ANNUAL CLIMATE CHANGE MEDIA BRIEFING WORKSHOP 2014

NEW DELHI, 6TH NOVEMBER

EXTREME RAINFALL & FLOOD FORECASTING

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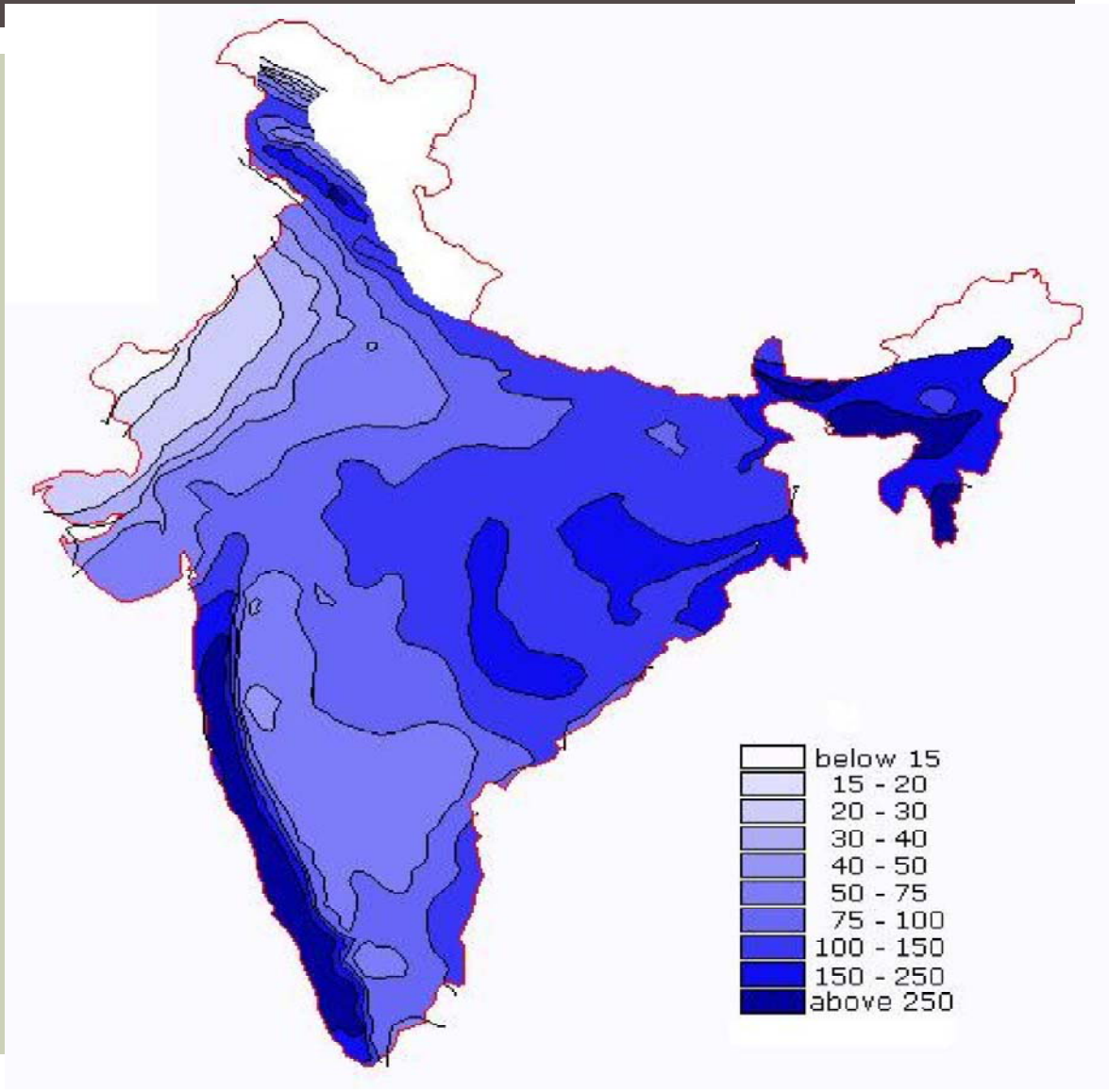
SPATIAL VARIATIONS IN RAINFALL

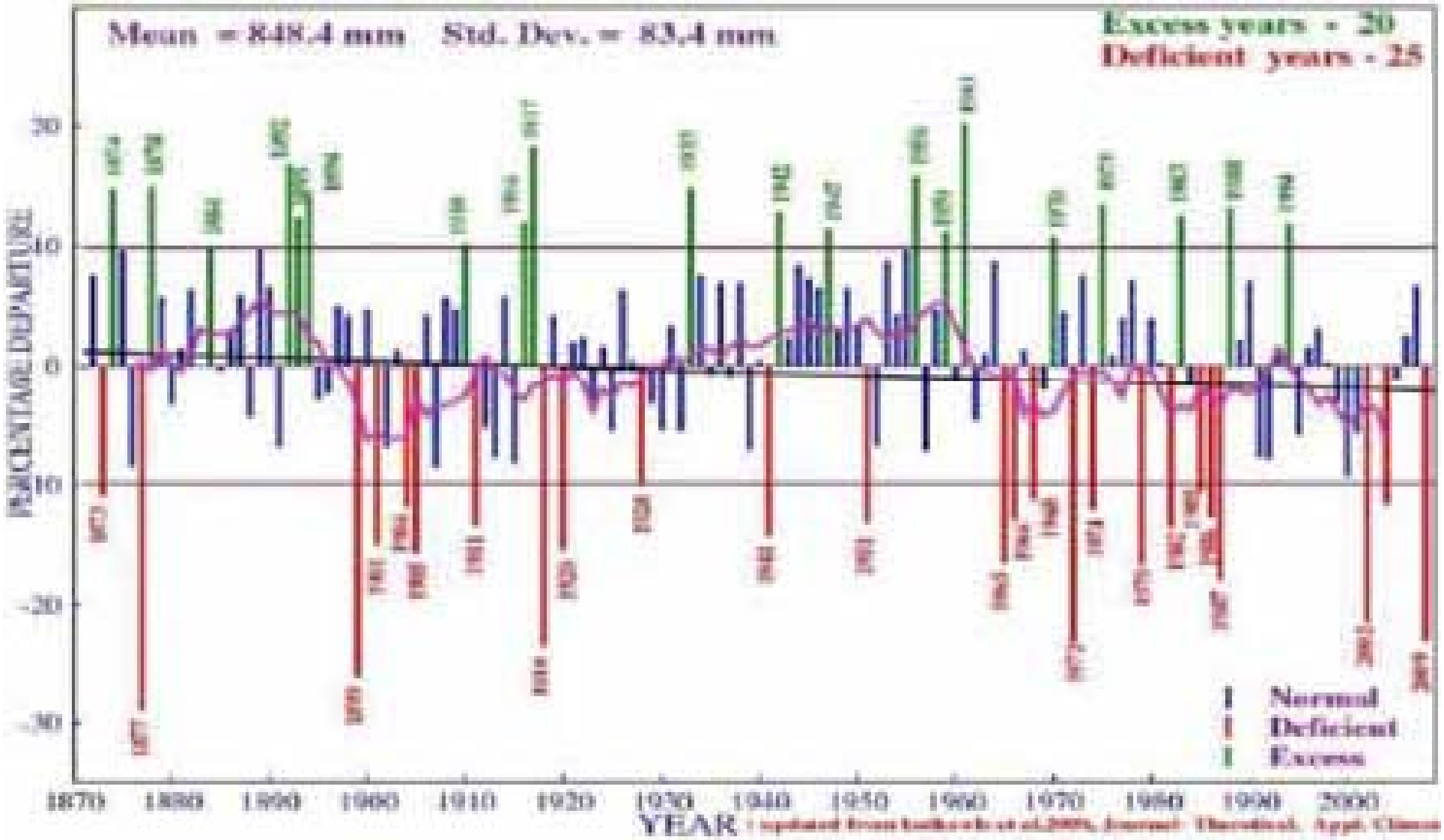
- Average annual rainfall varies from 10 cm to 1100 cm



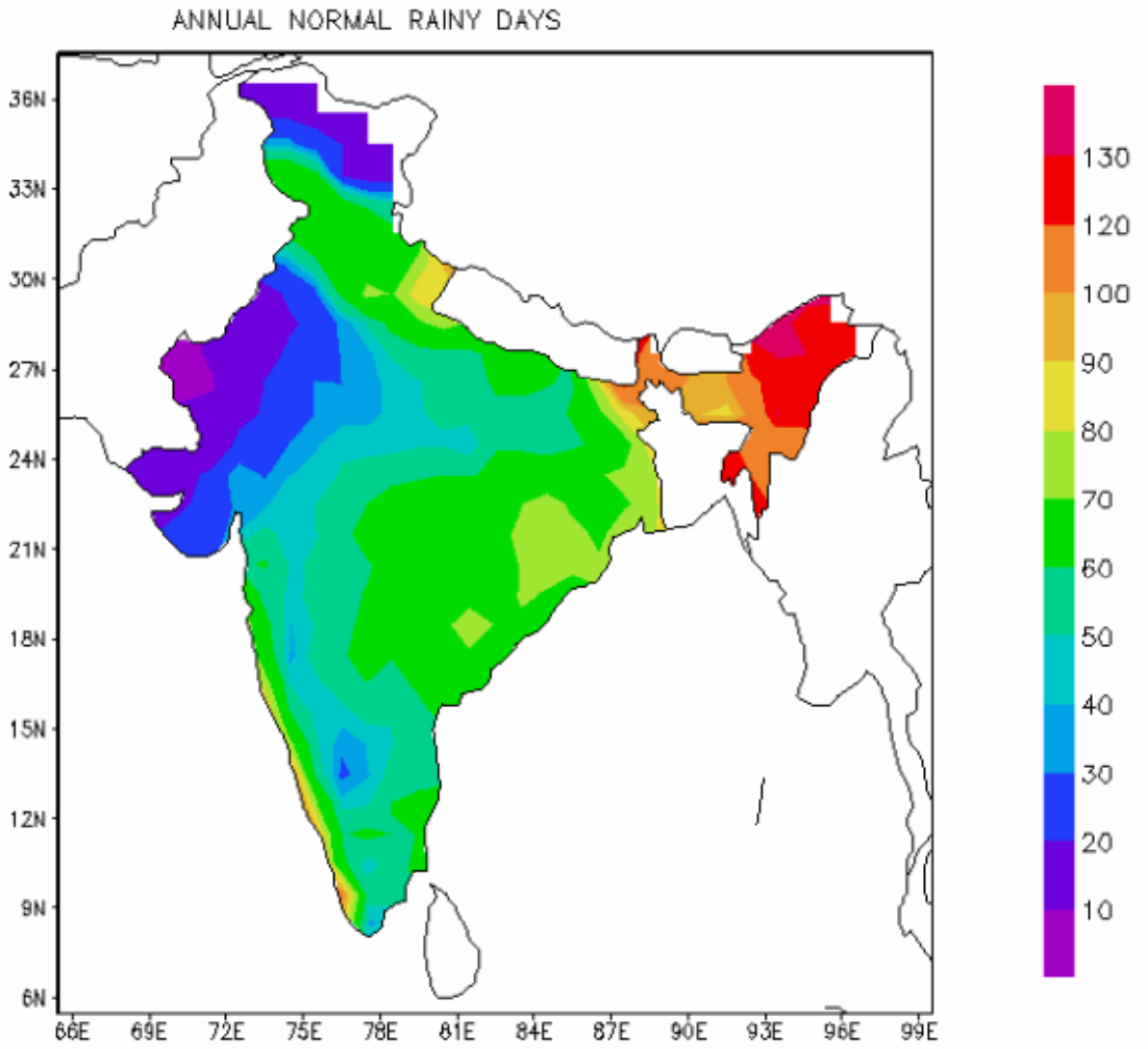
TRENDS IN RAINFALL

- Study by IMD “Changes in extreme rainfall events and flood risk in India during the last century” Dec. 2010
- 2599 stations – data >30 years – period 1901-2005
- Well defined epochal variability of approx. 30 years
- No significant trend (period 1871-2009)
- 25 deficient and 20 excess years (in 139 years)
- 13 deficient and 6 excess years (during 1961-2009)
- High regional variability

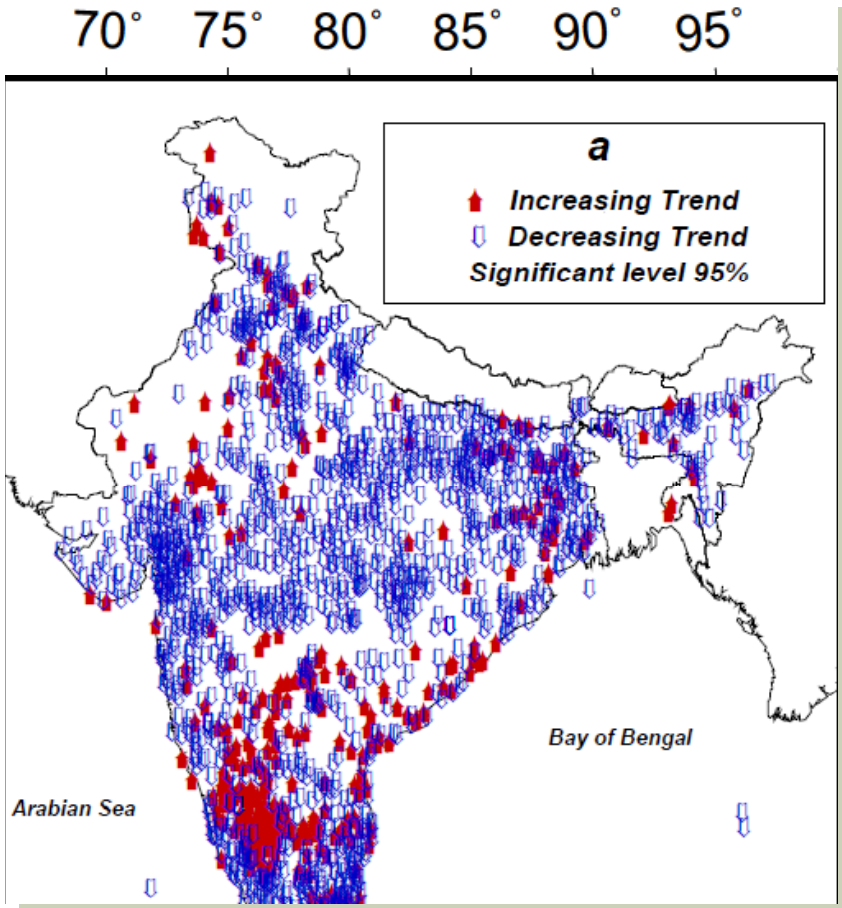
TRENDS IN RAINFALL (CONTD.)



