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PROCEEDING

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PREFACE

It is my great pleasure to warmly welcome you to the Eighth International Conference on Informatics and Computing (ICIC 2023) held for the first time, in Hybrid mode, with online participation will be held via the Zoom Meeting platform.

The ICIC is a conference series which is conducted annually by APTIKOM, the Indonesian Association of Higher Education in Informatics and Computing. This year the main theme of the conference is ***" Empowering Education and Research on Artificial Intelligence for Improving National Competitiveness"***, with an intention to bring up more awareness in our society on the importance of Artificial Intelligence in the current era and beyond.

The ICIC conference series as a flagship conference of APTIKOM serves as an arena for academicians and their students, experts and practitioners from the industry to meet, present, and have fruitful discussions on their research works, ideas, and papers in the wide areas of Computing which covers Computer Science, Information Systems, Information Technology, Software Engineering, and Computer Engineering. The conference is set to provide opportunities for participants from both academia and industry to share and exchange knowledge as well as the cutting-edge development in the computing field. It is expected that the ICIC participants will be able to take away new thinking and horizon from this conferential meeting to further their works in the area.

There are 330 papers submission and only 158 papers are accepted which is around 47,8% acceptance rate. The accepted papers will be presented in one of the 9 regular parallel and tracks sessions and will be published in the conference proceedings volume. The diversity of authors come from 9 different countries.

All accepted papers are submitted to IEEE Xplore. IEEE Conference Number: #60109. Catalog Number: CFP23G52-ART ISBN: 979-8-3503-4260-4

On behalf of the ICIC 2023 organizers, we wish to extend our warm welcome and would like to thank for all Keynote Speakers, Reviewers, Authors, and Committees, for their effort, guidance, contribution and valuable support. We would like to also extend our gratitude to IEEE Indonesia Section for technically co-sponsored this event.

I wish you all a most wonderful, enjoyable, and productive conference in this ICIC 2023. Thank you.

Wa billahi taufiq wal hidayah. Wallahul muwaffiq ila aqwamit tharieq.

Wasalaamu ‘alaykum warahmatullahi wabarakaatuh.

Yusuf Durachman, M.I.T

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Evaluating the Effects of Mobility Restrictions during COVID-19 on Land Surface Temperature with GIS and Satellite Data

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***Abstract*— In order to analyze specific occurrences, such as the COVID-19 pandemic's effects, experts from a variety of professions might work together. The majority of study, such as those on economics, health, spread projections, and similar topics, focuses on just one area of the field. Therefore, several multidisciplinary teams need to collaborate in analyzing the occurring phenomena. The method employed in this research involves using Remote Sensing and Geographic Information Systems (RS-GIS) to observe the impact of the pandemic phenomenon on environmental conditions, specifically surface temperature warming in Bekasi Regency, Indonesia. This is due to its impact not only on health but also on other aspects. This study converts Landsat 7 and Landsat 8 images using (RS-GIS) technologies to extract thermal sensors (Band 10 and Band 11). The test results indicate that the temperature rises annually, but that it falls during the COVID-19 pandemic.**

Keywords—Landsat 8, LST, QGIS, COVID-19, RS-GIS

I. Introduction

Natural phenomena known as global warming is currently causing major worry [1]–[4]. This is due to the fact that this issue affects human lives as well as the environment. By reducing warmth in each area, such as by cutting greenhouse gas emissions, boosting efficiency, growing greenery, and so on, global warming can be controlled. The pandemic is a rare event that may occur once in a century, so this phenomenon can be utilized to quantitatively and precisely examine an idea, for example, recommendations to reduce greenhouse gas emissions.

Numerous studies have been done on the COVID-19 phenomena, including management studies [5] and forecasting studies [6]. People were compelled to stay indoors due to the COVID-19 pandemic condition, which lowered transportation-related emissions. In order to ascertain how much the surface temperature drops when car emissions are lowered, this phenomenon will be studied in this study. This study's recommendations should help each region slow down global warming if they are implemented. By leveraging current satellite sensors, several studies have looked into changes in the earth's temperature [7]–[11].

The data are evaluated to comprehend the events that took place during the pandemic conditions (from 2019 to 2021) after describing the process used to transform satellite photos into Land Surface Temperature (LST), where the actual surface temperature is known. The final section offers insights into the events that took place over those years.

This research contributes to what-if analysis when greenhouse gas emissions are significantly reduced and observes their direct impact, without analogy or theoretical approaches that are still in doubt. Mobile restriction represents how much exhaust gas is normally emitted in the research area, so it can be further analyzed for its correlation with the local temperature decrease, which may also impact global temperatures. This research essentially demonstrates precisely how accurate existing theories about global warming are, and it is conducted at the right time (during the pandemic).

II. Materials and Methods

A. Materials

Landsat 7 and Landsat 8 satellite photographs for particular dates were employed in the current investigation. The United States Geological Survey (USGS) provided the information via its official website, Earth Explorer (https://earthexplorer.usgs.gov). August 2010 (Landsat 5), August 2013 (Landsat 8), September 2018 (Landsat 8), and September 2021 (Landsat 8), were chosen as the four capture dates. Following the COVID-19 pandemic circumstances, which started in early 2020 and persisted through 2021 for the Indonesian region, these time frames were chosen. Thus, the COVID-19 pandemic's effects on land surface temperature will be visible in 2021.

Landsat 8 used Bands 10 and 11, while Landsat 5 used Band 6 [12]. The downloaded files are about 1 GB in size. To be able to download the accessible satellite pictures, we first need to register on the USGS website. It's best to select clear (cloud-free) captures, while you can get rid of clouds using

GIS Tools when creating LSTs. Figure 1 shows the tile (Landsat capture region term) for the Jakarta Metropolitan Region.

