Early Warning Mechanism

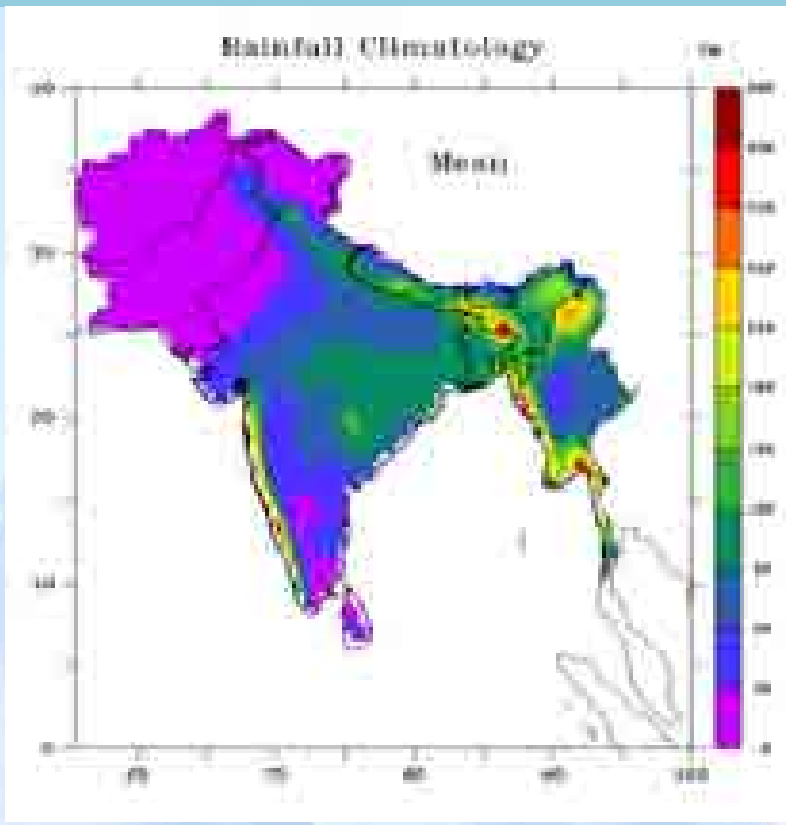
Naresh Kumar

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Weather Related Natural hazards occur throughout the year

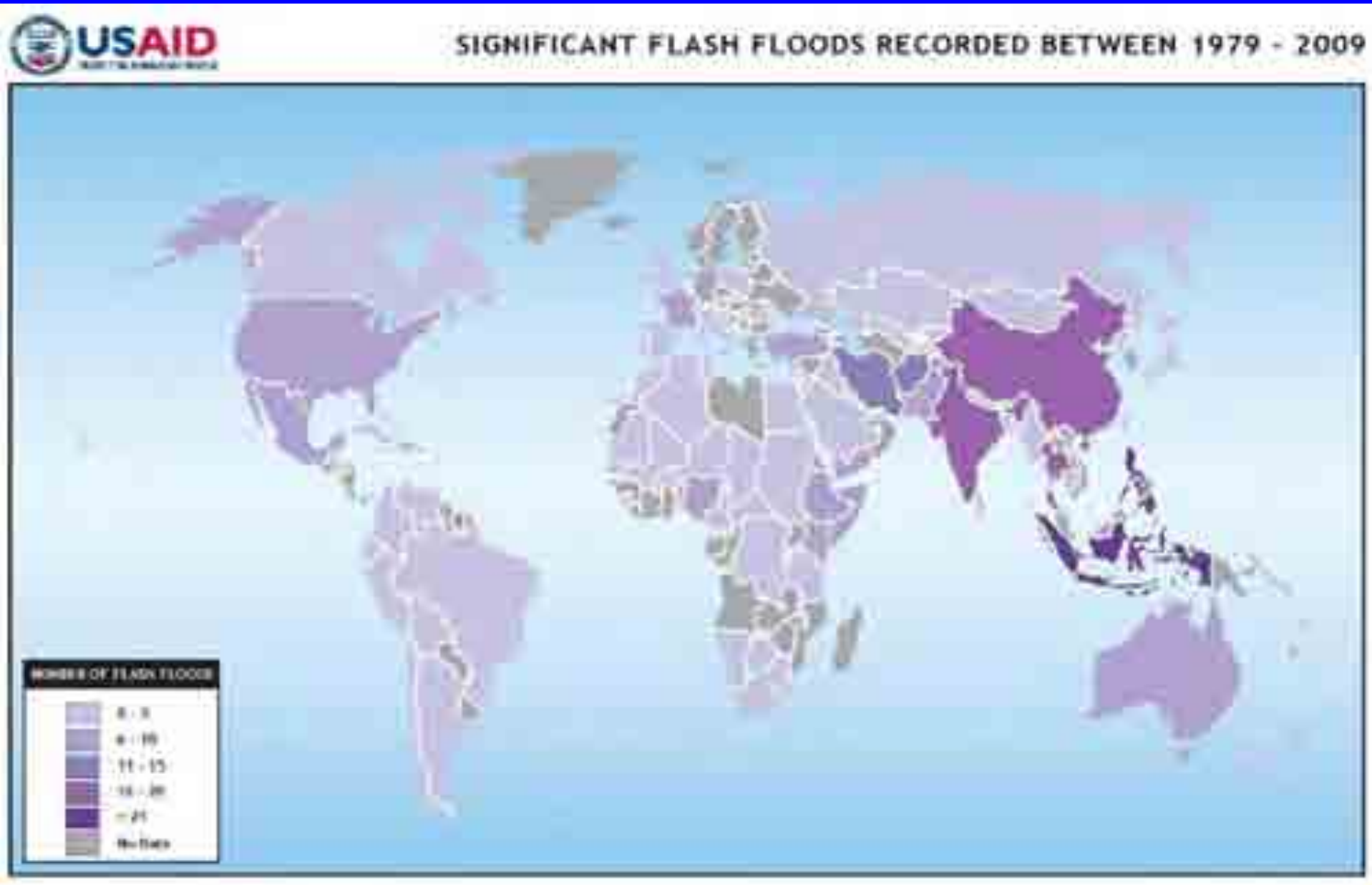
- WINTER (JAN-FEB)
- PRE-MONSOON (MAR-MAY)
- MONSOON (JUN-SEP)
- POST-MONSOON (OCT-DEC)

- WD
- COLD WAVE, FOG, HEAVY SNOW, AVALANCHE
- CYCLONIC DISTURBANCES
- HEAT WAVE
- THUNDER STORMS, SQUALLS
- HAIL STORM
- TORNADO
- HEAVY RAINFALL,
- FLOODS
- FLASH FLOOD
- DROUGHTS
- CYCLONIC DISTURBANCES
- NORTHEAST MONSOON
- EASTERLY WAVE



Near 90 % of loss of life due to natural disasters is caused by Weather, Climate and Water related hazards

FLASH FLOODS RECORDED BETN 1979-2009



FLASH FLOOD

- In India, flash flood are occurred more frequently over the northern states of India from Kashmir in the west to Arunachal Pradesh in the east.
- The major cause of flash floods in these areas are due to incidence of heavy rainfall and cloudbursts.
- Other causes of flash floods are landslide, dam bursts and rapid snow/glacier melts. The states of Himachal Pradesh, Uttaranchal and Arunachal Pradesh are the worst affected by flash flood (S. Chandra, 2007).
- Some times, Cyclonic Disturbances in the coastal areas of Orissa, West Bengal, Andhra Pradesh, Karnataka, and Tamil Nadu also cause flash floods .
- In Past, there are many instances, when flash flood in the mountain streams of the Himalayas have caused immense loss like washing away many villages, bridges and roads etc.

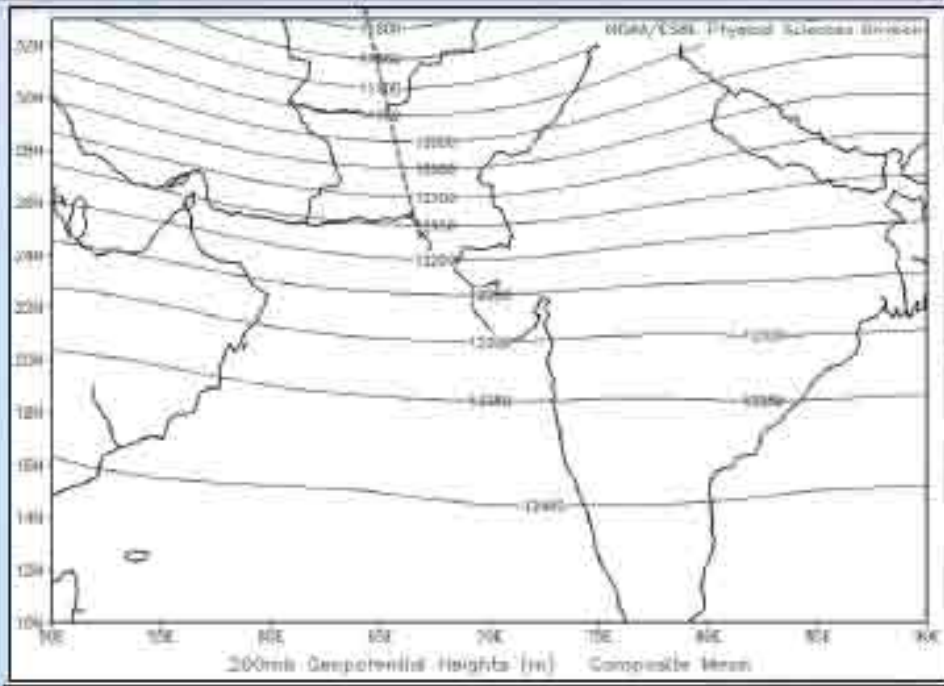
Meteorological features associated with severe weather over Himalayas and adjoining plains

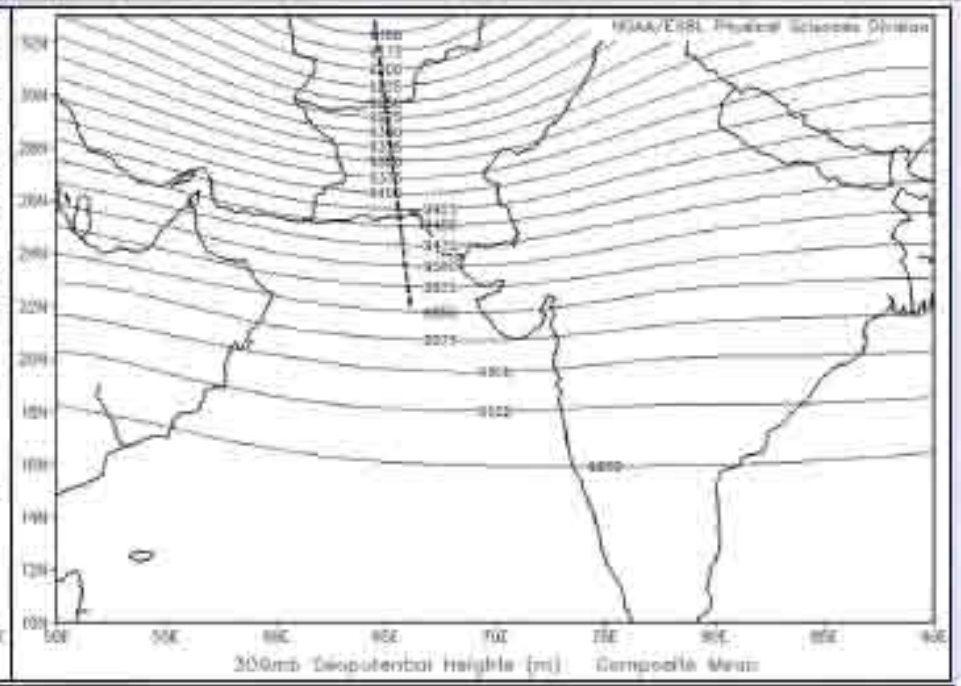
Western Disturbance

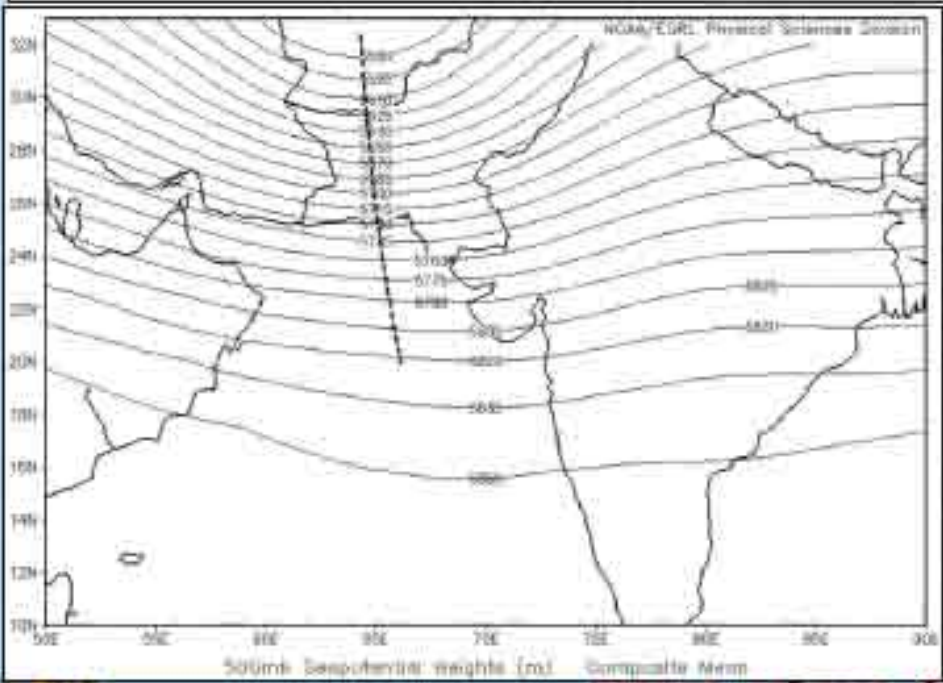
- Western Disturbances are the extra-tropical baroclinic systems in the form of upper air troughs or cyclonic circulations (CCs) in mid-latitude westerlies that move west to east across northwest India (Das et al., 2002; Lang and Barros, 2004; Puranik and Karekar, 2009, Naresh et al. 2015, 2017).
- Movement of WDs five degrees in a day, sometimes much lesser.
- Firstly these systems cause weather over Iran, Afghanistan & Pakistan. Thereafter, it take fresh moisture feed from Arabian Sea and cause precipitation over WHR & adjoining plains.

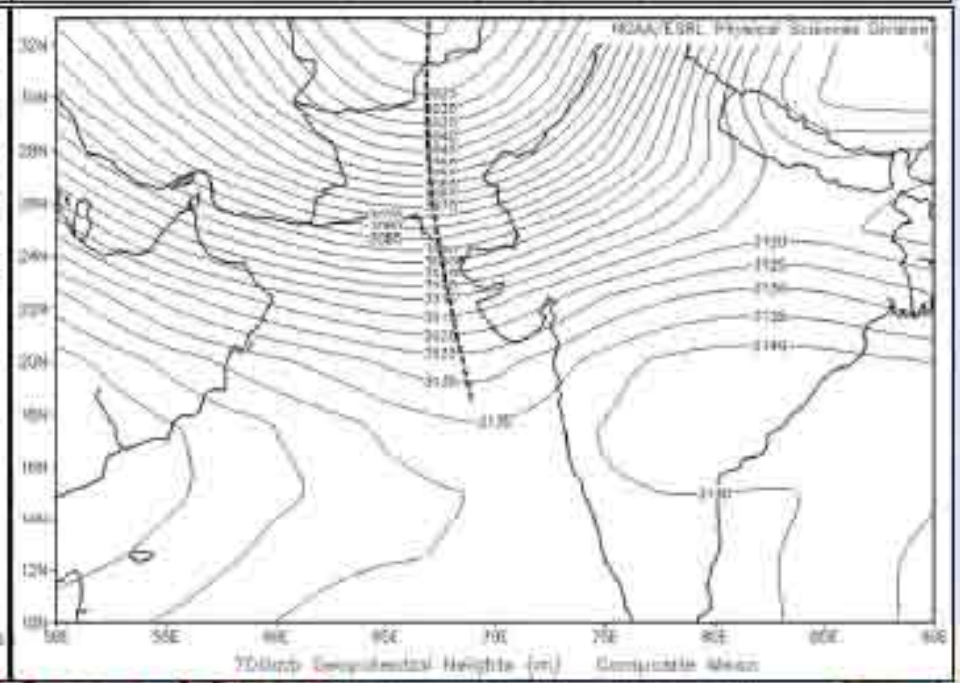
Western Disturbance

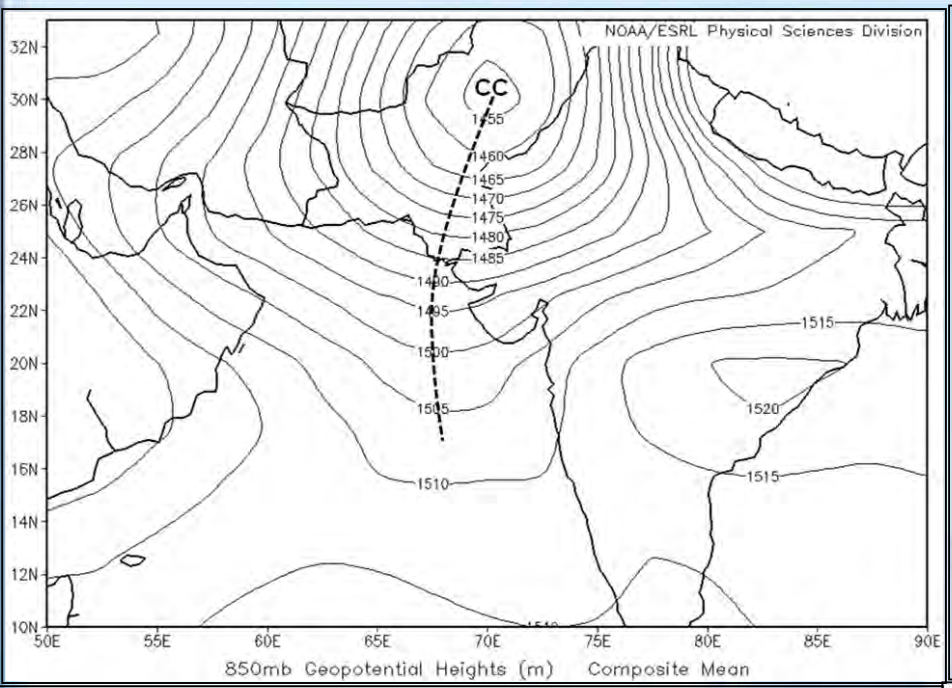
- Thereafter while moving eastward, it cause some precipitation over Nepal, Bhutan and Arunachal Pradesh.
- In the absence of fresh moisture feed from Arabian Sea, it only cause light precipitation over higher reaches of WHR.
- Generally after passage of WD, Tmin falls significantly over adjoining plains due to cold northwesterly winds. As a result Cold Wave, Frost and FOG occurs over adjoining plains of Himalayas.

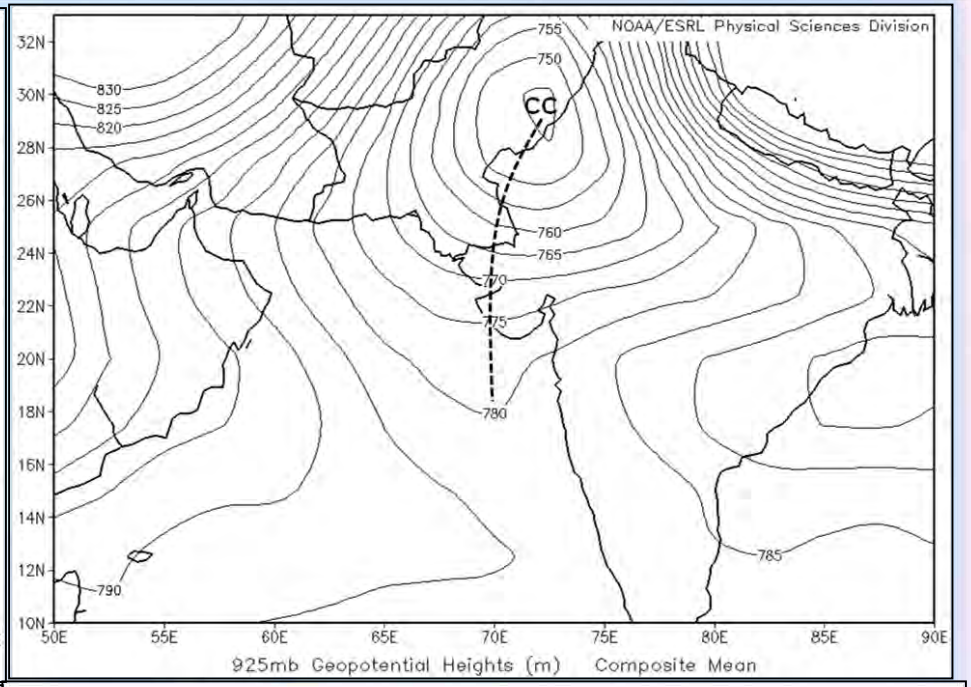

NOAA/ESRL Physical Sciences Division
200mb Geopotential Heights (m) Composite Mean

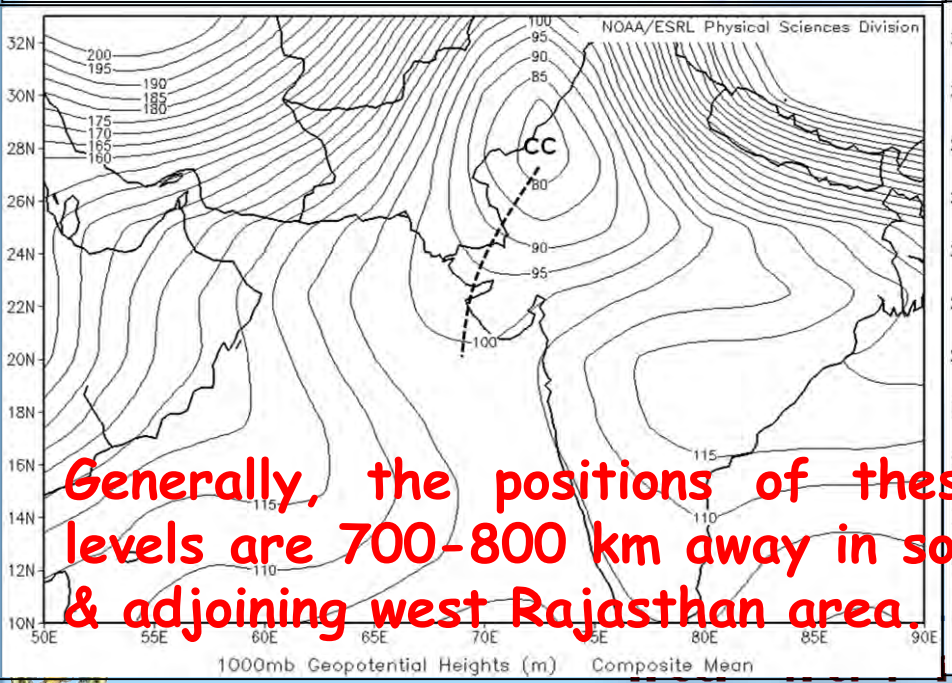

NOAA/ESRL Physical Sciences Division
300mb Geopotential Heights (m) Composite Mean

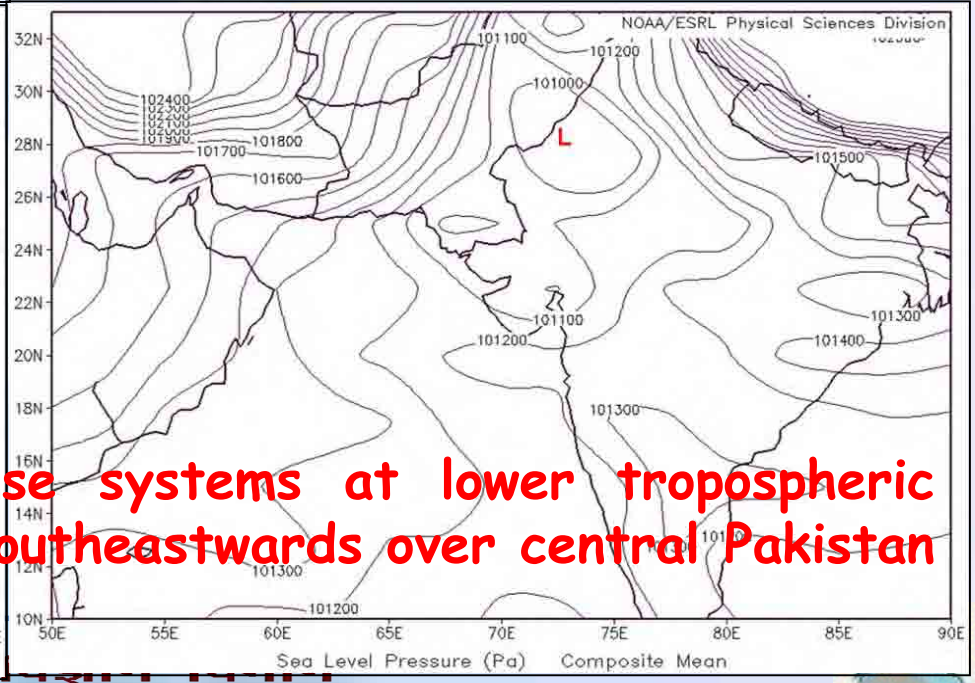

NOAA/ESRL Physical Sciences Division
500mb Geopotential Heights (m) Composite Mean


NOAA/ESRL Physical Sciences Division
700mb Geopotential Heights (m) Composite Mean





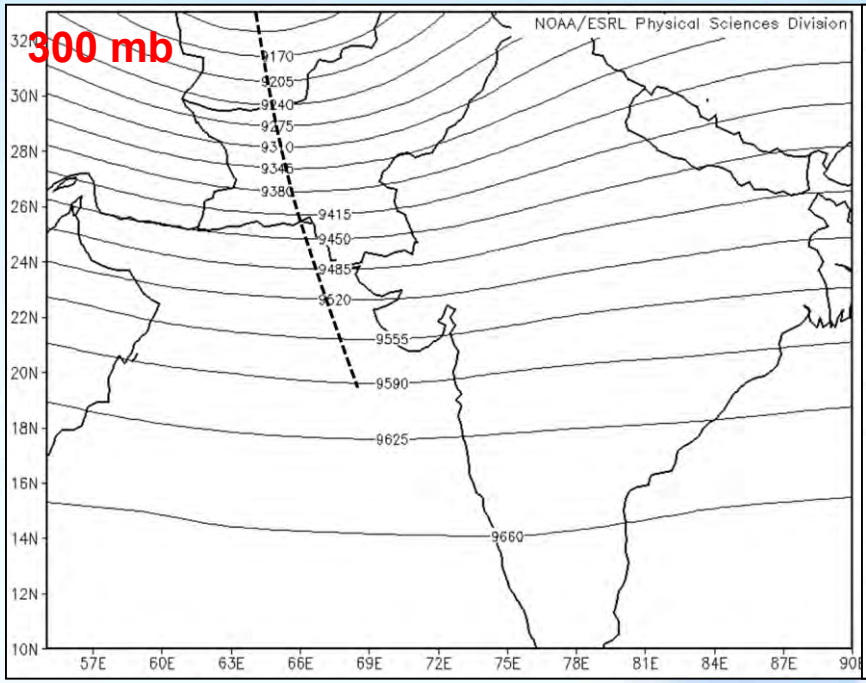




Generally, the positions of these systems at lower tropospheric levels are 700-800 km away in southeastwards over central Pakistan & adjoining west Rajasthan area.

Features associated with extreme precipitation over Himalayas

- Daily precipitation data of all surface observatories located in Jammu & Kashmir for the winter season (December to March) from 1985-2016 are used to find the extreme precipitation events over the region.
- During analysis, total 14 intense WDs cases are found.


