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ANALYSIS OF RECENT CLOUDBURST EVENTS IN HIMACHAL PRADESH

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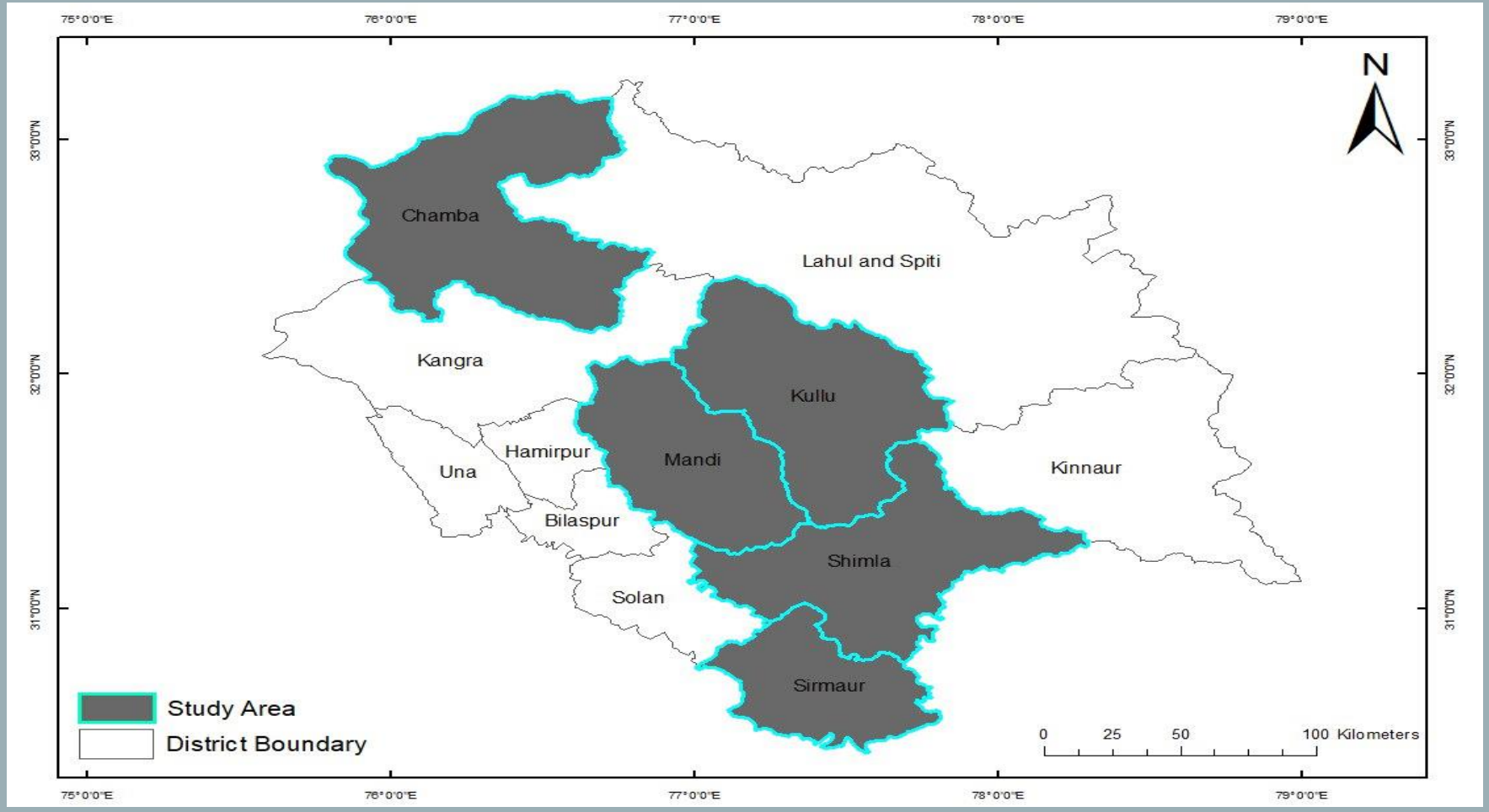
INTRODUCTION