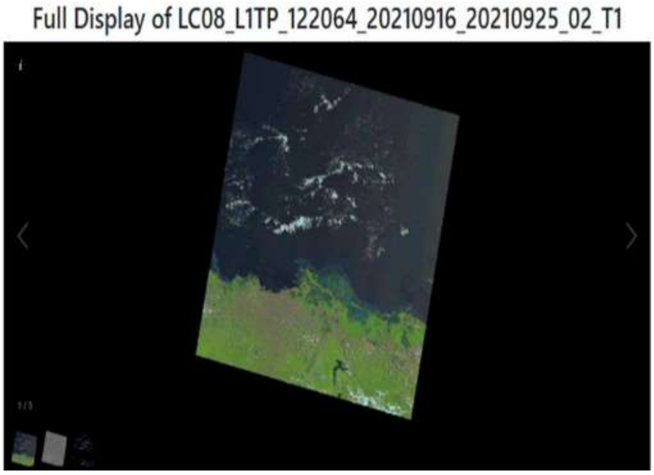


Fig. 1. The region downloaded (Tile) from USGS.

Satellite sensor captures are made up of a number of files that include crucial metadata and band indications. In order to calibrate devices, this metadata converts surface temperatures to degrees Celsius. Because Landsat 8 has more sensors than its predecessors (Landsat 1–Landsat7), it is different from those satellites. Band 6 was where the thermal sensor was on earlier Landsat spacecraft.

In addition to raster data representing satellite photos, vector data representing the research region—in this case, the Bekasi Regency in West Java, Indonesia—is also required. The detailed satellite pictures of the Jakarta Metropolitan Region (JABOTABEK) are cropped onto this map to fit the Bekasi Regency.

B. Methods

Land Surface Temperature (LST) thematic maps can be produced using a variety of GIS tools, including ArcGIS, QGIS, and others. Every tool has benefits, eases of use, and restrictions. To create LST maps of a region, they all adhere to the same procedure in theory. The steps to create an LST map are listed below.

B.1. Conversion to Top of Atmosphere (TOA) Radiance

The process by which the raw sensor data gathered by a satellite sensor is transformed into radiance values at the top of the Earth's atmosphere is referred to as "radiance" in the context of remote sensing and satellite image analysis [13]. Within the data pre-processing workflow for satellite imaging, this conversion is a vital step. The TOA is found in equation (1):

$$\text{TOA (L)} = M_L * Q_{CAL} + A_L \quad (1)$$

QCAL is retrieved from band 10, AL is Band-specific additive rescaling factor from the metadata, and ML stands for Band-specific multiplicative rescaling factor from the metadata.

B.2. Top of Atmosphere (TOA) to Brightness Temperature conversion

In remote sensing, especially for interpreting satellite images, the conversion of TOA Radiance to Brightness Temperature is essential. The surface or object's radiative temperature is determined by brightness temperature measurements made by a satellite sensor. Here is a display of the function to convert TOA to Brightness Temperature.

$$BT = (K_2 / (\ln (K_1/L) + 1)) - 273.15 \quad (2)$$

K_1 and K_2 are metadata-based thermal conversion constants for specific bands.

B.3. Calculate the Normalize Difference Vegetation Index (NDVI)

In remote sensing and environmental monitoring, the Normalized Difference Vegetation Index (NDVI) is a measurement and monitoring technique for the health and density of vegetation. The NDVI calculates the difference between the surface of the Earth and plant absorption of IR and visible light. As a result of the NDVI, numerical values between -1 and +1 are produced. These results are commonly interpreted as follows:

$$NDVI = (\text{Band } 5 - \text{Band } 4) / (\text{Band } 5 + \text{Band } 4) \quad (3)$$

B.4. Calculate the proportion of vegetation P_v

Vegetation influences the surface thermal through the emissivity.

$$P_v = Sqr((NDVI - NDVI_{min})/(NDVI_{max} - NDVI_{min})) \quad (4)$$

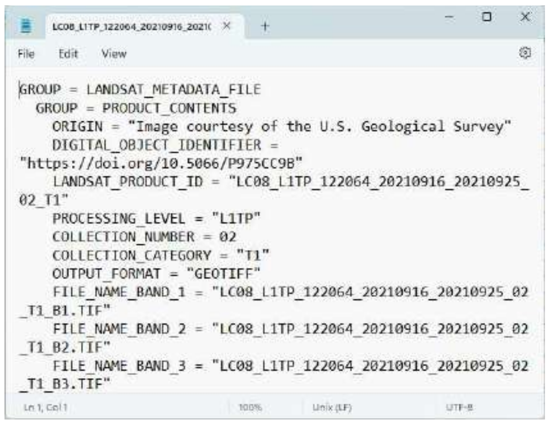
B.5. Calculate Emissivity ε

$$\varepsilon = 0.004 * P_v + 0.986 \quad (5)$$

B.6. Calculate the Land Surface Temperature

$$LST = (BT/(1 + (0.00115 * BT / 1.4388) * Ln(\varepsilon))) \quad (6)$$

The LST equation can then be used to produce the surface temperature map. Equations 1-6, including those utilizing raster data (Band 10 and the Bands utilized in the NDVI composite image), can be calculated using the raster calculator. The metadata utilized for these calculations is displayed in Figure 2.



```
GROUP = LANDSAT_METADATA_FILE
  GROUP = PRODUCT_CONTENTS
    ORIGIN = "Image courtesy of the U.S. Geological Survey"
    DIGITAL_OBJECT_IDENTIFIER =
"https://doi.org/10.5066/P975CC9B"
    LANDSAT_PRODUCT_ID = "LC08_L1TP_122064_20210916_20210925_
02_T1"
    PROCESSING_LEVEL = "L1TP"
    COLLECTION_NUMBER = 02
    COLLECTION_CATEGORY = "T1"
    OUTPUT_FORMAT = "GEOTIFF"
    FILE_NAME_BAND_1 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B1.TIF"
    FILE_NAME_BAND_2 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B2.TIF"
    FILE_NAME_BAND_3 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B3.TIF"
```

Fig. 2. Metadata of Landsat File.

The RS&GIS plugin for Quantum GIS is used in this study. The necessary bands (4, 5, 10, and 11) are integrated with metadata by this plugin. It produces an output consisting of a raster map with surface temperature ranges by simply inserting the compressed data downloaded from USGS and the shapefile of the research region.

III. Result and Discussion

LST maps were made using four time frames (2010, 2013, 2018, and 2021). Equations 1 through 6 were utilized in

ArcGIS to create LST maps, whilst the supplied dataset (in tar.gz format) is simply converted in QGIS using the RS&GIS plugin. Another choice is to indicate the folder or file that is created after the tar.gz file has been extracted. If the downloaded file is in tar format rather than tar.gz, we might need to rename it.

