*Mausam*, (1989), **40**, 2, 233-242

# Weather

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## HOT WEATHER SEASON (MARCH-MAY 1988)*

### 1. Introduction

During the pre-monsoon season the normal precipitation amount in the country is highest in Arunachal Pradesh (around 80 cm). The other areas of good thundershower activities are Andaman & Nicobar Islands, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim and Kerala, where the normal rainfall for the season ranges from about 50 cm to 65 cm. Also the rainfall during the season over Gangetic West Bengal, Himachal Pradesh, Jammu & Kashmir, coastal and south interior Karnataka and Lakshadweep is significant (between 19 cm & 37 cm).

In describing the rainfall distribution over the country two norms have been adopted for its classification, one for the monthly rainfall and the other for the seasonal rainfall. This has been done because of the fact that the limits for describing normal rainfall are generally decided on the basis of the variability or the standard deviation of the rainfall. Standard deviation generally decreases as the period increases. Thus, in case of monthly rainfall the limits of $\pm$19 per cent departures from the normal has been adopted as the normal, whereas in case of seasonal rainfall the same has been taken as $\pm$ 10 per cent of the normal. The other norms adopted for defining the monthly rainfall distribution are excess, +20 per cent and above; deficient, —20 to —59 per cent and scanty, —60 per cent or less. The legends for the seasonal rainfall are given in Fig. 1.

### 2. Chief features

(*i*) Moderate cold wave conditions in Jammu & Kashmir and Marathwada during March.

(*ii*) Moderate heat wave conditions in several parts of northwest and central India during April and May.

(*iii*) Avalanches in Kargil district of Jammu & Kashmir during March.

(*iv*) Hailstorms in several parts of the country during the season.

(*v*) Floods in Assam and Tripura during the end of May.

(*vi*) Onset of southwest monsoon over south Kerala on 26 May.

(*vii*) The rainfall during the season was excess, largely in Rayalaseema; moderately in Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Punjab, Tamil Nadu and slightly in Orissa and Haryana. It was normal in Sub-Himalayan West Bengal & Sikkim, Bihar, plains of Uttar Pradesh, Himachal Pradesh, east Rajasthan, coastal Andhra Pradesh, interior Karnataka and was deficient slightly in Andaman & Nicobar Islands, hills of west Uttar Pradesh, Jammu & Kashmir, east Madhya Pradesh, Gujarat region, Vidarbha, Kerala; moderately in west Rajasthan, west Madhya Pradesh, Madhya Maharashtra, Telangana, Lakshadweep and largely in Saurashtra & Kutch, Konkan & Goa, Marathwada and coastal Karnataka.

### 3. March

#### 3.1. *Weather and associated synoptic features*

Two induced lows developed over northwest India during the second fortnight. Apart from those systems, eight western disburbances moved away eastwards across Western Himalayas and neighbourhood, besides the last one of the previous month. A trough in the middle and upper tropospheric levels moved away eastwards across central and northeast India between 14th and 15th.

The wind discontinuity/trough at 0.9 km a.s.l. was observed over Peninsular India almost throughout the month and an east-west trough in the lower levels extending from Bihar to Assam was also observed on a few days in the last week of the month.

The salient synoptic features of the month are given in Table 1.

During this month major precipitation occurs over Assam and adjoining States, Sub-Himalayan West Bengal & Sikkim, Western Himalayas and Kerala. Rain or thundershowers were generally widespread on 8 to 12 days in Arunachal Pradesh, Assam & Meghalaya, Himachal Pradesh and Jammu & Kashmir and on 2 to 4 days in Nagaland, Manipur, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim' hills of west Uttar