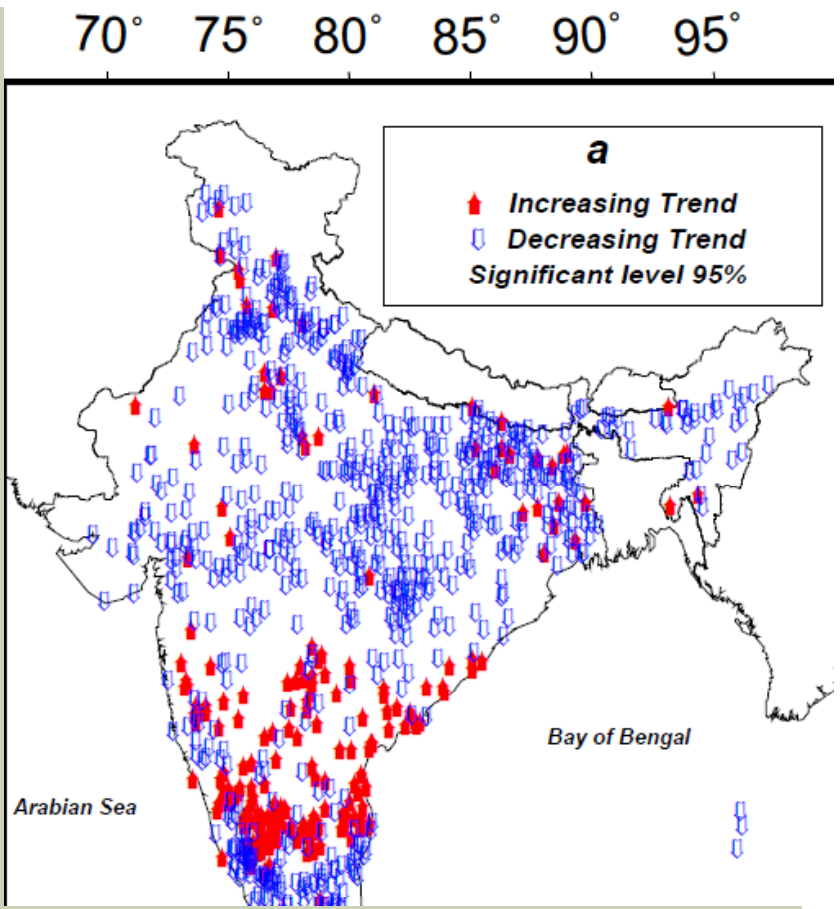
ANNUAL FREQUENCY OF NORMAL RAINY DAYS



TRENDS

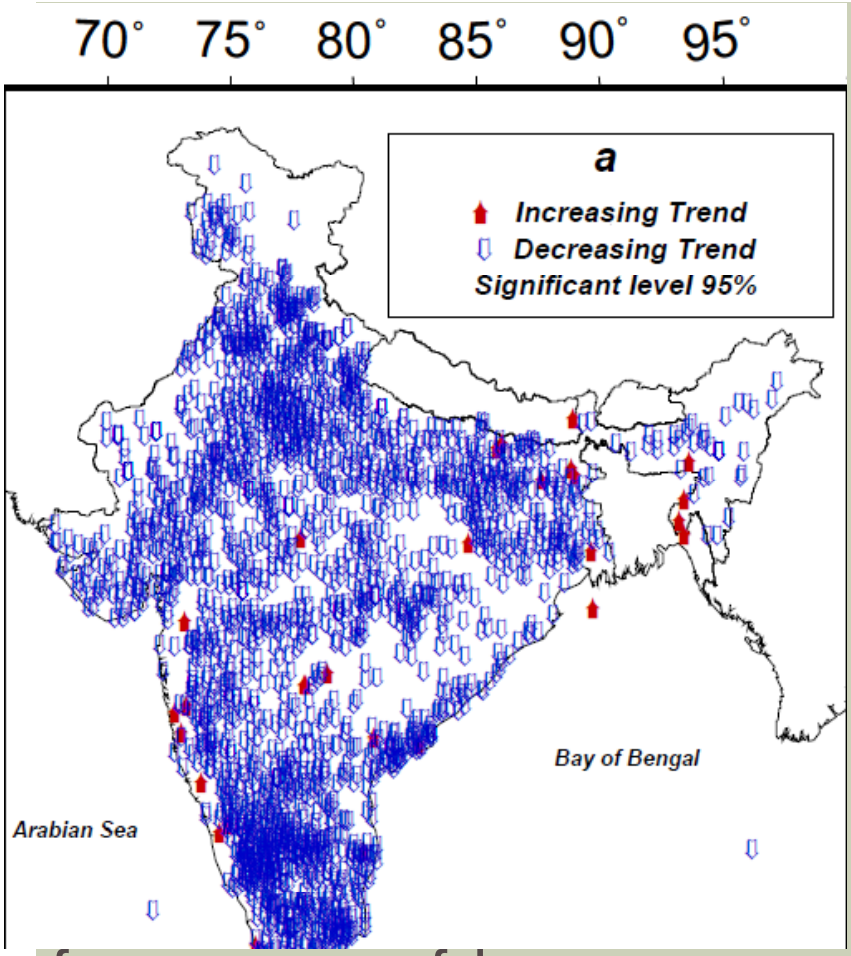


frequency of rain day

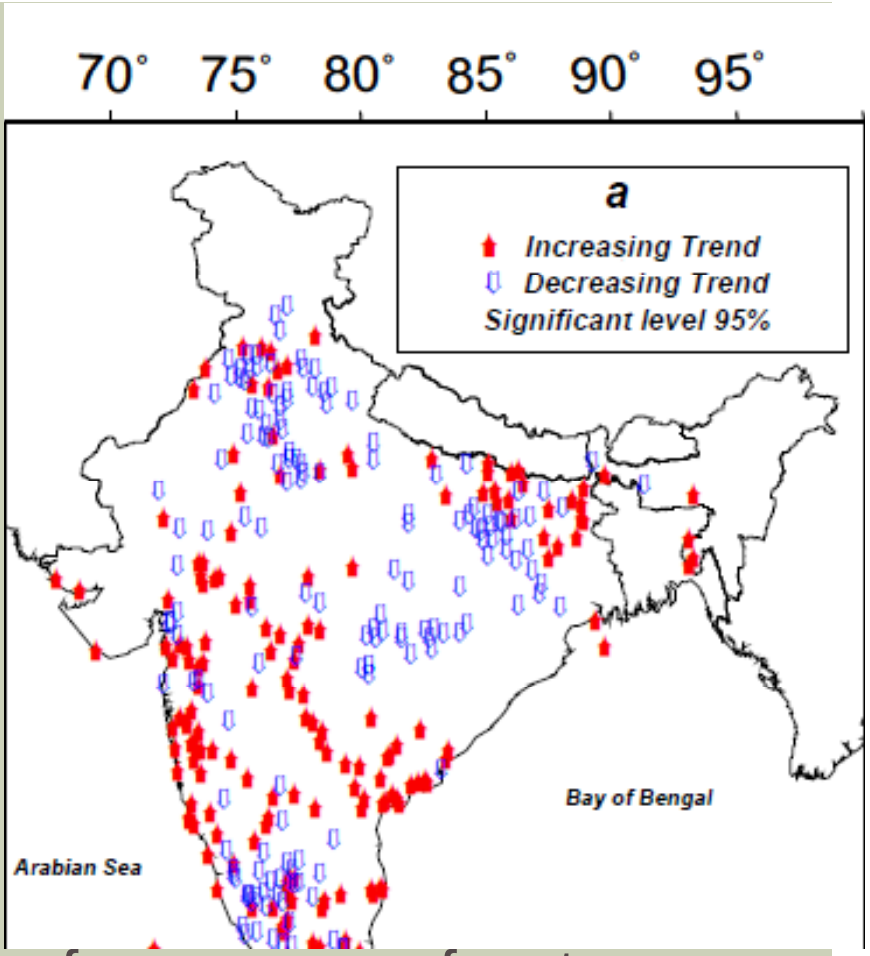


frequency of rainy day

TRENDS (CONTD.)



frequency of heavy rainfall day



frequency of extreme one day rainfall

EXTREME RAINFALL EVENTS

SN	Station	State	1-day rainfall in cm	Date of occurrence
1	Cherrapunji Obsy	Meghalaya	156.3	16-Jun-1995
2	Amini Divi	Lakshadeep	116.8	6-May-2004
3	Cherrapunji	Meghalaya	103.6	14-Jun-1876
4	Ambarnath	Maharashtra	101.0	27-Jul-2005
5	Cherrapunji	Meghalaya	99.8	12-Jul-1910
6	Mausynram	Meghalaya	99.0	10-Jul-1952
7	Dharampur	Gujarat	98.7	2-Jul-1941
8	Cherrapunji	Meghalaya	98.5	13-Sep-1974
9	Mawsynram	Meghalaya	98.0	4-Aug-1982
10	Tamenlong	Manipur	98.0	10-Aug-1970
11	Cherrapunji	Meghalaya	97.4	5-Jun-1956
12	Mawsynram	Meghalaya	94.5	7-Jun-1966
13	Mumbai	Maharashtra	94.4	27-Jul-2005
14	Tamenlong	Manipur	94.0	28-Jul-1970
15	Cherrapunji	Meghalaya	93.0	15-Jun-1995
16	Guna	Madhya Pradesh	92.8	23-Aug-1982
17	Cherrapunji	Meghalaya	92.5	27-Jun-1934
18	Cherrapunji	Meghalaya	90.7	25-Jun-1970

- Frequency of extreme values (<30cm) were more in the recent two decades ie. 1981-90 and 1991- 2000

UTTARAKHAND FLOOD-2013

- Excessive short duration rainfall and high melting of glaciers are considered as main reasons for devastating flood of Uttarakhand

DATES → DISTRICT	10	11	12	13	14	15	16	17	18	19	20
Almora	0.0	9.7	7.0	0.0	9.6	0.5	24.2	63.7	110.0	0.8	5.7
Bageshwar	2.1	10.2	14.7	11.4	29.1	11.6	83.0	183.0	73.1	0.0	0.0
Chamoli	3.8	9.8	28.8	26.1	2.3	22.6	61.5	113.1	85.2	6.2	2.8
Champawat	0.0	49.0	15.0	4.0	0.0	0.5	18.5	98.0	226.0	4.0	1.0
Dehradun	0.0	63.7	0.5	11.0	54.7	48.8	178.5	262.6	9.9	0.0	0.0
Garhwal Pauri	1.3	37.0	1.3	0.0	5.3	3.0	60.3	41.7	39.4	0.0	0.0
Garhwal Tehri	3.8	16.3	2.7	2.5	1.1	10.2	113.4	149.2	51.4	0.0	0.0
Hardwar	0.5	30.6	1.0	5.0	5.0	12.5	79.3	182.5	14.5	0.0	0.0
Nainital	5.4	31.0	23.3	0.0	9.6	10.7	71.0	204.1	210.5	0.6	4.7
Pithoragarh	7.7	23.1	10.7	13.2	2.0	12.5	27.6	85.3	96.1	0.7	0.0
Rudraprayag	47.8	28.4	8.7	36.0	14.5	41.4	105.2	100.1	62.1	7.0	0.0
Udham S. Nagar	1.8	24.0	12.4	0.8	0.0	32.5	3.8	46.6	74.0	0.1	0.0
Uttarkashi	7.7	37.7	0.6	25.1	13.4	38.8	113.6	117.4	38.4	0.0	0.0

Note: Rainfall is recorded at 08:00 Hrs. in India and is the cumulative rainfall occurred in past 24 Hours

Rainfall Departure from Normal during the J&K Floods in Jhelum Basin during 3-7 September 2014

District	Actual rainfall (mm) from 3-7 September	District Level Monthly Normal Rainfall (mm)						District Level daily normal rainfall (mm) between 3-7 Sept	% Dep
		Jul	% Dep	Aug	% Dep	Sep	% Dep		
Malangpura (Phulwama)	311	42	640	**47**	562	36	764	4.9	6247
Pahalgam (Anantnag)	248	**88**	182	82	202	50	396	8	3000
Kulgam	394	**80**	393	79	399	67	488	14.2	2675
Shopian	389	85	358	**92**	323	46	746	6.5	5885
Srinagar	175	56	213	**61**	187	30	483	4.9	3471
Av	**303.4**	**70.2**	**332**	**72.2**	**320**	**45.8**	**562**	**7.7**	**3840**

COMPARISON OF EXTREME POINT RAINFALL EVENTS

Station	Region	Max EPRE upto 1980	Max EPRE recorded between 1980 and 2010
Himalayas			
Ambala	Punjab	23 (Aug 10, 1896)	34 (Aug 03, 2004
Leh	Jammu and Kashmir	-	250 mm/hr (Aug 6, 2010)
Coastal Region			
Amini devi	Lakshwadeep	25 (Nov21, 1977)	170 (May 06, 2004)
Santacruz	Mumbai	38 (July 05, 1974)	94 (July 27, 2005)
Male gaon	Mumbai	16 (July 26, 1896)	29 (Oct 11, 2001)
Bhira	Konkan & Goa	43 (June 29, 1967)	71 (July 24, 1984)
Sand heads	Anadaman	37 (July 14, 1972)	51 (June 12, 1981)
Sagar	West bengal	38 (July 30, 1973)	48 (April 07, 2005)
North East			
Cherrapunji	Assam	19 (Sept 13, 1974)	156 (June 16, 1995)
Silchar	Assam	29 (My 30, 1893)	47 (July 7, 1991)
Jalpaiguri	North Bengal	39 (July 8, 1892)	47 (July 10, 1989)
Malda	North Bengal	24 (Oct 1, 1971)	57 (Sept 28, 1995)
North West			
Jaipur	Rajasthan	19 (August 16, 1959)	22 (July 19 (1981)

- Extreme point rainfall values exceeded on all stations after 1980

CLIMATE CHANGE PROJECTIONS - PRECIPITATION

- “Climate Change and India: A 4x4 Assessment”, Nov.2010 by Indian Network for Climate Change Assessment (INCCA) of MoEF used PRECIS model – 50x50 km grid
- All India summer rainfall increase by 3-7% by 2030 (base year 1970)
- Himalayan region: increase in annual rainfall by 60-206 mm (vary in range of 1268±225 to 1604±175 mm)
- West coast: increase in annual rainfall by 69-109 mm; winter rainfall to decrease by 19 mm
- East coast: increase in annual rainfall by 2-54 mm; winter rainfall to decrease by 14 mm
- North-East: increase in annual rainfall by 0.3-3%; winter rainfall to decrease substantially

CONFIDENCE LEVEL ON CLIMATE CHANGE PROJECTIONS

#	*Parameter*	*Quantitative assessment possible*	*Confidence level of estimates*		*Estimated climate change to mid century*
			Direction of Change	*Magnitude of Change*	
1.	Floods	Yes	Medium	Low	Increased rainfall, run off and in coastal areas sea level rise will increase flood risk.
2.	Droughts	Yes	Low	Low	Non quantified but estimated to increase
3.	Other Extreme events	No	Low	Low	Other Non quantified events all likely to increase-wind hail frost etc.
4 .	Sea Level rise	Yes	High	Medium	0.3m increase to mid century
5 .	Storm Surges/ wave heights	No	Medium	Low	Requires information on winds and currents.

Notes: Direction of change reflects whether there is an increase or decrease in the change parameter, magnitude is the quantification of the change

The above are subjective assessments. As yet the quality and availability of RCM simulations for India is insufficient to permit a fully objective assessment. The above is intended as a guide for planning only.

- MoWR study (2011) with ADB covering three areas having sensitivity for (a) snowmelt; (b) groundwater; and (c) sea level rise