Studying cloudbursts in the hilly terrain of the Himachal region is a challenging yet crucial task due to the substantial threat they pose to the lives of inhabitants and the extensive destruction of property. This research is dedicated to a thorough examination of various meteorological and geographical parameters.Most of these events in mountainous regions are associated with cumulonimbus or thunder clouds. In a very short time span over a much localized area heavy downpour ranging from 200 to 1000 mm/h occurs in these events.This research will include historical weather data ,temperature ,wind data,topographical features and satellite imaginary to create a comprehensive datasets. The study will focus on several cloudbursts and finding common parameters for analysis.

STUDY AREA

Study area is 5 major districts of Himachal Pradesh which gets heavy rainfall during monsoon season



RESEARCH OBJECTIVE

1.To study about the cloudburst events in Himachal.

2.To study and analyze the precipitation index, Elevation profile, and Temperature pattern

DATA & METHODOLOGY

Landsat 8-9 OLI/TIRS C2 L2

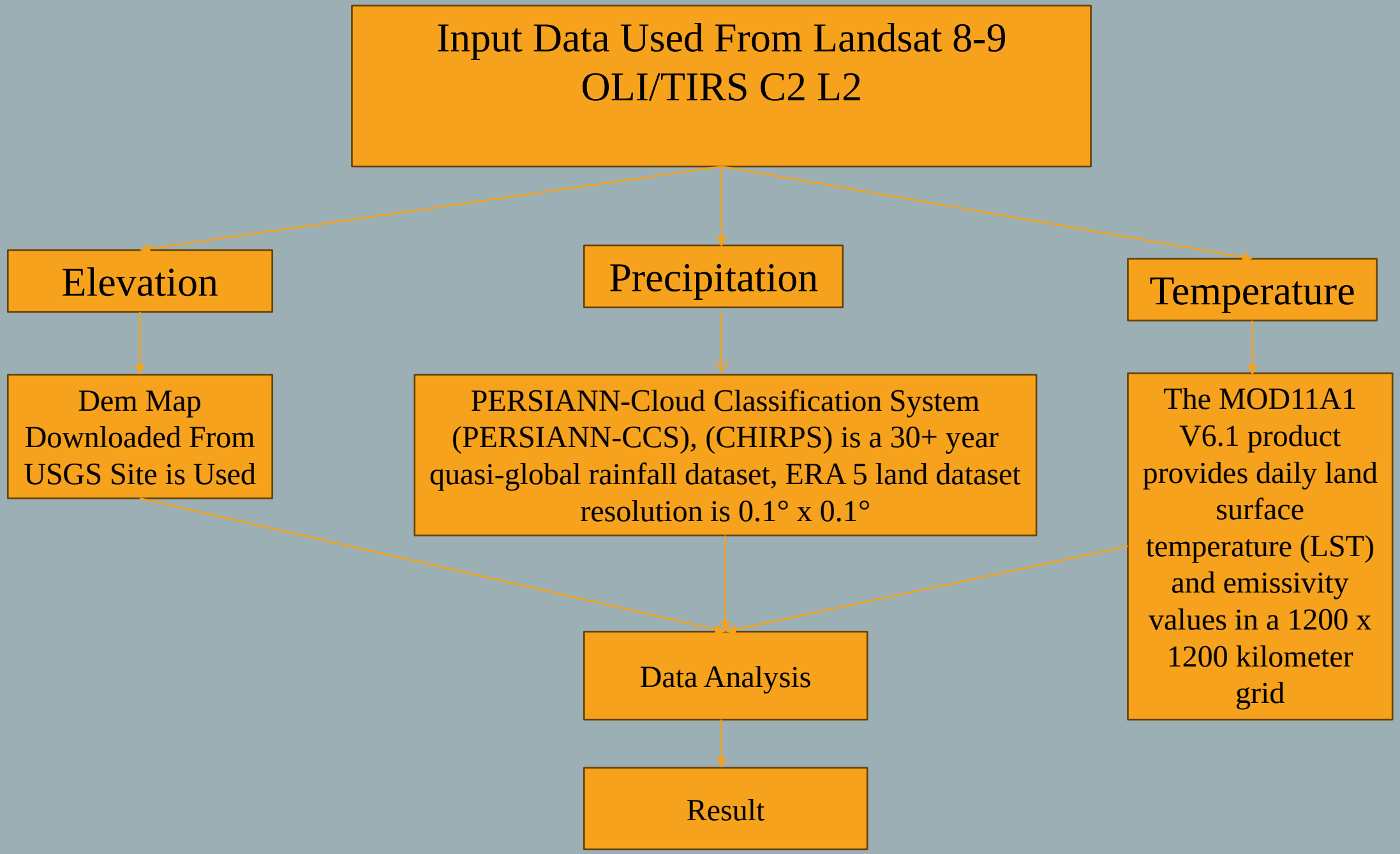
(Raw data used -https://earthexplorer.usgs.gov/)

