

# Retrieval of Parameters to Assess Extreme Climate Events Using Satellite Remote Sensing

Mohammad Suhail  
Professor & Director  
Centre of Applied Remote Sensing and GIS Applications  
Samarkand State University, Uzbekistan



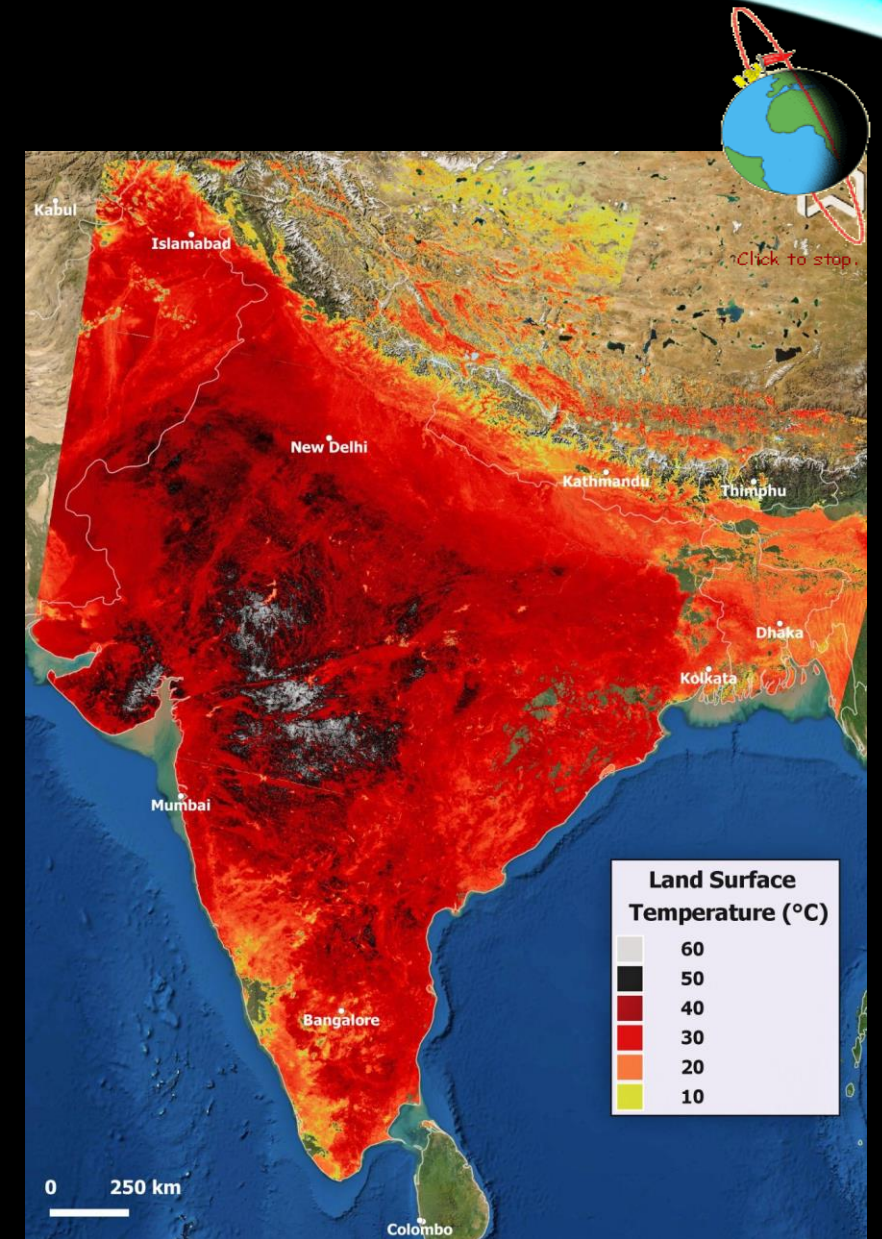
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*Centre of Applied Remote Sensing & GIS Applications  
Samarkand State University, Uzbekistan*

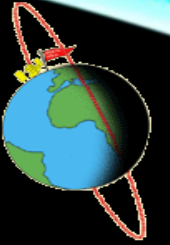


Extreme events are of interest worldwide given their potential for substantial impacts on social, ecological, and technical systems. Many climate-related extreme events are increasing in frequency and/or magnitude due to anthropogenic climate change, and there is increased potential for impacts due to the location of urbanization and the expansion of urban centers and infrastructures.

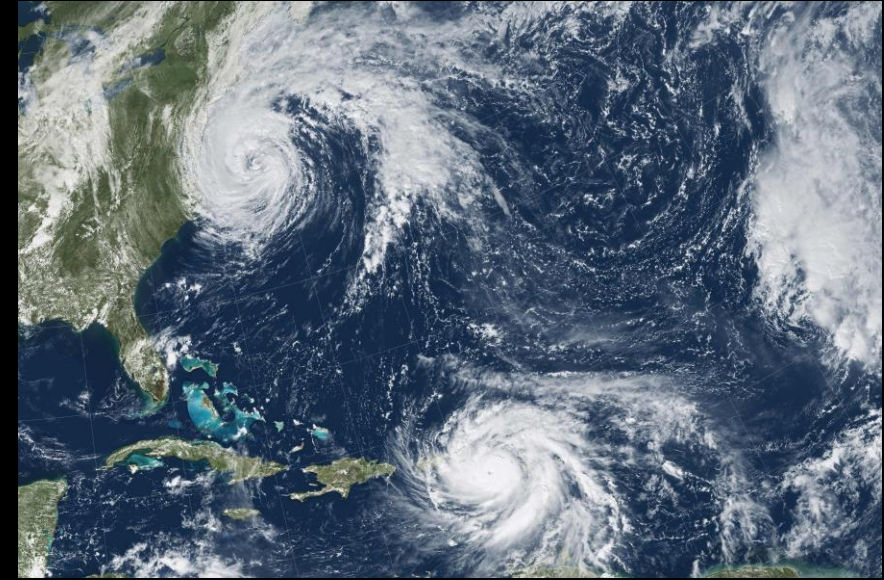
Extreme events, such as heat waves, widespread flooding, or very strong storms, are of interest to scientists and managers because of their potential to cause extensive damage and impacts on people, infrastructure, and nature. With climate change causing more of these events to happen. The top four events includes rainfall, flooding, heat, and drought.