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TABLE 1

**Details of weather systems during March 1988**

| S. No. | Weather system | Period | Place of first location | Direction of movement | Plac of dissipation | Remarks |
|---|---|---|---|---|---|---|
| | *(A) Low pressure area* | | | | | |
| (1) | Well marked low pressure area | 16th-17th | Northwest Rajasthan and adjoining Haryana and Punjab | — | *In situ* | Developed under the influence of a induced cyclonic circulation in the lower levels observed over west Rajasthan and Pakistan on 15th |
| (2) | Low pressure area | 25th-27th evening | Northwest Rajasthan, Punjab and adjoining north Pakistan | Easterly | Himachal Pradesh and adjoining Jammu & Kashmir | Observed as induced cyclonic circulation in lower tropospheric levels over south Pakistan and neighbourhood on 24th |
| | *(B) Cyclonic circulation* | | | | | |
| (1) | Lower levels | 4th-5th | Sub-Himalayan West Bengal & Sikkim | — | *In situ* | |
| (2) | Do. | 5th-7th | South Tamil Nadu and adjoining Kerala | — | Do. | |
| (3) | Do. | 10th-12th | Northwest Rajasthan and neighbourhood | — | Do. | |
| (4) | Do. | 12th-14th | Central Pakistan and adjoining Afghanistan | Easterly | West Rajasthan and adjoining Punjab | |
| (5) | Lower trop. levels | 16th-19th | Sub-Himalayan West Bengal & Sikkim | Easterly | Assam | |
| (6) | Lower levels | 16th-18th | South Tamil Nadu and adjoining Comorin area | Westerly | South Kerala and Lakshadweep area | |
| (7) | Lower trop. levels | 18th-20th | Extreme south Tamil Nadu and neighbourhood | Westerly | Moved away across Lakshadweep area | |
| (8) | Lower levels | 21st evening | Tamil Nadu and neighbourhood | | | |
| | *(C) Western Disturbance (W.D.)* | | | | | |
| (1) | Upper air system* | 29th Feb-5th | North Pakistan and neighbourhood | Easterly | Moved away across Western Himalayas | *Last month's western disturbance |
| (2) | Upper air system | 4th-7th | Noth Pakistan and adjoining Afghanistan | Easterly | Moved away across Western Himalayas | |
| (3) | Do. | 5th-10th | Central Afghanistan and adjoining Pakistan | Do. | Do. | |
| (4) | Do. | 9th-14th | North Pakistan and neighbourhood | Do. | Do. | |
| (5) | Do. | 15th-19th | North Pakistan and neighbourhood | Do. | Do. | |
| (6) | Do. | 19th-21st | North Pakistan and adjoining Jammu & Kashmir | Do. | Do. | |
| (7) | Do. | 21st evening-23rd | North Pakistan and neighbourhood | Do. | Do. | |
| (8) | Do. | 23rd evening-25th | Central Pakistan and neighbourhood | Do. | Do. | |
| (9) | Do. | 25th-28th | Northwest Afghanistan and neighbourhood | Do. | Do. | |

Pradesh and Kerala. The other areas, where generally widespread rain or thundershowers occurred on 1 to 3 days, were Andaman & Nicobar Islands, Gangetic West Bengal, Bihar, plains of Uttar Pradesh, Haryana, Punjab and south interior Karnataka. They were scattered on 8 to 16 days in Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, plains of Uttar Pradesh, Haryana, Punjab, Tamil Nadu and Kerala and on 2 to 7 days over the rest of the country outside Gujarat, Konkan & Goa, Madhya Maharashtra, Marathwada and coastal Karnataka, where the weather was mainly dry. Isolated heavy rainfall occurred on 1 to 2 days in Punjab, Himachal Pradesh, Jammu & Kashmir, south interior Karnataka and Kerala.

### 3.2. *Rainfall*

It was excess in Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Bihar, east Uttar Pradesh, hills of west Uttar Pradesh Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan and Tamil Nadu; normal in Andaman & Nicobar Islands, Assam & Meghalaya, plains of west Uttar Pradesh, Rayalaseema, south interior Karnataka and Kerala and deficient in Orissa, east Madhya Pradesh, Vidarbha, coastal Andhra Pradesh and north interior Karnataka. It was scanty over the rest of the country outside Gujarat, Konkan & Goa, Madhya Maharashtra and coastal Karnataka where there was no rain.

The significant amounts (cm) of rainfall were :

1st : Devikulam 6, Agartala AP, Alathur & Cherrapunji 5 each, Kuppam 4, Cochin AP, Pasighat, Silchar AP & Uthagamandalam 3 each

2nd : Hooghly 8, Durgachak & Gaya AP 4 each, Contai, Devikulam, Krishnanagar & Phulbani 3 each

4th : Yellandur 10, Hunsur 9, Usilampatti 7, Chittur 5, Denkanikottay 3

5th : Kayamkulam 8, Punalur 4, Trivandrum AP 3

6th : North Lakhimpur 8

8th : Chamba 7, Bhuntar AP 5, Banihal 3

9th : Sriniketan 7, Jamshedpur, Nancowry & Pehowa 5 each, Angul 4, Saswara AP 3

10th : Kupwara 3

11th : Batote 9, Manali 8, Jogindernagar & Kupwara 7 each, Amritsar AP, Banihal, Dharmsala & Jammu 6 each, Mukteswar 5, Kathua 4

12th : Chamoli 17, Batote 13, Jogindernagar & Tibri 11 each, Chamba & Fazilka 10 each, Manali 9, Katra & Quazigund 8 each, Srinagar, Bagati (Magra) & Gangtok 4 each, New Delhi AP, Pilani, Roorkee & Tuticorin 3 each

13th : Udhampur AP 10, Verinag 7, Chamba, Katra & Palayankottai 6 each, Jammu, Joshimath & North Lakhimpur 5 each, Batote & Dibrugarh AP 4 each

14th : Bagati (Magra) 9, Silchar AP & Pasighat 6 each, Bilaspur 4, Calcutta AP & Purulia 3 each

15th : North Lakhimpur & Pasighat 4 each, Agartala AP 3

16th : Gulmarg 10, Kanyakumari 6, Banihal 4

17th : Mana 19, Sivaganga 6, Manali & Quazigund 4 each, Aruppukottai & Palayamkottai 3 each

18th : Kayamkulam 8, Jogindernagar & Mannarghat 7 each, Kottayam, Manali & Verinag 3 each

19th : Krishnanagar 7, Midnapore & Sriniketan 5 each, Balahonnur, Kohima, Bagati (Magra) & Lumding 3 each