Composite of Band - 3,5,7

(For Cloud Cover detection and Precipitation)

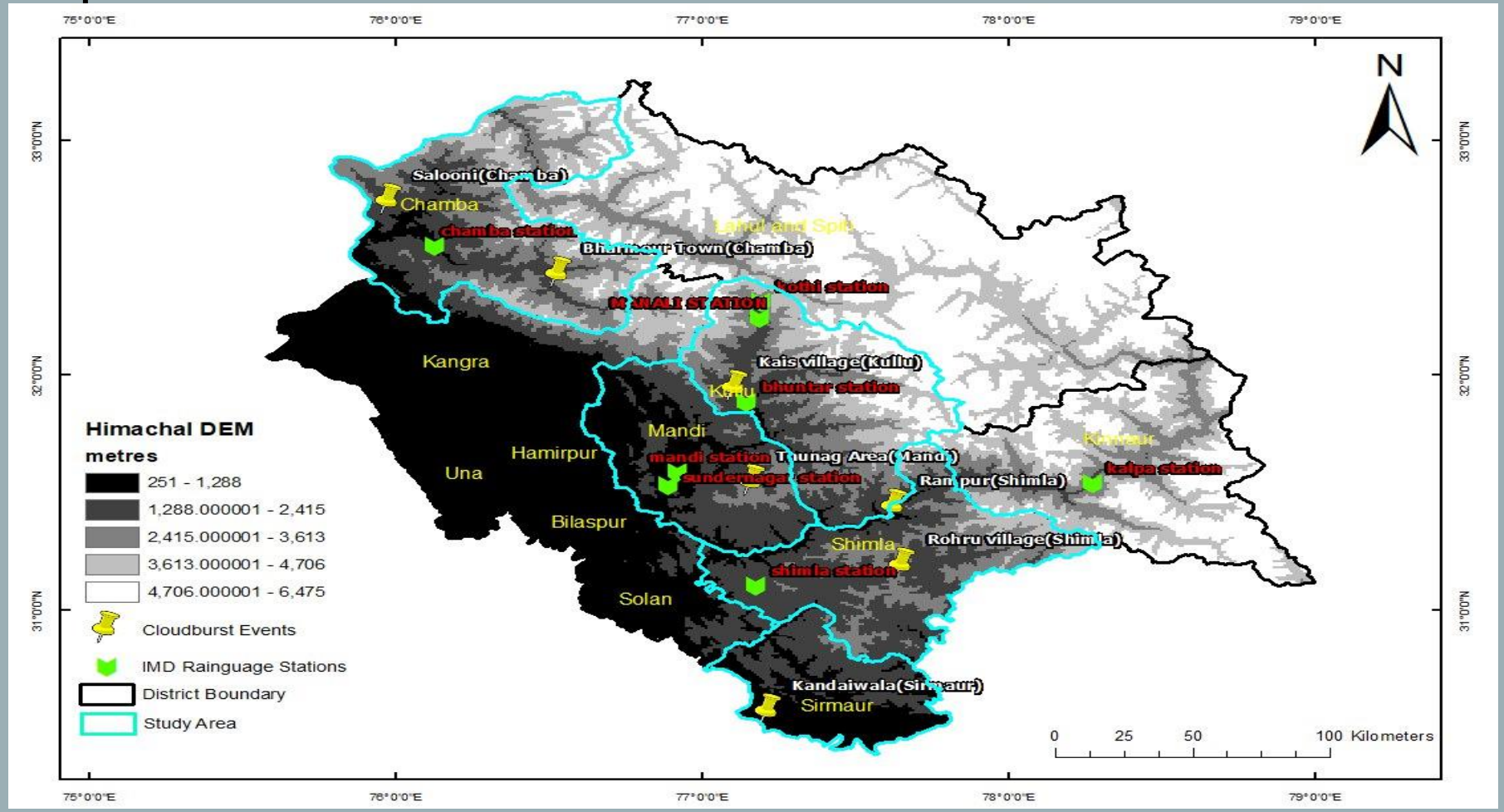
Comparison Of Parameters

(Analysis of various components on different parameters)


Input Data Used From Landsat 8-9 OLI/TIRS C2 L2
Elevation
Precipitation
Temperature
Dem Map Downloaded From USGS Site is Used
PERSIANN-Cloud Classification System (PERSIANN-CCS), (CHIRPS) is a 30+ year quasi-global rainfall dataset, ERA 5 land dataset resolution is 0.1° x 0.1°
The MOD11A1 V6.1 product provides daily land surface temperature (LST) and emissivity values in a 1200 x 1200 kilometer grid
Data Analysis
Result

RESULT & DISCUSSION

In the present review authors tried to discuss findings on most of the important issues linked with cloudburst events right from precipitation details – elevation details – temperature details.