300 mb
NOAA/ESRL Physical Sciences Division
9170
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9625
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30N
28N
26N
24N
22N
20N
18N
16N
14N
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57E
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63E
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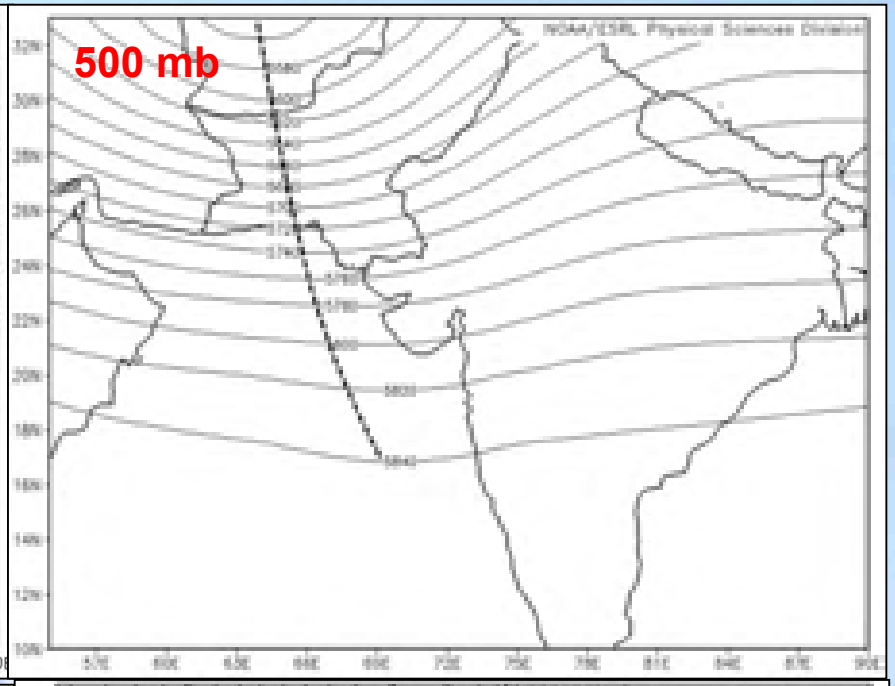
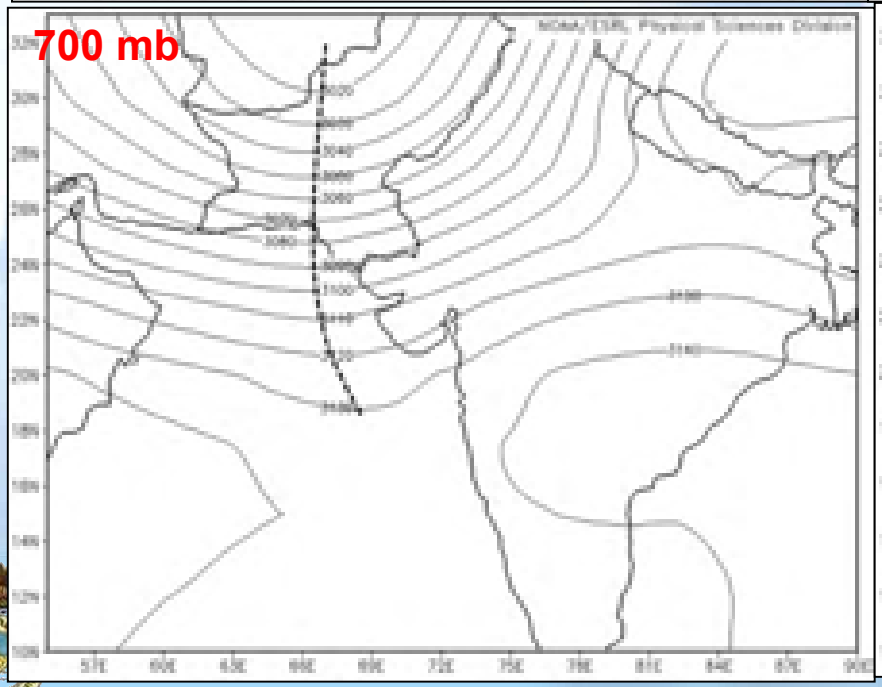
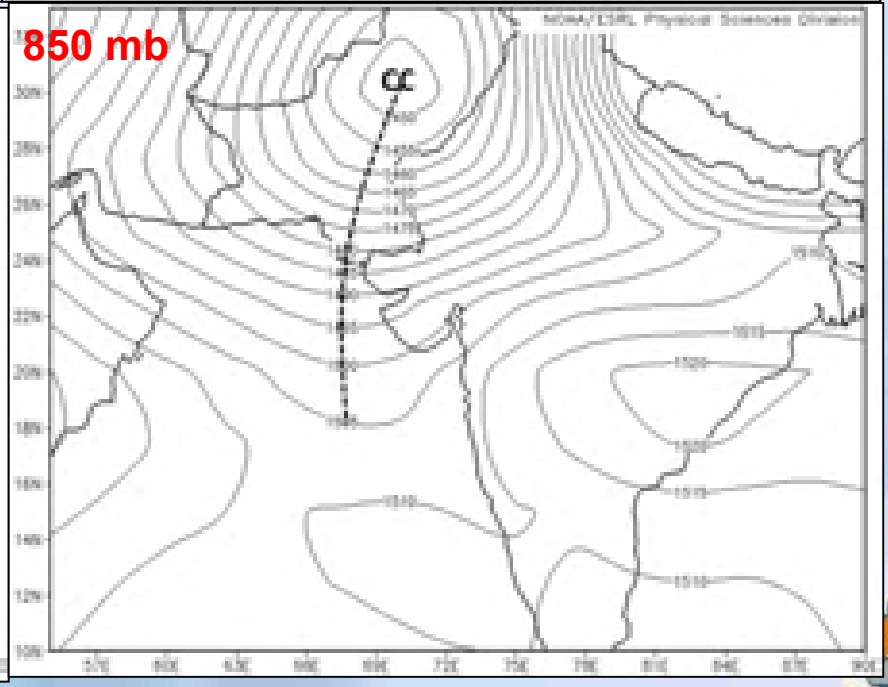
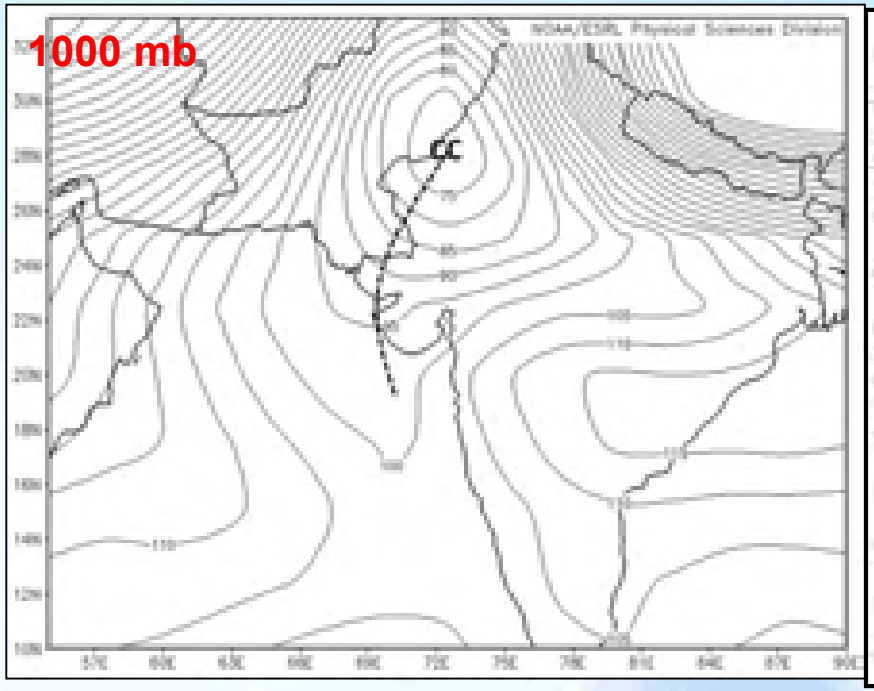
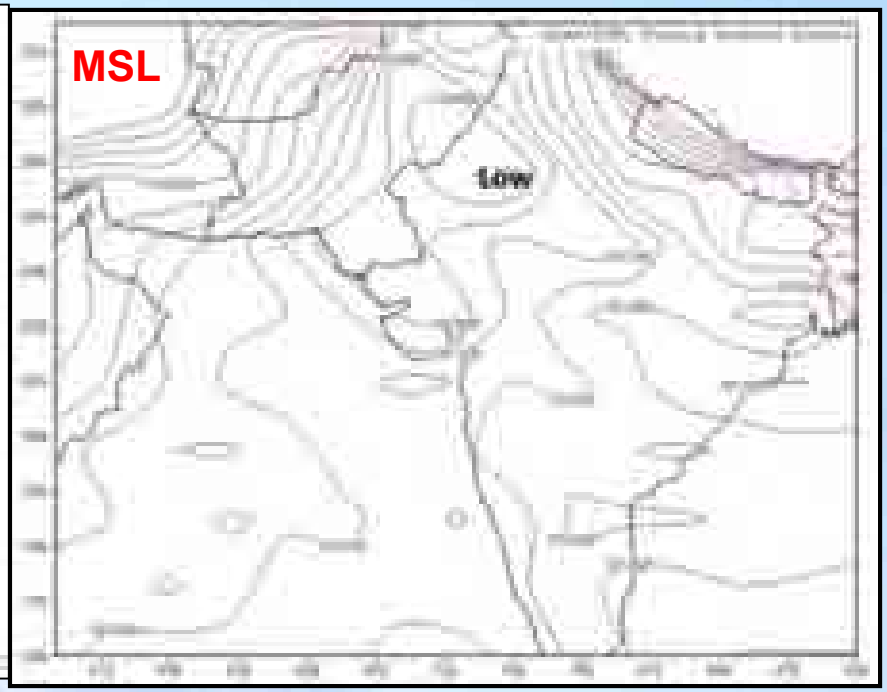
72E
75E
78E
81E
84E
87E


500 mb
NOAA/ESRL Physical Sciences Division


700 mb
NOAA/ESRL Physical Sciences Division

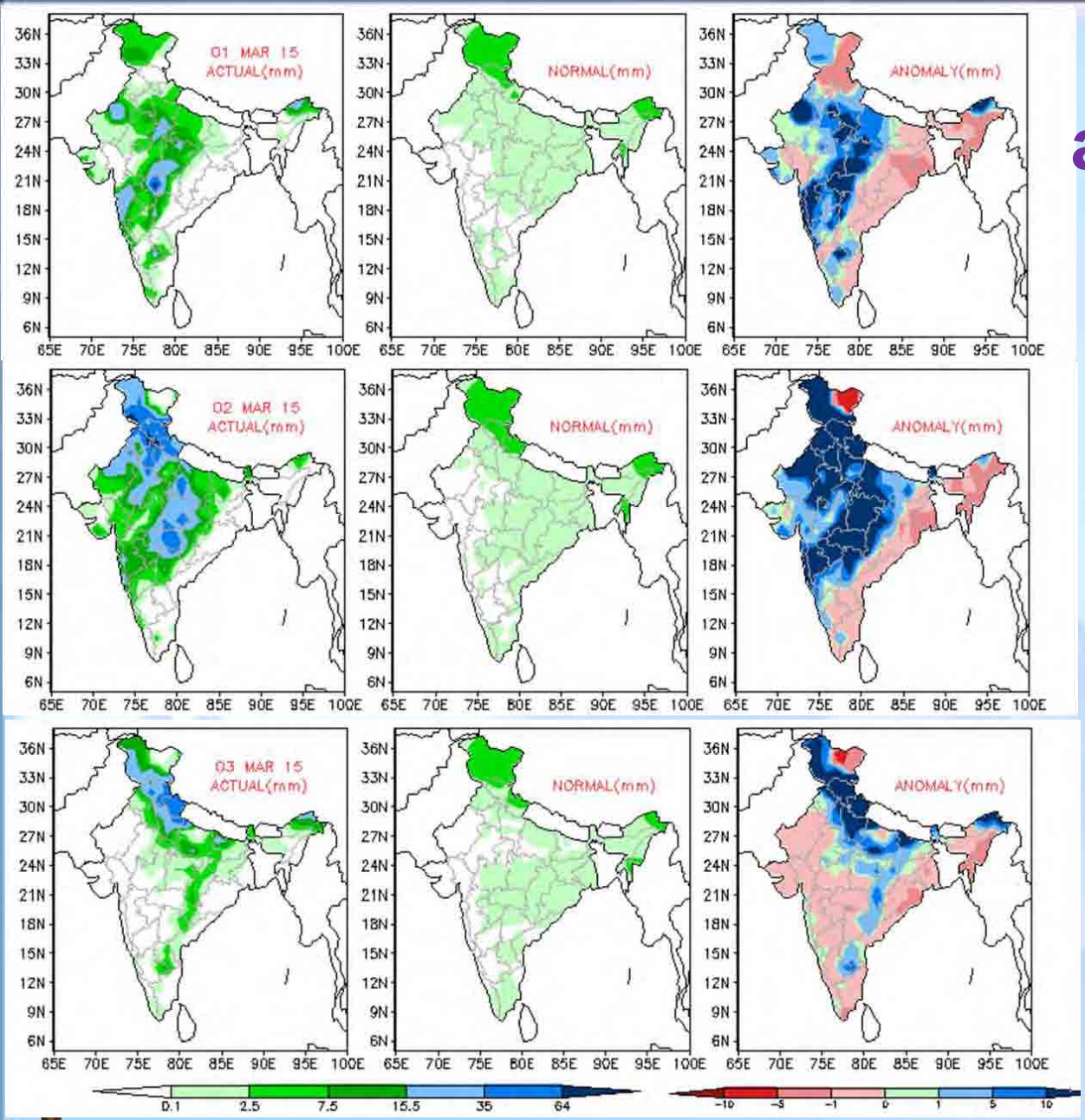

850 mb
NOAA/ESRL Physical Sciences Division





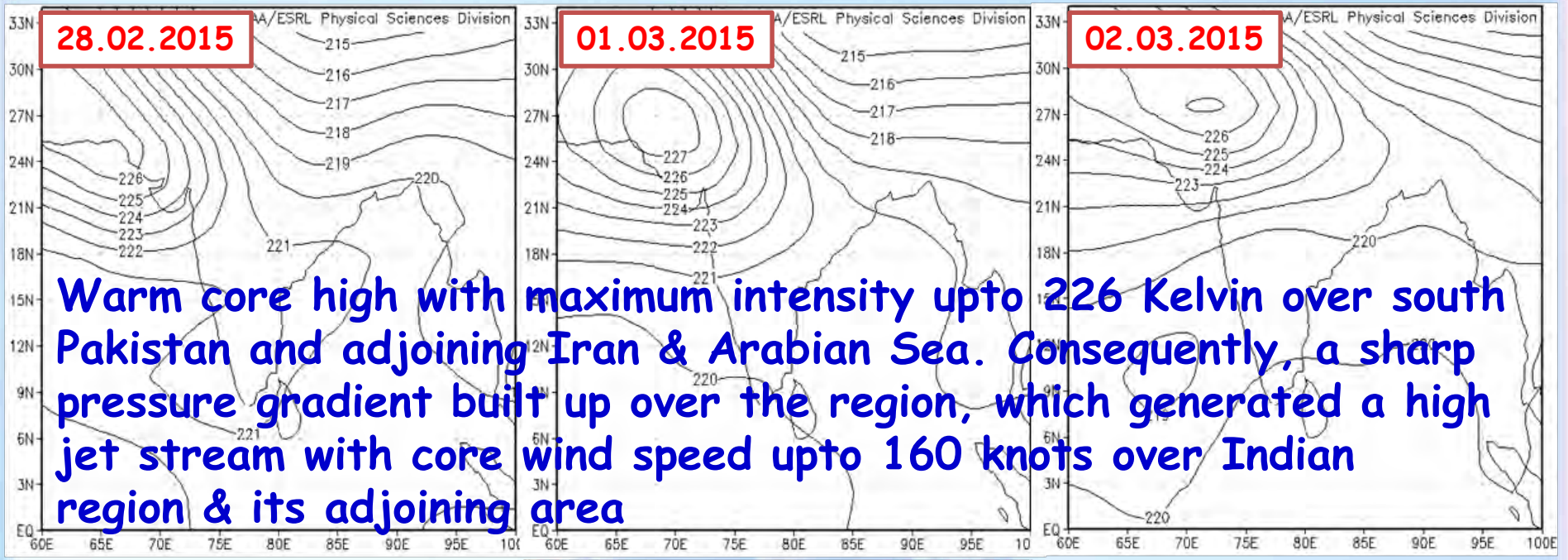
The composite mean charts of very heavy precipitation days associated with all the 14 WDs indicated that these are seen as CCs upto 850 mb over central Pakistan & adjoining west Rajasthan area along with a trough from the centre of CCs to deep in central Arabian Sea and as a deep north-south trough between longitude 63° to 67°E with its southern tip deep in central Arabian Sea between 700 to 200 mb resultant in huge moisture feed from Arabian Sea to Himalayan region from lower & upper levels.

Features associated with extreme precipitation over Plains

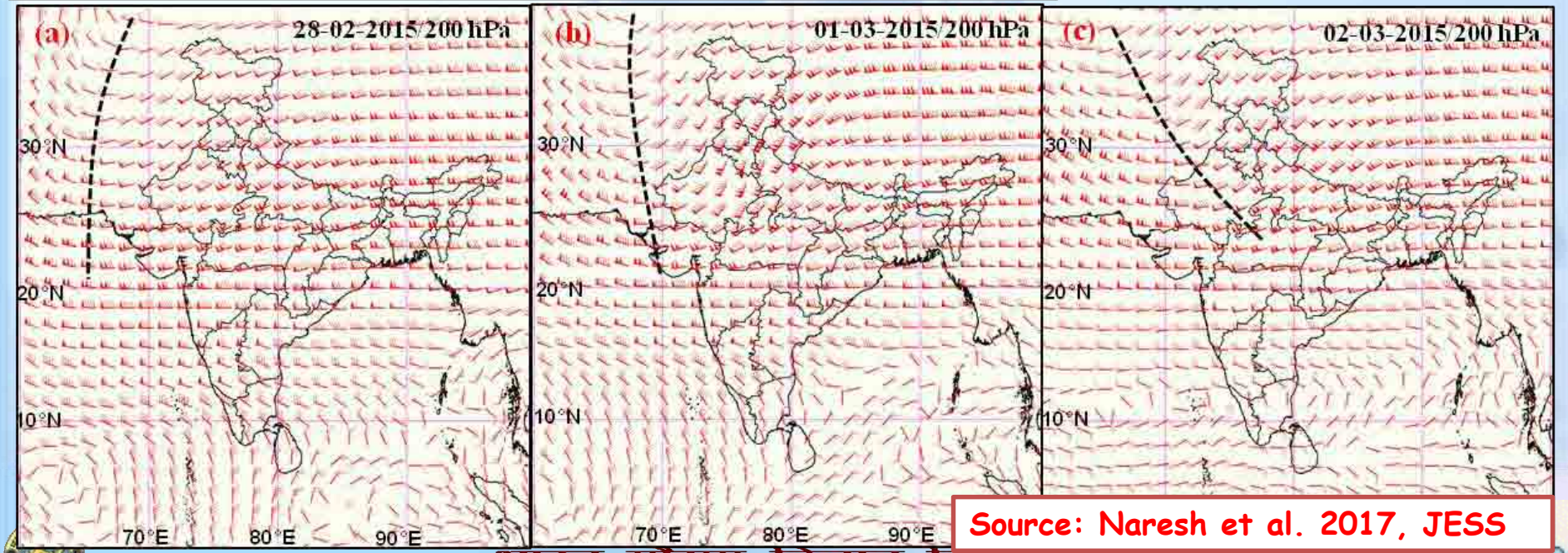


Actual, normal & anomaly of precipitation in past 24 hours of 1st, 2nd & 3rd March 2015 (reported at 0830 hours IST)

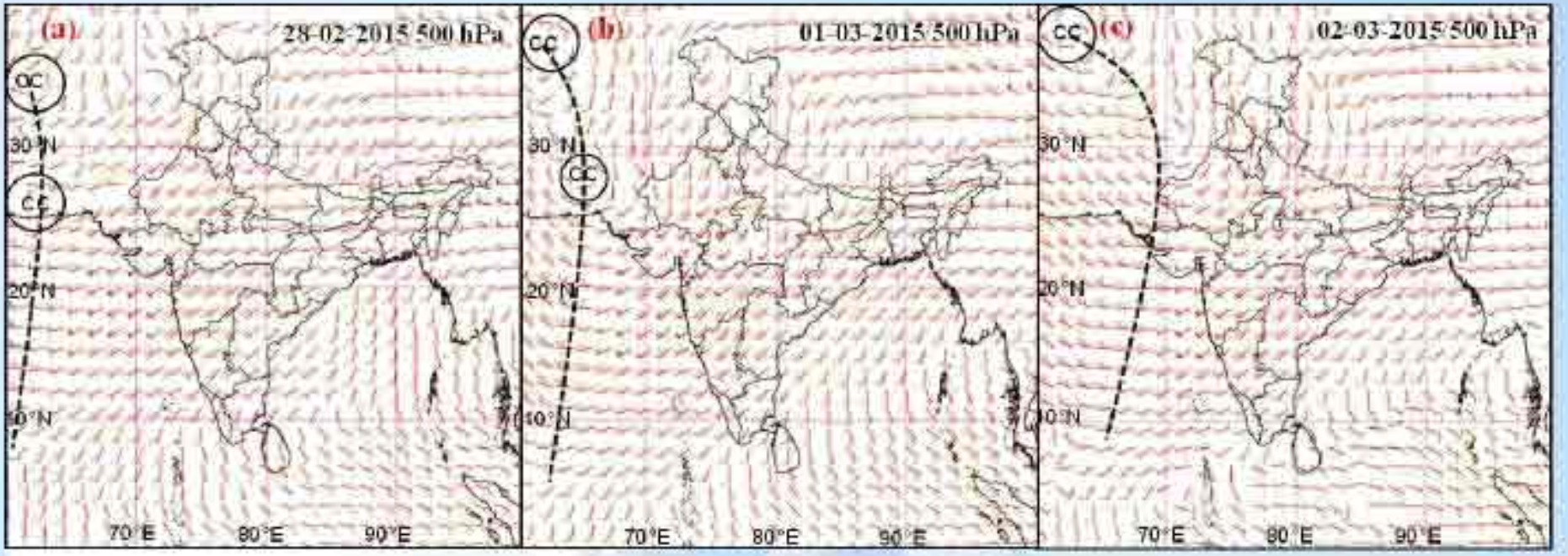
(Source: IMD Pune)



Warm core high with maximum intensity upto 226 Kelvin over south Pakistan and adjoining Iran & Arabian Sea. Consequently, a sharp pressure gradient built up over the region, which generated a high jet stream with core wind speed upto 160 knots over Indian region & its adjoining area



Source: Naresh et al. 2017, JESS


(a)
28-02-2015/500 hPa
CC
CC
30°N
20°N
10°N
70°E
80°E
90°E
(b)
01-03-2015/500 hPa
CC
CC
30°N
20°N
10°N
70°E
80°E
90°E
(c)
02-03-2015/500 hPa
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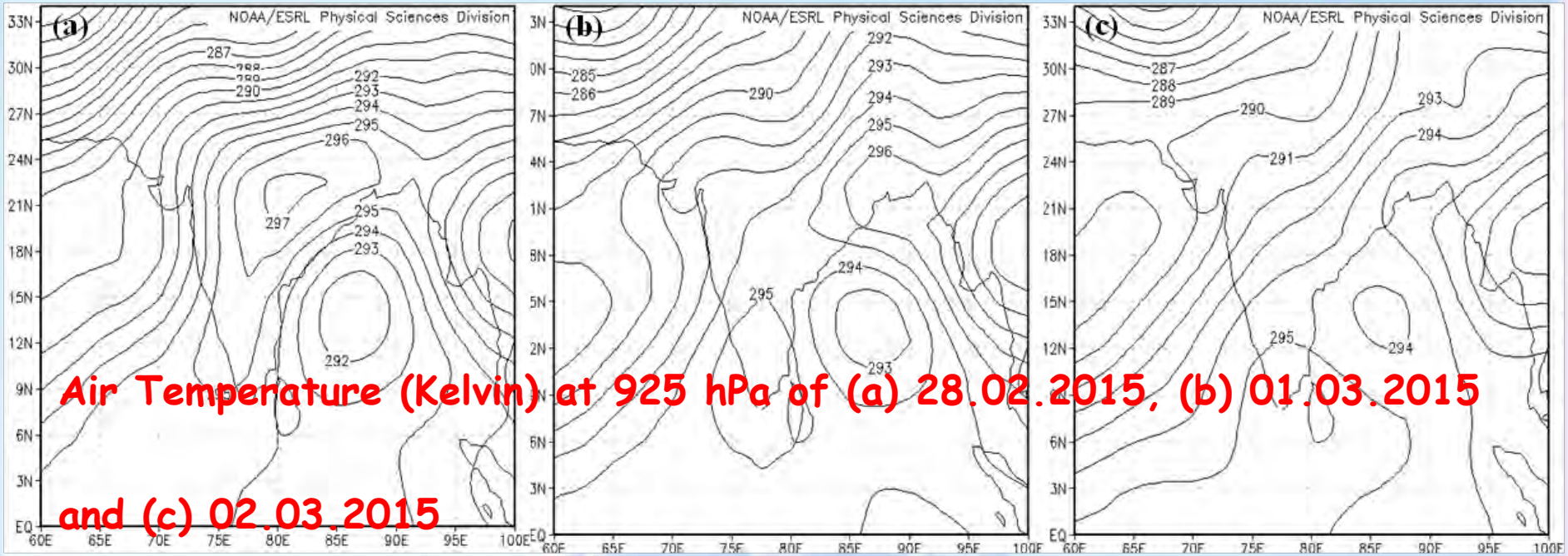
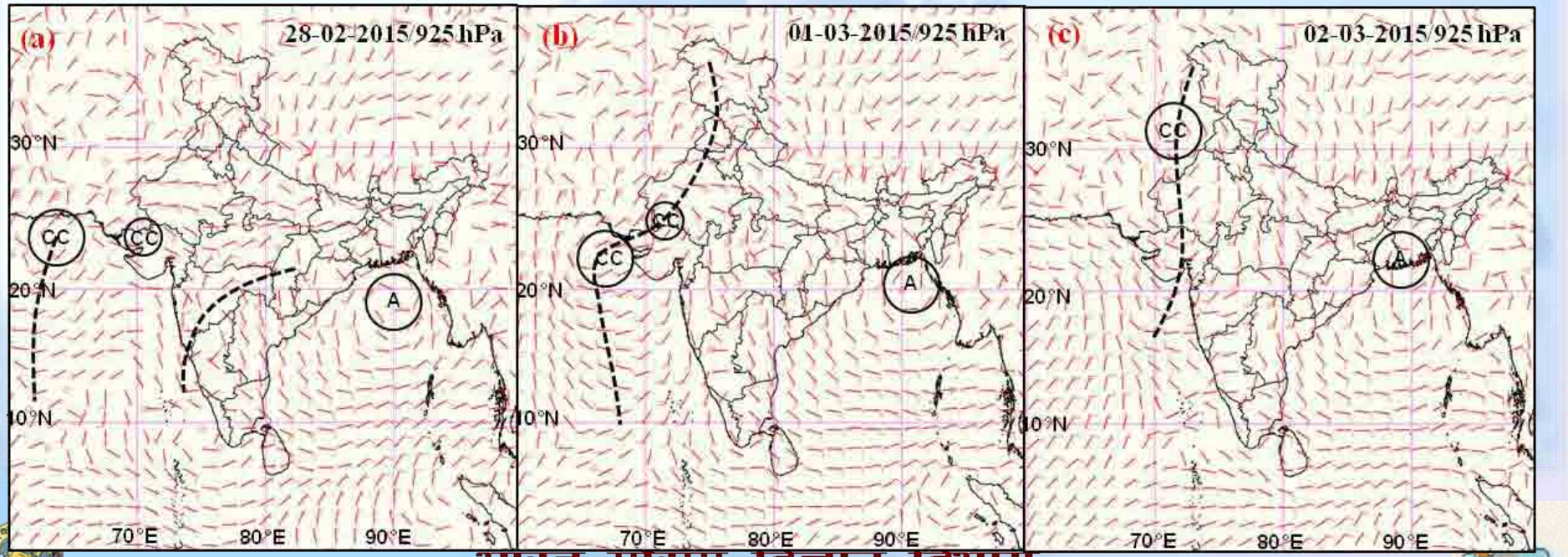
20°N
10°N
70°E
80°E
90°E



Air Temperature (Kelvin) at 925 hPa of (a) 28.02.2015, (b) 01.03.2015 and (c) 02.03.2015



The WD was in the form of north-south deep westerly trough in middle & upper tropospheric levels with its southern end deep in Arabian Sea, which pumped huge moisture feed over Indian region.

