

Demystifying urban -ization and migration interaction pathways Evidences from 80 cities in India

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ABSTRACT

The rapid rate of urban growth is being reported, and urbanization is recommended, but at what environmental, health, and equity costs? Phenomena such as the Urban heat island are resulting in an increased risk of heat-related mortality and morbidity, unequal benefits, and exclusionary planning. It is becoming increasingly critical that we understand and address the challenges arising due to unplanned and rampant urbanization. The current study aims to characterize SUHII in 80 cities in India and correlate its impacts on migration using Google Earth Engine. Different pathways in which migration and urbanization are summarized based on the evidence gathered from the remote sensing-based analysis. The results of the study will assist in deriving quantitative evidence that will notably support the design of urban risk reduction practices at a pan- India level.



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What are Tier 1 and Tier 2 cities?

Tier 1 cities in India are based on population, economic, and infrastructure indicators with populations of over 10 million people and are the economic hubs of the country. Tier 2 cities generally have lower population

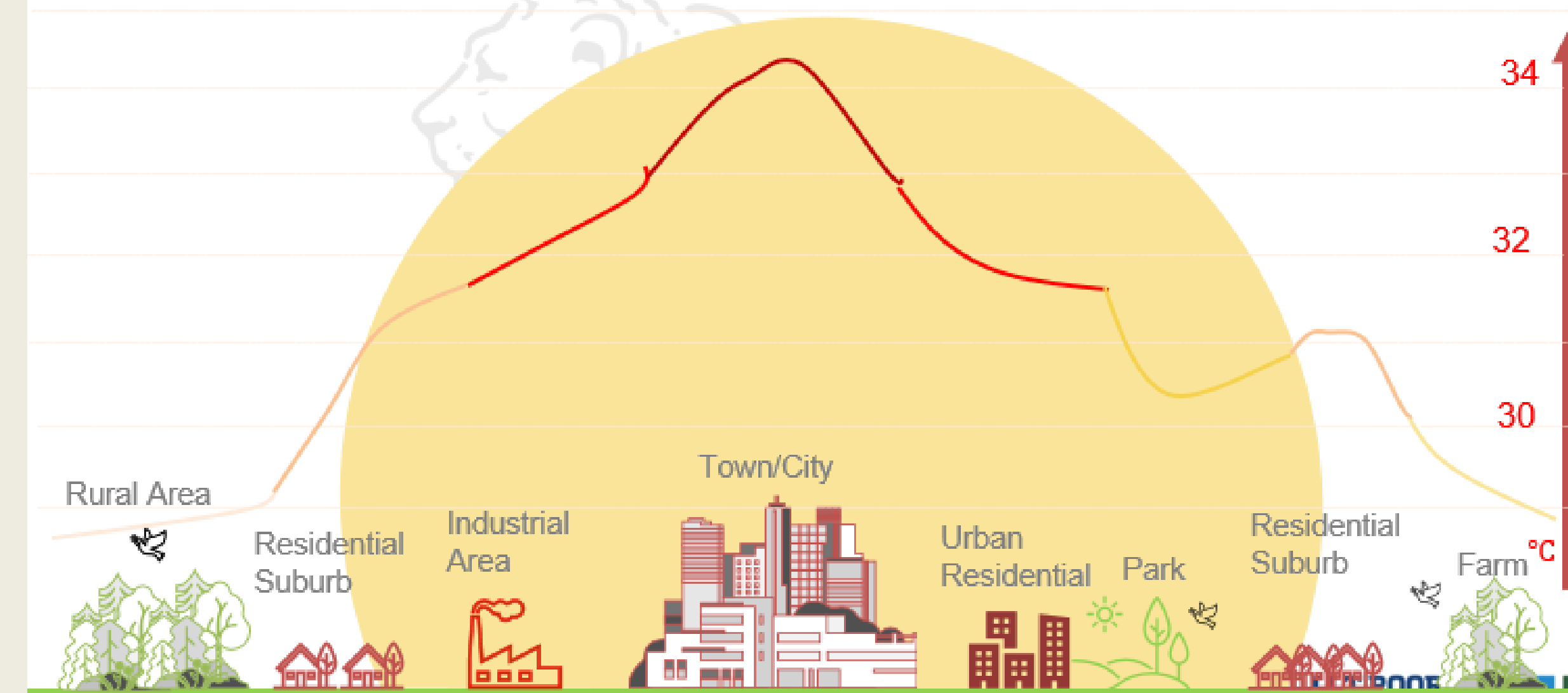
INTRODUCTION

Urbanization leads to Surface Urban Heat Island Intensity (SUHII) –

It represents the difference in land surface temperature (LST) in urban to rural areas. It is usually measured using satellite data.

