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**Application of Remote Sensing and GIS to Identify  
Ward-level Heat Hot Spots and Vulnerability  
A case study of Rajkot City**

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**Application of remote sensing and GIS to identify ward level heat hot spots  
and vulnerability – A case study of Rajkot city**

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### **Abstract**

In this paper, we report an attempt to identify ward level thermal hotspots in Rajkot city using satellite remote sensing and GIS. Landsat 8 images (band 10) of May and June months of 2017 and 2018 were used to develop Land Surface Temperature (LST) maps, and thermal hotspots with temperature  $>42$  °C were identified. Landsat 8 was selected as it provides data, which is freely available, and of sufficient spatial resolution to develop ward level maps. The slums within the city were then mapped and overlaid on thermal hotspot maps to identify vulnerable population in Rajkot city. These thermal hotspot maps were used to identify vulnerable heat hot spots for mitigation actions by Rajkot Municipal Corporation (RMC), Rajkot, Gujarat.

**Keywords:** Land Surface Temperature (LST), Landsat 8, Rajkot, vulnerability, heat hot spots

### **1. Introduction**

The increased events of heat waves in recent years have caused many fatalities in India and elsewhere. It is important to monitor the Land Surface Temperature (LST) because the warmth absorbed by the ground creates heat islands and hotspots which affect the in situ microclimates of a place as well as ex-situ climate at a major regional scale. The thermal maps give insight into the differences in the distribution of LST within the cities. The maps are important to identify heat hot spots within the city for effective local action by the government. With the advent of satellite data, it has been increasingly possible to map LST at better spatial resolution. In this paper, we report thermal hotspots mapped and identified in Rajkot city using Landsat 8 data. The LST mapped was validated using ambient air temperature (AAT) recorded by 20 AWS (Automatic Weather Stations) installed by RMC and the IMD (Indian Meteorological Department) station.

### **2. Methodology**

Landsat 8 provides a range of open-source data at a spatial resolution of 30 m and with 11 spectral bands, out of which two are thermal bands. The thermal bands, band 10 and band 11, are mostly employed for the purpose of LST retrieval; however, it has been observed that band 11 has more uncertainty than band 10 (Yu et al., 2014). Therefore, band 10 of Landsat 8 data was used for retrieval of LST. Data of May and June months of the years 2017 and 2018 were employed to map LST. For 2017, data of 04 May and 14 June were used, whereas, for 2018, data of 07 May and 08 June were used. Shapefile of Rajkot municipal wards and slum distribution data was obtained by RMC. Slum distribution in Rajkot was mapped in GIS (Geographic Information System), and slum distribution map was overlaid on LST maps to identify vulnerable thermal hotspots. Satellite images of Rajkot were downloaded from Earth Explorer portal of the United

States Geological Survey (<https://earthexplorer.usgs.gov/>) and processed using TRS Tool Box (Walawender et al., 2012) in ArcGIS software. The methodology flow chart is shown in Figure 1. The LST derived from satellite data was validated with ambient air temperature recorded by IMD station within the city as well as the data received from 20 AWS stations installed within the city by RMC.

