



GOVERNMENT OF INDIA  
INDIA METEOROLOGICAL DEPARTMENT

# CLIMATE DIAGNOSTICS BULLETIN OF INDIA

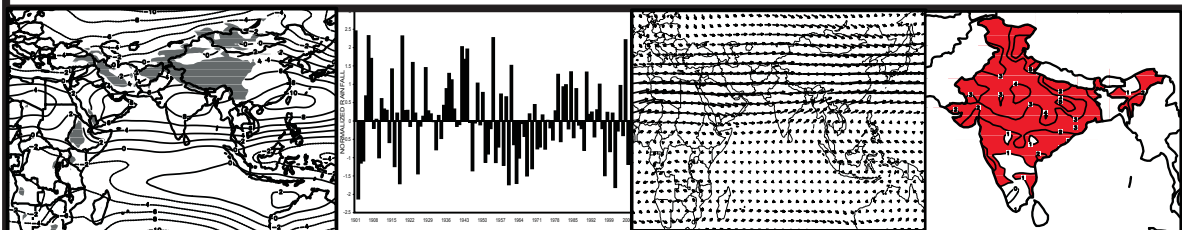
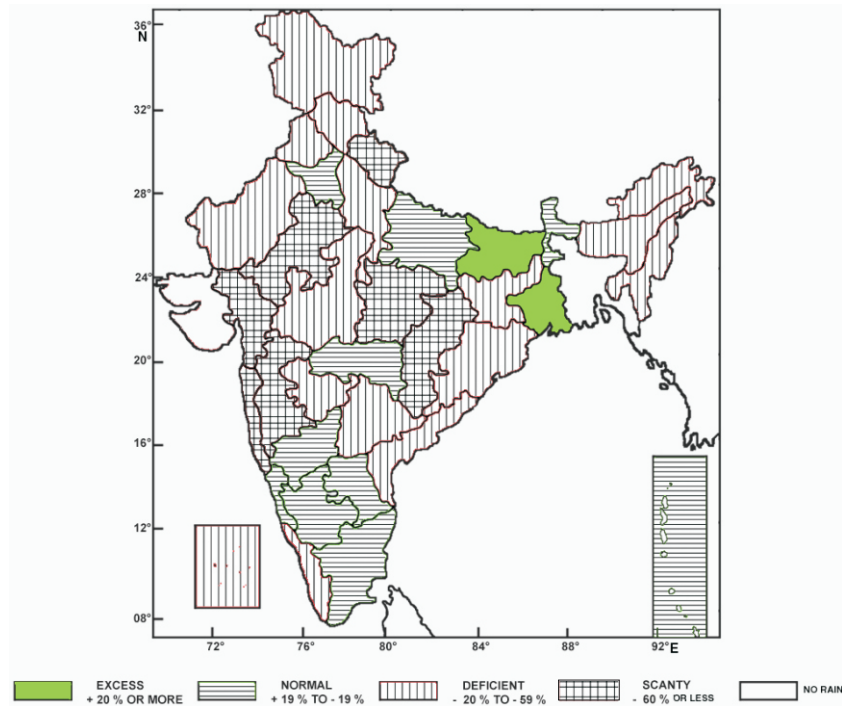
## PRE-MONSOON SEASON

(MARCH - MAY) : 2009

NEAR REAL - TIME ANALYSES



NATIONAL CLIMATE  
CENTRE



## PRE-MONSOON SEASON - 2009

### MAIN FEATURES OF THE SEASON

#### Heat Wave Conditions

Heat wave/ hot day conditions prevailed over some parts of central and peninsular India during the first three weeks of March, over the northern half of the country on many occasions during April and over northern, central and peninsular parts of the country during the second and third week of May. These conditions were severe over parts of Rajasthan on some days during the third week of May.

#### Rainfall Features

During the season, out of 36 meteorological subdivisions, 2 received excess rainfall, 10 received normal rainfall, 16 received deficient rainfall and 7 received scanty rainfall. One subdivision (Saurashtra & Kutch) did not receive any rain.(Fig.1).

Rainfall activity during the season over the country as a whole was very much subdued. However, Gangetic West Bengal and Bihar received excess rainfall, almost one and half times its normal value. All India area weighted rainfall over the country as a whole this year was only 91 mm (normal 135 mm). This was the third lowest since 1950 after 1996 (80.6) and 1954(88.8).

Table 1 shows the subdivision wise rainfall statistics (mm) for the Pre-monsoon season (March-May 2009).

Fig. 2(a) and 2(b) show the spatial pattern of rainfall received during the season and its anomaly (cm) respectively. Rainfall activity was mainly confined to the south peninsula and extreme northern and northeastern parts of the country, which received more than 10 cm of rainfall. Rainfall over parts of extreme northeastern region and Kerala exceeded 40 cm. Rainfall over the central parts of the country was of the order of 3 to 5 cm.

Rainfall anomaly was positive over parts of peninsula, central and northeastern parts of the country and was negative elsewhere. Positive rainfall anomaly exceeded by 5 to 10 cm over parts of south peninsula and eastern parts of the country viz. West Bengal and Bihar. Over parts of Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Coastal

Andhra Pradesh, Orissa and extreme northeastern parts of the country, rainfall deficiency was of the order of 5 to 10 cm.

Fig. 3 shows the area weighted cumulative weekly rainfall percentage departure during the season for the country as a whole. **Cumulative rainfall departure was negative during all the weeks of the season. For the pre-monsoon season 2009, rainfall for the country as a whole was 68% of its Long Period Average (LPA) value.**

Fig. 4 shows the normalized area weighted all India seasonal rainfall for the period, 1901-2009. **The normalized area weighted rainfall during the season for the country as a whole was -1.3.**

#### Pressure & Wind

Figs. 5(a) & 5(b) show the mean sea level pressure & its anomalies respectively. **The pressure anomalies were negative over most parts of the country except some northern parts.** Negative pressure anomalies were generally of the order of 0.5 hPa. Over some parts of extreme northeastern region, negative pressure anomalies exceeded 1 hPa.

Figs. 6(a) & 6(b), 7(a) & 7(b) and 8(a) & 8(b) show the mean circulation patterns and its anomalies at 850, 500 & 200 hPa levels respectively.

**At 850 hpa level, an anomalous cyclonic circulation over the southwest Bay of Bengal and an anomalous anticyclonic circulation over the extreme northwestern parts of the country, extending upto 500 hPa level, were observed. At 500 hPa level, an anomalous east – west trough over the south peninsula and another anomalous anticyclonic circulation over the northeastern parts and neighbourhood, extending upto 200 hPa level, were observed.**

#### Velocity Potential & Stream Function

Figs. 9(a) & 9(b) show the 200 hPa mean Velocity Potential & its anomalies. Similarly, Figs. 10(a) & 10(b) show the mean stream function & its anomalies at 850 hPa level. Negative values are indicated by dashed lines. **Anomalies in the**

**Velocity Potential at 200 hPa level were positive over most parts of the country except extreme northeastern parts. Anomalies in the stream function at 850 hPa level were negative over most parts of the country except the northwestern parts.**

#### Outgoing Longwave Radiation (OLR)

OLR anomaly ( $W/m^2$ ) over the Indian region and neighbourhood is shown in Fig. 11. OLR anomalies were negative over the south peninsula and adjoining Arabian sea and Bay of Bengal and also over some central and northern parts of the country. Negative OLR anomalies over these regions were generally less than  $5 W/m^2$ .

