CLOUDBURST OVER LEH AND FLASH FLOODS

SURINDER KAUR (INDIA)

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

- The cloud burst in India occurs during monsoon season over the orographically dominant regions.
- Leh is on a plateau at around 3500 meters above mean sea level (high altitude cold desert) and usually receives very little rainfall.
- Highest rainfall ever recorded over Leh during 24 hours = 51.3 mm (22 August, 1933)
- Average rainfall of August= 15.4 mm

Major Rivers of India

N

PAKISTAN
JAMMU & KASHMIR
Indus R.
Jhelum R.
Chenab R.
Ravi R.
Beas R.
Satluj R.
HIMACHAL PRADESH
PUNJAB
UTTARANCHAL
HARYANA
DELHI
RAJASTHAN
Luni R.
Chambal R.
Yamuna R.
Ganga R.
Gandak R.
Kosi R.
SIKKIM
BHUTAN
ARUNACHAL PRADESH
Subansiri R.
Lohit R.
Brahmaputra R.
ASSAM
NAGALAND
MEGHALAYA
MANIPUR
TRIPURA
MIZORAM
BIHAR
JHARKHAND
WEST BENGAL
BANGLADESH
GUJARAT
Saraswati R.
Narmada R.
MADHYA PRADESH
Tapi R.
CHHATTISGARH
Mahanadi R.
ORISSA
DIU
DAMAN
DADAR & NAGAR HAVELI
Godavari R.
MAHARASHTRA
Bhima R.
Krishna R.
ANDHRA PRADESH
YANAM (Pondicherry)
GOA
KARNATAKA
Payaswani R.
LAKSHADWEEP
MAHE (Pondicherry)
Kaveri R.
PONDICHERRY (Puduchchery)
KARAIKAL (Pondicherry)
TAMILNADU
KERALA
ANDMAN & NICOBAR ISLANDS
State Boundary
Rivers
Map not to Scale

An intense convective cloud cluster developed to the east of Leh by 2000 hours IST of 5th August.

A cloud burst occurred over Leh in Jammu and Kashmir around 0130–0200 hours IST on 6th August, 2010 leading to flash flood and mud slides over the region

The cloud burst was highly localised, as the nearby meteorological observatory (approx. 5 km. distance) of Indian Air Force (IAF) reported 12.8 mm of rainfall during 0830 hrs. IST of 5th to 0830 hrs. IST of 6th August.

