scientist 'E' attended Sub Group Meeting of Climate Application and Services (WGCCA-CAS) in Daegu, Republic of Korea from 30th November to 2nd December 2010.

Dr. R. Suresh, Director-in-charge, M.O. Chennai, represented IMD in the 'Asia Pacific Wind Shear systems Acquisition Workshop' held at Bangkok, Thailand during 01-03 Dec. 2010.



Dr. R. Suresh with group of participants at Bangkok

Dr. A. P. Pandey, Met. Gr. I was deputed to Moscow, Russia to attend the Joint Indo Russian Collaboration Project on Testing of the INQVA Earthquake Environmental effects using recent Indian Earthquakes under ILTP during the period 13-21 December 2010.

VISIT TO ICY CONTINENT — MAITRI, ANTARCTICA

Although IMD has been participating right from the first Indian Scientific Expedition to Antarctica in 1981, AVM (Dr.) Ajit Tyagi, the present DG, IMD made history by visiting Maitri (Antarctica), the icy continent of the World, on 19 December 2010. AVM (Dr.) Ajit Tyagi, along with Dr. Satheesh C. Shenoi, Director INCOIS visited various laboratories/experiments set up by IMD, IIGM, NGRI, SASE, GSI & NPL. DGM visited IMD observatory and appreciated efforts made by IMD members in restoring surface ozone measurement and installing high speed wind recorder. During his visit real time transmission of Meteorological data to NCAOR, Goa was started. On 20th Dec 2010, DGM along with Director INCOIS, Station Commander, Maitri, Shri K. Jeeva and IMD team members visited Russian station Novolazarevskaja. He held a meeting with station commandar Mr. Andry. V. and their Meteorologists and discussed bilateral exchange of meteorological data. He also visited Meteorological Observatory & balloon launching centre of Russian station. He appreciated and encouraged the work done by the Logistic team of Maitri. He also took part in "Shramdan" done at Maitri and inspired all the Maitrians by his exemplary gesture.



DG, IMD with other team members at Maitri, Antarctica



9 VISITORS



VISITORS

INTERNATIONAL VISITORS

Dr. Shaik H. Hakeem Scientist from RSMC, Darwin, Australia visited IMD, Pune on 8th January and delivered a scientific talk on the topic, "Tropical Climate Monitoring Activities at RSMC, Darwin, Australia". The officers of Pune office attended the lecture.

Prof. Timothy Del Sole, Associate Professor of Climate Dynamics, Harvard University COLA, USA was on a visit to IMD. The visiting professor delivered series of lectures in IMD on 'Statistical methods of Long Range Forecast' during 1st - 3rd February 2010. The scientists from IMD, NCMRWF and Indian Air Force also attended the lectures.

Prof. Mike Wallace and **Prof. Jagadish Shukla** from USA visited IMD, HQ's 17th February. Prof. Jagadish Shukla, George Mason University (GMU) President,



Prof. J. Shukla delivering lecture in Seminar Hall

Institute of Global Environment and Society (IGES) gave a talk on Global Warming : An Overview Climate Change over India. Prof Wallace, delivered a lecture on 'Climate change science, it is the hub of environmental science, or is it just a part of it?' followed by discussions. They also visited IMD, Pune office on 25th February.



Prof. Timothy Del Sole delivering lecture

Visit of Korean Delegation

A two member delegation consisting of Dr. Yun Won-Tae, Director, and Mr. Kim Seong-Heon, Dy. Director, International Cooperation, Korea Meteorological Administration visited IMD, New Delhi on 17th March 2010. DGM welcomed them in conference hall followed by meeting with senior officers and a presentation. The senior officers from HQ's were also present during the meeting. The delegates were apprised of present status and

functioning of RTH, NWP, Satellite Division and Seismology Division.



Korean delegation at DGM's Conference Hall

Mr. Arif Mahmood, Chief Meteorologist, Pakistan Met. Department visited Met. Office Pune on 16th April 2010.

Six member Japanese delegation along with JICA members visited M. C. Hyderabad office for discussion on Indo-Japan Collaboration Project with IIT (H) and IMD on 27th & 28th September 2010.

Prof. T. N. Krishnamurti, Florida State University delivered a lecture on 13th December 2010. In his lecture he mainly covered two important topics of monsoon and hurricane forecasting. He also explained about the ongoing programmes of NOAA particularly for the hurricane forecasting and its usefulness for the tropical cyclone forecasting over the Bay of Bengal region like that of FDP-Cyclone programme. After the lecture, he also interacted with



Prof. T. N. Krishnamurti delivering lecture

members of NWP group, IMD Delhi and explained about the ongoing activities of the division. DGM felicitated him by presenting a memento.

Dr. J. Vivekanandan, Senior Scientist of both Earth Observing Laboratory and Research Applications Laboratory, National Center for Atmospheric Research, Boulder, Colorado, USA delivered a lecture on 13th December, 2010 on the topic "Weather Radars and Lidar for Observing the Atmosphere". In his lecture he emphasized the interpretation of remote sensing instruments' responses to clouds and precipitation using mathematical models and actual field observations. He led the development of the dual-wavelength system by adding millimeter wave radar to NCAR's S-band polarization radar.

NATIONAL VISITORS

Dy. High Commissioner of Australia to India and ANGARU officials alongwith the **Dr. M. Satya Kumar**, Director I/C (Scientist "F") visited the site at Bairanpalli Village of Warangal on 20th April. Dr. Satya Kumar explained to Dy. High Commissioner of Australia the importance of the Agriculture Advisory Bulletins issued by India Meteorological Department.

Shri K. Rathnakar and **Shri Sreekanth** (Engineer) from M.C.F. Hassan visited earth station on 3rd and 4th May 2010 in connection with installation of INSAT-3D Ground Receiving System.

Scientists of State and Central Govt. visited cyclone warning division of IMD to share the activities/experiences of IMD on 11th May 2010.

Mr. Gary Quinn, Engineer, Environmental Systems & Services [ES&S] Australia and Engineers from BK Consimpex New Delhi visited Observatory during 17th and 18th May 2010 for frequency/site clearance of the HRPT installation at RS/RW buildings AMO Chennai. Mr. Gary Quinn gave a power point presentation on METOP Satellite based HRPT hardware/software and Products on 18th May 2010 in AMO Chennai.

Dr. M.S. Narayanan, Visiting Professor, SRM university visited DWR Chennai in connection with a rain estimation project funded by ISRO and being carried out in SRM university under his guidance. A collaborative study with DWR data of Chennai and its surrounding is envisaged in the proposed project.

Shri J. P. Dange, Hon'ble Chief Secretary, Government of Maharashtra and other state Government officials visited Regional Meteorological Centre, Mumbai office on 25th August, 2010. The visit was mainly intended towards recently installed Synergie Forecasting System.

Dr. Naqvi, Principal Scientific Officer (F) from Ministry of Earth Sciences, New Delhi visited M.C. Bangalore and he was briefed about the activities of M.C. Bangalore on 27th August 2010.

Prof. G.S. Bhatt, Indian Institute of Sciences, Bangalore visited M.C. Bangalore in connection with the launch of Radio Sonde ascents on 8th September, 2010.

Visit of Secretary MoES

Dr. Shailesh Nayak, Secretary MoES visited M.C. Ahmedabad on 13th September 2010. Dr Kamaljit Ray, Director gave a presentation on the existing facilities at MC Ahmedabad, the services provided by the centre, the facilities acquired as part of Modernization Programme and the future plans. The Secretary discussed the progress of the new MC Building and about the performance of AWS and ARG and their maintenance. He emphasized the need of team work. He visited the HPCS room and suggested to take up research topics, regarding validation of model products with the actual data available at the station. He also visited the observatory, ARG and AWS installed at the Station. He interacted with staff and discussed problems, which need to be addressed. He emphasized the importance of observing system and the need for their upkeep and maintenance.

Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences and AVM (Dr.) Ajit Tyagi, DG, IMD visited Seismo Observatory, Ridge, Delhi on 12th



Secretary MoES at M.C. Ahmedabad

November, 2010 to inspect the facilities created for archival and vector digitization of old seismic analog charts. Secretary, MoES complemented the officers and staff of Ridge Observatory for maintaining the facilities and observatory premises in a neat and clean manner.



Shri R.S. Dattatrayam briefing on Seismographs

Visit of Students

30 Students along with 2 teachers from Oakridge International School, Hyderabad and 30 Officials of Andhra Pradesh Agriculture & Research Department (APARD), Government of Andhra Pradesh visited M.C Hyderabad on 10th November and 25th November 2010 respectively. They were shown RS/RW Observatory & and explained the activities.



VISITS AND VISITORS



DG, IMD with Team Members at Maitri



Lecture by Prof. J. Shukla, USA



Presentation by Korean Delegation at Conference Hall



Australian delegation at IMD



Prof. T.N. Krishnamurti being felicitated by DG, IMD



DG, IMD & Dir. INCOIS at Maitri



Dr. J. Vivekanandan, USA delivering lecture



Shri M. K. Bhatnagar with President of CAeM

10 LECTURES



LECTURES

Shri Anand Kumar Sharma, Director-in-charge, Meteorological Centre, Dehradun delivered lectures on UNFCCC at Forest Research Institute, Dehradun during 11th to 14th January 2010.

Shri B. Puttanna, Director delivered a lecture on “Effect of climate vagaries on Agriculture” in the Farmers Awareness Program jointly organized by IMD and University of Agricultural Sciences, GKVK, Bangalore on 30th January 2010.

Dr. Y. E. A. Raj, DDGM, RMC Chennai gave an invited talk on “Urban Risks in Chennai with reference to Local Climate” on 18 Feb 2010 in an International workshop on “Local Climate and Disaster Resilience in Chennai” organized by University of Madras, Chennai.

Shri Surender Paul, Director M.C. Chandigarh delivered talk on “Role of IMD for Farming Community of Haryana” in a seminar organized by Department of Agricultural Meteorology, HAU Hisar on 19th February 2010.

Dr. S. C. Sahu, Scientist-‘E’ attended as expert to conduct an interview at Department of Marine Science, Berhampur University on 23rd February 2010 under PROBE- Orissa, DST Programme.

Dr. Y. E. A. Raj, DDGM, RMC Chennai attended as a Resource person, the seminar on “Climatic Change Mitigation” held at J. J. College of Engineering and Technology, Trichy on 9th April 2010 and delivered two lectures.

Shri Anand Kumar Sharma, Director-in-charge, Meteorological Centre, Dehradun invited to deliver lecture on “Climate Change, CDM, REDD,

Agreements and Treaties” to the scientists of Indian Council of Forestry Research and Education (ICFRE) at Forest Research Institute (FRI) on 12th April 2010. The training course was organized by Forest Research Institute University (FRIU).

Dr. S. Balachandran, Director delivered series of five guest lectures on “General circulation atmosphere and ocean and Northeast Monsoon” to the newly recruited Junior Research Fellows of National Atmospheric Research Laboratory (NARL), Gadanki during 15-16 April 2010.

Dr. S. C. Sahu, Scientist “E”, M.C. Bhubaneswar, attended and gave a lecture in a district level workshop on “Climate change–effect & their Mitigation” at collectorate conference hall, Jagatsinghpur on 17th April 2010.

Shri B. Puttanna, Director, participated in the “Earth Day” programme and delivered a talk on “Global Warming – Causes and Effects” organized by University of Agricultural Sciences, GKVK, Bangalore on 22nd April 2010.

Shri G. Sudhakar Rao, Director delivered lecture on aviation meteorology and instrumentation to trainee officers of AAI, Hyderabad on 23-24 April 2010.

Shri S. Venkateswarulu, Director CWC Visakhapatnam delivered a key note address on “Coastal Zone problems and their Remedies” in the inaugural session of the Staff Development Programme held at GMR Institute of Technology, Srikakulam, Andhra Pradesh on 26th April 2010.

Dr. M. Mohapatra, Director delivered two lectures - one on Cyclone Monitoring, Track and Intensity Prediction, Storm Surge and another on Cyclone Warning services at NIDM on 27th April 2010.

Dr. S. D. Attri, Director delivered inaugural talk in the National seminar on "Climate Change and Socio-Economic Development in India: Spatial and Temporal Variation" on 8th May, 2010 sponsored by ICSSR, New Delhi and organized by Meerut College, Meerut.

Shri Anand Kumar Sharma, Director Meteorological Centre, Dehradun delivered lecture on "Environmental Security" at the Joint Civil Military training workshop to senior IAS, IPS and Military officers on 18 May 2010 organized by Lal Bahadur National Academy of Administration, (LBSNAA), Mussoorie.

Dr. R. Suresh, Scientist 'E', as a resource person delivered two lectures on 'Southwest monsoon' and 'Thunderstorms and Tropical cyclones' to the JRFs at National Atmospheric Research Laboratory (NARL) ISRO, Gadanki on 19th May 2010.

Dr. R. Suresh, Scientist 'E' delivered two lectures on "Fundamentals of Signal Processing" and "Problems in Radar Measurements" in the ISRO sponsored training programme on 'Applications of Atmospheric Science and Remote Sensing in Environmental Management' at DRDO Centre for Life Sciences, Bharathiar University, Coimbatore on 23rd May 2010.

Shri Anand Kumar Sharma, Director-in-charge, Meteorological Centre, Dehradun was invited to deliver lecture on "Atmospheric monitoring and prediction for emergency management" to scientists of various research institutes of India on 2nd June 2010 at the Lal Bahadur National Academy of Administration, (LBSNAA), Mussoorie.

Dr. Medha Khole, Director delivered a lecture on 5th June 2010 on "Weather Forecasting" in Marathi at Muktangan Exploratory Science Centre, Bhartiya Vidya Bhavan, Pune during their summer workshop.

Ms. B. Amudha, Met.-I, RMC Chennai delivered a lecture on "Cyclone Disaster Management" at RMC Chennai to the trainees of Disaster Management Training Program conducted by Anna Institute of Management, Chennai for state Government officials on 8th June 2010.

