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SAR-Data-Based Flood Mapping and Regional Precipitation Trend Analysis

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INTRODUCTION

- The variability in the river flow in relation to rainfall changes plays a pivotal role in understanding the occurrences of disaster in the Ganga-Brahmaputra basin. In the recent decade, findings are indicating towards an increase in flash floods and droughts due to the impacts of climate change.
- As the frequency of flood events (Mirza, 2011) and their severity has increased, the global concerns are also increasing for lessening the fatalities because of the flood and other economic losses (Kuldeep et al., 2016).

- The flood inundation extent analysis and its information is necessary for understanding variables like the exposure of society, infrastructure, flood storage volumes, attenuation of flood waves and the future flood hazards and are the first steps for the formulation of any flood management strategy (Sahoo & Sreeja, 2017).

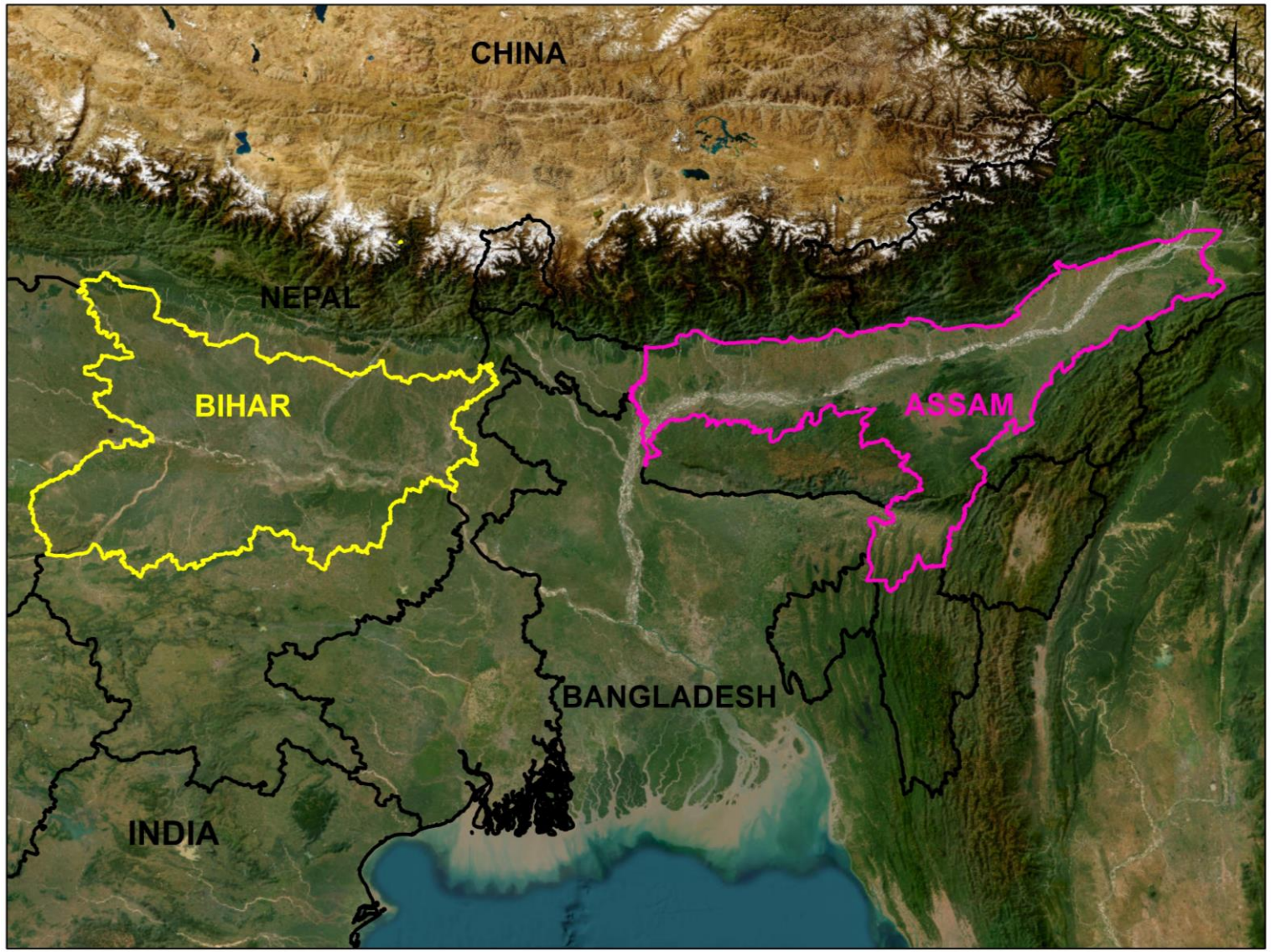
STUDY AREA

- The study area comprises of two major states (Bihar and Assam) in the Ganga-Brahmaputra basin, which are facing recurrent flood disasters over the years.

- The study area receives a maximum of precipitation during the monsoon season from July to September.

- Bihar has most of its geographical area under cultivation and is one of the highest population densities in the country.

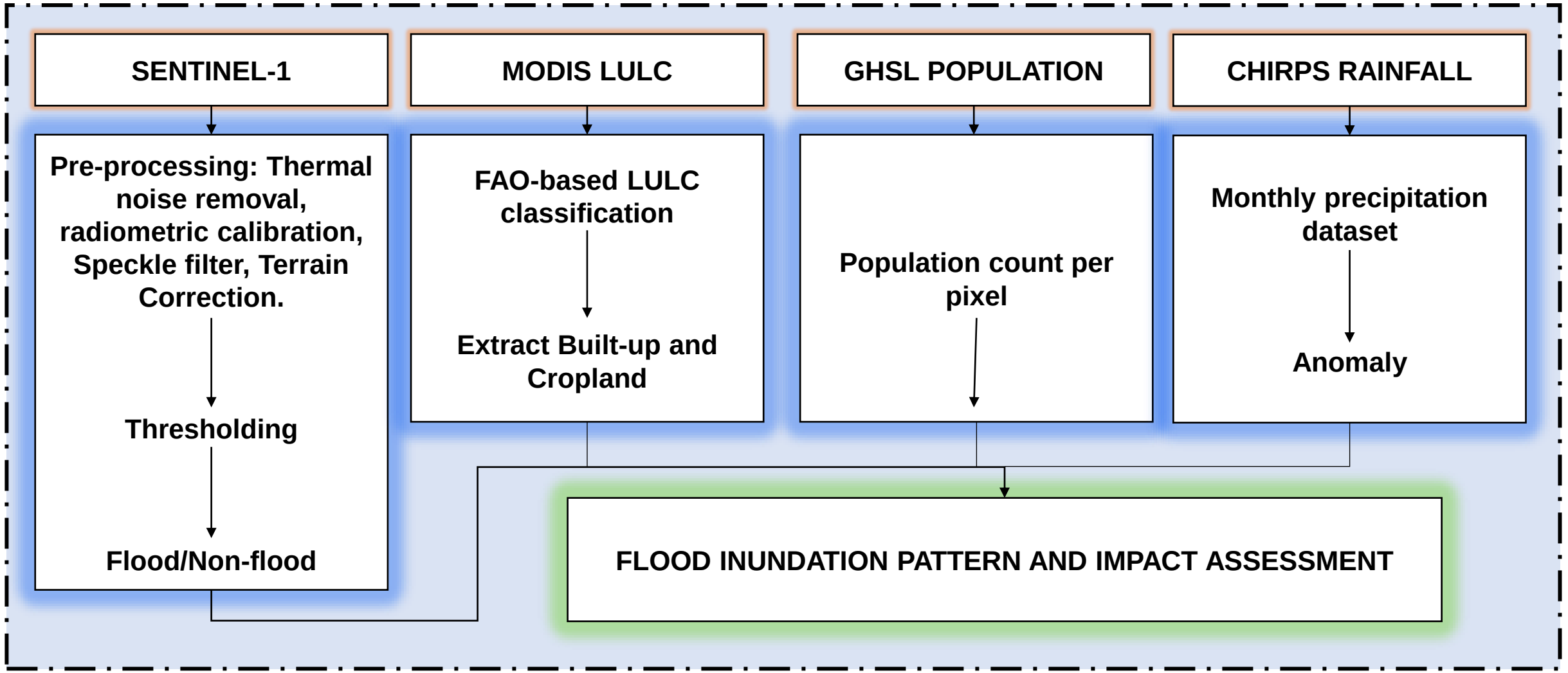
- In Assam, the population residing in the valley region are adversely affected by the high flow of the Brahmaputra River.



