



वार्षिक प्रतिवेदन  
**ANNUAL REPORT**  
**2008**

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

# FOREIGN VISITORS



Delegates from NOAA, USA



Meteo France International (MFI) and India Meteorological Department dignitaries

A lecture on Atmospheric Meteorological propagation by Dr. A. Dankmayer German Aerospace Centre, Oberpfaffenhofen and W-M. Boerner Chicago, IL/USA



Mr. Ahmed Hammod Mohamed Al Harthi, Sultanate of Oman being welcomed by Dr. Ajit Tyagi, D.G. IMD and Dr. T.A. Khan



Mr. Asko Numminen, Ambassador, Embassy of Finland

# Annual Report 2008



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## FOREWORD



It is my privilege to bring out first annual report in my tenure which will fill the decade- long gap after the previous annual report was published in 1995-96. The year 2008 will be remembered as an eventful and memorable year for IMD as it entered a new era of modernization aimed to improve quality of services by increasing the accuracy in weather prediction. This department is providing manifold services for different sectors of the economy thereby contributing significantly to national development. It is also our endeavour to save life and property from the impact of disastrous weather events like cyclones and heavy rain by issuing timely warnings. The user's workshops and conferences conducted by IMD have proved a mile stone towards enhancing weather awareness amongst the people. The five-day district-level weather forecast and Agromet advisories issued by Met. Centre are being used by the farmers in their day to day operation. The warnings for weather hazards for fishermen & aviators have been very beneficial for their safety. The accurate prediction of movement and landfall of cyclonic storms - Nargis, Rashmi, Nisha and Khaimuk has tested our forecasting capability and has been appreciated by international community. Now, a major responsibility and challenge before us is to provide venue specific accurate & timely weather forecast for Commonwealth Games due to take place in the second half of 2010. The requirement of realistic weather prediction is now realized essential not only for individuals but also for long term planning in the country.

By adopting new technology, IMD has entered a new era of modernization. Installation of state-of-the-art instruments such as Automatic Weather Stations, Automatic Rain Gauges, Doppler Weather Radars, Radio-Sonde Equipments, new Automatic Integrated Aviation Meteorological Systems, Digital Meteorological Data Dissemination systems and augmentation of Radiation Instruments etc. is under way.

IMD is in the process of transforming itself into a world-class National Meteorological Agency with quality manpower and infrastructure by the end of 11<sup>th</sup> five - year plan to meet the challenges of 21<sup>st</sup> century. I hope to achieve this dream by the sustained efforts and unstinted cooperation of all officers and staff of this Department spread across the country and with support provided by Ministry of Earth Sciences.

**AJIT TYAGI**  
**Director General of Meteorology**

## 1. IMD IN SERVICE OF THE NATION

Meteorology is the science of the atmosphere. It includes phenomena such as wind and rain. All ancient civilizations bear ample testimony to man's realization of his intimate dependence on weather and climate.

The beginnings of Meteorology in India can be traced since to ancient times. The earliest references to meteorological phenomena are found in the `Rigveda`. It quotes "Rain causing God (Indra) Seated in a Chariot driven by electricity". Two great Hindu epics, the Ramayana and the Mahabharata give climate and meteorological description that prevailed in their respective period. It is in later Sanskrit literature between 5<sup>th</sup> century A.D. that we find objective attempts at understanding weather phenomena. Kautilya, around 3<sup>rd</sup> century B.C. realized the importance of rainfall measurements. It is worth mentioning here that poet Kalidasa, mentioned the date of onset of Monsoon over central India and traces the path of the monsoon clouds.

The invention of the thermometer and barometer in the 17<sup>th</sup> century gave impetus to the instrumental observations of the atmosphere which served as a precursor to the development of modern meteorology.

India is fortunate to have some oldest meteorological observatories of the world. The earliest observation at Madras (now Chennai) observatory is known to have been taken in September 1793, Simla recorded magnetic and Meteorological observation during the period 1841-1845. In Bengal the first observatory was set up in Calcutta (now Kolkata), at Surveyor General's Office at

Park street in the year 1829. The first European Superintendent of this observatory was V.N. Rees who recorded meteorological observation from 1829 to 1852. The British East India Company established several such stations, by 1874, there were 77 Meteorological observatories in the country.



**Meteorological observatory Alipore Kolkata, 1877**

In 1875, the Government of India decided to set up the Meteorological department bringing all meteorological work in the country under a central authority. In 1875, Blanford opened a temporary branch office at Simla. Thereafter, four Provincial Meteorological. Reporters to the Governments of Bengal, Punjab, Madras and United Provinces (Now Known as Uttar Pradesh) based at Calcutta, Lahore, Madras and Allahabad respectively were established and all the observatories except the central observatory at Alipore (Calcutta) started functioning under the direct control of the respective Provincial Meteorological reporter. From 1875 to 1905 the headquarter of India Meteorological Department was located at



Calcutta. The India Daily Weather Report made its first appearance in 1878 from Simla during the monsoon season.

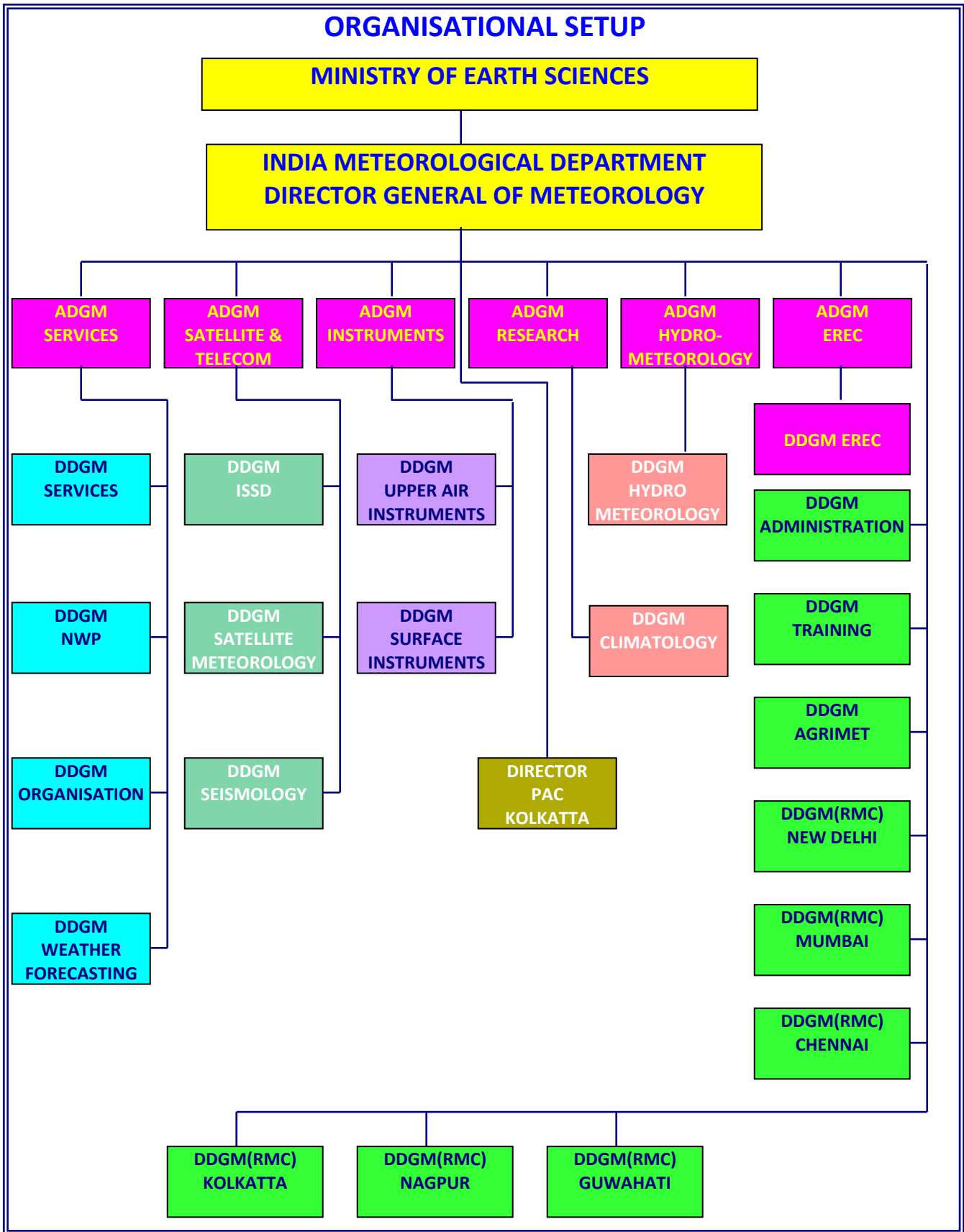
Blanford introduced the publication of the "Memoirs of the IMD". In view of the importance of foreshadowing monsoon season for agricultural economy of the country, Blanford initiated the system of Long Range Forecasting (LRF).

IMD H.Q. was shifted to Pune on 20<sup>th</sup> July 1928 & continued to be there till Second World War. An Agricultural Meteorology branch started functioning in Poona from 1931, under the steward-ship of Dr. L. A. Ramdas, Meteorologist. After 1920 service to aviation became one of the major activities of the department. The first known aviation forecasts were issued in 1921, for the Royal Air Force operations in the then NW India. The observational data recorded at various types of surface and upper air observatories, are scrutinized and archived at the National Data Centre, Pune. Every aspect of human activity from agriculture to aviation, and

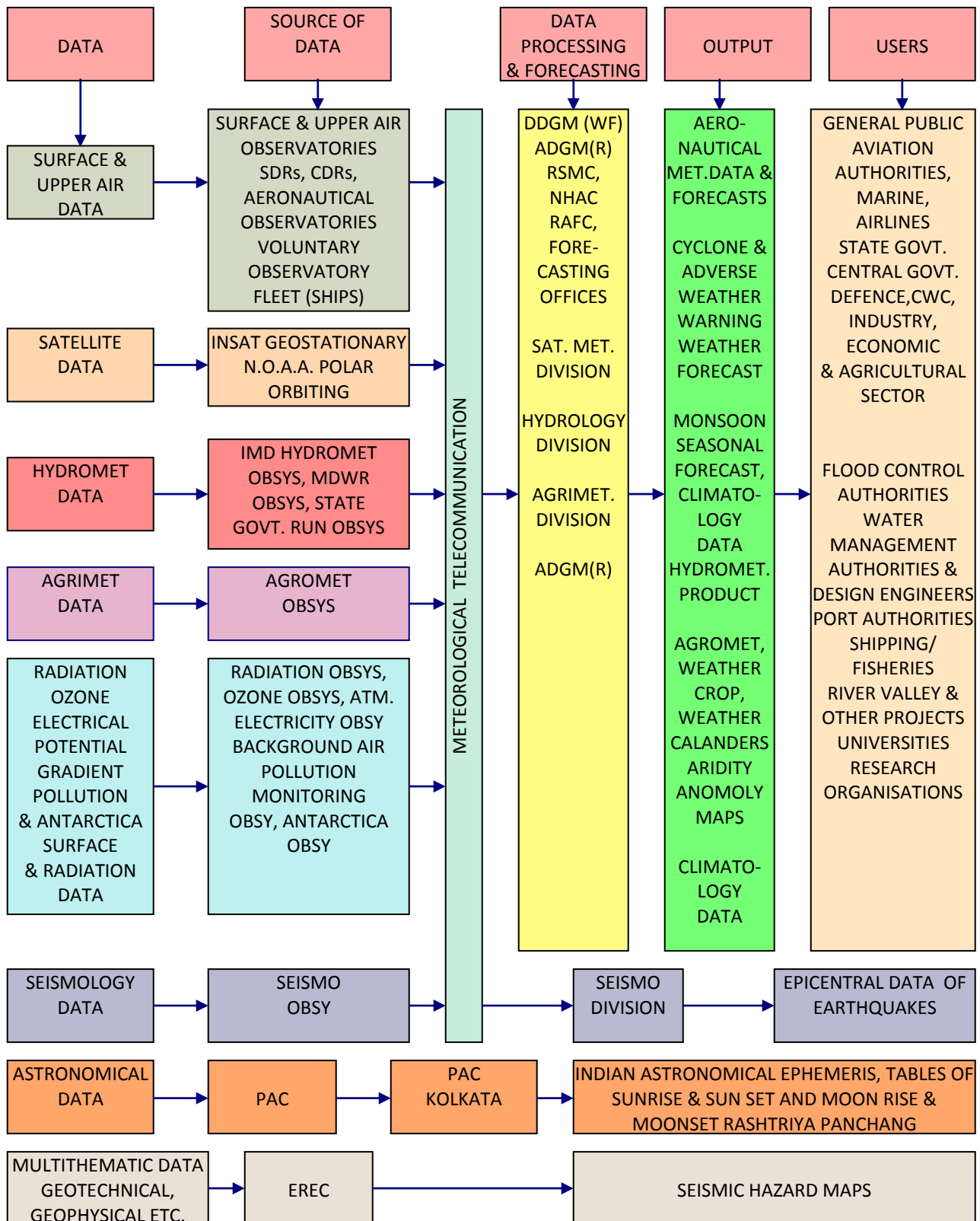
sports to space flight depends on weather. Issue of early warning and forecast is perhaps the most challenging activity of the Meteorological service

India started issuing long range forecasts in the year 1886. In very recent years long range forecast models developed in-house through the efforts of our scientists have enabled IMD to issue reasonably accurate monsoon forecast for the country as a whole.

Since then, IMD has indeed a long way of progress. It has ventured into a new era of application, services and steadily built upon its infrastructure. IMD achieved its prime objective for providing weather services to nation for use in various public sector through modernization program by induction of Doppler weather radar, AWS, weather satellite, management & improvement observational network HRD & training. The meteorology in India is poised at the threshold with an exciting future.



## FUNCTIONAL SETUP



## 2. WEATHER MONITORING AND FORECASTING

### WEATHER FORECASTING SYSTEM

One of the most important functions of the India Meteorological Department is to issue weather forecasts for the entire country and to issue warnings for the cyclonic storms to other Departments / Public / other agencies to save human life and reduce the loss of property. Weather Central, Pune is one among the main forecasting centres of the Department. This centre issued All India Weather Bulletin twice daily covering all the 36 Meteorological Sub-divisions and also for Bay of Bengal, Arabian Sea and Indian Ocean. The centre imparted technical guidance on forecasting matters to all forecasting offices of the Department. During cyclonic storms, the centre coordinated the cyclone warning work of the three Area Cyclone Warning Centres (ACWCs) located at Kolkata, Mumbai and Chennai and three Cyclone Warning Centres (CWCs) located at Ahmedabad, Bhubaneswar and Visakhapatnam. Weather Central, Pune issued advisory Weather bulletins for all the cyclonic storms and maintained a watch on the cyclone warning work and took timely remedial measures on real time basis. In addition, the centre organised the Annual Cyclone Review Meeting to review and improve the cyclone warning work of the Department. In addition, Annual Monsoon Review Meeting and Annual Technical Review meetings were also held.

O/o DDGM(WF) publishes All India Weather Summary, Weekly Weather

Report and India Daily Weather Reports, prepared seasonal weather summaries and storm accounts for publication in MAUSAM, brief for Indian delegates to WMO/ESCAP Panel on tropical cyclones, EC, RA-II, CBS meetings of WMO, brief to visitors about meteorology and weather forecasting and familiarize them with the activities of Weather Section and provide lectures and conducted special classes to the various trainees of the Department. Weekly map discussions were conducted to improve the forecasting skills and knowledge of meteorologists involved in the same. A publication entitled 'Forecasters Guide' containing instructions and circulars to be followed in operational weather forecasting was prepared during the year.

Northern Hemispheric Analysis Centre, New Delhi is another main forecasting Centre of the Department besides six Regional Meteorological Centres and Meteorological Centres at State headquarters. The weather reports from all these centres were disseminated through media, passed on to all concerned Government agencies, hoisted on the Website and published in the Indian Daily Weather Report (Fig. 1).

Experiencing the normal variability of weather, the year 2008 did not witness any remarkable heat and cold wave, unexpectedly heavy rainfall or persistent and widespread fog, except for a few cases of extreme weather which were successfully forecasted.

## IMD's Operational Weather Forecasting System

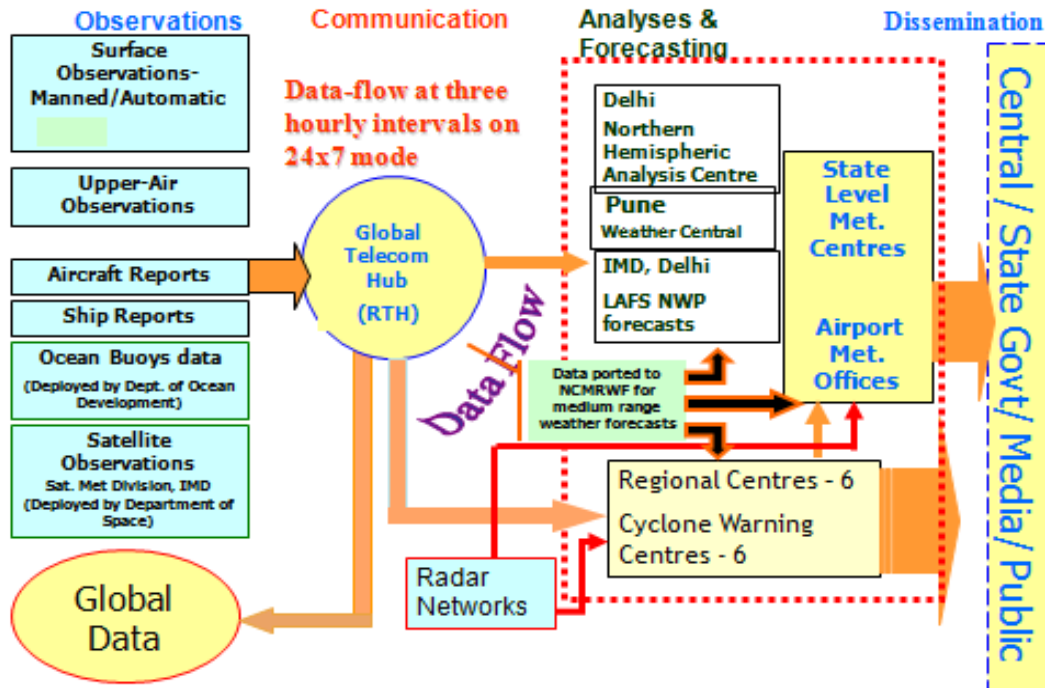


Fig. 1.

### 2.1. WINTER SEASON - 2008

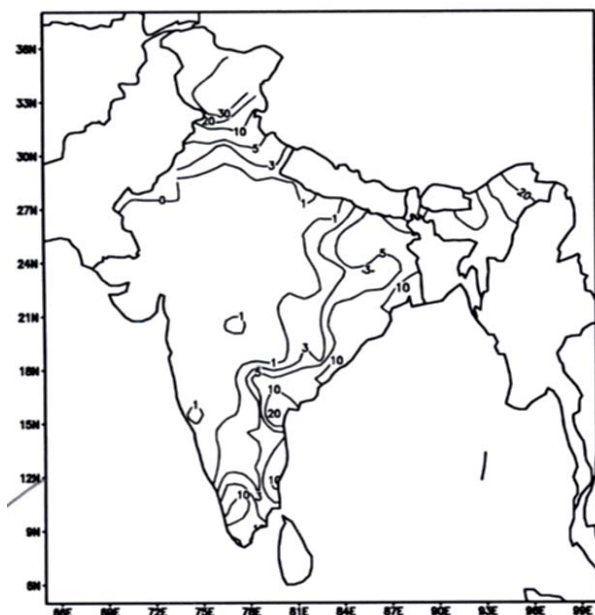
#### Cold Wave Conditions

Cold wave conditions prevailed over the northern parts of the country during the season. Northwestern, peninsular and central parts of the country experienced cold wave conditions during January and central, peninsular and eastern parts of the country during the first fortnight of February. On some days, minimum temperatures at few stations of north India hovered around the freezing point in both the months of the season. Similarly, over some stations of northern, central and western India, minimum temperatures were below normal by more than 5° C on many occasions in both the months of the season, which was a record since 1970.

#### Rainfall Features

During the season, out of 36 meteorological sub-divisions, 11 received excess rainfall, 5 received normal rainfall, 5 received deficient rainfall and 13 received scanty rainfall. Remaining 2 sub-divisions (Konkan & Goa and Madhya Maharashtra) did not receive any rain.

Fig. 2 shows the spatial pattern of rainfall (cm) received during the season. Rainfall activity during the season was confined to the south peninsula, northern and eastern parts of the country. Rainfall over these regions generally exceeded 3 cm. Extreme northern and northeastern parts of the country received more than 20 cm of rainfall. Rainfall over parts of the Coastal Andhra Pradesh, Kerala, Tamil Nadu and Gangetic West Bengal exceeded 10 cm.

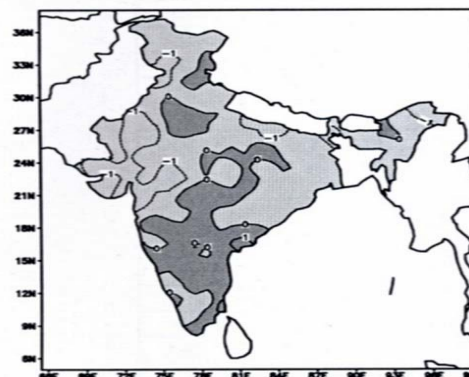


**Fig. 2. Seasonal rainfall (cm)**

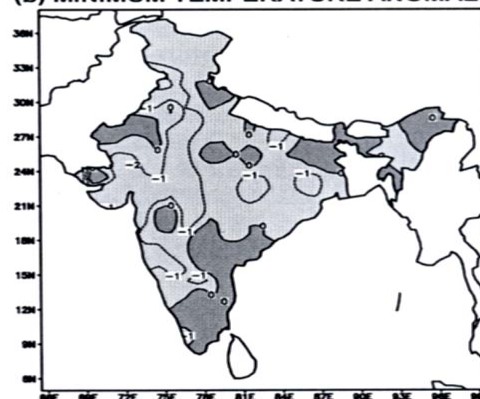
Rainfall anomalies were positive over the eastern parts of the country and most parts of peninsula and were negative over the northern parts (except the extreme northern region). Over parts of Jammu & Kashmir, Coastal Andhra Pradesh, Kerala, Tamil Nadu and extreme northeastern region, the positive rainfall anomaly exceeded 5 cm. While, rainfall deficiency over northern parts of the country viz. parts of Himachal Pradesh, Uttaranchal and West Uttar Pradesh exceeded 5 cm.

Cumulative rainfall departure was negative till the end of January. Subsequently it became positive and remained so for the next three weeks of February. It again became negative during last few days of the season. For the winter season 2008, rainfall for the country as a whole was 99% of its Long Period Average (LPA) value.

**(a) MAXIMUM TEMPERATURE ANOMALY**



**(b) MINIMUM TEMPERATURE ANOMALY**



**Figs. 3(a&b). Mean seasonal temperature anomalies (C) (a) maximum, (b) minimum**

### Pressure & Wind

The pressure anomalies were negative over most parts of the country except over parts of the west central region. The negative anomalies were generally of the order of 0.5 hPa.

At 850 hPa level, two anomalous cyclonic circulations, one each over the south Arabian sea and the northwest Bay

of Bengal & adjoining eastern region were observed. At 500 hPa level, an anomalous cyclonic circulation over the extreme northern parts of the country and an anomalous eastwest ridge across central parts of the country, were observed. The anomalous ridge extended at 200 hPa level also.

### **Outgoing Longwave Radiation (OLR)**

Positive OLR anomalies were observed over the entire country, except some extreme northern parts. Over some parts of peninsula, positive OLR anomalies exceeded  $10 \text{ W/m}^2$ . Positive OLR anomalies were also observed over the North Indian Ocean.

### **Temperature**

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 3(a&b) respectively.

Maximum temperatures were below normal over most parts of the country except over parts of peninsula. They were below normal by more than  $1^\circ\text{C}$  over some parts of westcentral region, Jammu & Kashmir, Punjab, East Uttar Pradesh and Arunachal Pradesh.

Minimum temperatures were also below normal over most parts of the country except over parts of peninsula, eastern- northeastern region and parts of West Rajasthan. They were below normal by more than  $2^\circ\text{C}$  over parts of Punjab and by about  $1^\circ\text{C}$  over parts of Jammu & Kashmir, Haryana, Chandigarh & Delhi, Rajasthan, West Madhya Pradesh, Gujarat, northern and southern parts of Maharashtra, northern parts of Karnataka, parts of Chattisgarh and Jharkhand.

### **Low Pressure Systems**

During the season, an induced low pressure area formed over the northwestern parts of the country in the month of January.

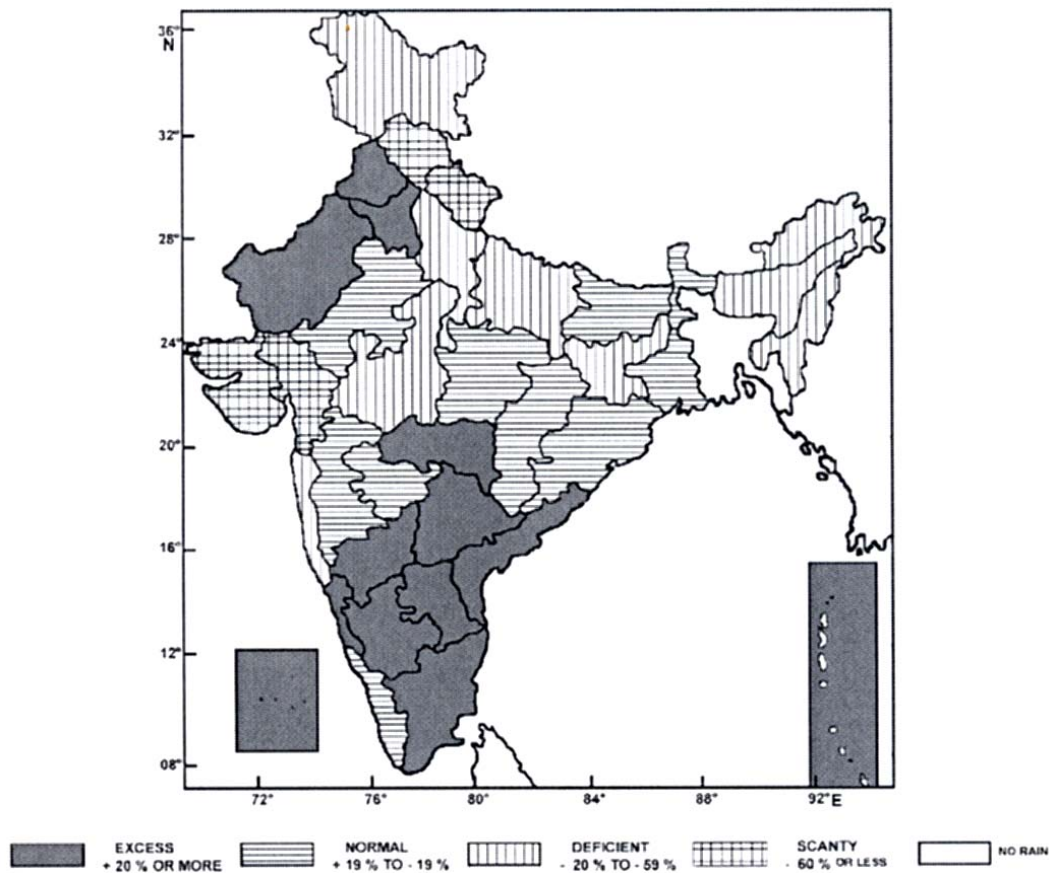
### **2.2. PRE-MONSOON SEASON - 2008**

Many stations of the central and northwest India reported considerably above normal maximum temperatures on a number of occasions during March. Maximum temperatures at some stations viz. Hissar, New Delhi, Amritsar, Ganganagar, Gwalior were above normal by more than  $5^\circ\text{C}$  (compared to 1971-2000 normals) for record number of days during the month.

During April, heat wave / hot day conditions prevailed over some parts of north and central India in the second week and over Gujarat, Andhra Pradesh, Tamil Nadu, Haryana, Bihar and Maharashtra during the third week.

During May, severe heat wave / heat wave conditions prevailed over parts of Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Orissa, Coastal Andhra Pradesh and Tamil Nadu during the first week. Over parts of Coastal Andhra Pradesh and north coastal Tamil Nadu, heat wave conditions continued till the third week also and became severe during the third week. Maximum temperatures recorded at Kakinada and Masulipatnam were above normal by more than  $5^\circ\text{C}$  (compared to 1971-2000 normals) for record number of days during the month.

Unprecedented Heavy Rainfall over South Peninsula during March and high rainfall activity over the northern parts of the country during May.



**Fig. 4. Sub-divisionwise rainfall percentage departures for the pre-monsoon season 2008**

During March, unprecedented heavy rainfall occurred over the south peninsula (comprising off our states viz. Andhra Pradesh, Tamil Nadu, Karnataka and Kerala). The area weighted average rainfall over the south peninsula was 915 % of its Long Period Average value, which is a record for the month since 1875.

During May, associated with western disturbances, unusually high rainfall activity was observed over the northern parts of the country. Haryana, Chandigarh & Delhi received 66.4 mm of rainfall which is the fourth highest for the sub-division since 1901 after 1913 (82.1mm), 1982 (76.2), 2002 (66.7).

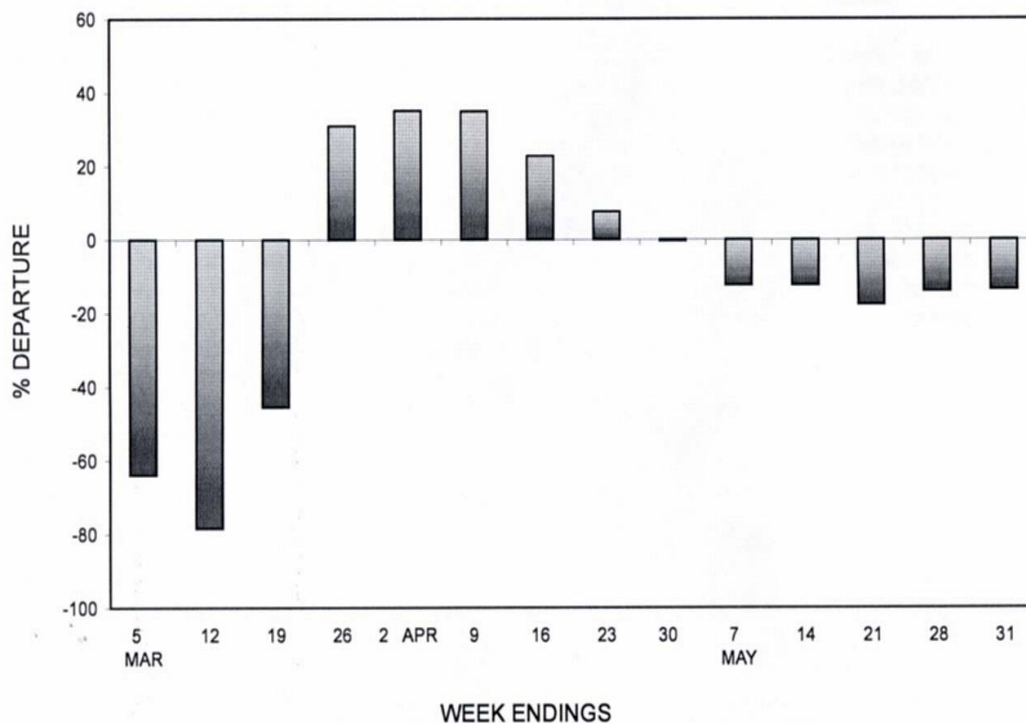
### Rainfall Features

During the season, out of 36 meteorological sub-divisions, 13 received excess rainfall, 10 received normal rainfall, 9 received deficient rainfall and the remaining 4 sub-divisions received scanty rainfall (Fig. 4).

Rainfall activity during the season over the country as a whole was below normal. However, Haryana, Chandigarh & Delhi, Telangana and Tamil Nadu received more than twice of its normal rainfall.

Rainfall activity was mainly confined to the south peninsula and northern and





**Fig. 5. Accumulated percentage departure of area weighted weekly rainfall over the country**

eastern parts of the country which generally received more than 10 cm of rainfall. Parts of Jammu & Kashmir, South Interior Karnataka, Coastal Karnataka and Tamil Nadu received more than 20 cm of rainfall. Rainfall over parts of northeastern region and Kerala exceeded 40 cm. Rainfall anomaly was positive over most parts of the country except some northern, westcentral and northeastern parts. Rainfall anomaly exceeded by 5 to 10 cm over the south peninsula and northwestern parts of the country. Over parts of Jammu & Kashmir, Uttaranchal, Himachal Pradesh and extreme northeastern parts of the country, rainfall deficiency exceeded by 5 to 10 cm.

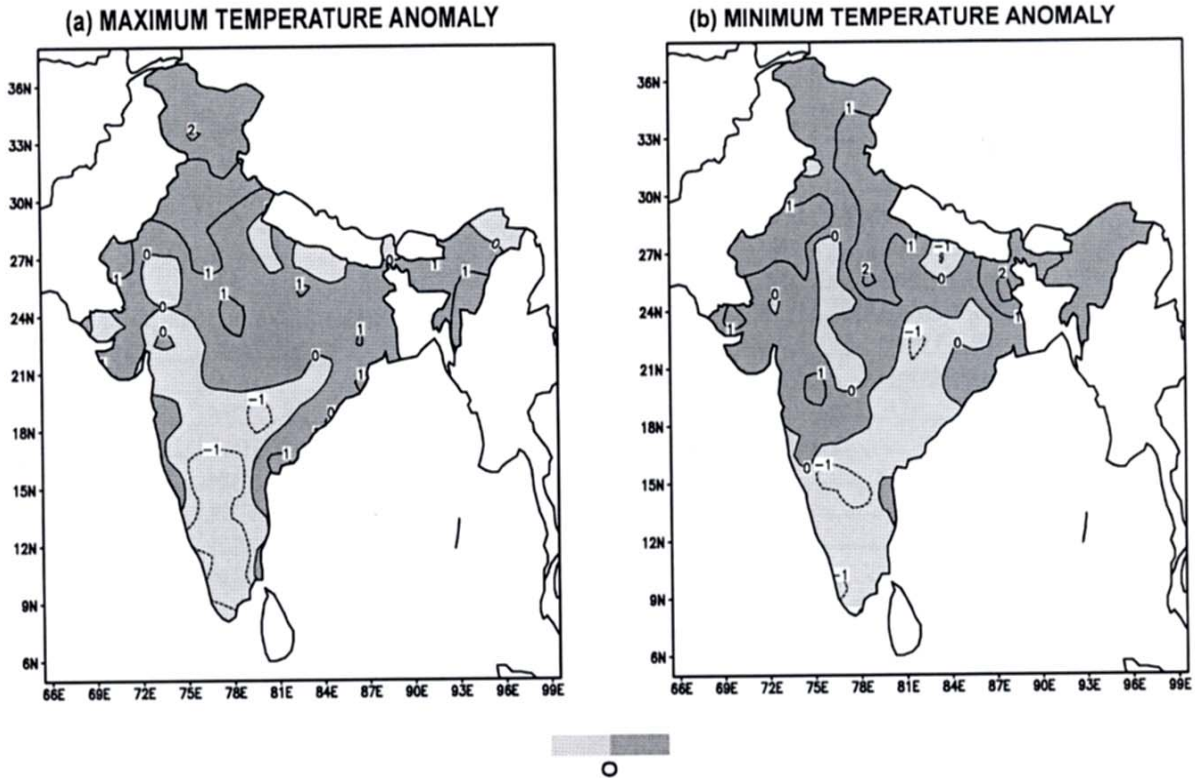
Fig. 5 shows the area weighted cumulative weekly rainfall percentage departure during the season for the country as a whole. Cumulative rainfall departure was negative during the first

three weeks of March. Thereafter, it became positive and remained so till the third week of April mainly due to good rainfall activity over the south peninsula. It again became negative since first week of May and remained so till the end of the season.

For the pre-monsoon season 2008, rainfall for the country as a whole was 86% of its Long Period Average (LPA) value.

### **Pressure & Wind**

The pressure anomalies were negative almost throughout the country. Negative pressure anomalies were generally of the order of 0.5 hPa. Over some parts of West Rajasthan and northeastern region, negative pressure anomalies exceeded 1.0 hPa.



Figs. 6(a&b). Mean seasonal temperature anomalies ( $^{\circ}\text{C}$ ) (a) maximum, (b) minimum

At 850 hPa level, two anomalous cyclonic circulations, one each over the south and adjoining central Arabian sea and south and adjoining central Bay of Bengal, extending upto 500 hPa level were observed.

### Outgoing Longwave Radiation (OLR)

OLR anomalies were negative over the south peninsula and eastern parts of the country and positive elsewhere. Over parts of northeastern region and adjoining north and central Bay of Bengal, the negative OLR anomalies exceeded  $5 \text{ W/m}^2$ .

### Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 6(a&b) respectively.

Maximum temperatures were below normal over most parts of peninsula and were generally above normal over rest of the country. Maximum temperatures were above normal by more than  $1^{\circ}\text{C}$  over northern parts of the country, parts of Nagaland, Manipur, Mizoram & Tripura and parts of Coastal Andhra Pradesh. These were above normal by more than  $2^{\circ}\text{C}$  over parts of Jammu & Kashmir.

Maximum temperatures were below normal by more than 1°C over parts of south peninsula. Minimum temperatures were below normal over most parts of south peninsula and east central parts of the country and were generally above normal over rest of the country. Minimum temperatures were above normal by more than 1°C over parts of Jammu & Kashmir, Himachal Pradesh, Uttaranchal, East Uttar Pradesh, West Madhya Pradesh, West Rajasthan and northeastern region of the country. They were below normal by more than 1°C over parts of Kerala, Ralalaseema and Karnataka.

### **Low Pressure Systems**

During the season, a very severe cyclonic storm Nargis formed over the Bay of Bengal in the month of April. The detail characteristics of this system are discussed in a section 2.5.

Apart from this cyclonic storm, three low pressure areas, one each during March and May over the Arabian sea and one over the Bay of Bengal during May, also formed during the season.

## **2.3. MONSOON SEASON 2008**

### **(a) Salient Features**

(i) The cumulative seasonal rainfall for the country as a whole was near normal. Rainfall for the season (1<sup>st</sup> June to 30<sup>th</sup> September, 2008) was 98% of its long period average (LPA).

(ii) Seasonal rainfall was 107% of its LPA over Northwest India, 96% of its LPA over Central India, 96% of its LPA over south Peninsula and 94 % of its LPA over Northeast India.

(iii) Out of 36 meteorological sub-divisions, 30 meteorological sub-divisions recorded normal rainfall. Only 2 (Punjab and Orissa) and 4 (Nagaland, Manipur, Mizoram & Tripura, West Madhya Pradesh, Vidarbha and Kerala) sub-divisions recorded excess and deficient rainfall respectively.

(iv) Out of 36 meteorological sub-divisions, 92% of the country's area comprising 32 meteorological sub-divisions received excess/normal rainfall and the remaining 8% received deficient rainfall during the season.

(v) Monsoon rainfall was marked by large temporal variations for the country as a whole, as rainfall was 24% above LPA in June and in July it was 17% below LPA. The rainfall was near normal during August and September as it was 3% and 1% below the LPA respectively.

(vi) While, there was rapid progress of monsoon over most parts of the country after the onset over Kerala on 31<sup>st</sup> May, there was delay in withdrawal of monsoon from northwest India. Monsoon covered the entire country on 10<sup>th</sup> July against its normal date of 15<sup>th</sup> July. The withdrawal of monsoon from west Rajasthan commenced on 29<sup>th</sup> September 2008 against normal date of 1<sup>st</sup> September.

