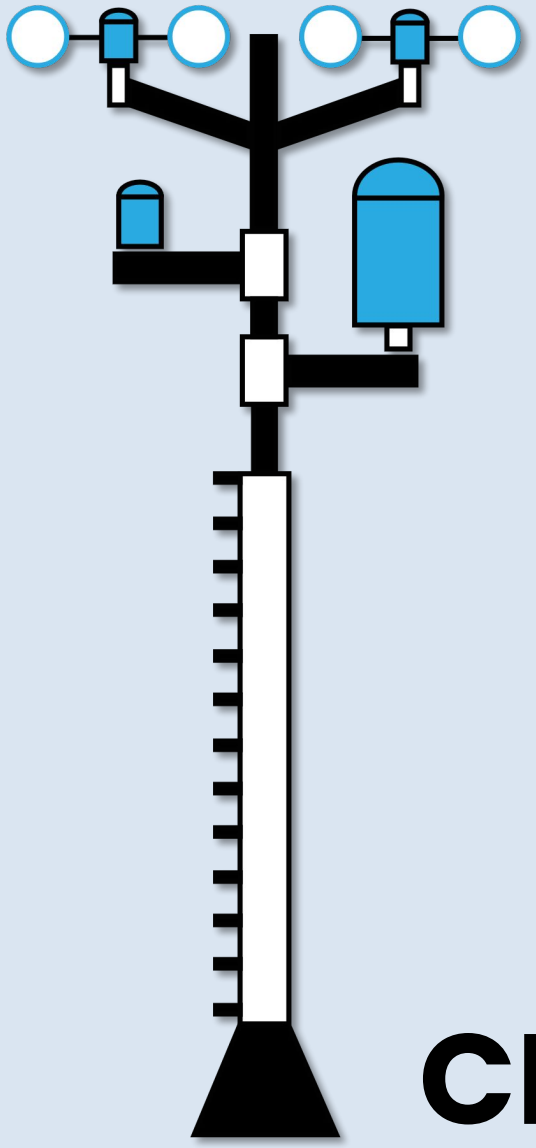


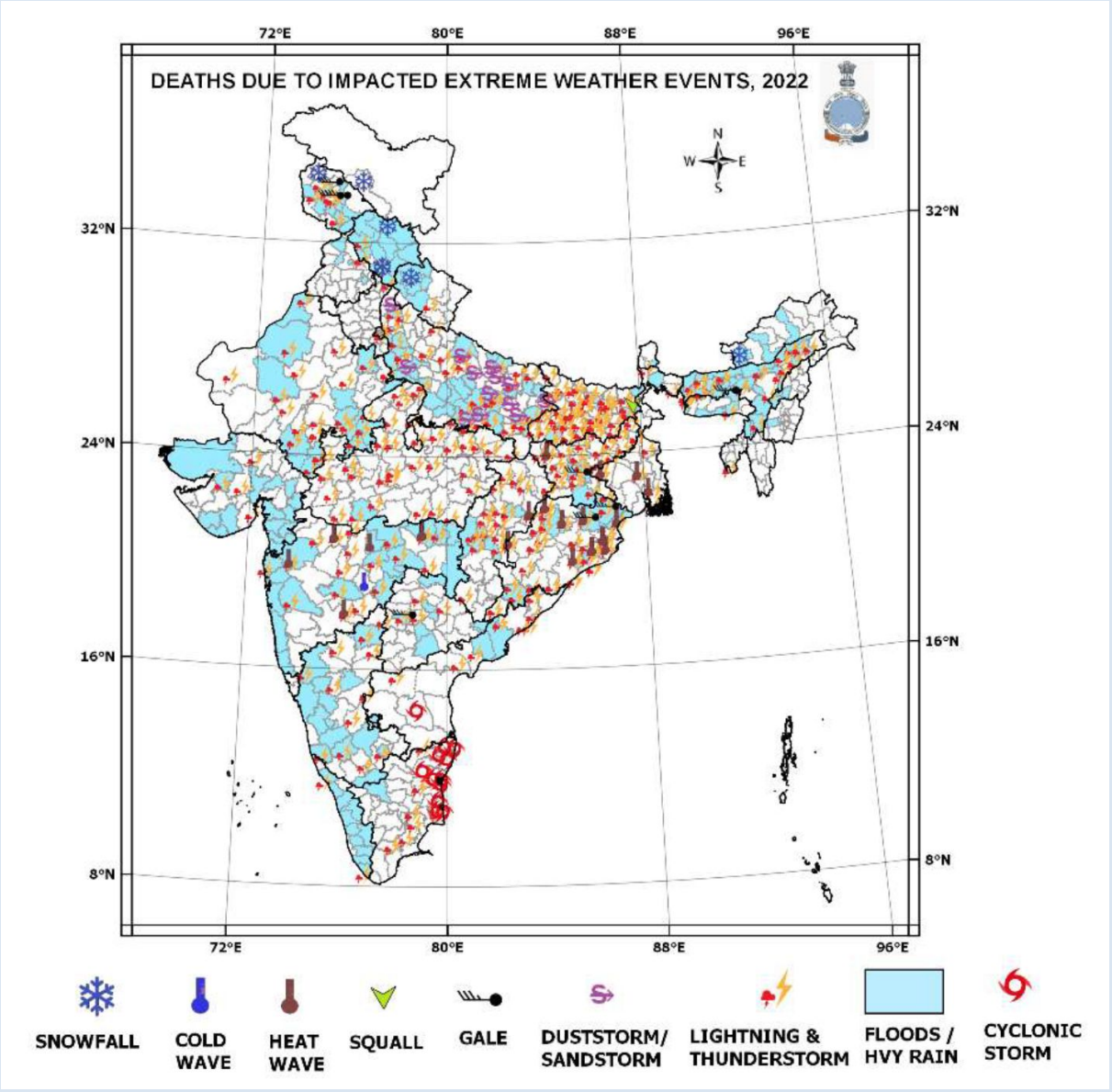
CENTER FOR THE ADVANCED STUDY OF INDIA

CASI

CLIMATE DATA

Roxy Mathew Koll
Centre for Climate Change Research
Indian Institute of Tropical Meteorology
Ministry of Earth Sciences, India

CLIMATE CHANGE | Extreme Weather Events



भारतसरकार

Government of India

पृथ्वीविज्ञानमंत्रालय(एम. ओ. ई. एस.)

Ministry of Earth Sciences (MoES)

भारतमौसमविज्ञानविभाग

INDIA METEOROLOGICAL DEPARTMENT

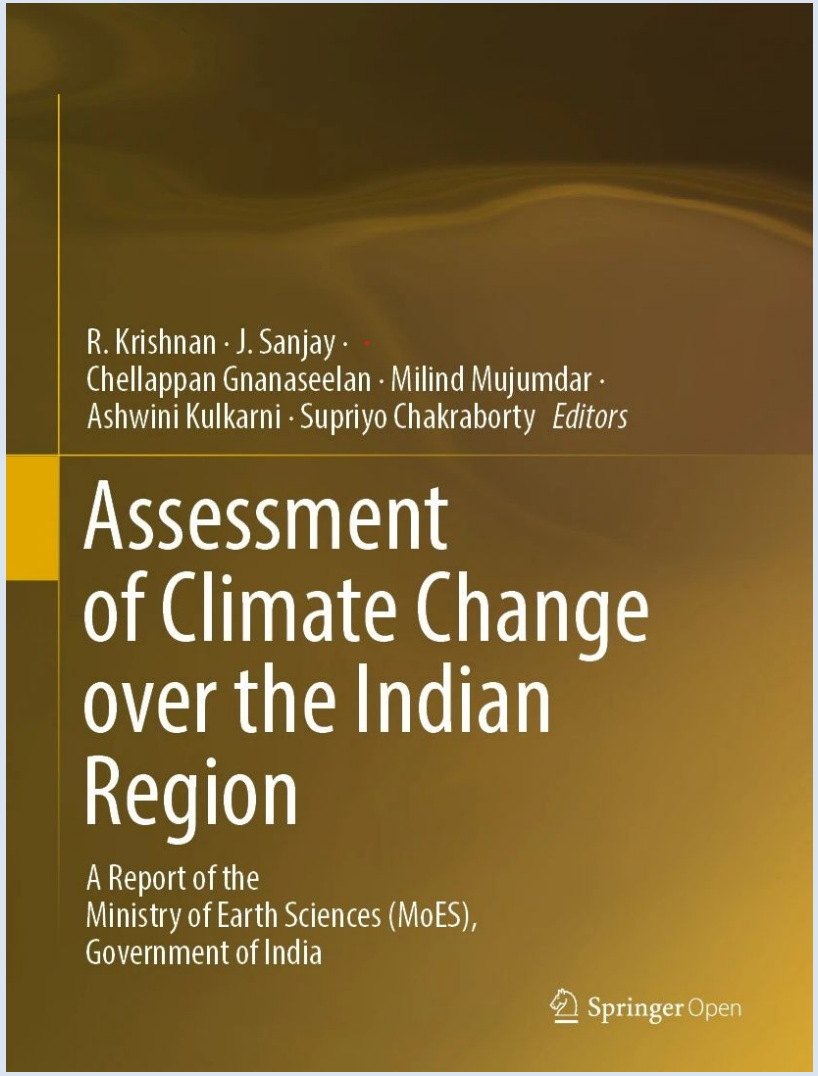
Climate Research and Services (CRS)

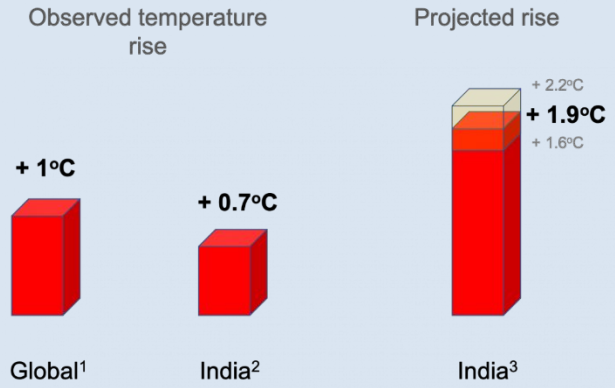
Statement on Climate of India during 2022

High Impact Weather Events occurred during 2022 along with loss of life reported by media and other state government agencies

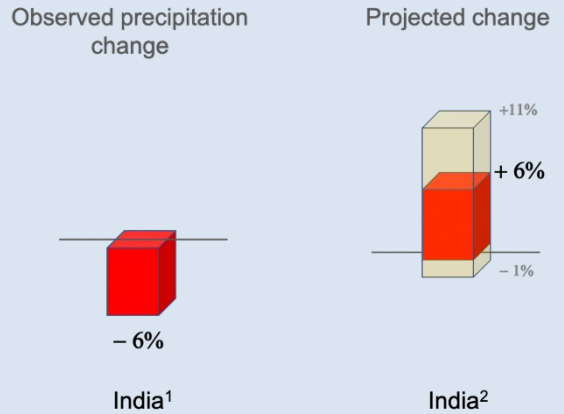
CLIMATE CHANGE | Extreme Weather Events

CLIMATE DATA

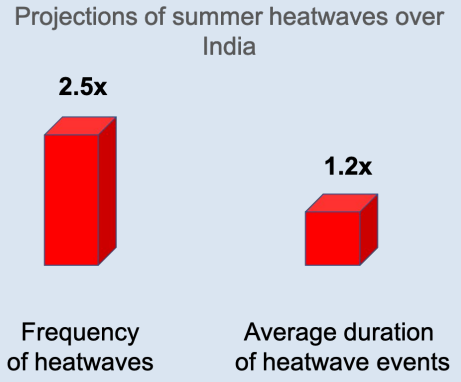




[1] IPCC SR1.5 (2018). Period: Since pre-industrial times.
[2]Assessment of Climate Change over the Indian Region, Springer (2020). Period: 1901 – 2018.
[3]Rise by mid-century under RCP4.5 relative to the average over 1976-2005.

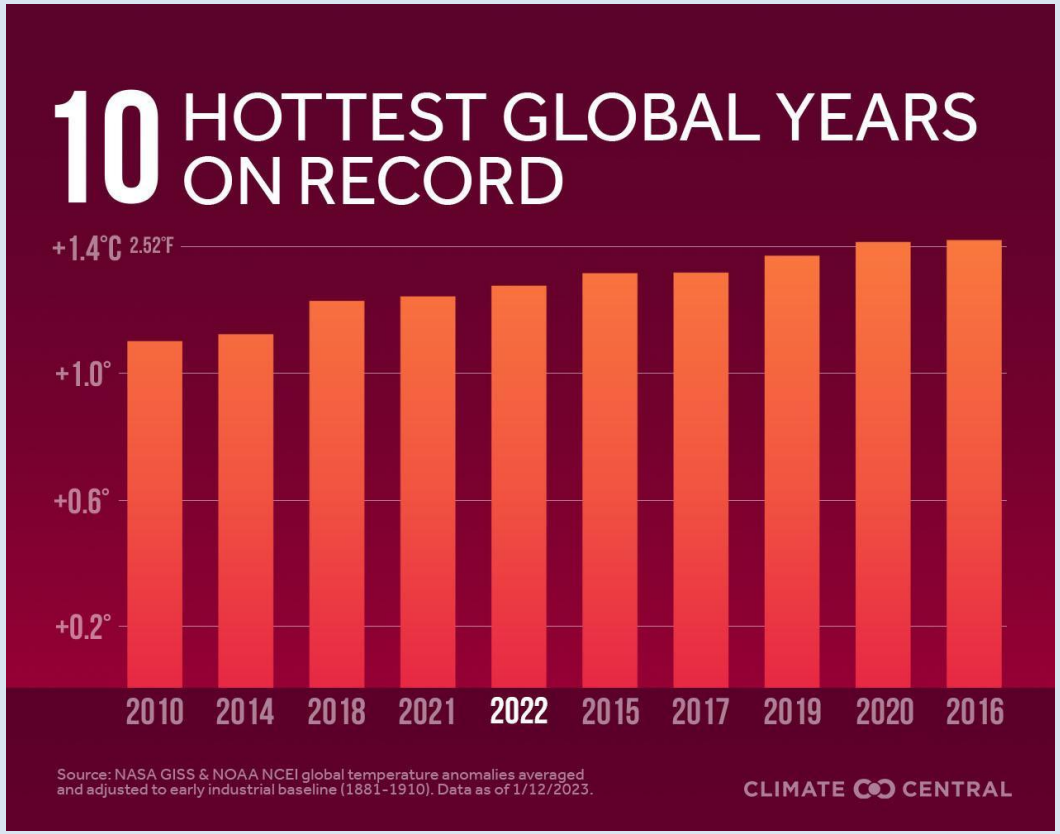


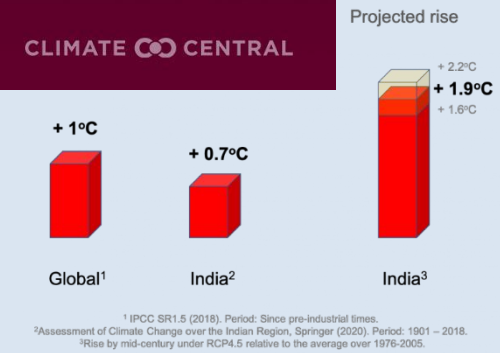
[1] Assessment of Climate Change over the Indian Region, Springer (2020). Period: 1950 – 2015
[2] Rise by mid-century under RCP4.5 relative to the average over 1976-2005.



Mid-century projections under RCP4.5 relative to 1976 – 2005 (all India average).

Top 10 hottest years are all after 2010





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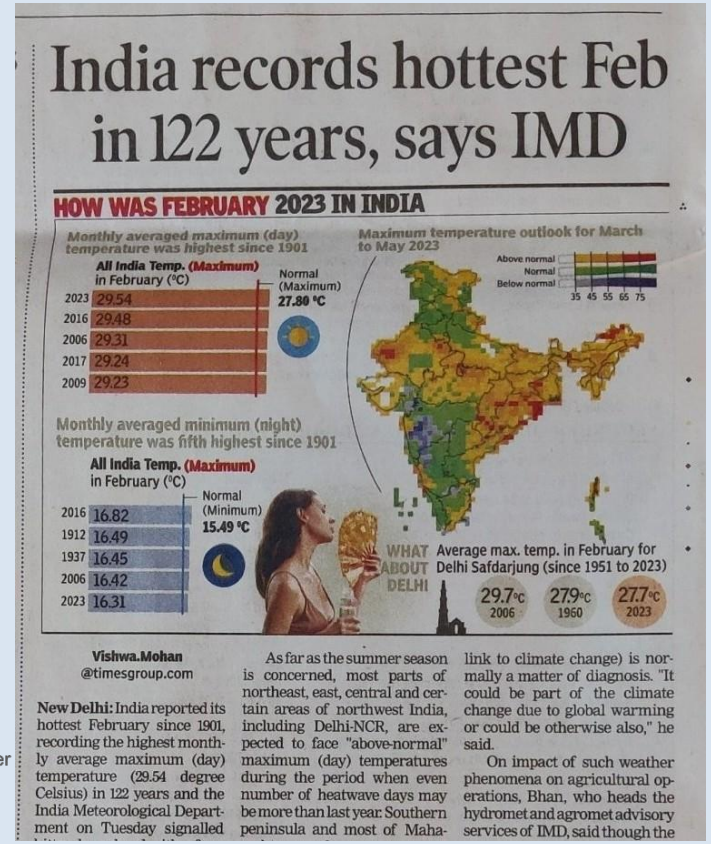
[3]Rise by mid-century under RCP4.5 relative to the average over 1976-2005.

Maximum Temperature in Feb 2023 in India was 1.7 degC greater than normal



India records hottest Feb in 122 years, says IMD

HOW WAS FEBRUARY 2023 IN INDIA

Monthly averaged maximum (day) temperature was highest since 1901

All India Temp. (Maximum) in February (°C)

2023	29.54
2016	29.48
2006	29.31
2017	29.24
2009	29.23

Normal (Maximum) 27.80 °C

Maximum temperature outlook for March to May 2023

Above normal
Normal
Below normal
35 45 55 65 75

Monthly averaged minimum (night) temperature was fifth highest since 1901

All India Temp. (Maximum) in February (°C)

2016	16.82
1912	16.49
1937	16.45
2006	16.42
2023	16.31

Normal (Minimum) 15.49 °C

WHAT ABOUT DELHI

Average max. temp. in February for Delhi Safdarjung (since 1951 to 2023)

29.7°C 2006 | 27.9°C 1960 | 27.7°C 2023

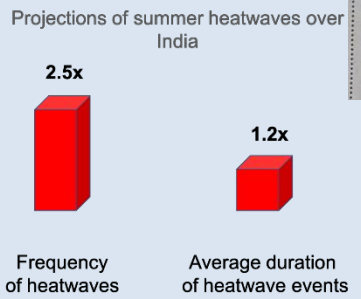
Vishwa.Mohan
@timesgroup.com

New Delhi: India reported its hottest February since 1901, recording the highest monthly average maximum (day) temperature (29.54 degree Celsius) in 122 years and the India Meteorological Department on Tuesday signalled

As far as the summer season is concerned, most parts of northeast, east, central and certain areas of northwest India, including Delhi-NCR, are expected to face "above-normal" maximum (day) temperatures during the period when even number of heatwave days may be more than last year. Southern peninsula and most of Maha-

link to climate change) is normally a matter of diagnosis. "It could be part of the climate change due to global warming or could be otherwise also," he said.

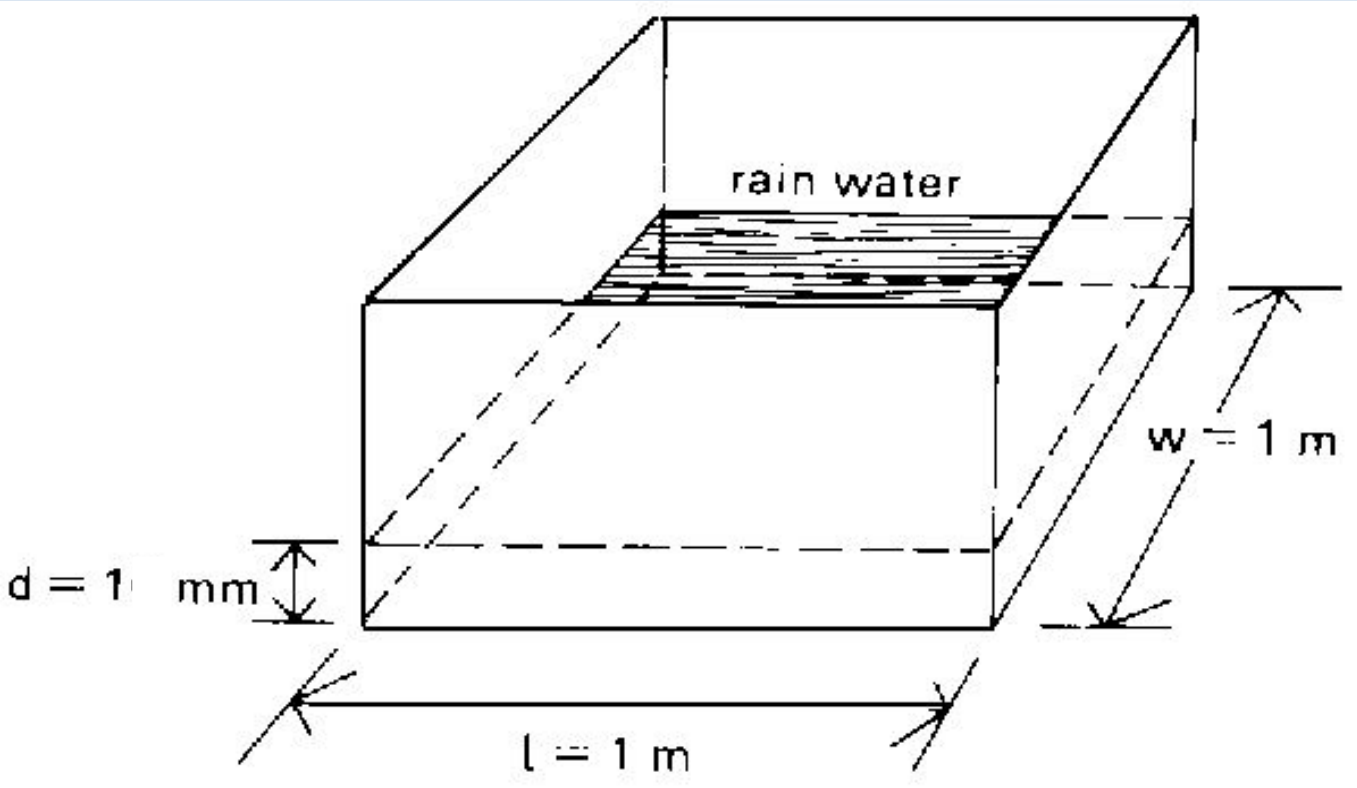
On impact of such weather phenomena on agricultural operations, Bhan, who heads the hydromet and agromet advisory services of IMD, said though the



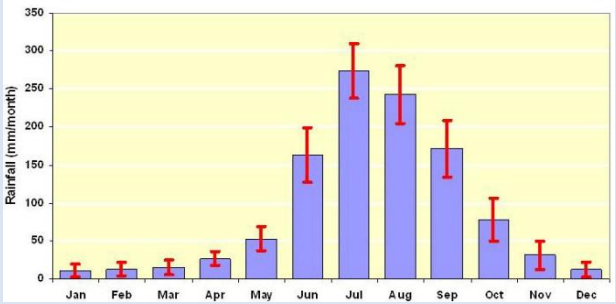
Mid-century projections under RCP4.5 relative to 1976 – 2005 (all India average).