DATASET USED

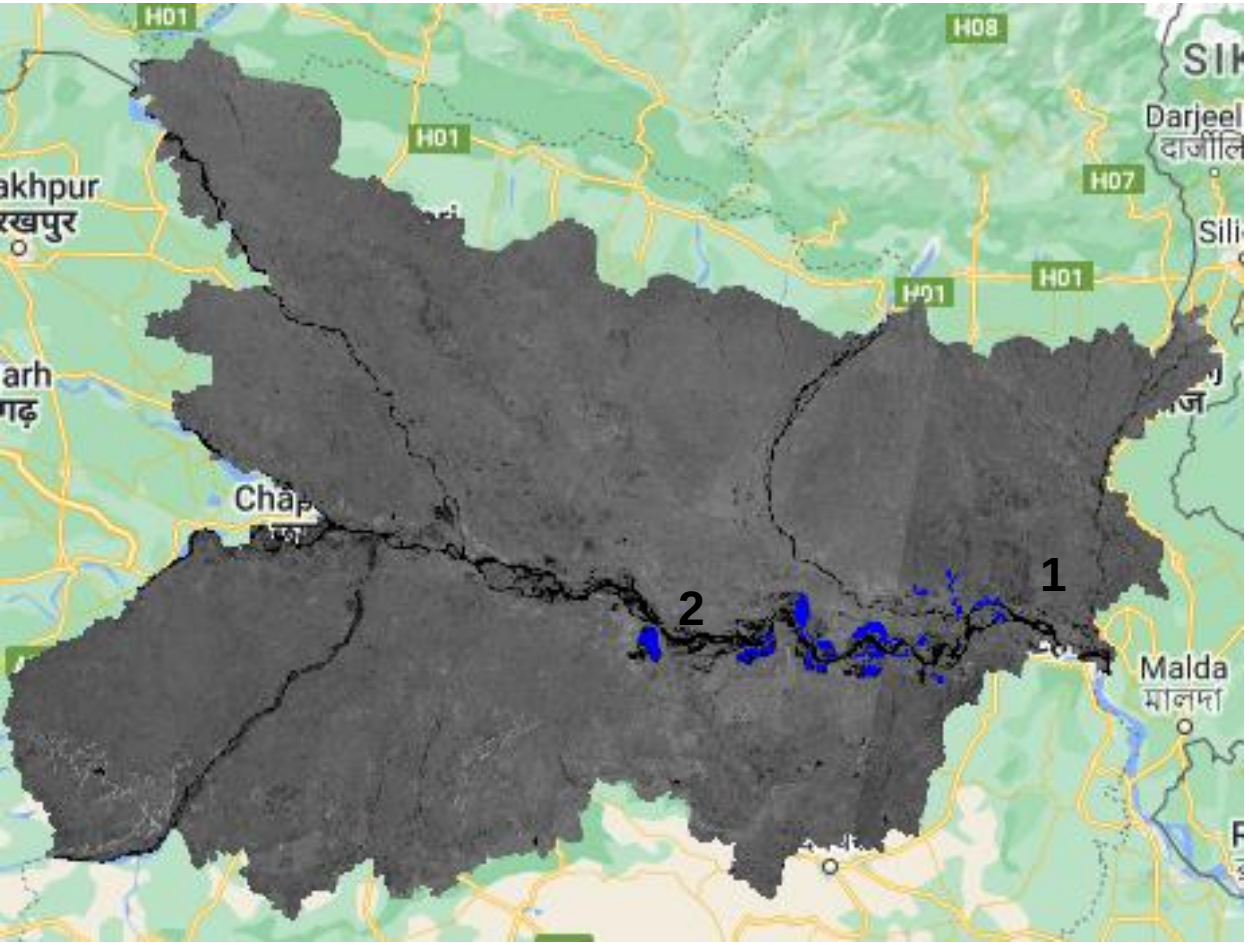
Dataset used	Spatial resolution	Acquisition date	source	purpose
MODIS LULC	500m	2019	Earthdata	Agriculture Land Extraction
CHIRPS	25 km	July' 2022 August' 2022 September 2022 October 2022	NRT GSFC	Rainfall anomaly
Sentinel 1	10m	July' 2022 August' 2022 September 2022 October 2022	GEE	Flood Extent estimation
Global Human Settlement Population data	9 arcsec	2015	GHSL	Population density

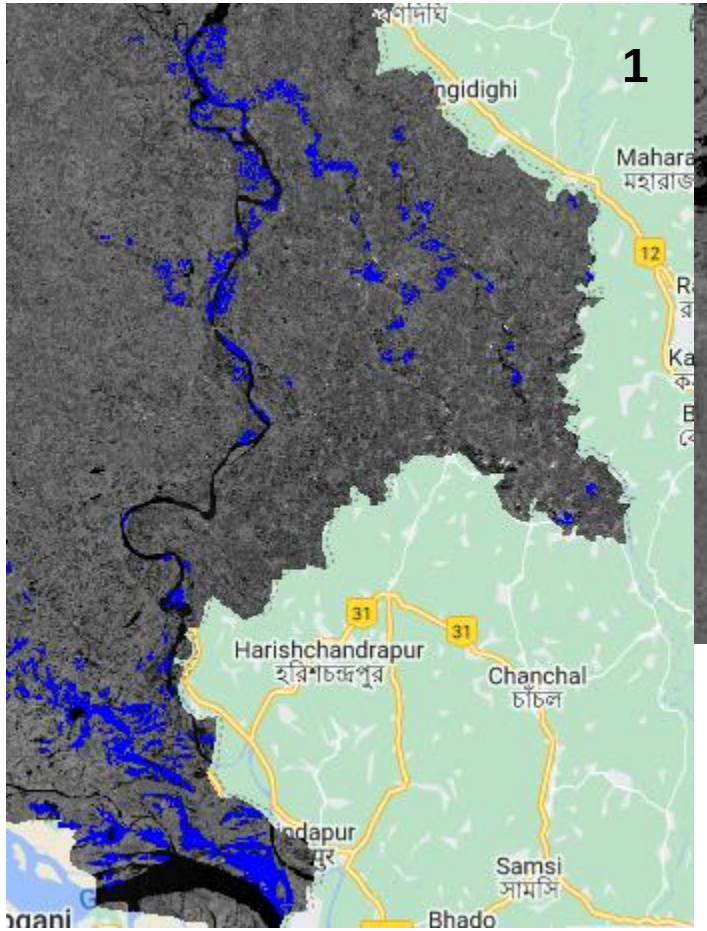
METHODOLOGY



Flood extent in Bihar during the monsoon period (2022)

The composite area from July to October (2022) under flood was estimated to be 4362.71 km^2 for Bihar.
However, the flood inundation extent reduced in subsequent months like August and September, indicating flood regression





