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वार्षिक प्रतिवेदन

ANNUAL REPORT

2011

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

पृथ्वी विज्ञान मंत्रालय, भारत सरकार

Ministry of Earth Sciences, Govt. of India

वार्षिक प्रतिवेदन

ANNUAL REPORT

2011

INDIA METEOROLOGICAL DEPARTMENT
(MINISTRY OF EARTH SCIENCES, GOVT. OF INDIA)
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PREFACE

It gives me immense pleasure to bring out the Annual Report of India Meteorological Department (IMD) for the year 2011. The report highlights significant activities of the department during the year. The department has been playing a leading role in the field of Earth and Atmospheric Sciences by providing efficient services in meteorology and contributing to safety of life and property. By all means this contribution is a major towards the cause of national development. The celebration of IMD's Foundation Day on 15th January, has provided ample opportunity to commemorate past glory and a reflection of the future vision. The Department's progressive strides towards modernization of scientific infrastructure in the fields of meteorological observations and information systems has helped to render better services in areas of agriculture, aviation, shipping, fisheries, energy and transport. Numerical Weather Predictions has established its credibility in giving medium and short range forecasting of severe weather phenomenon like cyclones, heavy rains, thundershower, cold and heat waves.

For better co-ordination of services, IMD has forged important links with other stake holder agencies. It has signed MoU with Centre Water Commission, C-DAC, ISRO and Pawan Hans. An important development has been a MoU with Andhra University. After successful training, the officers would be awarded with M.Tech. degree in Atmospheric Sciences from Andhra University. This would give a great boost to improving the quality of the scientific personnel in the Department. Organizations of meetings, workshops and various training programmes have not only reflected our capabilities but have also provided awareness among the public. They have added to our confidence to take up new responsibilities. It is a matter of pride for us that many IMD scientists have received honour and awards for their outstanding performances.

During this period the radiation laboratory of surface instrument division of Pune office got recognition as Regional Radiation Centre for RA-II by the WMO and has acquired ISO certification for the process of manufacturing, testing calibration and supply of Meteorological instruments which is one of the important achievement of the year. On the front of

encouraging the use of National Language the progressive use of Hindi on administrative / technical matters and preparation of Bilingual web-site are important mile stones in the implementation of Rajbhasha Programme.

On the international front IMD has engaged itself meaningfully with the neighbouring countries under the ESCAP. WMO activities in providing early warning to all cyclone affected countries in Asia and Asia Pacific. Re-election of India into the Executive Council of WMO during the 16th WMO Congress was also an important event. It strengthened India's position of eminence in the Region. There have been important bilateral programmes in capacity building too with countries such as Indonesia, and SAARC nation.

I would like to mention that apart from dedication and hard work of IMD personnel in improving the standard of quality of output, the department has established its supremacy in sports like bridge etc during Inter-departmental/ Inter Ministerial tournaments.

The anticipation is high from different service sectors and the weather forecasting area is of great concern to us. We need to strive even harder to fully meet the demand of the unbounded confidence reposed upon us. In conclusion, I am availing this opportunity to thank all the members of India Meteorological Department for their true dedication and strive to further enhance the reputation of the department with strong national and international credibility.

Dr. L. S. Rathore
Director General of Meteorology

ORGANISATION

Ministry of Earth Sciences
Govt. of India

Shri Vilasrao Deshmukh

Hon'ble Minister for
Ministry of Science & Technology,
Ministry of Earth Sciences and
Ministry of Parliamentary Affairs

Shri Ashwani Kumar

Hon'ble Minister of State for Ministry of Science & Technology, Ministry of Earth Sciences, Ministry of Planning & Ministry of Parliamentary Affairs

India Meteorological Department
(HQ), Mausam Bhawan, Lodi Road, New Delhi

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Ministry of Earth Sciences

Dr. L. S. Rathore
Director General of Meteorology

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Dr. K. K. Singh, Scientist 'F' (Head Agrimet.)	**Shri S. C. BHAN**, Scientist 'E' (DGM Secretariat)

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Pune office

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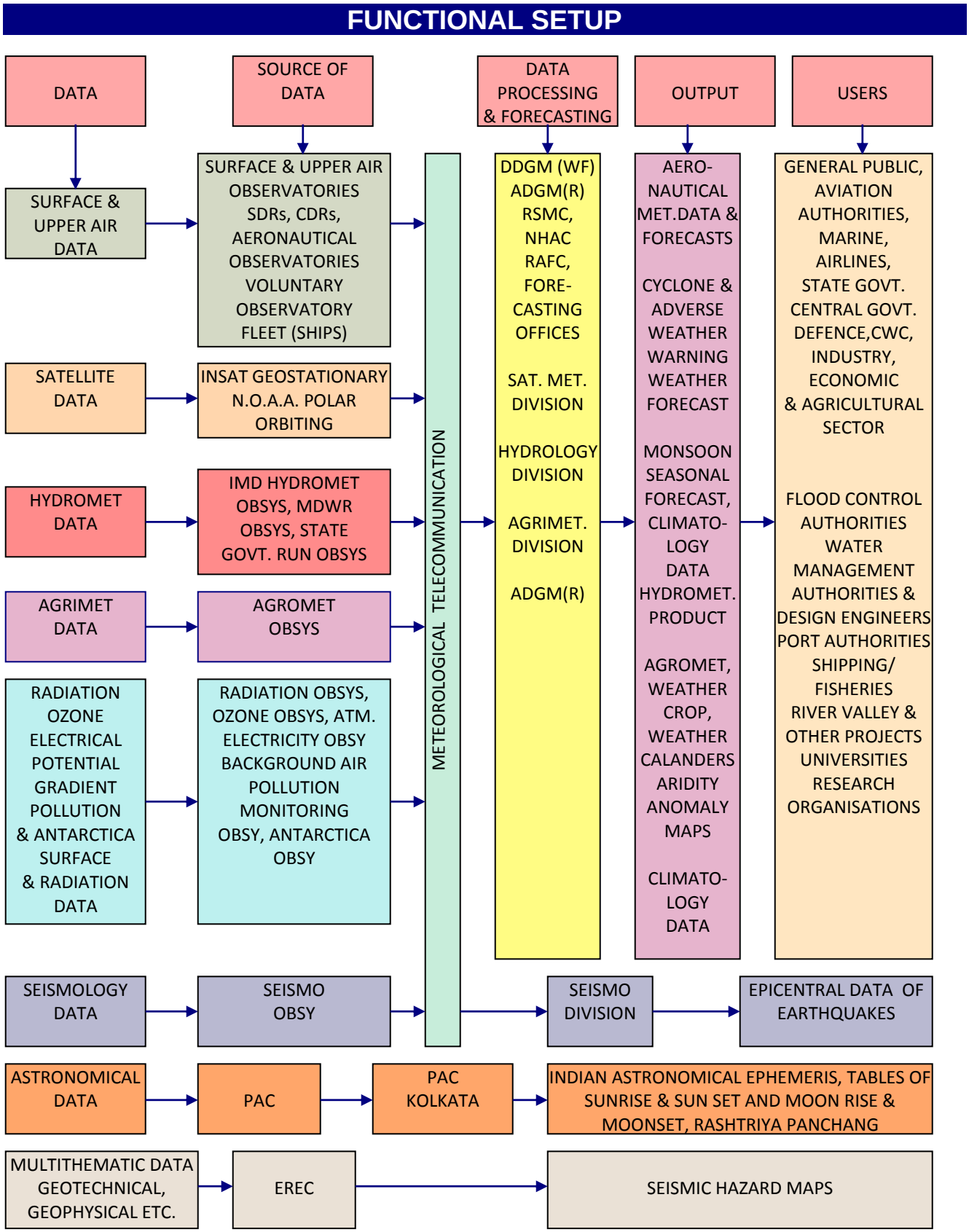
Shri S. Krishniah, Scientist 'F' (Surface Instruments)	**Dr. (Ms.) Medha Khole**, Scientist 'E' (Weather Forecasting)
Dr. N. Chattopadhyay, Scientist 'E' (Agrimeteorology)	**Dr. G. Krishnkumar**, Scientist 'E' (NDC)


FUNCTIONAL SETUP
DATA
SOURCE OF DATA
DATA PROCESSING & FORECASTING
OUTPUT
USERS
SURFACE & UPPER AIR DATA
SURFACE & UPPER AIR OBSERVATORIES SDRs, CDRs, AERONAUTICAL OBSERVATORIES VOLUNTARY OBSERVATORY FLEET (SHIPS)
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SEISMO OBSY
SEISMO DIVISION
EPICENTRAL DATA OF EARTHQUAKES
ASTRONOMICAL DATA
PAC
PAC KOLKATA
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Executive summary

The India Meteorological Department (IMD) was setup in 1875 by the Govt. of India with an objective to study systematically the climate and weather in India as a whole. Mr. H.F. Blanford was the first Imperial Meteorological Reporter to the Govt. of India with it's headquarter at Calcutta. In view of geophysical and meteorological diversity to meet administrative and operational requirements, presently whole India is divided in to six regional's meteorological centres, *i.e.*, Chennai, Guwahati, Kolkata, Mumbai, Nagpur and New Delhi with headquarter located at New Delhi.

Being a tropical country, the different parts of India experience wide range of heterogeneous weather and extreme weather conditions like heat waves, cold waves, excessive rainfall, floods and droughts etc. During winter season the cold wave conditions were observed over plains of northwest, central and eastern parts of the country. Pre monsoon season is known for heat wave conditions. This year heat wave conditions prevailed over western and central part of India during 3rd week of March. The severe heat wave conditions prevailed over many parts of Jharkhand, Chattishgarh, Orissa and Gangetic West Bengal and heat wave was experienced also at many places in Madhya Pradesh, Gujarat and Maharashtra. The eastern parts of southern peninsula were also in the grip of heat wave during 2nd week of May. Although all seasons are important and associated with various type of weather and weather systems but the Monsoon season (June-September) is considered to be more important in the view of agriculture production, national planning and economic growth of our country. The S-W monsoon set over Kerala by 3 days before the normal date (1st June) of onset of monsoon. Four depressions and 10 LOPAR formed during this season. Withdrawal of monsoon commenced from west Rajasthan w. e. f. 23rd September with a delay of more than 3 weeks. The Long Range Forecast (LRF) for all India seasonal monsoon rainfall was issued on 19th April as 98% of LPA with a model error of ± 5%. The country as a whole received the monsoon rainfall as 101% of LPA. The all India seasonal rainfall departure from its Long Period Average (LPA) was slightly positive. In other words, the year 2011 was a good monsoon year. Out of 36 meteorological sub-divisions of the country, the season's rainfall for the year 2011 was excess in 7 sub-divisions, normal in 26 sub-divisions and deficient in 3 sub-divisions. The district level weather forecasts were issued for the benefit of the farmers through various modes of communication including SMS on mobile phone. During the post monsoon season, country received 96% rainfall of LPA. Out of 5 sub-divisions of peninsula, Tamil Nadu and Puducherry received excess rainfall during the period. The

post monsoon season was abnormally warmer which was second warmest (+0.85 °C anomaly) since 1901.

Weather monitoring and forecasting are the main responsibilities of India Meteorological Department. The cyclonic storms formed in the Indian bay have very devastating effects while crossing the coastal areas. Therefore monitoring, track & landfall prediction of cyclonic storms of varying intensity becomes a necessity to protect the coastal population from the loss of life and property. The predictions for the tracks of the Cyclonic Storm KEILA over the Arabian Sea and Very Severe Cyclonic Storm THANE over the Bay of Bengal were issued with fairly good accuracy. The commissioning of high-tech weather monitoring instruments at the airports has improved nowcasting capability for air navigations. The weather services like monitoring warnings & nowcasting for thunderstorms, squalls, gusty wind and fog etc. at the Indian airports have been provided to user agencies with desired accuracy. The scientists of this department have been participating in Indian Scientific Expedition to Antarctica (Maitri) since beginning to collect climate data and to provide weather prediction for all outside activities which is a very challenging task. The synoptic data of Maitri station are uploaded on the departmental website and global network.

Presently Numerical Weather Prediction (NWP) is part and partial of weather prediction system of the department. High Performance Computing System (HPCS) is capable to run NWP models like, GFS T-574, T-384, WRF etc. The WRF model forecast system has been implemented at IMD HQ and ten other major Meteorological Centers. Based on the Multi-Model Ensemble (MME) coupled models outputs from the leading modeling centers like ECMWF, NCEP and JMA etc. IMD has started generating Extended Range Forecast for SW Monsoon and its results are found to be very encouraging. The extended range forecast for maximum & minimum temperature has provided basis for declaring the heat wave and cold wave conditions during summer and winter season respectively. The cyclogenesis is another area where the extended range forecast has captured successfully the system and associated rainfall.

Meteorological services have significant impact on every spheres of life. The demand for accurate weather prediction is increasing due to increasing public awareness. During the recent years, the department has undergone a changeover from being a data provider to service provider. The department provides services in the field of hydro-meteorology, agro-meteorology, air navigation, marine-meteorology, earthquake monitoring and public weather services etc. to a large number of

users in the country. Seismic Microzonation of NCT Delhi has been done and seismic telemetry network has been set up in N-E region for real time monitoring of earthquake in the region. Rainfall monitoring and time series for various river catchments is used to estimate design flood for hydraulic structures, irrigation projects and dam etc. The Quantitative Precipitation Forecast provided by IMD is an important component which is utilized by Centre Water Commission for flood prediction in rivers' catchments and their basins area. During 2011 out of 15495 QPF issues 10863 were realized as correct. Over and underestimated QPF 3992 and 683, were out by one and more than two stages respectably. Presently IMD caters to the need of farmers by providing bi-weekly agro met advisory bulletin for 552 districts of the country in English, Hindi and other local languages. SMS and IVR technology are utilized for dissemination of the bulletins, alerts, warning etc. and to receive users feedback. About 3 millions farmers have utilized SMS services during the year. Meteorological services provided for air navigation are mandatory and important for safe and efficient flight operation. At IGI airport, the accuracy of dense fog forecast with lead time 12 – 18 hrs in advance was 96%.The ground receiving and processing system for Metop/NOAA/MODIS was commissioned on 3rd June. The satellite products received from Metop/NOAA/MODIS are utilized for operational weather forecasting for each service sectors with considerably good accuracy. The success rate of Satellite derivative Night fog was 93.75%.

In addition to routine weather monitoring & forecasting, the environment, air quality and air pollution monitoring are some other areas of responsibility of the department. The AOD calculated from Skyradiometer data with the MODIS derived AOD found a very good agreement. The preliminary study of the data shows that AOD at 500nm values at background location Ranichauri in Uttarakhand is very low (0.1 – 0.3). The AOD values at Delhi have wide fluctuations, diurnal as well as monthly. On a clear sky day the AOD values are found to be less than 0.5 The impact of weather, climate and environment on human health will be emerging areas of future research. Another mandate is to generate astronomical data and publish in form of Indian Astronomical Ephemeris. India is one of the seven countries of the world having an ephemerides office at Positional Astronomical Centre, Kolkata. This centre is also responsible for publishing Rashtriya Panchang in fourteen Indian languages, sunrise & sunset table and fixing dates of all India festivals for all communities for declaring holidays by central and state government. Through two main libraries, one at H. Q. Delhi and another at Pune, the department continue to provide referral and reprographic services. The significant number of journals and books are added yearly as recurring assets of library, online access

of many journals were provided. Departmental publications like Meteorological Repots, Met monographs and Climate Summaries etc. were brought out during the year. In order to meet demand for growth and development of the country, the meteorological data & climate information services are provided to various kinds of users, industries and national agencies.

Right from its establishment the department has always been using the contemporary technologies like Satellites & telecommunication Systems, Doppler Weather Radars (DWR), Automatic Weather Station (AWS), High Performance Computing System (HPCS) etc. for upgrading its observational network and providing meteorological services to various users like farmers, fishermen, aviators, industrialists etc. The department has undertaken the Modernization Programme which is underway in a phased manner. The state-of-the-art technologies for surface instruments - AWSs and ARGs, Upper Air Instruments - Radiotheodolites, GPS radiosonde sky radiometers etc. have been acquired by the department. Now-a-days the department has been growing fast and developing its infrastructure for providing new services to almost all sections of the society through various new areas of application.

The scientists of the department are contributing very high standard research on meteorology and allied subjects which are published in reputed national and international scientific journals. Their research work has great recognition in international scenario. The scientists of the department have published about sixty research contributions in journal 'MAUSAM' and forty seven research contributions in other international reputed journals during the year. To provide a platform for publishing research papers, for scientists from IMD, institutes, universities and from abroad, the department publishes a quarterly research journal 'MAUSAM' - a Journal of Meteorology Hydrology and Geophysics. In addition to regular issues, a 'Special Issue on Polar Science' Vol 62, No 4 was also brought out during the year 2011. During the year, the 25th Biennial Mausam award for the biennial period 2008-2009 was conferred upon to Dr. M. Mohapatra, Shri H. R. Biswas and Shri G. K. Sawaisarje for their research paper entitled, "Daily summer monsoon rainfall over northeast India due to synoptic scale system" published in 'MAUSAM'.

Expeditious efforts have been made to better equip the department with quality manpower and upgrade the knowledge and skill of the personnel-scientific as well as administrative through their participation in various seminars, workshops, regular and short term training programmes at national and international level. The seminars and workshops have proved their utility for sharing of

knowledge and general awareness among various types of users. Being a founder member of WMO, IMD has played a leading role at different international forum and the department has implemented various schemes and program initiated by WMO. During World Meteorological Congress the then DG, IMD, AVM (Dr,) Ajit Tyagi was elected as member of WMO Executive Council. During meeting on Commission of Agriculture Meteorology (CAgM) WMO, Dr. L. S. Rathore, co-chaired OPAG-1 group management meeting which dealt with agro-meteorological services for agriculture production. Many other senior scientists of the department represented India in other prestigious international forum. National collaborations with many other department and international collaborations with other countries have been made in various fields for better co-operation and better services for the national and international users. In this connection, department has made bilateral international collaboration with Russia, Mexico, NASA and SAARC countries in national interest. The bilateral collaborations have been made with CWC, ISRO, Doordarshan, CDAC, BIAL and Andhra University etc. to provide better services to user communities. The delegations from Indonesia, Africa, Russia and WMO Geneva visited IMD under various programmes. They were apprised of divisional achievements due to modernization and development of human resources in the department. The scientists of international fame like Dr. Marat Khairoutdinov, from USA, Dr. Suresh Boodhoo, Ex-Chief Mauritius, Dr. Ramesh Kakkar, NASA USA, Dr. Simon Mason, IRI, Dr. Zhan Zhang and Dr. V.K.S. Venkata Tallapragada from NCEP, USA visited IMD H.Q. New Delhi and shared new findings in their area of specializations. The scientists of the department were also deputed abroad for participation in various scientific meetings, workshops, seminars and training to give momentum to modernization programs.

The department celebrated its 136th IMD Foundation day on 15th January at H. Q. New Delhi, with great enthusiasm. Shri Kapil Sibal, the then Hon'ble Minister for MoES was the chief guest on this occasion. On World Meteorological Day, the 23rd March, a seminar on 'Climate for You' was organized followed by an interactive session with farmers. Four partial solar eclipses and two total lunar eclipses occurred during this year; the scientists of the department are working as a member of different Research Advisory Committee, Ph.Ds thesis Evaluator, viva-voice examiner and conducted examination at various universities and institutes. During MoES foundation day Group "A" officers Dr. D. R Pattnaik, Shri A.D. Thate and Shri R. K. Singh have been conferred Certificate of merit for their outstanding contribution in field of Atmospheric Science and Technology. Shri A. K. Sharma Scientist -'E' was conferred Bharat Jyoti Award & Certificate of Excellence and Dr. Medha Khole

Scientist -‘E’ was conferred “Vocational Excellence Award” by India International Friendship Society and Rotary Club, Pune respectively

The department has been engaged in promoting the progressive use of Hindi, the official language of our country and successfully implemented the official language policy of the Government of India. The various programmes and competitions were conducted during “Hindi Pakhwara/Hindi Divas” at H.Q. New Delhi and all other sub offices situated at different places in India. These programmes threw light upon use of “Rajbhasha Hindi” in the department and motivated large number of officials to work in Hindi.

The IMD has contributed a lot towards achieving its objectives put forth during the year 2011. We can say confidently that the department will continue to keep up its leadership initiatives among world meteorological communities and keep up pride of the nation by providing weather services with full dedication for benefits of the mankind in national and international scenario.

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WEATHER SUMMARY 2011

1

WINTER SEASON (JF)

PRE-MONSOON SEASON (MAM)

MONSOON SEASON (JJAS)

POST MONSOON SEASON (OND)

1. WEATHER SUMMARY 2011

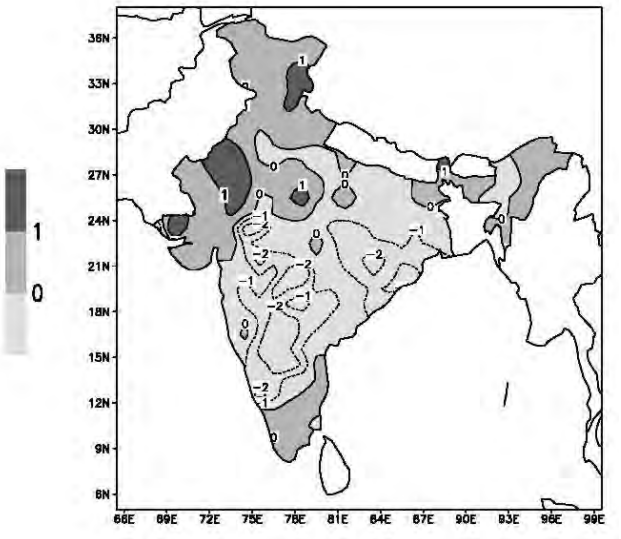
1.1. Winter season (J & F)

Cold Wave Conditions

Cold wave condition prevailed over plains of northwest, central and east India till 3rd week of January. Severe cold wave conditions prevailed over most of the northern and central parts of the country on most of the days during the first three weeks of January. These conditions also prevailed over the peninsular parts of the country during the second and third week of January.

Temperature

Maximum temperatures were generally above normal over most parts of the country except over parts of Gangetic plains and adjoining northwestern parts. These were below normal by about 1 °C over parts of Punjab, West Rajasthan, East & West Uttar Pradesh and parts of Gangetic West Bengal. Over parts of Jammu & Kashmir, Himachal Pradesh, East Madhya Pradesh, Chattisgarh and extreme northeastern region maximum temperatures were above normal by about 1 °C.



Minimum temperature anomaly

Minimum temperatures were below normal over many parts of the country except parts of northern/northwestern and northeastern region and parts of extreme south peninsula. Over north peninsula and adjoining central and eastern parts of the country, minimum temperatures were below normal by 1 to 2 °C. Over parts of Jammu & Kashmir, West and East Rajasthan and Saurashtra & Kutch, these were above normal by about 1 °C.

Rainfall Features

Rainfall activity over the country as a whole was below normal during the season. Sub-divisions of central and eastern/northeastern region and some sub-divisions of northern region received deficient/scanty rainfall. However, some sub-divisions of northwest India and south peninsula received excess rainfall. Rainfall activity was confined to northern/northwestern and eastern/ northeastern parts of the country and parts of south peninsula. Extreme northern and northeastern parts of the country and parts of Coastal Andhra Pradesh, Tamil Nadu and Kerala received more than 5 cm of rainfall. Rainfall received by parts of Uttaranchal, Himachal Pradesh and Jammu & Kashmir exceeded 10 to 20 cm.

For the winter season 2011, rainfall for the country as a whole was 78% of its Long Period Average (LPA) value.

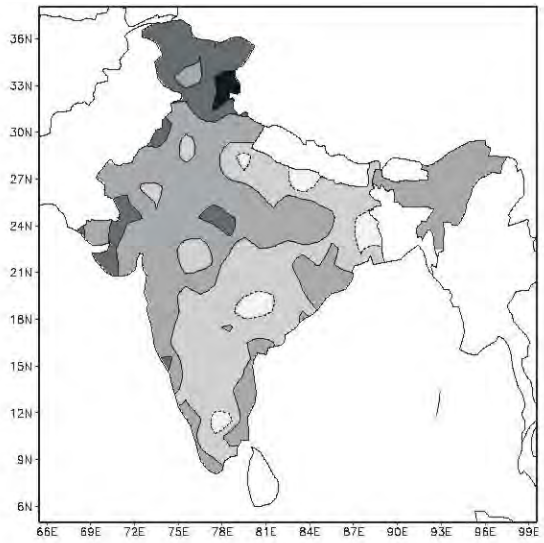
1.2. Pre-Monsoon Season (MAM)

Heat Wave Conditions

Heat wave conditions prevailed at many places over Jharkhand and Chhattisgarh and at isolated places of East Madhya Pradesh, interior Orissa and Gangetic West Bengal during 21st - 22nd March, 2011 .Severe Heat wave / heat wave conditions prevailed over the western and central parts of the country during third week of March. Coastal areas of Gujarat and Maharashtra were abnormally warmer on some occasions during this period. These conditions prevailed over some parts of northern, northwestern and central India on few occasions from last ten days of April to the end of the season. Eastern parts of south peninsula were also affected by heat wave during the first ten days of May.

Temperature

Maximum temperatures were below normal over most parts of peninsula and eastern/northeastern parts of the country and above normal elsewhere. These were below normal by over 1 °C over parts of Gangetic West Bengal, East Uttar Pradesh and Chattisgarh and above normal by about 1 to 2 °C over extreme northern parts of the country.



Maximum temperature anomaly

Minimum temperatures were below normal over peninsula and adjoining central and eastern parts of the country, and above normal elsewhere. These were below normal by over 1 °C over some parts of central and north peninsula and above normal by over 1 °C over northern/ northwestern and central parts of the country.

Rainfall Features

During the season, out of 36 meteorological sub-divisions, 8 received excess rainfall, 14 received normal rainfalls, 9 received deficient rainfall and 5 received scanty rainfall. The rainfall activity over the country as a whole was below normal. Meteorological sub-divisions of central, western/northwestern and extreme northeastern India received deficient/scanty rainfall while sub-divisions of south peninsula and eastern region received excess/normal rainfall.

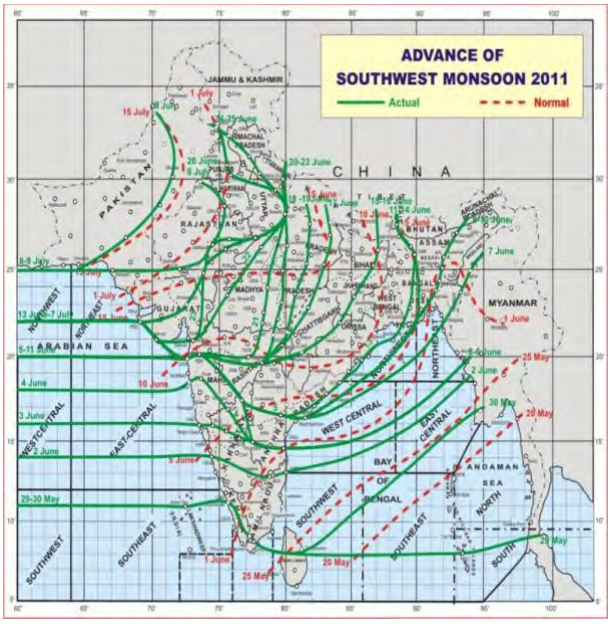
Rainfall activity was mainly observed over parts of south peninsula, eastern/ northeastern region and some northern parts of the country. Rainfall over these regions generally exceeded 10 to 20 cm. Rainfall over parts of Jammu & Kashmir exceeded 30 cm while over extreme northeastern region it exceeded 60 cm.

1.3. Monsoon Season (JJAS)

Onset of Southwest Monsoon

This year, setting in of southwest monsoon over Andaman Sea was delayed by about 10 days. However, it set over Kerala 3 days before its normal date of 1st June. Monsoon set in over most parts of South Arabian Sea, Kerala, some parts of Tamil Nadu, south Bay of Bengal and South Andaman Sea on 29th May 2011.

Due to strengthening of cross-equatorial flow over Arabian Sea and the northward movement of a vortex in the form of an upper air cyclonic circulation along the trough off the west coast, monsoon further advanced rapidly and covered entire Kerala, Tamil Nadu and Goa, most parts of Karnataka and some parts of south Andhra Pradesh by 5th June. However, during 6th - 10th June, there was a short hiatus in the further advance of monsoon along the west coast. On the other hand, the eastern branch of monsoon advanced over some more parts of Bay of Bengal and northeastern states, with a delay of nearly 5 days. Associated with the formation of a Depression over North Bay of Bengal on 13th June, the monsoon advanced into some more parts of Arabian Sea, parts of Saurashtra, most parts of the Bay of Bengal, parts of coastal Andhra Pradesh and coastal Orissa.



The isochrones of advance of Southwest Monsoon - 2011

Subsequently, there had been a rather steady advance during 15th - 26th June in association with the formation of

a Deep Depression during 16th - 22nd June over the northwest Bay of Bengal and its gradual west-northwestward movement. This synoptic situation caused the monsoon to cover most parts of the country outside western parts of Rajasthan and north Gujarat state.

With the formation of a low pressure area over south Chhattisgarh and adjoining Telangana and the off shore trough extending from south Gujarat coast to Kerala coast during 4th-8th July, the trough at mean sea level shifted southwards and became more pronounced and made favorable conditions for further advancement of monsoon. Thus, the southwest monsoon covered the entire country on 9th July, 6 days earlier than its normal date of 15th July.

Chief synoptic features

Strong cross equatorial flow prevailed during most parts of June but it became weak during the first fortnight of July. The cross equatorial flow maintained its strength all through the month of August and during the first half of September. Though there had been certain periods of subdued rainfall activity during the season in different spatial and temporal scales, there was no break monsoon condition during this year.

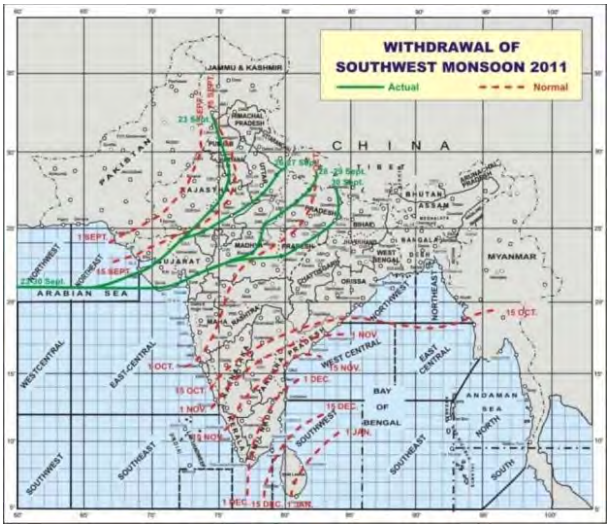
Four depressions and ten low pressure areas formed during this season.

Two Depressions formed on 11th June over Arabian Sea & the other during 22nd - 23rd July over Land had a short life span. The Depression formed during 16th - 23rd June and its subsequent west northwestward movement was responsible for the advance of the monsoon over the most parts of the country. The fourth Depression formed towards the end of the season (22nd - 23rd September) weakened before moving towards northeast, caused second spell of flood situation over Orissa and Bihar.

The month of June and July witnessed the formation of two low pressure areas each. The two low pressure areas in the month of June, one over Bay (8th - 9th June) and another over east Uttar Pradesh and adjoining areas of north Madhya Pradesh (29th - 30th June), dissipated in-situ. The two low pressure areas in July one over Bay (13th - 16th July) and another over south Chhattisgarh and adjoining Telangana (6th - 7th July) aided the monsoon to cover the entire country and were also responsible further for active monsoon conditions in the third week of July, which gave rise to widespread rainfall activity over most parts of the country outside southeast Peninsula.

Four low pressure areas formed during the month of August, two over land and one each over the Bay and the Arabian Sea. The low pressure area (8th - 11th August) formed over northwest Madhya Pradesh and neighborhood, caused extremely heavy rainfall over Madhya Pradesh and Rajasthan. The well marked low pressure area 11th - 17th August formed over Gangetic West Bengal and neighborhood which interacted with the cyclonic circulation in the westerly field caused extremely heavy rainfall over northwestern parts of India. Another low pressure area which formed on 30th August over Arabian Sea off north Gujarat coast, dissipated in-situ on 4th September. Two low pressure areas (6th - 13th and 13th-19th) formed during the month of September.

Withdrawal of Southwest Monsoon



The isochrones of withdrawal of southwest monsoon – 2011

The withdrawal of southwest monsoon from west Rajasthan started on 23rd September, with a delay of more than three weeks with respect to the normal date of withdrawal from extreme western parts of Rajasthan (1st September). Subsequently, the monsoon withdrew from most parts of northwest India and some parts of west Uttar Pradesh on 26th September and from most parts of Uttar Pradesh, some parts of Madhya Pradesh and some more parts of Gujarat state on 28th September. On 30th September, the monsoon further withdrew from some more parts of Uttar Pradesh and Madhya Pradesh. The subsequent withdrawal of the monsoon was delayed due to the presence of various transient synoptic scale systems in the mid latitude westerly wind regime, including troughs and cyclonic circulations causing moisture incursion and rainfall over the region. The southward shifting of the upper tropospheric anticyclone caused a reduction in the rainfall activity over the east and northeastern parts from 10th October.

The tendency of delayed withdrawal of southwest Monsoon from Rajasthan is being continued since 2006. The withdrawal started from the extreme west Rajasthan on 21st, 30th, 29th, 25th and 27th September respectively in the years 2006, 2007, 2008, 2009 & 2010.

The southwest monsoon withdrew from some more parts of central and peninsular India on 11th October and from the entire northeast and eastern parts of the country on 13th October. On 24th October, it withdrew from the entire country, including south Peninsula, Bay of Bengal and Arabian Sea followed by a simultaneous commencement of northeast monsoon rains over Tamil Nadu, Kerala and adjoining areas of Andhra Pradesh and Karnataka.

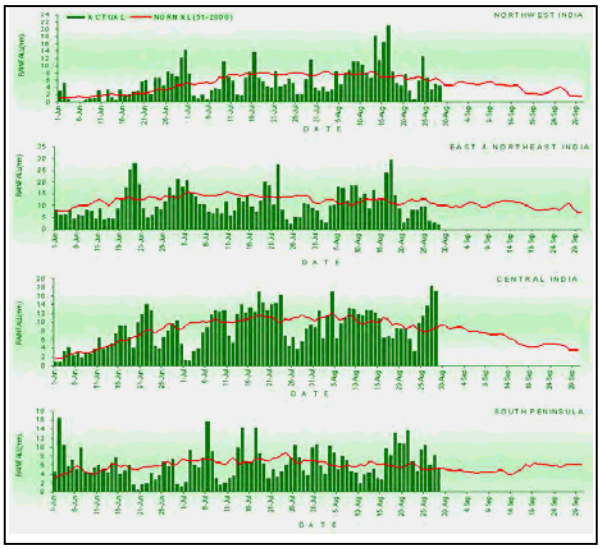
Rainfall Distribution

The southwest monsoon season (June to September) rainfall for the country as a whole and the four broad geographical regions are given in Table 1.1.

Table 1.1

Region	Actual (mm)	Long Period Average (LPA) (mm)	Actual for 2011 (% of LPA)	Coefficient of variation (CV) (% of LPA)
All-India	899.9	887.5	101	10.7
Northwest (NW) India	654.8	615.0	107	18.9
Central India	1073.6	975.5	110	15.0
South peninsula	715.2	715.5	100	15.3
Northeast (NE) India	1233.6	1438.3	86	12.6

The season rainfall is classified as normal when the actual rainfall is within LPA ± CV. The CV for season rainfall over various regions is given in the table above. Similarly season 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). In 2011, the southwest monsoon season (June to September) rainfall over the country as a whole was 101% of LPA. Season rainfall over NE India was below its LPA by 14%. Season rainfall over south Peninsula was normal. However, the season rainfall over Central India and NW India were 10% and 7% above their LPA values respectively.



Regional distribution of seasonal rainfall

The cumulative season rainfall from 1st June to 30th September 2011 was excess in 7 meteorological sub-divisions normal in 26 meteorological subdivisions and deficient in 3 meteorological sub-divisions. The monthly rainfall over the country as a whole during the season is given below.

June : 12% above LPA

July : 15% below LPA

August : 10% above LPA

September : 6% above LPA

Except for July, the rainfall during all other months was above the respective LPA values. In June, excess rainfall was observed over many sub-divisions of northern and west coast of the country. Deficient rainfall was observed over 5 sub-divisions from the eastern part of the south Peninsula and Lakshadweep. The scantly rainfall was observed over 2 sub-divisions of Gujarat state. The rainfall over the country as a whole was subdued during July. Deficient rainfall was observed over Kerala and many sub-divisions in the northern most part and eastern India. However, excess rainfall was observed over the two island sub-divisions Konkan & Goa and two sub-divisions from Maharashtra. In August, except for 4 sub-divisions from north east India and 2 sub-divisions from north India, from the remaining sub-division 14 received normal and 16 received excess rainfall. In September, excess rainfall was observed over sub-divisions along the west coast, island sub-divisions, many sub-divisions of north west India and east part of the central India.

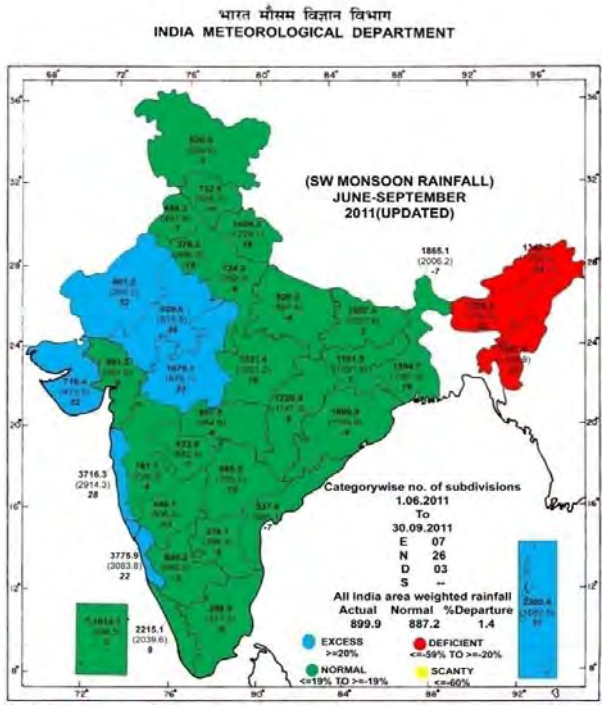
Deficient rainfall was also observed over 3 sub-divisions from of north east India and 2 sub-divisions of north India. The rainfall over north east India was deficient throughout the season. On the other hand except for few sub-divisions from eastern part of central India which received deficient rainfall during July and 2 sub-divisions of Gujarat state which received deficient rainfall during June, most of the other sub-divisions from northwest India and central India received excess or normal rainfall throughout the season.

In the beginning of the monsoon season weekly rainfalls were positive during all the weeks of June except during the second week. In July, the weekly rainfall anomalies were negative during all the weeks except during 3rd week. Except for the first and fourth weeks of August and last of week of September, weekly rainfall anomalies were positive during all the remaining weeks of the second half of the monsoon season. The all India cumulative weekly rainfall anomaly distribution shows that the all India cumulative weekly rainfall anomalies were negative from the second week of July to fourth week of August. The cumulative weekly anomaly became positive in the last week of August and remained so till end of the season.

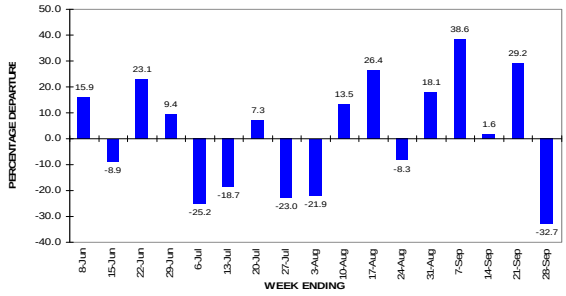
Long Range Forecasts during 2011

Based on an indigenously developed statistical model, it was predicted on 13th May 2011 that monsoon will set in over Kerala on 31st May with a model error of ± 4 days. The forecast came correct as the actual monsoon onset over Kerala took place on 29th May, two days earlier than the forecasted date. Thus this is the seventh consecutive correct operational forecast for the monsoon onset over Kerala since issuing of operational forecast for the event was started in 2005.

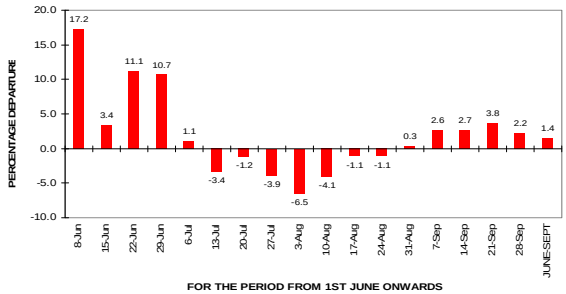
As per the first stage long range forecast issued on 19th April, the season (June-September) rainfall for the country as a whole was expected to be 98% ± 5% of LPA. In the updated forecast issued on 21st June, the forecast for the country as a whole was revised to a lower value of 95% ± 4% of LPA. Though the actual season rainfall for the country as a whole (101% of LPA) was within the forecast limits of the first stage forecast, it was slightly (by 2%) higher than the upper limit of the second stage forecast. The forecast for the second half of the monsoon season (August – September) for the country as a whole issued in August was 90% with a model error of 8% of LPA. This forecast was underestimated as the actual rainfall over the country as a whole during the second half of the season was 108% of LPA.



Sub-divisionwise rainfall distribution over India during southwest monsoon season (June to September) – 2011



Week - by - Week Progress of the Monsoon Rainfall



Week - by - Week Progress of the Monsoon Rainfall - 2011 Cumulative

The forecasts for monthly rainfall over the country as a whole for the months of July, August issued in June were 93% & 94% respectively with a model error of ± 9% and that for September issued in 1st September was 90% of LPA with a model error of ± 15%. The actual July month forecast, though overestimated the actual rainfall (85% of LPA), was within the lower forecast limit (93% - 9 % of LPA). Whereas the forecast for August and September month turned out to be underestimates as the actual rainfall during August and September were 110% and 106% of LPA respectively.

Considering the four broad geographical regions of India, the season rainfall was expected to be 97% of its LPA over northwest India, 95% of LPA over Central India, 95% of LPA over northeast India and 94% of LPA over South Peninsula all with a model error of ± 8%. The actual rainfalls over northwest India, central India, northeast India and south Peninsula were 107%, 110%, 86% and 100% of the LPA respectively. Thus the actual season rainfall over south peninsula was within the forecast limit. The forecast for northwest was 2% of LPA above the upper forecast limit and that for the northeast India was 1% below the lower forecast limit respectively. However, the forecast for season rainfall over Central India was 7% above the forecast limit.

Verification of the long range forecasts

The Table 1.2 gives the summary of the verification of the long range forecasts issued for the 2011 southwest monsoon.

Table 1.2
Details of long range forecasts and actual rainfall

Region	Period	Date of Issue	Forecast (% of LPA)	Actual Rainfall (% of LPA)
All India	Jun to Sep	19th Apr	98 ± 5	101
All India	Jun to Sep	21st Jun	95 ± 4	
Northwest India	Jun to Sep		97 ± 8	107
Central India	Jun to Sep		95 ± 8	110
Northeast India	Jun to Sep		95 ± 8	86
South Peninsula	Jun to Sep		94 ± 8	100
All India	Jul		93 ± 9	85
All India	Aug		94 ± 9	110
All India	Aug to Sep	1st Aug	90 ± 8	108
All India	Sep	1st Sep	90 ± 15	106

As a whole, most of the operational long range forecasts issued for 2011 southwest monsoon season were underestimating the actual rainfall situation and therefore were not very accurate. The main reason for the underestimation of the forecasts particularly those issued for second half of the monsoon season (forecasts for August, September and August to September) was due to the increased rainfall activity in the second half of the season in association with the sudden reemergence of the La Nina conditions over equatorial Pacific.

Salient Features of SW Monsoon

- For the country as a whole, the rainfall for the season (June-September) was101% of its long period average (LPA).
- Seasonal rainfall was 107% of its LPA over Northwest India, 110% of its LPAover Central India, 100% of its LPA over south Peninsula and 86% of its LPA over Northeast (NE) India.
- Out of the total 36 meteorological subdivisions, 33 subdivisions constituting92% of the total area of the country received excess/normal season rainfall and the remaining 3 subdivisions (Arunachal Pradesh, Assam & Meghalaya, and NMMT constituting 8% of the total area of the country) received deficient season rainfall.
- Out of 603 meteorological districts for which data are available, 453 districts (76%) received excess/normal rainfall and the remaining 150 districts (24%)received deficient/scanty rainfall during the season.
- Monthly rainfall over the country as a whole was 112% of LPA in June, 85% ofLPA in July, 110% of LPA in August and 106% of LPA in September.
- Advance of Southwest monsoon over the Andaman Sea was delayed by about 10 days. The monsoon set in over Kerala on 29th May, three days before itsnormal date of 1st June and covered the entire country by 9th July, 6 days earlier than its normal date of 15th July. The withdrawal of monsoon from west Rajasthan was delayed and it commenced only on 23rd September.
- Four depressions formed during 2011 monsoon season as against the normal 4-6 monsoon depressions per season.

- The forecast for monsoon onset over Kerala for this year was correct, which is the seventh consecutive correct forecast for this event.

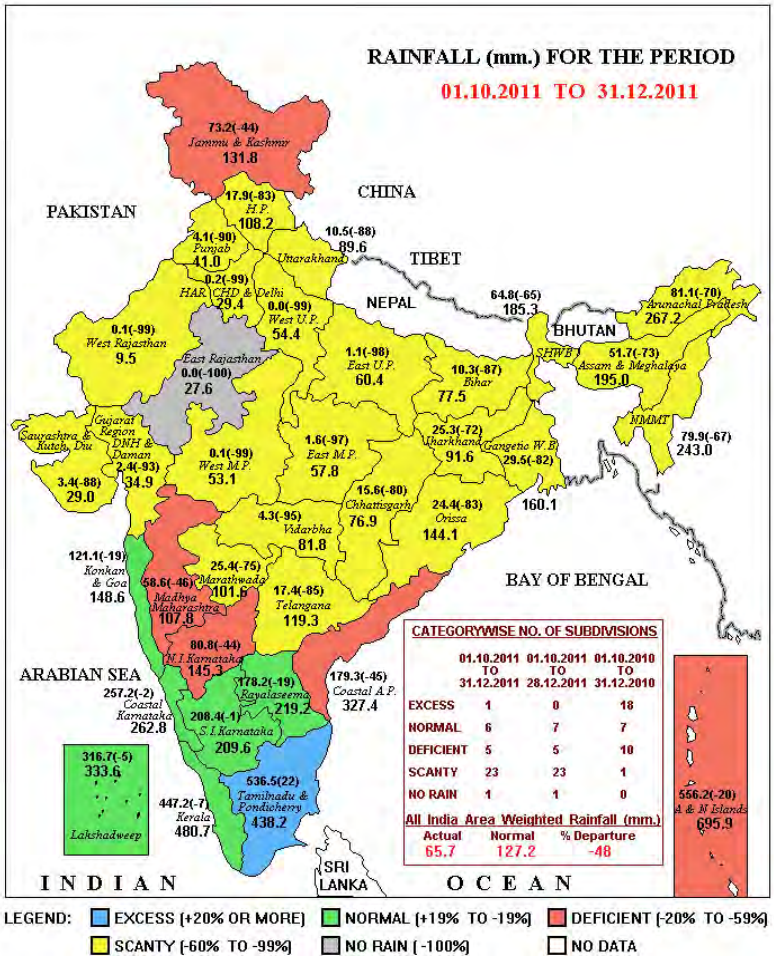
- Most of the operational long range forecasts issued for the 2011 southwestmonsoon rainfall were underestimating the actual rainfall and therefore werenot very accurate.

1.4. Post Monsoon Season (OND)

Southwest monsoon withdrew from the entire country on 24th October. The feature of this season follows:

Rainfall Features

During the season, rainfall activity over the country as a whole was subdued. During the season, out of 36 meteorological sub-divisions, 1 sub-division (Tamil Nadu & Puducherry) received excess rainfall, 6 received normal rainfall, 5 received deficient rainfall and 23 received scanty rainfall. Remaining one sub-division (East Rajasthan) did not receive any rain. Rainfall during the season as a whole was normal [96% of Long. Period Average (LPA)]. It was 91%, 121% and 73% of LPA during October, November and December respectively. coast, parts of extreme northeastern region and parts of Jammu & Kashmir received more than 10 cm of rainfall. Extreme South peninsula received rainfall of the order of 20 to 40 cm while that over parts of coastal Tamil Nadu, it exceeded 60 cm. Rainfall anomaly was negative over most parts of the country, except parts of extreme south peninsula and parts of Konkan & Goa, Jammu & Kashmir and Sub-Himalayan and Kerala received normal rainfall, while Coastal Andhra Pradesh received deficient rainfall Out of five sub-divisions of peninsula, Tamil Nadu & Puducherry received excess rainfall, Rayalaseema, South Interior Karnataka. Fig. 1.2(a) and 1.2(b) show the spatial pattern of rainfall (cm) received during the season and its anomaly respectively. Parts of South Peninsula and west.



Rainfall for the period 1 Oct to 31 Dec 2011

At the end of the post-monsoon season 2011, the rainfall for the country as a whole was 52 % of its LPA value. The seasonal rainfall for this year over the country as a whole was the third lowest since 1901 after the years 1908 (44% of LPA) and 1907 (49%).

Temperature

Post-Monsoon season was abnormally warmer. It was the second warmest (with +0.85 °C anomaly) since 1901 after the year 2008 (+1.02 °C).

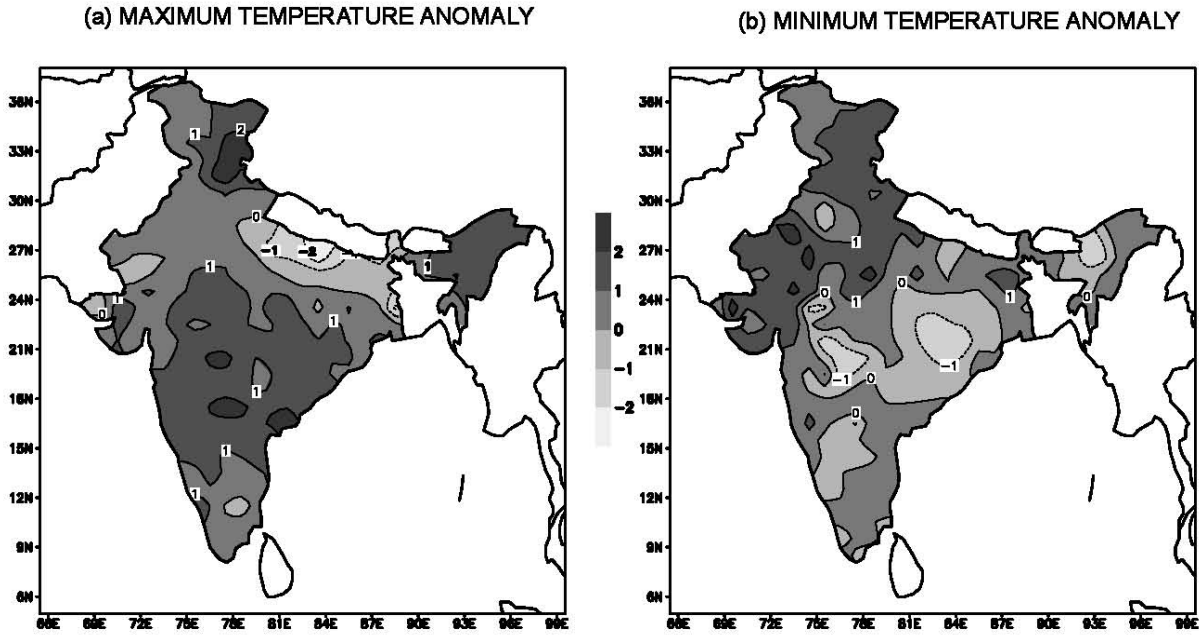
Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 1.1. (a&b) respectively.