$$\Delta Tu-r = Tu - Tr$$

• Where $\Delta Tu-r$ is UHI intensity, Tu is urban temperature, and Tr is rural temperature.

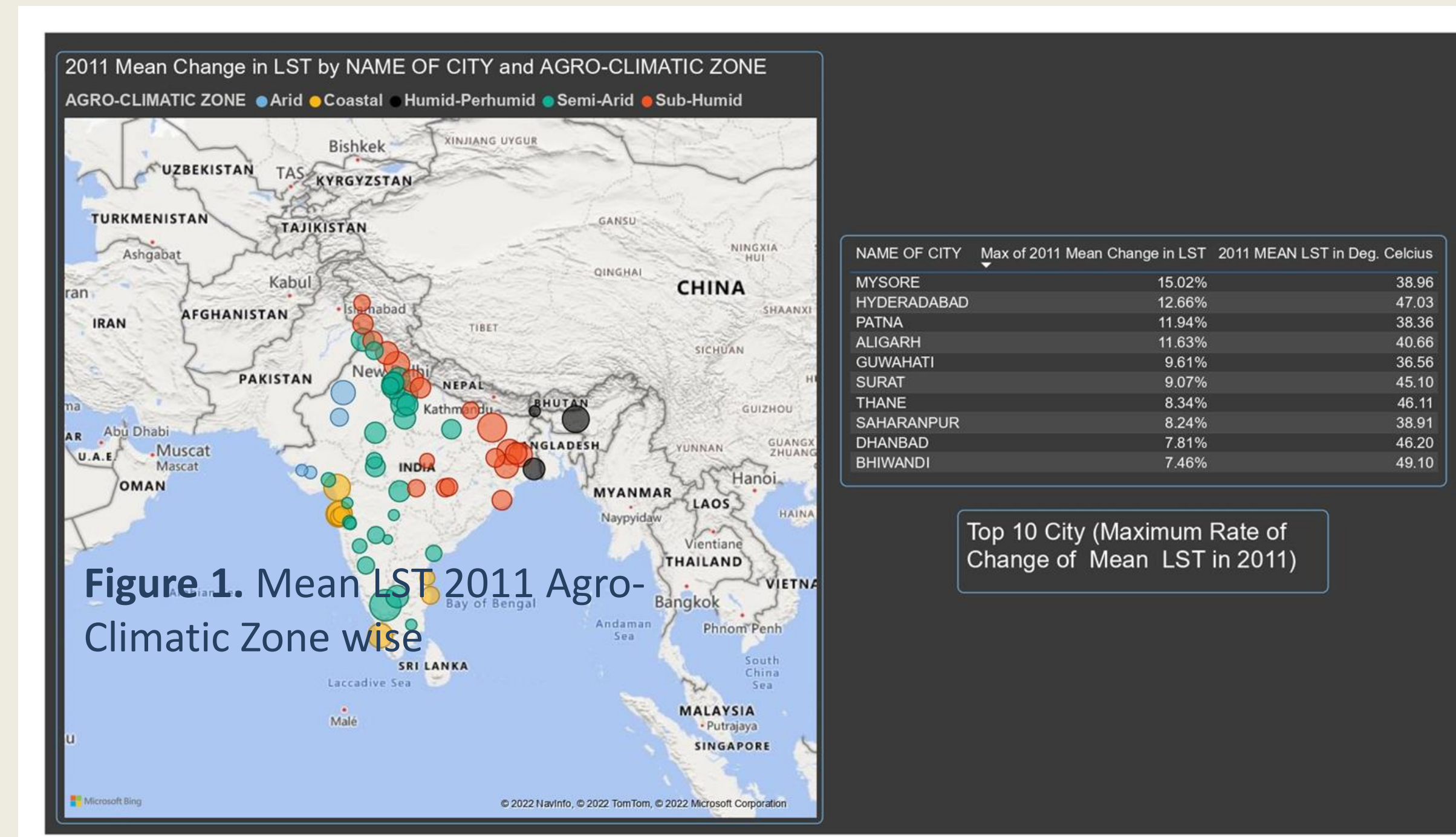


- The urban heat island effect is when urban areas suffer greater temperatures than non-urban areas.
- A number of variables, including diminished vegetation, anthropogenic heat, and the layout of urban infrastructure, contribute to the urban heat island effect.