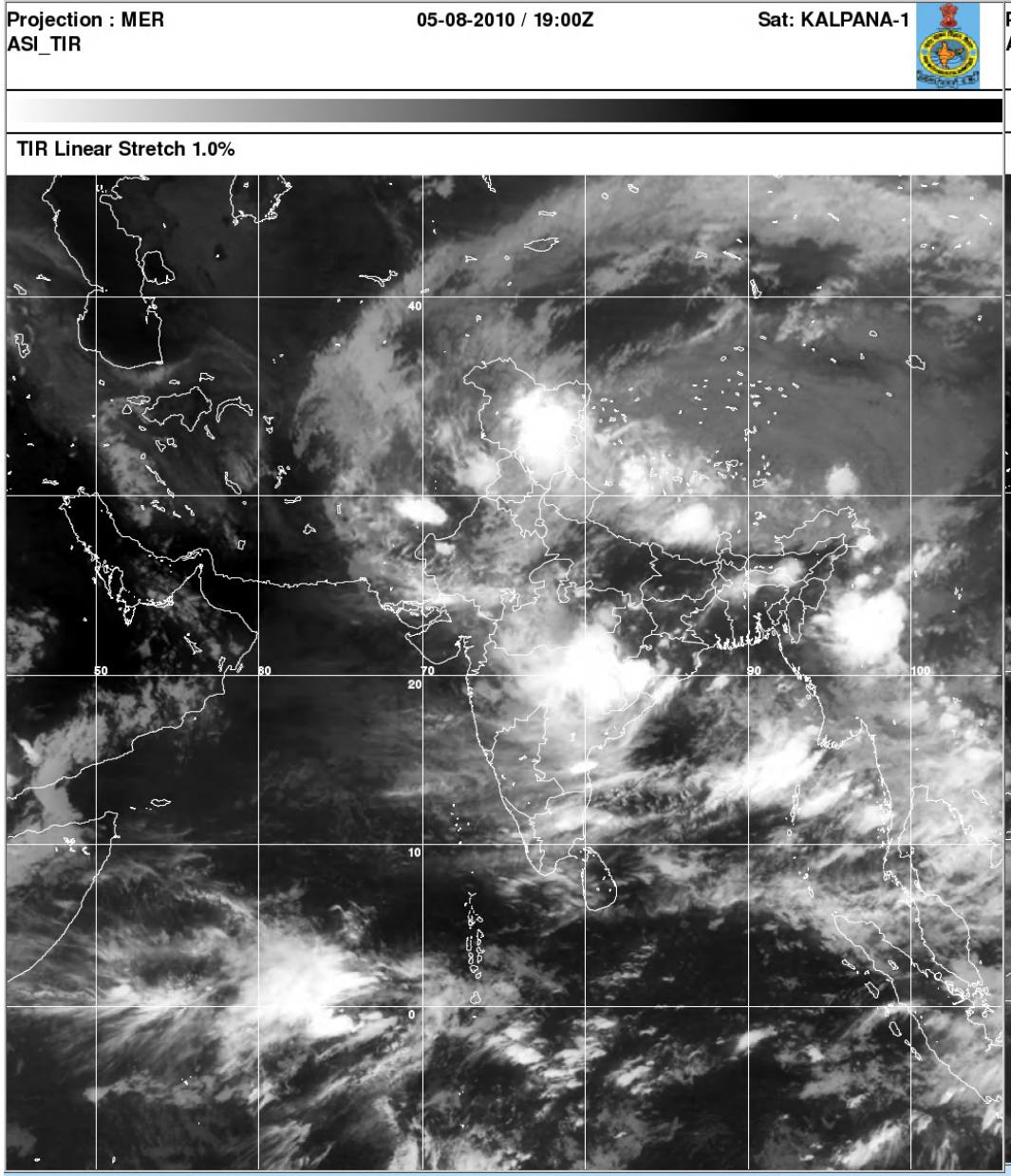
Cloud burst

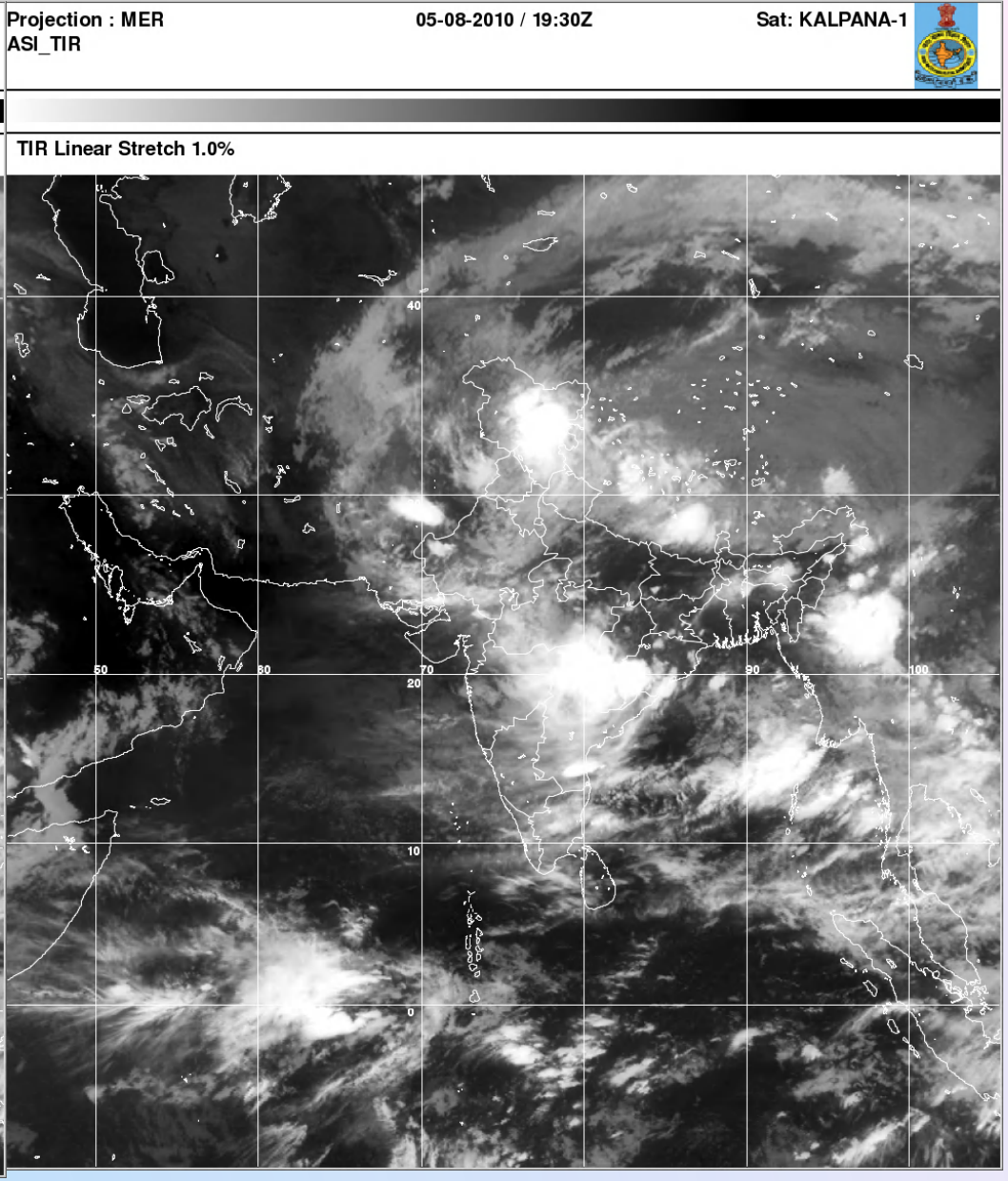
Synoptic Situation

The monsoon trough at the mean sea level lay to the south of its normal position on 4th and 5th August. There was a cyclonic circulation in lower levels over west Rajasthan and neighbourhood. A well marked low pressure area lay over northwest Bay of Bengal on 5th and over north Orissa and neighbourhood on 6th August. Under the influence of these systems, strong southeasterly winds with speed of 15-20 knots prevailed over western Himalayan region

Analysis of Satellite Imageries

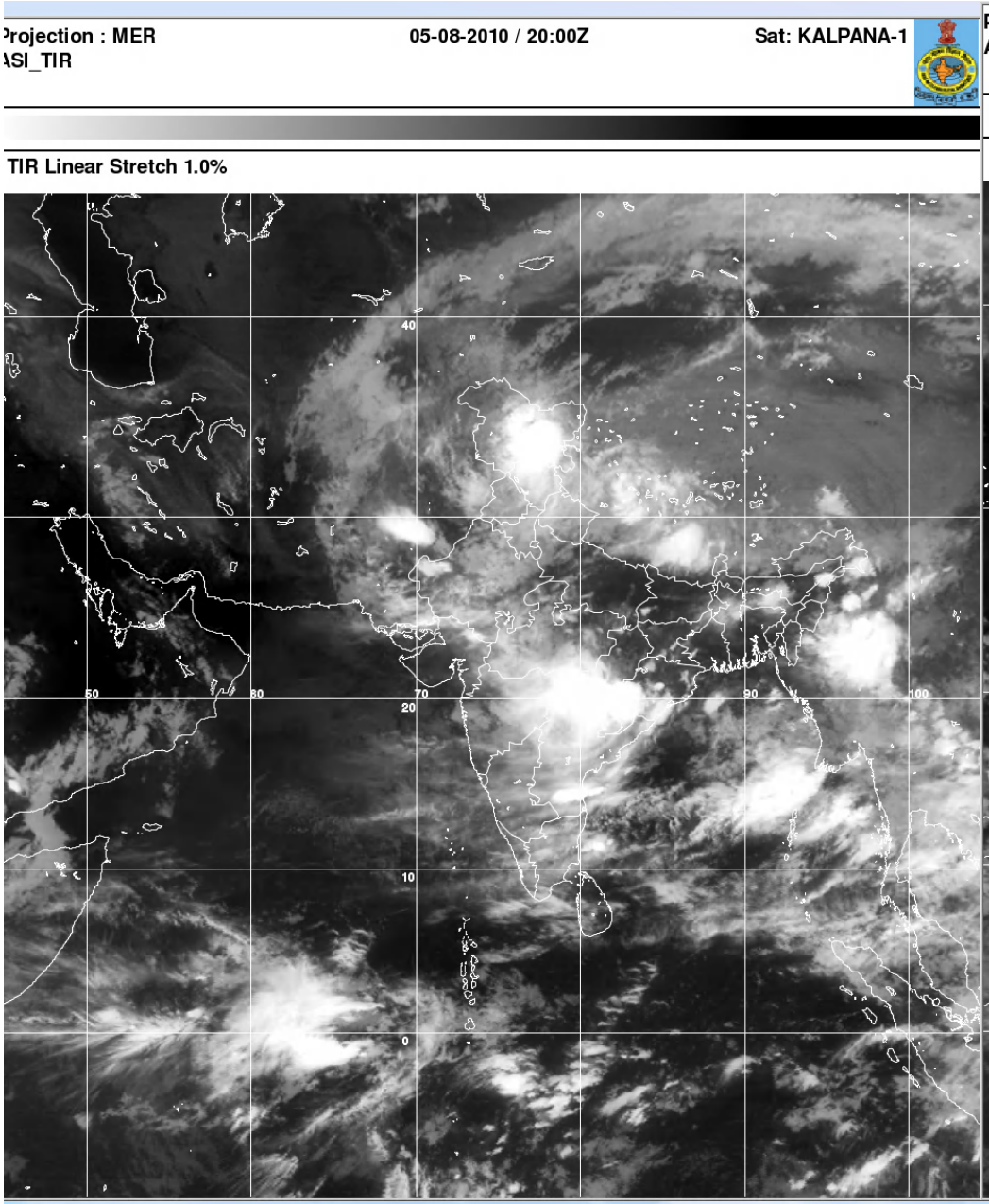
Intense convective system developed in the easterly current associated with monsoon conditions over the region. The convective cloud band extending from southeast to northwest developed over Nepal and adjoining India in the afternoon of 5th. It gradually intensified and moved west-northwestward towards Jammu & Kashmir. An intense convective cloud cluster developed to the east of Leh by 2130 hours IST of 5th August. Satellite Imageries of 0030 hours IST (2100 UTC) to -0600 hours IST (0030 UTC) of 6th August