Shri K. Ramachandran, Director, CDR Machilipatnam delivered a lecture on "Cyclones" on 16th June 2010 to the members of The Institution of Engineers, Vijayawada.

Dr. R. Suresh, Scientist 'E', delivered guest lectures on 'Fundamentals of Aviation Meteorology' in the training programme arranged by Airports Authority of India, Chennai for the Junior Executive trainees (JET) on 18th and 21st June 2010.

Dr. V. Rajeswara Rao, Director delivered lectures related to Satellite Meteorology at CTI, Pune during 28-30 June 2010.

Shri S. B. Thampi, Scientist 'E', DWR Chennai, delivered two lectures on Radar Meteorology to JRF at NARL Gadanki & "Z-R relations and calibration of Radar derived rain-rate using disdrometer data" at NARL Tirupati, on 30th June 2010.

Dr. Naresh Kumar, Met.-I, delivered a talk on "Weather & Climate Services of IMD over Himalayan Region and Precipitation pattern in Western and Central Himalayas" in International Conference on Geothermal and Other Energy Resources of Ladakh - Technological and Business Viability during 5 -7 July, 2010, Leh (Ladakh).

Dr. D. K. U. R. Bhagat, Director, **Dr. (Ms) Sathi Devi**, Director and **Shri V. K. Rajeev**, Director delivered lectures as part of 'Classroom Training to Junior Executives - ATC' on request of Airport Authority of India from 5th July 2010 for 2 weeks.

Dr. P. Guhathakurta, Scientist 'E' delivered a lecture on 'Chaos & Weather Prediction, predicting Uncertainty in Forecast of Weather at Bhilai Institute of Technology, Chathisgarh on 28th July 2010.

Shri B. K. Piyus, Director, Brahma Kumari Sansthan delivered an invited talk on 'Developing inner power and stress free management' at DGM Conference Hall at New Delhi on 11th August 2010.



Shri B. K. Piyus delivering talk at HQ, New Delhi

Dr. Devendra Singh, Scientist 'E', DST delivered a lecture on Application of Earth Observing System (NOAA/METOP and MODIS Satellites receiving and processing System) on 11th August 2010 in Conference Hall, Mausam Bhawan, New Delhi.



Dr. Devendra Singh delivering lecture

Dr. M. Mohapatra, Scientist 'E' (CWD) was on tour to INCOIS, Hyderabad during 17-18 August 2010 to deliver a specialized lecture on "Cyclone and Storm Surge Forecasting" during a training programme organized by INCOIS and SAARC Disaster Management Centre (SDMC), New Delhi on "Early Warning and Hydrometeorology Disaster for South Asian countries".

Dr. R. V. Sharma, DDGM, **Shri K. S. Hosalikar**, Scientist 'E' & **Shri V. K. Rajeev**, Director delivered

lectures for Extra Master's course at the LBS College of Advanced Maritime Studies & Research in the month of September.

Shri K. Santhosh, Director chaired a technical session on "Meteorological aspects of climate change" and delivered a lecture on "Climate change scenario over India" in the International Conference on Sustainable Development and Secular Spirituality organised by Santhigiri Research Foundation, Trivandrum on 9th September 2010.

Dr. M. Satya Kumar, Scientist 'E' delivered a lecturer on Disaster Management at Marry Chenna Reddy Institute, Hyderabad on 13th September 2010.

Shri Anand Kumar Sharma, Scientist 'E', Meteorological Centre, Dehradun delivered lecture on "Mausam ka Purvanuman" in Hindi at Indian Institute of Remote Sensing, Dehradun on the Hindi Divas, 14th September 2010. Shri Anand Kumar Sharma was the invited Guest.

Dr. Geeta Agnihotri, Met.-I delivered a lecture to 62nd All India Waterman ship course trainees on 'Weather forecasting system during floods' on 17th September 2010 organized by Home Guards and Civil Defence Academy, Bangalore.

Dr. Medha Khole, Scientist 'E' delivered lecture on 'Indian Monsoon' in Marathi on 28th September 2010 organised by Deptt. of Marathi, at Literature Bhavan, Marathi Vibhag, University of Pune.

Dr. S. D. Attri, Scientist 'E' participated and delivered talk on "Recent Trends in Climate Change over India in one day workshop on "Climate Science and Emerging Issue in Asia" organized by IIT Delhi.

Dr. A. L. Koppar, DDGM(C) made a presentation on Data Rescue and Climate Management System in the MoES-Korean Met. Administration MoU signing session at New Delhi on 29th September 2010. **Dr. D. S. Pai**, Scientist 'E' also participated in the session.

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Shri P. R. Baidya, Director delivered a lecture on the topic “Earthquake and its Parameters” on 11th October, 2010 in the training course on “Capacity Building of Engineers in seismic Assessment, Retrofitting & Rehabilitation of Buildings and Provisions of DM Act” organized by CPWD Training Institute, Ghaziabad.

Shri P. R. Baidya, Director delivered four lectures on Seismology on 25th October, 2010 for trainee Met Officers of 127 GDOC, 20 SSC(M) and 37 SSC(W) conducted by Air Force Administrative College, Coimbatore.

Dr. S. C. Sahu, Scientist ‘E’ delivered a Lecture on “Planetary effect on climate change on the eve of National Conference on 2012”: The Beginning of Sixth World” at Puri on 24th Oct, 2010.

Dr. M. Mohapatra, Scientist ‘E’ delivered a lecture on Early Warning System for cyclone on 26 October 2010 at National Institute of Disaster Management (NIDM) for District Collector, Senior and middle level officers of various state/UTs.

Shri Anand Kumar Sharma, Scientist ‘E’, M. C. Dehradun delivered a lecture on “How to effectively communicate major scientific and environmental issues” to Science communicators, writers and journalists on 1st November 2010 at the workshop for empowerment of the Science communicators, writers and journalists.

Dr. R. Suresh, Director delivered an invited talk on “Advance Statistical forecasting techniques” in the DST sponsored National workshop on Geostatistics and soft computing techniques for spatial data management at Shri V. Venkateswara University, Tirupati on 23rd November 2010.

Dr. R. K. Jenamani, Scientist ‘E’ A.M.O. IGI Airport New Delhi and Shri N. Nigam, Director gave their presentation on “Use of new technologies of weather monitoring and forecasting at Airports and their perspective” and “Meteorological services at airport” respectively during a conference on building capacity and efficiency in Indian airports held at Taj Hotel, New Delhi on 1st Dec 2010 organized by ASAPP media information group.



Dr. R. K. Jenamani & Shri N. Nigam participating in the India Airports Conference 2010

Dr. L. S. Rathore, Head Agromet, Shri Rajiv Sharma, DDGM (A & S), New Delhi and Dr. Y. E. A. Raj, Scientist ‘F’, DDGM, RMC Chennai visited M.C. Bangalore on 15th Dec 2010 in connection with Interview for recruitment of Senior Research Fellows.

Dr. Somenath Dutta, DDGM (Trg.) delivered a talk on “Contrasting southwest monsoon and atmospheric energetics” in the ICON GSECCES 2010 held at Banaras Hindu University, Varanasi, during, 21-23rd December 2010.



11

WORKSHOPS & CONFERENCES



WORKSHOPS & CONFERENCES

WORKSHOPS

Training-cum-Workshop on Doppler Weather Radar

A training-cum-workshop on Doppler Weather Radars was held during 15-17 March, 2010 at RMC, Chennai, in which officers and staff of IMD including IAF, Tambaram, INS Rajali and Indian Institute of Science, Bangalore participated.



DG, IMD with participants of DWR workshop

Workshop on Flood Meteorology

A Workshop on Flood Meteorology was held during 22nd – 23rd March 2010 at New Delhi. The Director-in-charge of FMOs and scientists from H.Q. Hydrology unit attended the workshop and presented various work done by them to mitigate flood damages. AVM (Dr.) Ajit Tyagi Director General of Meteorology gave concluding remarks at the end of the session.

GPS Upper Air Observations

A workshop on GPS Upper Air Observations was held on 19-20th April 2010 at New Delhi. AVM (Dr.) Ajit Tyagi, Director General of Meteorology, inaugurated the workshop and Shri D. R. Sikka Retd. Director, IITM Pune, chaired the workshop

to provide guidance for improvement of the GPS based RS/RW observation.

The workshop turned out to be useful. Shri P. K. Jain, DDGM (UI) presented the overview of upper air network of IMD and informed about the actions initiated for modernization of upper air network. Shri Sikka gave the brief history of upper air radio sonde in India and explained the purpose, use and importance of upper air data from GPS Upper Air Observation in NWP. Officers from O/o DDGM (UI) and invited guests delivered the lectures to improve the performance of the observations.

हिन्दी कार्यशाला का आयोजन

मुख्यालय में दिनांक 26 से 30 अप्रैल 2010 तक हिन्दी कार्यशाला का आयोजन किया गया जिसमें 14 कार्मिकों ने भाग लिया।

कार्यशाला में भाग लेने वाले समस्त कार्मिकों को समापन समारोह के अवसर पर प्रमाण पत्र प्रदान किए गए।



श्री एल. आर. मीना, श्रीमती सुषमा को प्रमाण पत्र देते हुए

Users' Workshop at Gangtok

A users' Workshop was organized by Meteorological Center, Gangtok on 30th April 2010 at the Seminar Hall of Office of the Chief Election Officer, Baluakhani, Gangtok. The conference was held in two sessions, the first being inaugural session and the second being the user's participation and interaction. On the occasion Mr. Bhim Prasad Dhungel, Minister for Tourism, & Science & Technology, Govt. of Sikkim, was the chief guest and AVM (Dr.) Ajit Tyagi, Director General of Meteorology presided over the conference.



Shri A. K. Bhatnagar addressing workshop

Senior officers of IMD, State & Central Government officials from Sikkim also participated. DGM gave introduction about advance technologies for better and accurate weather prediction and its timely dissemination to the end users of Sikkim.

Media Workshop



Shri Prabhu Chawla, Editor, India Today addressing the audience

IMD organized one day workshop on, "Communicating Weather and Climate Information" on 14th May 2010 at India Islamic Cultural Centre, New Delhi with an aim to enhance the interaction

between weather experts and media personnel. After the lighting ceremony DG IMD addressed the media people during the opening session. Other speakers highlighted prevailing public weather services of this department to media people.

The Hon'ble Minister of S&T graced the valedictory function as Chief Guest & Secretary MoES presided over the session. Dr. Aruna Sharma, DG, Doordarshan & Shri Prabhu Chawla, Editor, India Today, were the Guests of Honour. They spoke about importance of media and weather-men during adverse weather situation. Electronic and print media may play very crucial role not only in disseminating the weather forecast/warnings to every nook & corner of the country but also in making these understandable to the common people in their language.

Training Workshop on DWR Products

Five days training workshop on "DWR Products, their Interpretation and Utilization in Nowcasting" was conducted at DWR, Kolkata during 19-23 July, 2010. Five officers from Indian Air Force and two officers from IMD, participated in the workshop. Shri D. Pradhan and Shri Vivek Sinha, Scientist 'E' delivered the lectures. Trainees expressed their high level of satisfaction for the contents and quality of the training provided.

SAARC STORM Workshop at Kolkata

Under the STORM project a training workshop was jointly organized by SAARC Meteorological Research Centre (SMRC), Dhaka and India Meteorological Department at Doppler Weather Radar Kolkata during 09 – 13th November 2010 with objectives of utilization of Doppler Weather Radar products in Now-casting of Severe Weather Phenomena & development of Scan Strategy for Doppler Weather Radars from IMD, Calcutta University, IIT New Delhi, IIT Kharagpur and Indian Air Force. Workshop was inaugurated by AVM (Dr.) Ajit Tyagi, Director General of Meteorology, IMD at the conference Hall of National Library, Kolkata on 9th November 2010. Shri Jaswant Singh, Director General, Geological Survey of India chaired as "Guest of Honour" during the function. During the workshop, lectures were delivered by expert scientists in Radar

Meteorology Twenty participants from SAARC countries participated in the workshop.



Participants during SAARC STORM workshop

It was concluded to adopt a uniform scan strategy in all the Doppler Weather Radars installed in the SAARC countries and to exchange the data for improved forecasting, research and development.

Workshop on Monsoon Review



Dr. Medha Khole giving presentation during workshop

IMD organized Brainstorming Workshop to review the performance of southwest monsoon 2010 during 9 - 10 Dec, 2010 at Mausam Bhavan, New Delhi which was inaugurated by Dr. Shailesh Nayak, Secretary, MoES. Scientists from IIT, New Delhi, CMMACS, Bangalore & IITM Pune, apart from officials of Central Water Commission, Ministry of Home Affairs and Ministry of Agriculture participated in the workshop. In total 55 distinguished scientists attended the workshop.

Workshop on Flood Meteorology

Two days workshop on Flood Meteorology was held during 13-14 December, 2010 at Hyderabad for interaction between Flood Met Officers and user agencies. In this workshop, besides Flood Met Officers and DVC unit of IMD, officers from Central

Water Commission and state Govt. department of Irrigation, Agriculture, NRSC, Greater Hyderabad Municipal Corporation (GHMC) also participated and made their presentation on Flood related topics. Dr. K. M. Reddy, DG of APSRAC, Hyderabad was the Chief Guest during inaugural function of the workshop. Shri N. Y. Apte, Scientist 'F' and Shri R. D. Ram, Director attended the Workshop.

Workshop on Fog Monitoring & Forecasting Services



DG, IMD giving inaugural address

Forecaster-Users interactive Workshop on "Fog Monitoring and Forecasting Services 2010-2011" was organized by Airport Met. Office Palam, New Delhi on 27 Dec, 2010 at the New Auditorium, New Udan Bhavan at Terminal 3. AVM (Dr.) Ajit Tyagi, DG IMD was the Chief Guest and Mr. P. S. Nayar, Chief Executive Officer of DIAL; Mr. P. K. Mishra, GM, ATC, IGI was invited as Guest for the introductory session. Dr. R. K. Jenamani, Scientist 'E', AMO Palam welcomed all the participants and presented Fog projects in the field of Fog Monitoring and Forecasting undertaken during 2005-2010.