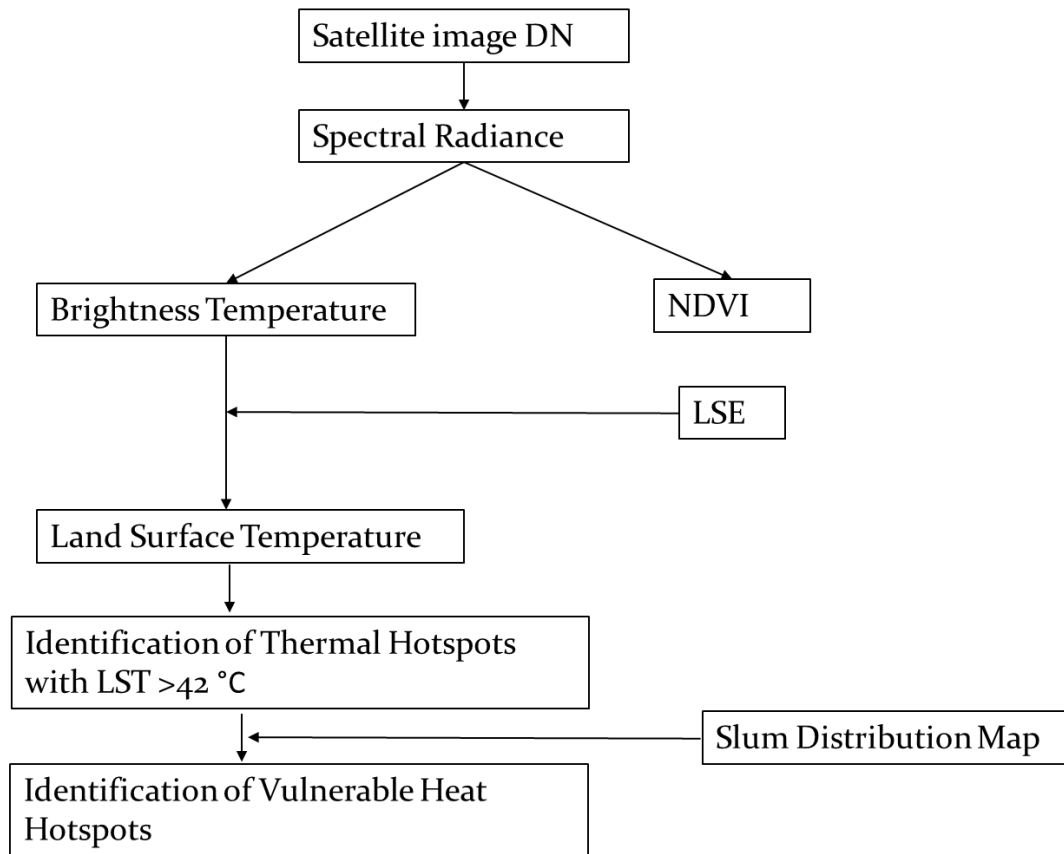
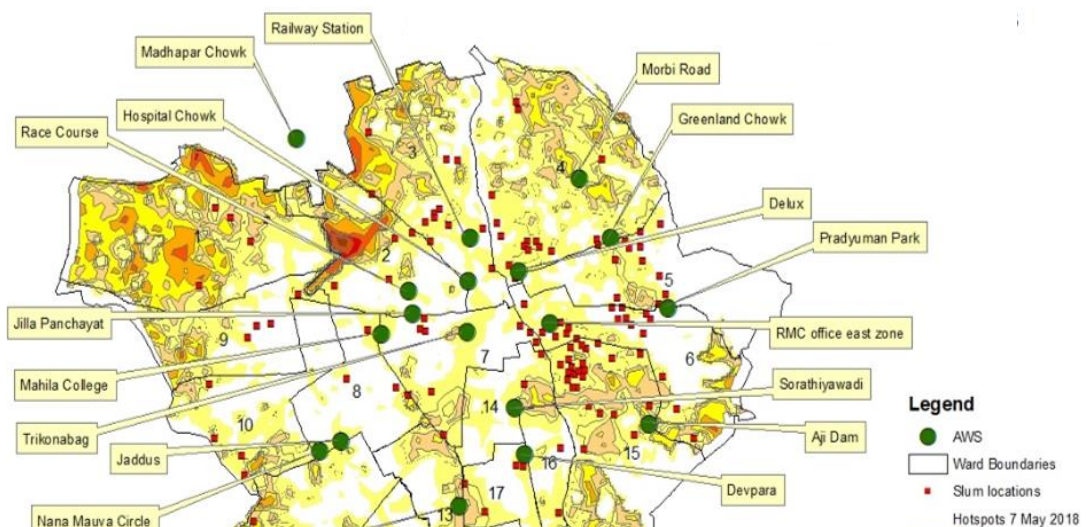


Figure SEQ Figure \\* ARABIC 1: Methodology for identification of vulnerable heat hotspots

### 3. Result

Figure 2 shows the areas with temperature  $>42^{\circ}\text{C}$  in Rajkot on 07 May 2018. The slum locations and the AWS stations installed within the city by Rajkot Municipal Corporations are also shown.



*Figure 2: Thermal hotspots with LST >42 °C in Rajkot on 07 May 2018*

The various areas identified as thermal hotspots in Rajkot city include Ambedkar Nagar, Rashulpura, Bajrangnagar, Rajyadhar, Shitaldhar, Jay Bhim Nagar, Bharat Nagar 1, Pradyuman park and Laludiwonkdi.

#### **4. Conclusion**

Satellite data was used to identify thermal hotspots within the city of Rajkot. These thermal hotspot maps were used to identify vulnerable heat hot spots for mitigation actions by Rajkot Municipal Corporation (RMC), Rajkot, Gujarat.

#### **5. Acknowledgement**

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#### **6. References**

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