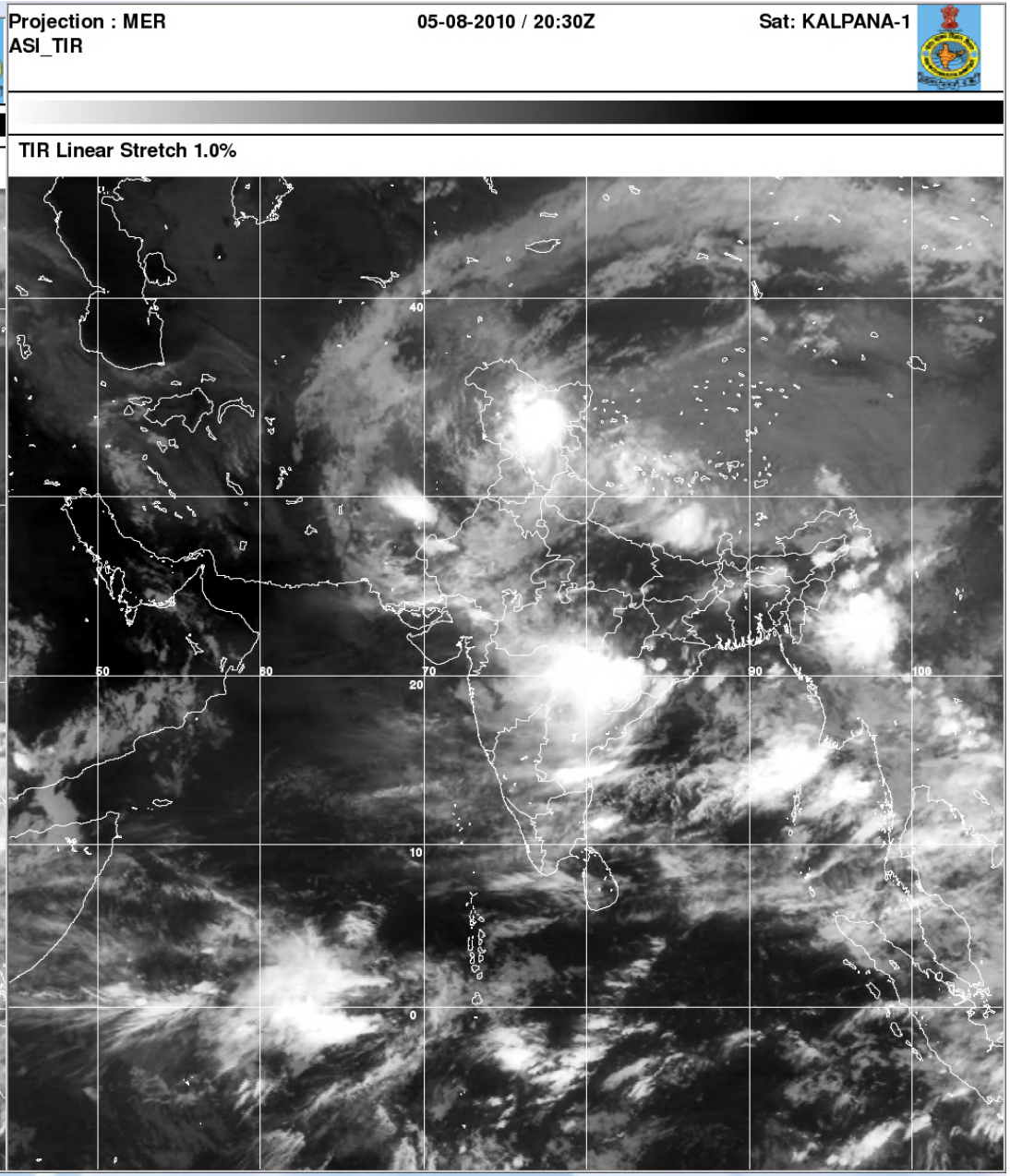




5.8.2010 /19:00Z

5.8.2010 /19:30Z





5.8.2010 /20:00Z **5.8.2010 /20:30Z**

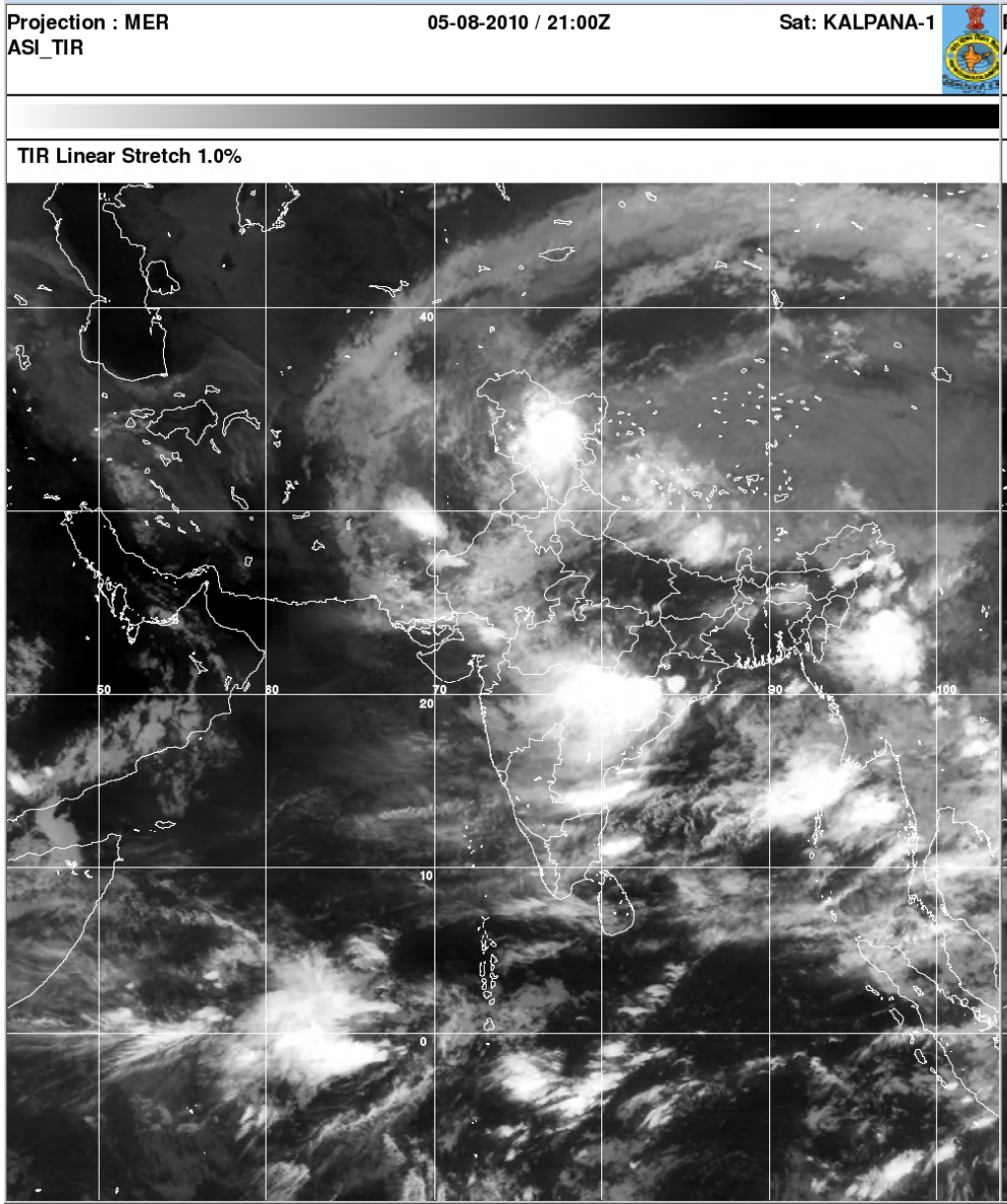
भारत मौसम विज्ञान विभाग

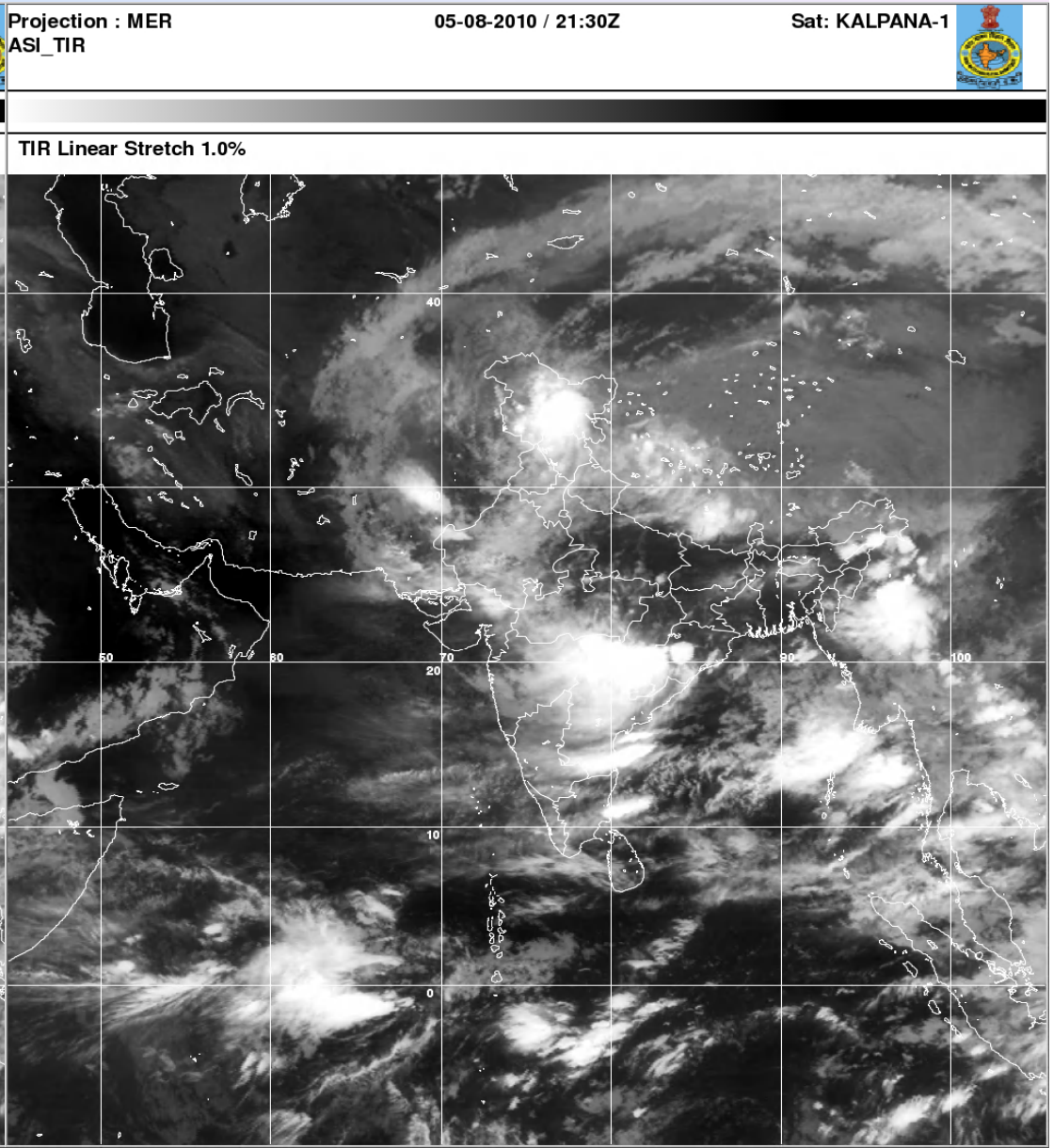
INDIA METEOROLOGICAL DEPARTMENT

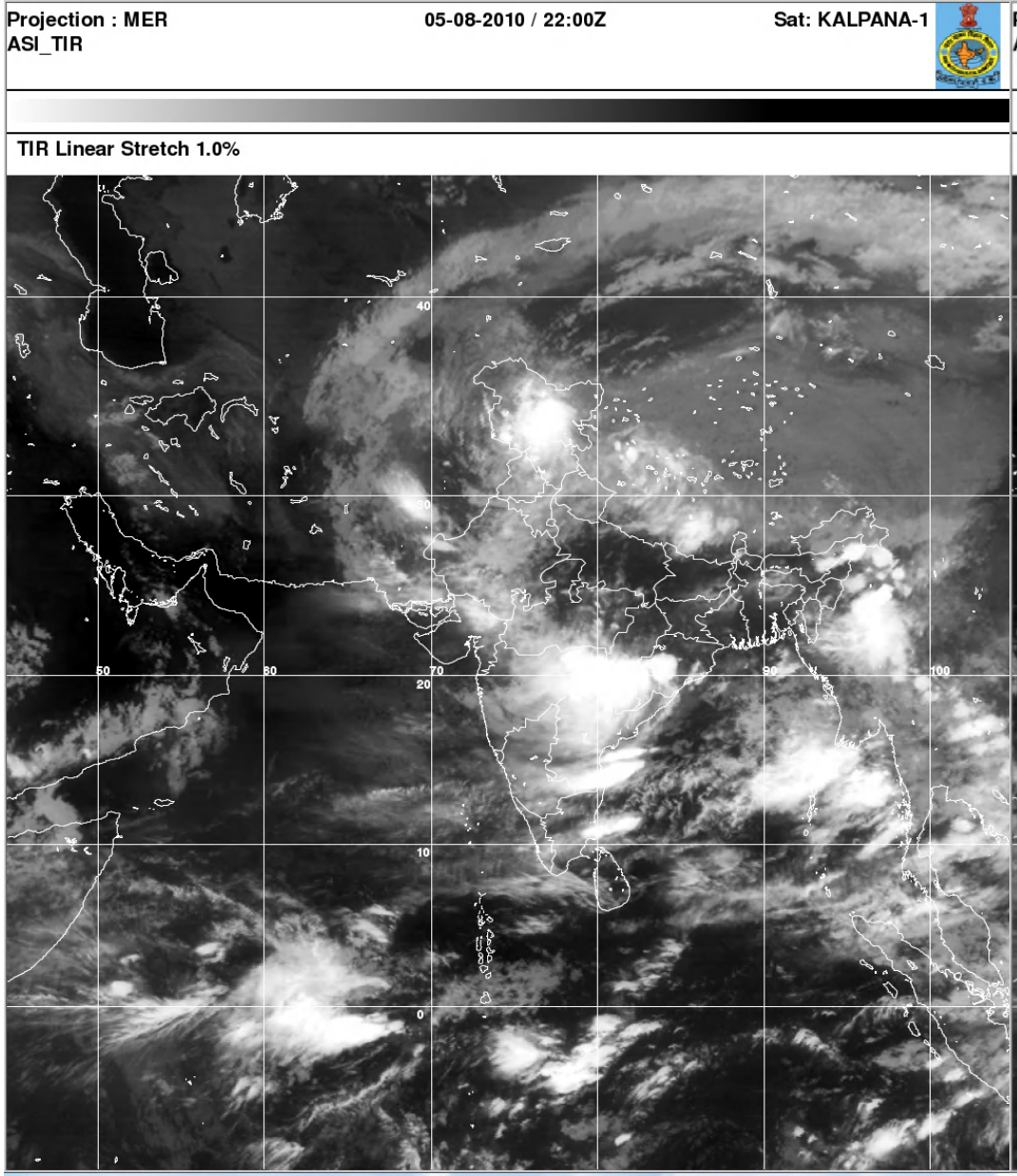
KALPANA-1

