भारत सरकार

Government of India

पृथ्वी विज्ञान मंत्रालय (एम. ओ. ई. एस.)

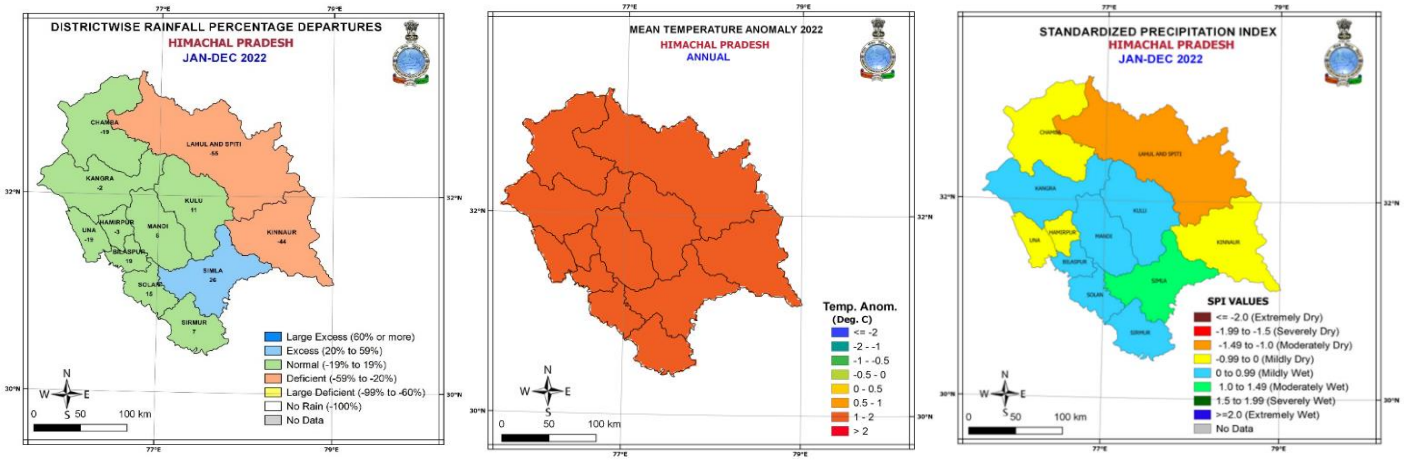
Ministry of Earth Sciences (MoES)

भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTMENT

जलवायु अनुसंधान एवं सेवाएँ

CLIMATE RESEARCH AND SERVICES



हिमाचल प्रदेश राज्य के लिए जलवायु पर वक्तव्य : २०२२

STATEMENT ON CLIMATE FOR THE STATE OF HIMACHAL PRADESH: 2022

द्वारा जारी / ISSUED BY

जलवायु निगरानी और प्रागुक्ति समूह / Climate Monitoring and Prediction Group

जलवायु अनुसंधान एवं सेवाएँ का कार्यालय / Office of Climate Research and Services

भारत मौसम विज्ञान विभाग / India Meteorological Department

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हिमाचल प्रदेश राज्य के लिए जलवायु पर वक्तव्य: २०२२
Statement on Climate for the state of Himachal Pradesh: 2022

जलवायु अनुसंधान एवं सेवाएँ का कार्यालय
O/o Climate Research and Services, IMD
Pune 411 005

Preamble:

It gives me immense pleasure to share this scientific document titled, "Statement on Climate for the state of Himachal Pradesh for 2022" prepared by office of Climate Research and Services, India Meteorological Department, Pune (Ministry of Earth sciences). The statement of climate is attempting to capture the regional climate variability of the state especially with reference to weather parameters like; temperature and rainfall which has huge impact on various sectors like agriculture, health, power, water management and many other critical domains. The information on severe weather analysis is also presented in this along with the statistics which could be, one of the important inputs for state for its planning purpose, disaster managements issues and overall the economic sustainability and growth. With the continuous projections of climate globally, indicating the possibility of increase in the severe weather events along with its severity, both at global and regional level, this annual update will be very useful to all concerned. The data used in this analysis is from 1901 to 2022 (122 years). I am sure this yearly update with climatological perspectives, will create more awareness among all the stakeholders, users in the state about the climate of the state and would enable to move parallelly with relevant global and regional scientific directives or advisories in the coming time.

This statement of 2022 which my office is conveying to your good office, would suggest here to have active participation from the state with required inputs in areas like economic losses, infrastructural losses, agricultural and other relevant inputs due to severe weather and other weather-related factors. The future Climate statements could be a joint publication of state government authorities of Himachal Pradesh and India Meteorological Department, with your kind cooperation and support. I am sure, that will have more improved contents and added value too. I wish that such joint ventures and integrated approach will yield more benefits to the society, state and in turn to our Nation. Any suggestion to improve the contents of this document will be highly appreciated.

Looking forward for your feedback and will work together.

