Journal of Selvicoltura Asean, 1(2) – April 2024 80-95

Analysis of Average Land Surface Temperature of Java Island, Indonesia in 2024 using reduceRegions in Google Earth Engine

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Received: July 25, 2024	Revised: Sep 04, 2024	Accepted: Sep 04, 2024	Online: Sep 04, 2024

ABSTRACT

This study presents a comprehensive analysis of the average Land Surface Temperature (LST) of Java Island, Indonesia, for the year 2024, utilizing the reduceRegions function in Google Earth Engine (GEE). Rapid urbanization and environmental changes on Java Island have significant implications for its climate and thermal conditions, necessitating effective monitoring and analysis of LST. The research employs satellite-based remote sensing techniques to assess the relationship between vegetation cover and surface temperatures, revealing that areas with higher vegetation density tend to exhibit lower surface temperatures. This finding aligns with previous studies, underscoring the importance of green spaces in urban environments. The analysis not only contributes to a deeper understanding of Java Island's environmental dynamics but also provides critical insights for policymakers and urban planners. The results can inform strategies for climate adaptation and sustainable development, addressing ongoing environmental challenges. Limitations of the study are acknowledged, and recommendations for future research are proposed, emphasizing the need for continued exploration of LST variations in relation to urbanization and climate change. Overall, this research serves as a valuable resource for enhancing environmental management practices on Java Island and similar regions facing rapid development.

Keywords: *Climate Adaptation, Google Earth, Vegetation Cover*

Journal Homepage https://journal.ypidathu.or.id/index.php/ijnis

How to cite: Nasution, R, A, R., Rakuasa, H., Turi, F., Hidayatullah, M & Latue, C, P. (2024). Analysis of Average Land Surface Temperature of Java Island, Indonesia in 2024 using reduceRegions in Google Earth Engine. *Journal of Selvicoltura Asean*, 1(2), 80-95. https://doi.org/10.70177/jsa.v1i2.1182
Published by: Yayasan Pedidikan Islam Daarut Thufulah

INTRODUCTION

Java Island, the most populous island in Indonesia, has been experiencing rapid urbanization and environmental changes in recent years (Rakuasa & Lasaiba, 2024). These changes have significant implications for the island's climate and thermal conditions. As such, monitoring and analyzing Land Surface Temperature (LST) has become crucial for understanding the environmental dynamics of this region (Diksha et al., 2023). This study aims to provide a comprehensive analysis of the average LST of Java Island in 2024 using the reduceRegions function in Google Earth Engine (GEE). The use of satellite-based remote sensing techniques, particularly through platforms like GEE, has revolutionized the way we study and monitor environmental parameters on a large scale (Rakuasa and Pertuack 2023). GEE's cloud-based infrastructure allows for efficient processing of vast amounts of geospatial data, making it an ideal tool for analyzing LST across Java Island's diverse landscape (Jaelani & Handayani, 2022).

LST is a critical indicator of the Earth's surface energy balance and plays a vital role in various environmental processes. It is particularly sensitive to land use and land cover changes, making it an essential parameter for studying urban heat islands, climate change impacts, and ecosystem dynamics (Satriadi et al., 2023; Rakuasa et al., 2024). Java Island's unique geography, spanning approximately 1,000 kilometers from east to west, encompasses a wide range of land cover types, including dense urban areas, agricultural lands, forests, and mountainous regions (Rakuasa 2024). This diversity presents both challenges and opportunities for LST analysis, as it allows for the examination of temperature variations across different land use patterns and topographies (Zhang et al., 2023).

The choice of 2024 as the study year is significant, as it represents a point in time where the cumulative effects of ongoing urbanization and climate change are expected to be more pronounced (Munawar et al., 2023). By focusing on this specific year, the study aims to capture the most recent trends in LST distribution across Java Island. The reduceRegions function in GEE is a powerful tool that allows for the aggregation of raster data within vector geometries. In the context of this study, it enables the calculation of average LST values for different administrative regions or land cover types across Java Island, providing a nuanced understanding of temperature variations at various spatial scales.

Previous studies have highlighted the importance of LST analysis in understanding climate patterns and urban development impacts in Indonesia. For instance, Jaelani and Handayani (2022) conducted a spatio-temporal analysis of LST changes in Java Island from 2005 to 2020, revealing significant temperature fluctuations and identifying areas of notable temperature increase and decrease. Building upon such research, this study aims to provide an updated and focused analysis of Java Island's LST in 2024. By utilizing the latest available satellite imagery and advanced GEE processing techniques, it seeks to offer insights into the current state of the island's thermal environment.