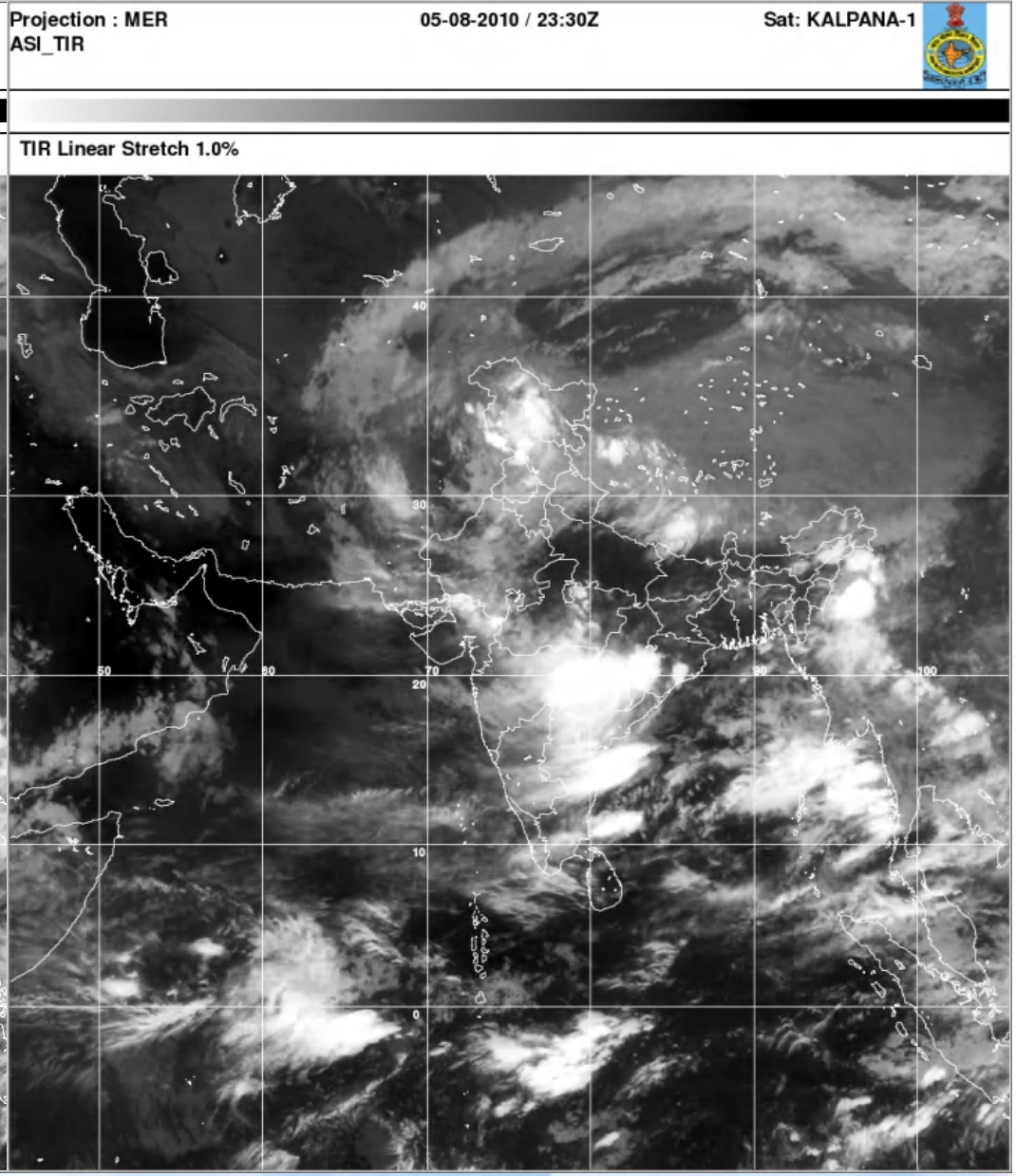
5.8.2010 /21:00Z

5.8.2010 /21:30Z









5.8.2010 /22:00Z

5.8.2010 /23:30Z

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

LEH

FLASH FLOODS

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

- one of the worst ever flood in Leh district of Jammu and Kashmir

- city was under 6 ft water.