Maximum temperatures were above normal over most parts of the country except parts of Uttar Pradesh, Bihar, Jharkhand and West Bengal. These were above normal by about 1 to 2 °C over north peninsula and adjoining central parts of the country and also over the parts of extreme northern and northeastern region. Over northern parts of East Uttar Pradesh and adjoining Bihar and parts of West Bengal, maximum temperatures were below normal by about 1 to 2 °C

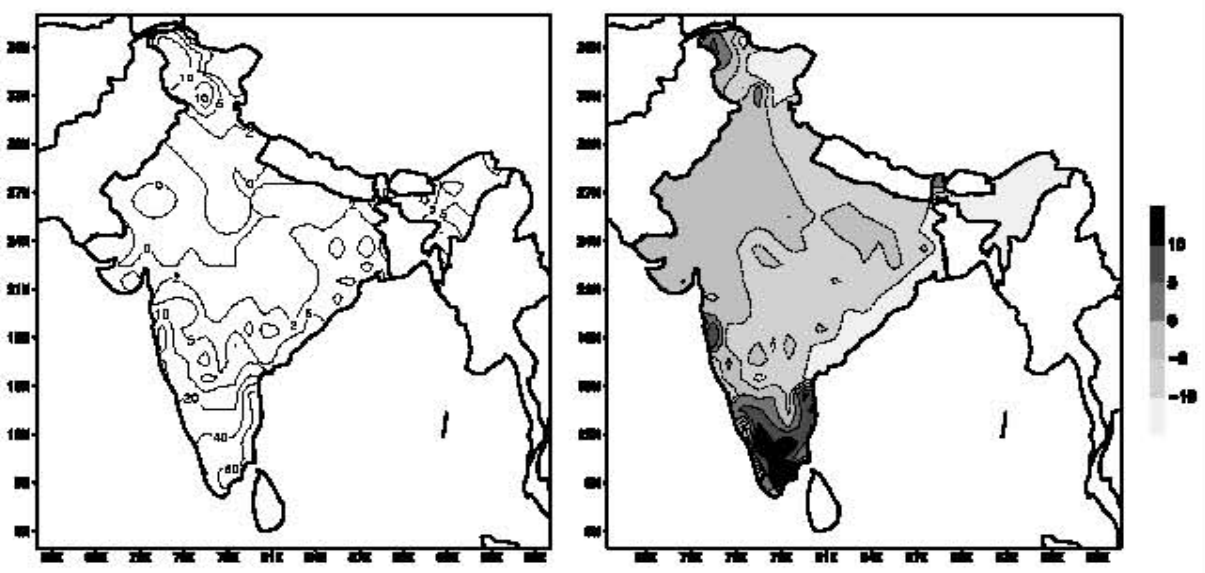
Minimum temperatures were above normal over most parts of the country except parts of central, peninsular and extreme northeastern region of the country. These were above normal by about 1 to 2 °C over most parts of northern/northwestern region of the country. Over parts of Orissa and adjoining Chattisgarh, Parts of Vidarbha and regions and parts of extreme northeastern region, the negative minimum temperature anomalies exceeded 1 °C.

Low Pressure Systems

Two cyclonic storms and three depressions formed over the Indian seas during the season. The first cyclonic storm formed over the west central Arabian sea on 2nd



Figs. 1.1. (a&b). *Mean seasonal temperature anomalies (°C) (a) Maximum (b) Minimum (Based on 1971-2000 normals)*



Figs.1.2. (a&b). *(a) Seasonal rainfall (cm) (Interval : 0, 2, 5, 10, 20, 40, 60) and (b) Seasonal rainfall anomaly (cm) (Interval : -10, -5, 0, 5, 10) (Based on 1951-2000 normals)*

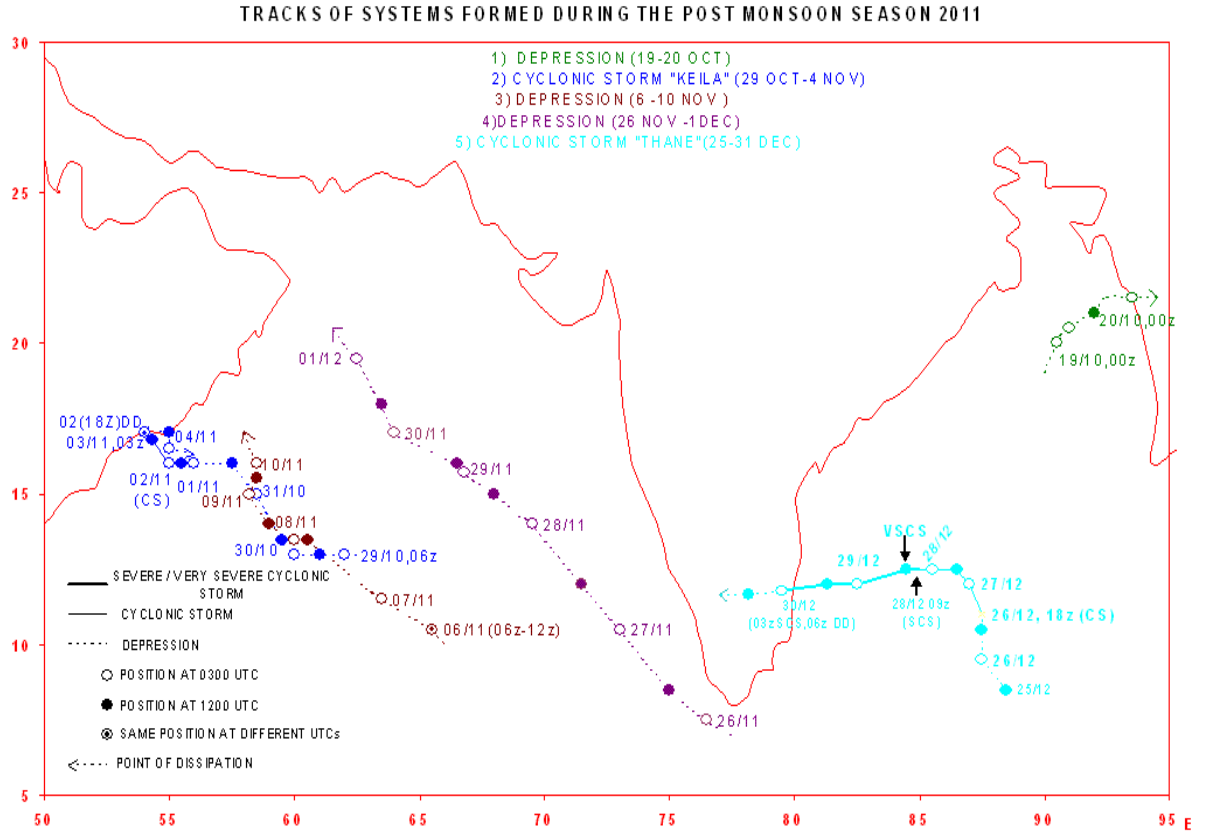


Fig. 1.3 *Tracks of these systems*

November. It maintained a west northwestward track all through its formative period and crossed the Oman coast without causing adverse weather over the Indian region. The second cyclonic storm of the season was a very severe cyclonic storm 'Thane' which formed over the Bay of Bengal at the end of December and crossed the north Tamil Nadu coast. The system was first seen as a low pressure area over the southeast Bay of Bengal and neighbourhood on 24th December, intensifying in stages into a depression (1200 UTC of 25th), deep depression (0000 UTC of 26th), cyclonic storm (1800 UTC of 26th), severe cyclonic storm and very severe cyclonic storm (at 0900 and 1200 hrs UTC of 28th respectively) and generally moving in a northwesterly direction, it crossed the north Tamil Nadu coast between Cuddalore and Puducherry in the morning of 30th. Gradually weakening, in stages over north Tamil Nadu and north Kerala, it finally became less marked over Lakshadweep area on 3rd January. This system gave heavy rainfall over the region.

Outgoing Longwave Radiation

Positive OLR anomalies exceeding 10 W/m^2 were observed over central and southern parts of the country and adjoining seas. Over south peninsula and adjoining Bay of Bengal these anomalies exceeded 20 W/m^2 and over parts of westcentral Bay of Bengal these were even higher exceeding 30 W/m^2 in magnitude.

WEATHER MONITORING

2

CYCLONES AND DEPRESSIONS OVER THE NORTH INDIAN OCEAN DURING 2011

DISTURBANCES FORMED DURING THE WINTER SEASON (JANUARY AND FEBRUARY)

DISTURBANCES FORMED DURING THE MONSOON SEASON (JUNE TO SEPTEMBER)

DISTURBANCES FORMED DURING THE POST-MONSOON SEASON (OCTOBER TO DECEMBER)

CYCLONIC STORMS

WEATHER MONITORING AND NOWCAST SYSTEM AT IGI AIRPORT DELHI

THUNDERSTORMS, SQUALLS AND GUSTY WINDS MONITORING, WARNINGS AND NOWCAST SYSTEM AT IGI AIRPORT DELHI

FOG DETECTION, MONITORING AND FORECASTING SYSTEM OF IGI AIRPORT AND THEIR REAL TIME PERFORMANCES IN 2008-2011

WEATHER AT MAITRI – ANTARCTICA 2011

2. WEATHER MONITORING

2.1. Cyclones and depressions over the north Indian Ocean during 2011

During 2011, in all 10 intense low pressure systems formed over the Indian seas. These include 1 Very Severe Cyclonic Storm (Thane), 1 Cyclonic Storm (Keila), 4 deep depressions and 4 depressions (including one land depression). Out of these 10 systems, 1 occurred during the winter season, 4 during the monsoon season and 5 during the post-monsoon season. No intense low pressure system formed during the pre-monsoon season, as in recent past years 1993 and 2005. The number of intense low pressure systems that formed over the Bay of Bengal was five and that over the Arabian Sea was four. Five, out of the ten low pressure systems were short-lived (24 to 48 hrs duration).

The depression (2-3 February) formed in the near equatorial latitude and did not affect the country. The Depression over the Arabian Sea (11-12 June) crossed Saurashtra coast. The Deep Depression over the Bay of Bengal (16-22 June) crossed West Bengal-Bangladesh coasts near Lat. 21.8° N / Long. 89.0° E, about 100 kms east of Sagar Islands. Out of the five systems, which formed during post-monsoon season, the Very Severe

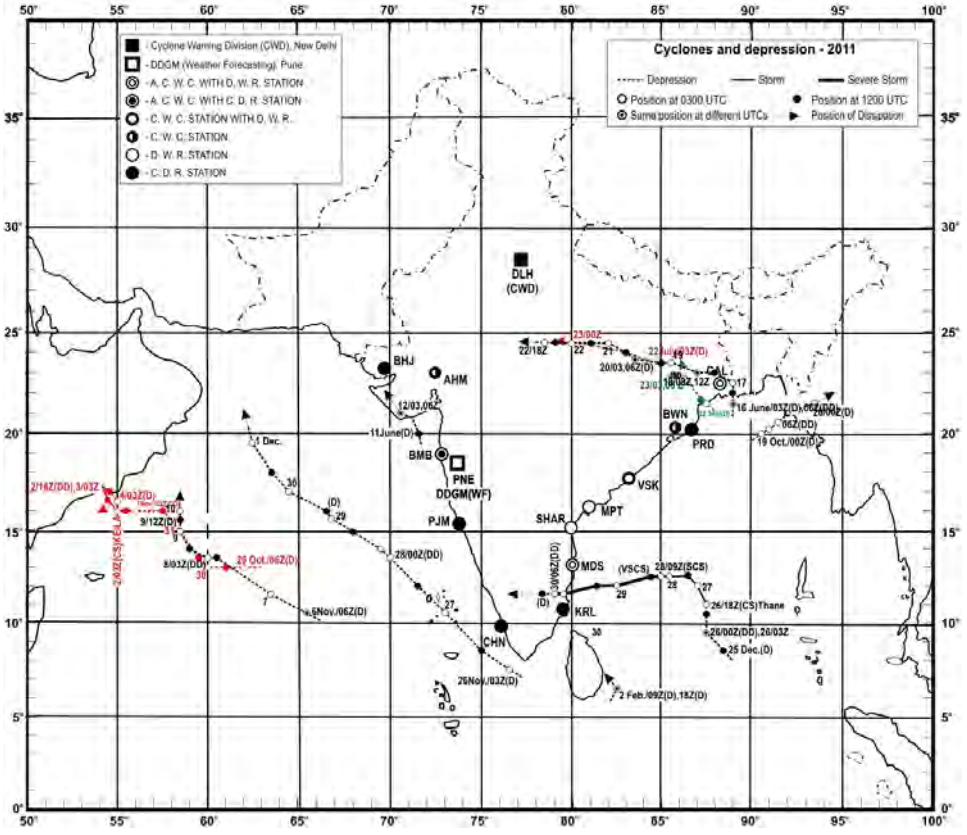


Fig. 2.1. *Tracks of cyclones and depression over the Indian Ocean during the year 2011*

Cyclonic Storm (VSCS, Thane) crossed Tamil Nadu coast, close to and to the south of Cuddalore. The VSCS (Thane) and the deep depression (26 November - 1 December) were the only system that affected the country.

The track/intensity of these systems is given in Fig. 2.1. Detailed season wise descriptions of these systems are given below.

2.1.1. Disturbances formed during the winter season (January and February)

One depression formed over the southeast Bay of Bengal during the month of February, which was short lived.

(a) Depression over the Bay of Bengal (2-3 February 2011)

Under the influence of a trough of low at mean sea level, a low pressure area formed over the southwest Bay of Bengal. It concentrated into a Depression at 0900 UTC of 2 and lay centered near Lat. 6.5° North / Long. 82.5° E, about 550 kms southeast of Kanyakumari. It remained practically stationary and weakened into a well marked low pressure area at 0000 UTC of 3 over southwest Bay of Bengal.

The lowest Estimated Central Pressure (ECP) was 1002 hPa. The maximum estimated mean wind speed was 25 kts. The salient features of the system include, its formation close to equator; short life (about 15 hours) and practically no movement.

The system was tracked with the help of satellite cloud imageries from 0900 UTC of 2 to 0000 UTC of 3. The maximum intensity of the T No. 1.5 was reported from 0900 UTC of 2 to 0000 UTC of 3.

The satellite imageries showed a developing low level circulation centre associated with increasing deep convection over the region. It was seen as a vortex with T1.0 in the evening of 1st February 2011. The meso-scale convective clusters in association with the system merged gradually along with increase in deep convection. Associated moderate to intense convection was seen over southwest Bay of Bengal, adjoining Sri Lanka, Comorin area, Gulf of Mannar, Palk Strait and coastal Tamil Nadu. The lowest cloud top temperature was –55 °C.

2.1.2. Disturbances formed during the monsoon season (June to September)

Four depressions formed during the monsoon season, two over the Bay of Bengal and one each over the Arabian Sea and land.

(a) Depression over the Arabian Sea (11 – 12 June 2011)

A low pressure area formed over the east central Arabian Sea off north Maharashtra coast on 6. It persisted there on 7 and lay as a well marked low pressure area over the east central Arabian Sea and neighbourhood from 8 to 10 and over the east central Arabian Sea off north Maharashtra-south Gujarat coasts on 11 morning. Subsequently, it concentrated into a Depression and lay centered over the northeast Arabian Sea off Maharashtra-Gujarat coasts at 1200 UTC of 11, near Lat. 20.0° N / Long. 71.5° E, about 180 km northwest of Mumbai. It moved north-northwestwards and crossed Saurashtra (Gujarat) coast near Lat. 20.8° N / Long. 71.2° E, about 25 km to the east of Diu around 2200 UTC of 11 and lay centered at 0300 UTC of 12 over Saurashtra and neighbourhood, about 70 km south southwest of Amreli, near Lat. 21.0° N / Long. 70.5° E and remained practically stationary over the same area till 0600 UTC. Gradually moving northwestwards, it weakened into a well marked low pressure area over Saurashtra and adjoining northeast Arabian Sea by 1200 UTC of 12. It further weakened into a low pressure area over the same region on 13 and became less marked on 14.

The lowest Estimated Central Pressure (ECP) was 996 hPa from 1200 UTC of 11 to 0200 UTC of 12. The maximum estimated mean wind speed was 25 kts. Maximum sustained wind of 40-50 kmph was reported along Saurashtra and Diu coasts. The system moved initially north northwestwards before crossing and then northwestwards, over land.

According to INSAT imagery, a vortex formed over east central Arabian Sea with T1.0 and lay centered at 0000 UTC of 8 June near Lat. 17.0° N / 70.0° E and near Lat. 19.0° N / 71.0° E at 0300 UTC of 11 June. The broken intense convection in association with the system became organized gradually.

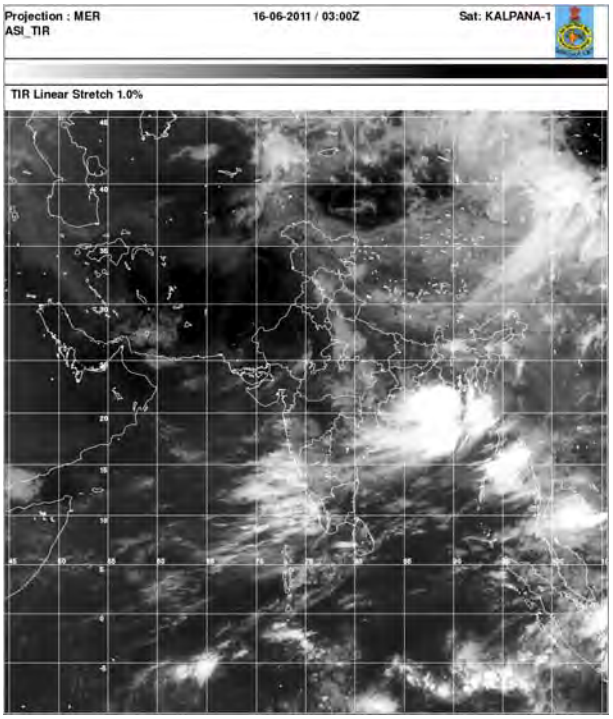
Maximum intensity of the system according to Dvorak's classification was T1.5 from 1200 to 2100 UTC of 11 June 2011. Associated broken intense to very intense convection (with cloud top temperature of -77 °C) lay over Arabian Sea between Lat. 16.5° N & 21.0° N and to the east of Long. 65.5° E.

(b) Deep Depression over the Bay of Bengal (16 – 23 June 2011)

A low pressure area formed over the northwest Bay of Bengal and neighbourhood on 14. It lay as a well marked low pressure area over the same region on 15. It concentrated into a Depression and lay centered at 0300 UTC of 16 over the northwest Bay of Bengal, near

Lat. 21.5° N / Long. 89.0° E, about 150 kms southeast of Kolkata and further intensified into a Deep Depression at 0600 UTC of 16 over the same region. It further moved north northwestwards and crossed West Bengal-Bangla Desh coasts, near Lat. 21.8° N / Long. 89.0° E, about 100 km to the east of Sagar Islands, between 1100 & 1200 UTC of 16 and lay over Gangetic West Bengal and adjoining Bangla Desh, near Lat. 22.0° N / Long. 89.0° E, about 100 kms southeast of Kolkata at 1200 UTC of 16. Moving slightly northwards, it lay centered near Lat. 22.5° N / Long. 89.0° E, about 80 km east of Kolkata at 0300 UTC of 17. Subsequently, moving westwards, it lay over Gangetic West Bengal, near Lat. 23.0° N / Long. 88.0° E, close to Burdwan at 1200 UTC of 17. Further moving westwards, it lay over Gangetic West Bengal and adjoining areas of Jharkhand, centered near Lat. 23.0° N / Long. 87.0° E, about 25 km south of Bankura at 0300 UTC of 18. It remained practically stationary over the same region at 1200 UTC of 18. Thereafter, it further moved northwards and lay over Jharkhand and adjoining Gangetic West Bengal, centered near Lat. 23.5° N / Long. 85.5° E, about 50 km southeast of Ranchi at 0300 UTC of 19. Moving slightly westwards, it lay centered near Lat. 23.5° N / Long. 85.0° E, about 25 km northnorthwest of Ranchi at 1200 UTC of 19. It further moved west northwestwards and lay over Chhattisgarh and adjoining areas of Jharkhand, about 50 km northeast of Ambikapur (Lat. 23.7° N / Long. 83.5° E) at 0300 UTC of 20 and further weakened into a Depression over the same area at 0600 UTC of 20. Moving slightly northwestwards, it lay centered at 1200 UTC of 20 over southeast Uttar Pradesh and neighbourhood, about 150 km south of Varanasi (Lat. 24.0° N / Long. 83.0° E). Subsequently moving west northwestwards, it lay centered at 0300 UTC of 21, over east Madhya Pradesh and adjoining south Uttar Pradesh, about 100 km east of Rewa (Lat. 24.5° N / Long. 82.0° E). Then it moved westwards and lay centered at 1200 UTC of 21, over the same area close to Satna (Lat. 24.5° N / Long. 81.0° E). Continuing the westward movement, it lay centered at 0300 UTC of 22, over east Madhya Pradesh, close to and to the west of Panna (Lat. 24.5° N / Long. 80.5° E) and over the central parts of Madhya Pradesh and adjoining south Uttar Pradesh, about 50 km northeast of Sagar (Lat. 24.5° N / Long. 79.1° E) at 1200 UTC of 22 and at 1800 UTC near Lat. 24.5° N / Long. 78.5° E. It moved further northwestwards and weakened into a well marked low pressure area over west Madhya Pradesh and neighbourhood in the early morning of 23.

The lowest ECP was 978 hPa at 0600 UTC of 17. The lowest observed pressure was 983.4 hPa at 1200 UTC of 18 at Bankura. The maximum estimated mean wind speed was 35 knots. The maximum sustained surface wind was reported as 35 knots by an AWS to the northeast of Kolkata around 0600 UTC of 17 June.



Satellite imageries at 0300 UTC of 16 June 2011

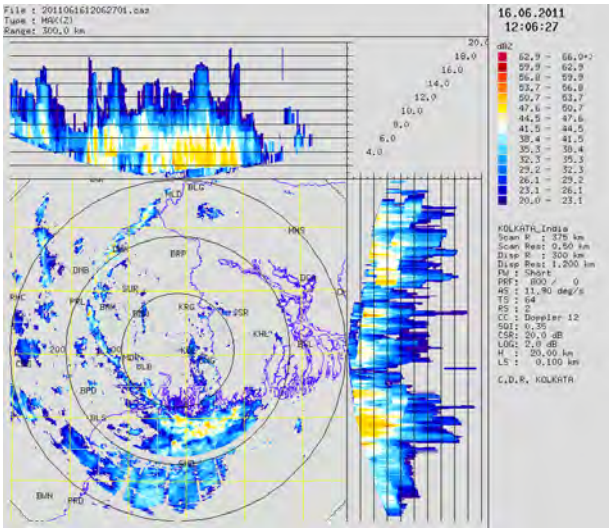
As per the DWR Kolkata observations, the maximum radial wind as observed from PPI (V) was 25 mps at a height of 0.5 km above ground level at 1806 UTC of 17 June at a distance 60-65 km west-southwest of DWR Kolkata. The maximum horizontal wind estimated from VVP_2 product is 40 knots at height 1.2, 2.4, 2.7 & 3.0 km within 50 km radius of Kolkata at 1836 UTC of 17 June 2011.

An important feature of the system was the abnormal pressure drop at the centre of the system (max. 12 hPa over the land, even though the maximum surface wind speed was reported as 30-35 knots over Gangetic West Bengal.

The system moved initially in a northerly direction and crossed West Bengal-Bangladesh coast. It continued to move in northerly direction for some more time after crossing and then moved west-northwestwards across Gangetic West Bengal, Jharkhand, north Chhattisgarh and west Madhya Pradesh during 17-23 June.

Under the influence of the system, widespread rainfall with heavy to very heavy falls at isolated places occurred over Orissa, Gangetic West Bengal Jharkhand, Chattisgarh, Madhya Pradesh, Bihar and Uttar Pradesh.

Doppler Weather Radar (DWR), Kolkata, tracked the system since 0300 UTC of 15 June 2011 at every 10



DWR Image, 1200 UTC (16.06.2011)

minutes interval. As per the observations, the front part of the system hit the coast at about 1106 UTC of 16 June at 108 km SSE of Kolkata. The system got better organised with two spiral bands by 1206 UTC of 16 June. It intensified further at 0558 UTC of 17 June.The maximum radial wind as observed from PPI (V) was 25 mps at a height of 0.5 km above ground level at 1806 UTC of 17 June at a distance 60-65 km WSW of DWR Kolkata.

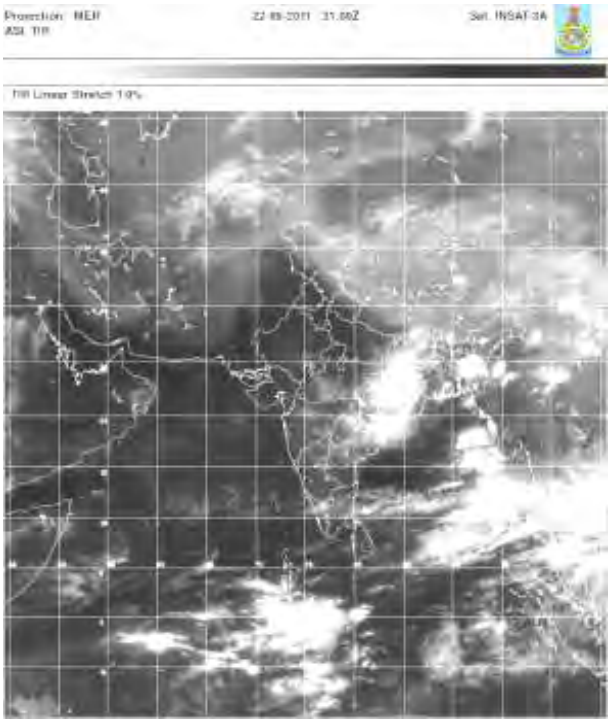
(c) Land Depression over Jharkhand (22 – 23 July 2011)

The low pressure area over Gangetic West Bengal and neighbourhood, concentrated into a Depression which lay over northwest Jharkhand and neighbourhood, about 50 km southeast of Daltonganj (Lat. 23.5° N / Long. 84.5° E) at 0300 UTC of 22. Moving in a west northwesterly direction, it lay over southeast Uttar Pradesh and neighbourhood, about 100 km east of Sidhi (Lat. 24.0° N / Long. 83.0° E) at 1200 of 22. Thereafter, it moved westwards and lay centered over east Madhya Pradesh, about 100 km northeast of Sagar (Lat. 24.5° N / Long. 80.5° E) at 0000 UTC of 23. Continuing the westward movement, it weakened into a well marked low pressure area and lay over north Madhya Pradesh and neighbourhood on 23 mornings and became less marked on 24.

The lowest ECP was 990 hPa from 0300 to 1200 UTC of 22. The maximum estimated mean wind speed was 20 knots. The maximum sustained surface wind was reported as 30 knots by Umaria at 0300 UTC of 22 July. The lowest central pressure of 989.4 hPa was reported by an Automatic Weather Station (AWS) at Singrouli in east Madhya Pradesh.

(d) Depression over the Bay of Bengal (22 – 23 September 2011)

A low pressure area formed over the northwest Bay of Bengal and adjoining coastal areas of West Bengal on 20. It lay as a well marked low pressure area over the northwest Bay of Bengal and adjoining West Bengal-Orissa coasts on 21. Subsequently, it concentrated into a Depression over the northwest Bay of Bengal off north Orissa-West Bengal coasts and lay centered at 0300 UTC of 22 near Lat. 21.5° N / Long. 87.5° E, about 50 km east southeast of Balasore. It moved slightly westwards and lay centered near Lat. 21.7° N / Long. 87.2° E at 1200 UTC and then moving west northwestwards, crossed north Orissa coast, close to Balasore between 1700 & 1800 UTC of 22. Subsequently moving northwestwards, it lay over Jharkhand and neighbourhood, centered close to Jamshedpur (Lat. 22.5° N / Long. 86.5° E) at 0300 UTC of 23. It remained practically stationary over the region, close to Jamshedpur till 0600 UTC and weakened into a low pressure area by 0900 UTC.



Satellite imageries at 2100 UTC of 22 September 2011

The lowest ECP was 995 hPa at 1200 UTC of 22. The maximum estimated mean wind speed was 25 knots. The lowest central pressure of 995.7 hPa was reported by Balasore at 0900 UTC of 22 which was very close to the estimated value.

Heavy rains associated with the system over the upper catchment areas caused floods over Orissa and Bihar.

Under the influence of the system, widespread/fairly widespread rainfall with heavy to very heavy falls at isolated places occurred over Orissa, Gangetic West Bengal, Jharkhand and Bihar during 22-24 September. The system, even as a low pressure area, gave widespread/fairly widespread rainfall with heavy to very heavy falls at isolated places during 25-27 September over Sub-Himalayan West Bengal & Sikkim and Bihar.

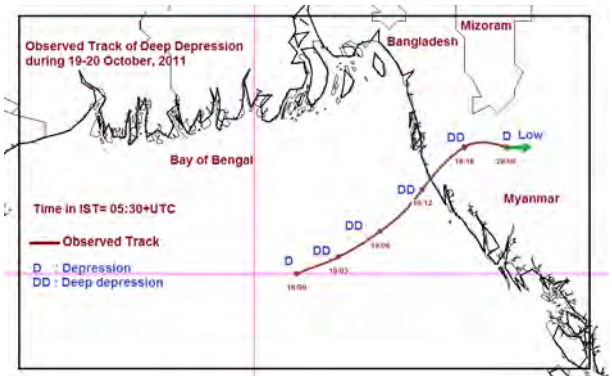
2.1.3. Disturbances formed during the post-monsoon season (October to December)

(a) Deep Depression over the Bay of Bengal (19 – 20 October 2011)

Under the influence of a cyclonic circulation, a low pressure area formed over southeast & adjoining southwest Bay of Bengal on 17 morning. It lay as a well marked low pressure area over east central & adjoining northwest and west central Bay of Bengal on 18. It lay over north and adjoining east central Bay of Bengal in the evening and subsequently concentrated into a Depression at 0000 UTC of 19 near Lat. 20.0° N / Long. 90.5° E, about 350 kms east-southeast of Digha. It further moved northeastwards and lay centered at 0300 UTC of 19 near Lat. 20.2° N / Long. 91.0° E and intensified into a Deep Depression at 0600 UTC near Lat. 20.5° N / Long. 91.5° E. It lay over northeast Bay of Bengal, near Lat. 21.0° N / Long. 92.0° E, very close to Bangladesh coast at 1200 UTC of 19. It crossed Bangladesh coast, close to south of Cox's Bazar around 1300 UTC and subsequently, weakened into a Depression at 0000 UTC of 20 and lay centered near Lat. 21.5° N / Long. 93.5° E. It further weakened into a low pressure area and lay over Myanmar and adjoining Bangladesh and Mizoram and northeast Bay of Bengal on 20 and became less marked on 21.

(b) Deep Depression over the Arabian Sea (6 - 10 November 2011)

A low pressure area formed over the southeast and adjoining east central Arabian Sea on 2. It lay as a well marked low pressure area over the central parts of Arabian Sea on 6 morning and concentrated into a Depression at 0600 UTC of 6, over the central and adjoining southeast Arabian Sea, near Lat. 10.5° N / Long. 65.5° E (about 1050 kms west southwest of Mangalore) and near Lat. 10.6° N / Long. 65.5° E at 1200 UTC of 6. Further moving west northwestwards, it lay at 0300 UTC of 7, near Lat. 11.5° N / Long. 63.5° E and at 1200 UTC, near Lat. 13.5° N / Long. 60.5° E. Moving westwards, it intensified into a Deep Depression and lay centered at 0300 UTC of 8, over the west central Arabian Sea, near Lat. 13.5° N / Long. 60.0° E. Thereafter, it moved west northwestwards and lay centred at 1200 UTC of 8, near Lat. 14.0° N / Long. 59.0° E. Further moving north northwestwards, it lay centred at 0300 UTC of 9, near Lat. 15.0° N / Long. 58.5° E. Thereafter it moved northwards, weakened into a Depression and lay centered at 1200 UTC of 9, near Lat. 15.5° N / Long. 58.5° E. It moved northwards and lay centered at 0300 UTC of 10, near Lat. 16.0° N / Long. 58.5° E. It then weakened into a well marked low pressure area and lay over the west central Arabian Sea off Oman coast in the evening of 10. It further weakened and became unimportant by the morning of 11.

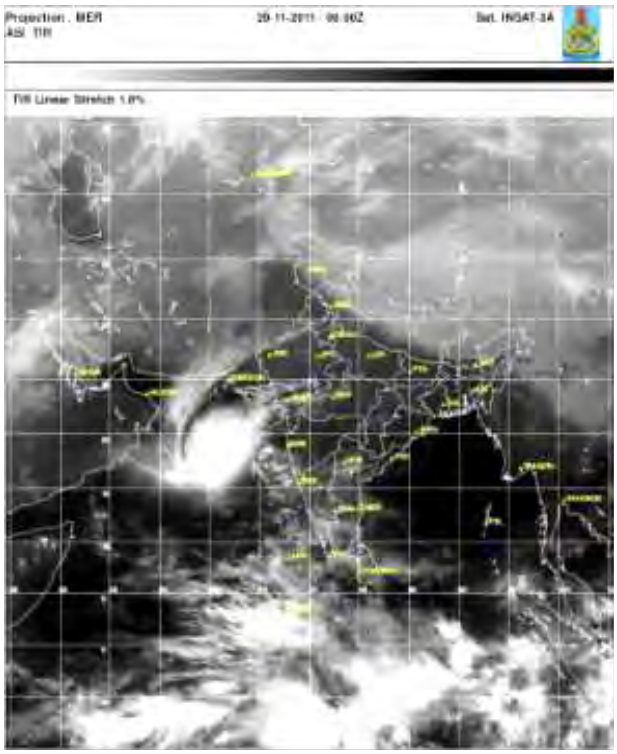


Observed track of Deep Depression during 19-20 October, 2011

The lowest ECP was 1000 hPa from 0300 UTC of 8 to 0600 UTC of 9. The maximum estimated mean wind speed was 30 knots. A ship SKWI (Lat. 14.9° N / Long. 58.8° E) reported highest mean wind speed of 50 kts and PPPP 1001.2 hPa at 0300 UTC of 9.

(c) Deep Depression over the Arabian Sea (26 November - 1 December 2011)

A well marked low pressure area formed over Comorin area and neighbourhood, under the influence of a cyclonic circulation over the area on 25. It concentrated into a Depression and lay at 0300 UTC of 26 centered near Lat. 7.5° N / Long. 76.5° E, about 120 kms south southwest of Thiruvananthapuram. It moved northwestwards and lay at 1200 UTC over Lakshadweep area and adjoining Maldives and Comorin area, centered near Lat. 8.5° N / Long. 75.0° E. It further moved northwestwards and lay at 0300 UTC of 27 over Lakshadweep area and neighbourhood centered near Lat. 10.5° N / Long. 73.0° E, about 70 km southeast of Amini Divi. It continued to move northwestwards and lay at 1200 UTC over southeast and adjoining east central Arabian Sea centered near Lat. 12.0° N / Long. 71.5° E. Maintaining its northwesterly course, it intensified into a Deep Depression and lay at 0000 UTC of 28 over east central Arabian Sea centered



Satellite imagery at 0000 UTC of 20 November 2011

near Lat. 13.5° N / Long. 70.0° E and Lat. 14.0° N / Long. 69.5° E, about 450 km northwest of Amini Divi (Lakshadweep Island) at 0300 UTC. Thereafter, it took a west-northwesterly course and lay at 1200 UTC of 28 over east central Arabian Sea centered near Lat 15.0° N / Long. 68.0° E and at 0300 UTC of 29 and near Lat. 15.7° N / Long. 66.8° E, about 750 kms southwest of Mumbai. It remained practically stationary and weakened into a Depression and lay centered near Lat. 16.0° N / Long. 66.5° E at 1200 UTC of 29. Further moving northwestwards, it lay over the east central and adjoining west central Arabian Sea, near Lat. 17.0° N / Long. 64.5° E at 0300 UTC of 30 and near Lat. 18.0° N / Long. 63.5° E at 1200 UTC. Moving further northwestwards, it lay centered at 0300 UTC of 1 December near Lat. 19.5° N / Long. 62.5° E, about 1100 kms west of Mumbai. It weakened into a well marked low pressure area at 0600 UTC of the same day over the same area and lay as a low pressure area over west central Arabian Sea in the evening. The system became less marked on 2 morning. The lowest ECP was 998 hPa from 0000 UTC of 28 to 0600 UTC of 29. The maximum estimated mean wind speed was 30 knots. Amini Divi reported lowest pressure of 996.3 hPa at 0300 UTC of 27 November when the system was 70 kms southeast of Amini Divi.

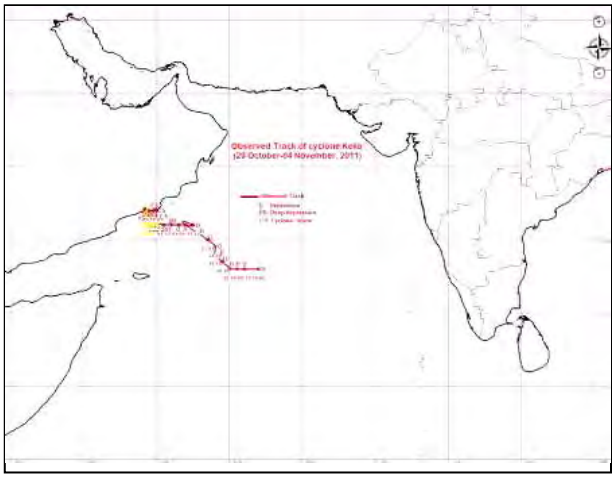
The system moved generally in a northwesterly direction, before dissipating over the Sea area.

As the system was far away from the Indian coast, it did not cause any damage.However, heavy to very heavy rainfall at isolated places occurred over Kerala on 27 November and Lakshadweep during 27 - 28 November in association with the system. Though the system moved into Arabian Sea, it drew moisture from the Bay of Bengal across Tamil Nadu. As such, all the sub-divisions covered by the Northeast monsoon regime received excess weekly rainfall during the week ending 30 November 2011.

2.1.4. Cyclonic Storm

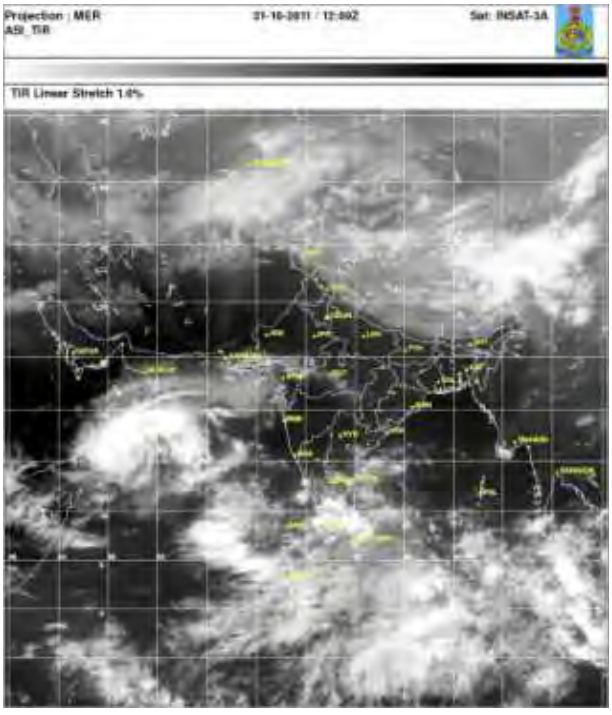
(a) Cyclonic Storm 'Keila' over the Arabian Sea (29 October – 4 November 2011)

A trough of low from south Arabian Sea to south Gujarat coast on 27, organised into a low pressure area over the central parts of south Arabian Sea and adjoining central Arabian Sea on 28. It lay as a well marked low pressure area over the central and adjoining south Arabian Sea on 29. It concentrated into a Depression over the west central and adjoining southwest Arabian Sea and lay centred at 0600 UTC of 29, near Lat. 13.0° N / Long. 62.0° E, about 1400 kms west of Mangalore. Moving westwards, it lay centred at 1200 UTC of 29 near Lat. 13.0° N / Long. 61.0° E and at 0300 UTC of 30 near Lat. 13.0°N / Long. 60.0° E. Subsequently moving northwestwards, it lay centred near Lat. 13.5° N / Long. 59.5° E at 1200 UTC of 30; near Lat. 15.0° N / Long. 58.5° E at 0300 UTC of 31 October and near Lat. 16.0°N / Long. 57.5° E at 1200 UTC of 31 October. Moving westwards, it intensified into a Deep Depression and lay centered near Lat. 16.0° N / Long. 56.0° E at 0300 UTC of 1 November and near Lat. 16.0° N / Long. 55.5° E at 1200 UTC. Continuing the westward movement, it further intensified into Cyclonic Storm 'Keila' and lay centered at 0300 UTC of 2, near Lat. 16.0° N / Long. 55.0° E. Subsequently, it moved north northwestwards and lay centered near Lat. 16.5° N / Long. 54.5° E, about 30 kms south southeast of Salalah (Oman) at 1200 UTC of 2. It further moved northwestwards and crossed Oman coast, close to north of Salalah (17.1/54.3) between 1600 – 1700 UTC and weakened into a Deep Depression and lay centered at 1800 UTC of 2, over coastal Oman, close to Salalah (17.1/54.2). It remained practically stationary over the same area at 0300 UTC of 3. Moving eastwards, it lay at 1200 UTC of 3, over Oman coast centered near Lat. 17.0° N / Long. 54.5° E. It meandered over the same region and then moving slightly southwestwards, weakened into a Depression and lay centered at 0300 UTC of 4 near Lat. 16.5° N / Long. 55.0° E. It subsequently weakened into a low pressure area at 0600 UTC of 4 and became less marked in the evening.



Cyclonic Storm 'Keila' over the Arabian Sea during 29 October – 4 November 2011

The ECP was 996 hPa from 0600 UTC of 2 November till the time the system crossed the coast. The maximum estimated mean wind speed was 35 knots. Around the time of landfall, Salalah reported maximum wind of 23 knots at 1500 UTC and 6 knots at 1800 UTC of 2 November 2011. It indicates that the system weakened just after the landfall.



Satellite imagery at 1200 UTC of 21 October 2011

Forecast performance of Keila cyclone

The Average Intensity forecast error given in Table 2.1.

Table 2.1

Average Intensity forecast error

Lead Period of forecast	Intensity Error (knots)			No. of forecasts verified
	Average	Absolute Average	RMS	
12	2.7	2.7	3.8	4
24	4.1	4.1	4.7	4
36	6.1	6.1	6.2	3
48	0	3.6	3.98	3
60	5.4	5.4	5.4	1

Track and landfall Verification

The average track and landfall forecast errors for various lead time periods as shown in Table 2.2 and 2.3 respectively. Average 24 hr track forecast error was 177 km, landfall point error was 108 km with time error of about 2 hrs. in the forecast issued 24 hrs in advance of the landfall. Landfall point/time error for the forecast was higher for 12 hrs lead period as the cyclone had slow movement before the landfall.

Table 2.2

Average track forecast errors (Direct position error in km)

Lead time (hours)	Direct position error (km)	Number of forecasts verified
12	89	4
24	177	4
36	260	3
48	397	3
60	336	1

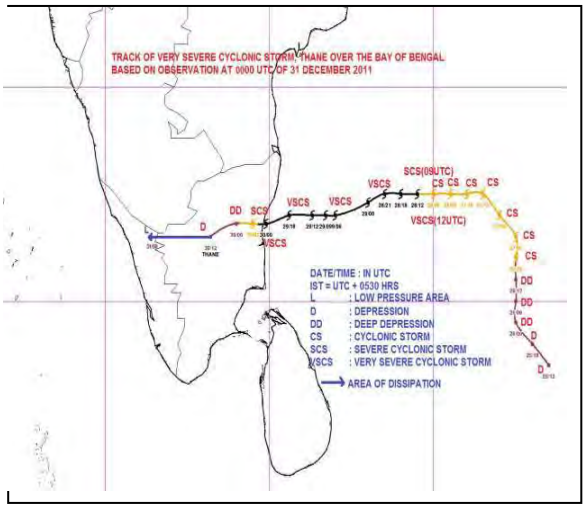
Table 2.3

Verification of landfall forecast

Lead time hours (Landfall point error in km)				Landfall time error (in hrs)		
Hours	F/C	Actual	Error (km)	F/C Date/Time (UTC)	Actual Date/Time (UTC)	Error
12	16.0°N/ 52.2°E	17.1°N/ 54.3°E	254	02/1230	02/1630	-4
24	16.5°N/ 53.5°E	17.1°N/ 54.3°E	108	02/1430	02/1630	-2
36	16.5°N/ 53.5°E	17.1°N/ 54.3°E	108	02/0030	02/1630	-16
48	16.5°N/ 53.5°E	17.1°N/ 54.3°E	108	02/0000	02/1630	-16.5

(b) Very Severe Cyclonic Storm (Thane) over the Bay of Bengal (25 – 31 December 2011)

A trough of low at mean sea level organized into a low pressure area over the southeast Bay of Bengal and neighbourhood in the forenoon of 24. It became well marked over the same area by 24 evening and persisted



Track of very severe cyclonic storm Thane over the Bay of Bengal at 0000 UTC of 31 December, 2011

there on 25 morning. It concentrated into a Depression and lay at 1200 UTC of 25 centred near Lat. 8.5° N and / Long. 88.5° E, about 1000 kms south east of Chennai. It moved northwestwards and intensified into a Deep Depression at 0000 UTC of 26 over southeast Bay of Bengal and lay centred near Lat. 9.5° N / Long. 87.5° E. It remained practically stationary during next 3 hours and lay centred at 0300 UTC of 26 near Lat. 9.5° N/Long. 87.5° E, about 900 kms southeast of Chennai. It moved further northwards and lay centred at 1200 UTC of 26 over the southeast Bay of Bengal, near Lat. 10.5° N / Long. 87.5° E. Further moving northwards, it intensified into Cyclonic Storm (Thane) and lay centred at 1800 UTC of 26 over the southeast Bay of Bengal, near Lat.11.0° N / Long. 87.5° E. It then moved northwestwards and lay centred at 0300 UTC of 27 over the southeast Bay of Bengal, near Lat. 12.0° N / Long. 87.0° E, about 750 kms eastsoutheast of Chennai and near Lat. 12.5° N / Long. 86.5° E at 1200 UTC. It then moved westwards and lay centred at 0300 UTC of 28 over the southwest & adjoining southeast Bay of Bengal near Lat. 12.5° N / Long. 85.5° E, about 550 kms eastsoutheast of Chennai. Continuing its westward movement, it intensified into a Severe Cyclonic Storm at 0900 UTC, near Lat. 12.5° N / Long. 85.0° E and further intensified into a Very Severe Cyclonic Storm at 1200 UTC of the same day and lay centered near Lat. 12.5° N / Long. 84.5° E. It further moved westsouthwestwards and lay centred at 0300 UTC of 29, near Lat. 12.0° N / Long. 82.5° E, about 270 kms east of Puducherry and at 1200 UTC near Lat. 12.0° N / Long. 81.3° E. It further moved westwards and crossed north Tamil Nadu coast close to and to the south of Cuddalore between 0100 - 0200 UTC of 30. It continued to move westwards and weakened into a Severe Cyclonic Storm and lay centred at 0300 UTC of 30, near Lat. 11.6° N / Long. 79.5° E, about 30 kms west of Cuddalore and 35 kms southwest of Puducherry. Moving further westwards, the system weakened rapidly into a Deep Depression at 0600 UTC, near Lat. 11.6° N / Long. 79.0° E, about 100 kms west of Cuddalore. It moved westsouthwestwards and further weakened into a Depression and lay centred at 1200 UTC, over north Tamil Nadu close to Salem (Lat. 11.6° N / Long. 78.2° E). Moving westwards, it further weakened into a well marked low pressure area over north Kerala and neighbourhood at 0000 UTC of 31.

Other features observed

As per the post cyclone survey conducted by IMD, the lowest observed mean sea level pressure was 969 hPa was recorded at Cuddalore. The maximum estimated wind speed was 75 kts. Puducherry reported maximum wind of 68 knots (125 kmph) and Cuddalore reported maximum wind of 76 knots (140 kmph) at the time of landfall. Gale wind speed reaching 120-140 kmph prevailed along and off north Tamil Nadu and Puducherry coast. The storm

surge of about 1 metre height inundated the low lying coastal areas of Cuddalore, Puducherry and Villuparam districts at the time of landfall of the Very Severe Cyclonic Storm (Thane).

The system moved initially in a northwesterly direction and then in a northerly direction. It again moved in a northwesterly direction and further moved in a westerly direction. After attaining the intensity of Very Severe Cyclonic Storm, it moved generally in a west to west southwesterly direction and crossed north Tamil Nadu coast between Cuddalore (43329) and Puducherry (43331) during 0100 UTC to 0200 UTC of 30 December.

Weather and damage caused

Incidents related to heavy rains claimed 35 lives in Tamil Nadu, 7 in Puducherry and 4 in Kerala. About 73292 thatched houses were fully and 94633 houses were partially damaged by winds and rains in various districts of Tamil Nadu. Six thousand people were sent to relief camps. Standing crops of Sugarcane, Tapioca, betel nuts, banana and coconut over thousands of hectares were affected. The storm uprooted trees and electric posts, disrupted power supply and transport services and standing crops. The district of Cuddalore was the worst-hit with roads severely damaged. Also, hundreds of boats were damaged in the cyclone affected coastal areas. The estimated damage was 1300 to 1500 crore of rupees.

Under the influence of the system, widespread/fairly widespread rainfall occurred over Andaman & Nicobar Islands from 25-27 December and over coastal Andhra Pradesh, Rayalaseema, Tamil Nadu and Kerala during 31 December 2011-1 January 2012.Heavy to Very heavy rainfall occurred at isolated places over Andaman & Nicobar Islands on 24 and from 26 - 27 December and at a few places over Tamil Nadu and Kerala during 30-31 December and 31 December respectively.

The maximum intensity of T 4.5 was reported from 0300 UTC of 29 to 0000 UTC of 30. EYE was reported during this period.

DWR Chennai issued the serially numbered RADAR bulletins from 1200 UTC of 28, till 0600 UTC of 30 and then the hourly RADAR based bulletins were discontinued as the system had weakened beyond reasonable estimation of features.CDR Karaikal also tracked the system from 1800 UTC of 28 till the time of landfall.

Forecast performance of Thane cyclone

The Average Intensity forecast error given in Table 2.4.

Table 2.4

Average intensity forecast error

Lead Period of forecast	Intensity Error (knots)			No. of observations verified
	Average	Absolute Average	RMS	
12	-10.2	17.4	18.0	17
24	-1.1	10.5	11.0	15
36	-2.5	12.9	13.9	13
48	-6.1	16.0	16.4	11
60	-10.2	17.4	18.0	9
72	-8.9	21.2	22.4	7

Track and landfall

The track forecast errors were significantly less than long period average in this system, as 24, 48 and 72 hr forecast errors were 77, 160 and 181 km against the long period average of 150, 250 and 350 km respectively (Tables 2.5 and 2.6).

