J. Ind. Geophys. Union, 28(2) (2024), 119-130

Effect of land use and land cover changes on surface temperature: a case study from Chalisgaon (Jalgaon district, Maharashtra), India

Nilesh S. Patil[1], Bhavesh D. Patil[1]*, V. J. Patil[2], S. N. Patil[1], A. K. Kadam[1], Mayuri A. Patil[1]
[1]School of Environmental and Earth Sciences, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon-425001, India
[2]Annasaheb G. D. Bendale Mahila Mahavidyalaya, Jalgaon, Maharashtra-425001, India
***Corresponding author:** bdpatil.r@nmu.ac.in

ABSTRACT

This study examines the relationship between Land Surface Temperature (LST) and Land Use and Land Cover (LULC) through a combination of ground-based, satellite-based, and re-analytical products. It focuses on the most recent changes in land surface temperature between 1991 and 2021 in the Chalisgaon Taluka of Maharashtra State, India. The results demonstrate that LULC changes have a significant impact on the climate through a range of mechanisms. There appears to be a connection between the changes in LULC spatial pattern with change in LST and Normalised Difference Vegetation Index (NDVI). The error matrix is calculated for the assessment of the accuracy of classified land use land cover images. This analysis confirms that the most substantial alterations are related to changes in plant cover, as reflected by the alterations in LULC classes as well as in NDVI. The Built-up area covered 0.91% in 1991, but grew to 6.48% in 2021 compared to 1991. Between 1991 and 2021, the study region's vegetation and agricultural land area declined by 2.64%. It was discovered that there has been a quick transition from vegetation to built-up area. The mean LST ranges were amplified dramatically from 35.05^{0} C to 46.22^{0} C from 1991 to 2021, largely due to the growing build-up zone and decrease vegetation The study found that the growth of urban landscapes and associated rise in human activities, as well as shifting of agricultural patterns, LULC related changes to surface temperature, and regional climate feedback across this region, warrants further research. The finding of the present study will be useful for city planner and developers as baseline information for achieving the sustainable development of the area.

Keywords: Remote Sensing, Land Use and Land Cover (LULC), Land Surface Temperature (LST), Normalised Difference Vegetation Index (NDVI), Chalisgaon (India)

INTRODUCTION

One of the most crucial aspects of the interaction between the land surface and the environment is the land surface temperature (LST). A variety of factors, including the amount of vegetation, hydrological components, glacier melting, water stress, topography, soil, groundwater, and anthropogenic structures, affect the earth's land surface and direct subsurface, therefore can be influenced by the distribution of LST. Land Use Land Cover Pattern (LULC) does have an impact on LST (Cristobal et. al., 2008; Li et. al., 2013; Ahmed et. al., 2020; Shimod et. al., 2023; Pande et. al., 2023). It depends on the earth's surface's local and global water and energy balance. It describes the evolution of surface energy over time. This is a critical indicator for evaluating a developed region, vegetation, and global warming. Currently, the LST is a major environmental problem (Lambin et. al., 2003; Rozenstein et. al., 2014; Tyagi et. al., 2023; Molnárová et. al., 2023). Because it is a fundamental factor in the physics of land surface processes, land surface temperature (LST) is an essential climatic indicator, connected to climate change and an indication of the energy balance at the surface. Crop health has been harmed over time by a variety of environmental and climate changes, including unpredictable rainfall, extreme heat stress, changing land surface temperature (LST), and population shifts from rural to urban regions (Kimuku and Ngigi, 2017; Nilesh et al., 2022; Rajesh and Pande, 2023; Thanabalan et al., 2023). Due to the ozone hole, growing greenhouse gas concentrations, and other factors, temperatures are rising everywhere in the world. In order to mitigate the effects of global climate change, scientists must concentrate their efforts on studying the LST. Therefore, it is imperative to conduct further study in this field.

Thermal remote sensing has been used in recent experiments to calculate the LST. The changes in land use and land cover (LULC) have a substantial impact on ecological services. They also have an impact on human variables including environmental and governmental planning (Southworth, 2004; Sahana et. al., 2016; Athick et. al., 2019; Gaur and Singh, 2023). Land use change and its impact on land surface temperature (LST) are identified using remote sensing and geographic information system (GIS) approaches. Land surface temperature map was created for the Yardang area of the Lut Desert (Iran) using remote sensing and Landsat thermal data (Alavipanah et. al., 2007; Buyadi et. al., 2013; Brema et. al., 2023; Gadekar et. al., 2023; Shahfahad et. al., 2023; Shang et. al., 2023). The exact methodologies they used to estimate the dynamism of land use changes on average surface temperature for a specific case study in Kenya were discussed in detail. Several studies have also shown that environmental factors influence land use and land cover changes (Cheema and Bastiaanssen, 2010; Ragin, 2014; Kayet and Pathak, 2015; Das and Sarkar, 2019; Tan et al., 2020; Chu et. al., 2022).