K. S. Hosalikar
Head, Climate Research and Services,
India Meteorological Department,
Pune.

February 2023

HIGHLIGHTS

The Himachal Pradesh State averaged annual mean land surface air temperature (17.6 ^{0}C) during 2022 was 1.2^{0}C warmer than its Long Period Average (LPA) for the period 1981-2010 thus making it the 2nd warmest year on record for the state since 1901.

The annual maximum temperature averaged over the state during the year 2022 was of 1.0^{0}C above its LPA ((5th warmest since 1901), while annual minimum temperature was warmer by 1.3^{0}C (1st warmest since 1901).

Out of 12 districts of the state, 1 received excess rainfall (20% to 59% of its 1971-2020 period LPA) and 9 districts received normal rainfall (-19% to +19% of its LPA) and 2 districts received deficient rainfall (-59 % TO -20% of its LPA)

Objective

The objective of this brief report is to provide the analysis of state's temperature, rainfall and extreme weather events that occurred during 2022. This report will be useful for various stakeholders and general public who are interested on the latest weather and climate conditions and its impact in 2022.

Introduction

India Meteorological Department (IMD) is the official agency responsible for providing operational weather and climate services required for the country in various sectors. IMD provides climate services through its office of the Climate Research and Services (CRS) situated in Pune. As part of its climate monitoring activities, CRS office in coordination with IMD's state Meteorological Centers and state governments have decided to issue the statement of annual climate 2022 for each individual state in line with the annual statement of climate issued for the country. The present statement contains, important information about the monthly, seasonal and annual State averaged temperature, rainfall and Standardized Precipitation Index (SPI) for the year 2022 and as well as long term trend for some of the parameters. This statement also includes State specific information related to various extreme weather and climate events experienced during 2022.

Temperature

The monthly, seasonal and annual maximum, minimum and mean temperature anomalies averaged over the State of Himachal Pradesh for the year 2022 is given in the **Fig. 1**. The anomalies were computed based on the LPA for the period 1981-2010. Top 10 warmest/coolest months/seasons are marked on the graph. The winter season (January – February) was relatively cooler, while other seasons were warmer for the state. Especially the Pre-monsoon (March to May) season as a whole was record warmer for the state. The annual maximum temperature averaged over the state during the year 2022 was warmer than average with anomaly of 1.0^{0}C (5th warmest since 1901) while annual minimum

temperature was warmer than average by 1.3^{0}C (1st warmest since 1901). The mean temperature for the state was 1.2^{0}C warmer than the average (2nd warmest year on record since 1901).

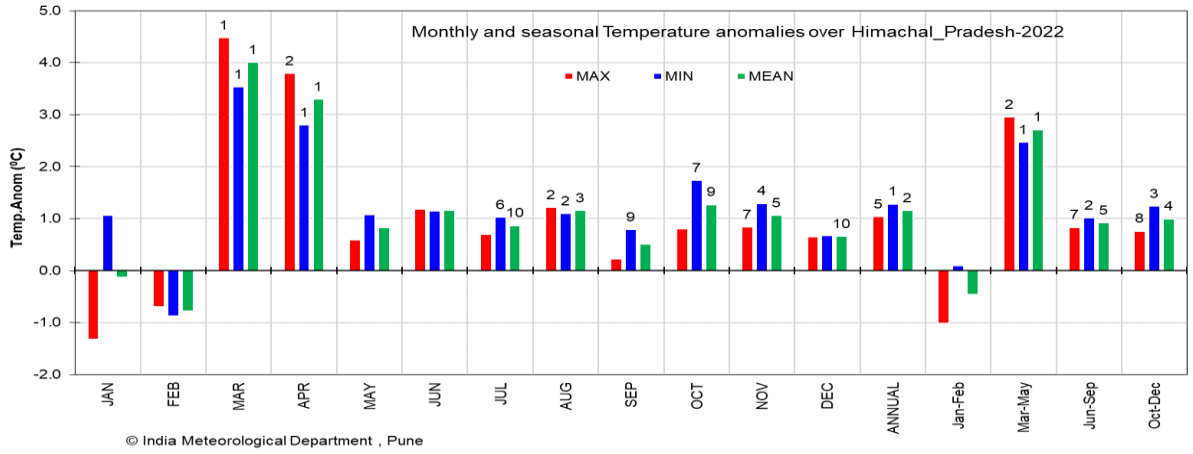

Fig. 1: Monthly and Seasonal Maximum, Minimum and Mean Temperature anomalies averaged over Himachal Pradesh during 2022.The anomalies were computed from the LPA base period of 1981-2010. The numbers above/below the bar indicate top 10 warmest/coolest ranking since 1901.

The Spatial pattern of Annual Maximum, Minimum and Mean Temperature anomalies over Himachal Pradesh during 2022 given in **Fig 2**. The temperature anomalies were between 1 – 2 ^{0}C over most parts of the state. However, the western districts of Himachal Pradesh were relatively less warm in respect of maximum temperature with anomaly between 0.5 to 1^{0}C.

