Statement on Climate of India during 2021 and trends in extreme weather events

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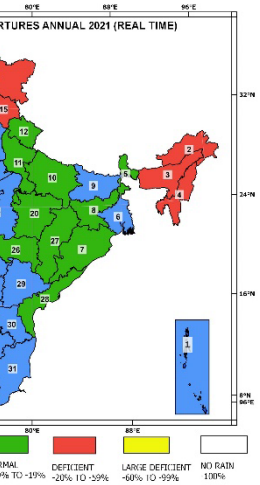
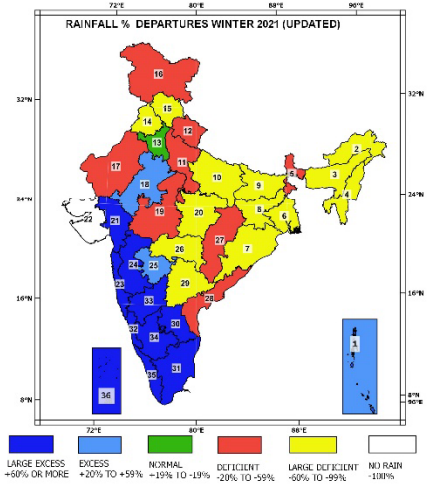
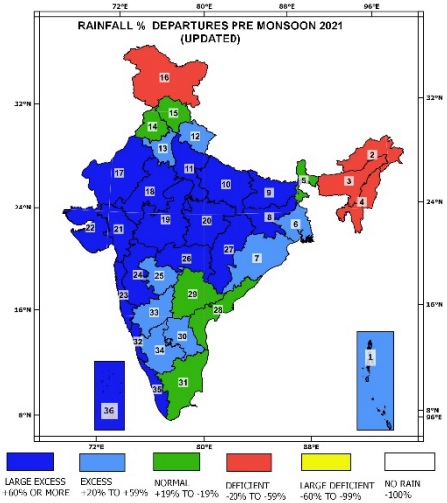
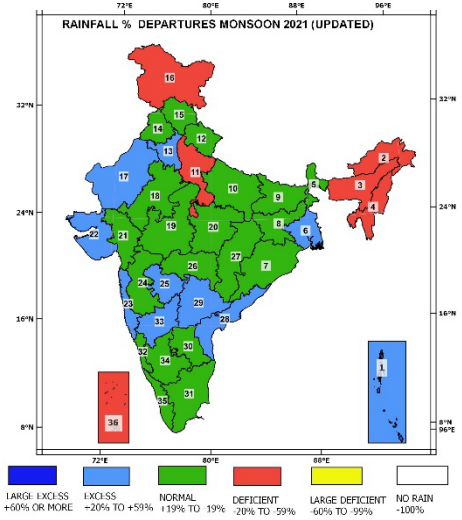
INDIA METEOROLOGICAL DEPARTMENT

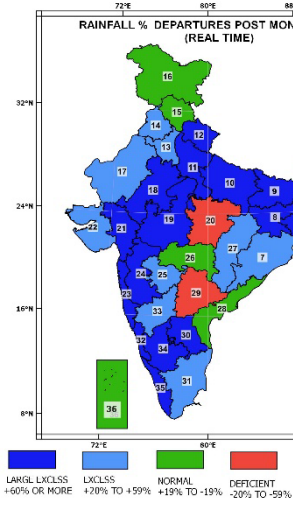
Rainfall Anomalies (% Departure) for the year 2021











ANNUAL **WINTER** **PRE-MONSOON** **MONSOON** **POST-MO**

2021 annual rainfall over the country as a whole was 105% of its Long Period Av

) value for the period 1961-2010.

monsoon season rainfall over the country as a whole was 99% of its LPA.

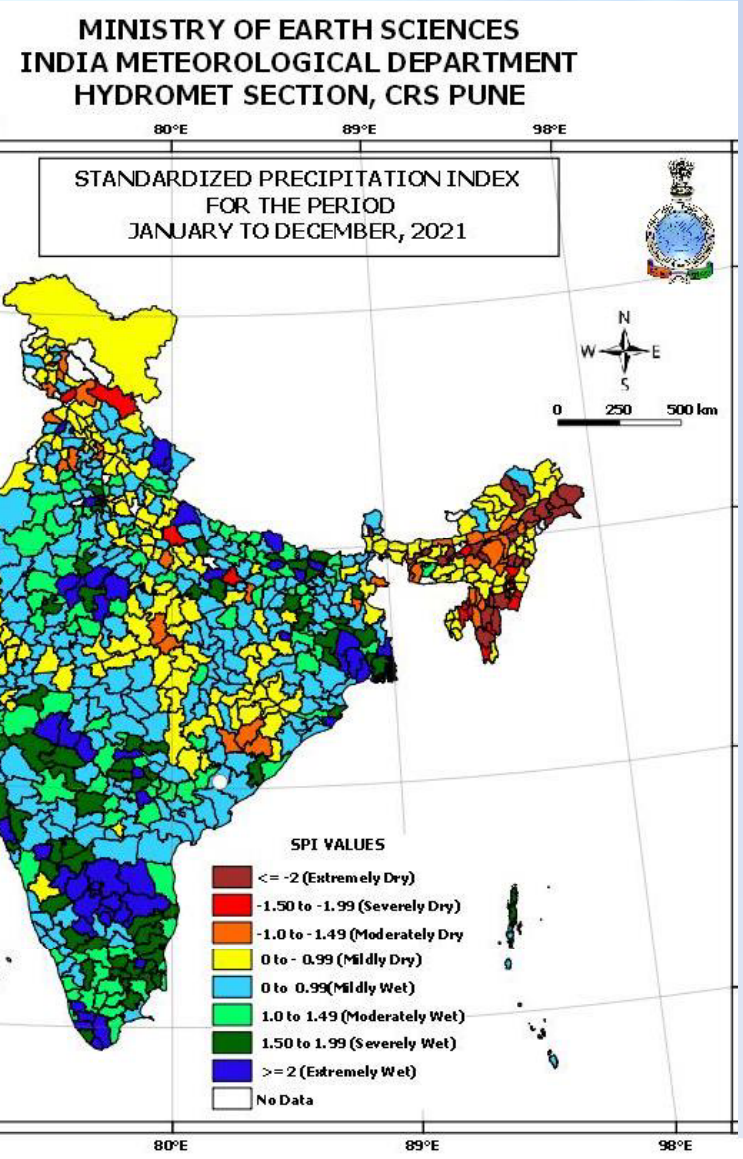
seasonal rainfall during the Northeast monsoon season (October – December) ov

lonsoon core region of the south peninsula was 171% of its LPA.

ainfall received over core region (579.1 mm) was highest since 1901

Standardized Precipitation Index for 2021

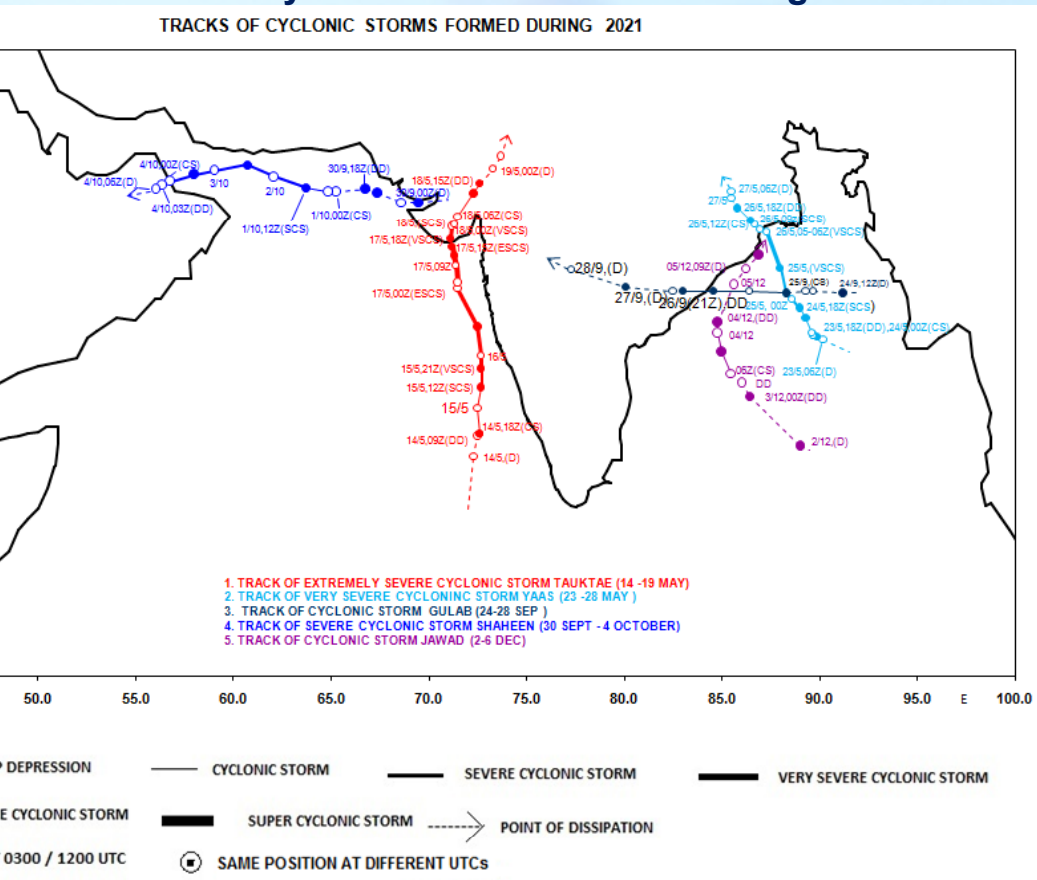
ized Precipitation Index (SPI)
uary to December 2021



- The Standardized Precipitation Index (SPI) is u monitoring drought conditions
- It is based on precipitation.
- It is negative for dry, and positive for wet conditio
- As the dry or wet conditions become more seve index becomes more negative or positive.
- Extremely wet-severely wet conditions over parts N Islands, Gangetic West Bengal, Odisha, Jha Bihar, East Uttar Pradesh, Uttarakhand, H Chandigarh & Delhi, Punjab, East Rajasthan Madhya Pradesh, Gujarat, Maharashtra, Andhra P state, Telangana, Tamil Nadu, Interior Karnataka, K
- Extremely dry-severely dry conditions observed o states, Sub Himalayan West Bengal & Sikkim, We Pradesh, Himachal Pradesh and Jammu & Kashm