- Many buildings were destroyed including Hospitals, bus terminals, radio station transmitter, telephone exchange and mobile-phone towers, even the BSNL communication systems were fully destroyed, the communication was then restored by the Indian Army

- the buses were carried more than a mile by the mud

- Above 150 persons lost their lives
- About 500 people injured
- Five relief camps opened
- 125Crores PM's Relief Fund

STATE-WISE % DEPARTURE OF RAINFALL DURING S-W MONSOON

S. NO.	STATES	%Dep.										
		2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
1	JAMMU & KASHMIR	29%	-34%	2%	-3%	32%	-12%	-25%	-10%	22%	6%	-1%
2.	HIMACHAL PRADESH	14%	-34%	-5%	-36%	-24%	-8%	-46%	3%	-20%	-16%	-7%
3.	PUNJAB	-7%	-34%	20%	-32%	-13%	-8%	-45%	-5%	-36%	3%	-16%
4.	UTTARAKHAND	40%	-27%	-6%	28%	-20%	9%	14%	10%	-2%	-6%	8%
5.	HARYANA	21%	-35%	15%	-34%	-39%	2%	-23%	14%	-38%	-5%	-15%
6.	CHANDIGARH(UT)	33%	-10%	31%	-24%	-36%	6%	9%	6%	-4%	-6%	9%
7.	DELHI	23%	-27%	-5%	-18%	-24%	-15%	-42%	39%	-39%	-28%	-21%
8.	RAJASTHAN	28%	-35%	0%	-14%	16%	-10%	-22%	-2%	-64%	-15%	-27%

EXCESS (+20% or more)

NORMAL (+19% to -19%)

DEFICIENT (-20% to -59%)

SCANTY (-60% to -99%)

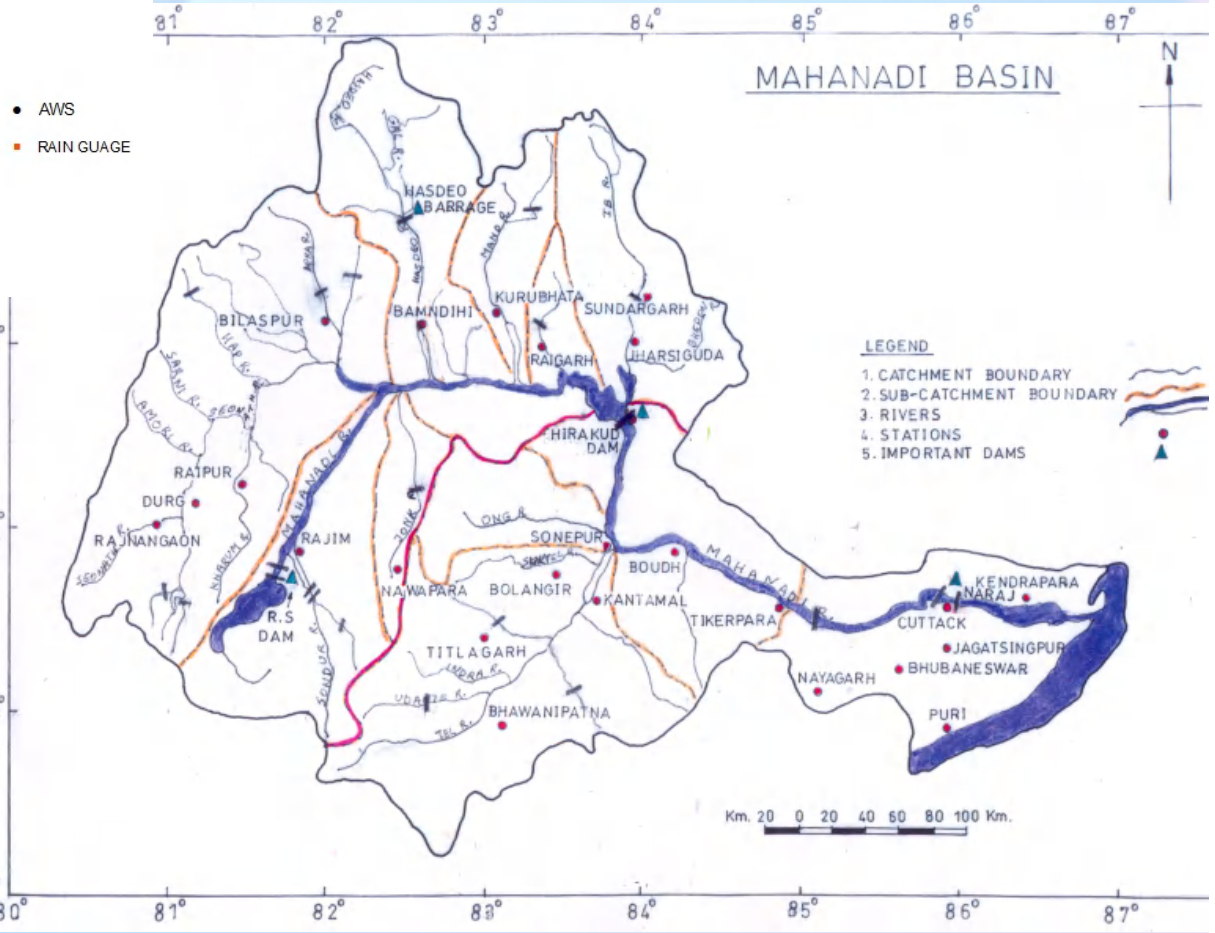
WEEKLY C.RAINFALL % DEP

S.No.	PERIODS ENDING ON --- / STATES/ UT's	09 JUN 2010	16 JUN 2010	23 JUN 2010	30 JUN 2010	07 JUL 2010	14 JUL 2010	21 JUL 2010	28 JUL 2010	04 AUG 2010	11 AUG 2010	18 AUG 2010	25 AUG 2010	01 SEP 2010	08 SEP 2010	15 SEP 2010	22 SEP 2010	29 SEP 2010
1	JAMMU & KASHMIR	90%	50%	40%	58%	24%	6%	2%	32%	27%	31%	30%	38%	35%	33%	34%	32%	29%
2	HIMACHAL PRADESH	421 %	142 %	82%	40%	79%	43%	12%	7%	6%	2%	4%	9%	7%	10%	15%	16%	15%
3	PUNJAB	223 %	40%	-9%	-15%	21%	12%	14%	14%	-2%	-10%	-9%	-3%	-8%	-9%	-4%	-4%	-7%
4	UTTARAKHAND	0%	-30%	-38%	-30%	-4%	-17%	3%	5%	11%	8%	6%	18%	17%	24%	26%	43%	40%
5	HARYANA	110 %	4%	-33%	-52%	35%	7%	1%	-6%	-8%	-18%	-13%	5%	2%	6%	16%	22%	21%
6	CHANDIGARH(UT)	738 %	234 %	92%	38%	148 %	88%	60%	40%	33%	19%	14%	19%	12%	16%	21%	31%	33%
7	DELHI	-80%	-86%	-92%	-81%	-12%	-11%	-11%	-27%	-28%	-38%	-29%	-7%	-8%	-3%	8%	20%	23%
8	RAJASTHAN	379 %	134 %	42%	-7%	13%	-10%	-21%	5%	18%	15%	20%	22%	18%	20%	30%	31%	28%

WEEKLY RAINFALL % DEP

S.No.	WEEKS ENDING ON ---> / STATES/ UT's	09 JUN 2010	16 JUN 2010	23 JUN 2010	30 JUN 2010	07 JUL 2010	14 JUL 2010	21 JUL 2010	28 JUL 2010	04 AUG 2010	11 AUG 2010	18 AUG 2010	25 AUG 2010	01 SEP 2010	08 SEP 2010	15 SEP 2010	22 SEP 2010	29 SEP 2010
1	JAMMU & KASHMIR	145 %	16%	-9%	100 %	-39%	-40%	-8%	125 %	6%	56%	15%	133 %	2%	-4%	46%	-15%	-31%
2	HIMACHAL PRADESH	554 %	-57%	-30%	-28%	151 %	-44%	-43%	-10%	-1%	-19%	13%	66%	-35%	70%	100 %	87%	-1%
3	PUNJAB	288 %	-92%	-98%	-24%	64%	-4%	20%	13%	-72%	-53%	2%	53%	-87%	-19%	104 %	3%	-64%