20th : Panagarh AP 5, Dhanbad & Pasighat 3 each

21st : Yellandur 5, Nilacottai & Vellore 4 each, Malur, Mannarghat & Pasighat 3 each

22nd : Madurai AP 3

23rd : Gangtok 3

24th : Devikulam, Dindigul & Tirupathi 3 each

25th : Narasipatnam 4

26th : Quazigund 5, Katra 4, Banihal, Srinagar & Sundernagar 3 each

27th : Nahan 9, Aruppukottai & Pahalgam 7 each, Katra & Manali 5 each, Palayamkottai & Phulbani 4 each, Dehradun, Srinagar & Uttarkashi 3 each

28th : Karaikal 7, Chaparkmukh 4, Sundernagar 3

### 3.3. *Temperature*

The day temperatures were generally below normal (departure—2°C to —3°C) in Nagaland, Manipur, Mizoram & Tripura, Bihar, Haryana, Punjab, Himachal Pradesh and Jammu & Kashmir. They were as much as —6°C to —9°C below normal in Nagaland, Manipur, Mizoram & Tripura on 15th, in Haryana and Himachal Pradesh on 12th and 28th, in Jammu on 11th and 13th and in Kashmir from 11th to 17th. They were generally above normal (departure + 2 to +3°C) in Madhya Pradesh, Rayalaseema, Tamil Nadu and north interior Karnataka during the month.

Night temperatures were generally below normal in west Uttar Pradesh, Punjab, Himachal Pradesh and Jammu between 13th and 31st and also in west Rajasthan, Madhya Pradesh, Gujarat, Maharashtra between 19th and 31st. Moderate cold wave conditions (departure— 6°C to — 7°C) prevailed in Kashmir on 12th, in Marathwada on 27th and in Jammu on 28th and 31st. They were appreciably (departute+4°C to+5°C) to markedly (departure+6°C to+7°C) above normal on 4 to 8 days in Kashmir, west Rajasthan, Gujarat and Rayalaseema during the first fortnight and in east Madhya Pradesh and Marathwada between 8th and 19th of this month.

### 3.4. *Disastrous weather events and damages*

As per the press reports about 130 people were killed in avalanches in Kargil district during 2nd and 3rd week of March. Heavy snowfall was reported over Tawang district in Arunachal Pradesh between 12 and 15 March disrupting road communication in the area. Occurrences

of severe squalls and hailstorms were reported from Calcutta and Howrah districts on 1st, which claimed one life and injured severely 4 persons and also from Narkhed Bhisnur in Nagpur district and Wardha on 9th. Severe squalls and hailstorms occurred between 13th and 24th at several places in Golaghat, Kamrup, Nowgong, Sonitpur, Barpeta, Lakhimpur and Dibrugarh districts of Assam causing damages to vast areas of agricultural crops. These claimed 3 human lives and damaged about 100 houses in the area.

**4. April**

4.1. *Weather and associated synoptic features*

During this month seven western disturbances moved away across extreme north India. The eighth one was observed over north Pakistan and neighbourhood on the last day of the month.

A wasterly trough in lower tropospheric levels lay over northeast India on 1st and another between 7th and 10th. The weather over this region was also influenced due to the east-west trough in the lower levels. Such troughs were seen on 6th extending from Bihar to Assam, between 17th and 20th extending from Uttar Pradesh to Assam and between 28th and 30th extending from Bihar to Nagaland.

Also a westerly trough in the lower tropospheric levels was present over the Peninsula almost throughout the month.

The salient synoptic features of the month are given in Table 2.

The areas of major precipitations during April are Assam and adjacent States, Sub-Himalayan West Bengal & Sikkim, Jammu & Kashmir and Kerala. The precipitation decreases to some extent during the month compared to March over Himachal Pradesh and hills of west Uttar Pradesh and increases over Tamil Nadu, south interior Karnataka and Gangetic West Bengal.

Rain or thundershowers were generally widespread on 6 to 11 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim and Kerala during the month. Gangetic West Bengal, Orissa, Bihar plains, Himachal Pradesh, Jammu & Kashmir, Telangana, Rayalasema, Tamil Nadu, interior Karnataka, Andaman & Nicobar Islands and Lakshadweep area experienced generally widespread rain or thundershowers on 1 to 3 days during the second fortnight of the month. They were scattered or isolated on 15 to 21 days in Assam & Meghalaya, Tamil Nadu and south interior Karnataka; on 10 to 14 days in Sub-Himalayan West Bengal & Sikkim, east Madhya Pradesh, Madhya Maharashtra, Vidarbha, coastal Andhra Pradesh, north interior Karnataka and Kerala; on 5 to 9 days in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Orissa, Bihar, east Uttar Pradesh, hills of west Uttar Pradesh, Jammu & Kashmir, east Rajasthan, west Madhya Pradesh, Marathwada, Telangana, Rayalaseema, coastal Karnataka and Lakshadweep and were on 1 to 4 days over the rest of the country.