AVM (Dr.) Ajit Tyagi, DG IMD emphasized to take up further new projects in integrating all real time data and disseminating them timely to various users. DIAL chief appreciated the IMD fog services and assured all immediate support for it.

SEMINAR/CONFERENCES

PWS For Kerala & Lakshadweep

Users' conference Meet on "Public Weather Services for Kerala & Lakshadweep" was held on 20 January 2010 at Meteorological Centre, Thiruvananthapuram. AVM(Dr.) Ajit Tyagi, DGM presided over the meetings. The conference was

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attended by 46 delegates from 22 User agencies and media. 25 delegates from IMD attended the meet. Dr. D. Alexander, Director of Research, Kerala Agricultural University, Thrissur was the Chief Guest. There were 3 presentations from the Officers of MC Thiruvananthapuram and 12 presentations from User Agencies.

Seminar on Doppler Radar and Weather Surveillance



Release of booklet by Secretary, MoES

RMC Chennai organized National seminar on 18-19 March 2010 at National Institute of Ocean Technology, Pallikarantal, Chennai to explore the potential of Doppler Weather Radars and analyse the still unexplored areas of Doppler Weather Radar application. Dr. Shailesh Nayak, Secretary, MoES, was the Chief Guest. Dr. M.A. Atmanand, Director, NIOT, Chennai was the Guest of Honour. AVM (Dr.) Ajit Tyagi, DG, IMD, presided over the function. The Book of Abstracts 'DRaWS - 2010' and the Booklet on 'History of Radar Meteorology in India' compiled by Shri S. Raghavan, DDGM (retd.) IMD was released on the occasion. During the two-day seminar, 14 Invited Talks by eminent experts in the field of radars were delivered. Fourteen organizations including IMD had nominated their scientists for participation and presentation of papers in the seminar including media persons.

Global Framework Climate Services



VM (Dr.) Ajit Tyagi, DG, IMD addressing the audience

IMD organized Consultative Meeting on "Global Framework Climate Services" held on 9th April, 2010 at India Habitat Centre, New Delhi under the Chairmanship of Secretary, MoES which was attended by senior scientists & experts from different Departments & Organizations. DGM welcomed and Secretary, MoES addressed the delegates. A talk on "WMO initiative for building GFCs" was given by Dr. Avinash Tyagi, Director Climate & Water Department, WMO. At the end of the session formation of National Consultative group was recommended.

South Asian Climate Outlook Forum

IMD organized South Asian Climate Outlook Forum (SASCOF) meeting at Indian Institute of Tropical Meteorology, Pune from 13 April to 15 April 2010 jointly with World Meteorological Organisation (WMO) and Indian Institute of Tropical Meteorology, Pune. Experts from other SASCOF member countries viz. Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka, also participated. AVM (Dr.) Ajit Tyagi, DG, IMD, Dr. H. R. Hatwar, ADGM(R), Dr. R. D. Vashishta, Scientist F, and many other scientists from IMD attended the meeting. It was recognized that climate predictions could be of substantial significance in risk management and adaptation to cope with the impacts of climate variability and change.

Users' need of Satellite data and products

Sat. Met Division organized a Brainstorming session on "Users' need of Satellite data and products" on 23rd April 2010 in Conference Hall of Mausam Bhawan, New Delhi under the chairmanship of DGM (IMD) in which participants from NHAC/NWP/MO's/RMC Kolkata & Chennai, IITM, IAF and INDENOM presented their satellite data requirements and views.

National Seminar on "TROPMET 2010"

A three days National Seminar was organized by IMS Kolkata chapter alongwith RMC Kolkata during 19-21 May 2010. AVM (Dr.) Ajit Tyagi, DGM inaugurated the seminar and Dr. G. Madhevan Nair, Ex-Chairman ISRO was the Guest of Honour. About 200 Scientists from various organizations participated in the seminar.

Shri Srikumar Mukherjee, Hon'ble Minister, Disaster Management, Govt. of West Bengal chaired the valedictory session of the seminar on 21st May 2010. All participants appreciated the arrangements made during the seminar. A souvenir of the presented paper abstracts was also published during the seminar.

CLIPS -Training Workshop on "Urban Climatology"

WMO, through its Commission for Climatology (CCI) and Climate Information and Prediction Services (CLIPS) project, and in collaboration with the WMO Regional Training Centre of the India Meteorological Department (IMD) Pune, organized an Inter-Regional Training Workshop on Urban Climatology.

This workshop focused on the potential role of climate information to urban decision makers and on how urban-scale issues can be incorporated into climate services. Its primary purpose was to educate and train meteorologists in urban climate methods that extend existing services to urban citizens and a range of professional urban users, including architects, engineers, urban designers and planners.

The workshop was inaugurated on 6th September 2010 at the Barah, Mihira hall of IITM, Pune, by AVM (Dr.) Ajit Tyagi, DGM, IMD & PR of India with WMO. Besides him, Dr. Rupa Kumar Kohli from WMO Secretariat, Prof. B. N. Goswami, Director IITM, Dr. A. B. Mazumdar, ADGM (R), IMD and Prof. Gerrald Mills from Dublin University, Dublin Ireland also attended the workshop. At the outset, during his inaugural speech, Dr. Tyagi expressed his sincere thanks to WMO for choosing India, especially IMD to host the workshop. He mentioned about the role of urban development on climate change. He mentioned about the urban climatology programme taken by IMD during 1970-1990. Dr. Rupa Kumar



CLIPS - Training workshop in progress

thanked Government of India for kindly been agreed to host the workshop.

Met. Instrument

A seminar on Meteorological Instrument and AWS was jointly organized by IMD, Pune and Bureau of Indian Standards at DCP, Pashan. AVM (Dr.) Ajit Tyagi, DGM inaugurated the seminar on 26th February. Dr. H. R. Hatwar, ADGM(R), Dr. R. D. Vasistha, DDGM(SI) participated in the seminar.

SAARC Seminar at Colombo

Dr. S. N. Roy, DDGM, RMC Kolkata and Dr. R. K. Jenamani, Scientist 'E' visited Sri Lanka and participated in two days SAARC Seminar in Colombo, organized by SMRC, Bangladesh, Dhaka and Department of Meteorology, Government of Sri Lanka on "Application of Meteorology in Mitigating Aviation hazards" during 14-15 June 2010. Dr. R. K. Jenamani, presented two research papers. One of the recommendations in this important meeting was to extend the present development and improvement done in India in the field of Fog Monitoring, understanding its Science and objective method of Fog forecasting to other SAARC Countries.

Brain Storming Session on Polar Sciences



Brain Storming Session on Polar Sciences in progress

IMD conducted a Brain Storming Session on "Polar Sciences" on 24th September 2010 at India Habitat Centre, New Delh. Dr. Shailesh Nayak, Hon'ble Secretary, MoES graced the occasion as Chief Guest and delivered the inaugural address.

Dr. P. C. Pandey, Prof. IIT Kharagpur, Ex-Director, NCAOR, Goa gave a lead-talk on Polar Sciences. Twelve speakers from various participant organizations

viz., IMD, NPL, NCAOR Goa, IITM Pune, SASE Chandigarh, Shri Ram Institute of Industrial Research New Delhi, SAC Ahmedabad etc. gave presentations during three sessions on topics related to Weather Prediction & Modelling, Environmental Monitoring and Polar Linking processes. At the end of the session a panel discussion was held and recommendations were given to further strengthen Indian Antarctic Programme for 5-10 years future planning.

Roving Seminar on "Weather, Climate and Farmers"



Distribution of rain gauges to farmers

A one day roving seminar on "Weather, Climate and Farmers" was organized by Natural Resource Management division of Central Agricultural Research Institute (CARI), Port Blair sponsored by IMD, Ministry of Earth Sciences, New Delhi on 29 Nov, 2010 in which 90 farmers and 15 members of women self help group participated apart from officers from Development department and scientists of CARI. The main focus of the seminar was on awareness creation among the farming community on weather based crop, livestock management and utilization of agromet advisories. The programme was inaugurated by Dr. R. P. Samui, DDGM (Agrimet). On this occasion 5 rain gauges were handed over to farmers.

INDIVIDUAL PARTICIPATION

Dr. Medha Khole, Director participated in the two days workshop on 7 & 8 January 2010 at University of Mumbai, Kalina, Campus on the topic 'Natural Disasters : Cyclones, Monsoon Floods – Outreach Programme and delivered a talk on "Indian Summer Monsoon : General Features".

Dr. Ajeet P. Pandey and **Shri R. S. Dattatrayam** presented a paper entitled, "Real time seismic monitoring towards early warning of tsunamis", at the workshop on "Application of satellite geodetic techniques for scientific studies in India", held at IISM, Hyderabad, 3-4th February, 2010.

Shri P. S. Biju, Met.-I attended a seminar on "Standardisation activities in the field of Meteorological instruments including Automatic Weather Stations jointly convened by IMD and Bureau of Indian Standards at Pune during 24th to 26th February 2010 and presented a paper entitled "Automation of Meteorological Instruments".

Dr. Y. E. A. Raj, DDGM, RMC Chennai attended as a Resource person, the seminar on "Climatic Change Mitigation" held at J. J. College of Engineering and Technology, Trichy on 9th April 2010 and delivered two lectures.

Dr. Jayanta Sarkar, Director participated in the Training Workshop on "Climate Risk Management in Agriculture" held at Bhubaneswar from 12-17th April 2010.

S. Sudevan, Met.-I attended the workshop on formulation of action plan to face calamities due to monsoon convened by Department of Agriculture, Govt. of Kerala on 13th April 2010.

Shri L. D. P. Roy, Director, M. C. Bhubaneswar participated in a "Workshop on State level Vulnerability Assessment and Adaptation strategies" held on 17th April, 2010 at Bhubaneswar.

Shri S. B. Thampi, Scientist 'E', DWR Chennai and **Ms. B. Amudha**, Met. Gr.-I, RMC Chennai participated in a workshop on Coastal HF Radar organized by National Institute of Ocean Technology, Chennai on 13th May 2010.

Shri E. Kulandaivelu, Director and **K. V. Balasubramanian**, A.M.-II Hindi Coordinating Officer attended the "All India Rajbhasha Seminar on the use of Indian Languages" organised by TOLIC at Chennai on 8th June 2010.

Shri Shankar Prasad, AM-II, member of 30th ISEA attended One day workshop on "Evaluation of Research Projects for Planning the 30th Indian Scientific Expedition to Antarctica" held on June 17, 2010 at NCAOR, Goa. He gave a presentation of Scientific Programme of IMD for 30th ISEA and review of IMD's earlier work on Antarctica.

Shri N. Y. Apte, DDGM(H) attended an inception workshop on Establishment of Regional Flood Information System in the Hindu Kush Himalayan region during the period 23-25th June 2010 organized by International Centre or Mountain Development (ICIMOD), Kathmandu, Nepal.

Shri B. Puttanna, Director attended the Brainstorming Workshop on "Improvement of Water Cycle – Science, Technology and Management Options and Challenges" at KSCST Conference Hall at Bangalore on 8th November 2010.

Dr. S. D. Attri, Scientist 'E' attended International Conference on "Climate Change, Agriculture and Food Security in Indo-Gangetic Plains : Exploring Key Research Opportunities and Developing Regional Scenarios" in New Delhi, held during 8-10th Nov., 2010.

Shri Y. K. Reddy, Scientist 'E' participated at the SAARC STORM workshop on utilization of Doppler Weather Radar products and development of scan strategy for Doppler Radars from 10-13th November 2010 at DWR Kolkatta.

AVM (Dr.) Ajit Tyagi, DGM and **Dr. S. D. Attri**, Scientist 'E' attended "Indian Network for Climate Change Assessment (INCCA)" – National Workshop on Impacts of Climate Change, A 4 × 4 Assessment" chaired by **Shri Jairam Ramesh**, Hon'ble Minister for Environment & Forest on 16th November, 2010 at New Delhi.

Shri R. S. Dattatrayam and **Shri P. R. Baidya** presented a paper entitled, "Earthquake catalogs and their role in precursor studies" at the International workshop on 'Earthquake precursor studies-Scenario and future directions" held at NGRI, Hyderabad during 25-27th November, 2010.

IMD's PRESENCE AT WMO

WMO Executive Council Meet

AVM Dr. Ajit Tyagi, DGM, was on tour to Geneva, Switzerland to attend the third session of WMO Executive Council working Group on Strategic and operation planning implementation which was held at WMO, H.Q., during the period 29-31 March 2010. The Executive Council working Group reviewed actions taken from the last meeting of the EC WG/SOP held in March 2009 and discussed WMO Strategic Plan and Operating Plan 2012 – 2015 followed by discussions on, The Sixty-third Session of the WMO Bureau (BUR-LXIII), WMO Interaction with the Private Sector, Secretariat implementation plan and budget and Statement on the role and operation of NMHSS.

62nd Session of WMO Executive Council Meet

AVM (Dr.) Ajit Tyagi, Director General of Meteorology was invited to attend the 62nd Session of WMO Executive Council Meet which was held during the period 9-14 June 2010 at Geneva, Switzerland with the objective to review progress made in the provision of critical weather, water and climate services and to optimize its programmes in a changing world.