1 mm rain means

~ 1 liter of rain water in 1 square meter



Volume = 1m x 1m x 0.001m = 0.001 m^3 or 1 liter



Summer Monsoon Rainfall received = 850 mm

That's about 2 million (20 lakh) liters of water per person

The math:
Area = 3 trillion m^2
Rain = 850 mm
Volume= 2700 trillion liters

Population = 1.3 billion
Per capita water = 2,000,000 liters
= **2 million liters of water per person**

RAINFALL | Classifications

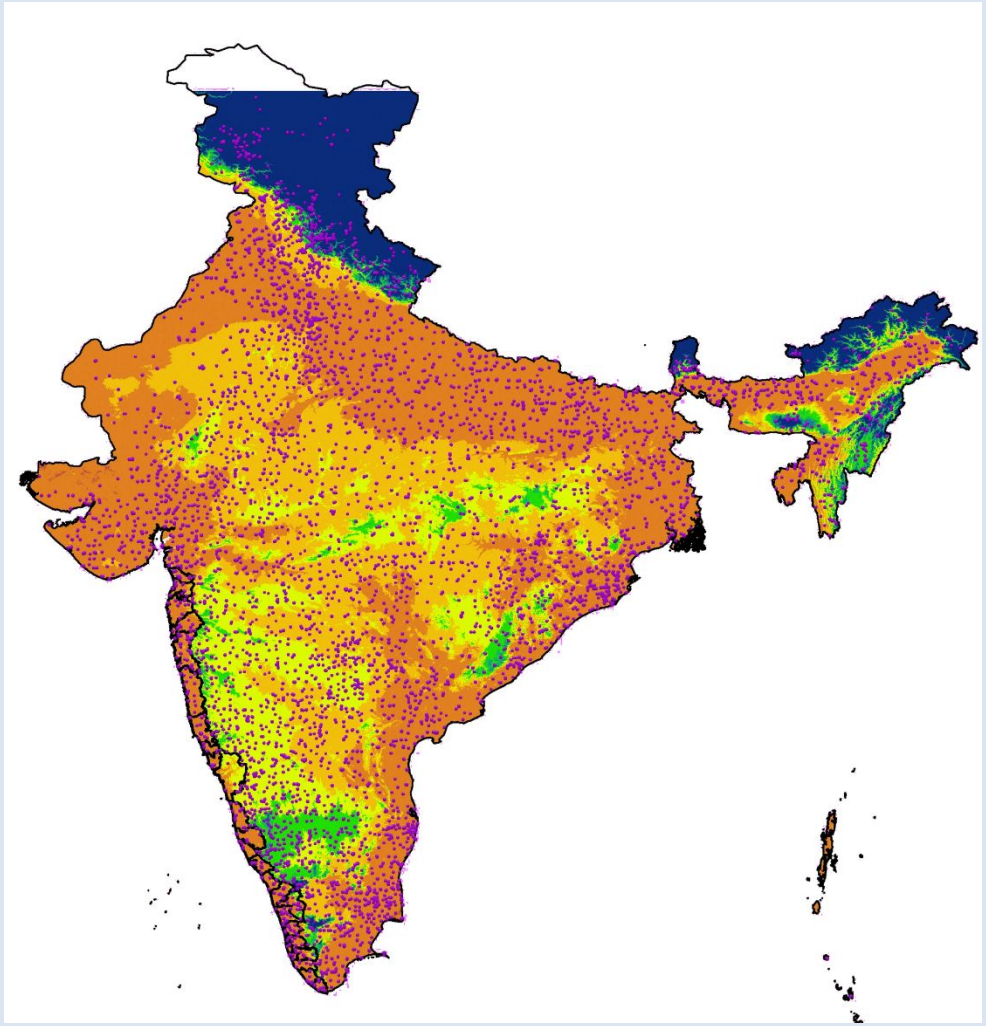
Description term used	Rainfall amount (mm/day)
Very light rain (VLR)	0.1–2.4
Light rain (LR)	2.5–7.5
Moderate rain (MR)	7.6–35.5
Rather heavy rain (RHR)	35.6–64.4
Heavy rain (HR)	64.5–124.4
Very heavy rain (VHR)	124.5–244.4
Extremely heavy rain (EHR)	> 244.5

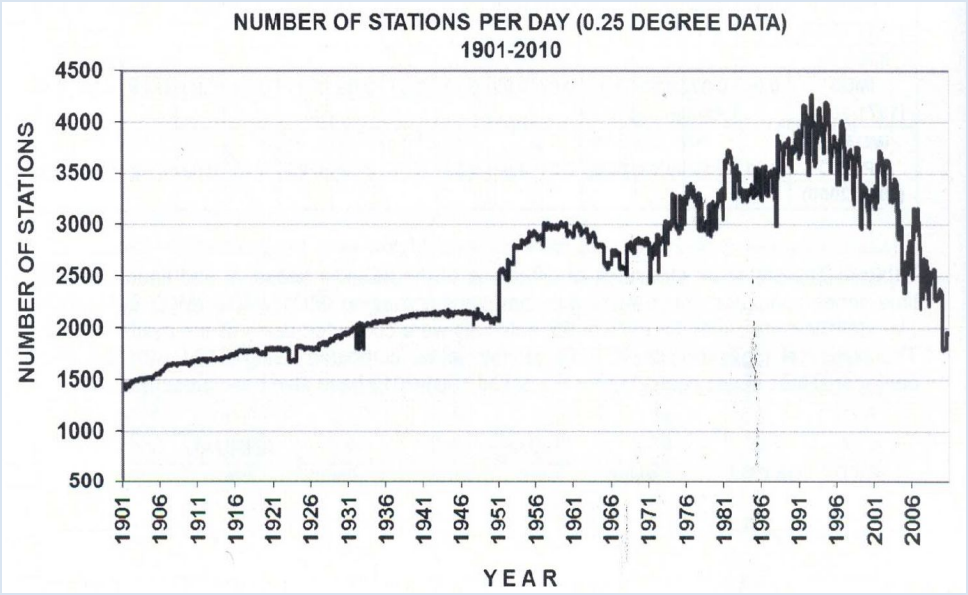
Mahabaleshwar Rains

19/07/2021	098 mm
20/07/2021	110 mm
21/07/2021	164 mm
22/07/2021	480 mm
23/07/2021	600 mm

1080 mm in two days

RAINFALL DATA | Rain Gauge Stations



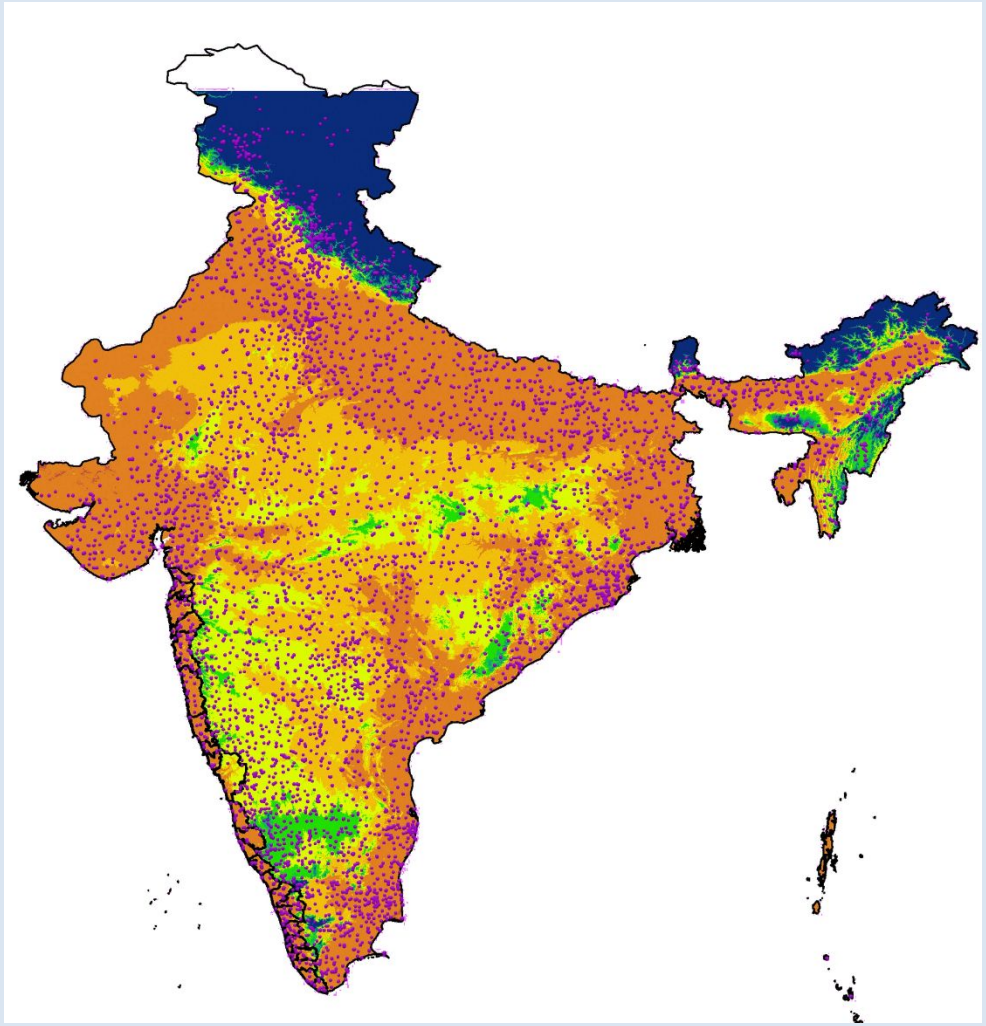


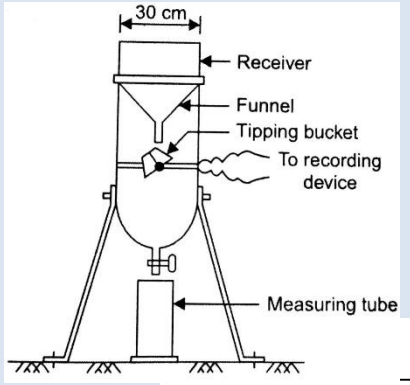
2600 rain gauge stations on an average
6955 varying stations over the period

547 are IMD observatory stations
494 are Hydro-Meteorology observatories
74 are Agromet observatories

Remaining are rainfall reporting

RAINFALL DATA | Rain Gauge Stations

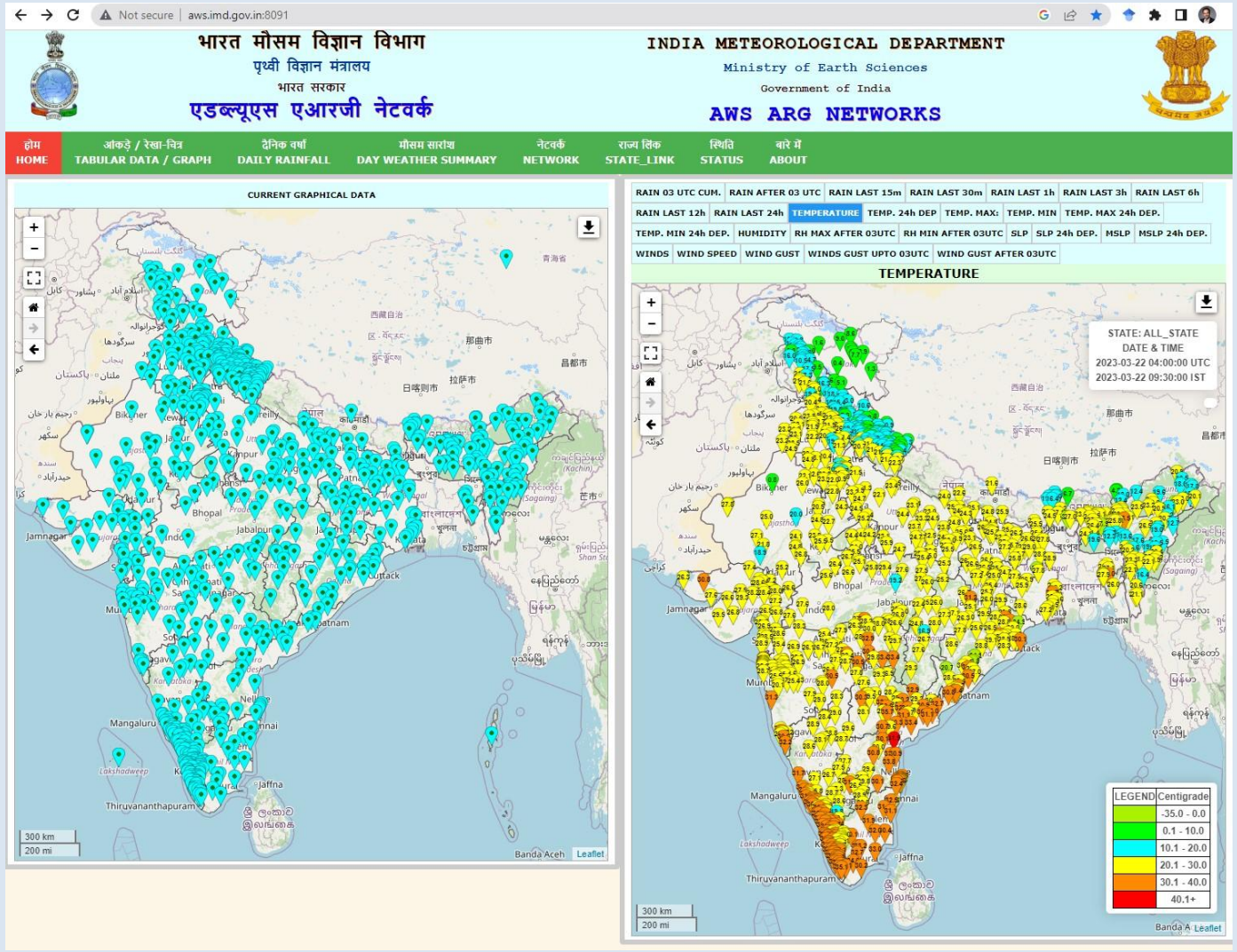




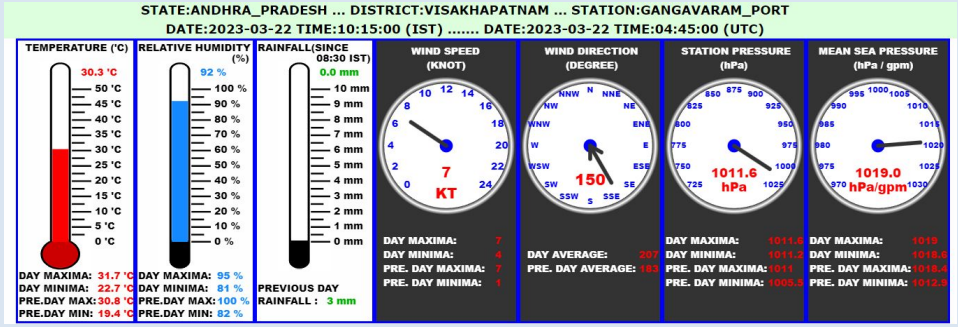
AWS sensor details and characteristics

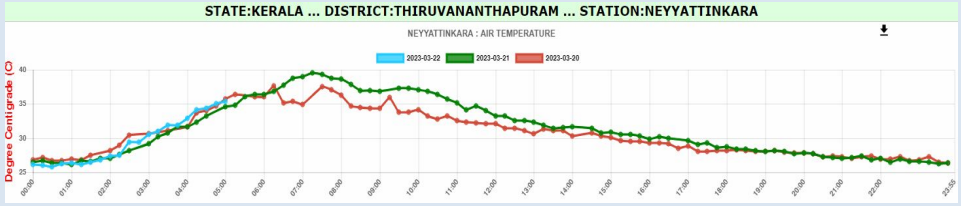
Parameter	Type and Make	Height	Accuracy	Range & Resolution
Air temperature	Thermistor (Sutron make)	2 m	± 0.2 °C	- 40 °C to + 60 °C, Resolution: 0.1 °C
Relative humidity	Capacitive type (Sutron make)	2 m	± 3%	0% to 100%, Resolution: 1%
Atmospheric pressure	Accubar solid state (Sutron make)	1.5 m	0.2 hPa	600-1100 hPa (100 hPa above datum value), Resolution: 0.1 hPa
Rainfall	Tipping Bucket (Sutron make)	0.6 to 1 m	2% at 240 mm/hr	Resolution: 0.5 mm
Wind speed	Ultrasonic (Gill Instruments)	10 m	1.2 m/s	0-60 m/s Resolution: 0.1 m/s
Wind direction	Ultrasonic (Gill Instruments)	10 m	1°	0° - 360° Resolution: 1°
Global solar radiation	Silicon photo-diode Licor-200SZ	2 m	5% against Eppley lab	0.3 - 4 µm
Soil temperature	Campbell Scientific	-20 cm	±0.4 °C	- 40 °C to + 50 °C Resolution: 0.1 °C
Soil moisture	Stevens Hydra Probe	-20 cm	±0.03 wfv	0 to 0.45 wfv Resolution: 0.01 wfv

RAINFALL DATA | IMD Automatic Weather Stations



AWS: Automatic Weather Station
ARG: Automatic Rain Gauge





Link: http://aws.imd.gov.in:8091

RAINFALL DATA | IMD Automatic Weather Stations

CLIMATE DATA

Not secure | aws.imd.gov.in:8091

भारत मौसम विज्ञान विभाग
पृथ्वी विज्ञान मंत्रालय
भारत सरकार
एडब्ल्यूएस एआरजी नेटवर्क

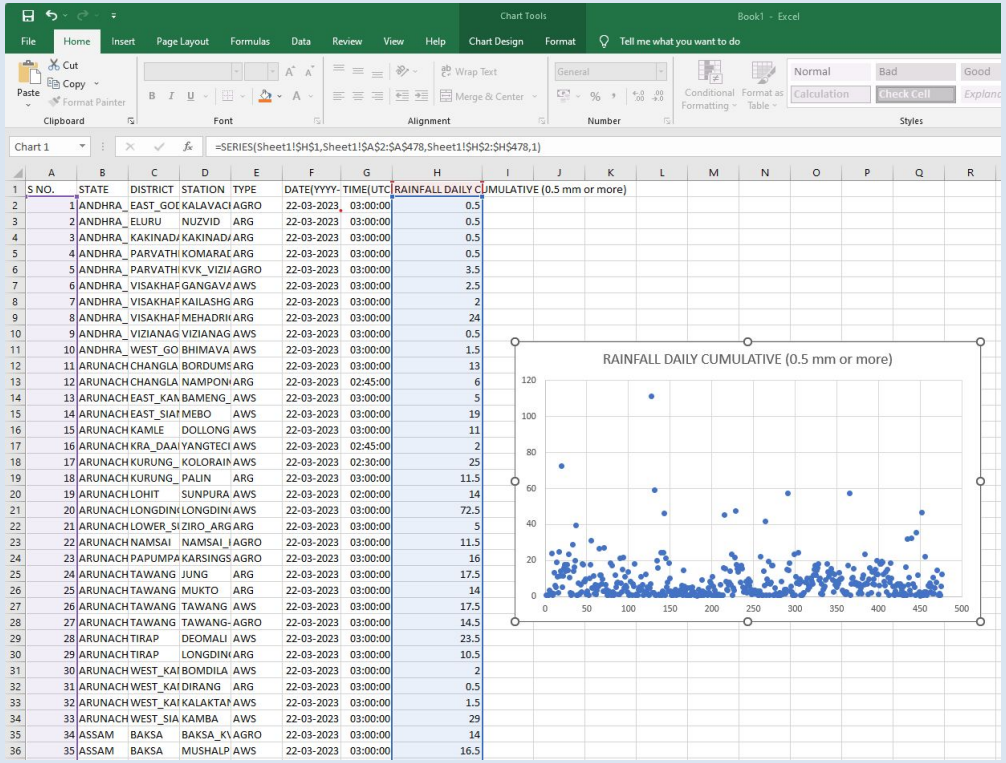
INDIA METEOROLOGICAL DEPARTMENT
Ministry of Earth Sciences
Government of India
AWS ARG NETWORKS

होम HOME | आंकड़े / रेखा-चित्र TABULAR DATA / GRAPH | दैनिक वर्षा DAILY RAINFALL | मौसम सारांश DAY WEATHER SUMMARY | नेटवर्क NETWORK | राज्य लिंक STATE_LINK | स्थिति STATUS | बारे में ABOUT

ALL_STATE | 2023-03-22 | ALL | AWSAGRO | AWS | AGRO | ARG | देखना / VIEW | डाउनलोड / DOWNLOAD

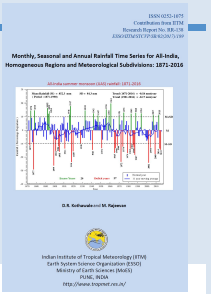
RAINFALL DATA

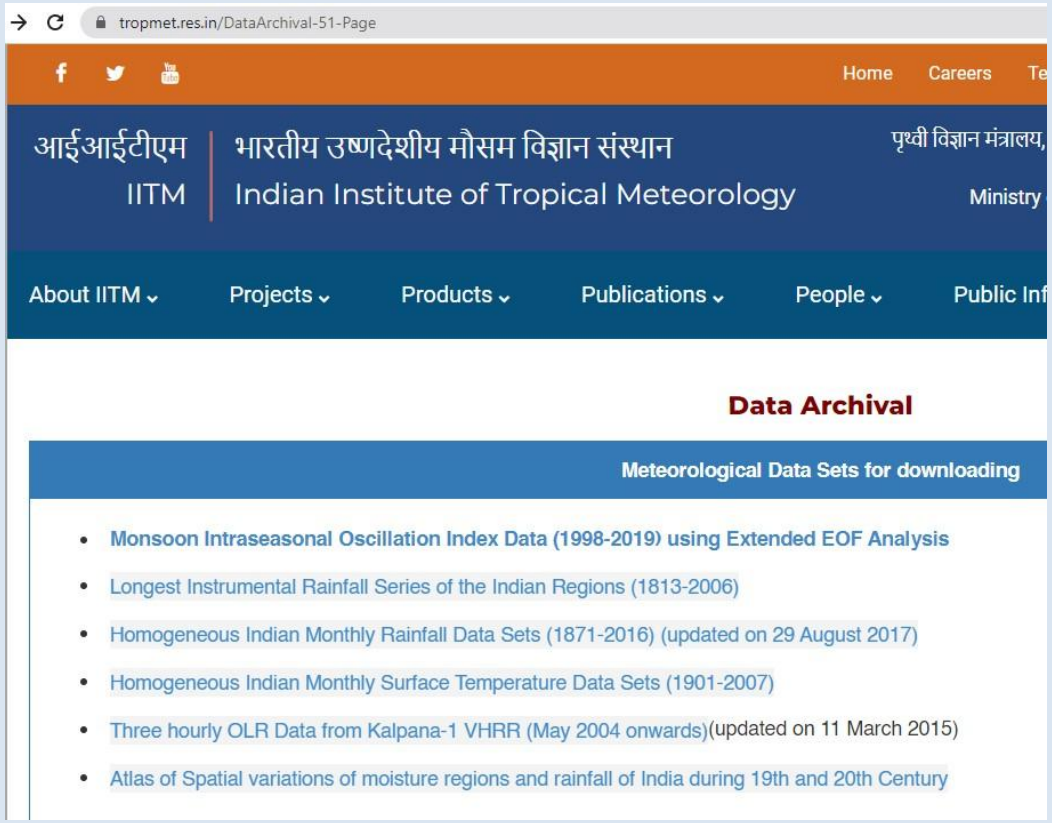
S NO.	STATE	DISTRICT	STATION	TYPE	DATE(YYYY-MM-DD)	TIME(UTC)	RAINFALL DAILY CUMULATIVE (0.5 mm or more)
1	ANDHRA_PRADESH	EAST_GODAVARI	KALAVACHARLA_KVK	AGRO	2023-03-22	03:00:00	0.5
2	ANDHRA_PRADESH	ELURU	NUZVID	ARG	2023-03-22	03:00:00	0.5
3	ANDHRA_PRADESH	KAKINADA	KAKINADA	ARG	2023-03-22	03:00:00	0.5
4	ANDHRA_PRADESH	PARVATHIPURAM_MANYAM	KOMARADA	ARG	2023-03-22	03:00:00	0.5
5	ANDHRA_PRADESH	PARVATHIPURAM_MANYAM	KVK_VIZIANAGARAM	AGRO	2023-03-22	03:00:00	3.5
6	ANDHRA_PRADESH	VISAKHAPATNAM	GANGAVARAM_PORT	AWS	2023-03-22	03:00:00	2.5
7	ANDHRA_PRADESH	VISAKHAPATNAM	KAILASHGIRI	ARG	2023-03-22	03:00:00	2.0
8	ANDHRA_PRADESH	VISAKHAPATNAM	MEHADRIGADDA_DAM	ARG	2023-03-22	03:00:00	24.0
9	ANDHRA_PRADESH	VIZIANAGARAM	VIZIANAGARAM	AWS	2023-03-22	03:00:00	0.5
10	ANDHRA_PRADESH	WEST_GODAVARI	BHIMAVARAM	AWS	2023-03-22	03:00:00	1.5
11	ARUNACHAL_PRADESH	CHANGLANG	BORDUMSA	ARG	2023-03-22	03:00:00	13.0
12	ARUNACHAL_PRADESH	CHANGLANG	NAMPONGCIRCLE	ARG	2023-03-22	02:45:00	6.0
13	ARUNACHAL_PRADESH	EAST_KAMENG	BAMENG_CIRCLE	AWS	2023-03-22	03:00:00	5.0
14	ARUNACHAL_PRADESH	EAST_SIANG	MEBO	AWS	2023-03-22	03:00:00	19.0
15	ARUNACHAL_PRADESH	KAMLE	DOLLONGMUKH	AWS	2023-03-22	03:00:00	11.0
16	ARUNACHAL_PRADESH	KRA_DAADI	YANGTECIRCLE	AWS	2023-03-22	02:45:00	2.0
17	ARUNACHAL_PRADESH	KURUNG_KUMEY	KOLORAING	AWS	2023-03-22	02:30:00	25.0
18	ARUNACHAL_PRADESH	KURUNG_KUMEY	PALIN	ARG	2023-03-22	03:00:00	11.5
19	ARUNACHAL_PRADESH	LOHIT	SUNPURA	AWS	2023-03-22	02:00:00	14.0
20	ARUNACHAL_PRADESH	LONGDING	LONGDING	AWS	2023-03-22	03:00:00	72.5
21	ARUNACHAL_PRADESH	LOWER_SUBANSIRI	ZIRO_ARG	ARG	2023-03-22	03:00:00	5.0
22	ARUNACHAL_PRADESH	NAMSAI	NAMSAI_KVK	AGRO	2023-03-22	03:00:00	11.5
23	ARUNACHAL_PRADESH	PAPUMPARE	KARSINGSA_KVK	AGRO	2023-03-22	03:00:00	16.0
24	ARUNACHAL_PRADESH	TAWANG	JUNG	ARG	2023-03-22	03:00:00	17.5
25	ARUNACHAL_PRADESH	TAWANG	MUKTO	ARG	2023-03-22	03:00:00	14.0
26	ARUNACHAL_PRADESH	TAWANG	TAWANG	AWS	2023-03-22	03:00:00	17.5
27	ARUNACHAL_PRADESH	TAWANG	TAWANG-CHAMGBU_KVK	AGRO	2023-03-22	03:00:00	14.5
28	ARUNACHAL_PRADESH	TIRAP	DEOMALI	AWS	2023-03-22	03:00:00	23.5
29	ARUNACHAL_PRADESH	TIRAP	LONGDING	ARG	2023-03-22	03:00:00	10.5
30	ARUNACHAL_PRADESH	WEST_KAMENG	BOMDILA	AWS	2023-03-22	03:00:00	2.0
31	ARUNACHAL_PRADESH	WEST_KAMENG	DIRANG	ARG	2023-03-22	03:00:00	0.5