4.2. *Rainfall*

It was excess in West Bengal & Sikkim, Orissa, Bihar plains, east Uttar Pradesh, east Rajasthan, Gujarat, Konkan & Goa, Madhya Maharashtra, Vidarbha, coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, interior Karnataka and Kerala ; normal in Assam & Meghalaya, Bihar Plateau, plains of west Uttar Pradesh, west Rajasthan, Madhya Pradesh, Telangana and Lakshadweep; deficient in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, hills of west Uttar Pradesh, Haryana, Punjab and Marathwada and was scanty in Himachal Pradesh, Jammu & Kashmir and coastal Karnataka.

Significant amounts (cm) of rainfall were :

6th : Dibrugarh AP 5, Mavelikara 4, Vridhunagar 3

7th : Kodaikanal 5, Cochin AP, Manantoddy & Punalur 3 each

8th : Vayittri 4, Peermade & Trivandrum 3 each

9th : Gangtok 10, Tedong 6, Minicoy 3

10th : Cherrapunji & Karaikudi 6 each, Cochin & Karaikal 4 each, Dibrugarh AP & Kayamkulam 3 each

11th : Coonoor & Kanyakumari 6 each, Cochin AP 5, Kozhikode 4, Dibrugarh AP, Hosadurga & Tadong 3 each

12th : Kottayam 7, Chittur 6, Belthangady & Kodaikanal 5 each, Palghat 4, Nagapattinam 3

13th : Gangtok, Gauhati AP & Kanyakumari 3 each

14th : Silchar AP 6, Alleppey, Kailashahar & Yelandur 5 each, Punalur & Trivandrum 4 each, Aijal & Gauhati AP 3 each

15th : Chaparmukh & Silchar AP 6 each, Hasan 4, Belthangady, Kurnool & Salem 3 each

16th : Hosanagara 9, Bantwal, Sandheads, Silchar AP & Tezu 5 each, Pandavapura 3

17th : Hosanagara & Sandheads 9 each, Nilakottai 8, Balasore 6, Tumkur 5, Cooch Behar, Kalingapatnam, Punalur & Tezpur 4 each, Visakhapatnam 3

18th : Tiruvalla 13, Coimbatore 10, Tuticorin 8, Nelamangala, Ottapalam & Silchar AP 5 each, Ajnala, Cooch Behar, Dharmshala & Madras AP 4 each, Jalpaiguri & Tezpur 3 each

19th : Ajnala 6, Srinagar 5, Banihal & Silchar AP 4 each, Bhubaneswar AP, Jalpaiguri & Nahan 3 each

20th : Amravati 9, Chamba, Kailashahar & Uthagamandalam 5 each, Idar, Motihari & Nilambur 3 each

21st : Peermade 8, Chintalapudi 5, Anantapur & Punalur 4 each, Bareilly 3

22nd : Kolar Gold Fields 8, Peermade 7, Sengareddy 5, Dibrugarh AP, K. Paramathy & Narsipatnam 4 each, Gangtok, Hyderabad AP & Kurnool 3 each

TABLE 2

**Details of weather systems during April 1988**

| S. No. | Weather system | Period | Place of first location | Direction of movement | Place of dissipation | Remarks |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | *(A) Cyclonic circulations* | | | | | |
| (1) | Lower trop. levels (induced) | 2nd-4th evening | West Rajasthan and neighbourhood | Northerly | Punjab | |
| (2) | Lower trop. levels | 3rd-4th | Sub-Himalayan West Bengal & Sikkim and adjoining Bihar | — | *In situ* | |
| (3) | Lower and mid-trop. levels (induced) | 6th-8th | North Rajasthan and adjoining Haryana | Easterly | Northwest Uttar Pradesh and adjoining Haryana | |
| (4) | Lower levels | 6th-7th | Southeast and east central Arabian Sea off north Kerala and Karnataka coast | — | *In situ* | |
| (5) | Lower trop. levels (induced) | 9th-13th | Southeast Rajsthan and neighbourhood | Easterly | North Orissa | |
| (6) | Lower and mid trop. levels | 10th-12th | Lakshadweep & Maldives areas | Westerly | Moved away | |
| (7) | Lower trop levels (induced) | 11th-14th | West Rajasthan | Eastsoutheasterly | Central parts of Madhya Pradesh | |
| (8) | Lower trop. levels | 12th-14th | Konkan & Goa and neighbourhood | Easterly | East central Arabian Sea oft north Maharashtra coast | |
| (9) | Mid. trop. levels | 14th-15th | Lakshadweep & Maldives areas | Westerly | Moved away | |
| (10) | Lower trop. levels | 15th-18th | South Tamil Nadu and adjoining Kerala | Do. | Do. | |
| (11) | Do. | 17th-19th | Northwest Rajasthan and adjoining central Pakistan | Northeasterly | Merged with the western disturbance over Himachal Pradesh and hills of west Uttar Pradesh | |
| (12) | Lower trop. levels (induced) | 19th-20th | Southeast Rajasthan and adjoining northwest Madhya Pradesh | — | *In situ* | |
| (13) | Lower trop. levels | 20th-21st | Plains of west Uttar Pradesh and adjoining north Madhya Pradesh | — | *In situ* | |
| (14) | Mid-trop. levels | 23rd-27th | East central Arabian Sea off Maharashtra coast | — | *In situ* | |
| (15) | Lower trop. levels | 22nd evening-24th | South Madhya Maharashtra and neighbourhood | Eastnortheasterly | Marathwada and neighbourhood | |
| (16) | Lower trop. levels (induced) | 24th-28th | Central Pakistan and neighbourhood | Easterly | Northwest Madhya Pradesh and adjoining Uttar Pradesh | |
| (17) | Lower trop. levels | 29th* | North Sri Lanka and adjoining southwest Bay | — | — | *Persisted there on 30th |
| (18) | Do. | 30th | North Bay and neighbourhood | — | — | |