# Floods and Storm



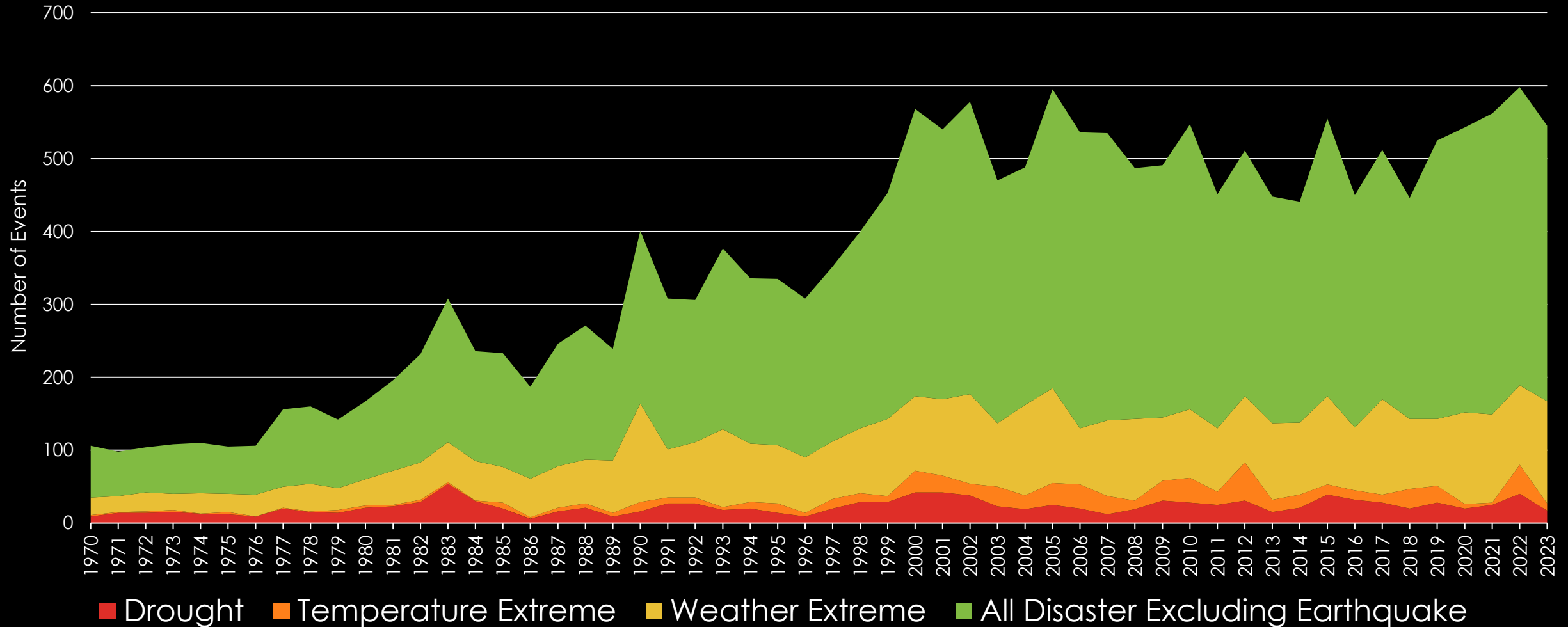
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# Inventory of Extreme Events (1970 onwards)



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Globally, more than 50% of the world's population now lives in cities, with overall urban population and rates of increase varying by region.

This increase in disasters can be partly explained by considering the expansion of cities and suburban areas into hazard-prone zones, and the subsequent increased exposure of people and infrastructure.



Cities are also more vulnerable to extreme heatwaves due to the exacerbation of impacts from the urban heat island and air pollution.

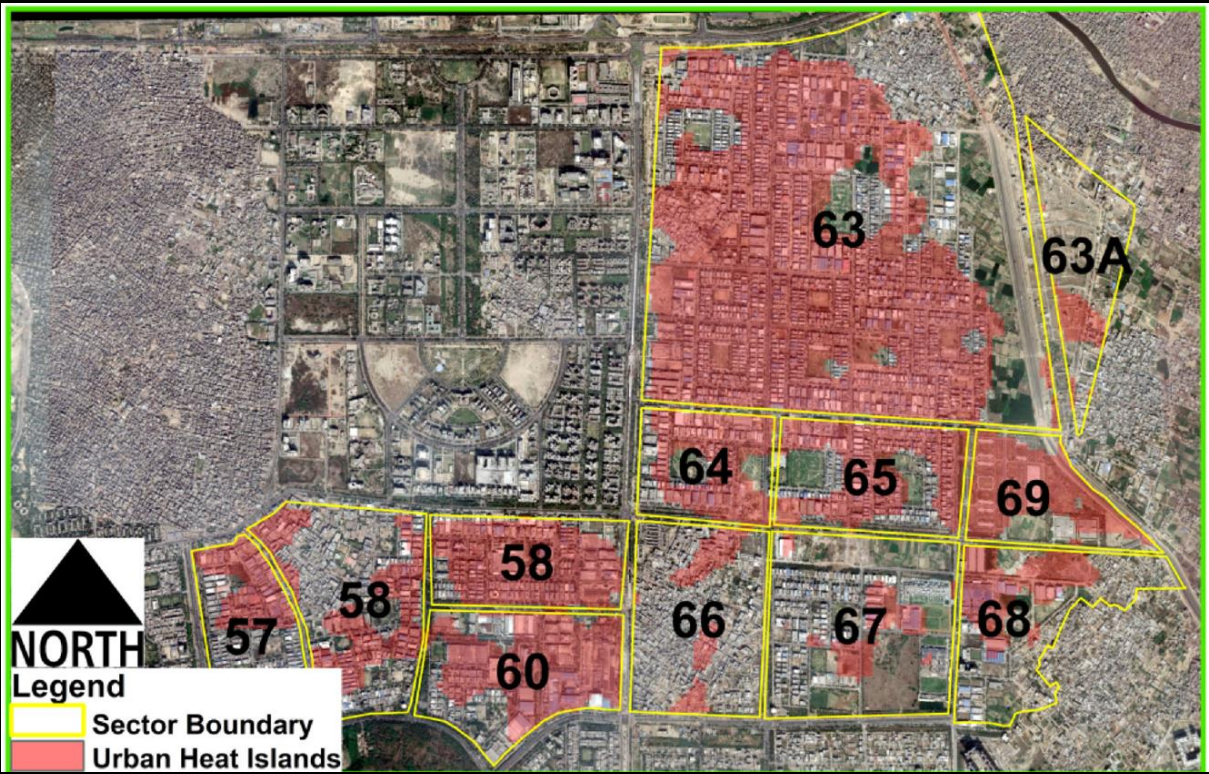
It is very likely that there has been an increase in the number of warm days and warm nights. Extreme heat events are expected to increase in **Frequency, Intensity, Magnitude, and Duration** throughout the 21st century