The Council addressed a range of programmes and topics to review WMO activities and enhance the capabilities, in particular, of the National Meteorological and Hydrological Services of its 189 members to provide critical weather, water and climate assessments and services. The Executive Council was chaired by **Dr. Alexander Bedritsky**, President of WMO. A major topic on the Council's agenda was the progress made towards the establishment of a Global Framework for Climate Services, in line with

the decision taken by World Climate Conference-3 (WCC-3). A High-Level Taskforce was established to advise on the content and format of the framework, to shape a framework that should respond to the urgent needs of society for user friendly climate information and services. During the meeting, it was agreed to give special attention on enhanced early warning systems, National Meteorological Services of Haiti, volcanic ash eruptions and monitoring climate change.

Fifteenth Session of WMO (CAgM)

The World Meteorological Organization Commission for Agricultural Meteorology held its 15th session during 15-21 July 2010, in Belo Horizonte, Brazil. The meeting was attended by about 120 representatives from 62 countries. **AVM (Dr.) Ajit Tyagi**, DGM represented IMD. A programme was chalked out to enhance Agro Meteorological Services to assist the farming community and cope with the increasing impacts of climate variability and climate change. The Commission for Agricultural Meteorology identified several priorities for its future work until 2014. A few of them are developing enhanced services for the agricultural activities, encouraging the knowledge-sharing between forecasters and agricultural decision makers.

The 15th session of the Commission for Agricultural Meteorology was preceded by the international workshop on "Addressing the Livelihood Crisis of Farmers: Weather and Climate Services," organized by WMO and a number of partner organizations, which took place during 12-14 July 2010, in Belo Horizonte, Brazil. **Shri B. Mukhopadhyay**, DDGM represented IMD. The workshop was attended by about 150 participants from over 50 countries.

WORKSHOPS & CONFERENCES



AVM (Dr.) Ajit Tyagi, DGM on User's meet on 20th Jan. 2010



Dr. R. K. Jenamani at SAARC Workshop, Colombo



Workshop on Monsoon Review 2010



DG, IMD giving memento to DG, Doordarshan – Media workshop



Press meet at DWR 18-19 March, Chennai



Lighting of lamp – Brain Storming Session on Polar Sciences



38th Session of WMO/ESCAP panel of Tropical Cyclone



Trainees Officers workshop at Kolkata

12

HUMAN RESOURCE DEVELOPMENT



HUMAN RESOURCE DEVELOPMENT

Human Resource Development (HRD) is the framework for helping employees of this department to develop their personal and organizational skills, knowledge, and abilities. Human Resource Development includes such opportunities as employee training, employee career development, performance management and development, coaching, mentoring, succession planning, key employee identification, and organization development. The focus of all aspects of Human Resource Development is on developing the most superior workforce so that the organization and individual employees can accomplish their work goals in service to customers. IMD have many opportunities for human resources or employee development, both within and outside the workplace.

Central Training Institute, Pune

Human resource development has always been one of the prime thrust areas of the India Meteorological Department for capacity building and to keep pace with latest trends in various activities of the Department. The Central Training Institute (CTI) of the India Meteorological Department (IMD) is a World Meteorological Organization (WMO) rated Regional Meteorological Training Centre (RMTTC), headed by Deputy Director General of Meteorology (Training), and is situated at Pashan in Pune. IMD is the national meteorological and hydrological service of the country and the principal Government agency in all matters relating to Meteorology, Seismology and allied subjects. Facilities for meteorological training at Pune and New Delhi have been recognized by the WMO to function as RMTTC in all the four main disciplines namely, General Meteorology, Radio-meteorology, Telecommunication and Agro-meteorology.

Foreign students also undergo short duration courses in Computer Programming, Data Processing, Radiation measurements, Maintenance of Surface and Upper Air Instruments and Satellite Data interpretation. These training courses are organized keeping in view the knowledge and background of the trainees and



Central Training Institute, Pune

their specific requirements. Candidates nominated by the Meteorological Services of other countries have been trained here from time to time.

Instrument Training Centre

Instruments Training Centre (ITC) was established at New Delhi in 1962 for imparting specialized training in the discipline of instrumentation related to Upper Air Instruments, Surface Instruments, Radar, Seismological Instruments, Sat. Met. Instruments, Telecom Instruments etc. The ITC is one of the Regional Training Centre of World Meteorological Organization. Foreign nominees from more than 22 countries have been trained so far under various international co-operation schemes.

The centre is equipped with latest teaching aids and facilities viz., Electronic Board (with facilities of print out)/Interactive teaching board/Multimedia Projection system, Scanner, Digital Camera, CD writer, Color & B/W Photostat machines, Over head Projector & Personal Computers etc. The training centre has its own library having more than 400 books besides the main library at H.Q.

Telecom Training Centre

Telecom Training Centre is a unit of Information System & Services Division. It was established in IMD in 1977 for imparting training to departmental trainees/foreign trainees under the fellowship programme of Telecommunication recognized by WMO. Trainees from countries like, Egypt, Maldives, Afghanistan, Sri Lanka, Nepal, Bangladesh, Thailand, Ethiopia, Sudan, Tanzania, Yemen, Botswana, Laos, Sierralene, Zambia, Philippines, Nigeria, Rwanda, Mongolia, Uganda and Oman have been trained in Telecom Training Centre. The centre has so far imparted training to more than two thousand departmental/foreign trainees sponsored under various technical/co-operation programme such as TEC, SARC, COLOMBO PLAN, UNDP and WMO fellowship etc. In addition various other courses/training/attachments are being conducted in Telecom

Training Centre as per office requirement e.g. Met Gr-II trainees, Instruments trainees from DDGM (UI), office, Intermediate Meteorological Course trainees of RMC New Delhi, Antarctica trainees and various other international sponsored programme under WMO, UNDP etc.

Telecom training centre organized three regular course and three short term course. Training courses are:

- i. Level-I Course in Meteorological Telecommunication & Information Technology, Duration 3 Months
- ii. Level-II Course in Meteorological Telecommunication & Information Technology, Duration 4 Months
- iii. Level-III Course in Meteorological Telecommunication & Information Technology, Duration 6 Months.

Training Course During 2010

Divisional Training Programme

- Agrimet Division conducts various training courses for the officers and staff of the departmental and non departmental candidates. Training was organized for AMFU Scientist.

AVM (Dr.) Ajit Tyagi, DGM, inaugurated the short term (3 weeks) Training Course on Agrometeorology towards better advisories for serving end user requirement to AMFU scientists conducted by Agrimet. Division, Pune on 18th January 2010. 22 scientists have attended this course. The DGM also visited office of ADGM(R) and held discussions with senior officers.

- Training on purchasing and file management was organized jointly by MoES and RMC, New Delhi at B. R. Ambedkar Institute of Hotel Management catering and nutrition, Chandigarh on 5th and 6th February 2010. Shri H. L. Syal, Assistant Meteorologist and Shri Rajiv Kumar, Scientific Assistant from

M.C. Chandigarh attended the training.

- An orientation programme of training of 10 Observers of Part Time Observatory of Tamil Nadu was held at RMC Chennai during the period 8-12 March 2010. The observers were issued certificate by RMC Chennai.
- Intermediate Course (Instrumentation) batch XXXV commenced on 20th May 2010 and concluded on 17 September 2010 and Advanced Course (Instrumentation) batch XXII also commenced on 20th September 2010.
- A two weeks CLISYS Users Training Course was conducted for NDC officers & staff by MFI officials from 13th to 24th September and CLISYS Administrator's Training Course was conducted for NDC officers from 2nd to 14th September 2010.
- Seismology Division organized training programs/courses in Seismology and allied subjects at various levels to station operators and various departmental officers and non-departmental agencies, such as Indian Navy, Air Force, State Government agencies, etc. Officers of Seismology Division also delivered lectures, on request, at various state/central Government organizations dealing with earthquake related matters.

Computer Software Training

- Linux Operating System training course was conducted during 1-11 Feb at NDC by MFI in association with Focus Training Services, Pune as a part of CLISYS implementation.
- A training course on Oracle was conducted at NDC from 10th to 21st May 2010 for 10 officials by Meteo France International in association with Focus Training Services, Pune as part of CLISYS implementation at NDC.
- COMPDDO - a software for preparation of pay bill was installed at RMC Chennai. Two batches of training were organized to familiarize operation of the software. Apart

from RMC Chennai staff, 25 personnels from other offices were also trained in using the software.

Training from Meteo France

- MFI experts from France imparted training to Officers on MFI at RMC Chennai during the period 7-11 June 2010.
- MFI Administration Advanced training was conducted at Delhi HQ from 25-29 October 2010.

Synergie System Training

- Synergie Basic User Training was imparted to 16 officers/staff of RMC Mumbai by Mr. Hubert Brunet, Chief Forecaster, Meteo France International from 31st May to 4th June 2010.
- One week training in forecasting using Synergie System was organized at NWFC during 9-13 August 2010 for the forecasters from RMC, New Delhi. Dr. M. Mohapatra, Scientist 'E' (CWD), Shri M. Duraisamy, Director and Dr. Naresh Kumar, Meteorologist delivered lectures on various aspects.



- SYNERGIE Administration Advanced training was conducted at Delhi HQ from 15-19 November 2010. Integration training of MFI systems was conducted at Delhi HQ from 22-26 November 2010.

Trainee Officials

Foreign Trainees

Two officials, viz., Mr. K.H.M.S. Premalal, (Sri Lanka) and Mr. Kyaw Lwin, (Myanmar) were sponsored by WMO/ESCAP panel for cyclone forecaster's attachment training with RSMC, New Delhi during 1-12 February, 2010. They were provided a certificate on successful completion of the training.

Dr. R.P. Samui, DDGM (Agrimet)/Scientist 'F' attended the Cochran Fellowship Training Programme on "Weather Modeling for Crop Forecasting" organized by the U.S. Department of Agriculture, Washington D.C.

S/Shri N. T. Niyas, Met.-I, **Shri D.J. Bhattacharya**, AM-I, **Shri Kalayansundaram Adiga**, A.M.-II and **Dr. D.M. Rase**, AM-II attended course in Mentoring skills conducted by MoES and DoPT at National Institute of Oceanography (NIO), Goa from 3rd to 5th May 2010.



Mr. K.H.M.S. Premalal receiving certificate from AVM (Dr.) Ajit Tyagi, DG, IMD

Smt. M. G. Huparikar, A.M.-I was deputed to undergo training on "Leadership and communication skills – HP II" at National Water Academy, Pune during 24-28th May 2010.

Shri Ashim Kumar Mitra, Meteorologist Grade-I, **Shri R. K. Giri**, Meteorologist Grade-I and **Dr. N. Puviarasan**, Meteorologist Grade-I from satellite division were deputed for training at University of Wisconsin, USA for 3-4 months in the following subjects:



Group of foreign trainees

- Derivation of Vertical profiles of temperature and humidity from INSAT-3D sounder data
- Development of INSAT-3D visualization software and
- Development of Navigational Algorithms for INSAT-3D.

Besides these two scientists were also deputed for this training from IITM, Pune and NCMRWF NOIDA U.P.

Shri A. C. Lyngdoh, Met-I, Meteorologist-in-charge, CSO, Shillong attended “Course in mentoring” training organized by DoPT & MoES at Guwahati from 5th to 7th July 2010.

Shri S. B. Gaonkar, Director attended “Direct Trainers skill” Training programme sponsored by DoPT organized jointly by Ministry of Earth Sciences and IMD, held at AWS Lab, Pashan, Pune from 26-30th July 2010.

Dr. R. Asokan, Scientist ‘E’ and **Dr. Geeta Agnihotri**, Met-I attended HPCS Training at IBM

Lab, Bangalore from 20th to 30th September 2010.

Training Needs Analysis

A course on “Training Needs Analysis” was conducted at Mausam Bhawan, Lodi Road, New Delhi from 8-19 November 2010. The course was inaugurated by Dr. Shailesh Nayak, Secretary, MoES in presence of AVM (Dr.) Ajit Tyagi, Director General of Meteorology. Shri R.A. Singh, Asstt. Met.-I was Course Coordinator from IMD. 16 participants from different divisions of IMD had training on needs Analysis.

Training in Agrometeorology

One week’s Capsule Course on Agrometeorology for Foreign Trainees from Indonesia was conducted from 13-17 December, 2010. The course covered various theoretical, operational and practical aspects of agrometeorology. Twenty lectures were delivered involving faculties from IMD, ex-IMD Officers, Indian Institute of Tropical Meteorology (IITM) and Centre for Advanced Studies in Agrometeorology (CASAM).



Group of Officers for Training Need Analysis alongwith Secretary MoES and DG, IMD

Inter Departmental Co-Operation

- CSSTEAP trainees (14 Nos.) of various countries who were undergoing training at SAC, Ahmedabad were on an educational visit to the Satellite-Meteorology Division on 22nd November, 2010. School children from various schools of Delhi were shown the Satellite-Meteorology Division at various times of the year in order to encourage them in this field.
- In connection with establishment of Met. Observatory in High Schools under PROBE-Orissa sponsored by DST, Govt. of India, New Delhi, five days training in batches were arranged by OSCARD, Bhubaneswar. M. C.



CSSTEAP trainees from Space Application Centre, Ahmedabad at HQ, New Delhi

Bhubaneswar actively participated in this training programme for about 400 teachers. Lectures including practical were delivered by officers.