- Urban planners and politicians should pay close attention to the urban heat island effect since it can have serious negative effects, such as an increased risk of heat-related illnesses and increased energy usage.

METHODOLOGY

- Indian cities with more than 500,000 population were aimed during this analysis for 3 time-steps 1991, 2001, 2011
- Finally, 80 cities across different agro-climatic zones were selected (Map 1)



- SUHI, LST, NDVI (Vegetation index), and NDBI (Built-up index) was calculated using Google Earth Engine
- Population, area, and in-migration data was collected from Census of India

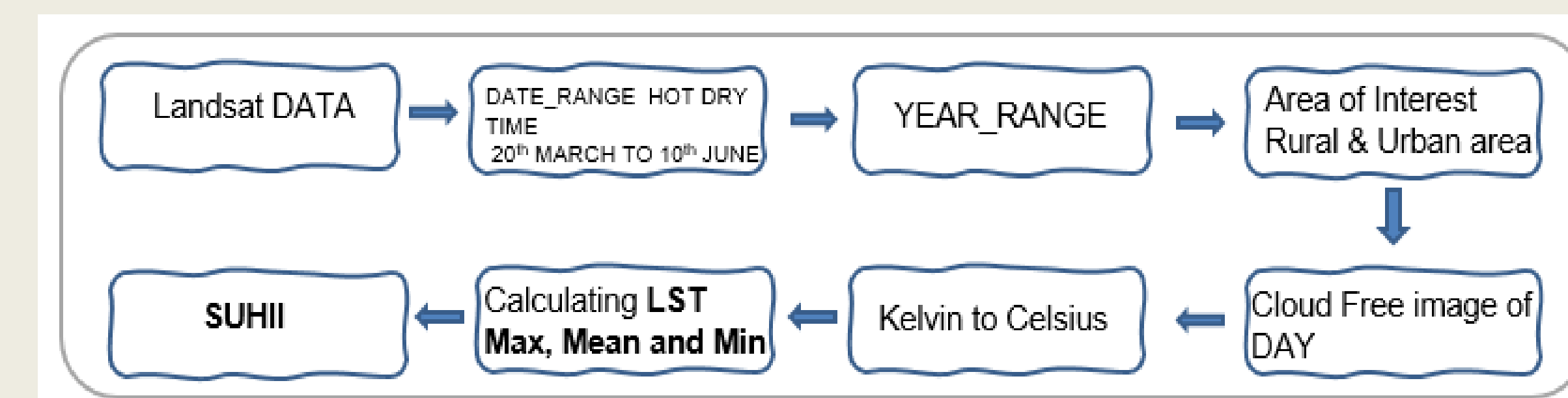


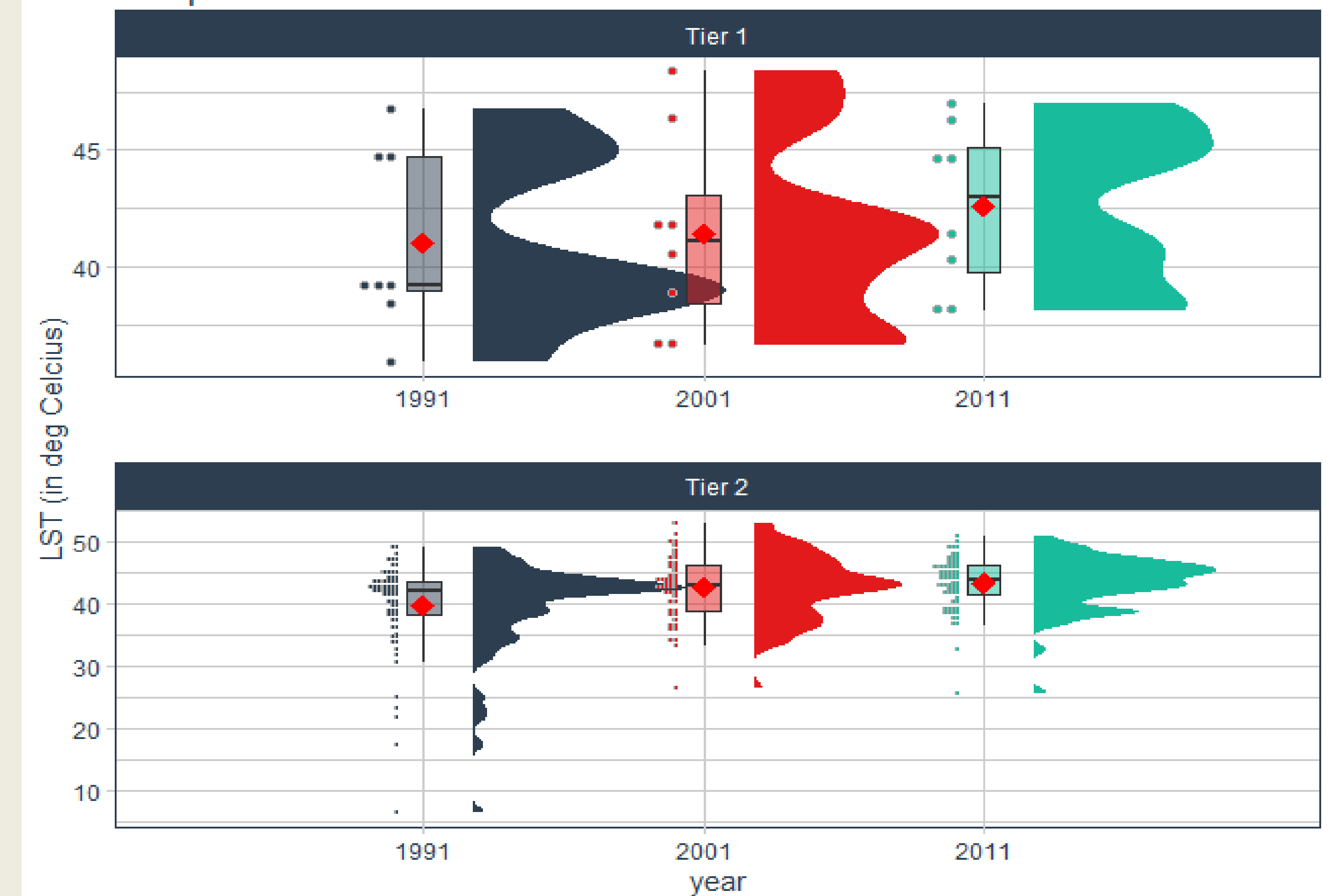
Figure 2. Methodology to Calculate LST and SUHII from LANDSAT in GEE