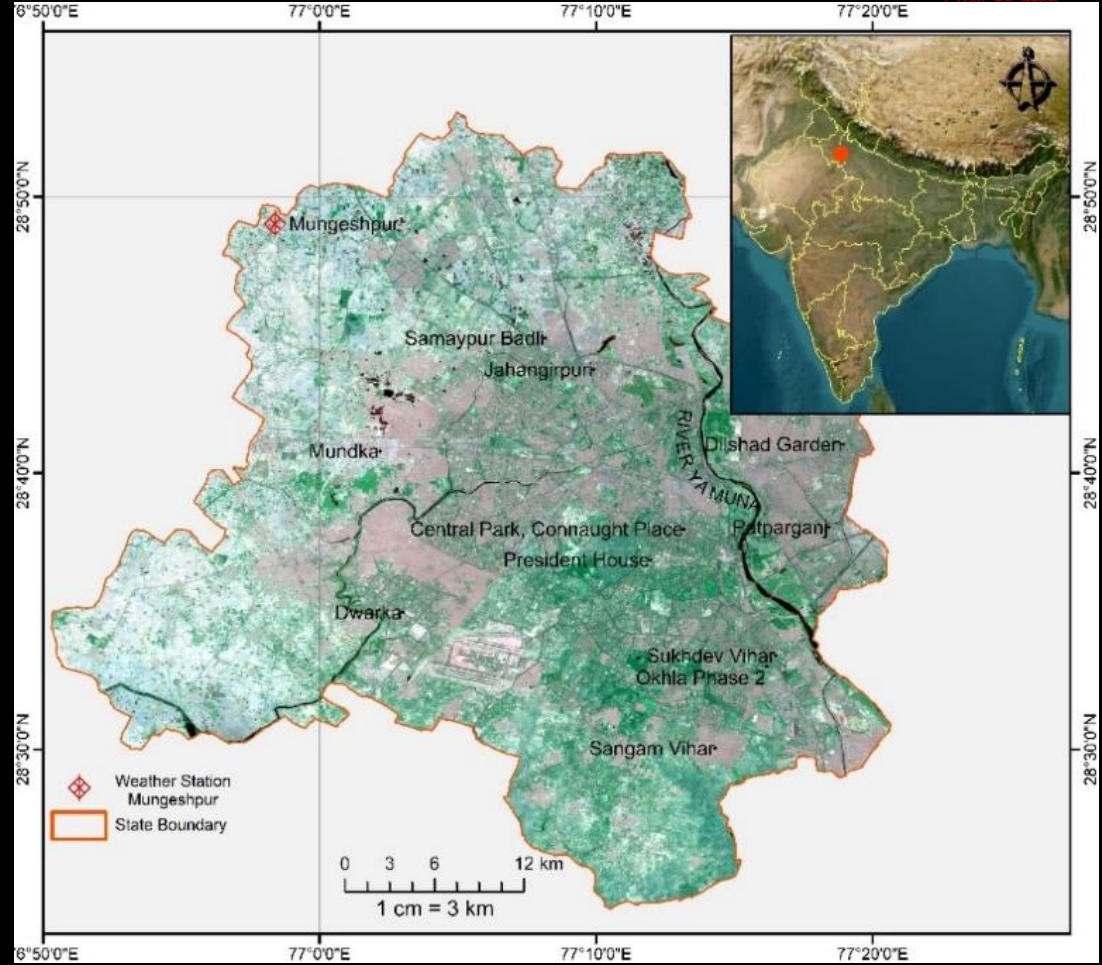
ORIGINAL PAPER

# Assessment of Urban Heat Islands Effect and Land Surface Temperature of Noida, India by Using Landsat Satellite Data

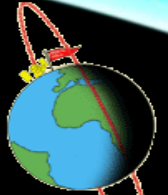
M. Suhail<sup>1</sup>, M. S. Khan<sup>2\*</sup> and R. A. Faridi<sup>3</sup>



## DELHI (National Capital Region, India)





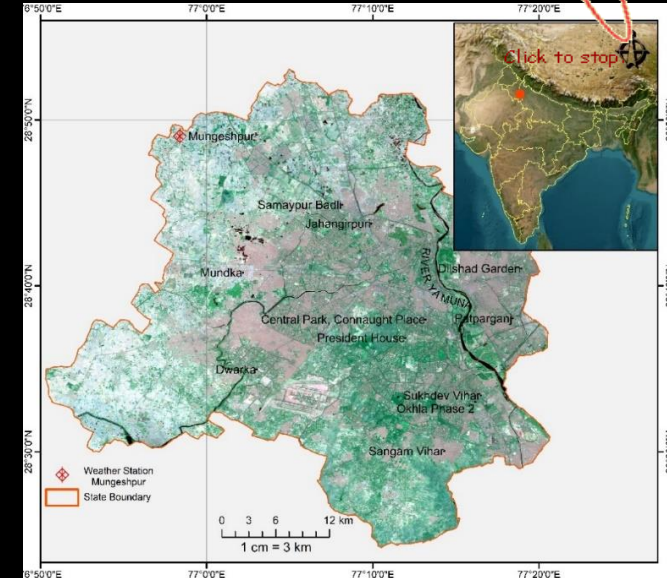


Idea starts from the publication of controversial temperature data, claiming that Delhi recorded its highest-ever temperature of 52.9°C on May 29, 2024, which was subsequently revised with new temperature data indicating a reading of approximately 49.1°C.

The India Meteorological Department (IMD) reported that several Indian cities recorded their highest maximum temperature on May 28, 2024. These include Agra (Uttar Pradesh), Bhatinda (Punjab), Churu (Rajasthan), Rewa (Madhya Pradesh), and among others.

The IMD also reported higher than above normal temperature for 18, 19, 20, 21, 27, 28, 29, 30, and 31 May 2024.

Many days were also designated as heatwave days, a classification in India where the maximum temperature in a specific region exceeds the normal range by 4.5 to 6.4°C.