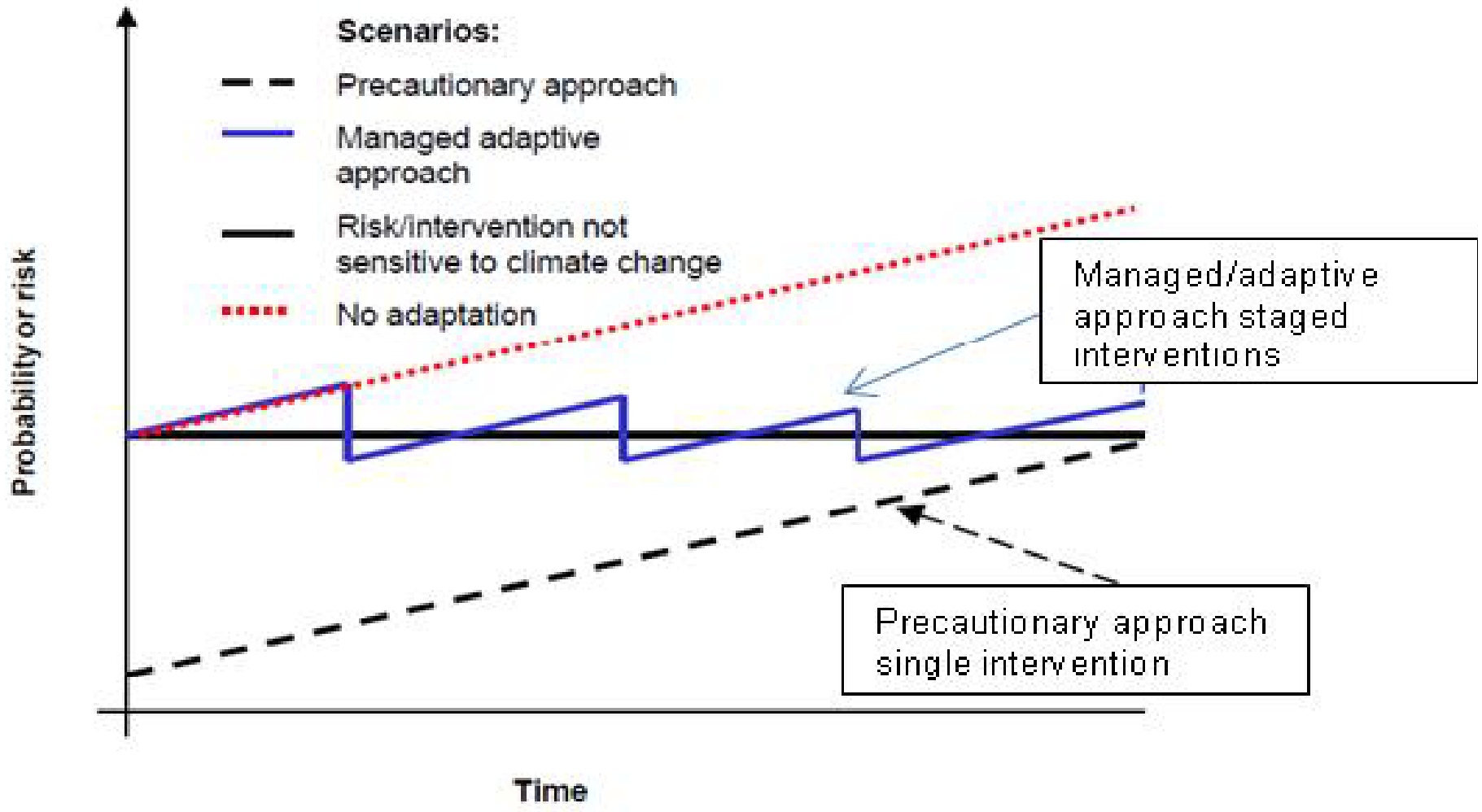
SUGGESTED APPROACH FOR INDIA

Projected changes by mid-century

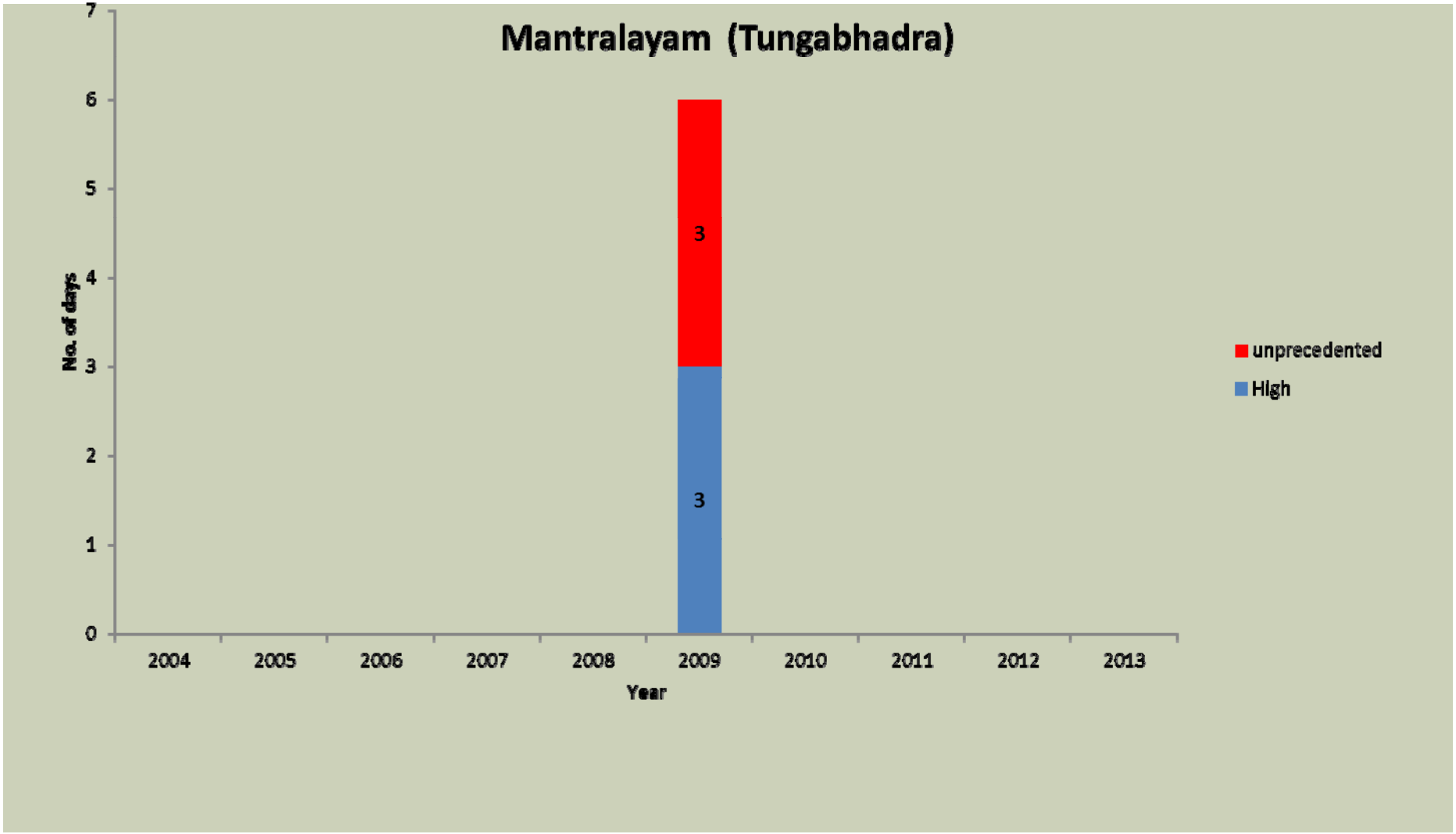
Sub Basin	Monsoon rainfall	Winter rainfall
Sutlej	+15%	+20%
Kshipra	+15%	-5%
Cauvery	-10%	+15%

- Regional variability in climate change projections;
- No uniform design factor/allowance is suggested;
- Managed/adaptive approach staged intervention suggested

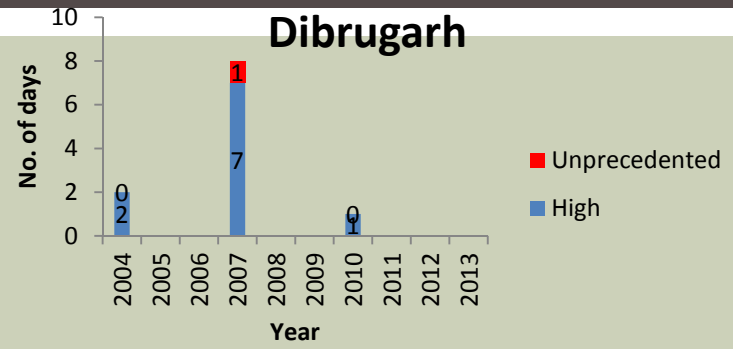
APPROACHES TO ADAPTATION

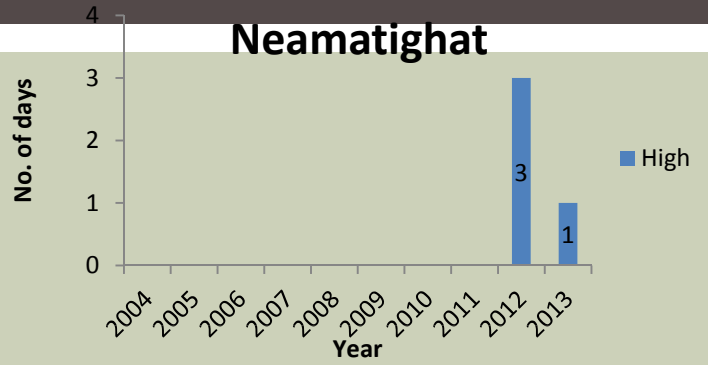


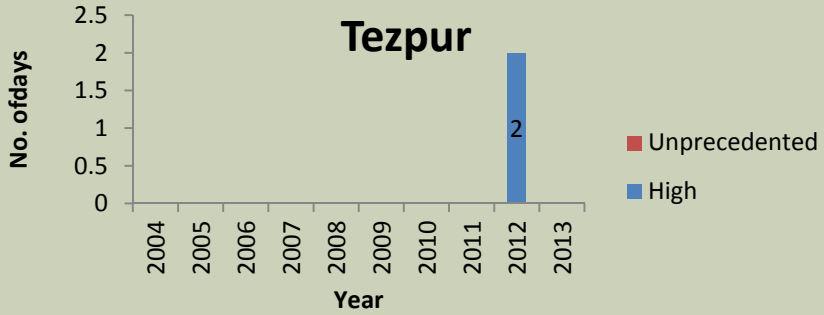
ANDHRA PRADESH

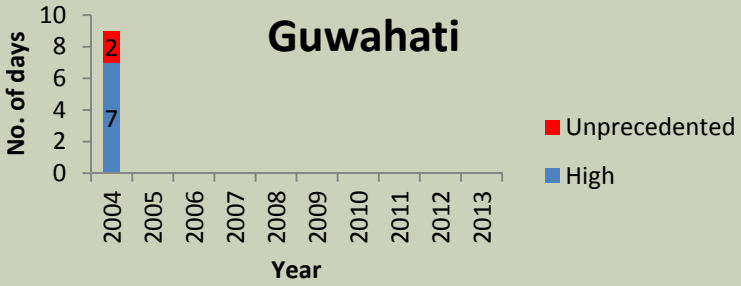


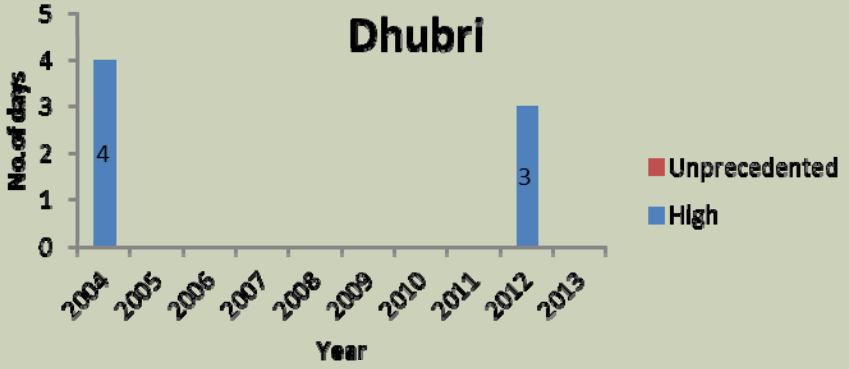
ASSAM(1/3)
RIVER BRAHMAPUTRA



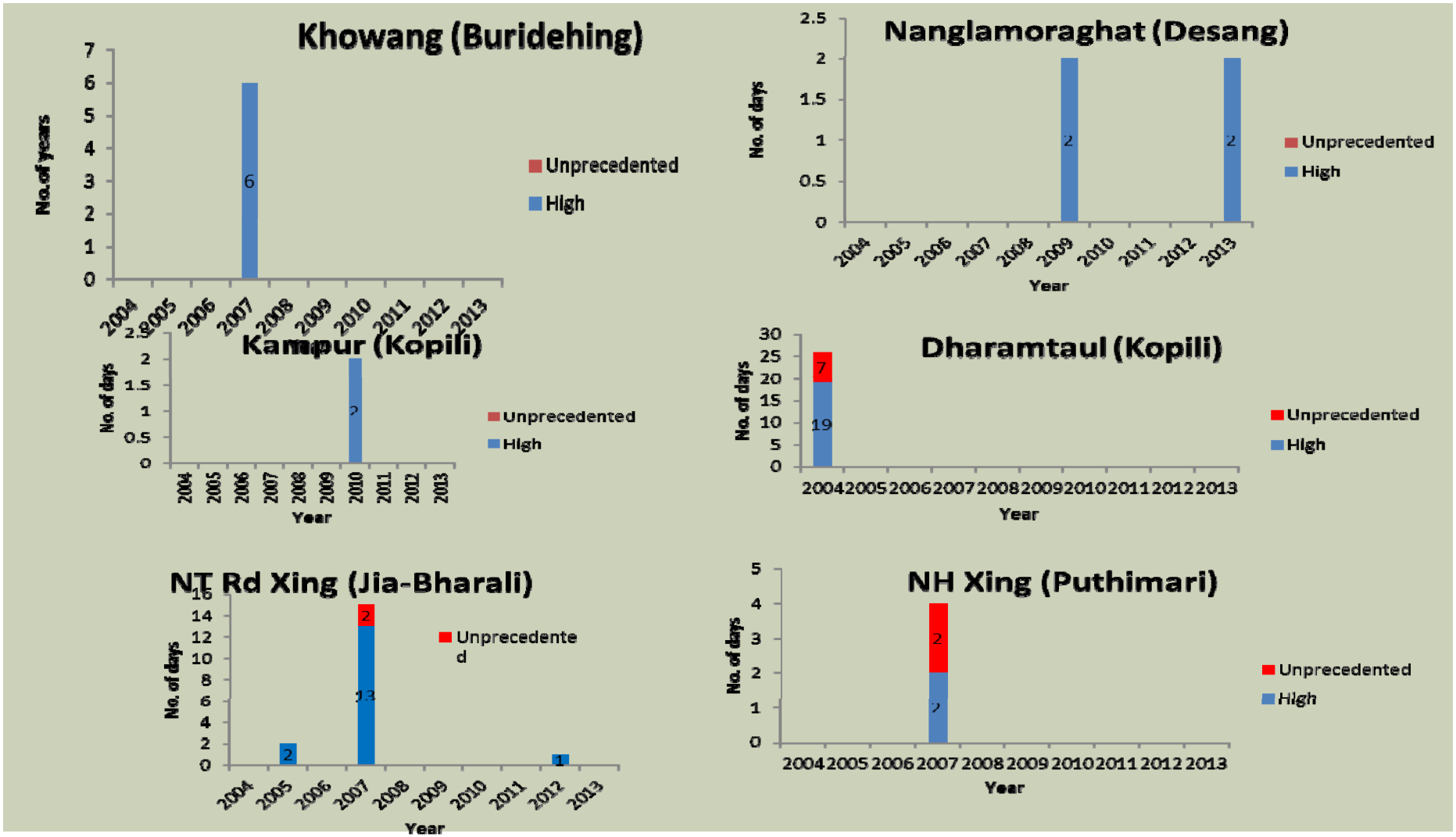




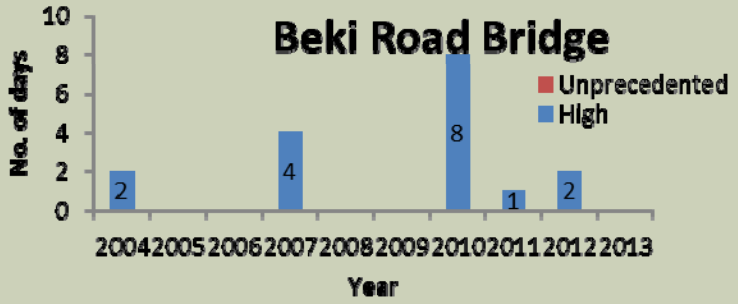


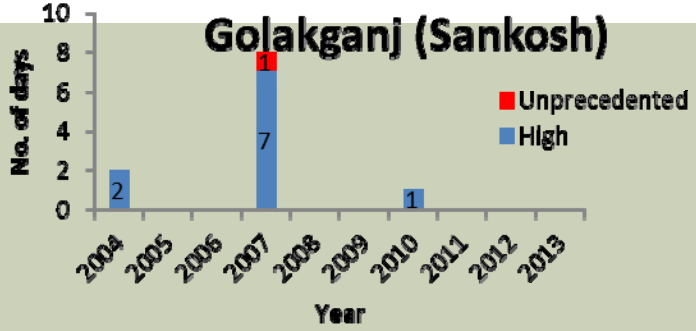


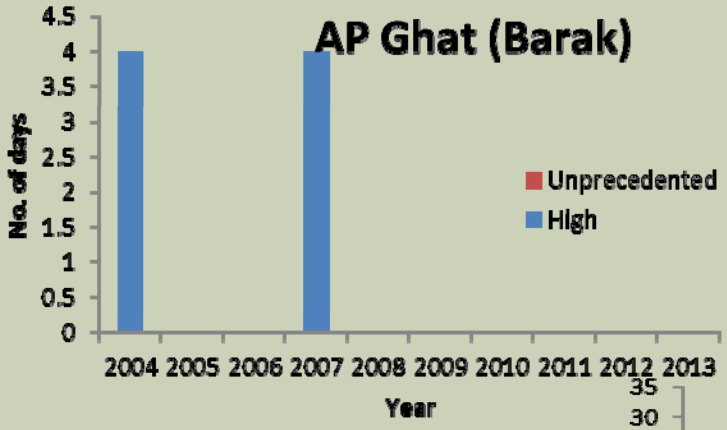
ASSAM(2/3)