Tropical Cyclones in the Indian Seas in 2021

Tracks of the Cyclonic storms formed during 2021



5 cyclonic storms formed

(1) ESCS TAUKTAE, Arabian Sea (14 – 19

(2) VSCS YAAS, Bay of Bengal (23 – 28

(3) SCS SHAHEEN, Arabian Sea (29 Sep t

(4) CS GULAB, Bay of Bengal (24 – 28 Se

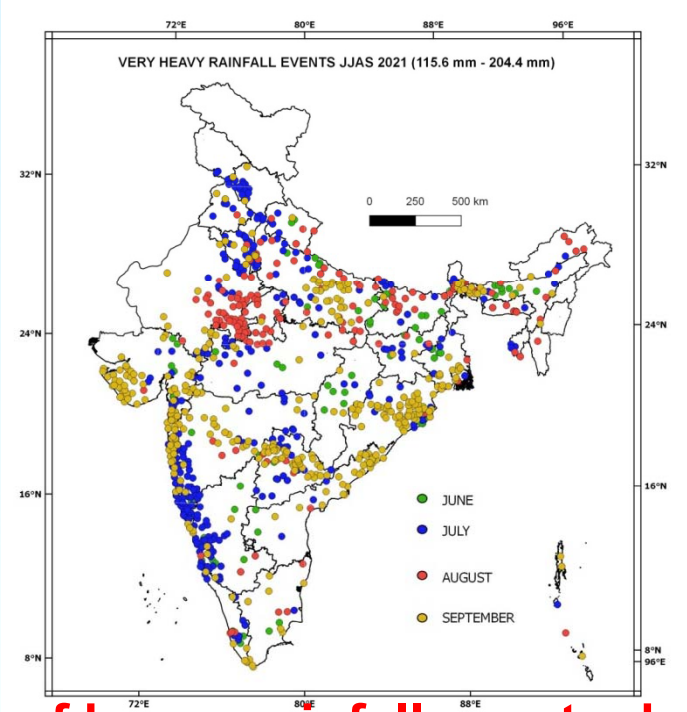
(5) CS JAWAD, Bay of Bengal (2-6 Decem

st devastating was TAUKTAE, which crossed Saurashtra coast on 17th May, claim

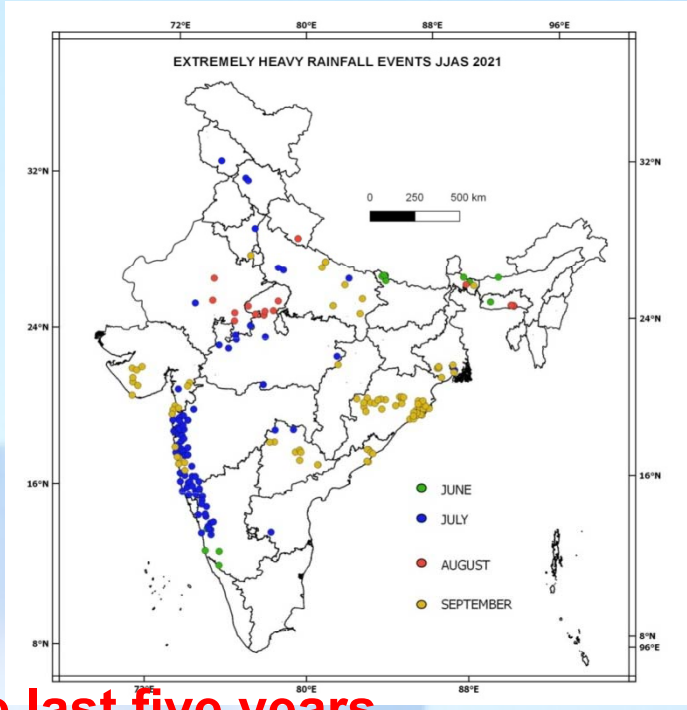
m across the states in western India stretching from Kerala to Gujarat.

Heavy Rainfall Events during Monsoon Season 2021

Location of Heavy Rainfall events



Location of Ext. Heavy Rainfall



Number of heavy rainfall events during the last five years

ear	2017		2018		2019		2020		2021	
onth	>115.6 and <204.5	>204.5	>115.6 and <204.5	>204.5	>115.6 and <204.5	>204.5	>115.6 and <204.5	>204.5	>115.6 and <204.5	>
un	248	36	380	64	211	52	262	36	277	
Jul	709	106	741	117	753	161	447	90	638	
Aug	401	90	510	96	987	282	1008	165	272	
Sep	205	29	229	44	551	59	308	61	449	
JAS	1563	261	1860	321	2502	554	1912	341	1636	

Mean Temperature in 2021

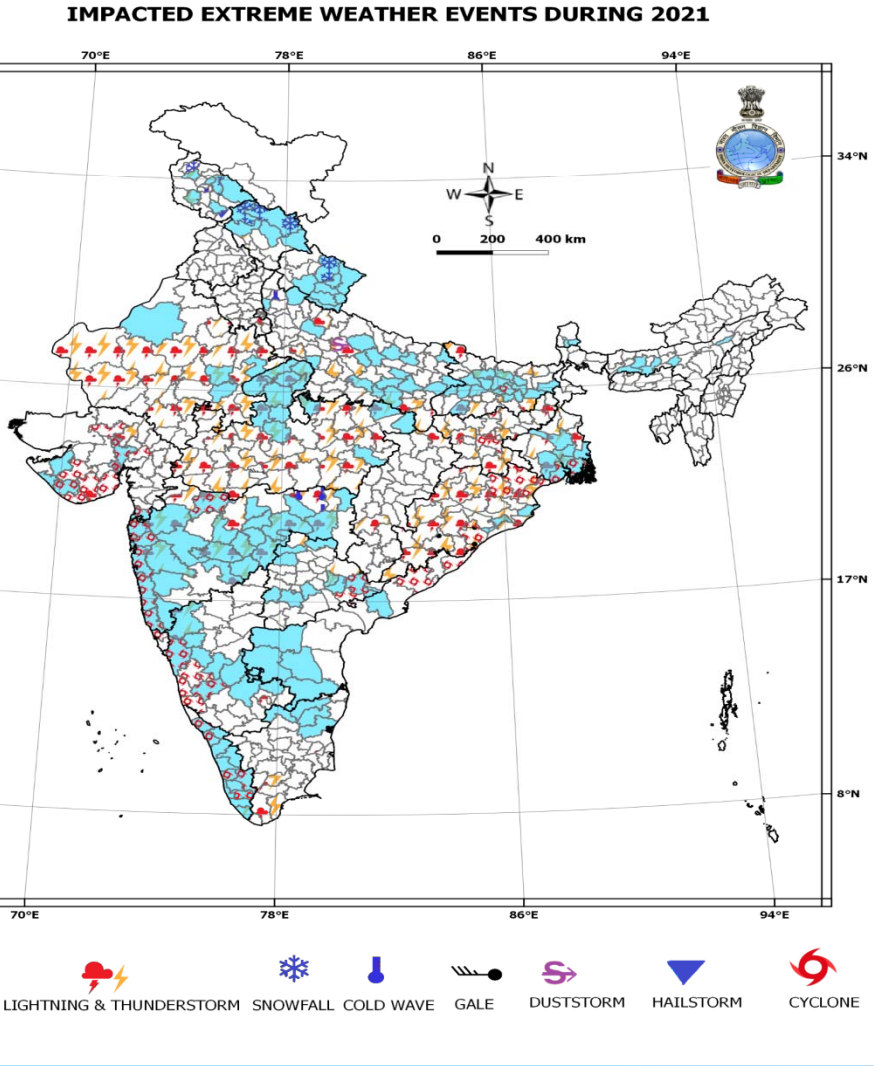
al mean land surface air temperature averaged over India during 2021 was +0.
e the long-term average (1981-2010 period).

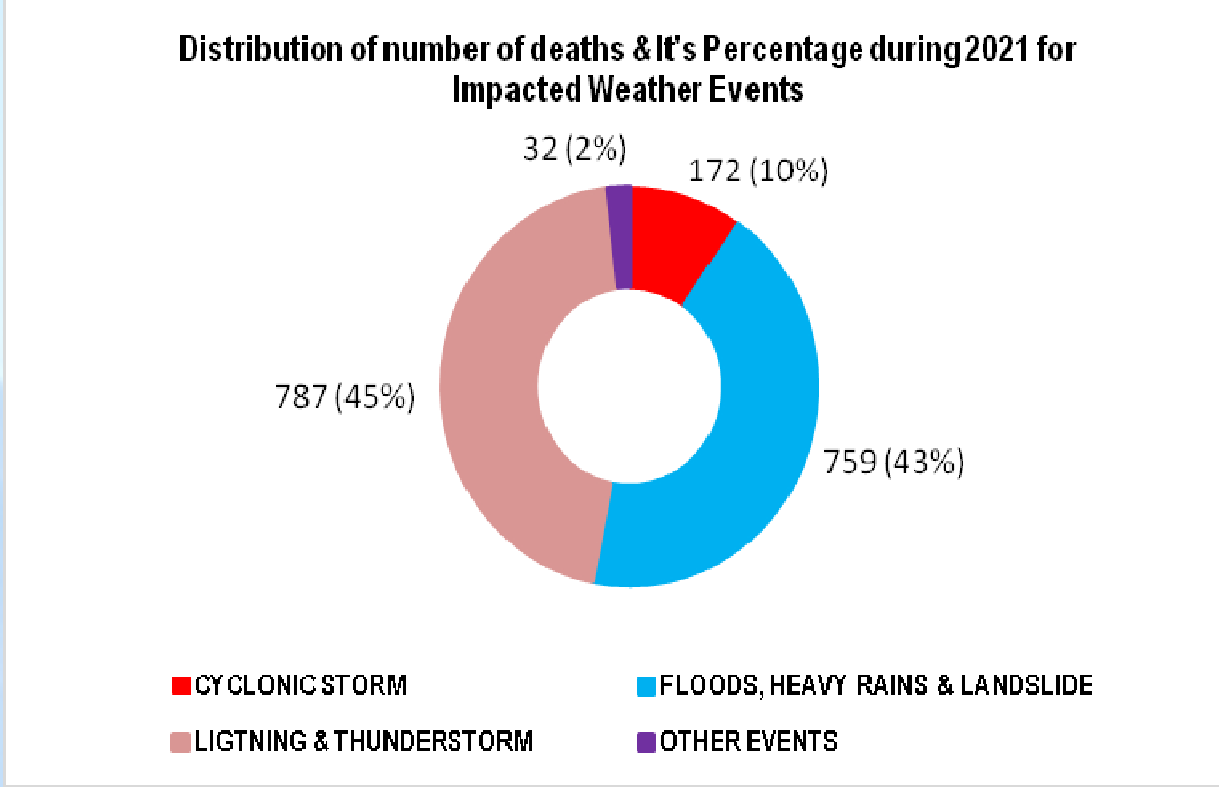
2021 was fifth warmest year since nationwide records commenced in 1901. How
s lower than highest warming observed over India during 2016 (anomaly of +0.71^{0}C).
r(January to February) & post-monsoon (October to December) seasons with all
temperature anomalies of +0.78^{0}C & +0.42^{0}C respectively mainly contributed to
ing.

dia mean temperatures during pre-monsoon (March-May) & monsoon(June-Septem
ons, were above normal with anomalies of +0.35^{0}C & +0.34^{0}C respectively.