RAINFALL DATA | All India Rainfall

CLIMATE DATA

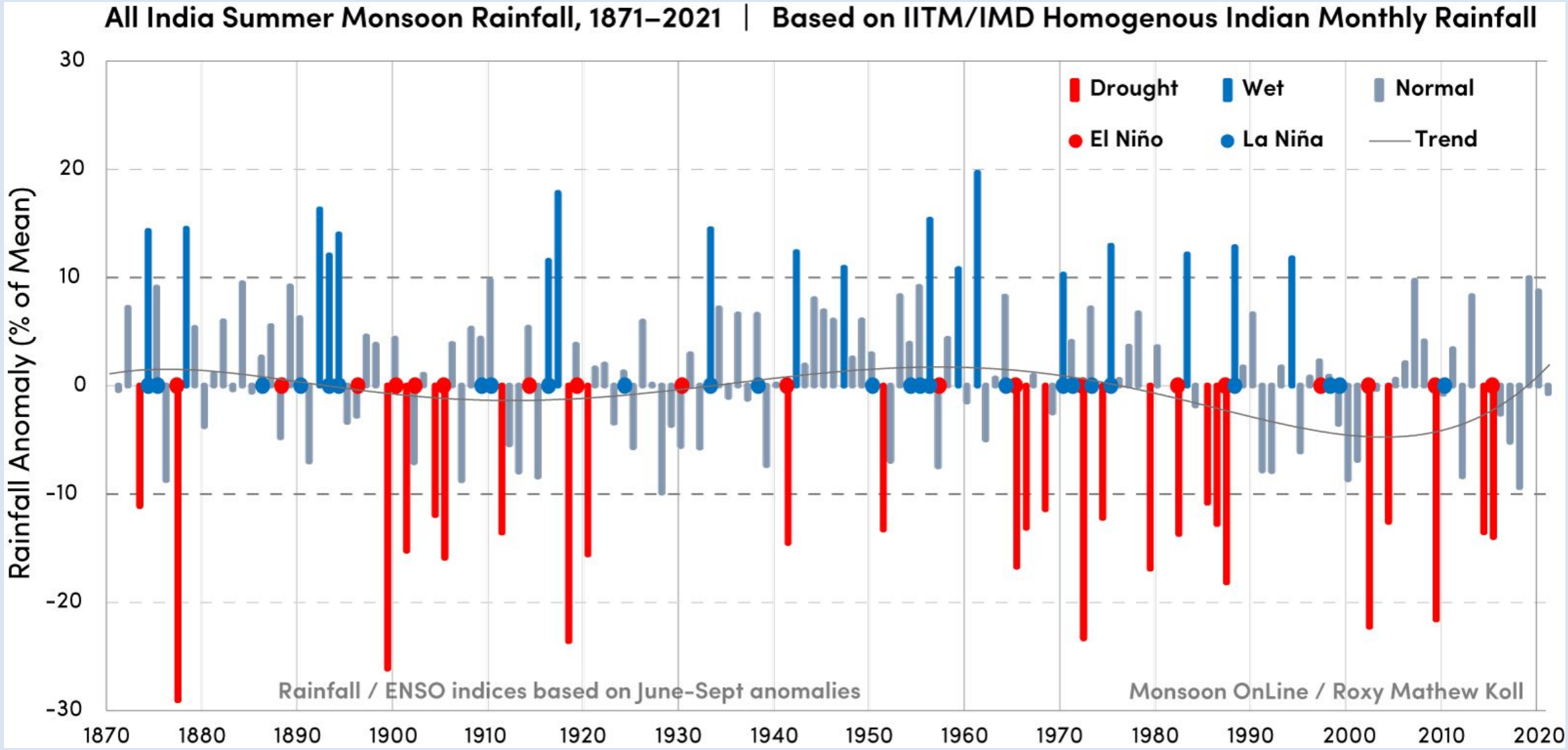




Link:
https://www.tropmet.res.in
Public Info > Data Archival

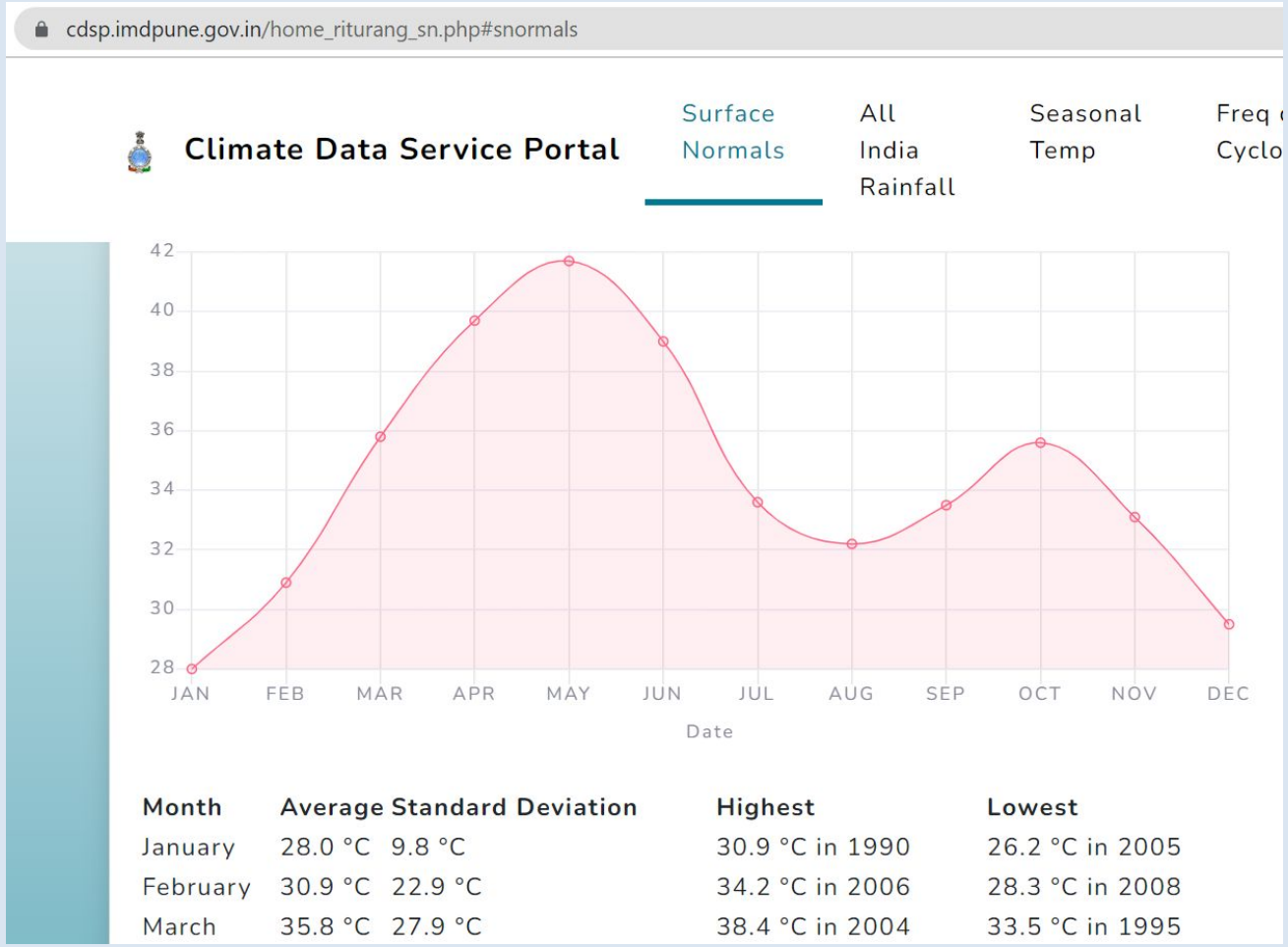
Table 1: **ALL-INDIA RAINFALL (1871-2016) 30 SUBDIVISIONS, AREA 2880324 SQ.KM.**
Monthly, Seasonal and Annual rainfall (in 10th of mm) 1871-2016 (1871-2013 based on 306 stations and 2014-2016 based on IMD Subdivisional rainfall)

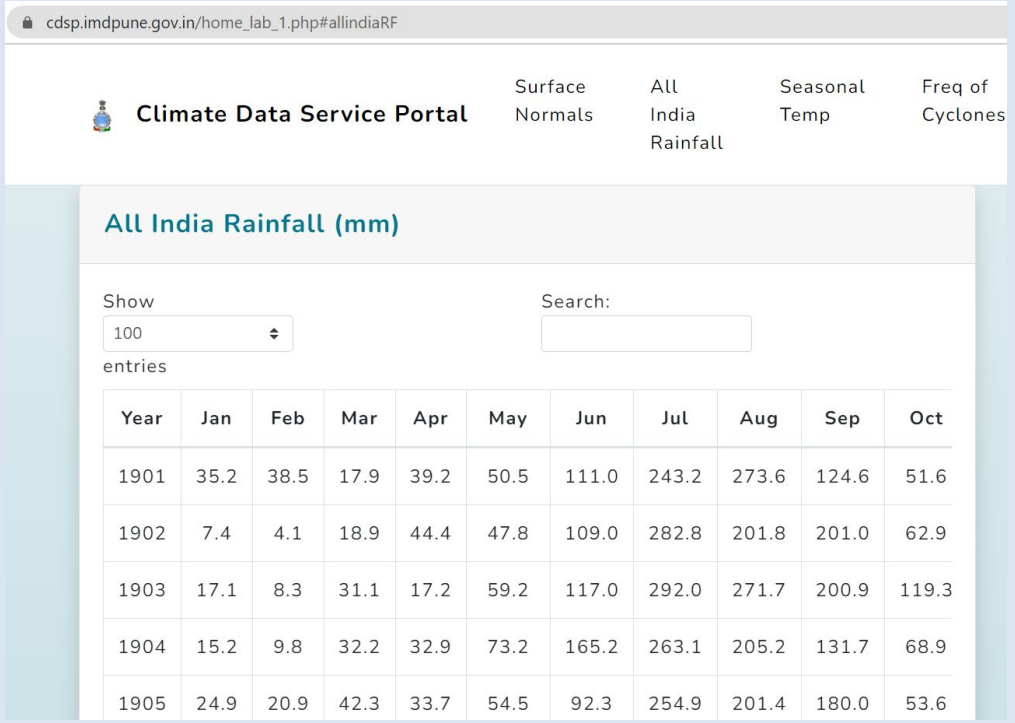
year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JF	MAM	JJAS	OND	ANN
1871	196	107	145	339	636	2080	2778	1794	1836	368	324	67	303	1120	8487	758	10670
1872	76	75	73	240	438	1892	2913	2452	1879	785	276	191	151	751	9136	1252	11289
1873	37	135	150	243	428	1130	2645	2142	1656	607	115	90	172	821	7573	812	9378
1874	86	158	107	169	683	2279	3069	2335	2062	932	187	40	244	959	9745	1159	12106
1875	99	114	131	232	506	1926	3079	2187	2105	566	63	71	213	869	9297	700	11078
1876	9	21	160	165	425	1233	2968	1956	1620	464	95	25	30	750	7776	584	9141
1877	291	234	240	353	674	1424	1564	1569	1483	1078	189	365	525	1267	6040	1632	9464
1878	108	91	102	361	665	1304	2940	3393	2124	798	273	140	199	1128	9761	1211	12299
1879	21	107	80	82	877	1900	2241	3221	1616	866	205	71	127	1039	8978	1142	11287
1880	39	165	151	211	496	1876	2717	1768	1840	877	528	111	204	858	8201	1516	10779
1881	13	32	331	237	531	1607	2927	2646	1433	493	347	62	45	1099	8613	902	10658
1882	100	94	90	188	596	2130	3311	1903	1685	739	596	62	194	873	9029	1397	11493
1883	179	36	189	165	621	2043	2690	1879	1881	830	282	155	215	975	8492	1267	10949
1884	71	74	82	203	383	1593	2924	2426	2385	866	270	305	145	668	9328	1441	11582
1885	96	99	136	199	528	1940	2728	2479	1327	737	321	502	195	863	8474	1560	11092
1886	49	12	222	124	711	1977	3159	2218	1390	1320	214	171	61	1057	8744	1705	11567
1887	176	6	148	209	552	1898	3013	2574	1508	879	411	130	182	909	8993	1420	11503
1888	197	136	119	259	531	1323	2743	2800	1250	382	531	72	333	908	8116	985	10342
1889	106	134	66	243	448	2035	2797	2781	1693	940	254	68	240	757	9306	1262	11565
1890	26	11	173	261	358	2279	3009	2141	1626	647	351	136	37	792	9055	1134	11017
1891	115	134	348	207	595	834	2571	2297	2222	602	173	71	249	1150	7924	846	10169
1892	53	106	56	329	541	1579	3139	3063	2135	993	126	70	159	926	9916	1189	12190
1893	224	283	467	252	946	2416	2568	2309	2256	970	642	22	506	1665	9549	1634	13354
1894	115	144	181	248	360	2168	3114	2415	2017	1388	385	137	259	789	9714	1910	12672
1895	109	77	118	376	415	1982	2567	2299	1388	793	134	119	185	908	8236	1046	10377
1896	31	61	68	170	412	2034	2845	2633	773	149	435	175	92	650	8284	759	9786
1897	92	124	208	216	435	1426	2599	2905	1981	856	130	18	215	859	8911	1004	10990
1898	21	307	28	211	375	1717	2929	2208	1992	655	393	125	328	614	8846	1173	10961
1899	58	66	74	522	526	1951	1878	1441	1020	507	41	26	124	1122	6290	574	8109
1900	153	67	103	385	406	1287	2521	2713	2372	490	104	141	220	893	8893	735	10742
1901	274	337	113	316	391	1149	2225	2590	1256	540	431	95	611	820	7220	1066	9717
1902	67	25	102	354	418	1038	2796	1972	2112	697	278	269	92	874	7918	1244	10128
1903	85	55	102	121	562	1269	2789	2593	1957	1288	434	152	140	785	8608	1874	11407
1904	59	86	203	311	686	1795	2476	1970	1262	707	90	99	145	1200	7503	896	9744
1905	128	144	286	271	476	908	2456	2052	1748	610	98	25	272	1033	7164	733	9202
1906	151	385	220	135	328	1818	2875	2418	1738	544	199	264	536	683	8849	1007	11075
1907	63	324	256	523	264	1541	2217	3014	1003	205	238	128	387	1043	7774	571	9775



Link: https://mol.tropmet.res.in

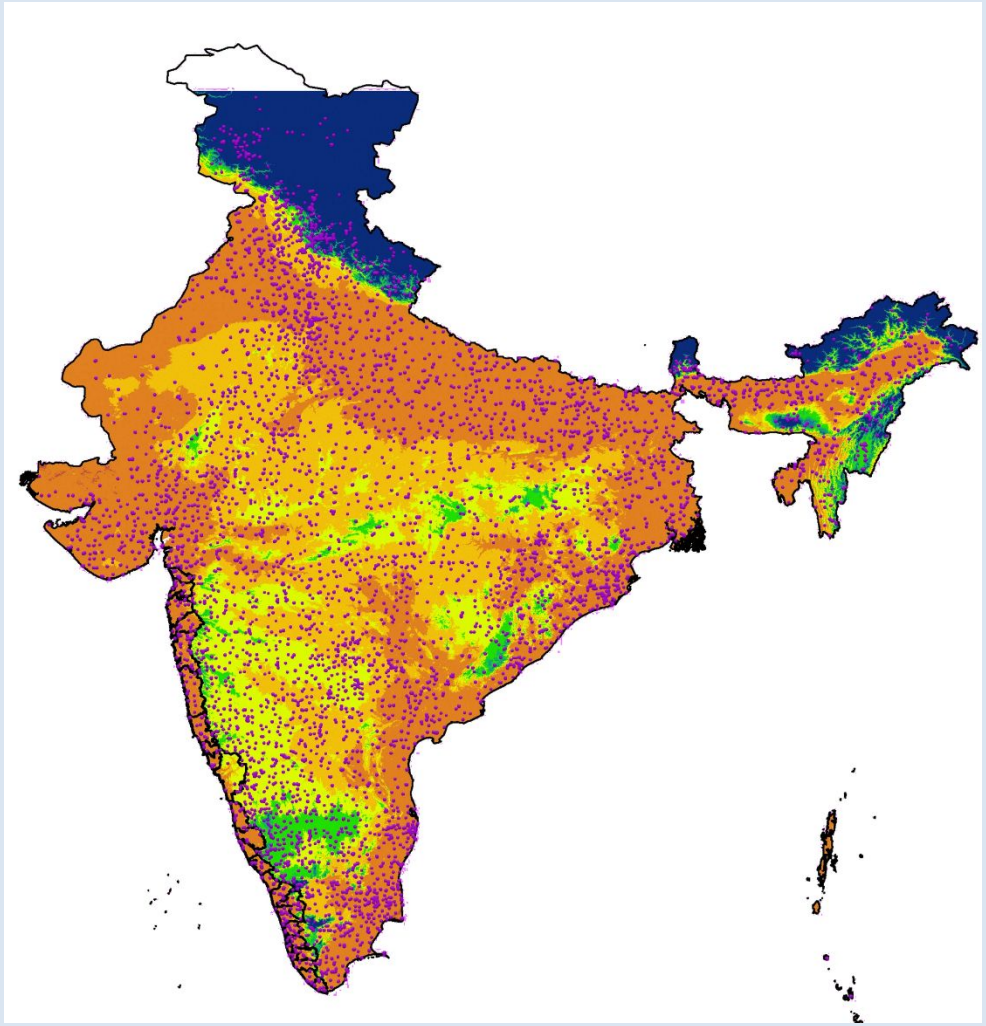
CLIMATE DATA | Climatology / Normal / Average





Link: https://cdsp.imdpune.gov.in

RAINFALL DATA | Gridded Rainfall Data



MAUSAM, **65**, 1 (January 2014), 1-18

551.501.777

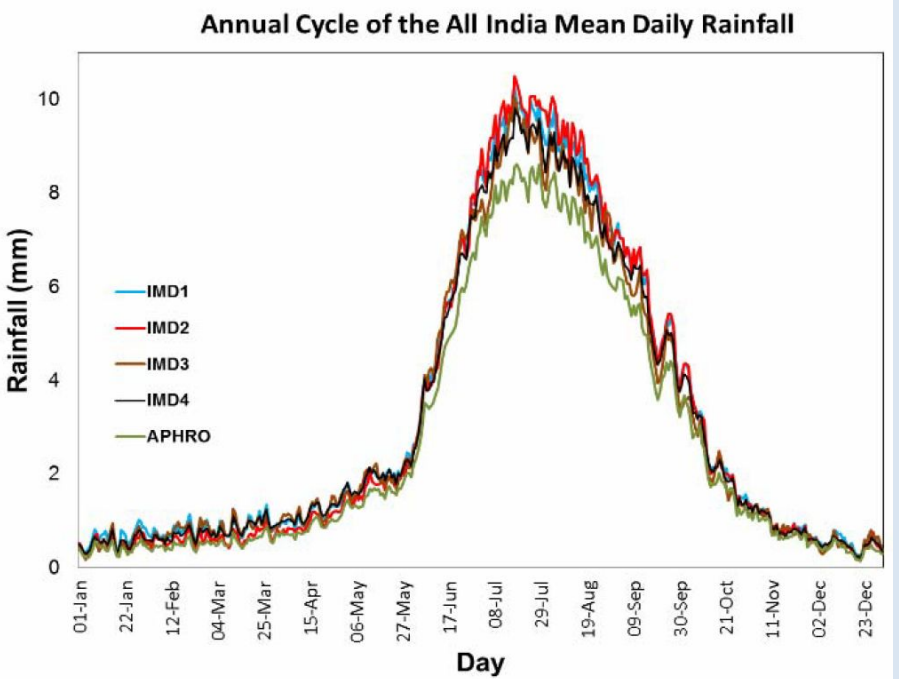
Development of a new high spatial resolution (0.25° × 0.25°) long period (1901-2010) daily gridded rainfall data set over India and its comparison with existing data sets over the region

D. S. PAI, LATHA SRIDHAR, M. RAJEEVAN*, O. P. SREEJITH, N. S. SATBHAI and B. MUKHOPADHYAY

India Meteorological Department, Pune, India

**Earth System Science Organization, Ministry of Earth Sciences, New Delhi, India*

Data set	Short name used in this study	Spatial resolution latitude × longitude	Data period	Rain gauge network used for preparing the gridded data	Interpolation method
IMD (Rajeevan *et al.*, 2006 & 2010)	IMD1	1° × 1°	1951-2007	fixed network of 2140 rain gauge stations	Shepard (1968)
IMD (Rajeevan *et al.*, 2008)	IMD2	1° × 1°	1901-2004	fixed network of 1380 rain gauge stations	Shepard (1968)
IMD (Rajeevan *et al.*, 2009)	IMD3	0.5° × 0.5°	1971-2005	varying network of 6076 rain gauge stations	Shepard (1968)
APHRODITE (Yatagai *et al.*, 2012)	APHRO	0.25° × 0.25°	1951-2007	varying network of rain gauge stations	Willmott *et al.* (1985)
Present Study	IMD4	0.25° × 0.25°	1901-2010	varying network of 6955 rain gauge stations	Shepard (1968)



CLIMATE DATA | Gridded Datasets

imdpune.gov.in/lrfindex.php

जलवायु अनुसंधान एवं सेवाएं, पुणे | CLIMATE RESEARCH & SERVICES, PUNE
भारत मौसम विज्ञान विभाग | India Meteorological Department
पृथ्वी विज्ञान मंत्रालय | Ministry of Earth Sciences
भारत सरकार | Government of India

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hmir and Ladakh)is most like(<86 % of Long Period Average (LPA)).

- Pre Monsoon Season 2023
- Previous Seasons
- Daily Rainfall Spatial Maps
- Daily Temperature Spatial Maps
- Weekly Rainfall
- Weekly Temperature
- Nino Indices and DMI
- Climate Diagnostics
- Gridded Data Archive
  - Rainfall (0.25 x 0.25) Binary
  - Rainfall (0.25 x 0.25) NetCDF
  - Rainfall (0.25 x 0.25) Merged NetCDF
  - Rainfall (1.0 x 1.0) NetCDF
  - Maximum Temp. (1.0 x 1.0) Binary
  - Minimum Temp. (1.0 x 1.0) Binary
- Gridded Data Real Time
- Climate Diagnostic Bulletins
- Monthly Climate Summary
- Annual Climate Summary
- SW Monsoon Rainfall Data

Yearly Gridded Rainfall (0.25 x 0.25) data NetCDF File

Rainfall:

IMD New High Spatial Resolution (0.25X0.25 degree) Long Period (1901-2022) Daily Gridded Rainfall Data Set Over India. This data product is a very high spatial resolution daily gridded rainfall data (0.25 x 0.25 degree). The unit of rainfall is in millimeter (mm). Data available for 122 years, 1901 to 2022. Data is arranged in 135x129 grid points. The first data in the record is at 6.5N & 66.5E, the second is at 6.5N & 66.75E, and so on. The last data record corresponds to 38.5N & 100.0E. The yearly data file consists of 365/366 records corresponding to non leap/ leap years.

Click here for sample Fortran code To read the data.

Click here for sample C code to read the data.

Click here for sample grads control file for reading the data in grads software .

For comments and questions on the data or for any other clarificaltons regarding the data set, please contact:

Climate Prediction Group,
Office of Head, Climate Research and Services,
India Meteorological Department
Pune, INDIA. 411 005.
Phone : 091-20-2553 5211 / 2553 5877
Fax : 091-20-2553 5435.
E-Mail : lrfimdpune@gmail.com, ncc@imd.gov.in

Gridded Rainfall (0.25 x 0.25) NetCDF File

2022 Download

CITATION (for Rainfall 0.25 x 0.25):

Should you refer to our product in your paper/presentation, please cite Pai et al. (2014). Pai D.S., Latha Sridhar, Rajeevan M., Sreejith O.P., Satbhai N.S. and Mukhopadhyay B., 2014: Development of a new high spatial resolution (0.25° X 0.25°)Long period (1901-2010) daily gridded rainfall data set over India and its comparison with existing data sets over the region; MAUSAM, 65, 1(January 2014), pp1-18.

DISCLAIMER:

Although every care has been taken in preparing and testing the data set, India Meteorological Department cannot guarantee that the data are correct in all circumstances. India Meteorological Department also does not accept any liability whatsoever for any error or omission in the data, or for any loss or damage arising from its use.