Demonstration Basin: Seonath Basin



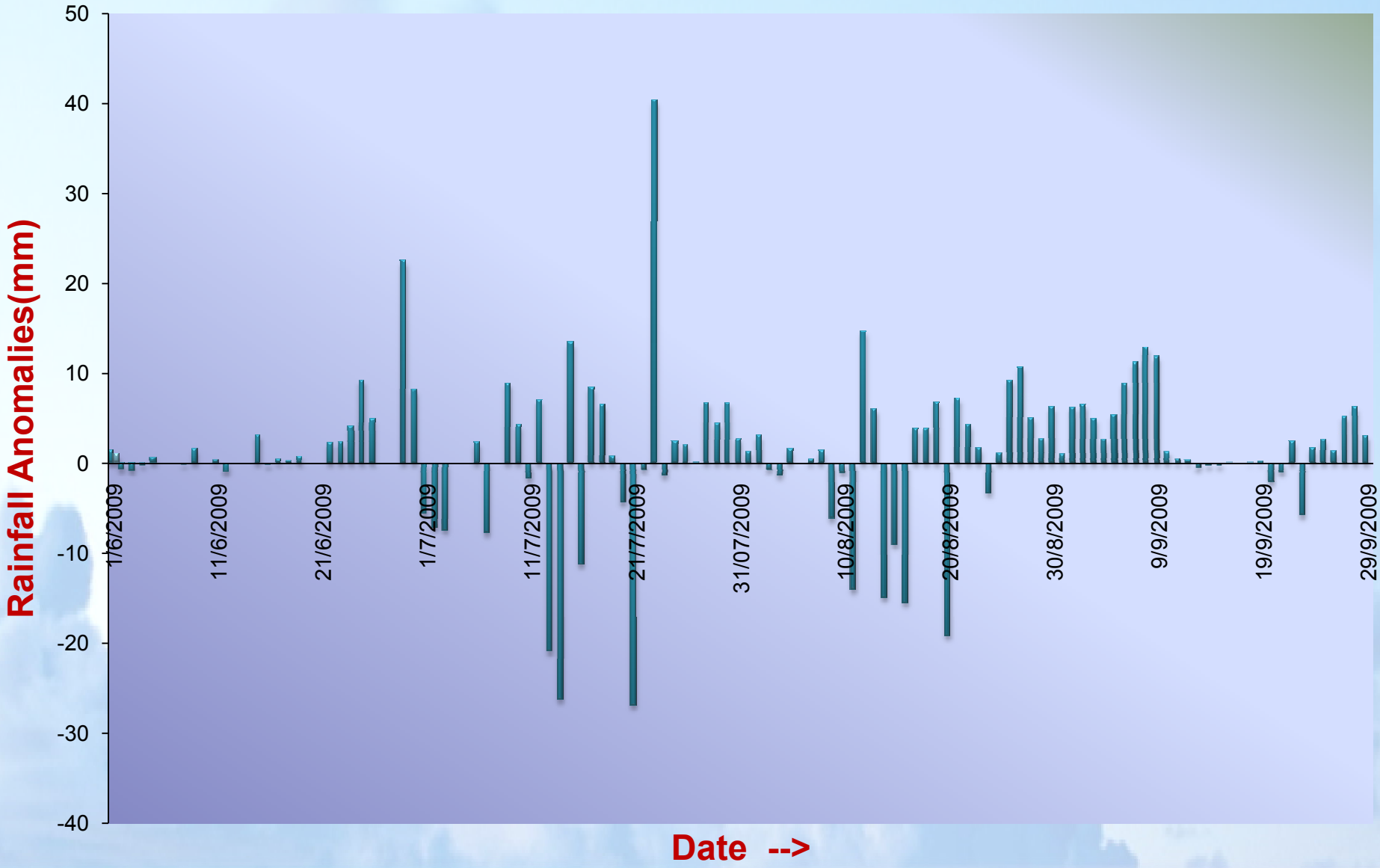
भारत मं
INDIA METEO

QPF RANGE (mm)

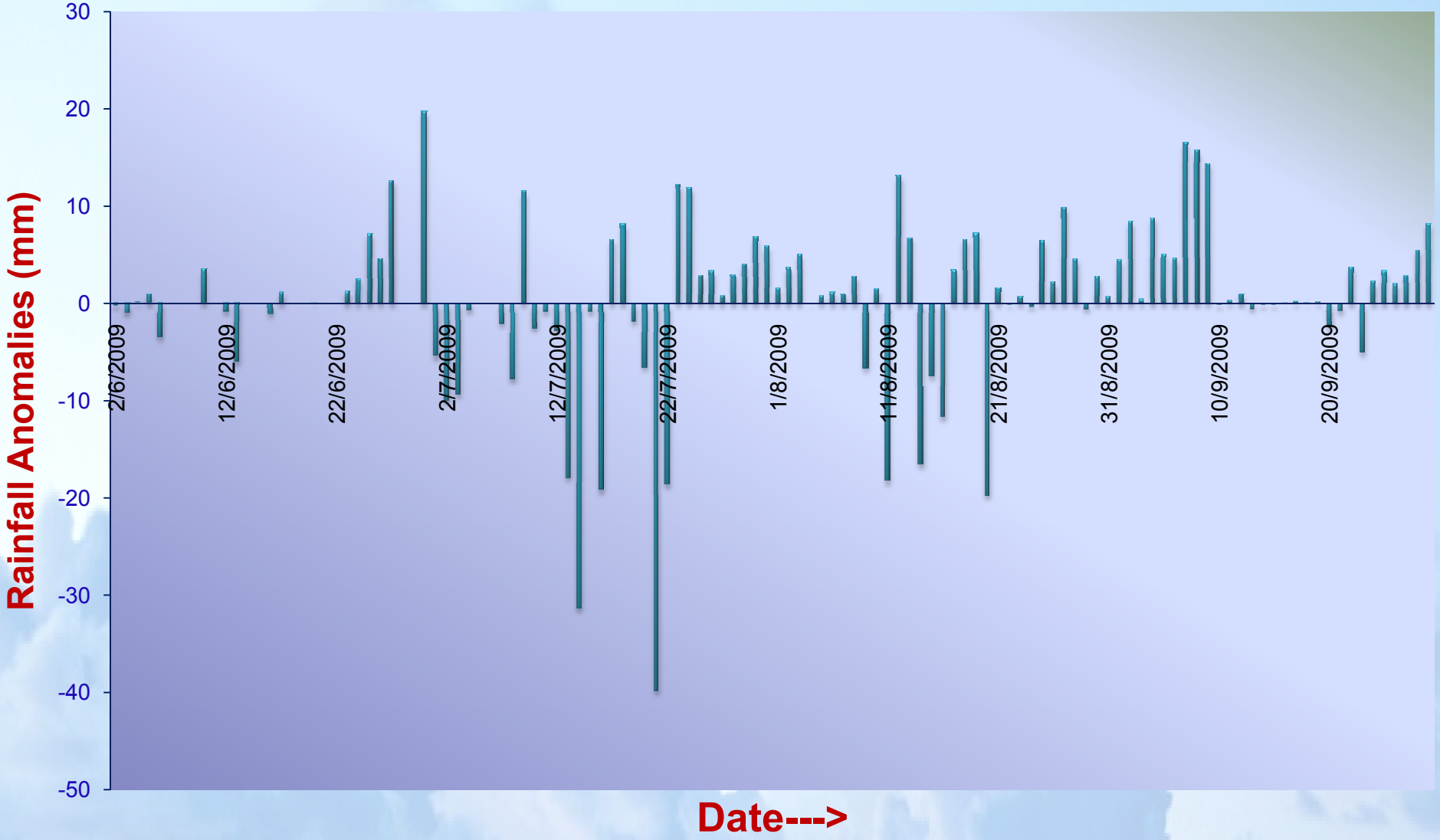
Forecast for Subcathments in the following ranges

- 1-10
- 11-25
- 26-50
- 51-100
- >100

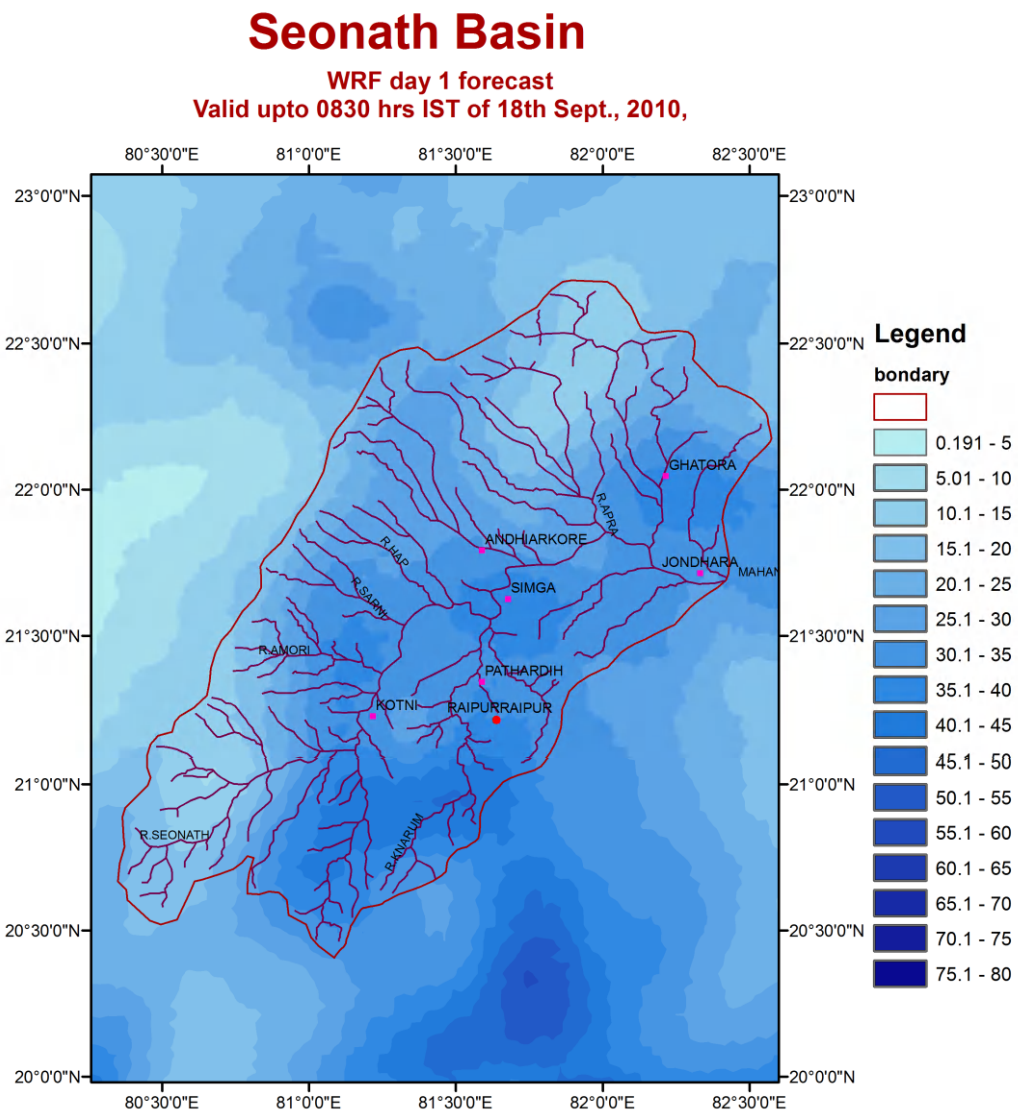
Rainfall Anomalies of Upper Mahanadi (day-1 MME F/C), 2009