The methodology employed in this study involves the use of thermal infrared data from satellites such as Landsat and MODIS, which are processed and analyzed within the GEE platform. The reduceRegions function is applied to aggregate LST data across various administrative boundaries and land cover classifications, allowing for a multi-scale analysis of temperature patterns (Latue & Rakuasa., 2023). One of the key aspects of this research is the examination of urban heat island effects in Java's major cities. As urbanization continues to intensify, understanding the thermal characteristics of urban areas becomes increasingly important for urban planning and climate adaptation strategies (Rakuasa 2022).

Additionally, the study aims to investigate the relationship between LST and various environmental factors such as elevation, proximity to water bodies, and vegetation cover. These analyses can provide valuable insights into the drivers of temperature variations across the island (Ermida et al., 2020). The temporal dimension of the study is also significant, as it allows for the comparison of 2024 LST patterns with historical data. This comparison can reveal trends and changes in temperature distribution over time, potentially highlighting areas of concern or improvement in terms of thermal conditions.

Furthermore, the research seeks to explore the potential impacts of LST variations on agriculture, one of Java's key economic sectors (Maulana & Bioresita, 2023). By analyzing temperature patterns in agricultural regions, the study can contribute to our understanding of how changing thermal conditions may affect crop yields and agricultural practices. The use of GEE's reduceRegions function enables the efficient processing of large datasets, allowing for a comprehensive island-wide analysis that would be challenging with traditional computing methods (Zhengming Wan, 2020). This approach demonstrates the potential of cloud-based geospatial analysis in environmental monitoring and research.

The study also aims to investigate the relationship between LST and socio-economic factors, such as population density and economic activities. This interdisciplinary approach can provide valuable insights for policymakers and urban planners in addressing the challenges posed by changing thermal conditions (Ghanbari et al., 2023). Moreover, the research seeks to identify potential heat stress hotspots across Java Island, which could be crucial for public health planning and the development of heat mitigation strategies (Gadekar et al., 2023). By pinpointing areas with consistently high LST values, the study can inform targeted interventions to reduce heat-related risks.

The analysis of LST patterns in 2024 also offers an opportunity to assess the effectiveness of existing green space and urban cooling initiatives implemented in various cities across Java. This evaluation can provide feedback on the success of current strategies and inform future urban development plans. Lastly, this study aims to contribute to the broader field of climate change research in Indonesia (Maulana & Bioresita, 2023). By providing a detailed snapshot of Java Island's thermal conditions in 2024, it adds to the growing body of knowledge on regional climate patterns and their evolution over time.

In conclusion, this comprehensive analysis of Java Island's average LST in 2024 using GEE's reduceRegions function represents a significant contribution to our understanding of the island's environmental dynamics. The insights gained from this study have the potential to inform policy decisions, urban planning strategies, and climate adaptation measures, ultimately contributing to the sustainable development of Java Island in the face of ongoing environmental challenges.

LITERATURE REVIEW

Recent studies on Land Surface Temperature (LST) in Java Island have highlighted the importance of satellite-based observations for understanding climate dynamics in this densely populated region. Jaelani and Handayani (2022) conducted a comprehensive spatio-temporal analysis of LST changes in Java Island using Terra and Aqua MODIS satellite imagery from 2005 to 2020. Their study, which utilized Google Earth Engine (GEE) for data processing, revealed significant annual LST changes, with the most notable temperature decrease occurring between 2015 and 2016. This research demonstrated the effectiveness of GEE in processing large-scale environmental data and provided valuable insights into LST trends over an extended period.

The use of advanced data processing techniques, such as the reduceRegions function in GEE, has been instrumental in enhancing the spatial and temporal resolution of LST analyses. This approach allows for the aggregation of raster data within vector geometries, enabling researchers to calculate average LST values for different administrative regions or land cover types across Java Island. Such methodologies provide a more nuanced understanding of temperature variations at various spatial scales, which is crucial for identifying areas experiencing significant thermal changes (Jaelani & Handayani, 2022).

Correlation studies between satellite-derived LST data and ground-based weather station measurements have shown promising results. Jaelani and Handayani (2022) reported correlation coefficients ranging from 0.2599 to 0.8361 between Terra and Aqua LST data and temperature data from BMKG weather stations. These findings indicate a moderate to very strong correlation, validating the reliability of satellite-based LST measurements for climate studies in Java Island.

The spatial patterns of LST changes observed in previous studies have revealed important insights into the environmental dynamics of Java Island. Areas experiencing significant temperature increases were primarily identified in the northern part of East Java Province and the eastern part of Central Java Province. Conversely, regions showing notable temperature decreases were mainly located in West Java Province, the eastern part of Central Java Province, and the northern part of East Java Province (Jaelani & Handayani, 2022). These patterns suggest a complex interplay between urbanization, land use changes, and local climate factors influencing LST distribution across the island.

Looking ahead to 2024, the analysis of average LST using reduceRegions in Earth Engine presents an opportunity to build upon these previous findings and provide an updated assessment of Java Island's thermal conditions. By leveraging the latest satellite imagery and advanced GEE processing techniques, researchers can offer valuable insights into the current state of the island's thermal environment, potentially revealing new trends or changes in LST patterns. This ongoing monitoring and analysis of LST are crucial for informing policy decisions, urban planning strategies, and climate adaptation measures in one of the world's most populous and rapidly developing regions.

RESEARCH METHODOLOGY

Data Collection

The data is sourced from remote sensing satellites and processed using Google Earth Engine (GEE) https://earthengine.google.com. LST values are obtained by applying a scaling factor and offset to the raw satellite data, which is then visualized using a specified color palette representing different temperature ranges (Gorelick et al., 2017).

Study Area Definition

Java Island is the primary focus of this study. The region includes various provinces such as DKI Jakarta, Jawa Tengah, Jawa Timur, Jawa Barat, Daerah Istimewa Yogyakarta, and Banten. The boundaries of these regions are defined using a geographical dataset (GAUL) filtered to include only the relevant administrative units (Onisimo Muntaga, 2019). This ensures that the analysis is confined to the correct geographical scope.

Data Processing

The reduceRegions function in GEE is employed to compute the mean LST for each administrative unit within Java Island. This involves aggregating pixel values over defined regions at a specified scale of 1000 meters. The mean LST values are then assigned to each region, enabling a comparative analysis across different areas (Onisimo Muntaga, 2019). This step is crucial for understanding spatial variations in temperature.

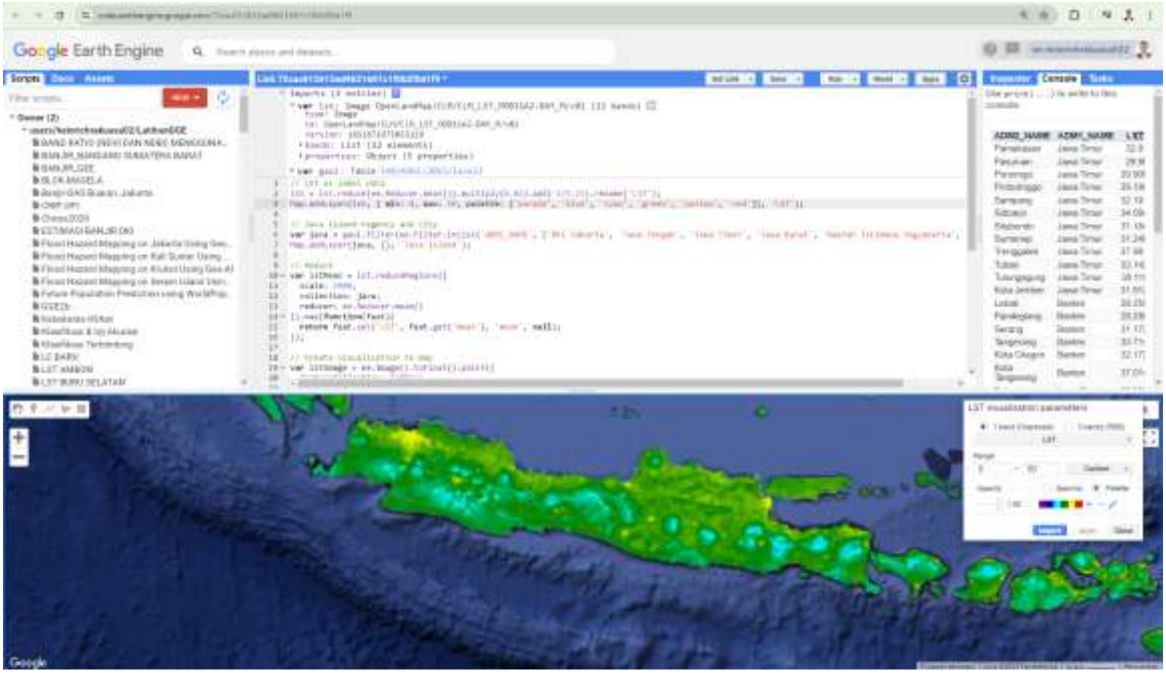

Figure 1. Google Earth Engine display

Visualization

Visualization of the LST data is an integral part of this study. The mean LST values for each region are used to create an image layer that is added to the GEE map.

This layer uses a color gradient to represent temperature variations, providing an intuitive way to interpret the data. Additionally, a table chart is generated to display the mean LST values for each administrative unit, facilitating easier data interpretation (Rahman et al., 2021).

Data Export

For further analysis and record-keeping, the processed LST image is exported to Google Drive. The image is saved with a resolution of 30 meters per pixel and includes all the regions defined earlier. This step ensures that the data can be accessed and analyzed outside of the GEE environment, providing flexibility for additional research and validation (Xie et al., 2019).

Script Explanation

The provided script outlines the steps taken to analyze and visualize LST data for Java Island in 2024. Initially, the LST data is processed to obtain mean values and mapped using a color palette. Java Island's administrative boundaries are defined, and the reduceRegions function is used to calculate mean LST for each region. The resulting data is visualized on the map and in a table chart. Finally, the processed image is exported for further use.

RESULT AND DISCUSSION

Banten Province

This research uses the reduceRegions method in Google Earth Engine to analyze LST data from satellite images. The results show significant temperature variations among cities in Banten Province, reflecting differences in urbanization levels and environmental characteristics. The cities studied include Lebak, Pandeglang, Serang, Tangerang, Cilegon City, and Tangerang City, with a temperature range from 28.26°C to 37.01°C (Tabel 1 and Figure 1).

Table 1. Average Land Surface Temperature (°C) Banten Province

City/District	Mean Land Surface Temperature (°C) 2024
Lebak	28.26
Pandeglang	28.29
Serang	31.17
Tangerang	33.71
Cilegon City	32.17
Tangerang City	37.01

Lebak and Pandeglang have the lowest surface temperatures, 28.26°C and 28.29°C respectively. This relatively low temperature is likely due to the lower level of urbanization and more green areas in these two cities. This finding is consistent with previous studies that show that areas with more vegetation cover tend to have lower surface temperatures, as reported by Jaelani & Handayani (2022), in their study of LST changes on Java Island.Serang and Cilegon City show a significant increase in temperature compared to Lebak and Pandeglang, with LST of 31.17°C and 32.17°C respectively. This increase may reflect higher levels of urbanization and industrial activity, especially in Cilegon City which is known as an industrial city. This phenomenon is consistent with the urban heat island concept, where urban areas tend to have higher temperatures than their less developed surroundings, as described in a study by Satriadi et al. (2023) on the prediction of surface temperature in Java Island.

Tangerang and Tangerang City show the highest surface temperatures in this dataset, with LSTs of 33.71°C and 37.01°C, respectively. The extremely high temperatures in these two cities are most likely due to intense urbanization, high population density and reduced green open spaces. Tangerang City, with the highest LST, may experience the most severe urban heat island effect. This finding is in line with the trend of increasing temperatures in urban areas reported in the Munawar et al., (2024), on variations in land surface temperature decline in Java and Bali.