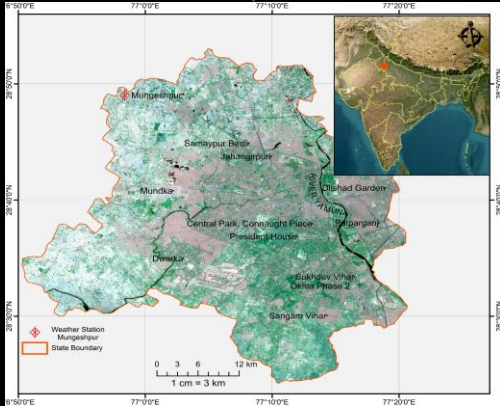


MODIS (Moderate Resolution Imaging Spectroradiometer) data have been utilized to extract the land surface temperature for Delhi. MODIS features two sensors, i.e., Terra and Aqua. Terra orbits from north to south across the equator in the morning, while Aqua moves from south to north in the afternoon. Together, Terra MODIS and Aqua MODIS scan the entire Earth's surface every 1 to 2 days, capturing data in 36 spectral bands.

Satellite	Sensor	Datasets	Date of Acquisition	Spatial Resolution	Rescaling Factor		Version
					$M_L$	$A_L$	
Terra	MODIS	LST Product	May 2024	1 km	0.002	N/A	Version 0.61
		Band 31	May 2024	1 km	0.002	0.49	MYD11A1 v06
		Band 32	May 2024	1 km	0.002	0.49	(LST and B31 & B32 emissivity product)
Aqua	MODIS	LST Product	May 2024	1 km	0.002	N/A	Version 0.61
		Band 31	May 2024	1 km	0.002	0.49	MYD11A1 v06
		Band 32	May 2024	1 km	0.002	0.49	(LST and B31 & B32 emissivity product)