13

RESEARCH CONTRIBUTIONS



RESEARCH CONTRIBUTIONS

13.1 DEPARTMENTAL JOURNAL 'MAUSAM'

MAUSAM, 61, 1 (January 2010)

Real time forecasting of the Bay of Bengal cyclonic storm "RASHMI" of October 2008 – A statistical-dynamical approach

S. D. KOTAL, S. K. ROY BHOWMIK and B. MUKHOPADHYAY

Diagnostic study of a recurving cyclone – 'MALA' over the Bay of Bengal

RAMESH CHAND and M. MOHAPATRA

An account of low level wind shear over Chennai airport - Part I : Observation and forecasting aspects

R. SURESH

Fractal analysis: Annual rainfall in Chennai

R. SAMUEL SELVARAJ, R. GAYATHRI and S. TAMILSELVI

Meteorological factors associated with July 2005 floods in river Jhelum

B. P. YADAV and S. C. BHAN

Large scale fluctuations of the Continental Tropical Convergence Zone (CTCZ) during pilot CTCZ phase-2009 and the evolution of monsoon drought in 2009

D. R. SIKKA, AJIT TYAGI and L. C. RAM

Modeling the effect of planting date on Maize (Zea mays L.) crop in Sabour region of Bihar using DSSATv3.5 crop simulation model

P. K. SINGH, L. S. RATHORE, K. K. SINGH, A. K. BAXLA and R. K. MALL

Technical feasibility on reception of VHRR signals from Kalpana-1 satellite in the event of

contingency with the existing operational ground receiving system

J. K. S. YADAV, A. K. CHAKARBORTY and R. K. GIRI

Utilisation of 'Aerostat' Doppler Weather Radar in nowcasting of convective phenomena

P. K. ARORA and T. P. SRIVASTAVA

Unprecedented rainfall over Bangalore city during October, 2005

M. MOHAPATRA, NARESH KUMAR and B. K. BANDYOPADHYAY

Erraticness of the rainfalls in different regions of India

R. P. KANE

Short term stratospheric ozone trend over Dumdum and its relation with Flare Index of northern hemisphere

S. C. GANDA and S. K. MIDYA

Crop coefficient and water requirement of Okra (Abelmoschus Esculentus L. Moench)

CHANABASANAGOUDA. S. PATIL

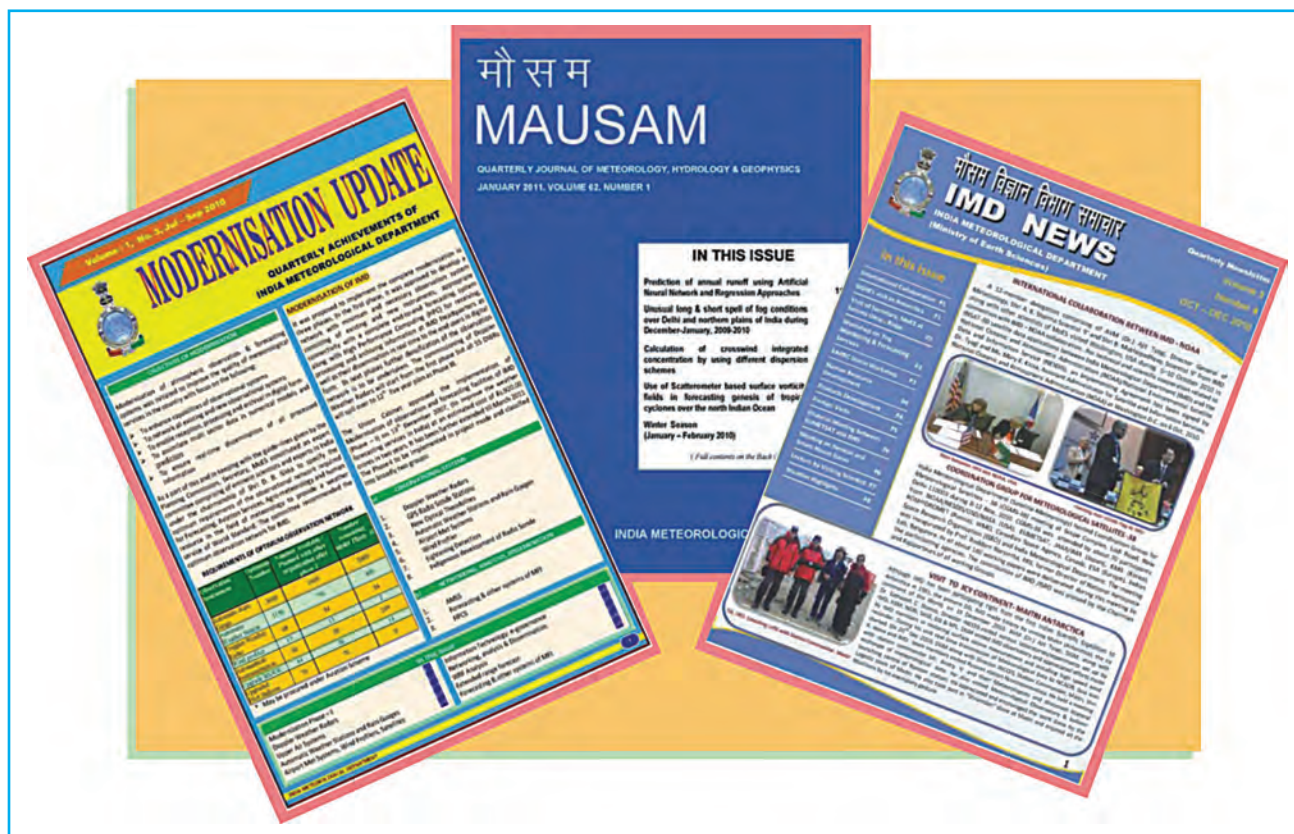
MAUSAM, 61, 2 (April 2010)

Performance evaluation of precipitation prediction skill of NCEP Global Forecasting System (GFS) over Indian region during summer monsoon 2008

V. R. DURAI, S. K. ROY BHOWMIK and B. MUKHOPADHYAY

Study of rainfall features over Goa state during southwest monsoon season

S. M. METRI and KHUSHVIR SINGH



Recent winter warming over India – spatial and temporal characteristics of monthly maximum and minimum temperature trends for January to March
A. K. JASWAL

Semi-quantitative precipitation forecasts for Kosi/ Mahananda catchment by synoptic analogue method
K. M. SINGH, M. C. PRASAD, G. PRASAD, R. PRASAD and M. K. JHA

Study of rainfall departure over catchments of Bihar plains
T. N. JHA and R. D. RAM

Effect of broadcast and precise satellite orbits in the estimation of Zenith tropospheric delay and integrated precipitable water vapour from GPS
J. K. S. YADAV, R. K. GIRI and D. K. MALIK

Precipitable water vapour monitoring using ground based GPS system
N. PUVIARASAN, R. K. GIRI and MANISH RANALKAR

Impact of AMDAR observations from Lufthansa aircraft on Global Analysis - Forecast System
SURYA K. DUTTA, MUNMUN DAS GUPTA and V. S. PRASAD

Stochastic modeling of the occurrence of rainfall over some districts of Assam during 1987-1992
G. N. RAHA and S. C. KAKATY

Rainfall models – a study over Gangtok
K. SEETHARAM

Development of weather based prediction model for leaf roller population of Sesame in Bundelkhand zone of Madhya Pradesh
M. P. GUPTA, A. K. SRIVASTAVA and M. K. NAYAK

Water balance studies for the crop planning in Ranchi, Jharkhand
P. K. SINGH, A. K. BHARGAVA, VASU MITRA, AWADHESH PRASAD and M. JAYAPALAN

MAUSAM, 61, 3 (July 2010)

Relation between pressure defect and maximum wind in the field of a Tropical Cyclone – Theoretical derivation of proportionality constant based on an idealised surface pressure model

Y. E. A. RAJ

Evaluation of Indian summer monsoon rainfall features using TRMM and KALPANA-1 satellite derived precipitation and rain gauge observation

V. R. DURAI, S. K. ROY BHOWMIK and B. MUKHOPADHYAY

Semi quantitative forecasts for Baghmata/Adhwara Group of rivers/Kamala Balan catchments by synoptic analogue technique

K. M. SINGH, M. C. PRASAD and G. PRASAD

Signatures of northeast monsoon activity and passage of tropical cyclones in the integrated precipitable water vapour estimated through GPS technique

S. BALACHANDRAN and B. GEETHA

An indigenous state-of-the-art High Wind Speed Recording (HWSR) system for coastal meteorological observatories

R. D. VASHISTHA, K. N. MOHAN and P. S. BIJU

Recent trends in meteorological parameters over Jammu and Kashmir

A. K. JASWAL and G. S. PRAKASA RAO

Climatological and synoptic aspect of hailstorm and squall over Guwahati Airport during pre-monsoon season

G. K. DAS, R. P. SAMUI, P. A. KORE, L. A. SIDDIQUE, H. R. BISWAS, B. BARMAN

A severe hailstorm over Guwahati airport and its vicinity on 2nd April 2006 : Synoptic and thermodynamic perspectives

H. R. BISWAS, D. CHAKRABARTI, P. A. KORE and G. K. DAS

Forecasting low level vertical wind shear over Chhatrapati Shivaji International (C. S. I.) Airport Mumbai

VINOD KUMAR, M. SATYA KUMAR, THAKUR PRASAD and S. G. KAMBLE

MAUSAM, 61, 4 (October 2010)

Changes in total cloud cover over India based upon 1961-2007 surface observations

A. K. JASWAL

Seasonal prediction of cyclonic disturbances over the Bay of Bengal during summer monsoon season : Identification of potential predictors

M. MOHAPATRA and S. ADHIKARY

Statistical analysis of monsoon rainfall distribution over West Bengal, India

AVIK GHOSH DASTIDAR, SARBARI GHOSH, U. K. DE and S. K. GHOSH

Weather – based crop protection stewardship at Pattambi, Kerala

R. P. SAMUI, K. KARTHIKEYAN and J. P. SABALE

Rainfall variability and probability pattern for crop planning of Roorkee region (Uttarakhand) of India

A. K. BHARGAVA, P. K. SINGH, VASU MITRA, AWADHESH PRASAD and M. JAYAPALAN

Probability distribution functions of weekly reference crop evapotranspiration for Pune station of Maharashtra state, India

D. T. MESHRAM, S. D. GORANTIWAR, H. K. MITTAL and R. C. PUROHIT

A quantitative assessment of KALPANA-1 derived water vapour winds and their improvement from the use of NCEP first guess forecast fields

A. K. MITRA, P. K. KUNDU, A. K. SHARMA and S. K. ROY BHOWMIK

Drought monitoring over India through Normalized Difference Vegetation Index (NDVI)

M.V. KAMBLE, K. GHOSH, M. RAJEEVAN and R. P. SAMUI

A statistical study of pre-monsoon weather over south Bengal using descriptive and inferential techniques

S. DASGUPTA and U.K. DE

The onset and advance of Indian summer monsoon in relation with the sea level pressure field

MEDHA KHOLE

Evapotranspiration and heat unit requirement of cowpea

CHANABASANAGOUDA SANGANAGOUDA PATIL

Crop specific requirement of growing degree days and agrometeorological indices in rice growing zones

A. KASHYAPI, A. L. KOPPAR and A. P. HAGE

13.2 EXTRA DEPARTMENTAL PUBLICATIONS

“Hailstorms in India”, U. S. De, D. M. Rase and M. M. Dandekar, Deccan Geographer.

“Seasonal variability and trends in lower and middle tropospheric temperatures over India”, I. J. Verma, V. K. Soni and A. L. Koppar, Journal of Earth System Science.

“Tropical cyclones and climate change” Review Article, Thomas. R. Knutson, John L. McBride, Johnny Chan, Kerry Emanuel, Greg Holland, Chris Landsea, Isaac Held, James P. Kossin, A. K. Srivastava and Masato Sugi published in Nature Geoscience Vol.3, March 2010.

“Impact of climate changes on extreme weather events and flood risk in India”, P. Guhathakurta, O. P. Sreejith and P. A. Menon. Journal of Earth System Science.

“District wise Drought Climatology of the Southwest Monsoon Season over India Based on Standardized Precipitation Index (SPI)”, D. S. Pai, Latha Sridhar, Pulak Guhathakurta and H. R. Hatwar, Natural Hazards.

“Seismotectonic Zones Demarcation in the Shillong Plateau Using the Microearthquakes and Radon Emanation Rate”, A. C. Lyngdoh, Acta Geophysica Vol. 58, No.5.

“Evaluation of Physics options of the Weather Research and Forecasting (WRF) Model to simulate high impact heavy rainfall events over Indian Monsoon region”, Anil Kumar, J. Dudhia

and S. K. Roy Bhowmik, 2010, Geofizika, 27, 101-125.

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14

IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY



IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY

1. IMD is actively engaged in promoting the progressive use of Hindi, which is the Official Language of our country. Hindi Section at HQ, New Delhi is responsible for the implementation of the Official Language policy of the Government. It maintains coordination and liaison with the Department of Official Language (DOL), Ministry of Science and Technology, Ministry of Earth Sciences (MOES), Central Translation Bureau (CTB) and other Government offices.
2. In order to review, monitor and ensure progressive use of Hindi in IMD, Official Language Implementation Committee has been set up at HQ New Delhi and also at the other sub-offices outside Delhi. These committees at their quarterly meetings review and suggest means and measures to promote the progressive use of Hindi in IMD. The targets fixed in the Annual-programme issued by DOL discussed during these meetings and decisions taken to achieve the same.
3. The Department has been carrying out the important function of training its officials in Hindi, Hindi Typing, Hindi Stenography under the Hindi Teaching Scheme. In accordance with the government instructions and orders, adequate incentives and awards are being given to the officials who qualify Hindi examinations according to the prescribed standards. This has definitely generated encouragement and interest among them to complete the stipulated training courses successfully.
4. Hindi workshops are being conducted periodically at HQ, New Delhi and sub-offices outside Delhi in order to impart training to the officials to enable them to do their administrative and technical work in Hindi.
5. Total 52 officials were granted the amount of Rs 50,000/- as a cash/lumpsum award for passing Hindi Prabodh/Praveen/Pragya/Typing/Stenography Examination meritoriously under Hindi Teaching Scheme.
6. "AAJ KA HINDI SHABD SCHEME " continued for giving valuable knowledge of words, idioms, phrases and sayings in Hindi.
7. All India Departmental Hindi Essay competition 2010 organised and results declared on the basis of recommendations of the evaluation committee. In total six officials of HQ and sub-offices were awarded the first, second, third and 3 consolation prizes.
8. Fifteenth Edition of Departmental Hindi Magazine "Mausam Manjusha" was printed and sent to the members of OLIC and writers.
9. Offices of Met Office, Puri & RS/RW Jodhpur were notified in the Gazette under the rule 10(4) of Official Language Rules 1976.
10. Hindi pakhwara was celebrated at HQ from 1 to 15 September 2010. Hindi Diwas was celebrated on 14 September 2010. On this occasion cultural programme was also organised. During this period various competitions, namely Hindi Essay, Hindi Typing, Hindi Noting and Drafting, Self-Composed Hindi poetry and Hindi Debate were organized. Certificates and prizes

were given by DGM to the first, second, third and two consolation prize winners of various Hindi competitions organised during Hindi pakhwara. This year two new competitions namely Hindi Slogan and Hindi Cartoon Competitions on mausam were also organised. Raj Bhasha Rolling shield for the year 2009-10 was given by DGM to DDGM, RMC New Delhi for the overall best performance in Official Language.