#### Temperature

Mean seasonal maximum and minimum temperature anomalies are shown in Figs. 12(a) & 12(b) respectively.

**Maximum temperatures were above normal over most parts of the country except parts of south peninsula, East Uttar Pradesh and Gangetic West Bengal.** Maximum temperatures were above normal by more than  $1^\circ C$  over some central and entire northern, northwestern and extreme northeastern parts of the country.

**Minimum temperatures were also above normal over most parts of the country except parts of peninsula and some central and extreme northern parts.** Minimum temperatures were above normal by more than  $1^\circ C$  over the northwestern and some northern parts of the country and parts of Marathwada, West Bengal, Jharkhand and Bihar. Over northern parts of Rajasthan, the minimum temperature anomalies exceeded  $2^\circ C$ .

#### Low Pressure Systems

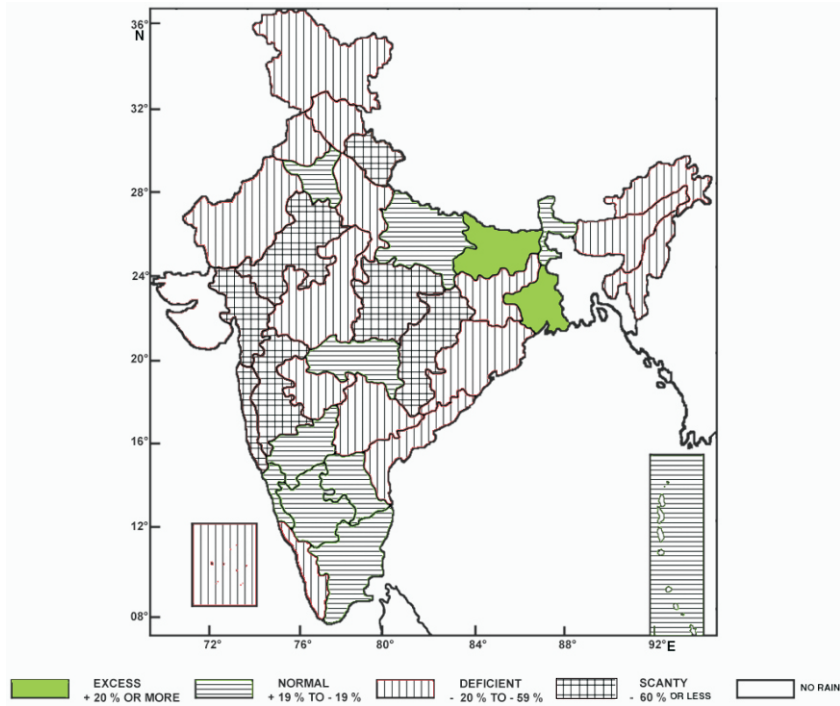
During the season, two cyclonic storms (**Bijli** in April and **Aila** in May), formed over the Bay of Bengal.

The cyclonic storm "**Bijli**" was first seen as a low pressure area over the southeast Bay of

Bengal and neighbourhood on 13 April. It concentrated into a **depression** with centre near Lat.  $12.5^\circ N/Long. 88.0^\circ E$  at 0600 UTC of 14. Moving slowly northwestwards, it intensified into a **deep depression** with centre near Lat.  $14.5^\circ N/Long. 87.0^\circ E$  at 0900 UTC of 15 and then into a **cyclonic storm** at 1200 UTC of the same day with centre near Lat.  $15.0^\circ N/Long. 86.5^\circ E$ . It initially moved in a northwesterly direction till 0300 UTC of 16 and then recurved in a northeasterly direction. It weakened into a **deep depression** at 0900 UTC of 17 with centre near Lat.  $21.5^\circ N/Long. 89.5^\circ E$ . and then into a **depression** at 1200 UTC of the same day. It moved northeast wards and crossed the Bangladesh coast and weakened into a well marked low pressure area over Bangladesh and adjoining Mizoram and Tripura at 1800 UTC of 17. It further weakened and became less marked at 0300 UTC of 18.

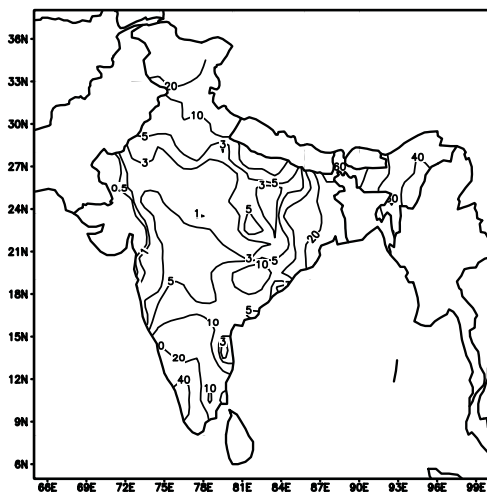
The second cyclonic storm of the season "**Aila**" which formed in May, was first seen as a low pressure area over the eastcentral Bay of Bengal and neighbourhood on 22. It concentrated into a **depression** on 23 and lay centred at 0600 UTC near Lat.  $16.5^\circ N/ Lon.88.0^\circ E$  on the same day. It remained practically stationary over there till 1200 UTC. Moving northwards, it intensified into a **deep depression** at 0300 UTC of 24 and into a **cyclonic storm (AILA)** at 1200 UTC near Lat.  $18.5^\circ N/ Lon.88.5^\circ E$ . Continuing its northerly movement, it further intensified into a **Severe Cyclonic Storm** at 0600 hrs UTC of 25, near Lat.  $21.5^\circ N/ Long. 88.5^\circ E$  (close to the southeast of Sagar Islands). Subsequently, it crossed West Bengal coast, close to Sagar Islands between 0800 & 0900 hrs UTC and lay centred at 1200 hrs UTC of 25th, close to Kolkata. Moving further northwards, it weakened into a **cyclonic Storm** close Kolkata at 1500 UTC of the same day and then into a **deep depression**, at 0300 hrs UTC of 26th. It further weakened into a well marked low pressure area over Sub-Himalayan West Bengal & Sikkim and neighbourhood by 0900 hrs UTC of 26th and became less marked in the evening.

Fig. 13 shows the tracks of these two cyclonic storms.