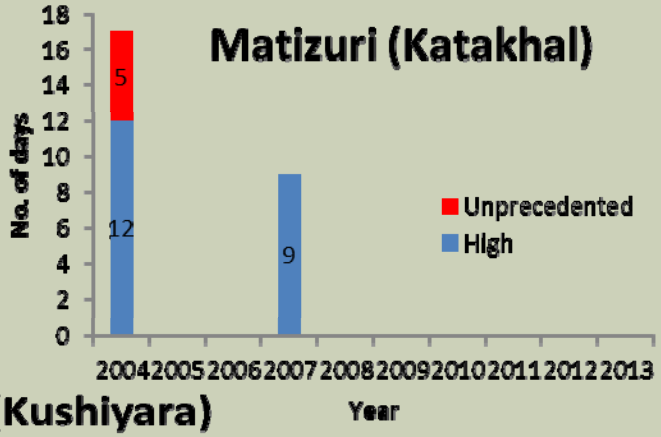

Khowang (Buridehing)
No. of years
Unprecedented
High
Nanglamoraghat (Desang)
No. of days
Year
Unprecedented
High
Kampur (Kopili)
No. of days
Year
Unprecedented
High
Dharamtaul (Kopili)
No. of days
Year
Unprecedented
High
NT Rd Xing (Jia-Bharali)
No. of days
Year
Unprecedented
NH Xing (Puthimari)
No. of days
Year
Unprecedented
High

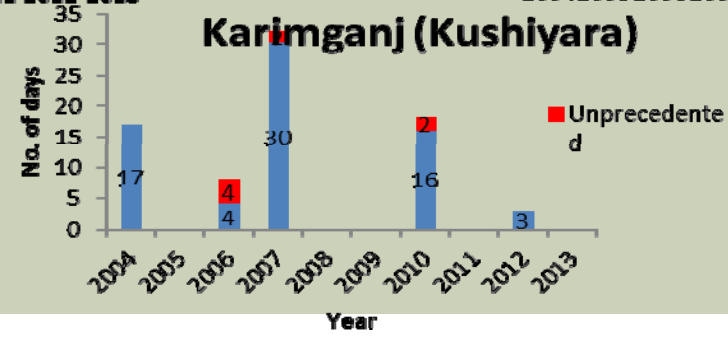
ASSAM(3/3)


Beki Road Bridge
No. of days
Year
Unprecedented
High
2
4
8
1
2
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

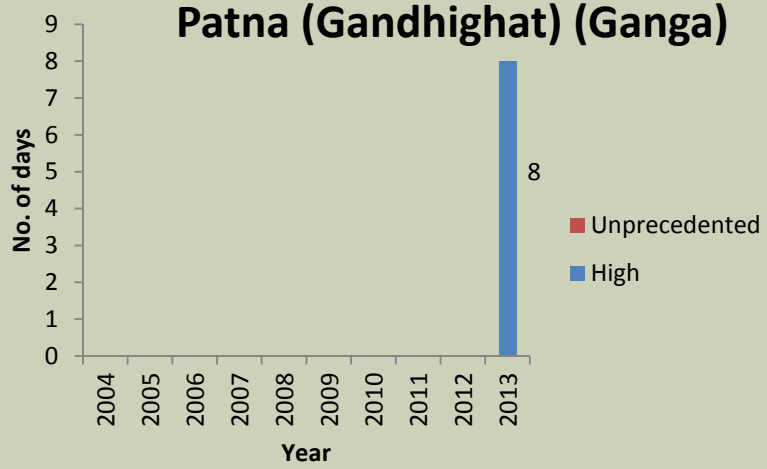

Golakganj (Sankosh)
No. of days
Year
Unprecedented
High
2
7
1
1
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

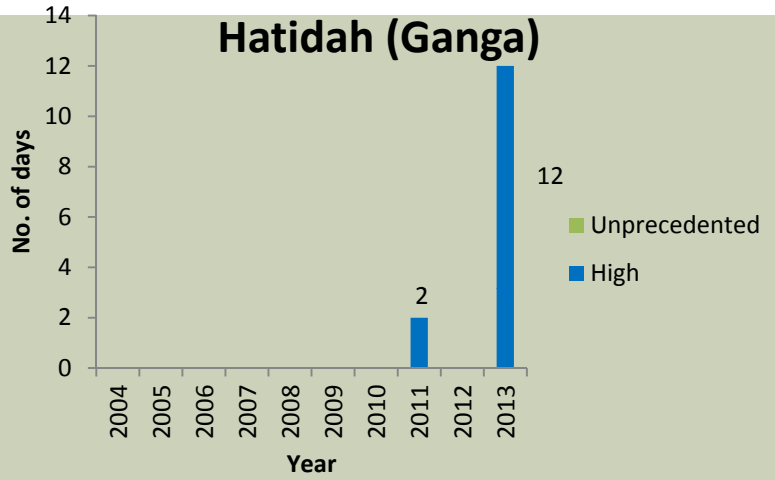

AP Ghat (Barak)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

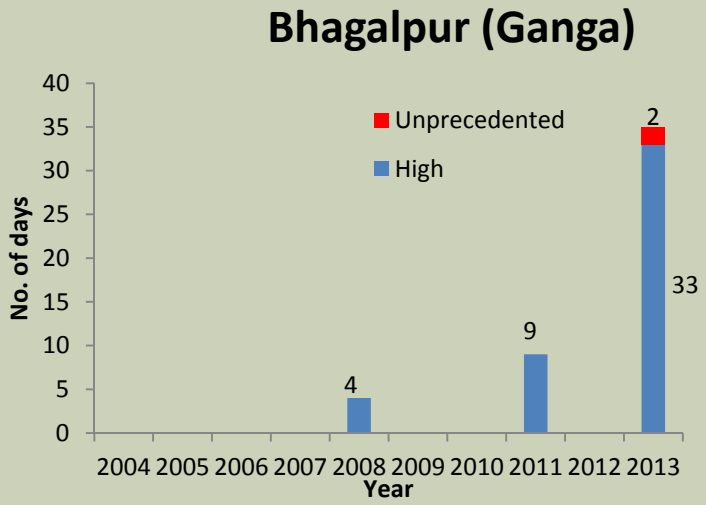

Matizuri (Katakhal)
No. of days
Year
Unprecedented
High
5
12
9
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

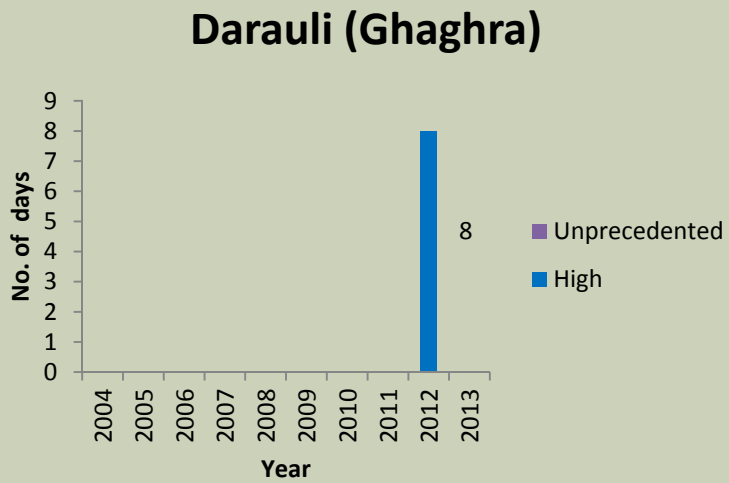

Karimganj (Kushiyara)
No. of days
Year
Unprecedented
17
4
4
30
2
16
3
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

BIHAR (1/4)

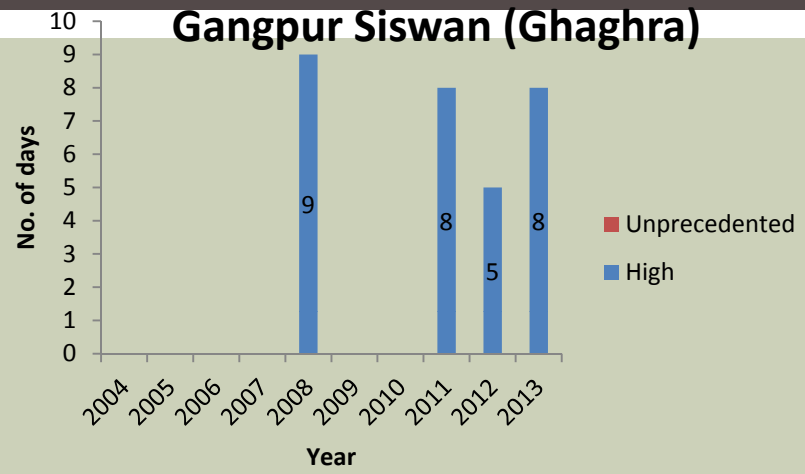

Patna (Gandhighat) (Ganga)
No. of days
Year
Unprecedented
High
8
0 1 2 3 4 5 6 7 8 9
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

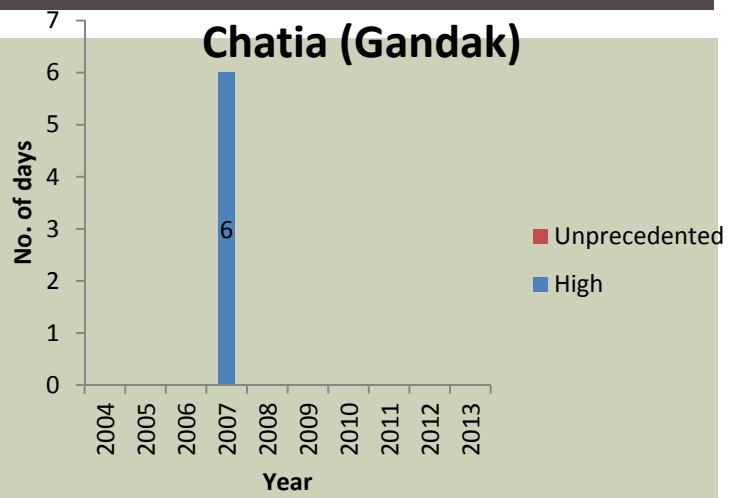

Hatidah (Ganga)
No. of days
Year
Unprecedented
High
2
12
0 2 4 6 8 10 12 14
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

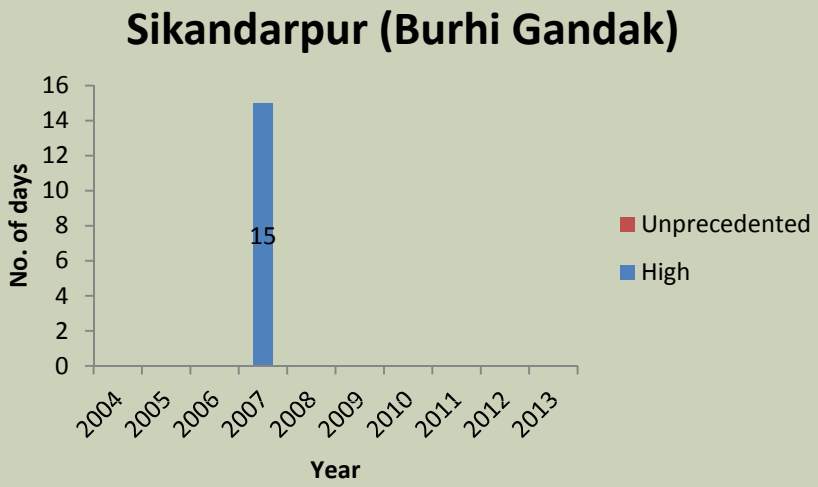

Bhagalpur (Ganga)
No. of days
Year
Unprecedented
High
4
9
2
33
0 5 10 15 20 25 30 35 40
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

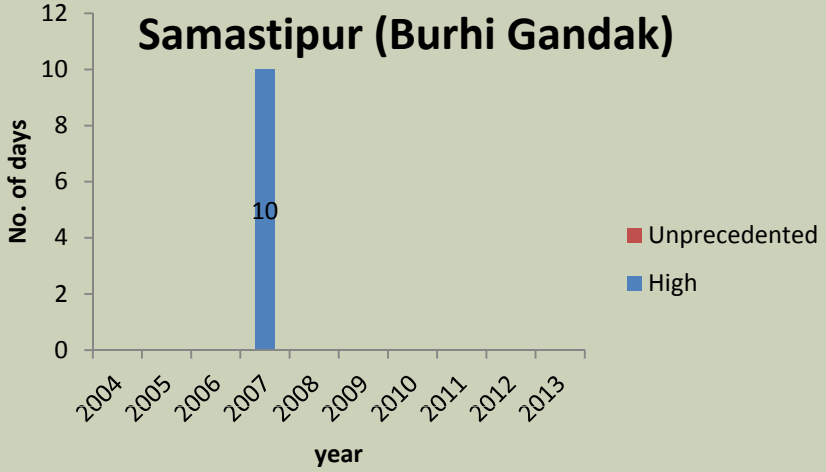

Darauli (Ghaghra)
No. of days
Year
Unprecedented
High
8
0 1 2 3 4 5 6 7 8 9
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

BIHAR (2/4)