11. An inspection of I.M.D (H.Q) was carried out by the second sub-Committee of Parliament on Official Language on 08 April 2010. Questionnaire to be presented during the inspection prepared bilingually and submitted to the office of Parliament Official Language Committee Secretariat.
12. An inspection of Met. Office Kodaikanal, Met. Office Palam and Satdarjung was carried out by the honourable Second Sub-Committee of Parliament Official Language on 08 July 2010, 01 October 2010 and 01 November 2010 respectively. These offices were given co-operation in preparing Questionnaires to be presented during Inspection.
13. Senior Hindi Officer Ms Reva Sharma and Senior Translator Smt M. Anuradha attended the discussion seminar regarding official language policy organised on 22 March 2010 by Indian Institute of Technology (IIT) New Delhi.
14. A cash award of Rs. 1200/- was awarded to the 2 officials of RMC Nagpur for doing Official work originally in Hindi.



15

INTERNATIONAL & NATIONAL CO-OPERATION



INTERNATIONAL & NATIONAL CO-OPERATION

15.1. INTERNATIONAL CO-OPERATION

IMD – NOAA collaboration

A delegation comprising of Dr. Ajit Tyagi, DGM, and Shri A. K. Sharma DDGM (SM) along with other scientists of MoES visited Washington DC, USA during 5-10 October 2010 in connection with IMD – NOAA collaboration. For Technical and scientific cooperation related to INSAT-3D satellite data applications between the Ministry of Earth Sciences (MoES)/India Meteorological Department (IMD) and the National Oceanic and Atmospheric Administration (NOAA)/National

Environmental Satellite, Data, and Information Service (NESDIS) an Implementing Arrangement regarding INSAT-3D Satellite Data (IA-3D) has been signed by Dr. Ajit Tyagi, Director General of Meteorology and Ms. Mary E. Kicza, Assistant Administrator for Satellite and Information Services, National Oceanic and Atmospheric Administration (NOAA) at Washington D.C. on 6th October, 2010.

Coordination Group for Meteorological Satellites-38 (CGMS-38)

India Meteorological Department (Satellite-Meteorology) has hosted Coordination Group for Meteorological Satellites-38 (CGMS-38) meeting at Scope Complex, Lodi Road, New Delhi-110003 between 8-12 Nov 2010. CGMS is a forum through which independent satellite agency plans are harmonised to meet common mission objectives and produce certain compatible data products from geostationary meteorological satellites for users around the world. CGMS-38 was attended by about 70 participants from NOAA/NESDIS/OSD/NASA (USA), EUMETSAT, JAXA/JMA (Japan), KMA (Korea), ROSHYDROMET (Russia), WMO, Canadian Space Agency, Canada, ESA (Europe), Indian Space Research Organisation (ISRO) and India Meteorological Department. The meeting was inaugurated by Prof. Roddam Narsimha, FRS. In all about 180 working papers were deliberated during this meeting by the participating agencies.

India Meteorological Department and Indian Space Research Organization submitted 26 Working papers jointly which is the biggest number so



Dr. Ajit Tyagi, DGM and Ms Mary E. Kicza, Assistant Administrator signing agreement at Washington, USA



Lighting the Lamp



Handing over flag of CGMS to IMD

far in any CGMS meeting. The contribution of IMD/ISRO was praised by the Chairmen and Rapporteurs of all working Groups.

Collaboration between EUMETSAT and IMD

A bilateral meeting was held between EUMETSAT and IMD officers on 09th Nov. 2010 to discuss the areas of cooperation. The meeting proved very fruitful as EUMETSAT assured IMD of EUMETSAT broadcast receiving station at Delhi through which the data of all European satellites can be received at IMD and used in NWP models. EUMET cast has also agreed to assist Satellite-Meteorology

Division of IMD in making a Centre of Excellence of WMO and also in the technology transfer development of satellite products in India. The installation of EUMETcast receiving station at IMD New Delhi will be a landmark achievement and will be very useful for NWP models as well as for satellite meteorology.

Global Space-based Inter Satellite Calibration System (GSICS)

A GSICS meeting was held after the CGMS-38 meeting at the same venue which discussed about the calibration of Satellite data of various countries. Shri A. K. Sharma, DDGM (Sat.Met.)



Global Space Satellite Picture presented for IMD

also attended this meeting and asked the Chairman for the membership of GSICS for IMD. WMO invited IMD for becoming the member of GSICS. The membership of this group will be useful in knowing the international standard procedures for calibrating the satellite data of past as well as future satellites.

Collaboration with Russia and Mexico

As part of international collaboration, bilateral cooperation in the fields of Seismology and earthquake prediction research is currently being pursued with Russia and Mexico. Under the Integrated Long Term Programme (ILTP) of Department of Science and Technology, IMD officers are engaged in the implementation of as many as six projects. These projects are at various stages of implementation. As part of a joint collaboration between Government of India (Department of Science & Technology) and National Council for Science and Technology of United Mexican State, Mexico, Prof. S K. Singh and Prof. Arturo Iglesias from Instituto de Geofisica, UNAM, Mexico city visited Seismology Division and worked with Indian Scientists during

the period 26-30 November, 2010 to develop algorithms for Near real-time estimation of long-period magnitude, moment tensor and tsunami potential of offshore earthquakes.

15.2. NATIONAL CO-OPERATION

MoU Between IMD-ISRO

A memorandum of Understanding among ISRO, IMD and Doordarshan for installation of 500 nos. DTH modified type Cyclone Warning Dissemination System (CWDS) to replace the existing network of CWDS is under processing. Implementation of this project will be very useful for giving Cyclone Warning or any other warning to the affected areas as this warning will be on one of the DTH television channels. A new Earth station for receiving the data from INSAT-3D was installed at IMD New Delhi for reception of data from INSAT-3D Earth station under an MoU between IMD and M/S Antrix Corporation Ltd. (ISRO).

MoU between IMD & Pawanhans Helicopters Ltd.



Precipitation Collector for Iwin

A meeting was held between Pawan Hans Helicopters Ltd. (PHHL) and India Meteorological Department (IMD) to sign an MoU for enhanced Safety of Helicopter operations in India. This MoU was signed by Shri R. K. Tyagi, Chairman and Managing Director Pawan Hans Helicopters Ltd. and AVM (Dr.) Ajit Tyagi, D G, IMD on 18th August 2010. IMD shall provide support to the Helicopter Services of PHHL at all the Airports and will install and operationalize Automatic Weather Stations at remote locations or Helipads. In addition, IMD shall provide briefing to all the pilots of helicopters operated by PHHL. Pawan Hans will provide sites for installation and shall be responsible for acquisition of the land.

National programme on Isotope fingerprinting of Waters of India (IWIN)

National programme on Isotope fingerprinting of Waters of India (IWIN), a project by National Physical Laboratory, Ahmedabad is supported by this station for the study of isotopic composition of atmospheric moisture. Atmospheric moisture samples are collected by conical condensation device and observation on weather parameters (Temp, RH, Rainfall) is taken during the sampling period. Collected samples are sent to NPL, Ahmedabad for research.



16

BUDGET



BUDGET

BUDGET ESTIMATE (NON PLAN)

For FY 2010-11(Rs./Thousand)

GRANT(2010-11)	Expenditure (2009-10)
B.E (Revenue) - Rs.155100	Rs.2523899
B.E (Capital) - Rs. 25000	Rs.9782

BUDGET SCHEME & THEIR IMPLIMENTATION

Plan Scheme for 2010-2011

00.101 Satellite Services

- Ongoing projects on Space Meteorology continued from previous Five Year Plan
- Installation and maintenance of DCWDS/ CWDS.
- Establishment of INSAT-3D Met. Data Processing system and maintenance.
- Establishment of INSAT-3D Earth Station and maintenance.
- Establishment & Maintenance of National Satellite Data Centre.
- Establishment & Maintenance of 5 GPS and peripherals and also augmenting the network to another 50 nos GPS stations
- Establishment of Metop Satellite Data receiving and processing system and maintenance.

00.102 O W S, 01.01 Operation and Maintenance. ISSD

- Modernization of communication facilities at field observatories of IMD – High
- Speed Data Terminals
- Establishment of Satellite based data receiving system
- Procurement of 2 display systems for Main Gate of IMD and Palam.
- Interactive Voice response System
- Procurement of unified threat management system (Network Security Solution of IMD)
- Procurement of Trend Micro neat suite premier antivirus solution.
- Establishment of MPLs VPN Connectivity, Antivirus solution/LAN Security.
- Strengthening of internet band width and security (HQ-10, RMC-02, MC-512, MO-128/ BB)

Hydrometeorology

- Upgradation of Hydromet services of IMD

ADGM(R) Pune

- Development of LRF capabilities and Upgrading of L&ERF capabilities -Upgradation of existing LRF unit

Annual Report 2010

- Upgrading the L&ERF capabilities & Climate monitoring activities of NCC
- Archival of Manual Weather Charts into digital form
- EMRC: Automatic Precipitation collector, UV-VIS spectrophotometer, High Volume sampler, Autosampler and software
- Climatological Data Rescue Scheme

Environment Monitoring and Research

- Consolidated Proposal of EMRC

DDGM(SI) Pune

- Consolidated statement
- Establishment of UV radiation network.
- Upgradation of existing Radiosonde/ ozondesonde.
- Procurement of Wind tunnel.
- Modernization of manufacturing capabilities of Surface Met. Instruments in Workshop at Pune.
- Upgradation of test and calibration facility of Surface & Airport Met. Instruments.
- Procurement of Digital Station Barometers (100 Nos.)
- Procurement of radiation standard (Cavity radiometer)
- Augmentation of radiation network: Installation of radiation instruments and procurement of Sunshine recorders.
- Various construction & renovation works for Radiation, Surface and Airport Instruments, workshops and Laboratories at Pune.
- EMRC: Procurement of Sky radiometer, Aethalometer, Surface Ozone analysers.

- Procurement of Hand held dataloggers- 200 nos.

DDGM(WF)/DDGM(Training)

- User Survey for fine tuning of the weather forecasting activities of IMD
- Customized heavy duty storage space for old weather charts and storage space for the sections of O/o DDGM (WF) Pune.
- Infrastructure development at CTI, Pune

Forecasting Services (HQ)

- Forecast Development Programme (FDP)
- Integrated Himalayan Meteorology (Project-PARVAT)
- Development of Mountain Meteorology in Central Himalaya

DDGM(UI)

- Test equipment for DWR at Chennai, Kolkata and SHAR.
- Procurement of 2 DWR (BEL) for Bhuj and Kochi
- Procurement of Disdrometer
- Establishment of testing facilities for digital radiosonde
- Procurement of different types of stores and spares
- Spares for IMS-1500 Radio Theodolite

Major Works not related with any Scheme at HQ and Field offices

- Infrastructure development under RMC Guwahati
- Infrastructure development under RMC New Delhi

- Infrastructure development under RMC Mumbai
- Infrastructure development under RMC Kolkatta
- Infrastructure development under RMC Nagpur
- Infrastructure development under RMC Chennai

00.102 O W S

02 Aviation Meteorology

- Aviation Weather Decision Support System (AWDSS)
- National Aviation Meteorology Centre.
- AMDAR
- Integrated Airport Met. Instruments
- Integrated Instrument System for Helicopters

00.200 O M S

01 Agro Met Advisory Services

- Replacement of lysimeter equipment
- Integrated Agromet Advisory Services:
- Modernization of CAgMO, Pune.

00.800 Other Expenditure

01 Seismic Hazard and Risk Evaluation.

E R E C

- Operation and Augmentation of VSAT based Delhi Telemetry Network
- Establishment of a VSAT based seismic telemetry network in NE India
- Continuation of E R E C.
- Establishment of National Earthquake Information System (NEIS).

- Upgradation and replacement of old equipment related with Micro Earthquake (MEQ) survey.
- Creation of Data base for Seismic Hazard & Risk Appraisal (30 Cities) including seismic microzonation
- Establishment of Geotechnical/Geophysical investigation lab

Total E R E C

Seismology

- Augmentation of NSN and NSDC facilities.
- Optimum Seismological Network Programme.
- Archival and digitization of seismic analogue charts.
- Additional civil and electrical works for observatories.

00.800 Other Expenditure Mod of IMD

Mod. of IMD Phase-I

- Procurement of 12 imported DWR for Mumbai, Paradip, Goa, Karaikal, Delhi Airport, Patna, Lucknow, Nagpur, Mohanbari, Agartala, Patiala, Bhopal
- High Performance Computing System (HPCS) for global data process and Numerical Weather priction (NWP) for weather forecasting Services in IMD.
- Commissioning of new integrated and automated systems for airports (42 nos)
- Commissioning of automated weather stations AWS (550 nos)
- Commissioning of automatic raingages (ARGs) 1350 Nos.