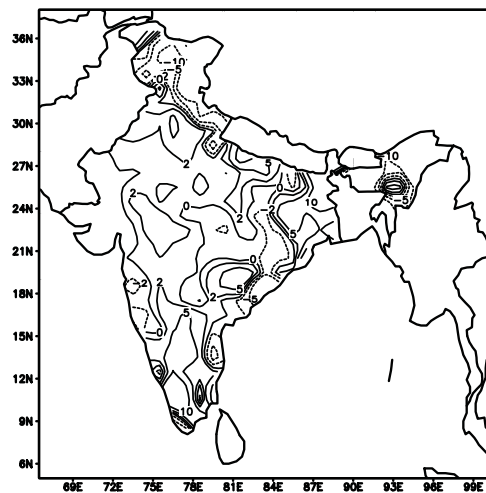


**FIG. 1 : SUB-DIVISIONWISE RAINFALL PERCENTAGE DEPARTURES FOR THE PRE-MONSOON SEASON 2009**

RAINFALL

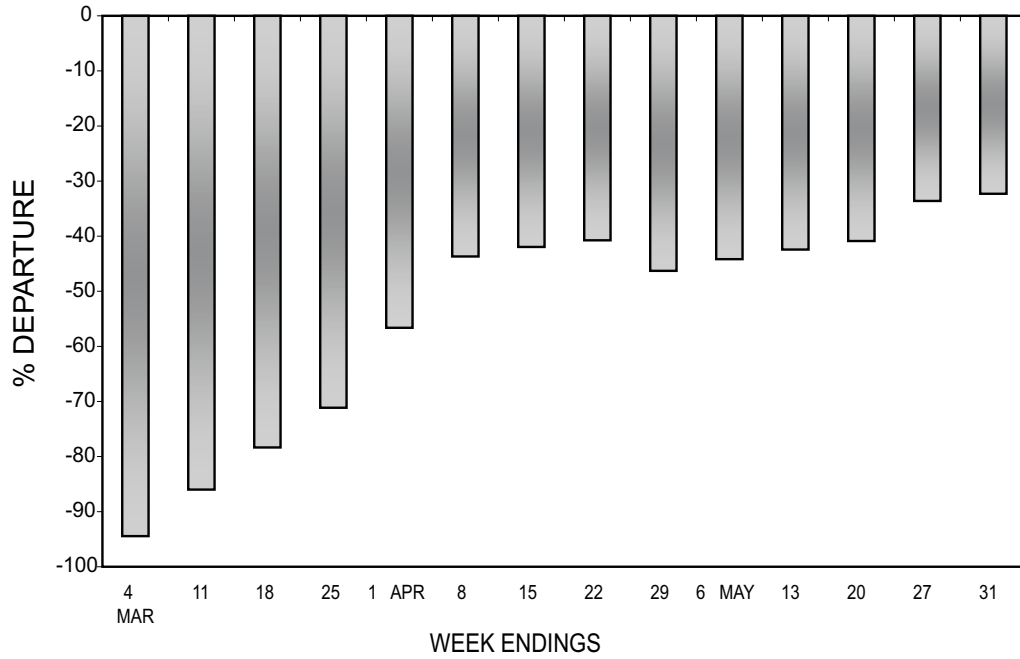


**FIG. 2(a) : SEASONAL RAINFALL (cm)**  
(INTERVAL : 0.5, 1, 3, 5, 10, 20, 40)

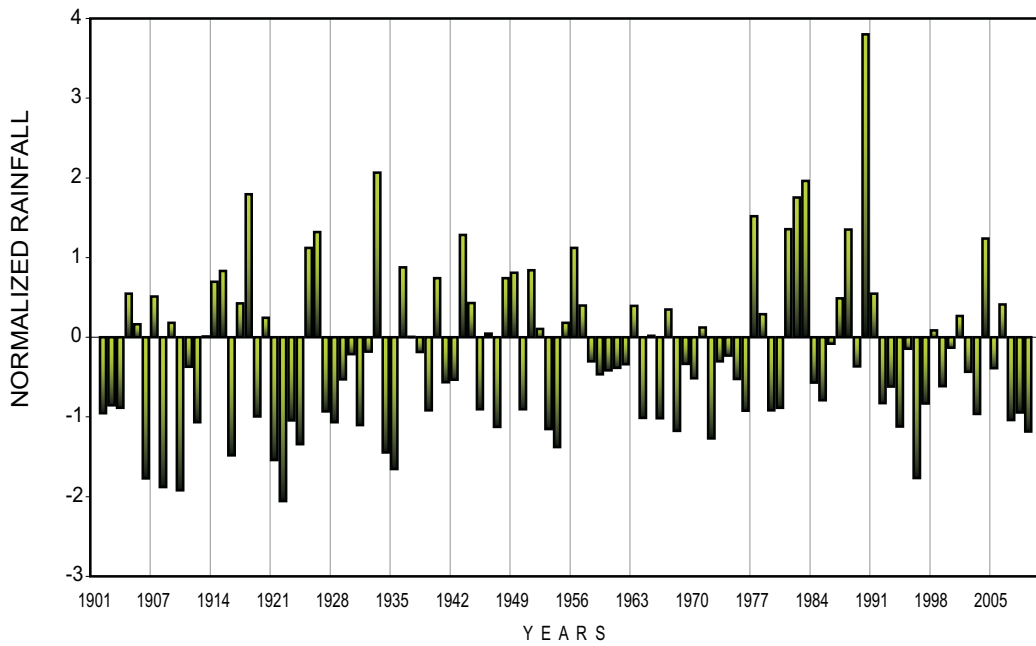


**FIG. 2(b) : SEASONAL RAINFALL ANOMALY (cm)**  
(INTERVAL : -10, -5, -2, 0, 5, 10)  
(BASED ON 1951 - 2000 NORMALS)

RAINFALL

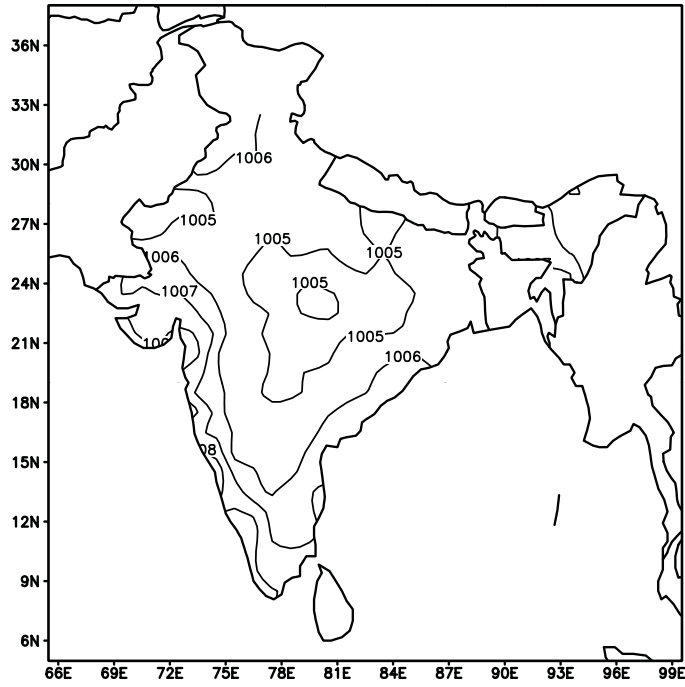


**FIG. 3 : ACCUMULATED PERCENTAGE DEPARTURE OF AREA WEIGHTED WEEKLY RAINFALL OVER THE COUNTRY AS A WHOLE FOR PRE-MONSOON SEASON**



**FIG. 4 : NORMALIZED AREA WEIGHTED RAINFALL OVER THE COUNTRY AS A WHOLE FOR PRE-MONSOON SEASON (1901 - 2009)**  
 (NORMAL IS BASED ON THE DATA FOR THE PERIOD 1941 - 1990)

(a) MEAN SEA LEVEL PRESSURE (MSLP)