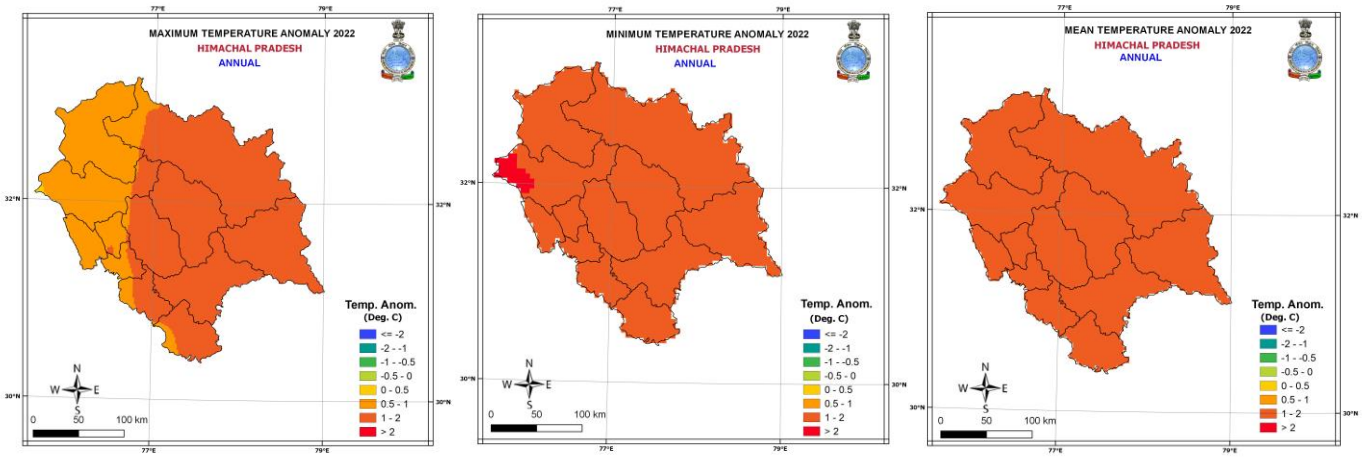

Fig. 2: Spatial pattern of Annual Maximum, Minimum, and Mean Temperature anomalies over Himachal Pradesh during 2022. The anomalies were computed from LPA for the base period of 1981-2010.

The time series of variation of annual maximum, minimum and mean land surface air temperature anomalies averaged over the State for the period 1901-2022 is given in **Fig 3**. A significant increasing trend of 1.50 ^{0}C/100 years is observed in the State averaged annual mean temperature during 1901-2022. It was more significant in respect of maximum temperature (+2.18^{0}C/100 years) and relatively less significant (+0.82^{0}C/100 years) in respect of minimum temperature. The five warmest years on record in order for Himachal Pradesh are 2016(anomaly+1.361°C), 2022(+1.16°C), 2017(+0.98°C), 2010(+0.9°C) and 2021(+0.78°C).

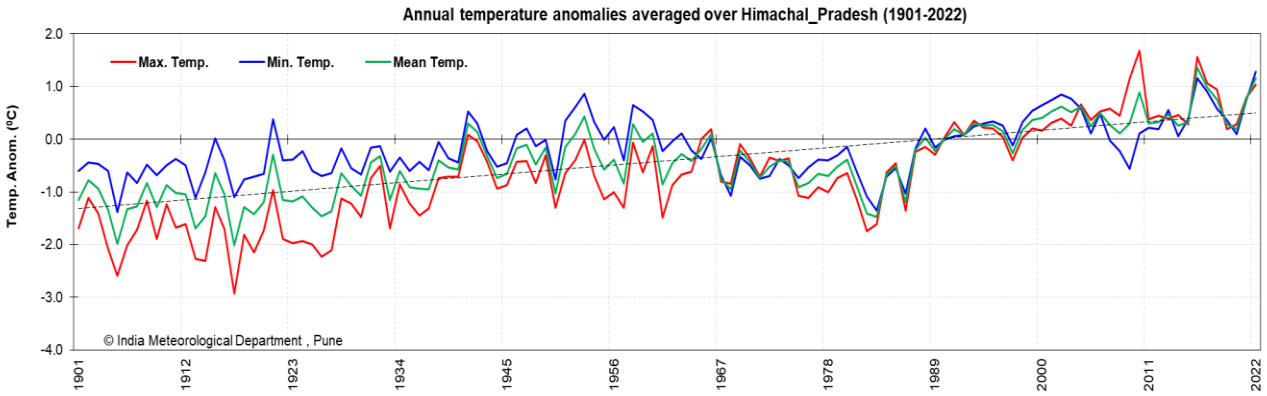

Fig. 3: Annual maximum, minimum and mean land surface air temperature anomalies averaged over the State of Himachal Pradesh for the period 1901-2022. The anomalies were computed with respect to the base period of 1981-2010. The dotted black line indicates the linear trend in the annual mean temperature time series.