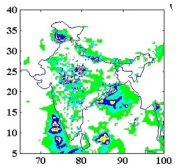
Link: https://imdpune.gov.in

Journal of the Meteorological Society of Japan, Vol. 87A, pp. 265–279, 2009
DOI:10.2151/jmsj.87A.265

Daily Indian Precipitation Analysis Formed from a Merge of Rain-Gauge Data with the TRMM TMPA Satellite-Derived Rainfall Estimates

A. K. MITRA, A. K. BOHRA

National Centre for Medium Range Weather Forecasting (NCMRWF), Noida, India



M. N. RAJEEVAN

National Atmospheric Research Laboratory, Tirupati, India

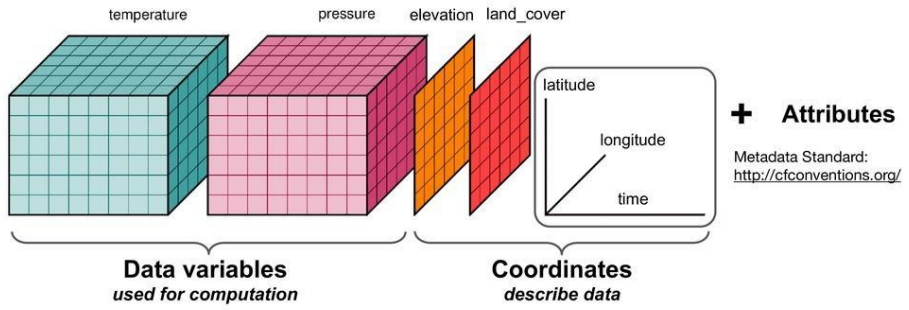
and

T. N. KRISHNAMURTI

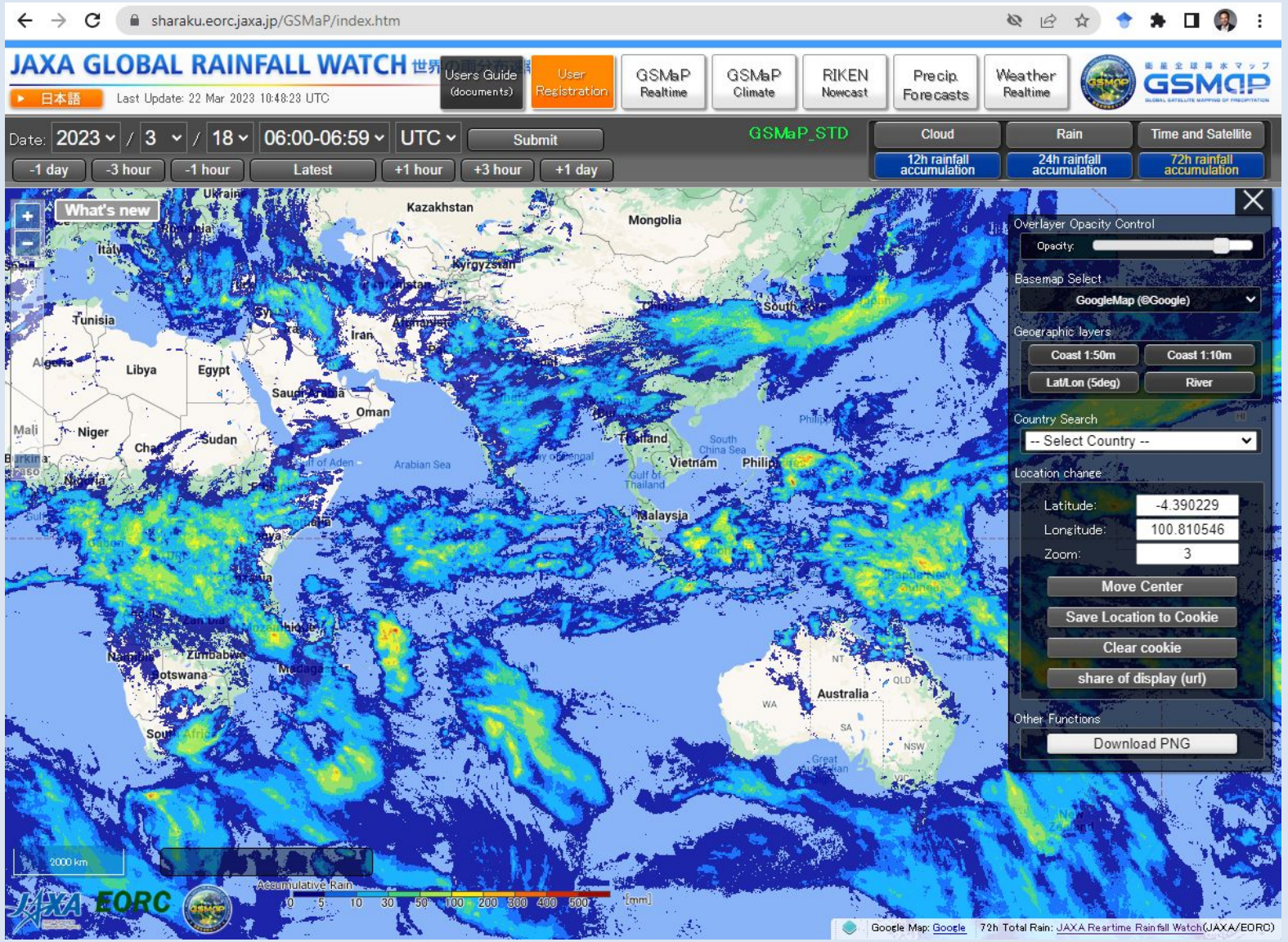
Department of Meteorology, FSU, Tallahassee, Florida, USA

(Manuscript received 16 July 2008, in final form 16 December 2008)

Gridded Data / netCDF

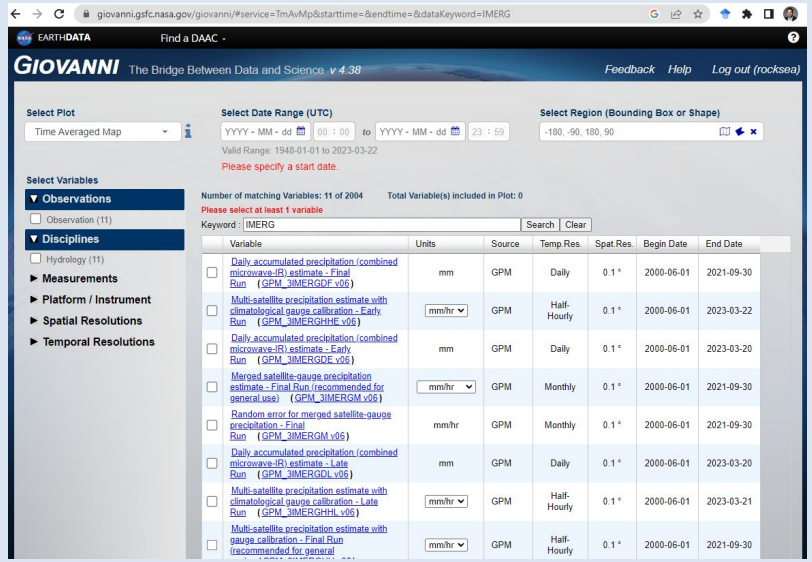


CLIMATE DATA | Satellite Data



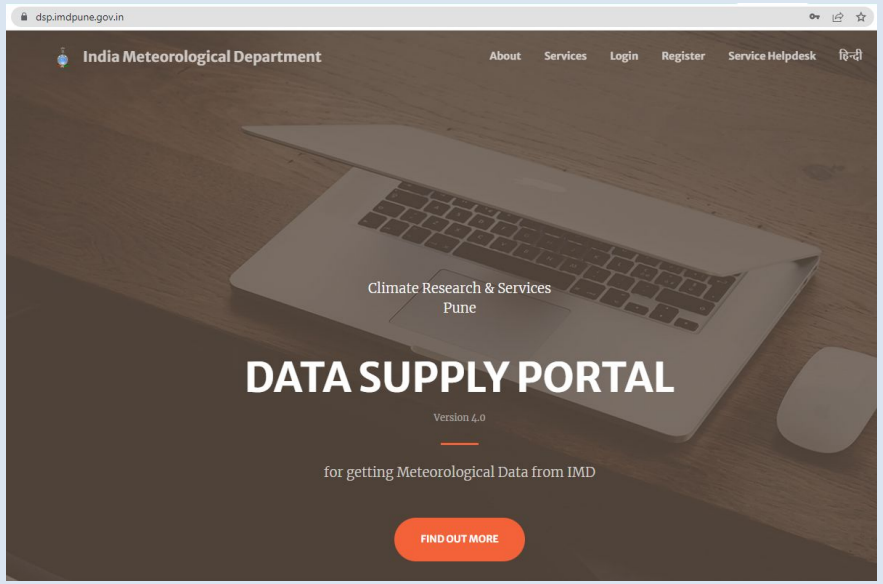
Link: https://sharaku.eorc.jaxa.jp/GSMaP/

Data Plot / Download

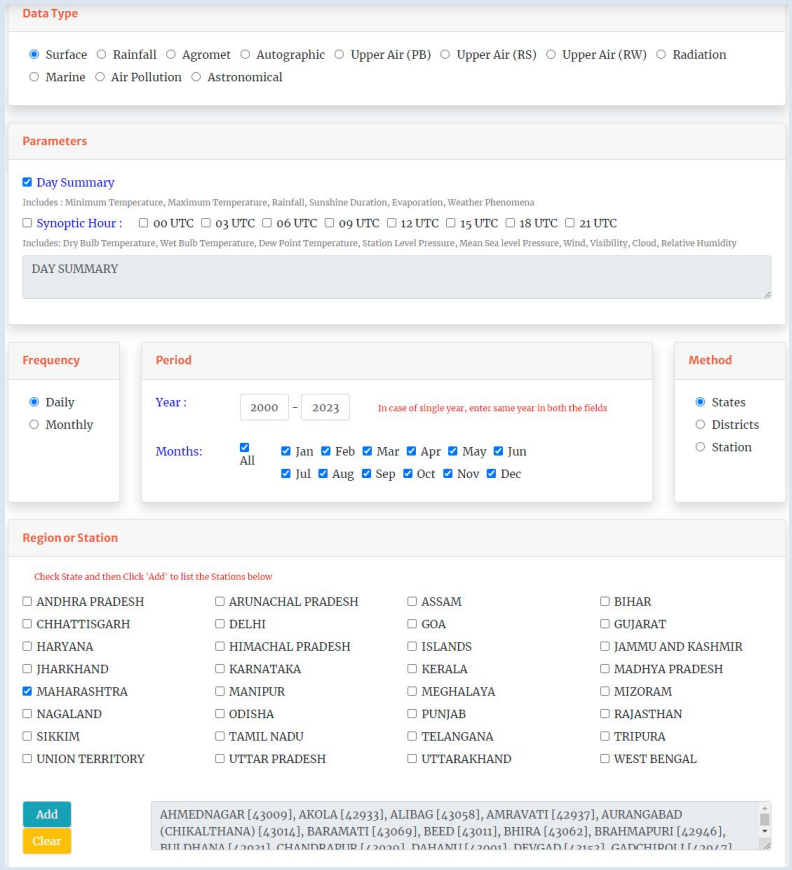


https://gpm.nasa.gov/data/imer

CLIMATE DATA | Station Data



Link: https://dsp.imdpune.gov.in

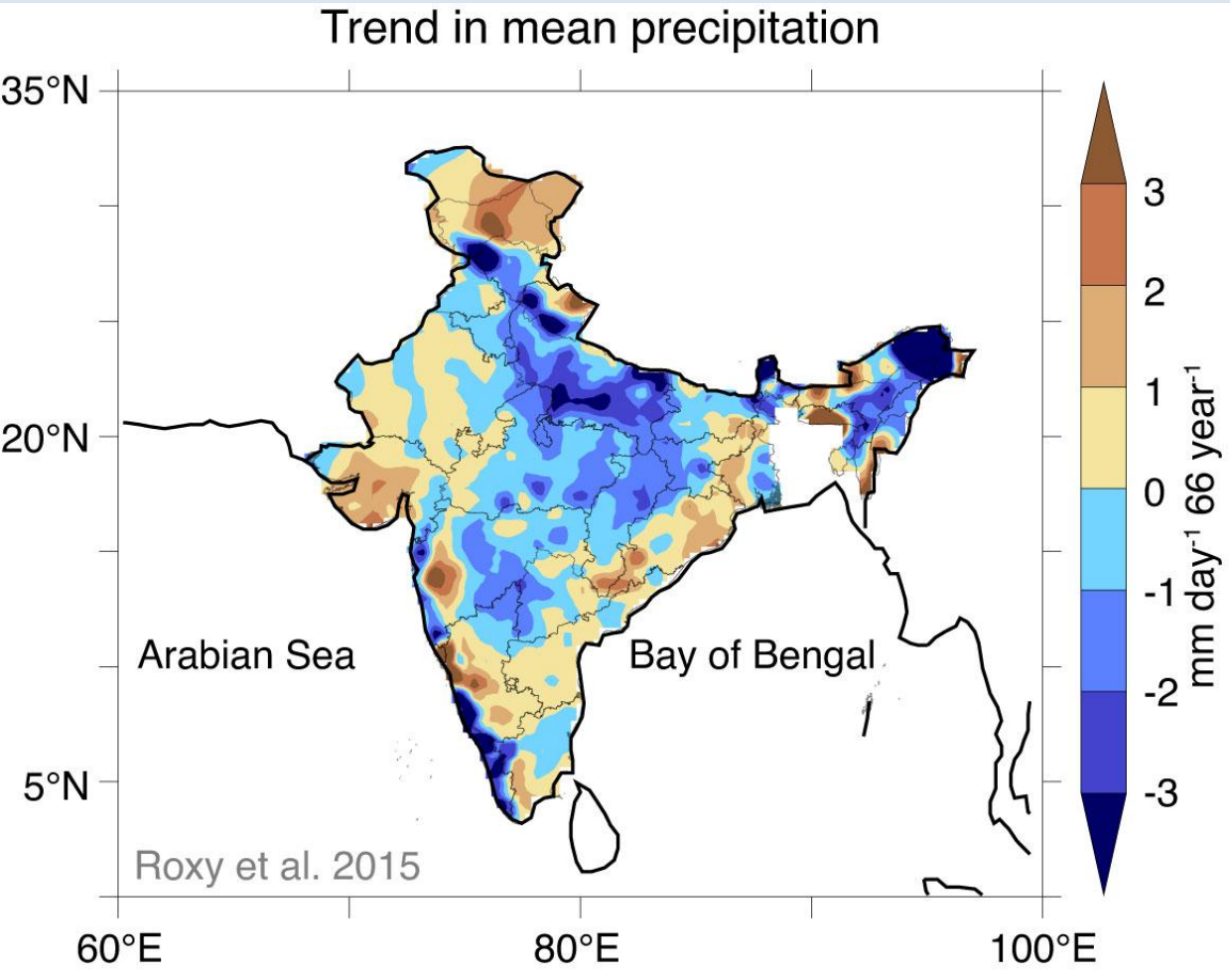


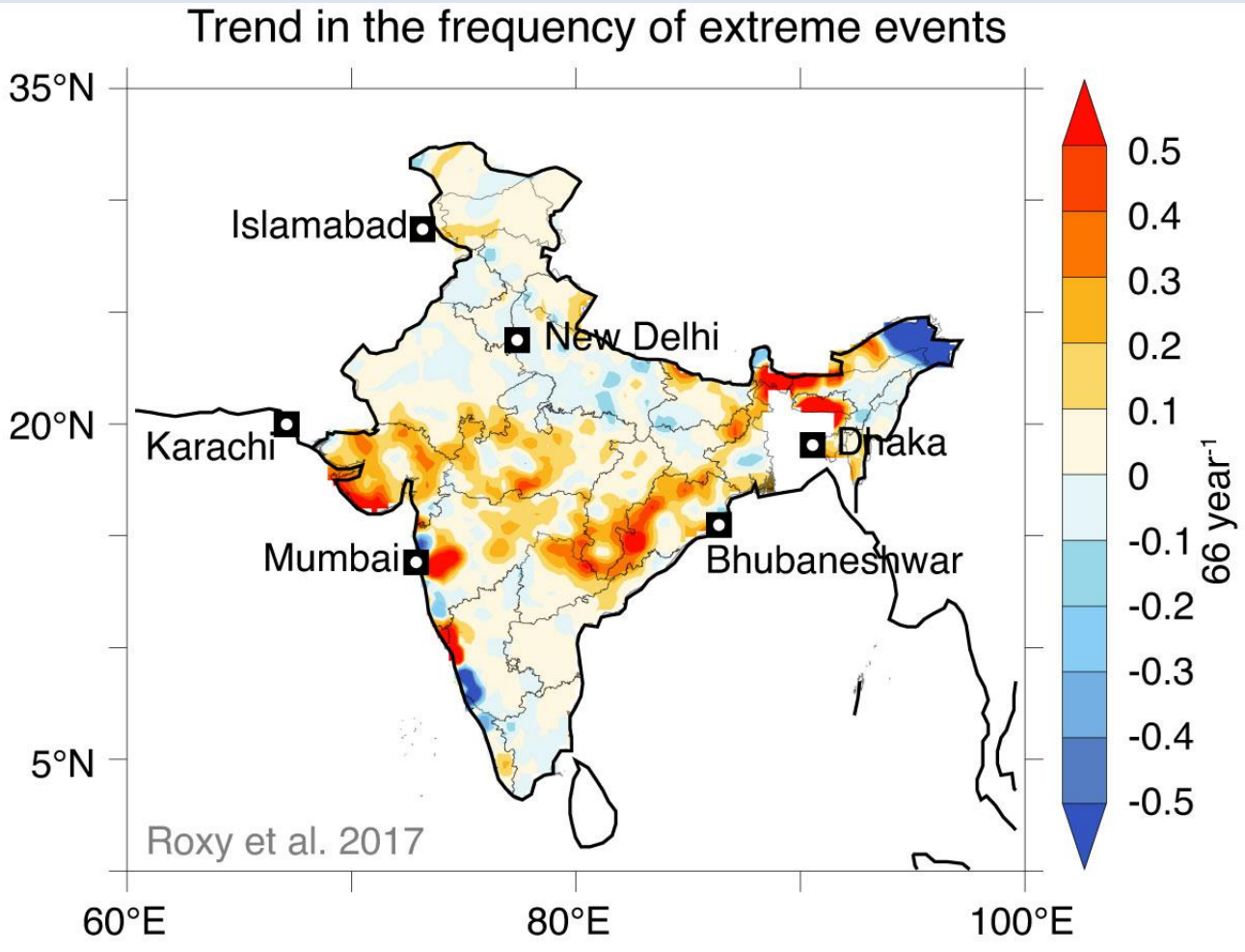
List of Data Requests

Sl. #	Date of Request	Enquiry No.	Data Type	Parameters	Frequency and Period	Records	Data Cost	Status	Action
1	21-03-2023	NDCQ/2023/03/242	SURFACE	DAY SUMMARY Station List Availability File	DAILY From : 1990 To 2023 Months : ALL	11446	INR 84815 Waived Off = 84815	✓ DATA AVAILABLE FOR DOWNLOAD.	Download Data
2	19-03-2023	NDCQ/2023/03/225	RAINFALL	Station List Availability File	DAILY From : 2020 To 2023 Months : ALL	48	INR 2117 Waived Off = 2117	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
3	27-02-2023	NDCQ/2023/02/361	SURFACE	DAY SUMMARY Station List Availability File	DAILY From : 2020 To 2022 Months : ALL	10347	INR 76671 Waived Off = 76671	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
4	27-02-2023	NDCQ/2023/02/358	SURFACE	DAY SUMMARY Station List Availability File	DAILY From : 2009 To 2023 Months : ALL	4462	INR 33063 Waived Off = 33063	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
5	21-02-2023	NDCQ/2023/02/282	RAINFALL	Station List Availability File	DAILY From : 2020 To 2022 Months : ALL	192	INR 8467 Waived Off = 8467	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
6	19-01-2023	NDCQ/2023/01/256	SURFACE	DAY SUMMARY Station List Availability File	DAILY From : 2020 To 2023 Months : ALL	10347	INR 76671 Waived Off = 76671	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
7	27-09-2022	NDCQ/2022/09/181	SURFACE	DAY SUMMARY Station List Availability File	DAILY From : 2000 To 2021 Months : ALL	7670	INR 56835 Waived Off = 56835	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data
8	26-09-2022	NDCQ/2022/09/163	AGROMET	AGROMET (SM) Station List Availability	DAILY From : 2000 To 2021	7602	INR 64617 Waived	✓ DATA DOWNLOADED. ✓ REQUEST COMPLETE.	Download Data

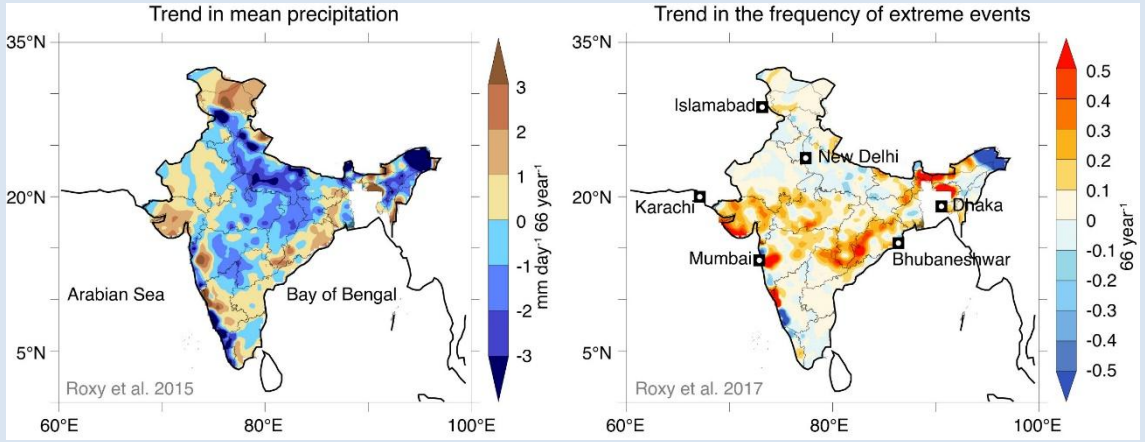
RAINFALL TRENDS | Droughts and Floods

CLIMATE DATA

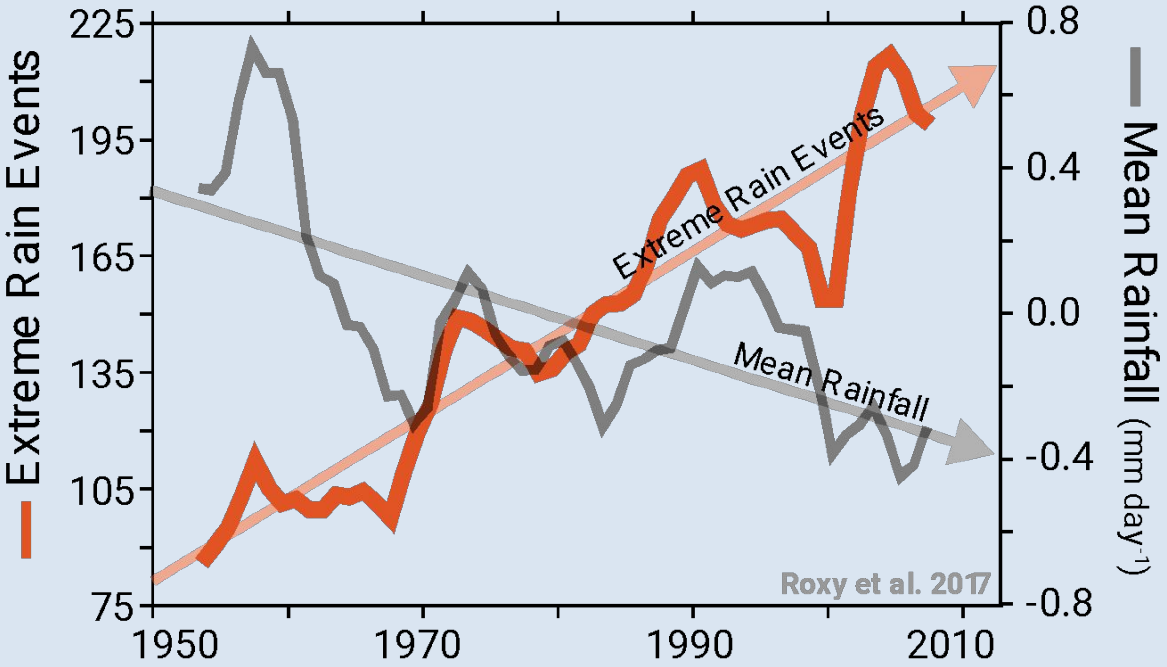




RAINFALL TRENDS | Droughts and Floods

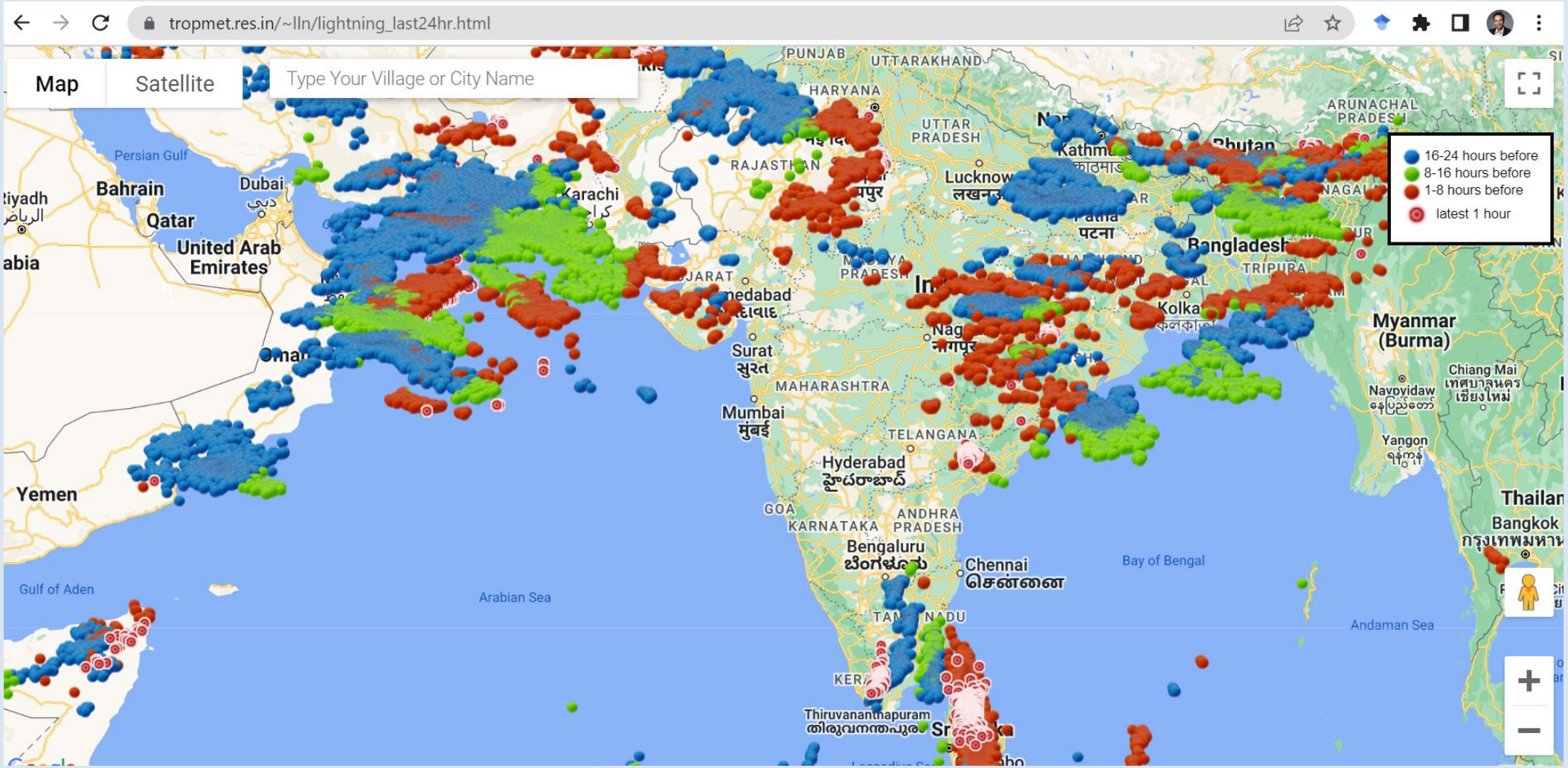


While the total monsoon rainfall is decreasing, number of extreme rains (above 150 mm/day) are increasing