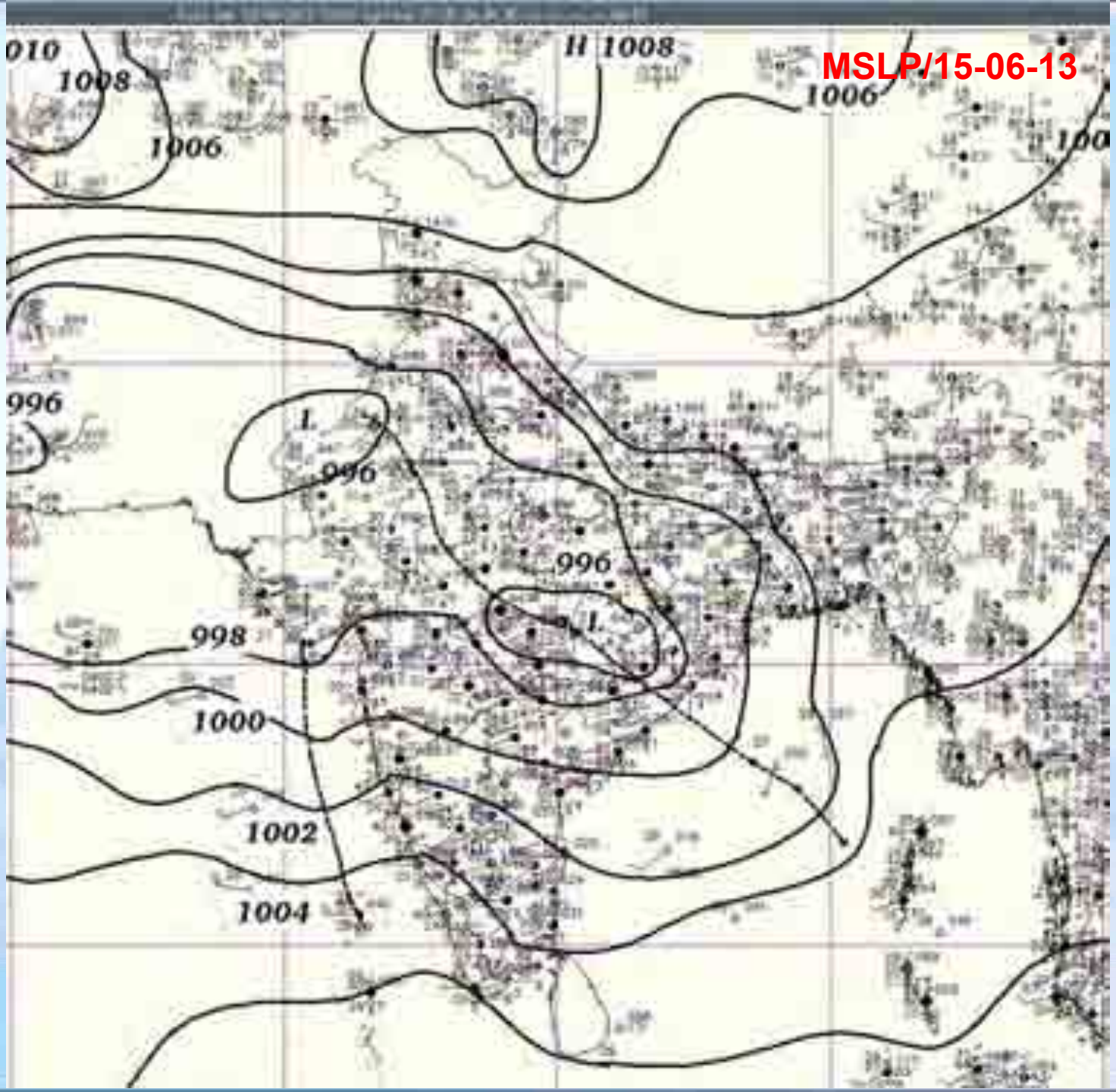
Also, there was a Jet stream with core wind speed upto 160 knots that generated high positive divergence at upper tropospheric level over Indian region.

It caused intense upwards motion and forced lower levels air to rise and strengthen the lower levels CCs/Lows.

Also, the induced CCs/Lows at lower tropospheric levels associated with WD were very much south of its normal position.

Additionally, there was high wind confluence over central parts India due to westerlies in association with WD and easterlies from anticyclone over north Bay of Bengal.

2013 Monsoon extreme rainfall event from 15-17 June over Uttarakhand


MSLP/15-06-13
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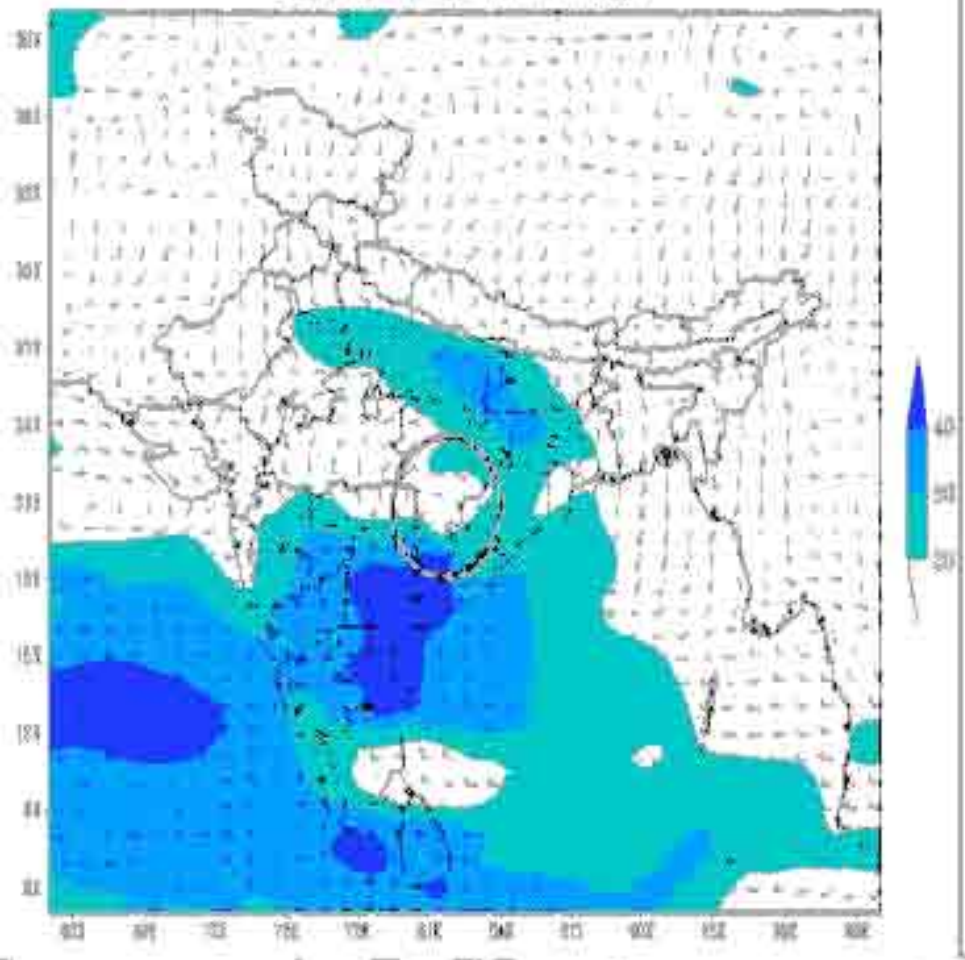
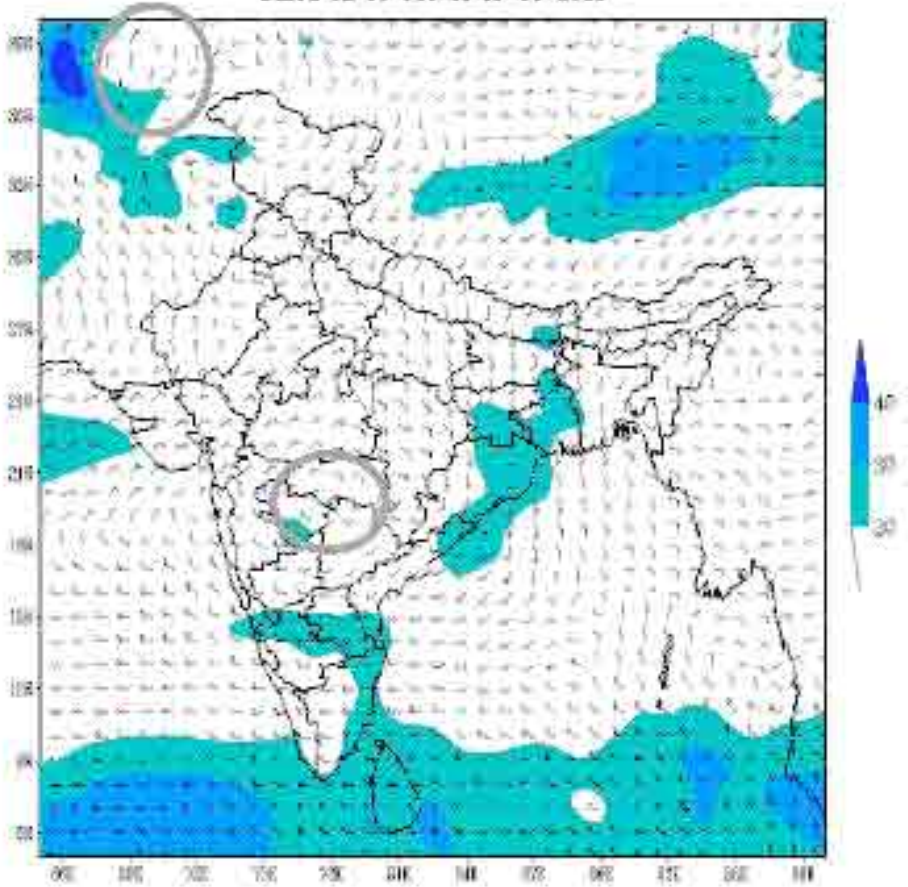
IMD GFS 850 hPa WIND (kt) ANALYSIS (00H)

Based on 00 UTC of 15-06-2013



IMD GFS 500 hPa WIND (kt) ANALYSIS (00H)

Based on 00 UTC of 15-06-2013



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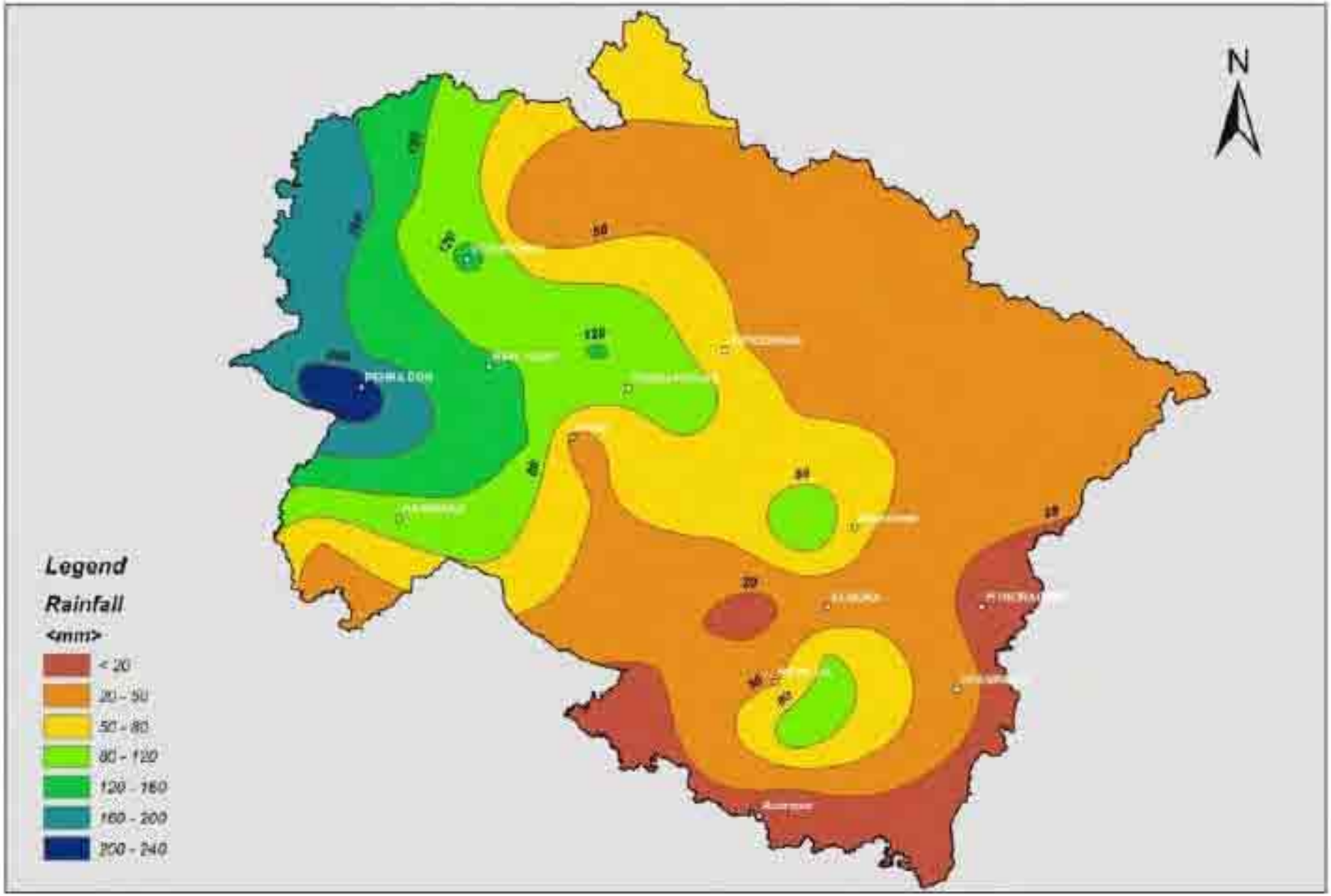
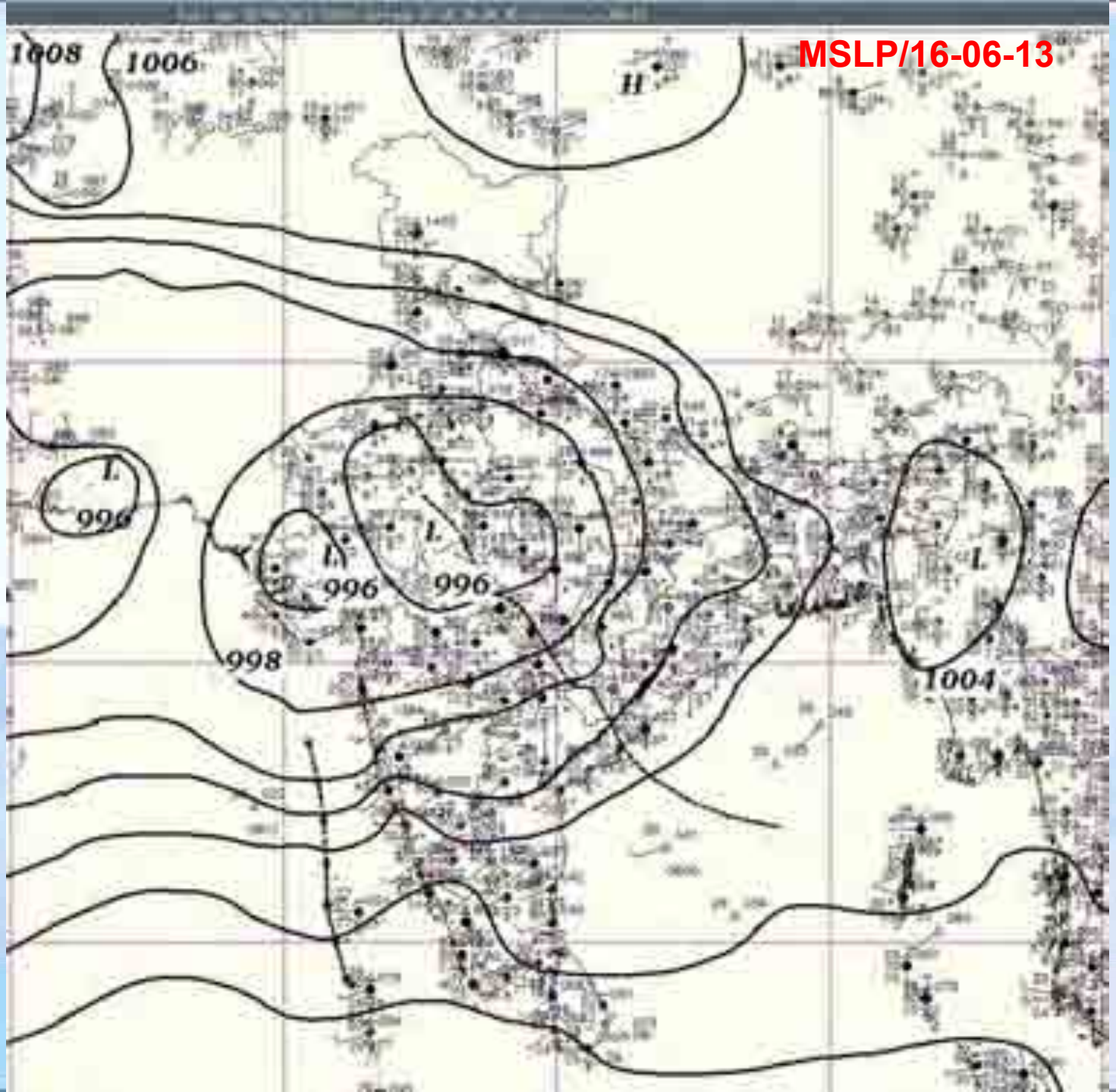
INDIA METEOROLOGICAL DEPARTMENT

Uttarakhand Rainstorm : 16 June 2013




MSLP/16-06-13
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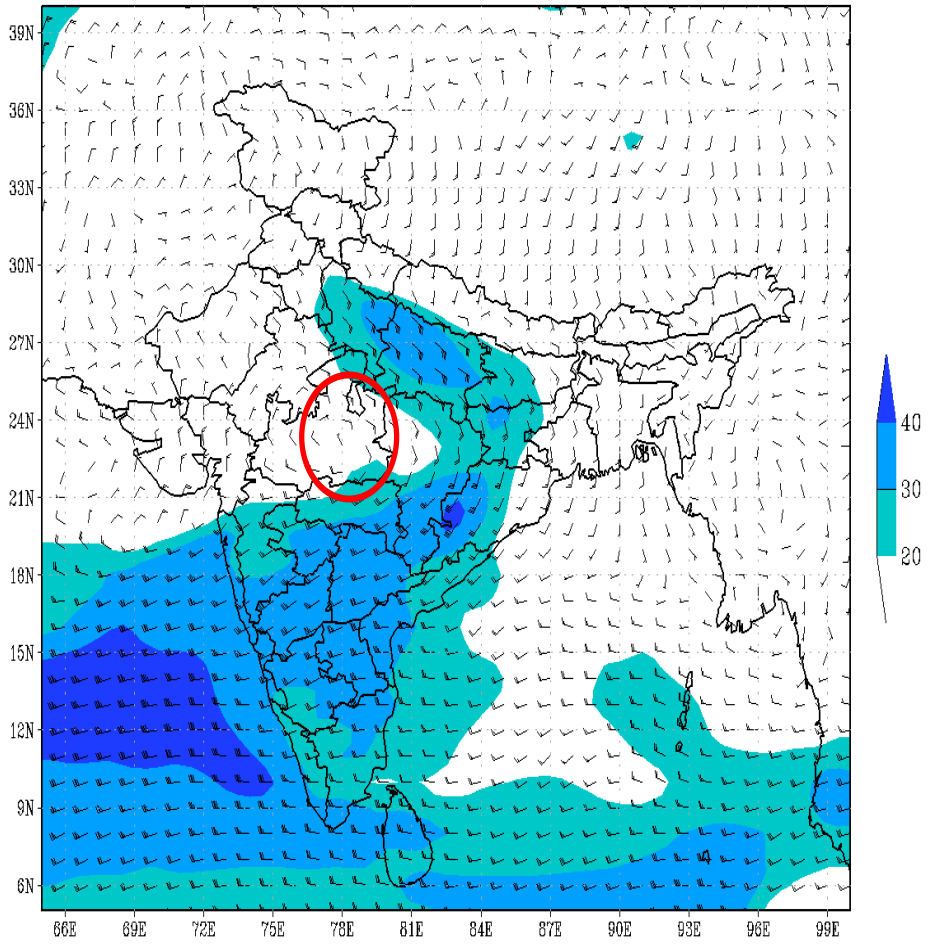
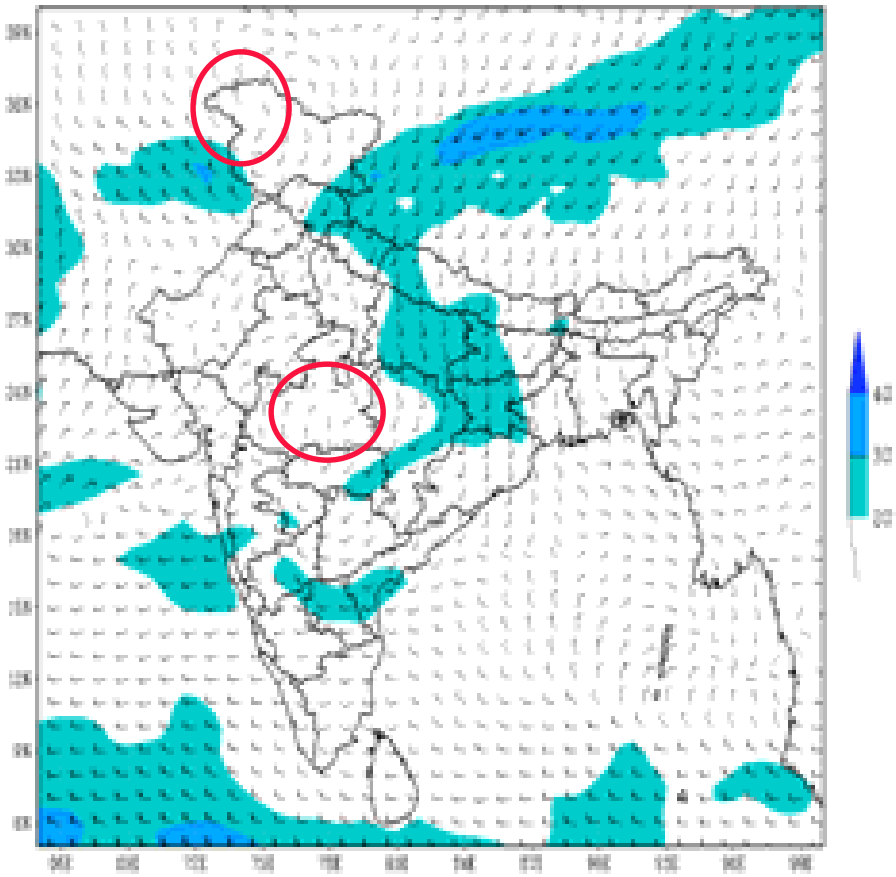
IMD GFS 850 hPa WIND (kt) ANALYSIS (00H)

Based on 00 UTC of 16-06-2013



IMD GFS 500 hPa WIND (kt) ANALYSIS (00H)