Fig.4 (a and b) shows daily variation of minimum and maximum temperature anomaly during the year respectively. The anomalies were computed with respect to the base period of 1981-2010. State was warmer in respect of minimum temperature throughout the year on most of the days and maximum temperature was warmer mostly during the pre-monsoon and December months.

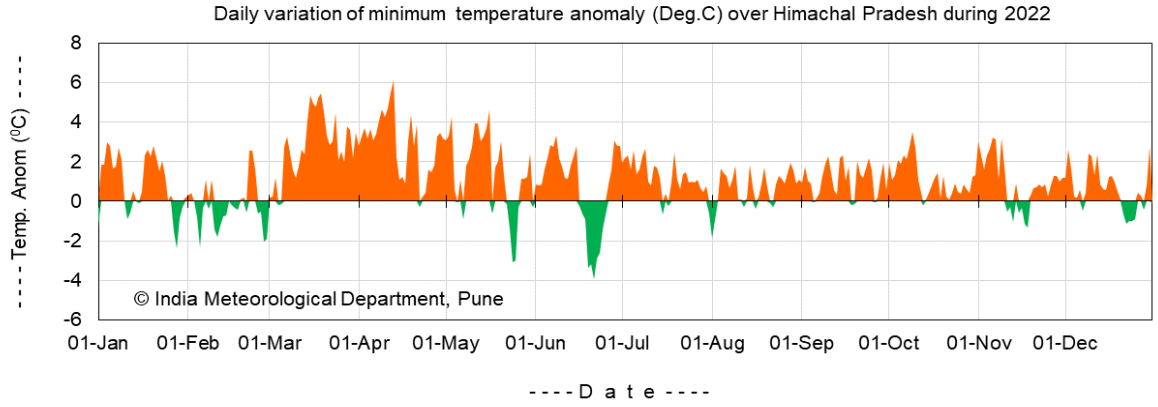

Fig. 4(a): Daily variation of minimum temperature anomaly (^{0}C) over Himachal Pradesh during 2022

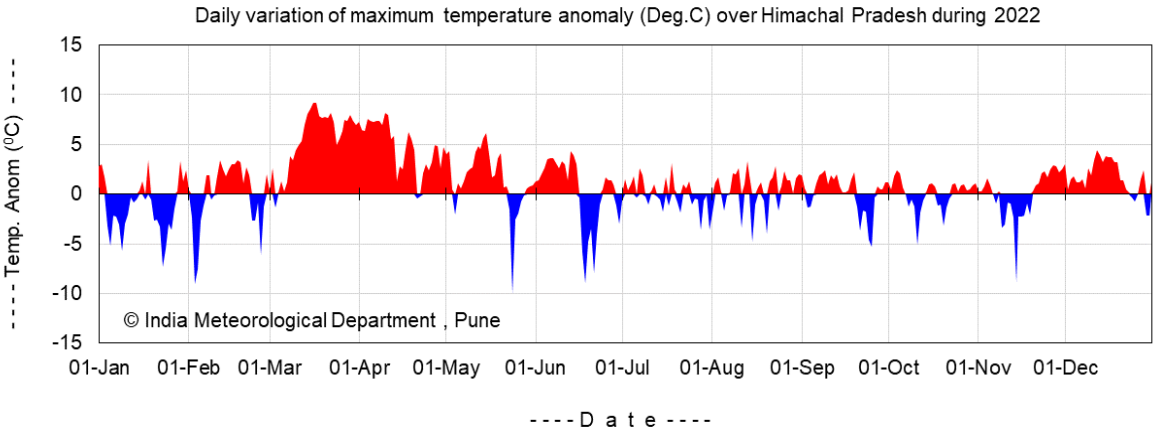

Fig. 4(b): Daily variation of maximum temperature anomaly (^{0}C) over Himachal Pradesh during 2022

Rainfall

Based on 1971-2020 climatology, Himachal Pradesh state as a whole receives 15 % of its annual rainfall during the winter season (Jan-Feb), 19.3% during the Pre-Monsoon season (Mar-May), 59.0 % during the southwest monsoon season (Jun-Sept) and 6.7 % during the Post-Monsoon season (Oct-Dec). Thus, though the Southwest monsoon season is the principal rainy season for the state, the state receives considerable rainfall during the winter and pre monsoon seasons also. **Fig. 5** shows the annual departure of rainfall over different districts of Himachal Pradesh during 2022. The anomalies were computed based on the 50 year LPA for period of 1971-2020. Out of 12 districts of the state, 1 district (Simla) received excess rainfall (20% to 59% of its LPA), 9 received normal rainfall (-19% to +19% of its LPA) and 2 received deficient normal (-59 % to -20% of its LPA).