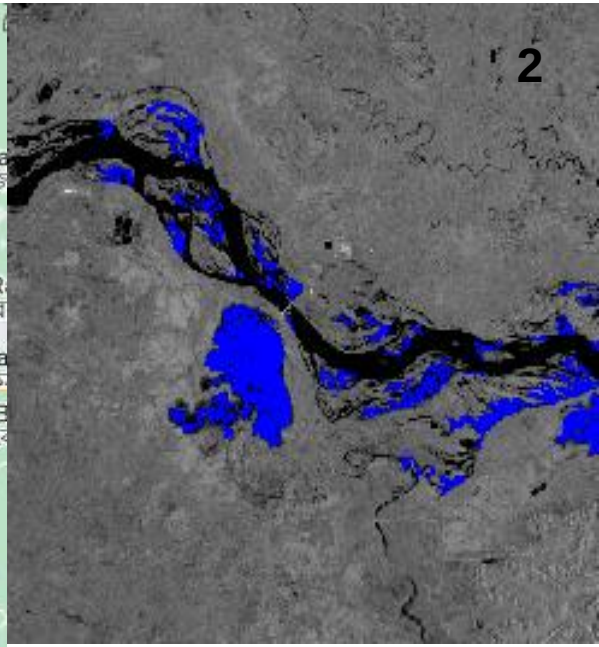
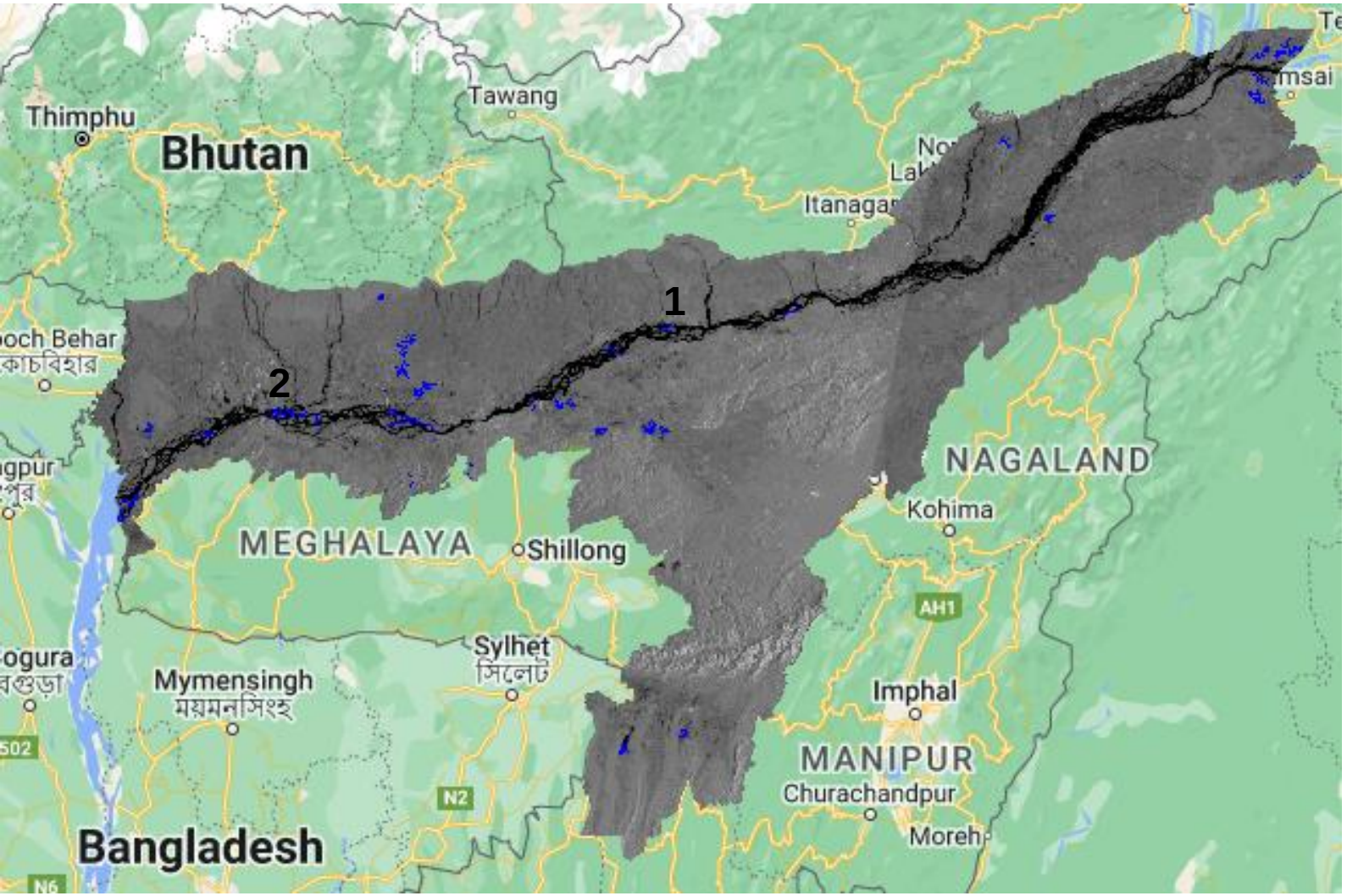
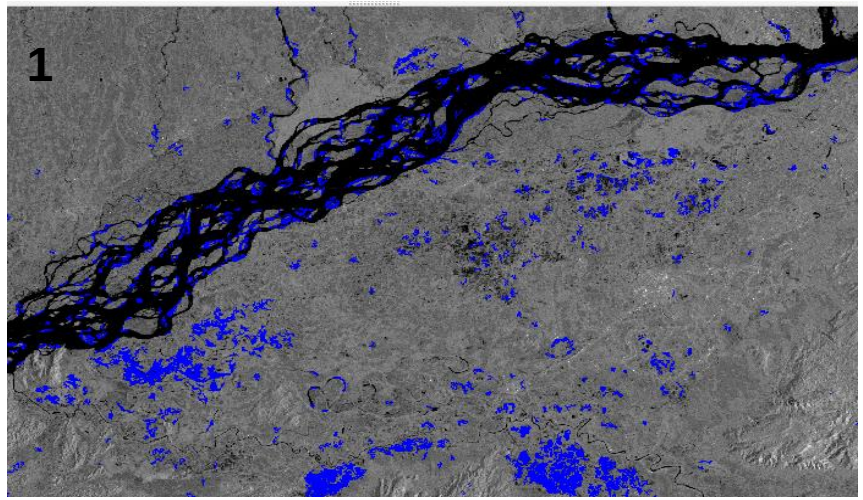


Fig 2: Flood extent (Composite) in Bihar

Flood extent in Assam during the monsoon period (2022)

The composite area for July to October under flood was estimated to be 11048.52 km^2 for Assam.
In Assam the flood extent is largely confined to the proximity areas of Brahmaputra River