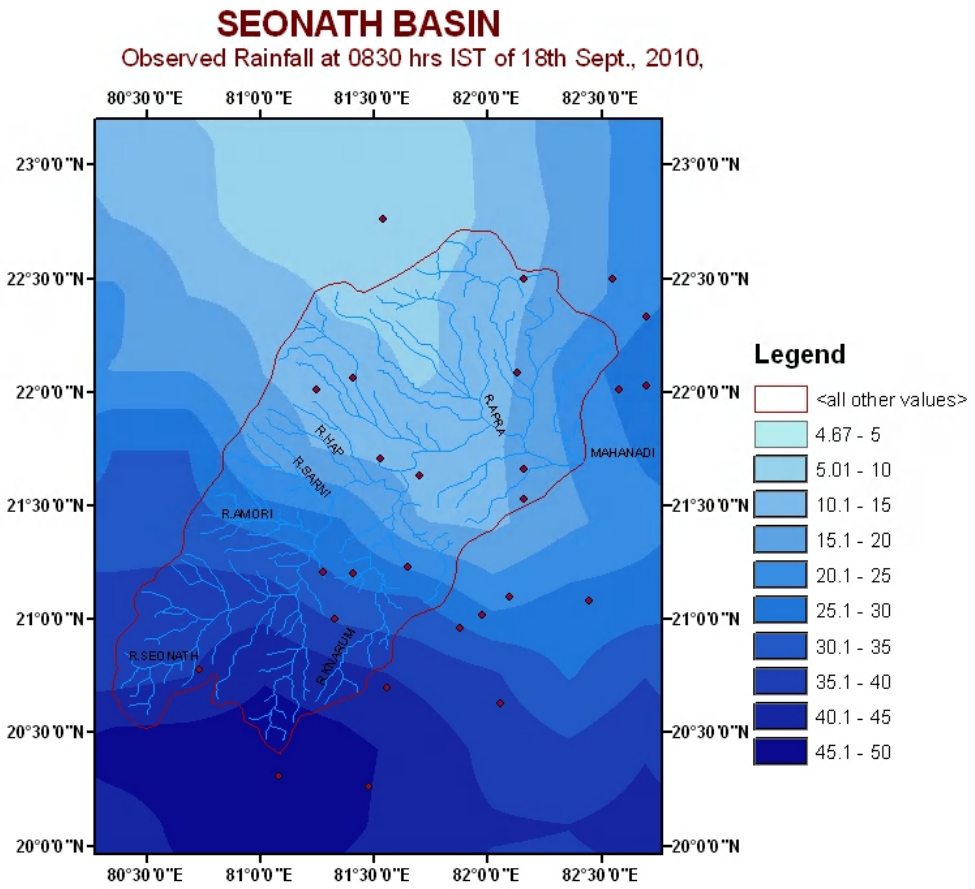


Rainfall Anomalies (MME Day-2 F/C)



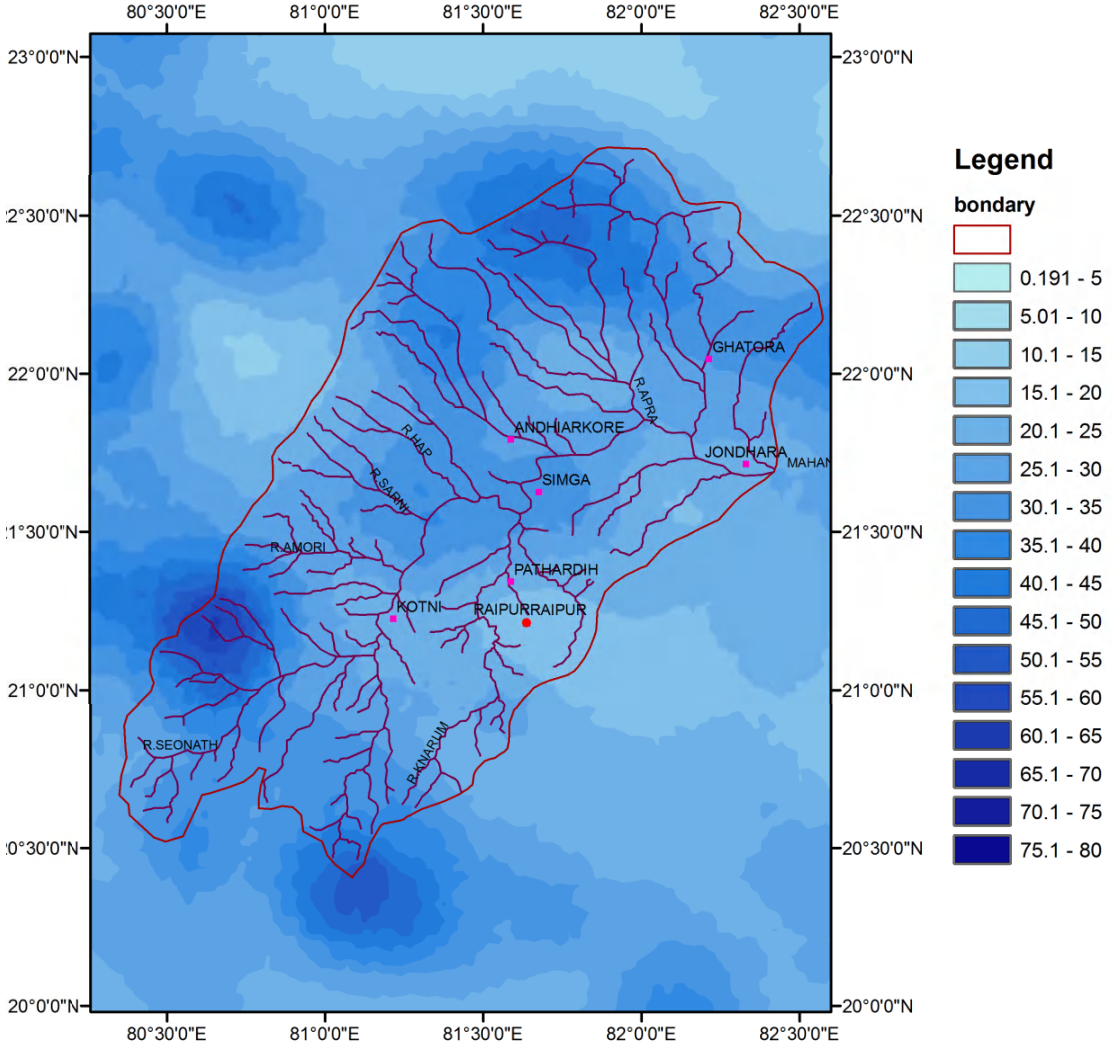
WRF Model (Seonath Basin)