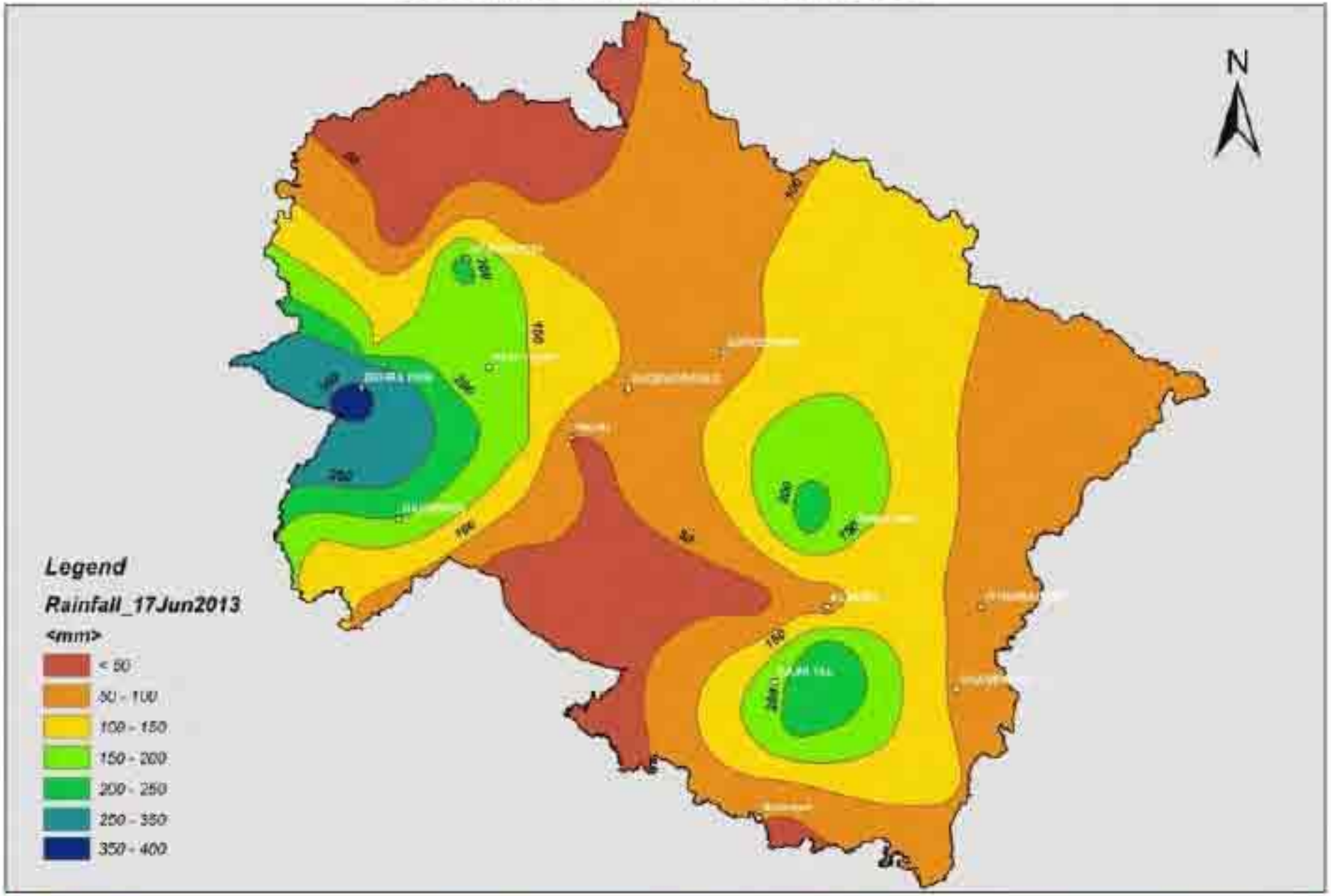
Based on 00 UTC of 16-06-2013

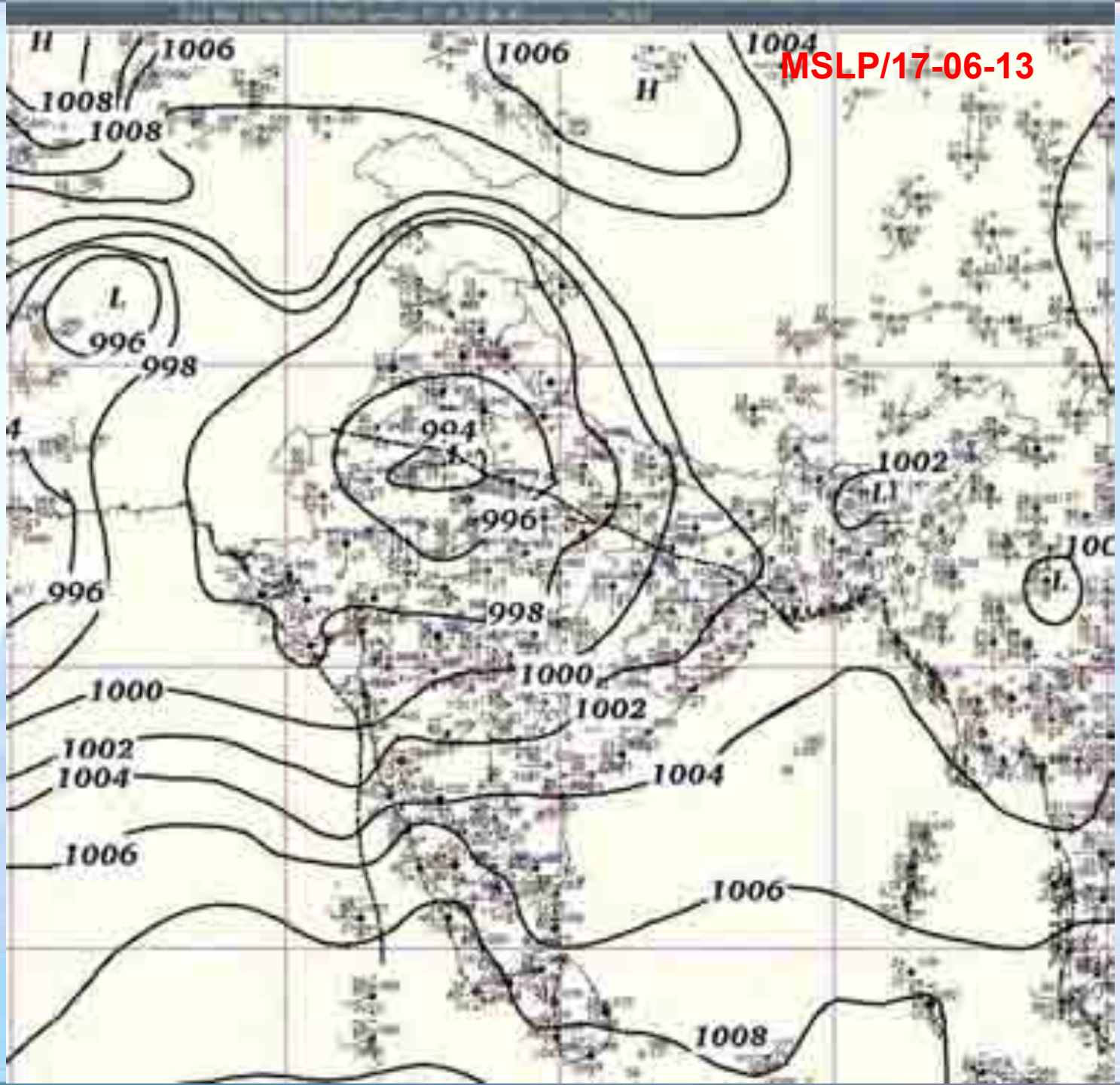


भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

Uttarakhand Rainstorm : 17 June 2013




MSLP/17-06-13
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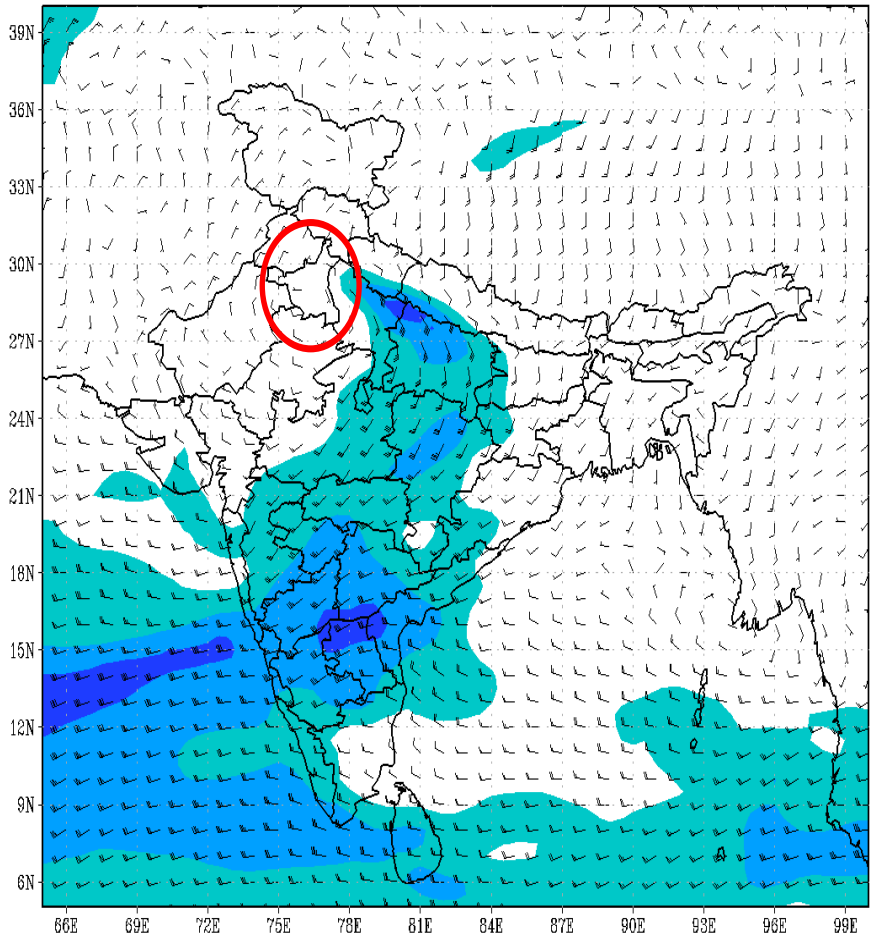
IMD GFS 850 hPa WIND (kt) ANALYSIS (00H)
Based on 00 UTC of 17-06-2013
39N
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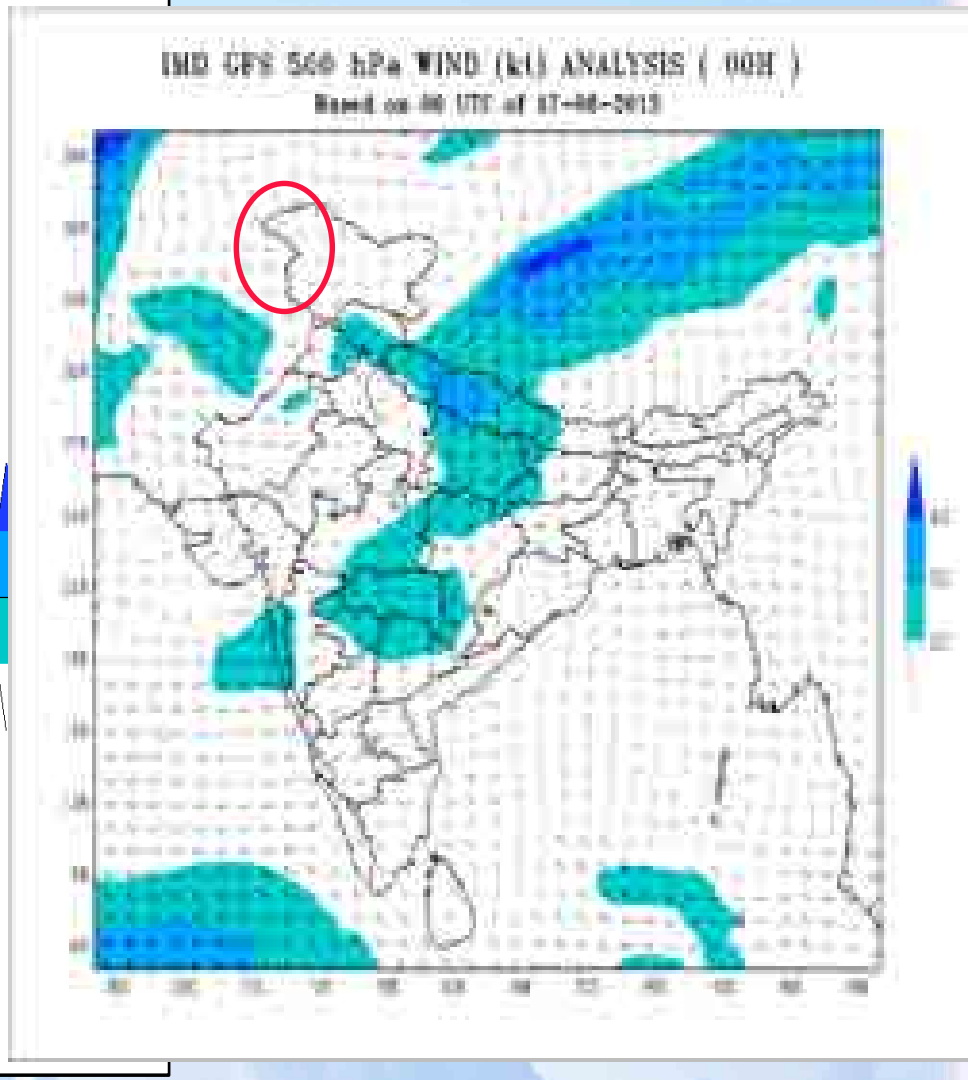
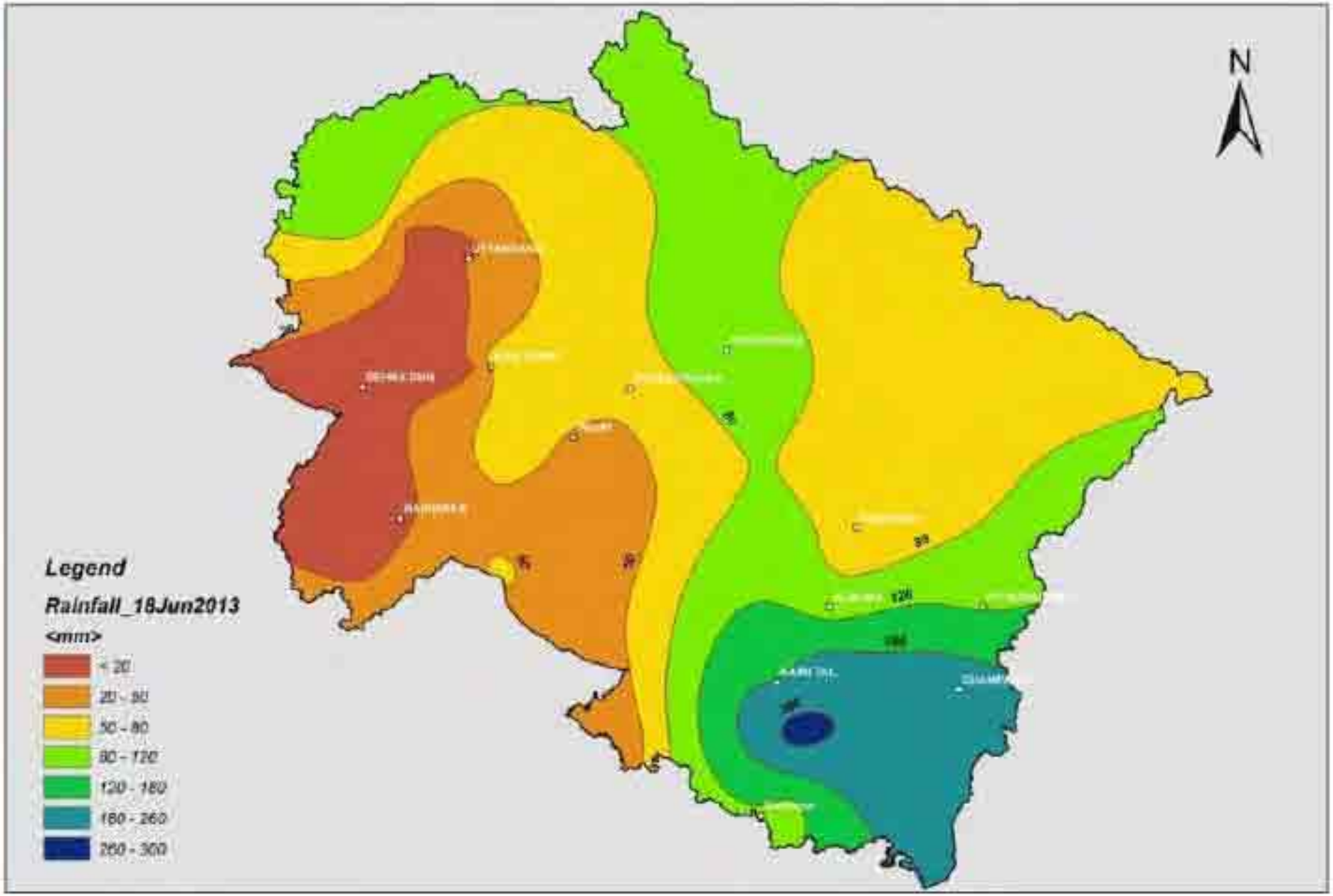
33N
30N
27N
24N
21N
18N
15N
12N
9N
6N
66E
69E
72E
75E
78E
81E
84E
87E
90E
93E
96E
99E


IMD GFS 560 hPa WIND (kt) ANALYSIS (00H)

Uttarakhand Rainstorm : 18 June 2013



2014 Monsoon extreme rainfall event from 2-5 September over Jammu & Kashmir


MSLP/02-09-14
2 LPA
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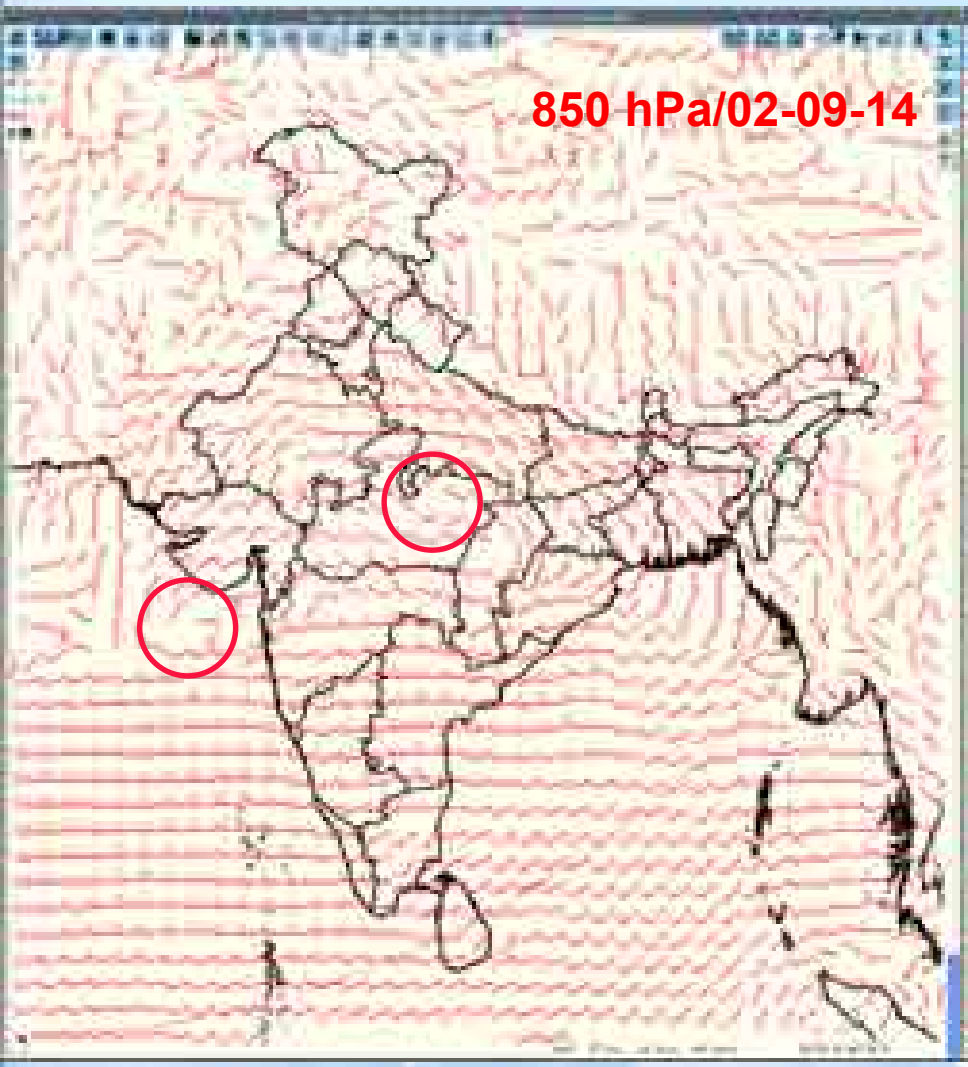
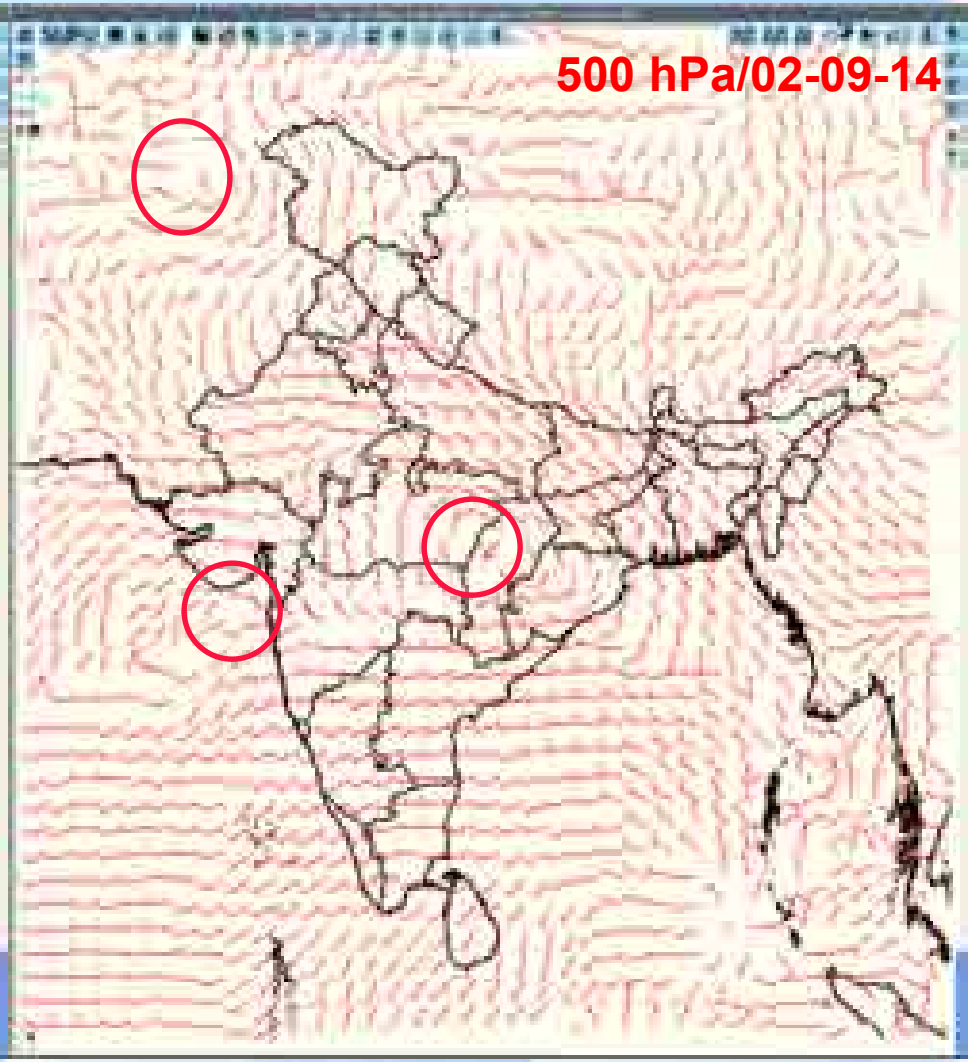
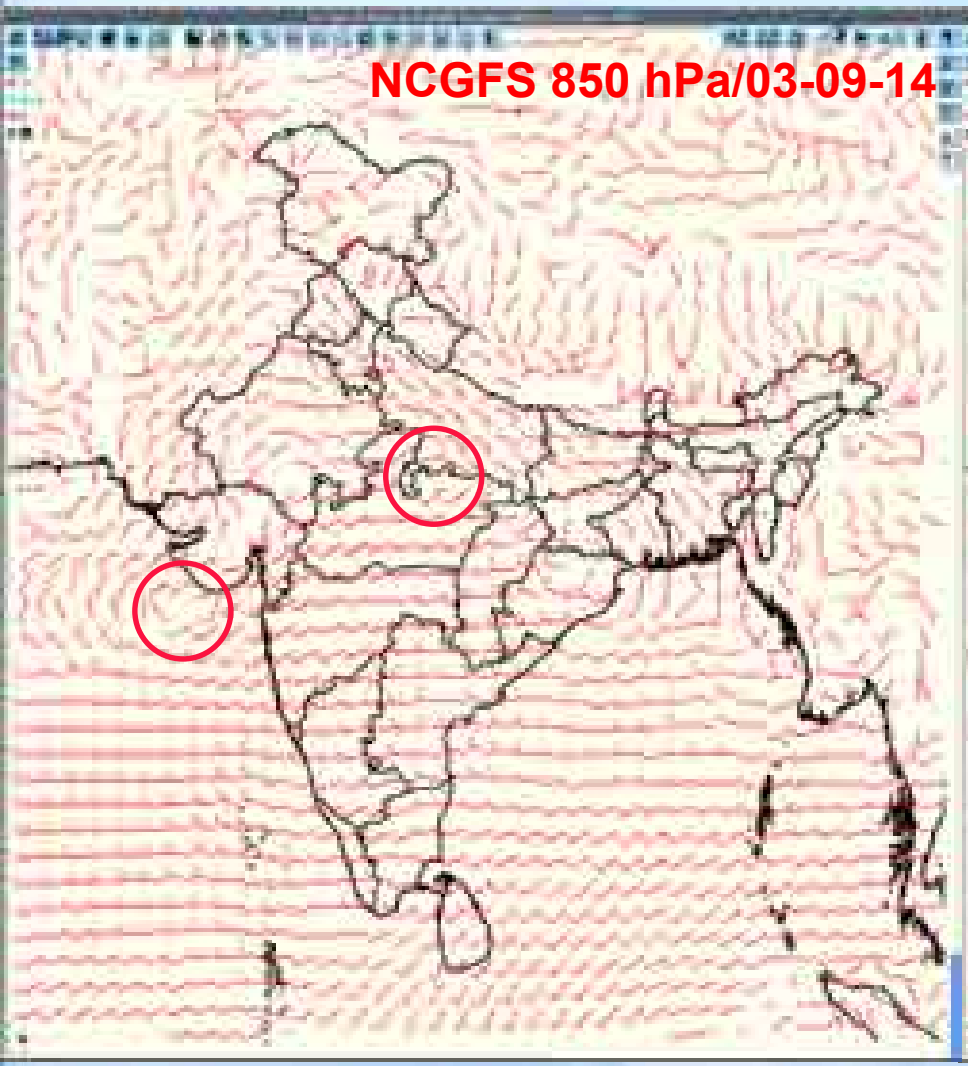