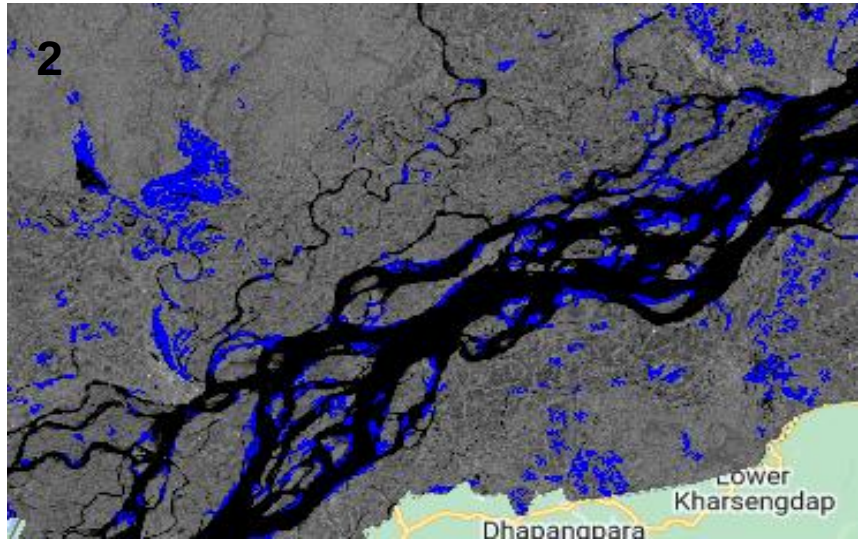


Fig 3: Flood extent (Composite) in Assam

FLOOD THREAT LIKELY OVER THE STATE OF BIHAR

August 26, 2023 3:51 PM | Skymet Weather Team

Monsoon was subdued over most parts of Bihar and Bihar is still rain deficient. Now, we expect these moderate showers to bring down the rain deficiency to a great extent leading to some relief for farmers. However, the Fury of flood will be a concern

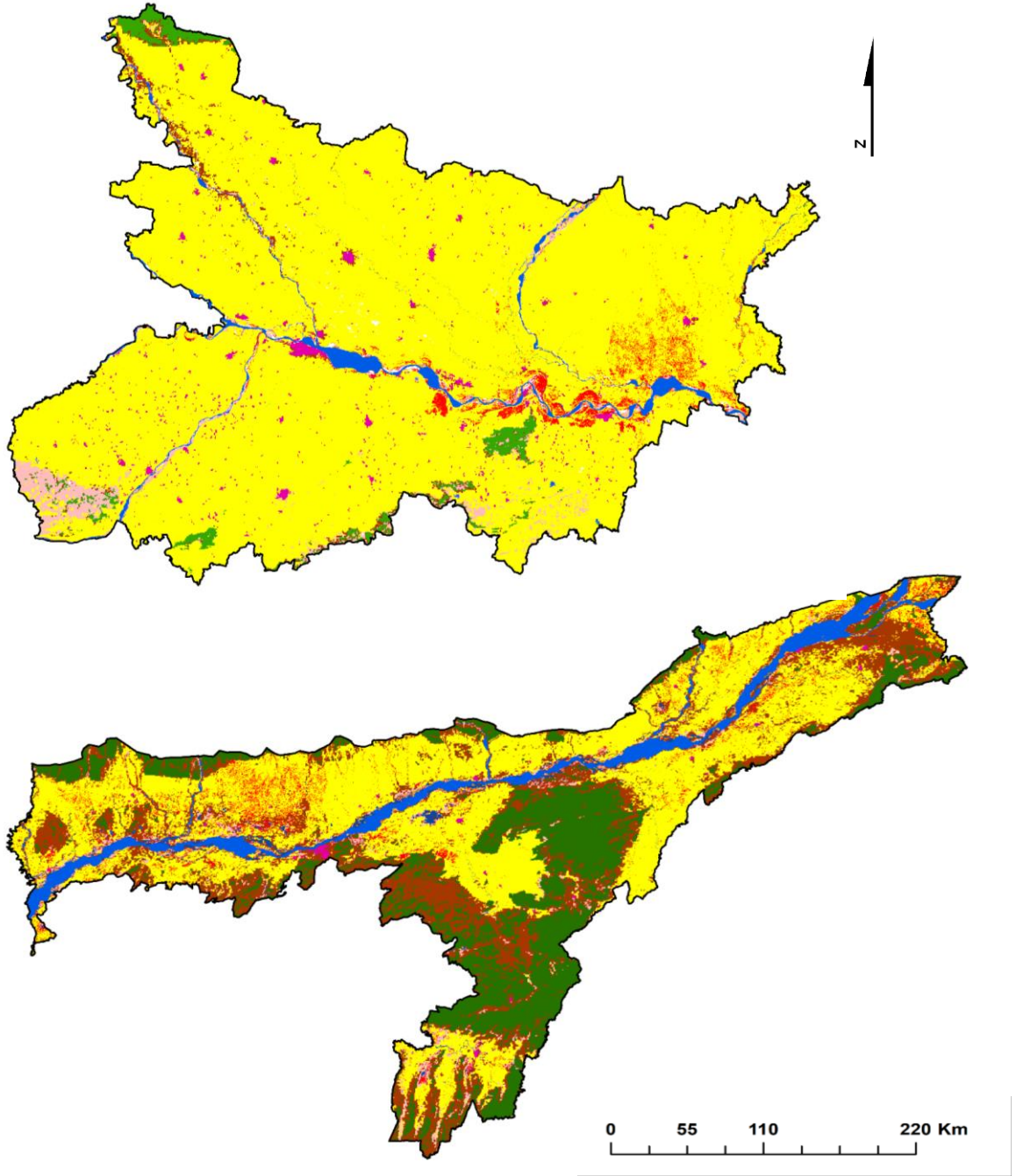
Flood in Bihar is a normal phenomenon during the monsoon season but for the last 2 to 3 years, we have not seen any significant water logging or flooding in Bihar. Moreover, the state remained rain-deficient most of the time

Shifting Flood Vulnerability Zones Increasing India's Disaster Management Challenges

With flood vulnerability zones shifting towards central India and the west coast, India needs to plan infrastructural development carefully.

Assam in northeastern India is no stranger to devastating floods, often multiple times a year. Between 2012 and 2022, floods in Assam claimed 1,010 human lives, caused loss of 21,898 cattle, and damage to the tune of Rs 40,721 crore. However, harder days might be ahead, as according to the state's disaster management plan for 2022, floods are going to rise by more than 25% in the southern parts of Assam.