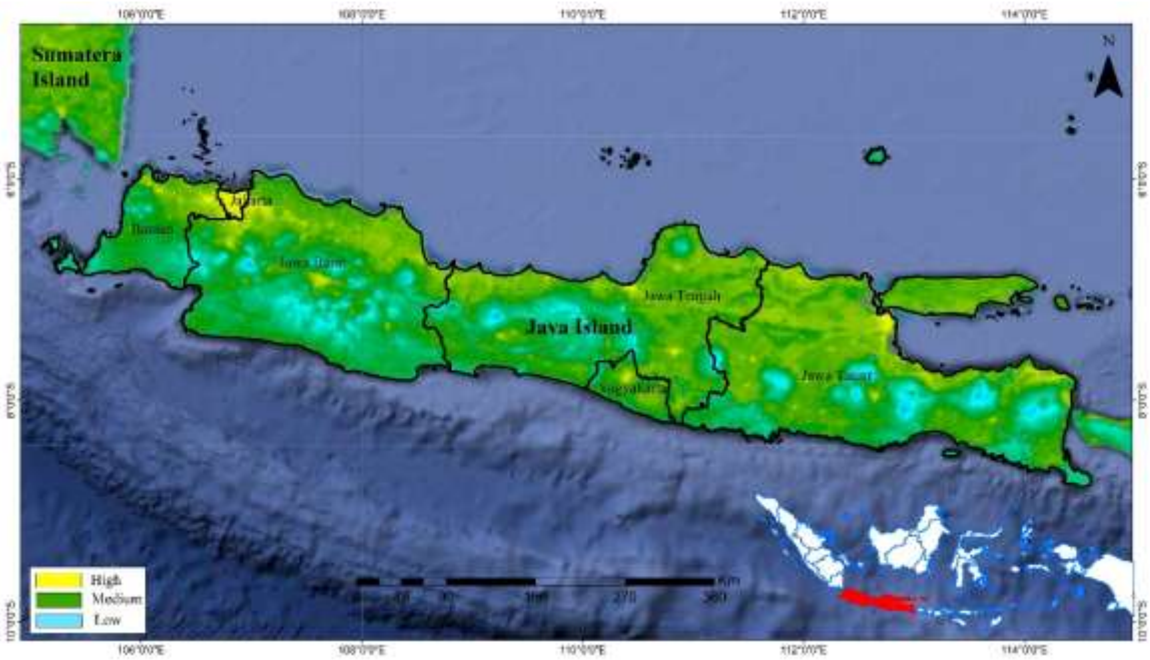

Figure 2. Average Land Surface Temperature on Java Island, Indonesia

The temperature variations observed in this study have important implications for urban planning and climate change mitigation (Rakuasa et al., 2023). Cities with higher LST such as Tangerang City and Tangerang may need to consider strategies to reduce the urban heat island effect, such as increasing green open space or implementing green roofs. Meanwhile, cities with lower LST such as Lebak and Pandeglang can focus on maintaining their vegetation cover while managing urban growth sustainably. This research provides a solid foundation for data-driven decision-making in urban planning and climate change adaptation in Banten Province.

Jakarta Province

Table 2 presents LST data for five administrative regions in DKI Jakarta, namely North Jakarta, West Jakarta, Central Jakarta, South Jakarta and East Jakarta. This data was obtained using the reduceRegions method in Google Earth Engine, which enables efficient spatial analysis of satellite data for large areas. Results show significant temperature variations between regions, with a temperature range from 36.89°C to 39.15°C, reflecting the complexity of urban temperature patterns in Jakarta (Figure 2 and Table 2).

Table 2. Average Land Surface Temperature (°C) Jakarta Province

City/District	Mean Land Surface Temperature (°C) 2024
Jakarta Utara	36.89
Jakarta Barat	38.32
Jakarta Pusat	39.15
Jakarta Selatan	38.03
Jakarta Timur	38.30

North Jakarta has the lowest LST among the five regions, at 36.89°C. Although still relatively high, this relatively lower temperature may be influenced by its proximity to the sea which can have a cooling effect. However, this temperature still indicates a significant level of urban heat island, consistent with the findings of Jaelani and Handayani (2022) on increasing LST in urban areas on Java Island. Central Jakarta recorded the highest LST with 39.15°C, followed by West Jakarta (38.32°C) and East Jakarta (38.30°C). The very high temperature in Central Jakarta is likely due to the high density of buildings, lack of green open spaces, and high intensity of human activities in the city center. This finding is in line with the SSRN study (2024) which reported an increasing trend of temperature in dense urban areas in Java.

Overall, these data show that DKI Jakarta is experiencing a very strong urban heat island effect, with an average LST above 36°C in all areas. The temperature variations between areas, although relatively small (range 2.26°C), can provide important insights into the factors that influence urban temperatures, such as building density, land cover and human activity patterns. These findings have significant implications for urban planning and climate change mitigation strategies in Jakarta, suggesting an urgent need for the implementation of urban cooling solutions such as increased green space, use of reflective building materials, and more sustainable urban planning.

Jawa Barat Province

Table 3 presents LST data for 25 cities and districts in West Java Province, with a temperature range from 26.89°C to 37.03°C. The use of the reduceRegions method in Google Earth Engine allows efficient spatial analysis of satellite data for large areas. Results show significant temperature variations between cities, reflecting differences in urbanization levels, land cover, and other geographic factors.