TABLE 2 (*contd*)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|
| | (*B*) *Western Disturbance* (*W.D.*) | | | | | |
| (1) | Upper air system | 2nd-4th | North Pakistan and neighbourhood | Easterly | Moved away across Western Himalayas | |
| (2) | Do. | 4th-6th | Do. | Do. | Do. | |
| (3) | Upper air system | 7th-10th | Northeast Afghanistan and neighbourhood | Do. | Moved away across Western Himalayas | |
| (4) | Do. | 9th evening-11th evening | North Pakistan and neighbourhood | Do. | Do. | |
| (5) | Do. | 18th-20 evening | North Pakistan and adjoining Jammu & Kashmir | Do. | Do. | |
| (6) | Do. | 20th-24th | Extreme north Pakistan and adjoining northeast Afghanistan | Do. | Do. | |
| (7) | Do. | 24th-25th evening | North Pakistan and adjoining Jammu & Kashmir | Do. | Do. | |
| (8) | Do. | 30th | North Pakistan and Neighbourhood | — | - | Moved away in May |
| (C) | Trough in mid and upper trop. westerlies | 25th-29th | Extended from western Tibet to Kerala | Quasistationary | *In situ* | |

23rd : Jalpaiguri & Madurai AP 4 each, Tadong & Tezpur 3 each

24th : Hasan 9, Kanakpur & Namakkal 7 each, Midnapore, Salem & Talegaon 4 each, Balasore, Bangalore & Gulbarga 3 each

25th : Polavaram 12, Alathur, Peermade, Kakinada, Phulbani, Salem & Satara 5 each, Nidadavole & Rewa 4 each, Nagapattinam 3

26th : Jalpaiguri, Purnea & Shillong 3 each

27th : Nandurbar 5, Gangtok & Mandya 4 each, Aruppukottai, Jalpaiguri, Quilon & Talegaon 3 each

28th : Usilampatti 7, Gauhati AP, Madurai & Tezu 5 each, Silchar AP 4, Kozhikode 3

29th : Kailashahar 7, Hunsur, Nedumangad 5 each, Tenali 4, Shillong 3

30th : Hut Bay & Mannarghargaht 4 each, Cochin AP 3.

4.3. *Temperature*

Moderate heat wave conditions prevailed on 1 to 4 days at a few places in east Uttar Pradesh and hills of west Uttar Pradesh, Punjab, Jammu and Rajasthan between 5th and 18th. Day temperatures were appreciably above normal on 4 to 8 days in West Bengal & Sikkim, Bihar, east Uttar Pradesh east Madhya Pradesh and Vidarbha during the first fortnight and on 5 to 11 days in west Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu, Rajasthan, west Madhya Pradesh between 3rd and 19th. They were 6° to 7°C above normal in Kashmir on 9 days. Day temperatures were below normal by 6°C to 7°C on 5 days in Assam & Meghalaya beetween 14th and 19th, on 16th in Sub-Himalayan West Bengal & Sikkim, on 19th in Bihar plains and Jammu and on 26th in Nagaland, Manipur, Mizoram & Tripura.

4.4. *Disastrous weather events and damages*

Hailstorms were reported from Gauhati AP on 13th and from Amreli in Saurashtra on 24th. As per press reports heavy hailstorms lashed the twin hill stations in Madhya Maharashtra, namely Panchgani and Mahabaleshwar on 22nd causing extensive damages to raspberry crops and claiming the lives of 3 persons. Heavy rains and hailstorms in Kolar district of south interior Karnataka on 24th damaged considerable crops and property. House collapse due to heavy rain on 26th in Gubbarkar village in Raichur district also claimed the lives of 4 persons. As per press reports severe squalls in some parts of Keonjhar, Mayurbhanj and Balasore disticts of Orissa on 16th left 3 persons dead and 59 injured.

**5. May**

5.1. *Weather and associated synotic features*

A trough in the lower tropospheric levels was observed over the Peninsular India on most days during the month. An east-west trough in the lower levels also developed over northeast India in the first week and continued to persist during the month. This trough sometimes extended either from east Uttar Pradesh or from northeast Madhya Pradesh.