(vii) IMD's long range forecast for the seasonal rainfall over the country as a whole and over different homogeneous regions except northwest India have been accurate. However, the seasonal rainfall over northwest India and rainfall during July for the country as a whole have not been accurate. While the prediction overestimated the rainfall during July for the country as a whole, it underestimated the seasonal rainfall over northwest India.

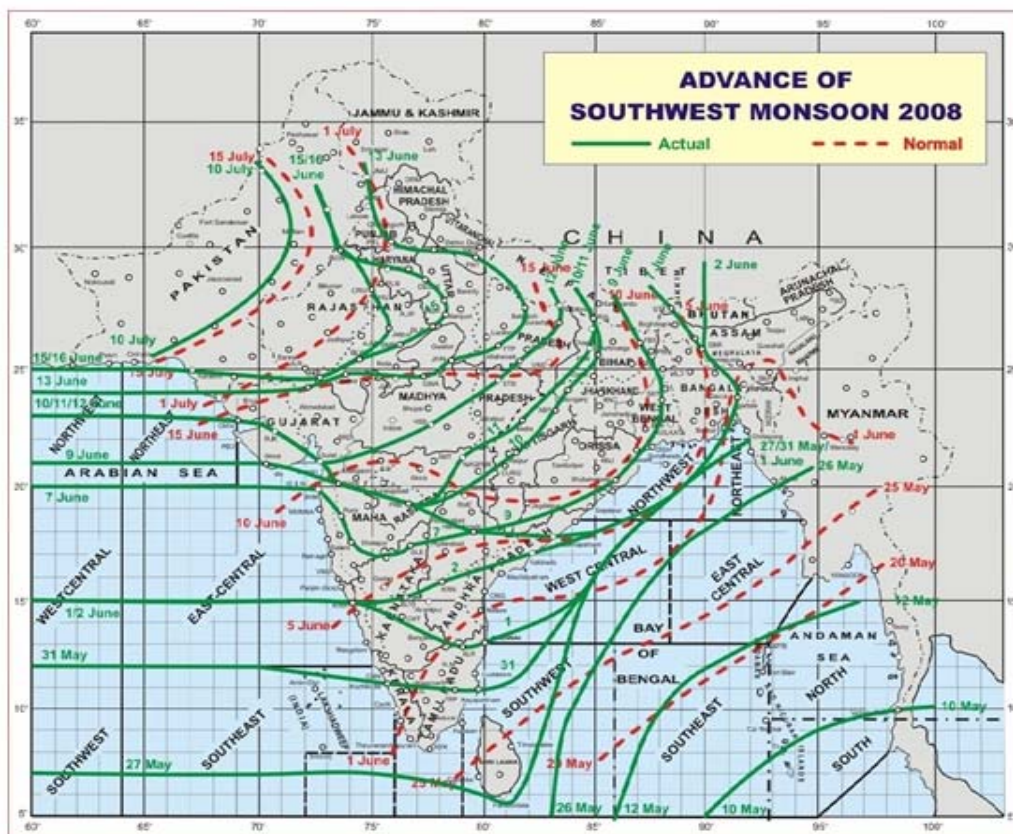


Fig. 7. Progress of Southwest Monsoon – 2008

### (b) Onset of Southwest Monsoon

Southwest monsoon advanced over parts of southeast Bay, most parts of Andaman Sea and Bay Islands on 10<sup>th</sup> May, 2008, about 5 days ahead of its normal date (Fig. 7). The monsoon set in over Kerala on 31 May, one day prior to the normal date. Further, advance took place quite rapidly mainly due to a depression (5 – 6<sup>th</sup> June) over the east central Arabian Sea and a well marked low pressure area (9 – 11<sup>th</sup> June) over Saurashtra & Kutch and neighbourhood. By 16<sup>th</sup> June, southwest monsoon had covered most parts of the country except for some parts of Rajasthan. The rapid advance of monsoon could be

attributed to the interaction of the monsoon circulation with mid-latitude westerly system. Subsequently, there was a hiatus in the further advance due to the weakening of the monsoon current. The monsoon covered the entire country by 10<sup>th</sup> July, against normal date of 15<sup>th</sup> July.

### (c) Chief Synoptic Features

The mid latitude westerly intrusion, which occurred during advance phase, resulted into above normal rainfall over most parts of north India (North of Lat. 20° N) during June. The monsoon trough with normal southward tilt with height could not be active due to the absence of

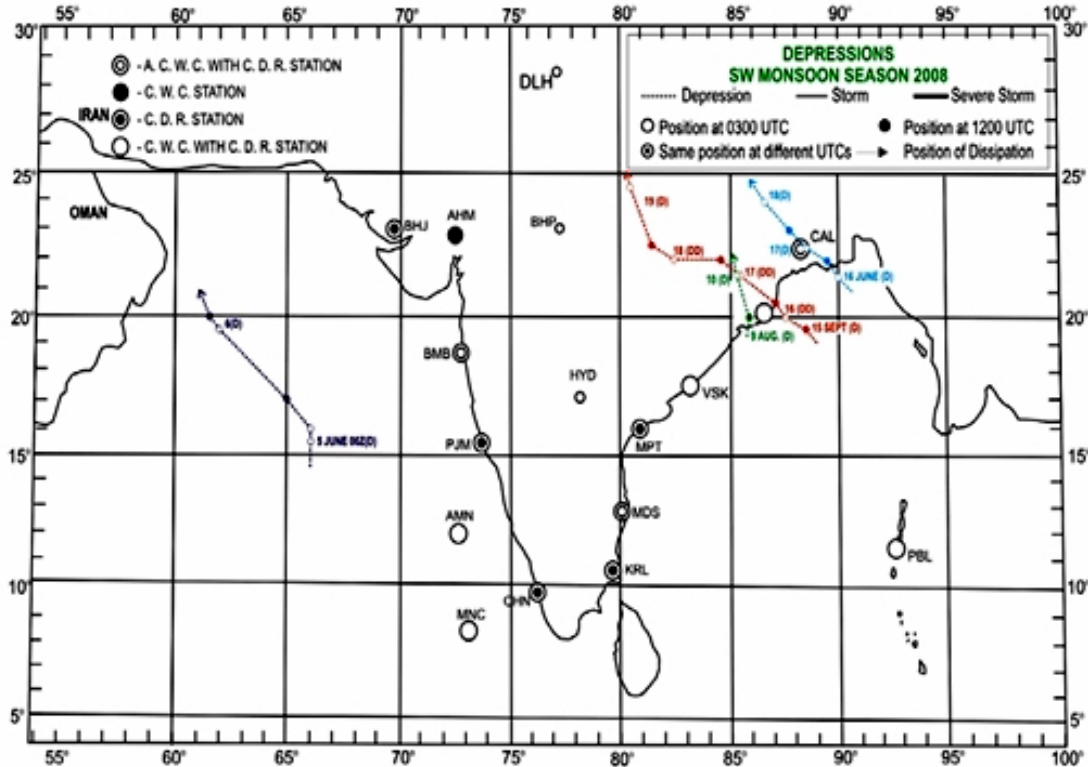


Fig. 8. Tracks of the cyclonic disturbances over Indian seas during the southwest monsoon season- 2008

normal large scale north-south horizontal temperature gradient. The break monsoon conditions also prevailed over the country during second fortnight of July. It adversely affected the rainfall over the central and south peninsular India in July.

Compared to last two years, the frequency of monsoon depressions has been less with development of only four depressions during this monsoon season. These included one depression over the Arabian Sea and another over Bay of Bengal during June, one land depression over coastal Orissa during August and one deep depression over the Bay of Bengal during September. The tracks of these systems are shown in Fig. 8. The month of July was devoid of any monsoon depression like the previous July of 1995, 1998, 2000, 2001, 2002 and 2004. However, seven low pressure areas

developed during the season and contributed to the seasonal rainfall.

The depression over the Arabian Sea during 5<sup>th</sup> to 6<sup>th</sup> June moved away westwards and weakened over the Ocean.

The second depression over the Bay of Bengal during 16<sup>th</sup> to 18<sup>th</sup> June crossed Bangladesh coast and moved across Gangetic West Bengal and Jharkhand. It then moved as a low pressure area upto east Uttar Pradesh and adjoining east Madhya Pradesh. The system caused heavy to extremely heavy rainfall over Gangetic West Bengal, north Orissa and Jharkhand leading to flood over these regions. The third system was a land depression (9 - 10 August) over coastal Orissa and was short lived with the life period of less than 12 hours. The fourth system was a deep depression

(15-19 September) over the northwest Bay of Bengal which crossed Orissa coast near Chandbali and moved across north Orissa, north Chhattisgarh, northeast Madhya Pradesh and central Uttar Pradesh. The remnant low pressure area moved upto northwest Uttar Pradesh. This system caused heavy to extremely heavy rainfall over Orissa and Chhattisgarh leading to severe flood over Orissa. This system also interacted with mid-latitude westerly systems and caused good rainfall over northwest India and led to flood over Haryana and Himachal Pradesh. Apart from the above systems, 7 low pressure areas formed during the season.

#### (d) Withdrawal of Southwest Monsoon

There was a delay in the commencement of withdrawal of southwest monsoon from extreme west Rajasthan. The southwest monsoon withdrew this year from entire Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Chandigarh & Delhi, west Rajasthan, most parts of Uttarakhand, west Uttar Pradesh and east Rajasthan, some parts of north Gujarat State and north Arabian Sea on 29<sup>th</sup> September. The normal date of withdrawal of southwest monsoon from west Rajasthan is 1<sup>st</sup> September. The delay was mainly due to the presence of systems in westerlies over northwest India interacting with the monsoon circulation. Comparing with recent years (1990-2007), the latest withdrawal in recent years from west Rajasthan took place on 30 September during 2007.

#### (e) Rainfall Distribution

The southwest monsoon rainfall (June to September) for the period 1<sup>st</sup> June to

30<sup>th</sup> September 2008 for the country as a whole and four broad homogeneous regions are as follows:

Region	Actual (mm)	Normal (mm)	Percentage Departure
All -India	873.2	892.2	-2%
Northwest (NW) India	651.7	611.6	7%
Central India	956.9	993.9	-4%
South peninsula	692.5	722.6	-4%
Northeast (NE) India	1346.0	1427.3	-6%

For the country as a whole, the seasonal rainfall from 1<sup>st</sup> June to 30<sup>th</sup> September was 98% of its LPA. Seasonal rainfall over NW India, Central India, NE India and South Peninsula was 107%, 96%, 94% and 96% of the LPA respectively. The sub-division wise cumulative rainfall distribution is shown in Fig. 9. The spatial distribution of seasonal monsoon rainfall during 2008

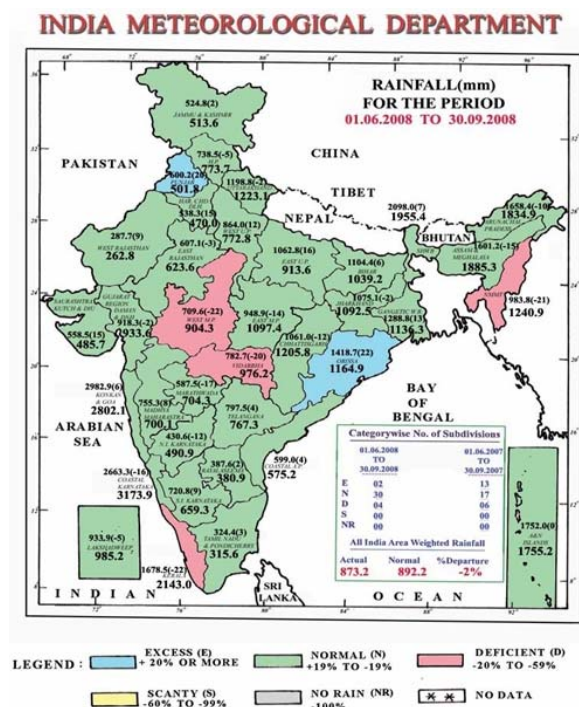


Fig. 9. Sub-division wise rainfall distribution over India during southwest monsoon season (Jun to Sep 2008)

was largely uniform with 30 meteorological sub-divisions recording normal rainfall. Only 2 (Punjab and Orissa) subdivisions recorded excess and 4 (Nagaland, Manipur, Mizoram & Tripura, West Madhya Pradesh, Vidarbha and Kerala) sub-divisions recorded deficient rainfall.

Out of 36 meteorological sub-divisions, 92% of the country's area comprising 32 meteorological sub-divisions received excess/normal rainfall and the remaining 8% received deficient rainfall during the season.

Thus during the 2008 monsoon season, rainfall activity was near uniformly distributed in space with most parts of the country receiving near normal seasonal rainfall.

Monsoon rainfall was marked by large temporal variation. Monsoon rainfall over the country as a whole was 24% above LPA during June and 17% below LPA in July. It was near normal during August (97% of LPA) and September (99% of the LPA). The monthly rainfall over India as a whole is given in the following Table.

Monthly rainfall over the country as a whole during different monsoon months

<i>Month</i>	<i>Actual rainfall (mm)</i>	<i>Long period average (mm)</i>	<i>Percentage departure from long period average</i>
June	201.9	162.2	24
July	243.0	293.3	-17
August	254.3	262.0	-03
September	173.4	174.6	-01

The excess rainfall in June for the country as a whole was mainly due to the excess rainfall over north and adjoining central India, which could be attributed to the mid-latitude westerly systems interacting with the monsoon circulation. The excess rainfall over eastcentral & adjoining northeast India, Bihar, Jharkhand and West Bengal was mainly associated with the monsoon depression (16-18 June), which developed over north Bay of Bengal and moved northwestwards across Bangladesh, Gangetic West Bengal and Jharkhand. The deficient rainfall in July was mainly due to the deficient rainfall over central and south peninsular India, excluding southeast peninsula. At the same time, the rainfall in July was higher along the foothills of the Himalayas, especially over east Uttar Pradesh, Bihar and Arunachal Pradesh. This type of rainfall distribution was mainly due to the break monsoon condition, which developed during 14-24 July. The deficient rainfall over south peninsular India during June and July was compensated by the excess rainfall during August. Specifically, the deficient rainfall over Maharashtra and Gujarat during June and July was compensated with excess rainfall during August and September. The spatial distribution of monthly rainfall is shown in Fig. 10.

Fig. 11 depicts the monsoon rainfall for the country as a whole as received week by week. In June, the weekly rainfall was above normal during the first three weeks. It was maximum for the week ending 18 June in association with the monsoon depression (16-18 June). In July, the rainfall was below normal during all the weeks. The rainfall was highly deficient for the week ending 23 July due to break monsoon condition,

# INDIA METEOROLOGICAL DEPARTMENT

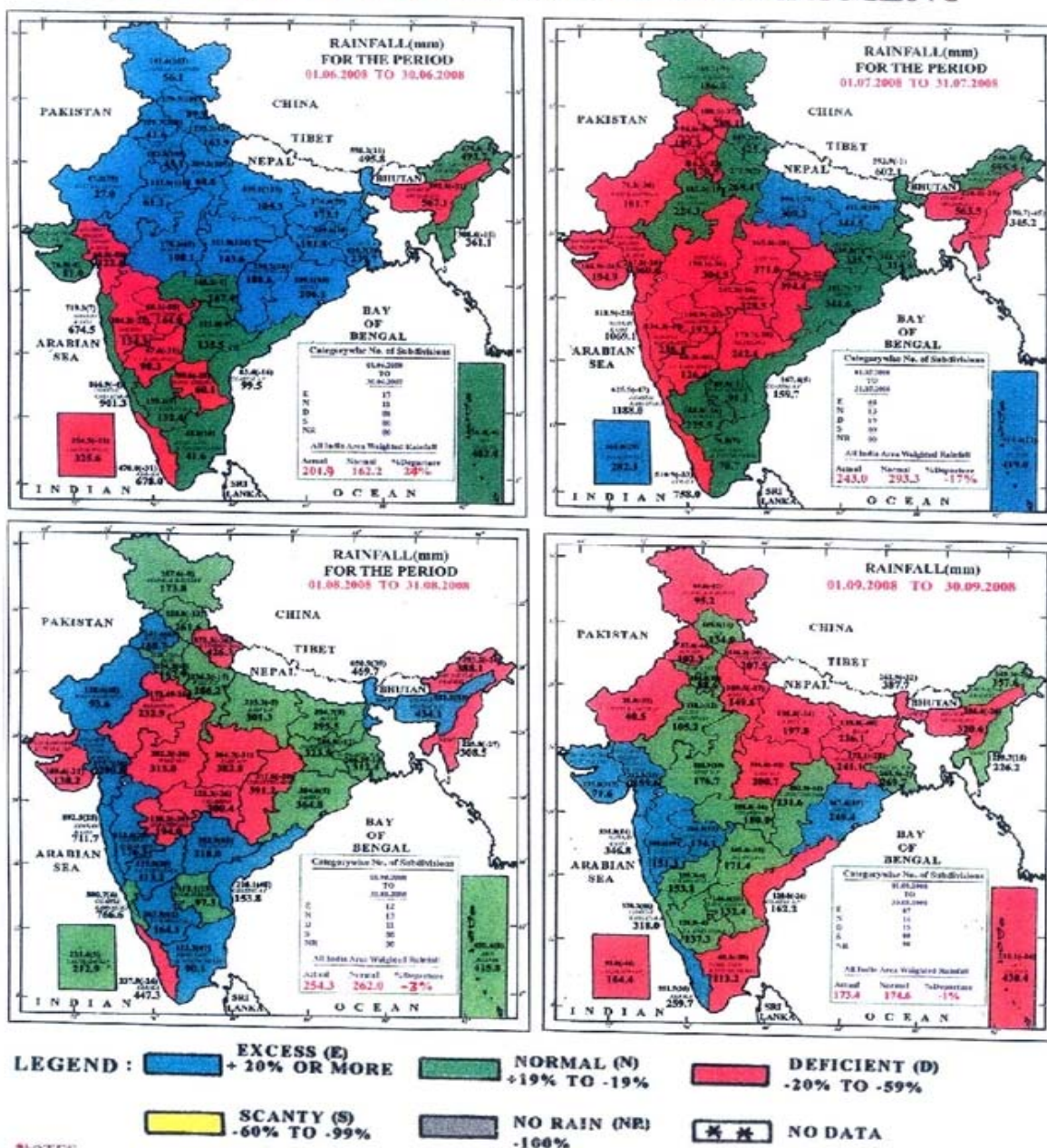
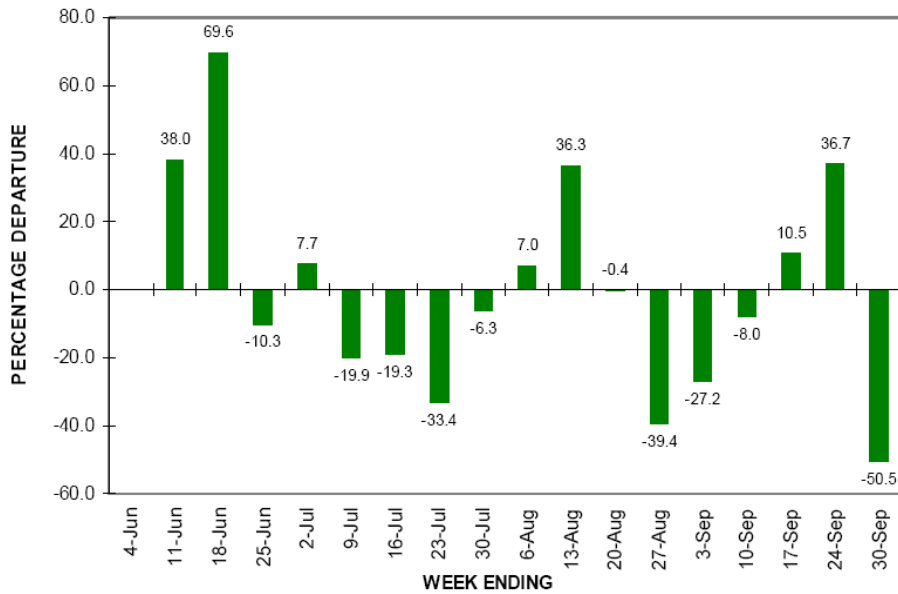


Fig. 10. Spatial distribution of monthly rainfall over India during southwest monsoon season - 2008

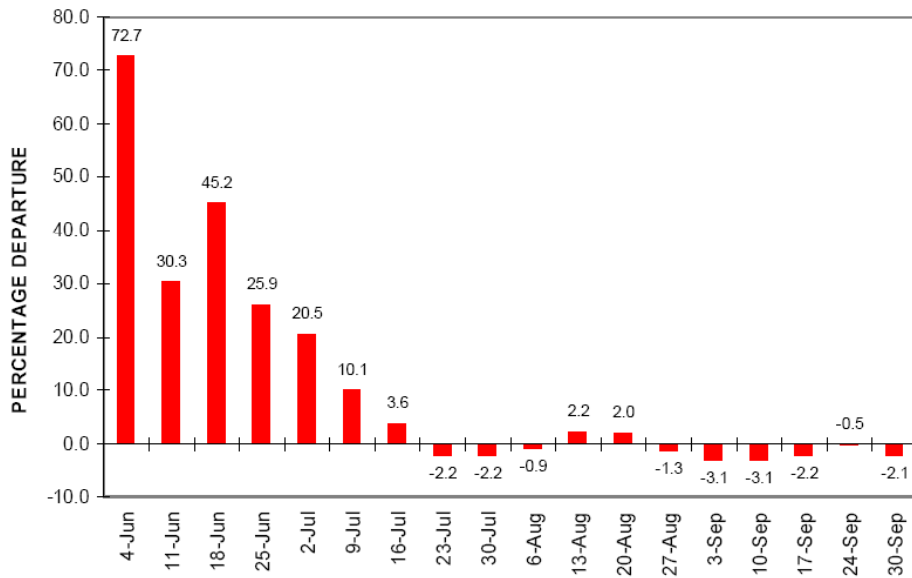
which prevailed during this period. In August, the rainfall was above normal during the first two weeks and significantly below normal during last

week. Significantly higher rainfall for the week ending 13 August could be mainly attributed to the depression (09 - 10 August), which developed over coastal





**Fig. 11. Week by week progress of the monsoon rainfall - 2008**



**Fig. 12. Week by week progress of cumulative rainfall during - 2008**

Orissa and moved northwestwards. Significantly deficient rainfall for the

week ending 27 August and 3 September may be attributed to break

monsoon condition during this period. The rainfall was significantly above normal for the weeks ending 17 and 24 September due to a low pressure area and a deep depression (15-19 September), which developed over the Bay of Bengal and moved northwest wards. Large rainfall deficiency was observed during last week of September. It may be mentioned that the withdrawal of southwest monsoon commenced from northwestern part on 29 September.

The week by week progress of cumulative rainfall during season is presented in Fig. 12. The cumulative rainfall was excess for the country as a whole in the beginning of the season. It had decreasing trend till the week ending 23 July. However, the excess rainfall condition for the country as a whole continued till the week ending 9 July. From the week ending 23 July, the cumulative seasonal rainfall over the country as a whole continued to remain near normal, as the rainfall departure from the LPA was within about  $\pm 2\%$ .

### **Pressure & Wind**

The pressure anomalies were positive almost throughout the country except over some parts of the south peninsula. The positive anomalies were of the order of 0.5 hPa over northern parts of country. Over parts of south peninsula and northeastern region the pressure anomalies were slightly negative.

At 850 hPa level, an anomalous cyclonic circulation was observed over the south Arabian sea. At the same level, an

anomalous anticyclonic circulation was observed over the westcentral Bay and adjoining peninsula, which extended upto the 500 hPa level with little westward shift. At 200 hPa level, an anomalous anticyclonic circulation was observed over the Tibetan region.

### **Temperature**

Maximum temperatures were below normal over most parts of the country except over some parts of extreme south peninsula, Jammu & Kashmir and northeastern region where it were slightly above normal. The negative anomalies in the maximum temperature were less than 1.0°C over central, northern and eastern regions. Over parts of Uttar Pradesh, East and West Madhya Pradesh the negative anomalies in the maximum temperature were less than 2.0°C.

Minimum temperatures were below normal over most parts of central region and eastern parts of south peninsula and were positive elsewhere. Positive and negative anomalies were generally less than 1°C. Positive anomalies over Jammu & Kashmir, eastern parts and Madhya Maharashtra exceeded 1°C.

### **Outgoing Longwave Radiation (OLR)**

OLR anomaly ( $W/m^2$ ) was observed over the Indian region and neighbourhood.

Positive OLR anomalies were observed over on northwestern and south peninsular parts of the country.

## (f) Long Range Forecasts and Actual Rainfall

### Onset of monsoon over Kerala

Using an indigenously developed statistical model, IMD predicted that monsoon onset over Kerala would take place on 29<sup>th</sup> May with a model error of  $\pm 4$  days. This year, the monsoon onset over Kerala was on 31<sup>st</sup> May, just one day earlier than its normal date and hence within the forecast range.

### Verification of the long range forecasts

The Table below gives the summary of the verification of the long range forecasts issued for the 2008 Southwest monsoon.

**TABLE**

**Details of long range forecasts and actual rainfall**

<i>Region</i>	<i>Period</i>	<i>Issued on</i>	<i>Forecast</i>	<i>Actual</i>
All India	Jun to Sep	16 Apr, 2008 30 Jun, 2008	99% of LPA $\pm 5\%$ 100% of LPA $\pm 4\%$	98% of LPA
All India	Jul	30 Jun, 2008	98% of LPA $\pm 9\%$	83% of LPA
Northwest India	Jun to Sep	30 Jun, 2008	96% of LPA $\pm 8\%$	107% of LPA
Northeast India	Jun to Sep	30 Jun, 2008	101% of LPA $\pm 8\%$	94% of LPA
Central India	Jun to Sep	30 Jun, 2008	101% of LPA $\pm 8\%$	96% of LPA
South Peninsula	Jun to Sep	30 Jun, 2008	98% of LPA $\pm 8\%$	96% of LPA

As per the long range forecast for the 2008 Southwest monsoon seasonal rainfall issued on 16<sup>th</sup> April, the seasonal rainfall for the country as a whole was expected to be 99% of LPA with a model error of  $\pm 5\%$ . In the updated forecast issued on 30<sup>th</sup> June, the forecast for the country as a whole was revised as 100% of LPA with a model error of  $\pm 4\%$ . The forecast came correct as the actual area-weighted rainfall for the country as a whole was 98% of the LPA. IMD had also issued the long range forecast for July 2008 rainfall over the country as a whole as 98% of its LPA with a model error of  $\pm 9\%$ . But the actual rainfall in July was 83% of LPA, much less than the lower limit of the predicted value. Considering 4 broad homogenous regions of India, rainfall was expected to be 96% of its LPA over NW India, 101% of LPA over Central India, 101% of LPA over NE India and 98% of LPA over South Peninsula with a model error of  $\pm 8\%$ . The actual rainfall over these 4 regions was 107%, 96%, 94% and 96% of the LPA respectively. Thus the long range forecasts for the seasonal rainfall over all the homogeneous regions except NW India were accurate. Over NW India the actual seasonal rainfall was slightly more than the upper limit of the predicted value.

## 2.4. POST MONSOON SEASON - 2008

### Northeast Monsoon Activity

The northeast monsoon rain commenced over Tamil Nadu and adjoining states of south peninsula on 15 October. During the season, rainfall activity over the northeast monsoon region was normal. However, rainfall during the season was not well distributed over the space and time. Tamil Nadu & Pondicherry received excess rainfall, Rayalaseema and Kerala received

normal rainfall, while Coastal Andhra Pradesh and South Interior Karnataka received deficient rainfall.

Some of the stations in Tamil Nadu received exceptionally heavy rainfall ( $\geq 25$  cm) in 24 hours period in the last week of November, due to the cyclonic storm 'NISHA'. These are given below :

27 Nov : Orathanadu (66), Tanjavur (53),  
Vedaranniyam (42),  
Adiramapatnam, Vadaranniyam &  
Orathanadu (33 each)  
Chidambaram(28)

28 Nov : Muthupet (30) Chennai (AP) (28)

29 Nov : Arkonam (25)

### Rainfall Features

During the season, out of 36 meteorological sub-divisions, 2 received excess rainfall, 4 received normal rainfall, 15 received deficient rainfall and 15 received scanty rainfall.

Southern Peninsula, eastern, northeastern region and parts of Jammu & Kashmir generally received more than 10 cm of rainfall. Parts of south Coastal Andhra Pradesh, Rayalaseema, South Interior Karnataka, Tamil Nadu, Kerala and Assam & Meghalaya received more than 20 cm of rainfall. Rainfall over parts of Tamil Nadu exceeded 40 cm.

Rainfall anomaly was generally negative over most parts of the country, except over the parts of south peninsula and extreme northeastern region. Over parts of Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, Kerala and parts of Assam & Meghalaya, positive rainfall anomaly was more than 10 cm.

Cumulative rainfall departure was negative during all the weeks of the season. At the end of post-monsoon season 2008, the rainfall for the country as a whole was 69% of its Long Period Average (LPA) value.

The northeast monsoon seasonal rainfall over the south peninsula for this year was 104% of its LPA.

### Pressure & Wind

The pressure anomalies were generally negative throughout the country and were of the order of 0.5 hPa.

The mean circulation pattern and its anomalies at 850, 500 & 200 hPa levels respectively.

At 850 hPa level, an anomalous ridge was observed across the south peninsula. At 500 hPa level, an anomalous anticyclonic circulation was observed over the central and northern parts. This anomalous anticyclonic circulation extended upto the 200 hPa level also.

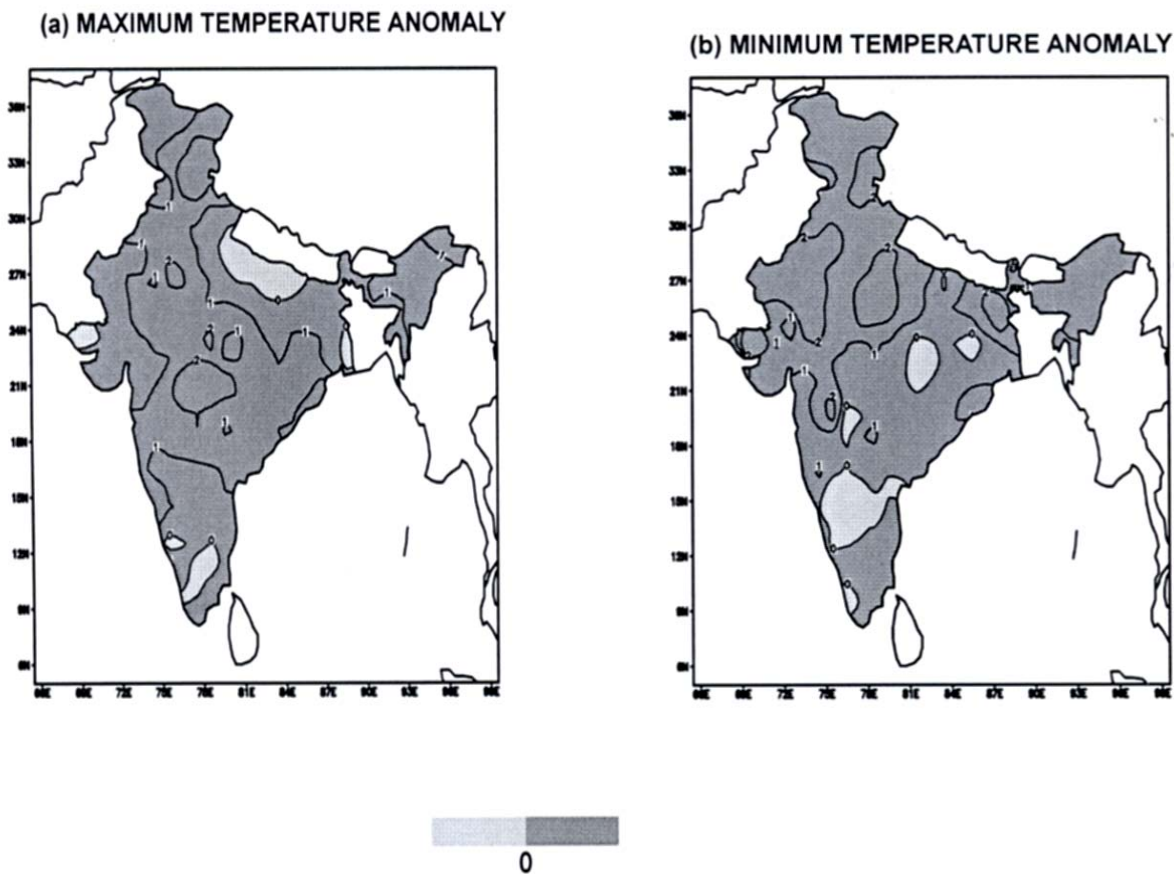
### Outgoing Longwave Radiation (OLR)

OLR anomaly ( $W/m^2$ ) was observed over the Indian region and neighbourhood. Positive OLR anomalies were observed almost throughout the country.

### Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 13 (a&b) respectively.

Maximum temperatures were above normal almost throughout the country except over some parts of Uttaranchal, East and West Uttar Pradesh. Over most parts of



Figs. 13. (a&b). Mean seasonal temperature anomalies ( $^{\circ}\text{C}$ ) (a) maximum, (b) minimum

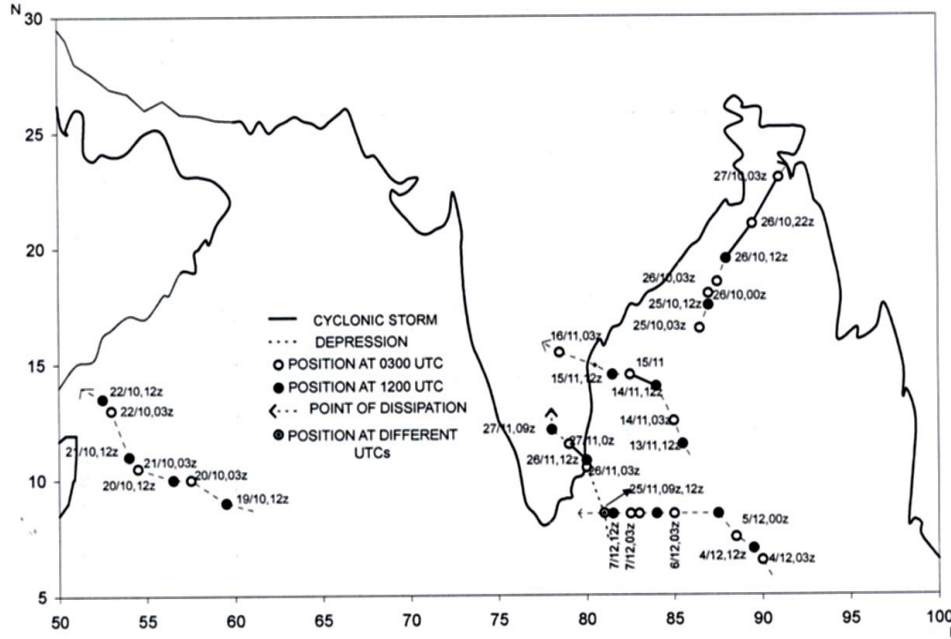
the country. the positive anomalies exceeded by  $1^{\circ}\text{C}$ . Over parts of Jammu & Kashmir, Uttaranchal, Himachal Pradesh and Vidarbha, positive anomalies exceeded by  $2^{\circ}\text{C}$ .

Minimum temperatures were also above normal almost throughout the country except over some parts of south peninsula. Over most parts of the country, the minimum temperatures were generally above normal by  $1^{\circ}\text{C}$ . Over parts of West & East Rajasthan, Jammu & Kashmir, Himachal Pradesh, West Uttar Pradesh and West Madhya Pradesh, the minimum temperatures were above normal by more than  $2^{\circ}\text{C}$ .

### Low Pressure Systems

During the season, three cyclonic storms, all over the Bay of Bengal (Rashmi, in the month of October, Khai Muk & Nisha, in the month of November) formed over the Indian Seas. In addition, two depressions, one in October, over the Arabian sea and the other in December, over the Bay of Bengal, also formed (Fig. 14). The main features of low and depression are discussed below. The characteristics of cyclones are discussed in section 2.5.

In the month of October, the first depression of the season formed over the southwest Arabian sea on 19<sup>th</sup> and lay



**Fig. 14. Tracks of cyclonic storms and depressions formed during the post monsoon season (Oct-Dec) 2008**

centred at 1200 hrs UTC near Lat. 9.0° N/Long. 59.5° E. Moving in a westnorthwesterly direction it intensified into a deep depression on 21 and lay centred at 0300 hrs UTC near Lat. 11.0° N/Long. 54.0° E. It further moved northwestwards and weakened into a depression and lay centred at 0300 hrs UTC of 22 near Lat. 13.0° N/Long. 53.0° E and at 1200 hrs UTC near Lat. 13.5° N/Long. 52.5° E and subsequently weakened into a well marked low pressure area on 23<sup>rd</sup> over west central Arabian sea and adjoining Gulf of Aden.

During the month of December a deep depression formed over the southeast Bay of Bengal on 5<sup>th</sup>. It was first seen as a low pressure area over the same region on evening of 3<sup>rd</sup> December. It concentrated into a depression and lay centred at 0300 hrs UTC of 4<sup>th</sup>, near Lat. 6.5° N/Long 90.0° E. It moved northwestwards and lay centred at 1200 hrs UTC of 4<sup>th</sup>, near Lat. 7.0° N/Long 89.5° E. Continuing the northwest-

wards movement, it intensified into a deep depression at 0000 hrs UTC of 5<sup>th</sup>, near Lat. 7.5° N/Long 88.5° E. It remained practically stationary over there at 0300 hrs UTC of 6<sup>th</sup> and lay centred near Lat. 8.5° N/Long 87.5° E at 1200 hrs UTC. Thereafter, it moved westwards and lay centred at 0300 hrs UTC of 6<sup>th</sup>, near Lat. 8.5° N/Long 85.0° E and at 1200 hrs UTC, near Lat. 8.5° N/Long 84.0° E. Subsequently it weakened into a depression and lay centred at 0000 hrs UTC of 7<sup>th</sup>, near Lat. 8.5° N/Long 83.0° E, at 0300 hrs UTC, near Lat. 8.5° N/Long 82.5° E and at 1200 hrs UTC, near Lat. 8.5° N/Long 81.5° E (close to Trincomalee). Moving further westwards, it weakened into a well marked low pressure area over Sri Lanka and adjoining southeast Bay at 1500 hrs UTC of 7<sup>th</sup>.

In addition, during October and December, a low pressure area formed over southeast and southwest Arabian sea respectively.

## 2.5. CYCLONE MONITORING

During this year, 10 cyclonic disturbances formed over north Indian Ocean including one deep depression and one depression formed over Arabian sea and 7 disturbances formed over the Bay of Bengal. Out of seven disturbances formed over the Bay of Bengal, 3 intensified into Cyclonic storms, one into very severe cyclonic storm and two into deep depressions. While the very severe

cyclonic storm, 'NARGIS' (28 April - 3 May) crossed Myanmar coast, cyclonic storm, 'RASHMI' (25-27 October) crossed Bangladesh coast and cyclonic storm 'NISHA' (24-27 November) crossed Tamil Nadu and Puducherry coasts. The cyclonic storm, 'KHAIMUK' (13-16 November) weakened into a deep depression before crossing south Andhra Pradesh coast. Each cyclonic disturbance was monitored and predicted by Regional Specialised Meteorological Centre (RSMC), New Delhi (Fig. 15).