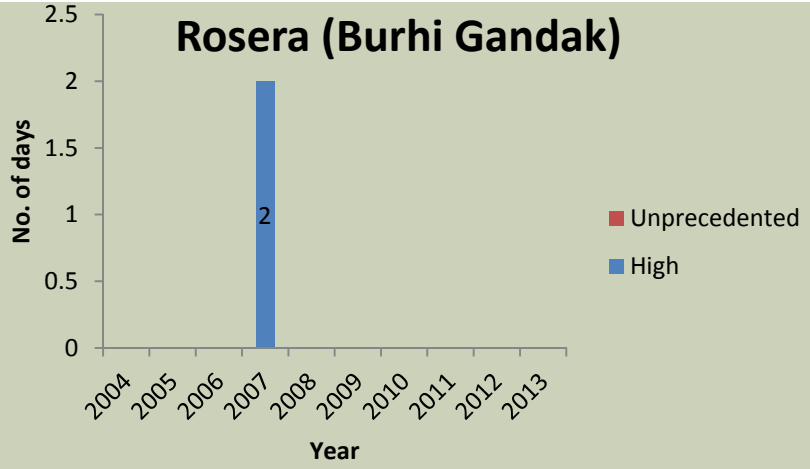

Gangpur Siswan (Ghaghra)
No. of days
Year
Unprecedented
High
9
8
5
8

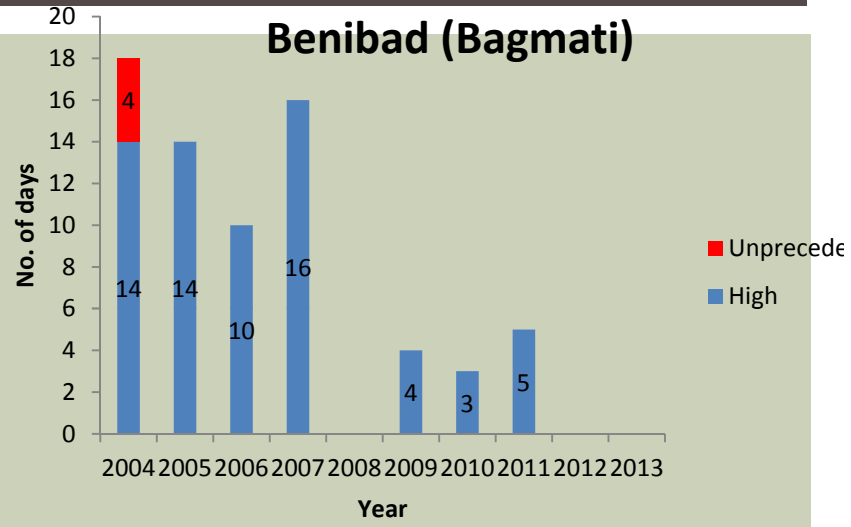

Chatia (Gandak)
No. of days
Year
Unprecedented
High
6

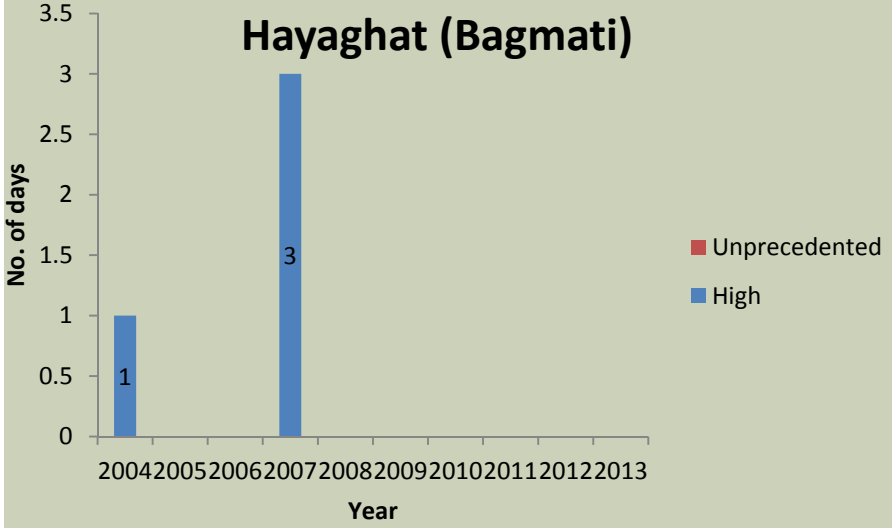

Sikandarpur (Burhi Gandak)
No. of days
Year
Unprecedented
High
15

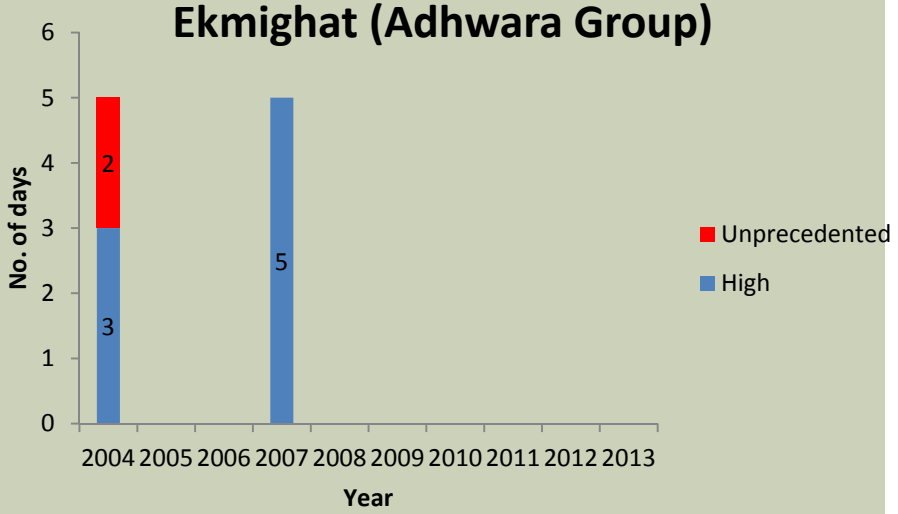

Samastipur (Burhi Gandak)
No. of days
year
Unprecedented
High
10

BIHAR (3/4)

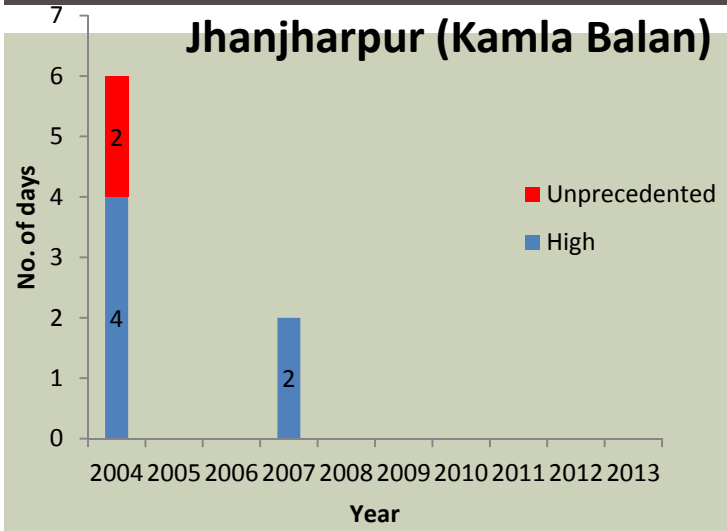

Rosera (Burhi Gandak)
No. of days
Year
Unprecedented
High
2
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

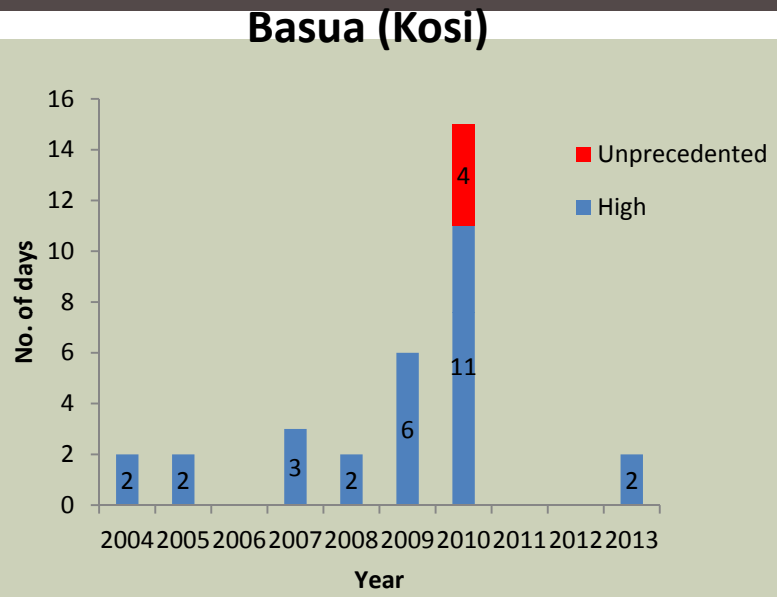

Benibad (Bagmati)
No. of days
Year
Unprecede
High
4
14 14 10 16 4 3 5
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

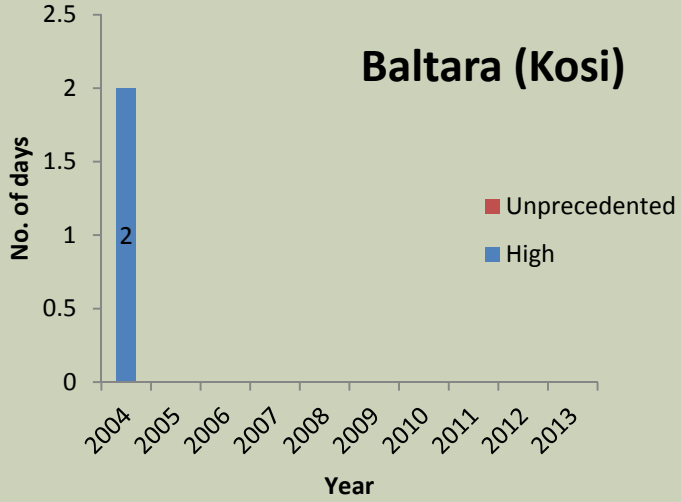

Hayaghat (Bagmati)
No. of days
Year
Unprecedented
High
1
3
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013


Ekmighat (Adhwara Group)
No. of days
Year
Unprecedented
High
2
3
5
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

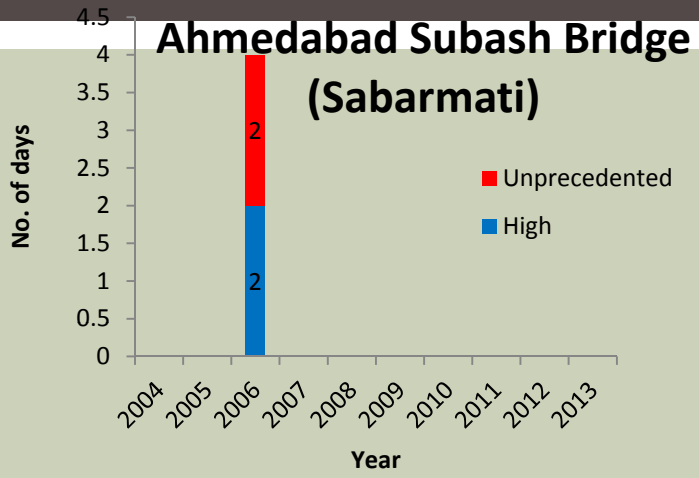
BIHAR (4/4)

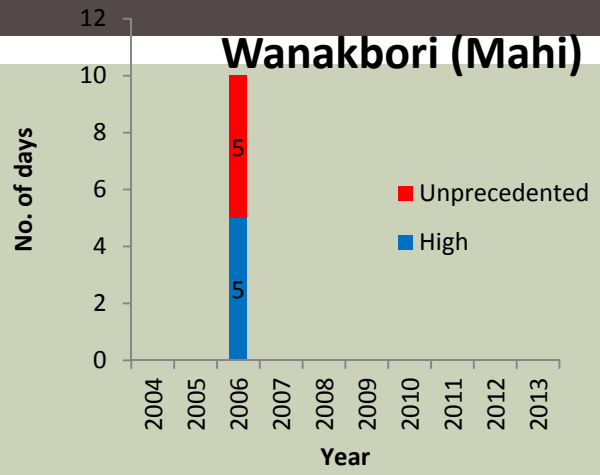

Jhanjharpur (Kamla Balan)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
2
4
2

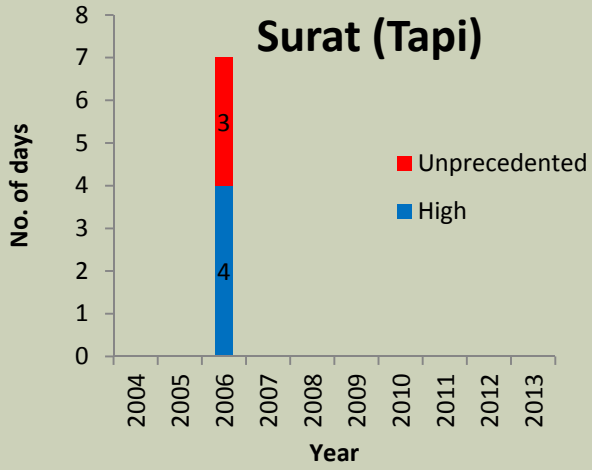

Basua (Kosi)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
2 2 3 2 6 4 11 2

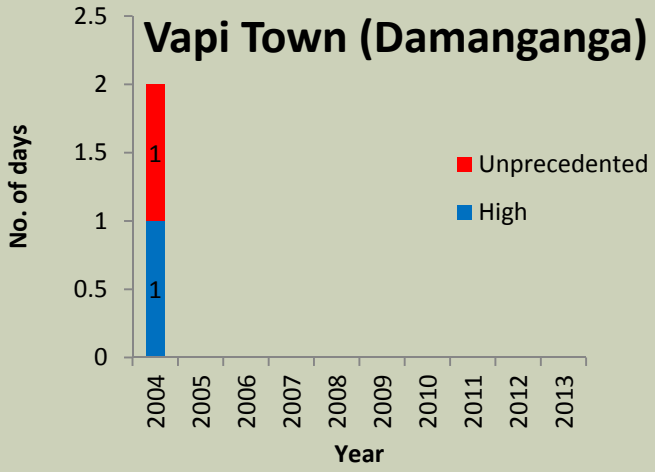

Baltara (Kosi)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
2

GUJARAT

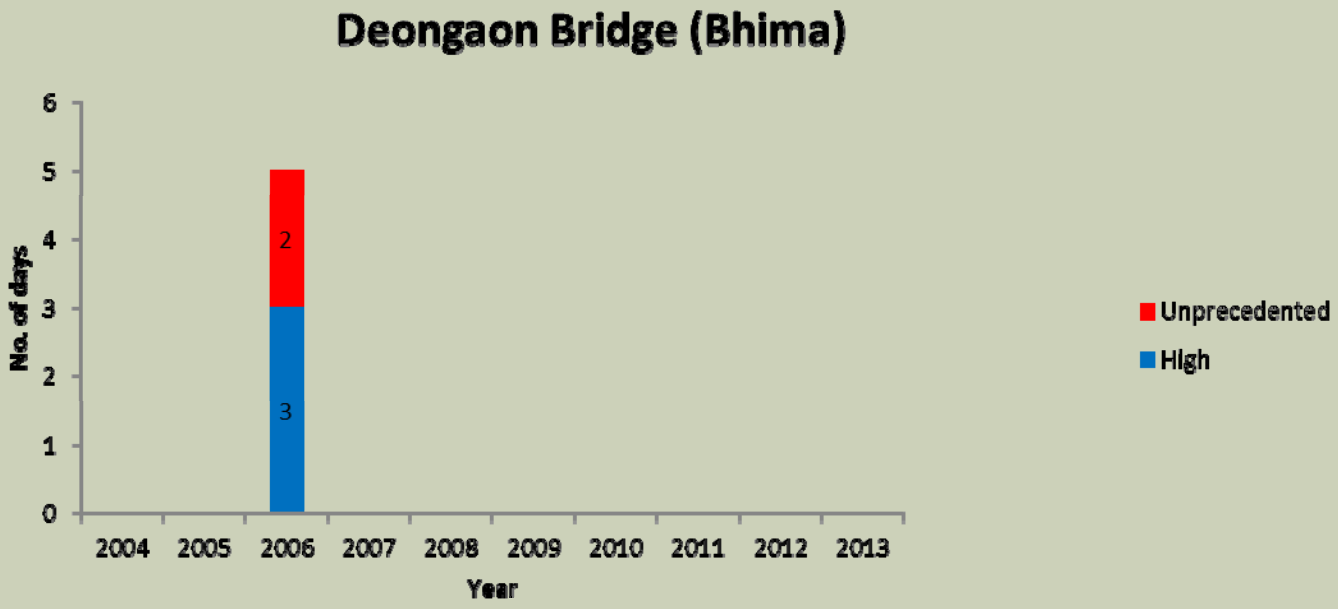

Ahmedabad Subash Bridge (Sabarmati)
No. of days
Year
Unprecedented
High
2
2
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013


Wanakbori (Mahi)
No. of days
Year
Unprecedented
High
5
5
12
10
8
6
4
2
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

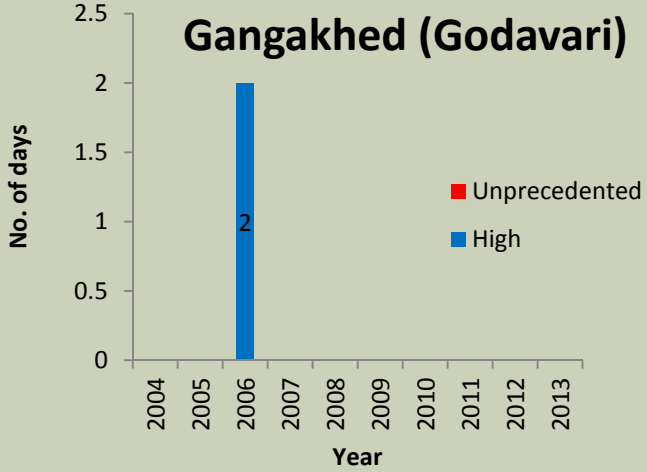

Surat (Tapi)
No. of days
Year
Unprecedented
High
3
4
8
7
6
5
4
3
2
1
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

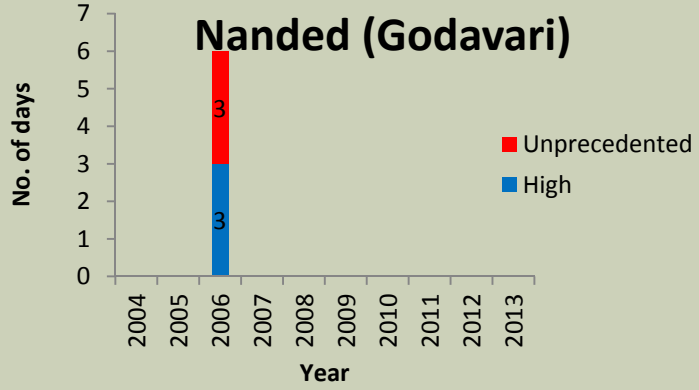

Vapi Town (Damanganga)
No. of days
Year
Unprecedented
High
1
1
2.5
2
1.5
1
0.5
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