# EXTREME CLIMATE EVENTS AND TEMPERATURE CHANGE

## DELHI METROPOLIS



## Satellite Data

### MODIS (Terra & Aqua)

## Field Observations

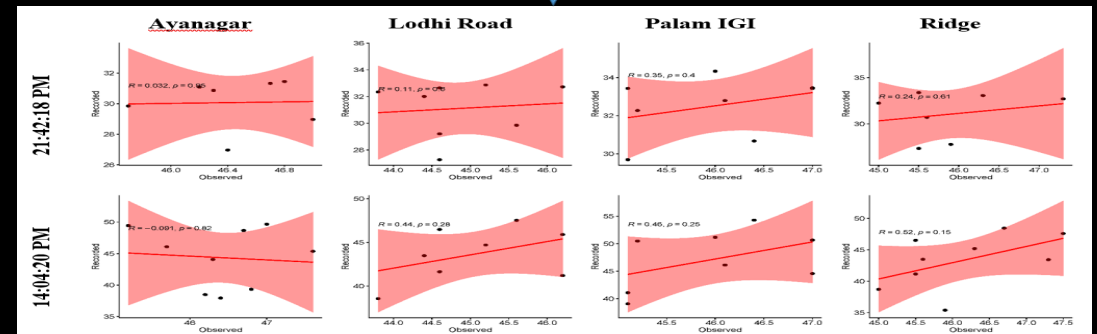


### Statistical Analysis and Validation

### Processing and Derivation of LST

### Production of Spatial Maps

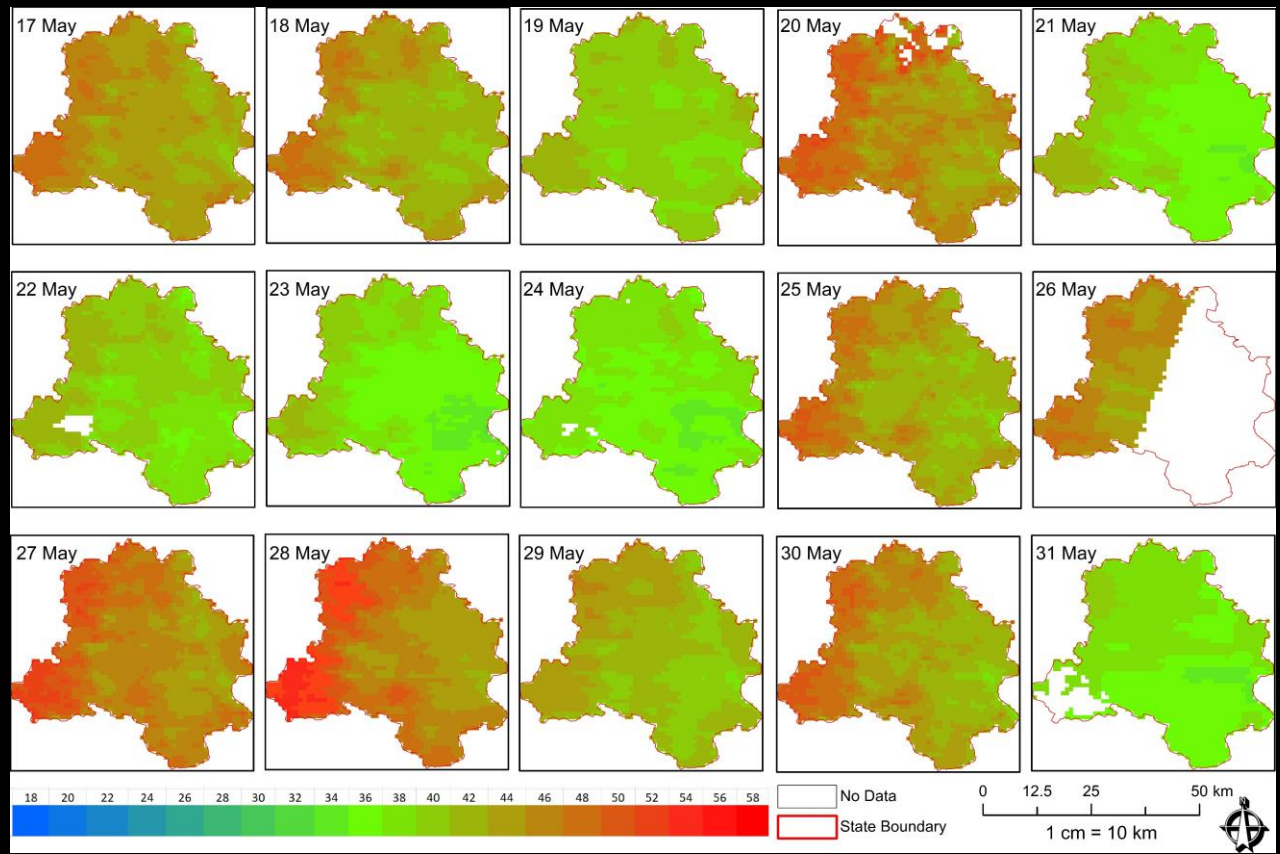
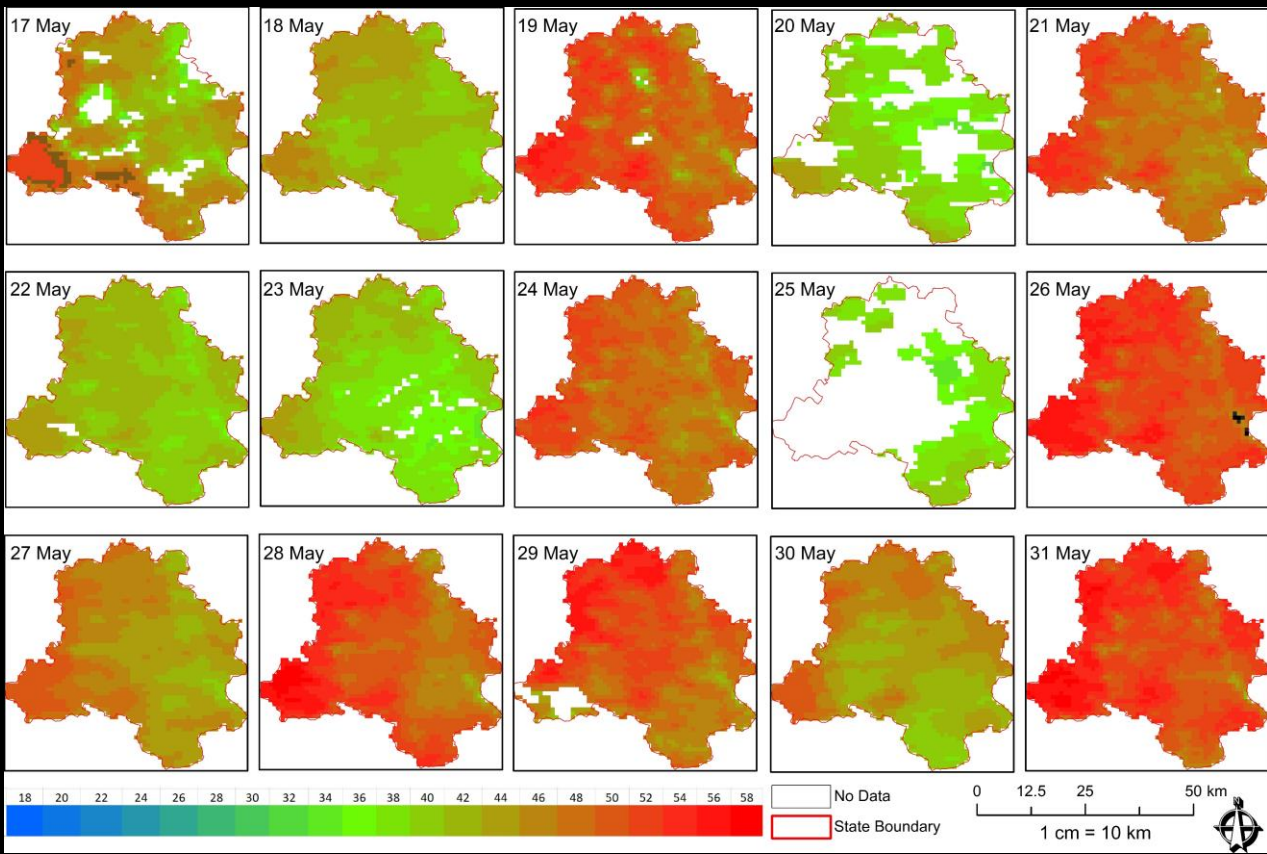
e-mail: netgeo.suhail@gmail.com