Table 2.5

Average track forecast errors (Direct position error in km)

Lead Time (hrs)	Average Track forecast error (km)	No. of forecast verified
12	43	17
24	77	15
36	129	13
48	160	11
60	175	9
72	181	7

Table 2.6

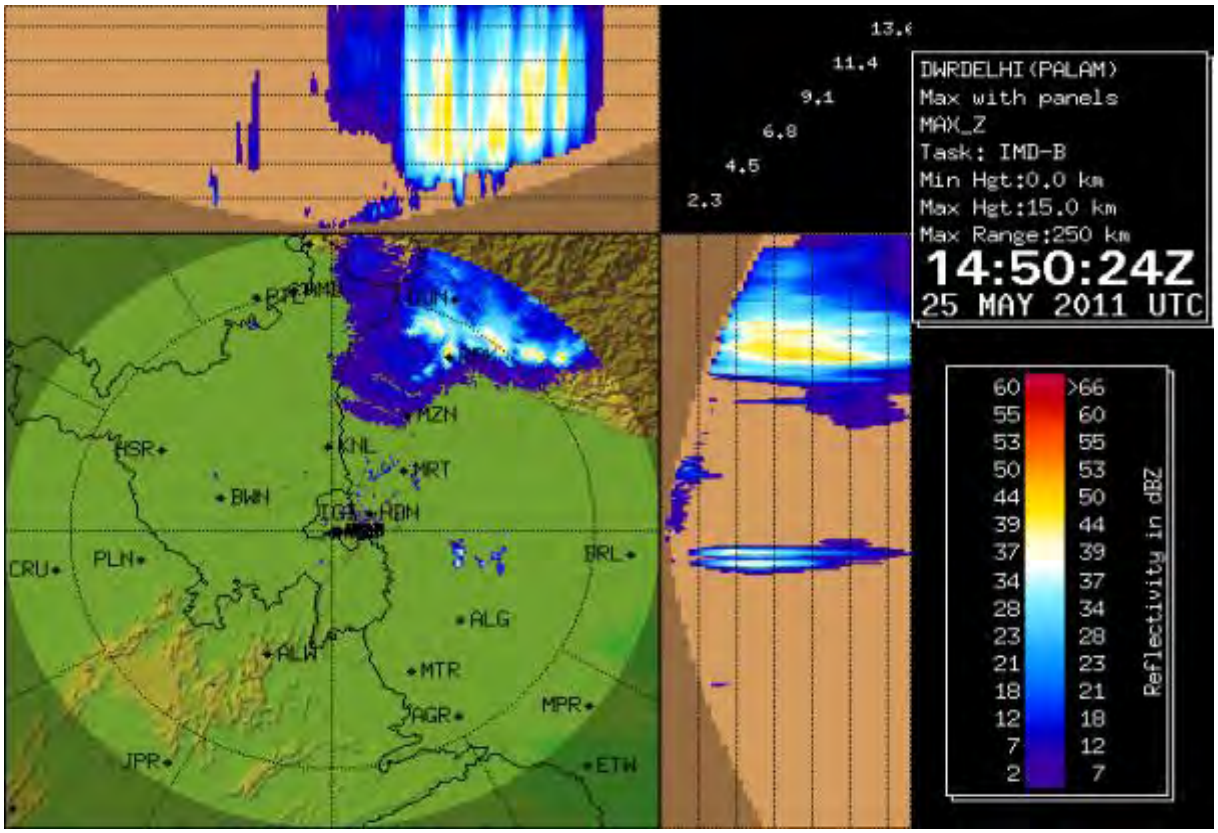
Landfall forecast error

Lead time hours (Landfall point error in km)				Landfall time error (in hrs)		
Hours	F/C	Actual	Error (km)	F/C Date/Time(UTC)	Actual Date/Time (UTC)	Error
12	12.0°N/ 79.9°E	11.8°N/ 79.9°E	20	30/0500	30/0700	-2
24	12.0°N/ 79.9°E	11.8°N/ 79.9°E	20	30/0600	30/0700	-1
36	12.50N/ 80.10E	11.8°N/ 79.9°E	80	30/0600	30/0700	-1
48	13.2°N/ 80.2°E	11.8°N/ 79.9°E	160	30/0600	30/0700	-1
60	13.1°N/ 80.2°E	11.8°N/ 79.9°E	150	30/0600	30/0700	-1
72	13.0°N/ 80.2°E	11.8°N/ 79.9°E	140	30/0600	30/0700	-1

2.2. Weather Monitoring and Nowcast system at IGI Airport Delhi

2.2.1. Thunderstorms, squallsd Gusty winds Monitoring, Warnings and Nowcast system at IGI Airport Delhi

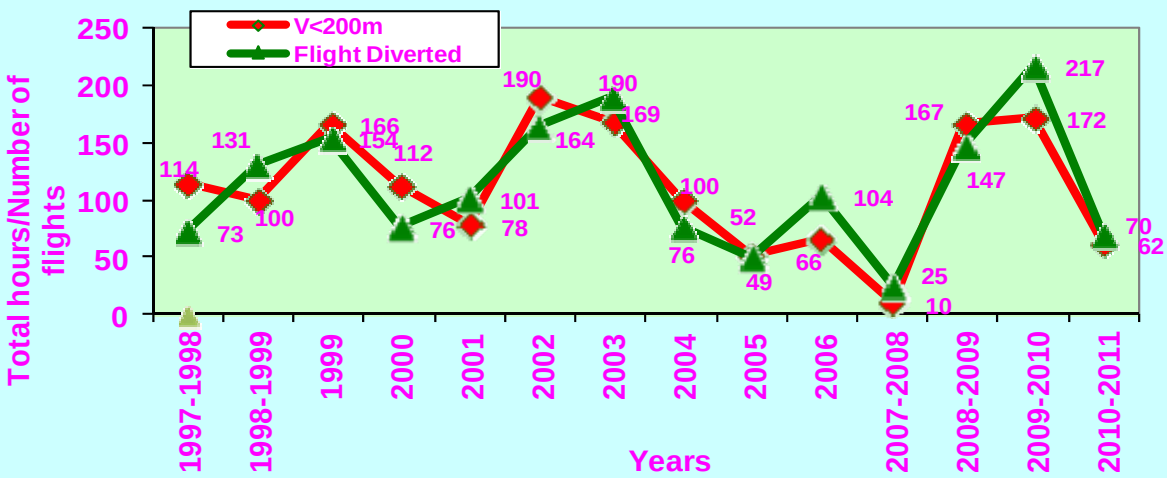
During 2011, IMD have further strengthened its observing system at IGI Airport and NCR Delhi with commissioning of many high-tech weather monitoring instruments. At IGI Airport, there are now eight very high resolution meso network of eight Integrated Auto Aviation weather observing systems (IAAWS)/Visibility RVR meters imported from Australia and German and located at various locations of three RWYs of the Airport which covers a domain of 7 × 6 sq km with data updated at second to minute time scale. The DWR observe various characteristics of cloud developments in and around Delhi with instant of time, etc., all these products were successfully utilized both by Met. office and aviation communities. Met office has been continuously using these products at 24 × 7 for monitoring various hazardous weather events especially Thunderstorms, squalls and localized intense rain spells and issuing forecast/nowcast. Met office IGI Airport has been utilizing the analysis and



DWR Cloud picture at 1450 UTC of 25 May 2011

forecasting workstations Synergie, *i.e.*, installed by METEO-FRANCE.

DWR Cloud pictures as early as 1450 UTC of 25 May 2011 confirms the development of vertically grown up CB clouds at NNE to IGI Airport at 100 km to 200 km circles over Uttaranchal hills based upon which IMD issuesd warning of DS/TS and squally/gusty weather. This is the date when the nine-seater, single-engine chartered plane in route Patna to Delhi, crashed over Faridabad around 1048 pm on 25 May 2011, 17 km from IGI Airport (IGIA) at its ESE just 15 minutes before its scheduled landing killing all the seven people on board.



Impact of CAT-III dense fog hours on flight diversion 1997-2011

2.2.2. Fog Detection, Monitoring and Forecasting System of IGI Airport and their real time Performances in 2008-2011

- During recent years, occurrences of large-scale intense fog conditions over Indo-Gangetic Plains in each winter including those over Delhi have been causing severe disruption to flights, For rendering a high quality operational fog services each season, IMD fog services at MWO Palam, has been concentrating in strengthening up following major aspects before start of each season:

- Installing new Fog monitoring system at RWYs and adjoining region of Delhi.

- Implementation of efficient RVR-Maintenance plan with "zero tolerance of fault development.

- Updating both objective and operational Fog Forecast/Nowcast System each year with Updating Checklist of Fog Forecast Methods and Updating Empirical Fog Model.

- Adopting new dissemination Systems each year-Live RVR in website/IVRS for fog Forecast/SMS services on fog informations.

Presenting new fog plan and Fog Climatological Information System in Inter-departmental Fog coordination meeting and organizing Fog Users Workshop for increasing users awareness.

Fog Climatological Information System

Fog climatological information System for IGI Airport developed at MO Palam, consists of digitized hourly visibility data recorded at IGI airport along with various analyses at micro-climatological time scale for finding various fog characteristics for the main winter months of December and January using data of 1981-2008 to find the intensity of the vulnerability of the place. It has users friendly analytical parameters e.g. monthly climatology of number of days and hours, daily average total hours of occurrence, onset timings, dispersal timings, etc. computed based on different intensity of fog types with hourly visibility data corresponding to below 1000m, 500m, 200m and 50m for aviation purpose.

Fog Monitoring System

It is the real time system in which characteristics of fog around the airport has been critically monitored round the clock by getting RVR observations at each second from eight Automatic instruments located at various places on three RWYs which feeds data at minute to second intervals.

IMD during 2010-2011 has implemented a further improved and efficient on-line Fog monitoring system by

making on-line availability of current fog information and visibility data of nearly fifty airports of India updated at each 10-30-minutes intervals [htmhttp://121.241.116.157/Palam1.php.,3]. There are 13 non aviation AWS at various key locations of NCR Delhi which also supplements this fog monitoring covering NCR Delhi by providing hourly temp, moisture and wind data. These data are integrated and processed by a high end weather analysis and forecasting workstations Synergie, which have been helping for timely analysis and visualizing trends of various parameters at minutes to weekly scales.

Fog Nowcasting System

It has been demonstrated by various expert groups around the world that the only way to improve the forecasting accuracies of very short period 0-6 hours are by significantly improving the observing and monitoring systems with induction of high tech AWS by developing a MESONET over the area, a dense network of DWR coverage, high resolution satellite pictures etc followed by development of very high resolution data analysis and forecasting systems at minute to second intervals or meter to km intervals with their forecast validity up to few hours.

Fog Forecasting System

Besides development and implementation "Empirical based Intensity and duration specific Fog prediction system" has also implemented a special forecasting Development program called Fog Forecasting Demonstration Project (FDP) with active participation from IAF and CMMACS, CSIR, Bangalore since 2008 at IGI. AMO Palam uses inputs from various sources to reach a consensus forecast about chances of fog formations in the ensuing nights at IGIA, their duration at various visibility ranges and time of lifting, etc.

Fog Dissemination system

Fog related information and forecasting have been disseminated to various user agencies mainly through IMD HQ Website in http://www.imd.gov.in with various users friendly suitable Sub-headers such as Fog Forecast, past RVR and Visibility of IGI, Current Visibility of IGI and METAR at IGI and alternate airports. IMD also regularly uploads instantaneous Live RVR from various location of RWYs by directly networking with website with RVR instruments functioning at IGI Airport.

Dense fog forecasts and their verification

All RVRs of IGI Airport worked excellently during fog season of 2010-2011 and also its forecast system. Skill of Dense fog forecasts and their verification when visibility < 200 m with lead timing 12-18 hours in advance is given in Table 2.7.

Table 2.7

Period 2008-2011 categorical verification method

Types	December			January		
	2008	2009	2010	2009	2010	2011
Bios for occurrences (Bias Score)	1.33	-	1.66	1.6	0.96	1.14
Critical Success Index (Threat Score)	0.56	-	0.60	0.51	0.84	0.88
Percentage Correct	74%	94%	94%	58%	81%	96%

2.3. WEATHER AT MAITRI – ANTARCTICA 2011

At Indian Antarctica station 'Maitri' the synoptic data is collected every three hours e.g., visibility, sky condition, wind speed and direction, pressure, temperature, overall weather conditions and snowfall etc. if any. The Aerosol Optical Thickness observations are also taken regularly. The Radiation budget of Global & Diffused Radiation is continuously recorded. Synoptic charts and Satellite pictures are also collected regularly which is essential for outlook for next few days. Weather forecast is provided for Ship, Helicopter, Convoy operation and any other outdoor Scientific & Logistic activity.

The following are the salient features of synoptic weather parameters during 30th expedition.

Temperature

During 2011 the highest monthly average maximum temperature was recorded as 1.3 °C in January. However, the lowest monthly average minimum temperature was recorded as -16.8 °C in September. The highest Maximum & Lowest Minimum temperatures of the expedition were recorded as 7.0 °C and -32.5 °C respectively. The highest average maximum temperatures and lowest minimum average temperature were recorded as 4.2 °C and -20.1 °C in January & September respectively.

Pressure

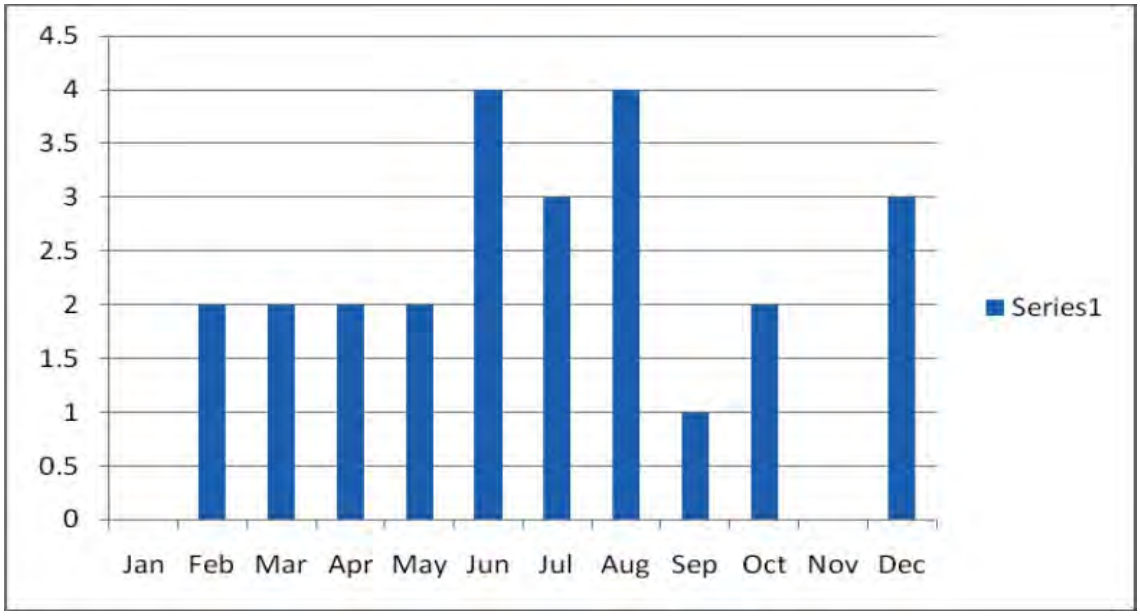
The average Mean Sea Level Pressure (MSLP) fluctuated monthly peak of 991.6 and low of 984.2 hPa. The highest Maximum MSLP of 1027.1 hPa was recorded during the month of July 2011 and the Lowest Minimum MSLP of 952.8 hPa was recorded during the month of May 2011.

Wind

The month of July was the windiest month of the expedition and recorded Max average wind of 57 knots with Max Gust of 96 knots. However, the monthly average maximum wind was 24 knots and lowest minimum average wind was recorded 13 knots. Out of 365 days of the year 176 days recorded wind more than or equal 23 knots.

Blizzards

During the year 2011 Maitri experienced 22 Blizzards with Maximum of 4 each in June & August; 3 in July; 2 each in February, March, April, May & October and 1 in September. There were no Blizzards during, January 2011 and November 2011.



No of blizzards during 2011

In association with above mentioned Blizzards, the total snowfall precipitation throughout the expedition was recorded as 399.1 mm. The heaviest snowfall precipitation occurred during the month of June, July and August with Maximum snowfall precipitation of 108.0 mm during July 2011. Subsequently, June & August recorded snowfall precipitation of 88.0 mm and 103.7 mm respectively. The month of January 2011 of the expedition recorded least snowfall precipitation of amount Trace. The statistical details of the Meteorological parameters recorded during the expedition are shown in Table 2.8.

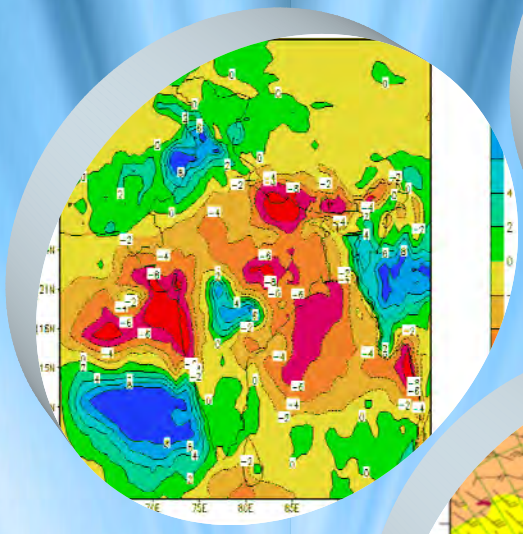
Table 2.8

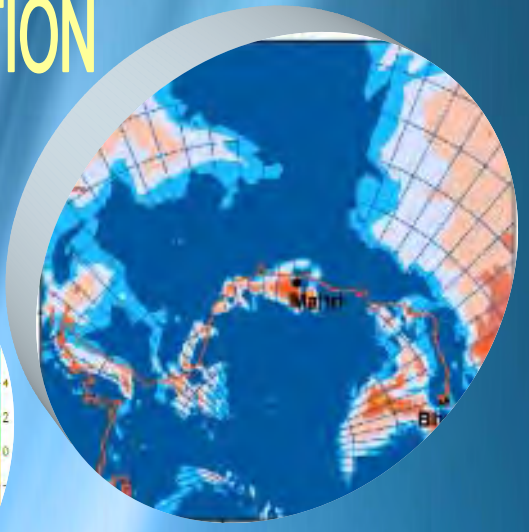
Synoptic data of maitri during 2011

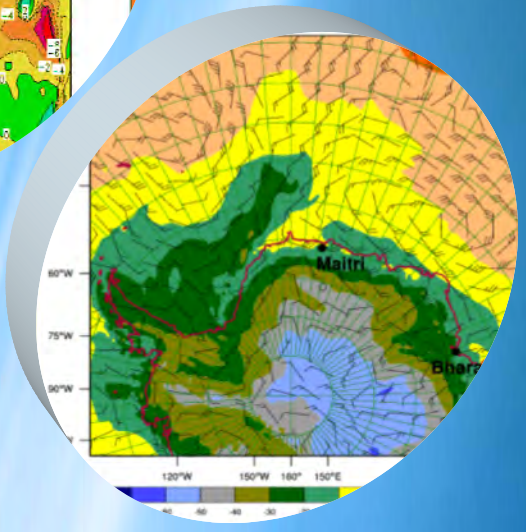
Month	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
Avg MSLP	987.3	986.6	988.4	985.8	984.2	987.9	990.6	988.7	991.6	986.6	990.7	979.5
Highest MSLP	998.3	1001.2	1011.8	1001.9	1006.0	1008.5	1027.1	1015.1	1005.7	1000.9	1010.0	988.7
Lowest MSLP	971.5	962.9	963.6	958.6	952.8	963.0	956.2	965.7	973.1	971.7	963.5	963.5
Avg Temp	1.3	-3.4	-8.4	-8.8	-14.0	-11.8	-15.9	-15.4	-16.8	-13.5	-3.8	-3.1
Max Temp	7.0	3.3	-0.8	-0.2	-6.9	-4.5	-7.5	-2.0	-7.0	-2.4	2.9	06.4
Min Temp	-2.9	-11.9	-19.8	-19.3	-27.8	-23.1	-28.7	-27.5	-32.5	-26.1	-15.3	-10.6
Avg Max	4.2	-0.5	-5.6	-6.9	-11.9	-9.2	-13.4	-11.9	-13.3	-9.9	-1.1	-03.1
Avg Min	-0.6	-6.1	-11.1	-11.5	-17.8	-14.7	-19.2	-17.7	-20.1	-17.4	-7.2	-06.2
Avg kts	15	14	16	22	15	21	17	24	13	13	13	14
Max Avg kts	25	38	38	42	44	51	57	55	32	40	44	45
Max Gust	60	58	49	58	62	78	96	80	46	54	58	76
No of >23 kts	3	3	19	22	12	22	20	26	14	10	19	25
No.of Blizards	0	2	2	2	2	4	3	4	1	2	0	03
No. of Days with pptn	9	8	8	11	16	18	12	11	5	5	3	06
Snowfall	Trace	6.4	3.7	26.2	29.2	88.0	108.0	103.7	2.4	28.7	2.8	45.5

Units: MSLP - hPa, Temp - °C , Snowfall - mm

NUMERICAL WEATHER PREDICTION







3

ARCHIVED CHARTS VIEWING APPLICATION

EXPERIMENTAL GFS T-574

HWRF FOR INDIAN SEAS

WEATHER WARNING SYSTEM IN IMD

TC ENSEMBLE FORECAST PROJECT IN THE PTC REGION

EXTENDED RANGE FORECAST

3. Numerical Weather Prediction

IMD has undergone a changeover from being data provider to service provider. IMD has an exhaustive range of numerical forecast products (www.imd.gov.in). NWP division continues to provide multi-scale weather forecasts ranging from nowcast to medium range and extended range to support day to day operational and various user specific forecasts. National Centre for Environmental Prediction (NCEP) based Global Forecast System (GFS T382) is being operated in the real-time mode has been made at the H.Q of IMD, incorporating Global Statistical Interpolation (GSI) scheme as the global data assimilation for the forecast up to 7 days, twice in a day (0000 UTC and 1200 UTC). In addition to this, the mesoscale 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 weather forecast (48 hours) 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. NWP based objective cyclone forecast products are generated to support cyclone warning service. GFS based five days forecasts are being generated for 200 cities.

Of late there has been an awareness and appreciation of the fact that GIs/Web-Gis offers a unique combination of analysis and display tool to the Meteorological community. There has been an intentional effort to integrate WEB_GIS technology with the products developed in NWP division. This would give the users, an interactive approach to examine the NWP products.

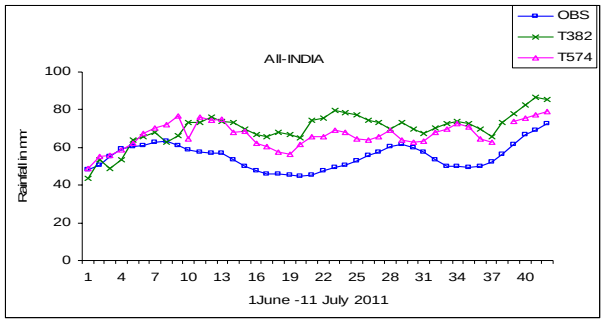
3.1. Archived Charts Viewing Application

A new Web application in Python was developed in-house to generate query based display system. It is a web based application for accessing NWP Archived Charts & Bulletins. A user can access GFS, WRF, ECMWF Charts and Bulletins.

It provides user with facility for accessing charts based on date, month and year. A user can view charts of 0000 & 1200 UTC. Charts can also be viewed for various forecast hours (00, 24, 48, 72, 96, 120, 144, 168) and various parameters (MSLP, 925, 850, 700, 500, 300, 200, 100 hPa wind, GPM height of 500 hPa and Rainfall). WRF Model charts, 27 km – domain (d01) and 09 km – domain (d02) can be viewed. A user can even view charts of all the forecast hour at one go. A user can view archived bulletins giving date, month and year.

3.2. Experimental GFS T-574

Global Forecast System GFS T-574 is being operated in the experimental mode from May 2011. An inter-comparison seven days forecast of cumulative rainfall between GFS 574 and T-382 against the corresponding observed rainfall is shown in figure



An inter-comparison seven days forecast of cumulative rainfall between GFS 574 and T-382 against the corresponding observed rainfall (mm/day)

3.3. HWRF for Indian seas

Under NOAA-MoES Tropical Cyclone Program Dr. Vijay Tallapragada, Team Leader and Dr. Zhan Zhang, Research Scientist, HWRF, EMC, NCEP, USA were on deputation to India Meteorological Department, New Delhi from 28 June to 01 July 2011 for technology transfer of HWRF modeling system and to provide training on initial operating capability of HWRF model. The basic version of the model HWRFV (3.2+) which was operational at EMC, NCEP was ported on IBM P-6/575 machine, IMD, New Delhi with nested domain of 27 km and 9 km horizontal resolution and 42 vertical levels with outer domain covering the area of 80° × 80° and inner domain 6° × 6° with centre of the system adjusted to the centre of the observed cyclonic storm.

The model has special features such as vortex initialization, coupled with Ocean model to take into account the changes in SST during the model integration, tracker and diagnostic software to provide the graphic and text information on track and intensity prediction for real-time operational requirement. HWRF model was tested to run the model in cycling mode at IMD, New Delhi. In this run only the atmospheric model (HWRF) was tested. The Ocean Model (POM-TC) and Ocean coupler requires the customization of Ocean Model for Indian Seas. IMD is expecting to implement the Ocean cupping in collaboration with INCOIS, Hyderabad. The model is presently under testing for experimental operational implementation during the post-monsoon cyclone season 2011.

3.4. TC Ensemble Forecast Project in the PTC Region

As per the advise from WMO to provide a guidance of tropical cyclone forecasts in near real-time for the ESCAP/WMO Members based on the TIGGE Cyclone XML (CXML) data, under the joint project of World Weather Research Program (WWRP) and Tropical Cyclone Program (TCP) TC homepage was developed by JMA and the same software was transferred to IMD to generate similar page for RSMC, New Delhi. The software was implemented at NWP Division, IMD, New Delhi and ensemble TC products from ECMWF, UKMO, NCEP and JMA was provided experimentally during the post-monsoon cyclone season 2011 for ESCAP/WMO Members of RSMC, New Delhi region.

3.5. Weather Warning System

IMD implemented high-resolution WRF model forecast system at its H.Q., New Delhi and ten major Meteorological Centres at field station. Under the program, it was initiated to develop severe weather warning system with the basic frame work of WRF model for Indian region. The project is to be implemented during the FY-12 under the joint collaboration with the Institutes/ Universities working on weather related science and IMD/NCMRWF. The proposal is for implementation of data assimilation system using all the available DWR, Satellite, AWS and other data sets and also customization of WRF model for Indian region.

3.6. Extended Range Forecast

Just like the inter-annual variability of monsoon rainfall the Indian summer monsoon precipitation shows clear intra-seasonal variation associated with northward propagation of large-scale convective anomalies from the equator. This northward propagation is known to be accompanied by eastward propagation of convective activity along the equator (Madden Julian Oscillation; MJO) through the Rossby wave propagation. The Indian daily rainfall and MJO phases are related in a complex way. The forecasting of this intra-seasonal fluctuation of Indian rainfall is very difficult but is very useful for the country. In addition to the empirical models, there are many global modeling centers like ECMWF, NCEP, JMA etc. are also running atmospheric General Circulation Model and coupled atmosphere-ocean models operationally. An accurate coupling of the fast atmosphere to the slow ocean (with long memory) is essential to simulate the MJO, which in turn can simulate the intra-seasonal variability of Indian monsoon.

The 2010 and 2011 monsoons are two recent good monsoon years with seasonal rainfall departures slightly on the positive side of its long period average. However, on sub-seasonal scales weak monsoon conditions prevailed over many meteorological sub-divisions and ultimately many meteorological sub-divisions received deficient rainfall at the end of the season during both years. Similarly the drought year of 2009 witnessed three long dry spell one each in June, August and September. A proper real time monitoring of intra-seasonal fluctuation of monsoon rainfall was quite useful in providing forecast guidance to the farming communities of the country. In addition to the extended range forecast of southwest monsoon the extended range forecast of north east monsoon rainfall over Tamil Nadu during Oct-Dec, the extended range forecast of genesis of cyclonic

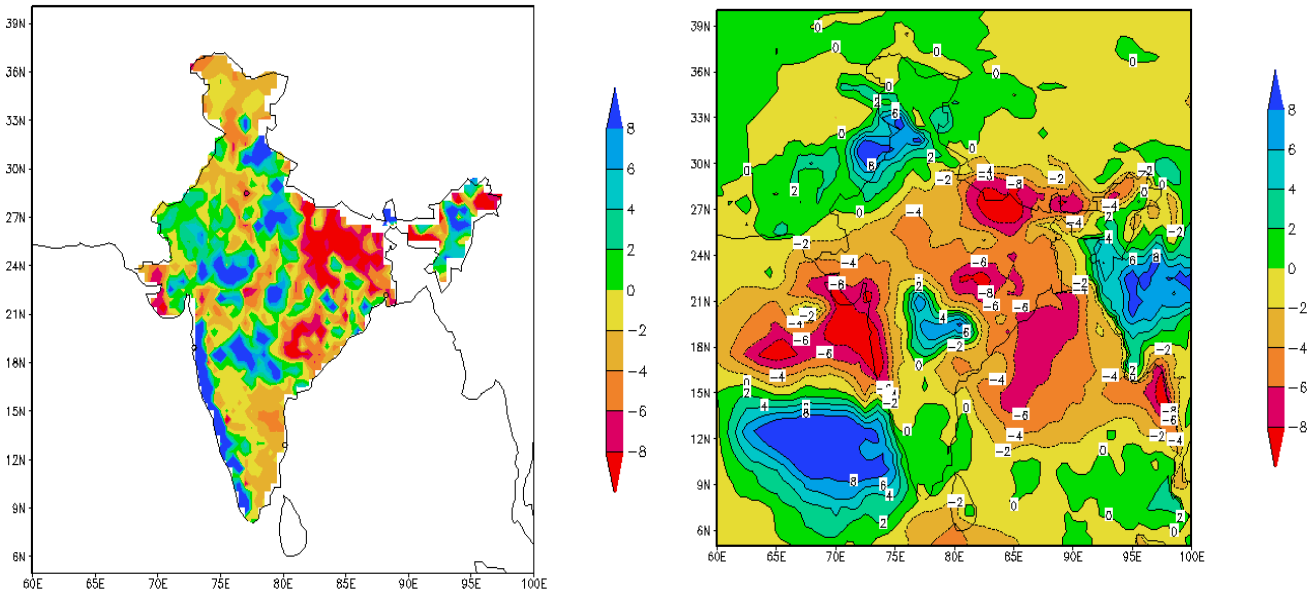
disturbances particularly for the post-monsoon season when tropical cyclones are more common over the north Indian Ocean and the extended range forecast of maximum and minimum temperatures during summer and winter seasons are also very crucial and useful to different users. IMD from 2010 has started generating the extended range forecast based on Multi-Model Ensemble (MME) of coupled models outputs from leading modeling centres around the globe viz., ECMWF, NCEP and JMA.

Extended range forecast of monsoon rainfall

Though there was no long dry spell during monsoon 2011 season some weak phase of monsoon prevailed during July. As shown below in Figs. 3.1(a&b) the weak spell of rainfall during 11-17 July was clearly demonstrated in the MME forecast based on initial condition of 30 July and valid for days 12-18. For the entire season of 2011 and 2010 monsoons the anomaly correlation coefficient as shown in Fig. 3.2 is found to be significant at least for 18 days. Thus, the real time extended range forecast of monsoon based on MME is found to be very useful. The MME forecast of monsoon rainfall is also calculated on meteorological sub-division level as shown in Fig. 3.3 during the period 12-18 September, 2011. Considering the difficulty of prediction of monsoon rainfall in the extended range on the smaller spatial scale, the results are found to be encouraging.

(a) Obs rainfall anomaly

(b) MME forecast rainfall (12-18 days forecast)



Figs. 3.1(a&b). *(a) Observed rainfall anomalies (mm/day) during 11-17 July, 2011, (b) MME forecast rainfall anomaly based on 30 Same and valid for (days 12-18) 11-17 July, 2011*

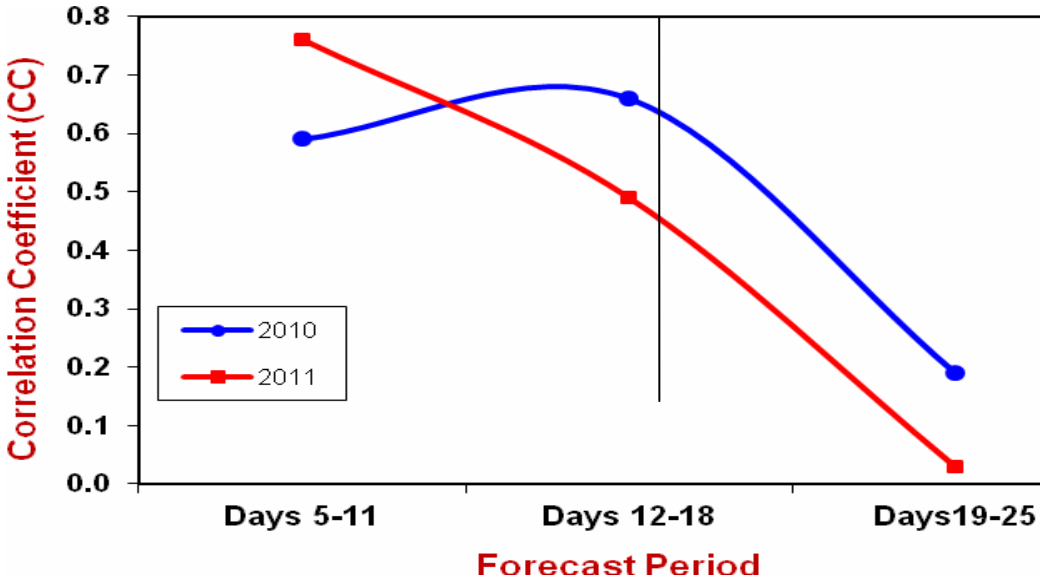
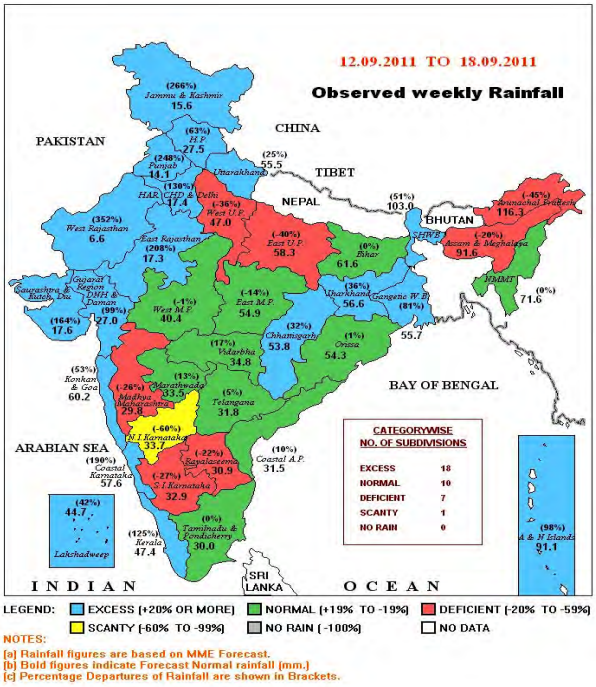
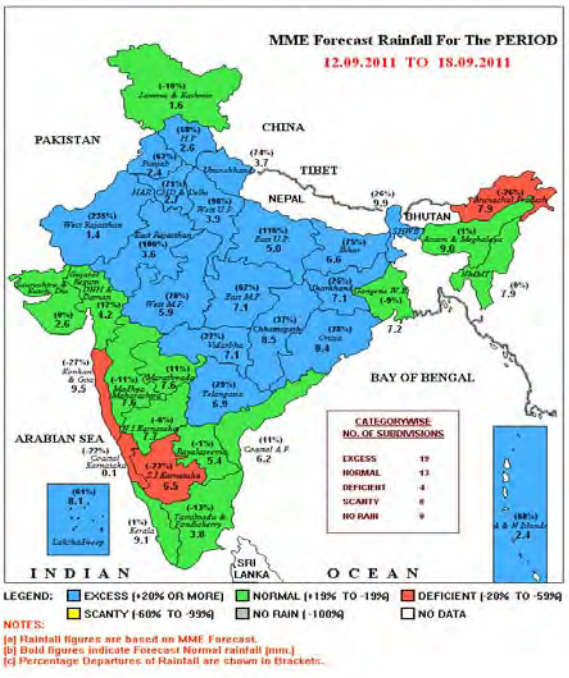


Fig. 3.2. *Correlation coefficient (CC) between the weekly observed and forecast rainfall from MME valid for week-1 (days 5-11), week-2 (days 12-18) and week-3 (days 19-25) during 2010 and 2011 monsoon season*

(a) Obs 12-18 Sep AISMR = +21.5%



(b) MME FC 12-18 Sep AISMR = +29.7%



Figs. 3.3(a&b). *(a) Weekly observed rainfall departure on Met. sub-division level during the period 12-18 September, 2011. (b) The corresponding MME forecast rainfall on Met. Sub-division level based on 8 Sep and valid for the period 12-18 September, 2011*

Extended range forecast of cyclogenesis

It is not only the extended range forecast of monsoon rainfall the extended range forecast of cyclogenesis is also very useful. The cyclone "Thane", which formed initially as a low pressure over southeast Bay of Bengal on 24th December, 2011 intensified into a cyclonic storm. The MME forecast mean relative vorticity (Fig. 3.4) and mean rainfall [Figs. 3.5(a&b)] valid for the period from 19- 25 December and 26 Dec-1 January, 2011 has captured the system and associated rainfall very well.

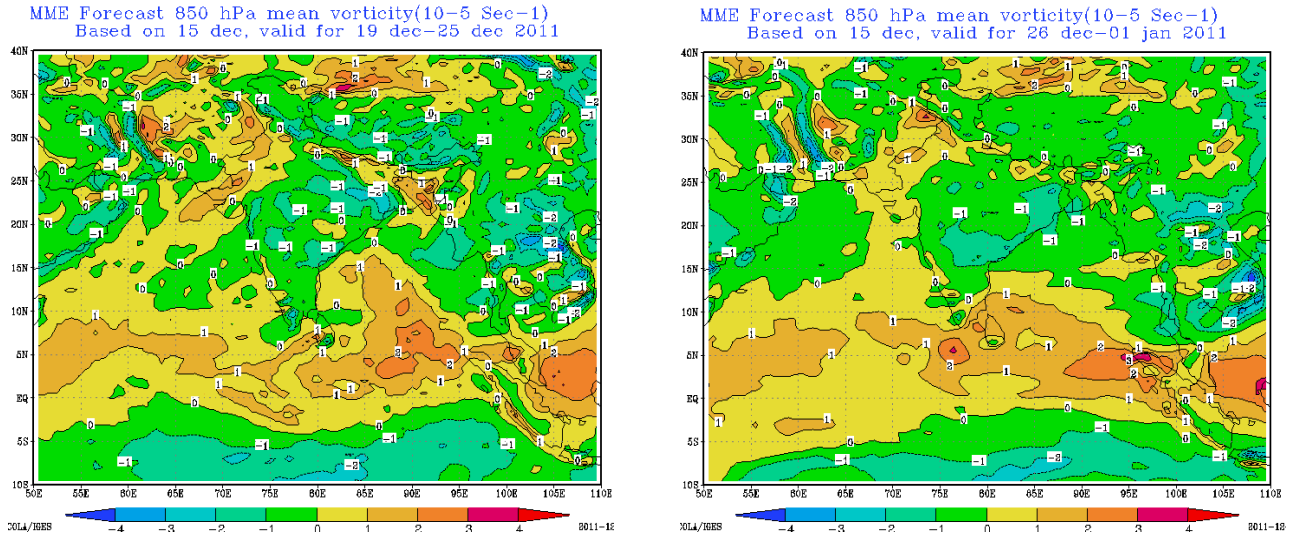
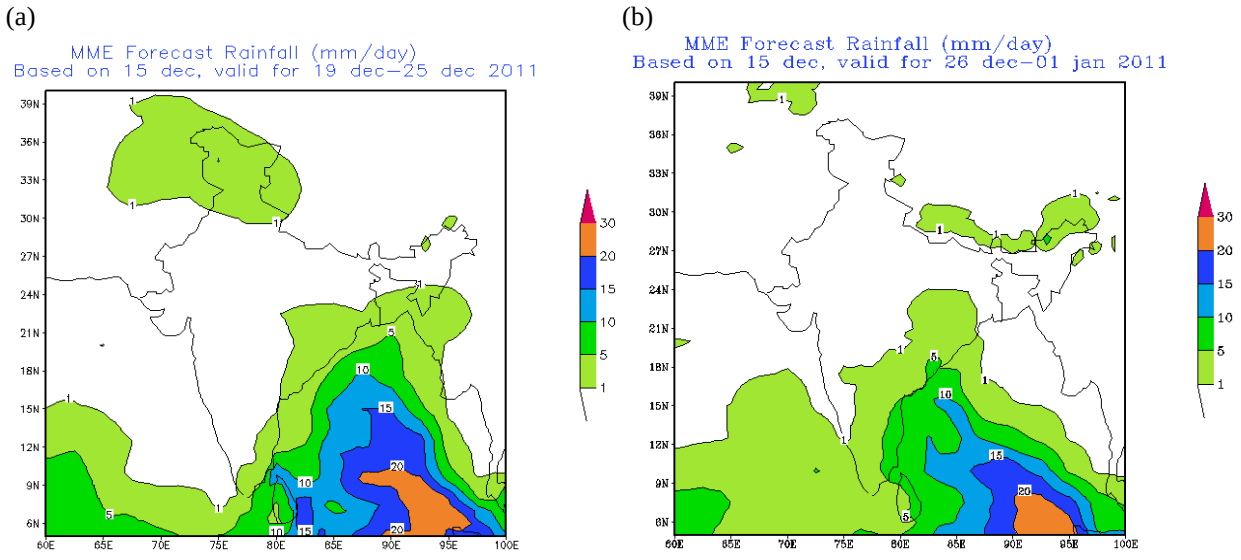
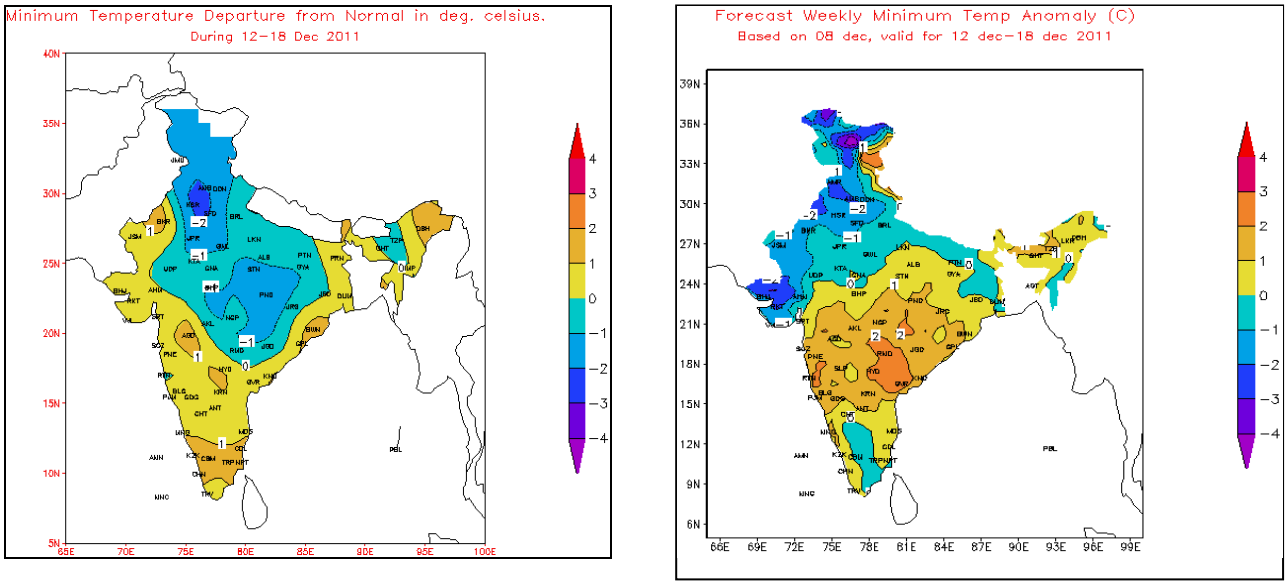


Fig. 3.4. *MME forecast weekly mean 850 hPa Vorticity (1x 10 Sec-1) based on 15 Dec and valid for (a) 19-25 Dec (day 5-11 forecast) and (b) 26- December - 01 January (12-18 forecast)*



Figs. 3.5(a&b). *MME forecast weekly mean rainfall (mm/day) valid for (a) 19-25 Dec (day 5-11 forecast) and (b) 26 December - 01 January (12-18 forecast) based on 15th December initial condition.*

(a) (b)

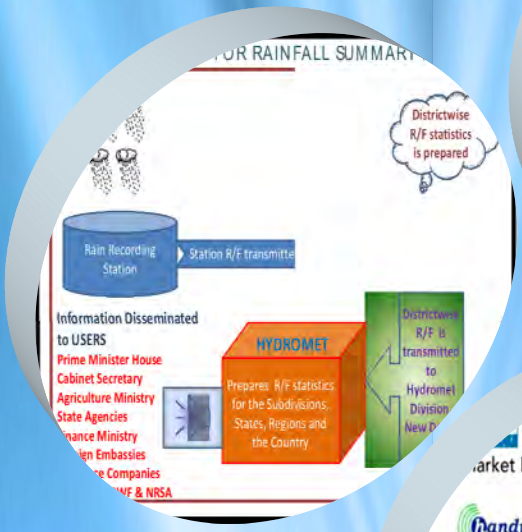


Figs. 3.6(a&b). *(a) Observed minimum temperature anomalies (°C) valid for 12-18 December, 2011. (b) The MME forecast Tmin anomaly based on 8 December 2011 and valid for 12-18 December, 2011*

Extended range forecast of maximum and minimum temperature

The extended range forecast of maximum and minimum temperature also provides useful guidance during summer and winter. The initiation of cold spell over north India during 12-18 December, 2011 was well captured in the MME forecast based on the initial condition of 8th Dec, 2011 [Figs. 3.6 (a&b)].

WEATHER SERVICES



4

HYDROMETEOROLOGICAL SERVICES

AGROMETEOROLOGICAL SERVICES

METEOROLOGICAL SERVICES FOR AVIATION

CYCLONE WARNING SERVICES

SATELLITE APPLICATIONS

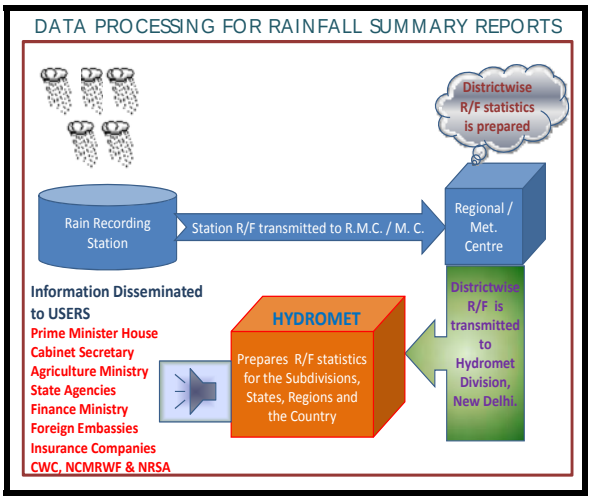
MARINE METEOROLOGY SERVICES

PUBLIC WEATHER SERVICES

WEB-GIS APPLICATION FOR RADAR PRODUCTS

4. WEATHER SERVICES

The Meteorological services have significant impact on every spheres of life. The demand for accurate prediction of weather and climate at short and longtime scales is increasing due to the increased awareness of possible impacts of weather and climate. Improved and reliable forecast of weather and climate requires routine integrations of observations using very high resolution dynamical models with high complexity (e.g. coupled ocean - atmosphere - biosphere – cryosphere models). A combined approach involving land, ocean and atmospheric processes hold the key to improve the forecasts at various temporal and spatial ranges for providing a credible policy tool. Intensive monitoring of various weather systems through different platform based observing systems including satellites provide not only the necessary information about weather systems but their assimilation in numerical models provides accurate forecasts.



4.1. Hydrometeorological Services

The hydrometeorological services consists of compilation of rainfall statistics, hydrometeorological analysis of different river catchments for project authorities and provides 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:

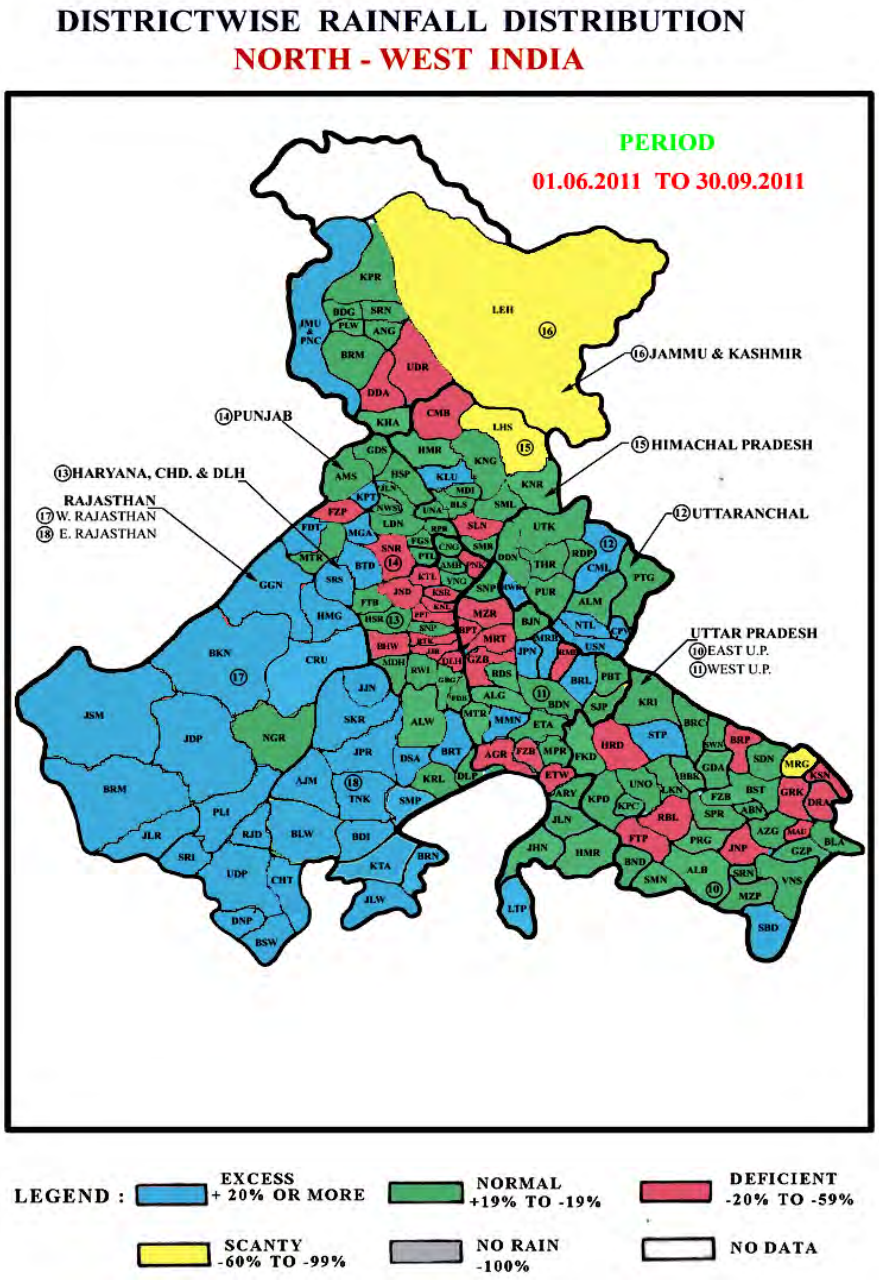
Design Storm Unit

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 authorities. An amount of Rs.27,92,500/- (Rupees Twenty Seven Lakh Ninety Two Thousand Five Hundred only) has been deposited in IMD's A/c for carrying out the design storm studies in respect of projects received from private/profit earning agencies.

Design storm studies of fortyone (41) projects have been completed during the year and results communicated to the concerned project. They are Almatti Dam, Nirsagar Kere Project, Harangi Project, Narayanpur Dam (Karnataka); Sachkhas Hydro Electric Project, Luhri Hydro Electric Project, Dhaulasidh HEP, Reoli Dugli Hydro Electric Project (Himachal Pradesh); Kuri-Gongri Hydro Electric Project (Bhutan); Kynshi Hydro Electric Project, New Umtru Hydro Electric Project (Meghalaya); Nuclear Power Plant at Kovaada, B A R C Campus at Atchutapuram, Ghanpur Anicut Project (Andhra Pradesh); Bargi Dam, Lower Orr Dam (Madhya Pradesh); 2-dams of Malshej Ghat Pumped Storage Scheme, Kalu River Project, Kalmusht Project (Maharashtra); Emra-II Hydro Electric Project, Subansiri Middle Hydro Electric Project, Subansiri Upper Hydro Electric Project, Jameri HEP, Bana HEP, Para Hydro Electric Project, Rebby Hydro Electric Project, Lachung Hydro Electric Project, Badao Hydro Electric Project, Dinchang Hydro Electric Project, Bhareli-II HEP, Bichom Dam, Tenga Dam, Rho Hydro Electric Project, Nyukcharongchu Hydro Electric Project, New Melling Hydro Electric Project, Gimliang HEP, Raigam HEP (Arunachal Pradesh); Rehar-I Hydro Electric Project (Chhattisgarh); Nuclear Power Plant at Mithi Virdi (Gujarat); Nuclear Power Project near Hissar (Haryana); Sawalkot HE Project (Jammu & Kashmir).

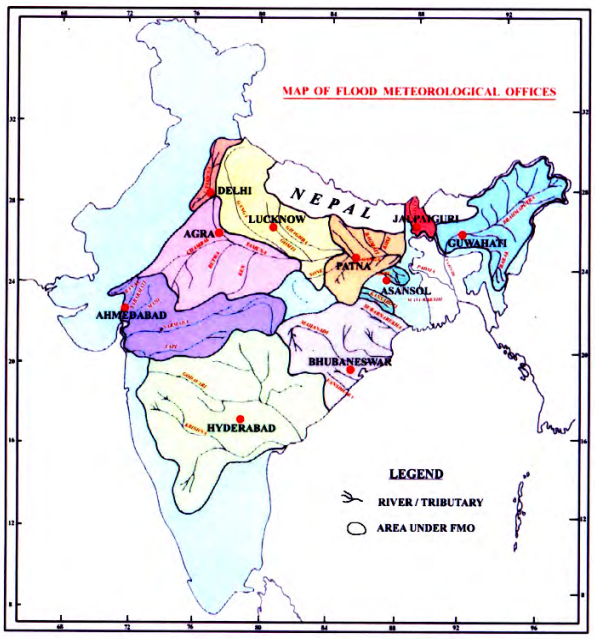
Rainfall Monitoring

During 2011, Rainfall Monitoring Unit prepared, the rainfall statistics in form of reports and maps for the Districts, Sub-divisions, States, Regions and for the Country as a whole. DRMS data base and Normal R/F data base in the format compatible to mkRAIN software was prepared for all the 641 districts and sent to all RMC's/MC's. Arc View software for FMU Hyderabad was purchased for Isohytal Analysis of Krishna and Godavari basins. Another GIS based software for Isohytal analysis and estimation of real rainfall over River Basins was procured.



Flood Meteorological Service

Flood Meteorological Service of IMD provides the following inputs to Central Water Commission (CWC) through their 10 Flood meteorological Offices (FMO estabhlished in different parts of India for operation flood forecasting. FMO's are located at Agra, Ahmedabad, Asansol, Bhubaneswar, Guwahati, Hyderabad, Jalpaiguri, Lucknow, New Delhi and Patna in the flood prone areas which caters to the river catchments Lower Yamuna, Betwa, Ken and Chambal, Narmada, Tapi, Deman Ganga, Sabarmati, Banas and Mahi, Ajoy, Mayuraksi and Kangasbati, Mahanandi, Brahmani and Subernarekha, Brahmaputra, Dehand, Lohit, Subansiri, Manas, Dhansiri and Barak, Godavari and Krishna, Teesta, Upper Ganga, Ghaghra, Gomati, Rapti and Sharada, Upper Yamuna and Sahibi, Lower Ganga, Kosi, Baghmati, Gandak, Burhi Gandak and Sone respectively. This unit is mainly engaged in developing Quantitative Precipitation Forecast (QPF) model using different dynamical models for river basins during flood season.



FMO's in India

Accuracy of QPF

The accuracy of QPF varies between 49-91% in all 10 FMO's. During 2011 out of 15495 QPF issued, 10863 were found correct. Over and under estimated QPF were 3992 and 683, out by one stage and out by more than two stages respectably. Therefore QPF realized correct as 70%, 25.7% were out by one stage and 4.3% were out by two stages.

Research & Development Unit

A Memorandum of Understanding (MOU) is signed between Central Water Commission (CWC) and India Meteorological Department (IMD) on 5th April, 2011 for Meteorological data sharing under National Water Mission for the study of Climate Change point of view.
Hydrological Section at O/o ADGM(R), Pune has prepared new rainfall normals for the period 1951-2000 are prepared for 641 districts to replace the old Normal based on the period 1941-90.

So far there is no long period district rainfall series available at India Meteorological Department. New monthly rainfall series for 641 Districts for the period 1901-2009 has been prepared. Subsequently monthly rainfall series for the 36 sub-divisions are worked out from the district series by district area weighted method and also all India rainfall series from the sub-division series.

4.2. Agrometeorological Services

IMD in active collaboration with Indian Council of Agricultural Research (ICAR), State Agriculture Universities (SAUs) and state Agriculture Departments is rendering Integrated Agromet Services through a network of 130 Agromet Field Units (AMFUs) co-located with SAUs, ICAR Centre and IITs, covering all 127 Agro-climatic zones in the country.

Agrimet Division, Pune

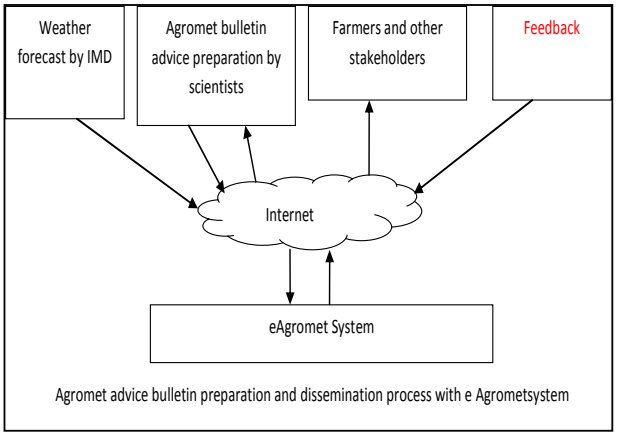
The prime mandate of Agricultural Meteorology Division, India Meteorological Department (IMD), Pune is to minimize the impact of adverse weather on crops and to make use of crop-weather relationships to boost agricultural production. This division caters to the needs of agriculturists and conducts research and developmental programme in the field of agricultural meteorologyIn order to strengthen these services, the major activities performed by the Division during 2011-12 were issuing of agromet advisory services, technical support to observatories, R & D activities in crop weather studies, capacity building, dissemination of agromet advisories through multi-purpose dissemination channels etc. Besides, this Division acts an apex body for issuance of agromet advisory at district, state and national level.

This division implements Integrated Agromet Advisory Services for providing Agromet Advisory Bulletin to the farming community and Crop Yield Forecast to Planners and Govt. managers in Ministry of Agriculture and other

stake holders under FASAL Scheme, a joint project of IEG, ISRO, IMD and Ministry of Agriculture. The following are the milestones achieved during FY 2011-12 along with the future targets to achieve under extended Agromet Advisory Services renamed as 'Gramin Krishi Mausam Sewa (GKMS). During 2011-12, this Division carried out the following important activities.

Agromet Advisory Service (AAS) Bulletins

District Level Agromet Advisory Service (AAS) Bulletins are issued by Agromet Field Units (AMFUs) located at State Agricultural Universities, ICAR institutes and IITs in different parts of country and it includes crop specific advisories for field crops, horticultural crops and livestock. At present these bulletins are issued for 581 districts of the country. State Level AAS Bulletins were prepared at SAMCs and National AAS Bulletins have been been prepared by the Division of Agriculture Meteorology, IMD, Pune.



Agromet advice bulletin preparation and dissemination process with e Agrometsystem

Dissemination of Agromet Advisories

Under the project Integrated Agromet Advisory Service (IAAS), agromet advisories are being disseminated to the farming community in through mass media (Print and electronic), web based and through SMS and Interactive Voice Response Technology (IVR). Under the SMS system an information platform has been created which allows the existing 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. At present 3.3 million farmers have been benefited by this service and receive Agromet Advisory Bulletin through SMS on their mobile phones from AMFUs. This service is provided through public private partnership (PPP) mode by roping in disseminating agencies viz. IFFCO (IKSL), Nokia, Hyandygo and RML. IMD has planned to reach to 10 million farmers during XII Five Year Plan. It is proposed to include more number of private agencies /companies for the dissemination of agromet advisories to different stake holders.

New Interactive Website

A new interactive website was launched to provide required information on AAS. Main features of website consists of value added medium range weather forecast for all districts, Severe Weather Warnings, District, State & National level AAS bulletins on real time basis twice a week, Bulletins in English and Local languages and 12 different languages namely English, Hindi, Marathi, Tamil, Manipuri, Nepali, Punjabi, Gujarathi, Assamese, users. Alerts/warnings, FAQ, SMS, Feedback. Oriya, Kannada and Malayalam and circulated among the users.

Training in Agricultural Meteorology

Agromet Core Course, 3-Week, Agromet Observers' Course, Basic Agromet Course, training course on Agrometeorology towards better advisories for serving end users requirement was conducted in this year. With regard to develop Agromet models under FASAL scheme. Training was imparted to SRFs and Technical Officers on crop simulation modeling on DSSAT, infor crop and statistical model for crop yield forecasting for planners and decision during 2011-12.

Existing projects

Proposed projects

Pilot Project on Block Level Weather Forecast & Agromet Advisory

Watershed Organization Trust (WOTR)

IMD has started providing local specific short range weather predictions for Sangamner and Akole clusters (WOTR's operational area) of Ahmednagar district from April 2012. The weather predictions are used by WOTR to prepare agro advisories. WOTR's agriculture team prepares agro advisory according to the conditions of the major crops standing in the field. The advisory is in the form of wall paper. WOTR's field agronomists share it with the farming community at 5-6 locations in every village.

International Water Management Institution (IWMI) for establishing Climate Smart Villages in pilot districts of Punjab and Bihar Considering the common interest of IMD and International water Management Institution (IWMI),a pilot project is initiatedjointly by IMD and the Consultative Group on International Agricultural Research (CGIAR) under the Research Program on Climate Change, Agriculture and Food Security (CCAFS) to develop block level advisories for selected districts in Punjab and Bihar.

AMFUs located at SAUs, ICAR centres and IITs with active support from IMD are provided the forecast based crop advisory to the farmers at district level successfully during 11th Five Year Plan. IFFCO Kisan Sanchar Limited (IKSL) and few other private organizations are supporting in outreach of bulletins/information to farmers through SMS on their mobile.

In its initial phase, villages selected for the project in two states are:

Bihar - Vaishali dist.

1. Raja Pakar, Block Raja Pakar
2. Bali Bathna, Block Mahua
3. Lal Pokhar, Block Hazipur

Punjab – Sangrur dist.

1. Kheri, Block Sangrur
2. Gaggarpur, Block Sangrur
3. Chaneri, Block Bhawanigarh

e Agromet: An IT-based Agro-meteorological Advisory System

a. The prototype is built by considering rice and cotton crops and weather situations of north Telangana and south Telangana agro-climatic zones. The agromet experts have prepared the agromet advices using the prototype. The overall feeling by agromet experts is very positive. The system is very easy to use and can be deployed in any region. They can enter the agromet advisories without any difficulty. The system is able to display the similar agromet advisories.

As a part of future work, efforts will be made to refine the system by considering more crops and livestock in different agro-climatic regions. It is anticipated that, for a given crop and region, after entering agromet advisories for a few years, the effort to prepare new agromet bulletin could be reduced significantly due to efficient search. It is possible to develop a system to generate automated agromet advisories for a given crop with minimum human intervention.

b. Soil Moisture estimation project using fusion technique in collaboration with IIT Roorkee using RADARSAT and satellite data. A Technology is being developed by IIT Roorkee for estimation of soil moisture maps of the piloted region. Two persons from Agrimet Div. Pune got training for this technology to make it operational in IMD for its use in preparation of Agromet Advisory Bulletin.

c. Determination of Soil Moisture over India Using Space Borne Passive Microwave Sensors onboard SMOS. International Centre for Radio Science (ICRS) Jodhpur Rajasthan is developing soil moisture technology using Space Borne Passive Microwave Sensors onboard SMOS and technique is being developed for estimation of soil moisture maps of the country.

Technical assistance to agromet observatories

Officers of the Division inspected 100 Agromet, 20 Evapotranspiration (ET) and 3 Soil Moisture

Observatories (SMO) observatories. Installation of instruments or regular visit was undertaken during the year. Overhauling / servicing of lysimeters at 11 ET (10 Gravimetric and 1 volumetric) stations have been made Action is in process for replacement of lysimeter at AET Ludhiana, AET Dharwad, AET. Dew gauge sets have been procured and supplied to 32 departmental Dew recording stations. Met instruments were supplied to AMFU Sindewahi., Igatpuri, Pantnagar and PET Nellore have been carried out.

Farmers' Awareness Programme:

During this year 34 AMFUs namely Bhairaich, Bhatinda, Jharnapani, Modipuram, Allahabad, Ambikapur, Anand, Bikaner, Bhawanipatna, Darisai, Dumka, Ranchi, Jagdalpur, Ambalavayal, Naganahalli, Sehore, Seobagh, Ranichauri, Kolasib, Bidar, Kumarakom, Naveli, Pillicode, Gossaigaon, Sabour, Sindewahi, Sriganganagar, Kalimpong, Dharwad, Pundibari, Targhadia, Junagadh, Raichur and Ooty have organized such programmes. So far such meetings have been organized at 94 locations in the country under the IAAS project.

Agromet Brochure

Agromet Brochure (multi-lingual) highlighting the activities of the Agrimet Division particularly different areas of Integrated Agromet Advisory Services launched by IMD/Ministry of Earth Sciences (MoES) for the benefit of the Indian farmers. For general awareness and easier access to the services of IMD, the brochures in 14 different languages were circulated to the concerned organizations/institutes and all other organization directly and indirectly related to the agricultural services in the country.

Annual Review Meeting on Agromet Advisory Service

Through the joint collaborative effortsof all stake holders agromet advisories wereprepared as per the requirements of the farmers and self-styled mechanism would be developed for dissemination of advisories on real time and ultimately these services would greatly contribute higher productivity and production of crops and in turn improve the economic condition of the farmers of the country.

Meteorological Centres and Annual Review Meeting of IAAS was conducted at Lambuchera Agartala to discuss the achievements and shortcomings of Agromet System and formed IMD strategy toimprove this service.

Forecasting Agricultural Output Using Space, Agrometeorology and Land Based Observations (FASAL)

Under FASAL project crop yield forecasting is being developed by both statistical and crop growth simulation models. First crop yield forecast (kg/ha) (F3) for 17 states and eight major crops (rice, groundnut, maize, jute, ragi, bajra, cotton and sorghum) in 150 districts the country has been prepared during kharif season 2011 Second crop yield forecast (kg/ha) (F3) for 17 states and 9 major crops (rice, groundnut, maize, jute, ragi, bajra, cotton, sorghum and sugarcane) in 239 districts in the country has been prepared during kharif season 2011.

The crop yield forecasts will be provided by IMD at different stages of the growth period, viz., mid-season yield forecast (F2) and pre-harvest yield forecast (F3) using agromet model with crop area estimation by SAC. Both these informations are communicated to DAC for final forecast of crops before harvest. In addition, Training on 'Use of Crop Simulation Models for Yield forecasting' under FASAL Project was organized during 17-28 January 2011 at TTC, IMD New Delhi for 14 SRFs. In order to develop capacity building in modeling for crop yield forecast for all the SRFs at RMCs/MCs and AMFUs, the training programmes have been organized on "Crop Yield Forecasting using statistical and crop simulation models" in two batches from 24-30 August 2011 and 08-14 September 2011 at IMD, Pune also.

Centre for Research and Excellence in Agrometeorology (CREAM)

To establish Centre for Research and Excellence in Agrometeorology (CREAM) in IMD with its counterpart at National Institute of Abiotic Stress Management (NIAM), Deemed University, Indian Council of Agricultural Research, Baramati, Malegaon, Maharashtra which will primarily look after the application of R & D in agrometeorology in operational agrometeorological services rendered by IMD.

Objectives of CREAM

(i) To help farmers to cope with climate risks and uncertainties and to help reduce the vulnerability of agro ecosystems to climate variability and change

(ii) To quantify greenhouse gas emissions from agriculture sector, form its reduction mechanism and to help achieve greater efficiency in natural resource use in agriculture sector.

(iii) To help Ministry of Agriculture in implementation of Weather Based Crop Insurance Scheme and to develop weather indices for crop insurance in collaboration with ICAR and other public and private stake holders.
(iv) To work for integration of total AWS network of different Public and private stake holders in the country under National umbrella.

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Future Plans

- At present weather forecast and agromet advisories are developed at district level. Efforts would be made to development of precise and accurate weather forecast at block level in addition to extended range weather forecast at fortnight, month and seasonal scale for its application in agriculture.

- To establish district level Agromet Field unit (DAMU) in each district to prepare block level Agromet Advisory bulletin with dissemination up to village level.

- Agromet advisories for new sectors like horticultural crops, livestock and wasteland and forest fires, postharvest would be initiated.

- Emphasis will be given for the development of a mechanism by which a farmer should be able to contact with the agricultural scientist through internet, telephone, video conference etc. and to get agro meteorological advice on his specific problem.

- Tie up will be made with the existing crop growers associations for high value crops like tea, coffee, apple, mango, sugarcane, cotton etc. to develop suitable crop-specific advisories and also to build up a mechanism to disseminate the information to the targeted growers.

- Appropriate training will be provided to farmers through capsule courses and also Extensive training for farmers will be provided through State Agricultural University/State Department of Agriculture with active support from IMD.

- Dissemination of the advisories will be done using multi-channel systems like Common Service Centre of Department of Information Technology, Virtual Academy / Virtual Universities / NGOs, Kisan Call Centres /KisanMelas/ KrishiVigyan Kendra (KVK) / ICAR and other related Institutes / Agricultural Universities/ Extension network of State / Central Agriculture Department, Ministry of Panchyati Raj etc.

4.3. 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, 13 Aerodrome Meteorological Offices and 53 Aerodrome Meteorological Stations located at the different airports in the country. A Tropical Cyclone Advisory Centre (TCAC) is also functioning at NWFC, 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. Around 259558 scheduled and non-scheduled flights were briefed through IMD's OLBS and through manual during the report period. 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.

Procurement process for IAAMS for forty six more airports is under process. IMD started receiving aircraft observed meteorological data (AMDAR) from Lufthansa Aircrafts visiting Indian airports w.e.f. 1st October 2010 under an agreement with European AMDAR panel. For improving the methods and resolution of observations at

airports, digital instruments have been installed. In order to promote the indigenous capabilities two instruments for assessing runway visual range developed by National Aeronautical Lab (NAL), Bangalore, in collaboration with IMD were tested and commissioned at IGI Airport, New Delhi.

MWOs, AMOs, and AMSs, in India

Creation of a New Division

In order to focus more on this important service of IMD, the aviation met organisation was reorganised leading to the creation of a new division, namely, Central Aviation Meteorological Division (CAMD) on 27 April 2011, at DGM, New Delhi. The aviation section which was functioning in O/o DDGM (WF), Pune was transferred and merged with CAMD for better centralized coordination of overall aviation meteorological services Subsequently, Shri. M.K Bhatnagar, Scientist F was designated as DDGM (Aviation Services). Consequent to the adoption of Amendment 75 to ICAO Annex-3, implementation of a Quality Management System in the service became mandatory. Efforts are on to implement QMS in IMD's Aviation Met service provision. Obtaining an ISO certification for the QMS is also contemplated and hiring a consultant for assisting IMD for the job is in process. In order to get further insight about implementing QMS, Implementation of QMS requires updation and creation of documents related to the service provision. The main document "Manual on Meteorological Services for Aviation India" is updated. All other documents are in various stages of updation or preparation.

4.4. Cyclone Warning Services

Cyclonic Disturbances

The north Indian Ocean witnessed the formation of seven cyclonic disturbances during the period 1 January to 15 November 2011 including one in winter, three in monsoon and three in post monsoon season. Comparing the Bay of Bengal and Arabian Sea, there were four and three disturbances over these basins respectively. Also there was a land depression during the monsoon season. Considering the intensity of the disturbances, only one cyclonic storm has formed so far against the normal of five. The cyclonic storm (KEILA) developed over the Arabian Sea during 29 October to 4 November and dissipated over west central Arabian Sea off Oman coast. The Bay of Bengal has been more inactive compared to Arabian Sea, as out of eight disturbances, only four developed over the Bay of Bengal and 3 in Arabian Sea. No cyclonic storm formed over the Bay of Bengal.

Activities during the year

- The Benchmarking of Weather Forecasting especially for severe weather events has been made as per the requirement of national disaster Management Authority.
- The manuscript on Standard Operation Procedure for High Impact Weather Events have been prepared.
- With the cooperation of WMO and Japan Meteorological Agency, IMD has introduced Ensemble Prediction System (EPS for track prediction of cyclonic disturbances over the North Indian Ocean. It has now the capability to predict the strike probability of cyclones and also the location specific probability.
- For the purpose of introducing the synthetic vortex in the NWP model analysis, IMD introduced a Cyclone Bulletin containing the vital parameters of the cyclonic disturbances from the deep depression stage so that the model prediction can be improved. It was provided to various users through GTS and also to national NWP centres like NCMRWF, IMD (NWP), and IIT Delhi etc through e-mail.
- Graphical Tropical Cyclone Advisory Centre (TCAC) advisory bulletin is being prepared as per the requirement of ICAO since 2011.

- User's workshop has been conducted during the year at Nagpur and Bhubaneswar.

Forecast Demonstration Project (FDP) on land falling cyclones over the Bay of Bengal

An FDP on landfalling tropical cyclones over the Bay of Bengal has been taken up. Its main objective is to minimise the error in prediction of tropical cyclone track and intensity forecasts, at least 48 hrs in advance. The programme has been divided into three phases

(i) Pre-pilot phase : 15 Oct - 30 Nov, 2008 and 2009

(ii) Pilot phase : 15 Oct - 30 Nov, 2010, 2011

(iii) Final phase : 15 Oct - 30 Nov, 2012

Like last year, the pre-pilot phase was conducted during 15 Oct - 30 Nov, 2011**.** Several national institutions participated for joint observational, communicational and NWP activities.

Cyclone hazard prone districts of India based on (i) frequency of total cyclones, (ii) total severe cyclones, (iii) actual/estimated maximum wind, (iv) PMSS associated with the cyclones and (v) PMP for all districts. The BMTPC, based on Hazard Vulnerability of India identified cyclone prone districts of India taking into consideration cyclone hazards of the coastal districts. These districts are also listed in cyclone guidelines published by NDMA. These lists have included some inland districts of a few states in northeast India which do not experience full impact of cyclone. Also, while preparing such list it appears that no weight was given for the number as well as intensity of cyclones crossing coast. Considering all the above, sub-committee constituted by NDMA subsequently suggested to prepare the first draft by Dr. G.S. Mandal, Specialist, NDMA and Dr. M. Mohapatra, Director, Cyclone Warning Division IMD New Delhi to be considered by the sub-committee. A report on cyclone hazard prone districts of India has been prepared and sent to the sub-committee for consideration. An attempt has been made to prepare a list of cyclone hazard prone districts by adopting hazard criteria.

4.5. Satellite Applications

Installation of Metop/Noaa/Modis Polar Orbiting Ground Receiving and Processing Systems

Ground receiving and processing systems from Metop/NOAA/MODIS

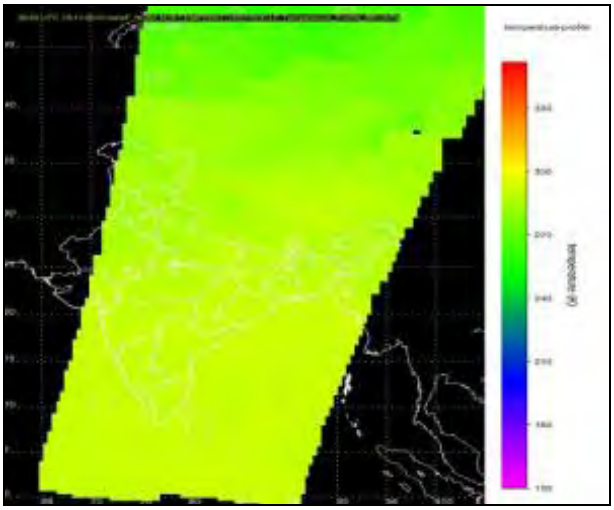
Three Ground receiving and processing systems for NOAA/METOP and MODIS Polar orbiting satellites were installed and made operational at IMD New Delhi, RMC Chennai and RMC Guwahati on 4th September 2010, 27th September 2010 and 21st November 2010 respectively. The system was declared commissioned at all the three stations on 3rd June 2011. Satellite Meteorological products (listed below) derived from these systems are useful in operational forecasting.

Geophysical Products

Geophysical Products derived from NOAA satellites

Atmospheric temperature profile, Atmospheric water vapour profile, Surface emissivity, Surface Temperature, Fractional cloud cover, Cloud Top Temperature, Cloud Top Pressure, Tropopause height, Cloud Liquid Water Content, Total Column Precipitable Water, Cloud Type (including Fog), Total Ozone from GOME, Total Ozone from HIRS, Ozone Profiles, Land Surface Temperature, Sea Surface Temperature, Normalized Difference Vegetation Index (NDVI), Day/Night time Fog detection.

. NOAA/MODIS/METOP Polar orbiting ground receiving and processing system



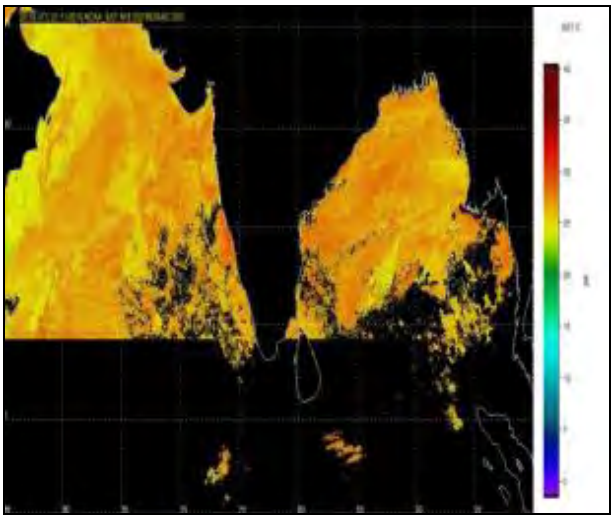
Atmospheric temperature profile

Geophysical Products derived from MODIS

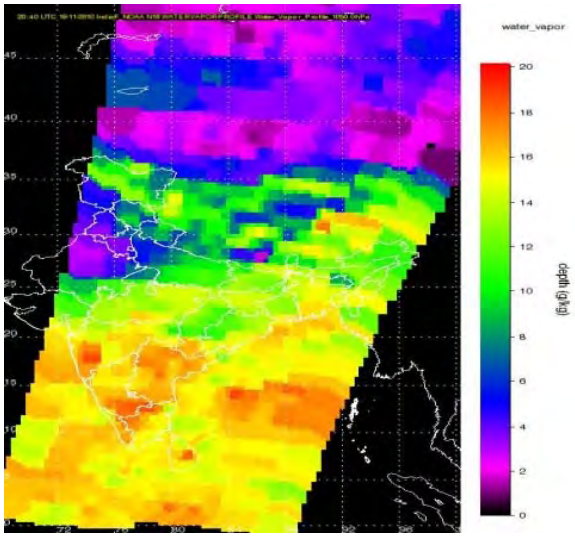
MODIS Level 2 geophysical products (Terra and Aqua), MODIS cloud mask (MOD35), MODIS cloud top properties (MOD06CT), MODIS atmospheric profiles, precipitable water and stability indices (MOD07), MODIS aerosol product (MOD04), MODIS Sea Surface Temperatures (IMAPP product), MODIS Near Infrared Water Vapor product (IMAPP product), Normalized Difference Vegetation Index (NDVI), Enhance Vegetation Index (EVI), Land Surface Temperature (LST).

The Images of some of the satellite products are illustrated below.

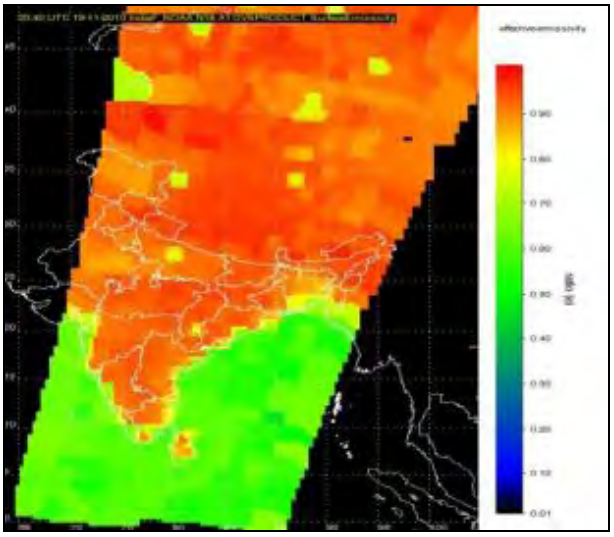
NOAA vertical sounding data are extracted from TOVS and AVHRR data. After data processing for navigation and calibration, a vertical profile of temperature and water vapor is retrieved. These profiles can be utilized in Numerical Weather Prediction (NWP). The NOAA product derives atmospheric temperatures and moisture at 42 pressure levels (0.1, 0.2, 0.5, 1, 1.5, 2, 3, 4, 5, 7, 10, 15, 20, 25, 30, 50, 60, 70, 85, 100, 115, 135, 150, 200, 250, 300, 350, 400, 430, 475, 500, 570, 620, 670, 700, 780, 850, 920, 950, 1000, 1025 and 1050 hPa).



Sea Surface Temperature



Atmospheric Moisture profile

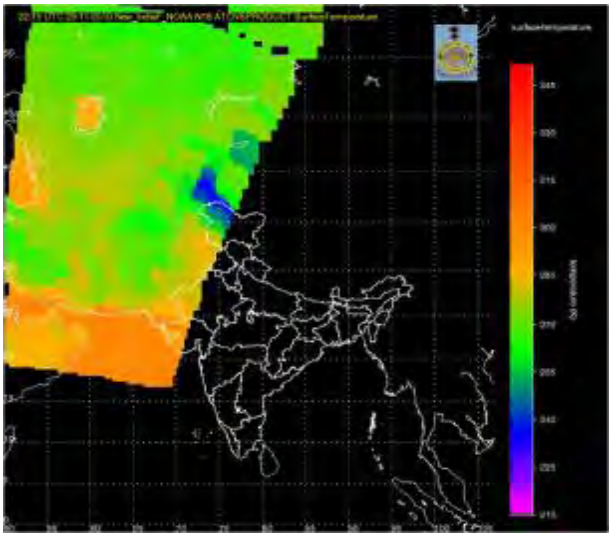


Surface Temperature

Surface Emissivity

Land surface temperature can be determined applying the split-window technique to the AVHRR channels 4 and 5. However, for this purpose the knowledge of land surface emissivity in the AVHRR channels 4 and 5 is essential.

Surface Temperature is derived from 5 km pixels resolution, channels used are derived from Level-1b emissive channels, physical values are from 150 to 350k. It is used for the study of Snowstorms, indication of climate conditions and the input to other level-2+ products.



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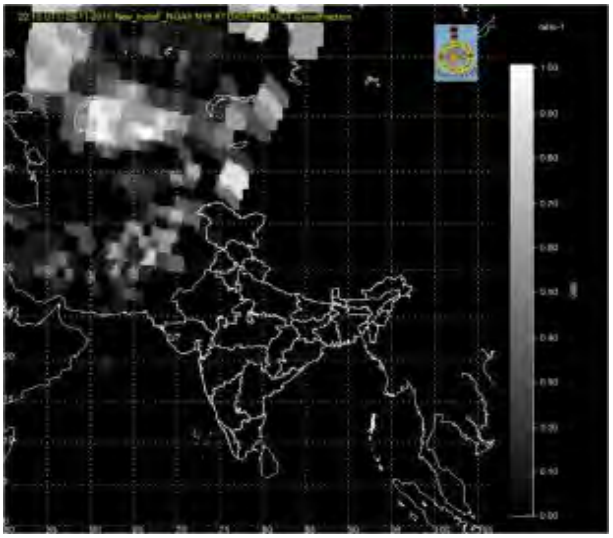


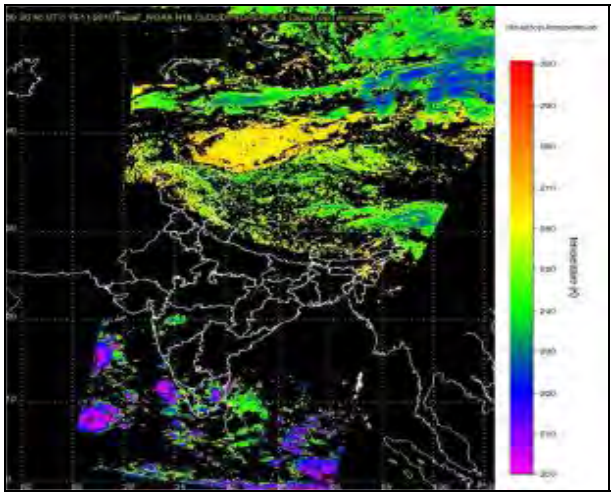
Fractional cloud cover

Fractional cloud cover

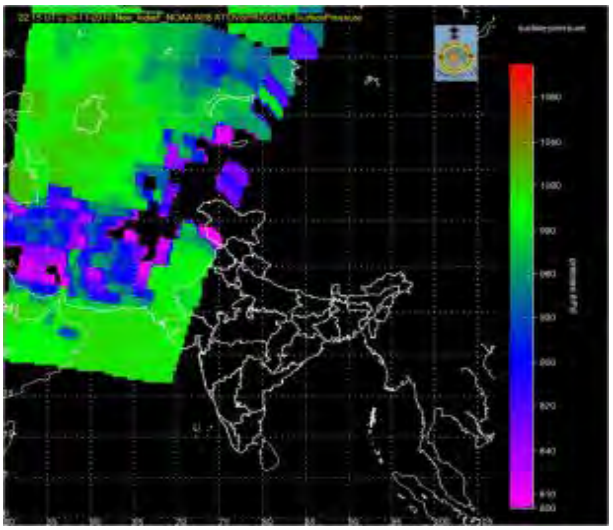
Cloud cover also known as cloudiness, cloudage or cloud amount refers to the fraction of the sky obscured by clouds when observed from a particular location. It can be used for Indicative of climate conditions, further investigations of phase and pollution, Radiative Transfer Model, Earth Radiation Budget, Air Quality (fog), and Climate Change.

Cloud Top Temperature

Cloud top temperature and cloud phase, derived from NOAA AVHRR measurements Surface Pressure is derived from 5 km pixels resolution; channels used are



Cloud Top Temperature



Surface Pressure

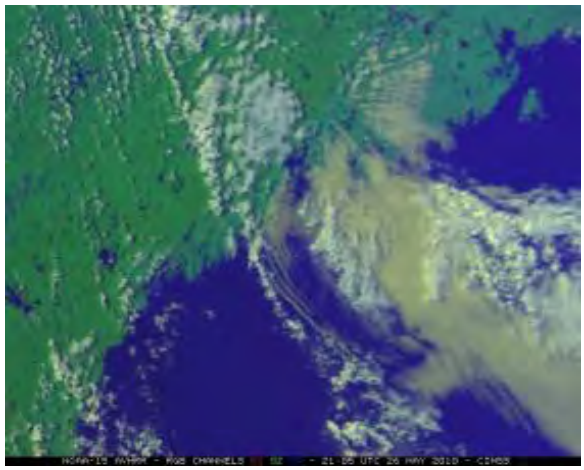
derived from GDAS1 datasets, physical values are from 800 to 1100 hPa.

A primary Source of surface pressure Meteorological data is National Center of Environmental Prediction (NCEP) Global Data Assimilation System (GDAS) where the surface pressure parameter is produced at a spatial resolution of 1 × 1 degree every 6 hours. It is also used for the indication of climate conditions.

Normalized Difference Vegetation Index (NDVI)

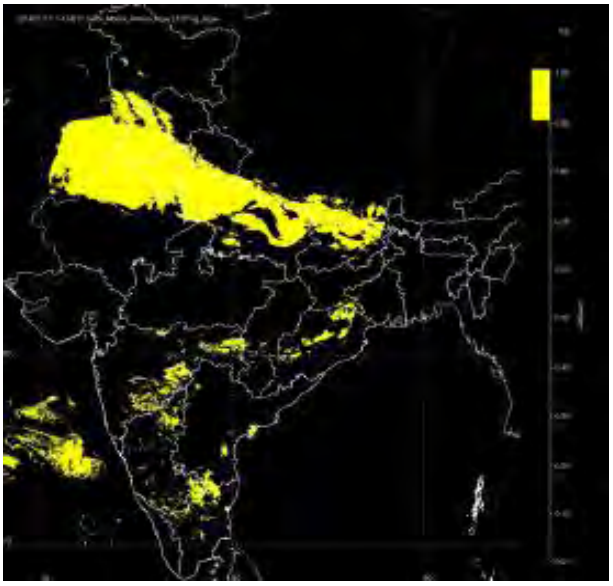
A vegetation index is a quantitative measure used to measure biomass or vegetative vigor, usually formed from combinations of several spectral bands, whose values are added, divided, or multiplied in order to yield a single value that indicates the amount or vigor of vegetation. The simplest form of vegetation index is a ratio between near infrared and red reflectance. For healthy living vegetation, this ratio will be high due to the inverse relationship between vegetation brightness in the red and infrared regions of the spectrum.

Vegetation Index (MOD13A1) is a multiple-observation, tiled product derived from atmospherically corrected surface reflectance intermediate product data at 250m per pixel resolution. The product name in the SATRAX-MODISapps system is VEGINDEX. Vegetation Index is based closely on the concepts in NDVI (bands 6 and 7). The VEGINDEX product has two datasets which can be rendered as PIC: NDVI. This is close to the traditional (e.g. NOAA/Landsat) Normalised Differential Vegetation Index but it uses the maximum surface reflectance values from the MOD09G tiles available.



Night Time Fog

Fog detection



Night Time Fog

The detection and short range forecasting of fog and low stratus clouds at night pose much difficulty to aviation and marine meteorologists. The number of surface-observing sites over land and ocean is not sufficient to determine the true areal extent of fog. Because of the low density of these surface observations, remote-sensing techniques must be used to determine the areal extent of fog and low stratus especially at night.

A new technique for the detection of fog at night was devised by taking the difference of either two infrared channels, channel 3 (3.7 μm) and channel 4 (11 μm) of the National Oceanic and Atmospheric Administration

(NOAA) Advanced Very High Resolution Radiometer (AVHRR) or of channels 20 and 31 of MODIS payloads. It has been widely used by forecasting weather in aviation especially in December and January months of 2011 when Northwest India has frequent and large spatial fog.

Accuracy and validation of satellite derived parameters:

All products on INSAT are derived by the algorithms supplied by ISRO as per the MOU of the system. The improvement of the products is a continuous process by interaction of IMD officers and ISRO scientists. The source code of all algorithms is with ISRO only (as per the contract). The following figures are the values of accuracies and validation:

Outgoing Long wave radiation : Accuracy : 3%

Validation with NOAA OLR : 5-8 Watt /meters square

Cloud Top Temperature : Accuracy : 0.3 K as per ISRO document

Temperature Profile from NOAA satellite:

Surface to 100 hPa (average for all levels) : within 2 to 3.5 deg Celcius validated against GPS sonde over New Delhi. Humidity Profile from NOAA Satellite: Surface to 300 hPa (average for all levels): within 2 to 3.8 gm/kg validated against GPS sonde over New Delhi.

Sea Surface Temperature (INSAT) : 3 Deg K

Atmospheric Motion Vector : Validation done as per CGMS guidelines against radiosonde data for August 2011

Cloud Motion Vector:

RMSE : 11.3131, 10.42763 and 8.287358 metres /second for low level (950-701 hPa), medium level (700-301 hPa) and high levels (300-100 hPa).

Bias : -3.35177, -4.56909 and -0.71233 m/s for low level, medium level and high levels.

Number of winds compared:

Low level : 44

Medium level : 177

High level : 196

Water Vapour winds:

RMSE : 10.10393 for 15.49976 m/s for medium (500-251 hPa) and high levels (250-100 hPa).

Bias : -2.59383 and -3.26352 m/s for medium and high levels

Number of winds compared:

Medium level : 100

High level : 316

Night Time Fog:

The method for night time fog was devised by Sat. Met. Division by subtracting the data of two channels of NOAA (channel 4 -3B) or MODIS (channel 20-31) and has been successfully implemented. The similar method of detecting fog is operational in other countries .The following validation was done over Delhi by taking 18 cases in January 2011.

Success : 93.75 % and

Failure : 6.25 %

The satellite cannot distinguish between mist and fog. The progress is on for generating a look up table to generate gradation in fog. Validation for this year is in progress. This product is generated by the newly installed NOAA/Metop/MODIS satellite receiving system.

4.6. Marine Meteorological Services

The Fourth Congress of WMO in 1963 apportioned the responsibilities of collecting and processing the meteorological observations to the eight responsible member countries. India is one among the 8 responsible

members of the Marine Climatological Summaries Scheme (MCSS) with the responsibility of the Indian Ocean area north of 15°S bounded by the longitudes of 20°E and 100°E. India Meteorological Department (IMD) carries out the responsibility. Marine Climatology Section (MCS) was established in IMD in 1971

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.

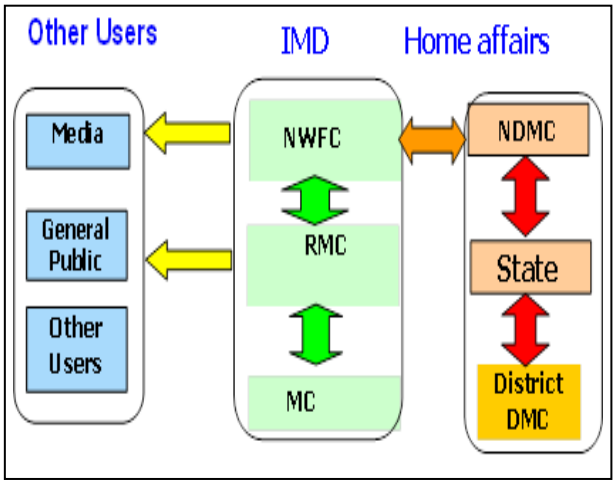
Excellent Award in the form of books and Certificate of Merit for meritorious meteorological work, were given to the ships' officers, who were involved in collecting routine as well as valuable Meteorological information from High Sea.

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.

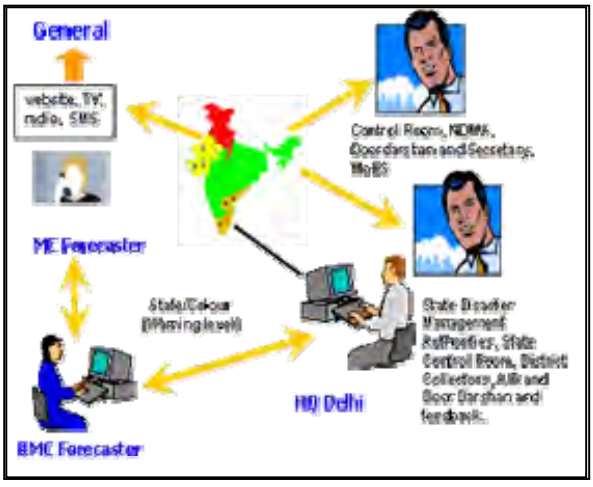
Meteorological observations are being recorded and transmitted by the Voluntary Observing Ships (VOS) on real time basis as well as in delayed mode.

4.7. Public Weather Services

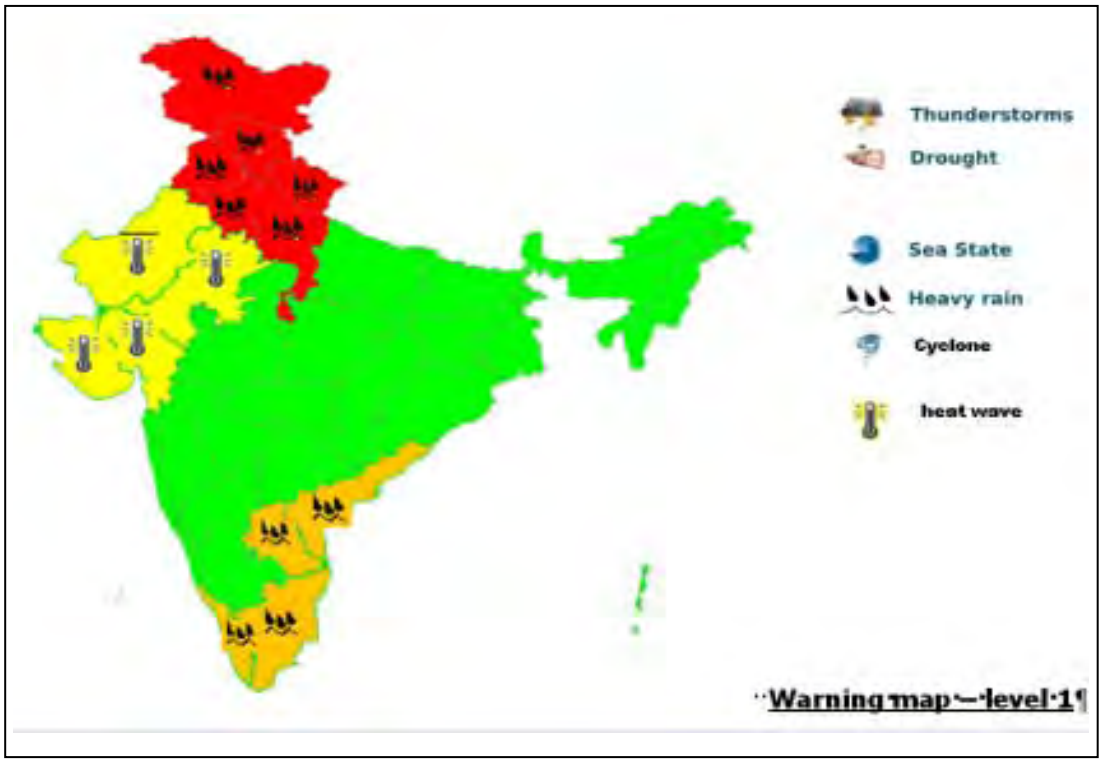
Public Weather Services (PWS) is one of the most vital components of National Weather Forecasting services of IMD. It has the capability to generate weather forecast and warnings in the form of easily usable products (Digital, text and graphical format). The customized weather report and products are auto designed, generated and disseminated to various specialized users and general public. The system has the capability to disseminate the products on real time basis through various means of communication including SMS, Fax, email, FTP etc. Modernization of PWS has helped in reducing the time gap between observation, forecast generation and product dissemination.



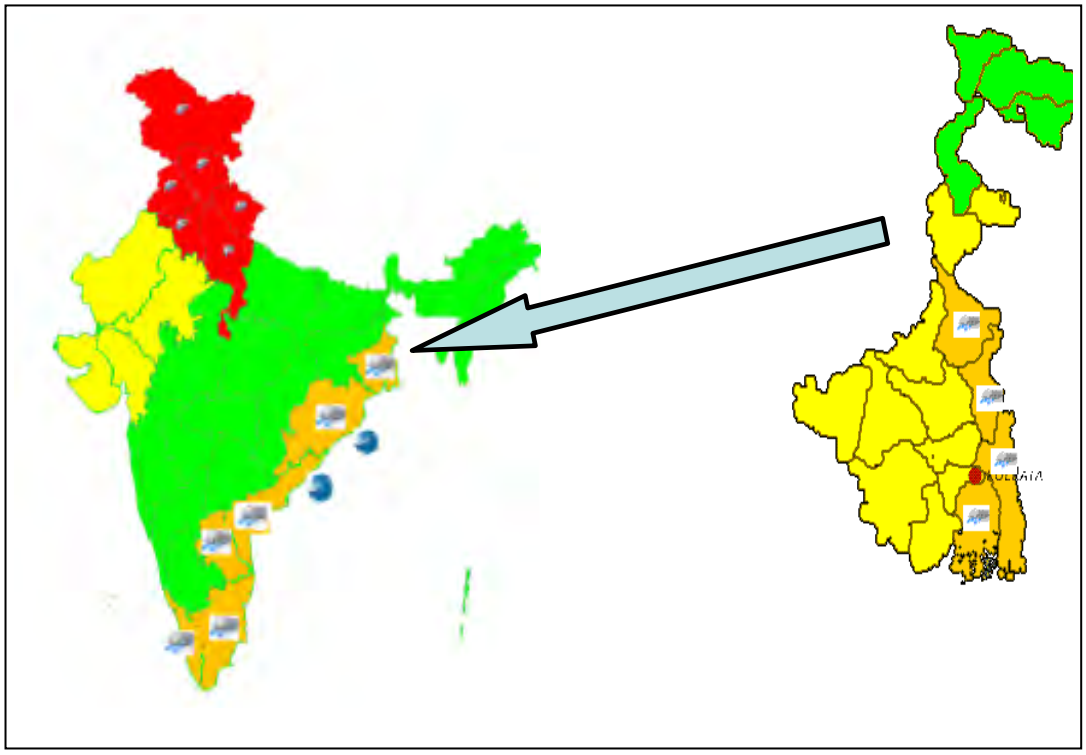
Organisation of Public Weather System



Basic functions of PWS



Ingests meteorological raw data



Produces automatically tailored products & services

Multi-hazard warning system

This service enables generation of systematic Warning Maps for high impact weather events. It is important to determine threshold/criteria for defining various high impact weather events. Four level alerts /colour code (green, yellow, orange and red) is followed to indicate the level of warning. It requires coordination between IMD, Disaster managers, media and other stake holders including public.

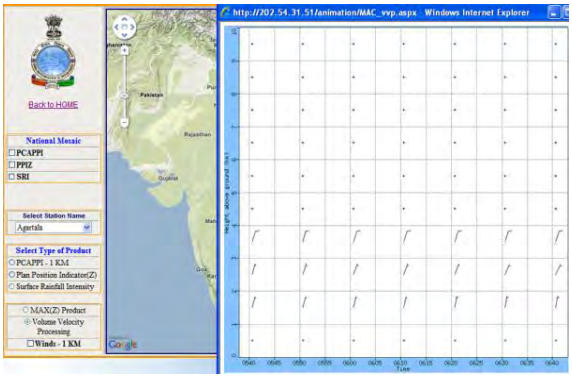
4.8. Web-GIS Application for Radar Products

Radar products form a very important guiding tool for improving our Nowcasting System. NWP and Radar Division recently developed a display system for the Radar products. IMD has a network of 12 DWR stations.

The raw data (Z, w & v) is received at the IRIS central server stationed at ISSD, New-Delhi. This data is then processed and reflectivity based products (PPI, PCAPPI and Surface Rainfall intensity) is produced.

PCAPPI along with Radar winds at 1 kms for Kolkatta.

This data is converted into png images, geo referenced and then put on Google maps using Java scripting. The real time data generates following products Plan Position Indicator (Z), Volume Velocity Processing, Surface Rainfall intensity and MAX (Z) Products Radar Winds at 1 kms is put in online mode.

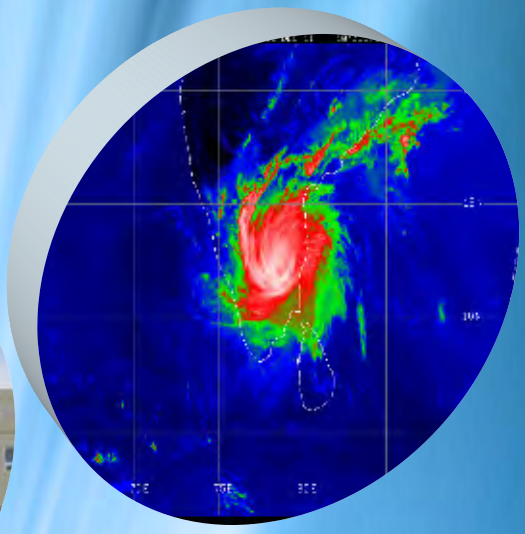


Wind profile

PCAPPI along with Radar winds at 1 kms for Kolkatta

The above data is available as a Mosaic for all the 12 stations for PPI, PC APPI and SRI. The information on the individual station is also made available on choosing the products. The data is put on the Google maps (using API key) with the facility to zoom and transparency - settings controlled by the user.

DIVISIONAL ACTIVITIES



5

PUBLICATION, LIBRARY & INFORMATION SERVICES

POSITIONAL ASTRONOMY CENTRE

ANTARCTIC & PROJECT EVALUATION CELL

NATIONAL DATA CENTRE (NDC)

ENVIRONMENT MONITORING AND RESEARCH

MONITORING OF AIR POLLUTION

5. Divisional Activities

5.1. Publication, Library & Information Services

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 & Geophysics. The four issues appear in January, April, July & October every year. All the four quarterly issues of MAUSAM for the year 2011 have been brought out. The impact factor (IF) of Mausam has improved from 0.110 (2010) to 0.170 during the year 2011.

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 value 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 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) per paper.

On the recommendation of the Judging Committee, the 25th MAUSAM Award has been conferred upon Dr. M. Mohapatra, Mr. H. R. Biswas and Mr. G. K. Sawaisarje for their research paper entitled, "Daily summer monsoon rainfall over northeast India due to synoptic scale systems" which was published in the January 2008 (Vol. 59, No.1) issue of MAUSAM.

In this paper the authors have studied the rainfall data over 50 uniformly distributed stations in northeast India during summer monsoon season (June-September) for a period of 10 years (1991-2000) with an objective to find out the contribution of the different synoptic systems - Low Pressure Systems (LPS) and cyclonic circulations (CYCIR) extending up to lower/middle troposphere levels over different regions - to the spatial variability of monsoon rainfall over northeast India. They have identified the regions of excess/deficient rainfall and active/weak monsoon conditions due to different synoptic systems. Also, they have developed synoptic analog maps which may be useful to the forecasters for 24 hours rainfall forecast with the knowledge of location, intensity and movement of the synoptic systems.