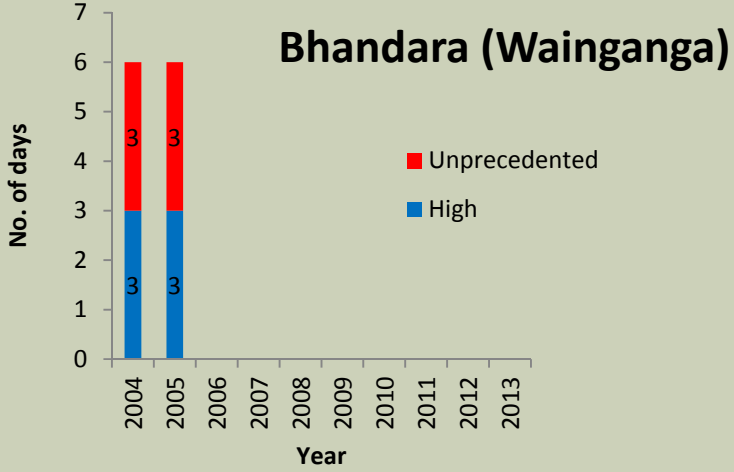
KARNATAKA

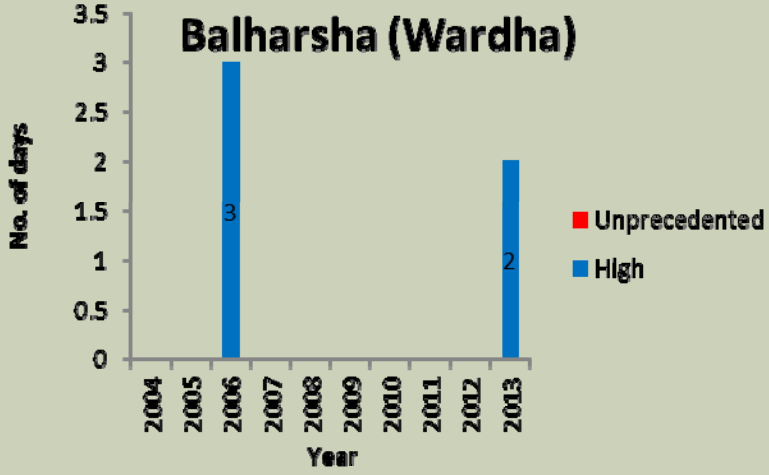

Deongaon Bridge (Bhima)
No. of days
0
1
2
3
4
5
6
2
3
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year
Unprecedented
High

MAHARASHTRA

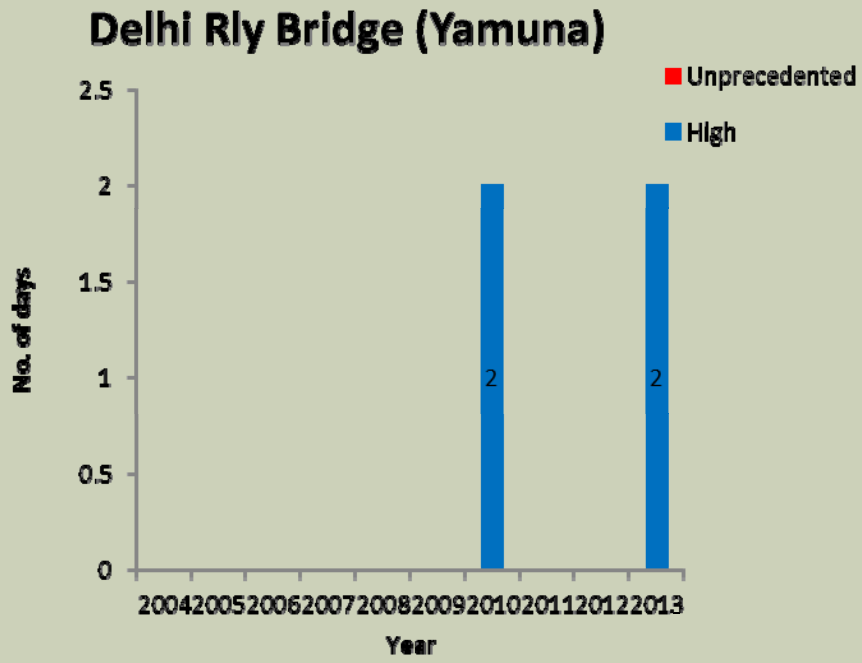




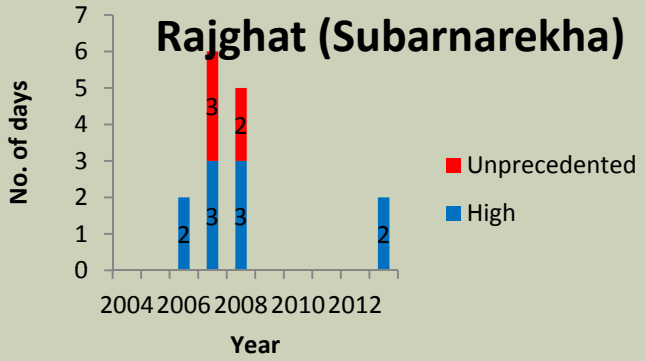


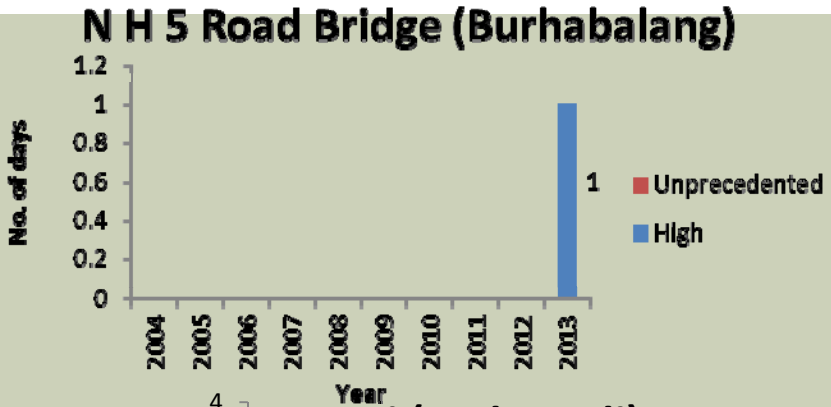


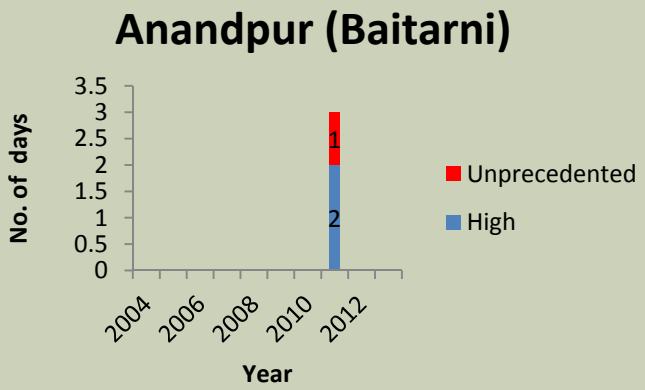
NCT DELHI

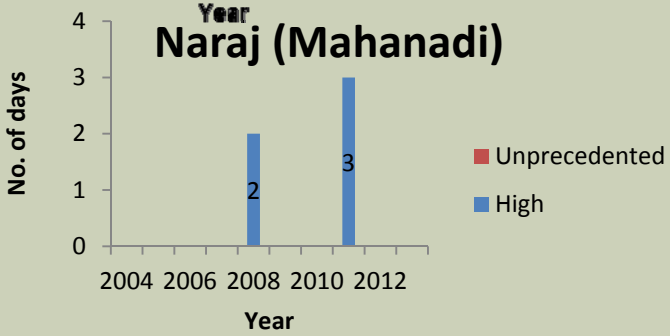

Delhi Rly Bridge (Yamuna)
Unprecedented
High
2.5
2
1.5
1
0.5
0
No. of days
2
2
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

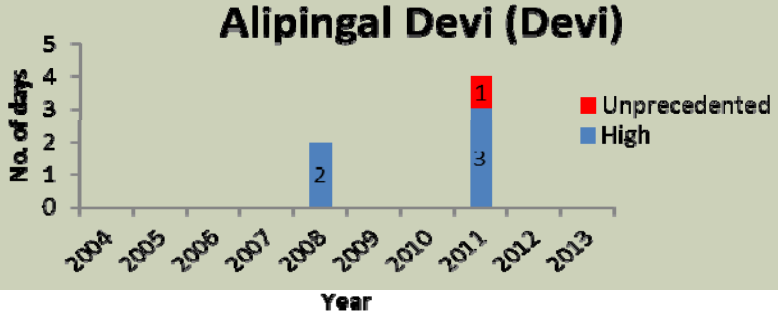
ODISHA

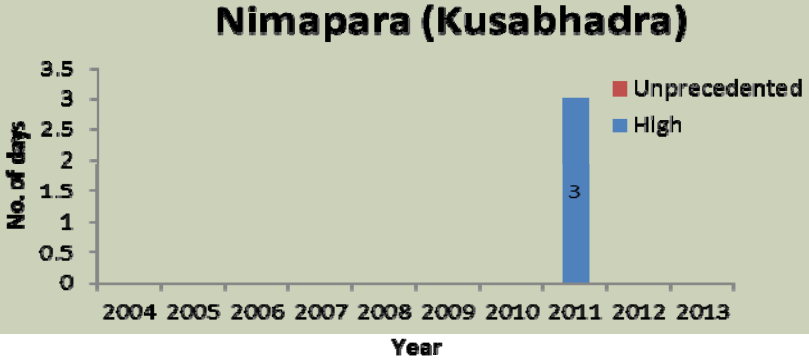

Rajghat (Subarnarekha)
No. of days
Year
Unprecedented
High
2004 2006 2008 2010 2012


N H 5 Road Bridge (Burhabalang)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

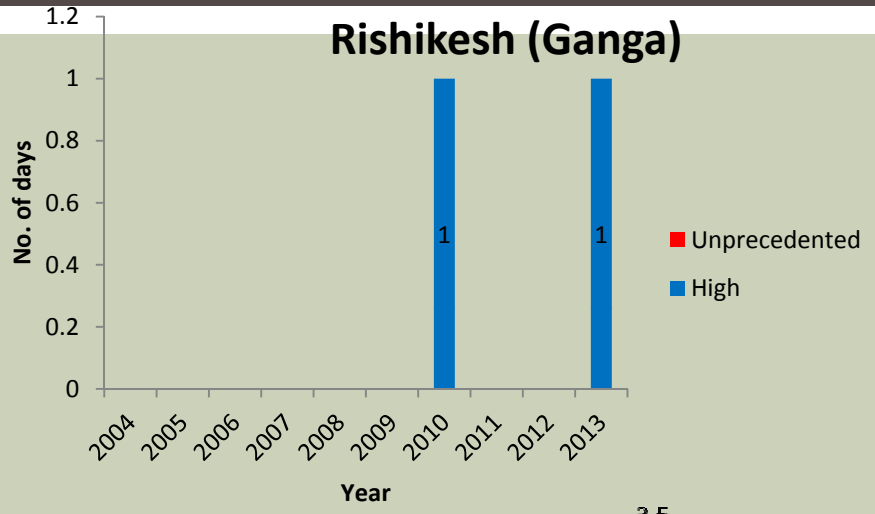

Anandpur (Baitarni)
No. of days
Year
Unprecedented
High
2004 2006 2008 2010 2012

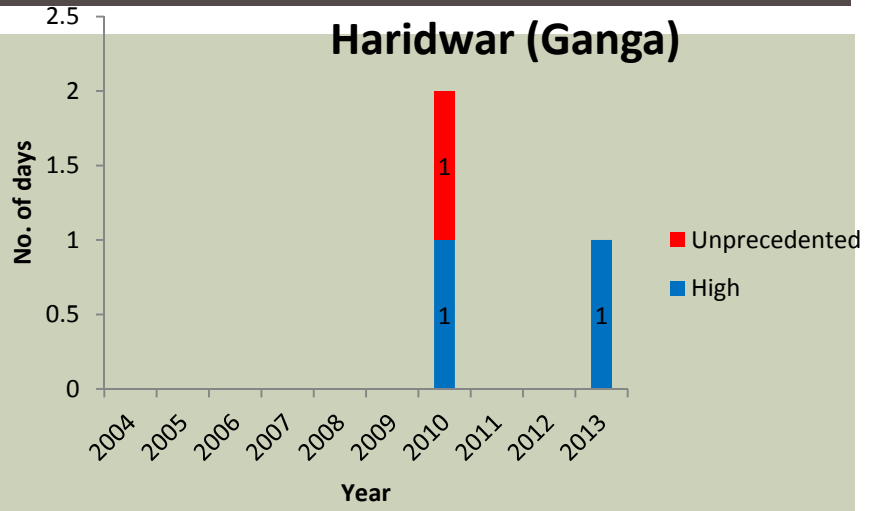

Naraj (Mahanadi)
No. of days
Year
Unprecedented
High
2004 2006 2008 2010 2012

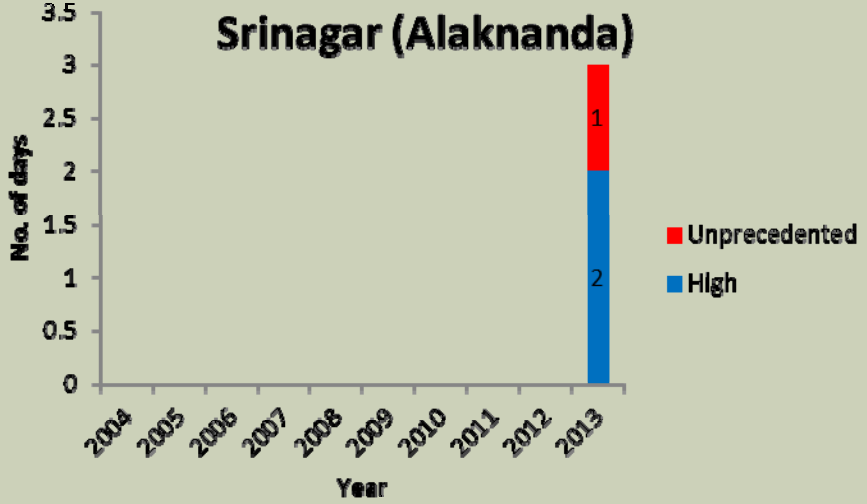

Alipingal Devi (Devi)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013


Nimapara (Kusabhadra)
No. of days
Year
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