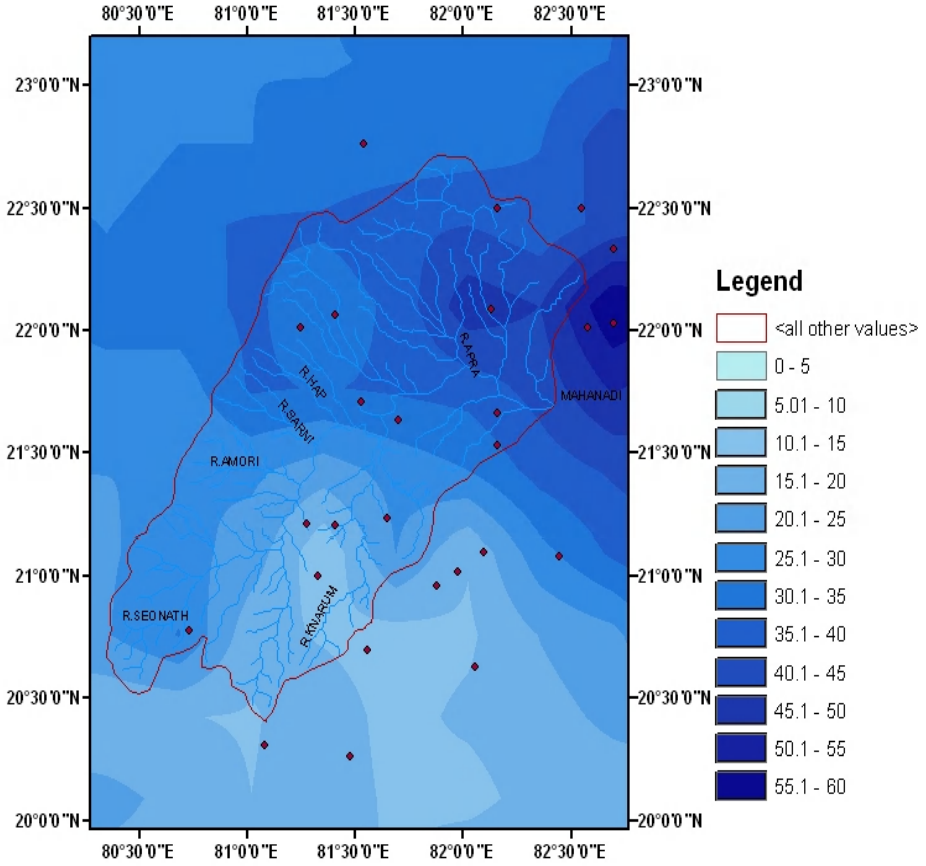
Seonath Basin

WRF day 2 forecast
Valid upto 0830 hrs IST of 19th Sept., 2010,



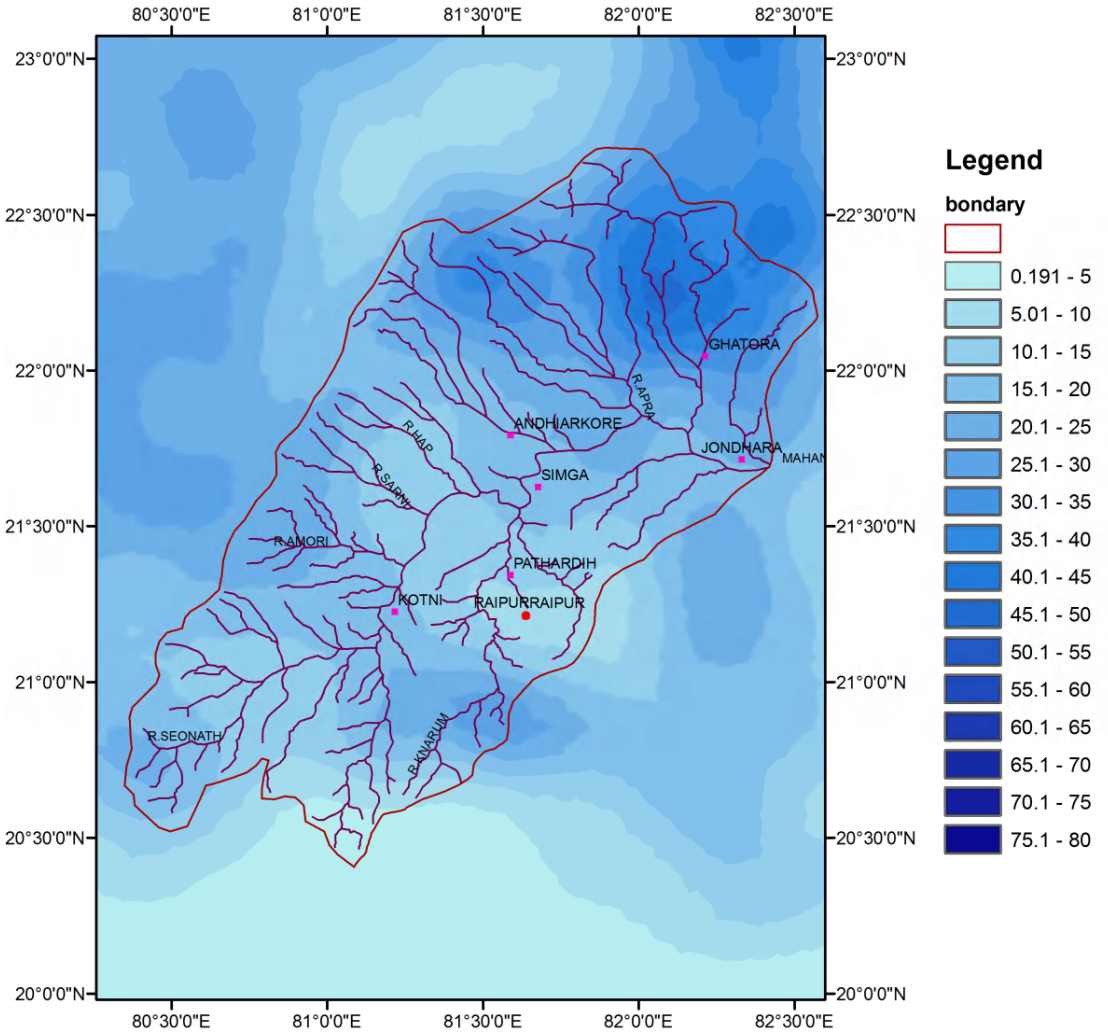
SEONATH BASIN

Observed Rainfall at 0830 hrs IST of 19th Sept., 2010,



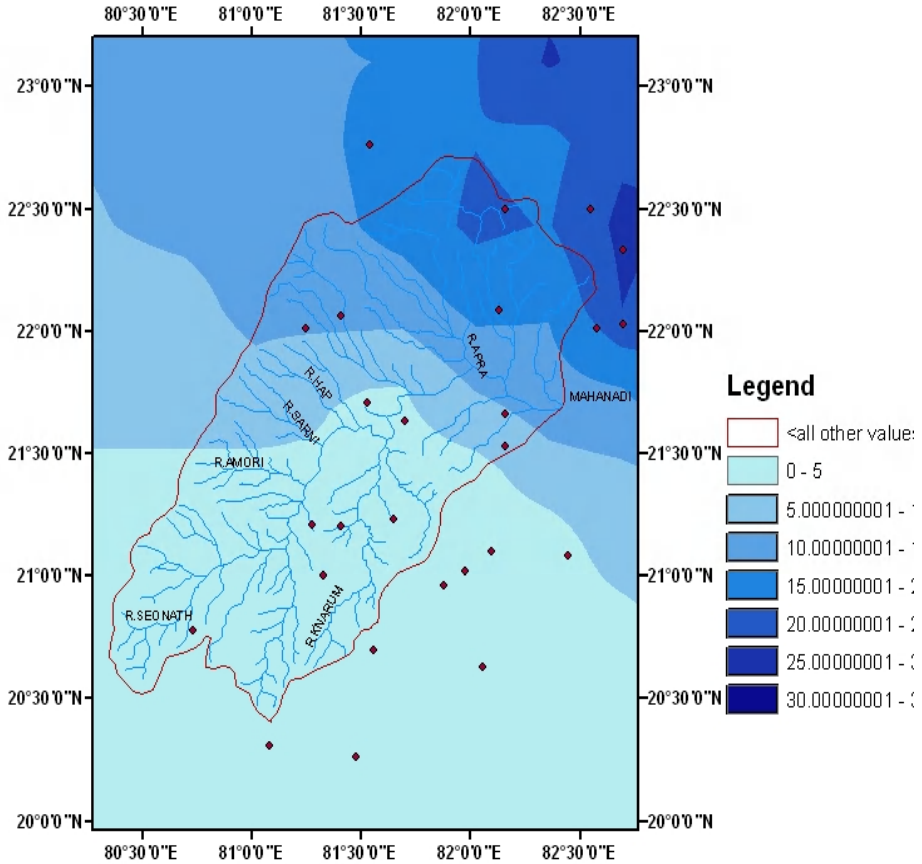
Seonath Basin

WRF day 3 forecast
Valid upto 0830 hrs IST of 20th Sept., 2010,



SEONATH BASIN

Observed Rainfall at 0830 hrs IST of 20th Sept., 2010,



THANKS

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT