

# The Impact of the COVID-19 Pandemic on Land Surface Temperature Change through Remote Sensing Data Processing

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**Abstract**— Various fields can collaborate in analyzing specific phenomena, such as the impact of the COVID-19 pandemic. Most research tends to focus on one aspect of the discipline, such as economics, health, spread predictions, and the like. Given its impact not only on health but also on other aspects, this study utilizes the processing of spatial data derived from satellite imagery using Geographic Information System (GIS) to observe the impact of the pandemic phenomenon on environmental conditions, i.e., surface temperature warming in the city of Bekasi, Indonesia. This research utilizes GIS tools to convert Landsat 7 and Landsat 8 datasets by extracting thermal sensors (Band 10 and Band 11). The test results show an annual increase in temperature, but a decrease of approximately 10 degrees Celsius during the COVID-19 pandemic. This indicates the possibility of reducing temperature by reducing carbon usage as closely as possible to pandemic conditions.

**Keywords**—Landsat, LST, Urban Heat Island, COVID-19, RS-GIS

## I. INTRODUCTION

Global warming is a natural phenomenon that is currently a serious concern [1]–[4]. This is because this phenomenon has an impact on human life, not just on the environment. Global warming can be mitigated by reducing warming in each region, such as reducing greenhouse gas emissions, improving efficiency, increasing vegetation, and so on.

Research on the COVID-19 phenomenon has been extensively conducted, both in terms of its management [5] and predictive calculations [6]. The COVID-19 pandemic condition has forced people to stay indoors, resulting in reduced emissions from transportation. This phenomenon will be investigated in this research to determine how much the surface temperature decreases when vehicle emissions are reduced. If each region follows the recommendations of this research, it is expected to contribute to mitigating global warming. Several studies have investigated global temperature changes by utilizing existing satellite sensors [7]–[11].

The suburbanization phenomenon appears to area near the central city, with the characteristic of the higher growth of the vicinity then the central city [12]. Bekasi City is 13 suburbanization area of Jakarta, providing an insight into the changes in Land Surface Temperature (LST) during the COVID-19 pandemic.

Most environmental research is still based on qualitative data in assessing the environment [1], [13]. Some experts advocate for reducing vehicle and industrial emissions, but the actual impact is rarely quantified. The occurrence of COVID-19, aside from affecting all aspects of life, can also serve as a crucial basis for the importance of emission reduction, accompanied by real quantitative data derived from Landsat satellite imagery. With this data, objectivity can be ensured, making it a reference for researchers focused on environmental issues. The obtained data is processed with the

assistance of computational tools involving Geographic Information Systems (GIS) and modules available in the application.

After explaining the method used to convert satellite images into LST, where the actual surface temperature is known, the results are analyzed to understand the phenomena that occurred during the pandemic conditions (from 2019 to 2021). The conclusion section then provides insights into the phenomena that occurred during those years.

## II. MATERIALS AND METHODS

### A. Materials

The current study used Landsat 7 and 5 Landsat 8 satellite images for specific dates. The data were obtained from the United States Geological Survey (USGS) through its official website (<https://earthexplorer.usgs.gov/>). Four capture dates were selected: August 2010 (Landsat 5), August 2013 (Landsat 8), September 2018 (Landsat 8), and September 2021 (Landsat 8). The selection of these time ranges follows the COVID-19 pandemic conditions, which began in early 2020 and extended into 2021 for the Indonesian region. Therefore, the year 2021 will demonstrate the effects of the COVID-19 pandemic on land surface temperature.

While Landsat 5 used Band 6, Landsat 8 utilized Band 10 and Band 11 [14]. The downloaded files have a size of approximately 1 gigabyte. We need to sign up on the USGS website first to be able to download available satellite images. It's advisable to choose clear (cloud-free) captures, although with GIS Tools, you can remove clouds during the LST creation process.

Satellites are widely available and can be utilized at no cost. Some satellites offer advantages in terms of resolution, the number of sensors, and other facilities. For this research, Landsat was chosen because it provides broad coverage at the city/district level. Additionally, this satellite is equipped with two bands that function as thermal image capturers of the Earth's surface for both daytime and nighttime conditions.

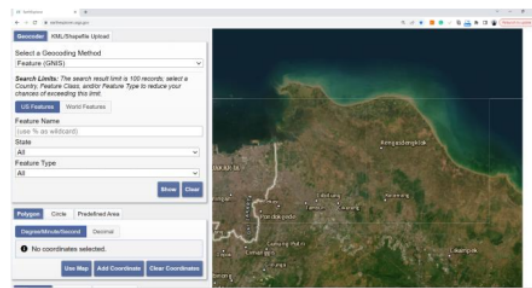


Fig. 1. The region downloaded (Tile) from USGS.

Satellite sensor captures consist of several files that indicate Bands along with important metadata. This metadata

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