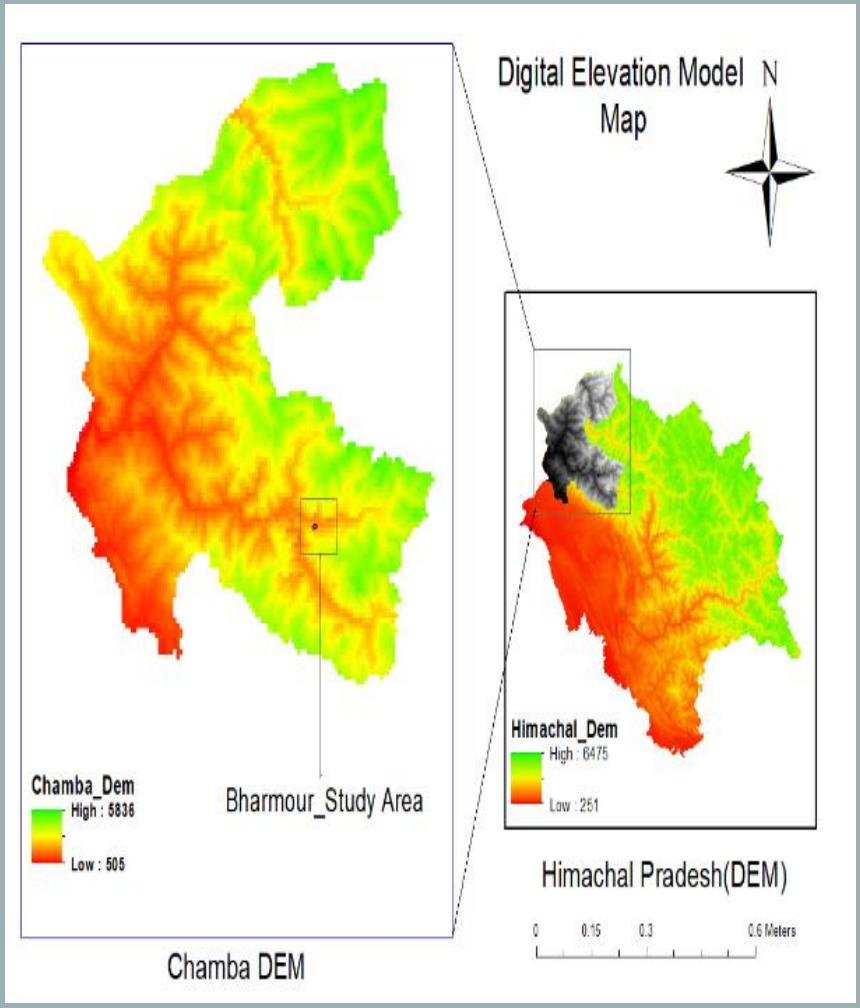


DATE	LOCALITY	DISTRICTS & LATITUDE, LONGITUDE	SOURCE	DAMAGES
25th June	Rampur	Shimla &(31.45,77.630)	https://www.tribuneindia.com/news/	A school, Five houses and Agricultural land
10th July	Thunag Area	Mandi &(31.552,77.165)	https://www.india.com/news/	14 lives lost,Roads filled with debris and mud
17th July	Kias Village	Kullu &(31.957,77.109)	https://timesofindia.indiatimes.com/city	1 dead,3 injured, and 9 vehicles damaged
20th July	Salooni Sub-division	Chamba &(32.752,75.98)	https://timesofindia.indiatimes.com/city/	8 pucca houses, 11 kutcha houses, 4 shops and 16 cowsheds were damaged
22th July	Rohru Village	Shimla &(31.197,77.657)	https://www.outlookindia.com/national	2 people died and 1 missing during Cloudburst in Shimla
26th July	Bharmour Town	Chamba &(32.441,76.535)	https://www.hindustantimes.com/	1 person lost his life
14th August	Kandaiwala Village (Nahan)	Sirmaur & (30.575,77.22)	https://www.livemint.com/news/	1 cowshed along with 3 cattles washed away