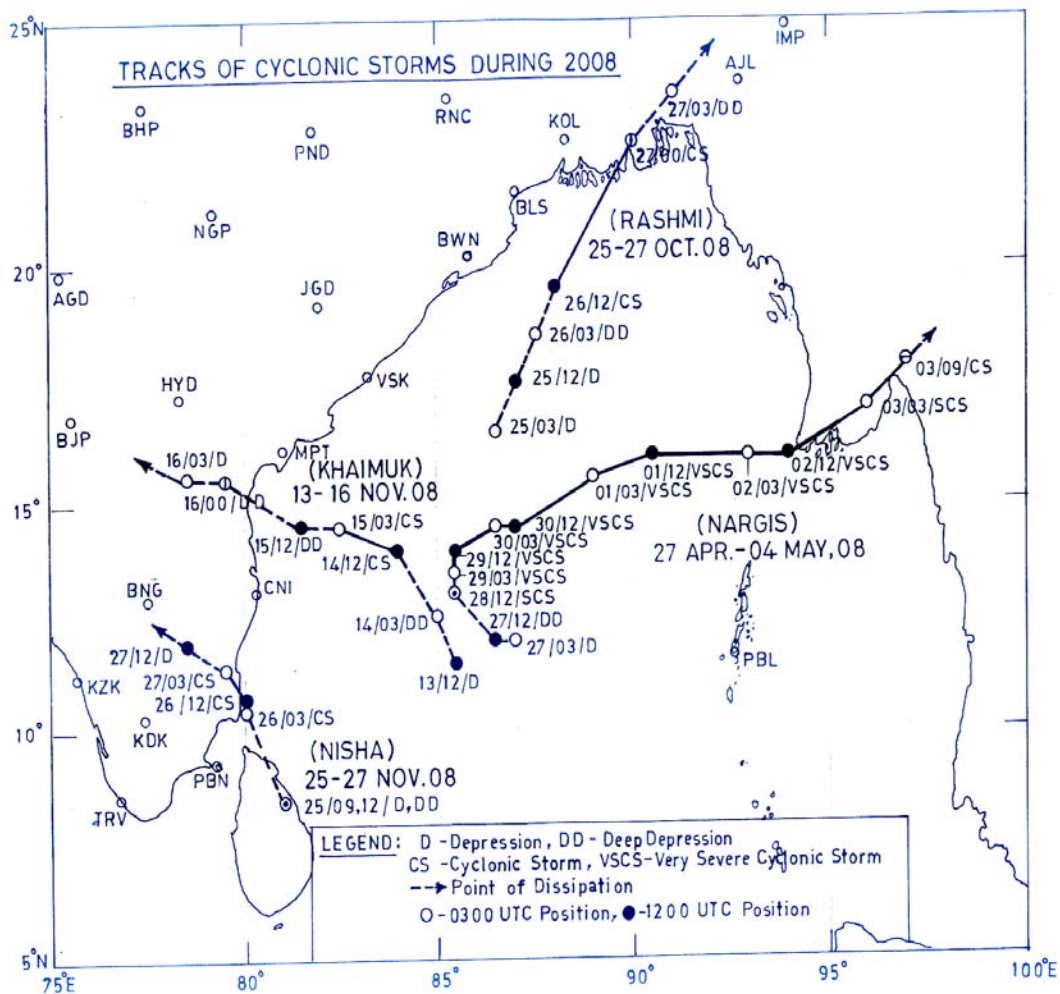


Fig. 15. Tracks of cyclonic storms during 2008

The total nos. of bulletins issued to national/ international agencies and disaster managers are given below.

### International Bulletins

- (i) Tropical weather outlook : 320
- (ii) Special weather outlook : 36
- (iii) Tropical cyclone Advisories : 74
- (iv) Tropical Cyclone Advisory Centre (TCAC) International civil aviation : 29

### National Bulletins

- (i) Bulletins for Indian coast : 152
- (ii) Bulletins issued by DGM : 21

WMO in its press release No. 814 dated 9<sup>th</sup> May, 2008 appreciated the efforts made by RSMC, New Delhi in providing tropical cyclone advisories to Myanmar in connection with the very severe cyclonic storm 'Nargis'.

### History of Cyclonic Storm

#### Very Severe Cyclonic Storm "NARGIS" over Bay of Bengal during 27<sup>th</sup> April to 3<sup>rd</sup> May, 2008

A low-pressure area formed over southeast Bay of Bengal in the morning of 26<sup>th</sup> April. It concentrated into a depression over the same region at 0830 hours IST of 27<sup>th</sup> April, 2008 and intensified into a deep depression at 1730 hours IST of same day. The system

started to move in a northwesterly direction and intensified into a cyclonic storm "NARGIS" in the morning of 28<sup>th</sup>. The system intensified into a very severe cyclonic storm on 29<sup>th</sup> morning. Thereafter, the system started to move in an east-northeasterly direction till 1730 hours IST of 1<sup>st</sup> May. It then moved in easterly direction while intensifying further and crossed southwest coast of Myanmar between 1730 to 1930 hours IST of 2<sup>nd</sup> May near Lat. 16.0° N. After crossing the coast, system maintained the intensity of very severe cyclonic storm till 3<sup>rd</sup> early morning and gradually weakened thereafter. It was the most devastating cyclonic storm over the north Indian Ocean after 1991, Bangladesh cyclone in terms of loss of life and property. The INSAT imagery of the system at 1030 hours IST of 02 May, 2008 is shown in Fig. 16.

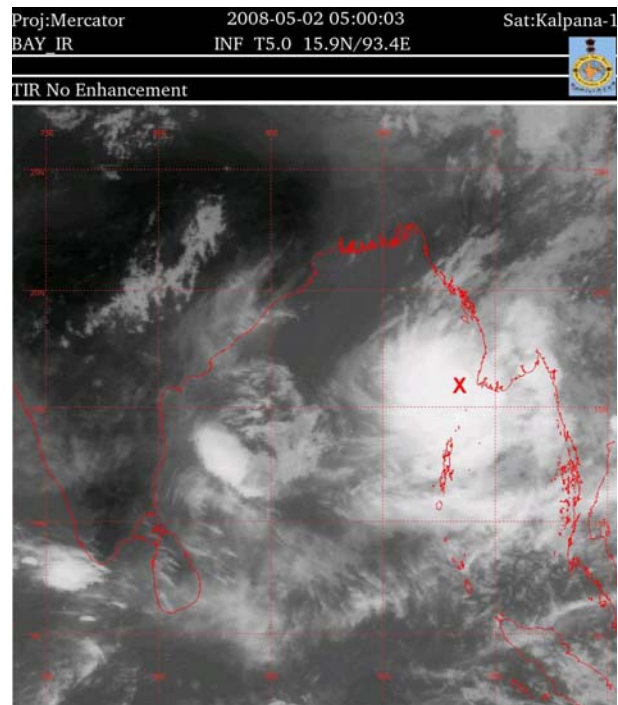


Fig. 16. INSAT imagery of the very severe cyclonic storm, 'NARGIS' at 1030 hrs IST of 02 May, 2008



## Cyclonic storm 'RASHMI' over Bay of Bengal during 25-27 October, 2008

A low pressure area formed over the westcentral Bay of Bengal off Andhra Pradesh coast on 24<sup>th</sup> October, 2008. It concentrated into a depression and lay centred at 0830 hours IST of 25<sup>th</sup> over west central Bay of Bengal. It moved in a north-northeasterly direction and intensified into a deep depression at 0530 hours IST of 26<sup>th</sup> over westcentral and adjoining northwest Bay of Bengal. It continued its north-northeastward movement and intensified into a cyclonic storm "RASHMI" over northwest Bay of Bengal at 1730 hours IST of 26<sup>th</sup>. Its INSAT imagery at 1730 hours IST of 26<sup>th</sup> is shown in Fig. 17(a) and DWR imagery at 2330 hours IST of 26<sup>th</sup> October 2008 is shown in Fig. 17(b). It intensified further, moved in a north-northeasterly direction and crossed Bangladesh coast as a cyclonic storm near longitude 89.5° E between 0330 & 0430 hours IST of 27<sup>th</sup> and gradually weakened thereafter. Under its influence, widespread rainfall

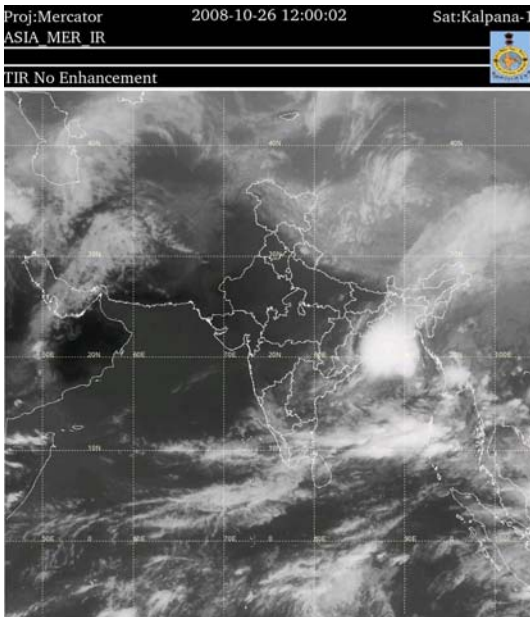


Fig.17(a). INSAT imagery of 'RASHMI' at 1730 hrs IST of 26 October 2008

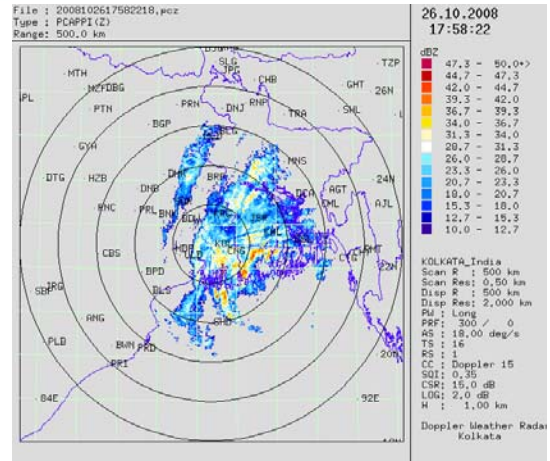


Fig.17(b). DWR imagery of 'RASHMI' at 2330 hrs IST of 26<sup>th</sup> October 2008

with isolated heavy to very heavy falls occurred over West Bengal & Sikkim and northeastern states. It caused loss of life and property in Bangladesh and northeastern states.

## Cyclonic storm "KHAI MUK" over Bay of Bengal during 13-16 Nov, 2008

A low pressure area formed over the southeast Bay of Bengal and adjoining

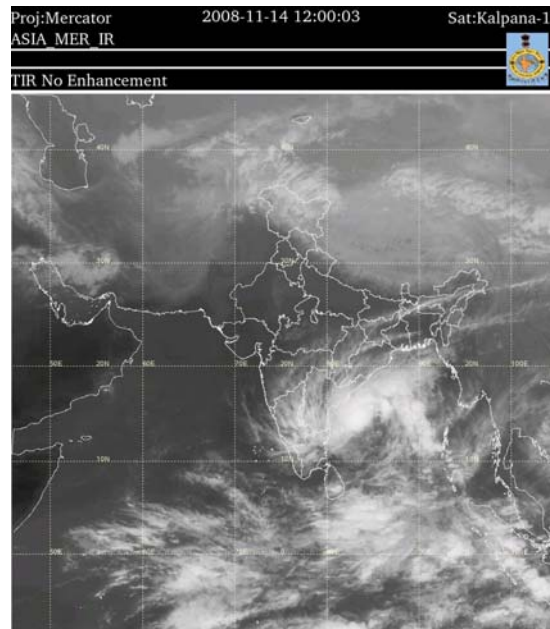
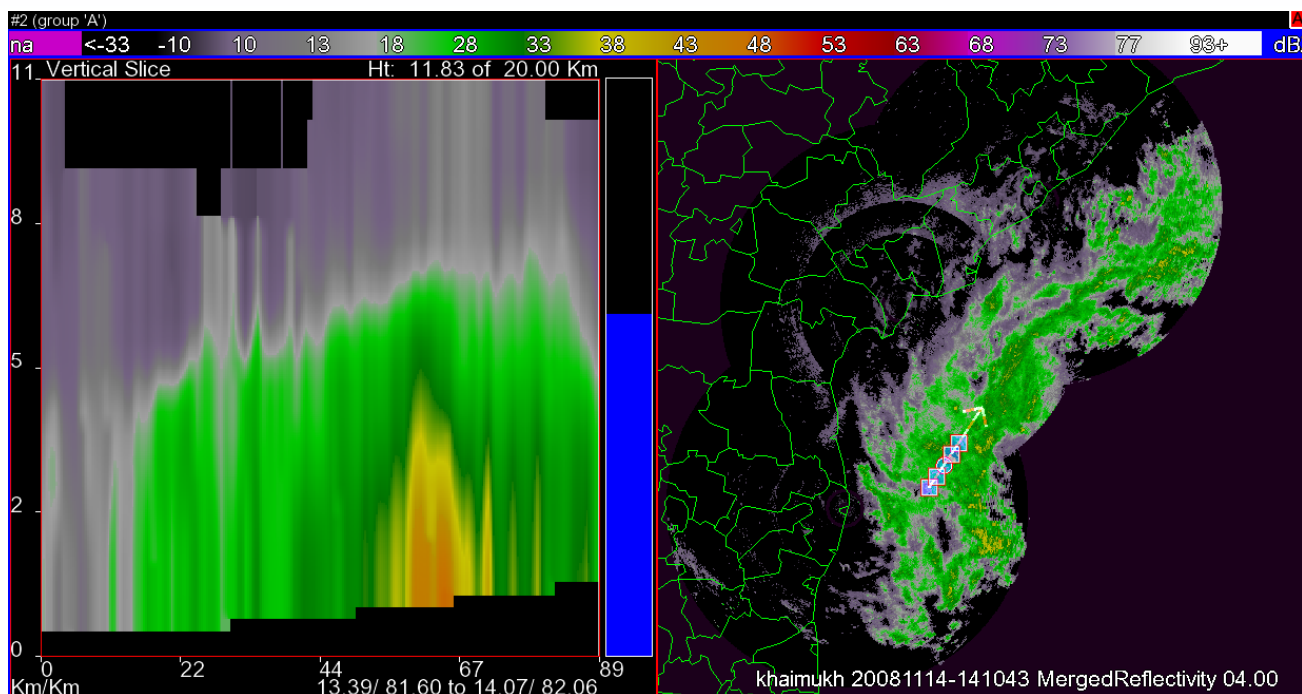


Fig. 18. INSAT imagery of 'KHAIMUK' cyclonic storm of 14 November 2008



**Fig. 19. A mosaic creation of the tropical cyclone KHAIMUK of 14 November 2008, which was tracked by the three radars at Chennai, Machhilipatnam and Visakhapatnam**

areas on 12<sup>th</sup> November. It concentrated into a depression at 1730 hours IST of 13<sup>th</sup> and intensified into a Deep Depression at 0830 hours IST of 14<sup>th</sup> and intensified further into a Cyclonic Storm (KHAI MUK) at 1730 hours IST of 14<sup>th</sup> over the southwest Bay of Bengal. The INSAT imagery of “KHAI MUK” at 1730 hours IST of 14<sup>th</sup> is shown in Fig. 18.

The system moved in northwest/ west-northwesterly direction and weakened into a Deep Depression at 1130 hours IST of 15<sup>th</sup> due to shearing of the system. The system then moved in a west-northwesterly direction and crossed South Andhra Pradesh coast close to north of Kavali between 0330 & 0430 hours IST of 16<sup>th</sup>. The Deep Depression moved west-northwestwards and weakened into a Depression and lay centred at 0830 hours IST of 16<sup>th</sup> over

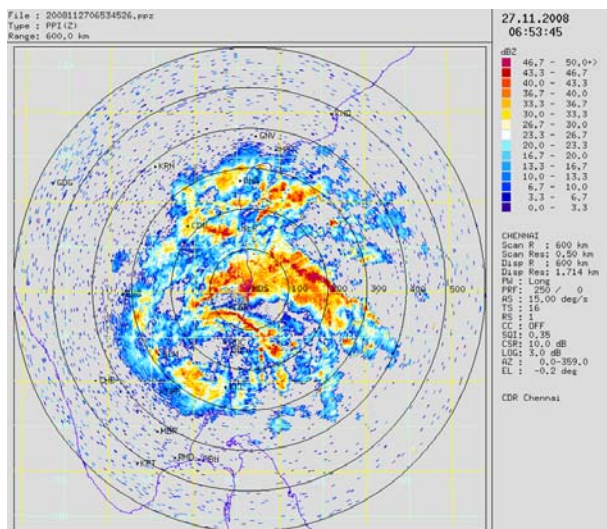
Royalaseema close to Nandayal. It further moved in a west-northwesterly direction and weakened gradually. Under its influence, fairly widespread rainfall with isolated heavy to very heavy falls occurred over south coastal Andhra Pradesh and Royalaseema (Fig. 19).

### **Cyclonic storm “NISHA” over Bay of Bengal during 24- 27 November, 2008**

A low pressure area formed over Sri Lanka and neighbourhood on 24<sup>th</sup> November, 2008. It concentrated into a depression and lay centred at 1430 hours IST of 25<sup>th</sup> over Sri Lanka. It remained practically stationary and intensified into a deep depression at 1730 hours IST of 25<sup>th</sup>. It then moved north-northwestwards and intensified into a cyclonic storm “NISHA” over southwest Bay of Bengal at 0830 hours IST of 26<sup>th</sup> close to



**Fig. 20 (a).** INSAT imagery of 'NISHA' cyclonic storm of 26 November 2008



**Fig. 20(b).** DWR imagery of 'NISHA' at 1230 hrs IST of 27 November 2008

Vedaranniyam. It then moved very slowly and crossed Tamil Nadu and Puducherry coast, close to the north of Karaikal between 0630 and 0730 hours IST of 27<sup>th</sup>. The INSAT imagery of NISHA at 0830 hours IST of 26<sup>th</sup> is shown in Fig. 20(a). The Doppler Weather Radar

(DWR) imagery at 1230 hours IST of 27<sup>th</sup> is shown in Fig. 20 (b). Under the influence of cyclonic storm, "NISHA", widespread rainfall with scattered heavy to very heavy falls and isolated extremely heavy falls occurred over Tamil Nadu & Puducherry.

## 2.6. NUMERICAL WEATHER PREDICTION

(a) NWP Models operational at IMD New Delhi are:

(i) The Limited Area Model (LAM) forecast is being produced regularly in respect of 0000 UTC and 1200 UTC observations for day-to-day operational use. The operational forecasting system known as Limited Area Forecast System (LAFS), is a complete system consisting of data decoding and quality control procedures, 3-D multivariate optimum interpolation scheme for objective analysis and a semi-implicit semi-Lagrangian multi-layer primitive equation model. The horizontal resolution of the model is  $0.75^{\circ} \times 0.75^{\circ}$  lat./long. with 16 sigma levels in the vertical.

(ii) The Quasi-lagrangian Model (QLM) model is run to produce track forecasts based on the initial conditions of each day based on 0000 UTC and 1200 UTC observations when the disturbance is in cyclonic storm stage. The QLM is a multilevel fine-mesh primitive equation model with a horizontal resolution of 40 km and 16 sigma levels in the vertical. The integration domain consists of  $111 \times 111$  grid points in a  $4440 \times 4440$  km<sup>2</sup> domain that is centred on the initial position of the cyclone. Very recently, model has been updated (from 36 to 72 hours) to get six hourly track forecasts valid up to 72 hours.

(iii) The non hydrostatic mesoscale model MM5 is run at the resolution of 45 km daily with 0000 UTC initial and boundary condition of NCEP GFS (National Centre for Environmental Prediction, USA; Global Forecast System).

(iv) A multi-model ensemble technique has been developed for five days weather forecasts making use of state of the art global model outputs. The method is made operational from 1 June 2008 for district level Integrated Agro-advisory services.

(v) The mesoscale model WRF has been implemented in experimental mode with the assimilation of local observations.

(vi) A good number of officers from regional centres are trained on the operation of WRF model and WRF model is made operational at some regional centres.

(vii) The storm scale model ARPS (Advanced Regional Prediction System) has been implemented in experimental mode at the horizontal resolution of 9 km with the assimilation of Doppler Weather observations.

(viii) Development and implementation of a Statistical Dynamical method for cyclone genesis and intensity prediction

(ix) For Storm Surge Prediction, Dynamical Storm Surge model of IIT Delhi has been made operational.

Graphics product of all these models are available in the IMD web site.

## (b) Data Management

Data management at NHAC is comprising of four stages namely, (i) Reception of data through the Global Telecommunication System (GTS) from RTH (ii) Processing of observations for various operational use (iii) Disposal of final products and (iv) Archival of data. Reception of data includes of real time weather observations and NWP outputs ECMWF (in the GRIB format)

*Reception* : Meteorological observational data received on line at RTH round the clock are being used in NHAC in two different channels namely: (i) Manual Plotting of operational Synoptic Weather Charts, (ii) Processing of data (Decoding, Quality Control) in the NHAC Computer system for Automatic Plotting of weather charts for synoptic use and ingesting of data in the assimilation cycle of NWP models. Manual synoptic weather charts are preserved

*Processing of data in NHAC Computer System* : Automatic Plotting of synoptic charts are done at every three hours interval where as plotting of AWS observations are done at hourly interval. Synoptic Observations are also used for preparation of various display tables (like Current Weather) and Graphics as required by the IMD web site, which are made updated on the basis of latest observation. At IMD H/Q, NWP models are run based on 0000 UTC and 1200 UTC observations. These models are run based on the initial and boundary conditions from NCEP GFS (received online through the Internet)/NCMRWF T-80 (received online through RTH). Based on the model outputs various NWP graphics products are prepared as required for the operational forecasting.

ECMWF model outputs are decoded and then graphics product are prepared.

*Disposal of Final Product* : All the automatic plots of weather charts and NWP graphics outputs are used for the operational forecasting at NHAC. Display tables and graphics product (based on observations as well as NWP outputs) are used for IMD web site. Some of the products are kept in IMD ftp site for access to the field forecasters at MC/RMC/MO.

*Archival data* : Following data are being archived at NHAC (Computer): (i) GTS observations (ii) Decoded synoptic and upper air observations (iii) NWP outputs both graphics and digital data and (iv) Automatic Plots of weather charts. Manual synoptic charts are also preserved at NHAC.

Data received from regional telecommunication hub (RTH) to NHAC computer through GTS channel are approximately 20MB/day ASCII data and 75MB/day binary data. These data are WMO specific code format. They are further processed for plotting as well as used for model input. Besides these data, initial and boundary fields are regularly downloaded from NCEP/NCMRWF site to run LAM and MM5. NCEP data are also used to run QLM to give cyclone track prediction up to 72hr. JMA and ECMWF outputs are also being achieved.

Graphic products of all model output are uploaded to web server of IMD ([www.imd.gov.in](http://www.imd.gov.in)) besides other routine observational data in tabular form. Hourly plots of AWS data, 3 hourly surface data & 12 hourly upper air plotting are regularly uploaded to ftp server of IMD. Five days forecast products from UKMET office &

T254L64 products received from NCMRWF are also uploaded to ftp server of IMD to facilitate field forecasting offices on day to day basis.

(c) Computer System: (i) Altix- 350 (ii) Origin 200 and (iii) IBM P5/595 (64 processors).

(d) On going NWP activities

Under the modernization programme, IMD is in the process of commissioning a state of the art High Performance Computing (HPC) system with a peak performance of 10 TF at IMD HQ., 1 TF at IMD Pune along with high end servers of 100 GF capacities to each in major meteorological centers viz. Delhi, Mumbai, Chennai, Nagpur, Kolkata, Guwahati, Ahmedabad, Bangalore, Bhubaneswar, Chandigarh, Hyderabad and Pune for global and regional NWP modeling, particularly for the regional database management, mesoscale data assimilation and high resolution local area model. From the ongoing modernization programme of IMD, observations (both conventional and non conventional) are expected to be available on the mesoscale both in space and time by means of Doppler Weather Radar (DWR), Satellites (INSAT Radiance), Wind Profilers, meso-network (Automatic Weather Stations), buoys and aircrafts in the real time mode with the use of advanced telecommunication system. Near future Weather Forecasting System of IMD would be as briefly given below:

*Now-casting and Mesoscale Forecasting System (valid for half hour to 24 hours)*

(i) Processing of Doppler Weather Radar (DWR) observations at a central

location (NHAC) to generate 3 D mosaic and other graphics products for nowcasting applications.

(ii) Enhancing mesoscale forecasting capability of local severe weather by providing 3 hourly area specific rainfall and wind forecasts (up to 24 hours) at the resolution of 3 km from ARPS (Advanced Regional Prediction System) with the assimilation (hourly intermediate cycle) of DWR, AWS, Wind profilers and other conventional and non-conventional observations.

(iii) Implementation of C-MMACS Fog model for visibility forecasting at the major airports of India.

*Regional Models for Short Range Forecasting System ( valid up to 3 days)*

(i) 72 hours forecasts from WRF model with 3 nested domains (at the resolution of 27 km, 9 km and 3 km). The nested model at the 3 km resolution would be operated at the Regional/State Met Centres at 6 hours interval with 3 DVAR data assimilation.

(ii) 72 hours forecasts from MM5 model with 2 nested domains (at the resolution of 27 km and 9 km) at 12 hours interval with 3 DVAR data assimilation.

(iii) For Cyclone Track Prediction, 72 hours forecast from Quasi Lagrangian Model (QLM) at 40 km resolution at six hours interval; WRF (NMM) at 27 km resolution with assimilation package of Grid Statistical Interpolation (GSI).

(iv) For Cyclone track and intensity prediction: multimodel ensemble technique and application of dynamical statistical approach for 72 hours forecasts, forecast would be updated at 12 hours interval.

(v) Development of multimodel ensemble technique for probabilistic forecasts of district level heavy rainfall events.

*Global model for Medium range Forecasting (valid up to 7 days)*

(i) NCEP Decoding System / MFI CIPS interface.

(ii) Global Data Assimilation System (GDAS), six hourly cycle with GSI (Grid Statistical Interpolation).

(iii) Global Forecast System (GFS) T-382

(iv) Multimodel Ensemble based district level forecasts

*Extended range forecast for rainfall and temperature*

(i) To implement a statistical dynamical model

*Long range forecast for summer and north-east Monsoon*

(i) To implement a dynamical model in conjunction with the statistical model.



## 3. Weather Services

### 3.1. METEOROLOGICAL SERVICES TO AVIATION

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

Letter of Agreement for provision of Aviation Meteorological Services at airports was signed with Airports Authority of India as per the ICAO guidelines.

Web based On-line Pilot Briefing system was started from Airport Meteorological Offices Mumbai and Kolkata airports. This system is already in operation at Delhi and Chennai.

IMD recovered a sum of Rs 60 Crores from Airports Authority of India for the meteorological services provided for aviation.

### 3.2. HYDRO METEOROLOGICAL SERVICES

The Hydrometeorological Division at New Delhi was established for providing the necessary technical and operational support to various Central / State Govt. Organisations and other agencies in the field of Hydromet design flood forecasting, water management and agricultural planning purposes. In the performance of these activities, this discipline carried out compilation of rainfall statistics, hydrometeorological analysis of different river catchments for project authorities and 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;

#### Rainfall Monitoring

Based on real time daily rainfall data, weekly districtwise, sub-divisionwise and statewise / seasonwise rainfall distribution summaries are prepared in the form of rainfall tables and maps. Districtwise and sub-divisionwise rainfall statistics provides important information useful to the agricultural scientists, planners and decision makers.

Preparation of weekly sub-divisionwise/districtwise/statewise rainfall reports including the statistics for the

country as a whole as well as for the four regions viz., North-West India, South Peninsula, Central India and North East India. During the Monsoon Season 2008, daily sub-division rainfall report (115 reports) were prepared and supplied to the Cabinet Secretary and other users.

Preparation of rainfall normal is another important work of IMD. Normal of monthly, seasonal and annual rainfall/rainy days based on the data of 1941-90 have been prepared.

Daily Rainfall data for about 9,200 raingauge stations in the country are being received from departmental and non-departmental observatories. These data are scrutinized and suitably processed for archival.

### **Flood Meteorological Service**

Flood Meteorological Service of IMD provides the following inputs to Central Water Commission (CWC) through their 10 Flood Meteorological Offices (FMO) established in different parts of India for operation flood forecasting. During the Flood Season 2008, 4012 QPFs were issued by FMOs and supplied to Central Water Commission for flood forecasting purposes.

### **Design Storm Studies**

Design Storm Studies are being conducted to evaluate design storm estimates (rainfall magnitude and time distribution) for various river catchments/projects in the country, for use as main input for design engineers in estimating design flood for hydraulic structures, irrigation projects, dams etc. on

various rivers. This estimation of design values is required for safe and optimum design of storage and spillway capacity. The design storm studies for more than 500 projects have been completed and results communicated to the concerned project authority.

During the current financial year 2008-09 (upto 31 October 2008), 25 projects have been completed and results communicated to the concerned project authorities. Storm Studies in respect of 39(thirty nine) Hydro-electric Dam Projects were completed and results communicated to the concerned Project Authorities

During the year 2008, a revenue of Rs.10,09,600/- (Rupees ten lakh nine thousand six hundred only) was deposited in IMD A/c for carrying out the Design Storm Studies for various Projects.

### **Storm Analysis Studies**

For designing medium and small structures like bridges, culverts, drainage structure etc. depth duration frequency analysis is carried out. For this purpose India have been divided into hydro meteorological homogeneous 7 zones and 26 sub-zones.

For the purpose of railway and road bridges construction, a committee has been formed viz., "Flood Estimation Planning & Co-ordination Committee" and the work is carried out jointly by the 4 departments viz., India Meteorological Department (IMD), Central Water Commission (CWC), Research Design Standard Organisation (RDSO) under Ministry of railway and Ministry of Transport. This study has been carried out for 92% of the sub-zone and published in the form of CWC's Reports.



## World Bank Funded Hydrology Projects

Govt. of India approved the Hydrology Project Phase-II. Objective of the Project is Quality Database Generation (useful for drought monitoring, flood forecasting and disaster weather warning like cloud-burst etc. The project is planned to be implemented for a period of 6-years. The Hydrology Project Phase-II commenced on 5/4/2006 and its target date of completion is 30/06/2012. The World Bank is assisting this Project as per terms agreed in the Credit Agreement. In FY 2008-09, 13 state officials of Himachal Pradesh have been given Basic Observer Course Training, 20 FCS and 80 SRGs have been inspected and 14 FCS and 70 SRGs have been selected so far by participating states.

### Hydrology Project Phase-II

(i) 13 officials from state Govt. of Himachal Pradesh completed Basic Observer's Course under Hydrology Project Phase-II.

(ii) State rainfall data of most of the stations under Hydrology Project in respect of Eight states (A.P., Chhattishgarh, Gujarat, Karnataka, Kerala, Maharashtra, Orissa and Tamilnadu) up-to 2006 (for Madhya Pradesh it is up-to 2004) has been validated by ADGM(R) Pune and sent back to the concerned states for inclusion in the State Data Bank.

(iii) Ministry of Finance has approved 21 posts Hydrology Project-II (DDGM-1, Director-4, Meteorologist Gr.I-3, AM II-11 & Senior Observer-2 as incremental staff.

### 3.3. METEOROLOGICAL SERVICE FOR AGRICULTURE

IMD continued to render Agromet Advisory Services to the State

Governments and farmers by issuing Weekly / biweekly bulletins. District level weather forecast and advisories were started since June 2008 through Agromet Field Units. These advisories are tailored to meet the requirements of farmers based on past and anticipated weather conditions and were broadcast by AIR stations in the respective regions in regional languages and also telecast through DD wherever the facilities exist. Significant agronomic and logistic interventions intended for crop protection and growth are based on these advisories.

Consolidated All India Agromet Advisory Bulletins were prepared by National Agromet Advisory Service Centre (NAASC), Pune and issued to Ministry of Agriculture and other users in the country to help policy decisions.

The Agricultural Meteorology Division of IMD maintains a network of Agrometeorological Observatories across the country in collaboration with the Agricultural Universities and Research Institutions. Processed agro-climatic data were supplied to end users like Ministry of Agriculture, State Departments of Agriculture, Scientists of Agricultural Universities / Institutes for planning agricultural strategy and research work.

Training pertaining to various levels of agricultural personnel (from observers to senior level officers/scientists/professors) were conducted as per approved academic calendar.

Annual inspection and maintenance of lysimeters & soil moisture equipments at 42 ET stations and 15 Soil moisture observatories was carried out. Annual inspection of agromet observatories under SAU set-up was carried out.

Research work was continued in the areas of Dry Farming, Soil moisture studies and crop pests and diseases and climate change with reference to agriculture in relation to weather.

### **District-Scale Quantitative Forecasts**

As a major step towards downscaling forecasting activities, IMD has initiated the project of issuing district scale quantitative forecasts for all 612 districts of India. Under this project, quantitative weather forecasts are issued for the Weather parameters of daily Weather Forecast - Maximum/Minimum temperature, rainfall, maximum & minimum temperatures (Trend). Total cloud cover, surface relative humidity (0300 & 1200 UTC) and surface wind (0000 & 1200 UTC) 5 days in advance.

These forecasts are generated through a multi-model ensemble system. The system consists of dynamical models, viz. European Centre for Medium Range Weather Forecasting (ECMWF) at 25 km resolution, National Centre for Environmental Prediction (NCEP) at  $1^{\circ} \times 1^{\circ}$  Lat./Long. resolution and Japan Meteorological Agency (JMA) at  $1.2 \times 1.2^{\circ}$  Lat./ Long. resolution. Each model output is converted into uniform 25 km resolution and weight for each model at each grid is computed. The models used in this scheme are the state of the art global models from the leading global NWP centres. The ensemble output is generated at 25 km resolution and district rainfall is computed by averaging the grid point values falling over a particular district. These forecasts are available on the national website of IMD.

### **District Level Agromet Advisory Service**

Integrated agro-meteorological advisory service is essentially a multi-institutional programme with participating organizations like IMD, NCMRWF, Agricultural Universities, ICAR Institutes, State Department of Agriculture, Department of Information Technology, Department of Space, MS Swaminathan Research Foundation, NGOs etc.

Considering the high variability of weather in time and space and need of farming sector, IMD has upgraded the Agro-Meteorological Advisory Service from agroclimatic zone scale to district level. From 1<sup>st</sup> June, 2008, IMD has started issuing district level (612 districts) weather forecast for meteorological parameters up to 5 days in quantitative terms. These products are based on a Multi Model Ensemble technique using forecast products available from number of models of India and other countries. The products are disseminated through Regional Meteorological Centres and Meteorological Centres of IMD located in different states after value addition to these products and communicate to 130 Agromet Field Units (AMFUs).

Agromet Advisory with contingency planning is being issued/advised for problem areas particularly with deficit/scanty/no rain through Integrated Agromet Advisory Services.

In order to strengthen Information Dissemination Organization at district/block/village level, District Agromet Advisory Service (DAAS) meeting were organized in each of the state of the country inviting the officers/scientists from all stakeholders with objectives to create appropriate information generation-cumdissemination mechanism

as well as extension mechanism for communicating the Agromet Advisory to the farmers.

### **Training**

The training unit of this Div. has conducted (i) 6 weeks Agromet Core course, (ii) Basic Agromet course and (iii) 'On the Job' training course.

Arrangement are being made for training course on 'Agrometeorology towards better advisories for serving end users' requirement for AMFU Scientists/ Technical officers.

### **Drought Research & Crop Yield Formulation**

Based on aridity indices, Biweekly Aridity Anomaly Reports for Southwest Monsoon Season for the whole country and for Northeast Monsoon Season for the five meteorological sub-divisions, viz. coastal Andhra Pradesh, Rayalaseema, south Interior Karnataka, Tamil Nadu & Pondicherry and Kerala, are prepared and sent to various agricultural authorities of State and Central Govts., and Research Institutes on operational basis for their use in Agricultural Planning and Research purposes. The Biweekly Aridity Anomaly maps are also uploaded in the departmental website. These Aridity Anomaly Reports help to assess the moisture stress experienced by growing plants and to monitor agricultural drought situation in the country.

The unit has developed empirical-statistical models using correlation and regression technique to forecast crop yields on operational basis for 26 rice growing meteorological sub-divisions and 16 wheat growing meteorological sub-divisions. Since meteorological parameters,

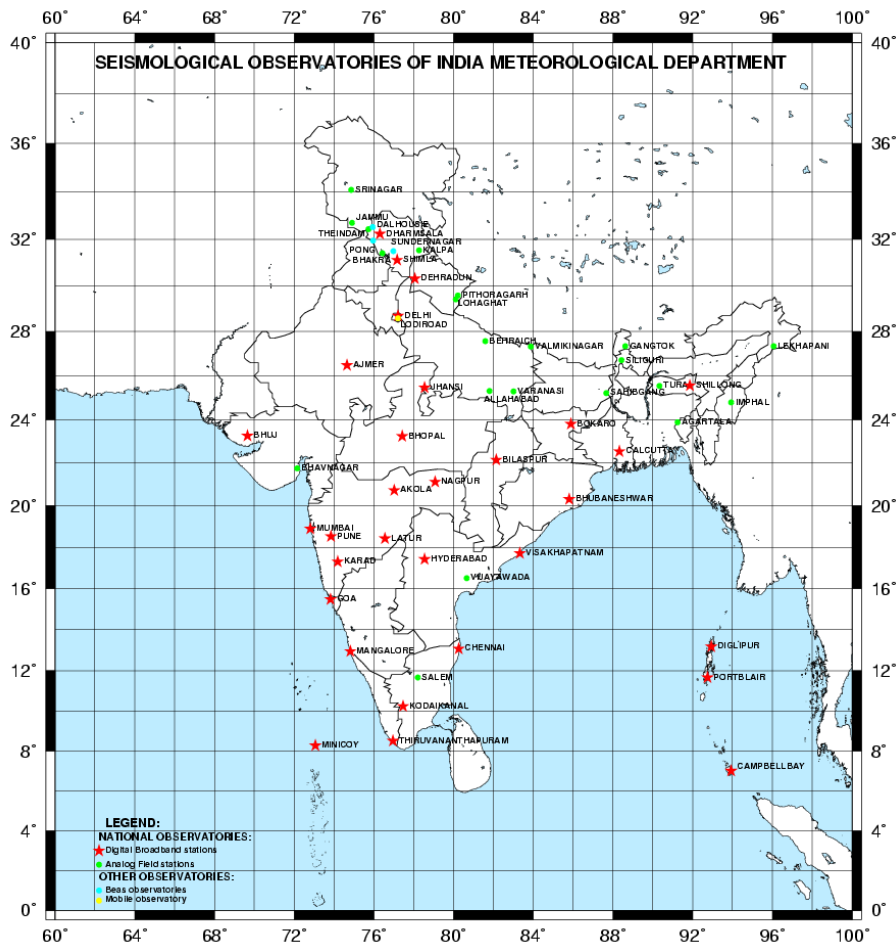
particularly the rainfall is highly variable in space and because the cultural practices vary from region to region, the unit has developed a number of models for each crop on meteorological sub-divisionwise basis. The models have been developed for Kharif rice and Rabi wheat crops which are grown on a large scale in the country.

Based on the crop yield forecast models, monthly quantitative forecast of interim and final yields are prepared every year during respective crop growing season and issued to Directorate of Economics and Statistics, Ministry of Agriculture & Cooperation, New Delhi on operational basis through H.Q. New Delhi for official use for national food planning.

The first interim forecast of kharif rice yield for 26 meteorological sub-divisions comprising of 15 States is issued during August. This forecast is updated in the subsequent months and the final forecast is issued in December. In the case of wheat the first interim forecast for 16 meteorological sub-divisions comprising of 12 States is issued in January which is updated in the subsequent months and the final forecast is issued in May, every year.

### **3.4. MARINE METEOROLOGICAL SERVICES**

The India Meteorological Department continued to maintain Voluntary Observing Fleet (IVOF), through six Port Met. Offices viz. Kolkata, Visakhapatnam, Chennai, Kochi, Goa and Mumbai. IVOF consisted of ships of Merchant Navy, Indian Navy and Foreign ships. Meteorological Observations from the oceanic area were collected on real time basis for operational forecasting. The ship weather logs were scrutinized in Marine Section and data sent to Marine Climatological Section of the O/o ADGM(R) for archival.