Thermal bands (Band 6 for Landsat 7 and Band 10 and 11 for Landsat 8) can be used to directly calculate the distribution of surface temperature, although calibration with the metadata files that come with the downloaded satellite images (txt file) is necessary to acquire its precise values.

A. Land Surface Tempature Map

The RS&GIS plugin used to generate LST is shown in Figure 3. A shapefile of the study area plus compressed USGS files make up the input. Check the "extra derived output" (LST), also known as the final result, carefully.

For high temperatures, the LST map provides accurate results, but under certain conditions, namely cloud cover, even though there are facilities to correct it, the results are less satisfactory, sometimes not displaying processed results. The less satisfactory results when there is cloud cover are due to the temperature dropping, as clouds consist of water vapor with temperatures close to freezing.

The finished product is a TIF file with standard coordinates and projection. It can be combined with a base map, like a street map or satellite view, for additional processing to make it easier to see actual places.

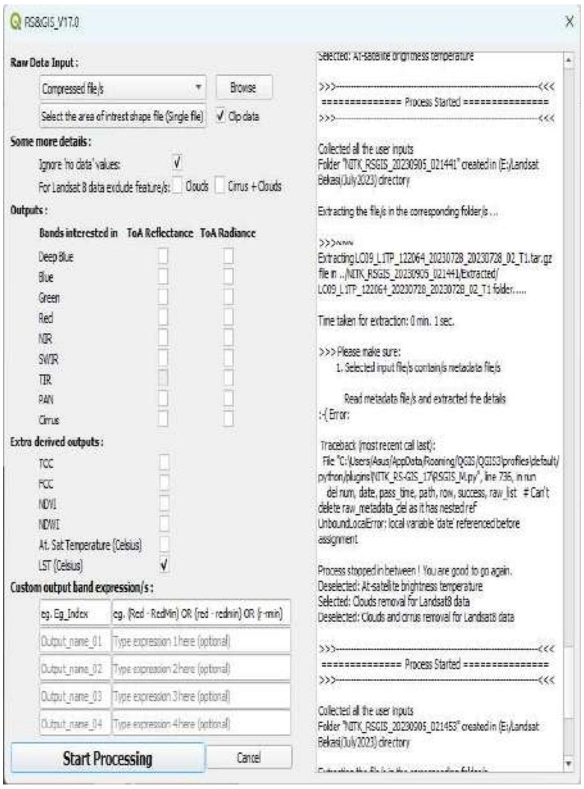


Fig. 3. RS&GIS Plugin for LST Callibration.

In the "For Landsat 8 data exclude feature/s" section, you can select the "Clouds" and "Cirrus + Clouds" choices to eliminate cloud interference specifically for Landsat 8. Since clouds often have low temperatures, they can have an impact on LST accuracy. The temperature range of the LST map is displayed in Figure 4.

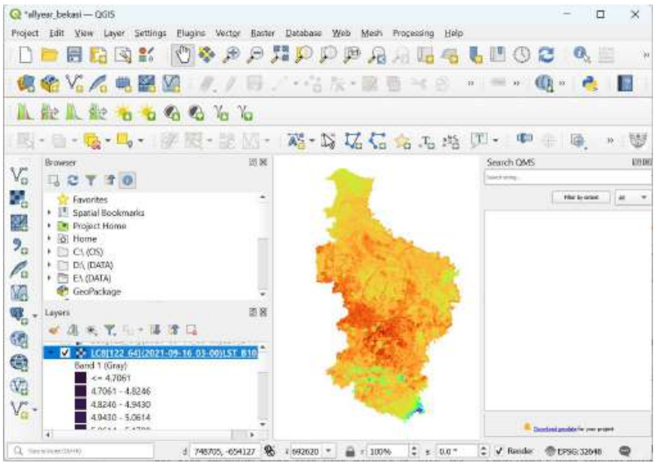


Fig. 4. LST Maps.

From low temperature (minimum) to high temperature (maximum), from brilliant red to dark red colors, the pixel colors gradually depict surface temperatures. The temperature graph for the four distinct time periods of the testing results is shown in Figure 5. According to the graph, the temperature has been gradually rising each year, peaking in 2018. It's probable that the temperature increased even after Bekasi employees in Jakarta, Bogor, and Tangerang were given the option to work from home. As a result, the temperature dropped during the COVID-19 pandemic. The outbreak is regarded as having peaked in 2021, when some people were permitted to leave their homes under specified conditions (PSBB).

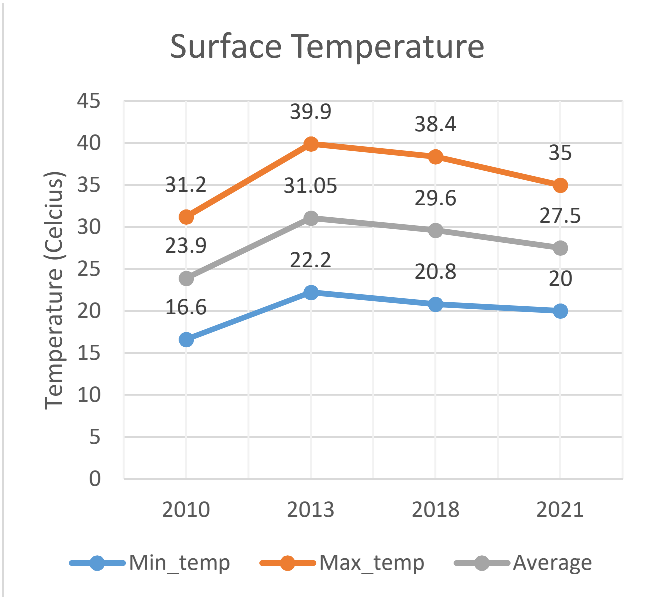


Fig. 5. Daytime Land Surface Temperature

The land surface temperature for Landsat 8 is calculated using Bands 10 and 11 [14]. Band 11 has a longer infrared wavelength than Band 10 and is used to monitor surface temperature at night. Band 10 is used to calculate temperature during the day. With the deployment of Landsat 5, only Band 6—which is usually used to record daytime imagery—was utilized during the year 2010 [10].