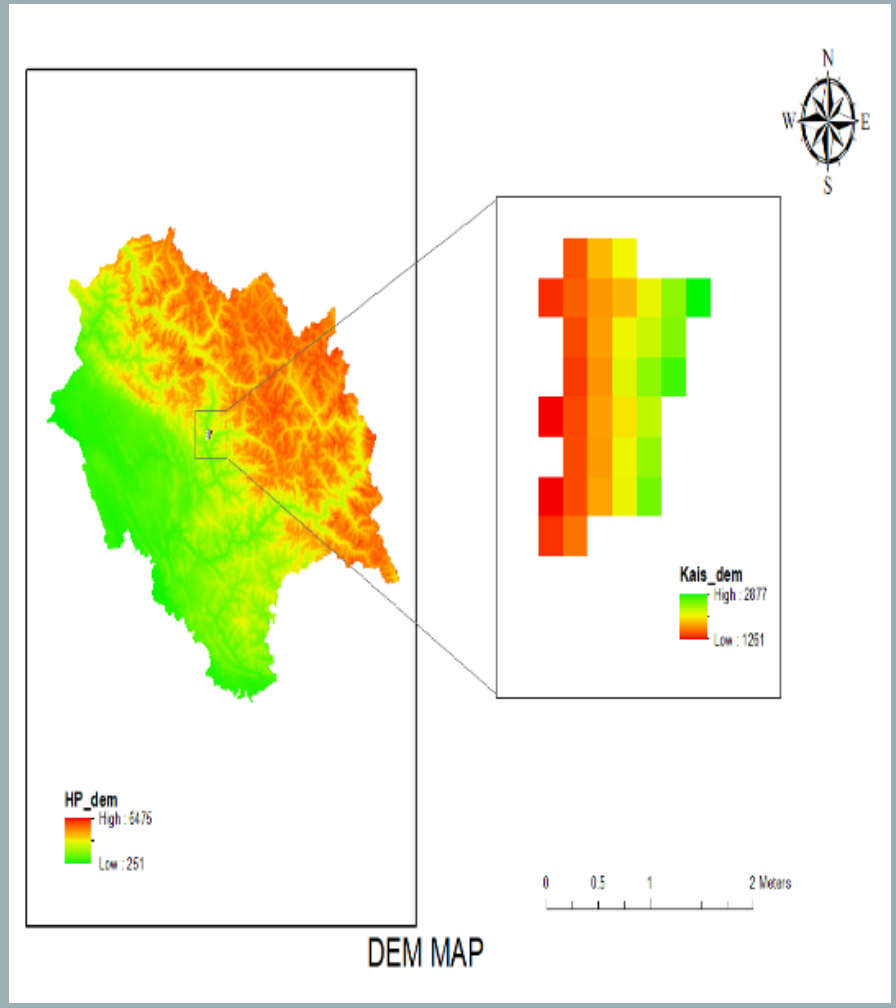
- **Elevation Analysis –**

Elevation analysis aids in determining the vulnerability of different areas susceptible to cloudbursts. Flash flooding is more likely to occur during periods of intense rainfall in low-lying areas or regions with poor drainage systems. Setting priorities for areas in need of preparedness and mitigation is made easier by this analysis.

Elevation of different districts of Himachal Pradesh are shown below in images and they varies from 1000 to 3000 metres. The basic analysis shows that maximum cloudbursts events occur at elevation <1000 metres and intensity and frequency of cloudbursts events are also decided by the elevation factors. The elevation is represented by digital elevation map through Arcmap 10.4.1 software.