LIGHTNING | Air Quality Index

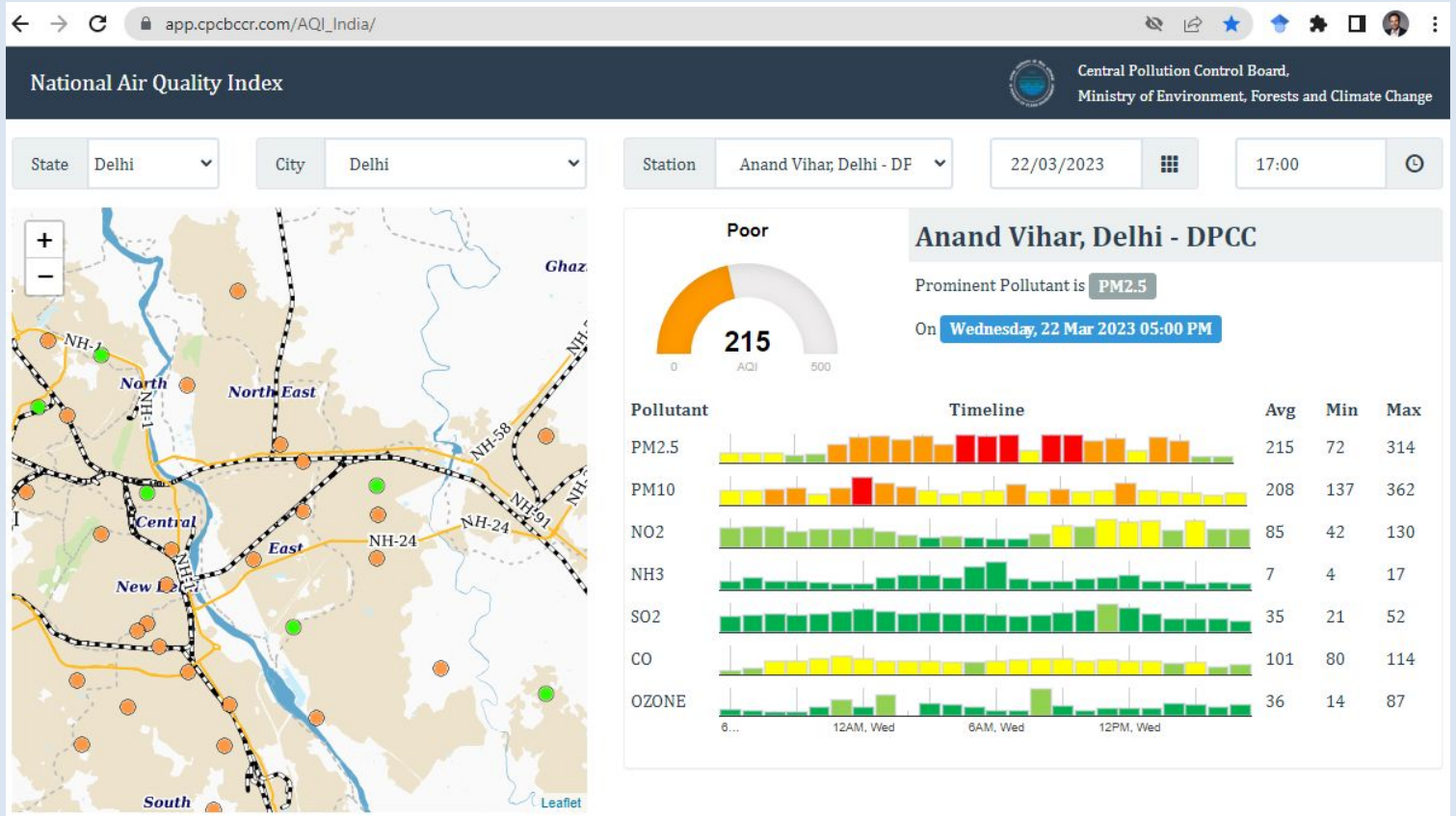
CLIMATE DATA



https://www.tropmet.res.in/~lln/lightning_last24hr.html

AIR POLLUTION | Air Quality Index

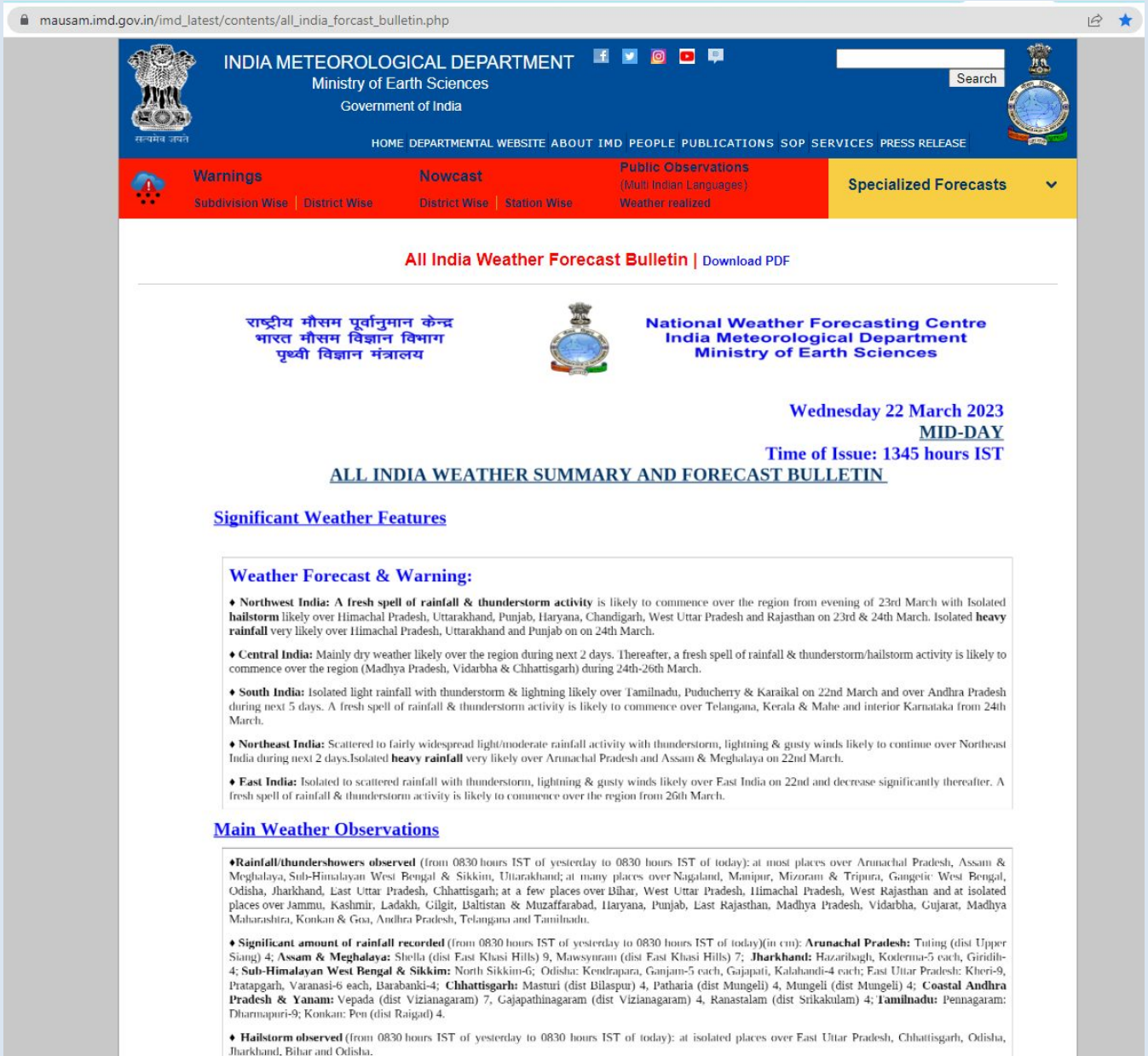
CLIMATE DATA



AQI	Remark	Color Code	Possible Health Impacts
0-50	Good		Minimal impact
51-100	Satisfactory		Minor breathing discomfort to sensitive people
101-200	Moderate		Breathing discomfort to the people with lungs, asthma and heart diseases
201-300	Poor		Breathing discomfort to most people on prolonged exposure
301-400	Very Poor		Respiratory illness on prolonged exposure
401-500	Severe		Affects healthy people and seriously impacts those with existing diseases

List of AQI Stations with Data of above selected Date & Time

https://app.cpcbccr.com/AQI_India/



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पृथ्वी विज्ञान मंत्रालय

National Weather Forecasting Centre
India Meteorological Department
Ministry of Earth Sciences

Wednesday 22 March 2023
MID-DAY
Time of Issue: 1345 hours IST

ALL INDIA WEATHER SUMMARY AND FORECAST BULLETIN

Significant Weather Features

Weather Forecast & Warning:

♦ **Northwest India: A fresh spell of rainfall & thunderstorm activity** is likely to commence over the region from evening of 23rd March with Isolated **hailstorm** likely over Himachal Pradesh, Uttarakhand, Punjab, Haryana, Chandigarh, West Uttar Pradesh and Rajasthan on 23rd & 24th March. Isolated **heavy rainfall** very likely over Himachal Pradesh, Uttarakhand and Punjab on on 24th March.

♦ **Central India:** Mainly dry weather likely over the region during next 2 days. Thereafter, a fresh spell of rainfall & thunderstorm/hailstorm activity is likely to commence over the region (Madhya Pradesh, Vidarbha & Chhattisgarh) during 24th-26th March.

♦ **South India:** Isolated light rainfall with thunderstorm & lightning likely over Tamilnadu, Puducherry & Karaikal on 22nd March and over Andhra Pradesh during next 5 days. A fresh spell of rainfall & thunderstorm activity is likely to commence over Telangana, Kerala & Mahe and interior Karnataka from 24th March.

♦ **Northeast India:** Scattered to fairly widespread light/moderate rainfall activity with thunderstorm, lightning & gusty winds likely to continue over Northeast India during next 2 days.Isolated **heavy rainfall** very likely over Arunachal Pradesh and Assam & Meghalaya on 22nd March.

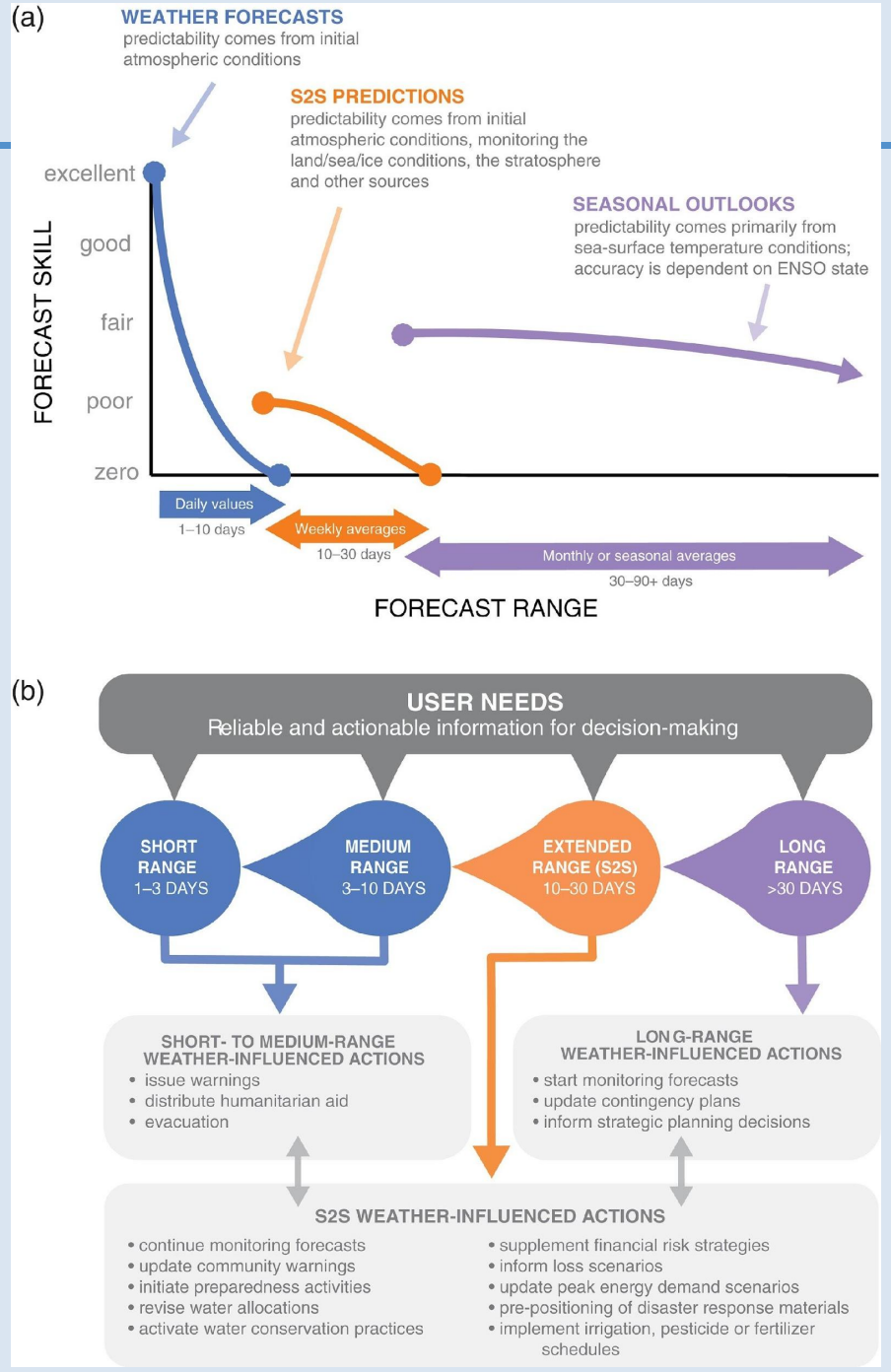
♦ **East India:** Isolated to scattered rainfall with thunderstorm, lightning & gusty winds likely over East India on 22nd and decrease significantly thereafter. A fresh spell of rainfall & thunderstorm activity is likely to commence over the region from 26th March.

Main Weather Observations

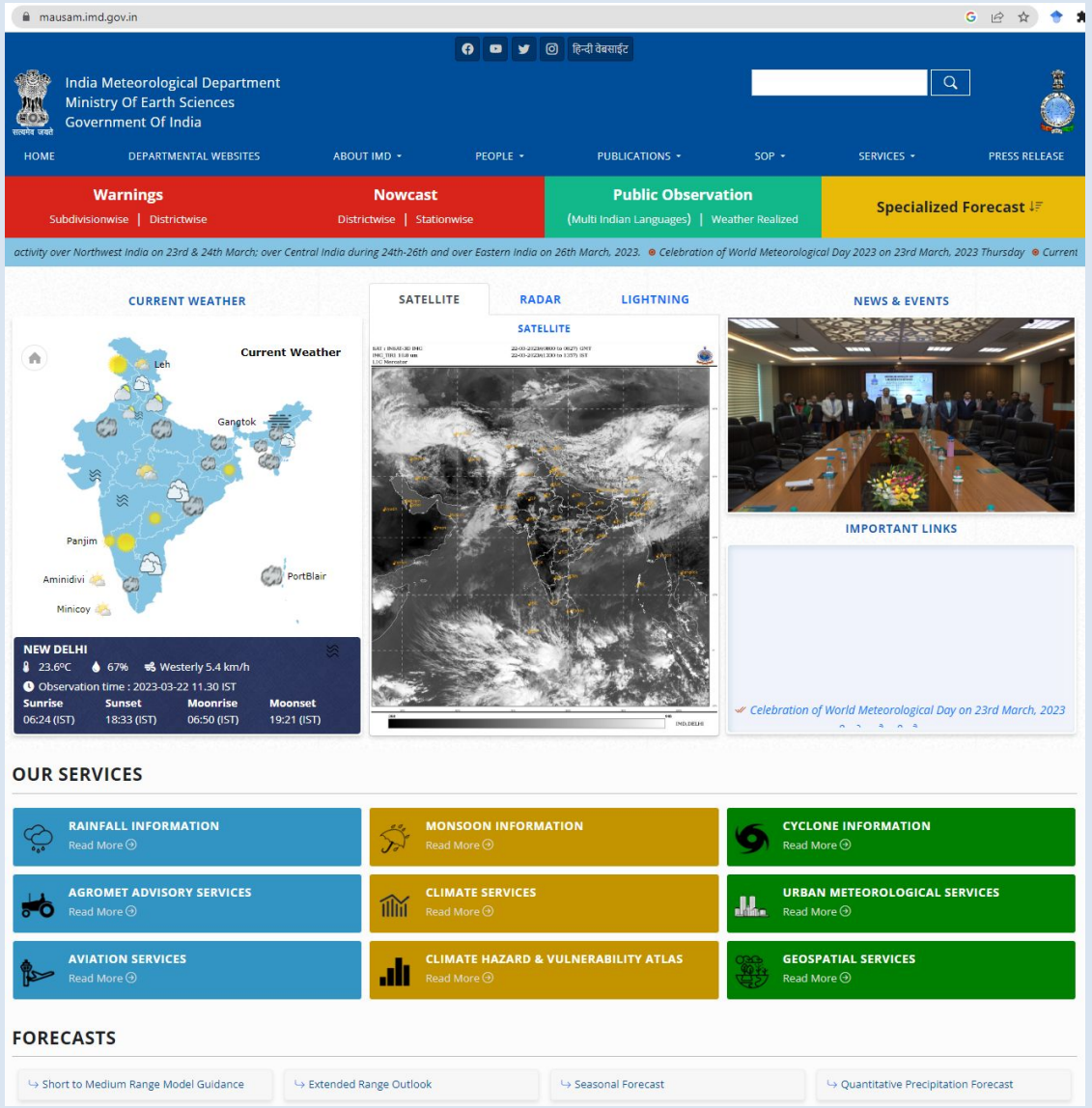
♦**Rainfall/thundershowers observed** (from 0830 hours IST of yesterday to 0830 hours IST of today): at most places over Arunachal Pradesh, Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Uttarakhand; at many places over Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Odisha, Jharkhand, East Uttar Pradesh, Chhattisgarh; at a few places over Bihar, West Uttar Pradesh, Himachal Pradesh, West Rajasthan and at isolated places over Jammu, Kashmir, Ladakh, Gilgit, Baltistan & Muzaffarabad, Haryana, Punjab, East Rajasthan, Madhya Pradesh, Vidarbha, Gujarat, Madhya Maharashtra, Konkan & Goa, Andhra Pradesh, Telangana and Tamilnadu.

♦ **Significant amount of rainfall recorded** (from 0830 hours IST of yesterday to 0830 hours IST of today)(in cm): **Arunachal Pradesh:** Tuting (dist Upper Siang) 4; **Assam & Meghalaya:** Shella (dist East Khasi Hills) 9, Mawsynram (dist East Khasi Hills) 7; **Jharkhand:** Hazaribagh, Koderma-5 each, Giridih-4; **Sub-Himalayan West Bengal & Sikkim:** North Sikkim-6; Odisha: Kendrapara, Ganjam-5 each, Gajapati, Kalahandi-4 each; East Uttar Pradesh: Kheri-9, Pratapgarh, Varanasi-6 each, Barabanki-4; **Chhattisgarh:** Masturi (dist Bilaspur) 4, Patharia (dist Mungeli) 4, Mungeli (dist Mungeli) 4; **Coastal Andhra Pradesh & Yanam:** Vepada (dist Vizianagaram) 7, Gajapathinagaram (dist Vizianagaram) 4, Ranastalam (dist Srikakulam) 4; **Tamilnadu:** Pennagaram: Dharmapuri-9; Konkan: Pen (dist Raigad) 4.

♦ **Hailstorm observed** (from 0830 hours IST of yesterday to 0830 hours IST of today): at isolated places over East Uttar Pradesh, Chhattisgarh, Odisha, Jharkhand, Bihar and Odisha.


(a)
WEATHER FORECASTS
predictability comes from initial atmospheric conditions
S2S PREDICTIONS
predictability comes from initial atmospheric conditions, monitoring the land/sea/ice conditions, the stratosphere and other sources
SEASONAL OUTLOOKS
predictability comes primarily from sea-surface temperature conditions; accuracy is dependent on ENSO state
FORECAST SKILL
excellent
good
fair
poor
zero
Daily values
1–10 days
Weekly averages
10–30 days
Monthly or seasonal averages
30–90+ days
FORECAST RANGE
(b)
USER NEEDS
Reliable and actionable information for decision-making
SHORT RANGE 1–3 DAYS
MEDIUM RANGE 3–10 DAYS
EXTENDED RANGE (S2S) 10–30 DAYS
LONG RANGE >30 DAYS
SHORT- TO MEDIUM-RANGE WEATHER-INFLUENCED ACTIONS
• issue warnings
• distribute humanitarian aid
• evacuation
LONG-RANGE WEATHER-INFLUENCED ACTIONS
• start monitoring forecasts
• update contingency plans
• inform strategic planning decisions
S2S WEATHER-INFLUENCED ACTIONS
• continue monitoring forecasts
• update community warnings
• initiate preparedness activities
• revise water allocations
• activate water conservation practices
• supplement financial risk strategies
• inform loss scenarios
• update peak energy demand scenarios
• pre-positioning of disaster response materials
• implement irrigation, pesticide or fertilizer schedules

FORECASTS | Forecasts



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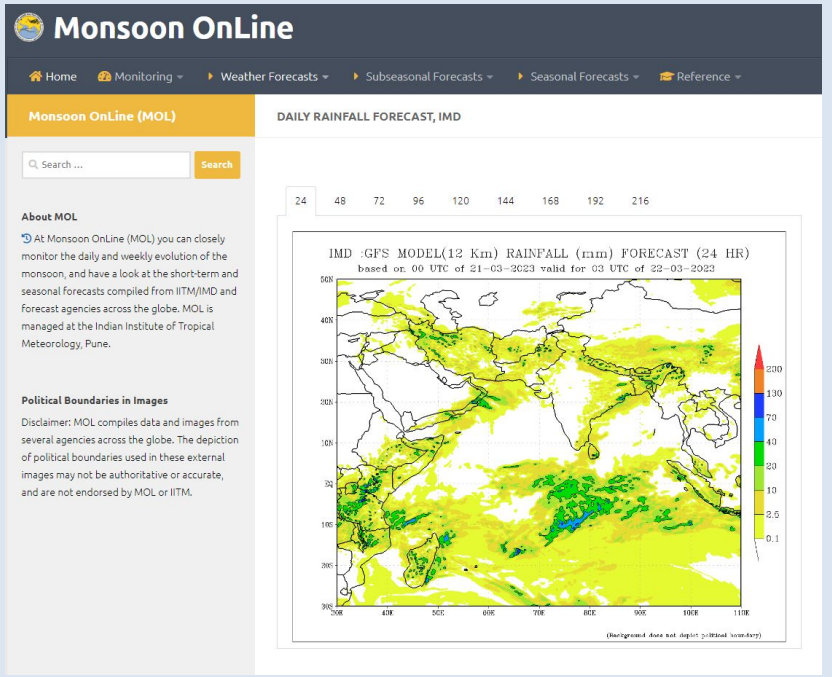
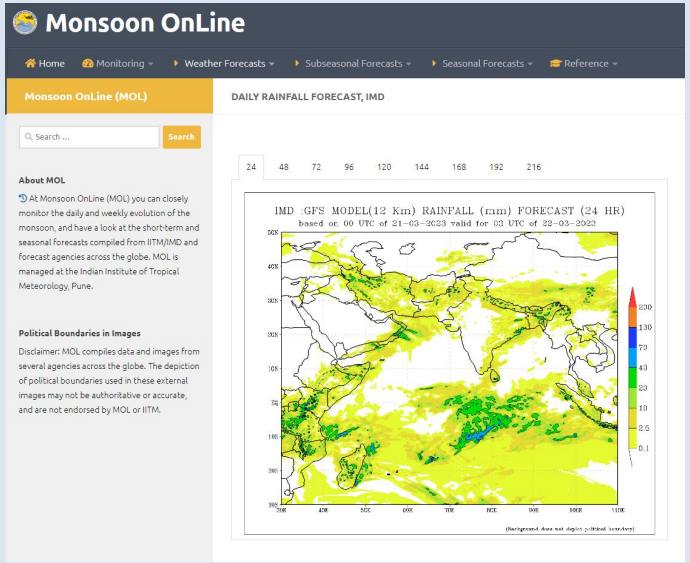
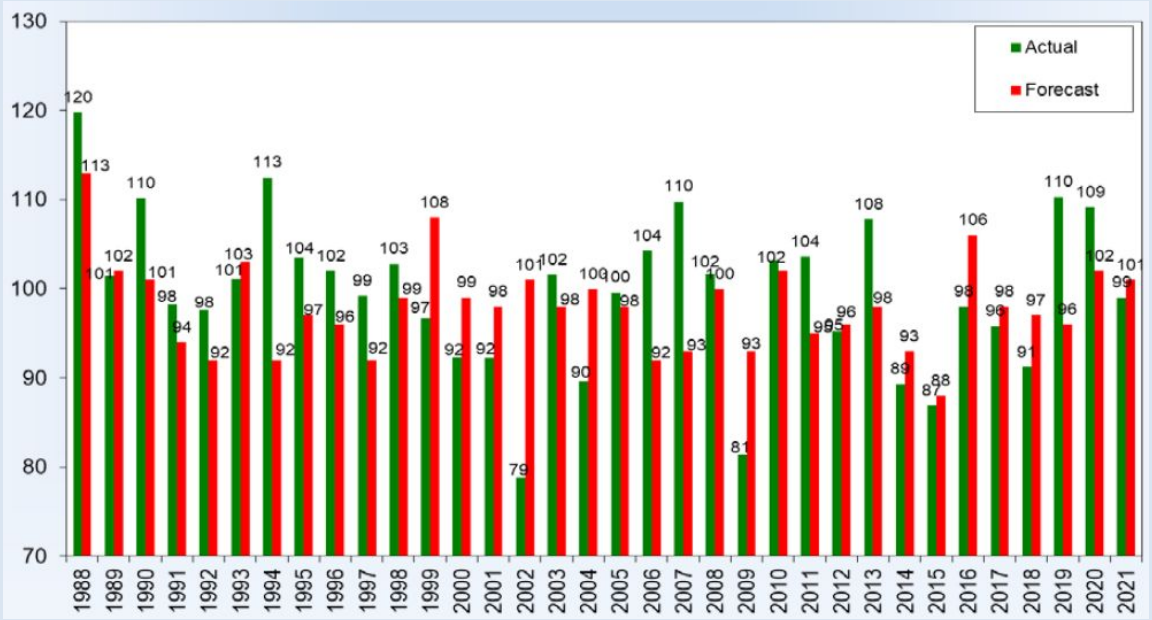


Link: https://mol.tropmet.res.in

FORECASTS | Forecast Skill





Q. What is criterion for declaring heat wave?

Heat wave is considered if maximum temperature of a station reaches at least 40^0C or more for Plains and at least 30^0C or more for Hilly regions.

a) Based on Departure from Normal

Heat Wave: Departure from normal is 4.5^{0}C to 6.4^{0}C

Severe Heat Wave: Departure from normal is >6.4^{0}C

b) Based on Actual Maximum Temperature

Heat Wave: When actual maximum temperature ≥ 45^{0}C

Severe Heat Wave: When actual maximum temperature ≥47^{0}C

If above criteria met at least in 2 stations in a Meteorological sub-division for at least two consecutive days and it declared on the second day.