850 hPa/02-09-14

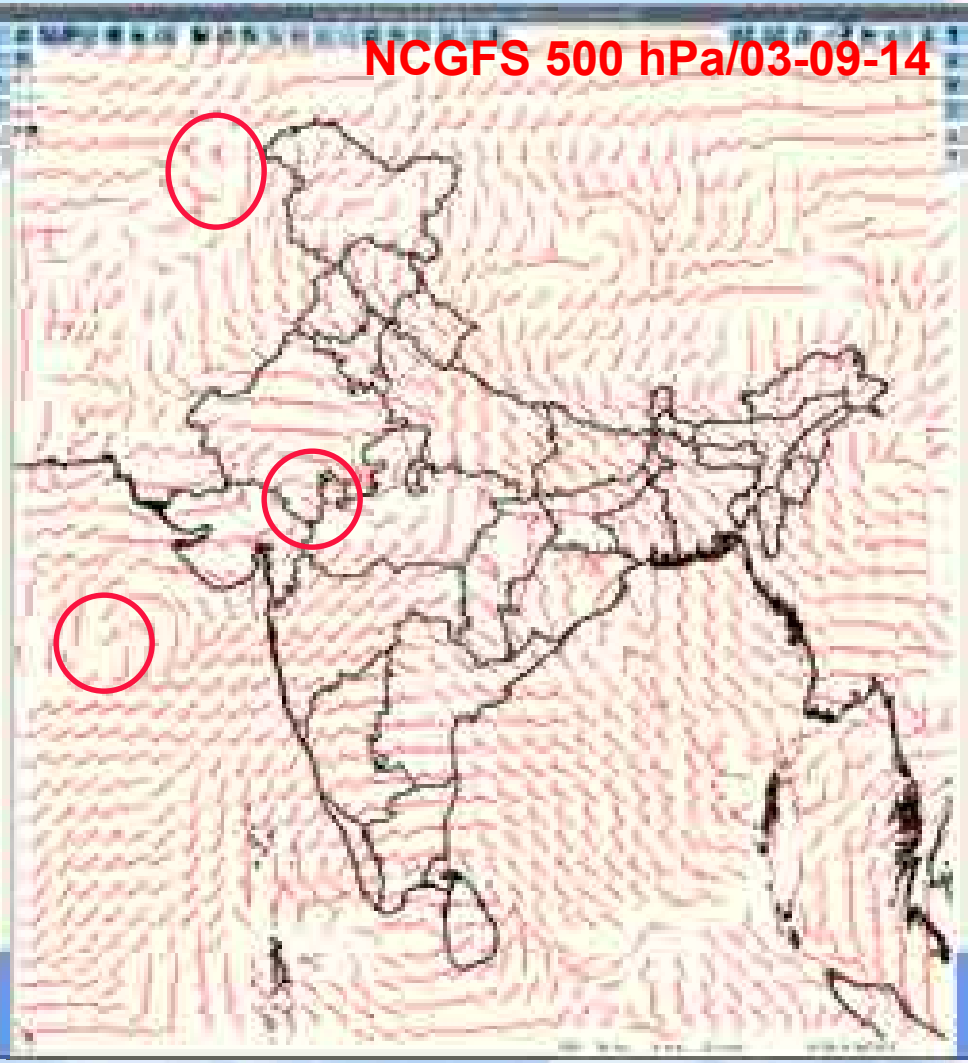

500 hPa/02-09-14


MSLP/03-09-14
2 LPA
1014
1012
1010
1008
1006
1002
1000
1000
1002
1004
1006
1008
1010
1012

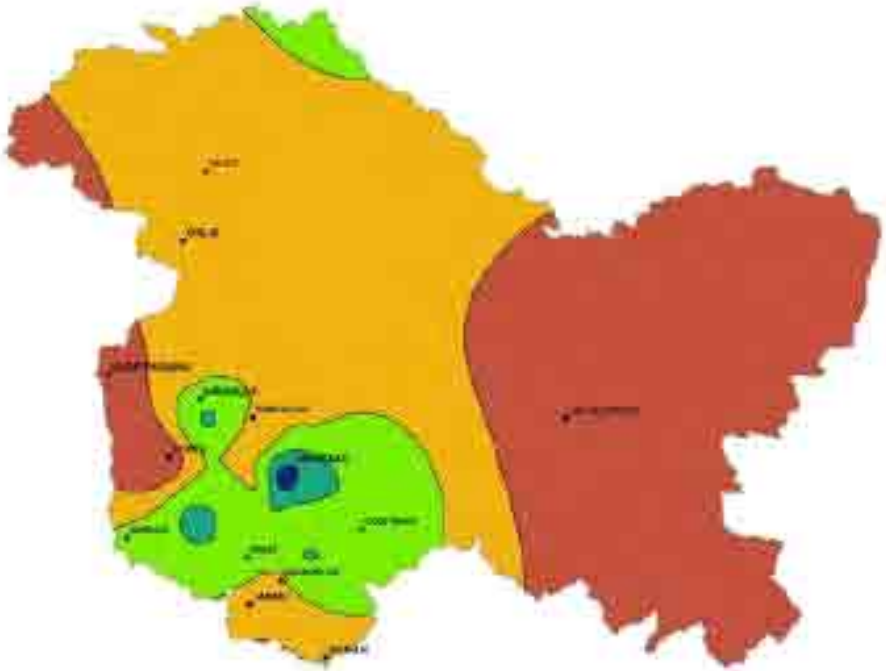
NCGFS 850 hPa/03-09-14

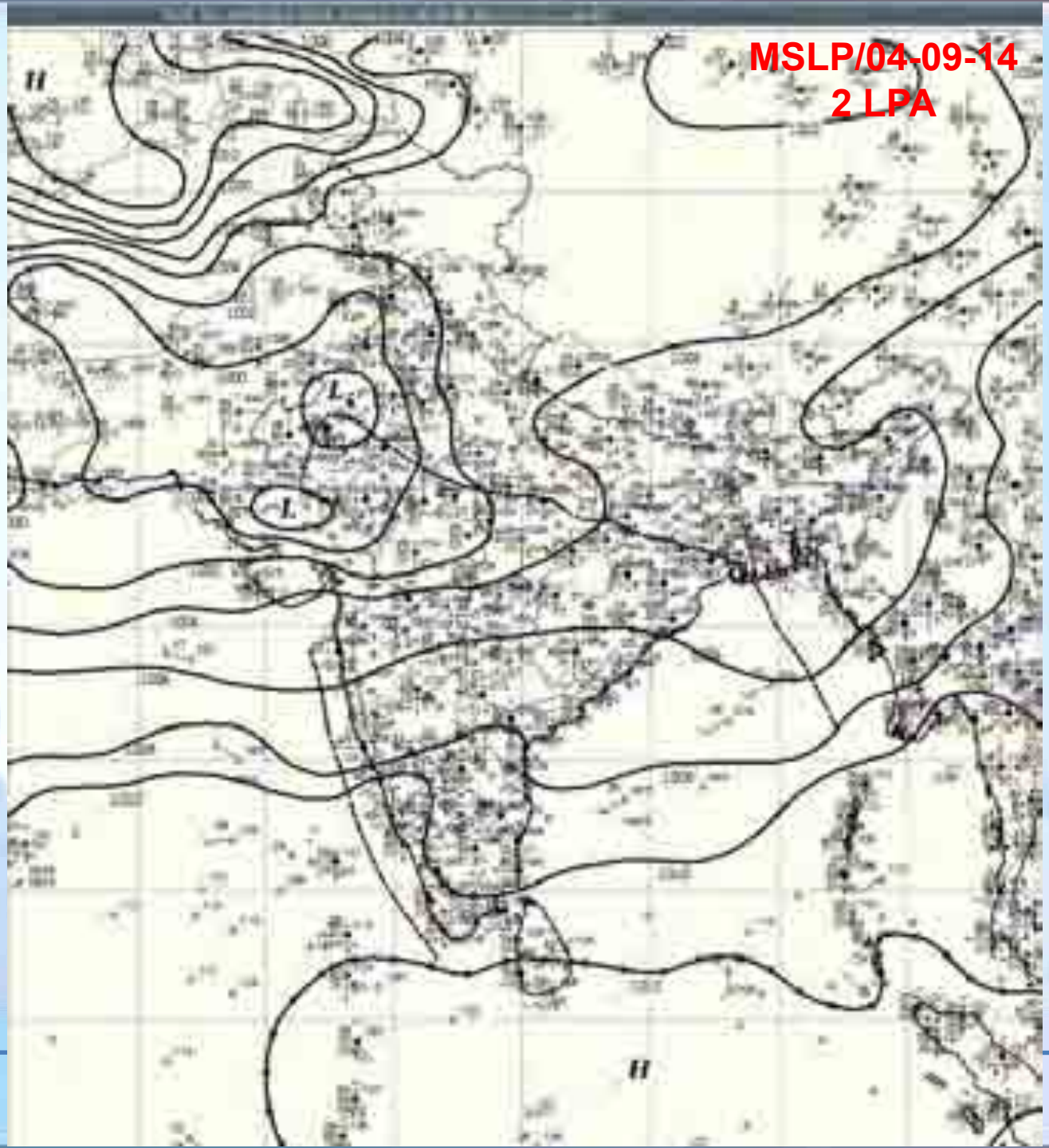


NCGFS 500 hPa/03-09-14



Jammu & Kashmir - Rainstorm 04 Sep 2014




MSLP/04-09-14
2 LPA
H
L
L
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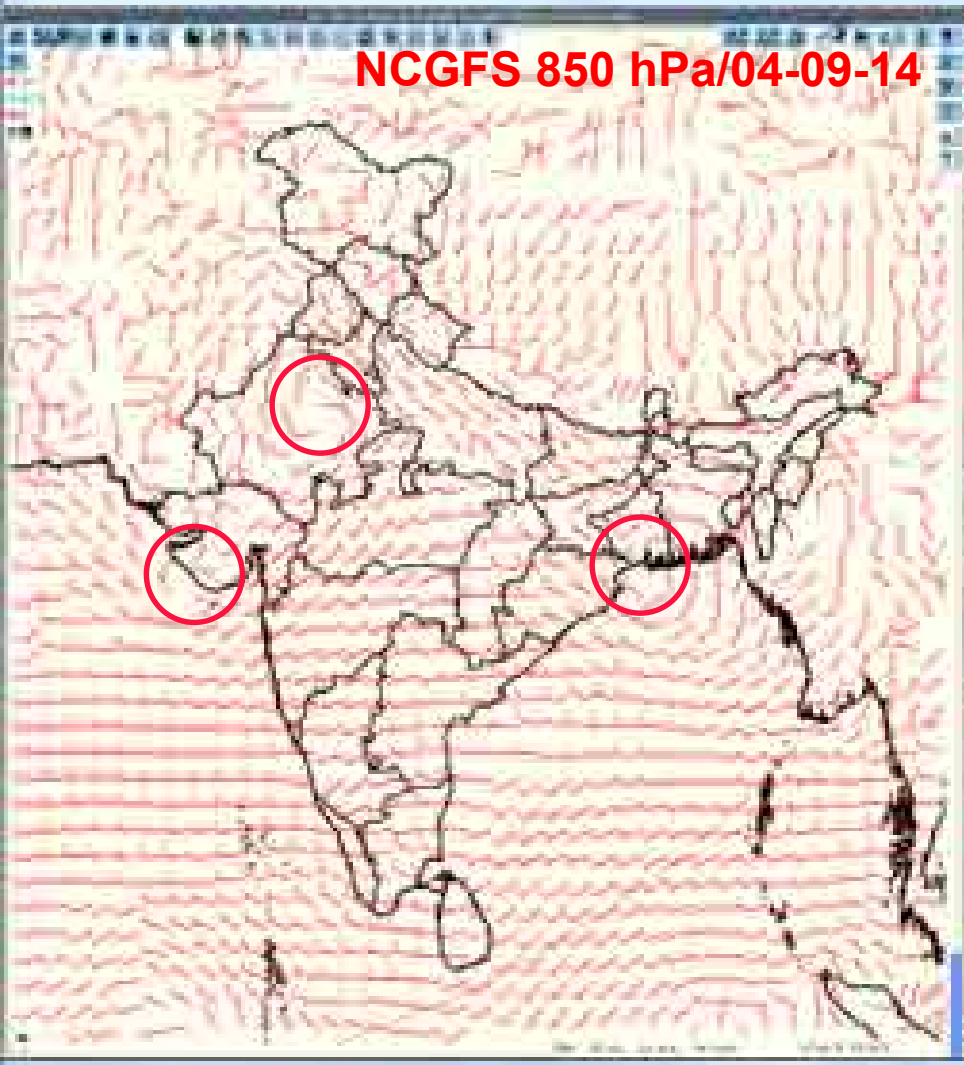
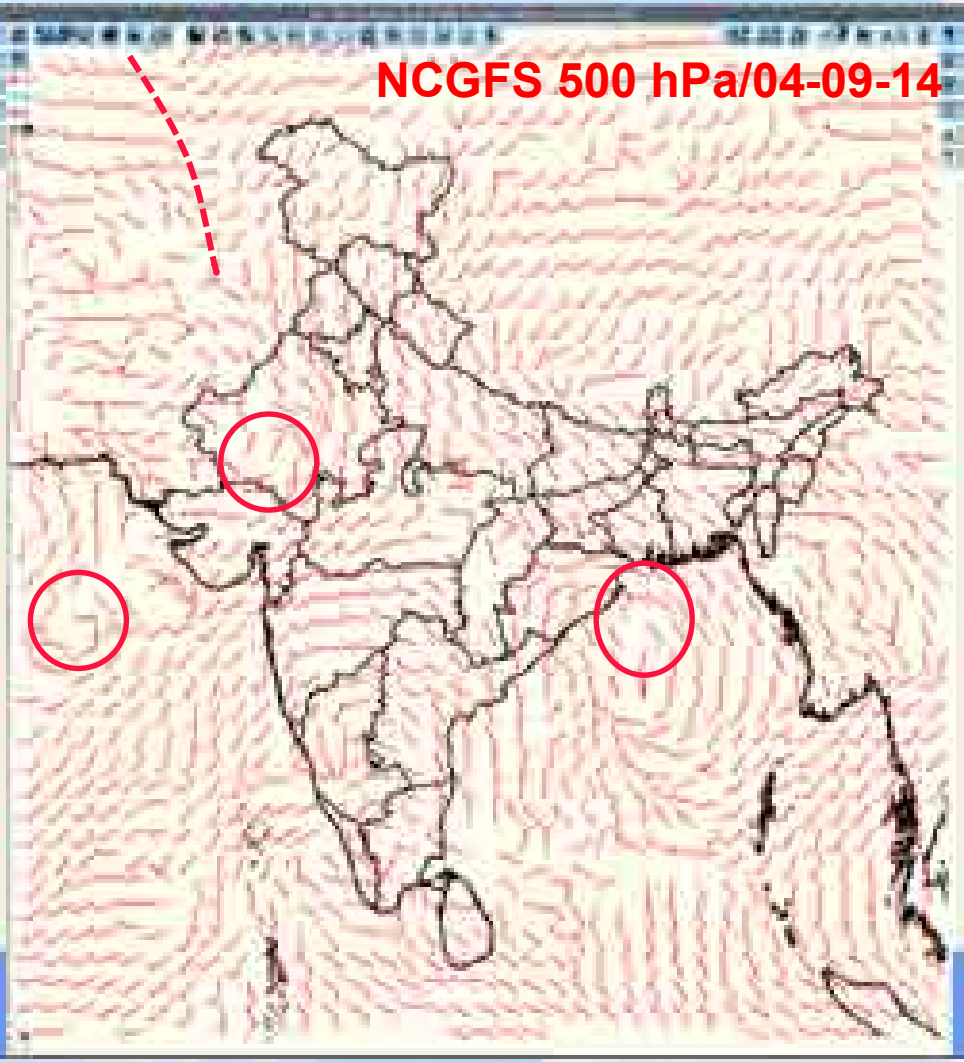
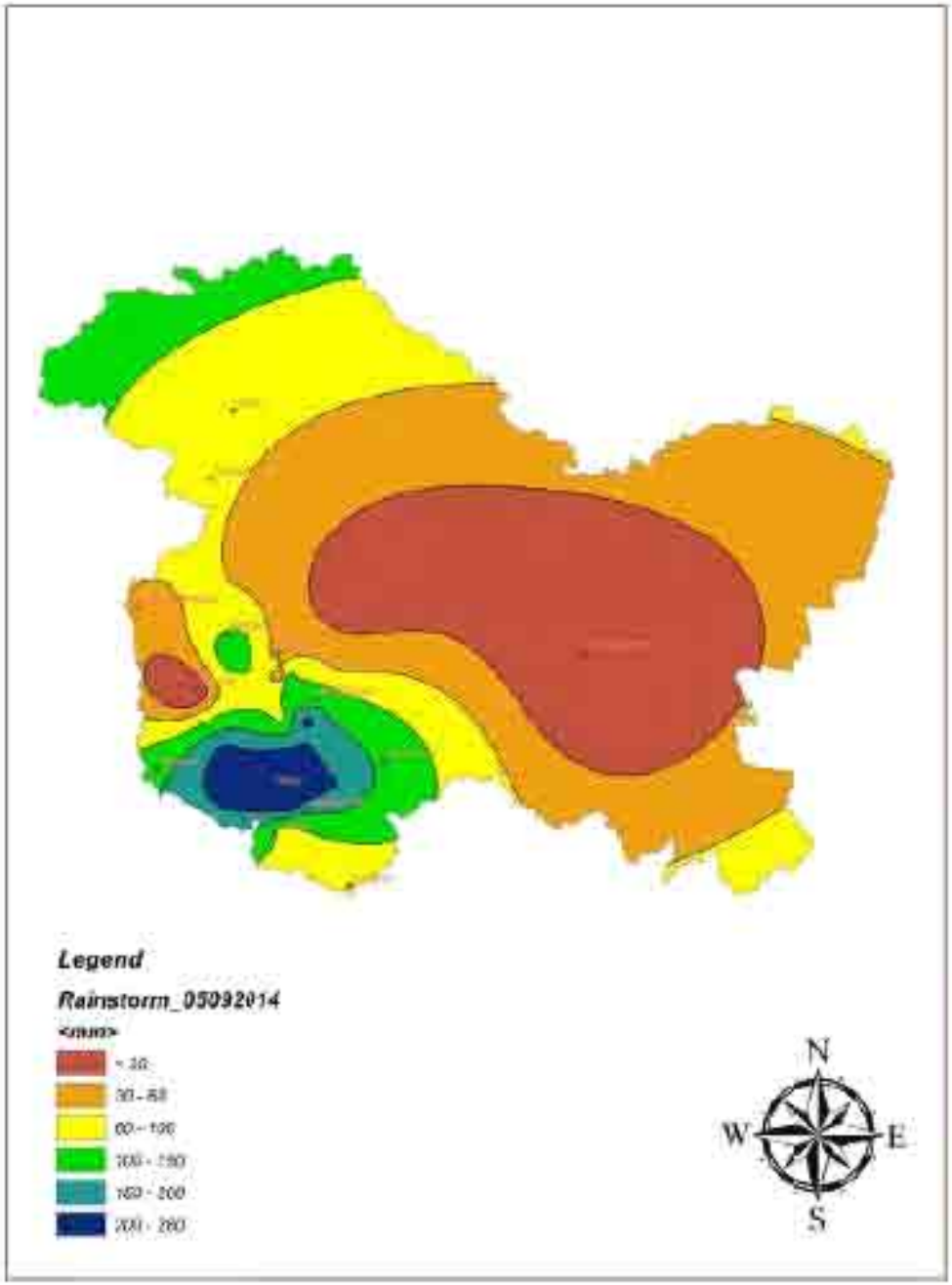
NCGFS 850 hPa/04-09-14