**Fig. 1 National Seismological Network (NSN) consisting of 55 observatories**

About 23 special ships under WMO/VOSCLIM project were recruited by IMD for providing quality and reliable observations to study climate change and providing inputs for numerical models.

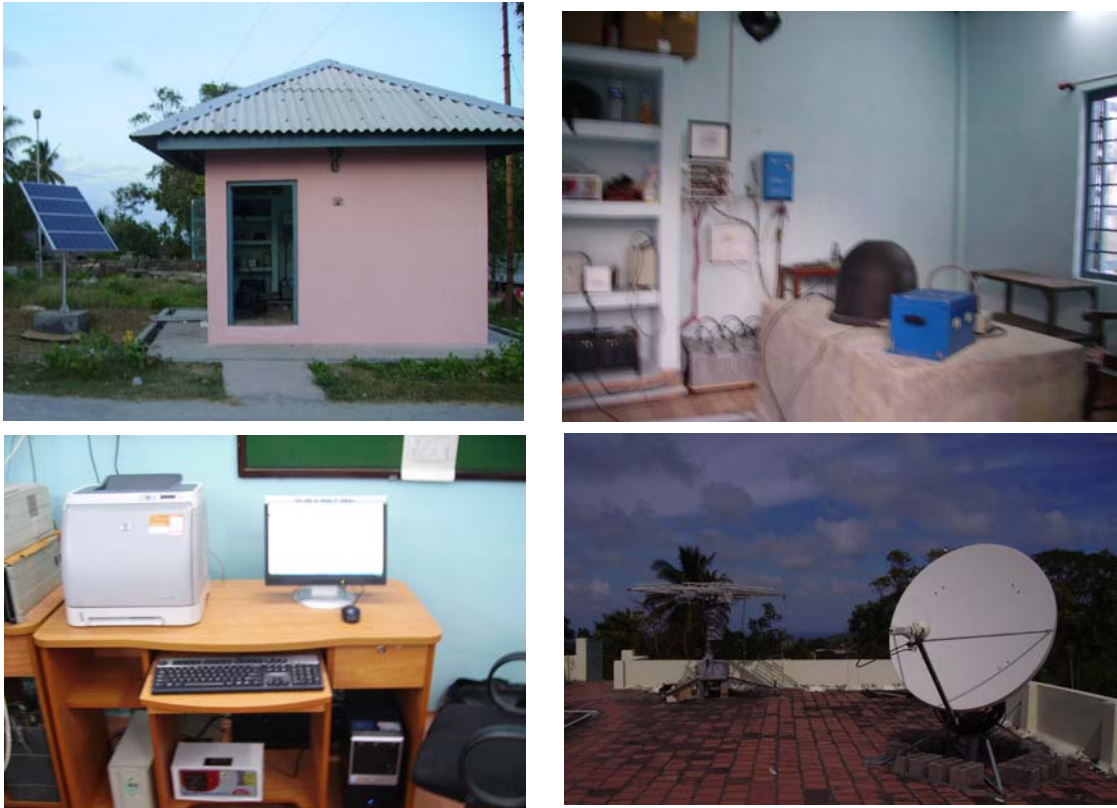
Necessary training was given for recording and transmitting meteorological observations on High Seas for Antarctica Expedition and Sagar Kanya Cruise. The tracks to be followed by the Sagar Kanya Cruises were also planned and prepared in Marine Section.

Excellent Award in the form of books and Certificate of Merit were given to the ships' officers, for their meritorious

meteorological work, who were involved in collecting routine as well as valuable Meteorological information from High Sea.

In order to cease hardship by marine observers, TURBOWIN software has been installed at many ships (35 Nos.) for automation of synoptic observation with the touch of a button and quick transmission.

145 observations of 26<sup>th</sup> Antarctica Expedition for the period 11 January 2007 to 15 February 2007 were quality checked, formatted & sent to NDC for keying & archival. Complementary copies of Publication entitled "Decadal Marine Climatological Summaries 1991-2000",



**Fig. 2. Typical Field station of RTSMN system at Port Blair**

(along with CD) brought out by MCS was distributed to WMO, Responsible member countries, concern Government Offices, Departmental Offices, Research Institutes etc. IVOF ship observations were quality checked & sent to GCC (UK & Germany).

### **3.5. EARTHQUAKE MONITORING**

India Meteorological Department (IMD) being the nodal agency of Government of India for monitoring seismicity, continued its operation of the National Seismological Network for keeping a round the clock vigil on seismic activity occurring in and around the country.. The information relating to under-sea earthquakes capable of generating tsunamis on the Indian coastal regions is also disseminated to all concerned user agencies including the Indian National Centre for Ocean

Information Services (INCOIS), Hyderabad for issue of tsunami related messages and warnings. The earthquake information is also transmitted to public information channels, press, media etc. and posted on IMD's Website.

India Meteorological Department is maintaining a country wise National Seismological Network (NSN) consisting of 55 observatories (Fig. 1), which includes 17-station Real Time Seismic Monitoring Network (RTSMN) and four observatories in Himachal Pradesh for dam related studies under the Bhakra Management Board (BMB). Of these, 30 stations are equipped with state-of-art broadband sensors, high dynamic range (24-bit) digitizers, GPS time synchronization and facility to access the data remotely through satellite communications and telephone mode. The

remaining 25 stations are equipped with analog seismograph systems, which are proposed to be replaced by digital seismograph systems. India Meteorological Department is also maintaining a 16-station V-SAT based digital seismic telemetry system around National Capital Territory (NCT) of Delhi for close monitoring of seismic activity in the region.

In the aftermath of the Great Sumatra earthquake of 26<sup>th</sup> December, 2004, Ministry of Earth Sciences has set up an Indian Tsunami Early Warning Center at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad. The Center is mandated to provide advance warnings on Tsunamis likely to affect the coastal areas of the country. As part of this, a 17-station Real Time Seismic Monitoring Network (RTSMN) has been set up by India Meteorological Department. The earthquake information is disseminated through various communication channels to all the concerned user agencies in a fully automated mode. A typical field station at Port Blair is shown at Fig. 2. Commissioning, integration and testing of the RTSMN system has been completed and the system is made operational.

In addition to the above, following are a few new schemes:

As part of implementation of the project on “Archival and digitization of seismic analog charts”, outsourcing of specialized services for raster scanning and vector digitization of analog charts has been approved and the order has been placed.

As part of a project under ILTP of DST titled “High Resolution monitoring of Geodynamic Processes using Borehole Seismic Investigations”, data of borehole seismic acoustic sensor is being archived

on regular basis for understanding the geodynamic processes in the region. The sensors were installed jointly by the Indian and Russian Scientists in a borehole of a depth of about 100 meters at Ridge Observatory, Delhi.

Implementation of project on “Optimum seismological network program” has been initiated.

A National Program on Earthquake Precursors (NPEP) as part of it's Eleventh plan activity through a multi-institutional and multi-disciplinary mechanism under the overall umbrella of MoES and India Meteorological Department (IMD) as the lead agency has been initiated. The program is aimed at generating multi-parametric geophysical observations in critical geographical location on long terms basis, as a basic scientific input for future earthquake prediction related studies.

### **3.6. EARTHQUAKE RISK EVALUATION**

Earthquake Risk Evaluation Center (EREC), India Meteorological Department (IMD), has been setup with the objective of Earthquake Risk Evaluation in national perspective to generate, archive and disseminate information and data on Seismic Hazard and Risk to user agencies for disaster mitigation planning. In this context, EREC has taken up multi-disciplinary studies on seismic microzonation of cities of the country having more than half million population and falling in seismic zones III, IV and V identified by Ministry of Home Affairs. EREC has also taken up initiative in close monitoring of seismic activity by deploying short aperture telemetry network. The VSAT based seismic telemetry in and around Delhi is being augmented and another is being established in NE India. Also, Micro

Earthquake Surveys by deploying local temporary field stations are being undertaken for the study of local seismicity during sudden rise in seismic activity as and when required.

### Seismic Hazard Evaluation

Seismic microzonation of NCT Delhi on 1:10,000 scale is in progress. Base map of NCT Delhi on 1:10000 scale has been prepared in collaboration with SOI. Geological mapping of NCT Delhi on 1:10000 scale in collaboration with GSI has been completed. Geotechnical Investigation at 15 sites in North Delhi is going to be completed. On the basis of geological map on 1:10000 scale, site identification for intensive geotechnical investigation at 550 sites is in progress.

### Delhi Telemetry network

More than 200 local events were located by Delhi telemetry network during Jan –Dec 2008 as shown in Fig. 3.

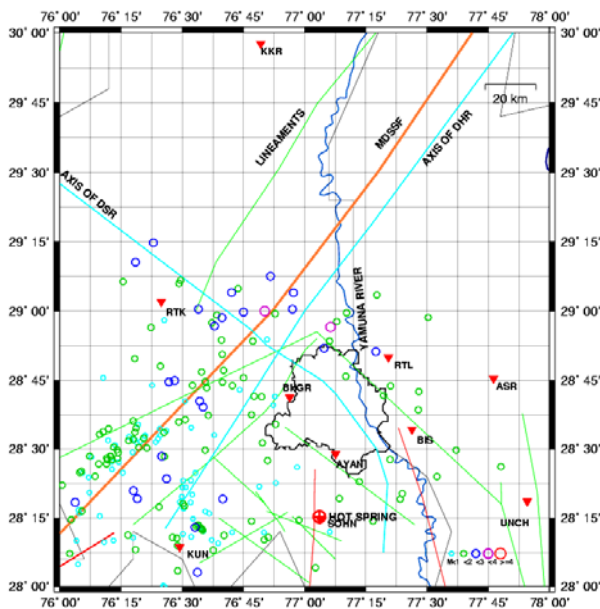


Fig. 3. Seismicity in and around Delhi during Jan – Dec 2008

### NE telemetry network

Fig. 4 shows the location of 20 stations and 2 CRS at Shillong and New Delhi; proposed to be set up under VSAT based Seismic Telemetry Network of NE India. All the 20 sites have been surveyed technically and selected for setting up the observatory. Site preparation has been completed at three sites and for remaining sites, it is in progress.

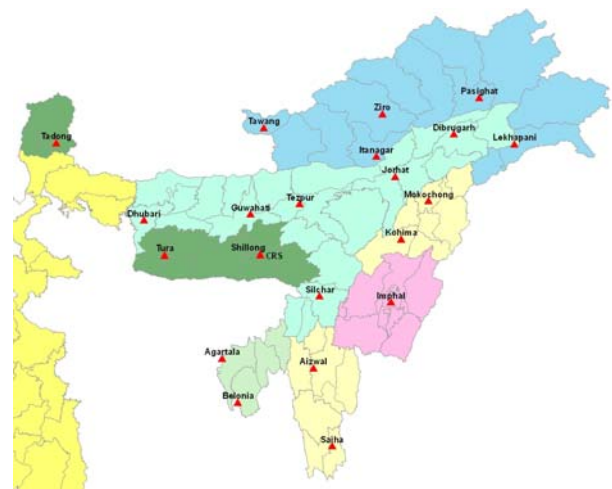
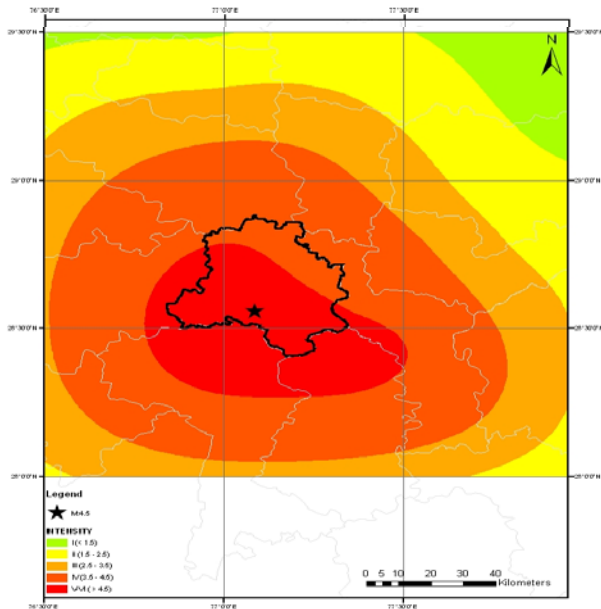


Fig. 4. Proposed Seismic Telemetry Network in North East India

On the basis of intermediate geological map on 1:25,000 six hundred sites have been identified for further geotechnical /geophysical investigations under seismic microzonation of NCT Delhi.

Technical Report on “Intensity and Isoseismal map of 25<sup>th</sup> Nov 2007 Delhi earthquake of magnitude ML 4.3 located at (28.56 N, 77.06 E)”, which was widely felt in and around Delhi; finalized in September 2008. The field Intensity Survey in epicentral zone and in the surrounding areas of Delhi was conducted and completed during Nov–Dec 2007. The surveyed intensity data was documented and analyzed using the GIS software (Geo-statistical analysis tool with local polynomial interpolation method) so as to generate the

isoseismal map. Subsequently, the final report was submitted in Sep 2008 [Fig. 5].



**Fig. 5. Iseseismal Map of Delhi EQ of 25<sup>th</sup> November 2007 M: 4.3**

### **Aftershock and other related survey**

Immediately on occurrence of a major earthquake, IMD deploys a local seismic network in and around affected area for monitoring aftershock activity & understanding rupture process and to assist the local administration. Besides this local seismic network is also deployed in an area affected by swarm activity, to monitor small magnitude earthquakes, to understand local seismicity & to assist the local administration. Noise survey is also conducted for site response study related to seismic hazard evaluation.

### **Major Plan Schemes / Projects under implementation**

Under the scheme “Optimum seismological network programme”, it is planned to establish 100 more state-of-art seismological observatories to enhance

earthquake detection capabilities to M 3.0 in India.

A proposal is under active consideration of MoES, for creation of a new ‘National Centre for Seismology’ at Ayanagar complex of IMD, New Delhi. As part of this, a new ‘Operational Centre’ and ‘Training Centre in Seismology’ are planned to be established.

The existing National Seismological Database Centre is also being upgraded to meet the increasing requirements of data analysis, information dissemination and archival.

As part of the joint collaboration with Russia under the Integrated Long Term Program (ILTP) of Department of Science & Technology, four new research projects have been approved for implementation by the Indo Russian Centre for Earthquake Research (IRCER) set up in IMD.

As part of the Indo-Mexican joint collaboration in the field of Seismology, a project proposal on “Near real-time estimation of (a) long-period magnitude, (b) moment tensor and (c) tsunami potential of offshore earthquakes” has been approved by DST / MoST for implementation by IMD scientists.

### **3.7. ENVIRONMENTAL MONITORING**

Environmental Management is the key to sustainable development. Meteorological dispersal of pollution is an important area to assess concentration of pollutants and to determine the assimilative capability of the atmosphere. The India Meteorological Department was entrusted to provide advisory to the Government of India in matters concerning environmental impacts arising out of all kinds of developmental activities.



Ministry of Earth Sciences has approved scheme on “Environmental Monitoring and Research” at an estimated cost of Rs 14.70 crore to monitor the concentration of greenhouse gases, aerosols, ozone and precipitation chemistry in the Country. MOU between MoES and NOAA, USA is underway to support establishment of GHGs monitoring and C-cycle modeling in the country.

### **(a) Environmental Appraisal**

The Environmental Meteorology Unit (EMU) evaluated Two thousand One hundred & thirty three (2133) projects (Thermal Power, Industrial and Mining projects) and provided specific comments during the year, 2008, the details of which are as under:

(i) EMU has extended its expertise to the Ministry of Environment & Forests, New Delhi in conducting impact assessment of 1265 projects related to all types of industries requiring environmental clearance in the country.

(ii) The Environmental Impact of power generation is a major concern in the context of public health & climate change. The Govt. of India takes complete caution in assessing the environmental impacts from all power projects. The EMU provided expert assessment to the Ministry of Environment & Forests, New Delhi for 378 Thermal Power Projects.

(iii) Comments of IMD to the Ministry of Environment & Forests (MoE & F) in the area of mining activity has been provided for 490 Mining proposals.

(iv) The India Meteorological Department (IMD) representative attended 43 meetings

of Expert Committee (where in all major coming up in different parts of the country are discussed) pertaining to the following three panels i.e. Expert Committee on Industrial Projects, Thermal Power Projects & Mining Projects.

### **(b) Meteorological Monitoring at Taj Mahal**

(i) Regular monitoring of meteorological parameter was continued at Meteorological observatory, Taj Mahal, Agra (U.P.).

(ii) AWS has been installed at Bose Institute for support in environmental studies.

### **(c) R & D activities**

(i) Officers of EMU have participated & presented papers in International and National Conferences/workshop/seminars.

(ii) Research papers have been published in Journals.

(iii) EMU has carried out evaluation of projects & reports sent by various Ministries in the area of environmental and climate change.

(iv) Parliament matters in the area of environment and climate change.

### **National Ozone Centre**

The importance of ozone is an environmental parameter stems from the

fact that several industrial substances are considered to be destroyers of the natural ozone layer in the stratosphere, thus enabling higher dosages of ultraviolet radiation penetrating to the ground to the serious detriment of health factors. The global network of total column ozone measurement has come up since late 1950s and India has been a pioneering country in this regard. The routine measurements have carried out to monitor Total Column Ozone, Vertical Ozone Profiles and Surface Ozone over India.

### **Air Pollution**

IMD set up a Background Air Pollution Monitoring Network (BAPMoN) programme in 1972 with the objective of documenting the long-term changes in composition of trace species of the atmosphere. The activity was brought under Global Atmosphere Watch, GAW in 1989. The monitoring stations located at Allahabad, Jodhpur, Kodaikanal, Minicoy, Mohanbari, Nagpur, Port Blair, Pune, Srinagar and Vishakhapatnam continued to collect rain samples for chemical analyses and measurement of atmospheric turbidity.

#### **(d) Environment Monitoring**



**Chemical analysis**



**Chemical analysis on Atomic absorption spectrophotometer lyses**

IMD has initiated a project for monitoring greenhouse gases (GHGs) and aerosols on a long-term basis. Such data are of vital interest to our country with regard to climate change studies and to create a sound database, which can be used in future climate change negotiations in the UN framework.

A Climate Monitoring Station has been established at Hill campus, G. B. Pant University of Agriculture & Technology, Ranichauri, Tehri Garhwal, (Uttarakhand). Two Air quality analysers have been installed in 2008.

#### **(e) Atmospheric Turbidity Program**

Atmospheric Turbidity which indicates the columnar aerosol load of the atmosphere is measured at : GAW stations (Allahabad, Jodhpur, Kodaikanal, Nagpur, Port-Blair, Srinagar & Pune) using Microtop-II multi-channel sunphotometer at 368, 500, 675, 778 & 1028 nm wavelength. Also, one such sunphotometer

is supplied recently for 28<sup>th</sup> Antarctica Expedition. Three GAW stations (Mohanbari, Minicoy, Visakhapatnam) using Volz's Sunphotometers at 500 nm wavelength.

Completed chemical analysis for all precipitation samples from 10 GAW stations, upto year 2007.

Air Pollution Section, regularly participates in acid rain inter-comparison programme conducted by WMO, twice every year in April and October. Results of these inter-comparison programs indicate that analytical procedures / methods followed at the central laboratory at Pune are of same standard followed by other WMO member laboratories.

Atmospheric Turbidity - computed turbidity values for all ten GAW stations, upto year 2007.

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.

### **3.8. CLIMATE SERVICE**

#### **National data centre**

IMD has long time series of various climate data in its archive. Data rescue and data services are mainly provided by National Data Centre (NDC) at Pune. NCC generates many climate data products for smaller spatial and temporal scales for the user community.

These data products include daily gridded (1° X 1°) rainfall (1951-2007) and temperature data (1969-2005) over Indian region, district wise normal for various surface parameters, grid point marine climate summaries for Indian Ocean region.

Preparation of rainfall normal is an important work of the Section. Normal of monthly, seasonal and annual rainfall/rainy days based on data since 1901 are updated. These normal for the data sets of 1901-50 and 1901-70 for all raingauge stations in India were already prepared. Recently latest rainfall normals based on the data of 1941-90 have been prepared and made it operational.

Daily Rainfall data for about 9,200 raingauge stations in the country are being received from departmental and non-departmental observatories. These data are scrutinized and suitably processed for archival. A District Rainfall Monitoring Scheme (DRMS) of about 2,400 of these stations has been started from 1990 onwards. The data from these stations are separately scrutinized and archived on routine basis.

Sub-divisional mean of rainfall for each month are carried out in the section as routine measure utilizing data of about 400 observatories. After receiving data from State Authority and Flood Meteorological Observatories, series of monthly, annual and seasonal (actual, normal and percentage departure) sub-divisional rainfall data are being updated and archived at National Data Center for supply to various users.

Rainfall data are supplied to Educational Institutes, Research Scholars, Government Organizations, etc.

Percentage departure rainfall charts (Annual and seasonal) are being prepared and supplied to departmental and non-departmental users.

### **Progress during the year 2008**

About 46,562 Rainfall Records were scrutinized and sent to National Data Centre for keying and verification and discrepancies were carried out in Rainfall records after keying the data.

Normal isohyetal map of Uttrakhand (Alaknanda river basin) and Godavari river basin were prepared and supplied to Tehri Hydro Development corporation Ltd, Rishikesh and Ex-Engineer, Vishnupuri Project Department, Nanded, Maharashtra respectively.

76 new Rainfall normals for the unrepresented districts were prepared.

Thus total number of 600 districts are now represented by Rainfall normals.

### **National Climate Center/Research Unit**

This unit prepares the climatological summaries for user interest and brings out publications. This unit has brought out so far, nine research support publications viz. Wind energy potential, Ten day averages of upper winds over Indian stations etc. which contain the climatological information useful for different users.

Rainfall Climatology for Agricultural Planning unit, based on climatology of daily rainfall, calculates appropriate sowing dates over different regions for the optimum crop production and brings in the form of a publication. The information contained in those publications is supplied to State Governments for its proper dissemination to the farmer community so that they may judiciously select proper sowing dates for a particular crop for the better agricultural production. So far, these publications have been brought out for six states. Draft publication entitled "Sowing rains over Andhra Pradesh" is in printing stage.

### **3.9. SERVICES FOR INDIAN OCEAN AND SOUTHERN HEMISPHERE AREA**

Indian Ocean and Southern Hemispheric Analysis Centre (INOSHAC) prepares extended area Synoptic Charts for the region covering 50° S to 45° N and 20° E to 155° E. The mean sea level chart is prepared four times a day while the upper wind and temperature charts for the levels 850, 700, 500, 300, 200 and 100 hPa are prepared twice daily.

For the safety Net. Met. Area VIII (N), IMD issued daily two GMDSS bulletins in fair weather. In disturbed weather (cyclone etc.) extra bulletins are issued every three hours. These bulletins are transmitted on Global Channel through INMARSAT.

INOSHAC issues daily two bulletins in fair weather for Indian Navy in the form of

fleet forecast for the area 10° S to 5° N and 60° E to 100° E. In case of disturbed weather (depression onward) frequency is increased and additional bulletins (2 to 6) are also issued depending upon the need.

INOSHAC issues two sea weather bulletins daily for the South Indian Ocean and Northwest Pacific for departmental exchange, to familiarize with the events in the area.



## 4. Deployment of State of the Art Technology

A scheme was proposed to undertake a comprehensive upgradation of Observational and Forecasting infrastructure of IMD to enhance its capabilities in regard to meteorological services. The Cabinet Committee on Economic Affairs approved this proposal in December 2007.

### 4.1. SURFACE EQUIPMENTS

Under modernization program of IMD, it is planned to establish a network of 1000 Automatic Weather stations (AWS) and 3600 Automatic Rain Gauge Station (ARG) across the country in a phased manner. The Projects under this umbrella proposal have now been taken up for implementation during 2008-2010 constituting the 1<sup>st</sup> Phase of Modernization. Under on-going programmes, those related to improvement of observational network have already been taken up. It was proposed to procure 550 AWS, 1350 ARG, 12 DWR and 20 Integrated Airport Meteorological Instruments.

In the first phase, 125 Automatic Weather Station (AWS) have been procured and installed. These stations are transmitting data which is available at GTS and IMD websites of Pune and Delhi office. For the second phase, the order for the installation of 550 Automatic Weather Station (AWS) has been placed to (i) M/s Astra Microwave Products Ltd., Hyderabad (Prime Bidder) and (ii) M/s SGS Weather & Environmental Systems (Pvt.) Ltd., New Delhi (Co-Bidder). The firms have supplied 350 AWS and the IMD has handed over 99 AWS to the firms for installation in North India. The firms have installed 14 A WS in

Haryana & H. P. The installation of the remaining A WS is in progress. TDMA type receiving Earth Station has been installed at Pune.

Analogue Distant Indicating Wind Equipment (DIWE) installed at M.O. Agra, M.O. Amritsar, M.O. Safdarjung were upgraded.

AWS 100 Sutron Make 9210 and 25 Astra, 3 old AWS have been installed at different sites under O/o ADGM (R). One AWS was installed at Shirdi (Maharashtra).

The installation of 2 numbers-SRRGs and 4 numbers-ORGs 6 number of snow gauges in the state of Sikkim have been completed. 136 numbers of sites were selected for installation of AWS and 332 numbers of sites were selected for installation of ARG in different states and Andaman & Nicobar Island under RMC Kolkata.

100 Nos of standard barometers have been received at the office of DDGM (SI) Pune. The barometer are to be supplied to RMCs/MCs.

Action for purchase of 44 data entry machines and software for all RMCs/MCs and ADGM(R)'s have been initiated at office of ADGM(R), Pune.

A Server and Software (High Speed Data Computing Platform) have been received and the same to be installed in the newly constructed building of Meteorological Centre in Sector 39-C at Chandigarh.

Automatic radiation station was installed at Meenambakkam Observatory on 10th September 2008. Automatic Radiation Station commissioned. Precision Infra Red Radiometer and Ultra Violet A - Radiometer were also installed at MC Thiruvananthapuram.

All 20 sites in Haryana and 18 sites in Punjab for AWSs and most sites for ARG (except 2 in Punjab and 5 in South Haryana) under Modernization Plan have been finalized and civil works there on have been started.



DDGM (SI), Pune has placed order to M/s Jin Yang Industrial Co. Ltd., Korea for procurement and installation of 1350 Automatic Rain Gauge (ARG) at various stations in India. The firm has supplied 700 ARGs. In this process 1200 sites have been selected for installation. In Maharashtra 43 sites have been prepared for installation. The site preparation in RMC Nagpur and MC Bhubaneshwar is in progress. Three model sites have been installed and the installation of other stations is in progress.

Radiation Instruments, i.e., Pyranometers, Pygeometers Solar Trackers have been procured from M/s SGS Weather & Environmental Systems (Pvt.) Ltd., New Delhi by O/o DDGM (SI), Pune for installation. These instruments have been installed at 20 stations and the work is under process for remaining stations.

A Pyranometer (PSP) were installed at M.C. Patna and RMC, Mumbai.

#### **4.2. METEOROLOGICAL TELECOMMUNICATION NETWORK**

India Met. Deptt. maintains a very extensive Telecommunication Network with Central Hub in its National Meteorological Telecommunication Centre (NMTTC) at New Delhi, connected with Five State of the art Regional Automatic Messages Switching Systems (AMSS) at Delhi, Kolkata, Chennai, Mumbai and Guwahati. AMSS at RTH New Delhi is under the process of upgradation (replacement) by the latest-state-of the art technology AMSS to be supplied by the M/s MFI. After installation of the new AMSS, RTH New Delhi will become at par with WIS Centre of WMO's GTS. For collection of Meteorological Data from the entire country and the neighbouring NMTTC, various modes of communication viz. dedicated leased line circuits, fax, internet, high speed data terminals, VPN connectivity, VHF / Walkie-Talkie have been installed at various locations dispersed throughout the country.

The Regional Telecom Hub (RTH) New Delhi maintains point to point Global Telecom System (GTS Ten links) and Five circuits through internet connectivity.

For public weather information's Interactive Voice Response Systems

(IVRS), popularly known as 'Weather on Telephone' have been installed at 26 stations (mainly state capitals) throughout the country. One can access current weather and forecasts for major Indian cities by dialing a toll free number 1800 180 1717 or 1717.28. Stations have been provided VPN Connectivity, which are mainly 26 Stations have been equipped with 64 kbps high speed data terminals.

A network of 26 V-SATs is being installed at selected seismological observatories, Cyclone Detection Radar stations, Cyclone Warning Centres for reception of observational data utilizing communication transponder of INSAT.

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A number of projects were undertaken at MC Agartala like conversion of 50 baud T/P line into High Speed Data Terminal (HSDT), installation of Digital Met. Data Dissemination system (DMDD), installation of IVRS, High speed VSAT System, provision of Broad Band Internet in the Forecasting unit and LAN connection.

HSDT was provided at Ranchi, IVRS & LAN connectivity, C band set were provided at RMC Kolkata.

However in total High Speed Data Terminals installed at 25 locations.

In addition a contract has been signed with **M/s Meteo France International** for Procurement of following items under package for Commissioning of End-to-End Forecasting System in India Meteorological Department (IMD). These are - Basic Design Study + Assistance to Change Management, Integration, General training, Upper Air systems x 5 stations & 4000 sondes, AMSS for Delhi HQ, Central Information and Processing system at IMD HQ, Synergie Forecasting Systems at 34 positions, Clisys Climate Data Management System at Pune & IMD HQ, Public Weather Services Meteofactory at IMD HQ & RMCs Delhi & Kolkata, TV system at IMD HQ & TV station.

PCs & Peripherals were provided to AMO Thiruvananthapuram, MOs-Tondi, Pamban, Kakinada & Honavar and Met. Unit, Kodaikanal.

Extended C Band DVB V Sat equipment was installed at CDR Machillipatnam.

### 4.3. AERONAUTICAL INSTRUMENTS

**A Satellite Data Dissemination System (SADIS)** (receive only) is in operation at New Delhi to receive aeronautical meteorological information from International Civil Aviation Organization (ICAO) Centres which are routed to four International Airports of India for National and International Flight briefing and for providing data in GRIB/BUFR format for Wind/Temperature and Sig. Wx Charts.

**New integrated automatic aviation Met. Systems (IAAMS)** has been commissioned on trial basis w.e.f. 23 October 2008 at MO, Mumbai. New integrated automatic aviation Met. Systems



(IAAMS) at Hyderabad, Delhi and Bangalore airports have been commissioned. These are state of the art instruments which provide valuable data to the user at the airport for RVR and current weather in real time.

This systems have been installed and have started functioning at Delhi, Mumbai, Jaipur, Bangalore and Hyderabad Airports. Site preparation (civil work, laying cable, etc.) is in process at Guwahati and Chennai Airports. The site selection is being carried out at Amritsar Airport.

Procurement for IAAMS for twenty six more airports is under process.

### **Integrated Automatic Met Aviation Instrument Systems (IAMAIS) at IGI Airport**

IGI Airport Met. Office, Palam made an excellent coordination with IMD, HQ, AAI, Delhi International Airport Limited (DIAL) and SGS for completion of installation of three **new high quality Integrated Automatic Met Aviation System** at new RWY-29 on time and one earlier at old secondary RWY-27. It includes construction of concrete platforms, Met. hubs, laying of very long distances power and signal cables etc by DIAL and AAI. With this, IGI airport has now seven RVR instrument values (three at old main 28-RWY) available for services round the clock from various locations at the airport- an exceptional instrumental supports unique in India to monitor low visibility during bad weather especially during dense fog and dust storms events of winter and summer respectively for which the airport is highly vulnerable. It happens to be biggest RWY 0(4430meters) in Asia having CAT-III ILS capable of handling all new generation bigger wide body aircrafts.

Two new green field **Airports at Hyderabad and Bangalore** became operational during March and May 2008 respectively and IMD started Meteorological services at these centers.

Under the modernization plan phase-I of IMD four numbers of wind profilers are proposed to be procured.

Following new installations/ activities completed in 2008.

- Automatic Weather System installed at Gondia airport.



**AWS at IGI Airport, New Delhi**

- Digital Current Weather Instruments System installed at Diu, Delhi, Calicut and Lucknow airports.
- Analog DIWEs converted into Digital DIWEs at Jabalpur, Indore, Madurai, Trichy, Bhubaneshwar, Jamshedpur, Barapani and Cooch Behar airports.
- IMD's Aviation Safety Oversight Audit Manual was prepared and copies were sent to ICAO through DGCA.

#### 4.4. AIR POLLUTION LABORATORY AT PUNE

The modernization of Air Pollution Laboratory is in progress under the Plan Scheme entitled "Modernization and Augmentation of Air Pollution Laboratory at Pune". The following Capital Equipments have been procured under Plan Scheme:

Atomic Absorption Spectrophotometer with Graphite furnace.

PERKIN ELMER, USA make	1 No
(Gas Analyzers (i) SO <sub>2</sub> & (ii) NO <sub>x</sub> Analyzer	2 Nos each
Multi-channel Sunphotometers, Microtops II, USA make	9 Nos
Ion Chromatograph. DX 600, DIONEX USA make	1 No
Microprocessor based pH and Conductivity Meters	2 Nos each
Ultra-pure water purification System	1 No

#### 4.5. SATELLITE APPLICATIONS

IMD continued to receive and process meteorological data from two Indian satellites namely Kalpana-1 and INSAT-3A. Kalpana-1 and INSAT-3A both have three channel Very High Resolution Radiometer (VHRR) for imaging the Earth in Visible (0.55-0.75 um), Infra-Red (10.5-12.5um) and Water vapour (5.7-7.1um) channels having resolution of 2 X 2 kms in visible and 8 X 8 kms in WV and IR channels. In addition the INSAT-3A has a three channel.

Charge Coupled Device payload for imaging the earth in Visible (0.62-0.69um), Near Infra Red (0.77-0.86um) and Short

Wave Infra Red (1.55-1.77um) bands of Spectrum. The Resolution of CCD payload in all the three channels is 1 km X 1 km. At Present about 48 nos. of satellite images are taken daily from Kalpana-1 which is the main operational satellite and 9 images are taken from INSAT-3A. Imaging from CCD is done 5 times during daytime only. All the received data from the satellite is processed and archived in National Satellite Data Centre (NSDC), New Delhi.

#### INSAT Meteorological Data Processing System (IMDPS)

IMDPS is processing meteorological data from INSAT VHRR and CCD data and supports all operational activities of the Satellite Meteorology Division on round the clock basis. Cloud Imagery Data is processed and transmitted to forecasting offices of the IMD as well as to the other users in India and foreign countries.

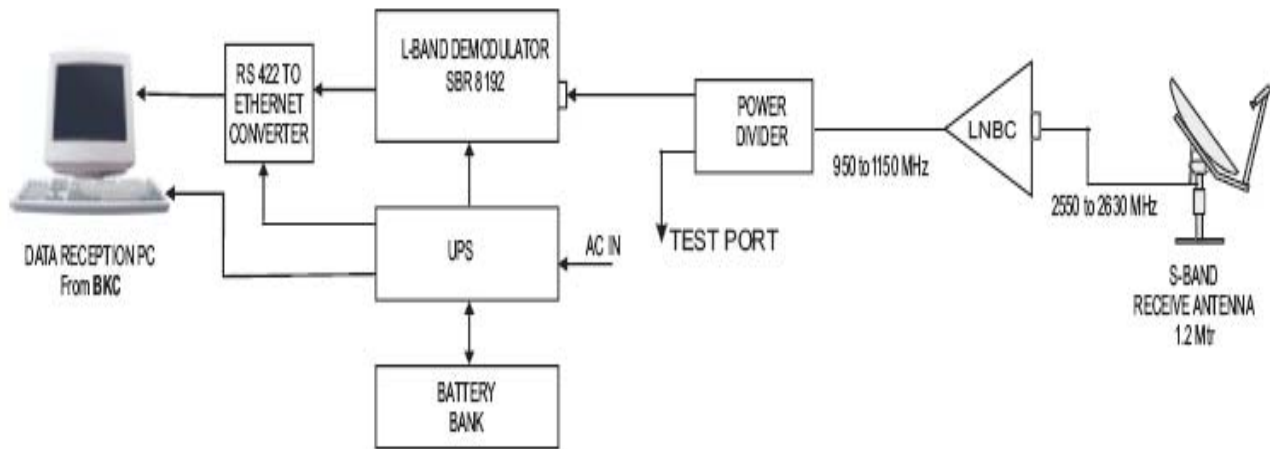
Apart from generating half hourly cloud imagery, IMDPS produces Satellite Data derived products from the processed data as follows:

Cloud Motion Vectors (CMVs) are derived using three consecutive half hourly images from the operational Kalpana-I Satellite. CMVs are generated at 0000 UTC, 0600 UTC, 1200 UTC & 1800 UTC using Infrared imagery daily.

Water Vapor Winds (WVWs) are derived using three consecutive half hourly images from the operational Kalpana-I.

Satellite. CMVs are generated at 0000 UTC, 0600 UTC, 1200 UTC & 1800 UTC using water vapour imageries data.

Sea surface Temperatures (SSTs) are computed at 1° x 1° grid intervals from all



**Digital MDD Overview**

Kalpana-I data on half hourly /daily /weekly/monthly basis.

Outgoing Longwave Radiation (OLR) at  $0.25^\circ \times 0.25^\circ$  grid intervals from all Kalpana-I data on half hourly/daily/ weekly/monthly basis.

Quantitative Precipitation Estimates (QPE) are generated at  $1^\circ \times 1^\circ$  Grid from Kalpana-1 imagery on half hourly/daily/ weekly/monthly basis.

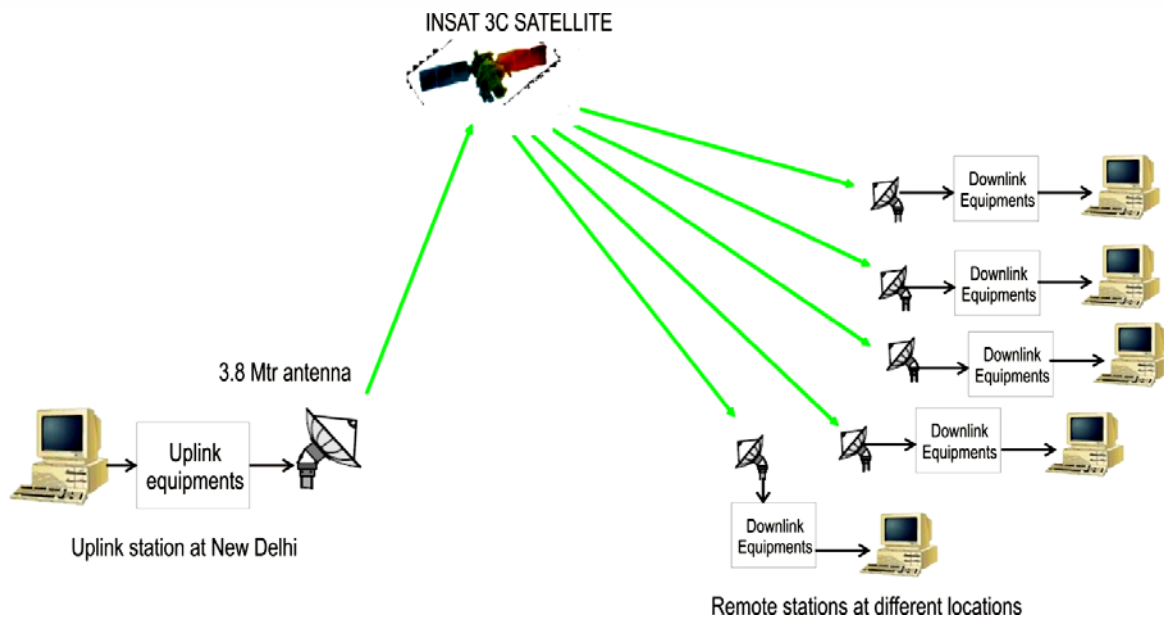
Special sector images are created for special events such as Amarnath Yatra, Cyclones, other special weather phenomena, and Satellite launches from SHAR center, Sriharikota.