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- Regional, Zonal and field maintenance Centres for ARG and AWS
- Transmissometer at six airports
- Transmissometer at Lucknow Airport
- Lightening Detection System (10 Nos)
- Wind Profilers
- Procurement of C-Band Polarized DWR at Delhi under Mod Programme and at Jaipur Under Common Wealth Games.
- Establishment of National Weather Radar Operation Centre (NWROC) at NewDelhi
- Improvement of data quality at 13 Nos of existing stations by deployment of improved quality GPS radio sonde
- Improvement of data quality through indigenous development/production
- Improvement in performance of IMD RS/ RW network_Procurement of 1500 H2 Gas Cylinder
- Design development and fabrication of MEMS sensors read about ASIC and conditioning electronics for IMD radiosonde
- Design and development of MMIC transmitter at 1680 MHz for IMD radiosonde.
- Commissioning of 65 Nos. of optical theodolite
- Commissioning of 5 Nos. Optical Electronic Theodolite
- M F I
- AMC of AMSS at various locations
- Web-based Briefing system at International Airports and Video wall for NWFC briefing room at New Delhi
- Information System, Security and Video Conferencing System
- Facility management system
- Replacement of AMSS GHT and installation of new AMSS at Nagpur and Pune
- Commissioning of Low Level Wind Shear Alert System

Modernization of IMD Phase-II

- 15 S-Band Dual Polarized DWRs under Phase-II Modernization.
- Procurement of 8 C-Band Dual Polarized DWRs.

04-Commonwealth Games and dedicated Weather Channel

- Metropolitan Weather Information and Forecast system for NCR of Delhi & CWG 2010

Scheme Accomplished During 2010-2011

- Met. Data receiving and processing system for Metop Satellite was established.
- Ground Segment equipment for reception & processing of Met. Data from INSAT-3D was commissioned.
- Internet Band width and security was strengthened and LAN upgraded.
- Indent was placed for procurement of various equipment like Aethalometers for B C measurements - 4 Nos. and sky radiometers -10 Nos. for Environmental Monitoring and Research.
- MPLs VPN connectivity, Antivirus solution and LAN security was established.
- Satellite based data receiving system was established and High Speed Data Terminals were procured.

- UV Radiation network was established.
- Existing Radiosonde & Ozonesonde was upgraded.
- Manufacturing capabilities of Surface Met. Instruments and Test and Calibration facilities of Surface and Airport Met. Instruments were upgraded.
- 100 Nos. Digital Station Barometers, Sunshine Recorders and Wind Tunnel were procured.
- 200 Nos. hand held Data Loggers was procured.
- Forecast Development Programme (FDP) at HQ was initiated.
- Implementation of Integrated Himalayan Project (Project – PARVAT) was initiated along with development of Mountain Meteorology in Central Himalayas.
- Indigenously fabricated 2 Nos. DWS was commissioned at Bhuj & Kochi.
- Calibration capabilities and testing capabilities of digital radiosondes was upgraded.
- Spares for IMS-1500 Radio Theodolites were procured.
- EFC Approved Aviation Weather Decision Support System (AWDSS) was established.
- Integrated Airport Met. Instrument and Integrated Instrument System for Helicopter will be procured.
- Vehicles for Airport offices were procured. Airport Instruments were also procured for 7 Airports. Supply order was placed for integrated Airport Met. Instruments for 40 Airports.
- Equipment was procured for the project “Integrated Agromet. Advisory Services”.
- Central Agromet. Observatory at Pune was modernized.
- Lysimeter tanks at various stations were replaced.
- Equipments for VSAT based seismic telemetry network in NE India were procured.
- Portable Micro Earthquake Monitoring (MEQ) system was put in place and activities of earthquake Risk Evaluation Centre was continued.
- Seismic analogue charts were archived and digitized.
- Operation of VSAT based Delhi Telemetry Network was augmented.
- Seismic analogue charts were archived and digitized.
- Optimum Seismological Network programme was implemented alongwith augmentation of NSN & NSDC facilities.
- HPCS for global data processing and numerical weather prediction for weather forecasting services in IMD commissioned.
- Forecasting system under MFI were commissioned.



REPRESENTATION OF SCs, STs AND OBCs

Representation of SCs, STs and OBCs														
	Number of Employees								Number of appointments made during the previous calendar year (2009)					
	As on (01.12.2010)				By Direct Recruitment				By Promotion			By Other Methods		
	Total	SCs	STs	OBCs	Total	SCs	STs	OBCs	Total	SCs	STs	Total	SCs	STs
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Group A	249	34	15	29	-	-	-	-	4	1	3	-	-	-
Group 'B' (Gazetted)	1016	160	52	6	-	-	-	-	136	110	26	-	-	-
Group 'B' (Non-Gazetted)	2038	379	125	267	4	-	2	-	324	46	10	5	-	1
Group 'C'	822	227	98	134	5	-	-	1	157	12	5	3	-	-
Group 'D' (Safai Karamcharis)	84	66	7	3	1	1	-	-	1	-	-	1	-	-
Total	5550	1340	430	559	20	2	7	1	639	174	45	11	-	1

Representation of Persons with Disabilities																		
Groups	Number of Employees				Direct recruitment								Promotion					
					Number of appointments made				Number of appointments made				No. of vacancies reserved			No. of vacancies reserved		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH
Group A	249	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-
Group 'B' (Gazetted)	1016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group 'B' (Non-Gazetted)	2038	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group 'C' & Group 'D'	2247	1	2	36	-	-	-	1	-	-	-	-	-	-	6	-	-	-
Total	5550	1	2	43	-	3	3	1	-	-	-	-	-	-	6	-	-	-



IMPORTANT TELEPHONE LINKS

NAME	DESIGNATION/OFFICE	EPABX New Delhi	OFFICE TELEPHONE NO./ FAX
AVM (Dr.) Ajit Tyagi	DGM	4201	011-24611842
Shri T.D. Chacko	Senior PS to DGM	4253	011-24611842
Shri Jagmohan Sharma	PS to DGM, New Delhi	4225	011-24611842
Dr. L.S. Rathore	Head, Agro. Met. & ADGM, New Delhi	4240	011-24617518
Shri D.K. Nim	Finance Officer, IMD	4502	011-24623210
Shri Rajiv Sharma	DDGM (A&S), New Delhi	4210	011-24621472
Smt. Mamta Negi	PA to DDGM(A&S), New Delhi	4302	011-24621472
Shri L.R. Meena	Scientist 'F' (ISSD), New Delhi	4314	011-24616051
Shri A.K. Sharma	Scientist 'F' (Sat. Met.), New Delhi	4415	011-24626021
Shri B. Mukhopadhyay	Scientist 'F' & Head (EMRC) (DM), New Delhi	4548	011-24697473
Dr. R.S. Dattatrayan	Scientist 'F' (Seismo), New Delhi	4405	011-24611305
Dr. S.K. Roy Bhowmik	Scientist 'F' (NWP), New Delhi	4482	011-24615815
Shri N.Y. Apte	Scientist 'F' (Hydro.), New Delhi	4223	011-24619167
Shri B. L. Verma	Scientist 'F' (Sat. Met.), New Delhi	4429	011-24698247
Dr. S.K. Peshin	Scientist 'F', (EMRC), New Delhi	4235	011-24635797
Shri S. K. Kundu	Scientist 'F', (UI), New Delhi	4245	011-24611451
Shri Surya Bali	DDGM (MFI), New Delhi	4227	011-24624486
Shri B.K. Bandyopadhyay	DDGM (S), New Delhi	4334	011-24611068
Shri S.Krishnaiah	Scientist 'F', LACD DDGM(SI), Pune		020-25535411
Dr. A.B. Majumdar	DDGM (WF) & LACD ADGM (R), Pune		020-25535886
Dr. R.P. Samui	DDGM (Agrimet.), Pune		020-25533420
Shri S.K. Prasad	DDGM (Training), Pune		020-25893330
Dr. A.L. Koppar	DDGM (Climatology), NDC, Pune		020 - 25535797

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Dr. R.V. Sharma	DDGM, RMC, Mumbai		022-22150517
Dr. Y.E.A. Raj	DDGM, RMC, Chennai		044-28276752
Shri S.N. Roy	DDGM, RMC, Kolkata		033-24793782
Dr. Smt. S. Kaur	Scientist 'F', RMC, Nagpur	4460	0712-2284266
Dr. H.G. Pathak	LACD DDGM, RMC, Guwahati		0361-2840206
Shri M.K. Bhatnagar	Scientist 'E', (Organisation), New Delhi	4301	011-24619196
Shri A.A. Farqui	Scientist 'E', (Publication), New Delhi	4554	011-24642432
Shri Satish Bhatia	Scientist 'E', (DGM Sectt.), New Delhi	4513	011-24611710
Dr. A.K. Shukla	Scientist 'F', (EREC), New Delhi	4576	011-24616309
Dr. Mrs. Suman Goyal	Scientist 'E', (Sat. Met.), New Delhi	4408	011-24626019
Dr. S.D. Attri	Scientist 'E', (EMRC), New Delhi	4309	011-24620701
Shri B.P. Yadav	Scientist 'E', (NWFC), New Delhi	4398	011-24629798
Dr. M. Mohpatara	Scientist 'E', (CW), New Delhi	4304	011-24652484
Shri D.P. Mishra	Scientist 'E', (Radar Lab.), New Delhi	4224	011-24632234
Dr. G. Krishna Kumar	Scientist 'E', (NDC), Pune		020-25530992
Dr. J. Rajendra Kumar	Scientist 'E', (AMO), Palam, New Delhi		011-25654335
Shri S.C. Bhan	Scientist 'E', (DGM Sectt.), New Delhi	4513	011-24611710
Shri S.K. Jain	Scientist 'E', (CPU), New Delhi	4236	011-24698247
Shri L.A. Siddiqui	Director (Finance), New Delhi	4487	011-24697640
Shri Vivek Sinha	Director (Establishment), New Delhi	4442	011-24625547
Shri A.K. Bansal	Director (Vigilance), New Delhi	4254	011-24652318
Shri R.P. Lal	Director (Planning), New Delhi	4260	011-24625917
Shri U.P. Singh	Director (Publication), New Delhi	4262	011-24651287
Shri K.N. Katyal	Director (Admn.), New Delhi	4204	011-24602480
Shri Shiv Ganesh	Director (IT), New Delhi	4388	
Caretaker, Mausam Bhawan	-	4372	
Guest House (H.Q.)	-	4472	