NCGFS 500 hPa/04-09-14

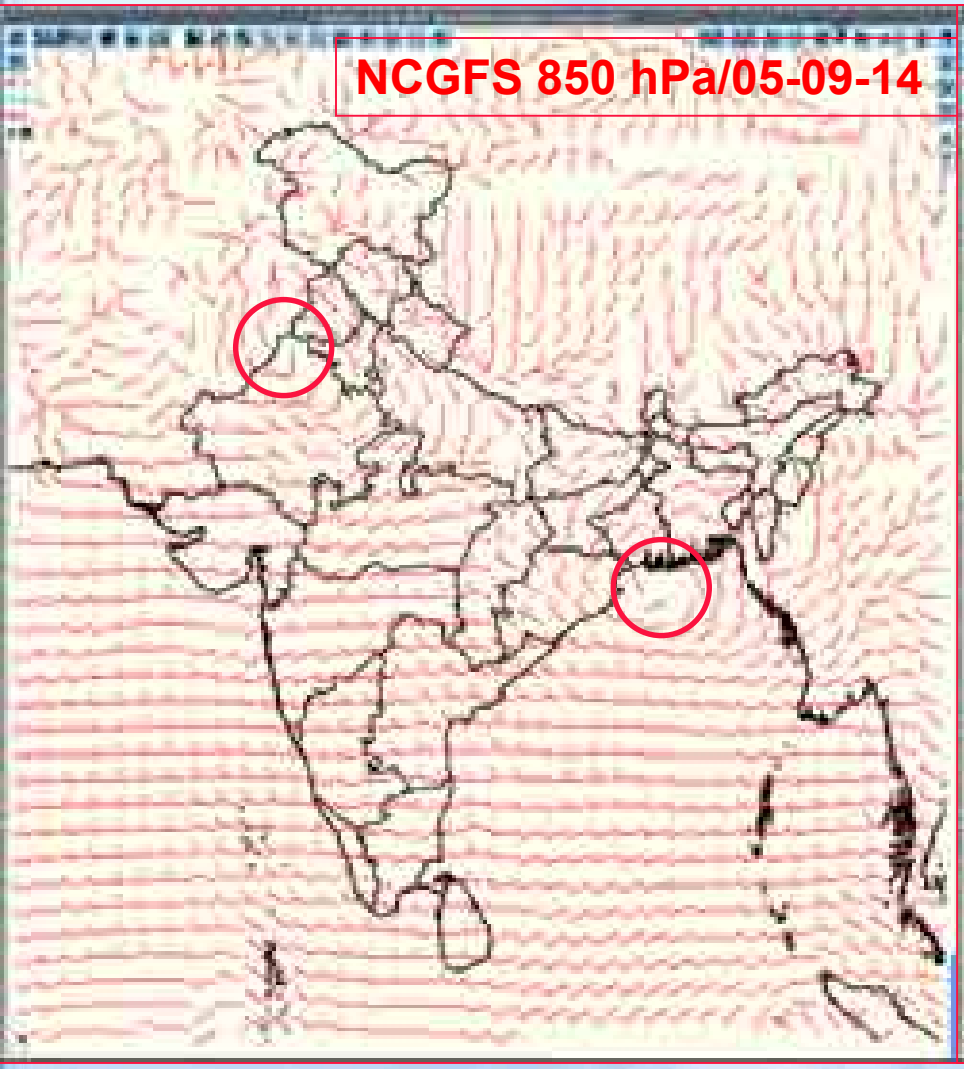


Jammu & Kashmir - Rainstorm 05 Sep 2014

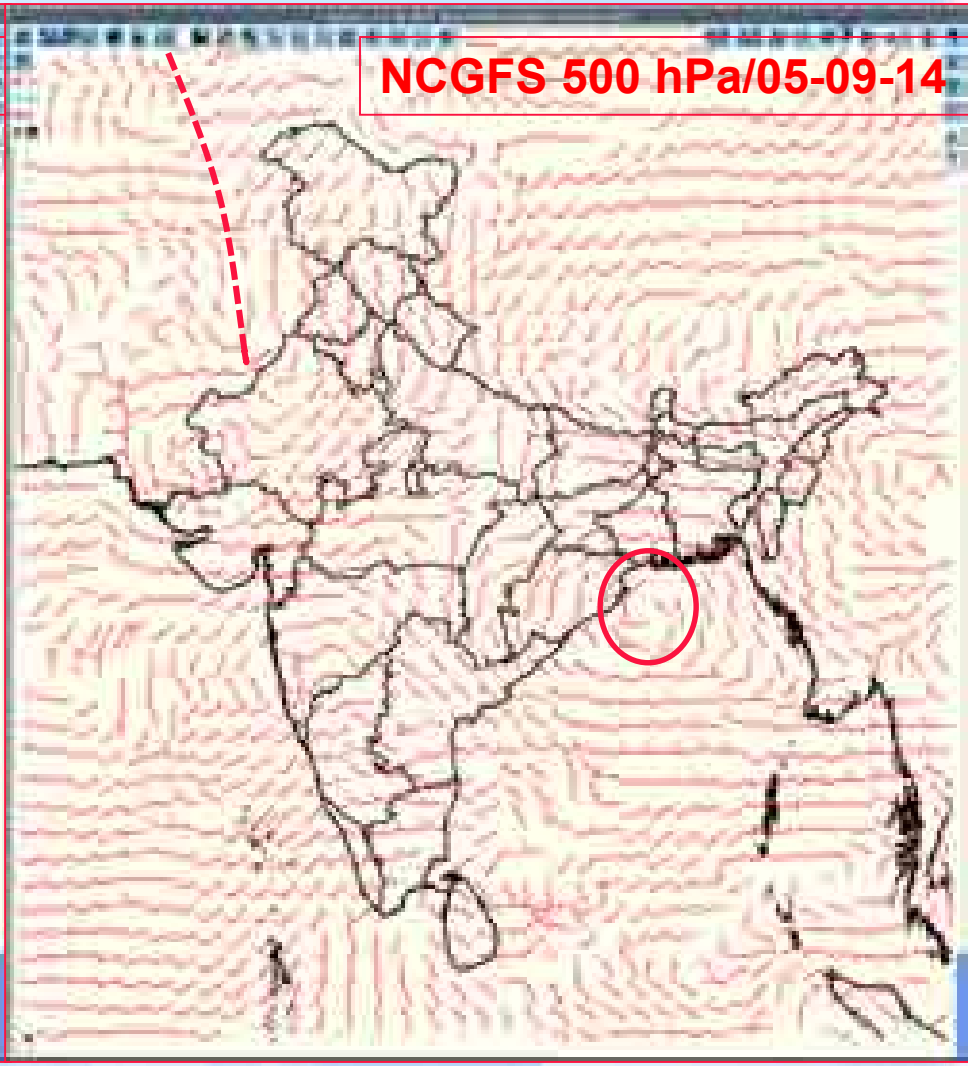



MSLP/05-09-14
WML
H
WML
L
L
L

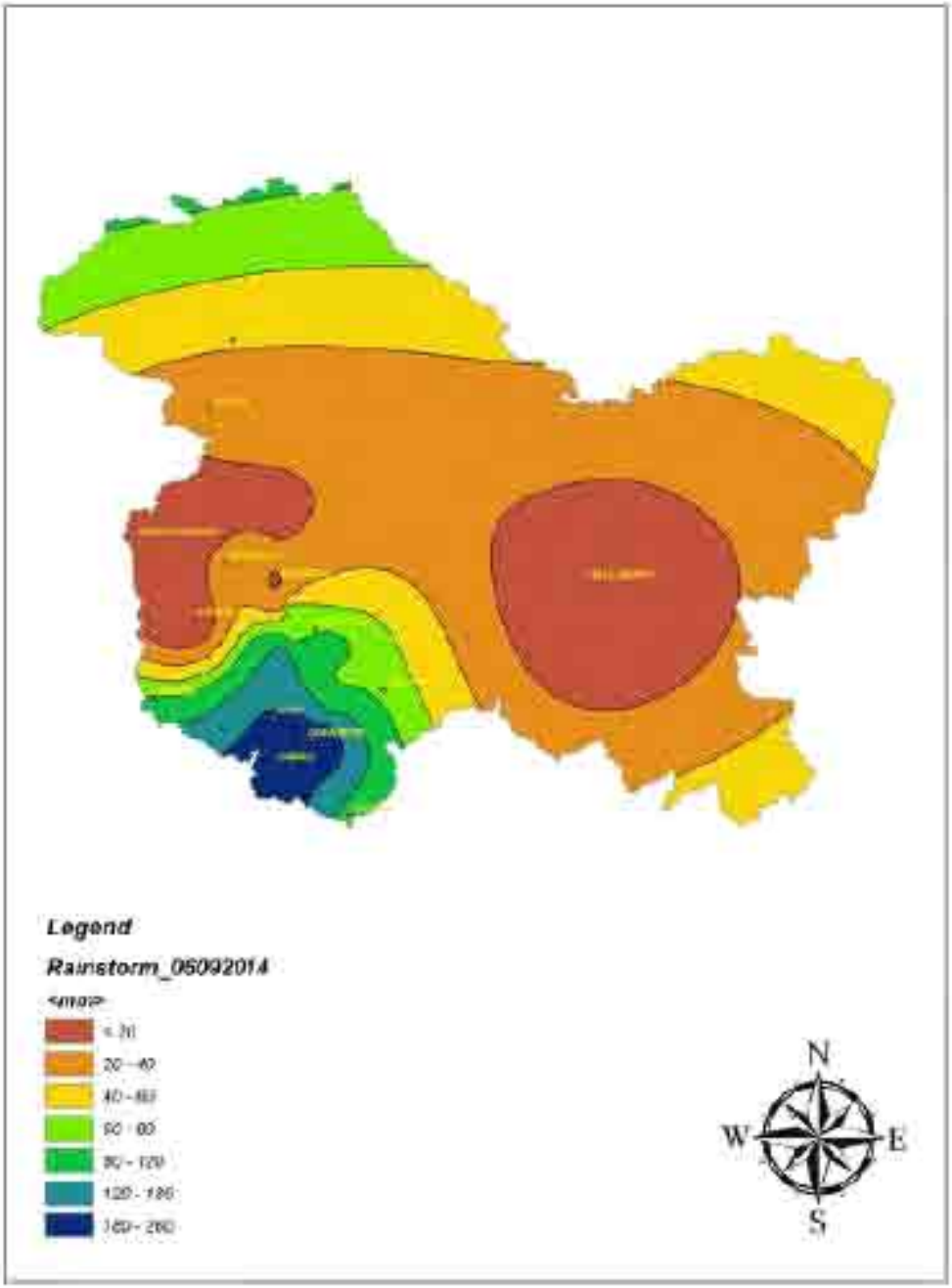
NCGFS 850 hPa/05-09-14



NCGFS 500 hPa/05-09-14



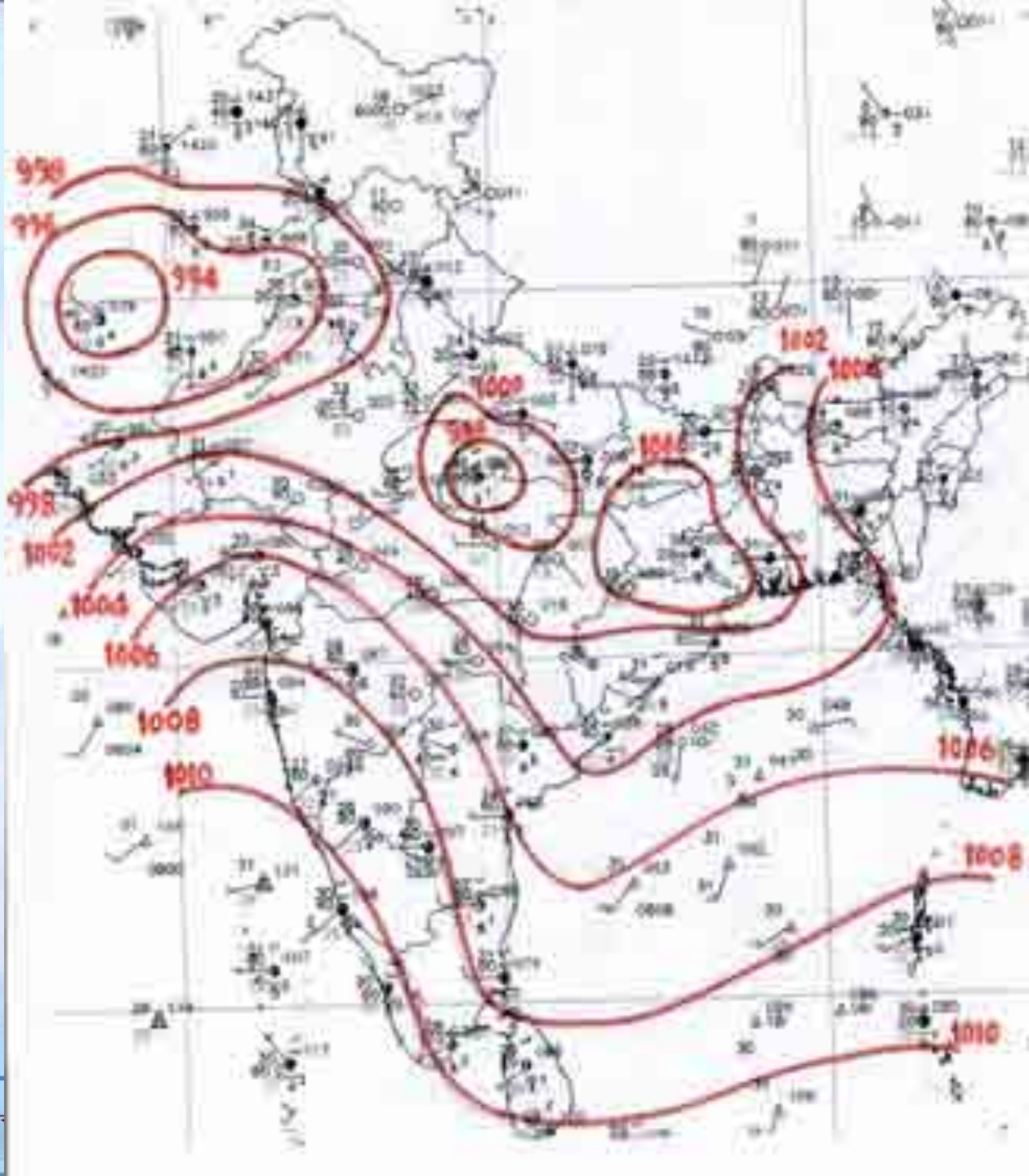
Jammu & Kashmir - Rainstorm 06 Sep 2014



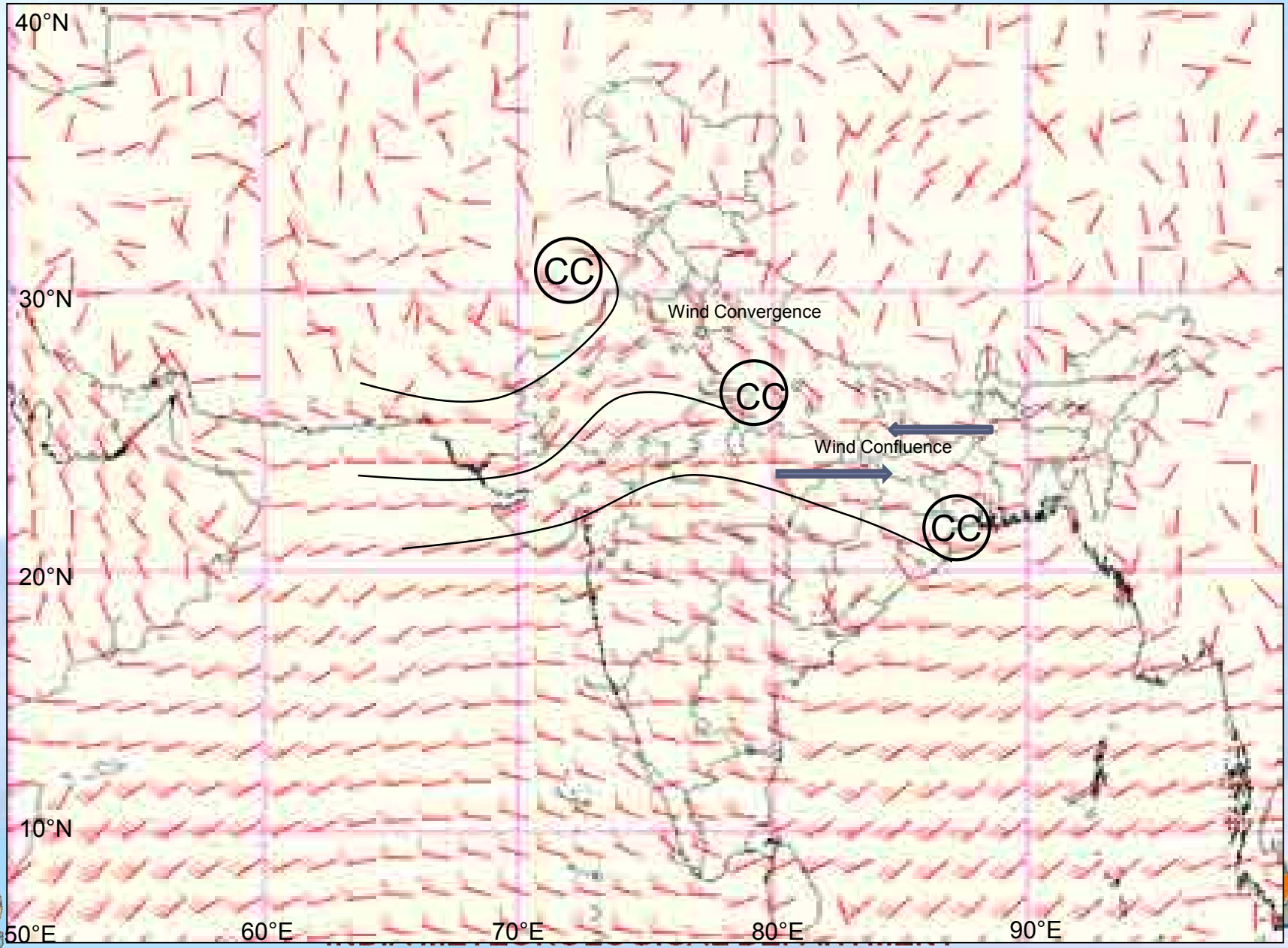
- In J & K episode, there was a WD in form of CC/trough in mid-tropospheric level, which remained practically stationary over Afghanistan and adjoining north Pakistan from 2-5 September, 2014 due to presence of intense TH, which was west of its normal position. During this period, there was three more synoptic system viz. 1st was LPA over Saurashtra & nbd and 2nd was WML over central & northwest India, in addition there was CC over north BoB. As result, a very high moisture feed over the region both from BoB and Arabian Sea..
- In UK episode, WD was in form CC firstly over Pakistan & nbd and moved slowly over J& K thereafter. Also there was a LPA over Central & northwest India during 15-17 June 2013. in this case, maximum moisture feed was mainly from Arabian Sea.

Unprecedented weather activity over foothills of Himalayas during pre-monsoon season in form of heavy rainfall, severe thunderstorm, hailstorm and dust storm

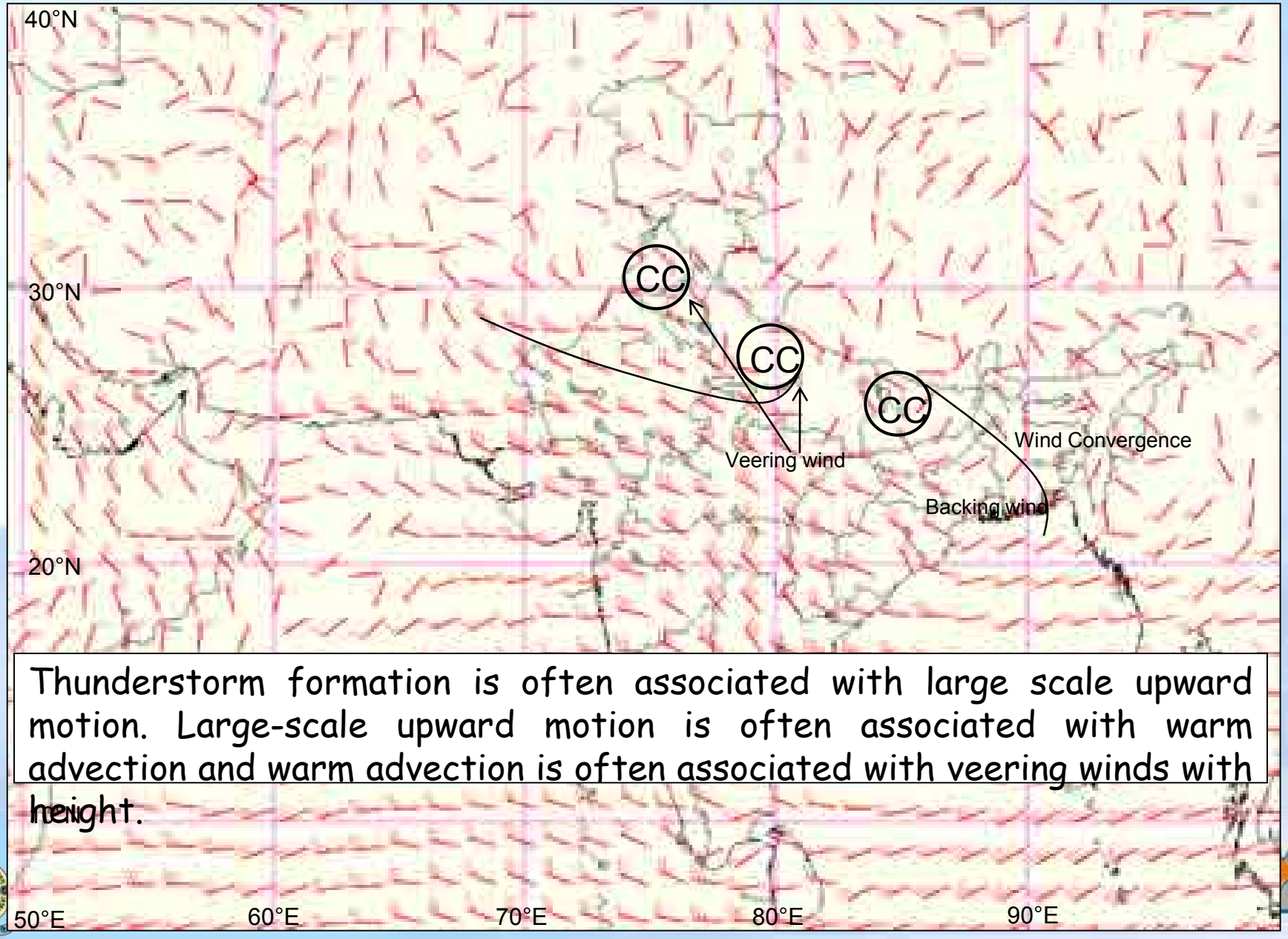
Mean Sea Level Chart based on 0300 UTC of dated 23.05.2016



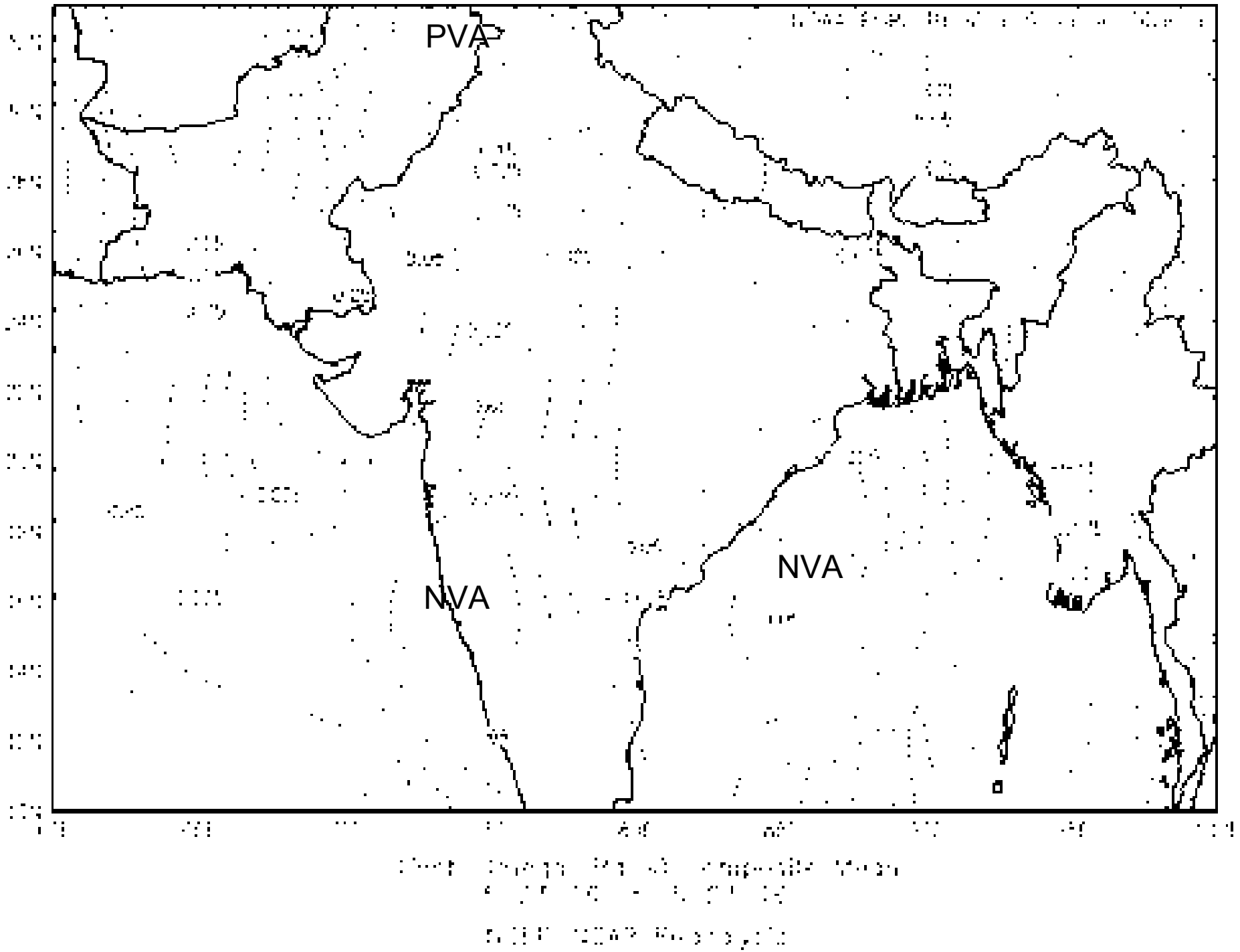
925 hPa wind analysis dated 23.05.2016



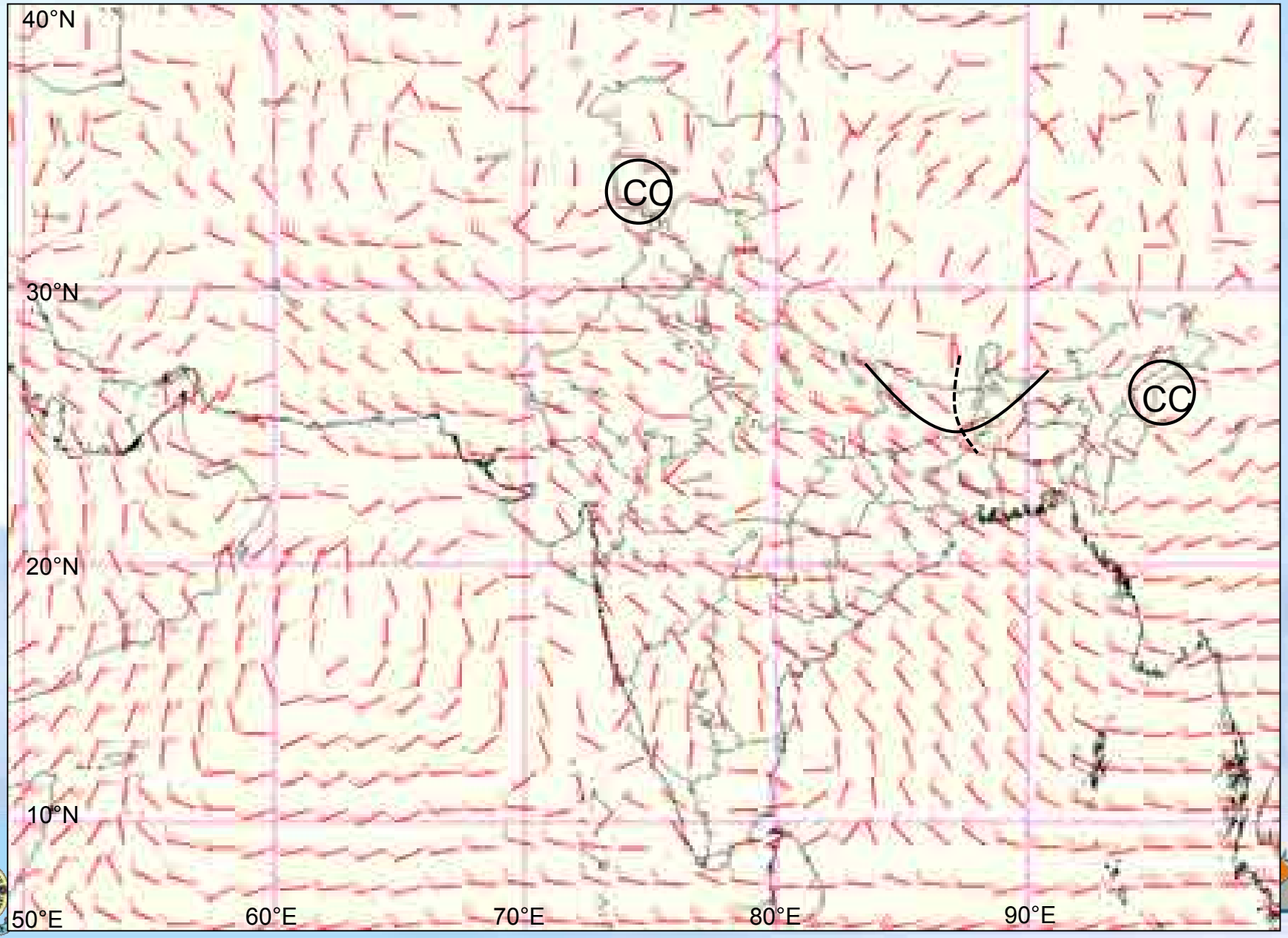
850 hPa wind analysis dated 23.05.2016

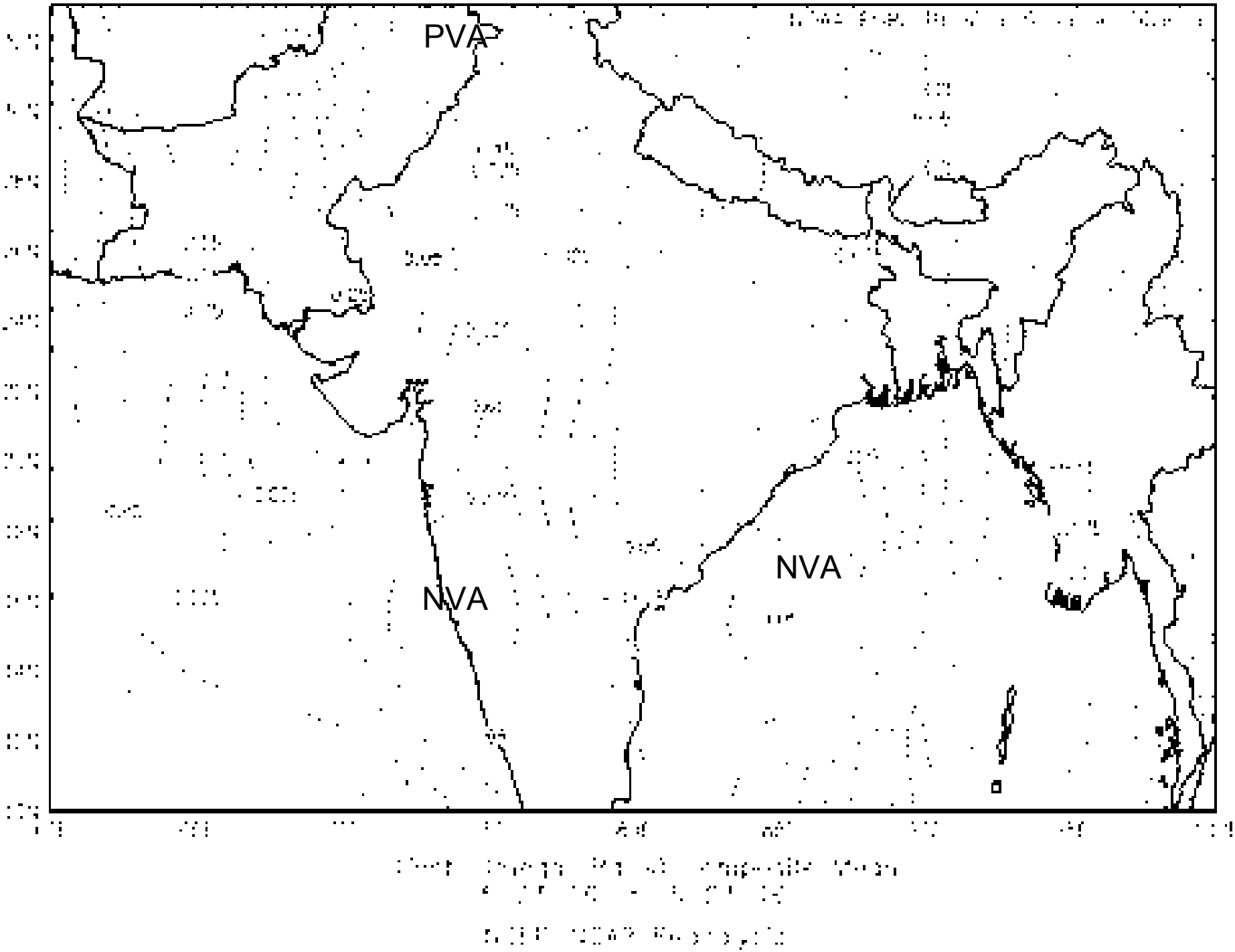


Thunderstorm formation is often associated with large scale upward motion. Large-scale upward motion is often associated with warm advection and warm advection is often associated with veering winds with height.