Impacted Extreme Weather Events

lajor Extreme Weather Events Occurred during 2021 & associated loss of life



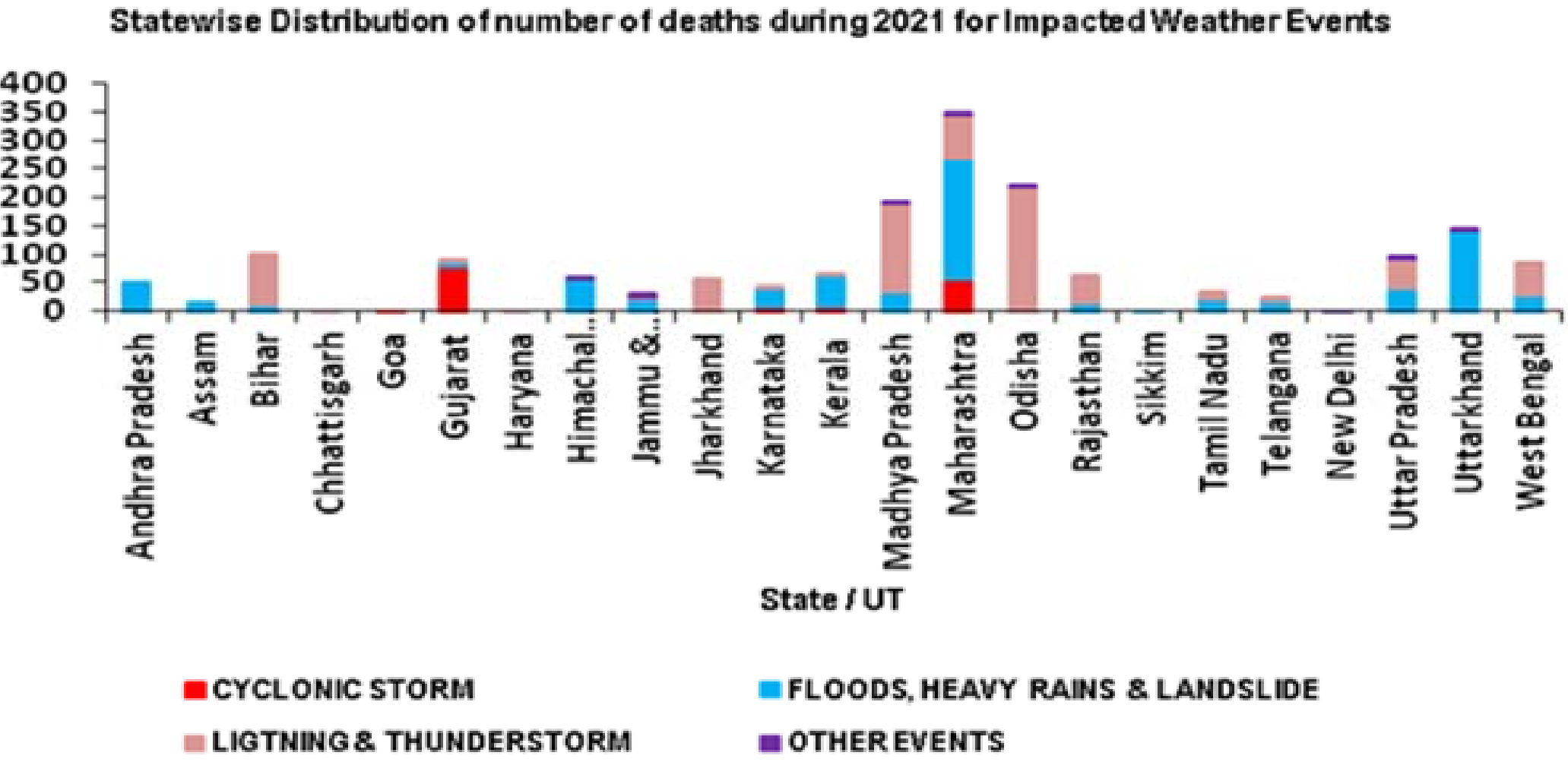


Heavy rainfall and flood-related incidents reportedly claimed over 750 lives

Thunderstorms and li reportedly claimed mo 780 lives from differe of the country.

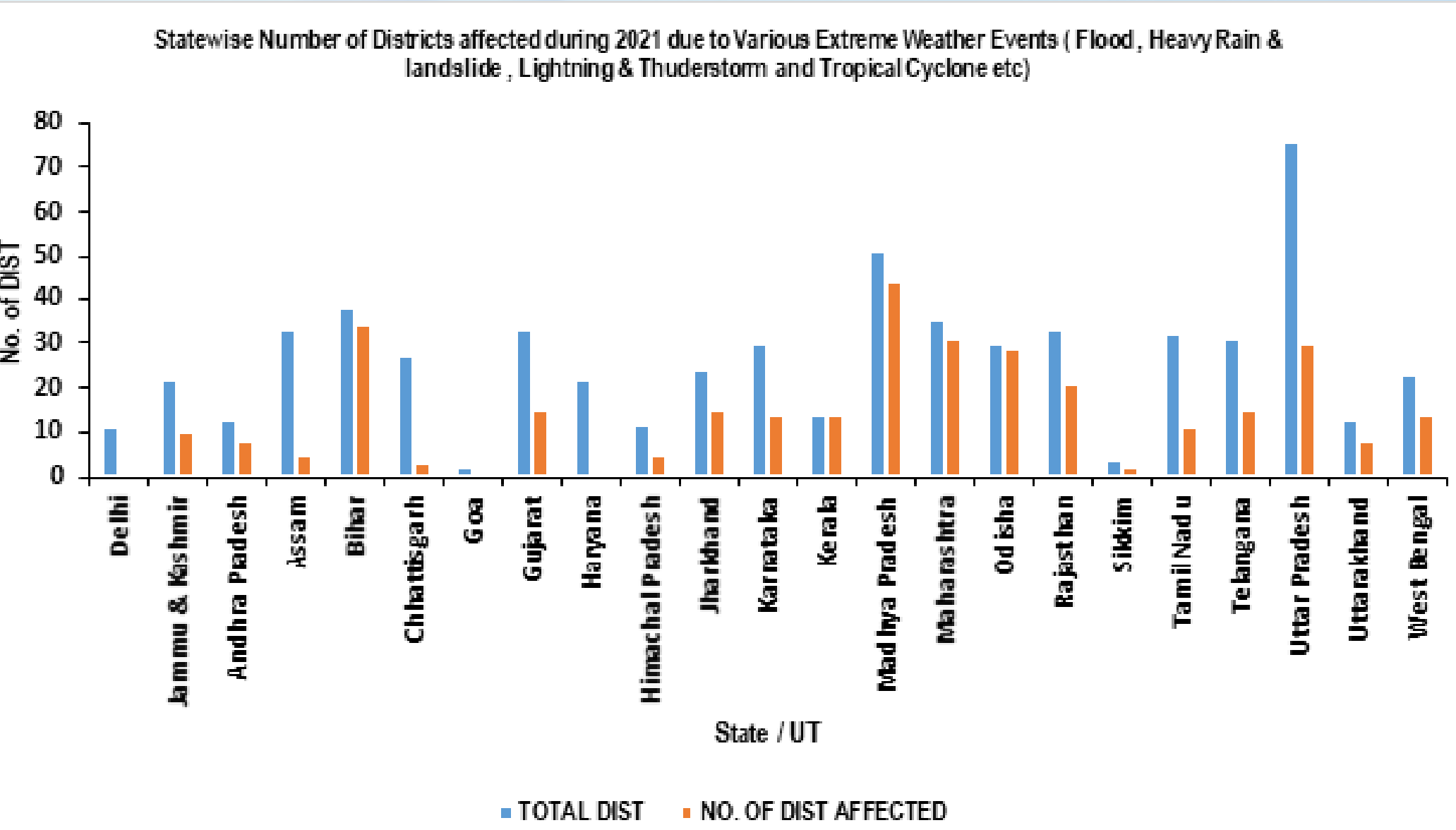
Impacted states by Extreme Weather Events

State wise Distribution of Major Extreme Weather Events Occurred during 2021



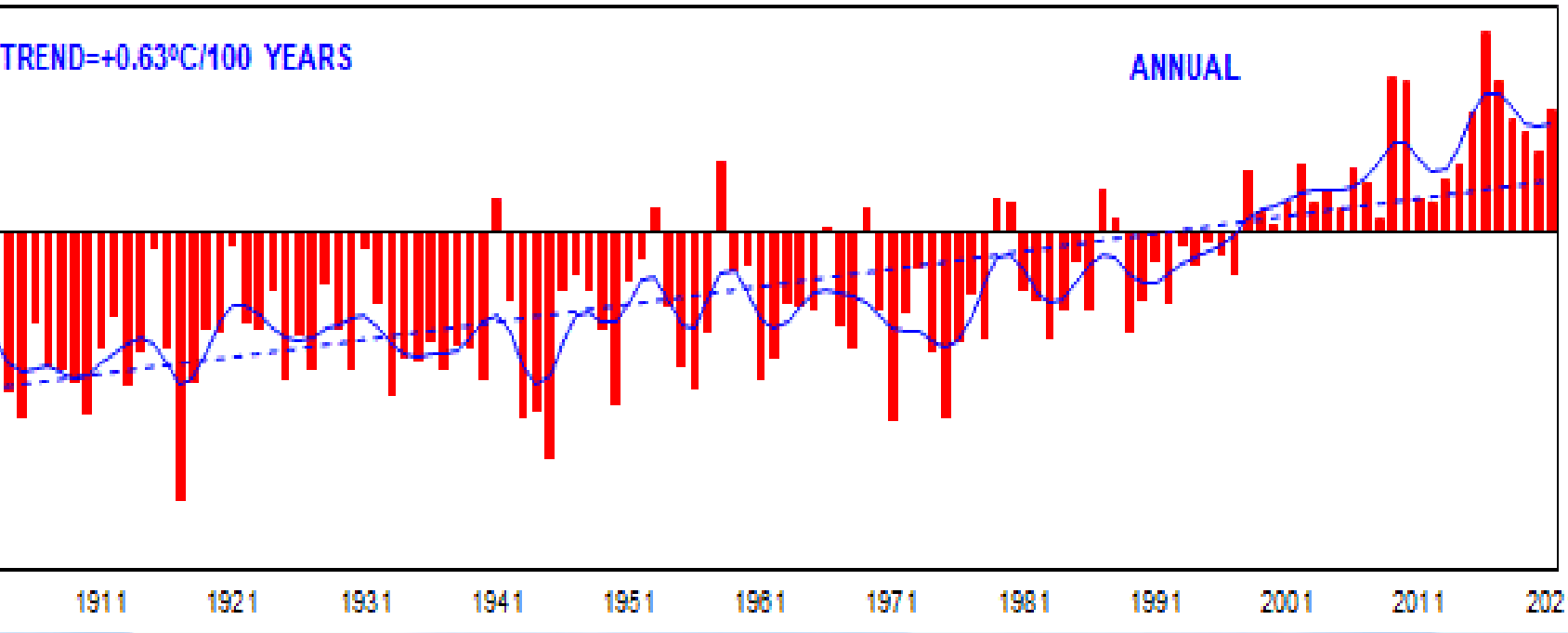
Impacted states by Extreme Weather Events

Number of Extreme Weather Events effected districts



Trends in Surface Air temperatureTemperature

Annual mean land surface air temperature anomalies over India for the period 1901-2021



Annual mean temperature fo country was +0 above normal (5th warmest y record since 190

2016 (+0.710
2009 (+0.550
2017 (+0.541
2010 (+0.539

Seasonal mean temperature

Winter (Jan to Feb)	= +0.78 ^{0}C
Pre-monsoon (Mar to May)	= +0.35 ^{0}C
Monsoon (Jun to Sep)	= +0.34 ^{0}C
Post monsoon (Oct to Dec)	= +0.42 ^{0}C

Annual mean temperature trend during 1901-2021

Mean temperature	= 0.63 ^{0}C/100 years
Maximum temperature	= 0.99 ^{0}C/100 years
Minimum temperature	= 0.26 ^{0}C/100 years

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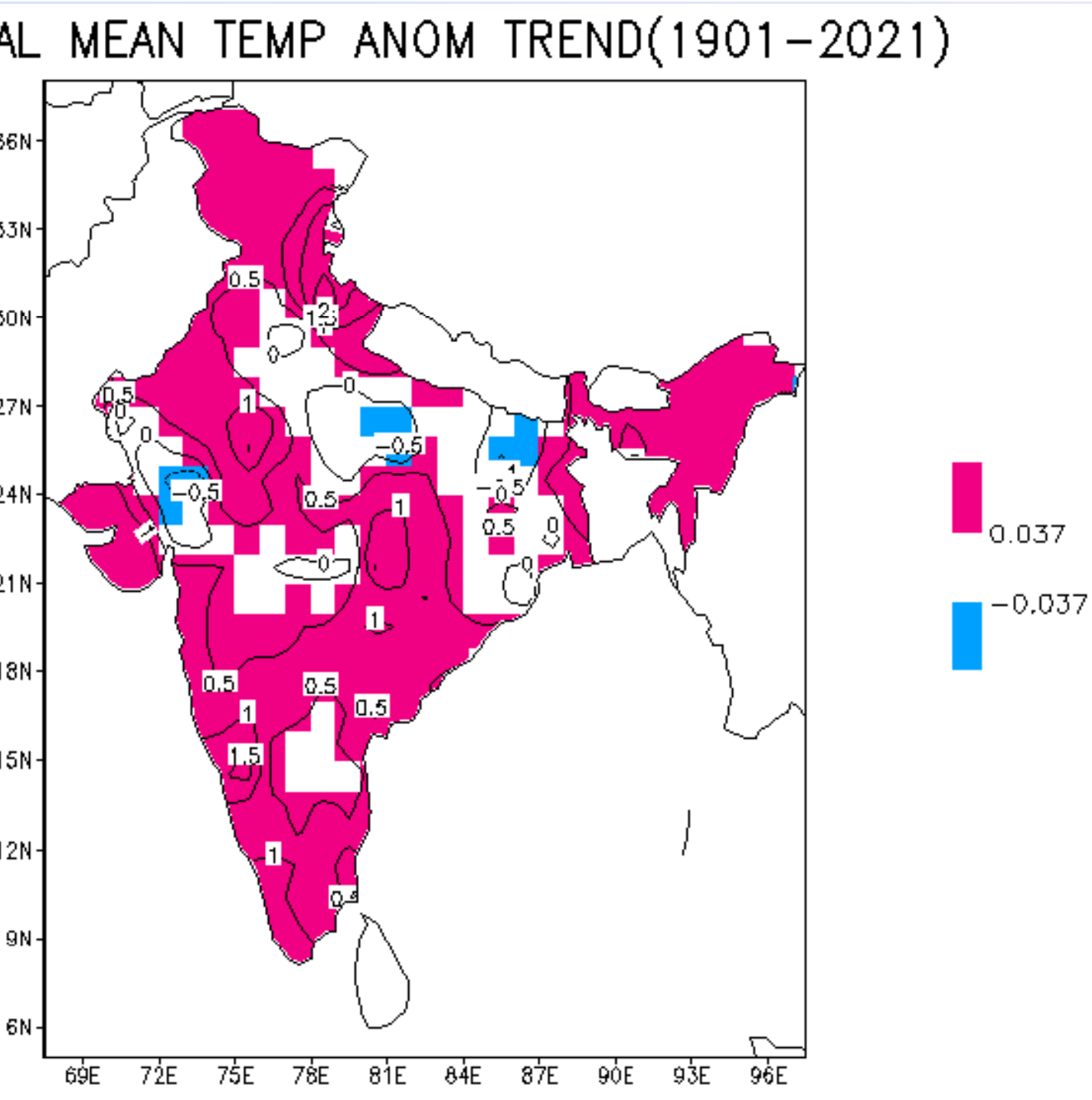