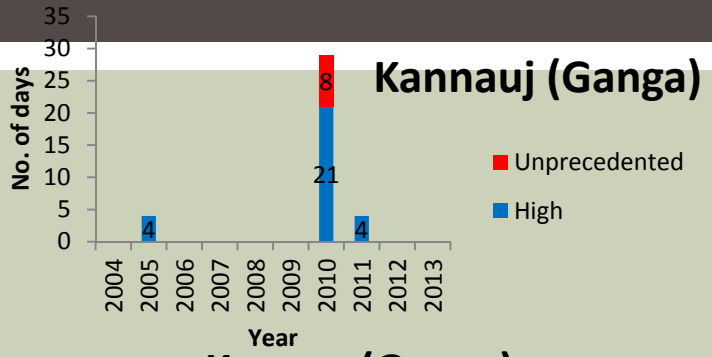
UTTARAKHAND

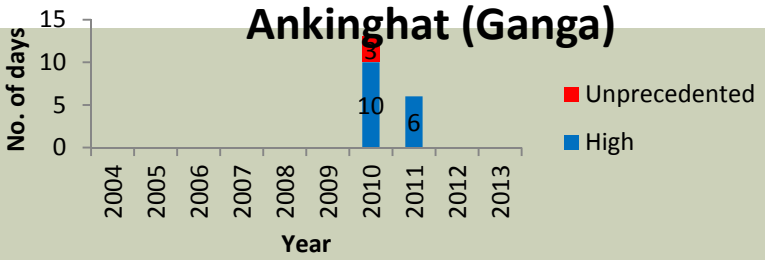


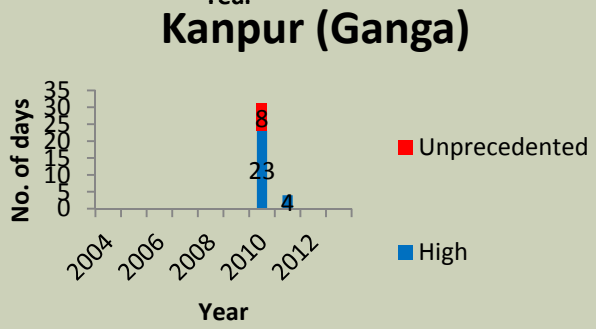


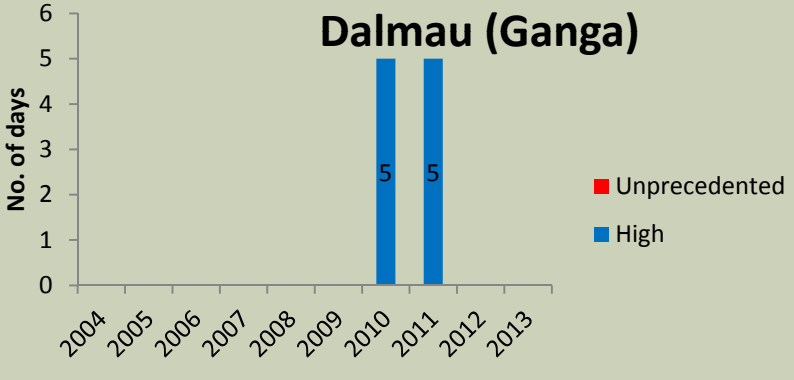


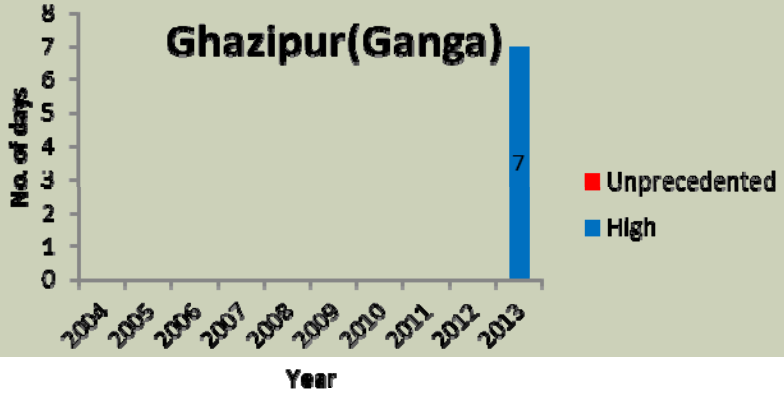
UTTAR PRADESH(1/3)

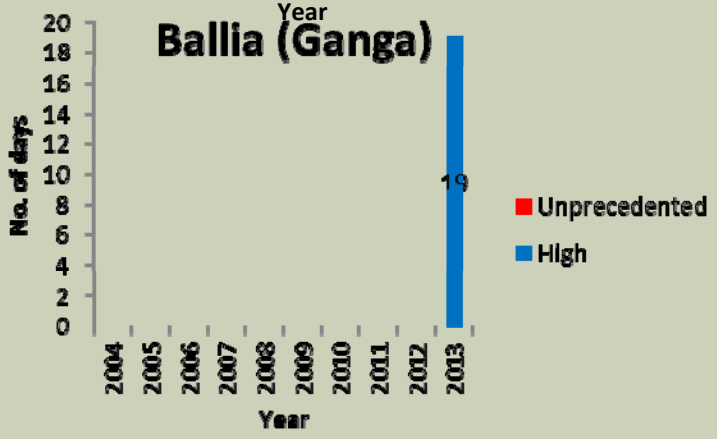




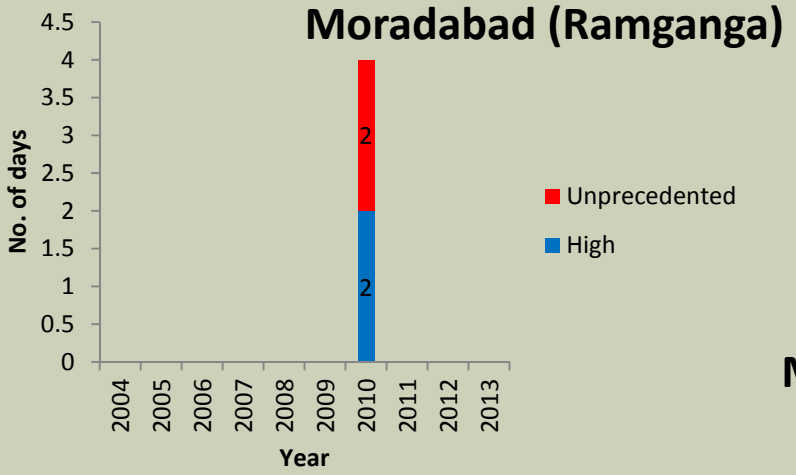


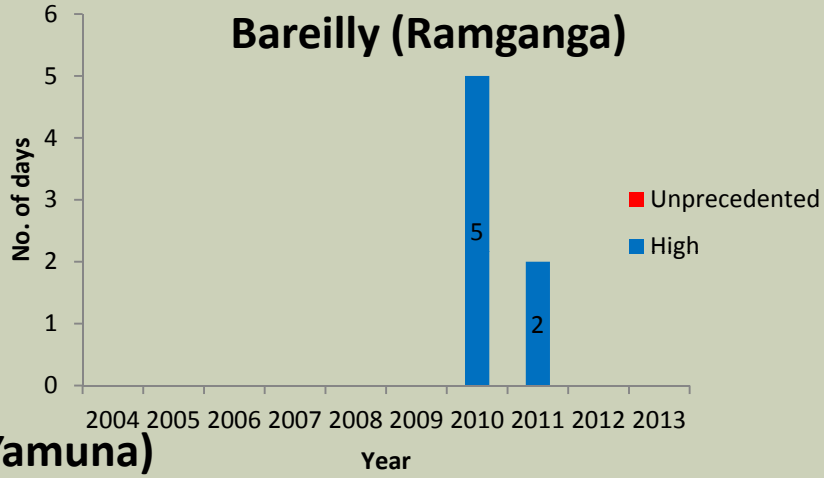


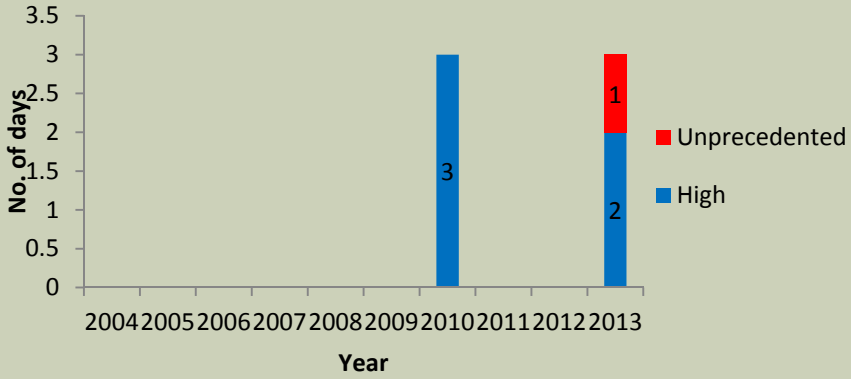




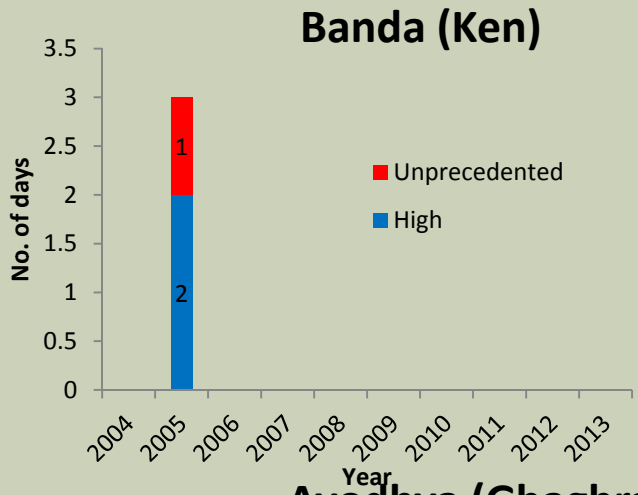
UTTAR PRADESH(2/3)

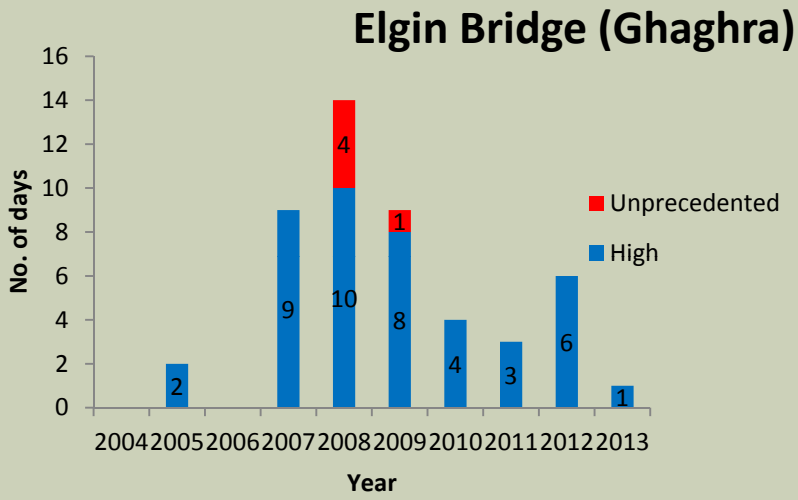


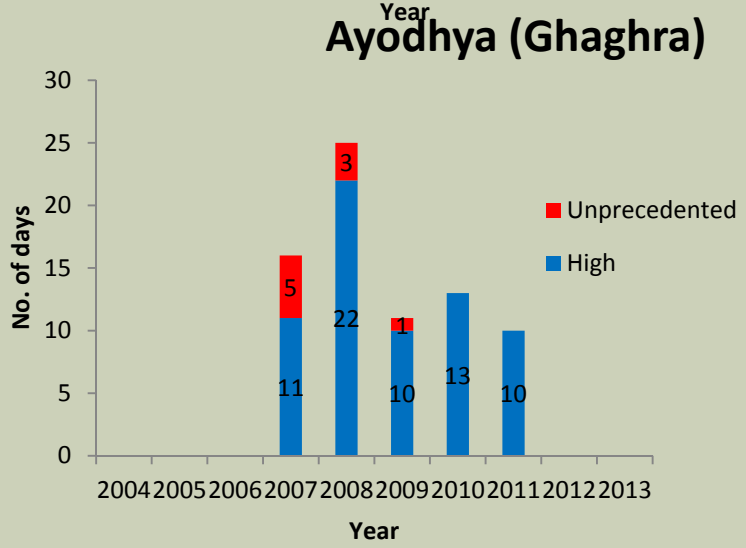


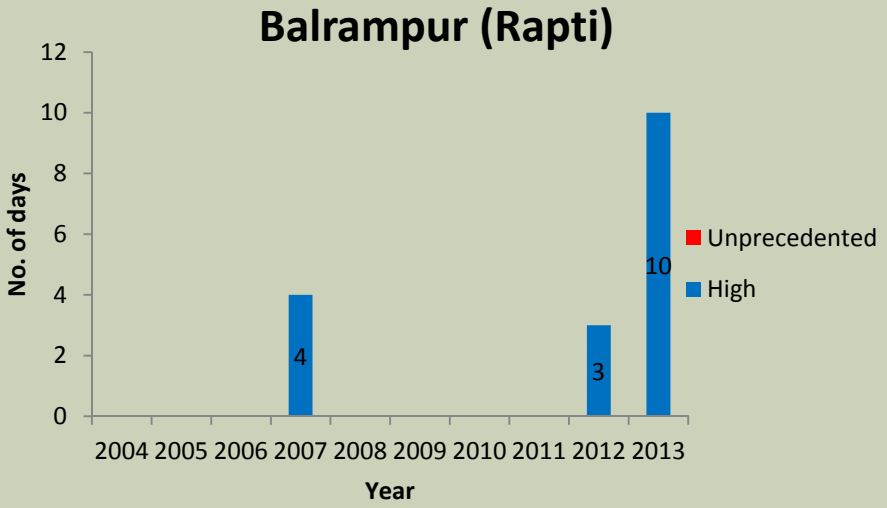


UTTAR PRADESH(3/3)

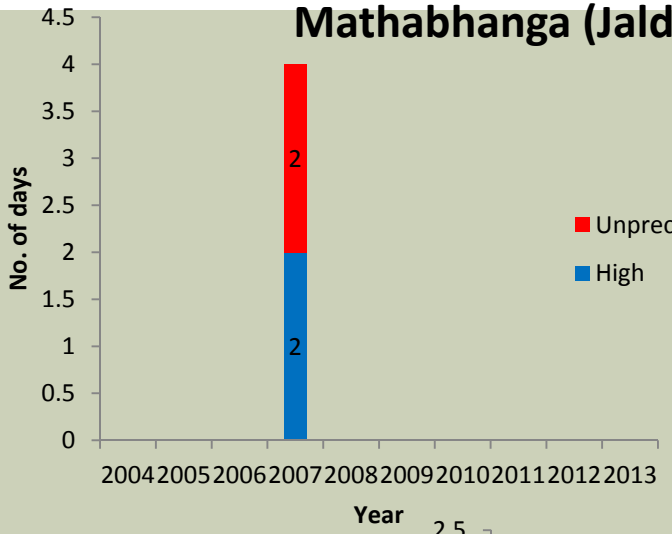


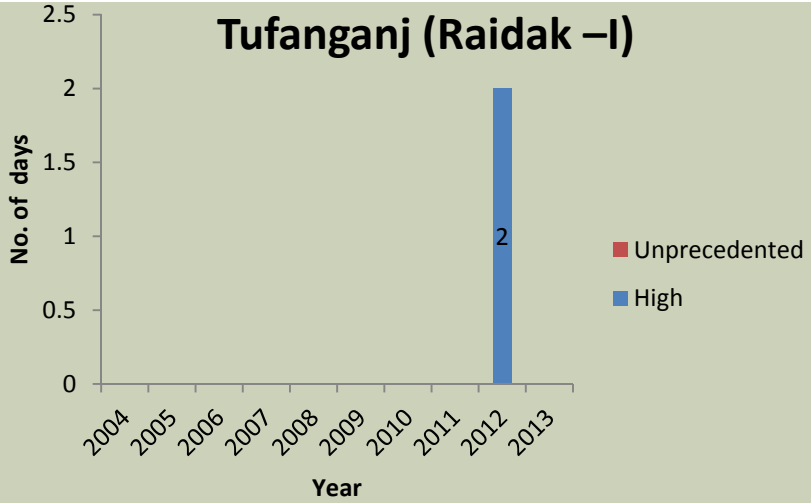


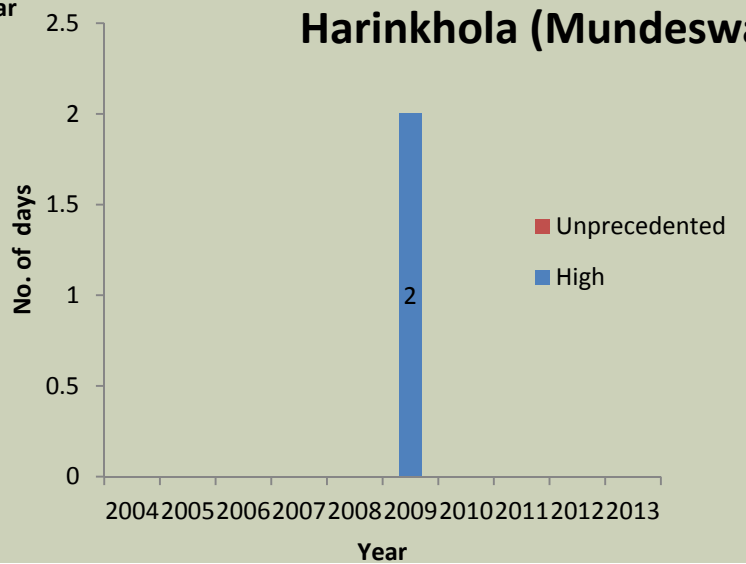




WEST BENGAL


Mathabhanga (Jaldhaka)
No. of days
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2
2
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year


Tufanganj (Raidak –I)
No. of days
2.5
2
1.5
1
0.5
0
2
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