IMD News

IMD has started publishing a quarterly Newsletter "IMD NEWS" highlighting the activities from January 2008 onwards. During 2011 all the four issues of quarterly newsletter "IMD NEWS" have been brought out in time.

Library &Information Services

Library Services

During the year 50 foreign and 25 Indian journals were subscribed. Also 14 newspapers in English & Hindi & 12 magazine were subscribed during the year. A total of 226 books in Hindi & English (168+58) were purchased during the year. During the year 2011, 340 books were issued to the Library members and 2500 visitors visited the library. About 1000 foreign / Indian issues of journals were added and Xerox facility was provided to 24 parties for their scientific research work. The Computerization of library books was completed and the report on physical verification of library books was generated through computer. Online access to 17 foreign journals was provided to the scientists of the department for the officials/research work. Total 508 volumes of journals were got bound.

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.Qrs. Significant Number of journals (Foreign and Indian) are subscribed in this library. Some journals (Foreign and Indian) are received on exchange basis. The library also maintains stock of copies of departmental publications brought out in-house and serves as sale / supply counter for these publications. Library unit prepared Non-plan estimates for "Annual Statement of publications".

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

5.2. Positional Astronomy Centre

With a view to developing astronomical and astrophysical studies in India as envisaged by the planning committee constituted by the Govt. of India in 1945, a small unit, known as Nautical Almanac Unit, was set up under CSIR at calcutta. Although the Govt. of India used Gregorian calendar for official use, divergent practices of calendar keeping were in vogue during the period of post independence of the country. A need was felt by the then Prime Minister, Late Pt. Jawaharlal Nehru to develop a unified National Calendar on the basis of the most accurate modern astronomical data in the interest of national integrity. Keeping these in view, a Calendar Reform Committee was formed in 1952 under the CSIR with Late Prof. Meghnad Saha as the Chairman. The Committee recommended preparation of the Indian Ephemeris and Nautical almanac (renamed as Indian Astronomical Ephemeris from 1979 issue) incorporating therein usual astronomical data calculated with most modern astronomical formula, to publish the National Calendar of India (using Saka era) in the form of Rashtriya Panchang with Solar Calendar system for civil use and Luni solar Calendar system for religious use. It was decided that these works should be done by the Nautical Almanac Unit. This Unit was taken over by the India Meteorological Department from CSIR on 1st December, 1955 and put under Regional Meteorological Centre, Calcutta. On 1st December 1979, following the recommendations of Dr. Ramanna Committee, the centre was made an independent centre and renamed as Positional Astronomy Centre. It was then brought under the direct administrative control of DGM. A standing advisory committee consisting of eminent experts in the field of astronomy advices DGM on technical matters and future scientific programs of the centre.

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 is also performing 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 ephemeride office like this centre and publishing the Indian Astronomical Ephemeris. As per mandate of the Govt 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 govt. 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 meets specific data requirements of a large number of users including Govt. organizations, non Govt. organizations, professional astronomers, research scholars, various panchang makers, general public etc. 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.

The centre also contributes to a great extent in popularizing astronomy through publication of monthly astronomical bulletin and star charts (presently star charts are being prepared on computer), publication of popular articles by its officers and staff members on current astronomical events through various print media, attending live discussions on various electronic media etc. 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.

Activities during the year

The Indian Astronomical Ephemeris for the year 2012, 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.

Fourteen language editions of Rashtriya Panchang of 1932 SE (2010-11 AD) and Sunrise-Sunset and Moonrise-Moonset tables for 2012 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-type, card-size calendar containing brief information on important celestial events during the year 2012 has been published for benefit of users.

The centre has prepared monthly star charts and astronomical bulletins for 12 months during the year 2011 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.

5.3. Antarctic & Project Evaluation Cell

AWS at Maitri

APEC Section deals with Antarctic Expedition, Sagar Kanya Cruises and Evaluation of Scientific Project received from Department of Science & Technology

Pre-Antarctic training

Antarctic trainees of IMD officials undergone Pre-Antarctic training at various offices of ADGM (R), Pune (i.e. DDGM(SI), Pune & DDGM(WF), Pune). IMD trainees of 31st ISEA completed their pre-Antarctic trainings at various offices/sections at H.Q. New Delhi. The training of 31st ISEA completed their medical examination at AIIMS, New Delhi during the period from 23 August 2011 to 26 August 2011 thereafter two IMD trainees underwent to snow-ice acclimatization training at ITBP, Auli during the period of 27 August 2011 to 9 September 2011.

Indian station at Antarctic (Maitri)

31st ISEA

IMD Team members S/Shri Amalendu Barua, AM-I of DGM's Office (APEC Unit) and R. S. More, SA of DDGM(SI), Pune deputed to participate in 31st Indian Scientific Expedition to Antarctica and they flew to Maitri, Antarctica on 29th November 2011 from Cape Town, South Africa by chartered flight and reached Maitri Station on 1st December 2011.

30th ISEA

Shri Shankar Prasad, AM-II of DDGM(UI), New Delhi and Shri Ashok D. Khutwad, SA of DDGM(WF), Pune, both members of 30th ISEA who were deputed at Maitri (Antarctica) from Nov.' 10 to Dec.' 11 for participating in 30th ISEA, have returned on 12th Dec. 2011 after successful completion of the expedition.

Project Evaluation

The evaluation report of ten Project proposals received from Department of Science & Technology during the year has been sent to DST.

5.4. National Data Centre (NDC)

As a custodian of all meteorological data collected at different stations of the country, National Data Centre (NDC) keyed, processed and archived them in standard

format. The total holding of meteorological data in the archives as of date is 103.5 million records.

NDC received a lot of queries and requests for data supply from numerous parties that including government, private institutions, industries, research and operational users. On receipt of requests, the required data were retrieved from the computer archives, within a short time and supplied to the users on CDs, in printout forms in the desired formats, following the usual formalities and as per department policy. During the period under consideration 6,61,95,032 records were retrieved and supplied (during 2011) to different users.

Climatological Data Rescue Scheme

The main aim of the scheme is to digitize all the available climatological data which are in paper form and put them in easily accessible and presentable form. This involves mainly preserving scanned images of the data sheets and data keying. The scheme is to be completed by outsourcing. 41 Radiation data is scrutinized and processed.

The Radiation data of 4332 Station Months have been archived under M/s CMC Ltd. has completed the work of scanning and keying at different RMCs/MCs by Sep. 2011. A total of 4.4 million data sheets were scanned and 28 million records were keyed in during this project.

Implementation of `CLISYS' at National Data Centre

NDC has been supplying data to innumerous users from operational and research fields. In order to equip with large storage and network systems at NDC for a fast communication and better data management activities, the proposal under modernization has been evolved. CLISYS is being implemented at Pune as part of this modernization of IMD.

Digitisation of Autographic Charts

HQ has approved the pilot project for development and supply of digitization software for 16425 autographic charts and also approved the draft MoU to be signed between Society for Applied Microwave Electronics Engineering and Research (SAMEER) and ADGM(R) at a total cost of Rs. 49.50 lakhs. This office has signed the Memorandum of Understanding (MoU) with SAMEER on 25th August 2010. M/s SAMEER has supplied and installed the hardware. They have also imparted a three day course to the staff / officers at RMC Mumbai and O/o ADGM (R). The validation of the software is in process.

5.5. Environment Monitoring and Research

Environment Monitoring and Research Center

India Meteorological Department has established Aerosol Monitoring Network by installing skyradiometer at twelve locations viz., New Delhi, (Reference Standard), Ranichauri, Varanasi, Nagpur, Pune, Port Blair, Visakhapatnam, Guwahati, Kolkatta, Jodhpur, Rohtak and Trivandrum. Skyradiometer is used to measure optical properties of aerosols such as Aerosol Optical Depth, Single Scattering Albedo, Size Distribution, Phase Function etc.

Environment Monitoring Center

India Meteorological Department has established Surface Ozone Monitoring Network by installing Surface UV absorption Ozone Photometer at New Delhi, Ranichauri, Varanasi, Nagpur, Pune, Kodaikanal, Thiruvananthpuram, Port Blair, Guwahati, Maitri. UV absorption photometer determines O_3 concentration by measuring the attenuation of UV light due to O_3 in the absorption cell.

Two research papers were presented using surface O_3 data in conferences as per the details given below :

"Study of Air Pollution over Delhi and its Health Implications", authored by S. K. Peshin and Siddhartha Singh, presented in national seminar on "Environmental Pollution and Bioremediation", held at Jawahar Lal Universuty, New Delhi, 28-29 December, 2011.

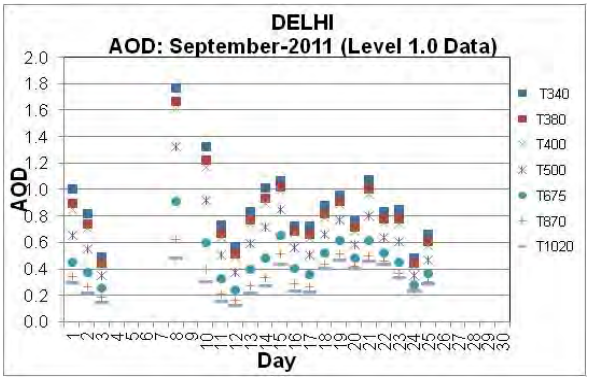
"Study of Surface Ozone during the Festival of Diwali : A Case Study of Delhi", authored by Siddhartha Singh and S. K. Peshin, presented in National Conference on "Science of Climate Change and Earth's Sustainability: Issues and challenges : A Scientists-People Partnership, Organized by The Society of Earth Scientists held at University of Lucknow, 12-14 September, 2011.

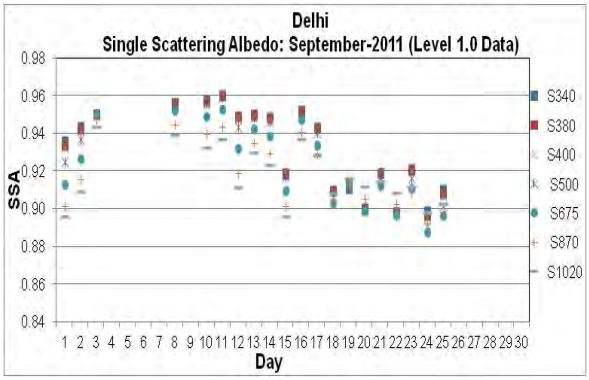
In addition, one research project is started with collaboration of Indian Council of Medical Research, New Delhi (AIIMS) and National Physical Lab., New Delhi to study the effects of surface Ozone on human health.

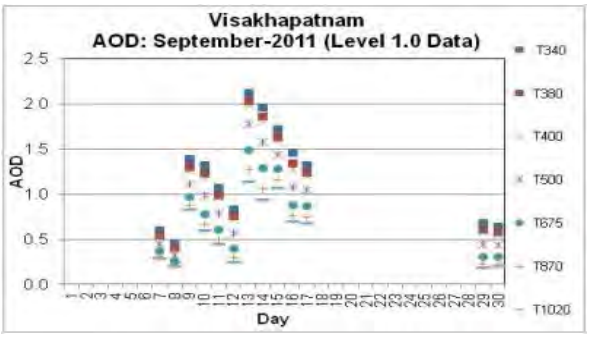
Air Quality Monitoring and Forecasting

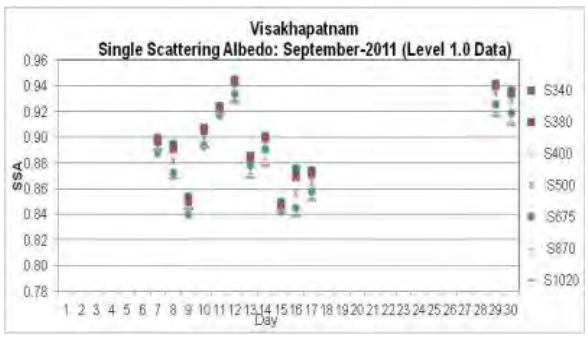
The system for air quality forecasting and research was used to monitor and forecast air quality and weather condition. The department System is in the process of relocating these stations across the city a joint project of IITM and IMD.

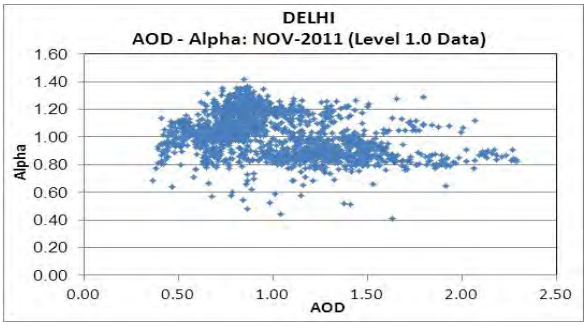
Some Results

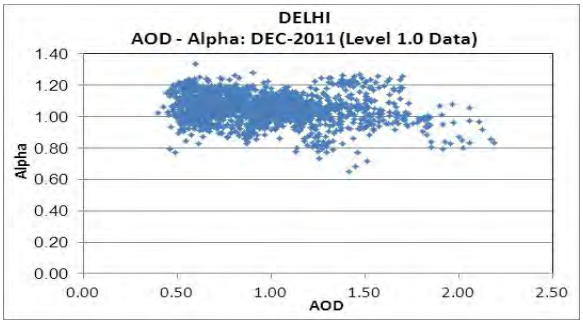












The skyradiometer network called IMD India-Skynet was established during May-June 2011. The network consisting of Skyradiometer Model POM-02 of Prede Co. Ltd, Japan make is used in IMD India-Skynet. Sky radiometers make measurements in eleven narrow wavebands in the ultraviolet, visible and infrared parts of the solar spectrum (315, 340, 380, 400, 500, 675, 870, 1020, 1627, 2200 nm). The optical properties measured using skyradiometer are Aerosol Optical Depth (AOD), Angstrom Exponent, Single Scattering Albedo (SSA), Aerosol Volume Size Distribution, Phase Function, Asymmetry Parameter and Complex Refractive Index. The observations were made at approximately 10 minute intervals.

Two papers were presented in National Conference on Satellite Meteorology "Validation of Aerosol Optical Depth derived from MODIS data with Sky Radiometer over Indian Subcontinent". The paper compared AOD calculated from Skyradiometer data with the MODIS derived AOD found in very good agreement. Another paper "Analysis of the spatial and temporal patterns of aerosols and their impact on climate in India" described the effect of aerosols on solar radiation over India.

MODIS satellite data, solar radiation data, skyradiometer and sunphotometer data were used in the paper.

Preliminary study of the data shows that AOD at 500nm values at background location Ranichauri in Uttarakhand is very low (0.1 – 0.3). These AOD values are considerably lower than the values reported by Ramana et al (2004, GRL) based on observations from four high altitude stations in Nepal. The AOD values at Delhi show very wide fluctuations, diurnal as well as monthly. On a clear sky day the AOD values are found to be less than 0.5. The results show that the significant difference of aerosol optical properties under background, haze, and dust days over different stations is probably due to different aerosol components under distinct weather conditions. Also it is observed that high AOD values are associated with the lower SSA, which indicates significant contribution of absorbing aerosol component in the atmosphere. Average value of Alpha is more than 1.0. Higher values of alpha indicate the dominance of small aerosols. Average SSA at Delhi during October, November and December is close to 0.9, which indicates that aerosols are moderately absorbing in nature. SSA helps determine whether aerosols have a heating or cooling effect on climate in their interaction with solar radiation. Some of the graphs from Delhi skyradiometer are presented below.

Also collaborative research work with IITM and NPL scientists has been planned to estimate the aerosol radiative forcing using radiative transfer models such as SBDART and other model OPAC. Efforts are also being made to utilize the solar radiation data with skyradiometer data.

5.6. Monitoring of Air Pollution

The activities during the year are:

(a) Precipitation chemistry

Chemical analysis for all precipitation samples of the year 2010 and partly of the year 2011 received from 11 GAW stations. Air Pollution Section Laboratory, O/o A.D.G.M.(R), participated in Laboratory Inter-comparison programme conducted by WMO, in April 2011. Three samples received for inter-comparision. They were analysed for all 10 parameters as per WMO guidelines and result sent to GAW data center, USA.

(b) Aerosol Optical Depth

Multi-channel Sunphotometers having 5 channels have been installed at seven GAW stations viz., (i) Pune (ii)

Kodaikanal (iii) Nagpur (iv) Allahabad (v) Jodhpur (vi) Srinagar (vii) Port-Blair. Data have been archived at IMD, Pune AOT data of 28th and 29th Indian Antarctica expedition have been received and scrutinized.

(c) Modernization Programme

Under Environmental Monitoring and Research scheme new programmes viz., Network of 13 Sun-sky radiometers, Automatic Precipitation Collectors, High Volume Air Samplers with microbalance, Black Carbon Measurement equipment UV-Vis Spectrophotometer. are being implemented.

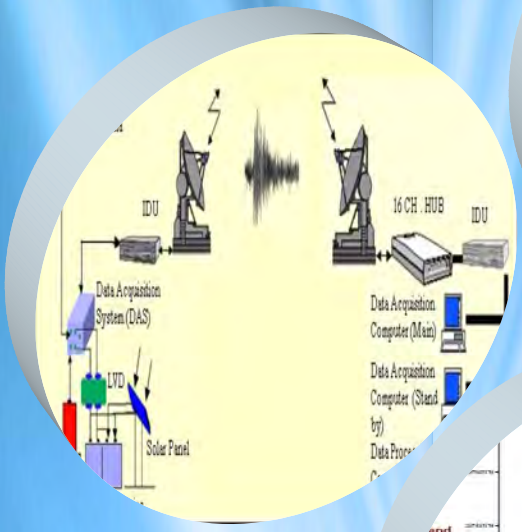
5.7 Monitoring of Drought

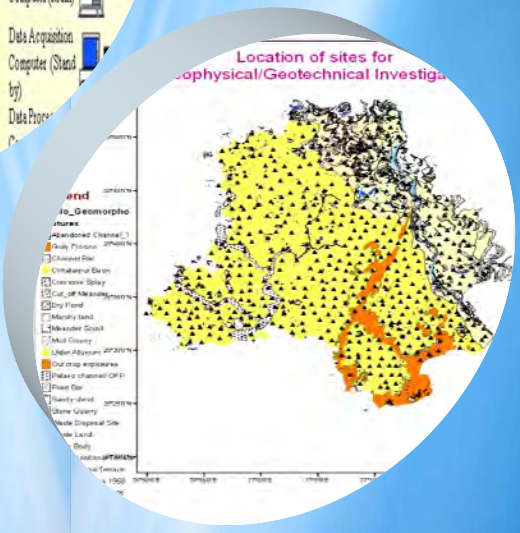
India Meteorological Department (IMD) monitors the incidence spread, intensification and cessation of drought (near real time basis) on a weekly time scale over the country based on Aridity anomaly Index. It also issues weekly drought outlook, based on this index, which indicates the impending drought scenario in the country in the subsequent week.

Based on aridity anomaly index, weekly aridity anomaly reports and maps for the southwest monsoon season for the country as a whole and for the northeast monsoon season for five met. subdivisions viz., coastal Andhra Pradesh, Rayalaseema, South Interior Karnataka, Tamil Nadu and Pondicherry and Kerala are prepared and sent to Hqrs., and various agricultural authorities of state and central Govts., research institutes on operation basis for there use in agricultural planning agencies. The maps are also uploaded on the departmental website. These maps help to access the moisture stress experienced by growing plants and to monitor agricultural drought situation in the country. The map is uploaded in the official web site, Pune. Monitoring of meteorological drought using standardized precipitation index (SPI) is also done and the map is uploaded in the official web site of Pune. Identification of meteorological drought is done, based on rainfall deficiency on subdivisionwise scale.

Quantitative crop yield forecast for Rabi wheat for 16 subdivisions and for Kharif rice for 26 subdivisions are prepared for onward transmission to the Economy and Statistical Advisory, Directorate and Economic & Statistics, Ministry of Agriculture and Corporation.

EARTHQUAKE MONITORING



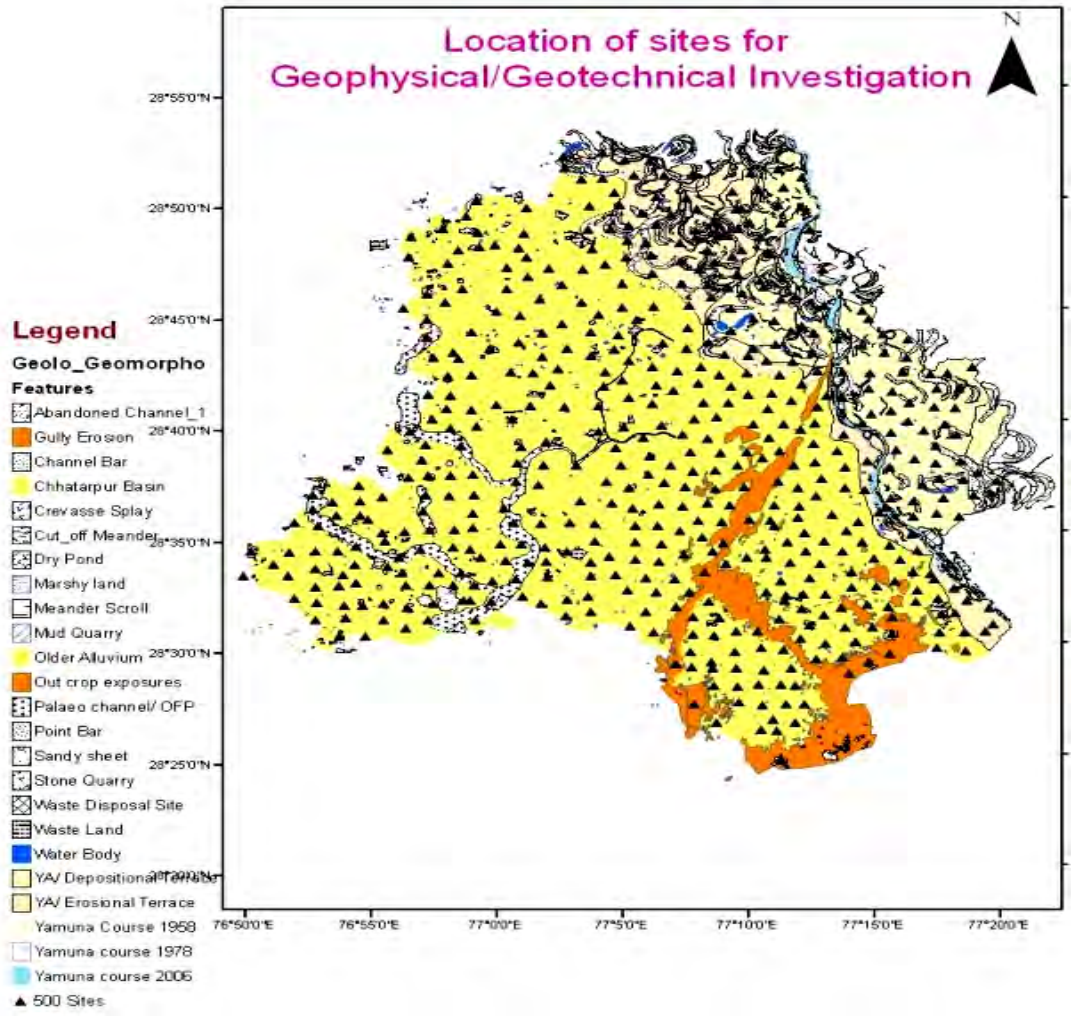


6

6. EARTHQUAKE MONITORING

6.1. Seismological Services

India Meteorological Department (IMD) is the nodal agency of Government of India responsible for monitoring seismic activity in and around the country. 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 (www.imd.gov.in and www. mausam.gov.in). Towards meeting these objectives, India Meteorological Department is maintaining the National Seismological Network (NSN) consisting of 55 observatories, which includes 17-station Real Time Seismic Monitoring Network (RTSMN) set up for early warning of tsunamis. India Meteorological Department is also maintaining two V-SAT based telemetry clusters, one each in (i) Delhi and surrounding regions (16 stations) and (ii) Northeast India (20 stations) region for close monitoring of seismic activity in the region.



Location of sites for Geophysical/Geotechnical Investigation

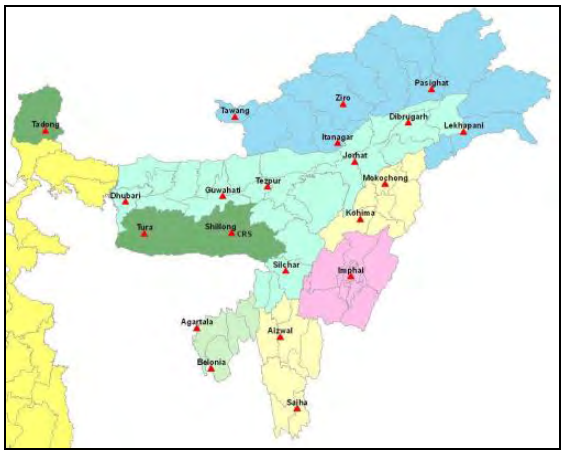
The National Seismological Network is in successful operation and a total of 2903 earthquake events have been detected and located during the period January-September, 2011. These include 1964 events of magnitude 5 and above.

The seismological data from all the network stations is 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 is 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 Shri R.S. Dattatrayam, Scientist 'F' & Head (Seismology) has been elected to serve for four years as member of Executive Committee of the International Seismological Centre (ISC), UK.

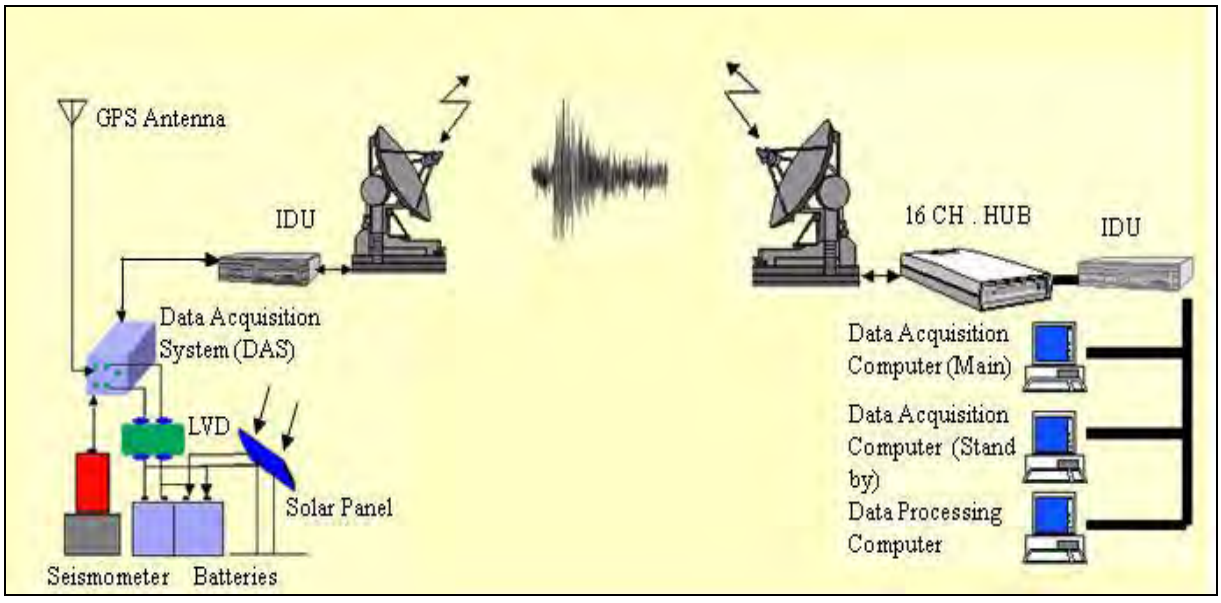
6.2. Seismic Monitoring Network in NE Region

A local seismic telemetry network has been setup in NE region for near real time monitoring of local earthquake in the region. The VSAT based Seismic Telemetry Network of NE India consists of 20 field stations spread over NE region of the country and CRS at IMD HQ New Delhi.

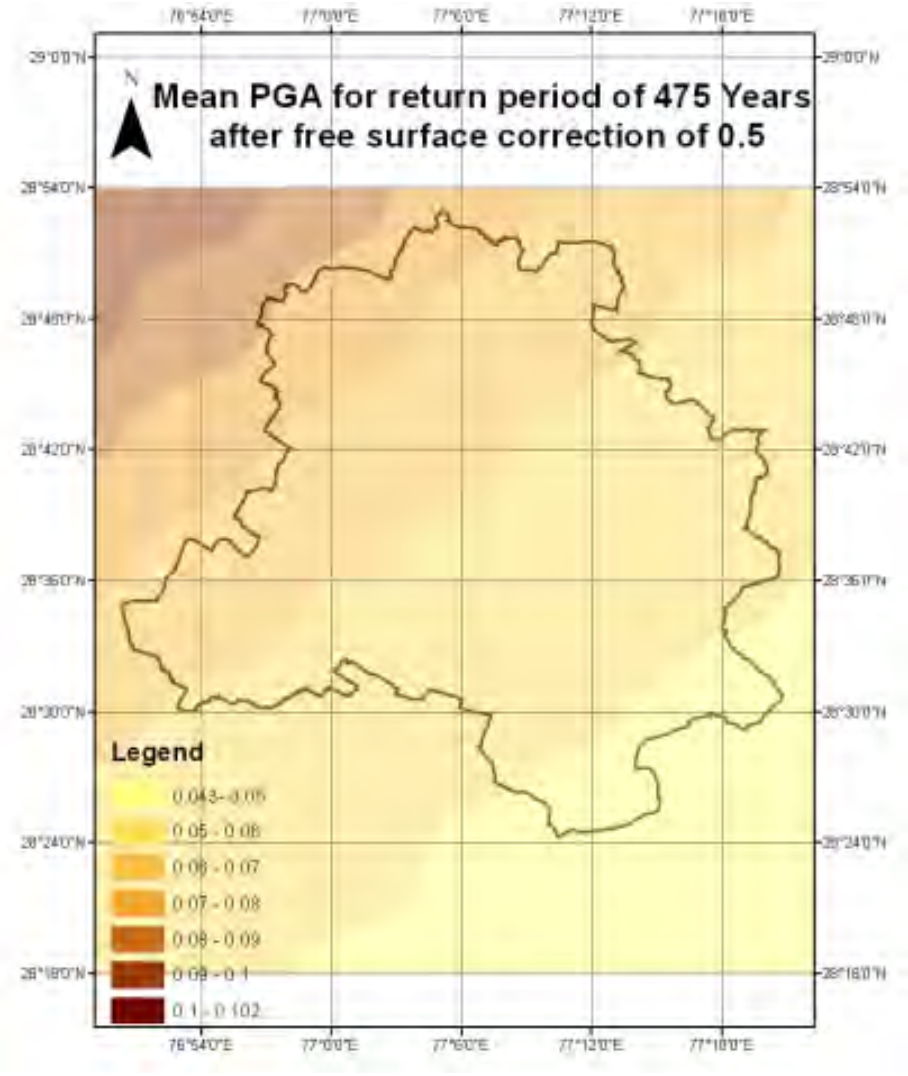


Seismic Telemetry Network of NE India

The network has been made operational on 11th May 2011. The network Configuration of field station and CRS at New Delhi is shown in Figure.



Network Configuration



Mean PGA for return period of 475 years after free surface correction of 0.5

6.3. Seismic Microzonation

Earthquake Risk Evaluation Centre (EREC) has been setup to guide national endeavour in mitigating the disastrous impact of earthquake and undertake/promote scientific task related to earthquake risk evaluation. In this regard Seismic Microzonation is the prime activity of the Center and has completed seismic microzonation of NCT of Delhi on 1:50,000 scale integrating several thematic maps viz., geotechnical, geological, seismological and site response etc. EREC is now in the process of generating such maps, at higher resolution on 1:10,000 scale. The programmes taken up during the year are as follows:

Seismic Hazard Microzonation of NCT Delhi on 1:10000 scale:

Under the Seismic Microzonation of NCT Delhi on 1:10000 scale, Base and Geological map on 1:10000 scale have been generated in collaboration with Survey of India (SOI) and Geological Survey of India (GSI) the nodal agencies.

The first part of Seismic Microzonation that is seismic hazard evaluation at engineering bedrock has been

completed in collaboration of IIT Roorkee and Spectral Acceleration maps for different period and different Probability of excedance have been generated.

In order to transfer Seismic Hazard to the surface through ground response analysis as a second part of the study, an intensive programme of Geotechnical/ Geophysical data generation and analysis have been taken up. Documentation map depicting location of different investigation is shown in the Figure

Data generation

Geotechnical data generated by drilling boreholes, collecting soil samples at different depth at about 500 sites spread over NCT Delhi. The laboratory analysis has been taken up and completed at 300 sites.

Evaluation of shear wave velocity using geophysical techniques such as Cross Hole Techniques (CHT), Down Hole technique(DHT) and Multichannel Analysis of Surface Wave (MASW) have taken up at 125 sites spread over NCT Delhi and completed at all sites.

7

DEPLOYMENT OF STATE-OF-THE ART TECHNOLOGY

SURFACE INSTRUMENTS

UPPER AIR INSTRUMENTS

COMMISSIONING OF RADAR

AUTOMATION OF INFORMATION SERVICES

E-GOVERNANCE SERVICES

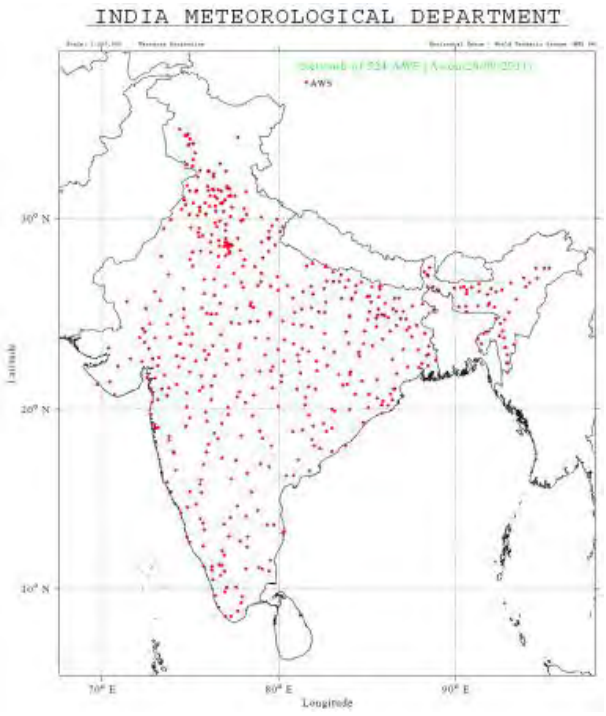
7. DEPLOYMENT OF STATE-OF-THE-ART TECHNOLOGY

7.1. Surface Instruments

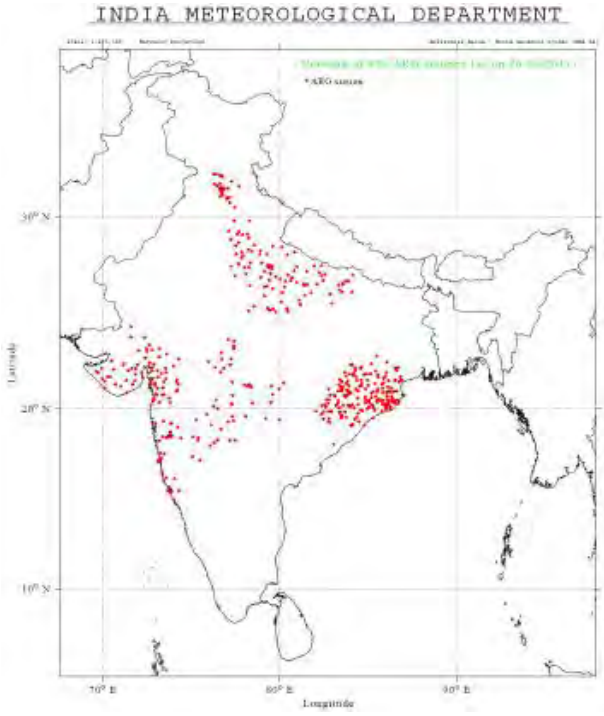
Strengthening of Surface Observational Network

A network of 125 Automatic Weather Stations (AWS) has been established during the year 2006-07 under the project "Replacement of old and obsolete network of Data Collection Platforms". Under the IMD Modernization Programme Phase-I, the network is being expanded with additional 550 AWS. The sensors for parameters Air Temperature, Relative Humidity, Atmospheric Pressure, Rainfall, Wind and Global Solar Radiation are being interfaced with each AWS. Out of 550 AWS planned for installation, 127 are Agro-AWS with additional sensors for parameters soil temperature, soil moisture, leaf temperature and leaf wetness. The network is required to meet the needs of diverse services of IMD such as Weather Forecasting, Cyclone Warning and Hydrological Studies etc. A meso-network of 12 AWS has also been established in and around National Capital Region. Thus, a fairly uniform and dense surface observational network of 550 AWS is expected to be available to meet operational forecasting requirements (both synoptic and meso-scale) of the nation.

In order to improve district-wise rainfall monitoring, a network of 1350 Automatic Rain Gauge Stations is being established during Phase-I of the modernization project. Out of 1350 ARG stations, 500 stations are being equipped with additional sensors for temperature and humidity observations. It is planned to install at least two Automatic Rain Gauge Stations in each district of India during Phase-I of the project. The ARG stations are also being installed on priority in flood prone river basins such as Brahmaputra, Ganga, Mahanadi, Tapi, Narmada, Godavari and Krishna.



Network of AWS (524 No.) established till Sep 2011



Network of ARG stations (456 No.) established till Sep 2011

Progress in implementation:

(a) Commissioning of 550 AWS and one TDMA type receiving Earth Station.

As on date (Sept 2011), 524 AWS have been installed and commissioned. Remaining 26 AWS are to be installed in the state of Manipur, Nagaland and Arunachal Pradesh.

(b) Commissioning of 1350 ARG stations.

As on date (September 2011), 456 stations have been installed and commissioned.

Upgradation of Radiation Network

Radiation Lab, Pune maintains a network of 45 radiation stations equipped with different radiation sensors. Sensors at these stations measure radiation parameters which are recorded and stored in data logger. Presently, these data are printed and sent on monthly basis to National Data Centre (NDC) for archival and providing to various users. GPRS technology based modules were interfaced to data loggers at 15 network stations. The module acquires data from the data logger and transmits it to the website www.imdaws.com. This has helped IMD to get real time radiation data from network stations on IMD website, at 10 minutes interval which can be accessed at any location.

13 Sky radiometers have been procured and installed at selected stations. Data being received at centralized data receiving and processing system established at EMRC, IMD, New Delhi.

RVR Instruments

IMD in collaboration with NAL, Bangalore has been successful in installation and commissioning of two new RVR at beginning RWY 29 and end RWY 11 of IGI Airport Delhi during December 2011. Both have been working smoothly by providing RVR values at 24 × 7 to ATC and airlines. With this, IGI Airport is now the only airport in the world to have Ten RVR located at three RWYs, commissioned by IMD to provide Fog and visibility data to ATC and airlines round the clock.

Automatic Weather Station

A total of 550 AWS and 1350 ARG have been procured. Out of these, 541 AWS and 557 ARG have been installed at field sites till the end of this quarter. Data transmitted by AWS & ARG are available at GTS and IMD Websites of Pune and Delhi.

Transmissometers

Indigeneous Transmissometers (2 Nos.), Dhristi were installed by IMD at RWY 29 and RWY 11 of IGI Airport, Delhi during 2nd Week of December 2011.

Transmissometers

Surface Ozone Analyzers

Ten (10) sets of UV Surface Ozone Analyzers was installed at New Delhi, Pune, Varanasi, Kodaikanal, Thiruvananthapuram, Ranichauri, Nagpur, Antarctica (Maitri), Portblair, Guwahati IMD observatories for continues monitoring and recording of ozone levels on surface.

National Knowledge Network (NKN)

National Knowledge Network (NKN) connectivity has been implemented at HQ New Delhi and Regional Meteorological Centres starting with 100 Mbps (Scalable to 1 GBPS). It is utilized for teleconferencing and web browsing at HQ New Delhi. Connectivity between NKN Close User Group (CUG) has also been established at HQ for data exchange with other agencies on NKN like IITM, INCOIS etc. Exchange of New datasets/ products from satellite and newly installed Doppler Weather Radar have been implemented at RTH New Delhi. Regular upload of several additional new Doppler weather radar / satellite products have been implemented.

7.2. Upper Air Instruments

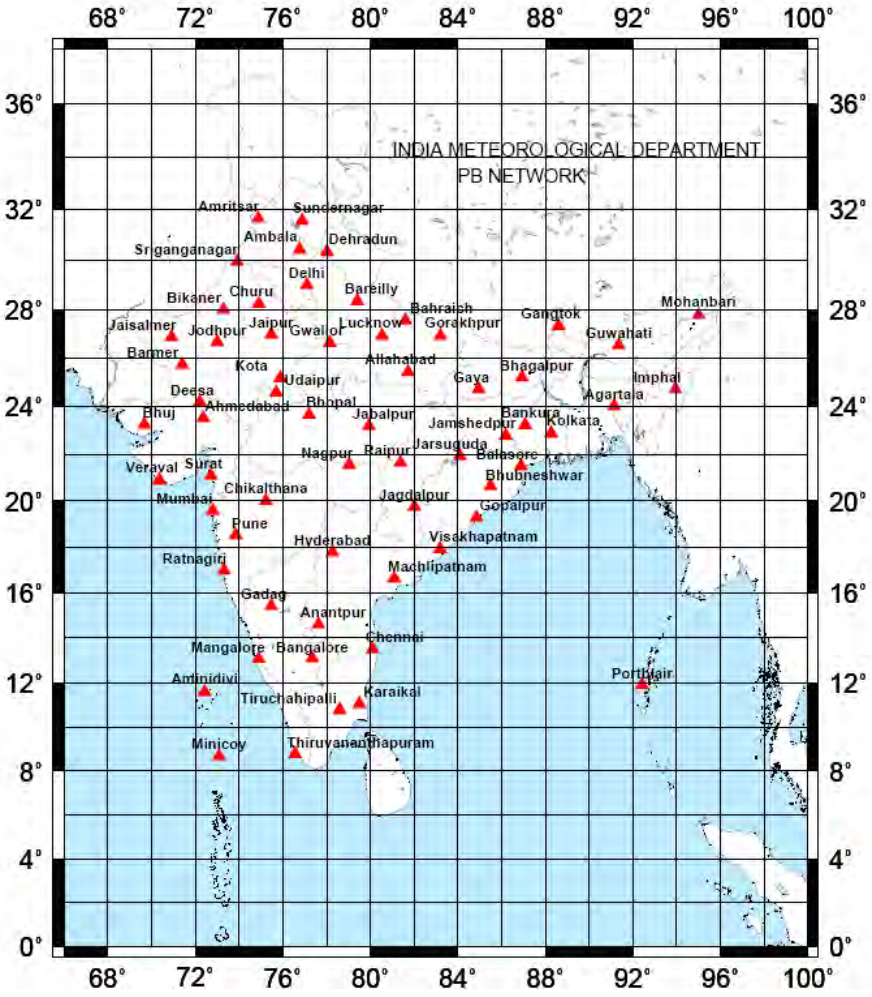
Observational Network

India Meteorological Department is operating a network of 39 Radiosonde/Radiowind stations including 3 stations

under Mountain Meteorology Project and 2 stations for radiosonde data only, twice a day on operational basis. There are 62 Pilot Balloon Observatories at present. The following projects are in process.

In order to complete the upgradation of 25 upper air stations in Modernization Phase-1, a new project for procurement of 13 numbers of GPS based radiosounding systems under the Modernization of IMD Phase-1 has been initiated to improve the data quality by deploying the high quality GPS radiosonde. These systems will be installed at various locations in the year 2012 after the procurement.

All 62 PB stations have been equipped with new optical theodolites to get the improved quality data from the Pilot balloon observations. Five Pilot balloon observatories would be equipped with imported electronic optical theodolite for improved quality of data reception and processing.



One 1680 MHz radiotheodolite with auto tracking capabilities and GPS radiosonde with ground system has been developed in collaboration with SAMEER.

To improve the data quality, R&D projects are in process with an aim to improve the data quality as listed below:

Development of MEMS based sensors and ASIC chip for new digital radiosonde Pressure & Temperature sensor development completed.

(b) Development of MMIC transmitters for radiosonde has been completed under MoU with M/s GAETEC, Hyderabad. Testing of first prototype has been done successfully. Fifty units have been received & trial ascents successfully completed.

7.3. Commissioning of Radar

Inaguration of DWR at Nagpur

Five more S-Band radar were commissioned at Nagpur, Agartala, Patna, Lucknow, Patiala and dedicated to nation this year. Radar at Mohanbari has also been installed and will be commissioned by the end of this year. C-band radar imported from Vaisala, Finland has been installed at Mausam Bhawan building, Lodi Road, New Delhi and undergoing Site Acceptance test. Another C-Band radar is undergoing installation at Jaipur. Standard Operating Procedures (SOP) for operation and maintenance of S-Band radar prepared and released during inaugural function of DWR Agartala on 18th October 2011.

A web based interactive tool which integrates the radar data with the GIS, thus providing a valuable tool for the forecasters has been developed and is available in the IMD Website. An all India Radar Composite is being generated and posted in IMD website.

Specific custom CAPPI type radar products are being generated and fed for generating nowcasting in SWIRLS nowcasting system. RAW Data is being converted to NetCDF and BUFR for usage in IMD and NCMRWF numerical models. Rainfall data in BUFR format has been integrated in PWS. Radar products generated as images and datasets are sent to TRANSMET system for onward distribution to end-users.

7.4. Information Services

National Knowledge Network (NKN) has been implemented in IMD.

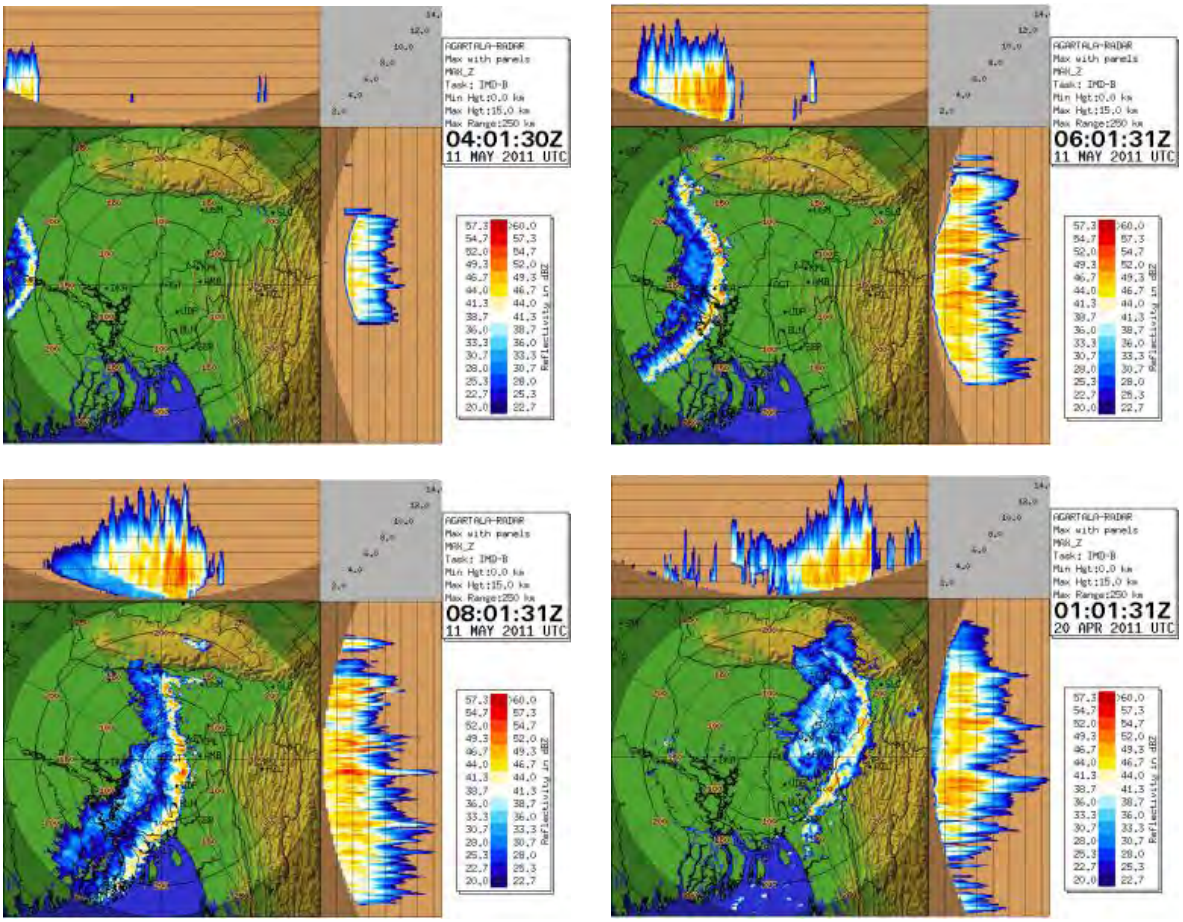
VPN Network has been extended to IMD field offices including DWR stations. Presently 44 VPN links have been made operational.

Under the project of providing Video Conference system at 9 IMD locations, installation is in process at all the stations.

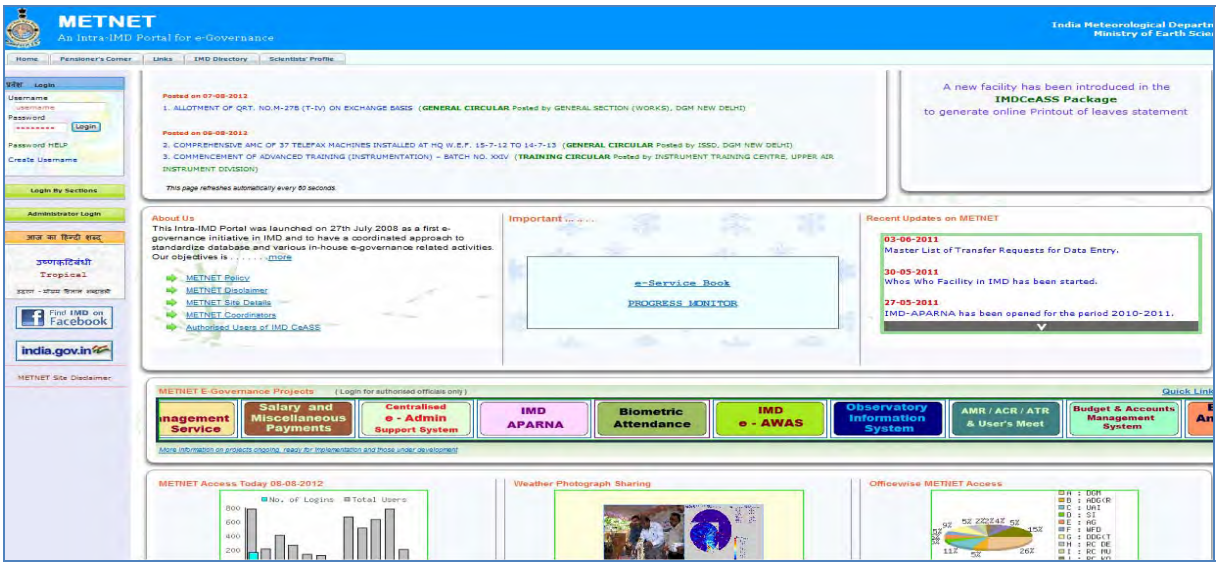
Access control system and cameras for surveillance have been installed at Mausam Bhavan.

In IMD intranet http://metnet.imd.gov.in many modules have been developed and hosted for use by IMD employees. Static pages of IMD web site http://www.imd.gov.in have been made bilingual (Hindi and English).

On WMO weather website http://worldweather.wmo.int/066/m066.htm IMD's city weather forecast for 100 cities has been automated.



Perfect Watch: The pictorial glimpse of a squall line observed at Agartala-DWR



Intra IMD portal (METNET) homepage

Database has been created for local city weather forecast on IMD website http://www.imd.gov.in

A training on Java, PHP, Web programming and database for twenty IMD officials from HQ and out stations has been arranged.

Intra IMD Portal (METNET)

This Intra-IMD Portal, popularly called METNET was launched on 27th July 2008 by the Information Systems and Services Division, India Meteorological Department, as a first initiative to have a coordinated approach to standardize database and various in-house e-governance related activities. METNET was developed by the team of dedicated officer and staff of IMD.