- ANNUAL MEAN TEMPERA ANOMALY TRENDS (°C YEARS) ARE SHOWN CONTOUR LINES.
- THE TRENDS SIGNIFICA 95% LEVEL ARE SHADED
- POSITIVE TRENDS SHOWN IN RED WHILE NEGATIVE TRENDS SHOWN IN BLUE.
- PERIOD OF ANALYSIS: 2021

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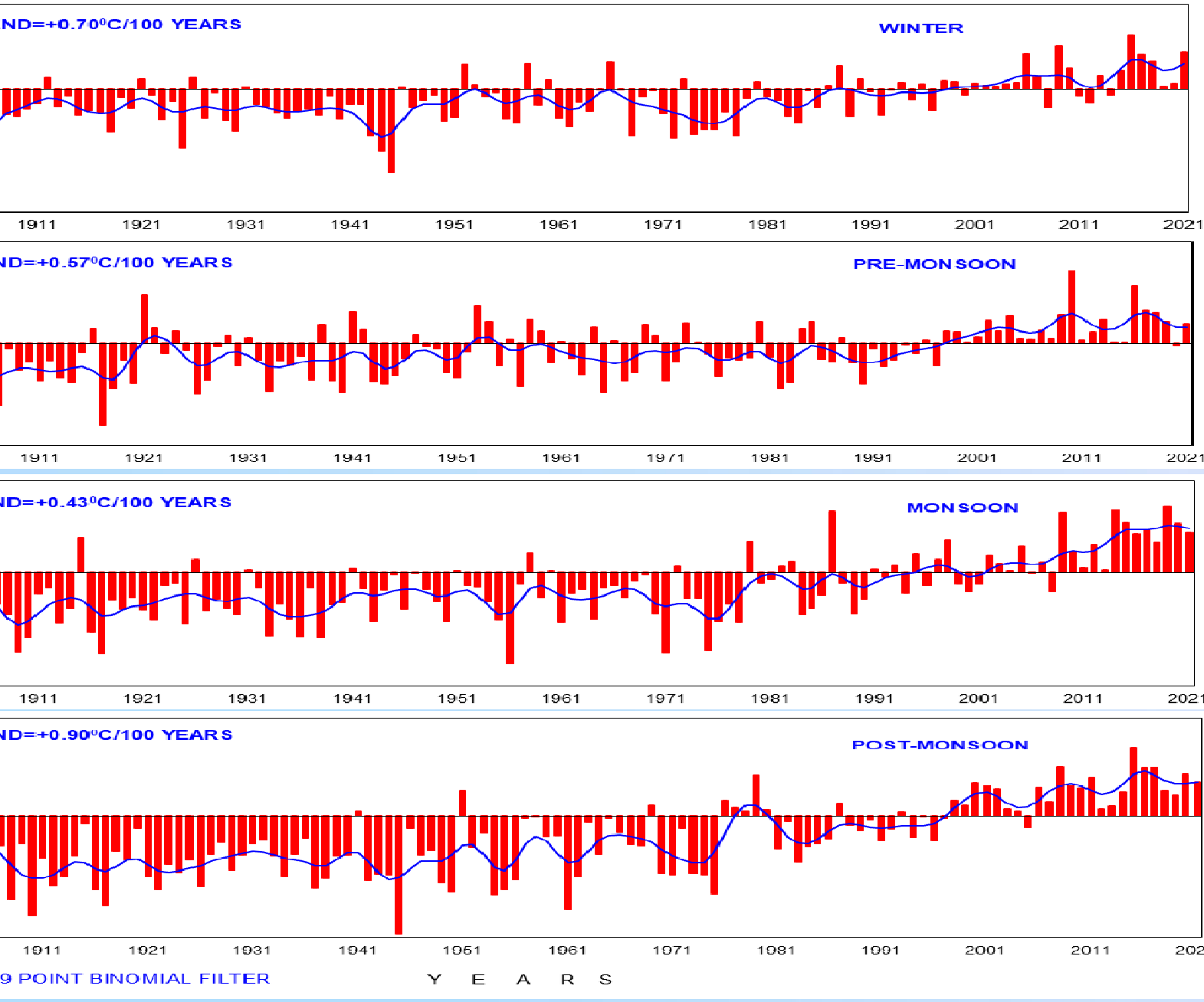
Surface Air temperatureTemperature



- All India temperature anor during 1901 - 2021 s as vertical bars.
- The solid blue curv sub-decadal time variations smoothe a binomial filter.
- Departure from the 2010 period averag
- The rising trend is significant in mo and post-mo seasons

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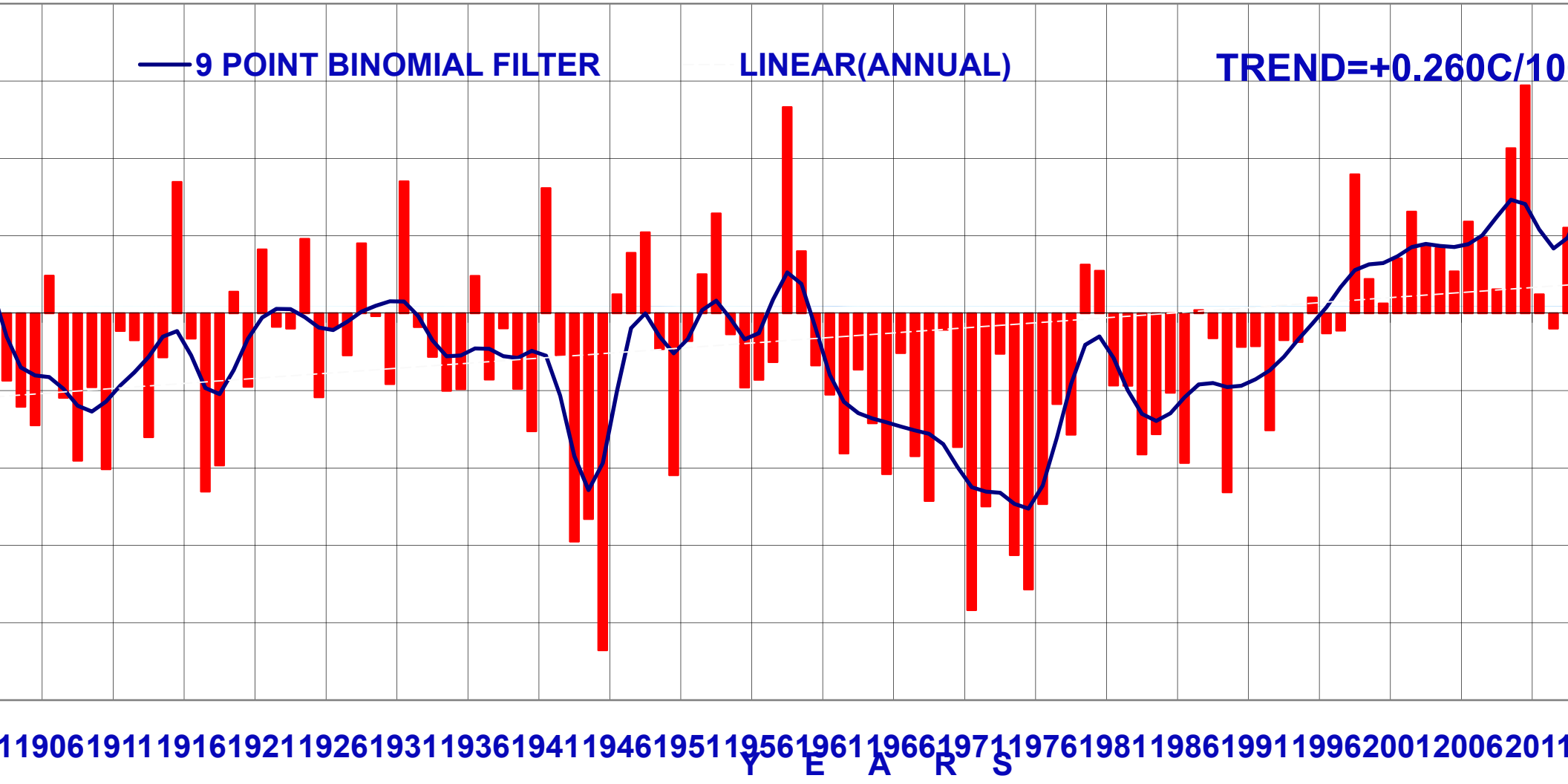
al Minimum land surface air temperature anomalies over Ind
the period 1901-2021