New Exchange – Airtel Telephone

Dialing from Delhi : 4382XXXX

Dialing from outside Delhi : 011 4382XXXX

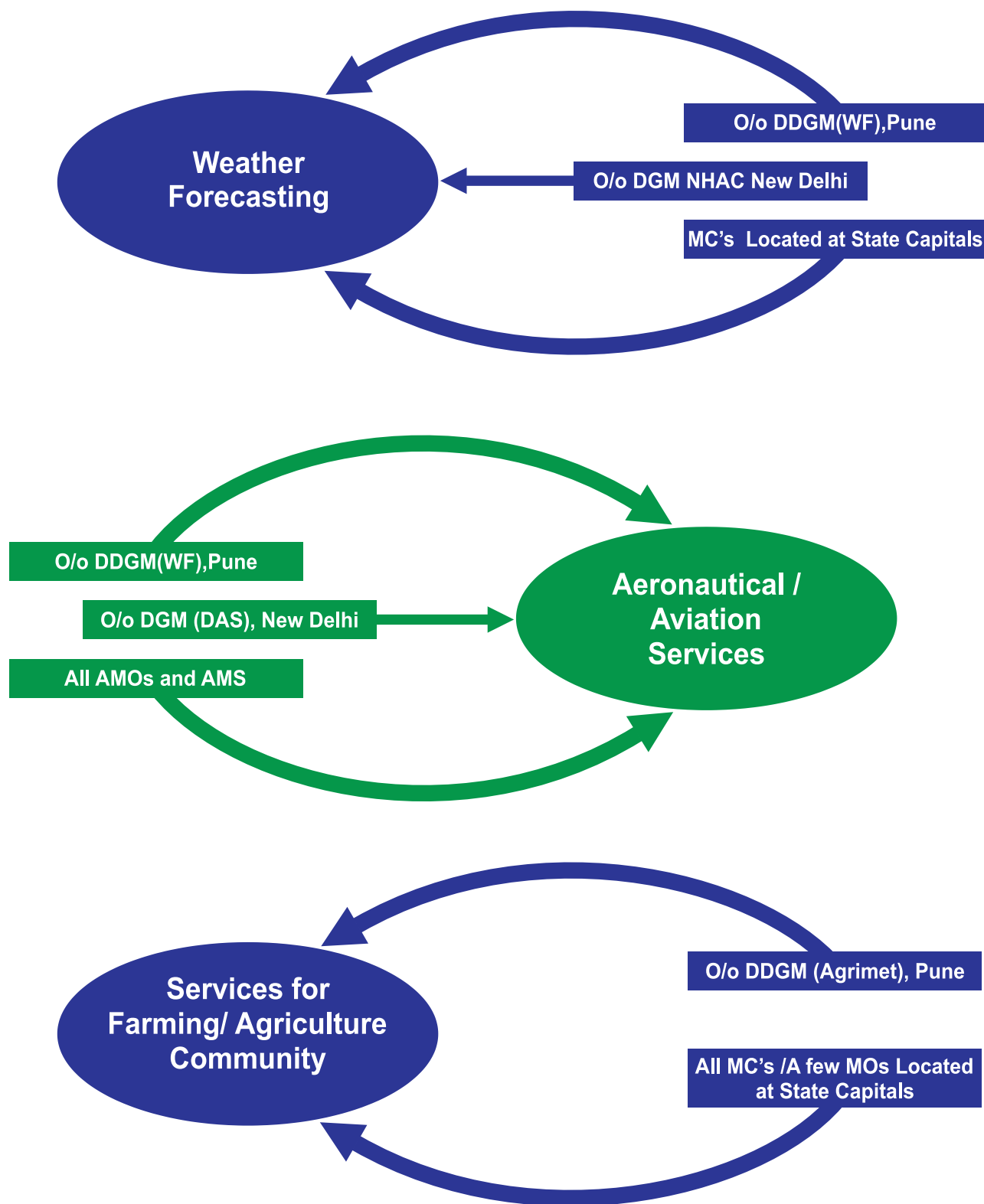
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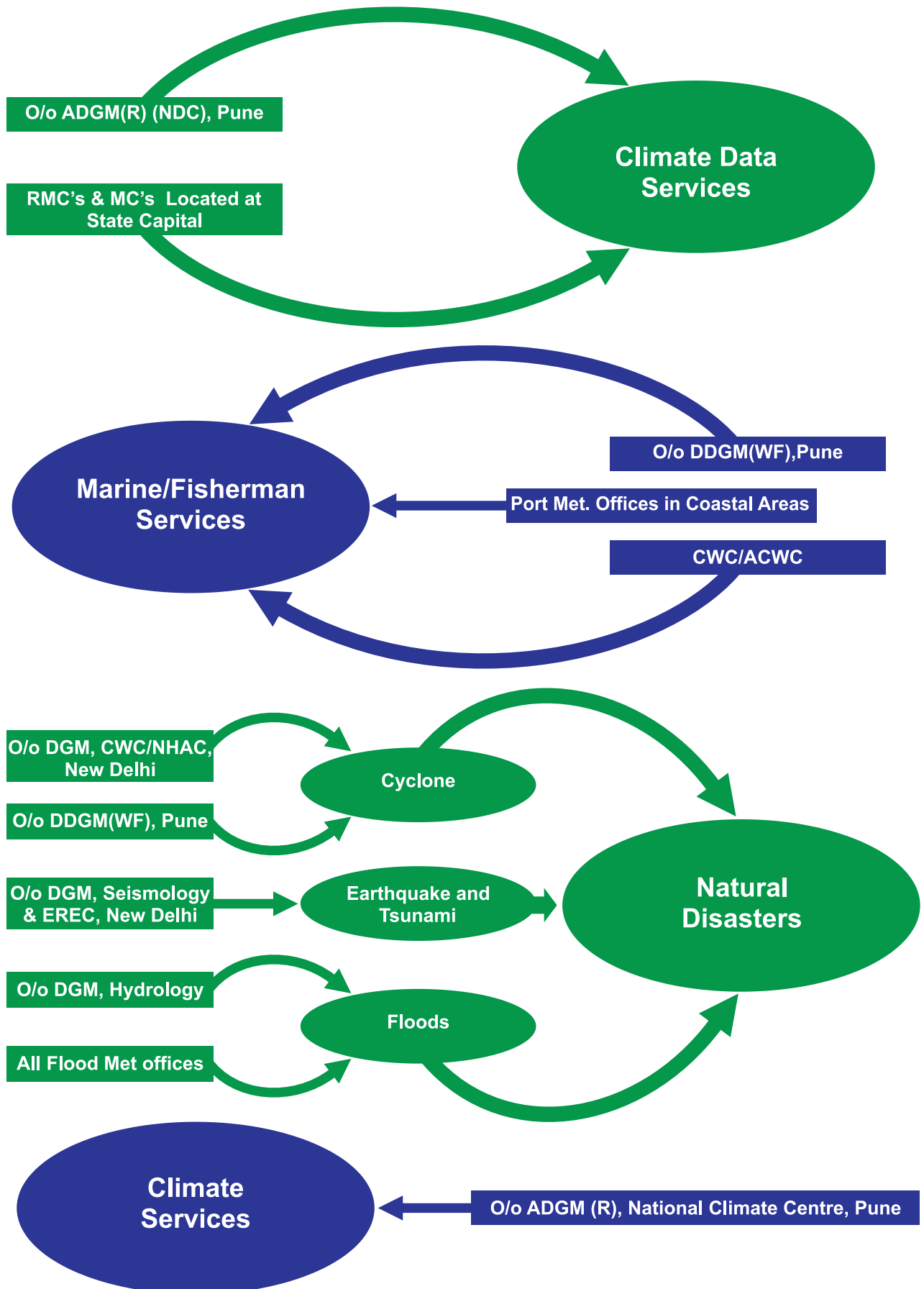
Telefax : 91-11-24699216, 91-11-24623220

Website : www.mausam.gov.in

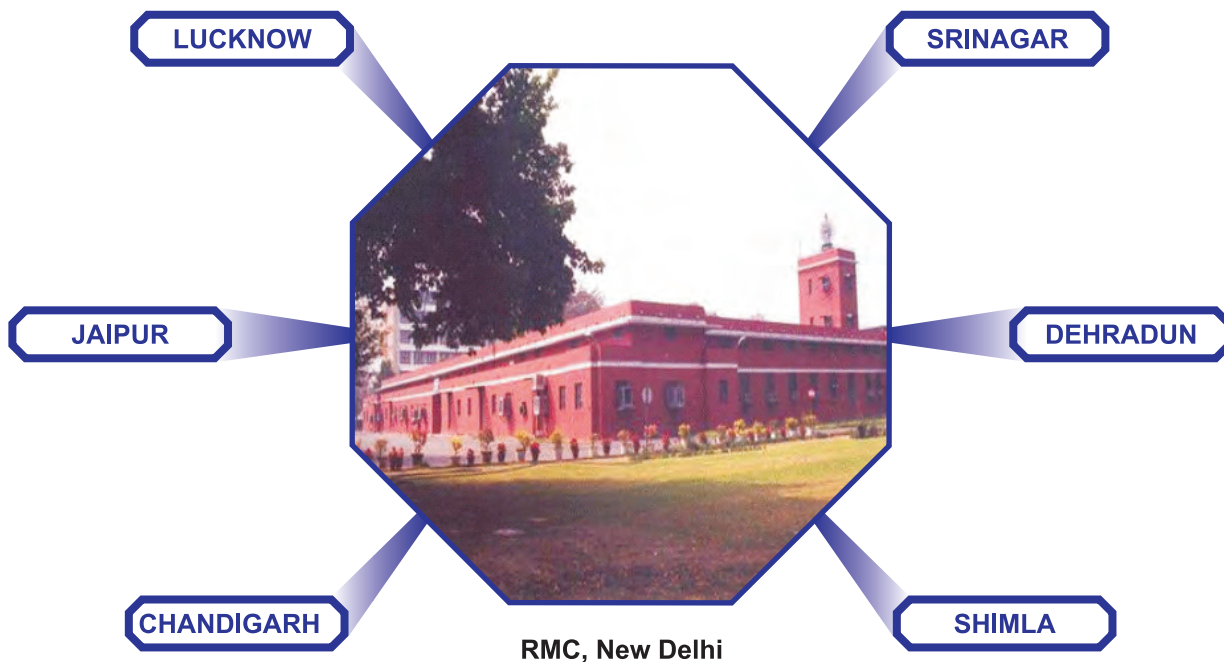
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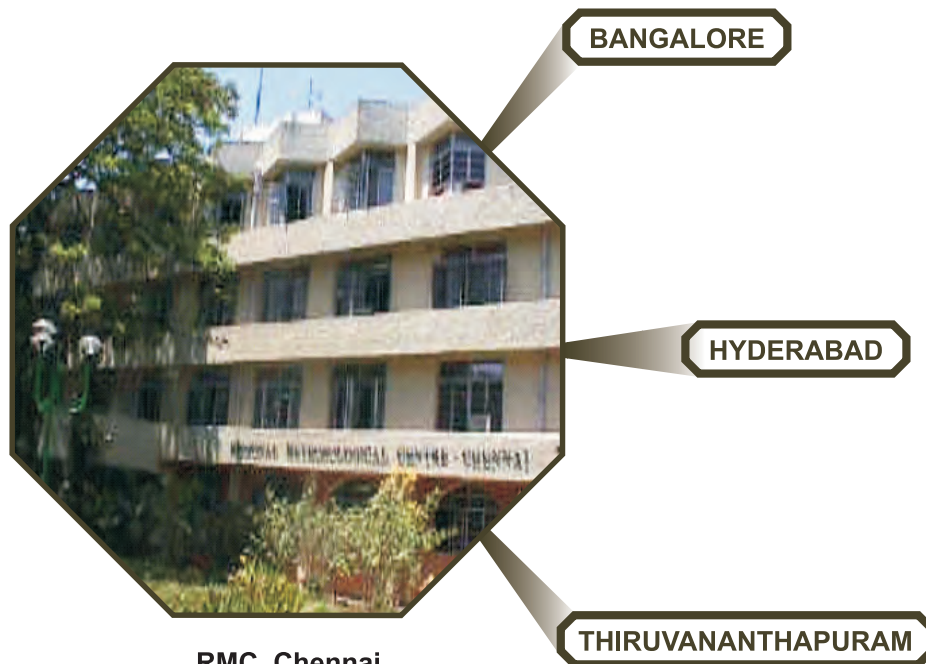
REGIONAL METEOROLOGICAL CENTRES



RMC, New Delhi

Under the administrative control of RMC, New Delhi, there are operational units such as Met. Centres at state capitals of U.P., H. P., Punjab, Haryana, J&K and Uttarakhand, Forecasting Offices, Agrometeorological Advisory Service Centres, Flood Meteorological Offices.

Regional Meteorological Centre at Chennai was started on 1 April 1945 to supervise and coordinate meteorological services in the Southern Region, which now covers the states of Tamilnadu, Andhra Pradesh, Karnataka, Kerala and Union Territories of Pondicherry and Lakshadweep.



RMC, Chennai

The Regional Meteorological Centre Guwahati was started at Guwahati Airport on 23 July 1949. It was upgraded to Meteorological Centre on 25 March 1974 and further upgraded to RMC on 01 April 1997. All Met Offices of North-East region except that in Tripura are under administrative & technical control of RMC Guwahati.



ITANAGAR

AGARTALA

RMC, Guwahati

BHUBANESHWAR

Regional Meteorological Centre, Kolkata located at 4, Daul Avenue, Kolkata - 700027 is the nodal office for the public to obtain any information pertaining to India Meteorological Department and its various offices located in the states of West Bengal, Orissa, Jharkhand, Bihar, Sikkim, Tripura and Andaman and Nicobar Islands.



GANGTOK

PATNA

RANCHI

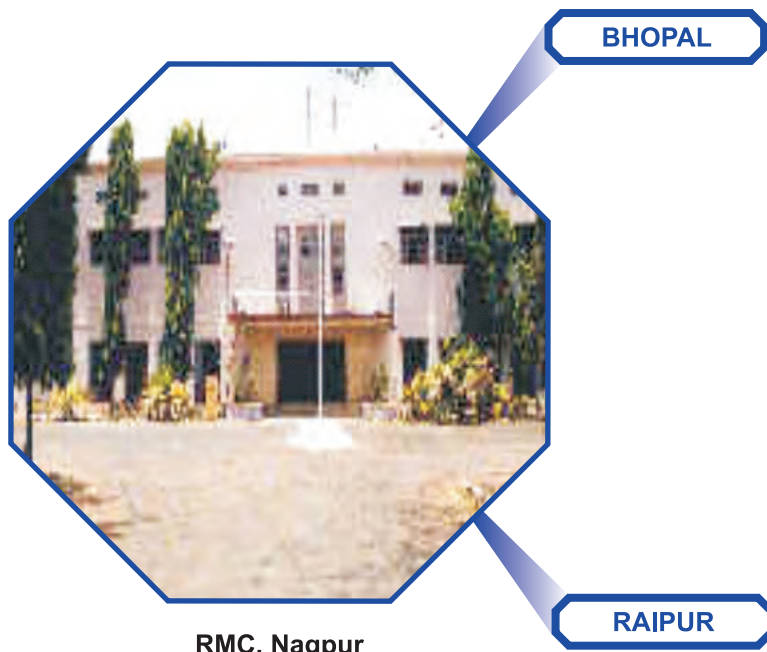
RMC, Kolkata

The R.M.C., Mumbai was established in April 1945 for providing weather Forecasting and related services to the states of Maharashtra, Goa and Gujarat excluding Vidarbha region of Maharashtra State. The centre is also responsible for the monitoring of tropical cyclone formation in Arabian Sea and cyclone warning work, which is carried out by Area C.W.C. Mumbai and C.W.C. Ahmedabad.



RMC, Mumbai

R.M.C., Nagpur was established in the year 1945 at Nagpur Airport. It controls M.C. Bhopal, M.C. Raipur and M.O. Nagpur. There are 16 departmental 48 non-departmental observatories, 6 Agrimet observatories and 3 Seismological observatories functioning under RMC Nagpur. RMC Nagpur covers Madhya Pradesh, Chhattisgarh and Vidarbha region.



RMC, Nagpur



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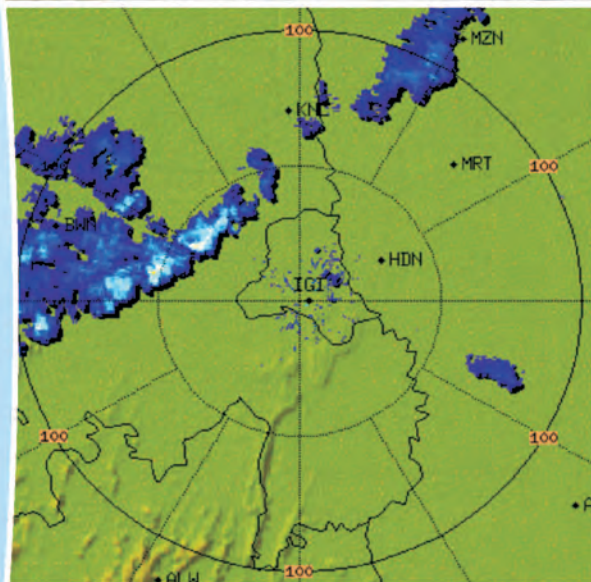
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GUWAHATI REGION

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Ministry of Earth Sciences, Govt. of India