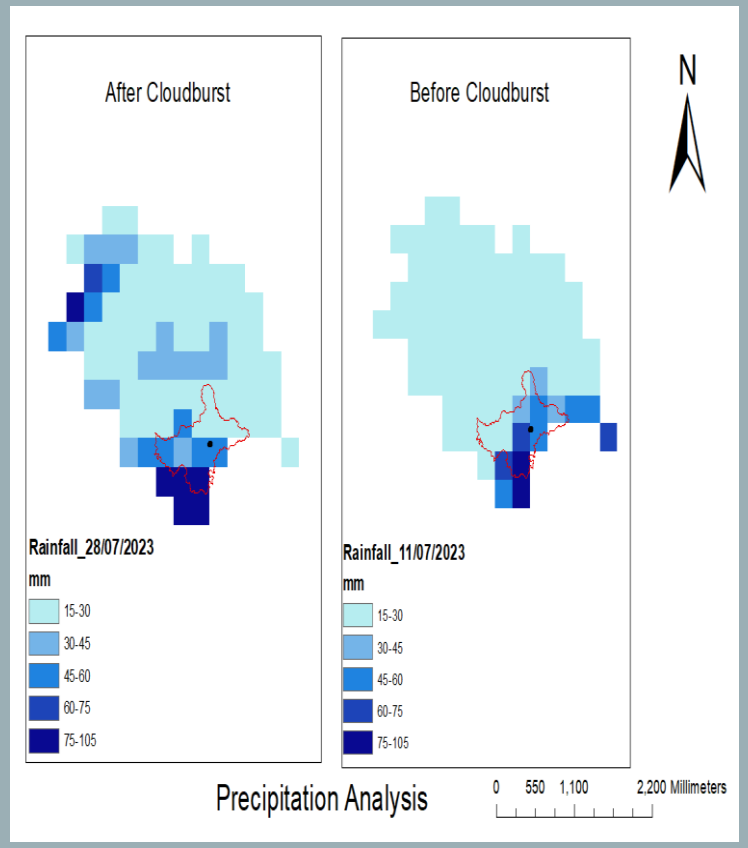
Bharmour & Chamba Elevation Map



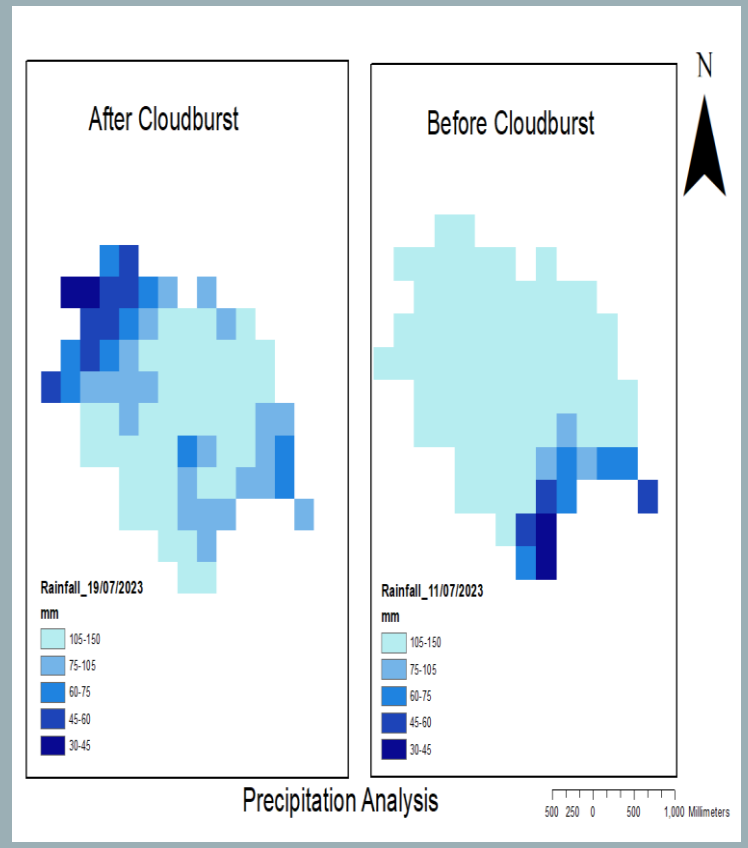
Kias Village & Kullu Elevation Map

Precipitation Analysis –

Precipitation of cloudburst events are shown below from which we can analyse that rainfall rate during cloudburst day is mostly higher than normal day.