TABLE 3

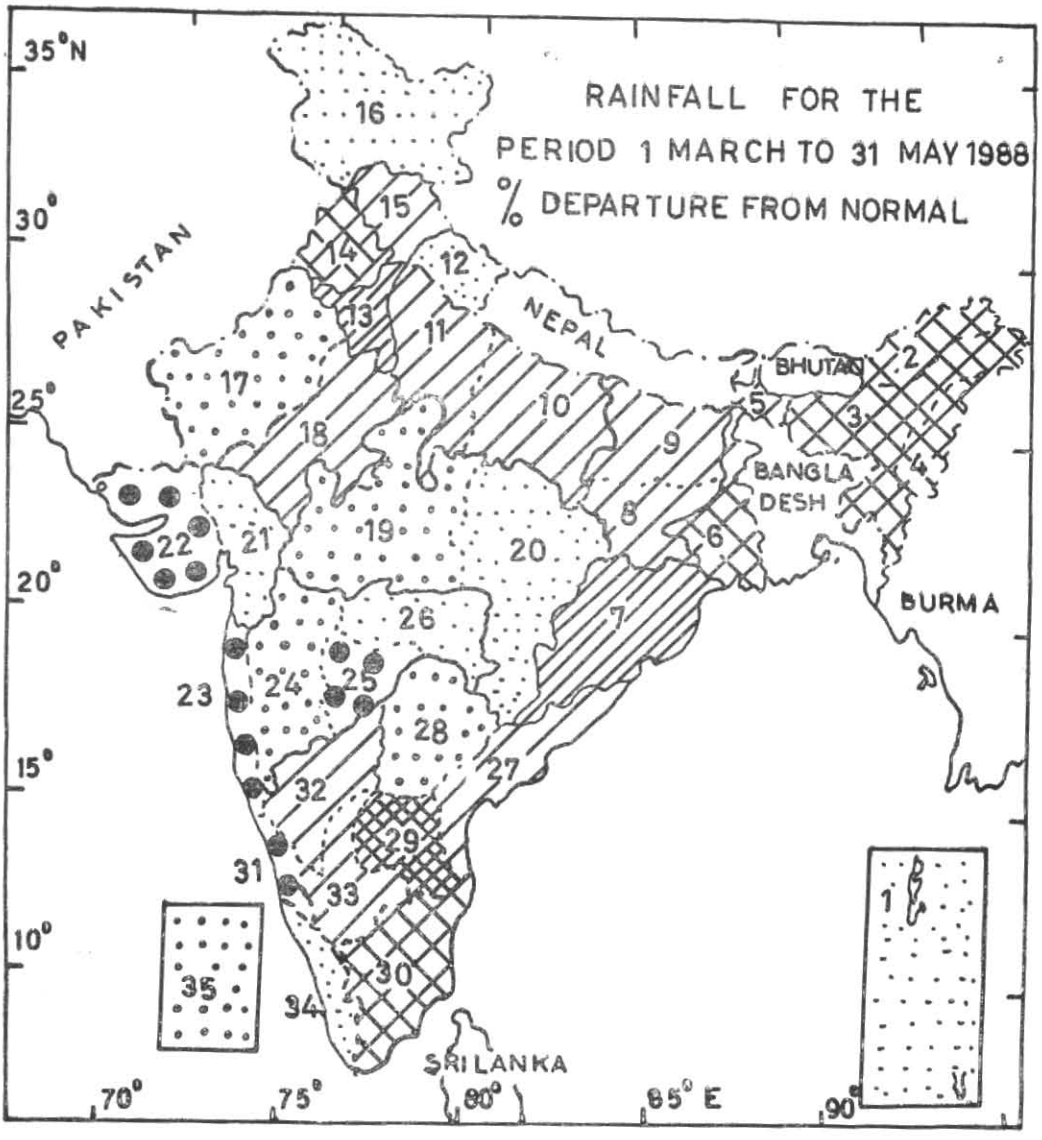
Details of weather systems during May 1988

| S. No. | Weather system | Period | Place of first location | Direction of movement | Place of dissipation | Remarks |
|---|---|---|---|---|---|---|
| | *(A) Cyclonic circulation* | | | | | |
| (1) | Lower trop. levels | 30 April-5 May | North Bay and neighbourhood | Easterly | Orissa and adjoining northwest Bay | |
| (2) | Do. | 2nd-7th | North Andaman Sea and neighbourhood | Westerly | North Andaman Sea and adjoining east central Bay | |
| (3) | Do. | 3rd-4th evening | Rayalaseema | Northerly | Telangana and neighbourhood | |
| (4) | Lower and mid. trop. levels | 9th-11th | Comorin and adjoining Tamil Nadu and Kerala | Westerly | Maldives & Lakshadweep area | |
| (5) | Lower trop. levels | 17th evening-19th | Punjab and neighbourhood | — | *In situ* | |
| (6) | Lower and mid-trop. levels | 18th-23rd evening | Southeast Bay and adjoining north Andaman Sea | Northwesterly/ Northerly | Gangetic West Bengal and neighbourhood | |
| (7) | Do. | 24th-29th | Lakshadweep area | Westerly | Southeast Arabian Sea west of Lakshadweep area | |
| (8) | Lower/lower trop. levels | 29th evening-31 | Bihar Plateau | Westerly | — | Lay on 31st over northeast Madhya Pradesh and neighbourhood |
| | *(B) Western Disturbances (W.D.)* | | | | | |
| (1) | Upper air system | 30 Apr-2 May | North Pakistan and neighbourhood | Easterly | Moved away across Western Himalayas | Last month's western disturbance |
| (2) | Do. | 4th-5th | Do. | Do. | Do. | |
| (3) | Do. | 5th evening-7th | North Pakistan and neighbourhood | Do. | Do. | |
| (4) | Do. | 19th-21st | Do. | Do. | Do. | |
| (5) | Do. | 26th-28th evening | Northeast Afghanistan and adjoining north Pakistan | Do. | Do. | |
| (6) | Do. | 31st | North Pakistan and adjoining Jammu & Kashmir | — | — | Moved away in June |