(b) MSLP ANOMALY

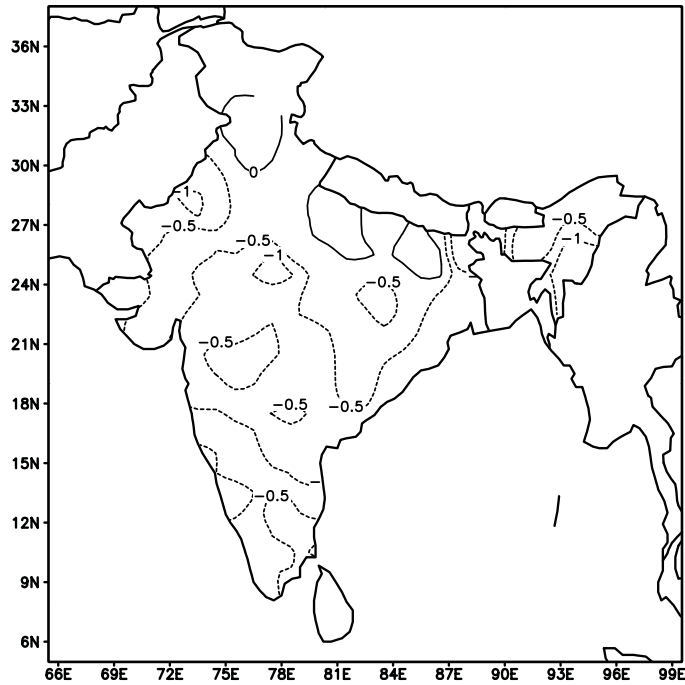
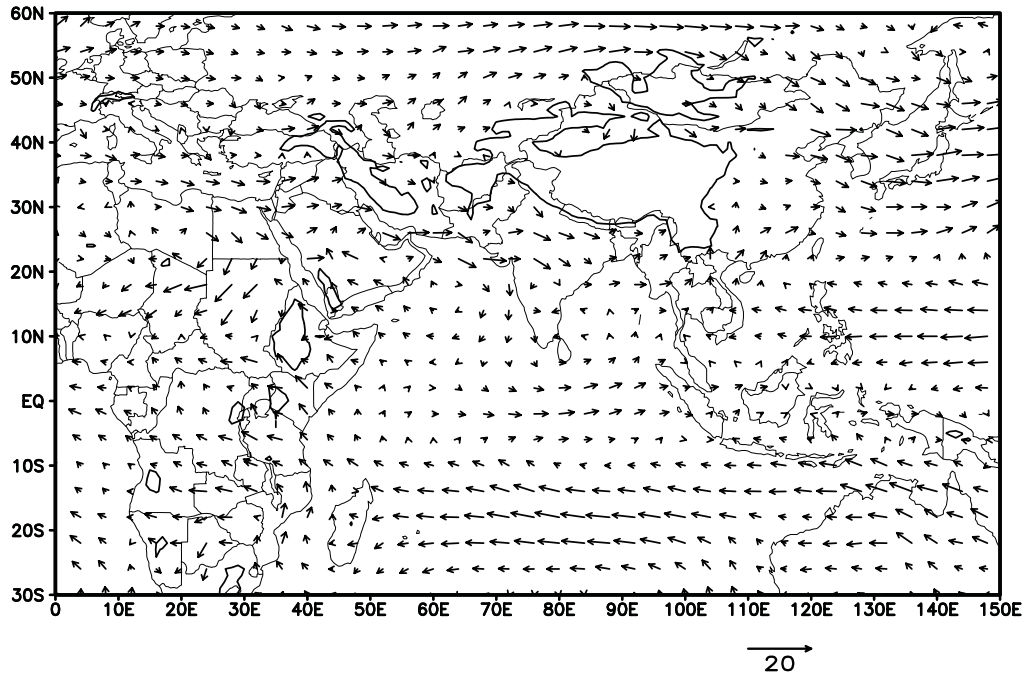


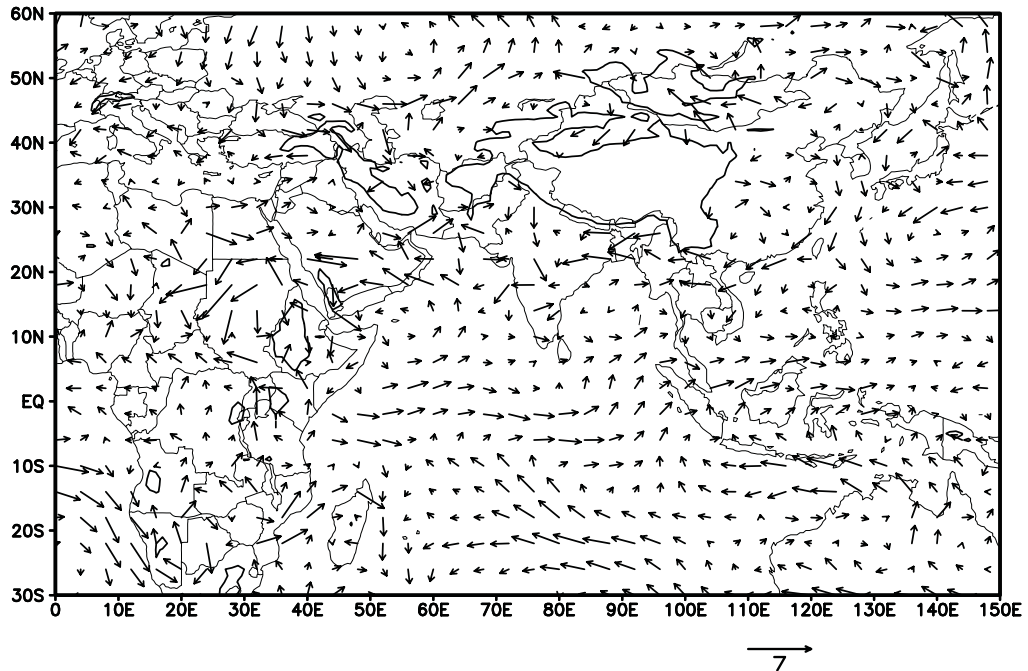
FIG. 5 : SEASONAL MEAN SEA LEVEL PRESSURE (hPa)  
(a) MEAN (b) ANOMALY  
(BASED ON 1971-2000 NORMALS)