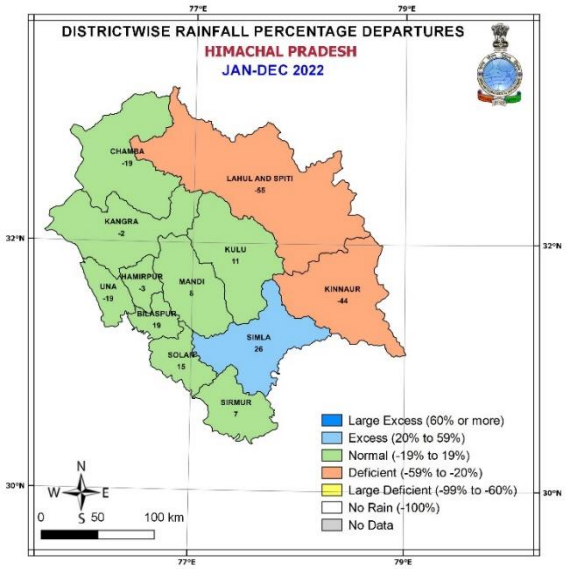

Fig. 5: District-wise annual rainfall percentage departures

The daily variation of rainfall (mm) during the year for the state is shown in **Fig. 6(a)**. The state received above normal rainfall on some days in the winter season and below normal rainfall on many days in the pre monsoon season. During monsoon season, the state received below normal rainfall at a stretch for many days in June and above normal rainfall on many occasions during July.

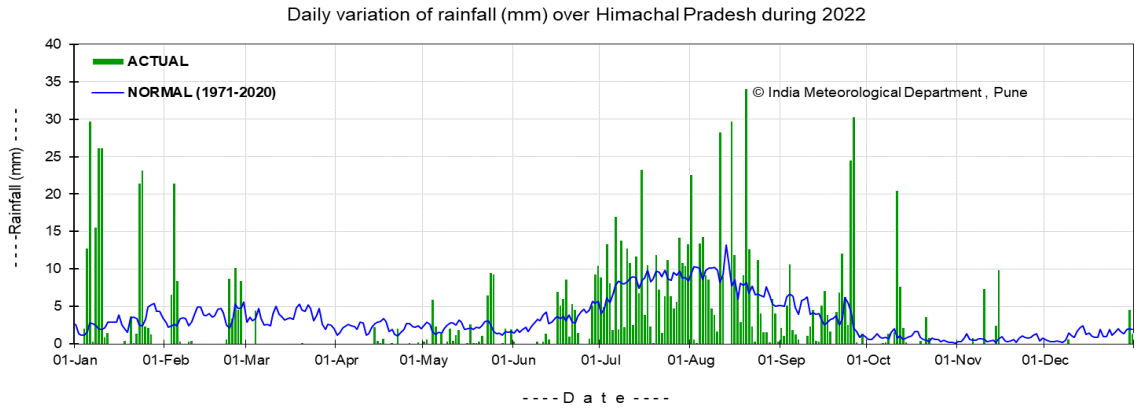

Fig. 6(a): Daily variation of rainfall (mm) averaged over Himachal Pradesh during the year.

The time series of variation of % departure of seasonal and annual rainfall for the state for the period 1901-2022 are shown in **Fig. 6(b) and 6(c)** respectively. The departures are calculated with respect to the LPA base period of 1961-2010. For the monsoon season and the year 2022, the state received 96% and 87% of its LPA rainfall respectively.

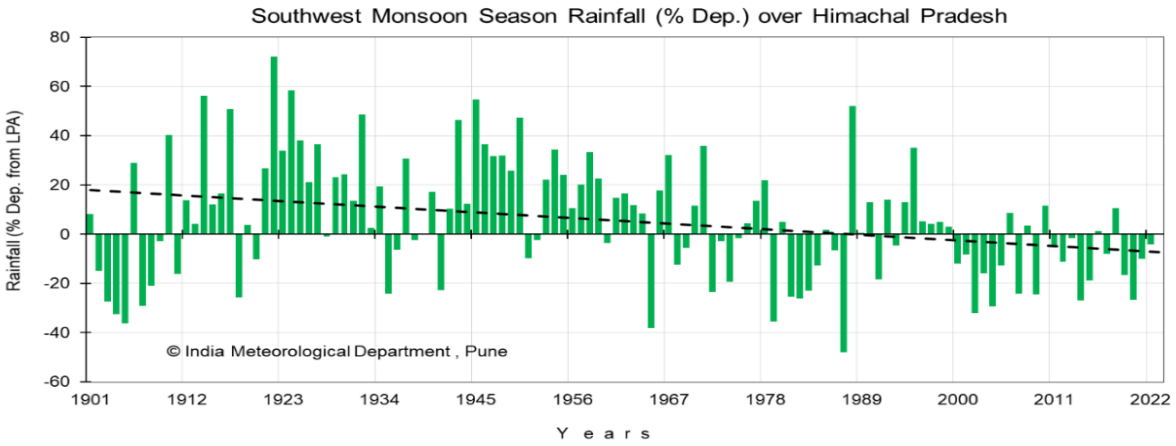

Fig. 6(b): Time series of % departure of southwest monsoon rainfall averaged over Himachal Pradesh (1901-2022)