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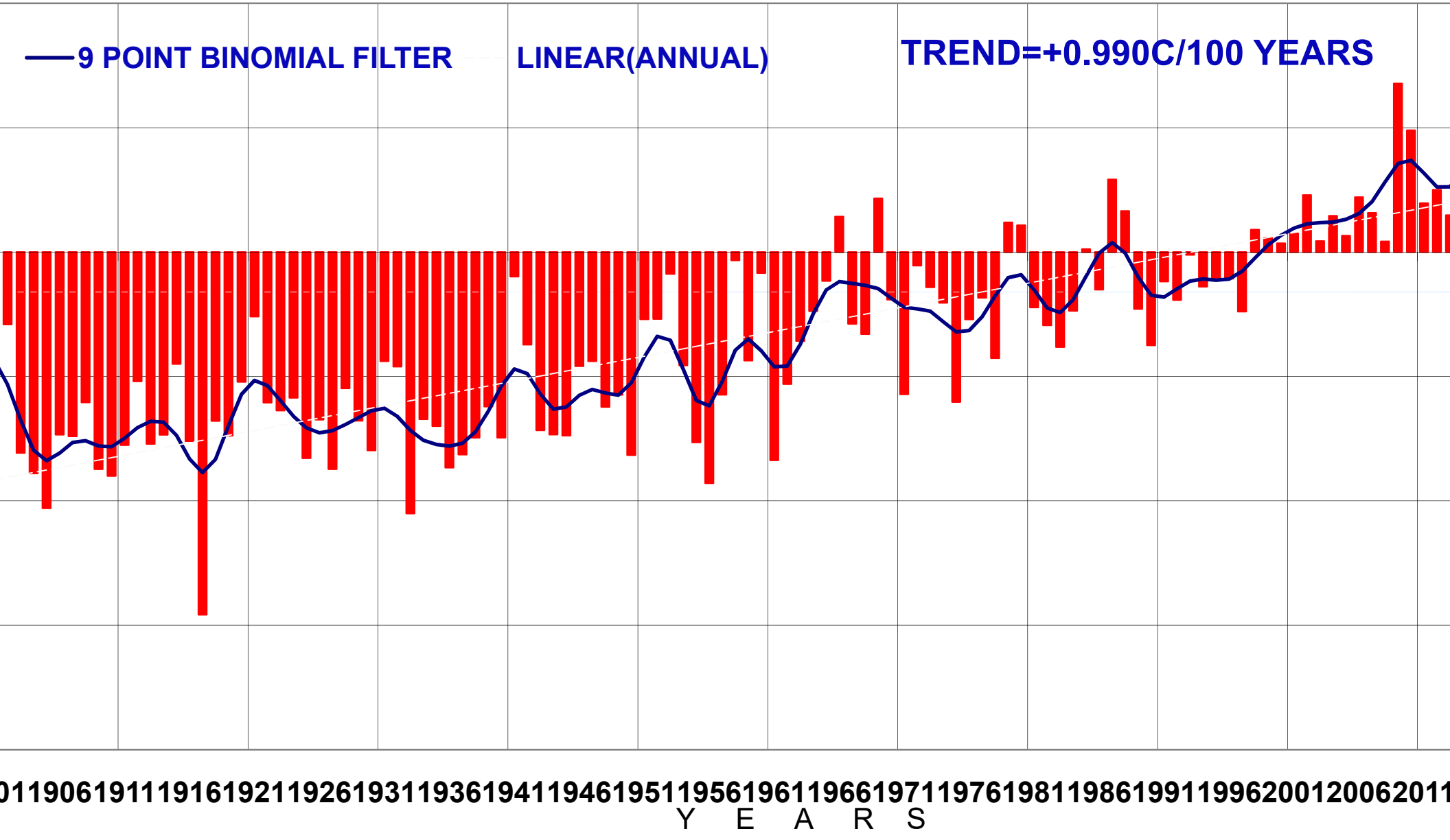
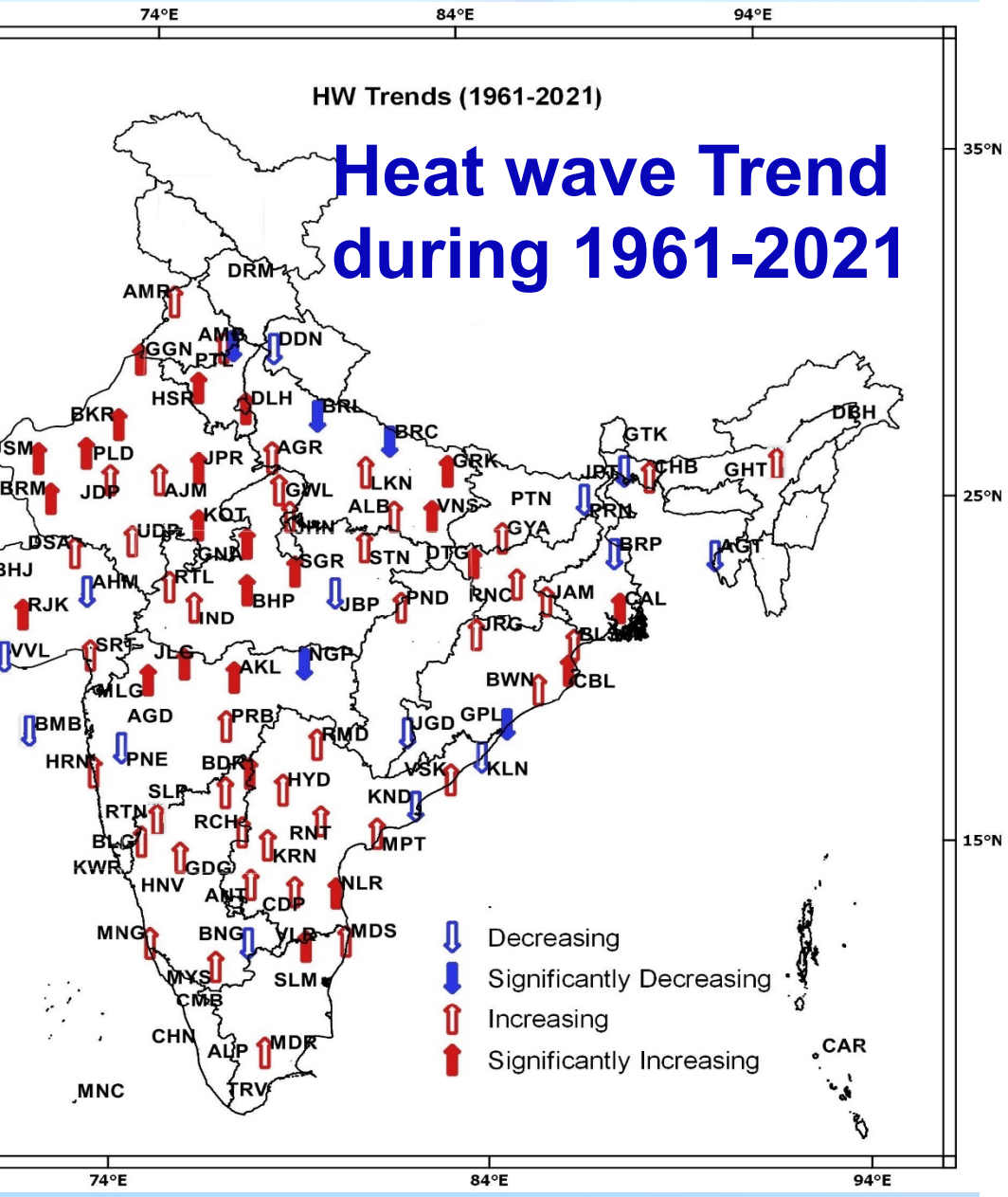
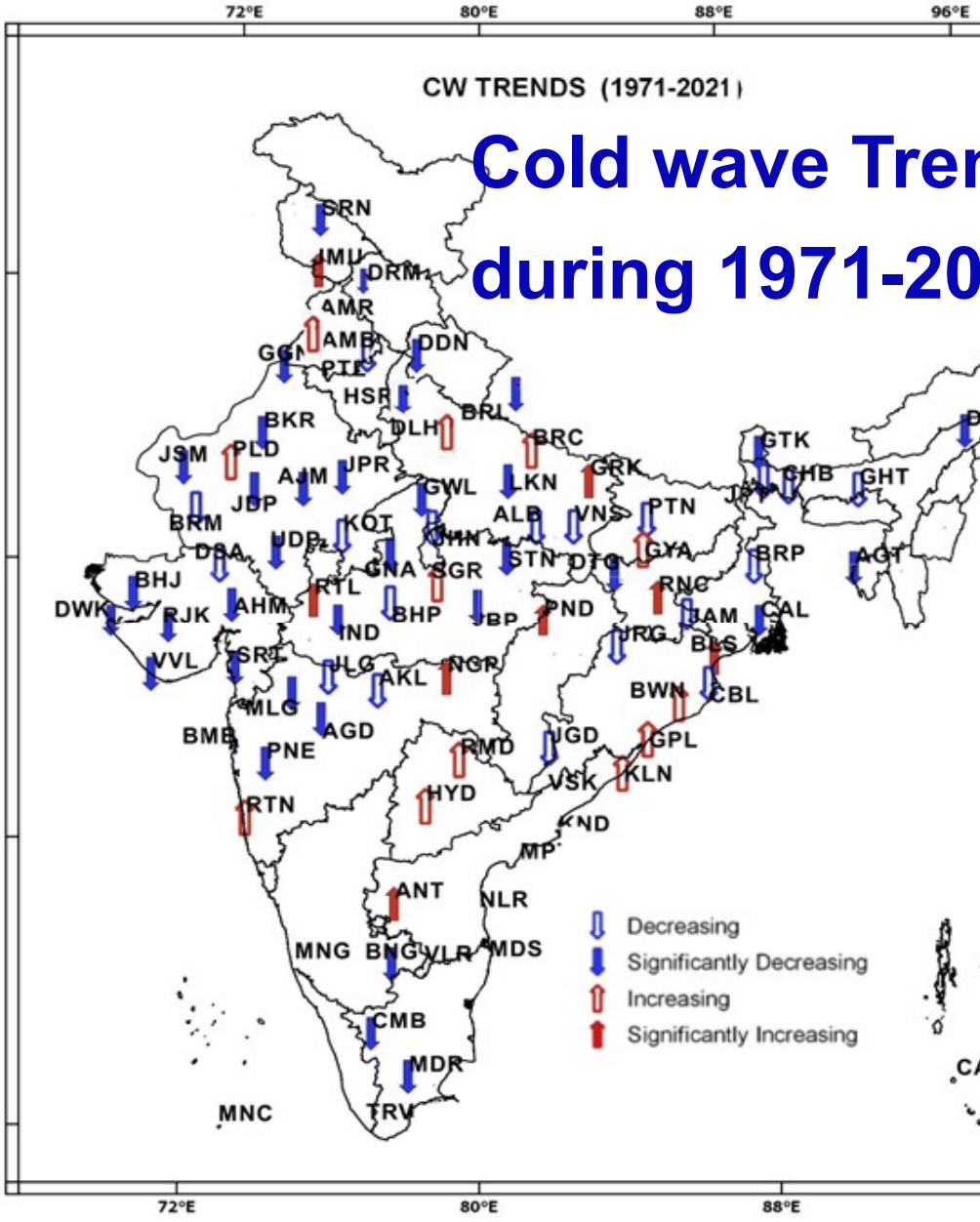
for the period 1901-2021