PRESSURE

(a) MEAN WIND : 850 hPa



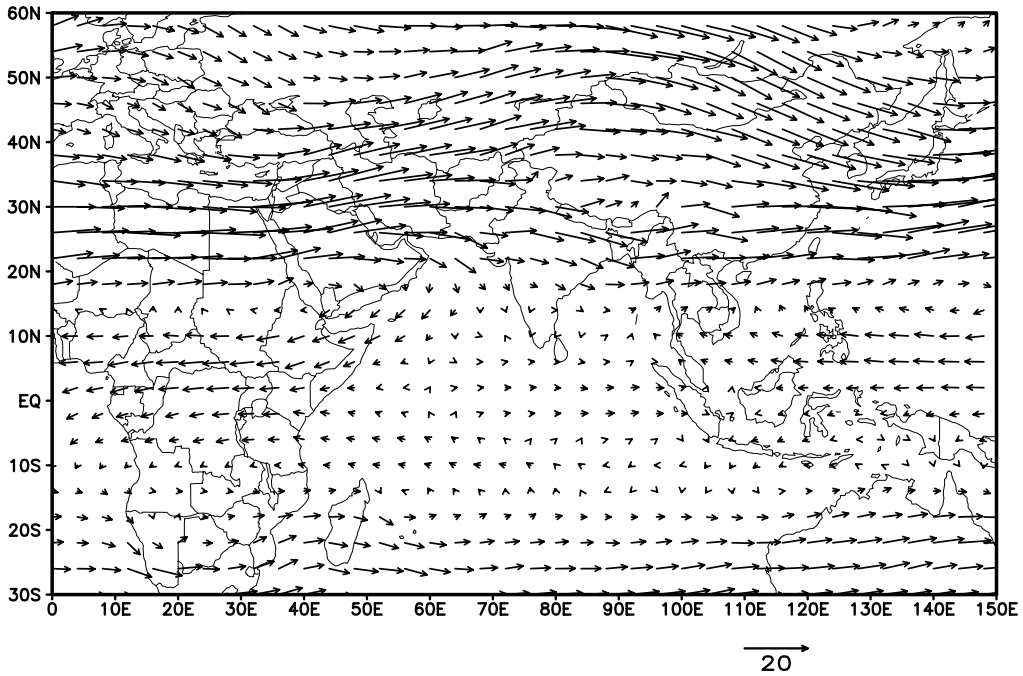
(b) WIND ANOMALY : 850 hPa



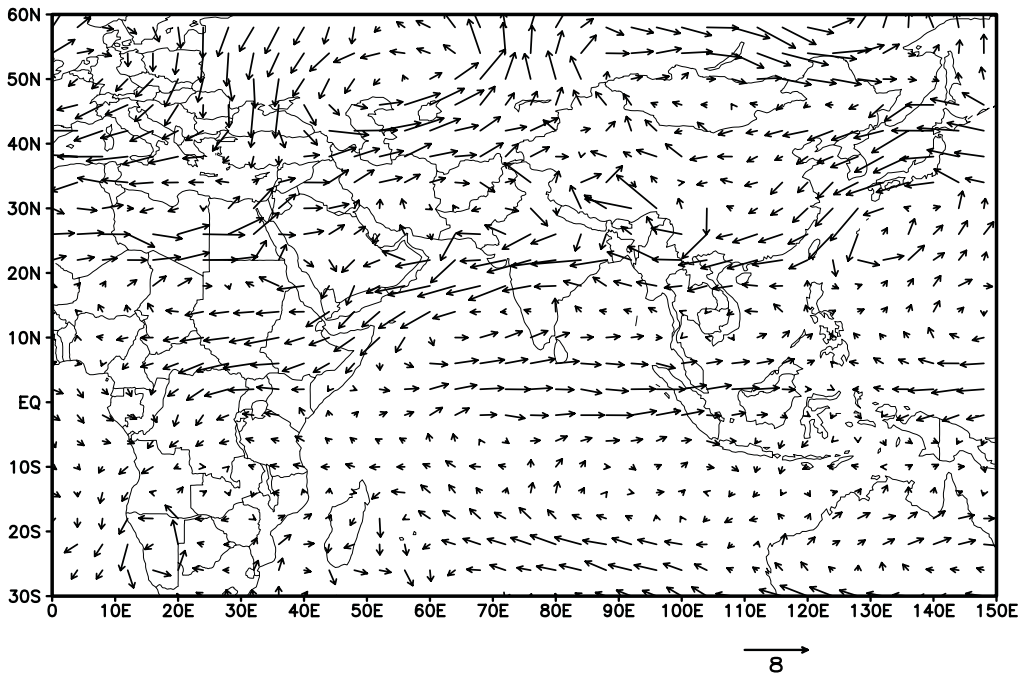
WIND AT 850 hPa

FIG. 6 : SEASONAL WIND (m/s) (a) MEAN (b) ANOMALY AT 850 hPa  
SOURCE OF DATA : IMD'S RSMC NWP OPERATIONAL ANALYSIS)