Synoptic Application Unit of the division issues satellite weather bulletins at synoptic hours and hourly bulletins during cyclone / severe weather conditions.

### **Cyclone Warning Dissemination System (CWDS)**

A scheme, known as Cyclone Warning Dissemination System (CWDS) using

INSAT is also in use. Under this scheme the cyclone warning messages are disseminated to the affected areas in their local languages. This communication method is more reliable as it does not use terrestrial links, which generally get disrupted during severe weather conditions. The scheme is very successful and has saved thousands of lives and invaluable property during the cyclone occurrences. Total numbers of 252 analogue CWDS receivers have been installed in the cyclone prone areas of east and west coasts of India. The cyclone warning messages are broadcast in local languages of the area likely to be affected. Messages for the state of West Bengal and Orissa are broadcast from ACWC Kolkata. Andhra Pradesh, Tamilnadu, Kerala and Karnataka are covered by ACWC Chennai. The broadcast for Maharashtra, Gujarat and Goa states originate from ACWC Mumbai. 100 more Digital CWDS receivers based on Digital Technology have been deployed in Andhra Pradesh under the World Bank Project. It is planned to replace all the 252 analogue CWDS receivers by the Digital CWDS in the current year 2008-09 and increase the network to 400 from 352 at present.



**Digital MDD Overview**

## Meteorological Data Dissemination (MDD)

The processed INSAT cloud imageries are broadcast through INSAT-3C, an Indian communication satellite using S band broadcast capability in digital mode every three hours. Meteorological data consisting of satellite cloud imageries, Meteorological Data and Analysed weather charts are provided to various field stations through this MDD network. At present there are 37 MDD receiving stations in India. In addition to IMD, IAF and Navy are using this service. Meteorological bulletins based on analysis of satellite cloud imageries are transmitted at synoptic hours and heavy rainfall advisories are also sent over MDD. During cyclone situations, actual position of system and its intensity and related forecast are also being transmitted to field stations every hour. MDD units have also been provided with work stations for detailed analysis of cloud imageries. The system transmits data in International LRIT/HRIT format through own transmitting station at New Delhi.

Digital Meteorological Data Dissemination System (DMDD) installed and commissioned at 37 locations.



**DMDD receiving system**

## Radiation Measurements

Solar radiation is a source of non conventional energy. It is the prime driver of atmospheric motions. It is also the source of

harmful radiation like the ultraviolet. IMD is maintaining a radiation network consisting of 43 stations measuring global radiation, diffuse radiation, terrestrial radiation and duration of bright sunshine hours. The data is scrutinized, processed and archived. The processed data is supplied to users on request. IMD has plan to augment its Radiation network- introducing additional measurements alongwith real-time data transfer to a central receiving station through INSAT DRT. A project on "Revision of the Hand Book of Solar Radiation Data for India" under joint collaboration with Solar Energy Centre, MNES is in final stage of completion.

### **Future Programmes of NSMC**

Under INSAT-3D programme, a new Geostationary Meteorological Satellite INSAT-3D is being designed by ISRO. It will have an advanced imager with six channels (VIS, SWIR, MIR, TIR-1, TIR-2, WV) and a nineteen channel sounder (18 IR & 1 Visible) for derivation of atmospheric temperature and moisture profiles. It will provide 1 km. resolution imagery in visible band, 4 km resolution in IR band and 8 km in water vapor channel. This new satellite is scheduled for launch in May , 2009 and will provide much improved capabilities to the meteorological community and users. In addition to the surface parameters the satellite will be able to provide vertical profiles of temperature, humidity and ozone and several other weather parameters. The Centre and the intensity of the cyclone will also be derived objectively using Advanced Dvorak Technique (ADT). The establishment of a new ground segment facilities to receive and process 25 data from INSAT-3D is going on at NSMC, New Delhi. A separate Earth Station for receiving

data from INSAT-3D shall also be established.

NSMC has plans to install

(a) 50 numbers GPS stations for computing Integrated Precipitable Water Vapor (IPWV). The stations will be mainly located in North-East and Eastern region and will be useful in studying Norwesters.

(b) Data reception / processing systems from NOAA / Metop / MODIS polar orbiting satellites at New Delhi, Chennai and Guwahati in one year time.

(c) 300 nos. Digital Cyclone Warning Dissemination Stations (DCWDS) in a year's time. The existing 252 Analog stations will be replaced under this scheme.

## **4.6. UPPER AIR INSTRUMENTS**

### **Upper Air Instruments**

IMD is one of the few Meteorological organizations that are manufacturing their own upper air instruments. The workshop has a workforce consisting of about 180 dedicated technical & skilled personnel and equipped with modern machines.

Besides being used operationally in the network of upper air stations, the radiosondes are supplied to Indian Antarctic station, Indian Navy, other scientific laboratories and Sri Lanka. A full fledged

carpentry unit manufactures Stevenson Screens used to house thermometers and autographic meteorological instruments for surface observations. Annually seventy Stevenson Screens are produced in the workshop. Repair and maintenance of PB Theodolite and electrical equipments like motors / generators are also carried out. Workshop is taking active part in celebration of national functions by arranging balloon release programmes on Republic Day at Rajpath and Independence Day at Red Fort where the President and the Prime Minister participate.

In I.M.D. upper air observations are made at 39 RS/RW stations twice a day at 0000 and 1200 UTC. There are 62 Pilot Balloon observatories spread all over the country conducting upper air wind measurements 2 - 4 times a day providing wind speed and direction up to a maximum altitude of 10 km employing optical theodolites.

Out of 39 upper air observatories, from which balloons with radiosonde are released twice a day for getting pressure, temperature and wind data.

RS/RW observatories have been equipped with three types of ground Equipment as under:

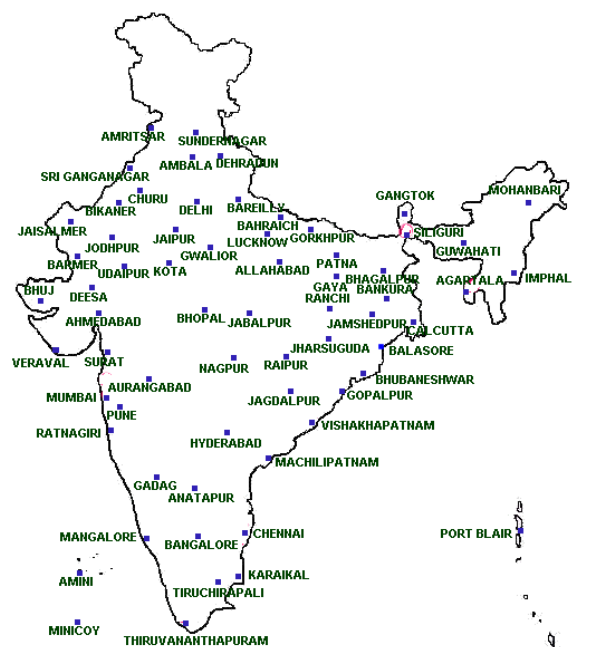
Radiosonde Ground equipment (ECIL/DIGITAL make) along with X band Wind finding Radars (EEC/BEL).

IMS-1500 Radio theodolite

SAMEER Radio theodolite

All the stations are provided with standby Radiosonde ground equipment so that if the primary unit goes defective then the ascent may be taken with the other standby equipment.

Development of the Indigenous Radiosonde for Upper Air Observation has been initiated. Other projects like, data quality, ten existing IMS – 1500 stations establishment of 10 GPS (5 GPS for upper air data collection station and 5 GPS system under MFI project, commission of optical theodolite at 62 PB station & 5 electrical optical theodolite have been taken up.



India Meteorological Department P. B. Network

These Pilot Balloon observatories have been upgraded by installation of Hand Held Data loggers. This has resulted in change of Manual Pilot Balloon Computation to Semi Automatic Pilot Balloon Computation. The old optical theodolites are being replaced with new one.

Technical support has been extended for taking GP sonde of ISRO from Observatory Campus and provided fine resolution upper air data for 0000 and 1200 UTC in connection with CAROSAT-2 satellite launch from 21<sup>st</sup> April 2008. Appreciation letter has been received from ISRO HQ in this connection.

### **Installation of GPS Upper Air System**

Installation of 10 Nos. of GPS based upper air systems at Srinagar, Mohanbari, Chennai, Thiruvananthapuram, Port Blair (under modernization of IMD) and Goa, Minicoy, Hyderabad, Vishakhapatnam, & Patna (under MFI project) will be completed by the end of May 2009.

### **Ground System with Receiver & Processor**



Development of GPS based radiosonde is under progress in collaboration with SAMEER, Mumbai. Plan, is to start regular ascents at five stations.

### **Improvements in Upper Air Computing System**

To eliminate manual interaction and to minimize instrument error, up-gradation of the RS/RW computing system has been done.

IMD Mark - IV radiosonde developed in-house has been implemented at all RSRW stations. This radiosonde is being used with IMS - 1500 Radiotheodolite as well as with new auto computation system. Plans are to completely stop the manufacturing of MK - III radiosonde as all the RS/RW stations are now equipped to work with MK-IV radiosonde. DDGM (SI) office has been requested to change the design of their radiometersonde and ozonesonde to MK-IV so that we may stop the manufacturing of MK-III radiosonde. The software developed by SAMEER, Mumbai generates Meteorological message in standard WMO format and also gives plots of T-Phi gram, temperature and humidity profiles.

The Pressure sensor of IMD MK-IV radiosonde is a mechanical design and needed urgent up-gradation for more reliable data. A solid state pressure sensor based radiosonde was designed and tested. The software was suitably modified and the ascents were conducted at RSRW Thiruvananthapuram. The sensor performed satisfactorily in the full range. More ascents are planned with new bead type thermistors to improve the data further. After the tests the modified MK-IV would be used for observations in the network.

Development of hand held data loggers along with software for PB computations has been completed under an MOD with SAMEER and implemented at 62 stations. All the optical theodolites would be replaced with new theodolites for improved ascents. The procurement for 5 numbers of electronic optical theodolites and 70 numbers of optical theodolites are in final stage.

## Future Plans for Further Improvements

It is proposed to install mini-electrolyser for generating hydrogen gas in-situ at the RS/RW stations employing technique of electrolysis of water. It will cut down expenditure on transportation of chemicals to the station. Electrolyser plant has already been installed and commissioned at RMO Ayanagar, Manali and Jammu.

Development of indigenous MEMS sensors for IMD radiosonde is being done in collaboration with SCL, Chandigarh in order to replace the existing sensors.

Development of 1680 MHz indigenous radiotheodolite and receiver is under progress in collaboration with SAMEER, Mumbai.

As a step for improvement of data quality a scheme for taking ascents with Sippicon radiosonde at ten stations with IMS radiotheodolite is under consideration.

Development of 1680 MHz MMIC transmitter for IMD radiosonde is under progress in collaboration with GAETEC, Hyderabad. Prototype expected to be ready within two months.

## Doppler Weather Radars

IMD presently operates a network of eleven Cyclone Detection and 29 Storm Detection Radars. Most of the radars of this network are very old and are based on conventional analog systems, which are now obsolete. Moreover, their products are incompatible with present day requirements of digital data on different parameters which can be directly used as inputs to weather prediction models.



There has already been some progress in this regard through procurement and commissioning of 5 Doppler Weather Radar systems on the east coast (Kolkata, Visakhapatnam, Machlipatnam, Chennai and Sriharikota). Induction of an adequate number of Doppler Radars in the network would facilitate improvement in analysis. Doppler radars will give us more derived products than the conventional radars, which are useful for weather forecasting. Some of the examples are radial winds, precipitation rates, vertical velocity of air etc. Doppler radars are especially useful for forecasting severe weather events, and are power full tools for nowcasting. Under the modernization plan of IMD, it is proposed to replace all existing old and obsolete conventional radars with the state-of-art modern radars having Doppler capabilities. It is proposed to install 55 S-band Doppler weather radars in the IMD's network to bring the entire country under radar coverage. In ,the first phase of modernization plan of IMD, it is proposed to replace 12 of the existing radars with state of art Doppler Weather Radars at Paradip, Mumbai, Goa, Lucknow, Patna, Patiala, Mohanbari, Agartala, Bhopal, Delhi, Karaikal and Nagpur supply order for which has already been placed on M/s METSTAR, China. In



addition, it is planned to install DWRs at Bhuj (Gujrat) & Kochi (Kerala) for which order has already been placed with M/s BEL Bangalore as part of the already

approved plan scheme of the Department. 2 C band dual polarization DWRs are also planned to install at Delhi and Jaipur before common wealth game – 2010.



## 5. OTHER ACTIVITIES

### 5.1. CLIMATE MONITORING AND CLIMATE INFORMATION SERVICES

IMD undertakes real time climate monitoring and publication of Climate Diagnostics Bulletins and reporting of major anomalous climate events. Various studies are conducted for development of new objective methodologies for drought monitoring over India.

- Prepares Climate related databases, Data Products and atlases for the user community.
- High-resolution gridded terrestrial climate of India has been recently released to the user community.
- Climatological Summaries for districts and states are regularly updated.
- The main activities of NCC/LRF are climate monitoring, Climate Information Services & Climate Prediction.

#### Activities during the year 2008-09

The verification of Winter season forecast (January to March 2008) over NW India was prepared.

Forecast for the 2008 SW monsoon season (June to September) rainfall for the country as a whole was issued on 16<sup>th</sup> April 2008. The forecast for the date of monsoon onset over Kerala was issued on 14<sup>th</sup> May 2008.

Update forecast for the 2008 South-west monsoon season rainfall over the country as a whole along with seasonal

rainfall over the four broad geographical regions of the country and July rainfall over the country as a whole were issued on 30<sup>th</sup> June 2008.

Operational forecast for the 2008 NE monsoon (October – December) rainfall over South Peninsula based on statistical models and South-west monsoon 2008 end-of-season report was prepared.

Monthly Climate Diagnostics Bulletin of India for the period December 2007 to August 2008 and seasonal Climate Diagnostics Bulletin for the Winter season (Jan-Feb 2008), Pre-monsoon season (March-May 2008) and Southwest monsoon season (June-September 2008) were published.

### 5.2. NATIONAL DATA CENTRE (NDC)

The NDC is the national repository of all meteorological data collected on a routine basis and through special campaign programmes. The total holding of meteorological data in the archives as of date is 103.5 million records.

NDC receives queries for data supply from numerous parties including Government, private institutions, industries, research and operational users. During the period under consideration 348 million records were retrieved and supplied till date to different users.

### 5.3. INVESTIGATION AND DEVELOPMENT

Investigation and Development Unit is a nodal research unit of the IMD. This unit also brings out a yearly publication

“Disastrous Weather Events” which includes detailed information of the casualties and the loss of private/public properties due to various meteorological elements every year.

Special Climatological Studies unit prepares the climatological summaries for users interest and brings in the form of publications. This unit has brought out so far, nine research support publications viz. Wind energy potential, Ten day averages of upper winds over Indian stations etc. which contain the climatological information useful for different users.

Rainfall Climatology for Agricultural Planning Unit calculates appropriate sowing dates over different regions for the optimum crop production and brings in the form of a publication. The information contained in those publications is supplied to State Governments for its proper dissemination to the farmer community so that they may judiciously select proper sowing dates for a particular crop for the better agricultural production. So far, these publications have been brought out for six states.

Nine Biweekly aridity Anomaly Reports for the Southwest monsoon season 2008 for the period 4<sup>th</sup> June 2008 to 7<sup>th</sup> October 2008 and One biweekly Aridity Anomaly Report for Northeast monsoon season 2008 for the period 8<sup>th</sup> October 2008 to 21<sup>st</sup> October 2008 for five meteorological sub-divisions viz. Coastal Andhra Pradesh, Rayalaseema, South Interior Karnataka, Kerala and Tamil Nadu & Pondicherry were prepared.

Eighteen Weekly aridity anomaly maps for the period 4<sup>th</sup> June 2008 to 7<sup>th</sup> October 2008 were prepared & computation of Aridity Anomaly Indices for the months of February, March and April 2008 was completed.

Quantitative Crop yield forecast for Wheat of 16 meteorological sub-divisions for the months of March, April and May 2008 was prepared & quantitative Crop yield forecast (preliminary) for Kharif Rice for 26 meteorological sub-divisions for the months of August, September and October 2008 was prepared.

Observations on the Drought Scenario in India during the period 4<sup>th</sup> June 2008 to 24<sup>th</sup> June 2008 were communicated to DDGM(S), New Delhi in response the comments sought on Chinese Publication on ‘Drought Watch’ge.

#### 5.4. ANTARCTIC METEOROLOGICAL PROGRAMME

IMD continues to operate its Meteorological Observatory at Maitri, (Index No. 89514) local Antarctica. Observational data and forecasts are regularly updated on IMD’s web site.

One Automatic Weather Station has been installed and commissioned at Maitri.

A two member IMD team is participating in the current 28<sup>th</sup> Antarctic Expedition.



Meteorological Programme continues to be an integral part of the Indian Scientific Expedition to Antarctica since the very first expedition to the icy continent during 1981-82. The main objectives of the

**MAITRI-Indian Antartic Station**  
**Mean Monthly average Meteorological parameters & weather during year 2008**

Months	Press. (hPa)	Temp. °C	Max. Temp. °C	Min. Temp. °C	Wind (Kts)		Blizzard
					Average Speed	Highest Speed	
Jan	985.8	-1.2	1.4	-3.6	12	62	0
Feb	983.7	-3.5	-0.5	-6.5	12	38	0
Mar	985.8	-6.5	-3.8	-7.4	18	64	3
Apr	997.3	-9.8	-6.8	-13.5	18	98	0
May	990.3	-16.1	-13.2	-19.3	10	90	2
Jun	986.0	-17.4	-14.4	-21.4	20	92	7
Jul	984.3	-16.3	-12.8	-19.8	18	94	6
Aug	985.9	-20.5	-17.2	-24.5	16	110	5
Sep	982.1	-15.1	-11.8	-19.2	17	90	2
Oct	982.9	-13.4	-10.5	-17.2	11	74	1
Nov	982.2	-5.7	-2.6	-9.7	13	67	1
Dec	981.1	-0.8	2.0	-3.3	16	64	5

meteorological programme have been (i) to prepare the climatology of the area and to study the influence of Antarctic weather, if any, over the weather of Indian subcontinent in general and over Indian monsoon in particular. (ii) to measure and study the ozone-hole phenomenon over Antarctica and (iii) to provide weather forecasting support for the various logistic and scientific activities of the expedition.

During the year 2008 the details of the following expedition are given below

### **26<sup>th</sup> Expedition**

Shri N. T. Niyas, Met-II of ADGM(R), Pune and Shri R. N. Tripathy, AM-I of MC Bhubneswar, members of 26<sup>th</sup> Indian

Antarctic Expedition have returned in the year 2008 after completion of expedition.

### **27<sup>th</sup> Expedition**

Shri S. P. Sharma, AM-I of RMC New Delhi, member of 27<sup>th</sup> Indian Scientific Expedition has returned in the month of December 2008 by ALCI Chartered flight TAC-1 (IL-76) after successfully completing the expedition. The other member of 27<sup>th</sup> IAE Shri K. C. Bhindwar, AM-II will return in the month of March 2009 after completion of the expedition.

### **28<sup>th</sup> Expedition**

Shri Kuldweep Wali, AM-I of CPU Unit (DGM's Office) and Shri P. Radhey Shyam, AM-II of Radar Unit (DDGM(UI),

New Delhi), have been selected for participating in 28<sup>th</sup> IAE. Shri Kuldeep Wali, AM-I has reached Matiri station (Antarctica) by charted flight in the month of November 2008.



**Aurore australis at Antartica**

Shri P. Radhey Shyam, AM-II of DDGM(UI), New Delhi (Radar Unit), departed from New Delhi on 26<sup>th</sup> Dec. 2008 for Goa. Thereafter he will proceed to be Cape town and then to Maitri (Antarctica) on 6<sup>th</sup> January 2009 by expedition ship.

### **Research Vessel Cruises**

IMD participated in multi-disciplinary scientific cruises of Ocean Research Vessel in the Arabian Sea, Bay of Bengal and Indian Ocean etc. during pre-monsoon, monsoon and post monsoon seasons of the year. These cruises were planned to collect meteorological data over the sea areas for the study of various aspects of monsoon circulation and other important weather systems affecting the country.

### **ICARB 2008 programme**

Shri Sunil Varpe, SO of ADGM(R), Pune was deputed onboard ship to participate in Vikram Sarabhai Space Centre's ICARB 2008 Ocean Cruise project.

The ship had started from Chennai on 27<sup>th</sup> December 2008 for a period of 30 days.

### **Evaluation of Research Projects**

12 Nos. of Scientific Research Projects (including Annual Progress Reports & Project Completion Reports) were received from DST during the year for evaluation. So far nine projects have been returned to DST after evaluation.

### **5.5. ASTRONOMICAL SERVICES**

The objective of PAC Kolkata is to generate accurate data on positional astronomy of celestial bodies i.e. positions of the Sun, Moon, Planets, Bright Stars etc and to provide a unified National calendar, both for civil as well as religious purposes in order to unify various divergent practices of Calendar making. The Center routinely publishes the Indian Astronomical Ephemeris which provides authentic data on positions of celestial objects with the desired accuracies for various applications in Astronomy, Space Engineering, Geodetic and other Survey work, etc. It also publishes the Rashtriya Panchang in 14 Indian languages. The Centre also supplies lunar data for prediction of tides for Survey of India, Sun-Moon rise/set data for a large number of places for newspapers, judiciary, religious bodies, defence and scientific bodies, eclipse phenomena for scientific researchers and general public etc. and also acted as national agency for determination of dates of festivals of all communities in India, for declaration of official holidays.

The centre contributed in popularising astronomy by displaying Star-Charts, Astronomical Bulletins, information on panchang matters and current astronomical events etc. on website and by organising sky viewing and other popular activities.

The office of Positional Astronomy Centre, Kolkata shifted to the newly constructed four-storeyed building at Salt Lake, Sector V, Kolkata-91 and started functioning from there w.e.f. 24.10.08.

The Indian Astronomical Ephemeris for the year 2009, a prestigious 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, was published in the month of September, 2008.

Fourteen language editions of Rastriya Panchang of 1930 SE (2008-09 A.D).and Sunrise-Sunset and Moonrise-Moonset tables for 2009 were 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.

### **Standing Advisory Committee (SAC) meeting**

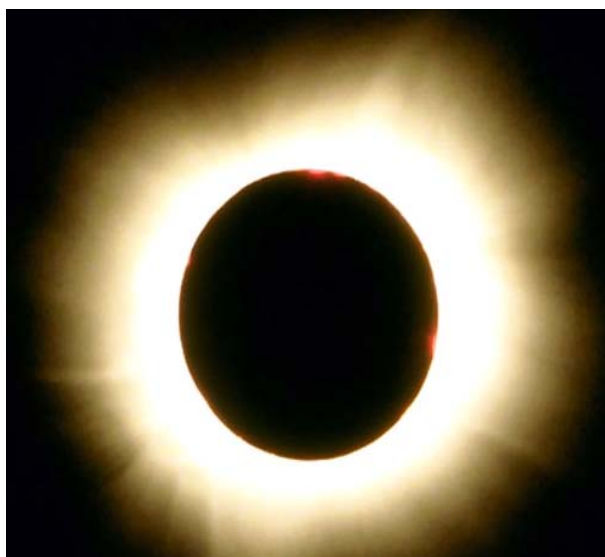
19<sup>th</sup> meeting of the Standing Advisory Committee (SAC) was held in April 2008 at PAC office in Kolkata under the Chairmanship of Prof. G.M. Ballabh of Osmania University, Hyderabad. The meeting was attended by AVM Dr. Ajit Tyagi, DGM, Shri A. K. Bhatnagar, ADGM (EREC) and other distinguished members of SAC. The Committee made some important recommendations for overall improvement in the functioning of PAC in future.

### **Pocket Calendar**

A pocket-type, card-size calendar containing brief information on important celestial events during the year 2008 was published for benefit of users.

### **Total Solar Eclipse**

There was a total solar eclipse on 1<sup>st</sup> August, 2008, the partial phase of which was visible throughout the country. To observe the event, the 6" Newtonian telescope of the Centre was installed on the roof-top of the old PAC building. As the Sun can't be directly watched through the telescope, the eclipse was observed by projecting the image of the Sun on a white



**Total solar eclipse August 2008**

screen placed at the back of the telescope. Contact timings corresponding to beginning and ending of the eclipse were noted and recorded by digital clock set up for the purpose. It was found that the recorded times tallied well with the theoretical values given in the Ephemeris published by this Centre. There were many visitors to observe the eclipse through telescope. The observational programme was fully covered by a number of local electronic and print media.

### **Monthly Star Charts**

The Centre brought out monthly star charts for 12 months during the year 2008

for giving an useful guidance for watching celestial objects in the night sky. The booklet contained brief texts explaining positions of objects in the sky and celestial diagrams showing positions for practical demonstrations. Apart from the regular sky chart, The Centre also issued astronomical bulletin for the total solar eclipse of 1st August 2008 (partial phase visible in India) for Press release for publicity.

## **5.6. WEATHER INFORMATION ON WEB**

IMD continued to provide weather information to public and other users through its highly popular website [www.imd.gov.in](http://www.imd.gov.in)

For public weather information's, Interactive Voice Response Systems (IVRSs), popularly known as 'Weather on Telephone' have been installed at 26 stations (mainly state capitals) through out the country. One can access current weather and forecasts for major Indian cities by dialing a toll free number 1800 180 1717 or 1717.

## **5.7. PUBLICATION, LIBRARY AND INFORMATION SERVICES**

### **Publication Unit**

#### **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 2008 have been brought out in time. Besides the regular issues, special issues on burning topics are also brought out from time to time.

From January 2008 onwards, IMD has started publishing a quarterly Newsletter "IMD NEWS" highlighting the activities of IMD. All the four issues of quarterly newsletter IMD News have been brought out in time.

A Biennial Award Instituted by the Govt. of India in 1960 is given to the authors of the best scientific research paper contributed by the Indian/foreign scientist(s) published in MAUSAM during a two year period.

The Award is aimed to encourage scientific research of high quality especially in the field of meteorology and allied subjects, so far, twenty three distinguished contributions have been found worthy of this Award now known as the MAUSAM Award. The award consists of a Citation and a sum of Rs.35,000/- (Rupees Thirty Five thousand only) in Indian currency for Indian scientists & its equivalent amount in foreign currency for International scientists per author of the award winning paper.

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 instated by Govt. of India in 1993. The said award is restricted to the departmental Scientifics including retired scientist of IMD. However, if the research paper selected for this award is co-authored by scientists of IMD and scientists from other are organizations, all the authors are

eligible for the Award. The Award consists of a Citation and a sum of Rs.10,000/- (Rupees Ten thousand only) per author of the Award winning paper.

Seminar / lectures covering various activities of IMD were organized by Publication Section every month.

The first Editorial Board Meeting of MAUSAM was organized by Publication Section on 14<sup>th</sup> July 2008. Suggestion given by the Members for all round improvement in quality of MAUSAM are being implemented.

The Editorial Committee consisting of 10-12 scientists in the field of Meteorology & allied subjects is nominated by the Editor & Chairman once in every three year period. The director General of Meteorology serves as Ex-officio Editor & Chairman of the Editorial Committee. In order to improve the referral process the journal MAUSAM a panel of subject Editors for different subject domains/areas has been constituted.

### Future Plan

This unit has plan & put MAUSAM online which will reduce to a minimum printing cost.

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

### Library Services

During the year 126, 52 number of books in English, Hindi and other publications were added in the Library. 888 numbers of Journals were added to the Library. Reprographic services were

provided to 85 visitors. 287 journals were bounded. Three Library Advisory Committee meetings were held under the chairmanship of ADGM (EREC).

### Information Services

Rashtriya Panchang 1931SE (2009-10 A.D) in 14 different languages were published by PAC, Kolkata and put on sale for public. Press release on the following events was sent to Press Information Officer, Shastri Bhawan, New Delhi:

- WMO day celebrated on 23<sup>rd</sup> March 2008.
- Total Eclipse of the Moon on 22<sup>nd</sup> February 2008.
- Total Solar Eclipse on 01 August 2008.
- Partial Eclipse of the moon on 17 Aug 2008.

SAC-PAC meeting of PAC, Kolkata was held on 3<sup>rd</sup> and 4<sup>th</sup> April 2008. Permission was accorded to 5 persons for shooting at various IMD offices. Three issues of IMD NEWS were published and circulated. Lectures/seminars were organized on different topics related to meteorology and other topics. The Booklet "Instructions for supply of Meteorological Data and Periodical Weather Reports" was revised and updated.

### 5.8. राजभाषा नीति का कार्यान्वयन

भारत मौसम विज्ञान विभाग हिंदी के प्रगामी प्रयोग के संवर्धन के लिए काफी सक्रिय रूप से कार्य कर रहा है। सरकार की राजभाषा नीति के कार्यान्वयन के लिए मुख्यालय का हिन्दी अनुभाग उत्तरदायी है। यह अनुभाग राजभाषा विभाग, पृथ्वी विज्ञान मंत्रालय, विज्ञान और प्रौद्योगिकी मंत्रालय, केन्द्रीय अनुवाद ब्यूरो और अन्य सरकारी कार्यालयों के



साथ सहयोग और संपर्क रखता है। भारत मौसम विज्ञान विभाग में हिंदी के प्रगामी प्रयोग की समीक्षा, मॉनीटरन और इसे सुनिश्चित करने के लिए दिल्ली स्थित मुख्यालय में और दिल्ली से बाहर के उपकार्यालयों में राजभाषा कार्यान्वयन समितियों का गठन किया गया है। इन समितियों की तिमाही बैठकों में भारत मौसम विज्ञान विभाग में हिंदी के प्रगामी प्रयोग की समीक्षा की गई तथा इसके संवर्धन के उपाय सुझाए गए। इन बैठकों में राजभाषा विभाग द्वारा जारी किए गए 'वार्षिक कार्यक्रम' में निर्धारित लक्ष्यों पर विचार-विमर्श किया गया और इन लक्ष्यों को प्राप्त करने के लिए निर्णय लिए गए।

### राजभाषा कार्यान्वयन समिति

विज्ञान और प्रौद्योगिकी पर्यावरण तथा वन विभागों से संबंधित संसदीय स्थायी समिति 2008-2009 के पृष्ठभूमि नोट का हिन्दी पाठ पृथ्वी विज्ञान मंत्रालय को भेजा गया। मौविउमनि (प्रा.मौ. केन्द्र, नई दिल्ली/हिन्दी) और ज्येष्ठ हिन्दी अधिकारी ने नियमित रूप से पृथ्वी विज्ञान मंत्रालय की राजभाषा कार्यान्वयन समिति की बैठकों में भाग लिया।

### प्रगति रिपोर्ट

मुख्यालय की सभी चारों तिमाहियों की तिमाही प्रगति रिपोर्ट समेकित कर पृथ्वी विज्ञान मंत्रालय और राजभाषा विभाग को भेजी गई। उपकार्यालयों की तिमाही प्रगति रिपोर्टों की समीक्षा की गई। उपकार्यालयों की राजभाषा कार्यान्वयन समिति की बैठक के कार्यवृत्तों की समीक्षा की गई और दिशा-निर्देश जारी किए गए।

### हिन्दी शिक्षण योजना

यह विभाग अधिकारियों और कर्मचारियों को हिन्दी शिक्षण योजना के अन्तर्गत हिन्दी, हिन्दी टंकण और हिन्दी आशुलिपि का प्रशिक्षण दिलाने का महत्वपूर्ण कार्य करता है। सरकारी अनुदेशों और आदेशों के अनुसार जिस अधिकारी/कर्मचारी ने निर्धारित मानदंडों के अनुसार हिन्दी परीक्षाएँ उत्तीर्ण की हैं उन्हें उचित प्रोत्साहन और नकद पुरस्कार दिए

गए हैं। इससे निश्चित रूप से उनमें निर्धारित पाठ्यक्रमों को सफलतापूर्वक पूरा करने का उत्साह और रुचि जागृत होती है।

हिन्दी शिक्षण योजना के अन्तर्गत हिन्दी प्रबोध/प्रवीण/प्राज्ञ/हिन्दी टंकण/हिन्दी आशुलिपि की परीक्षा अच्छे अंकों से उत्तीर्ण करने पर कुल 29 कार्मिकों को नकद पुरस्कार दिए गए। विभाग में 'आज का हिन्दी शब्द' योजना सुचारू रूप से चलाई गई। जिसमें कार्मिकों के ज्ञानवर्धन के लिए प्रतिदिन हिन्दी शब्द, कहावतें, लोकोक्तियाँ दोनों भाषाओं (हिन्दी और अंग्रेजी) में लिखी गईं।

नई दिल्ली स्थित मुख्यालय तथा दिल्ली से बाहर के उपकार्यालयों में समय-समय पर हिन्दी कार्यशालाओं का आयोजन विभाग के कार्मिकों को प्रशिक्षित कराने के लिए किया जाता है जिससे वे अपना प्रशासनिक/ तकनीकी कार्य हिन्दी में कर सकें।

मुख्यालय के विभिन्न अनुभागों के 122 कम्प्यूटरों में हिन्दी सॉफ्टवेयर 'अक्षर नवीन' लगाया गया।

### अनुवाद एवं मुद्रण

अनुवाद के सभी प्रमुख नेमी कार्य हिन्दी अनुभाग के अनुवादकों द्वारा किए गए। त्रैमासिक विभागीय शोध पत्रिका **मौसम** के लिए 32 शोध पत्रों के सारों का अनुवाद किया गया। विभागीय गृह पत्रिका '**मौसम मंजूषा**' की प्रतियाँ सभी अनुभागों, उपकार्यालयों और अन्य विभागों को भेजी गईं। कुल 32 विभागीय मैनुअलों का हिन्दी में मुद्रण किया गया। इसकी प्रतियाँ सभी अनुभागों तथा उपकार्यालयों को भेजी गईं।

### राजभाषा नीति की प्रगति

राजभाषा नियम 1976 के नियम 10 (4) के अन्तर्गत मौसम केन्द्र, चंडीगढ़ अहमदाबाद, रायपुर और मौसम कार्यालय बेरागढ़ के कार्यालयों को अधिसूचित किया गया।

दिनांक 28.01.2008, 30.01.2008, 04.02.2008 और 06.02.2008 को ज्येष्ठ हिन्दी अधिकारी ने राजभाषा नीति की प्रगति का जायजा लेने के लिए क्रमशः स्थापना (I), स्थापना (II), स्थापना (III) और सामान्य अनुभाग का निरीक्षण किया।

### हिन्दी पखवाडा का आयोजन

मुख्यालय में दिनांक 01.09.2008 से 15.09.2008 तक हिन्दी सप्ताह का आयोजन किया गया। इस अवधि के दौरान हिन्दी में टिप्पण और मसौदा लेखन, हिन्दी निबंध, हिन्दी टंकण, हिन्दी वाद-विवाद तथा स्वरचित हिन्दी कविता पाठ प्रतियोगिताओं का आयोजन किया गया तथा दिनांक 29.09.2008 को इन प्रतियोगिताओं में प्रथम, द्वितीय, तृतीय और चतुर्थ स्थान पाने वाले विजेताओं को महानिदेशक महोदय ने नकद पुरस्कार और प्रमाण-पत्र प्रदान किए।

इस समारोह में वर्ष 2007-2008 में सर्वाधिक पत्र हिन्दी में भेजने के लिए महानिदेशक महोदय द्वारा

मौविउमनि (प्रशासन एवं भंडार) को राजभाषा चलशील्ड प्रदान की गई। अखिल भारतीय विभागीय हिन्दी निबंध प्रतियोगिता 2008 आयोजित की गई। मुख्यालय और उपकार्यालयों के 9 कार्मिकों ने भाग लिया जिसमें 6 विजेताओं को प्रथम, द्वितीय, तृतीय और 3 सांत्वना पुरस्कार दिए गए।

माननीय संसदीय राजभाषा समिति की दूसरी उपसमिति द्वारा दिनांक 01.01.2008, 10.06.2008, 17.09.2008 और 04.12.2008 को क्रमशः मौसम केन्द्र अमृतसर, पूरी, कोज्जिकोड और मौसम कार्यालय, सांताक्रूज़ का निरीक्षण किया गया।

दिनांक 05.08.2008 और 08.08.2008 को हिन्दी अधिकारी तथा वरिष्ठ अनुवादक ने राजभाषा नीति की प्रगति का जायजा लेने के लिए क्रमशः मुख्यालय के कल्याण अनुभाग और जल मौसम अनुभाग का निरीक्षण किया।



## 6. RESEARCH PAPER PUBLISHED BY IMD SCIENTISTS

### Other Indian / Foreign Journals

**Agnihotri G., Rama Rao Y. V. and Dash S. K., 2008**, Impact of various synthetic vortices on Cyclone track prediction, **Natural Hazards**, 47 (3), 437-463.

**Basu, G. C.**, "A perspective of global warming, climate change & environmental pollution & its impact on human health", A.F.A.C. Met. Journal, **Vatavaran**, 32, 1.

**De, U. S. and Soni, V. K., 2008** "Urbanization and its impact on climate", and "Climate Change – Role of Citizens" were presented at IGU symposium held at Varanasi during 5 – 7 November 2008.

**Guhathakurta, P., 2008**, "Long Lead Monsoon Rainfall Prediction for Meteorological Sub-divisions of India using Artificial Neural Network Model" **Meteorology and Atmospheric Physics**, 101, 93-108, September, 2008 issue.

**Guhathakurta, P. and Rajeevan, M., 2008**, "Trends in Rainfall pattern over India", **International Journal of Climatology**, 28, 1453-1469.

**Gupta, D. C., Director and Gahalout, V. K., NGRI, 2008**, "GPS measurements post seismic deformation in Andaman & Nicobar Region", **Journal of Geo Physical Research letter**.

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**Kotal, S. D., Roy Bhowmik S. K., Kundu P. K. and Das Ananda, K., 2008**, A Statistical model for Cyclone Intensity Prediction, **Earth Sci. System**, 117(2), 157-168.

**Kotal, S. D., Roy Bhowmik, S. K. and Kundu Prabir, 2008**, Application of Statistical - Dynamical scheme for real time forecasting of the Bay of Bengal very severe cyclonic storm SIDR of November 2007, **Geofizika**, 25 (2), 139-158.

**Kotal, S. D., Kundu P. K. and Roy Bhowmik, S. K., 2008**, An analysis of Sea Surface Temperature and Maximum Potential Intensity of Tropical Cyclone over the Bay of Bengal, **Met Application**, (online published on October 2008, DOI 10.1002/met 96).

**Muthuchami, A. and Dhanvantham, P., 2008**, "Probable storm motion in the Bay of Bengal during April & May", **Journal of Indian Geo-physical union**.

**Pattanaik, D. R., Mohanty, U. C., Hatwar, H. R., Srinivasan, G., Sinha, P. and Brooksaw, 2008**, A simulation of maximum surface air temp over India using UKMO GloSea model, **Theoretical & Applied Climatology**, 92, 165-179.

**Roy Bhowmik, S. K., Sen Roy, S. and Kundu, P. K., 2008**, An analysis of large scale conditions associated with convection over Indian monsoon region, **Int. J. Clim**, 28, 797-821.

**Roy Bhowmik, S. K. and Durai, V. R., 2008**, Multi-model Ensemble Forecasting of rainfall over Indian monsoon region, **Atmosfera** , 21(3), 225-239.

**Roy Bhowmik, S. K. and Prasad K., 2008**, Improving IMD operational limited area model forecasts, **Geofizika**, 25(2), 87-108.

**Rajeevan, M. and Latha Sridhar, 2008**, "Inter-annual relationship between Atlantic sea surface temperature anomalies and Indian summer monsoon", **Geophysical Research Letters**, 35, L21704, doi:10.1029/2008 GL036025,2008.