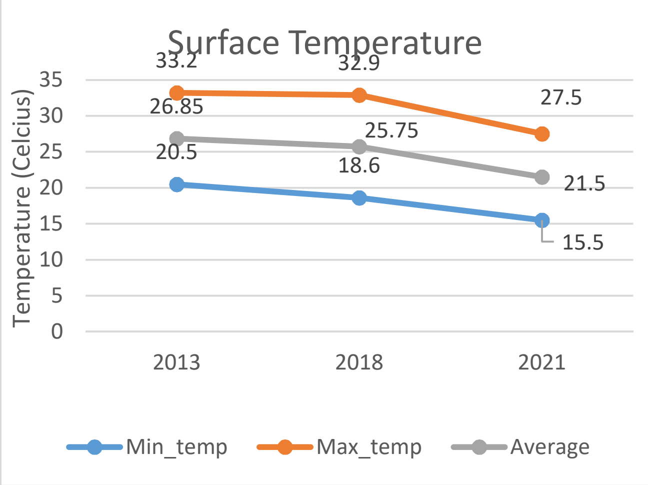


Fig. 6. Nighttime Land Surface Temperature

Temperatures at night for the years 2013, 2018, and 2021 are depicted in Figure 6. Band 11 is the sensor in use here. Only Band 6 with daylight wavelength data was available in 2010, therefore that year was left out. The change in temperature between day and night is roughly 5 to 7 degrees Celsius.

The use of a base map is crucial for assisting users in finding the actual location. Open Street Map (OSM) is used as a basis map, as seen in Figure 7.

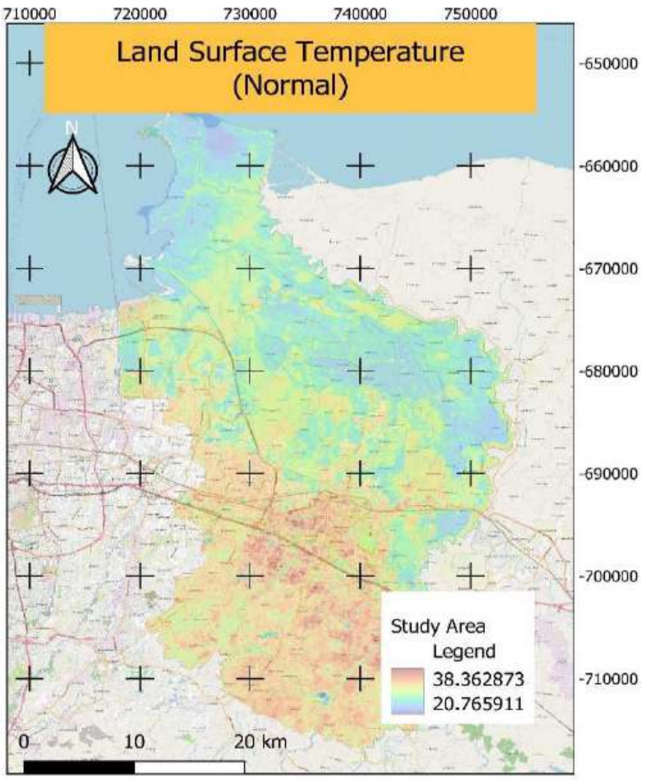


Fig. 7. Land Surface Temperature in Normal Condition (2018)

Figure 7 depicts the Bekasi Regency's hottest conditions before the COVID-19 epidemic, specifically in the year 2018. The Land Surface Temperature (LST) map shows several areas with surface temperatures, including the area near the toll road. Some areas, including those near rivers and lakes and reservoirs, show lower temperatures. Temperatures in most Bekasi Regency range from 21 to 38 degrees Celsius.

Figure 8 depicts the COVID-19 pandemic situation in Bekasi Regency. There has been a decrease in surface temperature of nine degrees Celsius. Areas around the toll road still show higher temperatures compared to their surroundings, especially in the northern region where there are many rice fields and fishponds. The Cikarang area, which is an industrial zone, continues to exhibit high temperatures but remains below normal conditions.

The implementation of work from home due to COVID-19 has a direct bearing on the drop in land surface temperature (LST). It has been established that a number of companies that depend on the burning of fossil fuels, as well as automobiles using Bekasi's roadways, increase land surface temperatures and contribute to air pollution that is dangerous to human health.

Equation 3 illustrates how to calculate temperature using the vegetation index NDVI. Regardless of the COVID-19 pandemic, vegetation's role needs to be taken into account. The Modified-UNet model, which combines U-Net with DeepLabV3+, is used to determine the percentage of vegetation [18].

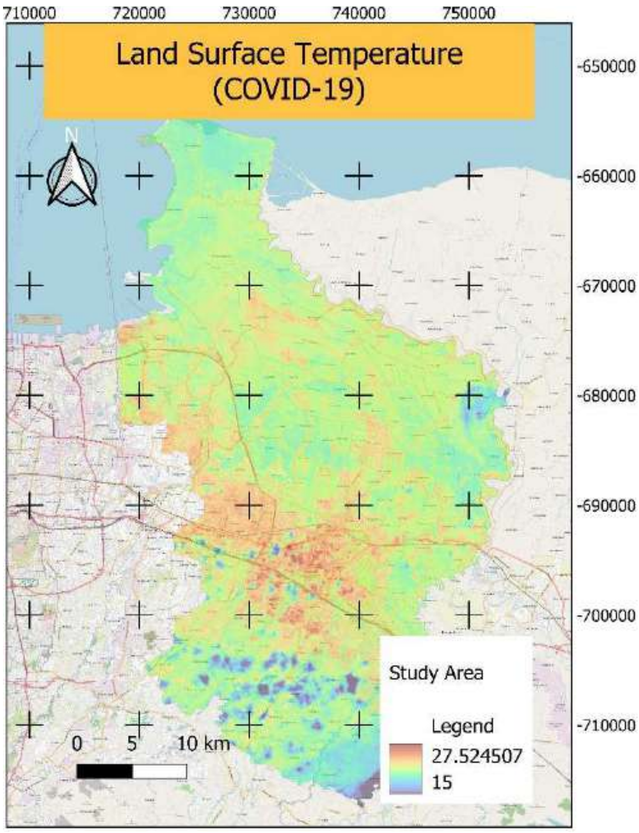


Fig. 8. Land Surface Temperature in COVID-19 Pandemic

Even while the RS&GIS plugin has the capacity to remove the impacts of clouds and cirrus, this still has an impact on measurement accuracy because clouds have extremely low temperatures because of the liquid that they contain. Therefore, finding a cloud-free area is vital. It is advised to do so in Indonesia during the dry season, which lasts from June to September. However, the accuracy is enough for the highest (hot) temperatures. Aside from flora, areas with low temperatures can include bodies of water like ponds, lakes, rivers, and the like. So, in addition to solving flood difficulties in the low-lying sections of Bekasi Regency, which has a low slope (about 0 to 2 percent), the presence of these water bodies is required [19].

IV. Conclusions

The phenomena of land surface temperature under certain circumstances—in this case, COVID-19—is discussed in this study. For the years 2010, 2013, 2018, and 2021, exact temperature data were collected using Landsat data from the USGS. The findings show a drop in temperature of about 7 degrees during COVID-19 in Indonesia (2020 – 2022). In order to lower surface temperatures owing to the greenhouse effect, the government should restrict car exhaust emissions. This research utilizes radians (TOA), vegetation indices, and calibration methods that may be useful for future research with the data obtained in this study for prediction.

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Evaluating the Effects of Mobility Restrictions during COVID-19 on Land Surface Temperature with GIS and Satellite Data

by Herlawati Herlawati

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Evaluating the Effects of Mobility Restrictions during COVID-19 on Land Surface Temperature with GIS and Satellite Data

***Abstract*— In order to analyze specific occurrences, such as the COVID-19 pandemic's effects, experts from a variety of professions might work together. The majority of study, such as those on economics, health, spread projections, and similar topics, focuses on just one area of the field. Therefore, several multidisciplinary teams need to collaborate in analyzing the occurring phenomena. The method employed in this research involves using Remote Sensing and Geographic Information Systems (RS-GIS) to observe the impact of the pandemic phenomenon on environmental conditions, specifically surface temperature warming in Bekasi Regency, Indonesia. This is due to its impact not only on health but also on other aspects. This study converts Landsat 7 and Landsat 8 images using (RS-GIS) technologies to extract thermal sensors (Band 10 and Band 11). The test results indicate that the temperature rises annually, but that it falls during the COVID-19 pandemic.**

Keywords—Landsat 8, LST, QGIS, COVID-19, RS-GIS

I. INTRODUCTION

Natural phenomena known as global warming is currently causing major worry [1]–[4]. This is due to the fact that this issue affects human lives as well as the environment. By reducing warmth in each area, such as by cutting greenhouse gas emissions, boosting efficiency, growing greenery, and so on, global warming can be controlled. The pandemic is a rare event that may occur once in a century, so this phenomenon can be utilized to quantitatively and precisely examine an idea, for example, recommendations to reduce greenhouse gas emissions.

Numerous studies have been done on the COVID-19 phenomena, including management studies [5] and forecasting studies [6]. People were compelled to stay indoors due to the COVID-19 pandemic condition, which lowered transportation-related emissions. In order to ascertain how much the surface temperature drops when car emissions are lowered, this phenomenon will be studied in this study. This study's recommendations should help each region slow down global warming if they are implemented. By leveraging current satellite sensors, several studies have looked into changes in the earth's temperature [7]–[11].

The data are evaluated to comprehend the events that took place during the pandemic conditions (from 2019 to 2021) after describing the process used to transform satellite photos into Land Surface Temperature (LST), where the actual surface temperature is known. The final section offers insights into the events that took place over those years.

This research contributes to what-if analysis when greenhouse gas emissions are significantly reduced and observes their direct impact, without analogy or theoretical approaches that are still in doubt. Mobile restriction represents how much exhaust gas is normally emitted in the research area, so it can be further analyzed for its correlation with the local temperature decrease, which may also impact global temperatures. This research essentially demonstrates precisely how accurate existing theories about global warming are, and it is conducted at the right time (during the pandemic).

II. MATERIALS AND METHODS

A. Materials

Landsat 7 and Landsat 8 satellite photographs for particular dates were employed in the current investigation. The United States Geological Survey (USGS) provided the information via its official website, Earth Explorer (https://earthexplorer.usgs.gov). August 2010 (Landsat 5), August 2013 (Landsat 8), September 2018 (Landsat 8), and September 2021 (Landsat 8), were chosen as the four capture dates. Following the COVID-19 pandemic circumstances, which started in early 2020 and persisted through 2021 for the Indonesian region, these time frames were chosen. Thus, the COVID-19 pandemic's effects on land surface temperature will be visible in 2021.

Landsat 8 used Bands 10 and 11, while Landsat 5 used Band 6 [12]. The downloaded files are about 1 GB in size. To be able to download the accessible satellite pictures, we first need to register on the USGS website. It's best to select clear (cloud-free) captures, while you can get rid of clouds using GIS Tools when creating LSTs. Figure 1 shows the tile (Landsat capture region term) for the Jakarta Metropolitan Region.

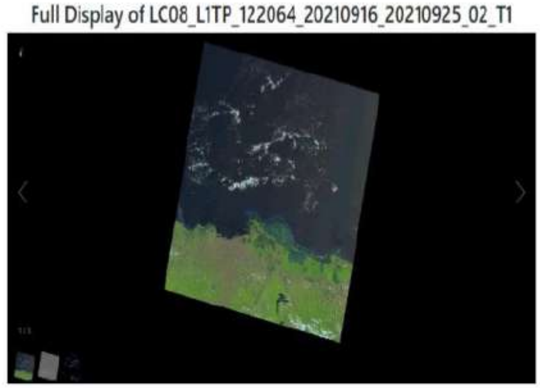


Fig. 1. The region downloaded (Tile) from USGS.

Satellite sensor captures are made up of a number of files that include crucial metadata and band indications. In order to calibrate devices, this metadata converts surface temperatures to degrees Celsius. Because Landsat 8 has more sensors than its predecessors (Landsat 1–Landsat7), it is different from those satellites. Band 6 was where the thermal sensor was on earlier Landsat spacecraft.

In addition to raster data representing satellite photos, vector data representing the research region—in this case, the Bekasi Regency in West Java, Indonesia—is also required. The detailed satellite pictures of the Jakarta Metropolitan

Region (JABOTABEK) are cropped onto this map to fit the Bekasi Regency.

B. Methods

Land Surface Temperature (LST) thematic maps can be produced using a variety of GIS tools, including ArcGIS, QGIS, and others. Every tool has benefits, eases of use, and restrictions. To create LST maps of a region, they all adhere to the same procedure in theory. The steps to create an LST map are listed below.

B.1. Conversion to Top of Atmosphere (TOA) Radiance

The process by which the raw sensor data gathered by a satellite sensor is transformed into radiance values at the top of the Earth's atmosphere is referred to as "radiance" in the context of remote sensing and satellite image analysis [13]. Within the data pre-processing workflow for satellite imaging, this conversion is a vital step. The TOA is found in equation (1):

$$TOA\ (L) = M_L * Q_{CAL} + A_L \quad (1)$$

QCAL is retrieved from band 10, AL is Band-specific additive rescaling factor from the metadata, and ML stands for Band-specific multiplicative rescaling factor from the metadata.B.2. Top of Atmosphere (TOA) to Brightness Temperature conversion

In remote sensing, especially for interpreting satellite images, the conversion of TOA Radiance to Brightness Temperature is essential. The surface or object's radiative temperature is determined by brightness temperature measurement made by a satellite sensor. Here is a display of the function to convert TOA to Brightness Temperature.

$$BT = (K_2 / (\ln (K_1/L) + 1)) - 273.15 \quad (2)$$

K_1 and K_2 are metadata-based thermal conversion constants for specific bands.

B.3. Calculate the Normalize Difference Vegetation Index (NDVI)

In remote sensing and environmental monitoring, the Normalized Difference Vegetation Index (NDVI) is a measurement and monitoring technique for the health and density of vegetation. The NDVI calculates the difference between the surface of the Earth and plant absorption of IR and visible light. As a result of the NDVI, numerical values between -1 and +1 are produced. These results are commonly interpreted as follows:

$$NDVI = (Band\ 5 - Band\ 4) / (Band\ 5 + Band\ 4) \quad (3)$$

B.4. Calculate the proportion of vegetation P_v

Vegetation influences the surface thermal through the emissivity.

$$P_v = Sqr((NDVI - NDVI_{min})/(NDVI_{max} - NDVI_{min})) \quad (4)$$

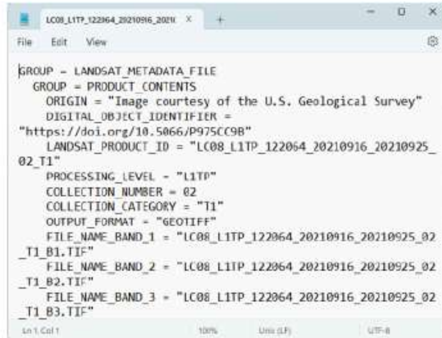
B.5. Calculate Emissivity ε

$$\varepsilon = 0.004 * P_v + 0.986 \quad (5)$$

B.6. Calculate the Land Surface Temperature

$$LST = (BT/(1 + (0.00115 * BT / 1.4388) * Ln(\varepsilon))) \quad (6)$$

The LST equation can then be used to produce the surface temperature map. Equations 1-6, including those utilizing raster data (Band 10 and the Bands utilized in the NDVI composite image), can be calculated using the raster calculator. The metadata utilized for these calculations is displayed in Figure 2.



```
GROUP = LANDSAT_METADATA_FILE
  GROUP = PRODUCT_CONTENTS
    ORIGIN = "Image courtesy of the U.S. Geological Survey"
    DIGITAL_OBJECT_IDENTIFIER =
"https://doi.org/10.5066/P975CC9B"
    LANDSAT_PRODUCT_ID = "LC08_L1TP_122064_20210916_20210925_
02_T1"
    PROCESSING_LEVEL = "L1TP"
    COLLECTION_NUMBER = 02
    COLLECTION_CATEGORY = "T1"
    OUTPUT_FORMAT = "GEOTIFF"
    FILE_NAME_BAND_1 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B1.TIF"
    FILE_NAME_BAND_2 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B2.TIF"
    FILE_NAME_BAND_3 = "LC08_L1TP_122064_20210916_20210925_02
_T1_B3.TIF"
```

Fig. 2. Metadata of Landsat File.

The RS&GIS plugin for Quantum GIS is used in this study. The necessary bands (4, 5, 10, and 11) are integrated with metadata by this plugin. It produces an output consisting of a raster map with surface temperature ranges by simply inserting the compressed data downloaded from USGS and the shapefile of the research region.

III. RESULT AND DISCUSSION

LST maps were made using four time frames (2010, 2013, 2018, and 2021). Equations 1 through 6 were utilized in ArcGIS to create LST maps, whilst the supplied dataset (in tar.gz format) is simply converted in QGIS using the RS&GIS plugin. Another choice is to indicate the folder or file that is created after the tar.gz file has been extracted. If the downloaded file is in tar format rather than tar.gz, we might need to rename it.

Thermal bands (Band 6 for Landsat 7 and Band 10 and 11 for Landsat 8) can be used to directly calculate the distribution of surface temperature, although calibration with the metadata files that come with the downloaded satellite images (txt file) is necessary to acquire its precise values.

A. Land Surface Tempature Map

The RS&GIS plugin used to generate LST is shown in Figure 3. A shapefile of the study area plus compressed USGS files make up the input. Check the "extra derived output" (LST), also known as the final result, carefully.

For high temperatures, the LST map provides accurate results, but under certain conditions, namely cloud cover, even though there are facilities to correct it, the results are less satisfactory, sometimes not displaying processed results. The less satisfactory results when there is cloud cover are due to the temperature dropping, as clouds consist of water vapor with temperatures close to freezing.

The finished product is a TIF file with standard coordinates and projection. It can be combined with a base map, like a street map or satellite view, for additional processing to make it easier to see actual places.

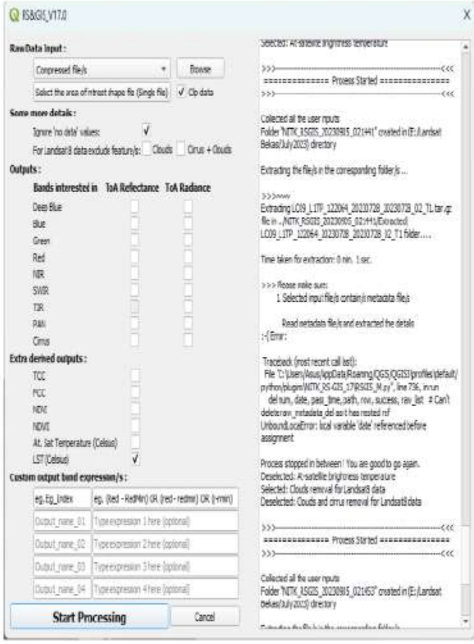


Fig. 3. RS&GIS Plugin for LST Callibration.

In the "For Landsat 8 data exclude feature/s" section, you can select the "Clouds" and "Cirrus + Clouds" choices to eliminate cloud interference specifically for Landsat 8. Since clouds often have low temperatures, they can have an impact on LST accuracy. The temperature range of the LST map is displayed in Figure 4.

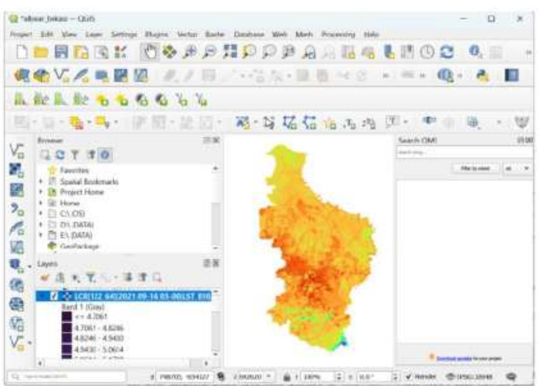


Fig. 4. LST Maps.

From low temperature (minimum) to high temperature (maximum), from brilliant red to dark red colors, the pixel colors gradually depict surface temperatures. The temperature graph for the four distinct time periods of the testing results is shown in Figure 5. According to the graph, the temperature has been gradually rising each year, peaking in 2018. It's probable that the temperature increased even after Bekasi employees in Jakarta, Bogor, and Tangerang were given the option to work from home. As a result, the temperature dropped during the COVID-19 pandemic. The outbreak is regarded as having peaked in 2021, when some people were permitted to leave their homes under specified conditions (PSBB).

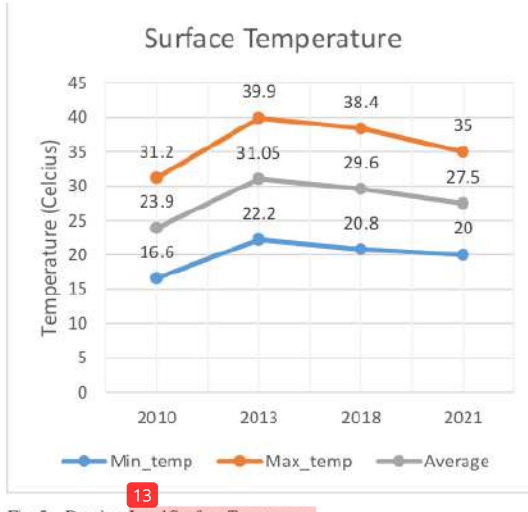


Fig. 5. Daytime Land Surface Temperature

The land surface temperature for Landsat 8 is calculated using Bands 10 and 11 [14]. Band 11 has a longer infrared wavelength than Band 10 and is used to monitor surface temperature at night. Band 10 is used to calculate temperature during the day. With the deployment of Landsat 5, only Band 6—which is usually used to record daytime imagery—was utilized during the year 2010 [10].

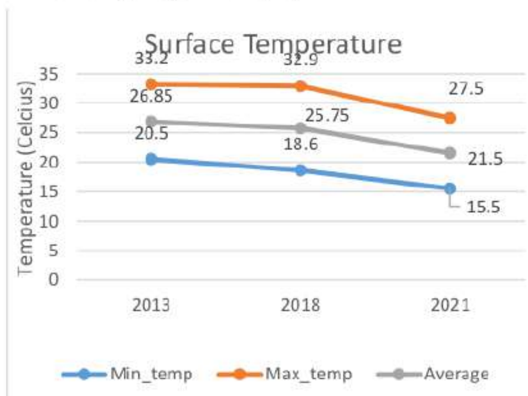


Fig. 6. Nighttime Land Surface Temperature

Temperatures at night for the years 2013, 2018, and 2021 are depicted in Figure 6. Band 11 is the sensor in use here. Only Band 6 with daylight wavelength data was available in 2010, therefore that year was left out. The change in temperature between day and night is roughly 5 to 7 degrees Celsius.

The use of a base map is crucial for assisting users in finding the actual location. Open Street Map (OSM) is used as a basis map, as seen in Figure 7.

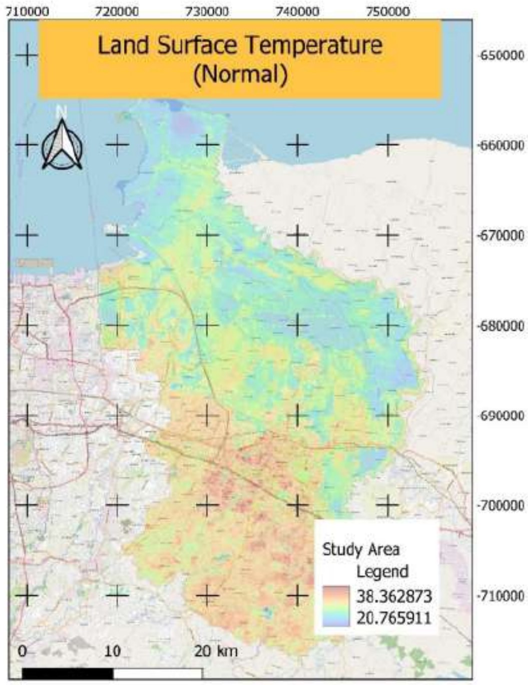


Fig. 7. Land Surface Temperature in Normal Condition (2018)