(a) MEAN WIND : 500 hPa



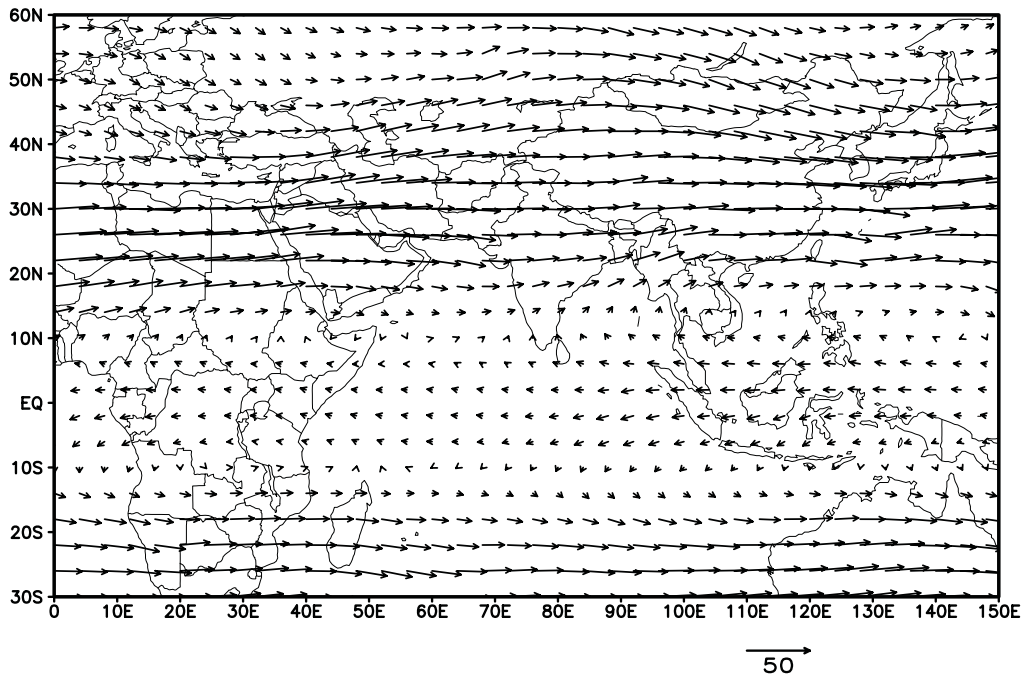
(b) WIND ANOMALY : 500 hPa



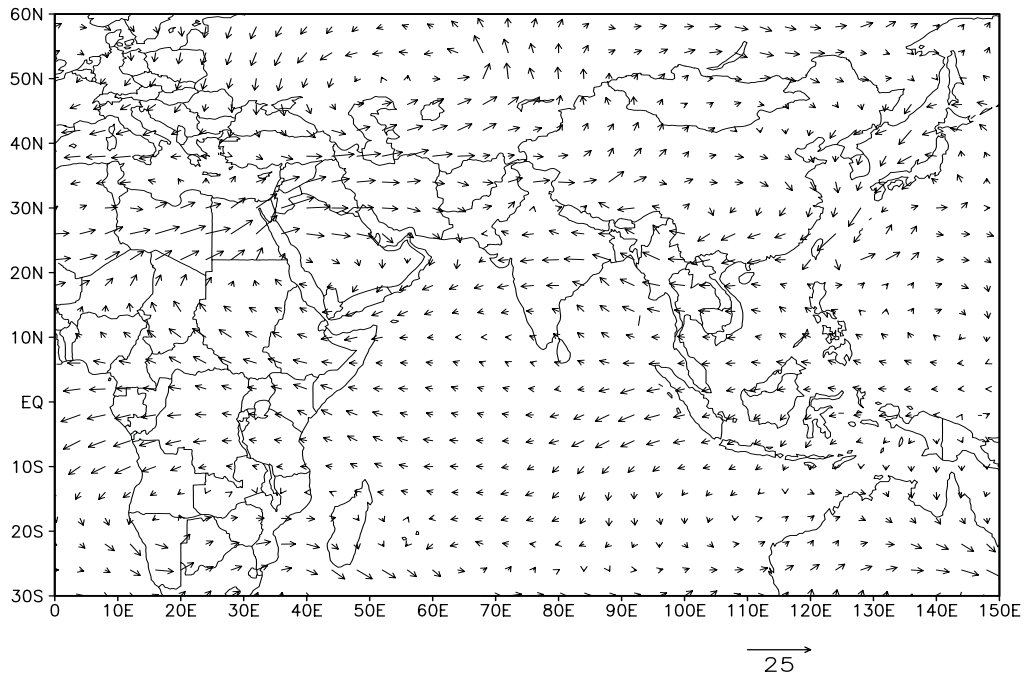
WIND AT 500 hPa

**FIG. 7 : SEASONAL WIND (m/s) (a) MEAN (b) ANOMALY AT 500 hPa**  
(SOURCE OF DATA : IMD'S RSMC NWP OPERATIONAL ANALYSIS)

(a) MEAN WIND : 200 hPa



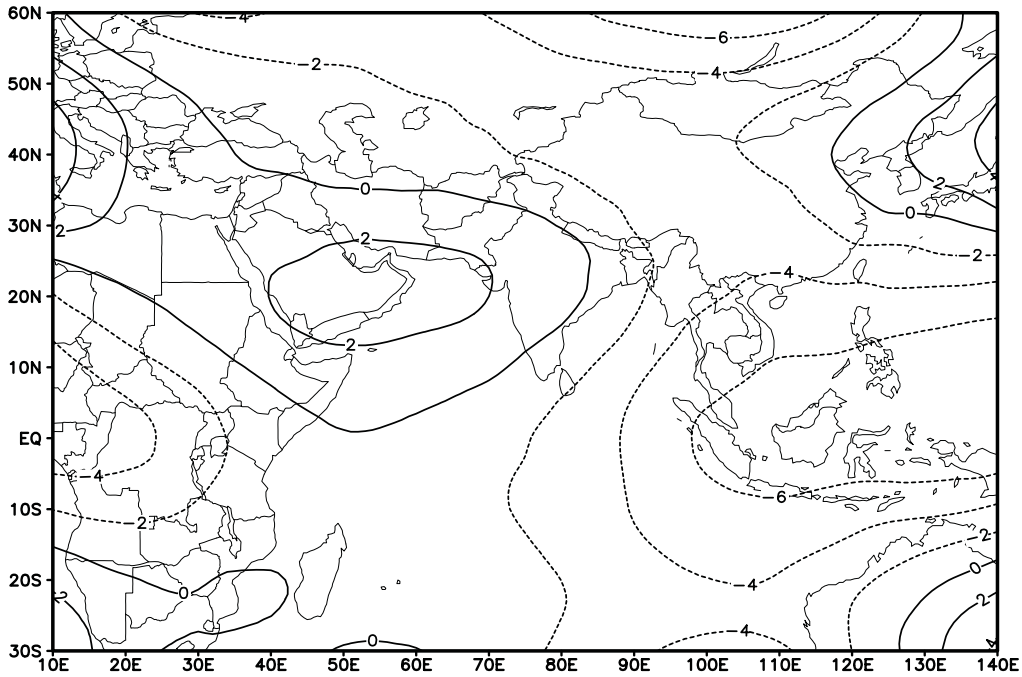
(b) WIND ANOMALY : 200 hPa



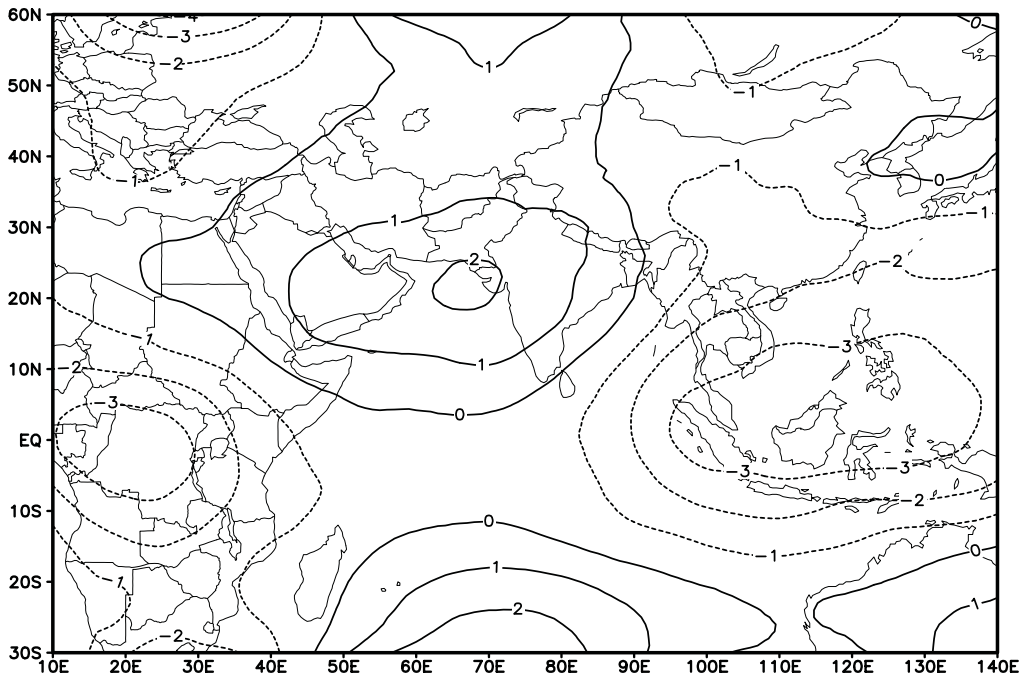
WIND AT 200 hPa

**FIG. 8 : SEASONAL WIND (m/s) (a) MEAN (b) ANOMALY AT 200 hPa**  
(SOURCE OF DATA : IMD'S RSMC NWP OPERATIONAL ANALYSIS)