Affected Cropland and Built-up during the floods of monsoon 2022

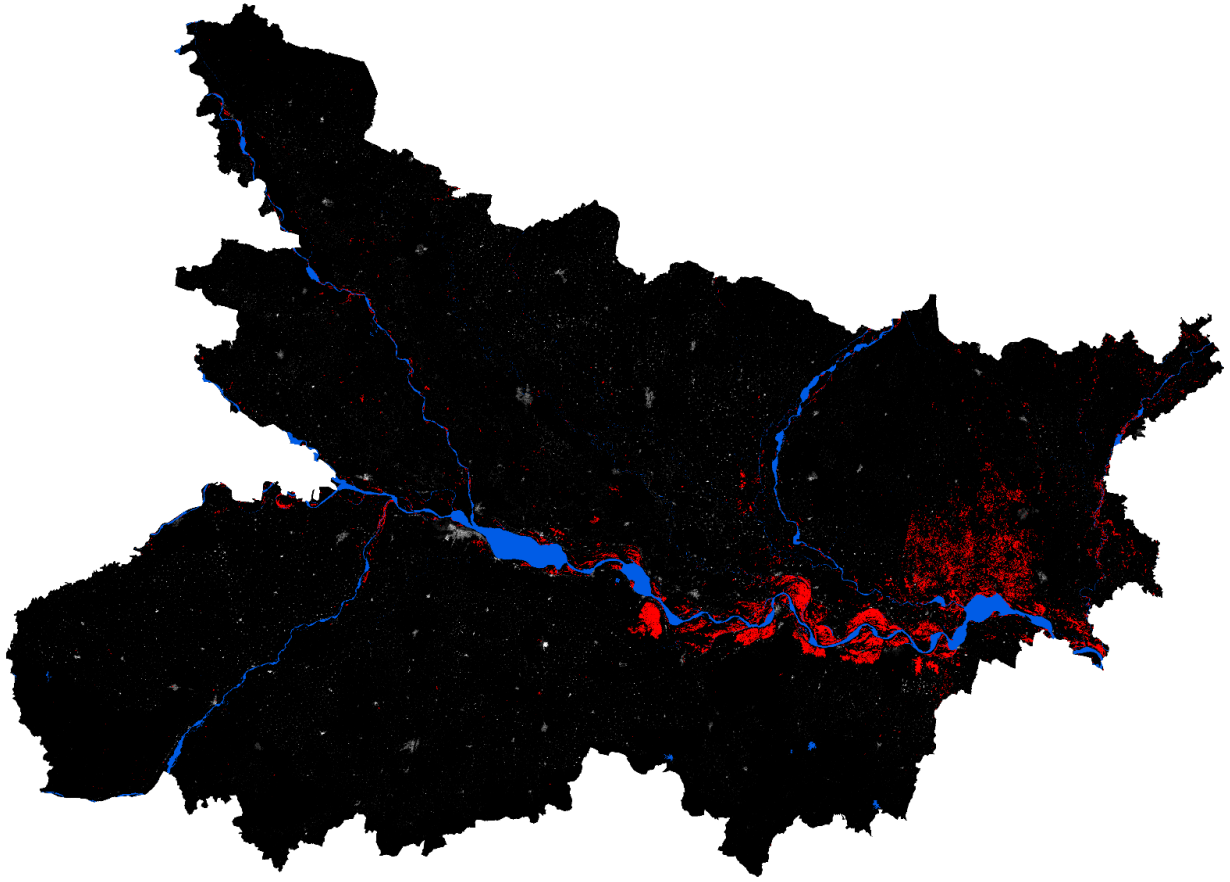


MODIS Land Cover Type Yearly Global dataset was used to calculate the impact of flood on agricultural area and urban areas which revealed that the highest impact was on Bihar with an area of 1563.14 km^2, 463.81 km^2 respectively, and Assam (161.19 km^2, 51.91 km^2).

- Flood Extent (monsoon)
- State Boundary
- Forest cover
- Shrubland and savannas
- Grassland
- Cropland
- Built-up
- Barren land

Affected Population during the floods of monsoon 2022

JRC Global Human Settlement Population Density layer was employed to evaluate the flood impacts which revealed that a total of 3.7 million of the population was affected.



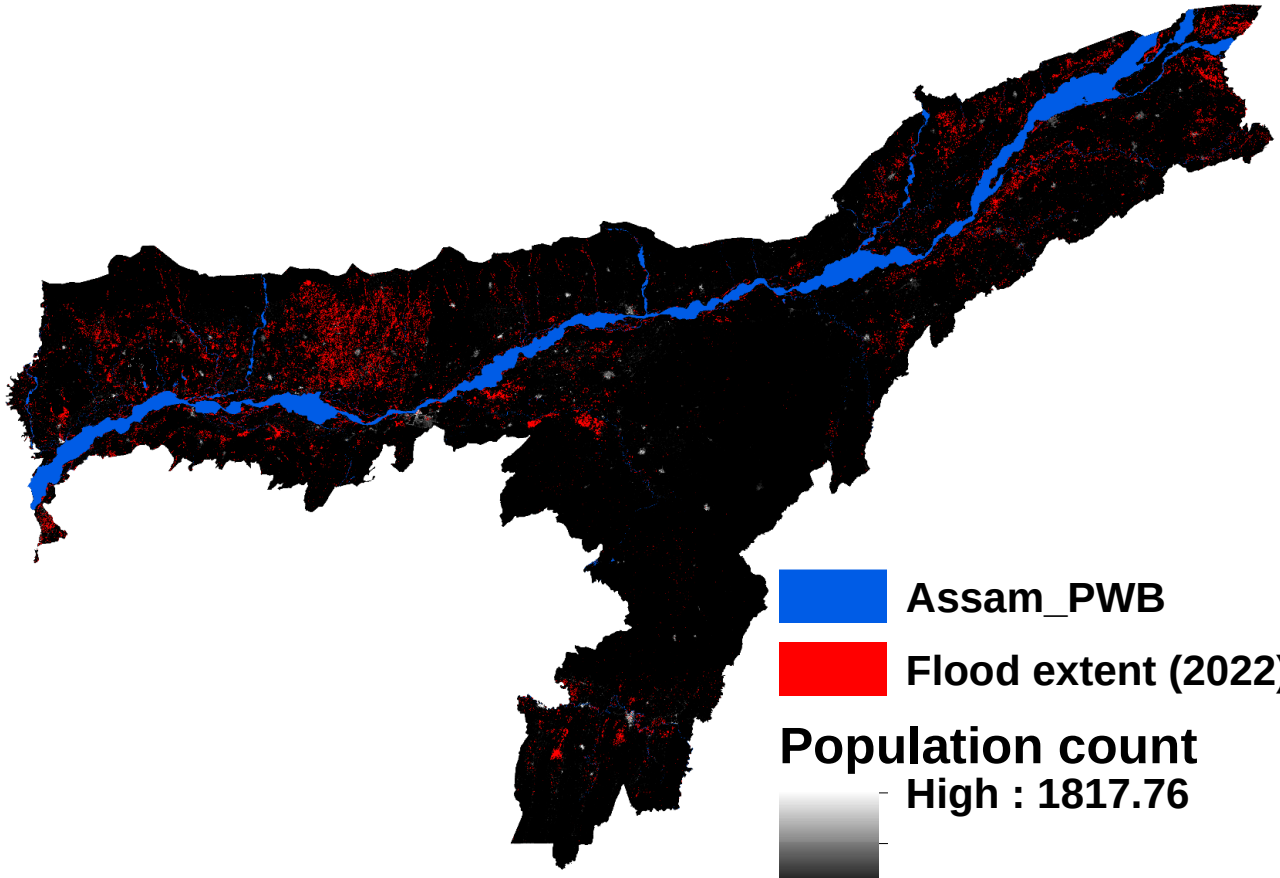
Bihar_PWB

Flood extent (2022)

Population count

High : 4357.47

Low : 0



Assam_PWB

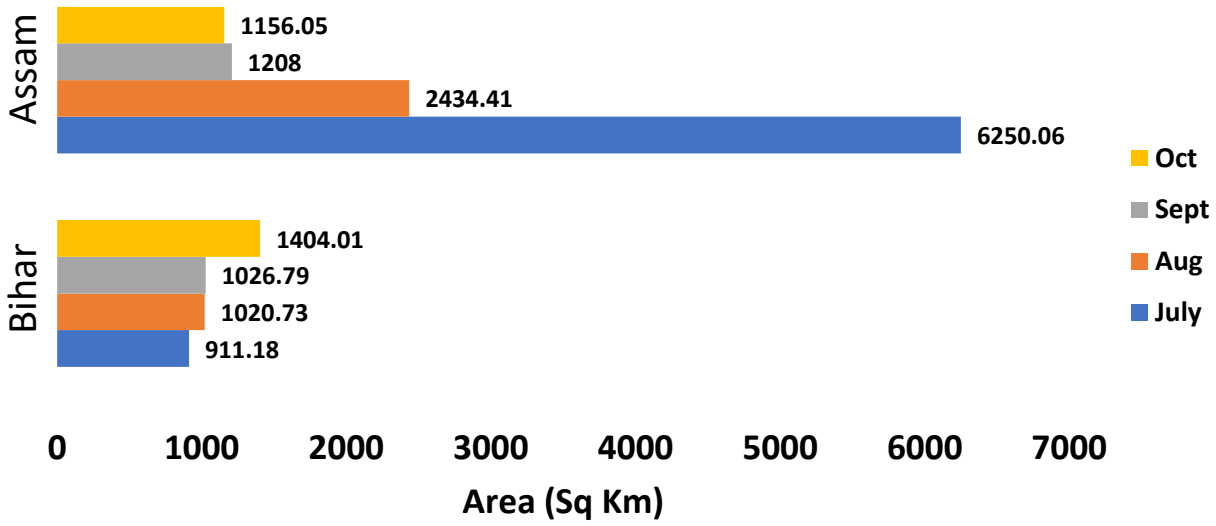
Flood extent (2022)