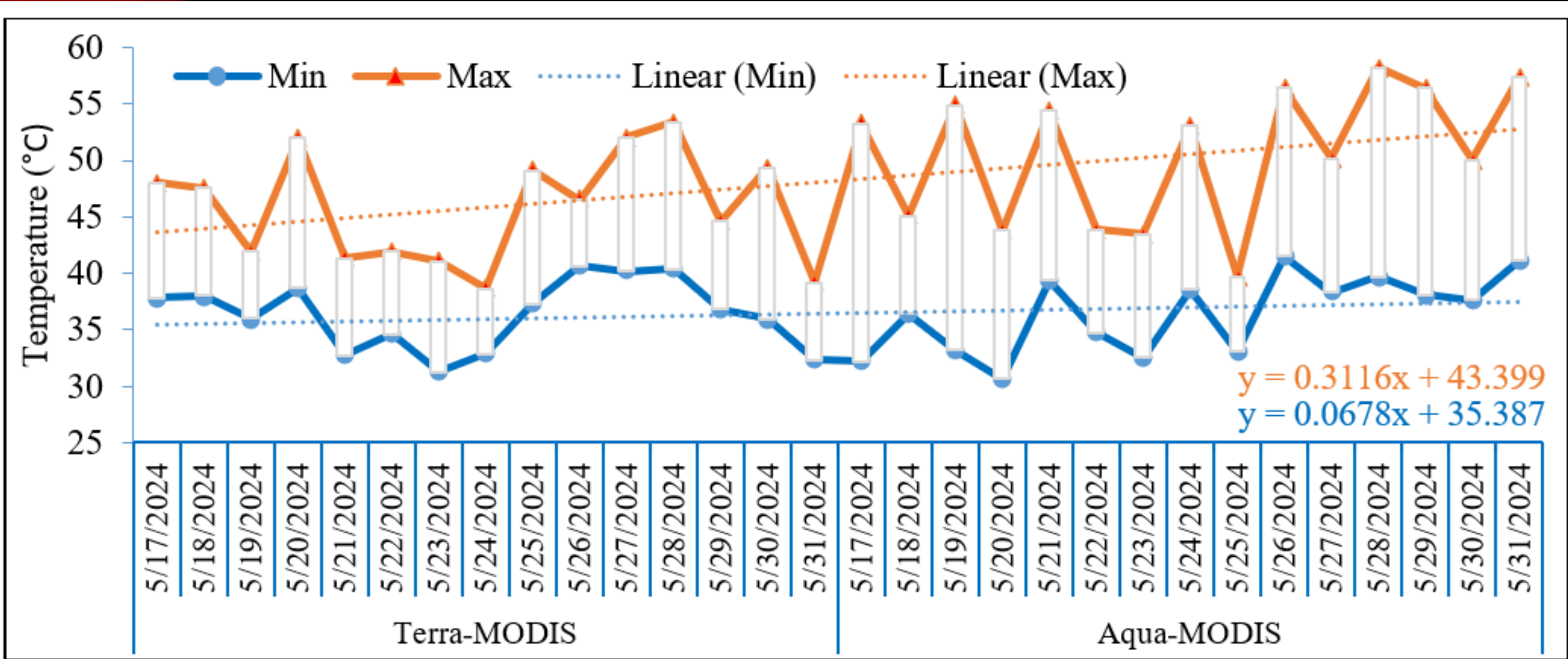
# Day Time Temperature °C

## Aqua – MODIS

## Terra – MODIS



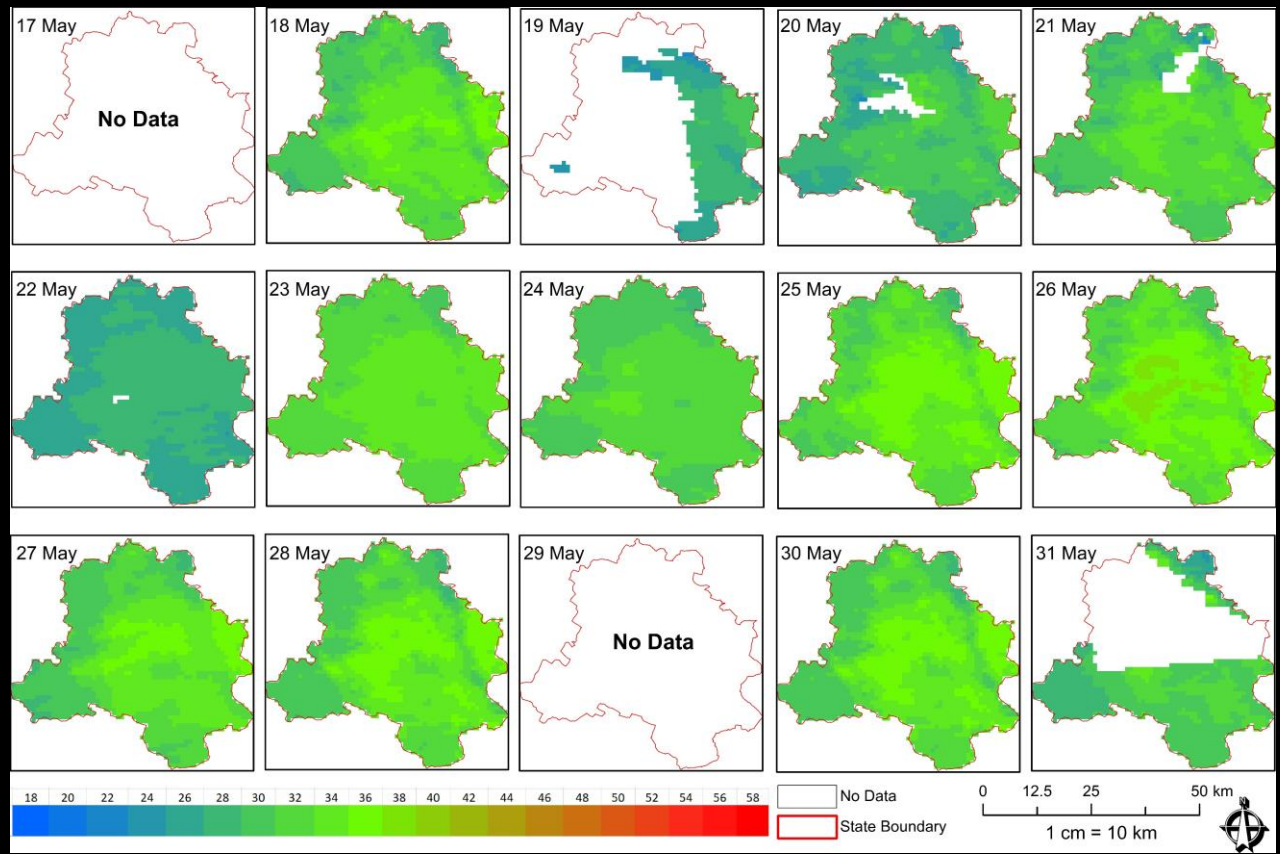
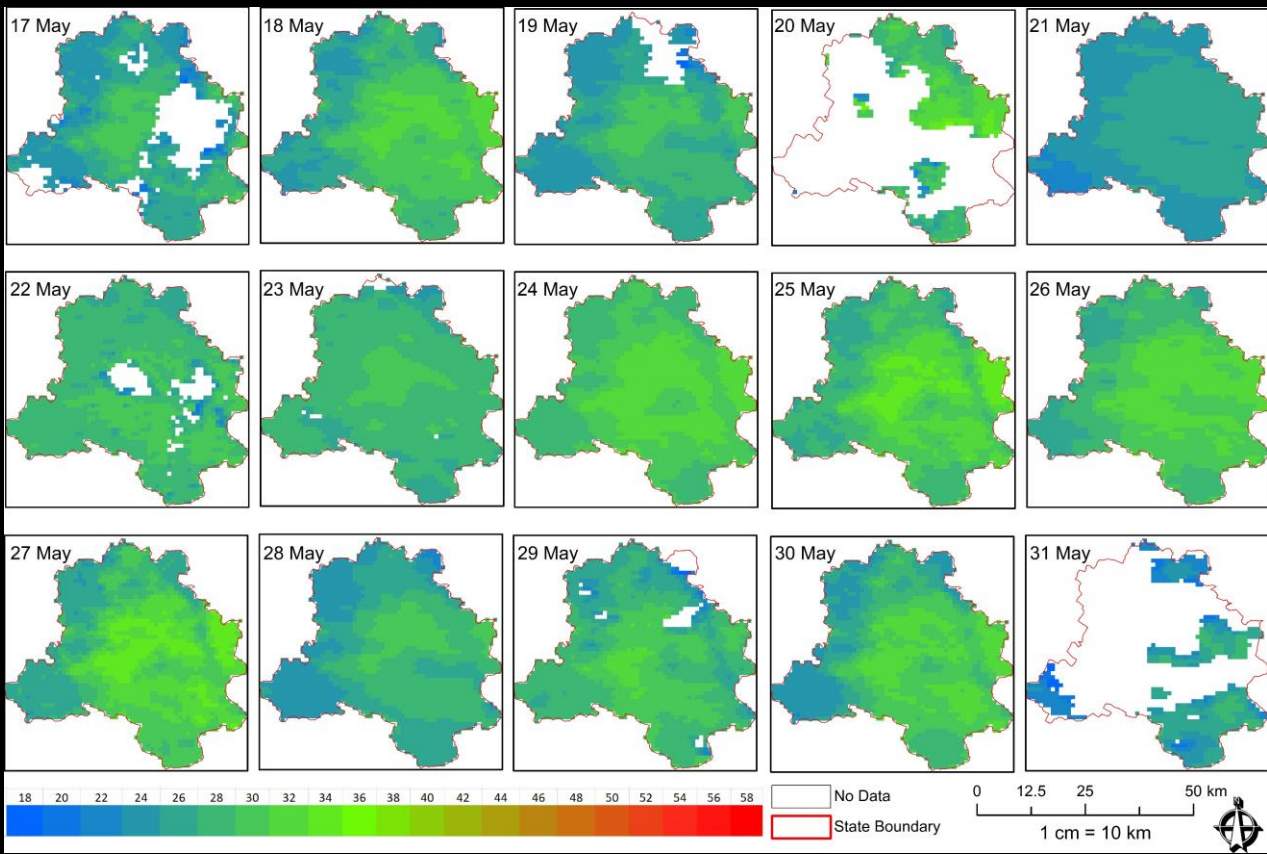
# Day Time Temperature °C