A trough in the lower tropospheric levels was observed over east central Bay and Andaman Sea between 8th and 12th and another in those levels extending from north Tamil Nadu coast to Andaman Sea on 14th. The latter one shifted northwards on 18th and became active. In the fourth week the oceanic trough developed vertically upto mid-tropospheric levels and generally extended from southwest Bay off north Tamil Nadu coast to east central Bay.

The other synoptic features, which affected the weather over the country are given in Table 3.

The most important weather event of the month was the onset of southwest monsoon over Andaman & Nicobar Islands and south Kerala. It advanced over Nicobar Islands on 10th and covered Andaman Islands by 19th. It set in over south Kerala on 26 th of this month. Andaman & Nicobar Islands, northeast India, Tamil Nadu and Kerala experienced rain or thundershowers almost all days during the month. Mainly dry weather prevailed over Rajasthan, Madhya Pradesh and Maharashtra between 6th and 15th, over north interior Karnataka between 7th and 20th and in Gujarat throughout the




| *Sub-divisions* | *Depar. from normal* | *Sub-divisions* | *Depar. from normal* | *Sub-divisions* | *Depar. from normal* |
|---|---|---|---|---|---|
| 1. A & N Islands | —14 | 13. Haryana | 15 | 25. Marathwada | —58 |
| 2. Arunachal Pradesh | 41 | 14. Punjab | 32 | 26. Vidarbha | —25 |
| 3. Assam & Megha. | 30 | 15. Himachal Pradesh | —8 | 27. Coastal A.P. | 10 |
| 4. N.M.M. & T. | 30 | 16. Jammu & Kashmir | —13 | 28. Telangana | —45 |
| 5. S.H.W.B. Sikkim | —4 | 17. West Rajasthan | —38 | 29. Rayalaseema | 93 |
| 6. G. West Bengal | 33 | 18. East Rajasthan | 2 | 30. Tamil Nadu | 35 |
| 7. Orissa | 25 | 19. West M. P. | —47 | 31. Cot. Karnataka | —83 |
| 8. Bihar Plateau | 0 | 20. East M. P. | —25 | 32. N.I. Karnataka | —2 |
| 9. Bihar Plains | 8 | 21. Gujarat Region | —17 | 33. S. I. Karnataka | —8 |
| 10. East U. P. | 0 | 22. Saurashtra & Kutch | —72 | 34. Kerala | —21 |
| 11. Plains of W. U.P. | —10 | 23. Konkan and Goa | —92 | 35. Lakshadweep | —26 |
| 12. Hills of W. U.P. | —11 | 24. Madhya Maha. | —47 | | |

Fig. 1. Rainfall for the period 1 March to 31 May 1988 (Percentage departure from normal)

month. Rain or thundershowers were generally widespread on 17 to 23 days in Andaman & Nicobar Islands, Assam & Meghalaya and Nagaland, Manipur, Mizoram & Tripura and on 8 to 12 days in Arunachal Pradesh Sub-Himalayan West Bengal & Sikkim and Kerala. They were so on 1 to 3 days in Gangetic West Bengal, Bihar, Himachal Pradesh, Jammu & Kashmir, coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, coastal and south interior Karnataka and Lakshadweep. Isolated heavy to very heavy rainfall occurred on 6 day in Assam & Meghalaya and on 1 to 3 days in Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura and Kerala. Scattered or isolated thundershowers occurred on 15 to 20 days in West Bengal & Sikkim, Orissa, Tamil Nadu, south interior Karnataka and Kerala and on 8 to 14 days in Bihar, hills of west Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Madhya Maharashtra, coastal Andhra Pradesh, Rayalaseema, coastal and north interior Karnataka. They ranged between 1 and 7 days elsewhere outside Gujarat.

5.2. *Rainfall*

It was excess in Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura and Rayalaseema ; Normal in Andaman &Nicobar Islands, Gangetic West Bengal, Orissa, coastal Andhra Pradesh and Tamil Nadu and deficient in Sub-Himalayan West Bengal & Sikkim, Bihar, Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Marathwada, interior Karnataka, Kerala and Lakshadweep. It was scanty over the rest of the country outside Gujarat where there was no rain.