Population count

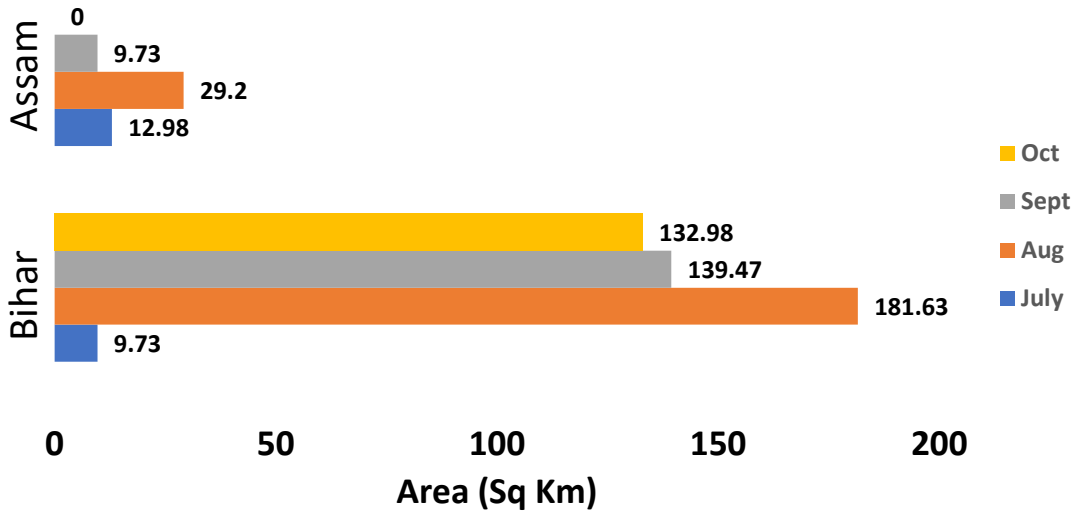
High : 1817.76

Low : 0

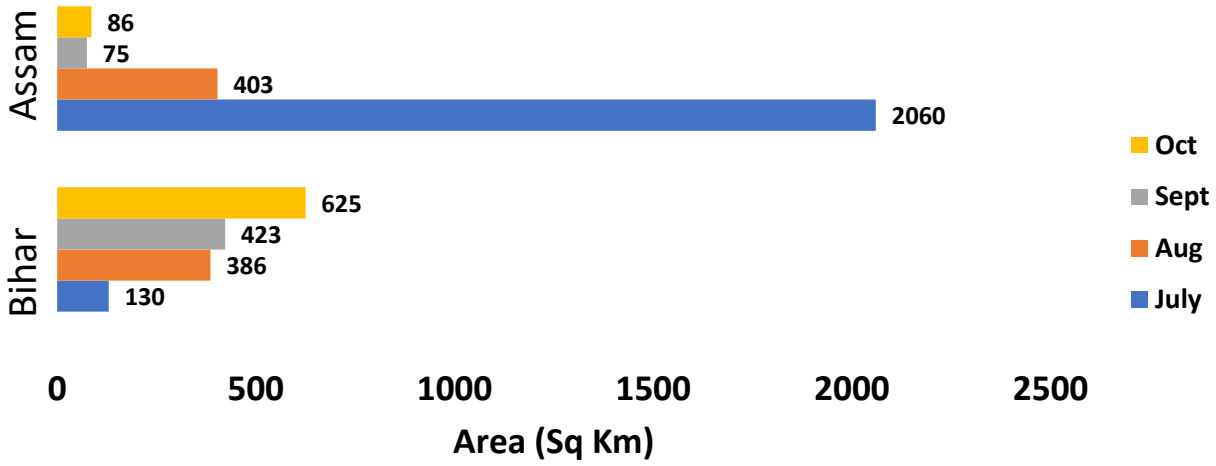
Flood Extent (2022)