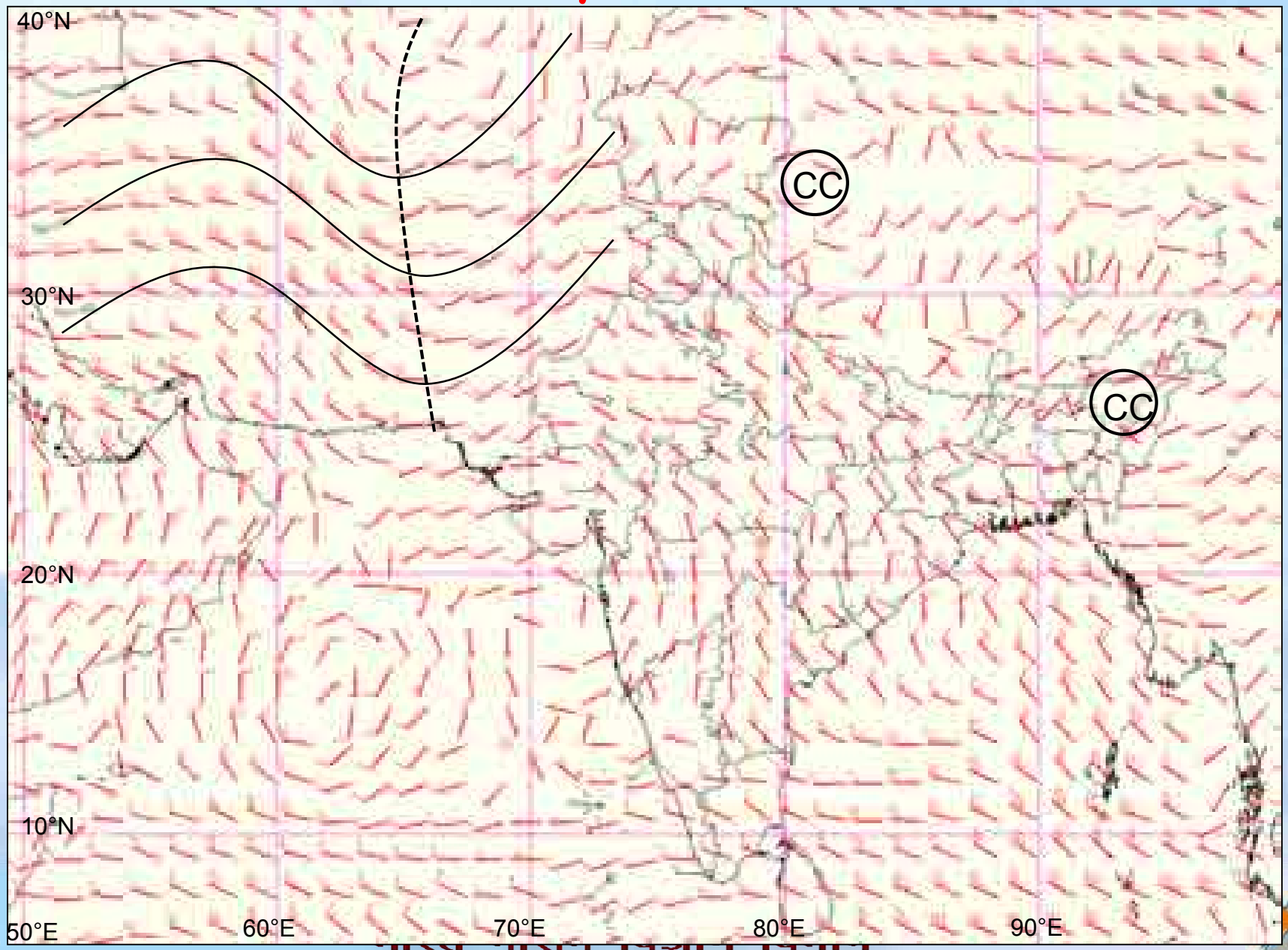

PVA
NVA
NVA

700 hPa wind analysis dated 23.05.2016

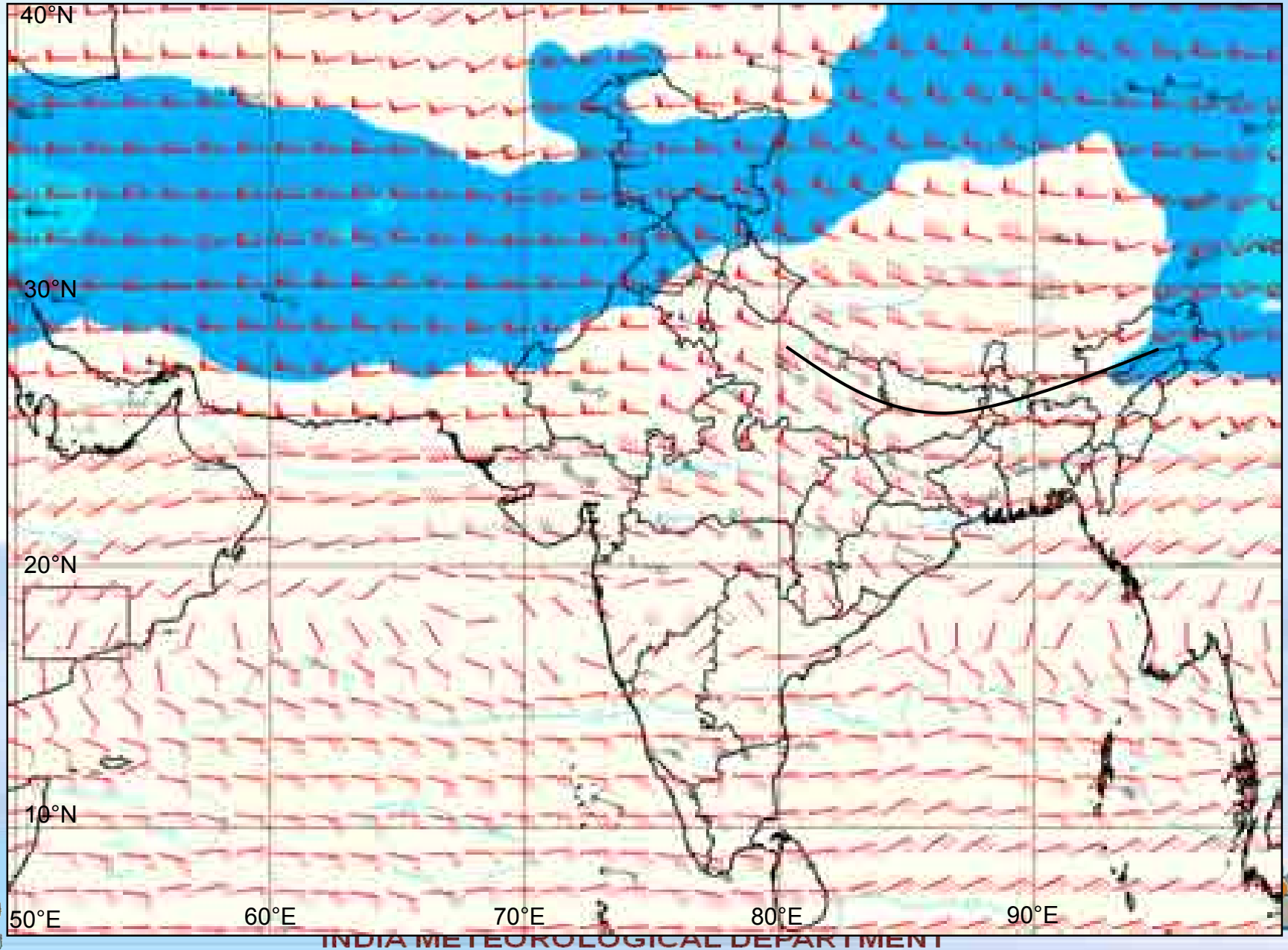



PVA
NVA
NVA

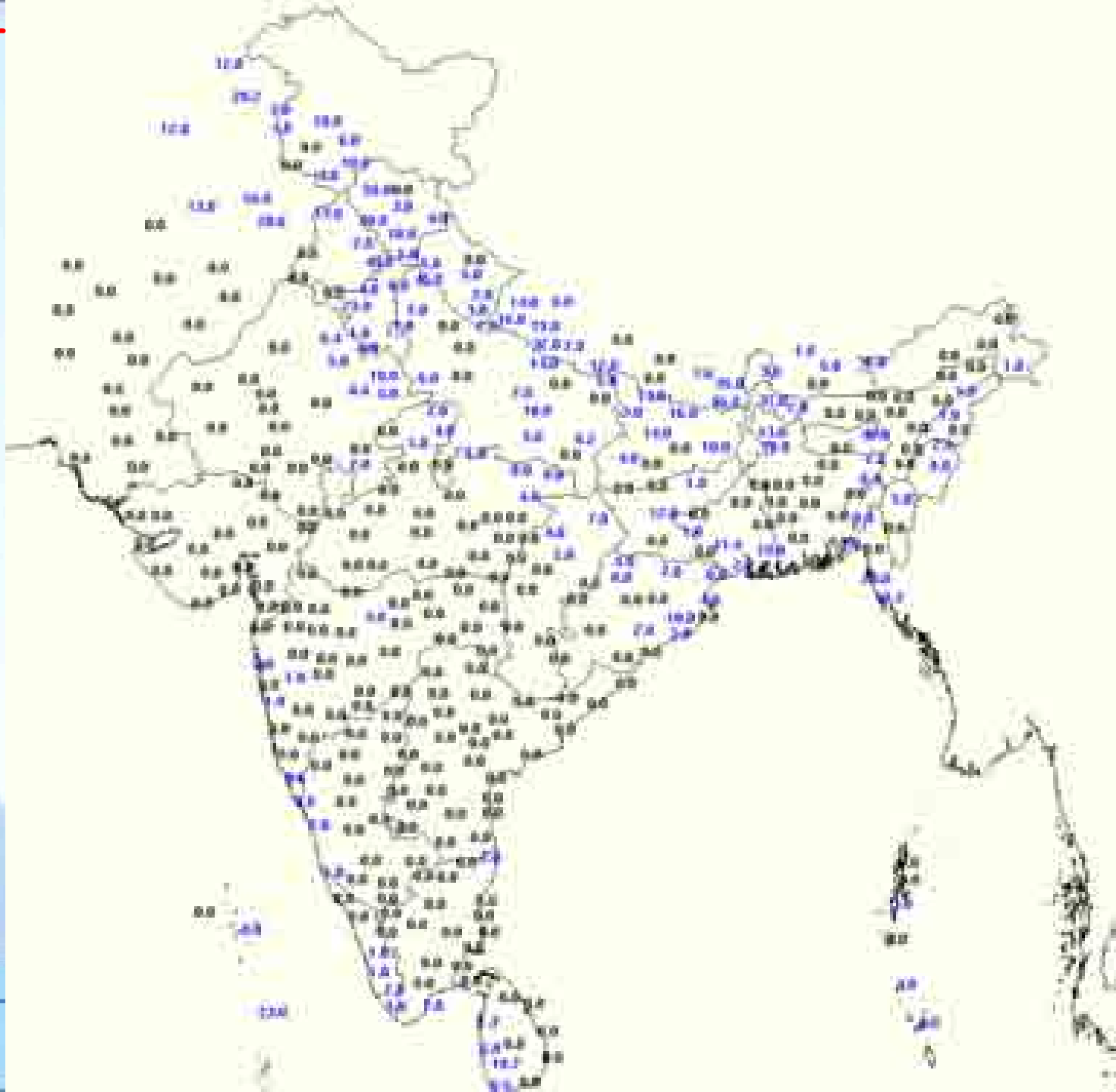
500 hPa wind analysis dated 23.05.2016



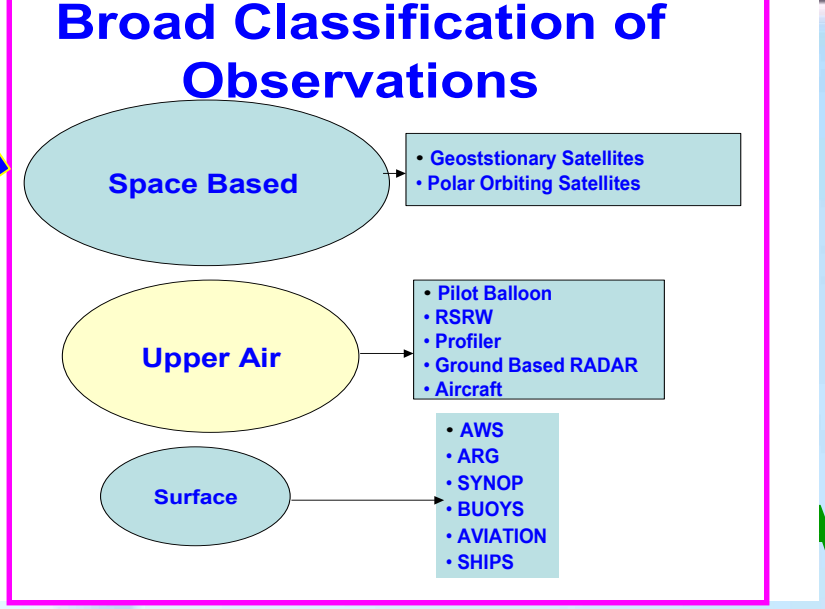
200 hPa wind analysis dated 23.05.2016



Observed past 24 hours precipitation at 0300 UTC of 24.05.2016



Early warning Mechanism in IMD



Initial conditions (Observations)

Runs of different Models,

Consecutive runs from the same model,

Ensemble runs ("choosing the best member")

Model runs

Forecaster

Decision maker

Numerical forecasts

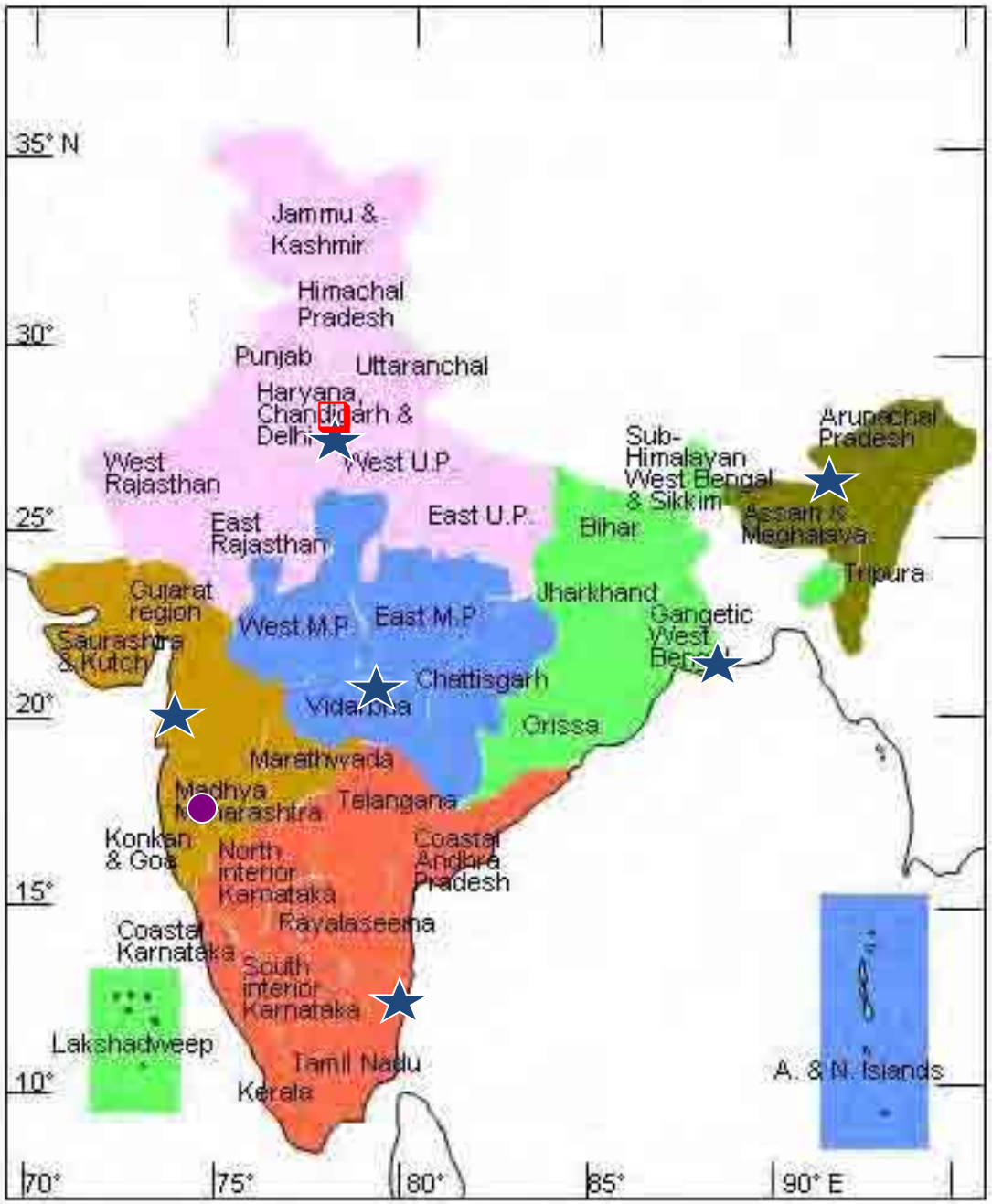
End forecast

Monitoring and Forecast Process

Three Tier Forecasting Structure

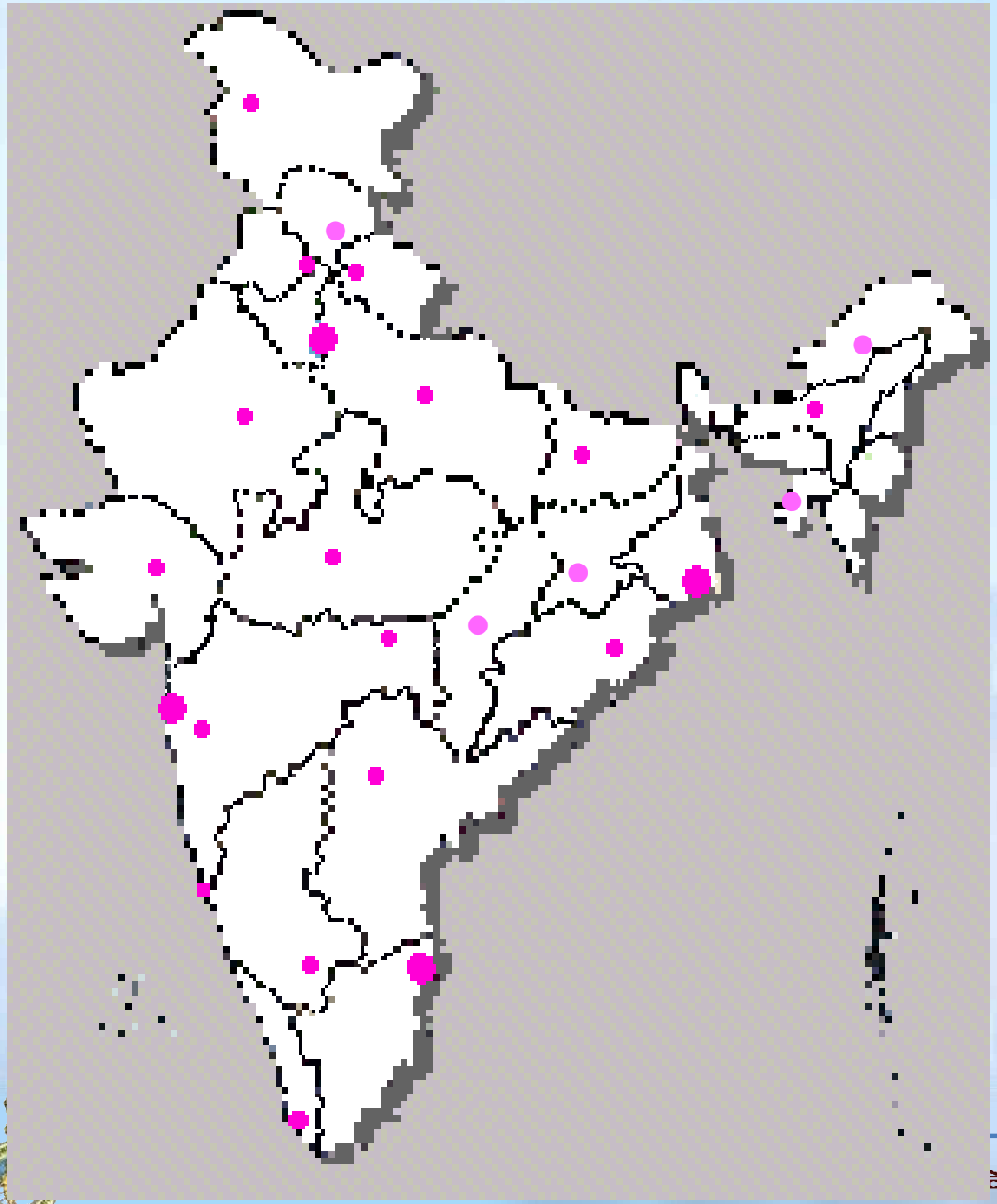
Level	Responsibility
National	
NWFC	Met Subdivision Forecasting/Warning, Guidelines Developmental work
PUNE	Documentation , Reports, National tools/Techniques
Regional	
RMCs	District-wise Forecasting/warning, other Forecasts
Local	
MCs	District-wise Forecasting/warning, other Forecasts

6 Meteorological Regions



- North Region
- East Region
- North East Region
- Central Region
- West Region
- South Region

- ❑ **NWFC at New Delhi and WF at Pune**
- ★ **Regional Centres**
  Delhi, Kolkata, Guwahati, Nagpur, Mumbai, Chennai
- ● **Pune Centre for Research /Training, Agromet, and surface instrumentation**



Meteorological Centres

1. Srinagar
2. Chandigarh
3. Shimla
4. Dehra Dun
5. Lucknow
6. Patna
7. Itanagar
8. Jaipur
9. Ranchi
10. Agartatala
11. Ahmedabad
12. Bhopal
13. Raipur
14. Bhuvaneshwar
15. Hyderabad
16. Bangalore
17. Thiruvananthapuram
18. Panjim
19. Gangtok

VIDEO- CONFERENCING

- Daily between NWFC, DDGM (WF), RWFCs
- To improve accuracy of Weather Forecast and Warnings
- To remove contradictions in Weather Forecast and warnings

Weather Parameters for which forecasts & warnings are issued

Rainfall/snowfall

- Spatial distribution & intensity.
- Warnings for Heavy rain/ snow.

Temperature

- Minimum/ Maximum
- Heat wave/ Cold wave

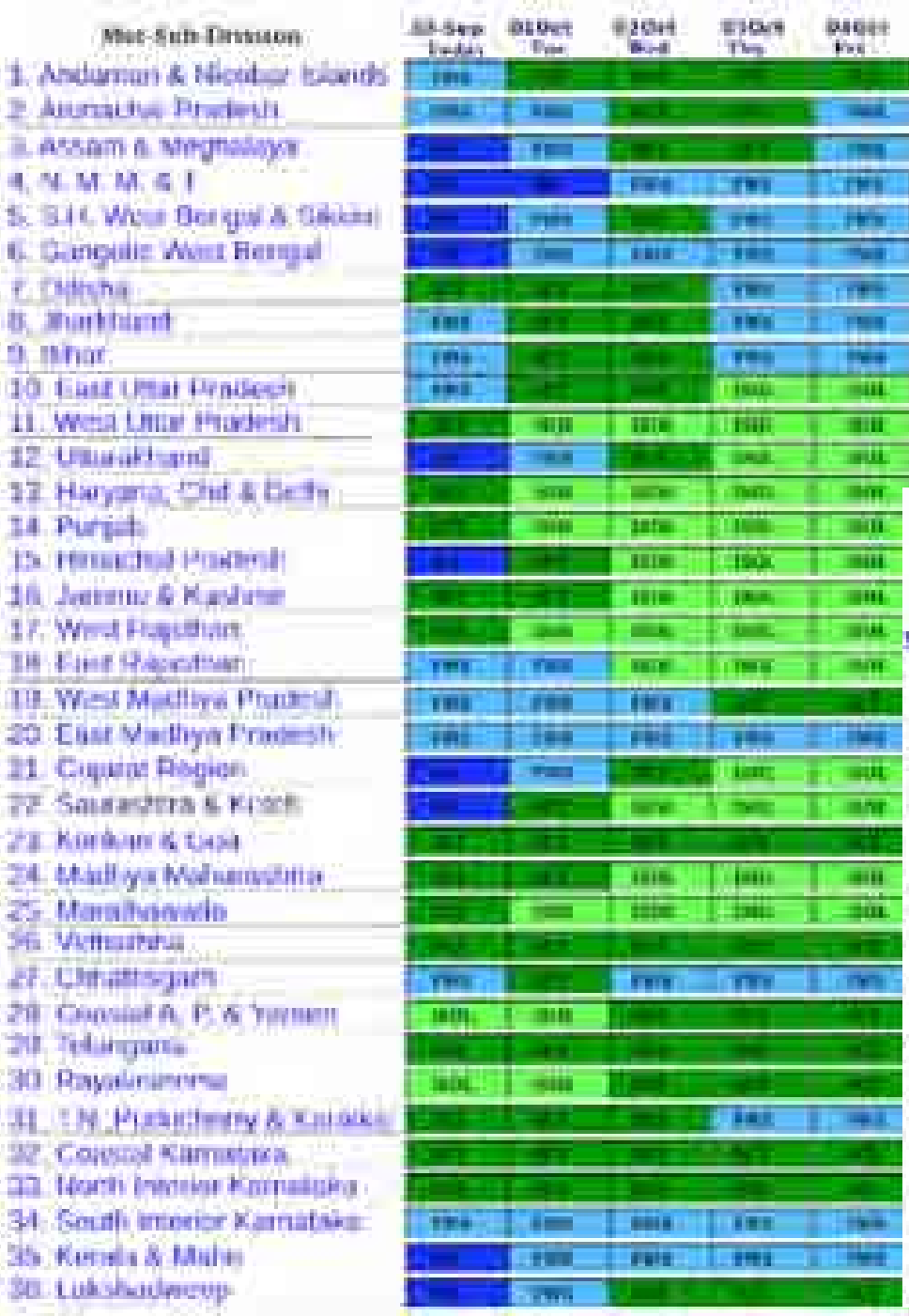
Special Weather Phenomena

- Hailstorm/ Thunderstorm
- Squall
- Ground Frost

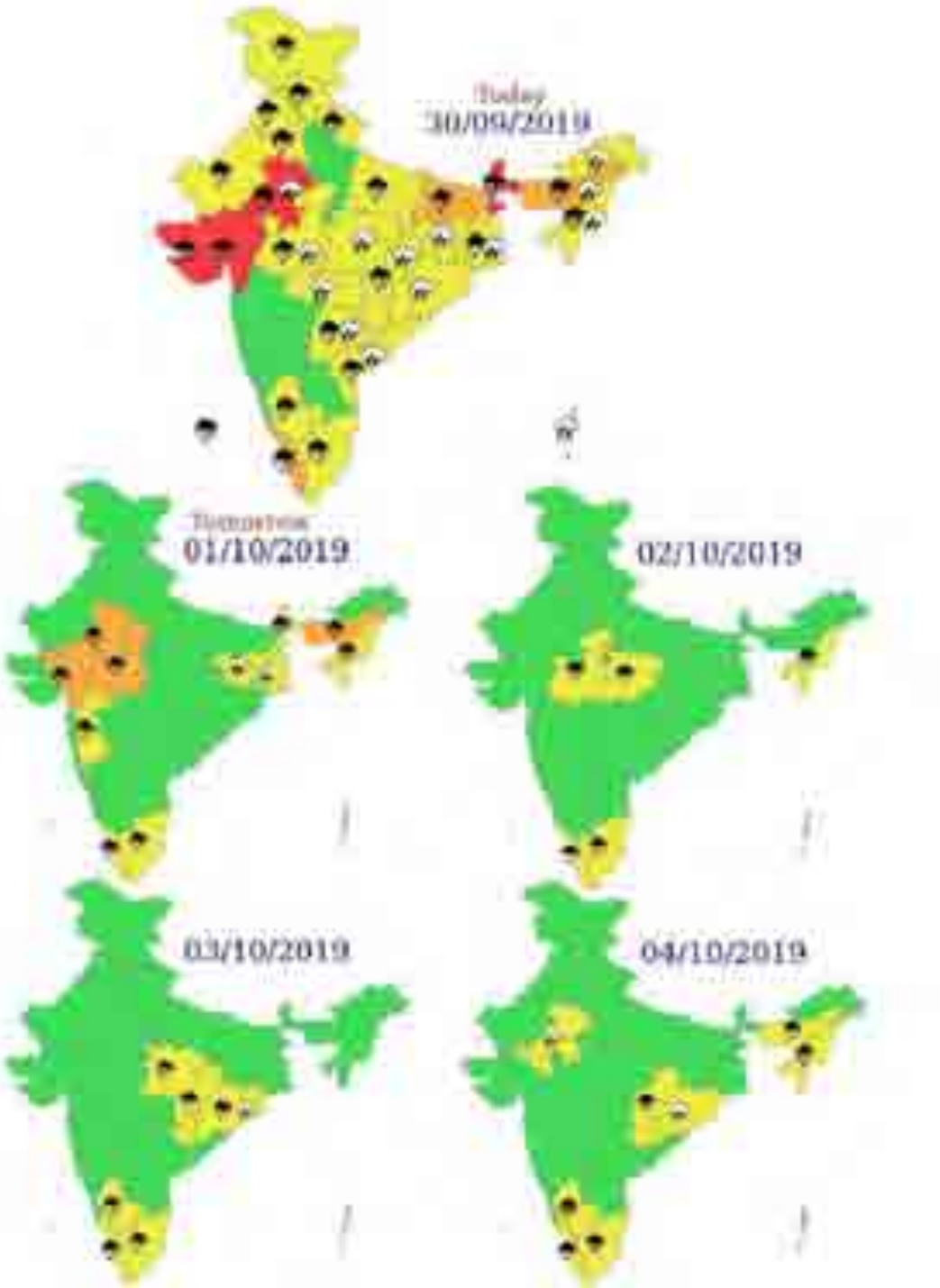
Classes of Weather Forecasts

- Nowcast- Few hours
- Short to Medium Range Forecasting < 3-10 days
- Extended Range Forecasting (ERF)- 10-30 days
- Long Range Forecasting (LRF) >30 days