**Singh, O. P., 2008**, "A Indian ocean dipole Mode and Tropical Cyclone frequency", **Current Science**, 94 (Jan 2008).

**Singh, R. K., Prakash, Rajesh, Shukla, A. K., Bhatnagar A. K. and Srivastava, H. N. (2008)**. Seismicity Pattern Preceding Great Muzaffarabad Earthquake of 8<sup>th</sup> October 2005. **J. Geol. Soc.of India**, Vol 71, pp388-396.

#### **Departmental Research Journal "MAUSAM"**

**A. K. Jaswal, G .S. Prakasa Rao and U. S. De**, "Spatial and temporal characteristics of evaporation trends over India during 1971-2000", 59 (2), 149-158.

**A. Muthuchami and S. Sridharan**, "Intensification and movement of cyclonic storm in the Bay of Bengal during post monsoon season", 59 (1), 51-68.

**A. P. Dimri**, "Diagnostic studies of an active western disturbance over western Himalaya", 59 (2), 227-236.

**Anil Kumar Rohilla, D. S. Pai and M. Rajeevan**, "Relationship between lower stratospheric circulation and Indian summer monsoon rainfall : Implication for long range forecasts", 59 (2), 173-184.

**Anil Kumar Rohilla, M. Rajeevan and D. S. Pai**, "Seasonal forecasts of Indian summer monsoon rainfall using local polynomial based non-parametric regression model", 59 (1), 77-86.

**B. R. Loe, R. K. Giri and L. R. Meena**, "Study of variation of thermodynamics parameters over Srinagar", 59 (1), 132-134.

**Charan Singh, B. K. Bandyopadhyay, B. L. Verma, Sunit Das and Ram Babu Verma**, "Some aspects of dissipation of tropical cyclones over north Indian ocean during 1990-2004", 59 (3), 376-380.

**D. Chakrabarti, H. R. Biswas, G. K. Das and P. A. Kore**, "Observational aspects and analysis of events of severe thunderstorms during April and May 2006 for Assam and adjoining states – A case study on 'Pilot Storm Project'", 59 (4), 461-478.

**D. R. Pattanaik**, "Variability of convective activity over the Bay of Bengal and the Arabian Sea", 59 (4), 479-490.

**Devendra Singh, Virendra Singh, R. K. Giri and R. C. Bhatia**, "Improvement and impact study of satellite derived CMVs over Indian region", 59 (4), 491-496.

**Ghulam Rasul, Qamar-uz-Zaman Chaudhry, Qingcun Zeng, Sixiong Zhao and Gao Shouting**, "Interaction of a mesoscale low and diffused tropical depression during south Asian summer monsoon", 59 (4), 453-460.

**H. P. Das, A. K. Dhotre and D. M. Rase**, *“Temperature variability and trends over Pune”*, 59 (3), 291-296.

**Heiko Paeth**, *“Understanding the mechanism of land-cover related climate change in the low latitudes”*, 59 (3), 297-312.

**I. J. Verma and V. N. Jadhav**, *“Recent variations and trends in pan evaporation over India”*, 59 (3), 347-356.

**I. J. Verma, H. P. Das and V. N. Jadhav**, *“A study on recent changes in weekly evaporation at selected locations in India”*, 59 (2), 211-218.

**I. J. Verma, V. N. Yadav and Erande R. S.**, *“Recent variations and trends in potential evapotranspiration (PET) over India”*, 59 (1), 119-128.

**Indu Bala and O. P. Singh**, *“Relationship between Indian Ocean dipole mode and summer monsoon”*, 59 (2), 167-172.

**K. Seetharam**, *“Impact of Madden-Julian oscillations on the Indian summer monsoon sub-divisional rainfalls”*, 59 (2), 195-210.

**K. V. Balasubramanian and S. Balachandran**, *“Thunder squall over Chennai – A case study”*, 59 (4), 533-540.

**Kuldeep Srivastava, S. K. Roy Bhowmik, H. R. Hatwar, Ananda K. Das and Awadhesh Kumar**, *“Simulation of mesoscale structure of thunderstorm using ARPS Model”*, 59 (1), 1-14.

**M. El- Nouby Adam and Sayed M. El. Shazly**, *“Diurnal variation of atmospheric stability at Qena (Upper Egypt)”*, 59 (1), 69-76.

**M. Mohanty, D. R. Pattanaik, V. R. Rao and A. Kesarkar**, *“Study on the frequency of thunderstorm occurrences during pre-monsoon season for the years 1994-2003 over Indian region”*, 59 (4), 513-517.

**M. Mohapatra**, *“Sub-divisional summer monsoon rainfall over India in relation to low pressure systems over the Bay of Bengal and adjoining land regions during 1982-1999”*, 59 (3), 327-338.

**M. Mohapatra, H. R. Biswas and G. K. Sawaisarje**, *“Daily summer monsoon rainfall over northeast India due to synoptic scale systems”*, 59 (1), 35-50.

**M. Rudraiah, S. Govindaiah and S. Srinivasa Vittala**, *“Delineation of potential groundwater zones in the Kagna river basin of Gulbarga district, Karnataka, India using Remote Sensing and GIS techniques”*, 59 (4), 497-502.

**Manmohan Singh and S. C. Bhan**, *“Will it be rain or snow at Shimla?”*, 59 (2), 237-239.

**Medha Khole**, *“Activity of Madden Julian Oscillation during 2002 and 2006 – A comparative analysis”*, 59 (3), 321-326.

**Mohammed Mansoor Al Muliki and H. T. Basavarajappa**, *“Morphometric analysis of Rasyan valley basin – A case study in the Republic of Yemen, using Remote Sensing and GIS techniques”*, 59 (2), 185-194.

**Mohanty, G. K.**, *“Heavy rainfall/snow fall event over Kashmir Valley in recent period”*, special issue of **Vayu Mandal**.

**N. Chattopadhyay, R. P. Samui and S. K. Banerjee**, *“Effect of weather on growth and yield of cotton grown in the dry farming tract of peninsular India”*, 59 (3), 339-346.

- N. Vivekanandan**, *“Intercomparison of determination of parameters of LP III for estimation of design flood”*, 59 (4), 527-532.
- O. P. Singh**, *“Evolutions of sea level high and warm pool in the southeastern Arabian Sea and their association with Asian monsoons : A study on cause-and-effect relationships”*, 59 (1), 87-94.
- P. S. Biju, R. R. Mali and R.D. Vashistha**, *“An indigenous design of Integrated Automated Current Weather Instruments System (IACWIS) for aeronautical meteorological observations”*, 59 (4), 503-512.
- R. P. Samui, Gracy John, M. P. S. Pillai and S. P. Ransure**, *“Water requirement and water use efficiency of Sorghum and its irrigation planning under limited water resources in arid and semi arid regions of India”*, 59 (2), 219-226.
- R. Asokan and S. Balachandran**, *“A pre-monsoon precursor for foreshadowing of northeast monsoon rainfall over Tamilnadu”*, 59 (4), 445-452.
- R. K. Giri, B. R. Loe, Rajveer Singh and S. Bali**, *“Precipitation variability and its trend analysis over Kashmir region”*, 59 (2), 239-242.
- R. P. Samui, N. Chattopadhyay, J. P. Sabale, K. Karthikeyan and P. V. Balachandran**, *“Predicting the outbreak of Green Jassid (Nepholethix Virescens) using different weather indices at Pattambi, Kerala”*, 59 (2), 243-246.
- Rajendra Kumar Jenamani and S. C. Bhan**, *“Exceptional rainfall event of 26<sup>th</sup> July, 2005 over Mumbai - Analysis of radar echoes and rainfall”*, 59 (3), 366-376.
- S. Deka, S. C. Kakaty and M. Borah**, *“Use of probability distributions for the analysis of daily rainfall data of north east Indian”*, 59 (4), 518-527.
- S. I. Laskar and T. N. Jha**, *“A study on variation of maximum and minimum temperature over Patna Airport”*, 59 (1), 129-132.
- S. K. Peshin**, *“Depletion of ozone over Antarctica during 2006”*, 59 (3), 313-320.
- Sujay Dutta, V. K. Dadhwal, N. K. Patel and J. S. Parihar**, *“Generation of district level rice crop inventory, growth profile and yield estimation in Orissa using spot - vegetation data”*, 59 (1), 111-118.
- Sukla Duttagupta**, *“Measurement and analysis of radio refractive index over Kolkata with respect to its seasonal and diurnal characteristics”*, 59 (3), 357-360.
- K. Seetharam**, *“Climate change scenario over Gangtok”*, 59 (3), 361-366.
- Suresh Ram and M. Mohapatra**, *“Some characteristics of fog over Guwahati airport”*, 59 (2), 159-166.
- U. R. Joshi, G. S. Prakasa Rao and Shraavan Kumar**, *“Climatological studies of lapse rates during summer months vis-à-vis All India Summer Monsoon Rainfall”*, 59 (1), 95-110.
- V. B. Dhawan, Ajit Tyagi and M. C. Bansal**, *“Forecasting of thunderstorms in pre-monsoon season over northwest India”*, 59 (4), 433-444.
- Y. E. A. Raj and B. Geetha**, *“Relation between southern oscillation index and Indian northeast monsoon as revealed in antecedent and concurrent modes”*, 59 (1), 15-34.

## IMS Journal "VAYU MANDAL"

**A.A.L.N. Sarma and T.V. Lakshi Kumar**, "Variability of surface water budget elements: Understanding land atmospheric coupling", Vol. 33 No.(1-4), 11-17.

**A.J. Litta and K. Mohankumar**, "Simulation of vertical structure and dynamics of thunderstorm over Cochin using MM5 mesoscale model – A case study" Vol. 33 No. (1-4), 51-57.

**A.T. Jeyaseelan and Anu Rani Sharma**, "IRS-P6AWiFS based NDVI and NDWI for assessment of drought and flood affected areas during 2006 in Maharashtra state", Vol. 33 No. (1-4), 80-86.

**Ajit Tyagi and A. V. Lele**, "Emerging Meteorological requirements of defence forces" Vol. 33 No.(1-4), 3-10.

**Anish Kumar, M. Nair, C. K. Rajan**, "A case study on the heavy rainfall incidence over Lakshadweep and Kerala during the pre-monsoon of 2004", Vol. 33 No. (1-4), 94-104.

**C. A. Babu and V. Hamza**, "Characteristics of ABL during active and weak phases of monsoon", Vol. 33 No. (1-4), 111-119.

**D. P. Dubey and Akhilesh Gupta**, "Probable causes of Failure of July rainfall during southwest monsoon – 2002", Vol. 33 No. (1-4), 145-151.

**E., Kulandaivelu and K. Vidya**, "Oscillation of ozone depletion over Antarctica in recent years – A study", Vol. 33 No. (1-4), 139-144.

**G. Krishnakumar, M. Rajeevan and Alaka S. Gadgil**, "Use of wind and temperature anomalies over the Indian Ocean" in the estimation of cyclonic disturbance activity", Vol. 33 No.(1-4), -28-33.

**G.C. Asnani and Mahesh Verma**, "A slightly new look at El-Nino/La-Nina phenomenon" Vol. 33 No. (1-4), -34-38.

**G.K. Mohanty**, "Heavy rainfall/snowfall events over Kashmir valley in the recent period", Vol. 33 No. (1-4), 120-126.

**G.N. Saha, Soma Sen Roy and V. Rajeswara Rao**, "Contrasting behaviour of Indian monsoon convection during ENSO years", Vol. 33 No. (1-4), 87-93.

**G.S. Meena, C.S. Bhosale and D.B. Jadhav**, "Seasonal variation in vertical column density of NO<sub>2</sub> and O<sub>3</sub> by UV-visible spectrometer", Vol. 33 No. (1-4), 132-138.

**Hamza V. And C.A. Babu**, "Recent change in the rainfall trend and associated characteristics with good and bad monsoons years", Vol. 33 No. (1-4), 105-110.

**J. Sanjay, S. Joshi and S. Taraphdar**, "Numerical simulation of heavy rainfall over Ratnagiri on May 30, 2006 using WRF", Vol. 33 No. (1-4), 39-50.

**J. Sanjay, S. Taraphdar, M. Rajeevan, G.B. Pant and P.C. Joshi**, "Vegetation feedbacks on regional climate model forecasts over Indian region", Vol. 33 No. (1-4), -18-27.

**M. Mohanty, V.R. Rao and A.K. Sharma**, "Study of convective activity using INSAT OLR data during tropical cyclone", Vol. 33 No. (1-4), 70-79.

**S. Taraphdar, J. Sanjay and P. Mukhopadhyay**, "On northward propagation of convergence zones over west coast of India in NCEP forecasts during onset of summer monsoon 2006" Vol. 33 No. (1-4), 58-69.

**S. Venkataraman**, "Assessment and depiction of crop drought scenario", Vol. 33 No. (1-4), 152-156.

**S.C. Bhan and S.D. Attri**, "Quantification of frost occurrence over northwest India", Vol. 33 No. (1-4), 127-131.

### Miscellaneous Publications

**Aridity Anomaly Reports** - Two Biweekly Reports for Northeast monsoon season for the period 22<sup>nd</sup> October to 4<sup>th</sup> November 2008 and 5<sup>th</sup> November to 18<sup>th</sup> November 2008 were prepared for 5 meteorological subdivisions and same were uploaded in the ADGM(R)'s website. Copies of the same were sent to 17 recipients including departmental and non-departmental offices and Ministry of Agriculture.

**Crop Yield forecast** for Kharif Rice for 26 sub-divisions for Nov. 2008 were prepared and sent to HQrs., New Delhi.

**Daily gridded rainfall data** at 0.5 x 0.5 grid for the period 1971-2005 was prepared

"**Monsoon 2007** – A Report" was published a IMD Met. Monograph No. 6/2008.

**NCC Report No 6**, by M. Rajeevan, Sulochana Gadgil & Jyoti Bhate 2008, "Active and Break spells of the Indian Summer Monsoon IMD, Pune.

**NCC Report No. 8** by K. Srivastava, M. Rajeevan & S. R. Kshirsagar, 2008, Development of a high resolution daily gridded temperature data set (1969-2005) for the Indian region, IMD Pune.

**NCC Report No. 9** by M. Rajeevan and Jyoti Bhate, 2008, A high resolution daily gridded rainfall data set (1971-2005) for mesoscale meteorological studies, IMD Pune.

**Monthly Climate Diagnostics Bulletin of India** for the period December 2007 to August 2008 and seasonal Climate Diagnostics Bulletin for the Winter season (January - February 2008), Pre-monsoon season (March-May 2008) and Southwest monsoon season (June-September 2008) and Post monsoon season (October-December) were published.

"**Disastrous Weather Events**" by ADGM(R), brings out a yearly publication which includes detailed information of the casualties and the loss of private/public properties due to various meteorological elements every year.

### Met Monograph on Cyclone "OGNI"

RSMC, New Delhi has two annual publication on regular basis viz, (i) 'RSMC-Report on Tropical cyclone over north Indian Ocean' and (ii) WMO/ESCAP Panel on Tropical Cyclone –Annual Review. Apart from these publications a Met monograph on cyclone "**OGNI**" was also published during this year. It is needless to mention that the scientists working in this division published a number of research papers in the reviewed journals.

The cyclone page on the website has been modified with inclusion of (i) Frequently Asked Question (FAQ) on cyclones. (ii) Naming of Tropical Cyclone over north Indian Ocean (iii) Technical report on cyclonic disturbances over the north Indian Ocean.

**Aridity Anomaly Reports** - Nine Biweekly Reports for the Southwest monsoon season 2008 for the period 4<sup>th</sup> June 2008 to 7<sup>th</sup> October 2008 and One biweekly Aridity Anomaly Report for Northeast monsoon season 2008 for the period 8<sup>th</sup> October



2008 to 21<sup>st</sup> October 2008 for five meteorological sub-divisions viz. Coastal Andhra Pradesh, Rayalaseema, South Interior Karnataka, Kerala and Tamil Nadu & Pondicherry were prepared.

**Weekly aridity anomaly maps** – Eighteen maps for the period 4<sup>th</sup> June 2008 to 7<sup>th</sup> October 2008 were prepared and distributed to users.

**Quantitative Crop yield forecast** for Wheat of 16 meteorological sub-divisions for the months of March, April and May 2008 was prepared and distributed to users.

**Quantitative Crop yield forecast** (preliminary) for Kharif Rice for 26 meteorological sub-divisions for the months of August, September and October 2008 was prepared and distributed to users.

**Marine Climatological Summaries** Published “Decadal Marine Climatological Summaries (along with CD) for the period 1991-2000”.

An **Atlas** titled “Statewise Generalised Isopluvial (Return Period) maps of Southern Peninsular Part - I” was published. The Part - II, III & IV of the Atlas containing Isopluvial Maps of Eastern India & Central Indian States have been sent to ADGM(R)’s Office, Pune for publication.

Indian Astronomical Ephemeris for the year 2009, a regular annual publication of Positional Astronomy Centre was published in the month of October 2008.

State-wise generalized pluvial maps/atlas (Return period) of southern peninsula for the states of Karnataka, Kerala, Tamilnadu and Andhra Pradesh have been published.

**ATLAS  
of  
Statewise Generalised  
ISOPLUVIAL (Return Period) Maps  
of the Southern Peninsula  
(Part - I)**



**ATLAS  
of  
Statewise Generalised  
ISOPLUVIAL (Return Period) Maps  
of Eastern India  
(Part - II)**



### **Cyclone Manual Review**

Cyclone warning is one of the most important functions of the India Meteorological Department. It was the first service undertaken by the department as early as in 1865 and thus the service started before the establishment of the department in 1875. In view of the developments in observational tools and analysis and prediction techniques, the monitoring and prediction methodology w.r.t. cyclones over north Indian Ocean has undergone several changes. All these above facts have been documented as

forecasting manual or cyclone manual. These manuals have undergone several changes in the past considering the requirements of forecasters and disaster managers. The last review of the cyclone manual was carried out and published by IMD during 2003.

In the recent years, there have been many developments in observational and prediction aspects including deployment of Doppler Weather Radar (DWR). Automatic Weather Station (AWS) and meteorological satellites and development of prediction models including Quasi Lagrangian Model (QLM), Weather Research and Forecast (WRF), Hurricane WRF (HWRR) models etc. in addition to various synoptic and statistical methods. Hence, the review of the forecasting manual on cyclone has been taken up

### **Niharika**

Two editions (Vol.2, No.2 & Vol.3, No.1) of the bi-annual magazine of the Centre named 'Niharika', which contains popular topics on Astronomy & Astrophysics, were published. There were contributions from Departmental and non-Departmental experts in the field on various interesting topics of Astronomy & Astrophysics.

### **Pre-Published Scientific Report**

A Pre-Published Scientific Report (PPSR) on 'Generation of comprehensive database on the statistics of Depression, Cyclonic Storms and Severe Cyclonic Storms over north Indian Ocean' has been prepared and published.



## 7. SEMINARS / LECTURES

**Shri A. K. Nath, AM-II**, attended the Science Exhibition-cum-Seminar on 7<sup>th</sup> January, organized by Dasghara High School, Hooghly as a part of 150<sup>th</sup> anniversary of the school.

**Shri M. Das, AM-I** attended a course of Orientation on Vigilance Administration at Gangtok conducted by CWS, New Delhi during 14<sup>th</sup> to 18<sup>th</sup> January 2008.

**Shri K. Seetharam, Director** attended 1<sup>st</sup> Glacier and Climate Change Commission Meeting, Govt. of Sikkim on 17<sup>th</sup> January 2008.

**Dr. S. K. Roy Bhowmik, Director** (NWP) delivered a talk on "Tropical Cyclone genesis, intensity and track prediction" at National Institute of Disaster Management (NIDM), New Delhi on 22<sup>nd</sup> January 2008.

**Dr. G. C. Debnath, Director**, delivered a lecture on 30<sup>th</sup> January on Cyclone Risk Mitigation at ATI Kolkata, organized by Natural Disaster Management, Govt. of West Bengal.

**Dr. A. B. Mazumdar, DDGM(WF)** and **Dr. Medha Khole, Director** delivered the lectures on occasion of training programme by Centre of Disaster Management, YASHDA. During this a lecture cum demonstration programme on "General Functioning of IMD System" was conducted by IMD on 10<sup>th</sup> February 2009. This was a part of the training programme by the The trainees visited the various sections like Weather Section, INOSHAC, National Data Centre and NCC.

**Dr. G. C. Debnath, Director**, delivered a lecture on "Global Warming and Its Impact on Climate Change" at the Muralidhar College on 25<sup>th</sup> March.

**Shri B. Mukhopadhyay, DDGM (DM)** attended annual AMFU meeting on 25<sup>th</sup> March, 2008 at Jodhpur and delivered a lecture on "District Level Forecasting".

**Shri A. K. Bhatnagar, ADGM (EREC)** delivered a lecture on Seismology in Seminar Hall, IMD, New Delhi on 2<sup>nd</sup> April 2008.

**Dr. A K Shukla, Technical Director** (EREC) delivered a lecture on Seismic Hazard Microzonation in the training course of Seismology for Naval Met. Officers on 09 April 2008.

**Dr. G. C. Debnath, Director** participated in a seminar organized by the Indian Science Congress on the occasion of Earth Day celebration on 22<sup>nd</sup> April at Bireswari Guha Street Kol-17, and delivered a lecture on "A Call for climate"

**Dr. G. Krishnakumar, Director** delivered lecture on 9<sup>th</sup> May on "Processing and Quality checks on meteorological data" to the trainees from all FMO offices conducted by CTI, Pashan.

**Shri P. A. Kore, Met-I** delivered lectures on "Validation of rainfall data" to AE / Executive Engineers of Central Water Commission, Khadakwasala on 15<sup>th</sup> May 2008.

**Dr. Ajeet P. Pandey, Met-II** delivered a lecture on title “Microtremor Site Response Characterization of Chhatarpur Basin, Delhi” on May 29<sup>th</sup>, 2008 in EREC.

**Dr. G. C. Debnath, Director** delivered a lecture on 29<sup>th</sup> May in the training course on the use of IMD weather forecast for flood management in West Bengal organized by Irrigation & Waterways Deptt of West Bengal.

**Shri B. S. Thampi, Director** CDR Chennai delivered a lecture on the topic ‘Flood and Cyclone Disaster management’ to the trainees of Anna Institute of Management, Chennai on 3<sup>rd</sup> June. He also delivered four lectures on DWR related topics in the 4<sup>th</sup> SERC school on Aviation Meteorology conducted at AFAC Coimbatore on 08<sup>th</sup> December 2008.

**Shri H. S. Mandal, Met-II** delivered a lecture on “Estimation of Disaster using RADIUS program” on 26<sup>th</sup> June 2008.

**Shri K. Seetharam, Director** Attended inaugural function on 7<sup>th</sup> July 2008 of “Disaster Safe Hill Areas” organized by G.B. Pant Institute, Gangtok & National Disaster Management Institute, N. Delhi.

**Shri K. Seetharam, Director** attended Rabi Kisan Mela 2008 organized by ICAR, Tadong and he delivered a lecture on 9<sup>th</sup> July 2008 on “Consequences of Extreme rainfall, lightening & flash floods” at the workshop “Disaster Safe Hill Area” in Gangtok organized by G.B.P.I, Gangtok & NIDM, and New Delhi.

**Dr. R. Suresh, Director** delivered a lecture for trainees of TNEB on ‘Role of IMD in disaster management’ on 14<sup>th</sup> July 2008.

**Shri A. K. Srivastava, Director** delivered a lecture on “Meteorological Drought indices for drought monitoring” held at IIRS during 15-24<sup>th</sup> July 2008

**Dr. Anand Sharma, Director** MC Dehradun delivered a lecture on topic Weather & Climate monitoring for Environment Mgmt 19<sup>th</sup> July, Global Environment Changes & its likely impact on various eco systems-I on 20<sup>th</sup> July as per invitation from the UGC-Academic Staff College, Kumaun University, Nainital.

**Dr. Anand Kumar Sharma, Director,** Meteorological Centre, Dehradun delivered an invited lecture on “Climatic variability and its impact on drought” in July 2008.

**Ms. Rupa Jaggi, Meteorologist** underwent familiarization forecasting NHAC (DGM) w.e.f 1<sup>st</sup> August 2008 to 14<sup>th</sup> August 2008.

**Dr. G. C. Debnath, Director** delivered lecture on use of Doppler weather Radar in weather forecasting on 4<sup>th</sup> September at the training workshop at CDR Kolkata during the period 1<sup>st</sup> to 5<sup>th</sup> September.

**Dr. G. C. Debnath, Director** delivered a lecture on Climate Change at India science Congress Association, Kolkata on 15<sup>th</sup> September.

**Shri R. C. Bhatia, ADGM** gave a lecture on Weather forecasting – Reality or a Myth organized by FGG-LP foundation on 25<sup>th</sup> September 2008 at New Delhi.

**Shri Ravi Kant Singh, Meteorologist-I** of EREC delivered an invited lecture on “Elementary Seismology” at “Capacity Building programme for performance based design and retrofitting of buildings against earthquake” for SAARC countries organized by BMTPC, at India Habitat Center New Delhi -110003 on 21<sup>st</sup> October 2008.

**Shri V. K. Soni, Met.I** attended the GURME-2008 International Workshop on, "Air quality forecasting" at IITM, Pune during 8-12 December 2008. Shri V. K. Soni gave a brief presentation on activities of IMD GAW network in the same. Dr. H.R. Hatwar, ADGM(R) attended the inaugural session.

**Dr. G. Krishnakumar, Director** delivered the guest lecture in one day seminar on, "Global Warming" at Moze college, Yeravada, Pune on 30<sup>th</sup> December 2008.

**Dr. P. Guhathakurta, Director**, has given lectures in Basic Agrimet course.

**Dr. Medha Khole, Director**, delivered a lecture on the topic "Science of Weather Forecasting" at the 13<sup>th</sup> National Seminar on Physics and Technology of Sensors organized by Centre for Sensor studies, Dept. of Electronic Science, University of Pune.

**Dr. Jayanta Sarkar, Director** delivered lectures on 'Drought Monitoring' and 'Crop Yield Forecasting' to the trainees of Agromet Core Course and lectures to the trainees of Basic Agromet Training Course.

**Dr. Medha Khole Director**, delivered a lecture on the topic of "Hydrological Cycle" at the Technical Training Course organized by Groundwater Surveys and Development Agency (GSDA), Pune.

**Dr. R. V. Sharma, DDGM** and **Dr. S. R. Ramanan, Director** attended a meeting to review on weather related matter pertaining for launch of PSLV- CII/CHANDRAYAN – 1 Mission.

**Shri G. K. Mohanty, Director** delivered lectures (3 times) in the training programme for climate change and disaster

management conducted by Shri Krishna Institute of Public Administration, Govt. of Jharkhand, Ranchi.

### **Seminars at H.Q. Delhi Office**

**Shri A. K. Bhatnagar** delivered lecture on the topic "Seismology" on 2<sup>nd</sup> April.

**Shri S. C. Bhan** delivered lecture on the topic "Common Wealth Games" on 7<sup>th</sup> April.

**Ms Soma Sen Roy** delivered lecture on the topic "Satellite INSAT - 3D" on 9<sup>th</sup> April.

**Shri B. Mukhopadhyay** delivered lecture on the topic "Environment / Climate Change" on 16<sup>th</sup> April.

**Dr. L. S. Rathore** delivered lecture on the topic "Agromet. Districtwise forecast" on 21<sup>st</sup> April.

**Shri N. Y. Apte** delivered lecture on the topic "Hydrology" on 23<sup>rd</sup> April.

**Shri M. K. Bhatnagar** delivered lecture on the topic "Moderinization of Airport service" on 28<sup>th</sup> April.

**Shri R. S. Dattatrayam** delivered lecture on the topic "Seismology" on 5<sup>th</sup> May.

**Shri R. K. Giri** delivered lecture on the topic "Sat. Met." on 7<sup>th</sup> May.

**Shri Sourav Adhikari** delivered lecture topic "Telecom" on 12<sup>th</sup> May.

**Dr. Smt. Surinder Kaur** delivered lecture on the topic "Hydrology" on 14<sup>th</sup> May.

**Shri Satish Bhatia** delivered lecture on the topic "Radiosonde System" on 19<sup>th</sup> May.

**Dr. S. K. Roy Bhowmik** delivered lecture on the topic "NWP" on 21<sup>st</sup> May.

**Dr. L. S. Rathore** delivered lecture on the topic "Agromet." on 25<sup>th</sup> May.

**Shri D. R. Pattanaik** delivered lecture on the topic "NWP" on 28<sup>th</sup> May.

**Shri M. K. Bhatnagar** delivered lecture on the topic "Modernization of Aviation Met. Services" on 4<sup>th</sup> June.

**Dr. M. Mohapatra** delivered lecture on the topic "Tropical Cyclone Forecasting" on 11<sup>th</sup> June.

**Dr. S. L. Singh** delivered lecture on the topic "Telecom" on 18<sup>th</sup> June.

**Smt. Suman Goel** delivered lecture on the topic "D'vorak's classification" on 25<sup>th</sup> June.

**Dr. R. K. Singh** delivered lecture on the topic Use of GIS in Met., Hydro and Seismo, on 2<sup>nd</sup> July.

**Shri S. C. Jain** delivered lecture on the topic Procurement Process, on 16<sup>th</sup> July.

**Dr. O. P. Singh** delivered lecture on the topic CTCZ programme, on 23<sup>rd</sup> July.

**Shri G. Suresh** delivered lecture on the topic Real time seismic monitoring network as part of Tsunami, on 6<sup>th</sup> August.

**Dr. R. K. Datta** delivered lecture on the topic New Developments in Radar Meteorology, on 13<sup>th</sup> August.

**Shri D. K. Nim** delivered lecture on the topic Human Resources Development / Management, on 20<sup>th</sup> August.

**Dr. S. K. Peshin** delivered lecture on the topic Ozone Monitoring over India, on 27<sup>th</sup> August.

**Shri D. C. Gupta** delivered lecture on the topic Cyclone Warning Dissemination System, on 17<sup>th</sup> September.

**Dr. K. Naga Ratna** delivered lecture on the topic Data Assimilation for tropical cyclone Forecasting, on 15<sup>th</sup> October.

**Shri A. D. Tathe** delivered lecture on the topic Development of Intra - IMD Portal, on 22<sup>nd</sup> October.

**Dr. T. N. Jha** delivered lecture on the topic Rainfall variability over Bihar, on 29 October.

**Shri G. N. Saha** delivered lecture on the topic Digital Meteorological Data Dissemination (DMDD) system, on 12<sup>th</sup> November.

**Shri Shankar Nath** delivered lecture on the topic Plan for LAN Extension, on 19<sup>th</sup> November.

**Shri N. Nigam** delivered lecture on the topic Automatic Message Switch System at M. O. Palam, on 26<sup>th</sup> November.

**Dr. Ajeet P. Pandey, Met-II** participated and made an oral presentation on "Site Characterization and Vulnerability Analysis of NCT, Delhi" in the 45<sup>th</sup> annual convention of Indian Geophysical Union (IGU) held at B.H.U. Varanasi during November 5-7, 2008.

**Dr. Naresh Kumar** delivered lecture on the topic Mathematical Modelling of Orographic Waves, on 10<sup>th</sup> December.

**Dr. S. D. Attri** delivered lecture on the topic Role of Meteorological in air quality modeling, on 17 December.

**Shri S. D. Kotal** delivered lecture on the topic A statistical – Dynamical Cyclone Intensity Production Scheme (CIPS), on 31<sup>st</sup> December.

**A. K. Shukla, Ajeet P. Pandey, Rajesh Prakash, Dal Singh, Ravikant Singh, H.S. Mandal, J.S. Jaryal, B.S. Rana, Anchal Gupta, S. Bali and A. K. Bhatnagar.** Application of GIS in Seismic Hazard Microzonation of NCT, Delhi – A First Level Inference. Accepted for the conference on Urban Infrastructure and Geoinformatics, IGEOMAP-2009, scheduled to be held at Indian Institute of Sciences, Bangalore during August 2009.

**H. S. Mandal, A. P. Pandey, R. K. Singh, D. Singh, Rajesh Prakash and A. K. Shukla** (2009). Generation of Seismic Intensity Maps at Guwahati region from Oldham Fault for Different Scenario Earthquakes using RADIUS. Accepted for the International Conference (ACSGE-2009), BITS, Pilani, Rajasthan.

## **Workshop On “Seismic Telemetry & Design And Construction Of Seismic Pillar”**



A training workshop on “Seismic Telemetry & Design and Construction of Seismic Pillar” was organized by EREC, IMD, New Delhi & CSO Shillong during 5<sup>th</sup> - 7<sup>th</sup> August 2008 at Shillong (5<sup>th</sup> - 6<sup>th</sup> August 2008) and Tezpur (7<sup>th</sup> August 2008). Total 15 participants (IMD & Non IMD officials) from NE region attended the workshop. 10 officials from IMD posted in NE India and 5 engineers from different part of the NE India participated in the workshop.

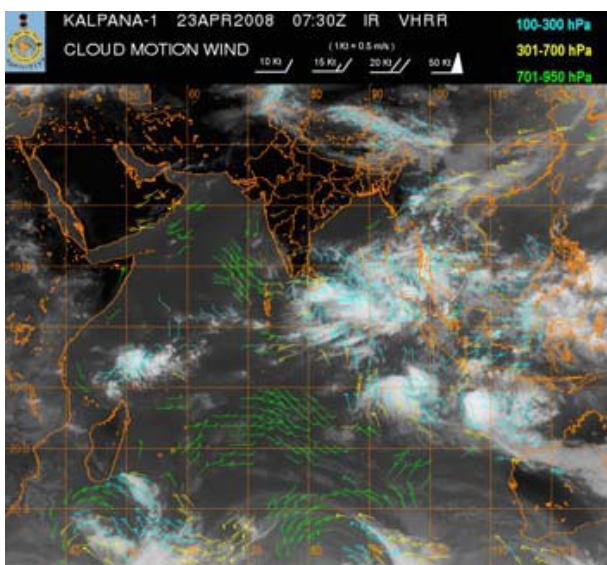
## 8. WORKSHOPS / PROJECTS

### Fog Forecasting Project

A meeting of the committee constituted by MOES was held at EREC, Mausam Bhavan, Lodi Road, New Delhi on 22 Feb in connection with reviewing empirical Fog Forecast Model, Dr. R. K. Jenamani, Director I/C A.M.O. Palam attended three meetings at DGM office related to Fog Forecasting Project-Phase-II on 22 February, 4 August & 26<sup>th</sup> August.

### SAARC Workshop

The South Asian Association of Regional Cooperation (SAARC) workshop on the "Use of Satellite Products in day to day forecasting Techniques" was organized by Satellite Meteorology Division, India Meteorological Department during 11<sup>th</sup> March to 14<sup>th</sup> March, 2008 at NASC Complex, Indian Council for Agricultural Research, Pusa, New Delhi.



Cloud Motion Vectors derived from IR band (SAC-ISRO Fast Track System)

The training workshop was inaugurated by Dr. P. S. Goel Secretary, Ministry of Earth Sciences as the Chief Guest and Dr. Kheya Bhattacharya, Joint Secretary, SAARC, Ministry of External Affairs, India in her address stressed the need for greater cooperation among the SAARC countries.

During the four days workshop twenty lectures were delivered by the officers of Satellite Meteorology Division and experts from IIT, Delhi and SAC, Ahmedabad. 15 participants from SAARC member countries participated in the workshop.

### Brain Storming Workshop

One day Brain Storming Workshop on Onset and Withdrawal of Monsoon-Pre assessment was held on 23<sup>rd</sup> May 2008 at H.Q. New Delhi. Features of onset & withdrawal of southwest monsoon and prediction and monitoring of monsoon onset were discussed at length. Many senior officer's of IMD participated in the workshop.

### Integrated Agro-Advisory Service

District Level Forecast System: A Multi-Model Ensemble based District Level Forecast System was developed in-house. The new forecast system was implemented from 1<sup>st</sup> June 2008 for the Integrated Agro-Advisory Service of India. Towards implementing the system in operational mode, 40 senior level Officers (Directors) from the Met. Centrs/Regional Met Centres were trained in two batches for 3 weeks during April-May 2008.



Networking and Processing of DWR Observation: An application software has been implemented at NHAC (Computer) for real-time processing of Doppler Weather Observations for mesoscale applications. The procedure involved (i) Standardization of Scan Strategy, (b) Networking (c) implantation of the application software for quality control of observations for use by NWP model and generation of various nowcasting products including mosaic creation. Fig. 19 shows an example of mosaic creation in presence of November Cyclone Khaimuk of 2008.

### Project Cyclone e-Atlas – IMD

Electronic version of IMD's Cyclone Atlas: The existing hard copies of cyclone Atlas of IMD presents the tracks for the period 1891 to 1990 and subsequent tracks are available in different departmental publications. The project on development of electronic version of cyclone atlas was conceptualized in CWRC RMC Chennai. The details of the tracks of Cyclones & Depressions (C&Ds) for all the 117 years (1891-2007) were digitized. The software was developed by outsourcing to CMC Ltd. at Chennai at a cost of Rs. 6.2 lakhs.



Director General of Meteorology Ajit Tyagi (centre) handing over the first copy of the Cyclone eAtlas-IMD CD to NIOT Director Dr. S. Kathirotli in Chennai

The e-Atlas will generate tracks of cyclones and depressions that formed over the North Indian Ocean given the requisite parameters. It will also generate all climatological information such as frequency of formation, Direction/Speed of movement of storms over North Indian Ocean and Coastal crossing in any month or season for a given period/ years. This will be helpful for both real time forecast and strategy for long term planning.

The WMO/ESCAP Panel - 33<sup>rd</sup> session appreciated the efforts made by India to digitize existing IMD's storm track Atlas into electronic atlas.

The CD of the software was released by the DGM New Delhi during August 2008 in a brief function at RMC Chennai.

A project named CWCDSTAT was undertaken at Cyclone Warning Research Centre, RMC Chennai to make full ready and swift use of the information which are contained in the hard copies of Atlases published by IMD in 1979 and in 1996 on Tracks of Storms and Depressions and of the Cyclones and Depressions available in various reports of ACR/RSMC and Mausam journal.

On the above project, A Met. Monograph No. Climatology 23/2008, "A FORTRAN based software – CWCDSTAT- to generate statistics on cyclones and depressions of north Indian Ocean" has since been published. The report describes various features of the project CWCDSTAT in brief and also presents a few results derived from the CWCDSTAT programs. The copies of this report are available at CWRC, RMC Chennai. CWRC can be contacted at email ID [cwrcrmcchennai@gmail.com](mailto:cwrcrmcchennai@gmail.com).

## Seminar at SMRC Dhaka

A seminar was conducted by SMRC at Dhaka on 20-21<sup>st</sup> August 2008. Shri D. Pradhan, Director CDR Kolkata and Dr. Somnath Dutta, Dir participated in SAARC seminar and presented their paper.



## Workshop for IAF Officers

Five days training workshop for IAF Officers on “Doppler Weather Radar and product utilization in weather forecasting” conducted during 1-5 September 2008 at CDR Kolkata.

## MFI Programms - MIMOSA Project



Honorable Mr. Kapil Sibal, Union Cabinet Minister for Science and Technology (Center), Director General Dr. Ajit Tyagi (Left) and President Patrick Benichou Meteo (Right), France International

A meeting was held between IMD and MFI officials at ADGM(R), Pune during 09 to 11 September 2008. The IMD team was led by Shri Thakur Prasad, DDGM(C) and the MFI team was led by Shri J. Boison, Project Manager. The activities discussed during the meeting were Initial System Design Review (ISDR), Climate System (CLISYS) and Presentation of the CLISYS survey scope.

Discussions were also held about CLISYS production, climatology processes and about further training program. Various points related to Met. Data were discussed in the meeting. IMD officials suggested that the Data Entry Software should have the facility to calculate some of the derived parameters like RH and VP etc. automatically. The products generated by other section e.g. district wise rainfall normals, climatological normals, upper air normals, Climate Temp message etc were also discussed during the meeting.