Q. What is a criterion for describing *Heat Wave* for coastal stations?

When maximum temperature departure is 4.5^{0}C or more from normal, *Heat Wave* may be described provided actual maximum temperature is 37^{0}C or more.

Link: https://internal.imd.gov.in/pages/heatwave_mausam.php

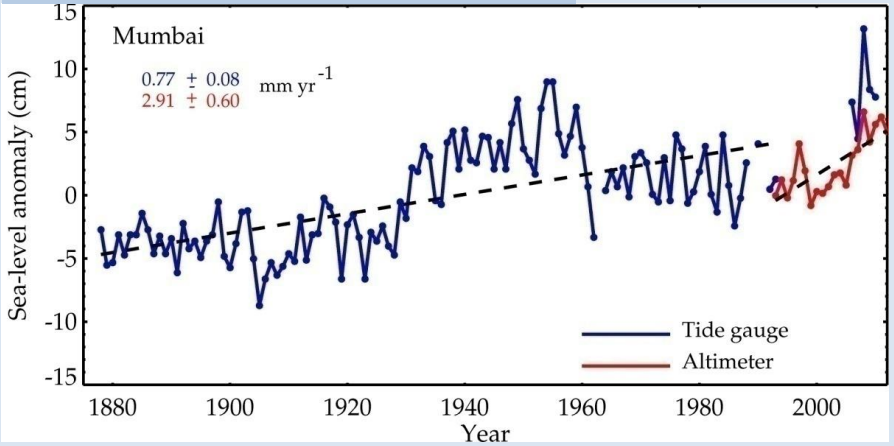
CLIMATE CHANGE | Sea Level Rise

Primary school on Sagar Island in the Sundarbans in January 2014 | Nagraj Adve

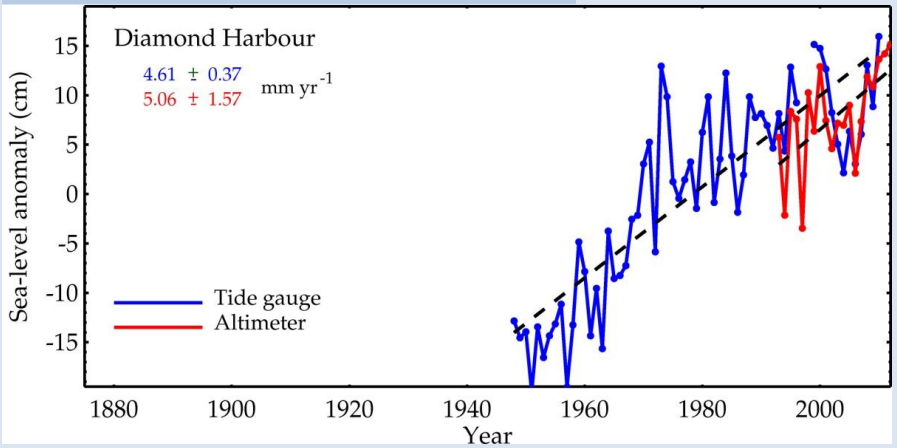
The same school four years later in November 2017, submerged by the rising waters of the Bay of Bengal | Utpal Giri

CLIMATE CHANGE | Sea Level Rise

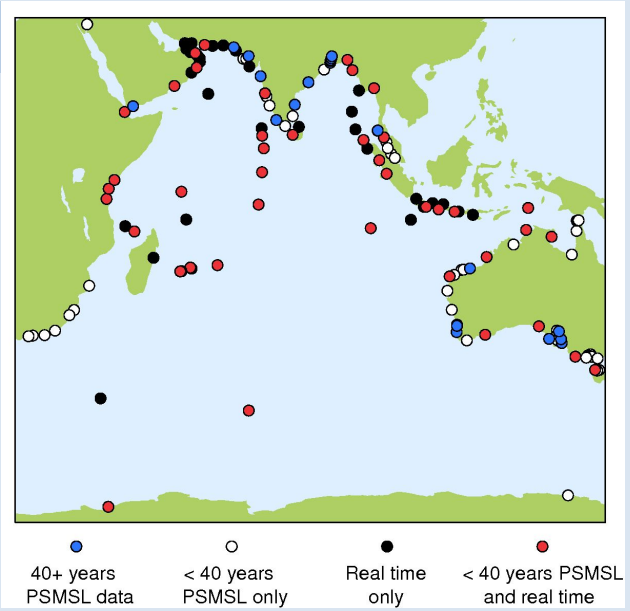
Mumbai Sea Level Change



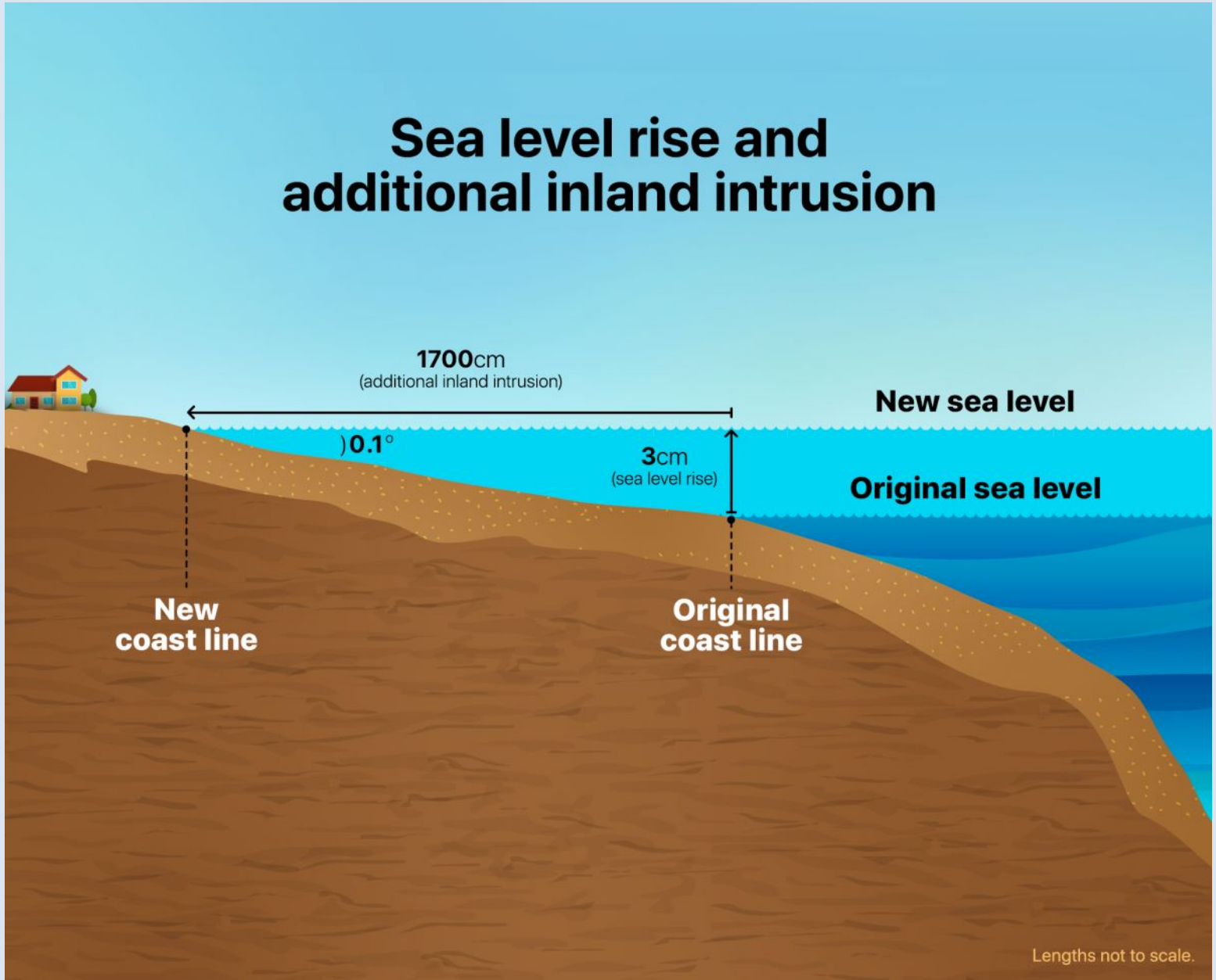
Kolkata Sea Level Change



Tide gauges



Link: https://psmsl.org/data/obtaining



The gently sloping area adjoining the coast, the continental shelf, has an average downward slope of about 0.1°.

A 3 cm rise for a slope of 0.1° would take away 17 meters of land.

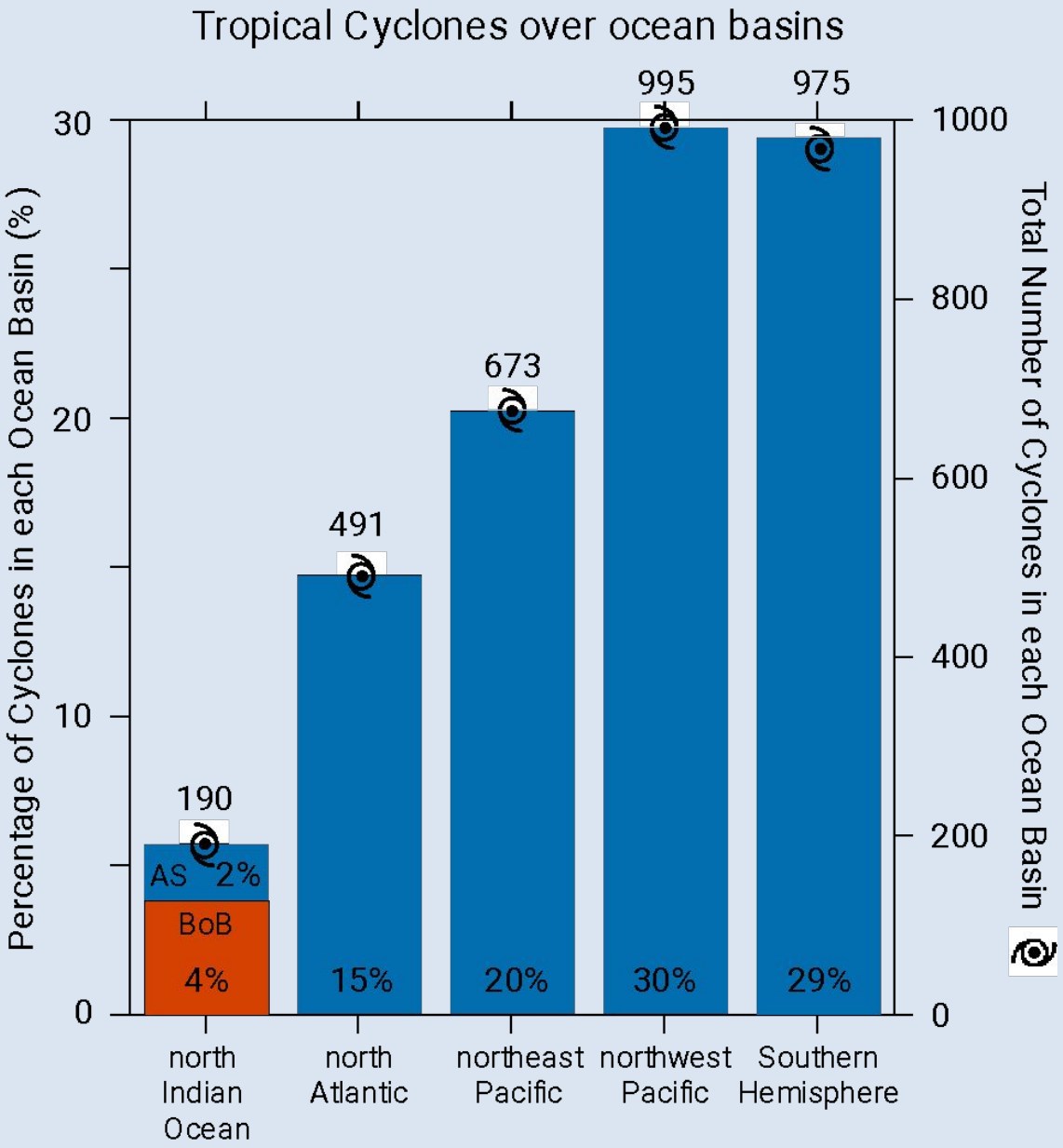
The trigonometry:

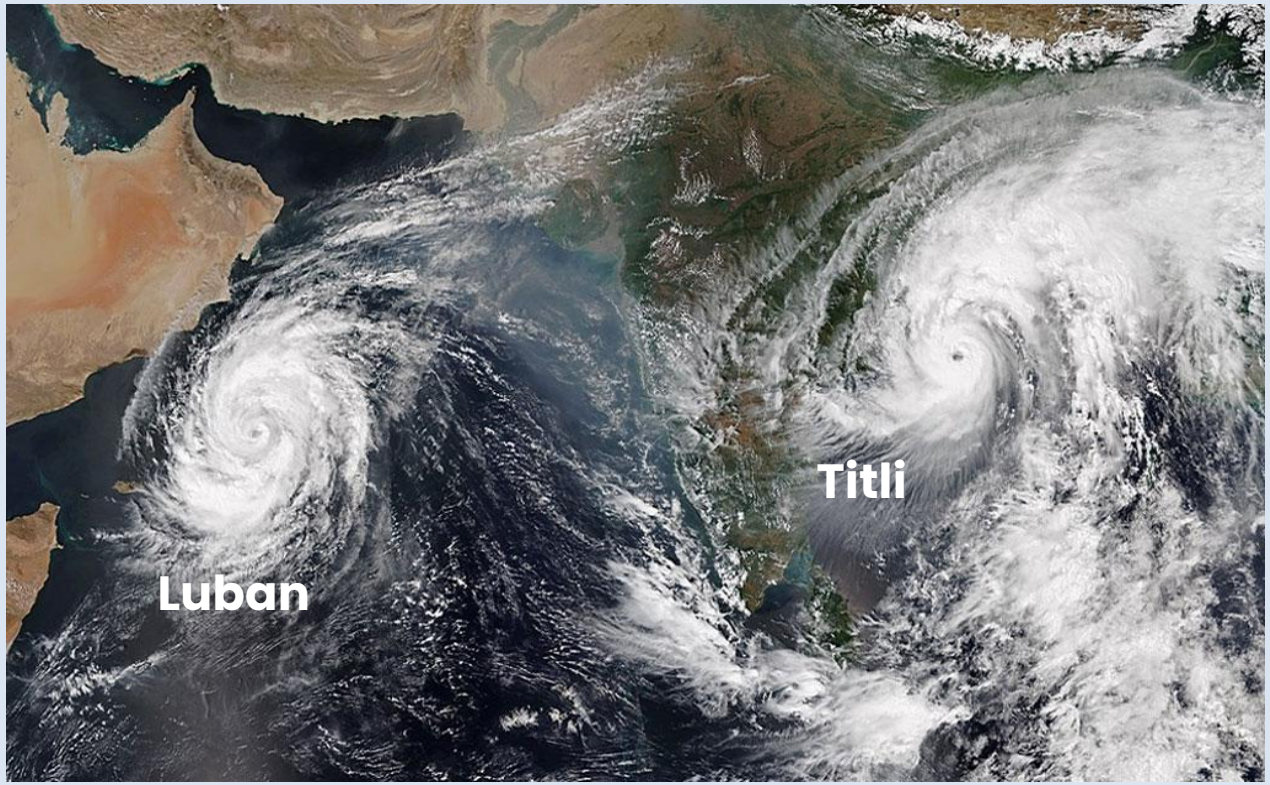
Land intrusion
= sea level rise / tan(slope)
= 3 cm / tan(0.1°)
= 1700 cm

Bramble Cay Melomy is the first species to be extinct due to anthropogenic climate change.

Sea level rise inundated the east Indian Ocean island where they lived.

CLIMATE CHANGE | Cyclones

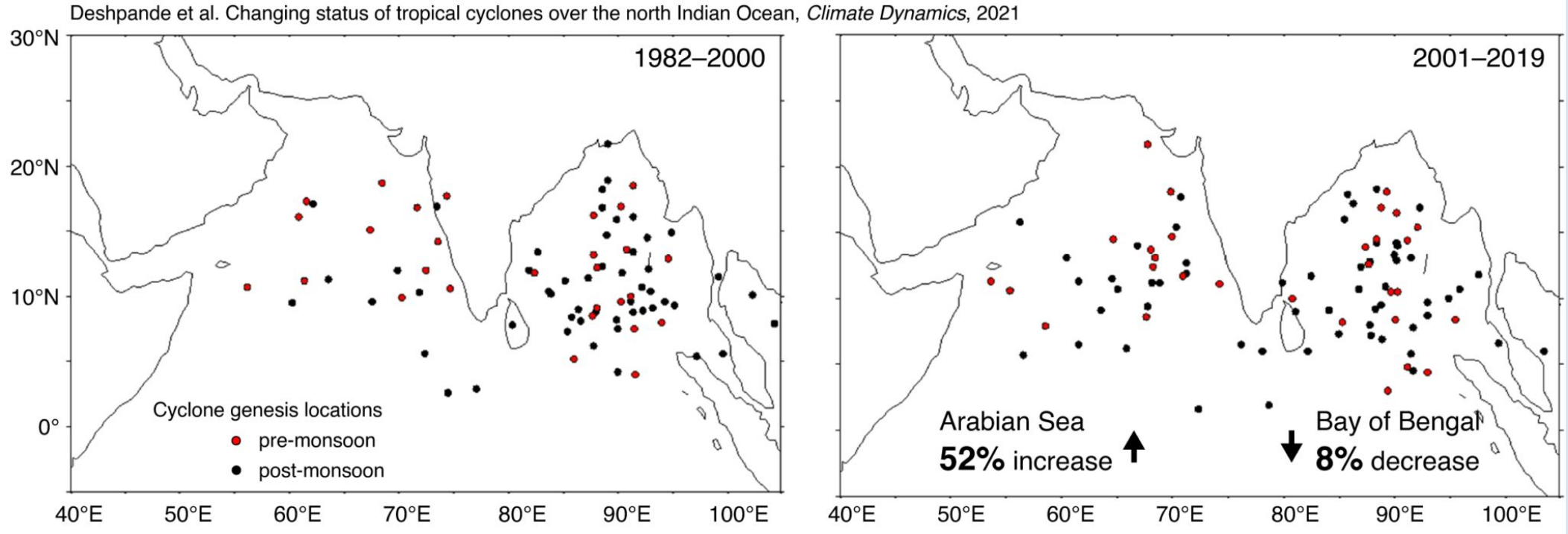


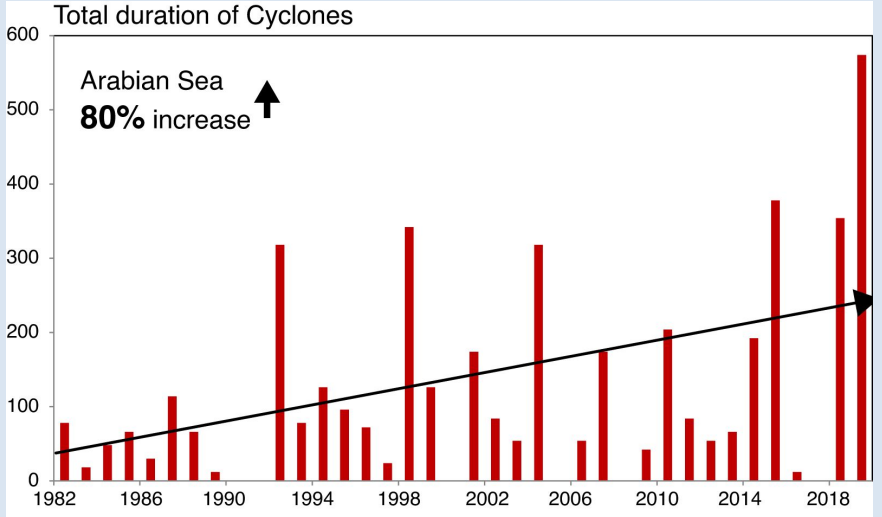


Cyclones derive their energy from the warm waters of the ocean.

Arabian Sea and Bay of Bengal together contributes to only 6% of global cyclones, but 80% of fatalities.