(a) VELOCITY POTENTIAL : 200 hPa



(b) VELOCITY POTENTIAL ANOMALY : 200 hPa

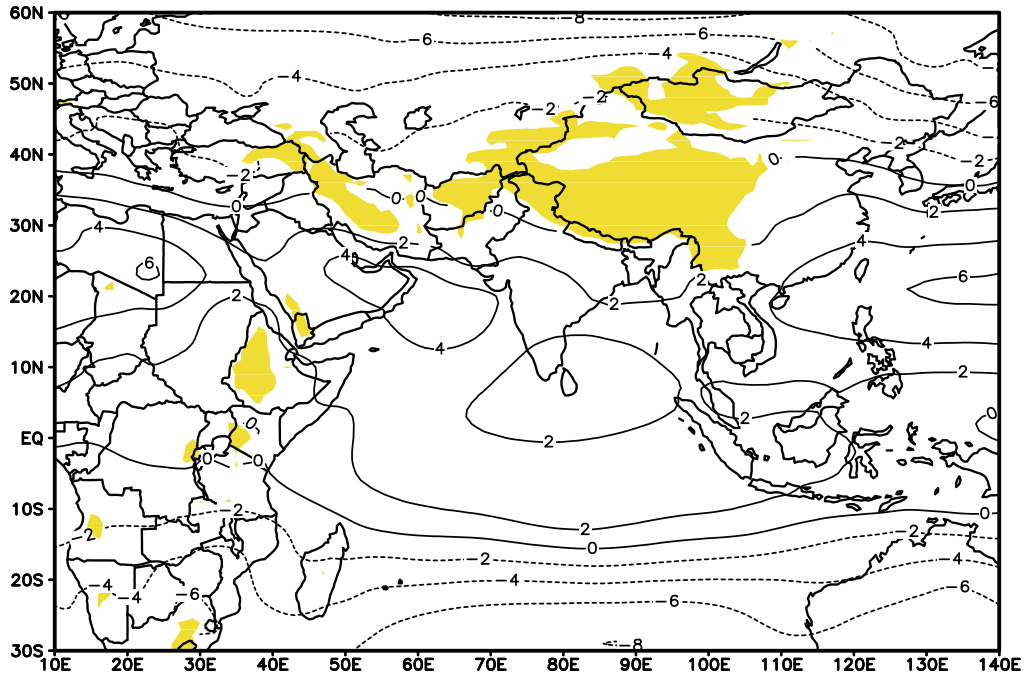


**FIG. 9 : SEASONAL VELOCITY POTENTIAL ( $10^6 \text{ m}^2/\text{s}$ )**  
**(a) MEAN (b) ANOMALY AT 200 hPa**  
(SOURCE OF DATA : IMD'S RSMC NWP OPERATIONAL ANALYSIS)

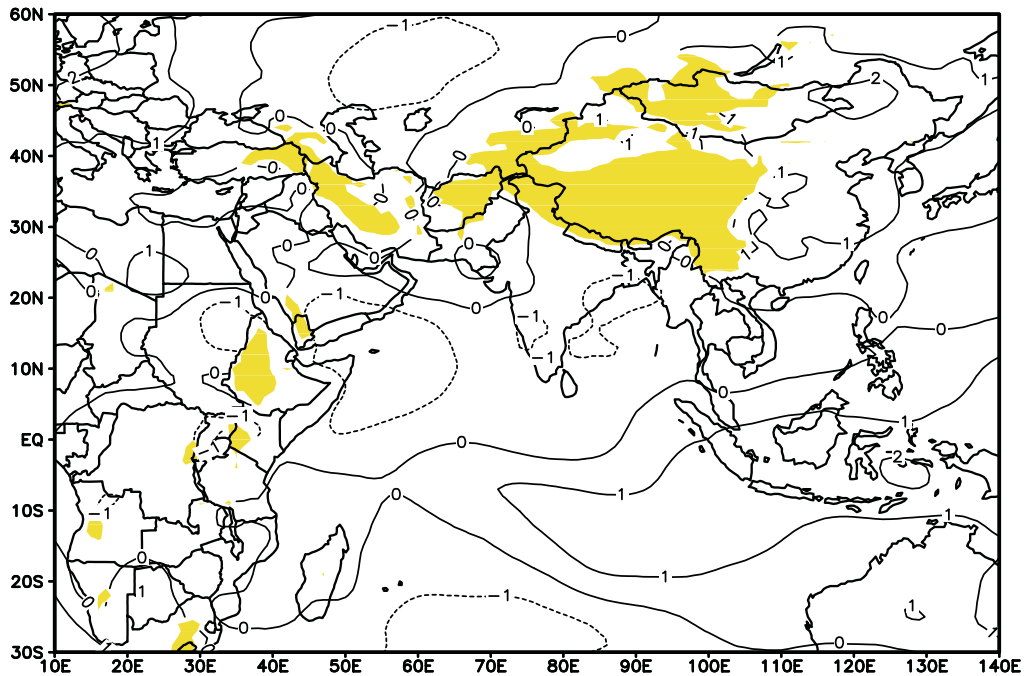
VELOCITY POTENTIAL

STREAM FUNCTION

(a) STREAM FUNCTION : 850 hPa



(b) STREAM FUNCTION ANOMALY : 850 hPa



**FIG. 10 : SEASONAL STREAM FUNCTION ( $10^6 \text{ m}^2/\text{s}$ )**  
 (a) MEAN (b) ANOMALY AT 850 hPa  
 (SOURCE OF DATA : IMD'S RSMC NWP OPERATIONAL ANALYSIS)

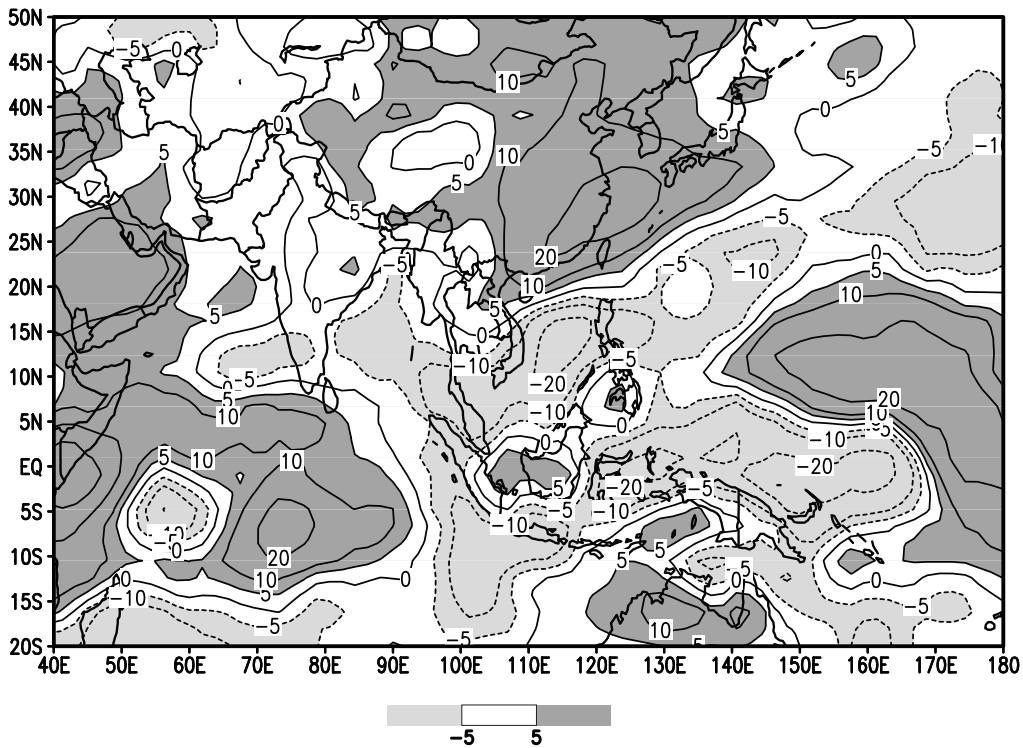
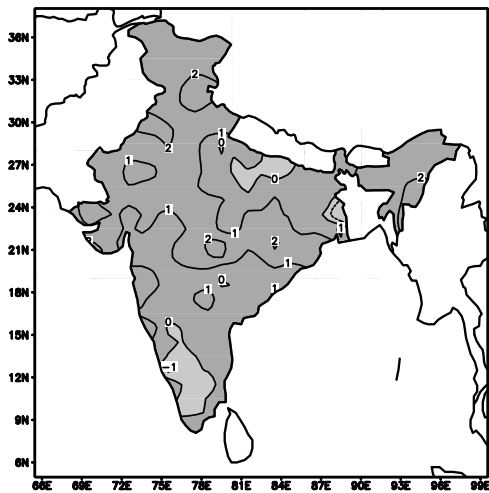