On 27th July 2011, METNET completed 3 years of e-governance services in IMD. The METNET is now recognized as the pioneer in conceiving and implementing e-Governance projects for effective administrative services. future developments. The beneficiaries include each and every official of IMD, the various admin and a large number of feedbacks and valuable critics, which helped to standardize the framework necessary for technical units, Ministry of Earth Sciences, other government agencies and also the general public. This has brought all employees of IMD on a single platform. During this period METNET MailDesk received.

The complete development and implementation of METNET is in-house with the existing manpower and practically no expenditure involved. The Intra-IMD Portal (METNET) has become the single and central point of information on the administrative matters. The communications between employees and the system administrators reveals the extent to which this project is popular and its objectives are achieved.

E-Governance Projects on METNET

Considering the ever growing influence of Information Technology in day to day affairs of the department, METNET coordinated the various IT related activities of the department. The details of various projects developed and made operational through METNET are listed below:

However considering the administrative aspects, the various projects are developed to cater the need of suitable platform to access information on real time basis by HQ, Regional and Met Centre offices. The same can be used to assist the administrative authorities and HR managers in effective decision making process as per their requirement,In addition to all above, orders related to the 6th CPC and Government of India, which are published, can be accessed on this portal. Provision has also been made to download forms and application formats which are required frequently.

S. No.	Project Name	Details
1.	Main Portal and Database	Development of main platform and centralised database architecture for hosting various e-governance applications.
2.	Personnel Information System	For HR Management and sharing real-time basic information of all IMD employees and statistics thereof.
3.	CPU Management Service	For general display status of procurement cases managed by the CPU Unit of IMD HQ.
4.	Weather Photograph Sharing	For sharing of images of meteorological interest among the IMD Officials. Any employee registered here can upload a photo and can view other's.
5.	Forms, Seniority Lists, IMD News, etc.	These are the facilities to view different Forms, Seniority Lists, IMD News, etc. User can also take the printout of them as per their requirement
6.	DGM Secretariat Diary	For online access to the appointments at DGM Secretatiat, occupations and availability of DGM, etc. The data is updated exclusively by the DGM Secretariat.
7.	IT Inventory System	Inventory Status of particular section can be maintain by using IT Inventory System through section login. It also display status of Inventory of IT assets in IMD.
8.	File Tracking System	File Tracking System is the online application to monitor and keep track of the movement of the files being shared between Offices and Sections located at New Delhi.

9.	Leave Management	Leave Management System is the online application in which a user can apply and track the leave applied by him/her and the section can approve and monitoring the leave records of their employees.
10.	MAUSAM Catalog	To facilitate Researchers in IMD with online access to the Papers, Arricles, Abstracts, etc. published in the journal MAUSAM of IMD. The documents are made available by the MAUSAM Publication Unit at IMD HQ.
11.	Salary and Payments Display	It provides the online information about the salary and payments of particular employee after his/her login on METNET.
12.	IMD Directory Search	IMD Directory Search is the online search engine. To locate a employees with his/her profile. Contact address of different sub-office under their main office, sections with their strength and observatories of IMD.
13.	Met Document Sharing	For sharing of documents of meteorological interest among the IMD Officials. Any employee registerd here can upload a document and can view other's.
14.	Progress Report Display & Upload	For Sharing the Progress Reports with the IMD Officials, made available by the RMCs, Offices at Pune, and those at HQ.
15.	Forecasting Facilities	This is a single-point access to the references, manuals, guides, reports, etc. necessarily required by the forecasting officials working in operational units. The documents are uploaded here by the main forecasting units of IMD.
16.	Biometric Attendance Record Updation	Biometric Attendance Records Updation is an application for uploading Biometric Attendance Records of the IMD Employees.
17.	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.
18.	APARNA Ver 1.0 (Annual Performance Appraisal Report Notation & Admin)	APARNA Ver 1.0 is a online package for Annual Performance Appraisal Report Notation and Administration.
19.	IMD Monitoring Observatory Network	IMDMON is designed to monitor the reception of data from the different functional observatories of IMD on real-time. It can be freely accessed without login authentication.
20.	METNET Instant Messenger	An Intra-IMD facility for IMD Officials to communicate and exchange documents among themselves related to the office matters .
21.	IMD AMR/ACR/ATR and Users Meetings.	This is a single point of access for the distribution and exchange of information amongst the Delegates relating to the AMR/ACR/ATR and Users meetings held every year in IMD.
22.	IMD Library Management	This is an online application which provides centralized management and automation related to the Library Borrowers Cards.
23.	IMD Centralized E-Administration Support System - IMD CEASS	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.
24.	IMD e- AWAS	Launched IMD e-AWAS, an online package for the centralised management of Residential accommodation of the Department.
25.	भारत मौसम विज्ञान विभाग राजभाषा पटल	To provide all offices and employees, the information related to the celebration of IMD fourth Hindi Seminar on 1st July 2011. This is a single pont of access for the distribution of the media files of the event.
26.	IMD Personnel Information System	This system has been relaunched with the inclusion of extra facilities about all IMD employees and statistics thereof.
27.	IMD Seminars and Conferences	This is a facility for Online hosting of seminars and conferences organised by IMD.

28.	My Briefcase	A facility for personal storage on METNET for IMD officials , where they can upload, store & carry, and share any document of Meteorological interest has been started.
29.	IMD Vision - 2030	It provides access to documents and reference materials of IMD Vision - 2030 related to various services in IMD.
30.	Scientist's Profile	Gives information of all scientists in IMD.

8. HUMAN RESOURCE DEVELOPMENT

International School on "Application with the Newest Multi-Spectral Environmental Satellites"

An International School on Applications with the Newest Multi-spectral Environmental Satellites was conducted at Satellite Meteorology Division, New Delhi from 30 January to 5 February 2011. The course included forty hours lectures and Labs on

- Radiation and the Radiative Transfer Equation
- Spectral signatures from Earth's surface and atmosphere
- Multi-spectral monitoring of land, ocean, and atmosphere
- Image combinations for cloud and volcanic ash detection
- Sounding using infrared high resolution spectral data
- Microwave detection of vertical changes of moisture in the atmosphere.

The course was inaugurated by AVM (Dr.) Ajit Tyagi, Director General of Meteorology on 30th January, 2011. The faculties to this course were Prof. Paul Menzel, Verner Suomi Professor, Dr. Paolo Antonelli and Dr. Sanjay Limaye, Scientist (all from Space Science and Engineering Centre, University of Wisconsin USA). The trainees (24 nos) were from IMD, NCMRWF (Noida), INCOIS, Hyderabad, IITM, Pune, IISC, Bangalore, IAF, New Delhi and IIT Delhi. The softwares like, HYDRA, Planck tool, Planck calculators etc. were provided to all the participants by US scientist. The trainees were also given MODIS data for lab practice. After completion of the training all trainees were assigned projects on different subjects.

Participants of International School on "Application with Newest Multi-spectral Environmental Satellites"

Orientation Programme

An orientation programme for office and asset management under modernization scheme phase – 1 was conducted at DGM office, New Delhi for M.C. in-charges during period from 7-12th February 2011. The aim of the programme was to have a brief knowledge regarding office procedure, management of stores and other Government of India guidelines issued under various rules and regulations. DGM addressed the trainees during the inauguration and the certificates were given by Secretary, MoES at the concluding session.

Training Course in Agro Meteorology

Group of Scientists of Agro Meteorological training

A training course on 'Agro Meteorology towards better advisories for serving end users requirement' for AMFU scientists, was conducted from 15 February to 7 March, 2011 at CTI, Pashan by the Agrimet Division. 24 trainees in the rank of Assistant Professor, Associate professor from different State Agriculture Universities, Advisory Board members from different Agrometeorological Field units participated in the course. The course covered various theoretical, operational and practical aspects of agrometeorology. The experts from IMD and other leading Institutes/Universities viz., NCMRWF, IIT, IITM, CASAM, SAU, SVU, MSSRF, ICAR, IARI, CAZRI, CRIDA, ICRISAT and SAC delivered lectures.

Tropical Cyclone Forecasters Training

A training Course was organized by RSMC, New Delhi for WMO Sponsored Cyclone forecasters from WMO/ESCAP panel member Countries, *i.e.*, Oman, Bangladesh and Myanmar during 28th February to 11th March 2011. Nine cyclone forecasters from Area Cyclone Warning Centers (ACWC) Kolkata, Chennai & Mumbai and Cyclone Warning Centre (CWC), Bhubaneswar, RMC, New Delhi and National Weather Forecasting Centre (NWFC) also participated in the training. The valedictory function of this training course was held on 11th March 2011 and certificates were distributed to the trainees by DGM, IMD.

WRF Model Training

A WRF Model Training Program was conducted by NWP Division during 28 March – 8 April, 2011 at Mausam Bhavan, New Delhi which was inaugurated by DGM. The aim of the training program was to familiarize the model configuration, data assimilation and model products evaluation to officers working at various RMC's. The

training program was attended by 33 officers from all RMCs, MCs, viz., Bangalore, Hyderabad, Ahmedabad, Thiruvananthapuram and O/o DDGM (WF) Pune including 8 local participants. Speakers from NCMRWF, IIT Delhi, IAF New Delhi, HCL New Delhi, NARL Gadanki and IMD Scientists were identified as resource persons to deliver lectures covering various aspects of the WRF model configuration, data assimilation, model evaluation and diagnostic studies. During the practical session, the trainees were made familiar with Model Evaluation Tools software installation and utilization for WRF model performance evaluation.

Brainstorming Session on WRF Model

A Brainstorming Session on Indian WRF Model was conducted by NWP Division during 28-29 April, 2011 at Mausam Bhavan, New Delhi to discuss the issues and conceptualize research opportunities for an Indian WRF model. The session was chaired by DGM and attended by various operational and research organizations in India such as IMD, NCMRWF, IAF, IITM, IIT Delhi, SAC Ahmedabad, NARL Gadanki, Andhra University, CDAC Pune, CMMACS Bangalore.

North East Telemetry Training

A two week's training program on North East Telemetry Network highlighting the hardware and software related aspects of the field stations and Central Receiving Stations was held during 27th June to 9th July, 2011. Senior officers and staff of Seismology division and EREC and a few officers from CSO, Shillong and other North East field stations participated in the training program. DGM also addressed the trainees during the course of training.

Budget and Account Management Training

A training programme on Budget & Accounts Management System meant for drawing and disbursing officers & Budget Asstt. of IMD was held during 10th & 11th August, 2011 at H.Q. New Delhi. Twenty eight officers & staff members of different offices participated in training programme. The participants were trained in Budget & accounts Management System of METET. All expenditure can be monitored online by the concerned officers.

Telecom Training

Under WMO WIS (WMO Information System) program, RTH New Delhi is in process of becoming GISC (Global Information System Center). WMO expert Mr. Timo visited RTH New Delhi from 5th to 7th September'2011 for training cum workshop on "WIS Jump Start" program

Utilization of Doppler Weather Radar Products

Five days training workshop on "utilization of Doppler Weather Radar products in now-casting of severe weather phenomena" was conducted for 7 nos. of Indian Air Force met. officers and 5 nos. of Integrated Test Range, Chandipur officers during 12 to 16 September 2011. Shri D. Pradhan Sc. E, Shri T. K. Ray, Asstt. Met I, Shri I. Talukdar, Sc. Asst. and Shri D. K. Kundu, Asstt. Met I (retired) delivered lectures on the various topics related to DWR image interpretation and their utilization for aviation and nowcasting. The officers expressed high level of satisfaction towards the quality of training provided and the hospitality extended by DWR and RMC Kolkata.

Training Courses in Seismology

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 NHPC, University of Jammu, State government agencies, etc. Officers of Seismology Division also delivered lectures, on request, at various state / central government organizations dealing with earthquake related matters. Familiarization training on various operational activities related to earthquake monitoring was also given to a trainee from Mauritius Meteorological Services during 25th to 30th Sep 2011.

Training on TESCO software

Facilities for raster scanning, processing and vector digitization of old analog charts were established at Seismological Observatory, Kamla Nehru Ridge, Delhi under a plan scheme "Archival and digitization of seismic analog charts". Under this project, a total of 46,820 analog charts have been raster scanned and 2432 scanned images vector digitized during the period January to September, 2011. As part of this project, Shri G. Suresh, Scientist-E, Shri H.P.Shukla, Director and Sh. Ajay Verma, Scientific Assistant were deputed to Instituto Nazionale di Geofisicae Vulcanologia (INGV), Rome, Italy for training on TESCO software (Vector digitization of analog seismograms) from 3 to 11 October, 2011.

Other Training

- Basic Agromet Course of three weeks for 10 officials from Scientific Assistant to AM-I level was conducted from 14 Nov, 2011 to 2 Dec, 2011. The course covered various components of Agrometeorology particularly on Basic Agricultural Meteorology, Operational Agricultural Meteorology and General Agricultural Meteorology.

Officers of Agromet Course

Cropping System Models-Applications in Land Resource Management

Dr. William Dar, Director General, Shri Anand Kumar Sharma Scientist 'E' Dr. James Jones Ken Bootee, Professors of Florida State, University USA

Shri Anand Kumar Sharma Scientist-E, Meteorological Centre, Dehra Dun and Jayanti Sarkar, Scientist 'E' attended a short term course on "Cropping system models-Applications in land resource management" at, ICRISAT, Patancheru from 4-9 Dec. 2011. The course was jointly organized by University of Florida, USA and International Crop Research Institute for Semi Arid Tropics (ICRISAT). The impressions and remarks on behalf of participants were presented by Shri Anand Kumar Sharma and were highly appreciated by the Director General of ICRISAT.

- Thirty (30) Trainees from National Institute of Disaster Management including senior Govt. officials from 17 African countries visited National Weather Forecasting Centre on 14th January 2011. They were briefed regarding NWFC and Cyclone Warning Organisation of IMD.

- Nine officials of Administration, RMC Chennai were imparted a training – "Centralised e-admin support system" conducted by HQ at RMC Chennai during 18-19, April 2011.

- Summer training has been imparted to the student of M.Sc. (Environmental science) from Pune University on activities of APS . at ADGM (R)

- Three days training workshop on "DWR Products, their interpretation and utilization" was conducted from 11-13 May 2011 at DWR Kolkata. Six forecasters from RMC Kolkata and AMO Kolkata attended the workshop.

- Training on Seismic Instruments was given to the trainees of Intermediate course (Instrumentation) Meteorology Training Batch No. XXXVI by Officers from Seismology Division during 23-27 May, 2011.

- A Training Workshop on Doppler Weather Radar was organized at DWR Chennai for eight IAF personnel (JCOs and NCOs), from 20th to 24th June 2011.

- 25 personnel from the Water Resources Deptt., Govt. of M.P. were imparted basic training in installation, inspection and validation of Met. Data organized by M.C. Bhopal . The training was arranged at Water And Land Management Institute (WALMI) Bhopal during 20-29 June 2011. The trainees were awarded certificates after undergoing meticulous training test and viva examination.

- Seventeen Trainee Officers and one Supervisor from State Agricultural Management Extension Training Institute (SAMETI), Hyderabad visited the Observatory of M.C. Hyderabad on 20 July 2011. They were shown the Observatory, Doppler Weather Radar and explained functioning of various instruments.

- A training on "Design of training (DOT)" had been conducted at CTI during the period from 16th - 20th August, 2011. Thirteen trainees from IMD participated.

- Twenty five African trainees attached to National Institute of Disaster Management (NIDM) visited India Meteorological Department on 23rd September 2011. They were briefed about various activities of IMD for disaster management. Dr. M. Mohapatra, Sc-'E' gave a presentation to the visitors on "Overview of cyclone and its mitigation by IMD

- Shri H. S. Manadal, Met-I, Dr. H. S. Sisodia, S.A. and Ms. Sarita Tiwari attended training Course on "Codal practice on Earthquake Resistance Design on Structures" jointly organized by BMTPC, New Delhi and IIT Roorkee held from 28-30 December 2011 at IHC, New Delhi.

- DoPT course on Evaluation of Training (EoT) organized by Ministry of Earth Science, Govt. of India and IMD was held at C.T.I during 17-21 October 2011 with 11 number of candidates from different offices of IMD and one candidate from Police Dept, Mumbai. AVM (Dr.) Ajit Tyagi, DGM attended the valedictory function of the course and also contributed as a resource person.

AVM (Dr. Ajit Tyagi, DGM giving certificate to Naval Officers

- Mid level update course for Naval Met officers in General Meteorology was conducted during 14-19 Nov 2011. AVM (Dr. Ajit Tyagi, DGM attended the valedictory function of the course and also contributed as a resource person.

- Basic Hydromet Observers course under Hydrology Project II was conducted at C.T.I, Pashan, Pune from 12-30 December 2011.

Mentoring Skills Course

Participants of Mentoring Skills Course

A training programme on 'Mentoring Skills Course', jointly organised by MoES and IMD, sponsored by DoPT was held during 7 to 9 December, 2011 at PAC Kolkata. PAC Kolkata acted as local organiser of the course. Another Mentoring skills course training conducted by DoPT & IMD, H.Q New Delhi at M.C. Ahmedabad from 12 - 14 October 2011. Twelve officers of the station attended the course.

9. MEETINGS

Monitoring Committee Meeting of Seismic Microzonation study

Advisory and Monitoring Committee Meeting

Fifth Meeting of Advisory and Monitoring Committee of Seismic Microzonation study of NCT Delhi on 1:10000 scale was held on 5th February 2011 at Earthquake Risk Evaluation Centre (EREC), India Meteorological Department, under the chairmanship of Padmshree Prof. A. S. Arya. The meeting was attended by eminent professor and scientists from IIT, GSI, IMD, IISc and the representative of CGWB, and SOI, New Delhi. Preliminary results of Seismic Microzonation of NCT Delhi, i.e., Design response Spectra at 25 sites and accelerated time history at bed rock depth and at surface at 25 representative sites distributed over NCT were discussed.

Annual Review Meetings

The Departmental Annual Review Meetings 2011 along with Users' meet was organised at RMC, Nagpur during 16-19 February 2011. The meeting was attended by scientists from RMCs, MCs, H.Q. and Pune office. All technical issues related to weather forecasting, monsoon and cyclones and administrative issues along with future plans were discussed and recommendations were made on various issues.

WMO/ESCAP Panel Meet

The inaugural function of the 38th Session of WMO/ESCAP Panel on Tropical Cyclones (PTC) was held at 1100 hrs (IST) of 21 February 2011 at SCOPE Complex, Lodi Road, New Delhi. Shri M. Sashidhar Reddy, Hon'ble Vice Chairman, National Disaster Management Authority (NDMA), Government of India, was the Chief Guest in the programme. Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences, Govt. of India presided over the meeting.

Members of 38th Session of WMO/ESCAP Panel

AVM (Dr) Ajit Tyagi, Director General of Meteorology, IMD and Permanent Representative of India at WMO welcomed the guests and delegates for the 38th Session of WMO/ESCAP Panel Distinguished delegates and invitees in the inaugural function included Dr. Quamar-uz-Zaman Chaudhry, Secretary, PTC, Dr. T. Toya, Regional Director for Asia and Southwest Pacific, WMO; Dr. K. Kuroiwa, Chief, Tropical Cyclone Programme, WMO; Dr Yuichi Ono, Chief of Disaster Risk Reduction Section, ESCAP, delegates from WMO/ESCAP Panel Member countries including Bangladesh, Myanmar, Thailand, Sri Lanka, Maldives, Pakistan, Oman, Delegates from China, ICAO, RIMES, Bangkok, Japan delegates from India (IMD, Central water Commission, Govt. of India and IIT, Delhi). All aspects of tropical cyclone over north Indian Ocean including disaster prevention and preparedness measures were discussed in the Session and resolution drafted.

Meeting on Implementation of FASAL

Dr. K.K. Singh, Scientist 'E' giving presentation before Steering committee

A Steering Committee Meeting on implementation of FASAL Scheme for crop yield forecasting held at DGM office on 18th March 2011. The meeting was attended by FASAL committee members from CRIDA, SAC, DAC, IMD, IARI and ANGRAU. The meeting was chaired by Dr. J. S. Parihar, SAC, Ahmedabad. He suggested that IMD and ISRO should make efforts for developing good database of Crop experiment and weather with larger accessibility. Dr. L. S. Rathore emphasized on building strong satellite based estimates of crop and weather parameters. The crop yield forecast at sustainable basis need to be institutionalized.

SAC - PAC Meeting

22nd Standing Advisory Committee Meeting of Positional Astronomy Centre was held on 26th March 2011 at Salt Lake, Kolkata under the chairmanship of Dr. G. M. Ballabh, Professor, Osmania University, Hyderabad in presence of AVM (Dr.) Ajit Tyagi, DG, IMD. The meeting was also attended by Shri U. P. Singh, Director (Publication). The meeting ended with several recommendations for future programme and progress of the PAC with vote of thanks by Shri S. Sen, Director, PAC, Kolkata.

Plan Review Meeting

A Plan Review Meeting was held during 4-6 April 2011 to review the performance of various plan schemes, the current status and constraints being faced in realization of desired targets. The meeting was attended by all heads of offices and divisional heads. DGM welcomed the participants and briefed on the achievements of last year. The change of people's perceptions about IMD weather forecasting was appreciated during the meeting. The presentations by various participants were made as per programme. At the end of the meeting DGM thanked all participants for active participation in deliberations and advised them to submit revised 12th five year plan schemes.

2nd South Asian Climate Outlook Forum

Second Meeting of South Asian Climate Outlook Forum (SASCOF), was jointly organized by IMD and IITM from 13th to 15th April 2011 at IITM Pune. Senior Officers from IMD, IITM, Experts from National Scientific institutes, Retired Scientists from IITM, invitees from USA, Japan & France delivered lectures in the forum meet. Representative from WMO also attended SASCOF-2 meet. Shri A. K. Srivastava, Scientist-'E' was the Chief Coordinator for this meet.

Second Meeting of South Asian Climate Outlook Forum

The Forum deliberated on various observed and emerging climatic features that are known to influence the

performance of the monsoon, such as sea surface temperature conditions over the equatorial Pacific and the Indian Oceans, winter and spring snow cover and surface temperature anomalies over Northern Hemisphere.

Users' Meet on Weather Services

Users' Meet on 'Weather services to Karnataka state delivered by IMD' was organized by M C Bangalore on 27th June 2011 at the Auditorium, Karnataka Veterinary Council, Hebbal, Bangalore. Dr. Y.E.A. Raj, DDGM, RMC Chennai welcomed the delegates. AVM (Dr.) Ajit Tyagi, DG IMD presided over the function and released the booklet on Met. Centre, Bangalore. Chief Guest Shri N. C. Muniyappa, IAS, Prinicpal Secretary to Govt. of Karnataka, delivered inaugural address. Also Shri M. Naveen Kumar, IAAS, Managing Director, Bangalore and Shri K. S. Prabhakara, IAS, Secretary to Government, Revenue Department Bangalore were the Guests of honor for the function.

Brainstorming meet on Southwest Monsoon

Lighting of lamp by Dr. Y. E. A. Raj & others

M. C., Thiruvananthapuram organized one day "Brainstorming meet on Southwest Monsoon" on 18th May 2011 at Thycaud, Thiruvananthapuram. The main objective of the meet was to provide a common platform for researchers, planners, hydrologists, agriculturists, disaster managers, and media professionals to share their knowledge. The session focused on all aspects of SW monsoon and experts delivered talk on various themes of SW monsoon. Dr. Y. E. A. Raj, DDGM, RMC Chennai presided over and Dr. C.T.S. Nair, Executive Vice President, Kerala State Council for Science, Technology & Environment, Thiruvananthapuram inaugurated the meet. There were seven presentations. 64 Senior Officers from 50 different organizations attended the meet.

E -Agromet

First meeting of Steering Committee on implementation of project 'e-Agromet: ICT Enabled Integrated Agro Meteorological Advisory System' was held on 18th June 2011 in IT for Agriculture Lab., IIIT, Hyderabad to review the progress as well as to render technical guidance for development and implementation of e-Agromet project.

A state level co-ordination committee meeting

A state level co-ordination committee meeting on mass media discussion was held at Library Hall of M. C. Bangalore on 03 August, 2011 & 07 September, 2011. Shri B. Puttanna, Director and other 17 Directors from Doordarshan, AIR, Agriculture Department, Animal Husbandry, Horticulture, Sericulture, WRD departments of State government participated in the meeting. The Committee members were taken round the observatory and explained the activities of M C Bangalore. Doordarshan recorded & broadcast the programme.

Inspection of Parliamentary Committee

Parliamentary committee on official language visited at Dwarka on 26 September for the inspection of Met Office, Okha. Dr. K. J. Ramesh Sc-'E' and Smt. Manjula Sharma from MoES, Shri L. R. Meena Sc-F and Ms. Reva Sharma from IMD, New Delhi, Shri N. Y. Apte Sc-'F' DDGM (RMC), Mumbai and Dr. Kamaljit Ray, Sc-'E', Dir. M.C. Ahmedabad, attended the meeting. The assurance on implementation of Rajbhasha was given for various points raised by Honourable Members of Parliamentary committee.

A meeting for collaboration between IMD and Water shed Organisation Trust

A meeting was held for the collaboration between IMD and Water shed Organisation Trust (WOTR) at Agrimet Division, Pune on 5th July 2011 for generation of block level agromet advisories in 2 specified clusters of 25 villages in Sangamner and Akole Taluka of Ahmednagar District, Maharashtra. Dr. Mario Rohrer, Climatologist, METEODAT, Swithzerland, Dr. Urs Steinegger, Hydrologist, METEODAT, Swithzerland, Mr. Crispino. Lobo, Managing Trustee, WoTR, Mr. Vivek Rishi, WoTR, Pune and Dr. N. Chattopadhyay attended this meeting.

Meeting for upgradation of HPCS

MoES subcommittee meeting to workout the details of requirements of various MoES units in connection with the upgradation of HPCS was held under the chairmanship of Dr. P.P. Chakrabarti of IIT Kharagpur on 27th August, 2011 in Conference Room, Mausam Bhavan, New Delhi. Members of sub-committee from IMD and other departments participated in the meeting.

Annual Review Meeting under IAAS

Fifth Annual review meeting under IAAS was held during 18-20 October, 2011 at Lembuchera, Tripura to review the annual progress of all the 130 units under State Agriculture Universities/Two IIT's-Roorkee and Kharagpur and ICAR centres in the country. Scientist from most of the RMCs and MCs of IMD participated In the meeting. The Hon'ble Minister of Science & Technology of the state was Chief Guest and the DGM was given the honor with State guest.

Regional Coordination Committee Meeting

Regional Coordination Committee meeting of Officers - in-charge of all sub offices and units of RMC Chennai was conducted at RMC Chennai during 19-20 September 2011. AVM (Dr.) Ajit Tyagi, DGM presided over the meeting on 19 September 2011. DGM released Annual Report of RMC Chennai for 2010-11. Dr. Y. E. A. Raj, DDGM, RMC Chennai chaired the RCC meeting on 20 September 2011 and discussed the agenda points.

Software Development

A Colloquium/Brainstorming meet on the topic "In-House Software Development" was held at RMC Chennai on 23 December 2011 to discuss the current status, potential areas where such software could be developed along with future plans. The opening address was given by Dr. Y. E. A. Raj, Scientist-'F' (DDGM). There were ten presentations by different experts followed by discussion.

State Level Review Meeting on AAS

A State Level Review Meeting on Agromet Advisory Service was held at RMC, Chennai on 12 October 2011. Dr. Y. E. A Raj, DDGM RMC Chennai presided over the meeting. Shri Sandeep Saxena, IAS Commissioner of Agriculture, Govt. of Tamil Nadu delivered inaugural address and inaugurated the meeting.

State Level Review Meeting on AAS at RMC, Chennai

About 50 delegates from various institutions like Tamil Nadu Agricultural University, MS Swaminathan Research Foundation, Agromet Field Units, State Department of Agriculture, All India Radio, Doordarshan, IFFCO Kisan Ltd., Nokia Tools, Krishi Vigyan Kendras etc., participated in the meeting. Seventeen invited talks were delivered and 8 lead farmers from various districts of Tamil Nadu also participated in the meeting. They were informed about the uses of Agromet Advisories.

Parliamentary Committee's Inspection at Met. Office, Okha

Inspection of Parliamentary committee on official language was organized at Dwarka on 26th September, 2011 for the inspection of Met. Office, Okha. Dr. K. J. Ramesh Sc-'E' and Smt. Manjula Sharma, from MoES, Shri L.R. Meena Sc-'F' and Ms. Reva Sharma, Sr. Hindi Officer from IMD, New Delhi, Shri N.Y. Apte Sc-'F' DDGM (RMC), Mumbai, Dr. Kamaljit Ray, Sc-'E', M.C. Ahmedabad, attended the meeting. The assurance on implementation of Rajbhasha was given for various points raised by Honourable Members of Parliament. On their honour a cultural dance programme followed by dinner was hosted on 25th evening.

Creation of National Centre for Atmospheric Technology

Brainstorming Meet on "Creation of National Centre for Atmospheric Technology" was held at NIOT on 12 December 2011 organised jointly by IMD and NIOT. Around 75 delegates from 40 organizations, industries, academic institutions and research laboratories participated in the meet. Dr.Shailesh Nayak, Secretary, Ministry of Earth Sciences, addressed the delegates of the Brainstorming Meet through telepresence. AVM Ajit Tyagi, DGM, IMD, Dr.Swati Basu, Director, NCMRWF, attended the meeting. Dr.Y.E.A.Raj, DDGM and few other officers from RMC Chennai viz. Shri.S.B.Thampi, Dr.R.Suresh, Dr.S.R.Ramanan, Dr.S.Balachandran, Sc-E's, Ms.B.Amudha and Shri.W.B.Gopal, Director participated in the deliberations.

Individual meetings

Dr. R. Asokan and **Shri B. Puttanna**, Director attended meeting under the Chairmanship of the Additional Chief Secretary & Development Commissioner, Govt. of Karnataka at Vikasa Soudha, Bangalore regarding Climate change organized by Environmental Management Policy Research Institute, Bangalore on 2nd February, 2011.

Dr. M. Satya Kumar, Sc. 'E' participated Project Review meeting at Andhra University from 9 to 11, February 2011.

Dr. Medha Khole, Scientist 'E', Smt. Sunitha Devi, S., Director, Shri M. V. Mande, S.A. and Shri S. B. Sarode, S.A. attended the ACR/AMR/ATR meeting 2011 during 15-20 February, 2011 at RMC Nagpur.

Brainstorming Meet on "Creation of National Centre for Atmospheric Technology"

Dr. A. L. Koppar. DDGM (C) attended the Project Design Review (PDR) meeting at SAMEER, Mumbai on 7 March.

Dr. Medha Khole, Sc. E participated in the meeting at University of Pune during 30 May – 1 June 2011 as a Member of the panel of paper setters for the subject `Earth Science', for the State Eligibility Test (SET) examination to be conducted by University of Pune.

Dr. Geeta Agnihotri, Director has attended a State level committee meeting to monitor 'Weather, Crop condition & Drought' held at Vidhana Soudha, Bangalore on 07 June, 2011.

Shri B. Puttanna, Director has participated in the 3rd meeting of State Level Steering Committee of the World Bank Aided Hydrology Project Phase-II under the chairmanship of Principal Secretary, WRD on 17 June, 2011 at Vikasa Soudha, Bangalore.

Dr. P. Guhathakurta, Sc. 'E', participated in the sectional committee meeting on Hand Book for Water Resources Management, WRD 27 of Bureau of Indian Standards on 20th July, 2011 at Manak Bhawan, Bureau of Indian Standards, New Delhi.

Shri R. S. Dattatrayam, Scientist 'F' & Head (Seismology) attended the 4th meeting of Project Advisory Committee on Seismology of MoES held on 22 July, 2011 at National Institute of Ocean Technology (NIOT), Chennai.

Dr. S. D. Attri, SE (EMRC) participated in SAARC Seminar on "Application of NWP Models in Mountain Weather Forecasting and Extreme Weather Warnning over SAARC Region" during 26-27 July, 2011 at New Delhi.

Dr. R. Asokan, Director-in-charge has participated in the Eighth Executive Committee Meeting of the Karnataka State Natural Disaster Monitoring Centre at Cauvery Bhavan, Bangalore on 27 July, 2011.

Shri B. Puttanna, Director has participated in a meeting convened by the Principal Secretary, Water Resources Department at Vikasa Soudha, Bangalore to review on performance of rain gauge stations, norms, dissemination of data and upgradation of RG stations on 28 July, 2011.

Dr. S. D. Attri, Sc. 'E' (EMRC) participated in the meeting of the National Steering Committee for India's Second National Communication to the UNFCCC held under the Chairmanship of Special Secretary, MoE&F on 1 August, 2011 in New Delhi.

Dr. A. B. Mazumdar, DDGM(WF) attended inaugural function of Annual Review Meeting on Forecasting Agricultural Output using Space Agro meteorology and Land base observations(FASAL)" organized by DDGM(Agrimet) on 1 August, 2011 at YASHDA, Pune.

Shri S. B. Thampi, Scientist-E and Dr.S.Balachandran, Scientist-E participated in the meeting on "Thunderstorm prediction model and development" held on 27 August, 2011 at National Atmospheric Research Laboratory (NARL), Gadanki, Andhra Pradesh.

Dr. R. Asokan, Scientist 'E', Director-in-charge and Sri L.Ramesh Babu, Scientist 'D' had a meeting with Shri Prithvi Ponappa, General Manager, Facilities, BIAL and signed MOU for the allotment of land at BIAL for the establishment of surface observatory on 30 August, 2011.

Dr. A. B. Mazumdar, DDGM (WF) attended the 83rd Governing council meeting of IITM, Pune on behalf of DGM on 30 August, 2011.

Shri P. R. Baidya, Scientist 'E' attended the 21st meeting of Koyna Tremor Sub-Committee (KTSC) held on 23 September, 2011 at Sinchan Bhavan, Pune organized by the Dam Safety Organization, Nashik.

Shri S. B. Thampi, Scientist-'E' DWR Chennai participated in the committee Meeting on "DWR Manual Review" held at IMD HQ New Delhi on 28 & 29 September, 2011 as a member of the committee.

Shri R. S. Dattatrayam, Head (Seismology) attended the 4th meeting of Group Monitoring Committee (GMC) on Geo-Sciences/Seismicity Program held on 4th and 5th November, 2011 at Kashmir University, Srinagar.

Shri B. Mukhopadhyay, DDGM(H) attended NDMA meeting of Brainstorming Session on Strategic Planning for Urban Flood Early Warning System on 16 November, 2011 at NDMA Bhawan, New Delhi .

Dr. R. S. Dattatrayam, Head (Seismology) attended the 1st meeting of the Committee as a Member for preparing draft policy for sharing, storage and archival of seismic and GPS data set up by the Ministry of Earth Sciences, held at Indian National Centre for Oceanic Information Services (INCOIS), Hyderabad on 28th November, 2011.

Shri S. B. Tyagi, Sc.-E attended NDMA meeting of Early Warning System for flash flood in Meenachal & Manimala in Kerala on 14 December, 2011 at NDMA Bhawan, New Delhi.

Dr. A. K. Shukla, Head, EREC, Chaired Technical Sessions of SAARC Expert group Meeting on Early Warning System for Cyclone and Tsunami, held during 19-20 December, 2011 at SAARC Disaster Management Centre, New Delhi.

10. SEMINAR / WORKSHOPS

INEMREC-2011

Releasing of book during the seminar

A seminar INEMREC-2011 on 'Indian Northeast Monsoon – Recent Advances and Evolving Concepts' was jointly organized by Indian Meteorological Society, Chennai Chapter and Regional Meteorological Centre, Chennai during 24-25 February 2011. Dr. S. Balachandran, Scientist-'E' delivered an invited talk on "Radiation budget and cloud effects during northeast monsoon" A book containing abstract of talk delivered during this seminar was also released and the first copy of this book was presented to Dr. J. Radhakrishnan, IAS, UNDP, New Delhi.

Conference for Hindi Media

Conference for Hindi Media in progress

IMD organized a round table conference exclusively with Hindi Weather Media Reporters, Editors/Producers of Weather related programmes, Science Correspondents, Editors of Science Magazines etc. on the theme "Weather systems during the summer season" on 7th April at Conference Hall, Mausam Bhawan, New Delhi. About 50 media personnel attended the conference. The queries raised by them about ensuing monsoon, thunderstorms and dust storms were replied by Dr. Ajit Tyagi, D. G., IMD and Shri B. P. Yadav, Sc-'E', NWFC.

National Seminar on "Climate for you"

Secretary, MoES addressing during National Seminar

A National Seminar on "Climate for you" was organized at New Delhi by IMD on 23 March, the World Meteorological Day. It was attended by more than 200 participants including scientists from Government and other research institutes, professors, WMO experts, IMD personnels, farmers, media personnel, university scholars etc. The seminar was inaugurated by Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences who stressed on the use of climate resource for societal benefits. WM Day address, Welcome address and Vote of thanks were delivered by AVM (Dr.) Ajit Tyagi, DGM, Dr. L. S. Rathore, Head (Agromet) and Dr. S. D. Attri, Scientist 'E' respectively. Dr. Ajit Tyagi (IMD) on 'Climate Perspective', Dr. Anil Kumar Singh (ICAR) on 'Climate Resources for Agriculture' , Dr. B. Bandhopadhyay (MN&RE) on 'Climate and Energy Management', Shri B. Mukhopadhyay (IMD) on 'Climate Services', Dr. R. C. Dhiman (ICMR) on 'Climate Change and Health', Dr. A. K. Gosain (IITD) on 'Framework for Water & Climate Change Impact Assessment', Wg. Cdr. Ajay Lele (IDSA) on "Climate and Aviation Strategic Applications" delivered specialized talks during the seminar.

Seasonal Prediction of SW Monsoon Rainfall

A training workshop on "Seasonal Prediction of SW Monsoon Rainfall" for participants from the south Asian countries was conducted at IMD, Pune during the period from 8-12 April, 2011. The training workshop was attended by representatives from six South Asian countries, namely Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka. Experts from the IMD and IITM, Pune and international experts from National Center for Environmental Prediction (NCEP), USA, Meteo France, France, International Research Institute for Climate and Society (IRI), USA, participated in the training workshop.

Organizing Hindi workshop

Second workshop was organized at Met. Office Palam on 20th May, 2011. Dr. O. P. Singh, DDGM, Regional Met. Centre, New Delhi, inaugurated the workshop. In his inaugurated speech Dr. Singh has given thanks for organizing Hindi workshop at Met. Office, Palam and expressed his hope that the participants will be benefited by the lectures in the workshop. About 42 participants of Palam office totaling 50 officials & others participated in the workshop. Workshop was concluded by Dr. Rajender Kumar Jenamani, Director, Met. Office, Palam with vote of thanks and with the discussion on the organization of workshop.

SAARC Seminar

Delegates from the SAARC countries

A SAARC Seminar on "Application of NWP models in Mountain Weather Forecasting and extreme weather warning over the SAARC region" was held in New Delhi during 26-27 July, 2011. IMD organized the Seminar on behalf of SAARC Meteorological and Research Centre (SMRC), Dhaka. Twelve delegates from the SAARC countries along with Indian delegates participated in the seminar**.** The Seminar was inaugurated by Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences. More than 60 delegates from IMD and other scientific organizations participated in the deliberations.

Workshop for Aeronautical Meteorological Personnel

Group photo of the participants of CSAMP workshop

India Meteorological Department and World Meteorological Organization have jointly organized workshop on Competency Standards for Aeronautical Meteorological Personnel in New Delhi from 31st October to 4th November 2011 at India Islamic Cultural Centre, Lodhi Road. Delegates from IMD, IAF, Indian Navy and members from other countries participated in the workshop along with four instructors from WMO. . A total of 35 participants including participants from 11 neighbouring countries have taken part in this workshop.

The main aim of this workshop was to convey general guidelines about, how to apply tools to conduct the Competency Standard for Aeronautical Meteorological Personnel in the region. The Competency and qualification Standards for Aeronautical Meteorological Personnel are applicable to individuals providing services to international air navigation. Taking benefit of the workshop, CAMD prepared a plan and started working on the basic level to implement this requirement. Further, as part of the IMD's safety oversight programme, safety audit of MWOs and a few international airport met offices have carried out. These two are ongoing programmes and will be integrated in the aviation met organisations functioning.

National Conference on Bay of Bengal Tropical Cyclone Experiment (BOBTEX-2011)

A National Conference (BOBTEX-2011) on the field experiments of Tropical Cyclone over the Bay of Bengal was organised by Cyclone Warning Division of India Meteorological Department during 1-2 November, 2011 at New Delhi. Prof. T.N. Krishnamurti, FSU, USA inaugurated the conference and Prof. J. Shukla, COLA, USA chaired the Panel Discussion and Concluding Session of the conference. Forty five scientific papers were presented in the conference including invited talks on various aspects of cyclones by experts on the field. Prof. T.N. Krishnamurti delivered a key note address on aircraft observations for cyclone monitoring and prediction.

BOBTEX-2011

4th All India Departmental Hindi Seminar

4th All India Departmental Hindi Seminar at H.Q. New Delhi

A Hindi Seminar on utility of Meteorological Services was organized on 1st July 2011 at IMD H.Q. New Delhi. The inauguration was started by lighting of candle and recitation of Saraswati Vandana. Seminar was conducted in two sessions. Honourable DGM addressed all speakers as well as audience. Mr. B. Mukhopadhyay Scientist-'F' was the Chairman of the first session and Mr. L. R. Meena Scientist-'F' for the second session. All the officials posted in the different offices delivered their lectures on various scientific topics through power-point presentation in Hindi. Chairman of both session congratulate the speakers for their good attempt and knowledge presentation in Hindi.

At the end of the session the DGM honoured all the speakers with mementoes and express his views that organizing such type of activity definitely will enhance the use of officials language Hindi in the department.

National Seminar on DRAWS 2011

National Seminar on Doppler Radar and Weather Surveillance (DRAWS 2011) was held at Balakrisha Hall, NGRI, Uppal, Hyderabad during 17-18 November 2011. It was inaugurated by Shri Pankaj Dwivewdi, Chief Secretary, Government of Andhra Pradesh, in presence of Dr. T. Radha, I.A.S., Relief Commissioner, Dr. Satheesh C. Shenoy, Director, INCOIS, Dr. Ajit Tyagi, DG, IMD, New Delhi, Dr. S. K. Kundu, DDGM (UI), New Delhi and Dr. Y. E. A. Raj, DDGM RMC Chennai. Shri D. Pradhan, Sc.'E' attended DRaWS - 2011 at M. C. Hyderabad and presented two papers on DWR applications.

Seminar on Polar Meteorology

A National Seminar on Polar Meteorology has been organized on 8th November 2011 at India International Centre, Lodi Estate, New Delhi. Dr. Shailesh Nayak, Hon'ble Secretary MoES, graced the occasion as Chief Guest and delivered the inaugural address. Shri Rasik Ravindra, Director (NCAOR), Goa gave key note address to delegates on "Polar Meteorology: Present Endeavors & Future Strategy".

Inaugural session on Polar Meteorology

AVM (Dr.) Ajit Tyagi, DGM IMD addressed the delegates. Prof. P. C. Pandey, IIT Bhubneswar delivered the welcome address. Scientists from various other institutes organization like MoES, IMD, NPL, SAC Ahmebabad, IIG, IIT Kharagpur & Asia Risk Centre presented their research papers during the three sessions on topics related to Polar Sciences, Satellite Observations over Polar Region and its Analysis & Meteorological/Environment Monitoring & Sharing of Experiences in Antarctica. Three books viz., Compendium of Antarctic Research Papers, Proceeding of Brain Storming Session-2010 & Special issue of MAUSAM on Polar Sciences were released during the National Seminar.

Weather and Climate Services in Haryana and Punjab

User Conference on "Weather and Climate Services in Haryana and Punjab " Emerging Issues and Challenges was organized by Met Centre Chandigarh on 14th November 2011. AVM (Dr) Ajit Tyagi was the chief guest of the function. More than 150 delegates from dfferent user agencies both Central/ State deptt. attended the conference. About 10 presentations on the topic were made by different organization. A booklet on Climate of Chandigarh prepared jointly by Met. Centre Chandigarh and RMC New Delhi was released by DGM and website developed by this office was also launched by DGM in the conference.

Release of Climate of Chandigarh booklet during conference

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Workshop on Seismic Hazard Microzonation

An interactive workshop was organized by Earthquake Risk Evaluation Centre (EREC), IMD, on 21st November, at India International Centre New Delhi to discuss seismic Microzonation products and assess further requirement by user agencies before finalization of products and maps. The workshop was inaugurated by Prof. A. S. Arya, Member of Bihar State Disaster Management Authority. About fifty Scientists, Engineers involved in design of buildings and City Planners from various scientific institutions and Department such as CPWD, DDA, and PWD participated in the workshop. The Seismic Hazard Microzonation study of half of NCT Delhi (North of NCT Delhi), covering an area of about 700 sq. km has been completed and several thematic maps have been generated. In this workshop preliminary results of Seismic Microzonation on 1:10000 scale of north Delhi, were presented.

National Conference on Satellite Meteorology

National Satellite Meteorological Centre of IMD organized national seminar on satellite meteorology (NCSM-I) on 26-27 December 2011 at New Delhi. The theme of the conference was utilization of MODIS/NOAA/METOP satellite data and products in weather analysis and forecasting. The conference was inaugurated by Secretary, Ministry of Earth Sciences. During the inaugural speech Secretary emphasized the validation, inter-calibration, sensitivity analysis and quality checks of the satellite data. Director General of Meteorology, AVM (Dr.) Ajit Tyagi highlighted the importance of satellite data in various spheres of meteorology, especially assimilation in Numerical Weather Prediction (NWP) models. The judicious utilization of the satellite data can help in nowcasting and forecasting the various scale phenomena and their complex interaction with Land and Ocean. About 35 research papers were presented by scientists/research scholars from various Departments/Institutes like: IMD, ISRO, JNU, University of Kolkata, INCOIS, IITM etc.

Tropmet 2011

Release of book Challenges and Opportunities in Agrometeorology

TROPMET 2011, a National Conference on "Meteorology for Socio-economic Development" was organized by Hyderabad Chapter of the Indian Meteorological Society at Hyderabad during 14-16 December 2011. About 300 delegates including senior scientists and young scholars from all over the country participated in the conference under 12 themes. The Conference was inaugurated by Shri M. Shashidhar Reddy, Vice-Chairman, (NDMA). Dr. Shailesh Nayak, Secretary, MoES, AVM (Dr.) Ajit Tyagi, DGM, Dr. R. K. Datta, Vice President IMS delivered Guest of Honour, Key Note and Presidential Address, respectively. Welcome address, award ceremony and vote of thanks were conducted by Dr. V. K. Dadhwal, Chairman, IMS Hyderabad, Dr. S. D. Attri, Vice-President IMS and Shri Y. K. Reddy, Organsing Secretary, respectively. Prof. S. K. Dash was conferred upon Fellowship of IMS. A Book on "Challenges and Opportunities in Agrometeorology" by S. D. Attri, L. S. Rathore, M. V. K. Sivakumar and S. K. Dash published though Springer was also released.

Workshop on Fog

A national Fog Forecaster-Users interactive Workshop on "IMD's Fog Monitoring, Forecasting and Dissemination Services 2011-2012" was organized by MWO Palam, on 30 Dec, 2011 at DIAL Conference Hall at New Udan Bhavan at IGI Airport. Dr. R. K. Jenamani, Sc-'E' was convenor. AVM (Dr.) Ajit Tyagi DG IMD was the chief guest at the Introductory Session of the workshop. Dr O. P. Singh, DDGM RMC Delhi, Mr. S. B. Sharma, Deputy GM ATC and Mr. N. Rao, Vice-Chairman DIAL, Mr. Marcel, COO Air side operation, DIAL also addressed the participants.

Individual Participation

Dr. A. B. Mazumdar, LACD ADGM(R) participated in the panel discussion and concluding session of Annual Monsoon Workshop 2010, organized by IMS, Pune Chapter on 13th January 2011.

Shri H. S. Mandal attended International Symposium on 'The 2001 Bhuj earthquake and Advances in earthquake Science held during 22-24 January 2011, at Institute of Seismological Research, Gandhi Nagarand and presented a paper on ,An Intra-plate Earthquake and the study of Ground Response Analysis using Equivalent Linear method- a case study of NCT Delhi.

Dr. M. Satya Kumar, Director I/C (Scientist 'E') and Shri Y. K. Reddy, Scientist 'E' participated in "Users Interaction Workshop" held at INCOIS, Hyderabad on 4 Feb. 2011.

Dr. Medha Khole, Scientist 'E' and **Smt. Sunitha Devi,** S. Director attended the workshop on, `Towards the era of Probabilistic Predictor from days to decades' organised by MoES at India Habitat Centre, New Delhi during 22-23 Feb. 2011 at New Delhi. Dr. Medha Khole, Scientist `E' made a presentation on the topic, "Communicating uncertainties in Weather Forecasting" in the said workshop.

Dr. D. S. Pai, Scientist 'E' and Shri. O. P. Sreejith, Met attended two days workshop on 'Towards the Era of probabilistic predictor from days to decades' from 21 to 24 February 2011, organized by MoES at India Habitat Centre, New Delhi.

Dr. G. Krishna Kumar, Scientist 'E' delivered Prof. C.B. Joshi Memorial lecture on 'Climate Change and Data Management' on 5th March, 2011 at Department of Geography, University of Mumbai.

A. K. Sharma, Scientist-'E', M. C., Dehradun participated in the workshop on "Mountain Agriculture in Himalayan Region" on 2-3 April 2011 at Central Soil and Water Conservation Research and Training Institute, Dehradun. The Workshop was inaugurated by the Union Minister of State for Agriculture Shri Harish Rawat.

Dr. Y. E. A. Raj, DDGM and Dr. S. R. Ramanan, Scientist-'E' participated in the inaugural function of the Regional Workshop on "Establishing a Co-operative mechanism for protection of Met. Ocean data and Tsunami Buoys in the North Indian ocean region" at NIOT, Chennai on 6th May 2011.

Dr. D. S. Pai, Scientist 'E' attended two days National Seminar on Climate Change held on 20th & 21st July 2011 at Goa Science Centre, Miramar, and delivered Key Note address entitled "Climate Change: Impacts & adaptation" and another invited lecture entitled "Science behind Climate Change & Global Warming".

Dr. A. K. Shukla attended a conference on Earthquake Risk Management for Industries (ERMI - 2011) July 21-22, 2011 ,Organized by National Disaster Management Authority (NDMA), Federation of Indian Chambers of Commerce & Industry (FICCI) and Global Forum for Disaster Reduction (GFDR) at New Delhi and presented a paper on Earthquake Hazard Mitigation Approaches vis-a-vis Seismic Hazard Microzonation

Dr. A. K. Shukla, Scientist 'F' (Head: EREC) attended a workshop on "Disaster preparedness an Road Maps of J&K held on 28 July 2011 at SKICC, Srinagar organized by State Disaster Management Authority (Revenue Deptt J&K) in collaboration with NDMA, New Delhi and made a presentation on "Use of Seismic Microzonation for Land use and Disaster Management".

Dr. Medha Khole, Scientist 'E' attended a National Workshop on, "Weather Forecasting" on 11th Aug. 2011 organized by Modern College of Arts, Science & Commerce, Pune and delivered a lecture on, `Monsoon Forecasting'.

Dr. A. P. Pandey, Met-I and Shri H. S. Mandal, Met-I attended a training course on "Earthquake Resistance Design and Construction" jointly organized by BMTPC, New Delhi and IIT Roorkee held between 01-03 September 2011 at IHC, New Delhi.

Dr. Y. E. A. Raj, DDGM participated in the Conference organised by Dr.M.S.Swaminathan Research Foundation, Chennai and chaired a session on 6 September 2011.

Dr. A. K. Shukla, Scientist-'F' (Head EREC) attended "Indo-Norwegian Workshop on Geohazards" organized by MoES held on 11-14 September, 2011 and made a presentation on Seismic Hazard Microzonation and a few results of Seismic Hazard Microzonation study of NCT Delhi.

Siddhartha Singh and S. K. Peshin, Study of surface ozone during the festival of Diwali: A case study of Delhi at National conference on science of climate change and Earth's Sustainability: Issues and and Challenges: A Scientists-People Partnership, organized by the society of Earth Scientist at university of Lucknow,12-14 Sep., 2011.

AVM (Dr.) Ajit Tyagi, DGM, New Delhi attended and chaired the inaugural function of National Conference on 'Science of Climate Change and Earth's Sustainability : Issues and Challenges' at Lucknow University Campus, Lucknow on 12th September 2011. Also he visited DWR, Lucknow.