CLIMATE CHANGE | Cyclones





CYCLONES | Cyclone Data

CLIMATE DATA

Cyclone eAtlas - IMD
Tracks of Cyclones and Depressions over
North Indian Ocean
1891 - 2021

Government of India
Ministry of Earth Sciences
India Meteorological Department
Regional Meteorological Centre
Chennai

Welcome rocksea [Edit Profile] [Change Password] [SignOut]

Display of Tracks
- View by general selection
- View by specific selection

Statistical information
Map form view
- Monthly frequency
- Formation / Dissipation
- Direction of motion
- Scalar / Vector speed
- Frequency of Recurvature
- Frequency between stations

Tabular /Graphical View
- Annual frequency
- % frequency & probability
- Consolidated list

Documentation
About eAtlas
Technical Notes
Help
Abbreviations
Contact Us
Copyright
Disclaimer

View of Tracks of C and Ds

Basic Options

First Year 2000 | Last Year 2021 | First Month March | Last Month June

Basin (F): Bay of Bengal, Arabian Sea, Land Area, All
Intensity: Depression, Cyclonic Storm, Severe Cyclonic Storm, All
Intensity Type: Maximum, At Crossing

Advanced Options

Advanced Options1, Advanced Options2

Advanced Options 1

Formed Over — Longitude 50 To 100; Latitude 5 To 35
Dissipated Over — Basin(Di) BOB, AS, Land, All; Longitude 50 To 100; Latitude 5 To 35

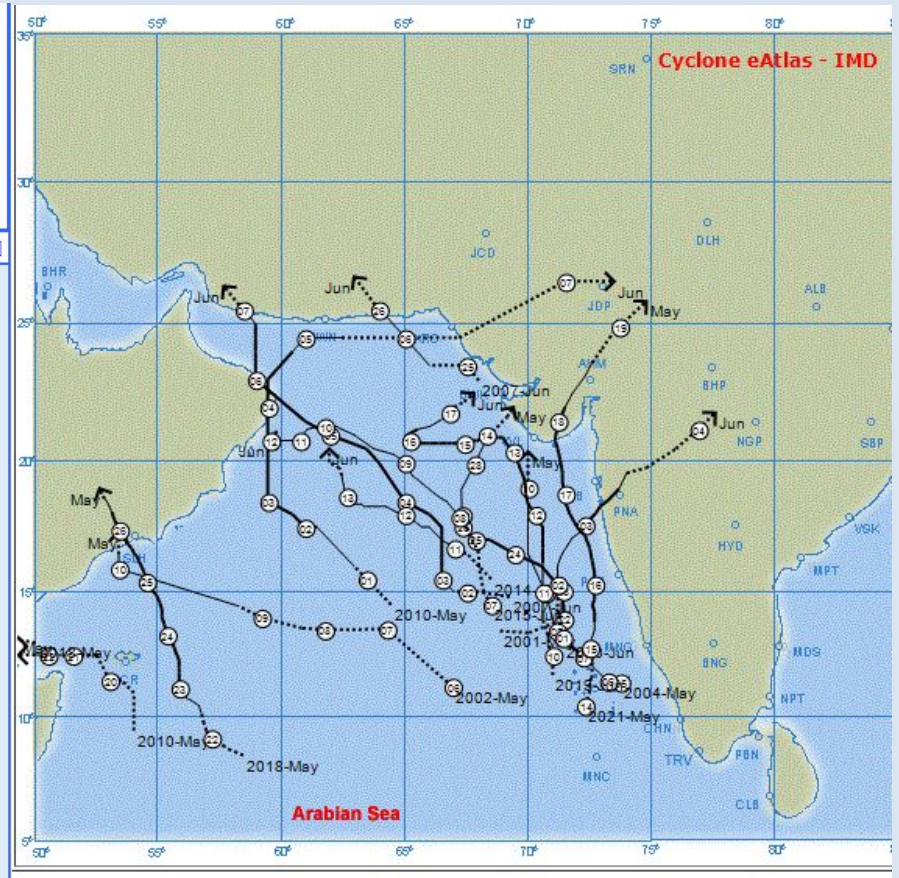
Advanced Options 2

Sea to Land / Land to Sea
Pre-defined Coastal Belt / View Coastal Belt
Andhra Pradesh, Arakan, Bangladesh, All
Custom Coastal Belt — Map for Custom use
Longitude To [50 to 100] — Custom Coastal Name
Latitude To [5 to 35]

Display Option

With Marking / Without Marking

View | Reset



Best Track

About Best Tracks
Best Tracks Data (1982-2022)

-- Year -- Search Show all

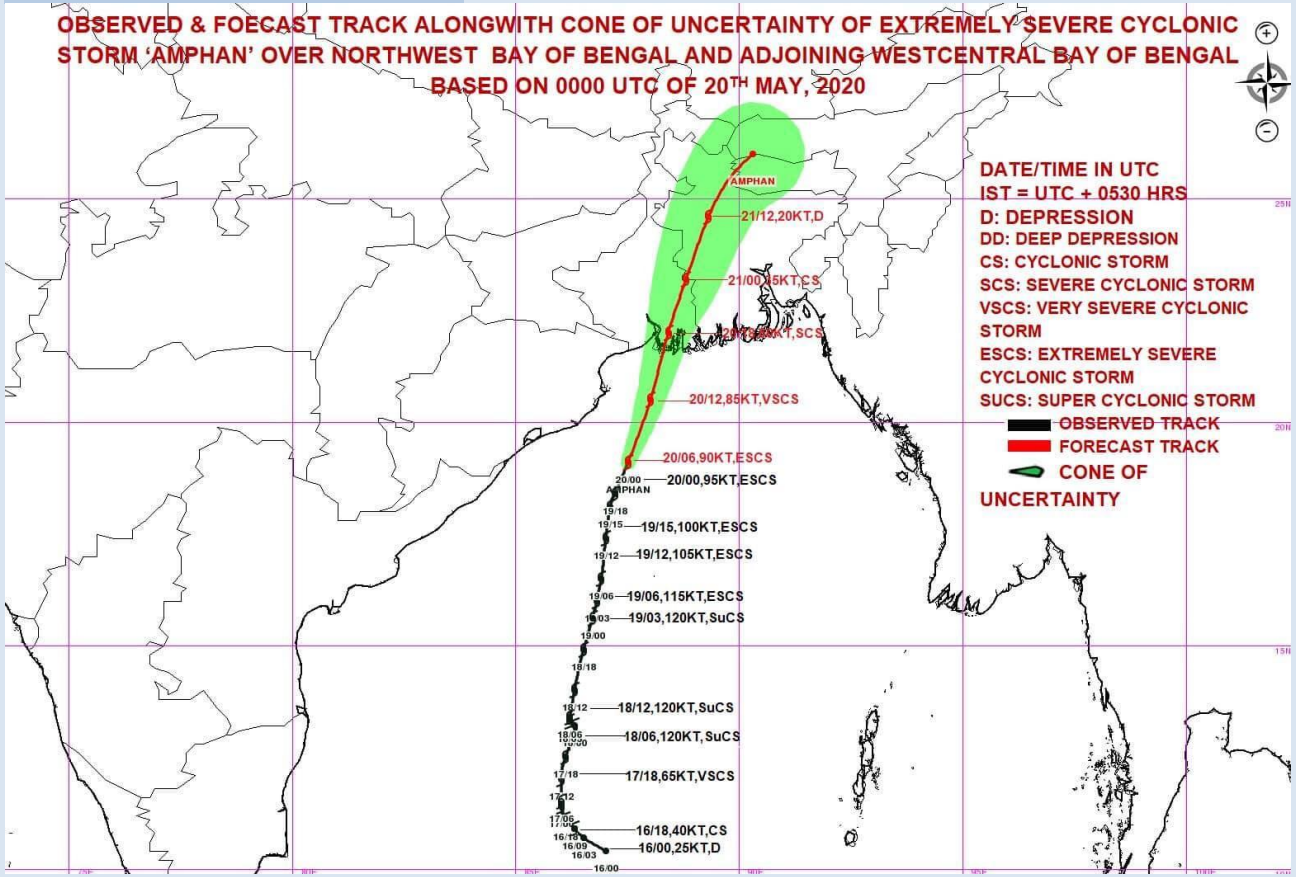
S.No.	Year	Title	Attachment
1	2022	Tracks of Cyclones and Depressions for the period of Jan-Dec 2022	

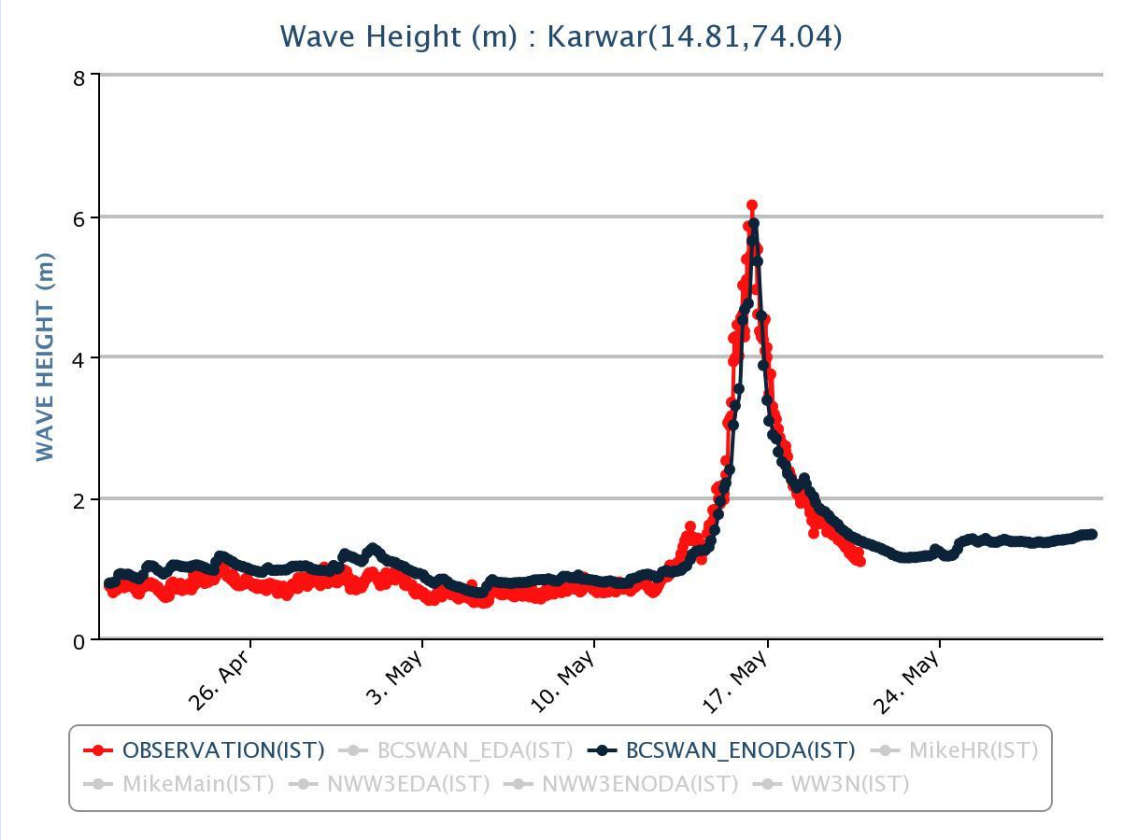
Link: https://rsmcnewdelhi.imd.gov.in

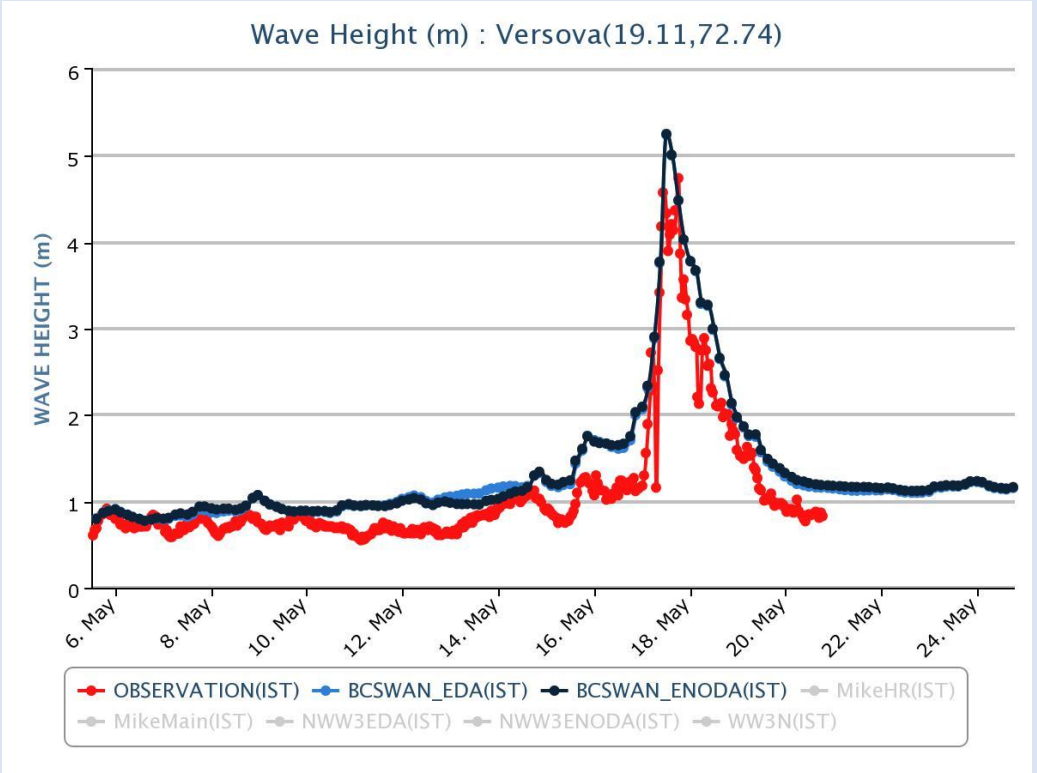
CYCLONES | Cyclone Forecasts

	Odisha Super Cyclone 1999	Phailin Very Super Cyclone, 2013	Amphan Super Cyclone, 2019
Loss of human life	10,000+	21	118
Ex-gratia by Govt @ Rs 6 Lakhs	Rs 593 Crores	Rs 1.26 Crores	
Area of evacuation	500 km (approx.)	180 km	

Cyclone Amphan
- Track and Forecast

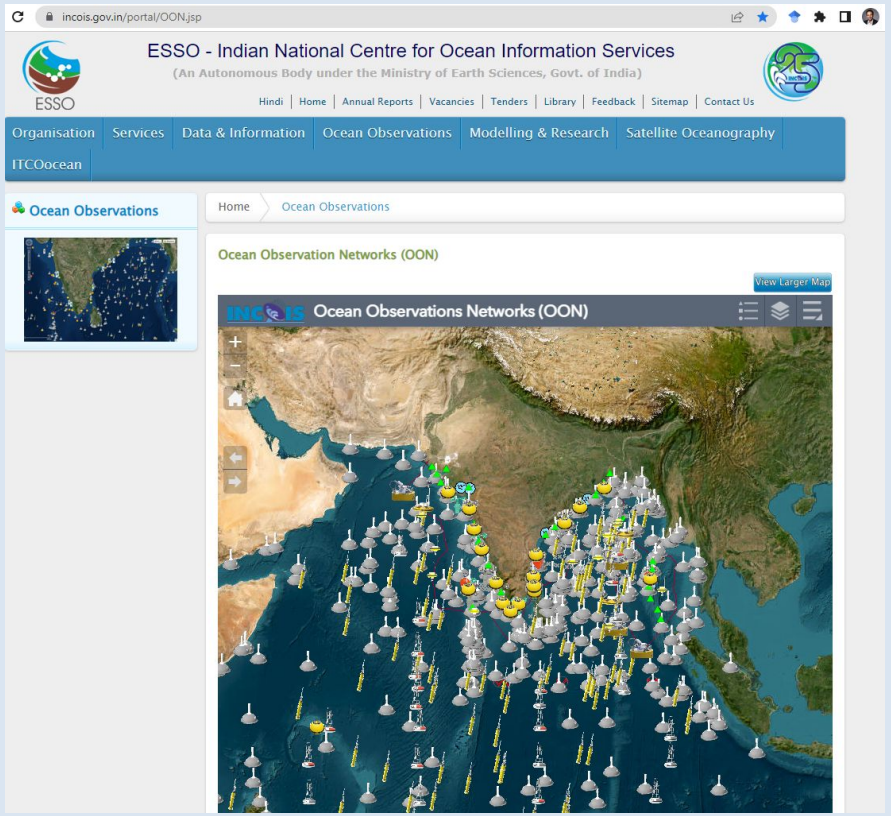



Wave Height (m) : Karwar(14.81,74.04)
WAVE HEIGHT (m)
0
2
4
6
8
26. Apr
3. May
10. May
17. May
24. May
OBSERVATION(IST)
BCSWAN_EDA(IST)
BCSWAN_ENODA(IST)
MikeHR(IST)
MikeMain(IST)
NWW3EDA(IST)
NWW3ENODA(IST)
WW3N(IST)


Wave Height (m) : Versova(19.11,72.74)
WAVE HEIGHT (m)
0
1
2
3
4
5
6
6. May
8. May
10. May
12. May
14. May
16. May
18. May
20. May
22. May
24. May
OBSERVATION(IST)
BCSWAN_EDA(IST)
BCSWAN_ENODA(IST)
MikeHR(IST)
MikeMain(IST)
NWW3EDA(IST)
NWW3ENODA(IST)
WW3N(IST)

OCEAN DATA | Ocean Monitoring

CLIMATE DATA



Link: https://incois.gov.in/portal/OON.jsp

CLIMATE DATA | NOAA

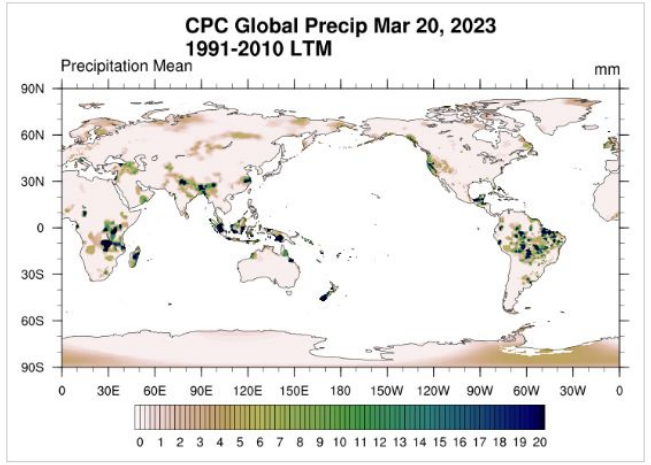
psl.noaa.gov/data/gridded/data.cpc.globalprecip.html

Physical Sciences Laboratory About

Home » Data » Gridded Climate » CPC Global Unified Gauge-Based Analysis of Daily Precipitation

CPC Global Unified Gauge-Based Ana

CPC 0.5x0.5 Global Daily Unified Gauge-Based Analysis of Precipitation.



Download and Plot Data

Data Help

Search Dataset Variables | Clear

	Variable	Statistic	Level	TimeScale	Options
2	Precipitation	Long Term Mean	Surface	Daily	
2	Precipitation	Long Term Mean	Surface	Monthly	
45	Precipitation	Total	Surface	Daily	

Thredds Catalog: Download: Plot/Subset:

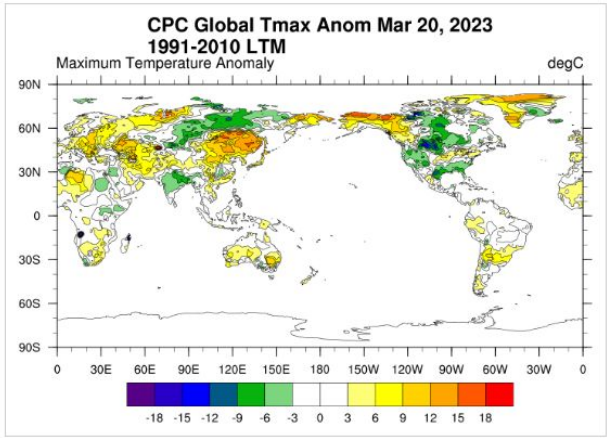
psl.noaa.gov/data/gridded/data.cpc.globaltemp.html

Physical Sciences Laboratory About

Home » Data » Gridded Climate » CPC Global Unified Temperature

CPC Global Unified Temperature

CPC 0.5x0.5 Global Daily Gridded Temperature



Download and Plot Data

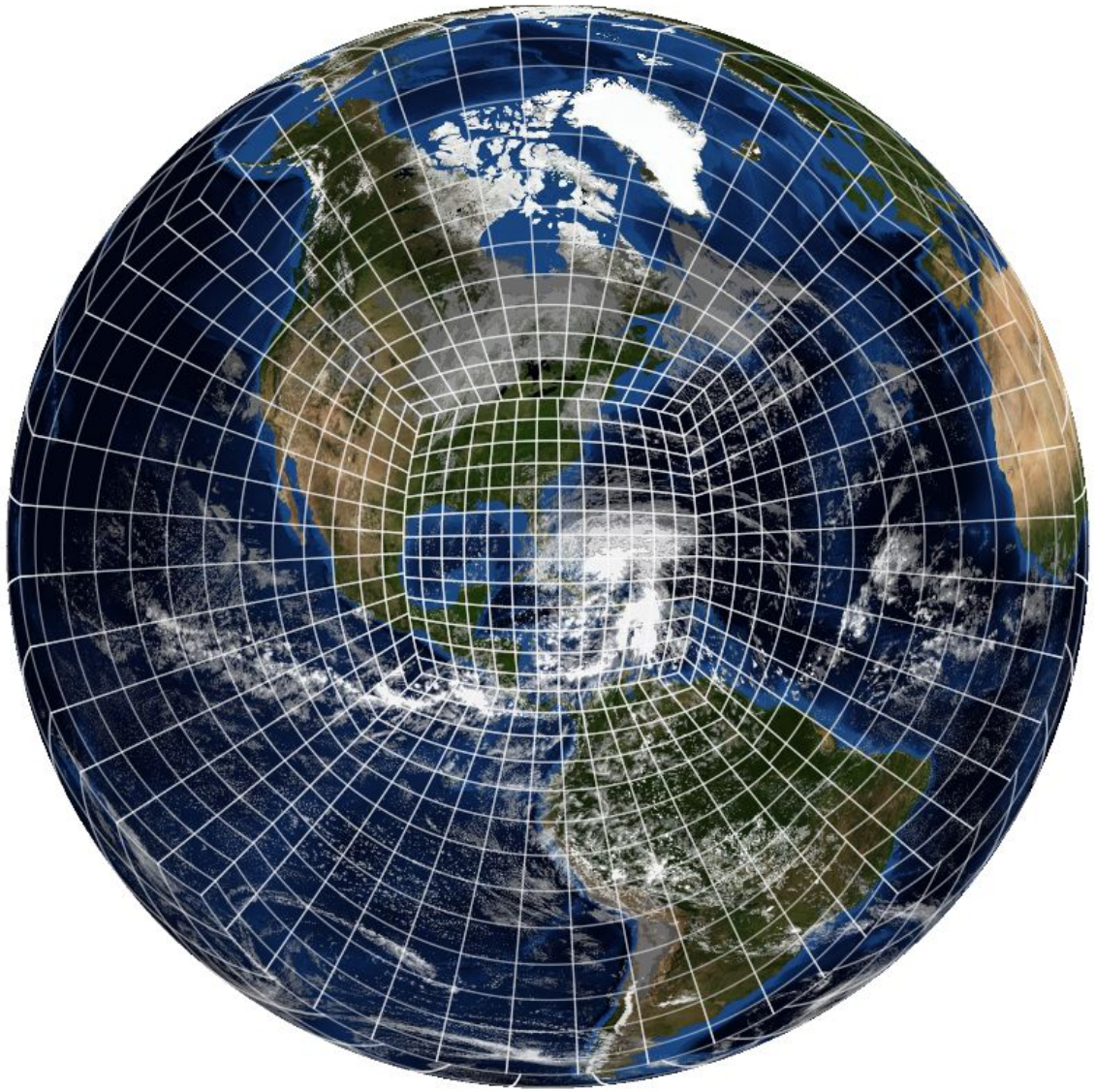
Data Help

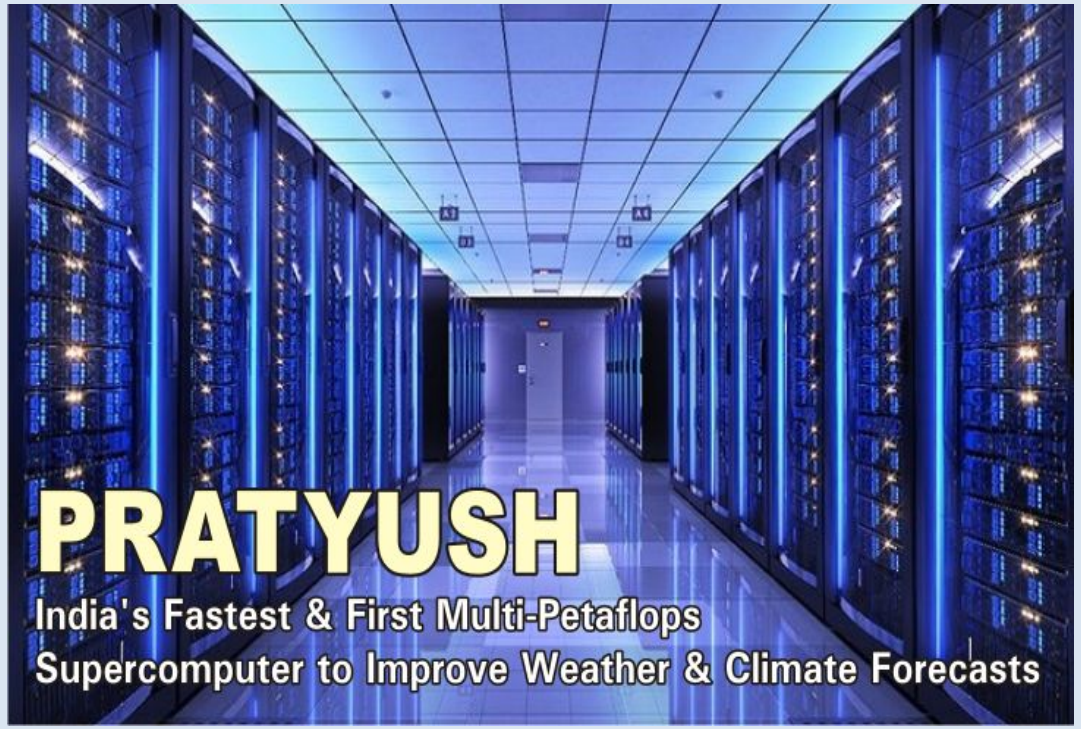
Search Dataset Variables | Clear

	Variable	Statistic	Level	TimeScale	Options
4	Maximum Temperature	Long Term Mean	Surface	Daily	
45	Maximum Temperature	Maximum	Surface	Daily	
4	Minimum Temperature	Long Term Mean	Surface	Daily	
45	Minimum Temperature	Minimum	Surface	Daily	

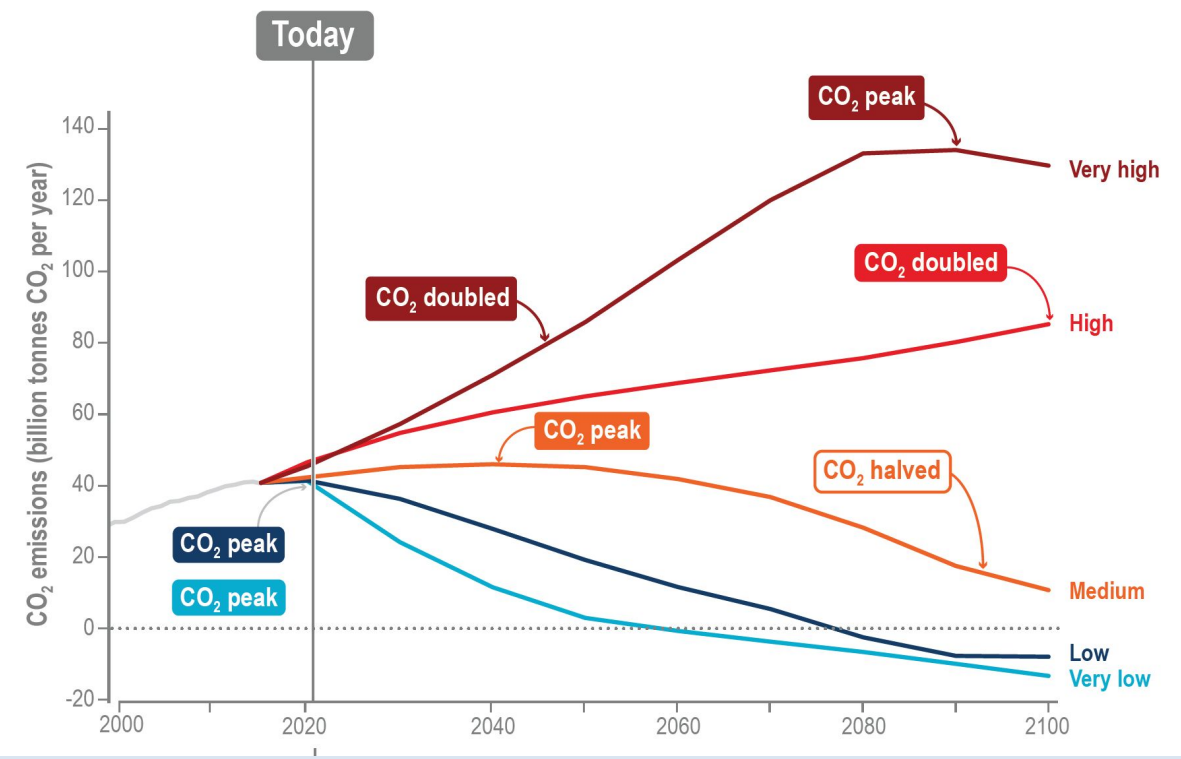
https://psl.noaa.gov/data/gridded/data.cpc.globalprecip.ht
https://psl.noaa.gov/data/gridded/data.cpc.globaltemp.htm