The significant amounts (cm) of rainfall were :

1st : Chintalapudi 25, Kozhikode 9, Krishnarajnagar 8, Cochin AP, Kurnool & Tiruttani 6 each

2nd : Kanakpura 6, Jammu 3

3rd : Narsipatnam 7, Phulbani 6, Trivandrum AP 5

4th : Narsipatnam 8, Adirampattinam & Pondicherry 7 each, Yelhanka AP 6, Maya Bandar 5

5th : Mannarghat 7, Bagati (Magra) & Chaparmukh 5 each, Tezu 4

6th : Holenarsipur 4, Malda 3

8th : Car Nicobar 10, Gangtok & Kayamkulam 3 each

9th : Cherrapunji 14, Car Nicobar 7, Gauhati AP & Kailashahar 6 each, Jalpaiguri & Tezu 4 each

10th : Pasighat 21, Agartala AP 8, Silchar AP 7, Trivandrum AP 5

11th : Cherrapunji 36, Pasighat 9, Kailashahar 6, Dibrugarh AP 5, Dhanbad 4

12th : Pasighat 13, Tezu 8, Kozhikode & North Lakhimpur 6 each, Agartala AP 3

13th : Mannarghat 6, Berhampore & Gauhati AP 5 each, Gangtok & Kailashahar 4 each

14th : Sandheads 19, Jalpaiguri 7, Cuttack 5, Calcutta & Chaparmukh 3 each

15th : Car Nicobar 6, Salem 3

16th : Yellandur 16, Alleppey 7, Dhanbad & Sriniketan 4 each

17th : Car Nicobar 6 , Calcutta AP 5, Agartala AP & Narsipatnam 3 each

18th : Tadong 6, Kandaghat 3

19th : Nancowry 8, Pasighat 4, Alleppey, Muzaffarpur & Nidadavole 3 each

20th : Cherrapunji 15, Imphal & Sandheads 6 each Tezu 4, Jalpaiguri 3

21st : Shillong 15, Gauhati AP 6, Agartala AP, Bijapur & Jalpaiguri 3 each

22nd : Cherrapunji 41, Gauhati AP 9, Car Nicobar 8, Agartala AP & Bagati (Magra) 6 each, Pasighat 5

23rd : Chaparmukh 12, Jalpaiguri, & Midnapore 6 each, Tirupati AP 5, Rentachintala 4, Gulmarg, Kailashahar & Minicoy 3 each

24th : Silchar AP 7, Chickmagalur, Shirole & Vellore 6 each, Agartala AP & Pasighat 5 each

25th : Pandavapura 18, Cherrapunji 10, Kottayam, Minicoy & Pasighat 7 each, Agumba & Panambur 6 each

26th : Cherrapunji & Yellandur 8 each, Gauhati AP 7, Agartala AP & Thanjavur 4 each

27th : Cherrapunji 47, Pasighat 10, Cooch Behar & Gauhati AP 6 each, Kasargode & Madurai AP 4 each

28th : Cherrapunji 58, Manantoddy & Tezu 9 each Car Nicobar 7, Amini Divi & Namakkal 6 each, Yellandur 5

29th : Agartala AP 14, North Lakhimpur 9, Maya Bandar 7, Aijal & Cooch Behar 6 each

30th : Agartala AP & Kozhikode 11 each, Chamarajnagar 6, Anantapur, Jagdalpur & Vridhunagar 5 each, Aijal & Alur 4 each

31st : Anatapur 7, Nandyal 6, Alur 5, Chitradurga & Malda 4 each, Cuddapah 3

5.3. *Temperature*

Moderate heat wave conditions prevailed in east Rajasthan on 9th, in Punjab on 13th and on 1 to 3 days in Bihar Plateau, Uttar Pradesh, Punjab and Jammu in the last week of the month. Day temperatures were 6°C to 7°C above normal on 3 days in Arunachal Pradesh during first week and 2 days in Kashmir during the last week of the month. They were generally above

normal, being appreciably so on a few days in Rajasthan, Madhya Pradesh, Gujarat Madhya Maharashtra, Marathwada, Vidarbha, Andhra Pradesh, Tamil Nadu and north interior Karnataka during the period from 6 to 31 May. Appreciably below day temperatures prevailed on most days in Arunachal Pradesh and Assam & Meghalaya between 22nd and 30th of this month.

5.4. *Disastrous weather events and damages*

As per press reports heat wave claimed 13 lives in Nagpur, 71 lives in Rajsthan and about 100 lives in north Madhya Pradesh.

Heavy rain caused floods in *Brahmaputra* and its tributaries in Assam in the last week of May. It affected about 1.3 million people in Nowgong, Karbianglong, Kamrup, Nalbari and Lakhimpur districts and inundated about 1100 villages. It claimed a toll of 30 human lives and damaged about 19,738 houses and crops in 2.17 lakh hectares. Road and rail communication remained completely disrupted for several days as the roads were submerged and the railway tracks were damaged. Also heavy rain had submerged roads in Agartala and its adjoining areas on 29th disrupting vehicular traffic. Rain water entered hundreds of houses in Agartala town.