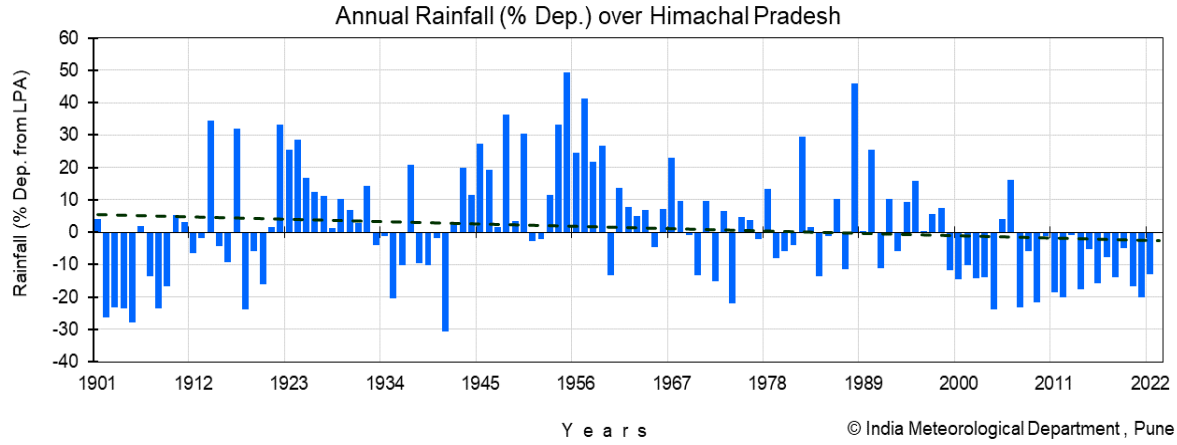

Fig. 6(c): Time series of % departure of annual rainfall averaged over Himachal Pradesh (1901-2022).

Table 1 below shows the monthly, seasonal and annual rainfall statistics for the state for the year 2022. The state as a whole received excess rainfall during winter, large deficient rainfall during pre-monsoon season, deficient during the post monsoon season and normal during the monsoon season and year as a whole.

TABLE 1

MONTH / SEASON	ACTUAL (mm)	NORMAL (mm)	% DEP.	CATEGORY
JANUARY	167.2	85.3	96.0	LE
FEBRUARY	80.5	101.8	-21.0	D
WINTER SEASON	247.6	187.1	32.3	E
MARCH	5.7	113.4	-95.0	LD
APRIL	8.5	64.0	-86.7	LD
MAY	53.9	63.3	-14.9	N
PRE-MONSOON SEASON	68.1	240.7	-71.7	LD
JUNE	66.1	101.1	-34.6	D
JULY	263.1	255.9	2.8	N
AUGUST	243.4	256.8	-5.2	N
SEPTEMBER	134.2	120.6	11.3	N
MONSOON SEASON	706.9	734.4	-3.7	N
OCTOBER	38.0	25.1	51.3	E
NOVEMBER	19.5	19.7	-1.0	N
DECEMBER	6.4	38.1	-83.3	LD
POST-MONSOON SEASON	63.9	82.9	-23.0	D
ANNUAL	1086.4	1245.1	-12.7	N

CATEGORY		
	LARGE EXCESS [LE]	+60 % OR MORE
	EXCESS [E]	+20 % TO +59 %
	NORMAL [N]	-19 % TO +19 %
	DEFICIENT [D]	-59 % TO -20%
	LARGE DEFICIENT [LD]	-99 % TO -60 %
	NO RAIN [NR]	-100%

The district-wise rainfall trends for annual rainfall for the period 1901-2021 is given in Fig 7. It is seen that among all the districts of the state, Kulu and Una show increasing trend. Rest all the districts show decreasing trend where Champa, Lahul and Spiti and Kinnaur shows significantly descresing trend.

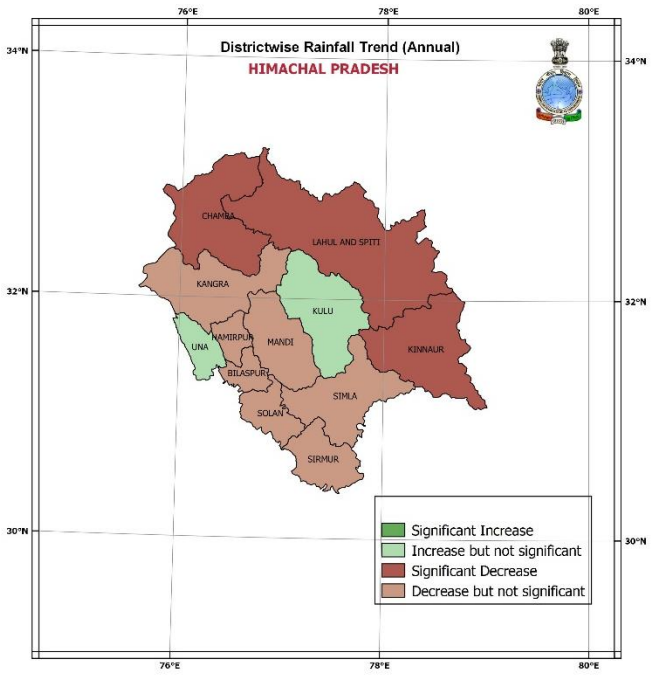

Fig. 7: District-wise annual rainfall Trend for Himachal Pradesh (period of study 1901-2022)