A. K. Jaswal, Director, **Smt. Sunitha Anil Nair and Smt. Latha Sridhar**, S. A., attended a National Conference on "Science of Climate Change and Earth's Sustainability: Issues and Challenges" at Lucknow on 12-14, September 2011 organized by "The Society of Earth Scientists, India" at University of Lucknow. Shri Jaswal presented a paper in this conference and Smt. Nair made a poster presentation on paper entitled "Heat Wave Conditions over India during 1961-2010"

Dr. O. P. Singh, DDGM, RMC, New Delhi attended the National Conference on 'Science of Climate Change and Earth Sustainability: Issues and Challenges' at Lucknow University Campus, Lucknow and presented a lecture on 13th September 2011. Also he visited DWR & M. C. Lucknow.

R. S. Dattatrayam, Scientist-'F' (Seismology) and Shri G. Suresh, Scientist-'E', Seismology Division attended the 'Indo-Norwegian Workshop on Geohazards' conducted by the Ministry of Earth Sciences (MoES) at New Delhi during 12-14 September 2011. He delivered a talk on "Real time earthquake monitoring in India" wheras Shri G. Suresh on the topic "Assessment of tsunamigenic potential from the ratio of broadband energy to high frequency energy for earthquakes in Sumatra-Andaman region".

Dr. S. K. Peshin Scientist 'F' and **Dr. S. D. Attri**, Scientist 'E', EMRC participated in the National Workshop on India's Second National Communication to UNFCC Chaired by Hon'ble Minister for Environment & Forests, on September, 20th 2011 at Hotel Ashoka, New Delhi.

Ms. B. Amudha, Scientist 'C' RMC Chennai participated in the National Seminar on 'Disaster Management and Law – Issues and Challanges' held at Chennai during 12-13 October 2011 and presented a paper on "Scope and limitations in handling the legalities of weather-related disasters".

Dr. Y. E. A. Raj, DDGM participated in the valedictory function of a seminar on Disaster Management held at Dr. Ambedkar Law University, Chennai and gave special address on 14 October 2011.

R. S. Dattatrayam, Scientist 'F' & Head (Seismology) and Shri G.Suresh, Scientist-'E' (NSN) attended a workshop on 14 October, 2011 organized by Ministry of Earth Sciences (MoES) on "Current scenario of Seismic Microzonation".

Dr. Rajesh Prakash, Scientist 'E' attended Indo-Ireland workshop on earthquake prediction at Wadia Institute of Himalayan Geology, Dehradun during 20-22 October, 2011.

Dr. Jayanta Sarkar, Scientist 'E' attended the Workshop on 'Drought Mitigation & Management' at NIH, Roorkee, from 29 October to 5 November, 2011.

Y. K. Reddy, Scientist 'E' attended National Seminar on Advances in floods and Cyclones forecasting on 10 November 2011 by APSDMS at their premises and delivered a presentation on infusing Doppler Radar Data in Flood Forecasting Models-2011.

Dr. Y. E. A. Raj, DDGM participated in the inaugural function of International conference on "Impact of Climate Change on coastal Ecosystem" organised by Sathyabama University and delivered an invited talk on 10 November 2011.

K. Seetharam, Scientist 'E' attended first National Seminar on advance in Flood and Cyclone Forecasting in India organized by APSDMS Government of Andhra Pradesh and Municipal Corporation Human Resource Development, Hyderabad on 10th & 11th November 2011.

H. S. Mandal, Met-I, participated in 17th Convocation IGC-2011 and International Conference on "New Paradigms of Exploration and Sustainable Mineral Development: Vision 2050" held on 10-12 November 2011 and made a presentation on "Frequency Dependent Spatial Variation of Shear Wave Quality Factor (Qs) of Central India Tectonic Zone (CITZ)".

AVM (Dr.) Ajit Tyagi, Director General of Meteorology was the Chief Guest in the inaugural function of 'International Conference on Environmental Knowledge for Disaster Risk Management' organized by National Institute of Disaster Management (NIDM) and delivered the inaugural address.

G. Sudhakar Rao, Scientist 'E' attended National Seminar on Doppler Radar and Weather Surveillance (DRAWS 2011) organized by India Meteorological Department, Hyderabad during 17-18 November 2011.

G. Sudhakar Rao, Scientist 'E' and Shri K. Seetharam, Scientist-'E' attended a workshop on delivery and evaluation of Agroment Advisories organized by ANGRARU, Hyderabad on 30th November 2011.

K. Seetharam, Scientist 'E' attended Seminar on Integrated Flood Analysis IFAS, during 21-25 November 2011 at NRSC, Hyderabad.

Dr. R. Asokan, Director-in-charge, Shri B. Puttanna, Director have attended a national workshop on climate change at CSIR-CMMAC Bangalore on 9 Dec, 2011.

O. P. Sreejith, Met.-I attended one day state level seminar on"Weather and Climate Change in Goa since Liberation" on 13th December 2011 organized by St. Xavier's College, Mapusa, Goa.

Dr. Medha Khole, Scientist-'E', DDGM(WF) attended the Annual Monsoon Workshop-2011 at NCL Auditorium, Pashan, Pune on 21st December 2011 organized by Indian Monsoon Society- Pune Chapter and delivered a lecture entitled, " An Overview of Monsoon-2011".

H. S. Mandal, Met-I, Dr. H. S. Sisodia, S.A. and Ms. Sarita Tiwari attended training Corse on "Codal practice on Earthquake Resistance Design on Structures" jointly organized by BMTPC, New Delhi and IIT Roorkee held between 28-30 December 2011 at IHC, New Delhi.

11. INTERNATIONAL & NATIONAL COLLABORATION

11.1. International Collaboration

Bilateral Cooperation with Russia and Mexico

As part of international collaboration, bilateral cooperation in the field of Seismology is currently being pursued with Russia and Mexico. In collaboration with Russia, 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. Under the ILTP project "Development of Artificial Intelligence algorithm and Expert System for recognition of seismic events and determination of source parameters", Dr. S. Bogoutdinov and Dr. A. Kagan visited IMD during 17 February to 2 March, 2011. During the visit the Fuzzy Comparison Algorithm for Recognition of signal (FCARS) developed by RAS was used for detection of anomalies in terms of analysis of seismic records. The original FCARS was modified for use in Window –XP and MATLAB 6.5 version. The algorithm was tested with test data and it was decided to develop the knowledge base for one station having three component seismographs for the three years.

As part of collaboration with Mexico, Shri G. Suresh, Scientist-'E' and Shri P.R. Baidya, Scientist-'E' visited Instituto de Geofisica, Mexico to carry out joint collaborative project on "Near real time estimation of (a) long period magnitude (b) moment tensor and (c) Tsunami potential of offshore earthquakes", for a period of 10 days from 28th January to 6th February, 2011 under the Indo-Mexican Scientific Technical Co-operation programme of DST.

Visit of WMO Team

A 3-member WMO team comprising of Mr. Jeffrey Wilson, Dr.(Ms) Wang Mehua and Prof. U.S. De, Retd. ADGM(R) IMD visited IMD during 21-28 March, 2011 to review the working of our Central Training Institute at Pune and Regional Training Centre at Delhi. Such reviews are conducted periodically to extend the recognition of designated Regional Training Centres of WMO (RTC). The above two Training Centres of IMD are RTC's for RA-II and RA-V regions.

An interactive session of faculty members of CTI, Pune with WMO team was held at CTI Pashan on 24 March 2011. The team also visited Agrimet Division on 25 March, 2011 and they were apprised of the training activities of the division by Dr. R. P. Samui, DDGM(Ag). The training programmes and infrastrutctures are currently undergoing improvement to stand requirements of the department in good stead.

Commission of Agriculture Meteorology (CAgM)

Dr. L. S. Rathore, Head (Agro-meteorology), participated in the meeting of the management group of the Commission of Agriculture Meteorology (CAgM), WMO, held at Bratialava, Slovakia during 9-10 May 2011. Dr. Rathore is the Co-Chair of OPAG-1 which is dealing with Agrometeorological Services for Agricultural Production. The Management Group discussed at length the aspects related to (i) improving Service Quality/Delivery, (ii) advancing Science & Technology with Implementing Applications, (iii) strengthening Capacity-building, (iv) establishing closer Collaborations with related programs and (v) strengthening Good Governance. India has emerged as a leader in operational agrometeorology through its agrometeorological advisory service. The Management Group felt that the linkages with regional associations need to be strengthened for development of Regional Pilot Projects of operational Agro-Meteorology. There is also need for strengthening current system of education, training and outreach. It was expressed that CAgM should play an active role for implementation of Global Framework of Climate Services (GFCS).

16th World Meteorological Congress

The Sixteenth World Meteorological Congress was held at the International Conference Centre of Geneva (CICG) from 16 May to 3 June 2011. Shri Pawan Kumar Bansal, Union Minister of Parliamentary Affairs, Science & Technology & Earth Sciences led the 13-member Indian delegation consisting of DG, IMD, officials from Ministry of Water Resources & Agriculture and Scientists from various disciplines of Atmospheric & Earth Sciences. The opening ceremony of Cg-XVI held on 16 May 2011. WMO President Alexander Bedritskiy and Secretary-General Michel Jarraud opened WMO's XVI Congress. More than 600 delegates, including Heads of States and Governments, Ministers, senior Government officials, heads of National Meteorological and Hydrological Services, and representatives of WMO partner organizations attended the three week meeting for determination of WMO's future direction.

Hon'ble Minister Shri P.K. Bansal and AVM (Dr.) Ajit Tyagi, DG, IMD with Mr. Michel Jarraud , Secretary General, WMO at the 16th WM Congress, Geneva

The Congress considered strategic plan and budget of WMO future priorities for 2012-2015, in particular. These include the proposal for the Global Framework for Climate Services, the WMO Strategy for Capacity Development, the WMO Integrated Global Observing System, the WMO Information System, the Disaster Risk Reduction & the Aeronautical Met. Services. The Hon'ble Minister Shri Pawan Kumar Bansal also addressed the Congress at Geneva. He assured to support global framework for climate services. On behalf of Indian delegation he expressed appreciation and gratitude to WMO for the excellent arrangements made for the Sixteenth Congress. Further, he emphasized that the co-operation of India towards the successful outcome of WMO's objectives and programmes remains unstinted. During this session AVM (Dr.) Ajit Tyagi, DG, IMD was elected as the member of WMO Executive Council.

WMO Executive Council Meet

63rd WMO Executive Council Meet was held during 6-8 June 2011. AVM (Dr.) Ajit Tyagi, DG, IMD represented India during 6-8 June 2011. The Congress decided to nominate /elect members from all six regions. It includes ten seats attributed to the President and Vice-Presidents of the Organization, and the Presidents of regional associations, as well as twenty-seven seats of Directors of Meteorological and Hydrological Services of Members of the Organization to be elected by Congress. Dr. Ajit Tyagi, DG, IMD along with other five members each from China, Korea, Japan, Saudia Arabia and Iran represented RA II region.

Capacity Building Workshop

A workshop capacity development requirement for GFCS was held at Geneva, Switzerland from 10-12 October 2011. The focus of this first meeting was further exploring the capacity development requirements for NMHSs to play a key role in the GFCS. It recognized that some NMHSs are already delivering climate services on a range of temporal scales whilst others are struggling to even collect quality control and archive observations. The majority of the participants for this first workshop were from the Climate Services Information System (CSIS) community. The outcome of the workshop was a better definition of the capacity development requirements of NMHSs in least developed, developing countries or Small Islands Developing States (SIDS) to allow them to fulfill their role in GFCS and provide options on how to present their requirements as part of the overall GFCS implementation plan.

ECTT-GFCS- 2011

The first meeting of the Executive Council Task Team on the Global Framework for Climate Services (ECTT-GFCS) was opened on 13 October 2011 at WMO Headquarters in Geneva and was addressed by Mr. Michel Jarraud, Secretary-General of the WMO. In his opening remarks, the Secretary-General of WMO, pointed out that the GFCS was established by WMO in the 60s. There is need to engage and collaborate with the UN family and partners, including key stakeholders. AVM (Dr.) Ajit Tyagi who is Member of Executive Council Task Team on the Global Framework for Climate Services and Permanent Representative of India with WM presented India during 13-15 October 2011.

11.2. National Collaboration

MoU among ISRO, IMD and Doordarshan

A memorandum of Understanding among ISRO, IMD and Doordarshan was signed on 17th March 2011 for installation of 500 nos DTH modified type Cyclone Warning Dissemination System (CWDS) to replace the existing network of CWDS. Implementation of this project will be very useful for giving Cyclone Warnings or any other warning to the affected areas as this warning will be on one of the DTH television channels and has a provision to stop any ongoing programme on TV (if DTH box is connected to TV) and issue the cyclone warning to the listener. Such systems will be installed along the coasts of India. The Technology is very economical, as compared to earlier systems.

MoU between IMD and CWC

DG, IMD, signing the MoU with CWC

A meeting was held between senior officers of IMD and Central Water Commission on 5th April 2011 at IMD, New Delhi. CWC, under the Union Ministry of Water Resources, collects hydro-meteorological data and issues flood forecasts on Major River and their tributaries in the country. IMD under the Ministry of Earth Sciences collects rainfall data. CWC & IMD agreed upon to exchange meteorological and rainfall data being collected by each department for effective use of these data. An MoU between CWC and IMD regarding exchange of Real Time Rainfall Data was signed. On behalf of Central Water Commission, the Chairman CWC, and on behalf of IMD, DG IMD signed the memorandum.

MoU between IMD and Andhra University

A Memorandum of Understanding (MoU) has been signed on 15th June 2011 between the Andhra University and IMD for conduct of an M. Tech course in atmospheric

MoU between the Andhra University and IMD

science for the officers of IMD. Andhra University will offer the course exclusively for the IMD officers. The MoU is a landmark to help develop capacity building between the two institutions. The memorandum was signed by DG, IMD, AVM (Dr.) Ajit Tyagi and Registrar, Andhra University Shri P.V.G.D. Prasad Reddy. The signing took place in the presence of Vice-Chancellor Dr. B. Satyanarayana, Principal of University Colleges, Dr. V. Veeraiah, Dr. G.S.N. Raju, and Dr. S.S.V.S. Ramakrishna, and Chairman of Board of Studies, Dr. K.V.S.R. Prasad. The IMD and AU will be involved in the design of the course work, conduct of lectures/practical/field work, examination and evaluation, project guidance and other aspects of the programme in conformity with rules and regulations.

MoU between IMD and CDAC, PUNE

MoU signing ceremony between IMD and CDAC

An MoU between India Meteorological Department and Centre for Development of Advanced Computing

(CDAC), Pune was signed by AVM (Dr.) Ajit Tyagi, Director General of Meteorology, IMD, New Delhi and Professor Rajat Moona, Director General, CDAC, Pune for Technology development for applications of weather and climate information in Agriculture, Hydrology Aviation etc. using interdisciplinary computational technologies such as GIS, networking, Indian language software and HPC.

MoU between BIAL and IMD

An MoU for the allotment of land at BIAL for the establishment of surface observatory was signed during a meeting of Dr. R. Asokan, Scientist 'E' and Shri L. Ramesh Babu, Scientist 'D' on 30th August, 2011 with Shri Prithvi Ponappa, General Manager, Facilities, BIAL.

MoU for provision of aeronautical

MoU for provision of aeronautical meteorological support at two newly commissioned airports at Sindhudurg and Durgapaur have been signed.

11.3. International Delegations

Visit of delegation from Indonesian

A six member delegation from Indonesian Meteorological Geophysical and Climatological Agency (BMKG), Jakarta visited Earth quake Risk Evaluation Center (EREC) New Delhi on 25 Jan, 2011. They were briefed about activities of EREC regarding monitoring, detection and evaluation of seismic hazards in and around country. They were also briefed about optimum seismological network program of the division. A brief presentation was made by Dr. A. K. Shukla, Sc. 'F' Head, EREC regarding the function of EREC and seismic Hazard evaluation of NCT Delhi.

Shri L.R. Meena, Scientist "F" briefing to Indonesian delegates

Visit of WMO Team members

An interactive session of faculty members of CTI, Pune with WMO team was held at CTI Pashan on 24th March 2011. The team also visited Agrimet Division on 25th March 2011 and they were apprised of the training activities of the division by Dr. R. P. Samui, DDGM (Ag). The training programmes and infrastrutctures are currently undergoing improvement to stand requirements of the department in good stead.

Visit of African Delegation

A 19-member African delegation visited IMD on 18th September, 2011. They were shown the various forecasting techniques using models of NWP. They were also shown the working of HPCS.

African delegates being briefed

Visit of Indonesian Delegation

DG, IMD presenting bouquet to Indonesian Delegation

A Four Member delegation of Indonesian Meteorological Climatological and Geophysical Agency, Jakarta, Indonesia visited India Meteorological Department, New Delhi from 24-25 October 2011. The delegation was welcomed by DG, IMD on 24 October in Conference Hall, IMD New Delhi. They were apprised of functioning of ISSD, NWP, NWFC, Sat. Met. Division etc.

Visit of WMO Delegation

Dr. S. K. Roy Bhowmik, Sc. 'F' showing products of various NWP models to WMO Delegation

WMO Delegation visited IMD from 7 to 8th November, 2011 to discuss the work plan for Regional Integrated Multi-Hazard Early Warning System for project countries with India taking leading role in the 'capacity building for generation of local specific warning information products' for development of Severe Weather Warning Forecasting Demonstration Project (SWFDP) for RSMC, New Delhi. The delegation also visited the NCMRWF, Noida.

Visit of Russian Delegation

Two Russian Experts Dr. Evgeniy Nesterov, and Dr. Yuri Resnyanskiy from Hydromet Centre, Moscow visited IMD, NWP Division from 20 to 26 November, 2011 under Indo-Russian Sub-working Group on Meteorology. Dr. Nesterov was for Theme 1.1 i.e. "Study of conditions of tropical cyclones formation and development based on the result of simulations produced by mesoscale numerical atmospheric models" and Dr. Yuri was for Theme 4.1 i.e. "Development of a global ocean data assimilation system based on a 3D VAR scheme".

11.4 International Visitors

Dr. Marat Khairoutdinov, Associate Professor in School of Marine and Atmospheric Sciences, Stony Brook University, USA, visited IMD. NWP Division, New Delhi on 24 January 2011 and delivered a lecture on "Multi-scale Modeling Frame work".

Dr. Suresh Boodhoo, Ex-Chief, Mauritius Meteorological Services delivered a lecture on the topic, "Impact of climate change on Mauritius" on 24th March 2011 at IMD, New Delhi.

AVM (Dr.) Ajit Tyagi, DGM welcoming Dr. Marat Khairoutdinov

Dr. Ramesh Kumar Kakkar, Weather focus Area Leader, NASA, delivered a lecture on the topic, "The NASA 'GRIP' (Genesis and Rapid Intensification Process) (Tropical Cyclones) experiment," on 24th March 2011 at IMD, New Delhi.

Dr. Simon Mason, Chief Scientist, IRI visited IMD and delivered a talk on "Evaluation of ensembles – what is the correct ensemble spread" at DGM's office, New Delhi on 19th April 2011.

Dr. Zhan Zhang and **Dr. Vijay Kumar Surya Venkata Tallapragada** Scientists NCEP, USA visited IMD (NWP Division) during 28 June to 2 July, 2011 for installation and training programme of latest operational version of Hurricane Weather Research and Forecasting (HWRF) model for Indian region. Lectures were arranged which were followed by discussions between US & IMD scientists.

Mr. Hassane H. Cisse, Aeronautical Meteorology Expert from ICAO Montreal, Canada along with Shri Jang Bahadur Singh, Inspector – Air traffic management, DGCA, New Delhi visited Tropical Cyclone Advisory Centre (TCAC), New Delhi on 18th August 2011. Dr. M. Mohapatra Sc-'E' (CW) briefed them regarding activities of (TCAC), New Delhi, which was appreciated by the visitors.

Dr. TimoProescholdt, WIS expert from WMO visited IMD (ISSD), New Delhi from 5th to 7th September 2011 in connection with 'Jump Start-WIS implementation'. Various topics like WIS overview, practical WIS metadata, WIS functional specifications, WIS designation procedures, WIS strategy and project plan (IMD) etc were discussed during the visit to proceed further for GISC (Global Information System Centre) designation of RTH New Delhi.

11.5 Visit Abroad For International Assignment

Dr. R. Suresh, Sc. 'E', participated in ICAO's Asia Pacific Wind Shear Systems acquisition workshop" held at Bangkok from 1st to 3rd January 2011.

S/Shri G. Suresh, Sc. 'E' and P. R. Baidya, Sc. 'E' of Seismo division visited Mexico from 28th January to 6th February, 2011 for joint collaboration Project "A near real time estimation under Indo-Mexican Joint research Project".

Shri B. K. Bandyopadhyay, Sc. 'F', visited Kathmandu, Nepal from 10th to 11th February, 2011 for workshop on "Improvement of weather services the socital development" and delivered a lecture on "Weather Sevices in India" in the workshop.

Shri A. K. Sharma, Sc. 'F', visited Tokyo, Japan from 21st to 23rd February, 2011 to participate in the WMO Meeting of the coordination of the RAII Pilot to develope support of NMHSS in Satellite data, Product and Training.

Dr. M. Mohapatra, Sc. 'E' was deputed to Miami, USA from 21st March, 2011 to 1st April, 2011 to participate in RA-IV Workshop on Hurricane forecasting and warning & Public Weather Service, Florida, USA.

Shri B. K. Bandyopadhyay, Sc. 'F' and **Mrs. Suman Goyal**, Sc. 'E' visited to Honolulu, Hawaii, U. S. A. during 11th to 16th April, 2011 to participate in the 2nd workshop on International Best Track Archive for Climate Standard (1 BTr ACS) from 11th - 13th April, 2011 and WMO International Workshop on Satellite Analysis on Tropical Cyclones (IWSATC) from 13th - 16th April, 2011. Dr. Bandyopadhyay made a representation on the characteristics of Best Tracks over north Indian Ocean.

Dr. Medha Khole, Sc. 'E' participated in the Sixteenth World Meteorological Congress in Geneva, Switzerland from 18th to 23rd May 2011.

Dr. D. S. Pai, Sc. 'E' was on deputation to Centre for Ocean-Land-Atmosphere Studies (COLA) Calverton, Maryland, USA from 20th May to 10th June, 2011 under collaborative Research between IMD and COLA, on Prediction and Predictability of Indian Summer Monsoon Rainfall.

Shri K. C. Sai Krishnan, Sc. 'E' and **Ms. Rekha Kandwal**, S.A., are on deputation to USA to attend 12 weeks training in software source code of 2 nos C-Band DWR system at M/S VAISHALA Boston, USA w.e.f. 31st May to 19th August 2011.

Shri A. K. Sharma with other participants at WMO Geneva

Shri A. K. Sharma, Sc. 'F', attended the "Global space Based Inter-Satellite calibration system executive panel (GSICS-P10)" meeting at WMO HQ Geneva, Switzerland from 6th to 8th June 2011.

Dr. O. P. Singh, Sc. 'F' and **Shri R. Suresh**, Sc. 'E' visited agency of Meteorology, Climatology and Geophysics at Indonesia during 13-17th July, 2011 for finalization of project under MOU and field visits.

Dr. R. Suresh, Sc. 'E', deputation to Indonesia (Jakarta & Denpasar Bali) during 13-17 July 2011 accompanying Secretary, MoES.

Dr. D. S. Pai, Sc. 'E' attended two days National seminar on climate change held on 20th & 21st July at Goa Science Centre, Miramar, and delivered key note address entitled, "climate change; impacts & adapation and another invited lecture entitled, "Science behind climate change & global warning.

Shri S. B. Tyagi, Sc. 'E' participated in Water Information Research & Developments in Science Symposium at Melbourne, Australia during 1-5 August 2011.

Six IMD officers deputed for twelve week training in hardware operation of C-band Doppler weather Radar at M/S Vaisala, Helsinki, Finland w.e.f. 29th August.

Dr. M. Mohapatra, Sc. 'E' was on Ex India deputation to St Petersburg, Russia during 7-9 September, 2011 as an expert member of a five member Indian delegation led by joint secretary Ministry of Home Affairs, Govt of India to participate in the 4th Trilateral Meeting of Experts on Disaster Management from India, Russia and China.

Shri Satish Bhatia, Sc. 'E' was deputed Dhaka during 11-12th September, 2011 to attend fourth International programme Committee (IPC).

Dr. D. R. Pattanaik, Director and **Shri O. P. Sreejith**, Meteorologist Gr. I visited Moscow to participate in the meeting to carry out joint activities on the theme "Development of methods for analysis and forecasting intra-seasonal and inter-annual variability of precipitation fields based on results of meteorological forecasts" during 24-30th September, 2011.

Dr. Y. V. Rama Rao, Sc. 'E' deputed to Bangladesh, Thailand during period from 28-30th September 2011 to participated in United Nation ESCAP & RIMES joint region project.

AVM (Dr.) Ajit Tyagi, DG, IMD deputed Dhaka, Bangaldesh during period 24-29th September, 2011 and participated in 17th Meeting of governing Board of SMRC on 26-27th September, 2011 followed by selection committee meeting on 28th September, 2011.

Shri O. P. Sreejith, Met.-I on deputation to Roshhydromet, Moscow under Indo-Russian sub working group in Meteorolgy invited as IMD experts for the study of theme 1-2 Development of methods for analysis and forecasting intra seasonal and inter annual variability of precipitation fields bases on results of meteorological forecasts from 25th to 30th September 2011.

Dr. V. Rajeswara Rao, Sc. 'G', was deputed on tour to attend the 39 CGMS Meeting at St. Ptersburg Russian, Federation during the period from 3-7th October, 2011

Dr. D. S. Pai, Sc. 'E', was on deputation to BMKG Training Centre in Cietko, Bagor, Indonesia from 3rd to 7th October, 2011. He has participated and acted as resource person in the Training Workshop on Operational Climate Prediction for Southeast Asia.

Dr. D. P. Dubey, Sc. 'E', has participated in the conference of WMO on Monsoon Heavy Rainfall Workshop, at Beijing (China) during 12-14th October and presented his paper on "Intense Precipitation over Central India."

Dr. S. D. Attri, Sc. 'E', was deputed on tour to auezon city, Philippines to attend the workshop on Human Resources Development for NMHSS in Asia (RA-II) and South West Pacific (RA-V) countries" during the period 17-21st October, 2011.

Scientists of IMD and SATA along with scientists of INGV, Rome, Italy

Shri G. Suresh, Sc. 'E', **Shri H. P. Shukla**, Director, Seismology Ridge, **Shri Ajay Verma**, S.A. were on tour to attend the software training on "TESCO" (Vector digitizer of analog Seismograms) at Instituto Nazionale di Geofisica e Vulcan logia (INGV) Rome, Italy during the period from 3-11th October, 2011.

Shri Charan Singh, Director was deputed on tour to Xiamen, China to attend the WMO / WRVRP "International Workshop on Rapid changes in the Tropical Cyclone Intensity and movement from 18-20th October, 2011.

Dr. S.K. Roy Bhowmik, Scientist F at WMO WorkingGroup Meeting Beijing China

Dr. S. K. Roy Bhowmik, Sc. 'F' was deputed to attend WMO Working Group Meeting on Tropical Meteorology Research during 10-11th October, 2011, Beijing, China.

Dr. Jayanta Sarkar, Sc. 'E', was deputed to attend the International Symposium on Intergrated Information System (ISIDIS) to be held in Casablanka Morocco, during the period 9-11th November, 2011.

Dr. D. R. Pattanaik, Sc. 'D', was deputed to attend the Meeting of the Commission for climatology Task team on Definition of Extreme Weather and Climate events and expert Review Meeting Global Climate Decadal Summary during the period from 21-25th November, 2011.

Shri Ashok Kumar Sharma, **Shri Manoj Kuamr Bhatnagar**, **Shri Naresh Kumar Pangasa**, Sc. 'F' and **Shri Manish Ranalkar**, Met. Gr. I were on tour to Seoul Korea to attend the Meeting of RAII working group on WMO Integrated observing system and WMO information system during the period from 30 November to 7th December, 2011

Dr. O. P. Singh, Sc. 'F', was deputed on tour to attend the HYCOS Project Regional Steering Committee Meeting organized by ICIMOD in Kathmandu, Nepal during the from 1 to 2nd December, 2011.

Dr. N. Chattopadhyay, DDGM (Agrimet) participated in the Severe Weather Warning Demonstration Project (SWFDP)-Eastern Africa Regional Training Workshop on Severe Weather Forecasting (GDPFS) and Warning Services (PWS) as an Expert Lecturer and Resource Person held in Arusha, Tanzania from 28th November to 2nd December, 2011.

Dr. O. P. Singh, Sc. 'F' was on tour to attend the HYCOS Project Regional Steering Committee Meeting organized by ICIMOD in Kathmandu, Nepal during the from 1 to 2nd December, 2011.

Shri U. R. Joshi, Director was on deputation to WMO Geneva from 5th to 7th December, 2011 to attend a meetingon`Data Rescue Scheme'.

11.6. Distinguished Visitors

Shri N. D. Tiwari, Ex. Chief Minister of U. P. and Uttarakhand visited Meteorological Centre, Dehra Dun on 9th March 2011 and enquired about the various new developments and coordination with state departments to facilitate various works.

Dr. Anil Kulkarni, Scientist, IISc, Bangalore delivered a lecture on "Himalayan Glaciers and Climate change" at M. C. Bangaluru on 23rd March 2011.

Dr. B. G. Sidhartha, Director, B. M. Birla Science Centre delivered a lecture on "THE EARTH IN SPACE" at M. C., Hyderabad on the occasion of WM Day the 23rd March 2011.

Dr. K. Sundara Raman, Senior Scientist & Scientists from Indian Institute of Astro Physics, Kodaikanal visited Chennai and a talk was arranged at Regional Meteorological Centre, Chennai on 11 October 2011 on "Space, Weather - Sun, Earth connections", under the joint auspices of Indian Meteorological Society, Chennai Chapter.

Shri V. V. Bhat, Member Finance, MoES visited RMC Mumbai on 20th October, 2011. He visited Forecasting Office (Synergie), Doppler Radar, Seismo unit and was briefed about the various activities of RMC, Mumbai.

Dr. Arindam Chakraborty, CAOS, Indian Institute of Sciences, Bangalore delivered lecture on 'Validation of ECMWF Forecast over Indian Region' at IMD on 4 November, 2011. The lecture was attended by the Scientists of various divisions of IMD.

Shri L.R. Meena briefing to Shri T. Nanda Kumar about ISSD

Shri T. Nanda Kumar, the Honourable member of NDMA visited IMD on 16 Dec. He was apprised about functioning of different divisions of the department.

12. ACTIVITIES

IMD Foundation Day

136th Foundation day of India Meteorological Department was celebrated on 15 January, 2011 in the IMD, H.Q. campus. Shri Kapil Sibal, the then Hon'ble Minister for Ministry of Earth Sciences was the Chief Guest on this Occasion and the function was presided over by Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences. The function was attended by a large number of employees and distinguished invited Eminent Scientists. An exhibition displaying the recent developments and achievements in the modernization programme of the department was also arranged.

Release of Monsoon Monograph CD

On this occasion the 'Monsoon Monograph' and NOAA/METOP/MODIS Satellites products Catalogue were released. A quiz and an art competition on the relevant theme was organized on this occasion for school children of Delhi & NCR. Students of Shyama Prasad School, Lodi Estate, New Delhi and Delhi Public School, Greater Noida won the 1st and 2nd prizes respectively. About 15 Schools participated in the Art Competition with great enthusiasm. Sakshi Yadav, Archit S. Nair and Monika won the 1st, 2nd & 3rd prize respectively. The awards were given by Prof. Yashpal, Eminent Scientist & Educationist. The outstanding officers and staff were also given the Best employee's award. The program was followed by a cultural show by the artists of song and drama division of Government of India.

Prof. Yashpal distributing awards

WM Day Celebration

World Meteorological Day was celebrated by India Meteorological Department, New Delhi and its various Meteorological Centres all over the country on 23rd March, 2011 by organizing exhibitions, seminars, press release, specialized talks on the theme for 2011, *viz.*, "**Climate for You**". On this occasion, Shri P. K. Bansal the Hon'ble Minister for Science & Technology and MoES and Shri Ashwani Kumar the Hon'ble Minister of State, Science & Technology and MoES, both conveyed their warm wishes to entire Meteorological community for rendering excellent weather and climate services to the nation and complimented for conservation of long series of quality data. A press release was given highlighting WMO theme for this year and inviting the general public to visit IMD offices/observatories for popularizing meteorology.

Science Week

Science week was celebrated from 23-28th February, 2011 at most of the sub-offices of IMD. A number of schools and colleges visited M. C., Dehra Dun during the period. On this occasion, "Science Day Utsav" was conducted by Gujarat Council of Science city, Government of Gujarat and an exhibition was arranged at Science city, Ahmedabad from 27th February to 3rd March. M. C., Ahmedabad participated in the Utsav by putting exhibits, posters, weather instruments. A meteorological exhibition was also organized at RMC, Chennai, for students, teachers and public. They were suitably briefed about

various meteorological and environmental issues and were also taken around the observatory for first hand knowledge about the working of the instruments.

Science Day exhibition at Ahmedabad

Eclipses During 2011

There are an amazing six eclipses during 2011 consisting of four Partial Solar Eclipses and two Total Lunar Eclipses. Two Total Lunar Eclipses (TLE) occurred on 15th June and 10th December 2011. The Partial Solar Eclipse (PSE) occurred on 4 January, 01 June, 01 July and 25 November respectively. This 4.2 ratio combination of solar and Lunar Eclipses in a single year is extremely rare - occurring only six times during the 21st century. All solar eclipse during 2011 are partial eclipses ranging from magnitude 0.0971 (3% Eclipsed) to magnitude 0.9047 (87.3% eclipsed). They are January 04: Partial Solar Eclipse June 01: Partial Solar Eclipse June 15: Total Lunar Eclipse July 01: Partial Solar Eclipse November 25: Partial Solar Eclipse and December 10: Total Lunar Eclipse.

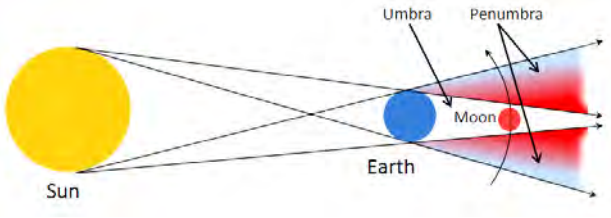
Partial Eclipse of the SUN

The first solar eclipse of 2011 occured at the Moon's ascending node in eastern Sagittarius. This partial eclipse of the Sun occurred on January 4, 2011 (14 Pausa, 1932 Saka Era) from 12h 10m IST to 16h 31m IST. The eclipse was visible from the northwest India. The partial eclipse was visible from most of Europe, the northern half of Africa, the Middle East, western Asia, northwest China, western Mongolia and the northwest part of India. The eclipse began at 12h 10m IST when the penumbral shadow of the Moon touches the Earth at local sunrise at a point in northern Algeria. The eclipse ended at 16h 31m IST when Moon's shadow finally leaves the Earth at local sunset at a point in east Kazakhastan.

Total Eclipse of Moon

On the night of 15 June, 2011 more than half the world watched one of the darkest Lunar eclipses. This was the darkest lunar eclipse in almost 100 years as the centres of the Sun, the Earth and the Moon would nearly be on one straight line. The earlier darkest lunar eclipse was observed on 6 August, 1971.

The lunar eclipse takes place when the Moon enters the shadow of the Earth. On such a night, the Earth is directly between the Moon and the Sun, blocking the sunlight reaching the Moon (otherwise put as "casting its shadow on the Moon"). Since the Moon and the Sun are on the opposite sides of the Earth, the event obviously is on a full moon night.



A total eclipse of moon was occur on 23h-53m IST of June 15, 2011 (25 Jaishtha, 1933 Saka Era) to 03h-33m IST of June 16, 2011 (26 Jaishtha, 1933 Saka Era) The phenomena was associated with this eclipse was visible throughout India. The moon passed almost through the centre of the earth shadow which was resulted in a long duration of total lunar eclipse. The entire eclipse i.e., complete umbral phase was visible from most of the Africa Middle East, central Asia including India and western Asutralia. The beginning of the umbral phase during moonset was visible from eastern Asia and eastern Australia. The ending of the umbral phase during Moon rise was visible from most of south America , western part of Africa and Europe.

Eclipse begins at 15, 2353 hrs IST and end at 16, 0333 hrs IST. The duration of eclipse was 3 hr 40 m and duration of totality was 1 hr 41 m.

Total eclipse of Moon 10 December, 2011

A total Moon was occurred on 10th December from 1815 hr IST to 2148 hr IST.

The eclipse was visible from North America except the eastern part, the northern half of Mexico, the Hawaiian Islands, Australia, Asia eastern Africa, Iceland and most of Europe. The complete umbral phase will be visible from central and western Asia, Australia and northwest North America. The beginning of the umbral phase, i.e., eclipse during moonset was visible from parts of Mexico, part of the USA and parts of Canada. The ending the umbral phase, i.e., eclipse during moonrise will be visible from part of Europe and parts of Africa. The eclipse was visible throughout India. The eclipse began at 10, 1815 hrs IST and ended at 10, 2148 hrs IST. The total duration was 3 hr 33 m and duration of totality was 52 m.

MoES - Annual Awards, 2011

DG, IMD alongwith MoES Awardees

Certificate of merit is given to Scientist working under Admin. Control of the Ministry for recognition of the scientific contribution towards achieving the task / goal assign to organization. Awards consist of a cash award of Rs.30,000/- trophy and a citation S/Shri Dr. D. R. Pattanaik, A. D. Thate and Ravi Kant Singh have been conferred certificate of merit for outstanding contribution in the field of Atmospheric Science and Technology. The best employee award is being given to one each in group B Gazetted and non Gazetted, group C and group D employees of the office under MoES. S/Shri R. K. Sharma, P. N. Chopade, V. Arvindan, Nirman Mondal Ajay Singh have been conferred best employees award in their cadre.

Biennial Mausam award

MAUSAM is a quarterly departmental journal dealing with Meteorology, Hydrology and Geophysics, published since January 1950. The Biennial Mausam award instituted in 1960 is presented to the best research paper published during the last two years. The award consists of a Citation and cash prize of Rs. (50,000/-) to be shared equally by authors. The 25th Mausam award for 2008-09 is being conferred upon **Dr. M. Mohapatra, H.R. Biswas and Shri G. K. Sawaisarje** for their research paper entitled, "**Daily summer monsoon rainfall over northeast India due to synoptic scale systems"**. In this paper the authors have studied the impact of different synoptic systems on the spatial variability of monsoon rainfall over northeast India. The distribution of excess/deficient rainfall and active/weak monsoon conditions has been explained.

Art Competition and Quiz Contest

Art competition and Quiz contest was organized on 20 & 21 Dec-2011 among school children of Delhi & NCR by Instrument Training Centre, Office of DDGM (UI) to mark the occasion of IMD foundation day 2012. First and second prize was won by Mother Teresa School, Preet Vihar and DPS Vidyut Nagar respectively in Quiz contest. In Art competition, 1st prize was won by student of Mother International School, 2nd prize by Modern School, Vasant Vihar , 3rd prize by Mother Teresa Public School, Preet Vihar and two consolation prizes by Air force Bal Bharti School, Lodi Road and Hans Raj Model School .

Achievements

Smt. Aasiya Aasif Bhat, S.A. of Meteorological Centre Srinagar was awarded First Prize in Hindi Reading Competition while participating in Hindi Workshop organized by Town Official Language Implementation Committee, Srinagar on 20 April, 2011.

Dr. D. P. Dubey, Sc. 'E' M. C. Bhopal was nominated as a panel member for selection of research fellows for Ph.D. in Physics in the Barkatullah University Bhopal .

Dr. S. D. Attri, Sc.-'E' evaluated Ph.D. thesis entitled "Physico-chemical characterization of Aerosols and Precursor Gases in and around Delhi" and conducted viva-voce examination on 6 April, 2011 at Jamia Millia Islamia University, New Delhi. He also conducted Viva-voce examination of M. Tech students at IIT Delhi on 31st May, 2011 and 24th June, 2011.

Shri R. S. Dattatrayam, Sc.-'F' & Head (Seismology) has been nominated as one of the members of the Research Advisory Committee (RAC) by the Governing Body (GB) of Wadia Institute of Himalayan Geology (WIHG), Dehradun.

RMC, Mumbai was presented "Best Work in official language award" by "Nagar Rajbhasha Karyanvayin Samiti", Mumbai on 28th October 2011.

Dr. A. K. Shukla, Head, EREC, has been nominated by State of Bihar as member of Technical Committee of Seismological Network to be setup at Bihar and attended first meeting held on 13th December, 2011 at Bihar State Disaster Management Authority (BSDMA), Patna.

Dr. Medha Khole, Sc.-'E' was conferred upon "Vocational Excellence Award" by Rotary Club of Pune from Dr. Budhjirao Malik, eminent Agriculturist on 23rd December, 2011.

Dr. Medha Khole receiving "Vocational Excellence Award"

Shri Anand Kumar Sharma, Sc.-'E', Meteorological Centre, Dehra Dun was awarded Bharat Jyoti Award and Certificate of Excellence by India International Friendship Society.

Dr. Medha Khole, Sc.-'E' worked as a Member of the panel of paper setters for the subject 'Earth Science', for the State Eligibility Test (SET) examination conducted by University of Pune.

Dr. V. Rajeswara Rao, Sc.-'E' was on tour to Andhra University, Visakhapatnam as External Examiner to conduct Examinations for M.Sc.

Dr. R. Suresh, Sc.-'E' has been appointed as a member of Board of Studies in Atmospheric Science, Cochin University of Science and Technology, Kochi.

Shri R. S. Dattatrayam, Sc.-'F' & Head (Seismology) has been elected to serve for four years as member of Executive Committee of the International Seismological Centre (ISC), UK.

Hindi Rajbhasha Chal Shield

The first Hindi Rajbhasha Chal Shield was awarded to Met. Centre Bhopal , out of 86 Central Govt. Offices, for maximum work being done in Hindi in office work and outstanding contribution in Hindi correspondence with other offices. The Prestigious Chal Shield was awarded at a grand function in Bhopal on 28-7-2011 by Shri Vijay Kumar Sharma IRS, Chairman Rajbhasha Kriyanvayam Samiti, Bhopal and Chief Commissioner, Income Tax Department, Bhopal to Dr. D. P. Dubey Sc. E

ISO certification for Surface Instruments Division Pune

IMD's Surface Instruments Division, headed by the DDGM(SI), manufactures, calibrates and maintains the surface met. instruments used in the met. Observatories. Bureau of Indian Standards (BIS) has authorized the laboratory of this division to calibrate met. instruments and sensors of other manufacturers in India and abroad. This division is also responsible for installation and maintenance of various observatories like surface met. Observatory, radiation station, AWS, ARG, AMO, etc. The radiation laboratory got recognition as Regional Radiation Centre for RA-II by the WMO. Recently this division has acquired ISO 9001: 2008 certification for the process of manufacturing testing calibration and supply of met. Instruments

Live Program

Shri B. Puttanna, Director participated in a live program regarding activities of M. C. Bangalore at AIR station, Bangalore and replied weather enquiries on 3rd Nov, 2011.

Dr. Y. E. A. Raj, DDGM participated in the programme organised by Doordharshan Kendra, Chennai on Monsoon and Cyclones on 21st November, 2011.

Shri Anand Kumar Sharma, Sc-'E', M. C., Dehra Dun participated on Hello D.D. programme of Doordarshan for interview with question – answer session on 16th December 2011.

Shri Sonam Lotus gave a "Live Phone in Programme" on Weather Services of IMD in J&K on Doordarshan Kashmir.

Exhibitions

RMC, Chennai participated in the 98 Indian Science Congress "Pride of India Exhibition" held at SRM University, Chennai from 2nd to 7th January, 2011.

IMD (HQ) participated in exhibition "Garwal Sarjan (Parola) 2011 at Parola, Distt. Uttrakashi, Uttrakhand w.e.f. 25th to 27th March, 2011 organized by CYME of Social Development (CSD), New Delhi. Shri J. P. S. Bhullar, A.M.-I was deputed on exhibition duties at Parola, Distt. Uttrakashi, Uttrakhand.

M. C. Bhopal has participated in the exhibition organized by National Science and Technology Expo. (CCRD N. Delhi) during 11-13 December, 2011 held at Shyamla Hills, Bhopal and was adjudged the best stall in the Science category.

Project Evaluation

EMRC evaluated sixty one (61) Thermal Power, one hundred eighteen (118) Industrial and forty four (44) Coal Mine projects referred to this Department by the Ministry of Environment & Forests, New Delhi.

Inspection Regarding Implementation of Rajbhasha Programme

A team from IMD (HQ) New Delhi comprising of Shri U. P. Singh, Director, Ms. Reva Sharma, Hindi Officer, Smt. Sarita Joshi & Shri Birender Kumar Sr. Hindi translator visited M. C. Ahmedabad on 22nd September, 2011 for inspection regarding implementation of Rajbhasha programme. During inspection, they suggested use of Hindi language in various areas of office work. Maximum use of Hindi is essential to implement program related to 'Implementation of Rajbhasha'.

.Inter-Ministry Bridge Tournament

IMD Bridge Team won the winners trophy of team Championship and also won the winners trophy of open pair in Inter-Ministry Bridge tournament 2011-2012 conducted by central Civil Services Cultural and Sports Board (CCSCSBI), New Delhi during 17-18 October, 2011.

Vigilance Awareness Week

The Vigilance Awareness Week was observed by India Meteorological Department, from 31 October to 5 November, 2011. The observance of the Vigilance Awareness Week was commenced with the pledge on 31 October, 2011. This year the theme of observing Vigilance Awareness Week was "Participative Vigilance". DG, IMD administered oath at 11 am at DGM Office. The Vigilance Awareness Week is celebrated in memory of Sardar Vallabh Bhai Patel who exercised a major influence in establishing the administrative structure in India. As we are well aware, there is an increasing concern about corruption eroding the basic values of life. It has not only a negative effect in social dynamics but also erodes the value system established in the country. It is important that the younger generation who has to play a pivotal role in the development of the country needs to be educated on the urgency to fight against such unethical practices

Celebration of Hindi Pakhwara

The Pakhwara was celebrated at IMD H.Q., New Delhi during the period 1-15 December 2011. During this pakhwara seven different type of competition viz. Essay, Noting & Drafting, Typing, Debate, Slogan and Cartoon etc. were conducted among the IMD employees. A cash prizes for 1st, 2nd, 3rd and two consolation prizes alongwith a certificate from DG, IMD were given to the winners.

Hindi Diwas was celebrated on 14th September at Chinmaya Mission, Lodi Road, New Delhi. The celebration programmes were conducted after lighting of lamp. On this occasion Senior Hindi Officer, Ms. Reva

Sharma read the message of Hon'ble Home Minister Shri P. Chidambram. On this occasion Mausam Manjusha was released. RMC, New Delhi received Raj Bhasha Chal Shield for doing maximum correspondence in Hindi.

The cultural programme conducted by school children and employees of this department left an unforgettable memory for their extra ordinary performances. During speech DG, IMD inspired the officials for doing maximum work in Hindi.

Hindi day and Hindi Pakhwada were also celebrated in the Regional Meteorological centres. RMC Chennai celebrated Hindi Pakhwara from 14th to 23rd September. Hindi Officer Mrs. Jaisurya Chelam from BSNL inaugurated this function on 14th September. During the Pakhwada of this celebration, the Director General of Meteorology released a Hindi Patrika 'Pawan Doot' on 19th September. During this celebration various type of Hindi competitions were conducted and winners of competitions awarded prizes.

Other Met. Offices of IMD also celebrated Hindi Day Hindi Pakhwara with great enthusiasm like H.Q. Positional Astronomical Centre, Kolkata celebrated Hindi Day on 15th September in which all officers and staff of the office participated with great enthusiasm. During this celebration Hindi Essay competition and self composed Hindi poet's recitation competition were conducted. Winners of the competitions were awarded during the celebration. Mr. D. Pradhan was invited as a Chief Guest of this celebration. At M.C. Lucknow Hindi daywas celebrated on 14th September and Hindi Pakhwada from 14-29th September. Officials participated in various competitions with great enthusiasm which were organized during the pakhwada. Prize distribution Samaroh was held on 29th September

Cultural programme at RMC, Chennai

Met Office Palam also celebrated Hindi Day on 14th September. The motto of this celebration was to improve the use of Hindi in the office work. Hindi Pakhwada was celebrated from 1-14 September. During this period Hindi poem recitation, Hindi noting, Hindi Essay writing competitions etc. were held and lectures on scientific subjects in Hindi were also conducted.

DDGM, RMC, New Delhi receiving Raj Bhasha Chal Shield from DG, IMD

Cultural programme at IMD

Release of Hindi Patrika "Pawan Doot"

13. LECTURES

Shri B. Puttanna, Director has delivered lecture on 11th January, 2011 on "Weather systems & forecasting and their likely impacts on water resources" in the trainers training program on 'scaling up of water productivity in Agriculture for livelihoods' organized by University of Agricultural Sciences, Bangaluru.

Dr. Murtugudde, Prof. University of Maryland, USA, delivered a lecture on "Earth life and sustainability", Prof. Pisharoity's distinguished lecture in the workshop at NCL, Pune organized by IMS, Pune on 13th January 2011.

AVM (Dr.) Ajit Tyagi, DG, IMD participated and delivered a talk on "Observed Climate Variability and Change" on 19th January, 2011 in the Seminar on "Socio-Economic Implications of Climate Change Initiatives" organized by GIS Development in association with DST, MoES and ISRO International Convention Centre at, Hyderabad.

AVM (Dr.) Ajit Tyagi, DGM welcoming Dr. Marat Khairoutdinov

Dr. Marat Khairoutdinov, Associate Professor in School of Marine and Atmospheric Sciences, Stony Brook University, USA, visited IMD. NWP Division, New Delhi on 24th January, 2011 and delivered a lecture on "Multi-scale Modeling Frame work".

Dr. R. P. Samui, Sc. 'F', delivered lectures on "Climate Change, Climate Extreme, Weather Events and Indian Agriculture on 4th February, 2011 and "Weather - based Insurance in Agriculture and Allied Sectors" on 5th February, 2011 in the 5th SERC School on "Agricultural Drought : Climate Change and Rain fed Agriculture" held at CRIDA, Hyderabad.

Dr. N. Chattopadhyay, Sc. 'E' delivered a lecture on "Impact of Climate Change on the Indian Monsoon" in the 10th Agricultural Science Congress held at National Bureau of Fish Genetic Resources, Lucknow during 10-12th February, 2011.

श्रीमती सरिता जोशी, वरिष्ठ अनुवादक, ने मुख्यालय की राजभाषा कार्यान्वयन समिति के सदस्यों के लिए कंप्यूटर प्रोद्योगिकी और हिन्दी विषय पर 28 फरवरी, 2011 प्रेंजटेशन दिया जिसमें कंप्यूटर पर यूनिकोड सक्रिय करने और हिन्दी में सरलतापूर्वक कार्य करने के विषय में बताया गया।

Sh. Anand Kumar Sharma, Sc. 'E', M. C., Dehra Dun delivered lecture on Ethics and Values in Scientific research to the middle level and senior scientists of various national scientific organizations at a workshop organized by the Lal Bhadur Shastri National Academy of Administration, Mussoorie on 1st March, 2011.

Dr. S. D. Attri, Sc. 'E', delivered a Lead talk on "Environmental Monitoring Strategies in India" in National Seminar on "Multidisciplinary Approach on Frontier areas of Environmental Science and Engineering" at GJU Hisat during 4-5th March, 2011.

Dr. S. D. Attri, Sc. 'E' delivering lead talk

Dr. A. Kashyapi, Sc. 'E', delivered lecture on "The Impacts, Vulnerability and Adaptation of Climate Change for Agriculture based on IPCC report" at Tamil Nadu Agricultural University on 14th March, 2011.

Dr. Suresh Boodhoo, Ex-Chief, Mauritius Meteorological Services delivered a lecture on the topic, "Impact of climate change on Mauritius" on 24th March, 2011 at IMD, New Delhi.

Dr. Ramesh Kumar Kakkar, Weather focus Area Leader, NASA, delivered a lecture on the topic, "The NASA 'GRIP' (Genesis and Rapid Intensification Process) (Tropical Cyclones) experiment," on 24th March, 2011 at IMD, New Delhi.

DG, IMD presenting memento to Dr. Ramesh Kumar Kakkar

Dr. Somenath Dutta, DDGM (T) and **Dr. P. Khare**, Director, delivered lectures on "General Meteorology" and "Climate of India" to the trainees of Agrometeorology, respectively.

Dr. S. D. Attri, Sc. 'E', delivered talk on "Climate Change: Science and Issues" at MDU Rohtak (Haryana).

Shri Jayanta Sarkar, Sc. 'E', delivered 4 lectures On "Drought Monitoring" and "Crop Yield Forecasting" to the participants of the Agromet Core Course organized by the Agrimet Division, IMD Pune.