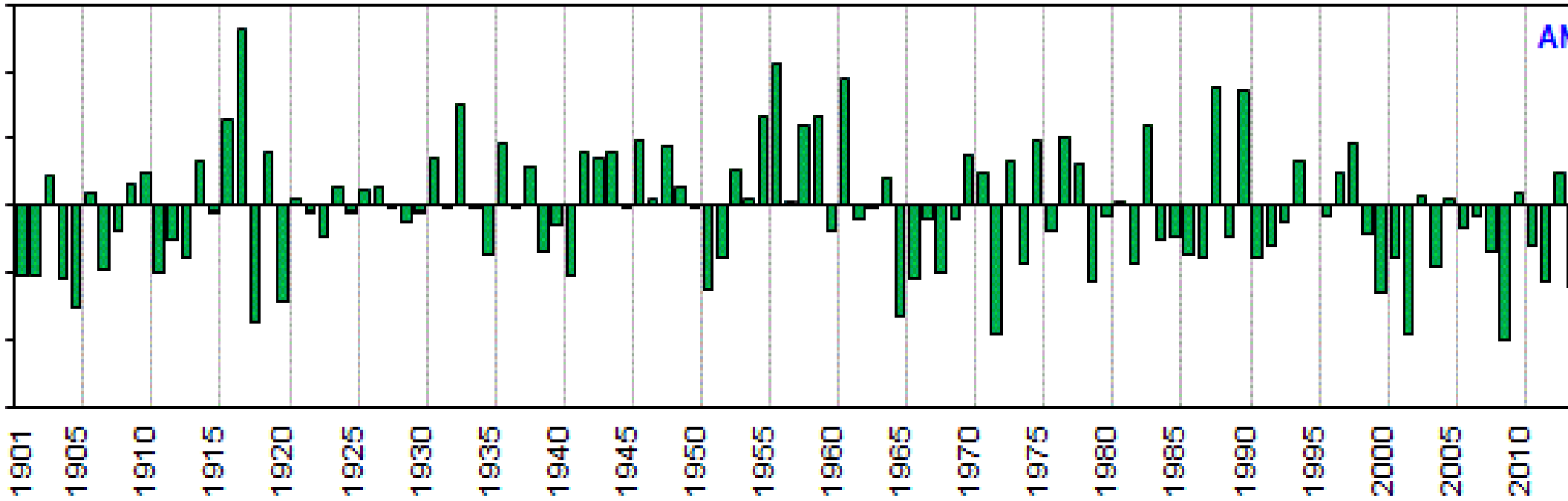
Heat and cold wave Trend



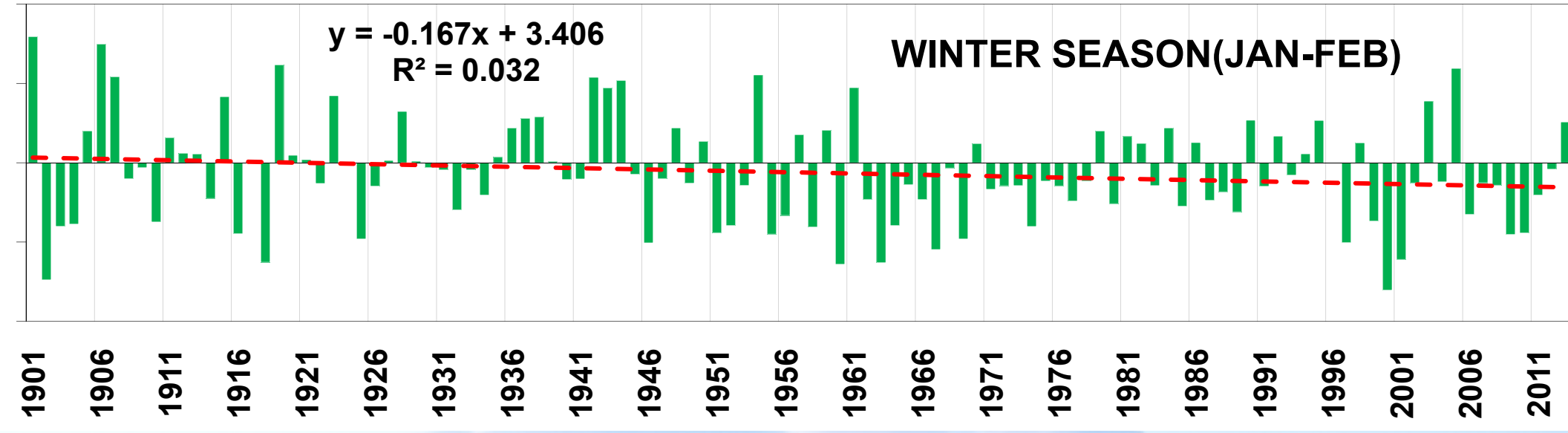


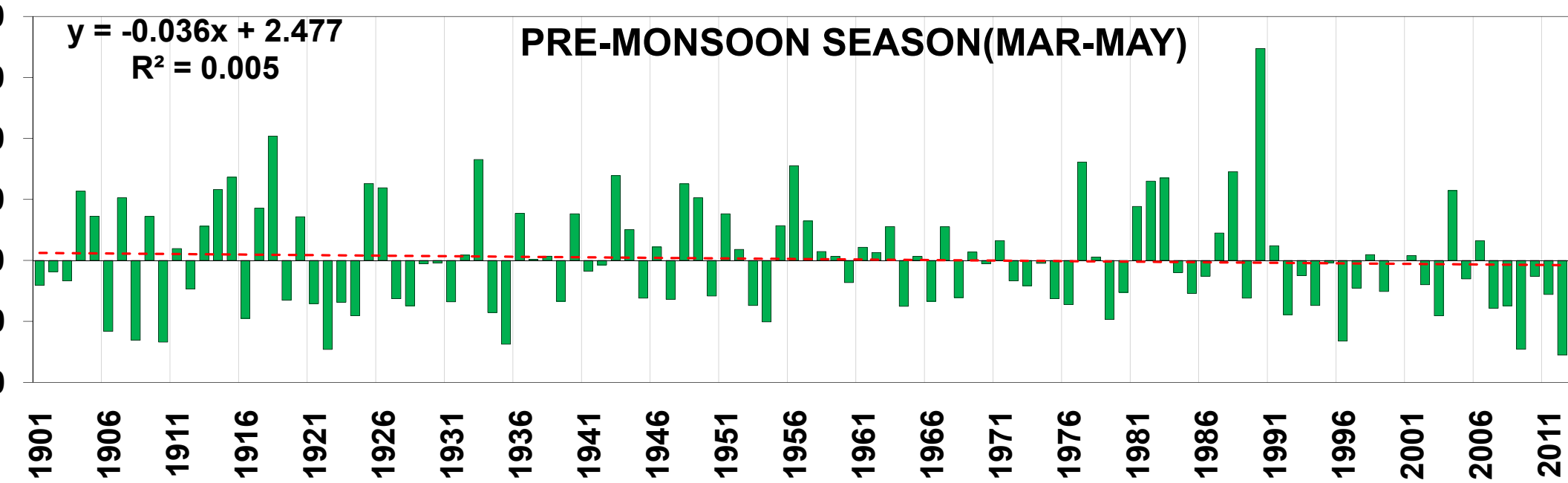
Trend in Rainfall

Time Series of All India Annual Rainfall percentage Departure (1901-2021)



ual Rainfall anomalies (% Departure) over India during 1901-





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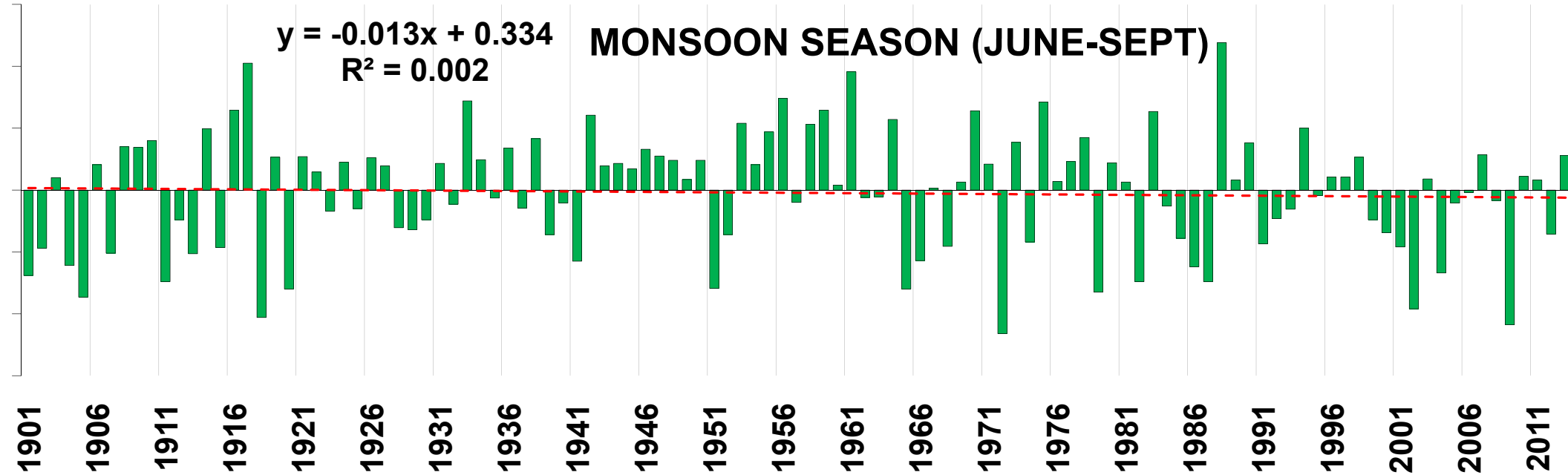
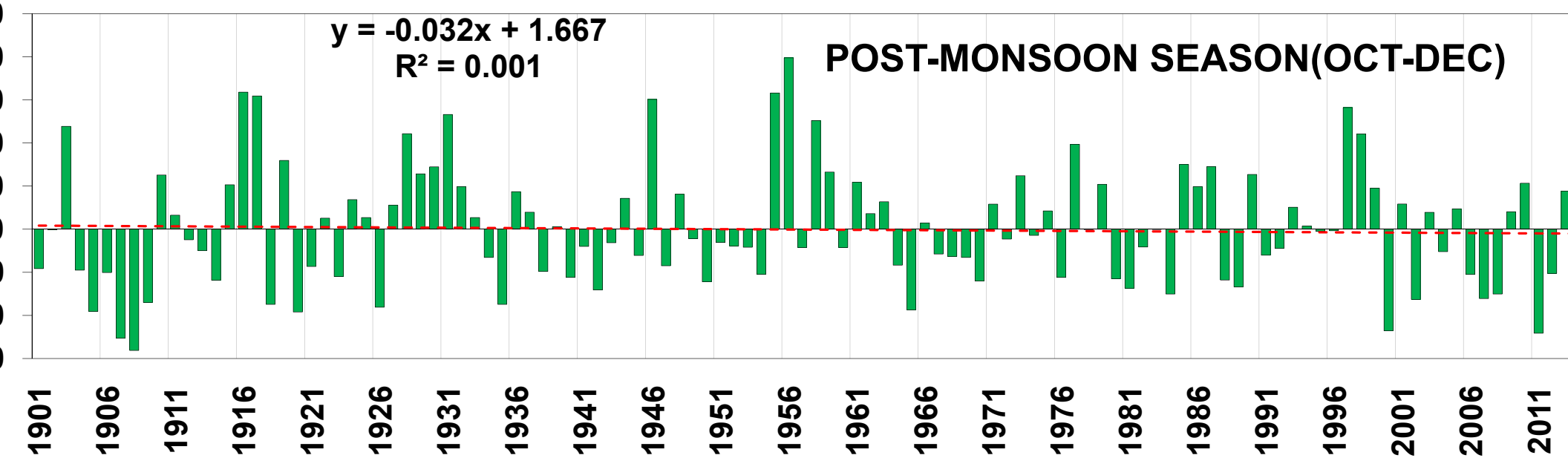
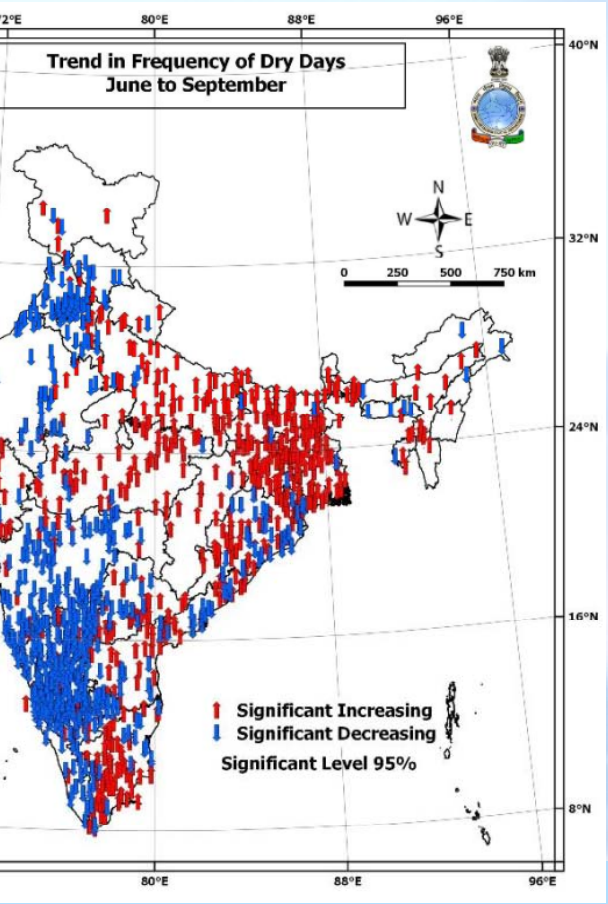
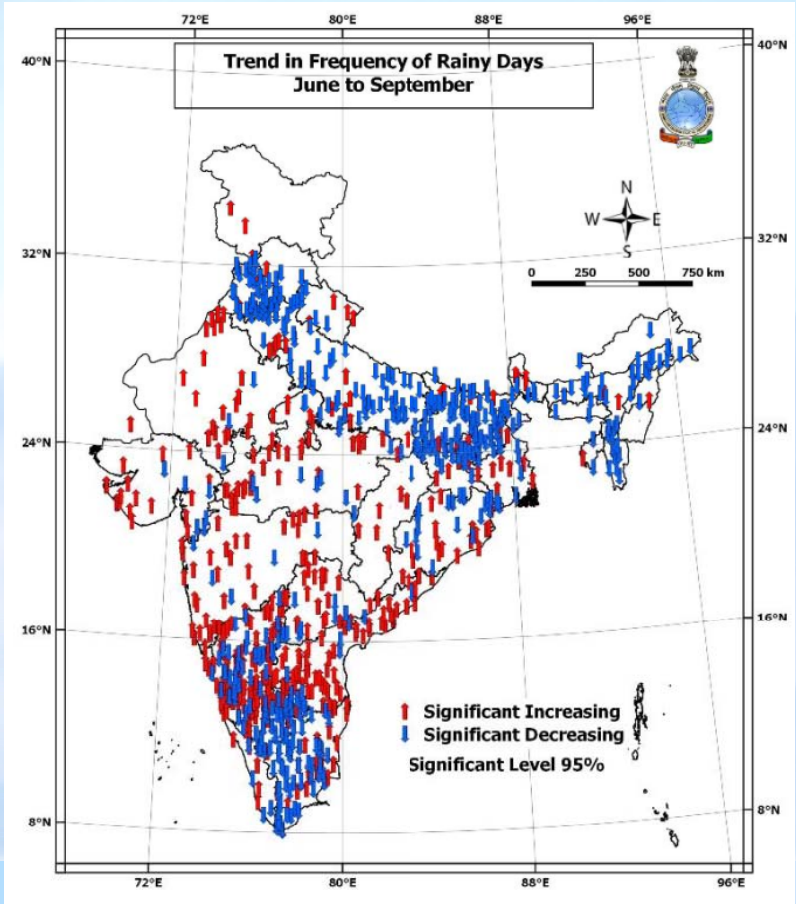


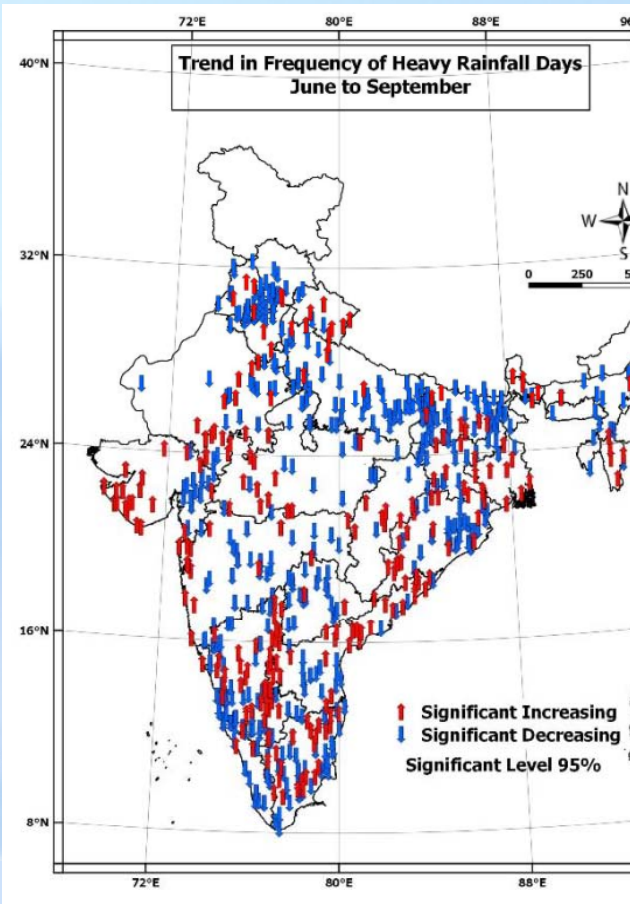


nges in the frequency of dry days, rainy days (daily rainfall of 2.5 mm but less than 6.5 cm) and heavy rainfall days (rainfall greater than equ 6.5 cm) in terms of increasing or decreasing trends during 1989-2018

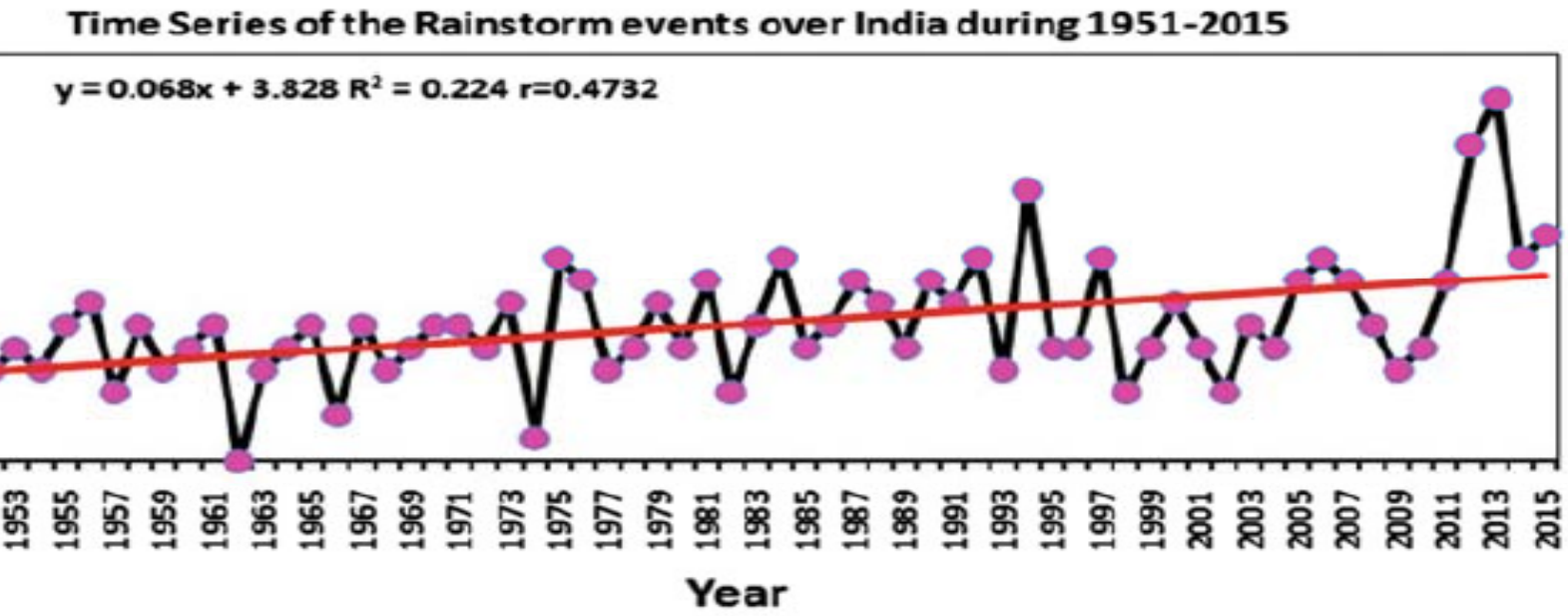
(a) Dry days (b) Rainy days (c) Heavy rainfall days

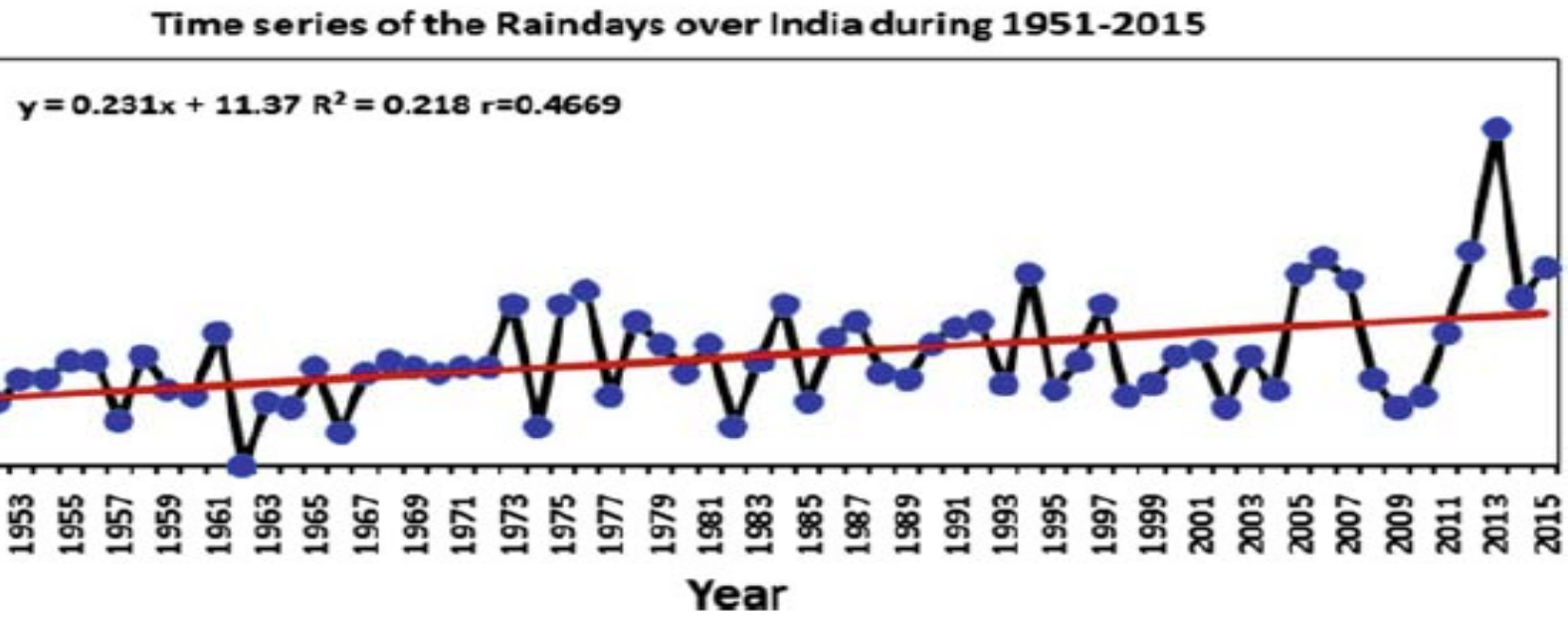






ends in Rainstorm events and Rain Days over India(1951-201

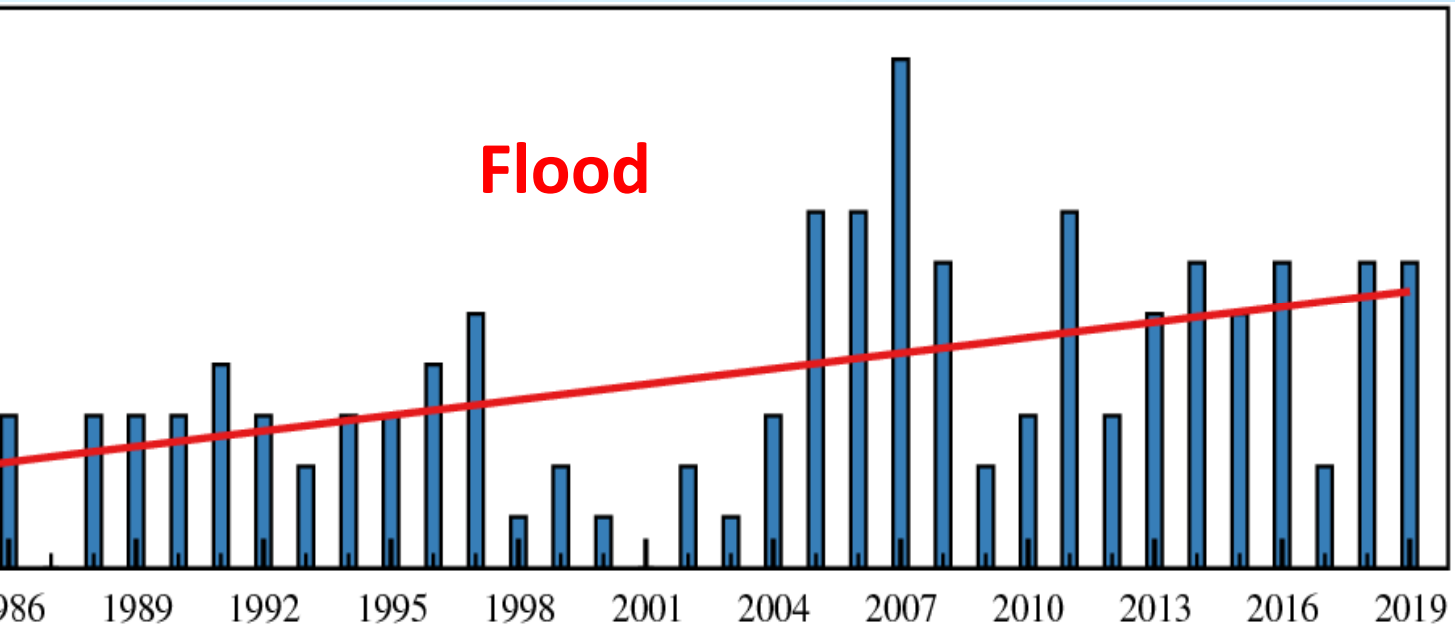


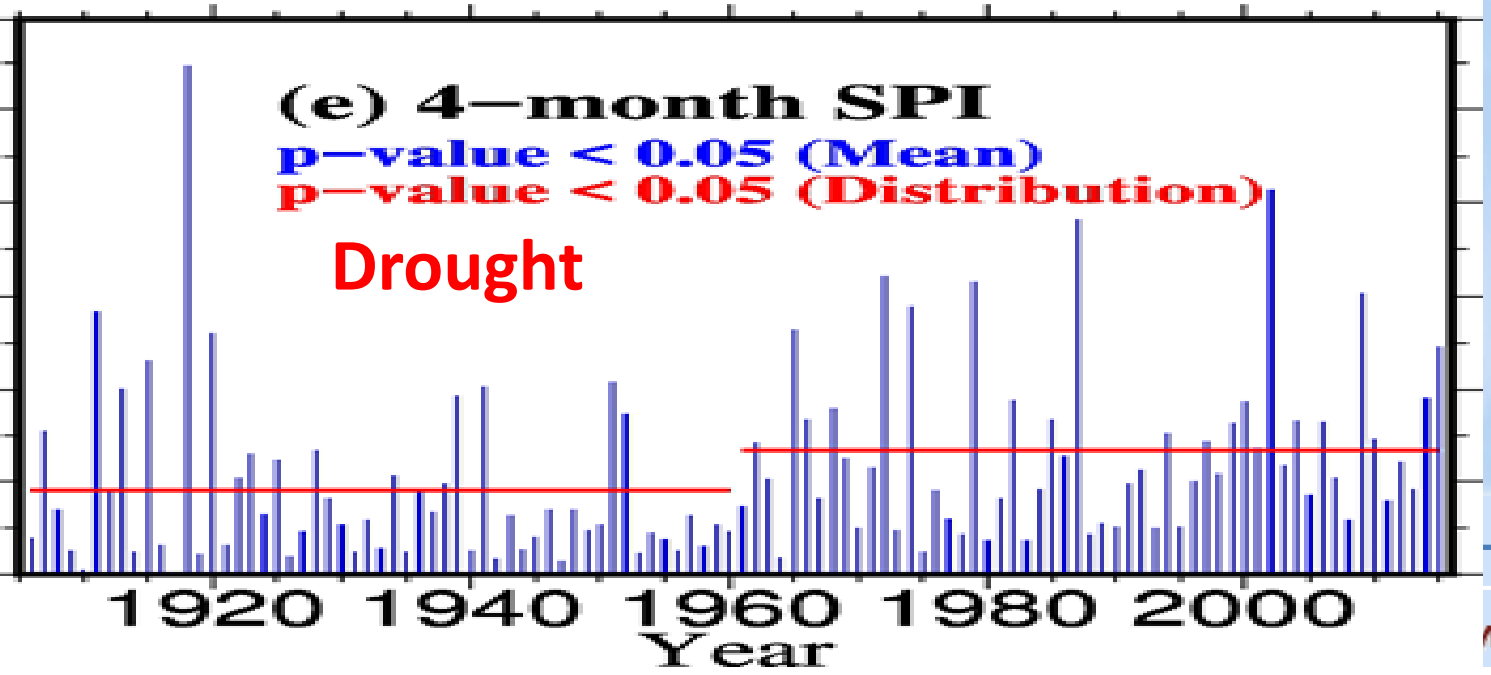


- Guhathukarta 2017, Variabi Trends of E Rainfall & Rains in book e Observed C varaibility & c over Indian Reg

- Edited by Rajeevan & Sl Nayak

Trends in frequency of floods and areal extent of Droughts





- Frequency spatial extent floods and dro over India increased significantly d recent decades

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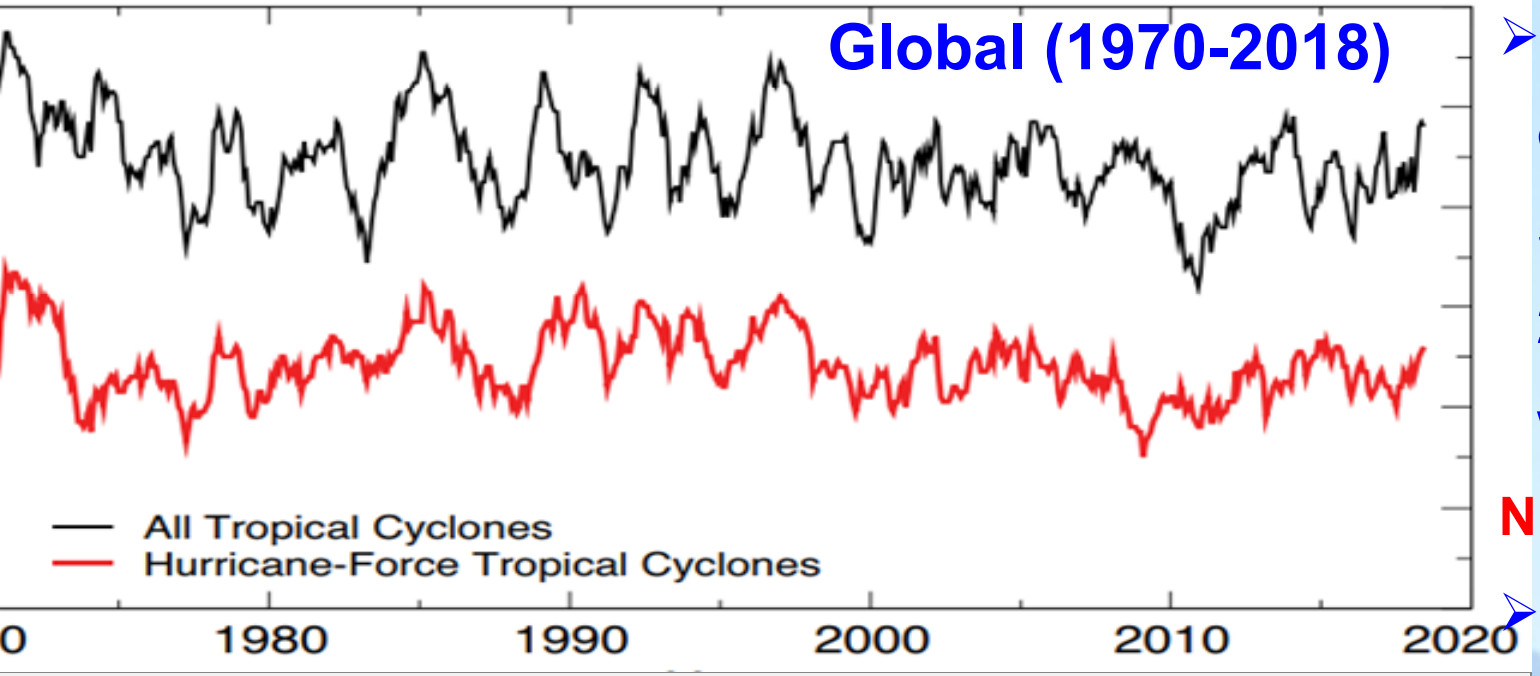
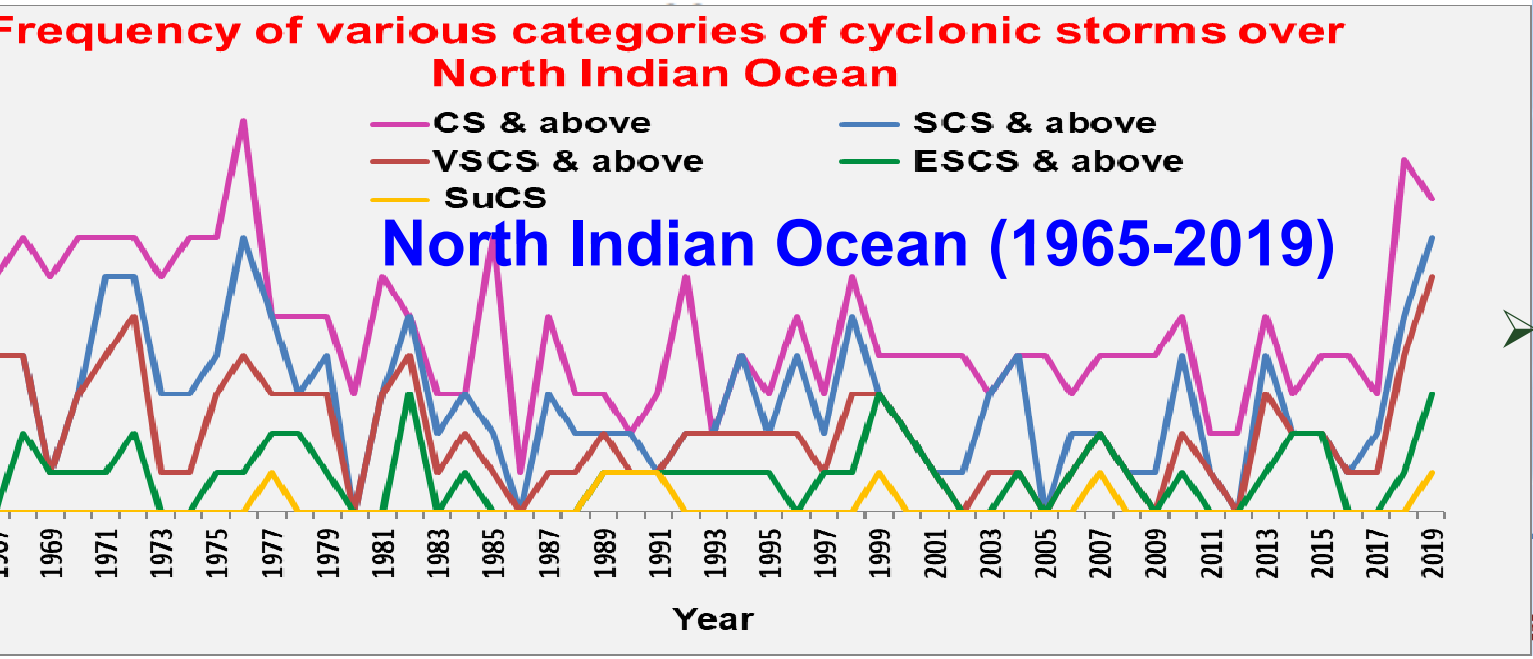
Frequency of Tropical Cyclones





Global trend:

- Increase in global pro
  of TCs reaching categ
  5 intensity in recent de
  25-30% per 1°C of
  warming in recent deca

NIO trend:

- Increase in freque
  extremely severe cycl
  above over Arabian
  recent years.
- Low confidence in de
  anthropogenic influe
  increasing cyclone ac
  Indian Ocean region.