DISCUSSION & CONCLUSION

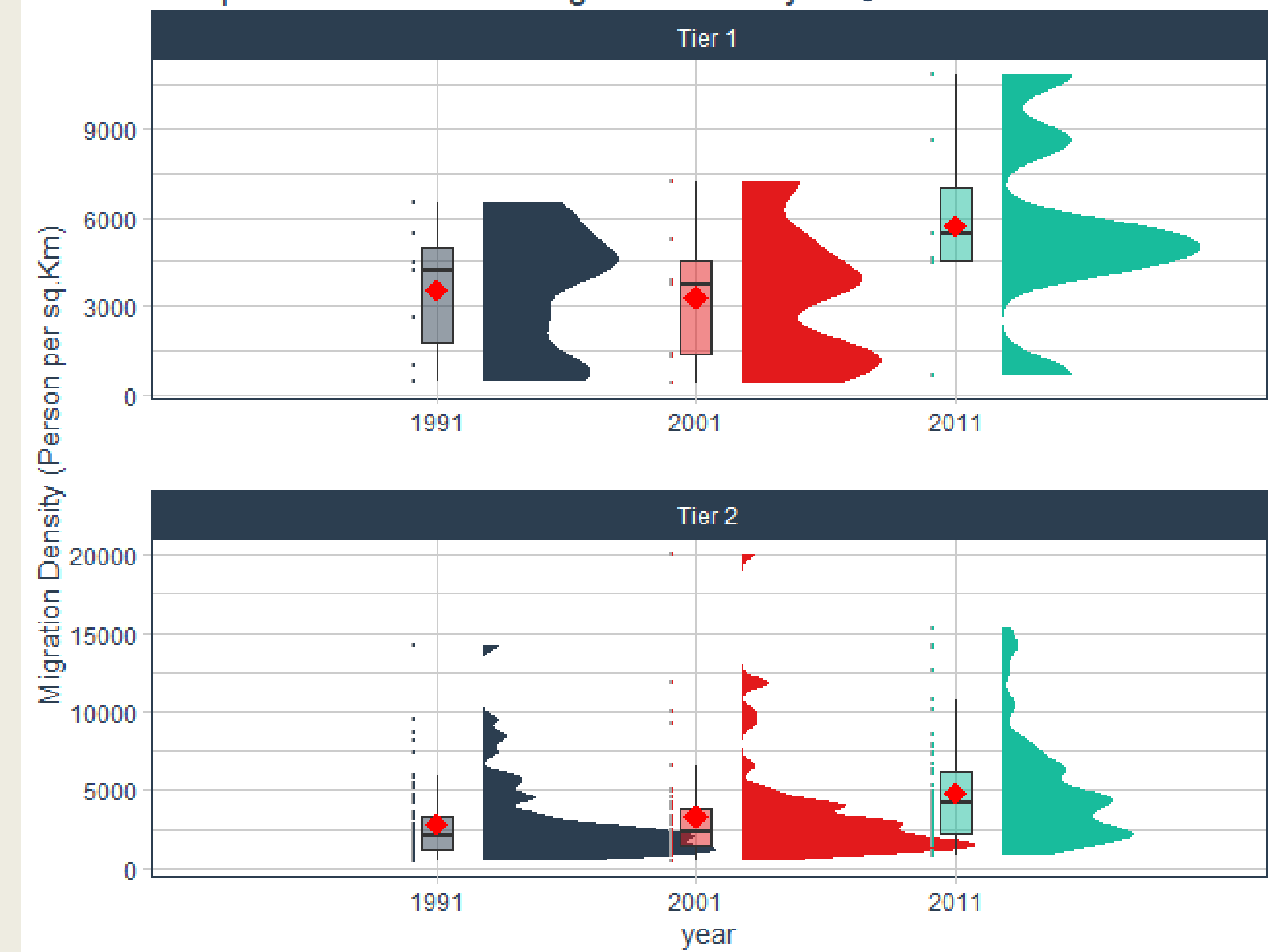
- Urbanization parameters like LST, and SUHII show a consistently increasing trend across the three-time steps for all the cities (Figure 3)
- However, the rate and magnitude differ across different cities and types of cities (Figure 3), as can be seen for Tier 1 and Tier 2 cities
- The study aimed to understand the determinants of urbanization (Table 1) for different types of cities (Tier 1 and Tier 2). We found that Tier 1 cities – highly populated metropolitan cities – show a different association with determinants as compared to evolving Tier 2 cities (Table 1).
- Surface Urban Heat Island Intensity shows a pattern that is contradictory to the results from most of the literature and supports the results of the Surface Urban Cool Island (SUCI) phenomenon reported by Tetali et al., 2022.

RESULTS

Temporal Distribution of LST Figure 3



Temporal Distribution of Migration Density Figure 4



Parameters		TIER 1	TIER 2
NDVI	LST	-0.71	-0.26
NDBI	LST	0.58	0.4
In-Migration	LST	0.47	0.15
In-Migration	NDBI	0.86	0.07
In-Migration	NDVI	-0.69	-0.14
NDBI	NDVI	-0.59	-0.57
SUHII	NDVI	0.51	0.22
SUHII	NDBI	-0.68	-0.27
SUHII	In-Migration	-0.65	0.14

Table 1. Correlation values among Urbanization parameters (LST, SUHII), demographic factors (in-migration), and Land cover indices (NDVI, NDBI) for Tier 1* and Tier 2* cities

*Definition explained below

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