Shri G. Sudhakar Rao, Sc. 'E', **Y. K. Reddy**, Sc. 'E', **K. Seetaram**, Director, **S. B. Tyagi**, Director and **R. V. Subba Rao**, Assistant Meteorologist Gr-I delivered a lectures on Aviation and General Meteorology to ATC Trainees at Begumpet Airport on 20 & 21st April, 2011.

Shri B. K. Bandyopadhyay, DDGM (S) and **Dr. M. Mohapatra**, Sc. 'E', attended the Interrelation Conference on Environmental knowledge for Disaster Risk Management, [EKDRM-2011] organized by National Institute; of Disaster, Management (NIDM) in collaboration with GIZ Germany on 10-11th May, 2011 at Vigyan Bhavan, New Delhi.

Dr. M. Mohapatra, Sc. 'E', delivered a presentation on "Cyclone Hazard Risk Profile of Coastal Districts of India".

Dr. Somenath Dutta, Sc. 'E' delivered lecture on "A Proposed Nowcasting method of different meso-scale weather orographic barrier" in the SERC School "CONMED" at AFAC, Coimbatore on 16th May, 2011.

Dr. R. Suresh, Sc. 'E' delivered a guest lecture on the topic "Basis of Radar Meteorology and Importance in Weather Prediction" in the national level training Programme on "Concepts of Nowcasting and Mesoscale disturbances (CONMED-2011)" held at AFAC Coimbatore on 17th May 2011.

Dr. Geeta Agnihotri, Director has delivered lecture on 'Weather Forecasting system during floods' on 18th May, 2011 to the trainee officers of 63rd All India Watermanship Course at Home Guards and Civil Defence Academy, Bangalore.

Ms. Reva Sharma, Senior Hindi Officer, **Mrs. Sarita Joshi** & **Mrs. Anuradha**, Senior Translators, delivered lectures in Hindi Workshop organized by M. O. Palam on 20th May, 2011.

Shri Anand Kumar Sharma, Sc. 'E , M. C., Dehradun delivered lecture on "Concepts in meteorology and climatology, tropical and extra tropical systems and application of satellite in operational meteorology" to the participants of NNRMS-ISRO certificate course conducted by Indian Institute of Remote Sensing on 31st May, 2011.

Shri S. Sudevan, Director delivered a lecture on "Role of IMD in disaster preparedness" for revenue officials in the training programme "Techno Legal Regime" on 8th June, 2011.

Dr. Kamaljit Ray, Director & **Mrs. Manorama Mohanty**, Met.-I attended Weekly weather watch group meetings under the chairmanship of commissioner of Relief, Government of Gujarat, with representation from CWC, Agriculture, Gujarat State Disaster Management agency (GSDMA), State irrigation department, Gujarat Maritime Board on 7th & 21st June, 2011.

Shri S. B. Thampi, Sc. 'E', DWR Chennai delivered five lectures on maintenance and calibration aspects of DWR in the training Workshop specifically arranged for officers and staff trained in Metstar Radar, held at MC Hyderabad on 21 – 22nd June, 2011.

Dr. M. Satya Kumar, Sc. 'E', **Shri K. Seetharam**, Director, **Shri S. B. Tyagi**, Director and **Shri R. V. Subba Rao**, AM - I delivered lectures on Aviation and General Meteorology to ATC Trainees of AAI, Hyderabad during the period from 23- 24th June, 2011.

Shri K. Santhosh, Sc. 'E', delivered a lecture on "Assessment and attribution of climate change and its impact on Agriculture" in project envisioning workshop on "Climate change" organized by College of Agriculture, Vellayani, Thiruvananthapuram as part of developing Vision 2030 document on 28th June 2011.

Dr R. K. Jenamani, Sc. 'E', M.O., IGI, Airport deliverd lecture on "Synoptic system during monsoon" in the SERC School organized at CAS, IIT Delhi on 30th June, 2011.

Shri A. K. Sharma delivering lecture at IIRS

Shri B. Puttanna, Director has delivered a talk on ' Climate change and early warning system in India' to Gr-A & B officers of Karnataka at Administrative Training Institute at Mysore on 8th July, 2011.

Dr. M. Mohapatra, Sc. 'E', delivered participated two lectures on 9th July 2011 on "Synoptic and statistical methods of prediction of summer monsoon circulation and precipitation" in the SERC school on Dynamics and forecasting of Indian summer monsoon organised by Centre for Atmospheric Sciences, IIT Delhi.

Dr. M. Satya Kumar, Sc. 'E', delivered a lecturer on "Cyclones and Floods at APARD, Rajendranagar, Hyderabad on 13th July, 2011.

Dr. Medha Khole, Sc. 'E', delivered a lecture on 19th July, 2011 on the subject, 'Weather Forecasting' at Athashri Foundation, Pune.

Dr. (Mrs.) Kamaljit Ray, Director delivered lecture on "Mid season review of Monsoon" at Space Application Centre, Ahmedabad, organized by IMS, Ahmedabad on 22nd July, 2011.

Shri P. R. Baidya, Sc. 'E', delivered a lecture on "Earthquake and its Parameters" on 11th August, 2011 in the training course on "Capacity Building of Engineers on Seismic Assessment, Retrofitting & Rehabilitation of Building" at CPWD Ghaziabad.

Dr. A. B. Mazumdar, DDGM(WF), delivered a special lecture on "Monsoon Forecasting" in a National Workshop on Weather forecasting on 12th August, 2011. organized by Modern College, Pune

Shri Anand Kumar Sharma, Sc. 'E', Meteorological Centre, Dehra Dun delivered a lecture on weather and climate effect on diseases on 12th August, 2011 to medical students of Shri Guru Ram Rai Medical College.

Dr. S. Balachandran, Sc. 'E', delivered a lecture on "Climate change and monitoring" at RMC Chennai to the students of Sathyabama University, who visited RMC Chennai on 23rd August, 2011.

Shri S. B. Thampi, Sc. 'E', DWR Chennai has participated in the inaugural function of Doppler Weather Radar Maintenance and Training Centre and also in the User's Meet at MC Hyderabad on 24th August, 2011.

Smt. Sunitha Anil Nair, Scientist and **Mrs. Sunitha Devi**, Sc. 'D' delivered a lecture each on National Disasters and Organizational structure of IMD for Disasters warning to officers from Revenue Department, Jila parishad, Police and Public work department from all district of Mahashtra who were undergoing a training programe organize under title, "Cyclone disaster Management by YASHADA" during September.

Shri P. R. Baidya, Sc. 'E', delivered a lecture on "Recent developments in seismic monitoring capabilities" on 22nd September, 2011 at IMD Pune, for the benefit of all officers & staff of IMD, Pune.

Shri D. Pradhan, Sc. 'E', delivered lecture at the seminar hall of geological survey of India, Kolkata on 28th September, 2011 on "DWR and its utilization on prediction of severe weather events".

Dr. Y. E. A. Raj, DDGM participated in the valedictory function of a seminar on Disaster Management held at Dr. Ambedkar Law University, Chennai and gave special address on 14th October, 2011.

Shri Anand Kumar Sharma Scientist-'E', Meteorological Centre, Dehra Dun delivered lecture on "Innovation, Technology and Services for Rural Empowerment" to the scientists of various central governmental scientific organizations at the Lal Bhadur Shastri National Academy of Administration (LBSNAA) Mussoorie on 31st October, 2011.

Dr. Medha Khole, Sc. 'E', was invited to be a Guest Speaker at a two day Conference organised by MAEER's MIT, Pune on "Agribusiness and Food Industry : Opportunities and Challenges". She delivered a lecture on the topic `Climate Change' during the said conference on 11th November, 2011.

Shri D. Pradhan, Sc. 'E', visited Central Training Institute, Pune during 15-16th November, 2011 to deliver lectures on "Applications of DWR in nowcasting" to "Mid level training course for Naval officers".

Dr. P.C.S. Rao, Director delivered lectures on short and Medium Range Weather Forecasting for Basic Agromet Course in Agricultural Meteorology on 21 and 22nd November, 2011.

Shri Sonam Lotus, Met-II and **Shri Y. S. Jadon, AM-I** gave presentation to army officers of 14th & 15th Corps on weather in Western Himalaya on 23 and 24th November, 2011 at Mountain Met Center (SASE) Srinagar during Annual Continuing Education programme of SASE.

Dr. Rajesh Prakash, Sc. 'E', delivered a lecture on the topic "Earthquake and its Parameters" on 14th December, 2011 in the training course on "Capacity Building of Engineers on Seismic Assessment, Retrofitting & Rehabilitation of Building" at CPWD Ghaziabad organized by CPWD, training Institute, Ghaziabad.

Dr. S. Balachandran, Sc. 'E', RMC Chennai delivered lecture on the topic "Cyclone Disaster Management" and field visit of RMC Chennai was arranged on 20th December, 2011 for the trainees (about 25 participants) of Anna Institute of Management, Chennai as part of the Training Programme on "Fundamental Course on "Disaster Management for Revenue Deptt.".

Shri G. Suresh, Sc. 'E', (NSN) delivered lectures in Seismology to the trainees of Advance Met. Training Course at Central Training Institute (CTI), IMD, Pune on 20 and 21 December 2011.

Dr. R. Suresh Scientist – 'E', AMO Chennai delivered five invited lectures in Aviation meteorology in the Advanced Forecasters' training course held at CTI, Pune during 21-22nd December, 2011.

Dr. A. K. Srivastava, Sc. 'E', delivered lectures in the one day Annual Monsoon Workshop-2011 at NCL Auditorium, Pashan, Pune on 21st December, 2011 organized by Indian Meteorological Society-Pune Chapter.

14. RESEARCH PUBLICATIONS

14.1. Papers published in Mausam during 2011

The Journal '**MAUSAM**' has an impact factor (IF) of **0.170** for the year 2011. Mausam is indexed and abstract by **Thomson Reuters**, U.S.A.

बद्री नारायण विश्नोईए भपश्चिमी राजस्थान के लिए पवन चक्कियों द्वारा विद्युत उत्पादन हेतु वायु विश्लेषण, *मौसम*, **62**, 1, 1-10.

N. Vivekanandan, "Prediction of annual runoff using Artificial Neural Network and Regression Approaches", *MAUSAM*, **62**, 1, 11-20.

Surinder Kaur and Ashok Kumar Das, "Catastrophic floods in Kosi catchment during August 2008", *MAUSAM*, **62**, 1, 21-26.

Mehfooz Ali, U.P. Singh and D. Joardar, "QPF Model for lower Yamuna catchment, synoptic analogue method", *MAUSAM*, **62**, 1, 27-40.

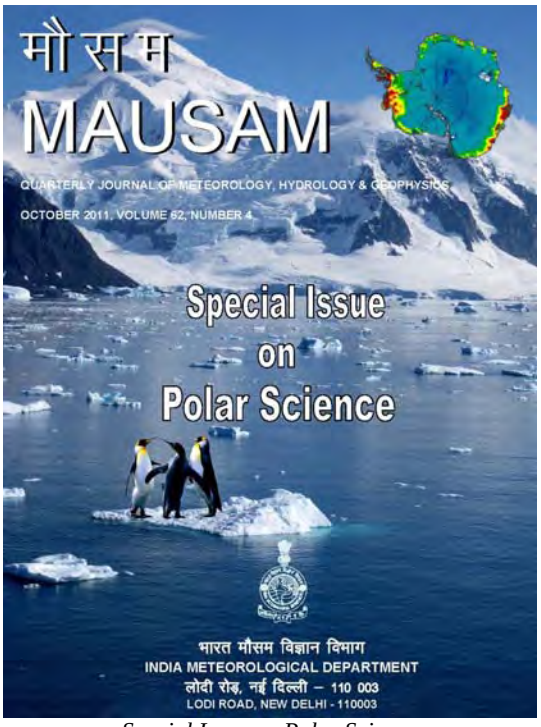
Charan Singh, "Unusual long & short spell of fog conditions over Delhi and northern plains of India during December-January, 2009-2010", *MAUSAM*, **62**, 1, 41-50.

Khaled S.M. Essa, Refaat A.R. Ghobrial, A.N. Mina and Mamdouh Higazy, "Calculation of crosswind integrated concentration by using different dispersion schemes", *MAUSAM*, **62**, 1, 51-60.

O. P. Singh and Harvir Singh, "Use of Scatterometer based surface vorticity fields in forecasting genesis of tropical cyclones over the north Indian Ocean", *MAUSAM*, **62**, 1, 61-72.

C. S. Patil, "A study on water consumption, water use efficiency and crop coefficient of groundnut", *MAUSAM*, **62**, 1, 73-76.

Suman Jangra and Mohan Singh, "Analysis of rainfall and temperatures for climate trend in Kullu valley", *MAUSAM*, **62**, 1, 77-84.



Special Issue on Polar Science

A. Murugappan, Subbarayan Sivaprakasam and S. Mohan, "Prediction of solar radiation with air temperature data in a coastal location in Tamilnadu", *MAUSAM*, **62**, 1, 85-90.

S. K. Midya and U. Saha, "Rate of change of total column ozone and monsoon rainfall – A co-variation with the variable component of 10.7 cm solar flux during pre-monsoon period", *MAUSAM*, **62**, 1, 91-96.

J. K. S. Yadav, R. K. Giri and L. R. Meena, "Error handling in GPS data processing", *MAUSAM*, **62**, 1, 97-102.

A. K. Sharma, Savita M. Datta and K. L. Baluja, "Global analysis of long-term trends in total ozone derived from Dobson or ground based instrument data", *MAUSAM*, **62**, 1, 103-106.

Ravi Kiran and G.S. Bains, "Evaluating water use efficiency in summer green Gram (Vigna radiata L. Wilczek) under changed hydrothermal regimes", *MAUSAM*, **62**, 1, 107-110.

I. J. Verma, H. P. Das and V. N. Jadhav, "A study on recent changes in monthly, seasonal and annual evaporation at selected locations in India", *MAUSAM*, **62**, 1, 111-118.

Somenath Dutta, S.G. Narkhedkar, D.R. Sikka and Sunitha Devi, "A dynamical comparison between two recent drought southwest monsoon seasons 2002 and 2009 over India", *MAUSAM*, **62**, 2, 133-144.

A.K. Jaswal and A.L. Koppar, "Recent climatology and trends in surface humidity over India for 1969-2007", *MAUSAM*, **62**, 2, 145-162.

Charan Singh, M. Mohapatra, B.K. Bandyopadhyay and Ajit Tyagi, "Thunderstorm climatology over northeast and adjoining east India", *MAUSAM*, **62**, 2, 163-170.

Arvind Kumar, Padmakar Tripathi, K.K. Singh and A.N. Mishra, "Impact of climate change on agriculture in eastern Uttar Pradesh and Bihar states (India)", *MAUSAM*, **62**, 2, 171-178.

D.S. Pai, O.P. Sreejith, S.G. Nargund, Madhuri Musale and Ajit Tyagi, "Present operational long range forecasting system for southwest monsoon rainfall over India and its performance during 2010", *MAUSAM*, **62**, 2, 179-196.

Ramesh Chand, U.P. Singh, Y.P. Singh, L.A. Siddique and P.A. Kore, "Analysis of weekly rainfall of different period during rainy season over Safdarjung airport of Delhi for 20th Century – A study on trend, decile and decadal analysis", *MAUSAM*, **62**, 2, 197-204.

Samarendra Karmakar and Md. Mahbub Alam, "Modified instability index of the troposphere associated with thunderstorms/nor'westers over Bangladesh during the pre-monsoon season", *MAUSAM*, **62**, 2, 205-214.

M. Mohapatra, H.R. Biswas and G.K. Sawaisarje, "Spatial variability of daily rainfall over northeast India during summer monsoon season", *MAUSAM*, **62**, 2, 215-228.

O.P. Singh and Onkari Prasad, "District - level forecast of northeast monsoon rainfall over Tamilnadu using Indian Ocean dipole mode index", *MAUSAM*, **62**, 2, 229-234.

M.S. Tomar, "Trends of pH and aerosols in the precipitation at Srinagar, Mohanbari, Allahabad, Jodhpur, Nagpur and Minicoy during the period 1981-2001", *MAUSAM*, **62**, 2, 235-238.

Khaled S.M. Essa and Fawzia Mubarak, "Using dispersion modeling for ground level concentration", *MAUSAM*, **62**, 2, 239-244.

S.K. Midya, A.K. Dutta and P. Panda, "Association of major earthquakes (Magnitude ≥ 6 Richter scale) with geomagnetic activity index Kp during the period 2001-2007", *MAUSAM*, **62**, 2, 245-252.

E. Kulandaivelu, M. Soundararaj and M.V. Guhan, "Cloud burst during south west monsoon season at Tiruchirapalli, Tamilnadu", *MAUSAM*, **62**, 2, 253-255.

Mannu Ram and Moti Lal, "Semi – quantitative precipitation forecasts for river Sharda catchment by synoptic analogue method", *MAUSAM*, **62**, 2, 256-260.

D. R. Pattanaik, Anupam Kumar, Y. V. Rama Rao and B. Mukhopadhyay, "Simulation of monsoon depression over India using high resolution WRF Model – Sensitivity to convective parameterization schemes", *MAUSAM*, **62**, 3, 305-320.

Ajit Tyagi, A. B. Mazumdar, Medha Khole, S. B. Gaonkar, Sunitha Devi and Rm. A. N. Ramanathan, "Re-determination of normal dates of onset of southwest monsoon over India", *MAUSAM*, **62**, 3, 321-328.

M. Duraisamy, S. K. Roy Bhowmik and B. K. Bandyopadhyay, "An objective method for predicting occurrence of pre-monsoon (March- May) thunderstorm events over Delhi using stability indices", *MAUSAM*, **62**, 3, 329-338.

D. R. Sikka and Satyaban Bishoyi Ratna, "On improving the ability of a high-resolution atmospheric general circulation model for dynamical seasonal prediction of the extreme seasons of the Indian summer monsoon", *MAUSAM*, **62**, 3, 339-360.

O. P. Singh and Harvir Singh, "Variability of scatterometer based surface vorticity over Arabian Sea and its use in monsoon onset forecasting", *MAUSAM*, **62**, 3, 361-374.

Julian Oscillation – M. Mohapatra and S. Adhikary, "Modulation of cyclonic disturbances over the north Indian Ocean by Madden", *MAUSAM*, **62**, 3, 375-390.

R. P. Samui, G. John, S. P. Ransure and M. A. Pachankar, "Factors affecting the trends in evaporation during different crop growing seasons over India", *MAUSAM*, **62**, 3, 391-402.

Gajendra Kumar, Ranju Madan, K. C. Saikrishnan, S. K. Kundu and P. K. Jain, "Technical and operational characteristics of GPS Radio sounding system in the Upper Air Network of IMD", *MAUSAM*, **62**, 3, 403-416.

Rajesh Prakash, R. K. Singh, A. K. Shukla, D. Singh, B. S. Rana, J. S. Jaryal, A. K. Bhatnagar and S. Bali, "Intensity and isoseismal map of 25th November 2007 Delhi earthquake", *MAUSAM*, **62**, 3, 417-424.

P. R. Salve, T. Gobre, R. J. Krupadam, S. Shastry, A. Bansiwal and S. R. Wate, "Chemical characterization of rainwater at Akkalkuwa, India", *MAUSAM*, **62**, 3, 425-432.

Hari Singh, R. K. Datta, Suresh Chand, D. P. Mishra and B. A. M. Kannan, "A study of hailstorm of 19th April 2010 over Delhi using Doppler Weather Radar observations", *MAUSAM*, **62**, 3, 433-440.

K. E. Ganesh, T. K. Umesh and B. Narasimhamurthy, "Variation of aerosol optical thickness with atmospheric water vapour – A case study over a continental station Mysore, India", *MAUSAM*, **62**, 3, 441-448.

V. M. Devappa, P. Khageshan and S. R. Mise, "Long term assessment of southwest monsoon drought events at Taluka levels in Gulbarga district of Karnataka, India", *MAUSAM*, **62**, 3, 449-456.

Bikram Singh, "Semi – quantitative precipitation forecast model for Subarnarekha catchment by synoptic analogue technique", *MAUSAM*, **62**, 3, 457-462.

Ajit Tyagi, U. P. Singh and M. Mohapatra, "Weather & weather systems at Schirmacher Oasis (Maitri) during recent two decades - A review", *MAUSAM*, **62**, 4, 513-534.

S. K. Roy Bhowmik, Anupam Kumar and Ananda K. Das, "Real-time mesoscale modeling for short range prediction of weather over Maitri region in Antarctica", *MAUSAM*, **62**, 4, 535-546.

O. P. Singh, U. P. Singh and R. P. Lal, "Recent trends and variations in surface meteorological parameters over Indian Antarctic station Maitri", *MAUSAM*, **62**, 4, 547-556.

H. S. Gusain, V. D. Mishra and Avinash Negi, "Comparative study of the radiative and turbulent energy fluxes during summer and winter at the edge of the Antarctic ice sheet in Dronning Maud Land - East Antarctica", *MAUSAM*, **62**, 4, 557-566.

K. S. Hosalikar, Sushma Nair and Rajiv Krishnamurthy, "A short term characterisation of wind and temperature over Maitri, East Antarctica", *MAUSAM*, **62**, 4, 567-576.

S. L. Jain, "Ozone hole over poles: Current status", *MAUSAM*, **62**, 4, 577-584.

S. M. Sonbawne , P. C. S. Devara, R. C. Reddy, P. D. Safai and P. S. Salvekar, "Polar aerosol characterization, sources and impacts", *MAUSAM*, **62**, 4, 585-594.

S. K. Peshin, "Study of SO_2 and NO_2 behaviour during the ozone-hole event at Antarctica by Brewer Spectrophotometer", *MAUSAM*, **62**, 4, 595-600.

Abhinav Srivastava, I. M. L. Das, Sandip R. Oza, Amitabh Mitra, Mihir Kumar Dash and N. K. Vyas, "Assessment of sea ice melting rates in the Antarctic from SSM/I observations", *MAUSAM*, **62**, 4, 601-608.

Amita Prabhu , P. N. Mahajan and R. M. Khaladkar, "Trends in the polar sea ice coverage under climate change scenario", *MAUSAM*, **62**, 4, 609-616.

A. K. Sharma, "Applications of satellite imageries for prediction of severe weather events along Maitri, Antarctica", *MAUSAM*, **62**, 4, 617-626.

N. Sharma, M. K. Dash, N. K. Vyas, S.M. Bhandari, P.C. Pandey and N. Khare, "Signature of ice melt over the Greenland derived from MSMR (OCEANSAT-1) data", *MAUSAM*, **62**, 4, 627-632.

Sandip R. Oza , R. K. K. Singh, Abhinav Srivastava, Mihir K. Dash, I. M. L. Das and N. K. Vyas, "Inter-annual variations observed in spring and summer Antarctic sea ice extent in recent decade", *MAUSAM*, **62**, 4, 633-640.

Dhruv Sen Singh and Rasik Ravindra, "Control of glacial and fluvial environments in the Ny-Alesund region, Arctic", *MAUSAM*, **62**, 4, 641-646.

A. D. Singh, S. Das and K. Verma, "Impact of climate induced hypoxia on calcifying biota in the Arabian Sea : An evaluation from the micropaleontological records of the Indian margin", *MAUSAM*, **62**, 4, 647-652.

Neloy Khare, "Influence of solar activity on climate : Poles to Tropics", *MAUSAM*, **62**, 4, 653-658.

Sunil Kumar Shukla and M. Sudhakar, "Comparison of modern and fossil diatom assemblages and their implication on sea-ice conditions on coastal Antarctic region", *MAUSAM*, **62**, 4, 659-664.

Meloth Thamban, Sushant S. Naik, C. M. Laluraj and R. Ravindra, "High resolution climate reconstructions of recent warming using instrumental and ice core records from coastal Antarctica", *MAUSAM*, **62**, 4, 665-672.

14.2. Extra Departmental Publications

Attri, S. D., Singh, K. K., Mall, R. K., 2011, "Simulation of growth and yield attributes of wheat genotypes under changing climate in recent years in India", *Challenges and opportunities in Agrometeorology*, Springer, 221-234.

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14.3. Papers published during proceeding

Hazard and Risk Microzonation, Proceeding of Indo-Norwegian Workshop on Geohazards on 12-14 September, 2011 held in New Delhi; Ministry of Earth Sciences, pp 67-70, H. S. Mandal, P. K. Khan and A. K. Shukla.

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14.4. Reports / Met Monographs

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Seismic Microzonation of NCT Delhi on 1:50000 scale, A. K. Shukla, Rajesh Praksh, A. P. Pandey, R. K. Singh, H. S. Mandal and Dal Singh.

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14.5. Miscellaneous Publications

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Pocket Calendar of 2012, containing important astronomical information and list of important festivals.

Rashtriya Panchang in English for the year 2012-13 (1933-34 Saka Era).

15. 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 definately generated among them encouragement and interest 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. Quarterly progress reports regarding progressive use of Hindi of HQ for all the four quarters were consolidated and submitted to the Ministry of Earth Sciences as well as Department of Official Language.

6. Quarterly progress reports of sub-offices reviewed and necessary guidelines issued. Minutes of the OLIC meeting of sub-offices reviewed and guidelines issued.

7. Total 10 officials were granted the amount of Rs. 10,000/- as a cash/lumpsum award for passing Hindi Prabodh / Praveen / Pragya / Typing / Stenography Examination meritoriously under Hindi Teaching Scheme.

8. All India Departmental Hindi Essay competition 2011 organised and results declared on the basis of recommendations of the evaluation committee constituted by DGM. In total six officials of HQ. and sub-offices awarded the first, second third and 3 consolation prizes.

9. Sixteenth Edition of Departmental Hindi Magazine “Mausam Manjusha” was printed and sent to the members of OLIC and writers.

10. Hindi pakhwara was celebrated at HQ from 01 September, 2011 to 15 September, 2011. Hindi Diwas was celebrated on 14 September, 2011. On this occasion Cultural programme was also Organised in Hindi day. During this period Various competitions namely Hindi Essay, Hindi Typing, Hindi Noting and Drafting, Self-Composed Hindi poetry and Hindi Debate were organised Certificates and prizes were given by D G M to the first, second, third and two consolation prize winners of various Hindi competition organised during Hindi pakhwara. This year two new competitions namely Hindi Slogan and Hindi Cartoon Competitions on mausam were also organised.

11. Raj Bhasha Rolling shield for the year 2010-11 was given by D G M to D D G M, (R M C) New Delhi for the overall best performance in Official Language.

12. Sixteenth Edition of Departmental Hindi Magazine "Mausam Manjusha" and C D of Power points presentatons of Hindi seminar organised on 01 July, 2011 were released by the Honourable D G M on Hindi Day.

13. In addition to all major routine translation work, translation of Departmental Website, appreciation letter from E-I section, press communique issued on the occasion of World Meteorological Day, Poster, advertisement, invitation-letter, press communique of long term forecast of south- west Monsoon, Memorandum of understanding etc were translated by the Hindi Translators.

14. For doing meritorius work in Official Language Hindi, Secretary of MoES Dr. Shailesh Nayak, has given the Certificate of Merit to the Senior Translator Smt. M. Anuradha on the occasion of 136th Foundation Day of India Meteorological Department.

15. Ms. Reva sharma, Senior Hindi Officer delivered a Iecture on the subject 'Manak Hindi vartani - problems and solutions' in the Divison of Advertisement Brodcastiong Service of All India Radio station on 21st January, 2011.

16. An inspection of Principal Evaporation Observatory, Pusa, New Delhi was carried out by the second sub-committee of Parliament on Official Language on 15th January, 2011. Dr. L. S. Rathore, Head of Agriculture Meteorology Cell and Ms Reva Sharma, Senior Hindi Officer were present during the inspection.

17. In order to review the progressive use of Hindi, inspection of Central Purchase Unit, National Weather Forcastiing Centre, Seismo Observatory Ridge were carried out by the Senior Hindi Officer respectively on 03 February, 2011, 04 February 2011, 08 February 2011.

16. Offices of Hydrogen Gas Factory. Bundu Katra Agra (U.P), Radiosonde/Radiowind Observatory, Punjab, University Campus, Patiala (Punjab) Met. Office, Palam, New Delhi were notified in the Gazette under the Rule 10(4) of Official Language Rules 1976.

19. Unicode was activated in the 235 computers of different sections of the Headquarter.

20. Lectures regarding Official Language were delivered by Ms. Reva Sharma, Senior Hindi Officer, Smt Sarita Joshi, Senior Translator and Smt M.Anuradha, senior translator in the Hindi workshop organisad by the Met Office, Palam.

21. Fourth All India Departmental Hindi Seminar was organised on 01 July 2011 in the headquarter subject entitied "Utilility of Meteorological Servies". 12 Officials of Headquarter and sub-Offices have given their power point presentations.

22. Special Hindi Workshop for all the Senior and Junior Translators posted in the different Sub-Offices of India Meteorological Deptt. was conducted trom 04 July 2011 to 07 July 2011 in the H Q.

23. A cash award of Rs 1500/- was awarded to the 3 Officials of R M C, Nagpur for doing Official work originally in Hindi.

24. Lectures regarding Official Language were delivered by Ms. Reva Sharma, Senior Hindi Officer and Shri Birender Kumar Junior Translator on 16th September, 2011 in the workshop organised by the Met Office, Safdarjung.

25. An inspection of Met Centre, Ahmadabad, Met Office Dwarka and Met Observatory Okha were carried out by the Senior Hindi Officer along with Hindi Translators respectively on 22.09.2011, 23rd September, 2011 and 24th September, 2011.

26. An inspection of Met Observatory Okha was carried out by the second sub-committee of Parliament on Official Language on 26th September, 2011. Shri L. R. Meena, DDGM, Shri U. P. Singh, Director and Ms. Reva Sharma, Senior Hindi Officer of Headquarter were present during the inspection.

16. FINANCIAL IMPLICATIONS DURING 2011-12

IMD provided financial support to number of projects during the year 2011-12.

16.1. Budget Estimates (Non-Plan)

For FY 2011-12 (Rs./Thousand)

Grant (2011-12)		Expenditure (2010-11)
B.E. (Revenue)	Rs.25574	Rs.2485574
B.E. (Capital)	Rs.11000	Rs.1931

16.2. Budget Estimates (Plan)

For FY 2011-12 (Rs./Thousand)

Grant (2011-12)		Expenditure (2010-11)
B.E. (Revenue)	Rs.888000	Rs.510685
B.E. (Capital)	Rs.2632000	Rs.1145829

16.3. Budget Scheme & their Implementation

Plan Scheme for 2011-12
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 OWS
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
- Upgrading the L&ERF capabilities & Climate monitoring activities of NCC
- Archival of Manual Weather Charts into digital form
- EMRC: Automatic Precipitation collector, UV-VIS spectrophometer, 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 radiation network: Installation of radiation instruments and procurement of Sunshine recorders.
- Various construction and 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 Infrastructure Field offices

- Development under RMC Guwahati
- Infrastructure development under RMC New Delhi
- Infrastructure development under RMC Mumbai
- Infrastructure development under RMC Kolkata
- Infrastructure development under RMC Nagpur
- Infrastructure development under RMC Chennai

00.102 OWS 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 OMS
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
EREC

- Operation and Augmentation of VSAT based Delhi Telemetry Network

- Establishment of a VSAT based seismic telemetry network in North East India
- Continuation of EREC
- 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 investigationlab

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 rainguages (ARGs) 1350 Nos.
- Regional, zonal and field maintenance centres for ARG and AWS
- Transmissometer at six airports
- Transmissometer at Luknow 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 New Delhi
- 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 H_2 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. of optical Electronic theodolite
- MFI
- 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 AMS 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 2010-11

- Met. Data receiving and processing system for Metop Satellite was established
- Ground segment equipment for reception & processing of Met. Data from INSAT-3 D 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 radiomeers -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
- Forest development programme (FDP) ay 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 Airports offices were procured Airports Instruments were also procured for 7 Airports. Supply order was placed for Integrated Airport Met. Instrument 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 inplace 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
- HPCS for global data processing and numerical weather prediction for weather forecasting services in IMD commissioned
- Forecasting system under MFI were commissioned

17. ANNUAL STATEMENT OF SHOWING THE REPRESENTATION OF SCs, STs AND OBCs IN THE DEPARTMENT

17.1. NUMBER OF APPOINTMENTS MADE DURING THE CALENDAR YEAR 2010 AS ON 01.01.2011

MINISTRY/DEPARTMENT/ ATTACHED / SUBORDINATE OFFICE
INDIA METEOROLOGICAL DEPARTMENT

REPORT – I

	Representation of SCs / STs / OBCs as on (01.01.2011)				Number of appointment made durint the calendar year 2010									
					By Direct Recruitment				By Promotion			By Deputation		
Groups	Total No. of Employees	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	13	22	-	-	-	-	110	15	9	-	-	-
Group B	1083	163	73	-	-	-	-	-	125	11	5	-	-	-
Group B (Non-Gaz.)	2236	395	87	210	-	-	-	-	78	15	7	-	-	-
Group C	2120	812	161	211	9	2	1	2	62	10	8	-	-	-
TOTAL	5688	1404	334	443	9	2	1	2	375	51	29	-	-	-

17.2. NUMBER OF APPOINTMENT IN THE SERVICE IN VARIOUS GRADE IN THE CALENDER YEAR 2010 IN VARIOUS GROUP 'A' SERVICES AS ON FIRST JANUARY 2011 OF THE YEAR

MINISTERY/ DEPARTMENT/ATTACHED/SUBORDINATE OFFICE

INDIA METEOROLOGICAL DEPARTMENT

REPORT – II

	Representation of SCs / STs / OB (01.01.2011)				Number of appointment made durint the calendar year 2010									
					By Direct Recruitment				By Promotion			By Deputation		
Pay Scale (in rupees)	Total No. of Employees	SCs	STs	OBCs	Total	SCs	STs	OBCs	Total	SCs	STs	Total	SCs	STs
PB-3 + GP 5400	2	-	1	19	-	-	-	-	1	-	-	-	-	-
PB-3 + GP 6600	53	7	5	1	-	-	-	-	4	1	1	-	-	-
PB-3 + GP 7600	103	15	3	2	-	-	-	-	24	4	2	-	-	-
PB-4 + GP 8700	68	9	3	-	-	-	-	-	60	8	3	-	-	-
PB-4 + GP 8900	20	3	1	-	-	-	-	-	21	2	3	-	-	-
PB-4 + GP 10000	--	-	-	-	-	-	-	-	-	-	-	-	-	-
75500-80000	1	-	-	-	-	-	-	-	-			-	-	-
	249	34	13	22					110	15	9	-	-	-

18. IMPORTANT TELEPHONE LINKS

NAME	DESIGNATION/OFFICE	EPABX New Delhi	OFFICE TELEPHONE NO. / FAX
Dr. L. S. Rathore	DGM	4201	011-24611842
Shri Jagmohan Sharma	PS to DGM, New Delhi	4225	011-24611842
Shri J. P. Sharma	Senior PS to DGM	4253	011-24611842
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
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
Dr. (Smt.) S. Kaur	Scientist 'F' (Hydro.), New Delhi	4223	011-24619167
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 Jaiswar	DDGM, New Delhi	4227	011-24624486
Shri B. K. Bandyopadhyay	Scientist 'F', (S), New Delhi	4334	011-24635664
Shri S. Krishnaiah	Scientist 'F', LACD ADGM (R), Pune		020-25535411
Dr. (Ms.) Medha Khole	DDGM (WF), Pune		020-25532875
Dr. N. Chattopadhyay	Scientist 'E', (Agrimet.), Pune		020-25513102
Dr. Somenath Dutta	Scientist 'E', DDGM (Training), Pune		020-25665530
Shri B. Mukhopadhyay	DDGM (Climatology), NDC, Pune		020 - 25535797
Dr. K. K. Singh	Scientist 'E', (Head Agrimet.)	4240	011-24619844
Dr. O. P. Singh	DDGM, RMC, New Delhi	4213	011-24690279
Shri N. Y. Apte	DDGM, RMC, Mumbai		022-22150517
Dr. Y.E.A. Raj	DDGM, RMC, Chennai		044-28276752
Shri Devendra Pradhan	DDGM, RMC, Kolkata		033-24793782
Dr. P. K. Nandankar	DDGM, RMC, Nagpur	4460	0712-2284266

NAME	DESIGNATION/OFFICE	EPABX New Delhi	OFFICE TELEPHONE NO. / FAX
Shri Awadhesh Kumar	DDGM, RMC, Guwahati		0361-2840206
Shri M.K. Bhatnagar	Scientist 'F', (CAMD), New Delhi	4301	011-24615371
Shri Satish Bhatia	Scientist 'F', (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	DDGM (Organisation), New Delhi	4309	011-24640701
Shri B. P. Yadav	Scientist 'E', (NWFC), New Delhi	4398	011-24629798
Dr. M. Mohpatara	Scientist 'E', (CWD), New Delhi	4385	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 Suresh Chand	Scientist 'E', (CPU), New Delhi	4236	011-24698247
Shri Y. P. Singh	Scientist 'E', (Finance), New Delhi	4487	011-24697640
Shri Shiv Ganesh	Scientist 'E' (IT), New Delhi	4549	
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
Dr. A. P. Pandey	Met. (Admn.), New Delhi	4204	011-24602480
Caretaker, Mausam Bhawan	-	4372	
Guest House (H.Q.)	-	4472	

New Exchange – Airtel Telephone

Dialing from Delhi : 4382XXXX

Dialing from outside Delhi : 011 4382XXXX

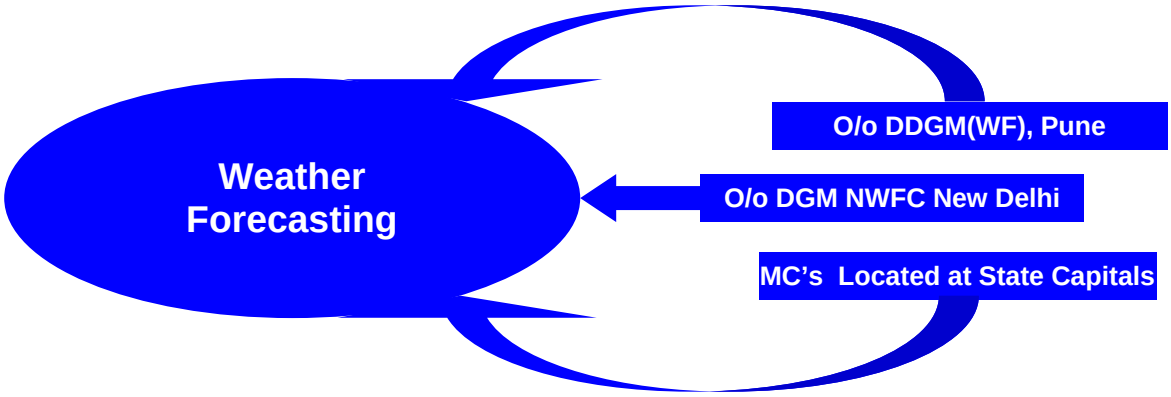
Where XXXX stands for 4 digit EPABX number

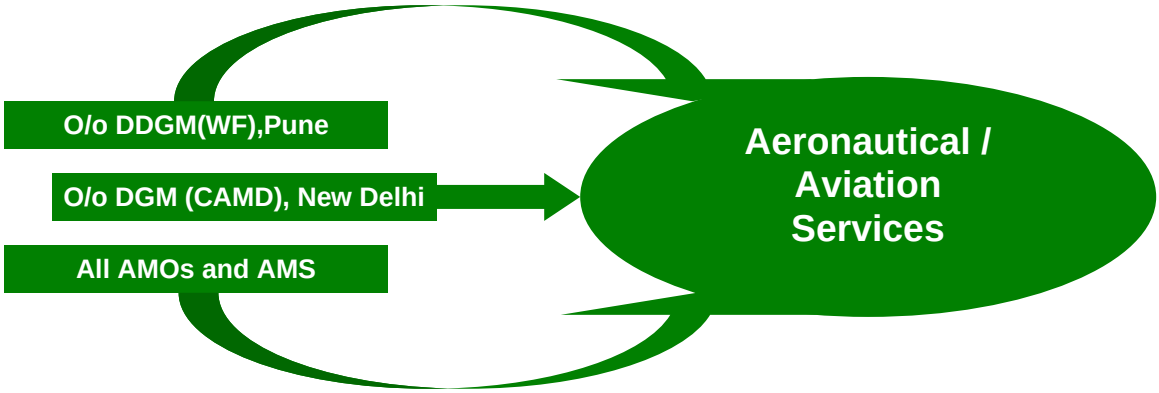
Telefax : 91-11-24699216, 91-11-24623220

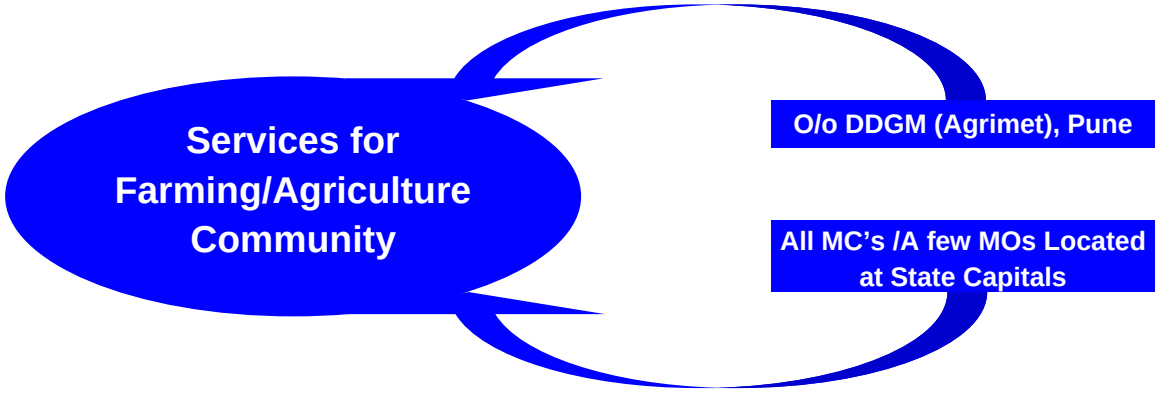
Website : www.mausam.gov.in

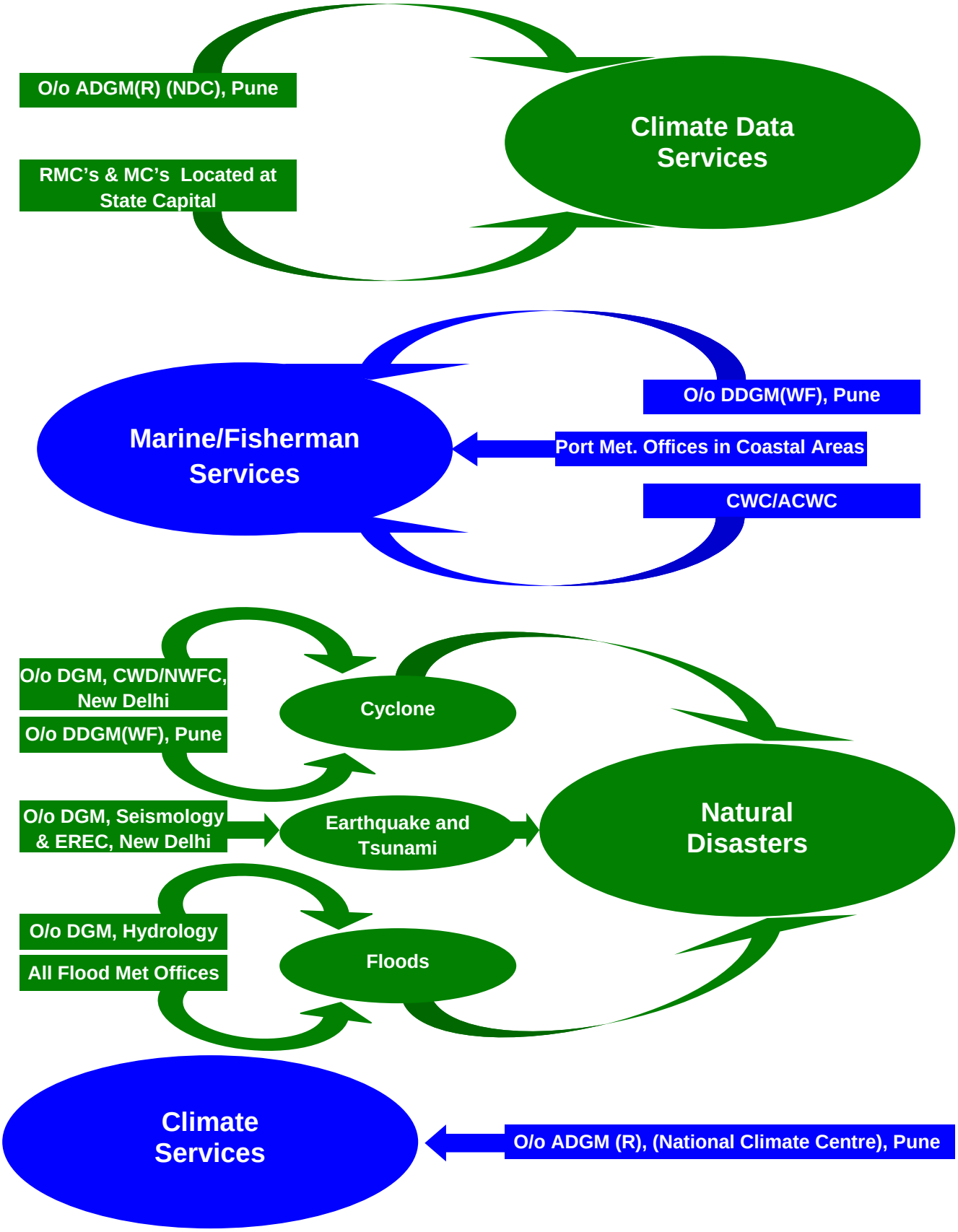
www.imd.gov.in

19. IMD's SERVICES







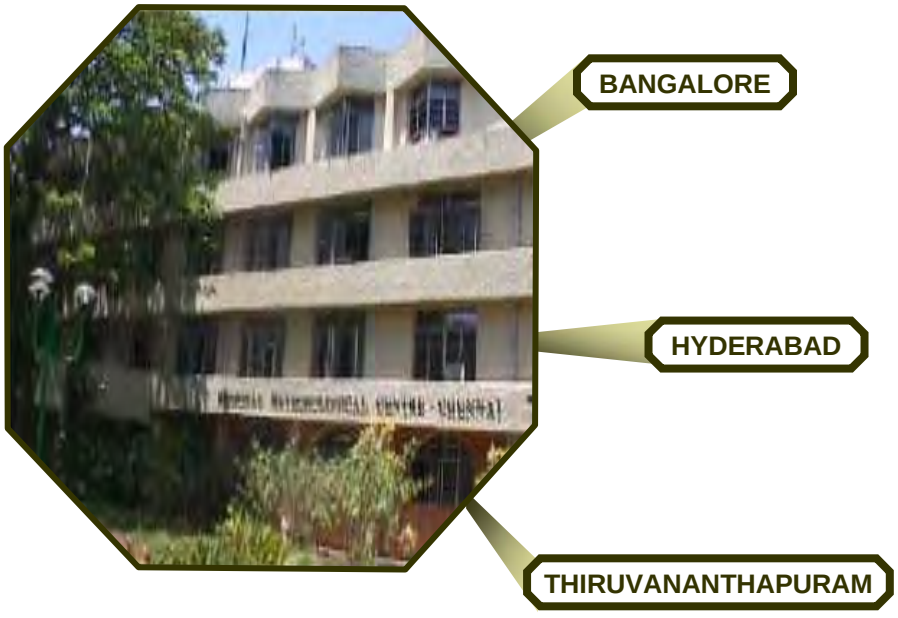

O/o ADGM(R) (NDC), Pune
RMC's & MC's Located at State Capital
Climate Data Services
Marine/Fisherman Services
O/o DDGM(WF), Pune
Port Met. Offices in Coastal Areas
CWC/ACWC
O/o DGM, CWD/NWFC, New Delhi
O/o DDGM(WF), Pune
Cyclone
O/o DGM, Seismology & EREC, New Delhi
Earthquake and Tsunami
Natural Disasters
O/o DGM, Hydrology
All Flood Met Offices
Floods
Climate Services
O/o ADGM (R), (National Climate Centre), Pune

REGIONAL METEOROLOGICAL CENTRES

RMC, New Delhi

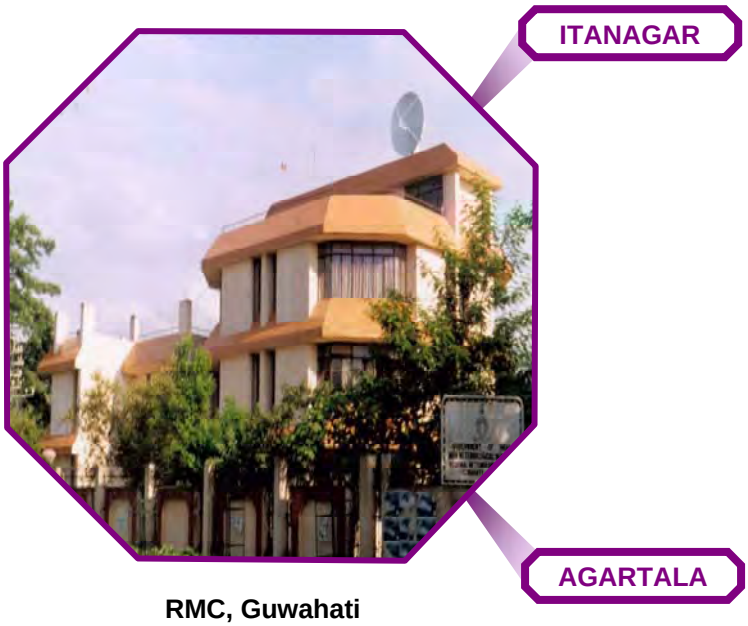
Under the administrative control of RMC, New Delhi, there are operational units such as Met. Centres at state capitals of U.P., H. P., Punjab, Haryana, J&K and Uttarakhand, Forecasting Offices, Agrometeorological Advisory Service Centres and Flood Meteorological Offices.

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.



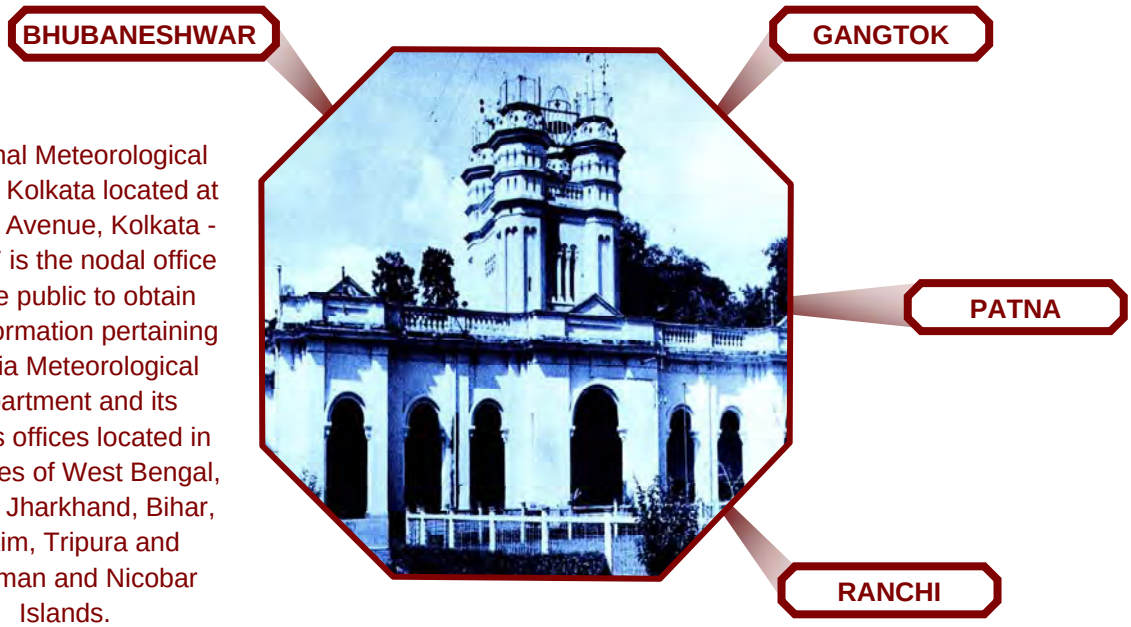
RMC, Chennai

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.



RMC, Guwahati

Regional Meteorological Centre, Kolkata located at 4, Duel 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.



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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rsrw.rpr@gmail.com

GUWAHATI REGION

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Director
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amo.agt@imd.gov.in

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

पृथ्वी विज्ञान मंत्रालय, भारत सरकार

Ministry of Earth Sciences, Govt. of India