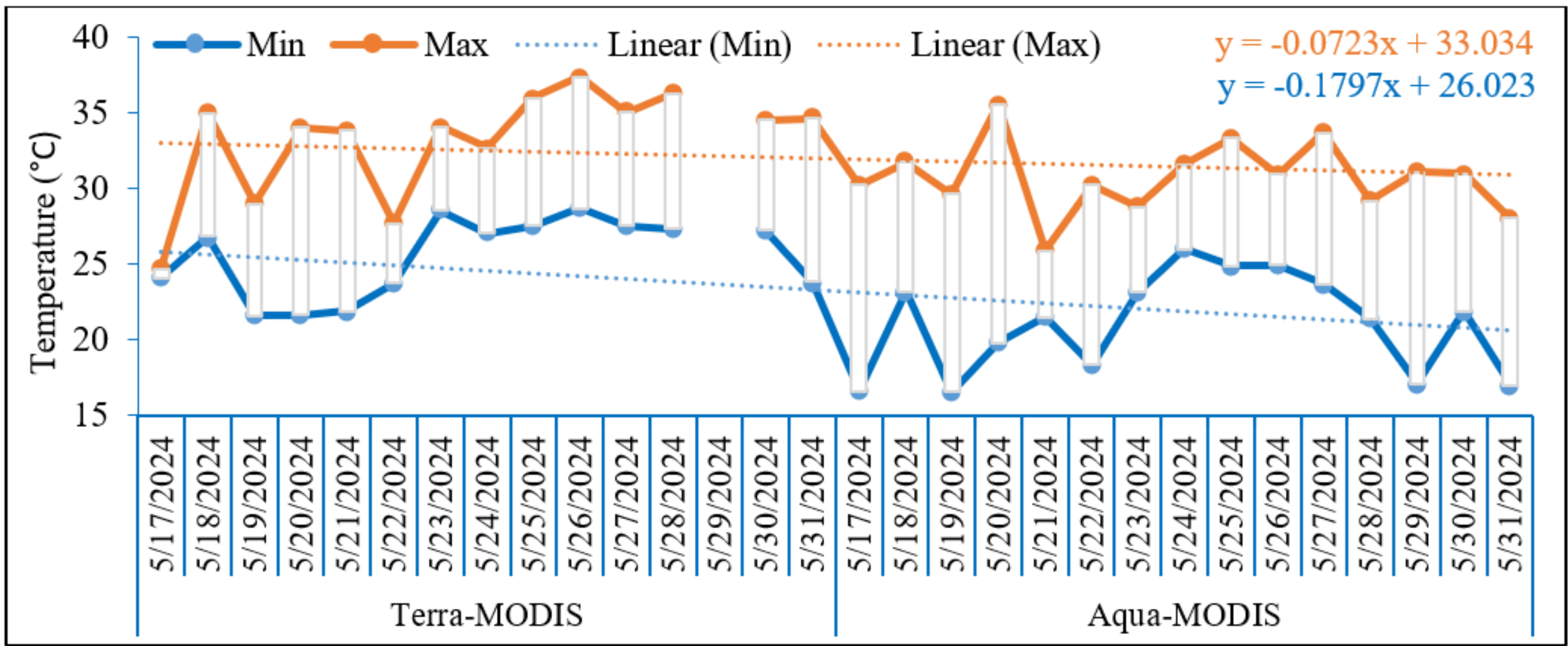
# Night Time Temperature °C

## Aqua – MODIS

## Terra – MODIS



# Night Time Temperature °C

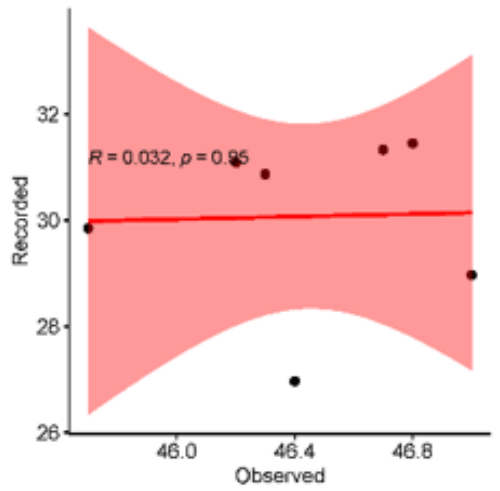




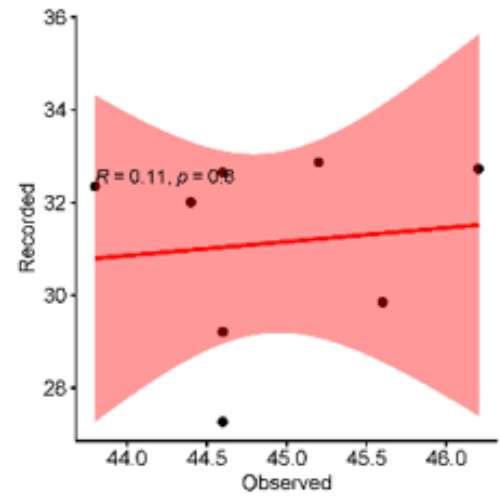
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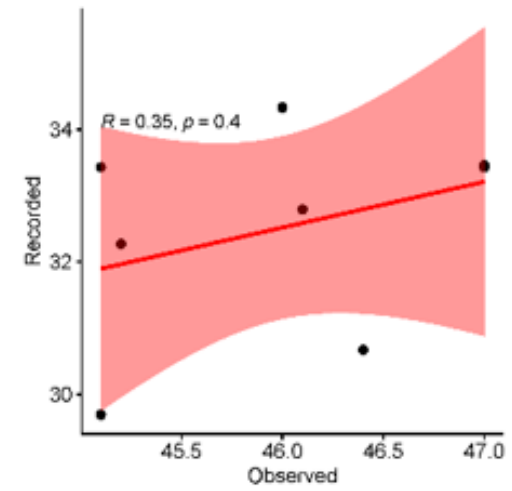
### Ayanagar