## User's Workshop on Weather and Climate in Western Himalayas at Shimla

A Workshop on “Users’ requirements of Weather and Climate in Western Himalayas” was organized by India Meteorological Department at Meteorological Centre Shimla, on 20<sup>th</sup> October 2008 in order to understand better the specific requirements of different users.

The workshop was inaugurated by Shri Narender Bragta, Hon'ble Minister of Horticulture, Govt. of Himachal Pradesh. He emphasized the need for immediate installation of a Doppler Weather RADAR at Shimla and another one in the tribal area of the state. He assured that all possible support & co-operation will be extended by Govt. of Himachal Pradesh to the IMD with

regard to allocation of land etc. for setting up of the entire infrastructure in the state.



**Chief Guest, Director General and Addl DGs of IMD on the dais**

Dr. Ajit Tyagi, Director General of India Meteorological Department presided over the function. He informed that an integrated project for the Himalayan Region is under active consideration and all existing Meteorological, Hydrological, Environmental & Seismological services will be upgraded.

ADGM (Sat.Met.), ADGM(EREC) and Senior officers of IMD, New Delhi also attended the workshop.

### **Forecast Demonstration Project (FDP)**

A Forecast Demonstration Project (FDP) on landfalling tropical cyclones over the Bay of Bengal has been taken up. It will help us in minimizing the error in prediction of Tropical Cyclone track and intensity forecasts. The programme has been divided into three phases :

- (i) Pre- pilot phase : Oct-Nov 2008
- (ii) Pilot phase : Oct-Nov 2009, 2010
- (iii) Final phase : Oct-Nov 2011

During pre-pilot phase (15 Oct-30 Nov 2008), several national institutions participated for joint observational, communicational & NWP activities. Three Intense Observation Periods (IOP) were conducted in association with the cyclones, 'Rashmi', 'Khai Muk' and 'Nisha'.

### **Weather services for community**

Workshop on weather services for community" was jointly organised by RMC Chennai and United Nations Development Programme, Chennai on 7<sup>th</sup> November 2008. As the part of the cooperation between various organizations/institutions, Officers from RMC, Chennai were deputed to deliver lectures. 36 lectures were delivered on various subjects like Floods/Cyclone Disaster Management/Role of IMD in Disaster Management/Global Warming, satellite sounding retrievals, Atmospheric turbulence in aviation applications, Doppler weather radar applications in aviation meteorology.

Mrs. Sunithadevi S., Met-I, has attended the SARAL-Altika National Workshop which was held on 16<sup>th</sup> – 17<sup>th</sup> September 2008 at Space Application Centre, Ahmedabad. She gave a presentation on the utilization of SARAL (Satellite Argos and Altika) data in marine forecasting.

### **IMD and United Nations Development Program**

One day workshop on "Weather Services for Community" was organized on 7th Nov 2008 under the joint auspices of India Meteorological Department, Chennai & United Nations Development Program, held at The Residency Towers, T. Nagar, Chennai. About 80 officials including 7 District Revenue Officials, 3 district

collectors, officials from State Agriculture Dept, fisheries, shipping & ports, railways, Coast Guard, ISRO, NIOT, electronic and print media participated in the workshop.

Dr. R. Suresh, Director delivered a lecture on Aviation Met. Services on this occasion.

### Satellite Meteorology Workshop

Two days workshop on Satellite Meteorology was conducted by Sat. Met. Division during 10<sup>th</sup> – 11<sup>th</sup> November, 2008 at IMD HQ, New Delhi. Scientists from NCMRWF, IIT, IAF and Indian Navy attended in addition to the offices from different division of IMD, H.Q., New Delhi.

### Fog Forecasting System

This is a multi-institutional collaborative project for development and implementation of Fog Forecast System for the major Airports of India. Under this collaborative project, a dynamical Fog model, developed by Centre for Mathematical Modeling and Computer Simulation (C-MMACS) has been implemented in test mode for Delhi Airport during November 2008 – February 2009.

### Cyclone Forecasting Model

A dynamical statistical model has been developed in-house for cyclone genesis and intensity prediction. The method has been implemented from November 2008.

WRF Model at Met Centres : The WRF model with NCEP GFS initial and boundary conditions are made operational at many Regional Meteorological Centres such as, Chennai, Kolkata, Nagpur etc. Prior to that, a good number of Officers/

Staff Members from Met. Centrs/ Regional Met Centres are trained at NHAC (NWP) at the H/Q of IMD.

### “Fog Monitoring, Forecasting and Dissemination System



On the eve of the Fog Season starting at IGI Airport, one day Workshop on “**Fog Monitoring, Forecasting and Dissemination System at IGI Airport**” was organized by Aerodrome Meteorological Office Palam at the Conference Hall, New ATS Complex, IGI Airport, New Delhi on 1<sup>st</sup> December 2008. AVM (Dr.) Ajit Tyagi, Director General of Meteorology was invited as the Chief Guest by AMO Palam and for the key note address of the Introductory Session of Workshop. Other invited dignitaries were Shri P. K. Mishra, GM (ATC) and Mr. P. P. Singh, AGM, Delhi International Airport Pvt Ltd (DIAL). There were 54 participants including 22 participants from outside organizations such as ATC, DIAL, Airline operators, Indian Air force , Officers/staff of AMO Palam serving in ATS and officers from Safdarjung and NHAC of IMD also participated in the workshop. The Introductory session started with the welcome address by Dr. R. K. Jenamani,

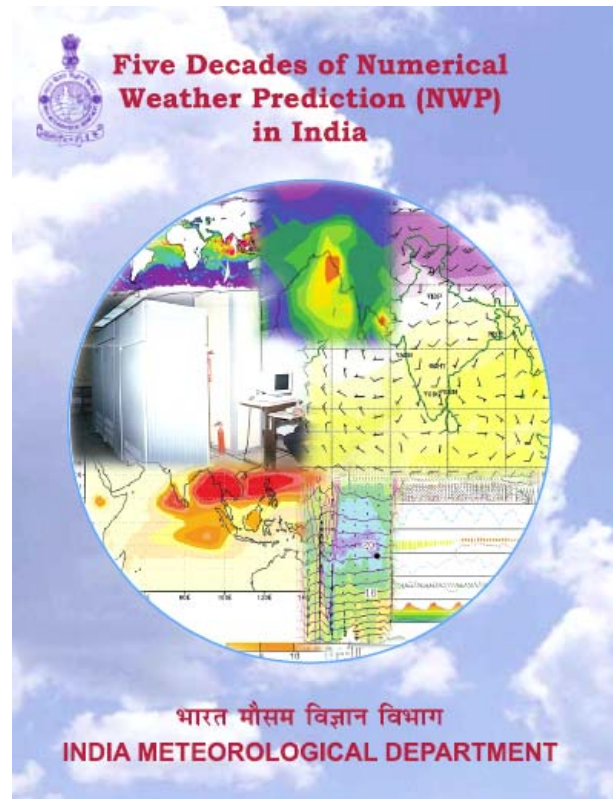
Director In-Charge AMO Palam. Mr. B. L. Verma, Dy. Director General of Meteorology highlighted the achievement by inspection of the various observatories to improve the quality of the observations and modernization work.

In the Key note address, the chief guest, AVM (Dr) Ajit Tyagi, Director General of Meteorology (IMD) stressed the need of the maintenance of RVR instruments and accurate monitoring and forecasting of fog situation at IGI airport and their timely dissemination to the users. He emphasized the efficient co-ordination among various agencies so that Met products of Met office Palam comes into proper use and passengers gets least inconvenience during bad weather conditions. He stressed the need of issuing accurate fog forecast with use of various Fog Forecasting models which are now available to Met Office IGI Airport, Palam, which is very much useful for getting a chance to know each others need and various type of products i.e. observation and fog forecast which are disseminated through website and other communication systems so that complete awareness will be created among the users.

### Five Decades of NWP

In India, a beginning was made towards the development of numerical methods for weather prediction in the late fifties with a classic paper of Dr. P. K. Das. With this landmark effort, the early and mid-1970s witnessed significant developments in Objective Analysis of meteorological observations – which is a crucial component of Numerical Weather Prediction (NWP). IMD celebrated the 50 years of NWP to highlight the important landmark and brought out a booklet on “**Five Decades of NWP in India**” edited by AVM (Dr.) Ajit

Tyagi and Dr. D. R. Pattanaik during 9-12<sup>th</sup> December.



The book contains contributions from number of operational centers and institutes/universities in India. In addition, the book also contains bibliography on NWP and articles by Individual scientists expressing and highlighting their impressions/views about the development of NWP in India during last five decades.

### Workshop on Synergy Forecasting System and Public Weather Service

A two day workshop was organized by IMD and M/s Meteo France International, France during 17-18 December, 2008 in IMD as a part of Modernization Plan of IMD. DGM inaugurated the workshop on 17<sup>th</sup>. The main aim of this workshop was to familiarize the IMD scientists with the tools

that are available in the Synergy, Meteofactory and customized design of the Forecasting PWS systems. About 30 participants from IMD and one officer from Indian Navy attended the workshop, interacted with the instructors and provided their inputs/requirements which are needed for routine operational forecasting. A visit to the Door Darshan studio followed by a meeting with the technical team of Door Darshan also formed part of the TV System workshop.

### **Weather and Climate In Himalayas with special reference to Uttarakhand**

A workshop was organized by Meteorological Centre, IMD, Dehra Dun in collaboration with Government of Uttarakhand on 19<sup>th</sup> December 2008. The workshop was inaugurated by the chief guest of the function Hon'ble Chief Minister of Uttarakhand, Major General (Retired) Shri B. C. Khanduri. He praised the work being done by Meteorological Centre, Dehradun. The key note address was



delivered by AVM Dr. Ajit Tyagi, Director General, India Meteorological Department, New Delhi. Apart from DGM, Shri B.L. Verma, DDGM RMC, New Delhi and officers from MC's, other scientists / media personalities, planners from various organizations and NGO's actively participated in the workshop.

### **Extended Range Forecast System for Agriculture service**

A program on development and application of Extended Range Forecast System (ERFS) for Climate Risk Management in Agriculture has been initiated by Ministry of Agriculture. It is a national coordinated program to be funded by the Department of Agriculture and Cooperation (DAC), Ministry of Agriculture. The major objective in this program is to develop a forecast system to provide seasonal monthly scale prediction of precipitation and surface air temperature during the monsoon season as well as other seasons over meteorological subdivisions/ agro-climatic zones in India for its use in agricultural sector and for other end-users. It is envisaged that about 12 national agencies (IMD, IITD, NCMRWF, DAC, ICAR, SAC, IITM etc.) and a number of leading international organizations will be associated with the development of ERFS for India.



Under the program IBM computer (P5/595 with 64 processors, DS 4700 storage, P5/550 with 4 processors as backup server) was installed at NHAC, IMD in January 2009 for development of forecast system to provide seasonal monthly scale prediction of precipitation and surface air temperature over meteorological subdivisions/major agro-climatic zones of the country for all four seasons of the year. Project activities for this R&D phase and validation of the application/operationalisation is likely to take about 2-3 years time.

### Thunderstorm Project

A research work is undertaken at RMC Kolkata to find out different parameters responsible for thunderstorm activity over Kolkata and also methods for better forecasting technique of severe thunderstorm.

Another research project entitled 'Regional **Climate Change over Orissa**' is undertaken at MC Bhubaneswar.

Project on **statistical analysis of rainfall** and temperature data of Jalpaiguri for the last 108 years has been undertaken at FMO Jalpaiguri.

### CLISYS hardware and software

A three members team of Meteo France International, France visited NDC from 9<sup>th</sup> to 11<sup>th</sup> September 2008 for detailed discussion on Data entry, processing, archival and retrieval activities of the section. This meeting was held as part of initial system Design Review for Installation of CLISYS hardware and software for modernization of NDC.

### Training/Workshop/Conference attended

**Dr. Medha Khole, Director**, participated in the Brainstorming meeting for improved **Weather Forecasting** during 26<sup>th</sup> – 29<sup>th</sup> February 2008 and presented paper on 'Salient features of southwest monsoon 2007'.

**Shri K. Seetharam, Director** attended the workshop on **Census data** dissemination 2001 on 18<sup>th</sup> March 2008 at ICAR conference hall, Tadong.

**Dr. G. C. Basu, Director** attended a selection board as an external expert to select on JRF in the DST project "Application of Graph Theory in the Study of Severe Thunderstorm" and another JRF in the project "Pilot Study for Physics and Dynamics of Severe Thunderstorm" at Calcutta University, Department of Atmospheric Sciences, Kolkata, on 14<sup>th</sup> March.

**Dr. O. P. Singh, Director (SM), Dr. V. Rajeswara Rao, Director** and other officers attended the workshop on "Atmospheric Remote Sensing from Space Platform" during the period from 7<sup>th</sup> to 12<sup>th</sup> April, 2008 at Space Application Centre, Ahmedabad.

**Shri A. K. Sharma, DDGM (SM)** attended the work Shop on "Atmospheric remote Sensing from space Platform" during the period from 9<sup>th</sup> April to 12<sup>th</sup> April 2008 at Space Application Centre, Ahmedabad and delivered lectures on "IMD Activities" "IMD activities and HOAA – IMD collaboration" in the workshop.

**Dr. A.K. Shukla, Technical Director** attended the National Workshop on Probabilistic Safety Hazard Analysis (PSHA) and Geotechnical Investigation for Seismic Microzonation of the Indian

landmass at NDMA, New Delhi on 16<sup>th</sup> July 2008.

**Dr. A. K. Shukla, Technical Director; Shri D. Singh, Director; Shri B.M.S. Nayal, Director; Dr. Ajeet P. Pandey, Met-II & Shri H. S. Mandal, Met-II** attended the training course on “Laboratory Soil Testing” at CSMRS, New Delhi during August 18-22, 2008.

**Dr. O. P. Singh Director** (Sat. Met.) attended the National Level workshop during 16-17<sup>th</sup> September 2008 at Space Application Centre, Ahmedabad under ISRO NCES Continued Co-operation a joint Satellite Mission called SAKAL (Satellite

with Agros & ALATIKA) scheduled for launch during 2009-2010.

**S/Shri Awadhesh Kumar, Rahul Saxena, and U. P. Singh, Directors** attended a Sub-Workshop on “Communication Skills” from 24<sup>th</sup> to 26<sup>th</sup> November, 2008 at Institute of Secretariat Training & Management, New Delhi.

**Shri A.K. Sharma, DDGM** (Sat. Met.) attended the International Conference on progress in weather and climate modeling over the Indian region during 12<sup>th</sup> December 2008 at NCMRWF, NOIDA, U.P.





## 9. MEETINGS

### Agro Met Annual Review meeting

India Meteorological Department and Central Arid Zone Research Institute, Jodhpur arranged the Annual Review Meeting (ARM) from 25<sup>th</sup> - 27<sup>th</sup> March 2008 to review the progress of the Agromet Advisory Service (AAS) in the country and to work out future course of action. Dr. Ajit Tyagi, Director General of Meteorology, Dr. R. C. Ray, Economic and Statistical Advisor, Ministry of Agriculture, New Delhi, Dr. K. P. R. Vittal Director, Central Arid Zone Research Institute, Jodhpur, Dr. L. S. Rathore, Head Agromet Division, IMD, Dr. J. S. Parihar, Deputy Director, Space Application Centre, Ahmedabad, Dr. G. G. S. N. Rao, Project Coordinator, All India Coordinated Project on Agriculture Meteorology, Central Research Institute for Dry Land Agriculture (CRIDA), Hyderabad, and number of scientists/officers from different institutions participated, Indian Council of Agricultural Research, Department of Agriculture & Cooperation, Prasar Bharati and the host institutes contributed significantly in various aspects of the future plan and dissemination of district level Agromet Advisory service in the meeting.

### Plan Review Meetings

During the year, four plan review meetings were held on 1<sup>st</sup> January, 7-8<sup>th</sup> April, 7-9<sup>th</sup> July and 13-14<sup>th</sup> October 2008. Many senior officer's of IMD attended the meeting for presentation their projects.

### Joint Meeting of AAI and IMD officials

Shri S. K. Banerjee, ADGM (H) and Shri M. K. Bhatnagar, DAS visited M. C. Patna to attend a meeting on 22<sup>nd</sup> October 2008 with high officials S/Shri Piyush Joshi, GM (Planning), S.Chadha, Jt. G.M. (ATM-OPS), and Atul Diksit, Airport Director of AAI, regarding site selection for Doppler Radar Building. They discussed various operational requirements of AAI concerned with meteorological services.

### CAIPEEX implementation program

First national level meeting on CAIPEEX Phase-I programme was held on 19 November 2008. AVM (Dr.) Ajit Tyagi, Director General of Meteorology attended the programme at IITM, Pune and appreciated the scientific objectives the Cloud Aerosol Interaction and Precipitation Enhancement Experiment.

### Annual Monsoon Workshop

Under the auspices of Indian Met. Society, Pune chapter, The Annual Monsoon Workshop 2008 was held at CTI, Pashan on 22<sup>nd</sup> December 2008. Dr. H. R. Hatwar, ADGM(R) chaired the first session of the workshop. Dr. R. D. Vashistha, DDGM(SI), Dr. Medha Khole, Director, Shri A. K. Srivastava, Director, Dr. D.S. Pai, Director, Dr. K. Ghosh, Met.I attended and delivered lectures in the workshop.

## DVC Advisory Committee Meeting

**55<sup>th</sup> meeting of DVC advisory committee** was held on 9<sup>th</sup> May at DVC Tower, Kolkata which was attended by Shri L. R. Meena, DDGM, Dr. P. K. Chakroborty, Director (DVC) and other officers of DVC Met Unit. Meetings were attended by AMO Kolkata with AAI / Coast guard for requirement of Met. Services for SAREX, 2008.

## Technical Advisory Group Meeting

ADGM (Sat. Com.) and DDGM (Sat. Met.) attended Technical Advisory Group meeting on 26<sup>th</sup> December, 2008 at ISRO HQ Bangalore, where in the requirement of multi channel Imager and Hyper spectral sounder was projected by the IMD till 2020 time frame.

## Joint Working Group of ISRO and IMD

A Joint Working Group (JWG) meeting was organized between ISRO & IMD officials under the Chairmanship of DGM on 16 May 2008 on "Modernization of meteorological infrastructure in the country and develop skills in advanced modeling".

Another JWG was organized by Sat. Met. Division under the chairmanship of AVM (Dr.) Ajit Tyagi, Director General of Meteorology held on 19<sup>th</sup> June 2008 on "Modernization of meteorological infrastructure in the country and develop skill in advance modeling".

Shri A. K. Sharma DDGM, alongwith many officers from Sat. Met. Division attended the meeting.

## Agromet Annual Review Meeting at Anand (Gujrat)

India Meteorological Department & Anand Agricultural University, Gujarat and Association of Agrometeorologists, Anand jointly organized the second Annual Review Meeting (ARM) and third National Seminar on Agrometeorological Services for Farmers (NSASF) from 10-13 November 2008. The main objective of the ARM is to review the implementation of the scheme "Integrated Agromet Advisory Services in the Country" in respect of the quality of Agromet Advisory Service (AAS) including the performance of District Level Weather Forecast (DLWF) and working out future course of actions for the improvements of the Advisory System.

The ARM was attended by Shri Dilip Sanghani, Hon'ble Minister of Agriculture, Govt. of Gujarat, Dr. Ajit Tyagi, Director General of Meteorology, Prof. M. C. Varshneya, Vice-Chancellor, Anand Agricultural University and many other eminent scientists.



There were twelve sessions in total including themes on Agrometeorological Services for the Farmers and District Level Weather Forecast. At the end, panel members consisting of AVM Dr. Ajit Tyagi, Prof. M. C. Varshneya, Dr. Y. S. Ramakrishna, Prof. P.S.N. Sastry, Shri B. V. Ramana Rao, Dr. G.G.S.N. Rao, Dr. P.

D. Mistry, Dr. G. B. Pant discussed the future activities of integrated agromet advisory service and prepared the recommendations of the meet. A number of recommendations and action plan were made to create a smart weather service to agriculture in the country.

The first District Agro meteorological Advisory Services meeting held on 12<sup>th</sup> May 2008 at Gangtok in connection with implementation of Integrated Agromet Advisory Services in the State of Sikkim.

### **Advisory and Monitoring Committee Meeting**

Second meeting of Advisory and Monitoring Committee for Seismic Microzonation studies in NCT, Delhi held on 24 October, 2008 at EREC Conference Hall, IMD under the Chairmanship of Prof. A. S. Arya, National Seismic Advisor, Govt. of India. Senior officers of IMD attended the meeting.

### **Meeting for Data Relay Transponder**

A Data Relay Transponder (DRT) users meeting was conducted by the Satellite-Meteorology Division for the benefit of all organizations using the Automatic Weather Stations (AWS), wherein it was discussed to update the information on AWS at DRT Secretariat, New Delhi and also to establish three National AWS Data Centers at IMD, New Delhi, Pune and ISRO, Ahmedabad.

### **Half Yearly Plan Review Meeting**

Half yearly performance Review of Plan Schemes of the Ministry of Earth Sciences (2008-09) for the period 1<sup>st</sup> April 2008 to 30 September 2008 was held in the



(Left to Right) Dr. V.L. Chopra, Member (Science), Planning Commission and Dr. Shailesh Nayak, Secretary, MoES and AVM Dr. Ajit Tyagi, Director General, IMD

Mausam Bhawan, H.Q. Lodi Road, New Delhi on 28<sup>th</sup> November under the Chairmanship of Prof. V.L. Chopra, Member (Science), Planning Commission. The meeting was attended by Dr. Shailesh Nayak, Secretary, MoES, AVM (Dr.) Ajit Tyagi, Director General, IMD and senior officers of MoES, IMD and Planning Commission.

### **Video-Conferencing at NCAOR, Goa**

Dr. Ajit Tyagi, DG IMD visited National Centre for Antarctic & Ocean Research (NCAOR), Goa on 26<sup>th</sup> September 2008 to attend a video-conferencing with 27<sup>th</sup> InSEA IMD team members at Maitri. He discussed status of IMD instruments at Maitri with them. He also discussed with Director (NCAOR), Goa regarding up gradation of IMD Lab. at Maitri (Antarctica). DGM wished them for a successful completion of the Indian Antarctic expedition program and a safe return to India.

## राजभाषा समिति की बैठक

भारत मौसम विज्ञान विभाग मुख्यालय की राजभाषा समिति की 105 वीं बैठक महानिदेशक महोदय ए.वी. एम.डॉ अजित त्यागी की अध्यक्षता में दिनांक 17 दिसम्बर 2008 को आयोजित की गई।

**Dr. G. C. Basu, Director** attended the Selection Committee meeting on 15<sup>th</sup> January as an external expert for the selection of JRF in the DST supported project on 'Pilot Study for Physics & Dynamics of Severe Thunderstorm' at Calcutta University, Dept. of Atmospheric Science, Kolkata.

**Shri K. Seetharam, Director**, MC Gangtok, attended the '1<sup>st</sup> Glacier and Climate Change Commission Meeting', Govt. of Sikkim, on 17<sup>th</sup> January.

**Dr. S. K. Roy Bhowmik, Director** (NWP) presented a talk on "Performance of operational NWP models during monsoon 2007" at NCMRWF Noida on 31<sup>st</sup> January 2008.

**Dr. R. K. Jenamani, Director** AMO, Palam attended the ATR/ACR meeting held on 14<sup>th</sup> February 2008 at Bhubneshwar and the MOES Brain storming meeting held from 26<sup>th</sup> to 28<sup>th</sup> February at WWF, Lodi Estate, Delhi and made a presentation on IGI empirical FOG FORECAST MODEL - Development and Strategy.

**Shri A. K. Sharma, DDGM** (SM), Dr. Miss Soma Sen Roy, Met -I and Shri A. K. Mitra, Met II Attended the Review meeting at INSAT-3D met data product system development at Space Application Centre Ahmadabad on 15<sup>th</sup> March 2008.

**Shri B. Mukhopadhyay, DDGM(DM)**, attended a meeting of "Scientific Advisory Committee" at positional Astronomy Centre (PAC), Kolkata on 3<sup>rd</sup> April 2008.

**Shri S. Sudevan, Met. I**, MC Thiruvananthapuram attended the Core Committee Meeting of Crop Weather Watch Group held on 7 April 2008 at the Chamber of Additional Planning & Economic Affairs, Government of Kerala, Thiruvananthapuram.

**Dr. G. Krishnakumar, Director** participated in the "Fourth session of the Forum on Regional Climate Monitoring, Assessment and Prediction for Asia (FOCRA II) held during 9 – 11 April 2008 in Beijing, China.

**Dr. A. K. Bhatnagar, ADGM** (EREC) and Dr. S. K. Roy Bhowmik, Director (NWP) attended a meeting at USAID-IRG office, New Delhi on 14 April 2008 to review the status of GOI-USAID project on "Climate Forecasting System".

**Dr. V. Rajeshwar Rao, Director** and other officers attended the Factory Acceptance Test of Data Reception and Processing and Infrastructure Coordination Committee Meeting for INSAT-3D IDPS during the 13<sup>th</sup> to 15<sup>th</sup> April 2008 at Space Application Centre, Ahmedabad.

**Dr. A. B. Mazumdar, DDGM** (WF) attended the TEC meeting on preparation of business plan and organizational structure for aviation met services held at New Delhi from 15<sup>th</sup> to 17<sup>th</sup> April 2008.

**Shri U. R. Joshi, Director** attended a meeting of CCI expert team on the Rescue Preservation and Digitization of Climate Records at Bomako, Mali from 13<sup>th</sup> to 15<sup>th</sup> May 2008.

**Shri Surya Bali, DDGM (EREC)** attended the meeting of NSDI at Conference Hall, R. K. Puram on 23<sup>rd</sup> May 2008.

**Dr. A. K. Shukla, Technical Director** attended a the 2<sup>nd</sup> meeting of Indo-Mexican Joint Committee on Science & Technology held on 23<sup>rd</sup> May 2008 under the chairmanship of Dr. T. Ramasami, Secretary DST and DG National Council for Science & Technology (CONACYT) Mexico.

**Shri M. D. Ramachandran, Director**, MC Thiruvananthapuram attended the meeting on Issues relating to Disasters, management and mitigation activities under the chairmanship of Hon. Minister for Revenue, Kerala on 29<sup>th</sup> May 2008.

**Shri S. Sudevan, Met. I**, MC Thiruvananthapuram attended a meeting for discussing the various aspects for effective cultivation of Punched crop during 2008-09 in Kuttanad area at Alappuzha on 2<sup>nd</sup> June 2008 under the leadership of Hon. Minister for Agriculture, Govt. of Kerala.

**Shri K. Seetharam, Director** attended meeting on 3<sup>rd</sup> and 4<sup>th</sup> June 2008 in connection with Inspection of Parliamentary Committee on Official Language Implementation in Gangtok.

**Shri K. Seetharam, Director** attended Kharif Kishan Mela 2008 at Saramsa Garden organized by Food Security & Agricultural Development Department, Govt. of Sikkim on 12<sup>th</sup> June 2008.

**Shri M. D. Ramachandran, Director**, MC Thiruvananthapuram attended first meeting with the stake holders of the State for implementation of the District Level Agromet Advisory Services was held on 20<sup>th</sup> June at Banquet Hall of Govt. Guest House, Thycaud, Thiruvananthapuram.

**Shri A. K. Jaswal, Director** attended the First Project Management Council meeting at New Delhi on 30<sup>th</sup> June 2008 and Modernisation of Indian Meteorological Observations System and Applications (MIMOSA) Phase I project meeting at New Delhi from 1<sup>st</sup> July to 3<sup>rd</sup> July 2008.

**Dr. S. C. Sahu, Director I/C**, MC Bhubaneswar, attended Flood Review Meeting under the Chairmanship of Special Commissioner & M.D., OSDMA, Govt. of Orissa, Bhubaneswar on 2<sup>nd</sup> July.

**Dr. S. K. Roy Bhowmik, Director (NWP)** attended a meeting on 2<sup>nd</sup> July 2008 at A NHAC of the Working Group III for the Forecast Demonstration Project Commonwealth Games.

**Shri B. Mukhopadhyay, DDGM (DM)** and Dr. Y. V. Rama Rao, Director (Computer) attended meeting on 10<sup>th</sup> July 2008 at IIT Delhi on "Development and Application of ERFS for climate risk Management in Agricultural.

**Dr. G. C. Basu, Director** attended selection committee meeting at Calcutta University, Kolkata on 25<sup>th</sup> July for recruitment of lecturer in Atmospheric Sciences Deptt.

**Shri B. Mukhopadhyay, DDGM (DM)** was on tour to Pune w.e.f. 28<sup>th</sup> July 2008 to 30<sup>th</sup> July 2008 to participate in Specification Committee meeting for Aerosol Measurement Device for commonwealth Games and to attend Sub-Committee meeting at Mausam Editorial Committee.

**Dr. S. C. Sahu, Director I/C**, MC Bhubaneswar, attended meeting on Dissemination of Early Disaster Warning through telecommunication services organized by OSDMA, Govt. of Orissa, on 5<sup>th</sup> August.

**Dr. Y. V. Rama Rao, Director** (Computer) attended PIC meeting in Min. of Agricultural on 7<sup>th</sup> August 2008 regarding "Project Implementation Committee Meeting on Development and application of Extended Range Forecast System (ERFS) for climate Range Management in Agriculture.

**Dr. A. B. Mazumdar, DDGM** (WF) was on tour to New Delhi from 3 to 5 September 2008 to attend the Technical Specification Committee meeting on implementation of SADIS 2G systems.

**Shri G. N. Raha Met I/C, FMO Jalpaiguri**, attended Flood Co-ordination meeting on 27<sup>th</sup> May at Jalpaiguri and 48<sup>th</sup> BTC meeting of NBFCC at Teesta Sech Bhawan, Silliguri on 15<sup>th</sup> & 16<sup>th</sup> September.

**Shri L. R. Meena, DDGM and Dr. G. C. Debnath, Director** attended a video conference meeting on preparedness against Landslide Disaster arranged by Disaster Management Dept., Govt. of West Bengal at their office on 17<sup>th</sup> September.

**Dr. A. B. Mazumdar, DDGM** (WF) was on tour to New Delhi from 18<sup>th</sup> to 21<sup>st</sup> September 2008 to attend the Annual Plan meeting and to give a presentation before Secretary, MoES at New Delhi on 20<sup>th</sup> September 2008.

**Dr. S. K. Roy Bhowmik, Director** (NWP) attended a two days workshop on the GIO-USAID Disaster Management Support Project organized by US Agency for International Development, New Delhi during 22<sup>nd</sup>-23<sup>rd</sup> September. Dr. Roy Bhowmik, Director made a presentation on the climate Forecasting System component of the project.

**Dr. A. K. Shukla, Technical Director** attended the 43<sup>rd</sup> CGPB meeting of Geological Survey of India on 29 September, 2008 held at Vigyan Bhawan, New Delhi to discuss the agenda points of EREC pertaining to generation of geological maps on 1:10,000 scale for NCT, Delhi and also to various other important cities having population more than half million and lying in the seismic zones II, IV and V.

**Dr. S. C. Sahu, Director I/C, MC Bhubaneswar** attended a meeting on Pre-Cyclone Exercise to discuss preparedness & mitigation of Natural Disaster organized by Govt. of Orissa at Bhubaneswar on 13<sup>th</sup> October.

**Dr. Y. V. Rama Rao, Director** attended Seminar on 'Air Traffic Flow Management' (AFIM) conducted by Indo-US Aviation Corporation Program on 21<sup>st</sup> October, 2008 at New Delhi.

**Shri A. K. Bhatnagar, ADGM (EREC) & Dr. A. K. Shukla, Technical Director** attended the first meeting of National Steering Committee (NSC) for Seismic Microzonation of selected cities in India held at IIT Kharagpur ext. center Kolkata on 23 October, 2008.

**Ajeet P. Pandey, R. K. Singh, A.K. Shukla, Rajesh Prakash, D. Singh, A.K. Bhatnagar** (2008). Site Characterization and Vulnerability Analysis of NCT, Delhi. Indian Geophysical Union, 45<sup>th</sup> annual convention meeting held at Banaras Hindu University, Varanasi during 05-07 November 2008.

**Dr. H. R. Hatwar, ADGM(R)** attended the 3<sup>rd</sup> meeting of the Sub-Committee of National Disaster Management Authority on 6<sup>th</sup> November 2008 at BARC, Mumbai.

**Shri U. R. Joshi, Director** attended "Progress System Design Review (PSDR)" meetings, MFI from 17<sup>th</sup> to 21<sup>st</sup> November 2008 at HQrs, New Delhi.

**Dr. H. R. Hatwar, ADGM(R)** attended 9<sup>th</sup> meeting of Programme Advisory Committee (PAC) on Atmospheric Sciences arranged by Department of Science & Technology at University of Assam, Silchar during 28<sup>th</sup> to 30<sup>th</sup> November 2008.

**Dr. A. K. Shukla, Technical Director** attended project monitoring meeting of the NDMA-SERC grant-in-aid project "Development of Probabilistic Seismic Hazard Map of India" held at SERC Chennai on 05 December 2008.

**Shri A. K. Srivastava, Director** attended a one day seminar on climate change held at S.M. Joshi Hall on 6<sup>th</sup> December 2008 organised by CMS VATAVARAN and delivered a talk on, "Climate Change : Impact on the western ghats in particular and India in general".

**Dr. S. K. Roy Bhowmik, Director (NWP)** attended international Conference at

NCMRWF Noida and made a presentation on the "District Level Forecast System" on 12<sup>th</sup> December in front of the International Advisory Panel on.

**Dr. H. R. Hatwar, ADGM(R)** was on tour to Bangalore during 12<sup>th</sup>-13<sup>th</sup> December 2008 for attending Monitoring Steering Committee meeting at NAL, Bangalore to review the progress of the project on, "Mesoscale modeling for monsoon related weather predictions – Phase II".

**Shri V. K. Soni, Met. I** attended a one day meeting held at HQrs on 15<sup>th</sup> December 2008 to plan strategy for implementation of the scheme "Environment Monitoring and Research".

**Shri A. K. Das, DDGM (LACD) and Dr. G. C. Basu, Director** attended meeting of BEC of Kolkata University, Kolkata on 16<sup>th</sup> December.

**Dr. A. B. Mazumdar, DDGM (WF)** was on tour to Visakhapatnam to attend Group Monitoring Workshop-2008 meeting on "Atmospheric Science Research Projects from 21 – 25 December 2008.



## 10. EVENTS/ACTIVITIES

### Appointment of DGM

AVM (Dr.) Ajit Tyagi assumed charge as Director General of Meteorology of India Meteorological Department on 11<sup>th</sup> March 2008. Prior to taking over as Director General of Meteorology, he was Assistant Chief of Air Staff incharge of Meteorological branch of Indian Air Force as Air Vice Marshal. Dr. Tyagi is a fellow of Indian Met Society.

### World Meteorological Day

World Meteorological Day was celebrated on 23<sup>rd</sup> March 2008 on the theme, 'Observing our planet for a better future'. On that day special arrangements were made by all offices of IMD for interaction with Public. Offices / observatory were kept open for visitors. Films shows on weather & Climate, exhibitions were organized. Local TV channels gave coverage to the event.

### Release of CDROM

The Hon'ble Minister of Science & Technology and Ministry of Earth Sciences, Shri Kapil Sibal released the CDROM of Daily Districtwise Normals of Meteorological parameters prepared by the National Climate Centre, IMD, Pune, in the press conference held on 7<sup>th</sup> April 2008 at New Delhi.

### Earth Day

April 22 is a day dedicated not just to recognise the beauty and riches of the planet Earth but also to make the Earth a healthier and safer place to live. Earth Day

was first observed on April 22, 1970 with the message "Give Earth a Chance" and aims at reclaiming the purity of the air, water and living environment.

### Appreciation from WMO

WMO in its press release No.814 dated 9<sup>th</sup> May 2008 has appreciated the cyclone warnings issued by RSMC (Regional Specialized Meteorological Centre), IMD New Delhi in respect of very severe cyclonic storm NARGIS that caused extensive devastation to Myanmar in early May 2008.

### Earthquakes in Gaya, Bihar

On occurrence of two consecutive earthquakes felt in Gaya, Bihar on 7<sup>th</sup> and 9<sup>th</sup> June 2008 of magnitude 4.3 & 3.3, a lot of panic was created. On behest of the request of Bihar Government and Hon'ble Chief Minister, an expert team was deputed for installation of temporary observatories for local monitoring in the area. A local network of three observatories was set up and made operational in Gaya and nearby areas during 13<sup>th</sup> - 29<sup>th</sup> June 2008. The team held number of meetings with public and media jointly with local administration to pacify the public to return to their homes.

### Release of First-ever IMD Quarterly News Letter

The department started the publication of its quarterly News Letter 'IMD NEWS' from January 2008. 'IMD NEWS' Vol. 1, No. 1&2 (Jan – Jun 2008) was the maiden issue. Thereafter the next two quarterly





issues (Jul – Sep 2008 and Oct – Dec 2008) were also published successfully in time. It covers the important activities undertaken by the department.

### Visit of Delegates from Thailand



About 75 delegates from Department of Disaster Prevention and Mitigation, Thailand, headed by Mr. Anucha Mookhavesa, visited IMD on 15<sup>th</sup> July 2008. The objective of the visit was to share the views on disaster preparedness and prevention aspects. In his welcome

address, DGM highlighted the cordial relationship between the two countries with respect to disaster management. Both the countries are members of WMO/ESCAP panel on Tropical Cyclones. The RSMC, New Delhi, provides tropical weather outlook and tropical cyclone advisories to all the eight member countries including Thailand.

### Foundation Day of MoES



On the occasion of the MoES Foundation Day celebration on 27<sup>th</sup> July 2008 at Vigyan Bhawan, New Delhi, Dr. Medha Khole, Director in DDGM(WF), Pune, Shri Anand Kumar Sharma, Director at M.C. Dehradun and Shri Manish R Ranalkar, Met. II in DDGM (SI), Pune, were awarded the Certificate of Merit for their outstanding contributions in the field of atmospheric sciences. Shri M. K. Purohit, Asstt. Met. II, Hydrology Section, DGM's office, Shri Wahid Khan, S.O., M. C. Bhopal and Shri Narendra Mahato, Chowkidar, DGM's Office were also awarded for their meritorious services to the department. The Awards were presented by Smt. Sheila Dikshit, Chief Minister of Delhi.

### Visit of Secretary to IMD

Dr. Shailesh Nayak assumed charge as Secretary MoES on 27<sup>th</sup> August 2008 and visited IMD on 28<sup>th</sup> August 2008 for

informal interactive discussion with senior officials of IMD during which he was given a detailed brief by way of presentation by Senior officers regarding functions and activities of IMD under its modernization plan. He made a second visit on 20<sup>th</sup> September 2008 and appreciated various activities undertaken by IMD.

### हिन्दी पखवाडा का आयोजन



मुख्यालय में दिनांक 01.09.2008 से 15.09.2008 तक हिन्दी सप्ताह का आयोजन किया गया। इस अवधि के दौरान हिन्दी में टिप्पण और मसौदा लेखन, हिन्दी निबंध, हिन्दी टंकण, हिन्दी वाद-विवाद तथा स्वरचित हिन्दी कविता पाठ प्रतियोगिताओं का आयोजन किया गया तथा दिनांक 29.09.2008 को इन प्रतियोगिताओं में प्रथम, द्वितीय, तृतीय और चतुर्थ स्थान पाने वाले विजेताओं को महानिदेशक महोदय ने नकद पुरस्कार और प्रमाण-पत्र प्रदान किए।

इस समारोह में वर्ष 2007-2008 में सर्वाधिक पत्र हिन्दी में भेजने के लिए महानिदेशक महोदय द्वारा मौविउमनि (प्रशासन एवं भंडार) को राजभाषा चलशील्ड प्रदान की गई।

अखिल भारतीय विभागीय हिन्दी निबंध प्रतियोगिता 2008 आयोजित की गई। मुख्यालय और उपकार्यालयों के 9 कर्मिकों ने भाग लिया जिसमें 6 विजेताओं को प्रथम, द्वितीय, तृतीय और 3 सांत्वना पुरस्कार दिए गए।

### Inauguration of canteen at RMC, Kolkata



AVM (Dr.) Ajit Tyagi, DGM, visited RMC Kolkata on 5<sup>th</sup> October 2008 where he held a meeting with Shri L. R. Meena, DDGM alongwith other officers and discussed various activities of the office. He inaugurated the renovated canteen building.