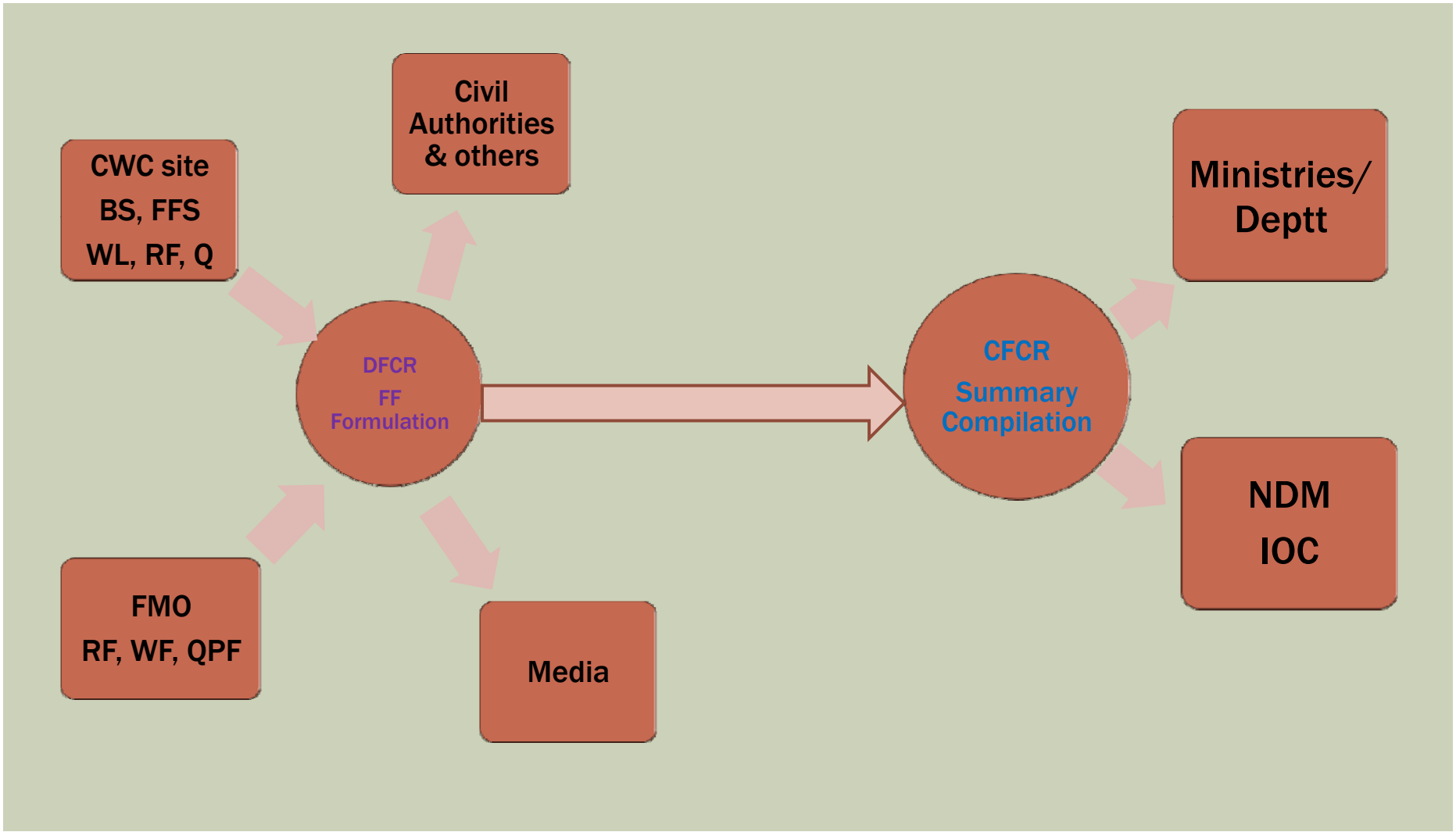

Harinkhola (Mundeswari)
No. of days
2.5
2
1.5
1
0.5
0
2
Unprecedented
High
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

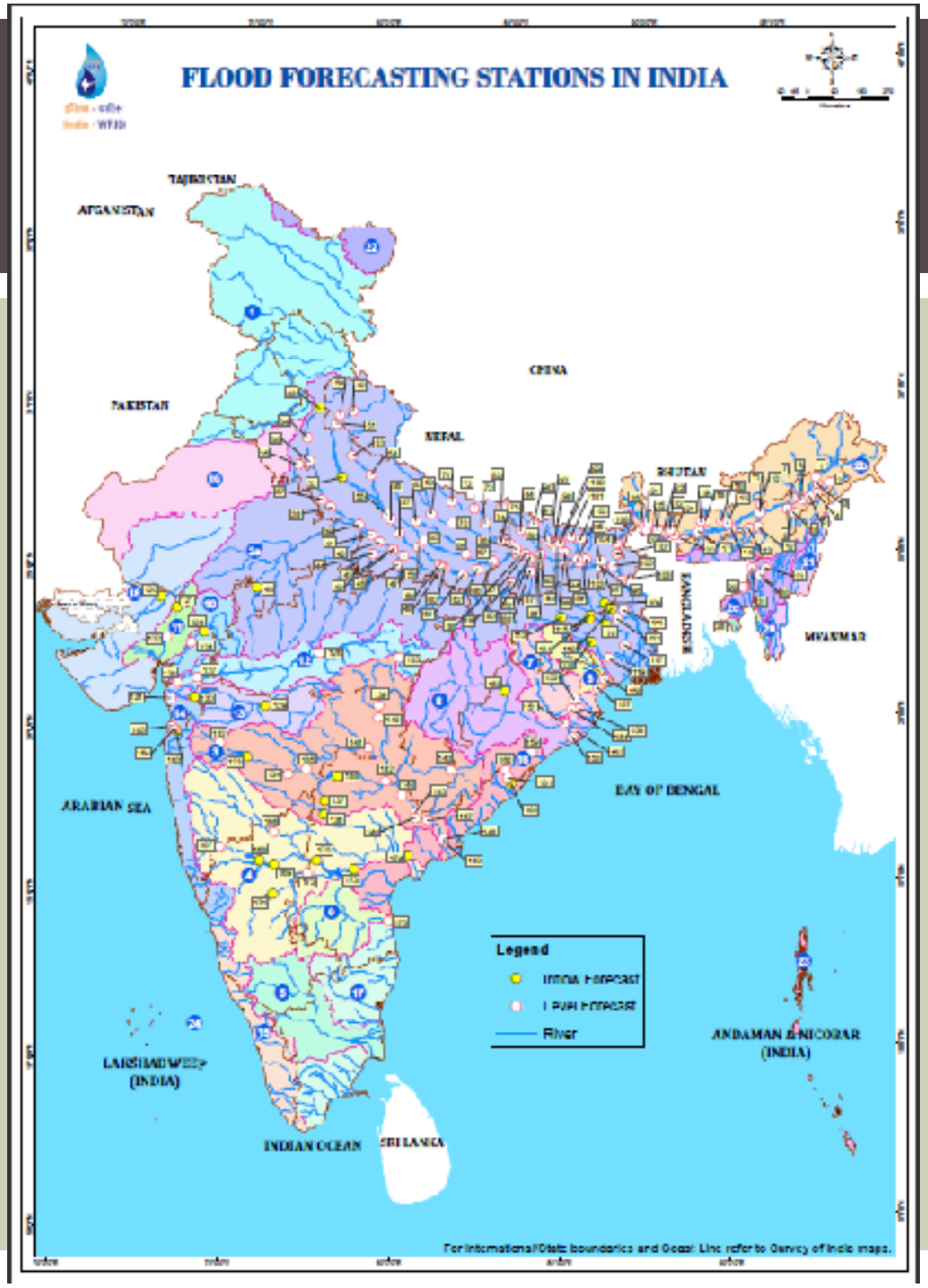
FLOOD CONTROL AND MITIGATION

- Floods are natural phenomena
- Complete immunity from flood not possible, however, their impacts can be minimised.

Structural Measures	Non-Structural Measures
•Dams and Reservoirs	•Flood Forecasting and Warning
•Embankments, Flood Walls, Sea Walls	•Flood Plain Zoning
•Natural Detention Basins	•Flood Proofing
•Channel Improvement	•Disaster Preparedness and Response Planning
•Drainage Improvement	•Disaster Relief
•Diversion of Flood Water	

FLOOD FORECASTING SET UP IN INDIA

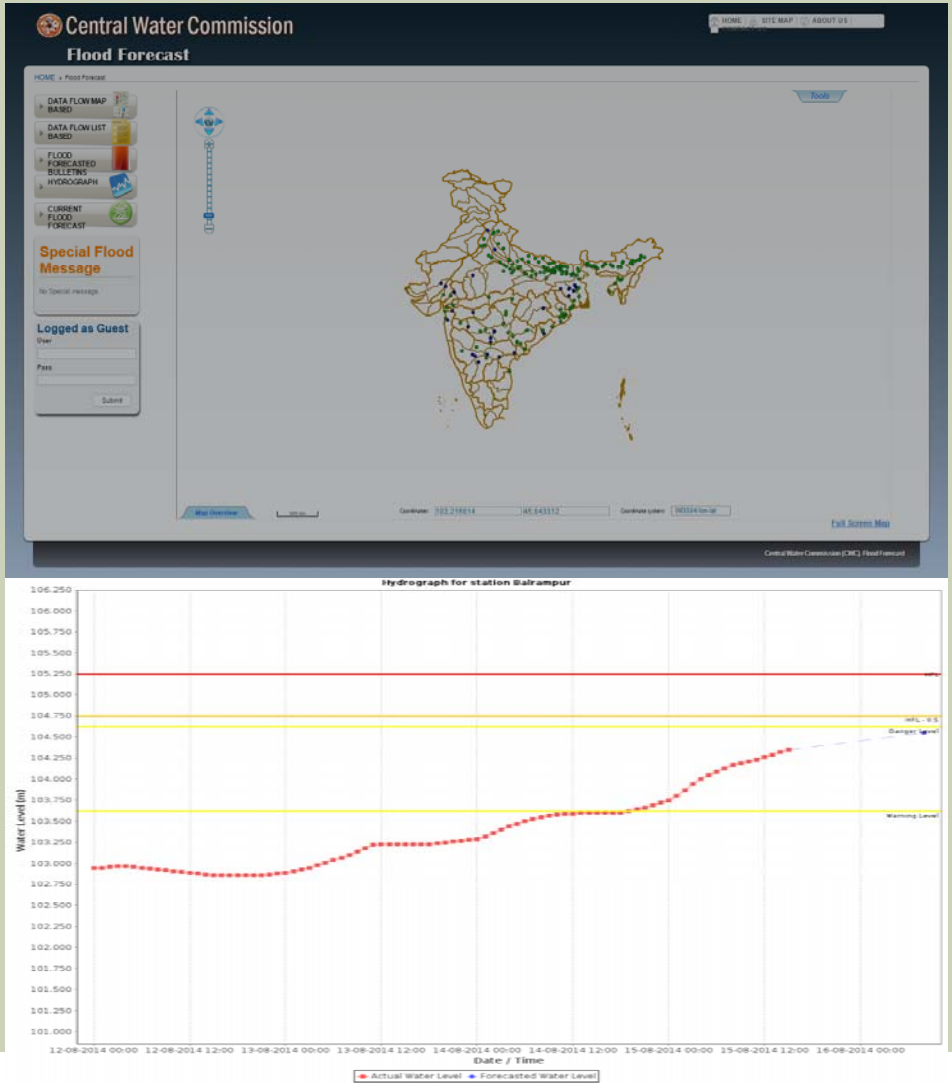



FLOOD FORECASTING STATIONS IN INDIA
TAJIKISTAN
AFGANISTAN
CHINA
PAKISTAN
NEPAL
BHUTAN
BANGLADESH
MYANMAR
ARABIAN SEA
BAY OF BENGAL
Legend
River
ANDAMAN & NICOBAR (INDIA)
(INDIA)
INDIAN OCEAN
SRI LANKA

FORECAST DISSEMINATION

- Mode of communication
  - Commonly used mode-Special Messenger, Telephone, Fax, Wireless
  - Now a days adopted widely-Email, SMS, Website **(http://india-water.gov.in/ffs)**
- Mailing List/ Beneficiaries
  - Commonly - civil/ **engineering authorities of concerned States, defence, railways/ highways authorities, industrial and other important establishments located in the flood prone areas through telephone/ fax/ e-mail/ special messenger for taking advance action for flood fighting & evacuating population to safer places.**
  - Also Media, Press **for the benefit of the likely flood affected population**

WEBSITE


Central Water Commission
Flood Forecast
Special Flood Message
Logged as Guest
Hydrograph for station Balrampur
Water Level (m)
Date / Time
Actual Water Level
Forecasted Water Level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WRIS Explorer
Geo-Visualization
Sub-Info System
Temporal Analyst
Watershed Info System
WRIS Connect
Live Telemetry Data
Data Download
Share Success Story
WR Planning & Management
Create Your WRIS
2D-3D Linked View
Collaborative Planning
Input Data Builder
Spatial Data
Non-Spatial Data
Metadata
India-WRIS
The project "Generation of Database and Implementation of Web Enabled Water Resources Information System in the Country" short named as India-WRIS WebGIS is a joint venture of the Central Water Commission (CWC), Ministry of Water Resources, Govt. of India and Indian Space Research Organization (ISRO), Department of Space, Govt. of India, as per the Memorandum of Understanding (MOU) signed on December 3, 2008 between the two departments for a period of four years - January 2009 to December 2012.
India-WRIS WebGIS aims as a 'Single Window' solution for comprehensive, authoritative and consistent data & information of India's water resources along with allied natural resources in a standardized national GIS framework (WGS-84 datum and LCC
News And Events
Basin Reports available for download
Watershed Atlas of India
Non Classified HO data available for download
River Basin Atlas of India has been launched on November 1, 2012.
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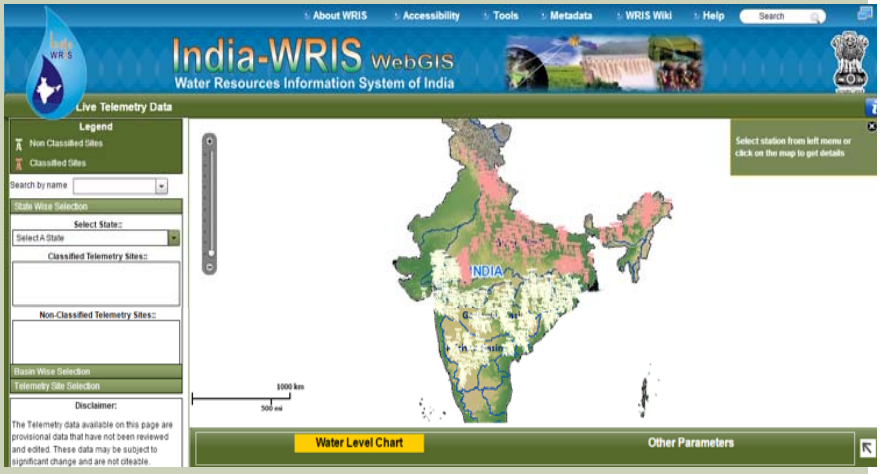
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Water Resources Information System of India
Live Telemetry Data
Legend
Non Classified Sites
Classified Sites
Search by name
State Wise Selection
Select State:
Select A State
Classified Telemetry Sites:
Non-Classified Telemetry Sites:
Basin Wise Selection
Telemetry Site Selection
Disclaimer:
The Telemetry data available on this page are provisional data that have not been reviewed and edited. These data may be subject to significant change and are not citeable.
INDIA
Select station from left menu or click on the map to get details
Water Level Chart
Other Parameters

LESSONS LEARNT

- Flooding in upper reaches of rivers especially in Himalayas where warning time available is very less and also the observational network is sparse as compared to plains.
- Flooding in rivers where Reservoir Projects are without specific flood cushion or not operated for flood moderation due to lack of reliable advance information.
- Flooding in rivers flowing from neighboring countries
- Landslide/Glacial Lake Outburst related flooding
- Design criteria of Flood Control structural measures are being exceeded.

WAY FORWARD

- Densification of meteorological & hydrological observational network in Himalayas has been planned for close monitoring of events
- Development of Rainfall based Flood Forecasting Models for these reached to have at least few hours warning time is being taken up.
- Review of safety of Dams and ensuring optimum release with advance inflow forecasting system planned and implemented in phased manner.
- Close monitoring of anticipated extreme weather events at highest Government level to deal with dam release related flooding.
- Glacial lake monitoring taken up
- Review of design criteria for Flood Control structural measures will be taken up after detailed study.

THANKS