FIG. 11 : OLR ANOMALIES ( $W/m^2$ ) FOR PRE-MONSOON SEASON 2009  
(SOURCE : CDC / NOAA, USA)

OLR / TEMPERATURE

(a) MAXIMUM TEMPERATURE ANOMALY



(b) MINIMUM TEMPERATURE ANOMALY

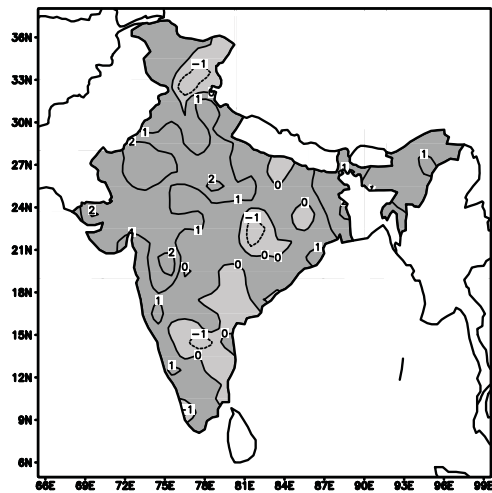


FIG. 12 : MEAN SEASONAL TEMPERATURE ANOMALIES ( $^{\circ}C$ )  
(a) MAXIMUM (b) MINIMUM  
(BASED ON 1971-2000 NORMALS)

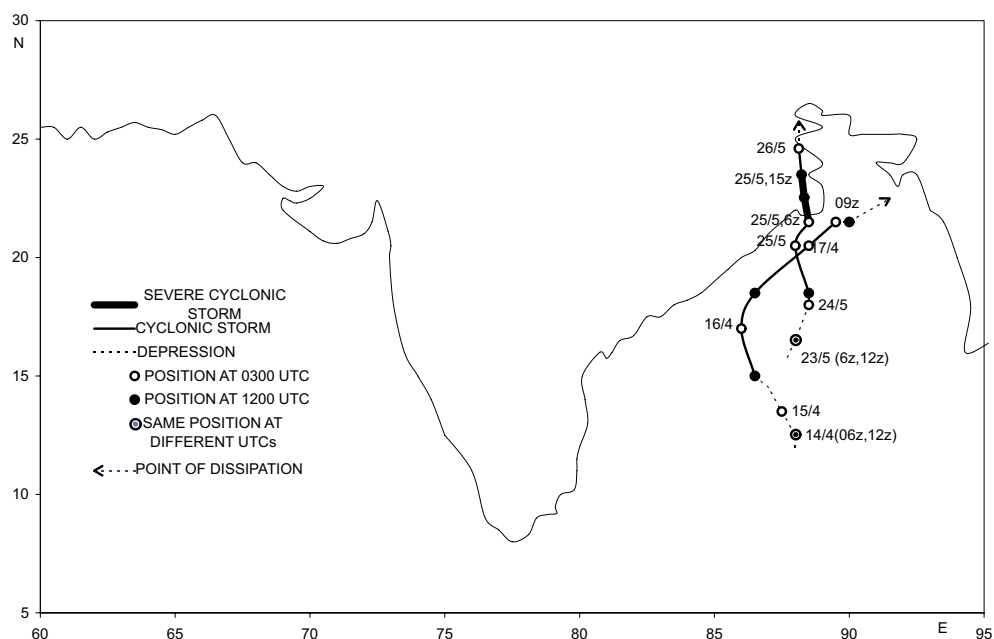


FIG. 13 : TRACKS OF CYCLONIC STORMS FORMED DURING THE PRE-MONSOON SEASON

TABLE 1  
METEOROLOGICAL SUBDIVISIONWISE RAINFALL STATISTICS  
FOR THE PRE-MONSOON SEASON (MARCH - MAY) 2009  
BASED ON OPERATIONAL DATA

	SUBDIVISION	ACTUAL (mm)	NORMAL (mm)	% DEP.
1.	Andaman & Nicobar Islands	493.3	461.0	7
2.	Arunachal Pradesh	361.9	719.5	-50
3.	Assam & Meghalaya	379.7	681.5	-44
4.	Naga. Mani. Mizo. & Trip.	274.5	443.3	-38
5.	Sub-Himalayan W. B. & Sik.	473.9	429.7	10
6.	Gangetic West Bengal	251.9	166.7	51
7.	Orissa	82.0	120.6	-32
8.	Jharkhand	58.0	88.7	-35
9.	Bihar	140.0	84.7	65
10.	East Uttar Pradesh	27.6	33.1	-17
11.	West Uttar Pradesh	15.1	29.0	-48
12.	Uttaranchal	42.4	157.0	-73
13.	Haryana Chnd. & Delhi	28.2	34.4	-18
14.	Punjab	36.7	54.4	-33
15.	Himachal Pradesh	131.5	246.6	-47
16.	Jammu & Kashmir	222.5	345.7	-36
17.	West Rajasthan	9.2	17.1	-46
18.	East Rajasthan	4.2	17.3	-76

	SUBDIVISION	ACTUAL (mm)	NORMAL (mm)	% DEP.
19.	West Madhya Pradesh	7.2	14.4	-50
20.	East Madhya Pradesh	9.0	28.1	-68
21.	Gujarat region	*	8.5	-99
22.	Saurashtra & Kutch	0.0	4.7	-100
23.	Konkan & Goa	3.9	40.1	-90
24.	Madhya Maharashtra	12.4	41.4	-70
25.	Marathwada	18.2	33.4	-45
26.	Vidarbha	27.8	31.3	-11
27.	Chattisgarh	11.6	53.3	-78
28.	Coastal Andhra Pradesh	55.0	94.4	-42
29.	Telangana	36.8	55.7	-34
30.	Rayalaseema	75.0	78.2	-4
31.	Tamil Nadu & Pondicherry	130.0	128.5	1
32.	Coastal Karnataka	149.0	179.4	-17
33.	North Interior Karnataka	72.0	87.9	-18
34.	South Interior Karnataka	151.0	150.4	0
35.	Kerala	321.8	427.8	-25
36.	Lakshadweep	180.3	233.7	-23

(\*: Rainfall amount of 0.01 to 0.4 mm)