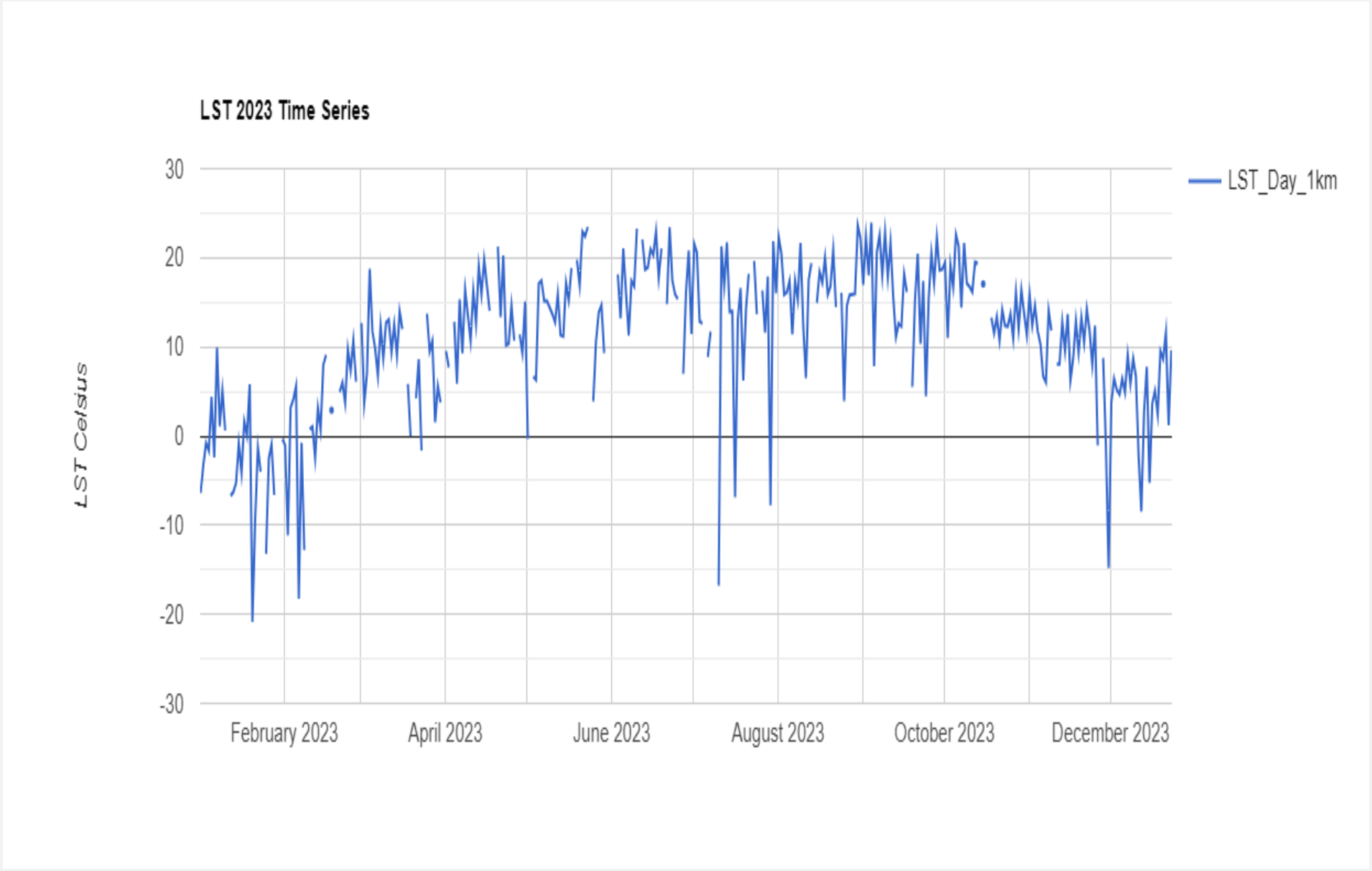
Bharmour Town(Chamba)



Kais Village(Kullu)

- **Temperature Analysis –**

Temperature is an important factor in convective instability, which is a key factor in cloudburst formation. During the day, solar heating can cause the Earth's surface to rapidly warm. Because of this heating, the atmosphere becomes unstable, causing warm air to rise quickly. As the air rises, it cools and condenses, forming towering cumulonimbus clouds that can cause heavy rain and cloudbursts. When warm, humid air masses come into contact with colder air masses, cloudbursts are more likely to happen. More moisture can be retained in warm air. This warm air cools as it rises, causing condensation and the cloud-forming process.



Land Surface Temperature Time Series Graph 2023(Using Google Earth Engine)

CONCLUSION

According to the study's findings, the districts of Kullu, Shimla, Sirmaur, Chamba, and Mandi are the most vulnerable to these events. Physical barriers in the form of steep hills contribute to the formation of cumulonimbus clouds, which leads to cloud bursts, and thus more cases of cloud bursts have been reported from these areas. As a result, these districts require special attention in terms of building protective structures against falling debris in the event of cloud bursts, as well as other corrective measures such as relocating habitations from vulnerable river banks (both seasonal and perennial), nullahs, and other protective measures. The following noteworthy characteristics of cloud bursts in Himachal Pradesh during the monsoon season have been identified.

(i) July and August have a higher frequency of cloud burst occurrences than June and September do.

(ii) The districts of Kullu, Shimla, Chamba, Sirmaur, and Mandi are the most susceptible to these occurrences. Particular care must be taken in these areas during the monsoon season.

(iii) It has been discovered that cloud bursts have the least impact on the districts of Una, Hamirpur, Bilaspur, Kangra, Kinnaur, Lahul & Spiti, and Solan.

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THANK YOU