All India Weather Summary and Forecast Bulletin issue 4 times in a day



All India Weather Warning Bulletin issue 4 times in a day



Heavy Rainfall

Heat Wave & Thundersquall

Fog/Visibility

Heavy Snow

Cold wave/ visibility & frost

Heat Wave

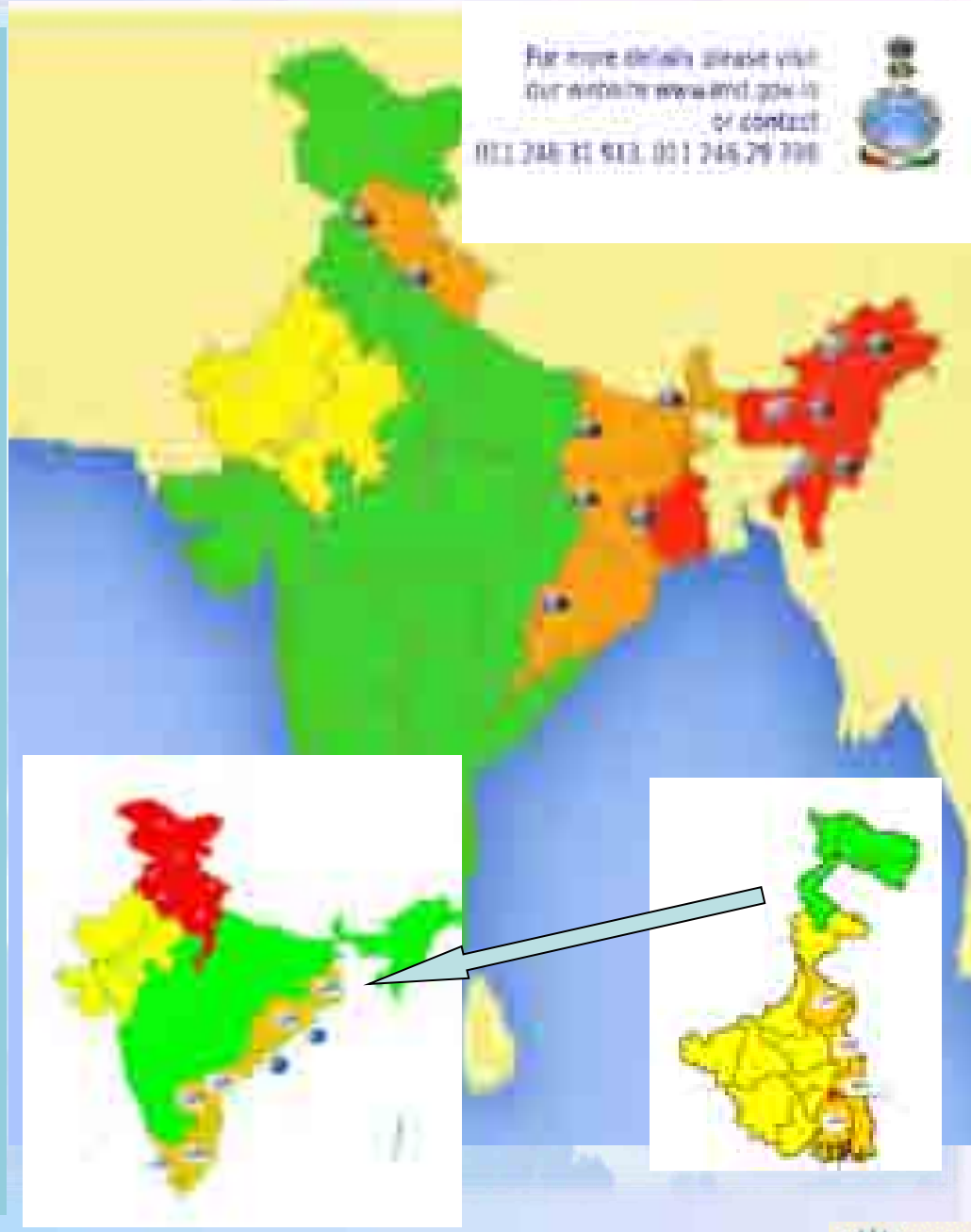
Multi Hazard Warning System

Green – No warning

Yellow – Be aware
Be updated

Orange – Be prepared
Keep vigil
Be updated

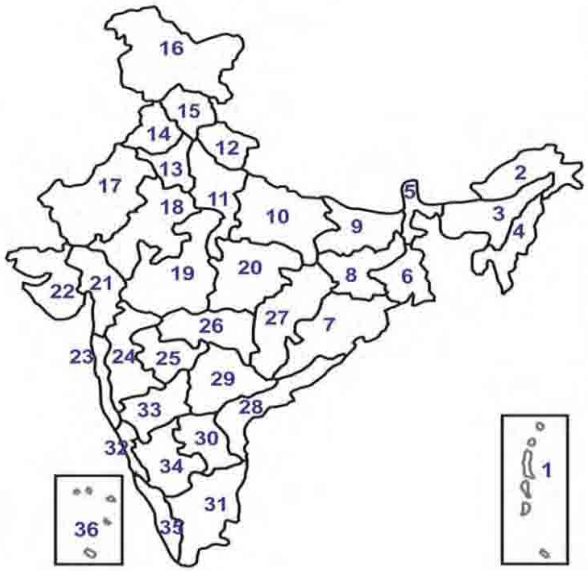
Red - Most vigil
Take action



36 Meteorological Sub-Divisions

LEGENDS

1. अंडमान और निकोबार द्वीप समूह
2. अरुणाचल प्रदेश
3. असम और मेघालय
4. नागालैंड मनीपुर मीजोरम और त्रिपुरा
5. उप हिमालय पश्चिम बंगाल एवम् सिक्किम
6. पश्चिम गांगेय बंगाल
7. ओडिसा
8. झारखंड
9. बिहार
10. पूर्वी उत्तर प्रदेश
11. पश्चिम उत्तर प्रदेश
12. उत्तराखंड
13. हरियाणा चंडिगढ एवम् दिल्ली
14. पंजाब
15. हिमाचल प्रदेश
16. जम्मू एवम् कश्मीर
17. पश्चिम राजस्थान
18. पूर्वी राजस्थान
19. पश्चिम मध्य प्रदेश
20. पूर्वी मध्य प्रदेश
21. गुजरात क्षेत्र
22. सौराष्ट्र एवम् कच्छ
23. कोंकण एवम् गोवा
24. मध्य महाराष्ट्र
25. मराठावाडा
26. विदर्भ
27. छत्तीसगढ
28. तटिय आंध्र प्रदेश
29. तेलंगाना
30. रायलसीमा
31. तमिलनाडू
32. तटिय कर्नाटक
33. आंतरिक उत्तरी कर्नाटक
34. आंतरिक दक्षिणी कर्नाटक
35. केरल
36. लक्षद्वीप



1. Andaman & Nicobar Islands
2. Arunachal Pradesh
3. Assam & Meghalaya
4. Nagaland, Manipur, Mizoram & Tripura
5. Sub-Himalayan West Bengal & Sikkim
6. Gangetic West Bengal
7. Orissa
8. Jharkhand
9. Bihar
10. East Uttar Pradesh
11. West Uttar Pradesh
12. Uttarakhand
13. Haryana, Chd & Delhi
14. Punjab
15. Himachal Pradesh
16. Jammu & Kashmir
17. West Rajsthan
18. East Rajasthan
19. West Madhya Pradesh
20. East Madhya Pradesh
21. Gujarat
22. Saurashtra
23. Konkan & Goa
24. Madhya Maharashtra
25. Marathawada
26. Vidharbha
27. Chhattisgarh
28. Coastal Andhra Pradesh
29. Telangana
30. Rayalaseema
31. Tamilnadu & Pondi
32. Coastal Karnataka
33. North Interior Karnataka
34. South Interior Karnataka
35. Kerala
36. Lakshadweep

SPATIAL DISTRIBUTION (% of Stations reporting)

Widespread (WS/Most Places)	76-100	Scattered (SCT/ A Few Places)	26-50
Fairly Widespred (FWS/ Many Places)	51-75	Isolated (ISOL)	1-25
Mainly Dry	Very Light Rain	Dry	No Rain

WARNING

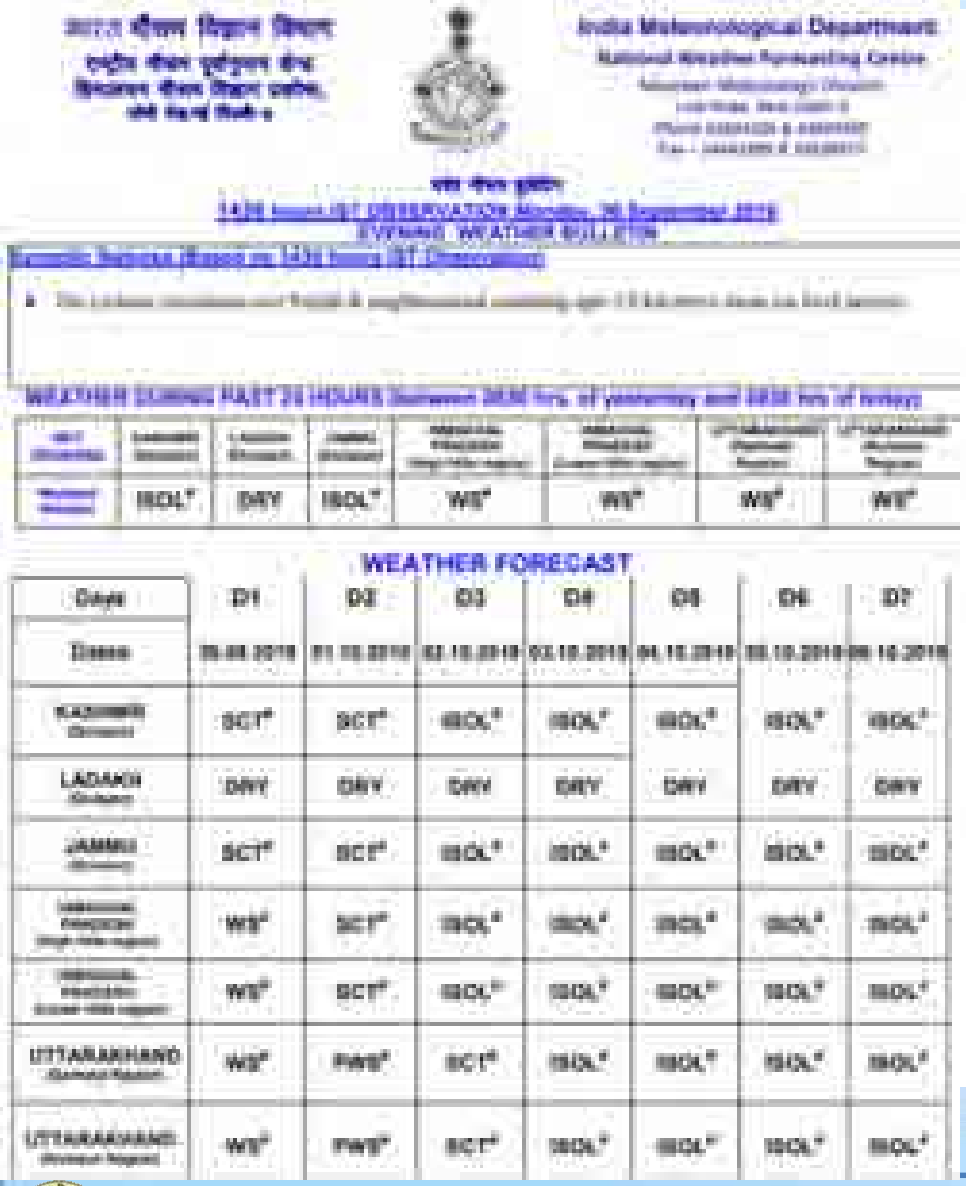
Most Vigil (Take Action)	Be prepared/updated (Keep Vigil)
Be aware (Be updated)	No Warning

Heavy Rain | Heavy Snow | Hailstorm | Dust Storm

Strong Winds | Visibility | Cyclone | Squall

Frost | Cold Wave | Heat Wave | Sea State

Mountain Meteorology Division



WEATHER FORECAST

Days	D1	D2	D3	D4	D5	D6	D7
Dates	30.09.2019	01.10.2019	02.10.2019	03.10.2019	04.10.2019	05.10.2019	06.10.2019
KASHMIR	SCT	SCT	ISOL	ISOL	ISOL	ISOL	ISOL
LADAKH	DRY	DRY	DRY	DRY	DRY	DRY	DRY
JAMMU	SCT	SCT	ISOL	ISOL	ISOL	ISOL	ISOL
HIMACHAL PRADESH	WS	SCT	ISOL	ISOL	ISOL	ISOL	ISOL
UTTARAKHAND	WS	FWS	SCT	ISOL	ISOL	ISOL	ISOL
UTTARAKHAND	WS	FWS	SCT	ISOL	ISOL	ISOL	ISOL

Weather Warning during next 5 days

SUB DIVISION	D1	D2	D3	D4	D5
	30.09.2019	01.10.2019	02.10.2019	03.10.2019	04.10.2019
KASHMIR					
LADAKH					
JAMMU	Heavy rainfall very likely at isolated places				
HIMACHAL PRADESH					
UTTARAKHAND	Heavy rainfall very likely at isolated places				
UTTARAKHAND	Heavy rainfall very likely at isolated places				

PROBABILITY FORECAST

Days	Probability of Occurrence (%)

Mountain Expedition Forecast

Government of India
India Meteorological Department
Ministry of Earth Sciences
Mausam Bhawan, Lodi Road,New Delhi – 110003

BULLETIN xxx xx/ DATE : 30/09/2019

Expedition conducted by NAVY

MT. SATOPANTH Expedition

Forecast for Lat. 30°50'58" N & Long. 79°12'39"E at altitude: 4.6 km

Forecast valid for next 24 hrs commencing from 1130 hrs IST of 30/09/2019 to 1130 hrs IST of 01/10/2019

Time	Wind Direction	Wind Speed (Kt/Kmph)	Temp. (°C)	Weather
1130 IST of 30.09.19 to 1730 IST of 30.09.19	Southwest	05-15	03-05	Generally cloudy sky with Precipitation age to 10 mm
1730 IST of 30.09.19 to 2330 IST of 30.09.19	West-Southwest	10-15	03-09	Partly cloudy sky with precipitation upto 2 mm.
2330 IST of 30.09.19 to 0530 IST of 01.10.19	West-Southwest	10-15	02-04	Partly cloudy sky.
0530 IST of 01.10.19 to 1130 IST of 01.10.19	West	05-15	01-03	Partly cloudy sky.

Outlook for subsequent 2 Days

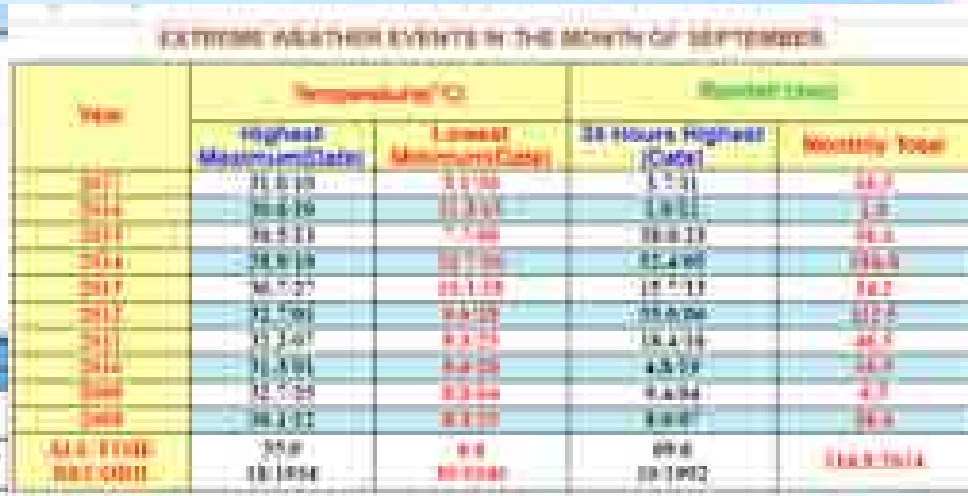
Time	Wind Direction	Wind Speed (Kt/Kmph)	Temp. (°C)	Weather
1130 IST of 01.10.19 to 1130 IST of 02.10.19	West-Southwest	10-20	03-04	Partly cloudy sky with Precipitation age to 05 mm
1130 IST of 02.10.19 to 1130 IST of 03.10.19	Southwest	10-15	-01-03	Partly cloudy sky with Precipitation age to 05 mm

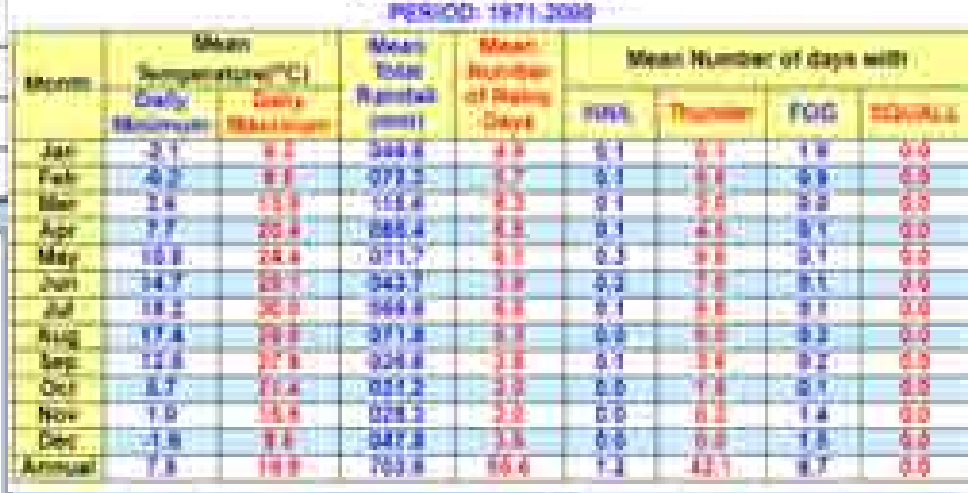
District Level Forecast

District-wise Weather Forecast for Uttarakhand

District-wise Weather Warning for Uttarakhand

City Forecasts





Highway Forecasts

Pilgrims Forecasts

Forecast and Warning Guidance for Winter Weather

In 2016, a multi-institutional initiative is taken to understand & study the various characteristics of

- WDs & its associated weather i.e. heavy rain/snow, spatial distribution of precipitation
- Dense Fog
- Cold wave/day
- Ground frost etc.

mainly for the northern parts of the country (north of 20°N), so that a better weather forecast & warnings advisories at least five days in advance may be issued.

Forecast and Warning Guidance for Winter Weather

Precipitation and its associated synoptic features:

- The western disturbance (WD) as an upper air cyclonic circulation (CC) over Pakistan and adjoining Jammu & Kashmir between 3.1 km & 4.5 km above mean sea level is very likely to move over Jammu & Kashmir and adjoining Pakistan by tomorrow. It is very likely to cause light snowfall activity over higher reaches of Jammu & Kashmir on 12th night & 13th.
- In quick succession, another active WD is very likely to affect Western Himalayan region (WHR) from 14th and its adjoining plains of northwest India from 15th onwards.
- The 2nd WD is very likely to be seen as trough in mid-tropospheric westerlies somewhere around Longitude 60°E and north of Latitude 20°N on 14th with high moisture feed from the Arabian Sea in the forward sector of the WD and strong winds of order more than 50 knots in right entrance of the trough. In result, the system is very likely to mention its intensity upto 18th.
- Therefore, in the presence of remnant of 1st WD and likely divergence field of 2nd WD over WHR, light to moderate precipitation at a few places is very likely to occur over WHR on 14th. Thereafter, WD would move eastwards gradually with very deep trough in mid-tropospheric westerlies (south of 20°N) and high moisture feed from Arabian Sea on 15th & 16th.
- Also, under its influence an induced CC circulation very likely to develop over Central Pakistan & neighbourhood on 15th. As a result, widespread precipitation activity with heavy falls at isolated places are very likely to occur over WHR on 15th & 16th and scattered to fairly widespread activity over Punjab and Haryana, Chandigarh & Delhi. Light rainfall at isolated places is also likely over northern parts of Rajasthan and northwest Uttar Pradesh during same period.

Forecast and Warning Guidance for Winter Weather

Minimum temperature and its associated synoptic features:

Currently strong northwesterly/westerly dry cold winds of order 10 to 15 knots are prevailing over Indo- Gangetic Plains (IGP) at 10m height above mean sea level with RH less than 60% over plains of northwest India. With speed is very likely to reduce to 5 to 10 knots over most parts of IGP and less than 5 knots over parts of central Uttar Pradesh and over northeastern states on 13th morning. RH is also most likely to be less than 60% over above regions on same day. Thereafter, strong northerly/northwesterly winds of order 10 to 15 knots are very likely to prevail over most parts of northwest and east India with RH less than 60% on 14th & 15th morning.

Due to prevailing above mentioned features, no significant change in minimum temperatures is observed over northwest India except East Uttar Pradesh, where they have dropped by 2-4°C in past 24 hours.

Hence, the prevailing below normal minimum temperatures trend over plains of northwest India are very likely to continue during next 3 days.

Cold Wave Warning:

In the influence of above mentioned scenario, Cold wave conditions at a few places over Punjab, Haryana, Chandigarh & Delhi and Uttar Pradesh most likely to continue to prevail till 14th morning.

Ground Frost Warning:

Considering the prevailing and forecast trends in minimum temperatures, ground frost conditions are also very likely to continue to occur over isolated pockets over Punjab, Haryana, north Rajasthan and Uttar Pradesh during next 2 days.

Forecast and Warning Guidance for Winter Weather

Fog:

Strong winds (10-15 knots) are very likely to continue to prevail over most parts of Indo- Gangetic plains during next 4 days (at 10 m above mean sea level)

RH is also very likely to be less than 60% over most parts of Indo- Gangetic plains during next 4 days

Considering wind pattern at lower levels, RH and likely minimum temperature pattern, no dense fog is likely over Indo- Gangetic plains during next 4 days.

Maximum temperature:

Considering prevailing synoptic & dynamical conditions and NWP model guidance, no significant change in maximum temperatures likely over northwest India during next 3-4 days.

Cold day condition:

No Cold day conditions are likely over any parts of northwest India during next 3-4 days.

PUBLIC WEATHER SERVICES

- "I came to learn very quickly that producing a good forecast was 10% of the work. 90% of the work relate to its efficient information dissemination to the end users through Media and other modes of communications"

Prof. Peter Webster

School of Earth & Atmospheric Sciences,

Georgia Institute of Technology,

Atlanta,

PUBLIC WEATHER SERVICES

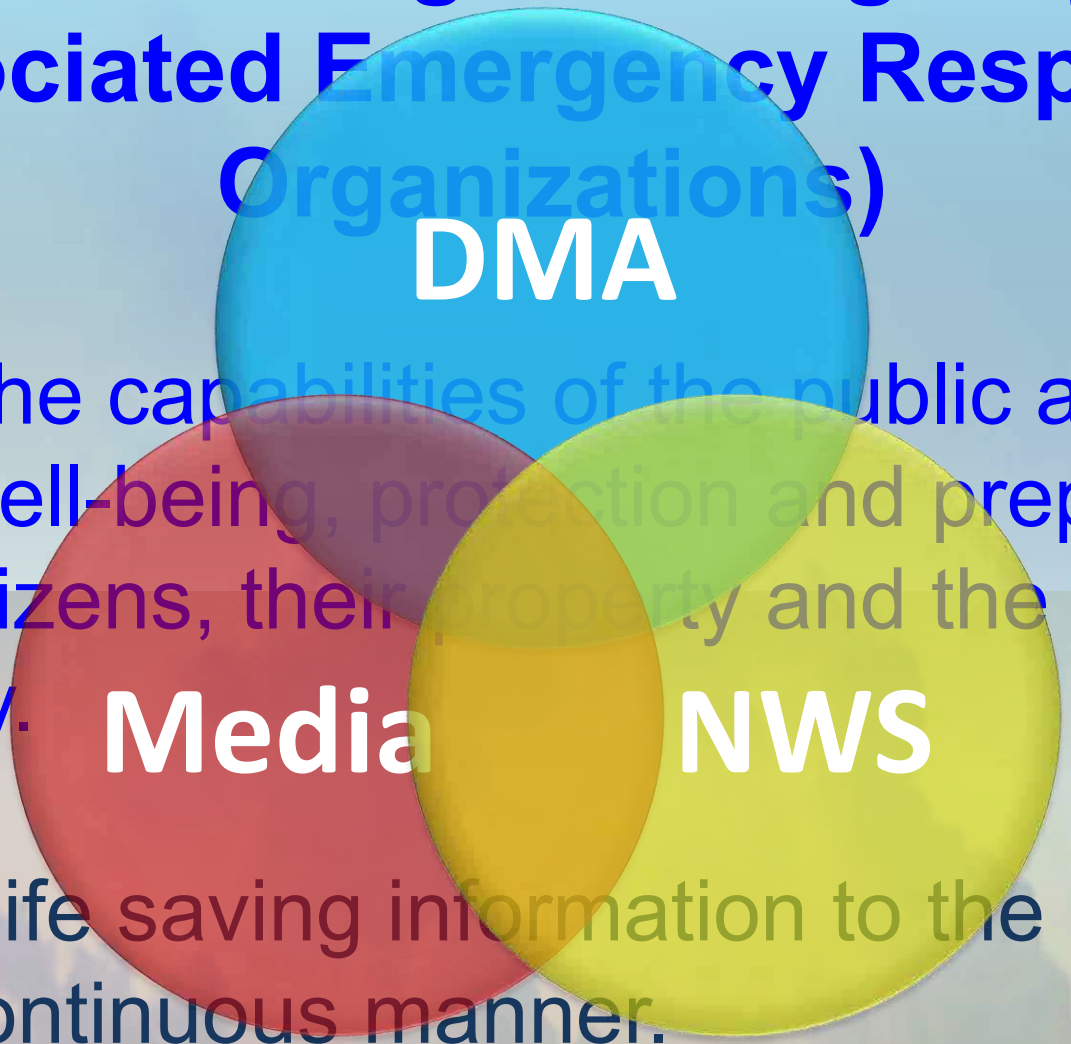
A warning must include 3 essentials to be effective:

1. **It must alert people.**
2. **It must call them to action.**
3. **It must be target-oriented.**

Main Warning User Groups

- The General Public
- Media
- Stakeholders
- Disaster Management Agencies (DMA)

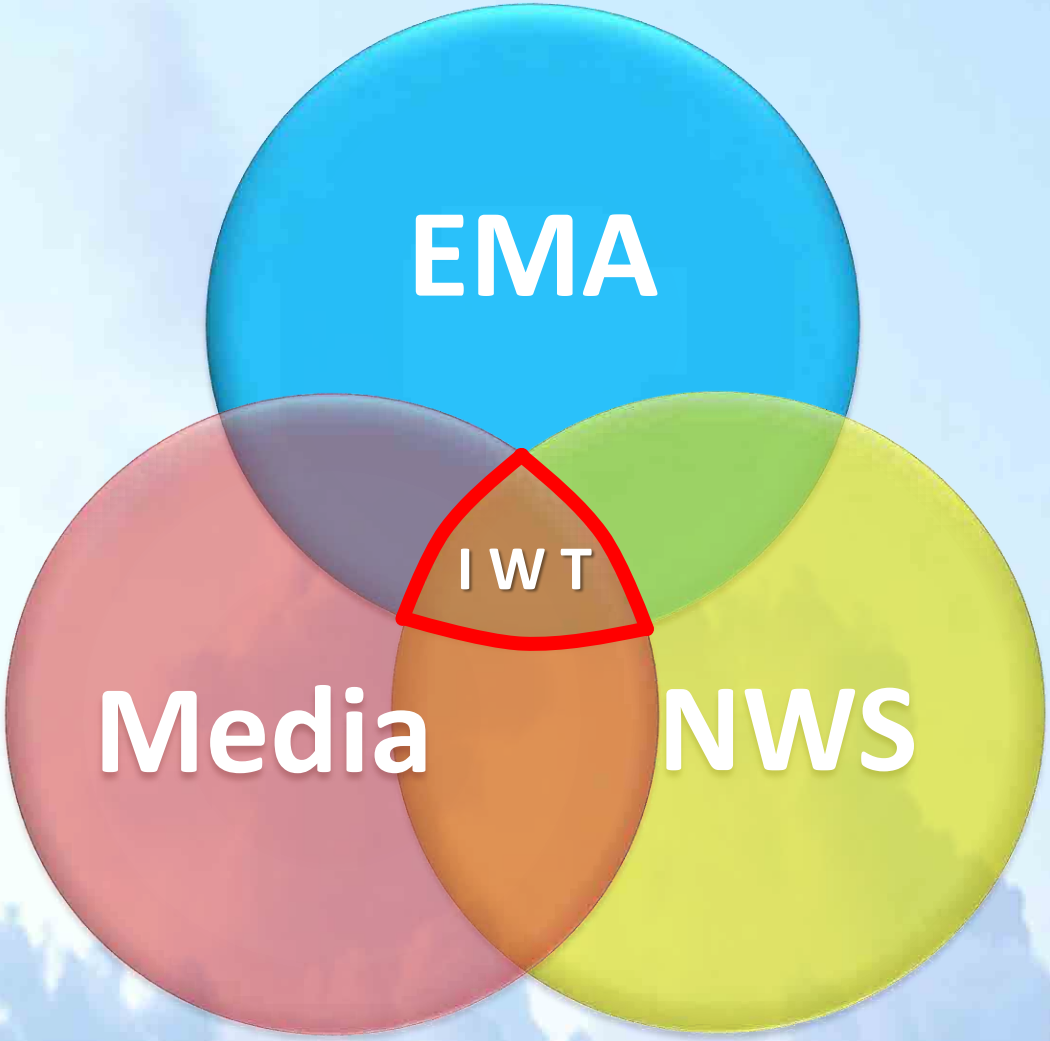
Disaster Management Agency (and associated Emergency Response Organizations)



- Ensure the capabilities of the public and provide for the well-being, protection and preparedness of the citizens, their property and the local economy.

- Provide life saving information to the public in nearly continuous manner.

  - Provide forecasts and warnings for the protection of life and property


EMA
I W T
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"Individually we are
one drop, together,
we are an ocean"

Thanks