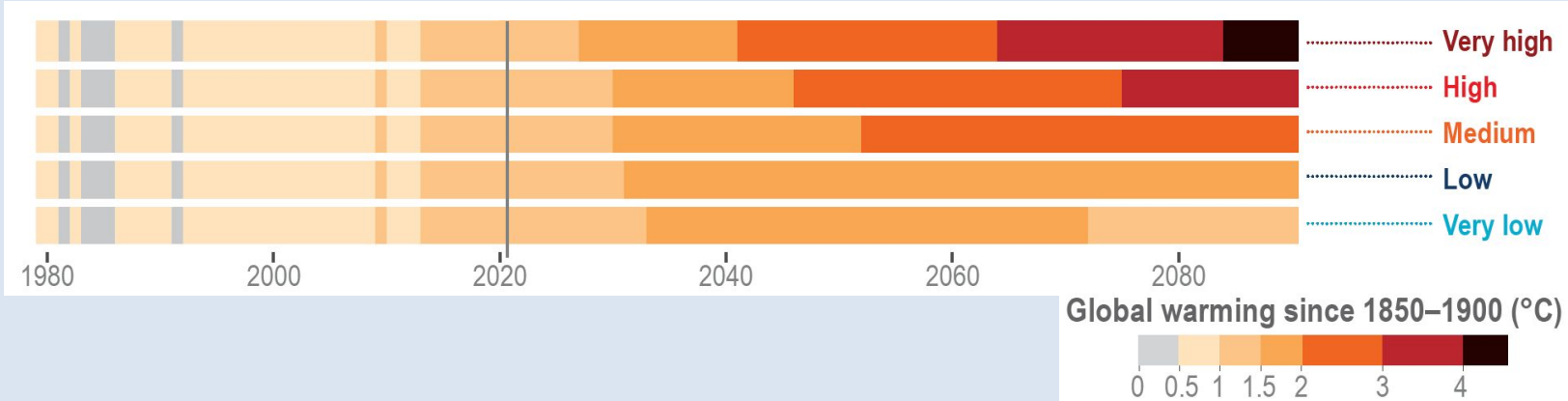
CLIMATE CHANGE | Climate Modeling



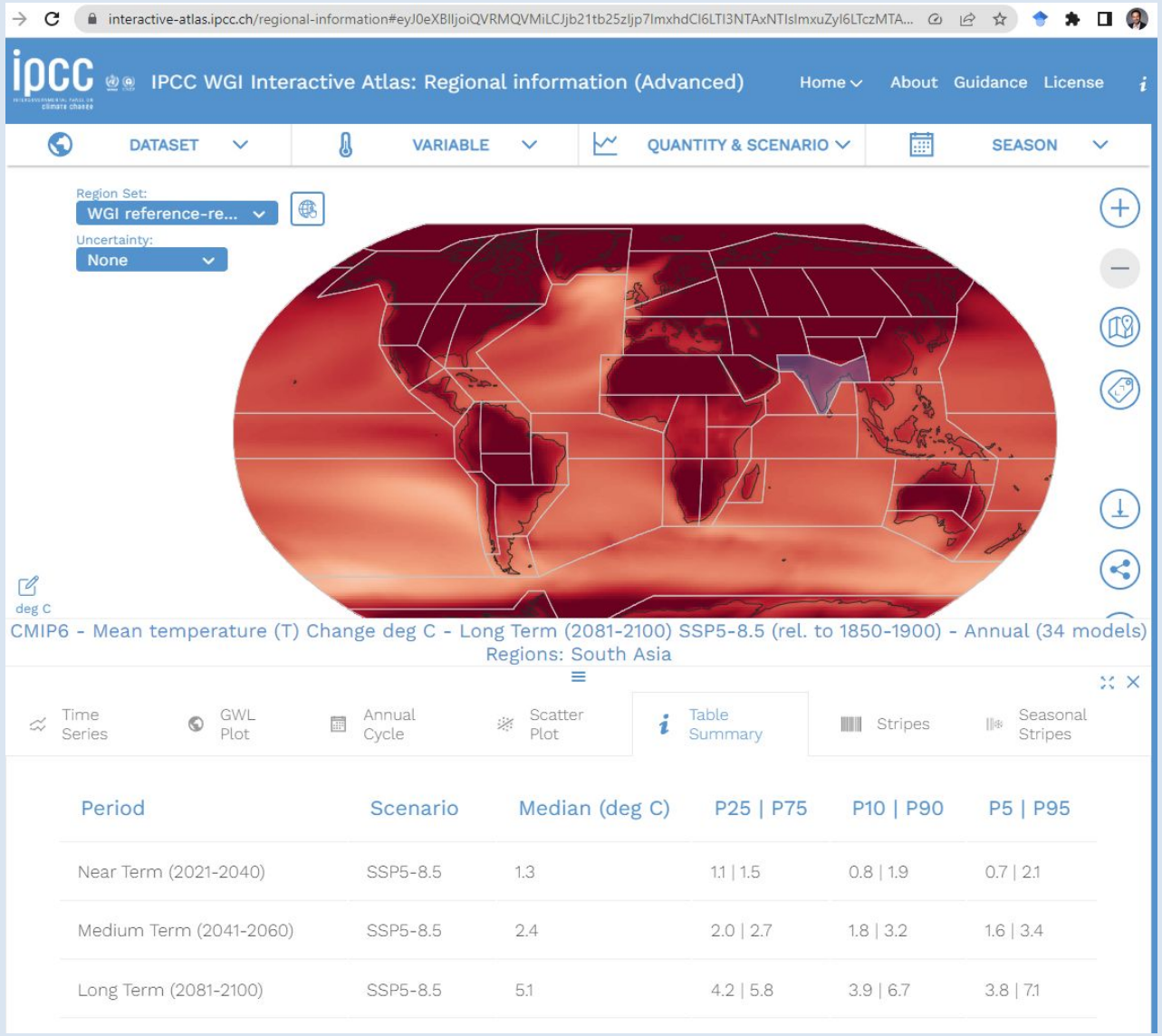


Shared Socioeconomic Pathways





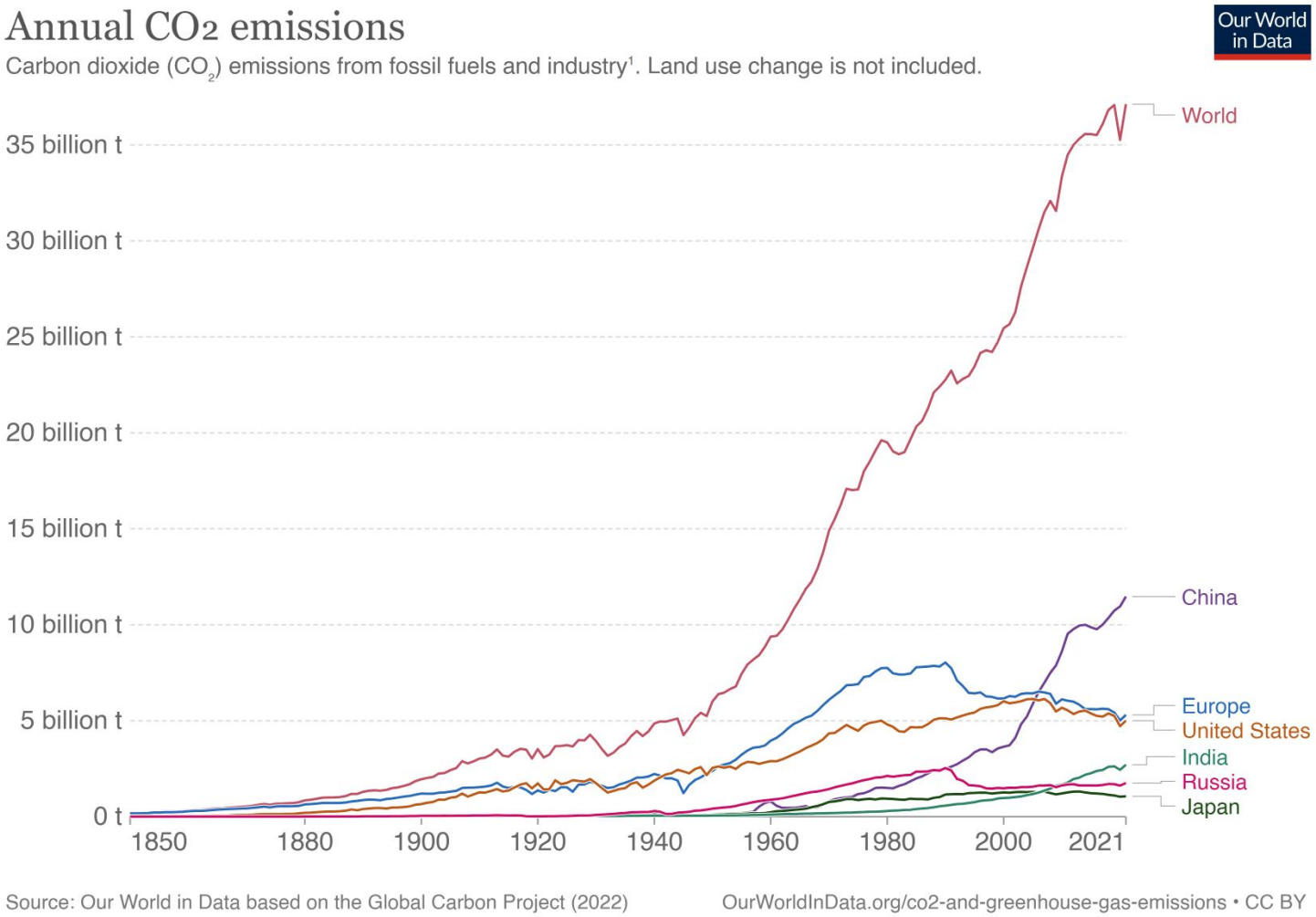
CLIMATE CHANGE | Future Climate Projections



Period	Scenario	Median (deg C)	P25 | P75	P10 | P90	P5 | P95
Near Term (2021-2040)	SSP5-8.5	1.3	1.1 | 1.5	0.8 | 1.9	0.7 | 2.1
Medium Term (2041-2060)	SSP5-8.5	2.4	2.0 | 2.7	1.8 | 3.2	1.6 | 3.4
Long Term (2081-2100)	SSP5-8.5	5.1	4.2 | 5.8	3.9 | 6.7	3.8 | 7.1

Link: https://interactive-atlas.ipcc.ch

Annual CO_2 emissions



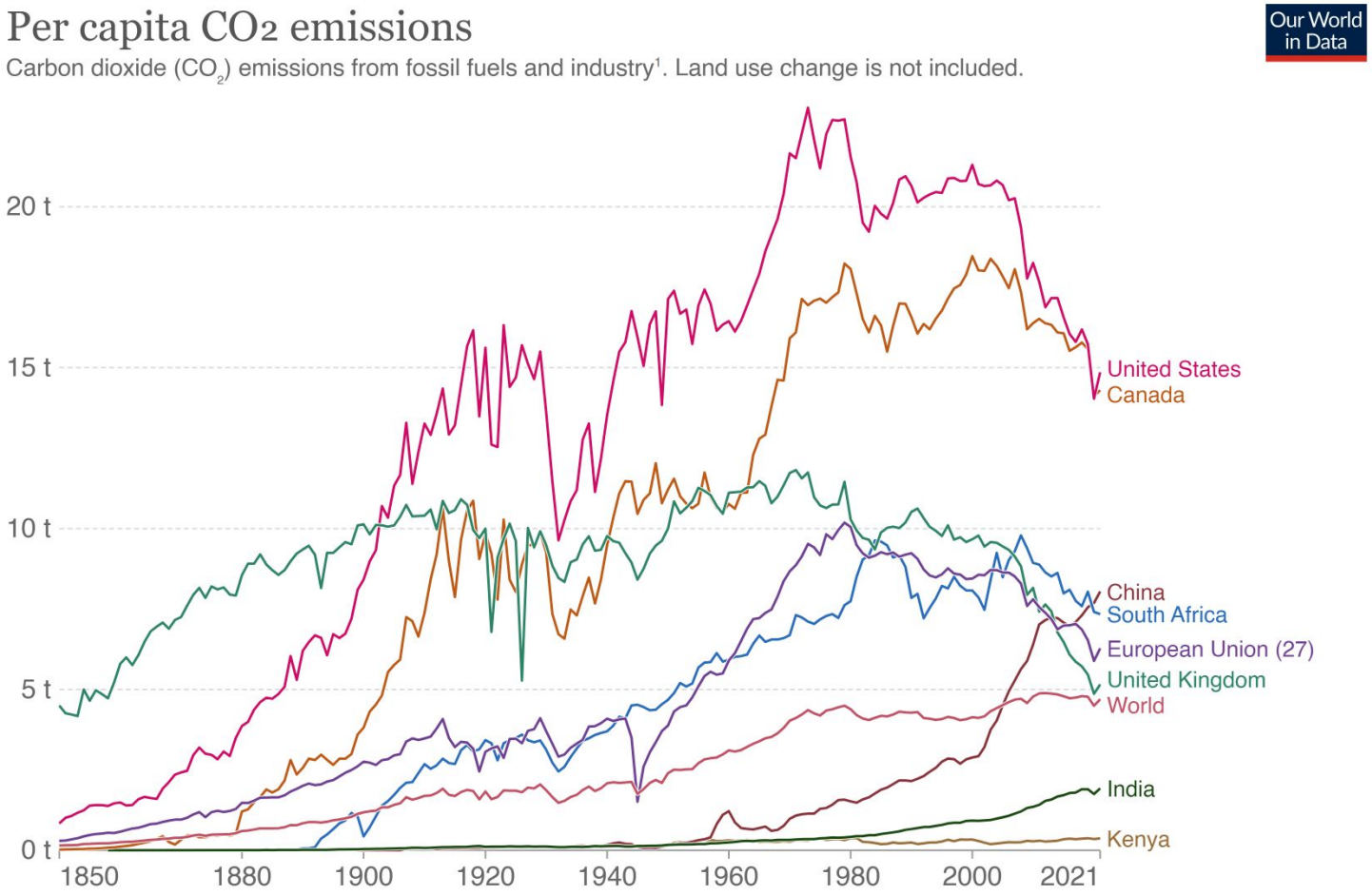
In 1950 the world emitted 6 billion tons of CO2.

Emissions have continued to grow rapidly; we now emit over 34 billion tons each year.

COVID: 2 billion tons dip, but not large enough to make a significant change.

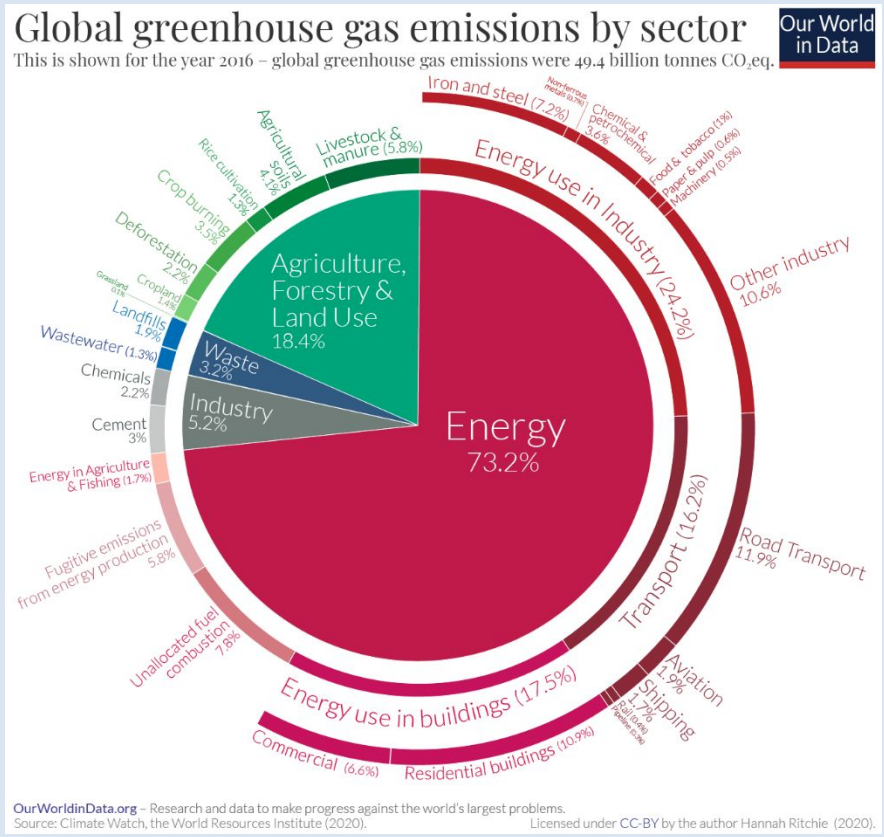
https://ourworldindata.org/co2-emissions

Annual per-capita CO_2 emissions

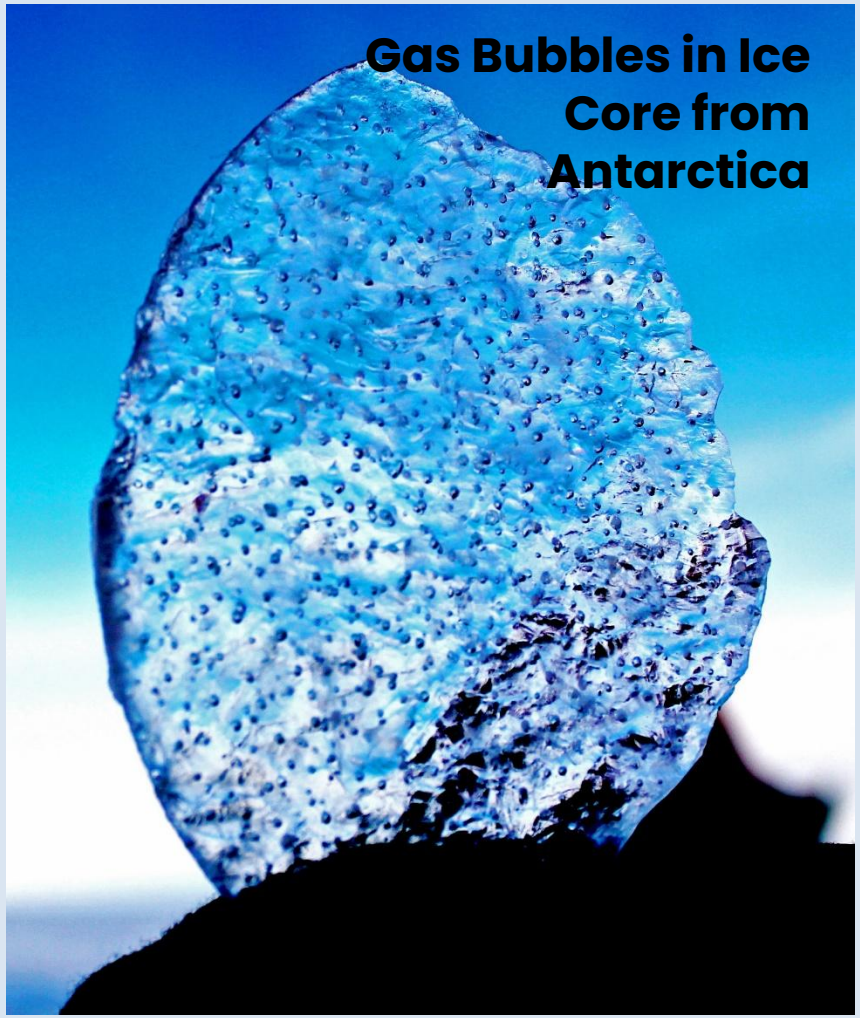


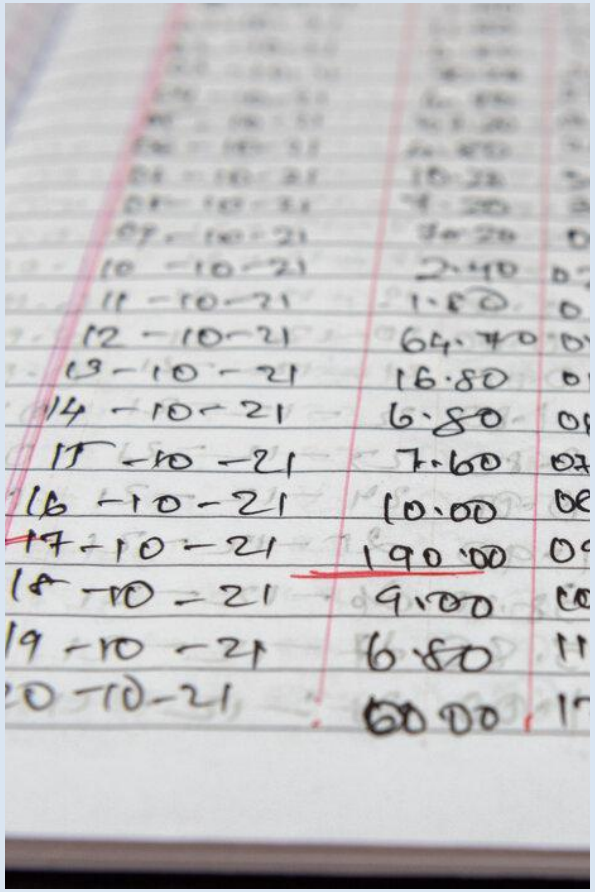
1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Energy: electricity, heat and transport



How do we measure past atmospheric CO_2?





Book on rain data from budding weather folk

Student meteorologists observe World Water Day

Students of the St, Joseph's Upper Primary School, Malayinchippara, with their book o rainfall details of the Meenachil river basin. ▪ VISHNU PRATAP

STAFF REPORTER
KOTTAYAM

It's always so much fun for kids to play outside in the rain. For this young bunch of amateur meteorologists, measuring these showers and assessing its impact on the local environment offers even more excitement.

As the world celebrated World Water Day on Tuesday, a group of students from St. Joseph's Upper Primary School in Malayinchippara brought out a book on the local rainfall database of the Meenachil river basin. Eminent conservationist Madhav Gadgil released the

details generally correlate with official measurements, while also helping one to understand the very localised nature of rainfall.

In his preface to the book, Roxy Mathew Koll, a climate scientist with the Indian Institute of Tropical Meteorology, Pune, said the initiative had taken the school closer towards being climate-equipped.

Daily basis

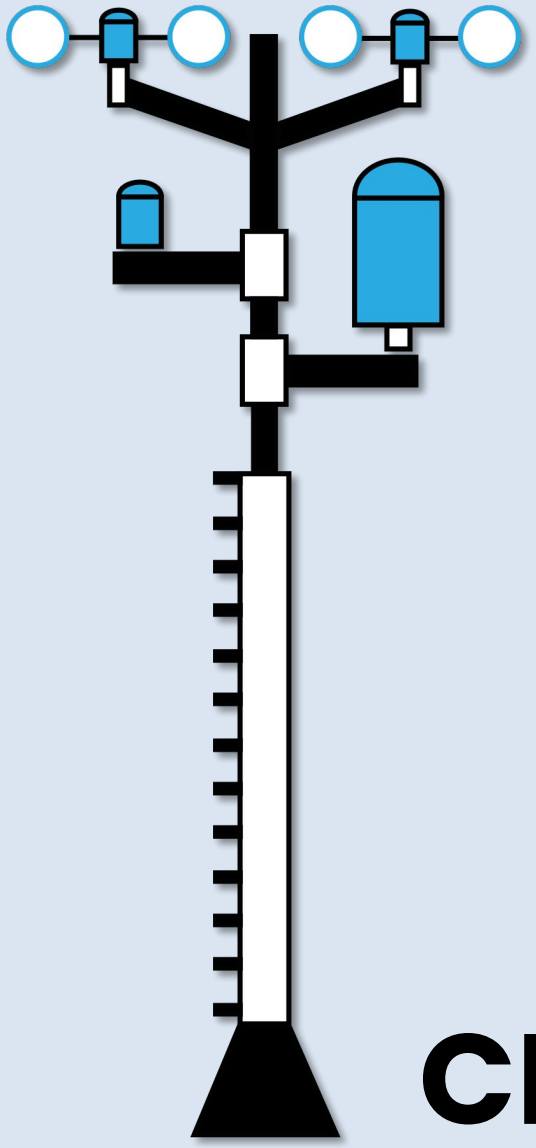
"The school now monitors rainfall using rain gauges on a daily basis. This exercise helps the students and the community make sense of the rainfall and weather

Mr. Koll had also co
training sessions for
in rain-gauging and
activities.

Climate Action Gr

These kids, member
school's Climate
Group, are also assis
Meenachil River Rai
toring Network run
Meenachil River Pro
Council (MRPC), a co
tionist collective.

Commenting on th
tive, Aby Immanuel
tary, MRPC, said pla
also afoot to install
flow monitoring sca
thermometer on the
premises to measu



CENTER FOR THE ADVANCED STUDY OF INDIA

CASI

CLIMATE DATA

Roxy Mathew Koll
Centre for Climate Change Research
Indian Institute of Tropical Meteorology
Ministry of Earth Sciences, India