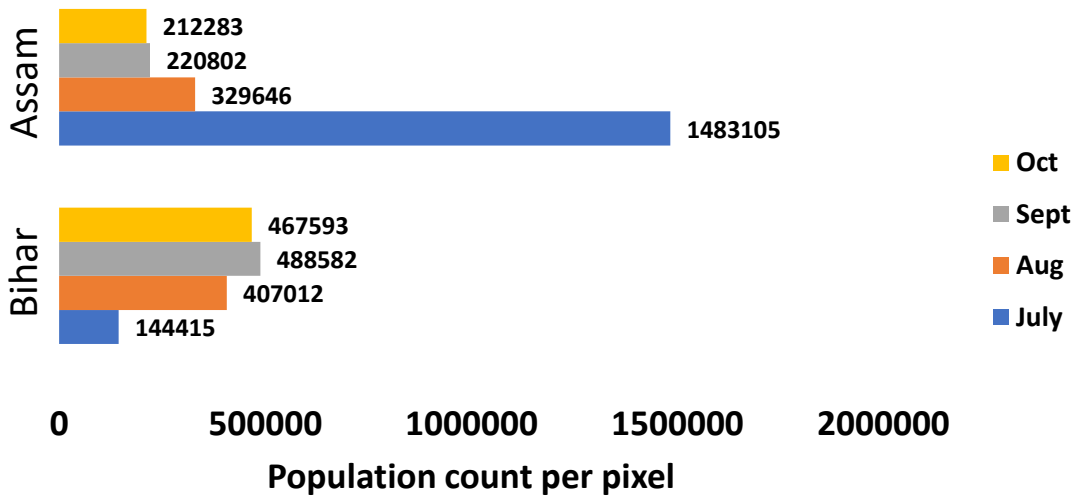
Affected built-up



Affected Cropland



Affected Population



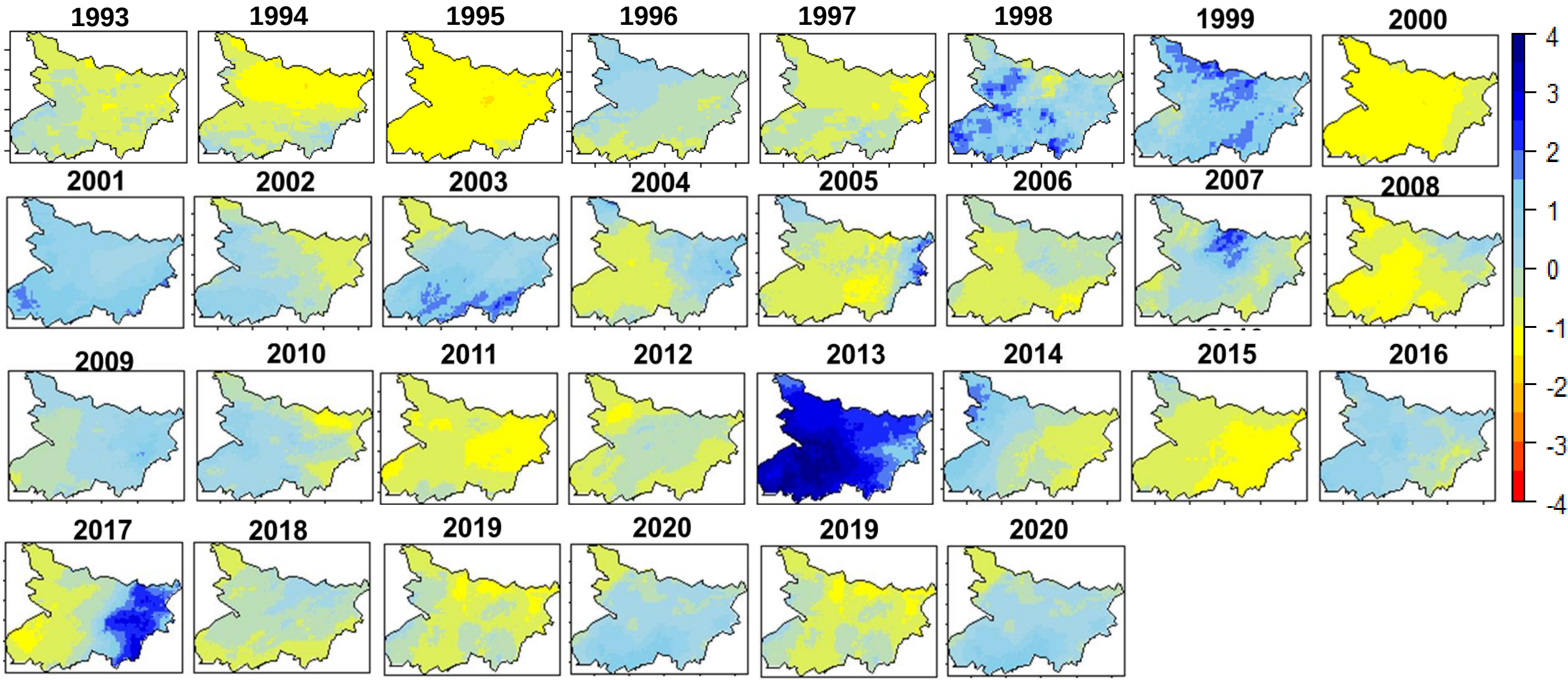
Major flood events in Bihar and Assam (1950-2022)

Bihar is highly influenced by the various stream system and the flow of river water from the Himalayan region creating havoc for the state in every monsoon season. Whereas for Assam being in low-lying zone has been the reason of most impact during the flood event.

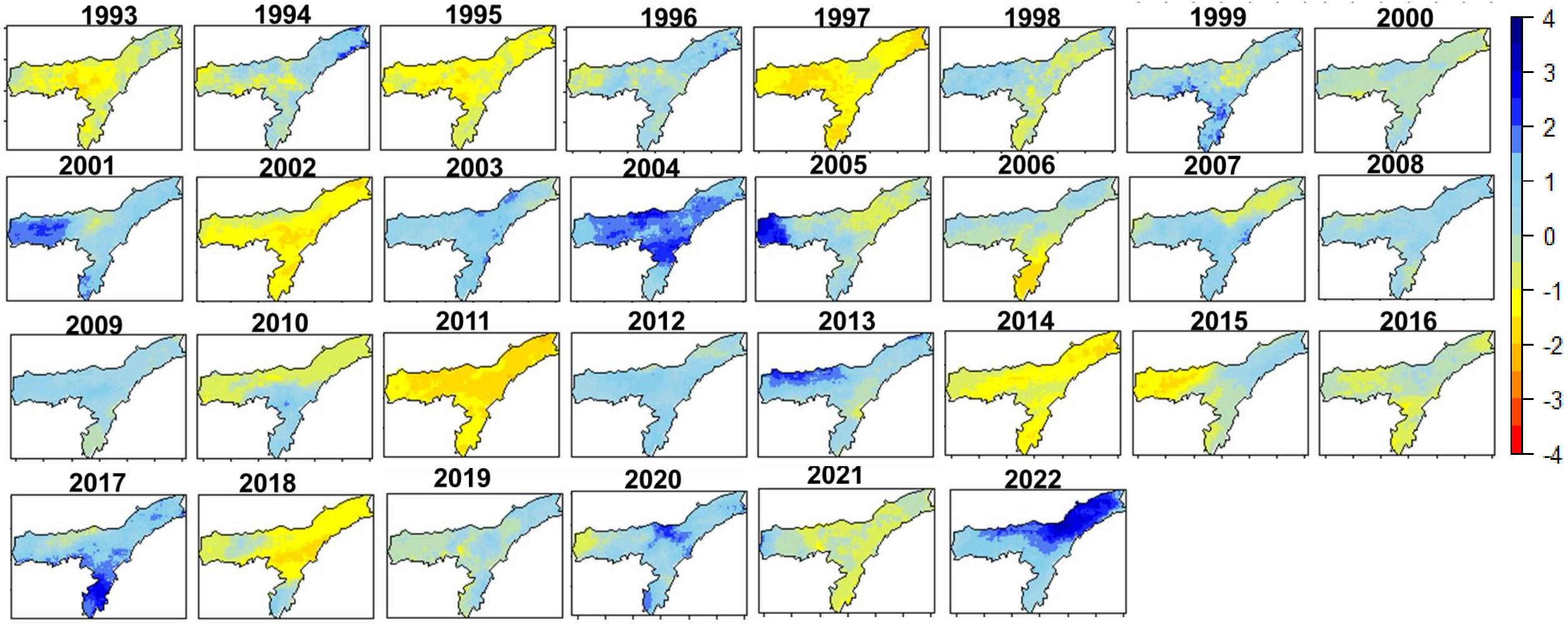
As per the composite flood maps during 2020 flood events, it inundated 19.48% (77493.1 km^2) of areas in the Ganga-Brahmaputra basin with maximum inundation in Bihar (22.11% (20837 km^2)) followed by Assam (17.16% (13460.1 km^2)) (Pandey et al., 2022). However in our analysis it was observed that the impact was higher in Assam as compared to Bihar.

States/ Country	Flood events	Source
Assam	1954, 1962, 1972, 1977, 1984, 1988, 1998, 2002, 2004, 2012, 2013, 2015, 2016, 2017, 2018, 2019, 2020.	(Govt. of Assam, 2023), (Pandey et al., 2022)
Bihar	1987, 1995, 1998, 2000, 2001, 2003, 2004, 2008, 2010, 2013, 2016, 2017, 2018, 2019, 2020, 2021.	(Tripathi et al., 2020), (Tripathi, Pandey, Parida, & Shakya, 2020)