### Visit of Delegation from OMAN

Three member Oman delegation headed by Ahmed Hammod Mohamed Al Harthi, Director Operational and Technical Services from Ministry of Transport and



AVM, Dr. Ajit Tyagi, DGM meeting with Three Member Oman delegation headed by Ahmed Hammod Mohamed Al Harthi in Conference Hall, H.Q., New Delhi

Communication of Sultanate of Oman visited India Meteorological Department, New Delhi from 23-24<sup>th</sup> October 2008 to gain experience in the field of Environmental Changes and prediction of weather conditions in the Indian Ocean and the Arabian Sea.

### **'Vigilance Awareness Week'**

'Vigilance Awareness Week' was observed w.e.f. 3<sup>rd</sup> November 2008 to 7<sup>th</sup> November 2008 and a pledge in this respect was taken by all officers and staff of IMD on 3<sup>rd</sup> November 2008.

### **Visit of Addl. Secretary of MoES**

Ms. Vilasini Ramchandran, Additional Secretary and Finance Advisor, MoES visited IMD, Pune on 21<sup>st</sup> November 2008. She held discussions with the Heads of Offices at Pune regarding finance review and various projects of IMD.

### **Visit of Ambassador, Embassy of Finland**



**AVM Dr. Ajit Tyagi, Director General, IMD Meeting with Mr. Asko Numminen, Ambassador, Embassy of Finland**

Mr. Asko Numminen, Ambassador, Embassy of Finland visited India

Meteorological Department, New Delhi on 25<sup>th</sup> November 2008. He showed interest to explore scientific cooperation between IMD and Finland Meteorological Institute in potential areas like Air Quality Process, Air Pollution.

### **Exhibitions during the year**

IMD participated in eight exhibitions at different places [Gorakhpur, Kolkata (3), Delhi (2), Hodel and Dehra Dun] of India during the year 2008.

### **Visit of Secretary, MoES**

Dr. Shailesh Nayak, Secretary, MoES visited DCP Lab. and CTI, Pune on 8<sup>th</sup> -9<sup>th</sup> December 2008. ADGM(R), DDGM(SI) and DDGM(T) briefed him about the activities of the IMD, Pune.

### **Sagar Kanya Expeditions**

Two IMD members have been nominated for participation in Southern Ocean Expedition R.V. Boris Petrov conducted by NCAOR, Goa and one member has been nominated for participation in ICARB Ocean Cruise Project, conducted by Vikram Sarabhai Space Centre with effect from 26<sup>th</sup> December 2008.

### **Forecast System for Commonwealth Games, Delhi - 2010**

The basic objective is to provide venue specific real time weather information, provide venue/event specific weather forecasts in medium, short and nowcast ranges and to standardize the nowcast techniques for Delhi region and adopt the system as a Metropolitan Weather Information & Forecast System.

The Infrastructure required has been identified as 60 AWS, one C-band Doppler Weather Radar, five Vertical Wind Profilers and five Lightning Detection Systems, one Radiometer, three portable GPS Sonde and one Professional Service Provider to provide and operate the auto-nowcast system; generate visualization products; designs and operates web-site/web portal and arrange for transmission and display of products.

## AWARDS

**Dr. Medha Khole, Director, Shri D.V. Vaidya, A.M. I and Shri J. S. Oswal, S.O.** The following officers/staff from Weather Section were honoured with “An award of excellence for outstanding performance” on Republic Day – the 26<sup>th</sup> January 2008 on the occasion of commemoration of 80 years of Meteorological Office Pune.

**Dr. G. C. Basu, Director** has been selected as a member of the reconstituted Ph.D. Committee in Atmospheric Sciences, by the Vice Chancellor, Calcutta University, Kolkata.

**Dr. Medha Khole, Director,** Research paper titled “Inter annual and decadal variability of sea surface temperature (SST) over Indian Ocean” has been sent for Dr. B. N. Award (IMS Award).

## मौसम शोध पुरस्कार

वर्ष 2004–2005 के लिए द्विवार्षिक तृतीय मौसम शोध पुरस्कार डा. हरी सिंह, निदेशक और श्री राजेन्द्र प्रसाद, सेवानिवृत्त निदेशक को 29 सितंबर 2008 को हिन्दी दिवस समारोह में मौसम विज्ञान के महानिदेशक डा. अजित त्यागी द्वारा प्रदान किया गया



विभागीय वैज्ञानिको को हिन्दी भाषा में वैज्ञानिक शोध-पत्र लिखने के लिए प्रोत्साहित करने के उद्देश्य से भारत सरकार द्वारा वर्ष 1993 में एक द्विवार्षिक मौसम शोध पुरस्कार की स्थापना की गई थी। यह पुरस्कार विभागीय शोध पत्रिका ‘मौसम’ में प्रकाशित सर्वश्रेष्ठ हिन्दी शोध-पत्र के लेखको को प्रदान किया जाता है। इस पुरस्कार में प्रशस्ति पत्र व दस हजार रुपये प्रति लेखक दिया जाता है।

## Participation of Agrimet Division in Kisan Mela, Pune

National level Kisan Mela was organized by Kisan Forum Pvt. Ltd., in Pune at International Arena, Moshi, Pune Nashik Road between 17<sup>th</sup> to 21<sup>st</sup> December 2008 to serve as a meeting place for farmers Agri professionals to exchange the knowledge



and technical advances in agriculture. Numerous persons dealing with different aspects of agriculture like input agencies, irrigation systems, machineries, Research & development institutes and scientific departments of government both Central and State participated in the Kisan Mela. Agrimet Division, IMD, Pune also participated in the Kisan Mela. Farmers

were apprised of the different services rendered to the farming community through displaying of exhibits and also by interactive mode. Farmers were provided all the information to get advice from the nearest Agromet Advisory Centres of IMD & Agromet Field Units on real time basis. About one lakh farmers visited the IMD's stall during the three days of the Mela.



## 11. INTERNATIONAL COLLABORATION

### International cooperation in Meteorology

India is a founder member of the International Meteorological Organization (IMO), which was later, reconstituted as World Meteorological Organisation (WMO), a specialised agency of the United Nations. The WMO Executive Council is responsible for implementation and coordination of the programmes of WMO and its constituent bodies.

- IMD continued to provide data services to the international community through the Regional Telecommunication Hub of WMO located at New Delhi.
- The Regional Specialized Meteorological Centre for Tropical Storms continued to provide advisories and warnings for all the Tropical Storms formed in the north Indian Ocean.
- The WMO recognized Regional Meteorological Training Centres (RMTC), Pune provided training to candidates from South East Asia, Africa and Middle East countries.

### Collaboration with ECMWF & JMA

Successful Collaborative actions were initiated to get access to high resolution model outputs of European Centre For Medium Range Weather Forecast (ECMWF) and Japan Meteorological Agency (JMA) to use them for the Multi-Model Ensemble forecasts.

A report entitled "Evaluation of IMD Multi-model Ensemble based district level forecasts over Indian region in medium range time scale during monsoon 2008"

was prepared and communicated to JMA and ECMWF as a part of above international collaboration. Another report entitled "Evaluation of prediction skill of ECMWF Forecasts over Indian Monsoon region in medium scale during summer monsoon 2008" prepared and communicated to ECMWF.

### INDO-US co-operation

An MOU was signed between DST/DOS (India) and NOAA/NASA(USA) for co-operation in Earth Atmospheric Sciences. Under the implementation of this MOU an INDO-US data exchange center was established in Sat. Met. Division of IMD in 1998 for exchange of satellite data with USA. NASA, USA, has provided a dedicated communication link of 512 Kbps with full duplex capability. IMD has been transmitting INSAT cloud imagery data every three hours to USA as per terms of agreement of the above-referred MOU. IMD has been receiving data from GOES satellites of USA in IMD, New Delhi. The exchange of scientific data between the two countries also takes place through the same link. India Meteorological Department has now come under the new ministry named Ministry of Earth Sciences (MoES) formed by Government of India. In order to have better interaction between IMD and NOAA/NASA of USA, a fresh MOU was signed on 16 April 2008 between MoES (India) and NOAA/NASA(USA) for cooperation in Earth Atmospheric Sciences.

### Meteo France International

Meteo France International (M.F.I) team led by Mr. Herve Grimaud visited RMC Kolkata on 26<sup>th</sup> August for

implementation of M.F.I. project under modernization programme. A two day workshop was organized by IMD and M/s Meteo France International, France during 17-18 December, 2008 in IMD as a part of Modernization Plan of IMD. DGM inaugurated the workshop on 17<sup>th</sup>. The main aim of this workshop was to familiarize the IMD scientists with the tools that are available in the Synergy, Meteo factory and customized design of the Forecasting PWS systems. About 30 participants from IMD and one officer from Indian Navy attended the workshop, interacted with the instructors and provided their inputs/requirements which are needed for routine operational forecasting. A visit to the Door Darshan studio followed by a meeting with the technical team of Door Darshan also formed part of the TV System workshop.

### **INDO – Nepal cooperation programme**

IMD has signed an MOU on 9<sup>th</sup> September, 2004 with Department of Hydrology & Meteorology, Nepal for cooperation in the field of Weather Forecasting. Under this arrangement an INSAT/METSAT Digital Meteorological Data Dissemination (DMDD) receiving system has been setup in Kathmandu in 2008.

### **Science Colloquium on Earth Observation and Earth Sciences: 11-12 September 2008, New Delhi**

The first Indo-US science colloquium was convened in New Delhi during 11-12 September 2008 by Ministry of Earth Sciences (MoES) and the United States National Oceanic and Atmospheric Administration (NOAA) on 'Earth Observations and Earth Sciences for Societal Benefits'. A Memorandum of Understanding (MoU) between MoES and NOAA was signed on 16<sup>th</sup> April 2008, in

response to the recognition of the importance of cooperation on the GEOSS. Topics discussed during the colloquium included enhancing Indian Ocean Observations, improving monsoon and weather forecasting, climate monitoring and prediction. The overarching theme was how best to work together to better the understanding of these phenomena for societal benefits.



**Delegates from NOAA, USA**

Co-chaired by Dr. Shailesh Nayak, Secretary of MoES and Dr. Chet Koblinsky, Director of NOAA's Climate Program Office, the colloquium resulted in the signing of three implementing arrangements (IAs) on Climate Monitoring and Prediction System for the South Asian Region, Climate Model and Ocean Assimilation Analyses for the Indian Ocean Region and Development of the South Asian Regional Reanalysis (SARR) to advance Understanding, Modeling and Prediction of Monsoon Hydroclimate Variability and Change.

### **INDO – Maldives cooperation programme**

An MOU for cooperation in Meteorology was signed between India and Maldives for setting up data receiving

system in Male. The entire project was on gratis from Govt. of India. IMD continues to provide technical support for maintenance of the system and also calibrated the meteorological equipments free of cost.

### **WMO regional association-II (Asia)**

AVM Dr. Ajit Tyagi, Director General of Meteorology visited Tashkent, Uzbekistan to attend 14<sup>th</sup> Session of WMO Regional Association-II (Asia) and participated in seminar on Strategic Capacity Development of National Meteorological Services in Asia during the period from 3-8 December 2008.

The agenda points were (i) Report by the President of the Association (ii) Programme activities – Regional Aspects; a. Science and Technology development and Implementation; b. Service delivery ; c. Partnership; d. Capacity building; (iii) Efficient management and good governance; (iv) Emerging issues and specific challenges; (v) WMO regional office for Asia and the South–West Pacific including WMO office for West Asia and (vi) Other administrative topics of RA-II.

### **IMD delegation to China**



**Indian delegates in China**

Five-member team headed by AVM Dr. Ajit Tyagi, Director General of

Meteorology visited China during 22<sup>nd</sup>-26<sup>th</sup> December 2008 for familiarization with existing system used in China for providing meteorological services for Beijing Olympic Games-2008 for planning to provide meteorological services for major events of Commonwealth Games-2010 to be held in New Delhi.

DGM was impressed by the Chinese Satellite Data. This data is open for all and IMD personnel/scientists should utilize this facility.

### **INDO-USAID on climate forecasting system**

Under the collaboration programme, five sub-projects for improving Hydro-Meteorological forecasting and Early Warning system in India were identified/ approved for scientific studies.

- Tropical cyclone forecasting & warning
- Local severe storms (including flash floods)
- Extreme temperatures
- Flood forecasting
- Forecast communications

15 short-term training components related with IMD were identified on the advanced data assimilation, numerical weather prediction and its application for severe weather prediction. The training also includes technology transfer. Training processes started from July 2006. Trainees from IMD have already completed training, returned to India and working towards implementation of their technical expertise and experience gained in USA.



## 12. FOREIGN VISITS

**Dr. A. P. Pandey, Met. Gr.II**, was deputed to Tsukuba, Japan to participate in Cramp training course in Global Seismological observation from 9<sup>th</sup> January to 8 March 2008.

**Dr. G. Srinivasan, Director**, was deputed to Switzerland to participate in the meeting of the International Organization Committee for the World Climate Conference(3) during period from 4-6 February 2008.

**Dr. L. S. Rathore, ADGM (Head Agrimet.)**, was deputed to Dhaka Bangladesh to participate in the workshop on Climate and Crop Diseases Risk Management: An International Initiative in the Asia Pacific Region from 11 to 14 February 2008.

**Shri R. C. Bhatia, DGM**, has visited to Geneva, Switzerland to participate in the first session of Executive Council Working Group on WMO Strategic and Operational Planning from 27 to 29 February. 2008.

**Dr. (Mrs.) Kopparthi Naga Ratna, Met.-II**, was deputed to Boulder, Colorado, USA for training under Indo-US AID Disaster Management Expenses etc. Support Project-Climate, Sub Project NOAA, USAID Tropical Cyclones Forecasting and Ncar, and Warning-WRF/HWRF Boulder, USA from 3<sup>rd</sup> March to 29<sup>th</sup> August 2008.

**Dr. M. Mohapatra Director and Dr. D. R. Pattanaik, Met.** participated in the SAARC Workshop on "Variability of SW Monsoon & its hydrological and aspect over the SAARC region in Kathmandu, Nepal on 27-28 March 2008.

**Dr. D. S. Pai, Director, ADGM(R)**, Pune participated in the meeting of Extended and Long range Forecasting in Beijing, China from 7-10 April 2008.

**Shri A. K. Bhatnagar, ADGM (EREC)** attended 5<sup>th</sup> meeting of IOC Intergovernmental Coordination Group for the Indian ocean Tsunami warning and mitigation system in Malaysia during 7 to 10 April 2008.

**Dr. G. Krishna, Director** participated in 4th session of forum on Regional Climate Monitoring (FOCRA-11) in Beijing, China during 9-11 April 2008.

**Shri R. P. Lal, Met-I** participated in workshop on Advisor on External Relations and field Study for RA-II/V. in Seol, Korea during 28 April 2008 to 03 May 2008.

**Shri B. K. Bandyopadhyay, Director (NHAC)** attended the 35<sup>th</sup> session of WMO/ESCAR Panel on Tropical Cyclone from 5<sup>th</sup> to 9<sup>th</sup> May 2008 at Bahrain.

**Shri U. K. Joshi, Director** participated in the expert team on the rescue Preservation and digitization of Climate records from 13 to 15 May 2008 in Mali.

**Dr. H. R. Hatwar, ADGM(R)**, attended Workshop on Tropical Cyclone Research from 28 to 30 May 2008 in France.

**Shri Shankar Nath, Met-II** attended Joint meeting on (RMDCN-SG) and the RMDCN Operation Committee (ROC in Austria during 3 to 6 June 2008.

**Dr. G. Srinivasan, Director** participated in meeting of Subsidiary Bodies to the United Nation Framework Convention on Climate Change from 7 to 13 June 2008 in Bonn, Germany.

**Dr. L. S. Rathore, Head Agrimet** participated in CAgM Management Group meeting from 11 to 13 June 2008 in Russia.

**AVM Dr. Ajit Tyagi, DGM** attended 60<sup>th</sup> session of WMO Executive Council from 23 to 27 June 2008 at Geneva, Switzerland.

**Shri A. K. Bhatnagar, ADGM (EREC)** participated on Climate Forecasting system under Indo USAID Project during 9 to 19 July 2008 in USA.

**Dr. D. S. Pai, Director** participated in meeting of the working group on climate related matters in regional association II in Japan during 7 to 8 August 2008.

**Shri D. R Pattanaik, Met-I** attended workshop on Multiscale Prediction of the Asian and African Summer monsoon from 11 to 15 August 2008 in Italy.

**Dr. N. Chattopadhyay, Director** participated in meeting of Regional symposium on climate change food security sea level rise and environment in South Asia in Bangladesh during 25 to 29 August 2008.

**Dr. G. Srinivasan, Director** participated in 2<sup>nd</sup> meeting of IOC for the 3<sup>rd</sup> world climate conference & 29<sup>th</sup> session of IPCC from 31<sup>st</sup> August to 5<sup>th</sup> September 2008 in Geneva, Switzerland.

**Shri S. K. Banerjee, ADGM (H&I)** attended International seminar on Long Lead Flood Forecast Technology for Disaster management from 3 to 4 September 2008 in Bangladesh.

**Shri N. T. Niyas, Met-II** attended WMO workshop on CLIPS IN polar region : Climate products generation, user liaison and training from 8 to 11 September 2008 in Russia.

**Shri Kuldeep Srivastav, Meteorologist** was deputed to Beijing, China to participate in the Symposium on Strengthening NMHSs External Relations and Field Study from 13<sup>th</sup> to 17<sup>th</sup> October, 2008.

**S/Shri Mohd. Hussain Mir, SA, V. P. Pradeep Kumar, SA, Alok Singh, SO, Deva Jyoti Gohan, SO and Binay Kumar Prasad, SO** were deputed to M/s Modem, France for Technical Training in Operation and Maintenance of GPS System during 13<sup>th</sup> to 24<sup>th</sup> October, 2008.

**Shri S. K. Prasad, DDGM** was deputed to Langen, Germany to attend the Training Seminar on the "Management of Meteorological Training Institutions" from 20<sup>th</sup> - 24<sup>th</sup> October, 2008.

**Dr. H. R. Hatwar, ADGM(R)**, was on deputation to Beijing, China from 20<sup>th</sup> to 25<sup>th</sup> October 2008, for attending the 4<sup>th</sup> WMO IWWRP International Workshop on Monsoon (IWM-IV) and two days training workshop on Operational Monsoon Research and Forecast issues.

**Dr. Surinder Kaur, Director** O/o DGM was deputed to Beijing, China from 3<sup>rd</sup> to 6<sup>th</sup> November, 2008 to participate in the 4<sup>th</sup> Conference of the Asia Pacific.

**Dr. Pulak Guhathakurta, Director O/o ADGM(R),** Pune was deputed to Tokyo, Japan from 4<sup>th</sup> to 7<sup>th</sup> November, 2008 to participate in the Training Seminar on Climate Information and Forecasting and the 9<sup>th</sup> Joint Meeting for the Seasonal Prediction of the East Asian Winter Monsoon.

**Shri M. K. Bhatnagar, Director Aviation Services,** visited Malaysian Meteorological Department, Petaling Jaya, Selangor, Malaysia from 17<sup>th</sup> - 21<sup>st</sup> November 2008 to attend workshop on 11<sup>th</sup> Aircraft Meteorological Data Relay (AMDAR)-XI Panel Meeting.

**Dr. Anupam Kashyapi, Director O/o DDGM (Agrimet.),** Pune was deputed to Oklando Florida, USA from 18<sup>th</sup> to 21<sup>st</sup> November, 2008 to participate in the Workshop on Climate Change Impacts and Adaptation to Agriculture, Forestry and Fishries at the National and Regional Levels.

**Shri A. Mitra, Met. Gr. II** visited Nepal during the period from 15<sup>th</sup> to 19<sup>th</sup> December 2008 to attend a Workshop on Application of Satellite Rainfall Estimate in the Hindukush Himalaya Region Phase-II.



## 13. PROJECTS TAKEN UP IN 2008

Name of Offices	S. No.	Name of the main schemes/sub-schemes
DDGM (Sat. Met.) New Delhi	1.	Establishment of Ground Segment for Reception and Processing of Met. Data from INSAT-3D and establishment of Earth Station for 3D.
	2.	Installation and maintenance of DMDD systems.
	3.	Maintenance of National Satellite Data Centre at New Delhi.
	4.	Software up gradation for INSAT-II E system and procurement of two No. SBS cards.
DDGM (Telecom) New Delhi	5.	Strengthening of internet Band Width and Security.
	6.	Provision of Interactive Voice Response System.
	7.	a) Modernization of communication facilities at field station at field observatories of IMD (i) Provision of high speed data (64 kbps) terminal at field station (ii) VSAT system (iii) Data Terminal (64 stations). b) HSDT (64kbps) for 58 more stations.
	8.	Replacement of old and obsolete Telecom. Equipment- HF/RT, VHF, WKTK.
	9.	a) Procurement of two display systems for Main Gate and at Palam. b) Weather display systems for 85 more stations.
	10.	Procurement of plotters/printers at different IMD stations.
	11.	Up gradation of extension of LAN.
	12.	Procurement of CICO Router and Server.
DDGM (WF), Pune	13.	Setting of LAN at DDGM (WF) Pune and installation LAN CTI-DDGM(WF) Pune.
DDGM (SI), Pune	14.	Replacement of old DCPs and establishment of Earth Station.
	15.	Augmentation of Radiation Network in India.
	16.	Additional requirement of Integrated AMI at 7 Airports and RWY-29/11 Delhi airport.
	17.	Up gradation of existing Radiosonde/Ozonesonde.
DDGM (RMC), Chennai	18.	Mod./Up gradation of communication facilities in Phased manner ( Provision of 64/128 kbps and broadband connectivity)- DDGM (RMC) Chennai.
DDGM (UI), New Delhi	19.	Up gradation of calibration facilities.
	20.	Indigenous Development of Radio theodolite and GPS radiosonde alongwith ground system.
	21.	Development of MEMS based sensors and ASIC chips for new radiosondes.
	22.	Design and development of MMIC transmitter for radiosondes.
	23.	Test equipment for DWR at Chennai, Kolkata and SHAR.

Name of Offices	S. No.	Name of the main schemes/sub-schemes
ADGM (R), Pune	24.	Archival of AWS data.
	25.	Purchase of 44 pentiums for RCs/MCs and ADGM(R) Office at Pune.
	26.	Up gradation of National Climate Centre at IMD Pune.
DGM, (Agromet Cell), New Delhi	27.	Mod of Agromet Unit at Pune.
	28.	Mod of Agromet Services in India.
	29.	Agrometeorological Services Technology Mission- 18 Sets of instruments for AMFU's.
DDGM (Seismology), New Delhi	30.	Augmentation of the NSN and NSDC facilities- Procurement of 5 Nos CSIO analog recorders and spares on PAC basis and AMC charges for SUN computer system.
	31.	Archival and digitization of seismic analogue charts.
DDGM, (EREC), New Delhi	32.	Augmentation of VSAT based Delhi Telemetry Network.
	33.	Establishment of a VSAT based seismic telemetry network in NE India.
	34.	Seismic Hazard and Risk Microzonation on 1:10000 scale of five cities including Delhi.
	35.	Geophysical / Geotechnical investigation, generation of products and their integration under Seismic Microzonation of NCT Delhi.
DGM, New Delhi	36.	Wind Shear Hazard Detection- Anemometer array for detection of Wind Sheer.
	37.	Commissioning of automated weather stations AWS (550 Nos).
	38.	Commissioning of automatic rainguages ARGs (1350 nos)
	39.	Commissioning of new integrated and automated systems for airports (20 nos)
	40.	Upper Air System Development. a) Commissioning of 5 GPS Radiosonde systems. b) Commissioning of 70 Nos. Optical Theodolites. c)Improvement of data quality at 10 Nos. of existing IMS stations by development of improved quality radiosonde.
	41.	Procurement of 12 imported DWR for Mumbai, Paradip, Goa, Karaikal, Delhi Airport, Patna, Lucknow, Nagpur, Mohanbari, Agartala, Patiala, Bhopal.
	42.	Replacement of AMSS at GHT and installation of new AMSS at Nagpur.
	43.	High Performance Computing System (HPCS) for Global Data Processing and Numerical Weather Prediction (NWP) for Weather forecasting services in IMD.
	44.	M. F. I.

### Project on 'Environmental Monitoring and Research'

Ministry of Earth Sciences has approved scheme on "Environmental Monitoring and Research" at an estimated cost of Rs. 14.70 crore to monitor the concentration of greenhouse gases, aerosols, ozone and precipitation chemistry in the Country. MOU between MoES and NOAA, USA is underway to support establishment of GHGs monitoring and C-cycle modeling in the country.

## 14. HRD & TRAINING

### Central Training Institute, Pune

The Central Training Institute of India Met. Dept. is a WMO recognized “Regional Meteorological Training Centre” (RMTC), which provides professional training in different disciplines of Meteorology to Officers and members of staff of different categories in IMD and officers of other government departments like Indian Navy, Indian Coast Guard, IITM, etc.

It also provides professional training in Meteorology to candidates from foreign countries.



Central Training Institute, Pune

### Ongoing Activities

(a) Advanced training in General Meteorology of one year duration for non IMD personnel and foreign trainees from RA- II region.

(b) Advanced training in General Meteorology of six months duration for IMD class II promotees.

(c) Intermediate training in General Meteorology of 4 months duration, three batches per year at New Delhi and Pune for IMD staff.

(d) Basic training course in General Meteorology of four months duration for fresh recruited `Senior Observers conducted at New Delhi, Kolkata and Chennai concurrently – three batches a year.

(e) Lab attendants Modular course for two months duration for promotees Gr. D, who have been promoted to Gr. C as Lab Attendants.

(f) A Refresher course was conducted in Aviation Meteorology for IMD personnel working at national and international airports.

(g) A refresher course on ‘Hydrometeorology’ for staff working at Flood Met. Offices was held at IMD’s Central Training Institute, Pashan, Pune during 5<sup>th</sup> - 9<sup>th</sup> May 2008.

(h) One Foreign Trainee of Papua New Guinea is undergoing advanced training in General Meteorology at the CTI, Pune in Batch No.169.

### Other Programmes in progress

(a) Modernisation of CTI with renovation of the Trainees Hostel and installation of WRF model

(b) LAN at Central Training Institute.

### RMC, New Delhi

Three batches Nos. 213, 214 & 215 for Intermediate Met Training Course were conducted during the year 2008. In this course 38 Scientific Assistants from various

offices viz. DGM / DDGM(UI) / RMC New Delhi / RMC Guwahati / C.S.O. Shillong were trained.

Three batches Nos. 10, 11 & 12 of Modular Course were conducted in which 28 Met Attendants from various offices were trained.

Two batches were conducted for imparting Met training to Army / SASE Personnel at MMC Srinagar. About 81 personnel were trained.

Two batches of Hydro-met Observer's Course under Hydrology project phase-II were conducted in which State Govt. officials from State of Himachal Pradesh / Punjab participated.

Modalities were set to retrain about 200 non-matric Group-D officials from DGM/ DDGM (UI) and RMC New Delhi including out stations.

### **Instruments Training Centre, New Delhi**

Training in the operation, maintenance and servicing of meteorological instruments

like Radiosonde / Radiowind instruments, Radiotheodolites, Radars, Satellite met instruments etc is conducted at Instruments Training Centre, New Delhi. This centre was established in 1962. The centre conducts various training courses for suitable departmental/extra departmental candidates and foreign nominees.

Following numbers of trainees have been trained in various training courses in Met Instrumentation during 2008-09.

Intermediate Course (Met Instrumentation)	:	10 (21 Jan 2008 to 19 Sep 2008)
Advanced Course (Met Instrumentation)	:	03
Special Courses	:	Nil

### **RMC, Chennai**

A short term training programme was conducted at RMC Chennai (M.O. Chennai) for the SSAPT, Puttaparthi Airport personnel as per IMD guidelines.

## 15. IMPORTANT TELEPHONE LINKS IN IMD

NAME	DESIGNATION/OFFICE	EPABX	OFFICE TELEPHONE NO. / FAX
A VM (Dr.) Ajit Tyagi	DGM	4201	011-24611842
Dr. A.K. Bhatnagar	ADGM(EREC), New Delhi	2448	011-24697473
Shri S.K. Banerjee	ADGM(H&I), New Delhi	4242	011-24617518
Dr. H.R. Hatwar	ADGM(R), Pune	200	020-25335877
Dr. R.D. Vashishth	DDGM(SI), Pune	400	020-25535411
Shri D. Chakrabarty	DDGM(Telecom)	4502	011-24616051
Dr. A.L. Koppar	DDGM(QAPPS), New Delhi	4318	011-24620020
Dr. T.A. Khan	DDGM(Org. & Vig.), New Delhi	4301	011-24615371
Shri N.Y. Apte	DDGM(H&A), New Delhi	4222	011-24619167
Shri Surya Bali	DDGM(EREC), New Delhi	4579	011-24629770
Shri B. Mukhopadhyay	DDGM(DM), New Delhi	4266	011-24615815
Shri B.K. Bandyopadhyay	DDGM(S), New Delhi	4285	011-24611068
Shri A.K. Sharma	DDGM(Sat. Met.), New Delhi	4415	011-24626021
Shri P.K. Jain	DDGM(UI), New Delhi	4245	011-24611451
Dr. A.B. Majumdar	DDGM(WF), Pune	500	020-25535886
Shri S.K. Prasad	DDGM(Training), Pune		020-25893330
Dr. R.P. Samui	DDGM(Agrimet.), Pune	300	020-25533420
Shri B.L. Verma	DDGM(RMC), New Delhi	4213	011-24490279
Dr. L.R. Meena	DDGM(RMC), Kolkata		033-24793782
Shri S.N. Roy	DDGM(RMC), Guwahati		0361-2840206
Dr. R.V. Sharma	DDGM(RMC), Mumbai	206	022-22150517
Dr. Y.E.A. Raj	DDGM(RMC), Chennai		044-28276752
Shri S. Krishnaiah	DDGM(RMC), Nagpur		0712-2288554



<b>Shri T.D. Chako</b>	<b>PS to DGM</b>	<b>4259</b>	<b>011-24611842</b>
<b>Shri Jagmohan Sharma</b>	PS to DGM	4225	011-24611842
<b>Smt. Mamta Negi</b>	PA to DDGM(A&S)	4302	011-24621472
<b>Shri V.K. Gupta</b>	Director (CPU)	4291	011-24698148
<b>Smt. Dr. S. Kaur</b>	Director (Hydrology)	4460	011-24693505
<b>Dr. O.P. Singh</b>	Director (Sat. Met., R&D Div.)	4429	011-24698247
<b>Shri Awadhesh Kumar</b>	Director (Services)	4285	011-24611068
<b>Dr. M.C. Rastogi</b>	Director (Telecom)	4227	011-24624486
<b>Shri L.A. Siddqui</b>	Director (Finance)	4487	011-24697640
<b>Shri Vivek Sinha</b>	Director (Establishment)	4271	011-24693661
<b>Dr. S.D. Attri</b>	Director (EMU)	4309	011-24620701
<b>Dr. S.K. Kundu</b>	Director (RM)	4208	011-24618974
<b>Shri S.C. Bhan</b>	Director (SFD.)		011-24623537
<b>Dr. R.K. Jenamani</b>	Director (MO Palam)		011-25654276
<b>Dr. R.S. Dattatrayam</b>	Director (Seismology)	4405	011-24611305
<b>Dr. A.K. Shukla</b>	Director (EREC)	4562	011-24616309
<b>Dr. S.K. Peshin</b>	Director (Ozone)	4235	011-24635797
<b>Shri M.K. Bhatnagar</b>	Director (Aviation Services)	4310	011-24619196
<b>Shri K. S. Gaharwar</b>	Director (Vigilance)	4254	011-24652318
<b>Shri R.P. Lal</b>	Director (Planning)	4260	011-24625917
<b>Shri U.P. Singh</b>	Director (Publication)	4262	011-24651287
<b>Caretaker, Mausam Bhawan</b>		472	
<b>Guest House (H.Q.)</b>		4471	
<b>Duty Officer, NHAC</b>		4241	
<b>Duty Officer, Seismo</b>		4484	011-24619946
<b>Duty Officer, Telecom</b>		4321	011-24693186

## EPABX EXCHANGE LINES, NEW DELHI STD CODE - 011

24618247	24654629	24654655	24618241	FAX No./Website
24619415	24654630	24654662	24618242	(91)(011)24699216
24654602	24654631	24654669	24618243	(91 )(11 )24623220
24654618	24654633	24654678	24618244	Website : <a href="http://www.imd.ernet.in">www.imd.ernet.in</a>
24654625	24654637		24618245	<a href="http://www.imd.gov.in">www.imd.gov.in</a>
24654626	24654645		24618246	

## 16. BRIEF OF IMD OFFICES

### MAUSAM BHAWAN, NEW DELHI



India Meteorological Department was established in the year 1875 with its headquarters at Calcutta. The headquarter was shifted to Shimla in 1905, then to Pune in 1928 and finally to Delhi in 1944.

It is the National Meteorological Service of the country and the principal government agency in all matters relating to meteorology, seismology and allied subjects and has the following mandate :

- To take meteorological observations and to provide current and forecast meteorological information for optimum operation of weather-sensitive activities like agriculture, shipping, aviation, offshore oil explorations, etc.
- To issue warnings for severe weather phenomena like tropical cyclones, norwesters, duststorms, heavy rains and snow, cold and heat waves, etc., which cause destruction of life and property.
- To provide meteorological statistics required for agriculture, water resource management, industries, oil exploration and other nation-building activities.
- To conduct and promote research in meteorology and allied disciplines.
- To detect and locate earthquakes and to evaluate seismicity in different parts of the country for development projects.

Indian Meteorological department fulfils the above objectives through its two nodal centres viz., New Delhi and Pune and Six Regional Centers at : New Delhi, Mumbai, Chennai, Nagpur, Kolkata and Guwahati.

## WEATHER FORECASTING AND RESEARCH CENTRE

### ADGM(R), PUNE



The transfer of Headquarters from Simla to Poona was approved by the Govt. in early 1926. The first section transferred to Poona started functioning by the end of March, 1928 and the All India Weather Report started being published from Poona from 1st April, 1928. The opening ceremony of the new H.Q. building of the India Meteorological Department was performed by then Governor of Bombay, Sir Leslie Orme Wilson, on 20<sup>th</sup> July, 1928, The shifting of staff from Simla to Poona was also completed by the middle of 1928. Poona (now Pune) continued to be the headquarters of the Organization till the outbreak of second World War in September, 1939. The Pune Met office is popularly known as "SIMLA OFFICE".

## REGIONAL METEOROLOGICAL CENTRES

### NEW DELHI



Under the administrative control of RMC, New Delhi, there are different types of operational units such as Meteorological Centres at state capitals of Uttar Pradesh, Himachal Pradesh, Punjab, Haryana, Jammu & Kashmir and Uttarakhand, Forecasting Offices, Agrometeorological Advisory Service Centres, Flood Meteorological Offices.

Regional Meteorological Centre, Lodi Road, NEW DELHI - 110 003

### CHENNAI

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.



Regional Meteorological Centre, Alipore, KOLKATA - 700 027

### GUWAHATI



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.

Regional Meteorological Centre, Guwahati Airport, GUWAHATI - 781 015

## REGIONAL METEOROLOGICAL CENTRES

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.



Regional Meteorological Centre, Alipore, KOLKATA - 700 027



Regional Meteorological Centre, Colaba, MUMBAI - 400 005

The Regional Meteorological Centre, Mumbai is one of the six Regional Centres of India Meteorological Department. This Centre 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. Cyclone warning work is carried out by Area Cyclone Warning Centre Mumbai and Cyclone Warning Centre Ahmedabad.

Regional Meteorological Centre Nagpur was established in the year 1945 at Nagpur Airport. RMC Nagpur controls Met Centre Bhopal, Met Centre Raipur and Met Office Nagpur. There are 16 departmental meteorological observatories, 48 non-departmental observatories, 6 Agrimet observatories and 3 Seismological observatories functioning under RMC Nagpur. RMC Nagpur covers Madhya Pradesh, Chhattisgarh and Vidarbha region.



Regional Meteorological Centre, Sonegaon Aerodrome, NAGPUR - 440 005

## METEOROLOGICAL CENTRES

### DELHI REGION

Director  
Meteorological Centre,  
SCO-2455-56, (First Floor),  
Sector 22 C,  
**CHANDIGARH - 160 022.**

Director  
Meteorological Centre,  
7A & 7B, Infront of Kamal Coach Company,  
Devnagar, Tonk Road,  
**JAIPUR - 302 015.**

Director  
Meteorological Centre,  
Civil Aerodrome, Amausi,  
**LUCKNOW - 226 009.**

Director  
Meteorological Centre,  
Ram Bagh Complex,  
**SRINAGAR – 190 015.**

Director  
Meteorological Centre,  
Survey of India Compound,  
17, E.C. Road, Karanpur,  
**DEHRADUN-248 001.**

Director  
Meteorological Centre,  
Bibra House, Cliffend Estate,  
**SHIMLA – 171 001.**

### CHENNAI REGION

Director  
Meteorological Centre,  
Central Observatory, Palace Road,  
**BANGALORE – 560 001.**

Director  
Meteorological Centre,  
Hyderabad Airport,  
**HYDERABAD – 500 016.**

Director  
Meteorological Centre,  
Observatory,  
**THIRUVANANTHAPURAM – 695 033.**

### KOLKATA REGION

Director  
Meteorological Center,  
P.O. Agartala Aerodrome,  
**AGARTALA**

Director  
Meteorological Centre,  
Civil Aerodrome,  
**BHUBANESHWAR - 751 009.**

Director  
Meteorological Centre,  
Ladaki Mansion,  
Baluwakhan,  
**GANGTOK – 737 101.**

Director  
Meteorological Centre,  
Civil Aerodrome,  
**PATNA – 800 014.**

Director  
Meteorological Centre,  
Civil Aerodrome,  
**RANCHI – 834 002.**

### BOMBAY REGION

Director  
Meteorological Centre,  
Civil Aerodrome,  
**AHMEDABAD - 380 012.**

### NAGPUR REGION

Director,  
Meteorological Centre,  
Mausam Vigyan Kendra,  
Area Hills, Satpura Post Office,  
**BHOPAL 462 004.**

Director  
Meteorological Centre,  
Lalpur,  
**RAIPUR**

### GUWAHATI REGION

Director  
Meteorological Centre,  
Naharlagun Helipad complex,  
**ITANAGAR – 791 110.**

# IMPORTANT ACTIVITIES



Dr. A.L. Koppar receiving memento from DGM



Cultural activities on the occasion of Hindi Diwas

Dr. P.K. Pius, Director, Brahma Kumaris giving lecture on stress management



Shri Rajendra Prasad receiving best Hindi paper award



Dr. V.L. Chopra, Member (Science) Planning Commission receiving bouquet from D.G. IMD





भारत मौसम विज्ञान विभाग  
(पृथ्वी विज्ञान मंत्रालय, भारत सरकार)  
मौसम भवन, लोदी रोड़, नई दिल्ली – 110 003, भारत

**INDIA METEOROLOGICAL DEPARTMENT**  
(Ministry of Earth Sciences, Govt. of India)  
Mausam Bhawan, Lodi Road, New Delhi – 110 003, India