Standardized Precipitation Index (SPI)

The district wise Annual SPI Map for the state for the year 2022 is shown in **Fig. 8**. The SPI is based on precipitation and is used for measuring drought. This index is negative for drought and positive for wet conditions. As the wet and dry conditions become more severe, the index becomes more positive or negative. Mildly wet to Moderately wet conditions were observed over seven districts of the state. Mildly dry conditions were observed over some districts of the state viz. Chamba, Harimpur, Kinnaur and Una and moderately dry conditions were observed Lahul and Spiti district.

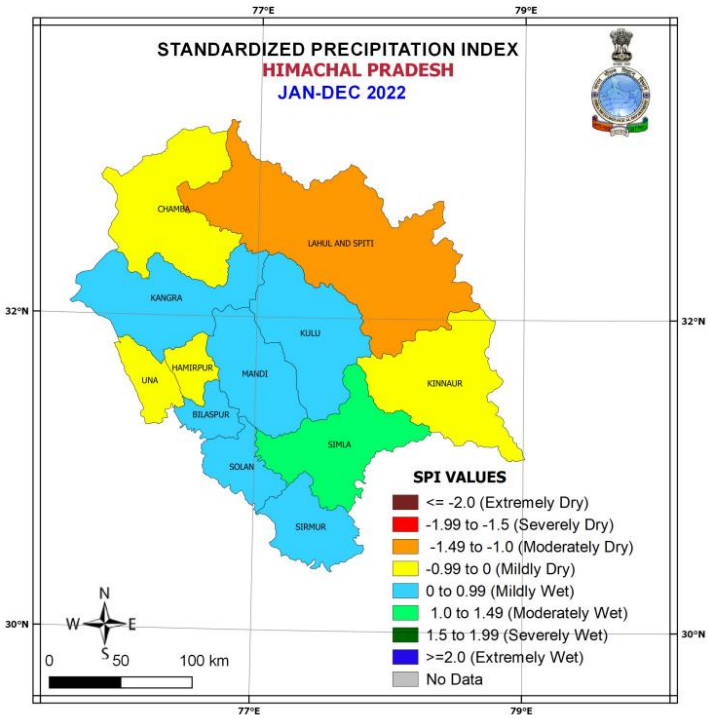

Fig. 8: District wise Annual SPI Map for Himachal Pradesh for the year 2022

Extreme Weather Events

Heavy (64.5-115.5mm), Very heavy (115.6-204.4 mm) and extremely heavy (more than 204.4 mm) rainfall events were recorded over some stations of Himachal Pradesh. **Fig. 9** shows the location and frequency of occurrence of such events during the year. Table 2 below shows the extremely heavy and very heavy rainfall values with the date of its occurrence and the location.

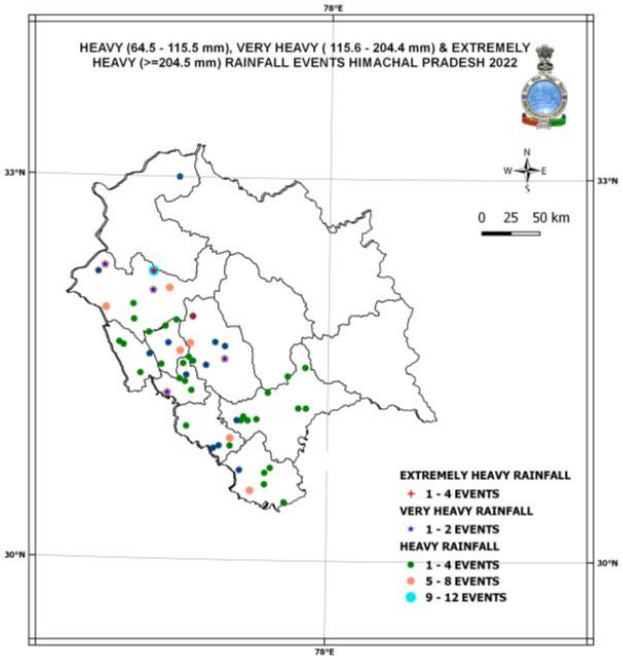

Fig. 9: Location and frequency of Heavy Rainfall, Very Heavy Rainfall and Extremely Heavy Rainfall events reported over stations of Himachal Pradesh during the period January to December 2022.

Table 2

Extremely heavy rainfall# (> 204.4 mm) or very heavy rainfall # (115.6-204.4 mm) recorded over some stations of Himachal Pradesh during January – December 2022.

DATE	STATION NAME	RAINFALL (mm)
06-Jul	BAIJNATH	128.0
11-Jul	DHARMSALA	227.4
15-Jul	NURPUR/JASSUR	120.0
17-Jul	KASAULI	163.0
	BANGANA_F	131.0
18-Jul	DHARAMPUR	121.0
20-Jul	NAGROTA SURIAN	130.0
24-Jul	GHUMARWIN	137.0
	GOHAR	120.0
31-Jul	DHARMSALA	137.2
11-Aug	AGHAR	118.0
	HAMIRPUR	120.0
	SUNDARNAGAR	141.8
15-Aug	DHARMSALA	215.3

DATE	STATION NAME	RAINFALL (mm)
15-Aug	JOGINDARNAGAR	149.0
19-Aug	DHARMSALA	181.5
20-Aug	NAINA DAVI	184.4
	BAIJNATH	155.0
	DHARMSALA	333.0
	BIJAHI	125.0
	GOHAR	129.0
	JOGINDARNAGAR	210.0
	MANDI	119.6
	PANDOH	117.5
11-Sep	NAINA DAVI	160.6
16-Sep	PACHHAD	122.3
26-Sep	PACHHAD	167.0

(#: Rainfall figures are for past 24 Hrs. ending on 8:30 Hrs. IST of the date)

The location of impact occurred due to major extreme weather events in Himachal Pradesh during the year 2022 is shown in **Fig 10**. The state experienced floods/heavy rainfall, snowfall and lightning/thunderstorms during the year 2022.

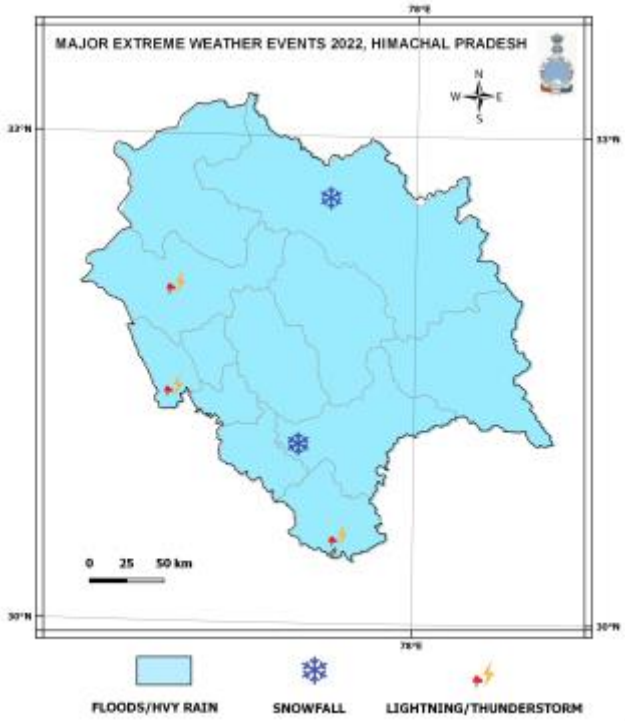

Fig.10: Locations of impact occurred associated with Major Extreme Weather Events occurred during 2022 (details provided in the Table 3 below).

Table 3

Major extreme weather events during 2022 which caused loss of human lives* in Himachal Pradesh

Event	Number of causalities and Date	Season	Affected districts
Lightning and Thunderstorm	**3** (22, 29 May; 10, 11 Sep.)	Pre-Monsoon (March to May), Monsoon (June to September)	Kangra, Sirmaur, Una
Floods and Heavy Rain	**75** (17 Jan.; 22, 29 May; 29 and 30 Jun.; 6, 14 Jul.; 8, 11, 15, 19, 20 Aug.; 25 Sep.)	Winter (January and February), Pre-Monsoon (March to May), Monsoon (June to September)	Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahaul and Spiti, Mandi, Shimla, Sirmaur, Solan, Una
Snowfall	**10** (10 Jan.; 12 Feb.; 17 Apr.)	Winter (January and February), Pre-Monsoon (March to May)	Lahaul and Spiti, Shimla

(: Based on the media reports and the reports from disaster Management Authorities of the government)*

Summary

The Statement on Climate for the state of Himachal Pradesh for 2022 is prepared based on the real-time meteorological observation across the state at the district/block level in different seasons and taking reference of more than 100 years of past climate data for the state. So, the observation made in this report are very important for different sectors like agriculture, health, power, disaster management, and water, etc. This report which is prepared by the India Meteorological Department is suggesting for crucial inputs from the state government in future. It is suggested that with the demanding need at global and regional level related to the climate change for sustainable development, the future joint reports/ventures would be a path breaking for the society. By saying so, following are the submitted:

(i) The report may please be circulated to all the concerned ministries/departments of the state government and other relevant stakeholders in the state.

(ii) Based on the feedback, further course of actions in different climate sectors can be planned, like holding workshops, pilot studies, and any other joint ventures.

Apart from this annual climate statement, India Meteorological Department, Pune comes out regularly with climate updates which are shared on the public domain for the users' benefit. It is suggested to check for these updates regularly on the India Meteorological Department (IMD), Pune website: https://www.imdpune.gov.in/.

Contact

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