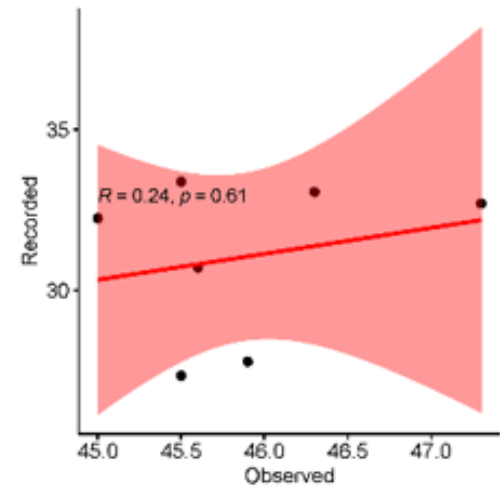
### Lodhi Road



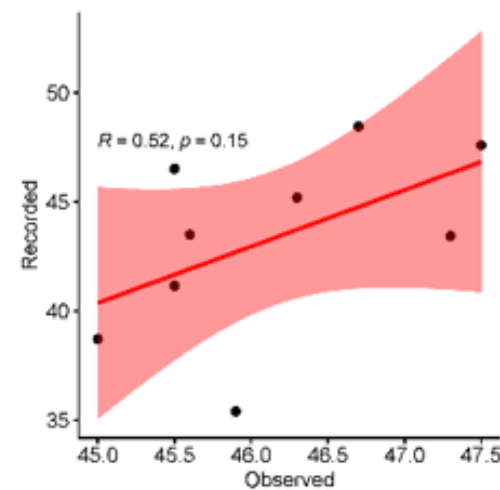
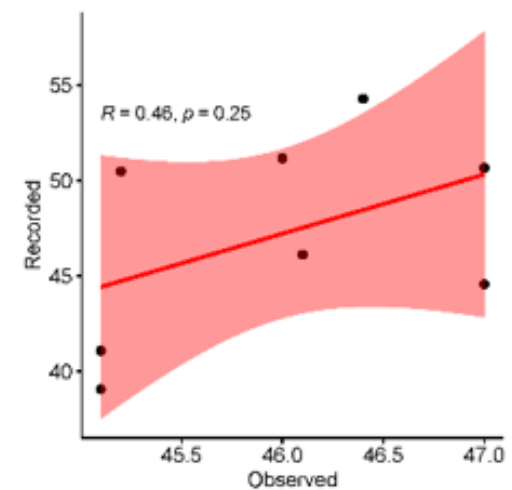
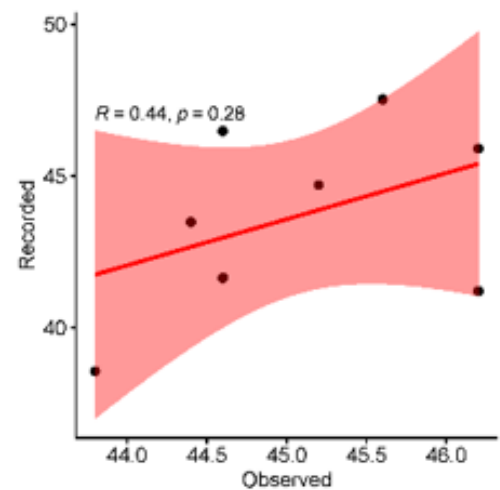
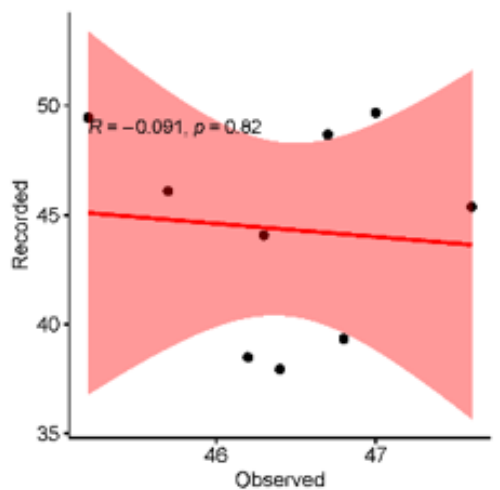
### Palam IGI



### Ridge



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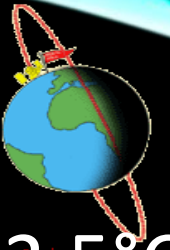




The study concluded that the maximum temperature estimated was to be 58.2°C, with minimal error less than  $\pm 1^\circ\text{C}$ . However, it is higher than initial IMD estimates of about 52.9°C.

The study also identified significant urban heat island (UHI) hotspots, with temperatures across most of Delhi exceeding the IMD's mean maximum of 41.4°C, surpassing the climatological mean by 1.5°C.

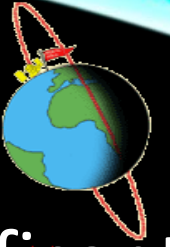
The highest temperature recorded was 46.8°C on May 30. The lowest temperature was estimated to be 16.5°C on May 19.



The analysis showed a maximum of 49.2°C and a minimum of 22.5°C on May 31, with an increasing trend of about 0.5°C per day.

Terra-MODIS and Aqua-MODIS data indicated rising daytime and decreasing nighttime temperatures. Sudden daytime temperature increases were noted on May 26, 27, 28, and 31.

Pearson correlation coefficients between observed (IMD) and recorded (MODIS) temperatures varied, with many correlations not statistically significant, emphasizing the need for rigorous analysis.



T-test values (6.53, 35.67, 2.87, and 42.20) indicated significant differences, rejecting the null hypothesis. Validation of LST from Aqua and Terra MODIS typically shows mean errors within  $\pm 1^{\circ}\text{C}$  (NASA, 2018).