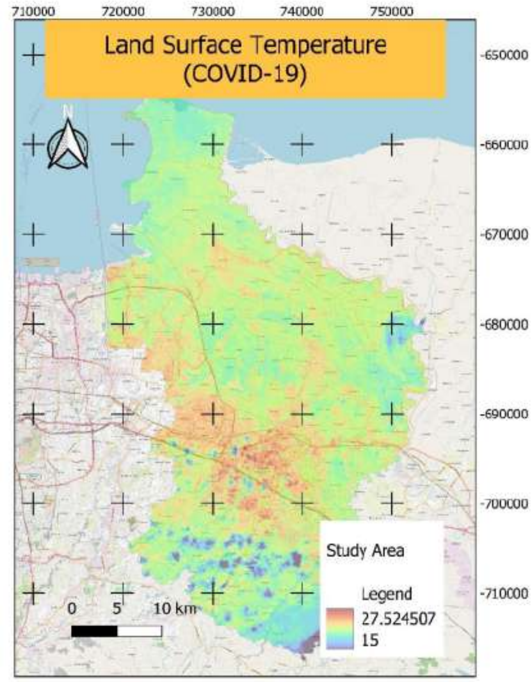


Fig. 8. Land Surface Temperature in COVID-19 Pandemic

Figure 7 depicts the Bekasi Regency's hottest conditions before the COVID-19 epidemic, specifically in the year 2018. The Land Surface Temperature (LST) map shows several areas with surface temperatures, including the area near the toll road. Some areas, including those near rivers and lakes and reservoirs, show lower temperatures. Temperatures in most Bekasi Regency range from 21 to 38 degrees Celsius.

Figure 8 depicts the COVID-19 pandemic situation in Bekasi Regency. There has been a decrease in surface temperature of nine degrees Celsius. Areas around the toll road still show higher temperatures compared to their surroundings, especially in the northern region where there are many rice fields and fishponds. The Cikarang area, which is an industrial zone, continues to exhibit high temperatures but remains below normal conditions.

The implementation of work from home due to COVID-19 has a direct bearing on the drop in land surface temperature (LST). It has been established that a number of companies that depend on the burning of fossil fuels, as well as automobiles using Bekasi's roadways, increase land surface temperatures and contribute to air pollution that is dangerous to human health.

Equation 3 illustrates how to calculate temperature using the vegetation index NDVI. Regardless of the COVID-19 pandemic, vegetation's role needs to be taken into account. The Modified-UNet model, which combines U-Net with DeepLabV3+, is used to determine the percentage of vegetation [18].

Even while the RS&GIS plugin has the capacity to remove the impacts of clouds and cirrus, this still has an impact on measurement accuracy because clouds have extremely low temperatures because of the liquid that they contain. Therefore, finding a cloud-free area is vital. It is advised to do so in Indonesia during the dry season, which lasts from June to September. However, the accuracy is enough for the highest (hot) temperatures. Aside from flora, areas with low temperatures can include bodies of water like ponds, lakes, rivers, and the like. So, in addition to solving flood difficulties in the low-lying sections of Bekasi Regency, which has a low slope (about 0 to 2 percent), the presence of these water bodies is required [19].

IV. Conclusions

The phenomena of land surface temperature under certain circumstances—in this case, COVID-19—is discussed in this study. For the years 2010, 2013, 2018, and 2021, exact temperature data were collected using Landsat data from the USGS. The findings show a drop in temperature of about 7 degrees during COVID-19 in Indonesia (2020 – 2022). In order to lower surface temperatures owing to the greenhouse effect, the government should restrict car exhaust emissions. This research utilizes radians (TOA), vegetation indices, and calibration methods that may be useful for future research with the data obtained in this study for prediction.

Acknowledgment

The authors thank to Universitas Bhayangkara Jakarta Raya for funding this research, Universitas Islam 45 Bekasi, and reviewers for suggestion and comments.

References

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Reviewer Response

We express our sincere gratitude for the constructive input, comments, and criticism from the reviewers.

Reviewer 1:

- The introduction section needs to be motivated better. Why did you need evaluate the impact of movement restriction on land surface temperature?

Response:

We have added "The pandemic is a rare event that may occur once in a century, so this phenomenon can be utilized to quantitatively and precisely examine an idea, for example, recommendations to reduce greenhouse gas emissions."

- What are states of the art related to the impacts of movement restriction on land surface temperature?

Response:

This research contributes to what-if analysis when greenhouse gas emissions are significantly reduced and observes their direct impact, without analogy or theoretical approaches that are still in doubt.

- I'm quite confused on how you evaluated the impacts of mobility restriction on land surface temperature. Did you use measure the correlation? or what?

Response:

Mobile restriction represents how much exhaust gas is normally emitted in the research area, so it can be further analyzed for its correlation with the local temperature decrease, which may also impact global temperatures.

- What are the implications of your study, both for theory and practice?

Response:

This research essentially demonstrates precisely how accurate existing theories about global warming are, and it is conducted at the right time (during the pandemic).

Reviewer 2:

- The abstract should include the three things that need to be conveyed in the Abstract research problems from the research gap, the methods used, and the results.

Response:

We have added the method (RS-GIS), the result and the gap (involve environment and RS-GIS domain).

- For the Introduction section, it is necessary to explain why the Support Vector Machine algorithm was chosen, connected with the findings of the gaps that will be resolved.

Response:

This research utilizes radians (TOA), vegetation indices, and calibration methods that may be useful for further research with the data obtained in this study.

- In the Introduction section, it is necessary to explain the reasons for conducting an evaluation of the Impact of Mobility Restrictions, linked to the findings of the gaps that will be addressed.

Response:

Mobile restriction represents how much exhaust gas is normally emitted in the research area, so it can be further analyzed for its correlation with the local temperature decrease, which may also impact global temperatures.

- Mention each table/figure before it appears, figure 1 has not been mentioned

Response:

We have added, "Figure 1 shows the tile (Landsat capture region term) for the Jakarta Metropolitan Region."

- In the conclusion section, it is necessary to state the limitations of the research and future research opportunities

Response:

We have added, "This research utilizes radians (TOA), vegetation indices, and calibration methods that may be useful for future research with the data obtained in this study for prediction."