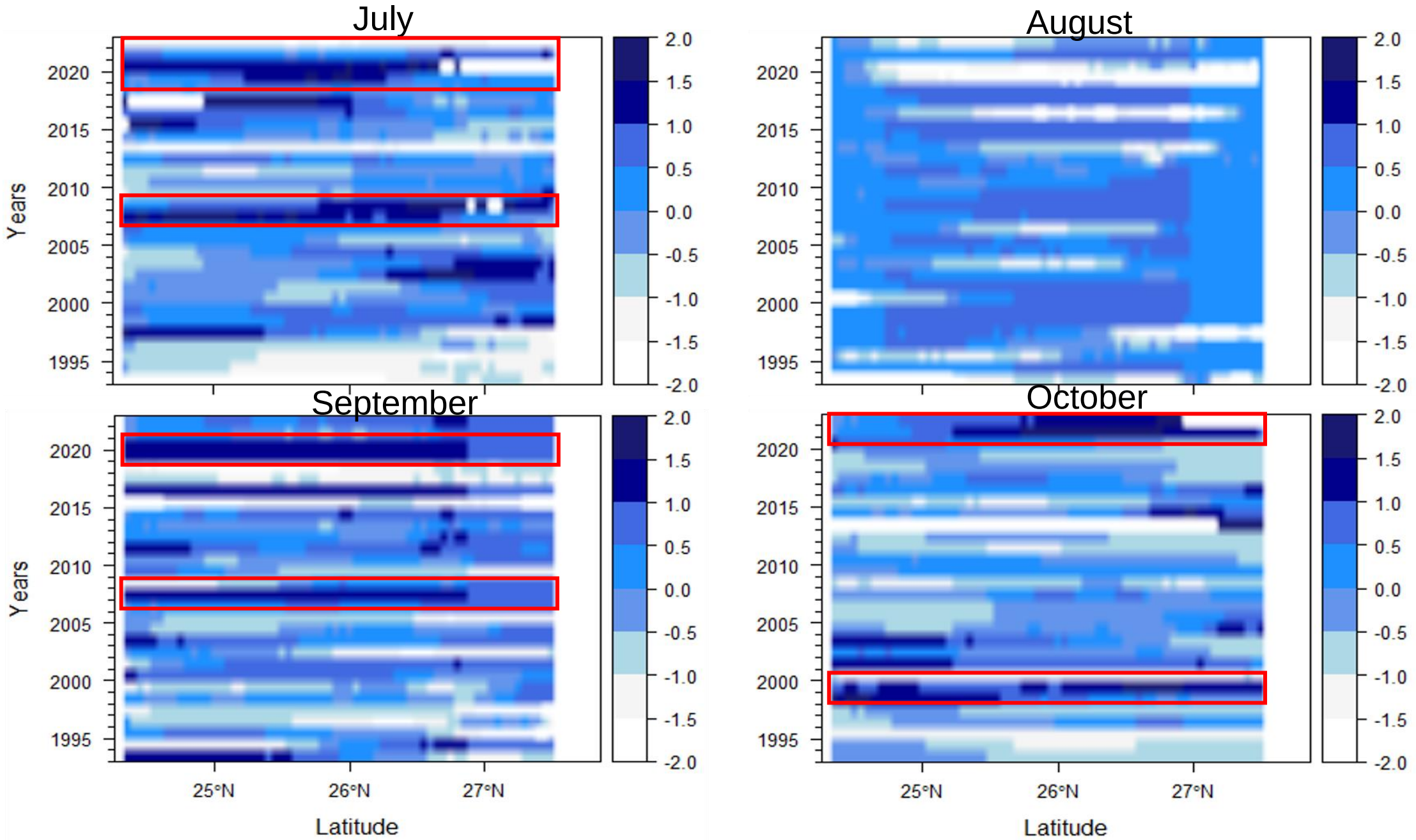
Rainfall Anomaly for the period 1993-2022 in Bihar



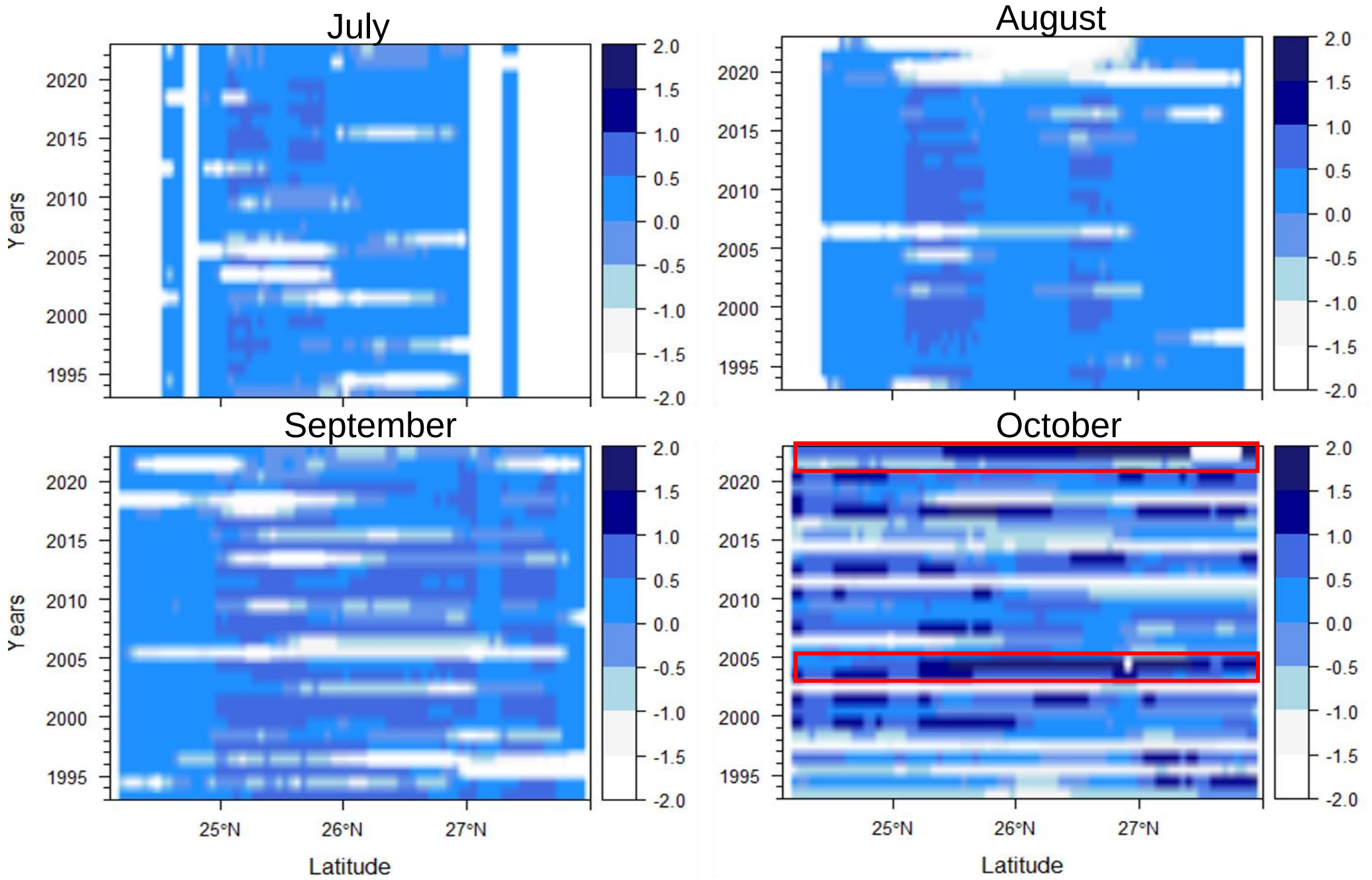
Rainfall Anomaly for the period 1993-2022 in Assam



Rainfall Anomaly for the period 1993-2022 in Bihar



Rainfall Anomaly for the period 1993-2022 in Assam



CONCLUSION

- The present study is focused on the recent flood disaster in the Ganga-Brahmaputra basin mainly affecting the states of Bihar, and Assam in India during the months of July, August, September, and October 2022.

- The composite area for July to October under flood was estimated to be 11048.52 km^2 for Assam and 4362.71 km^2 for Bihar. Extensive area was inundated in Assam due to increased rainfall intensity during the monsoon season with values ranging from 384.92 to 476.07mm as compared to Bihar with 272.56 to 386mm.

- Bihar recorded the least precipitation variation in the month of August with major values ranging between 0.5 to -0.5mm $year^{-1}$ however the month of October presents the highest variability over the past 30 years with an increase of more than 1.5mm $year^{-1}$ after 2020 which has previously been non-significant.

- However, in Assam, the monsoon period has not recorded significant change in the anomaly from July to September with values falling between -0.5 to 1.0mm $year^{-1}$.

- The near real time flood inundation mapping together with the possible impact over the cropland and settlements and population would provide relevant information to the disaster management authority for quick damage assessment and effective relief operation during flood impacts.

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THANK YOU

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