Table 3. Average Land Surface Temperature (°C) Jawa Barat Province

City/District	Mean Land Surface Temperature 2024
Bandung	27.11
Cimahi	34.71
Tasikmalaya City	29.39
Tasikmalaya	27.50
Ciamis	27.99
Banjar City	30.50
Bekasi	33.23
Bogor	29.48
Cianjur	27.77
Cirebon	33.00
Garut	26.89
Indramayu	32.85
Karawang	31.82
Bandung City	35.03
Bogor City	33.99
Cirebon City	35.33
Sukabumi City	31.28
Kuningan	28.82
Majalengka	30.42
Purwakarta	29.68
Subang	30.84
Sukabumi	28.25
Sumedang	29.10
Bekasi City	37.03
Depok City	35.65

Large cities and urban areas show higher LST compared to less developed areas. Bekasi City has the highest LST (37.03°C), followed by Depok City (35.65°C), Cirebon City (35.33°C), and Bandung City (35.03°C) (Figure 2 and Table 3). This phenomenon is consistent with the urban heat island concept, where urban areas tend to have higher temperatures due to factors such as building density, use of heat-absorbing materials, and lack of vegetation. This finding is in line with the study of Jaelani and Handayani (2022) who reported an increase in LST in urban areas on Java Island. In contrast, cities with the lowest LST include Garut (26.89°C), Bandung (27.11°C), and Cianjur (27.77°C). The relatively low temperatures in these cities may be due to geographical factors such as altitude (for Bandung and Cianjur) or more vegetation cover. The significant temperature difference between Bandung (27.11°C) and Bandung City (35.03°C) shows a sharp contrast between urban and rural areas, emphasizing the importance of urban planning that considers thermal aspects.

Some cities show moderate LST, such as Bogor (29.48°C), Sukabumi (28.25°C), and Sumedang (29.10°C). The lower temperatures in these cities compared to other major cities may reflect a better balance between urban development and environmental preservation. However, the significant difference between Bogor (29.48°C) and Bogor City (33.99°C) suggests that urbanization continues to have a strong impact on LST, even in areas traditionally known for their mild climate.

The LST variations observed in this study have important implications for urban planning and climate change mitigation in West Java. Cities with high LST such as Bekasi, Depok, and Cirebon may need to consider strategies to reduce the urban heat island effect, such as increasing green open space or implementing green roofs. Meanwhile, cities with lower LST such as Garut and Cianjur can focus on maintaining their vegetation cover while managing urban growth sustainably. This research provides a solid foundation for data-driven decision-making in urban planning and climate change adaptation in West Java Province, in line with the global trend to address climate change challenges in urban areas.

Jawa Tengah Province

Table 4 presents LST data for 37 cities and districts in Central Java Province, with a temperature range from 26.11°C to 36.81°C. The use of the reduceRegions method in Google Earth Engine allows efficient spatial analysis of satellite data for large areas. Results show significant temperature variations between regions, reflecting differences in urbanization levels, land cover, and other geographic factors. These temperature variations are consistent with previous research findings that show significant differences in LST across different regions of Java Island, as reported by Jaelani and Handayani (2022) in their study of LST changes over Java Island using MODIS satellite imagery.

Table 4. Average Land Surface Temperature (°C) Jawa Tengah Province

City	Mean Land Surface Temperature 2024
Banjarnegara	27.11
Banyumas	28.74
Batang	28.71
Blora	32.19
Boyolali	30.21
Brebes	30.58
Cilacap	29.18
Demak	32.19
Grobogan	32.34
Jepara	30.63
Karanganyar	29.06
Kebumen	29.71
Klaten	31.30
Magelang City	32.51
Pekalongan City	34.01
Salatiga City	30.18

Semarang City	33.54
Surakarta City	36.81
Tegal City	34.69
Kudus	31.87
Magelang	27.79
Pati	31.99
Pekalongan	28.97
Pemalang	30.30
Purbalingga	28.56
Purworejo	29.30
Rembang	32.58
Semarang	28.88
Sragen	31.68
Sukoharjo	32.37
Tegal	31.22
Temanggung	27.64
Wonogiri	30.31
Wonosobo	26.11
Kendal	30.51
Klaten City	33.40
Purwokerto City	34.34

Large cities and urban areas show higher LST compared to less developed areas. Surakarta city has the highest LST (36.81°C), followed by Tegal city (34.69°C), Purwokerto city (34.34°C), and Semarang city (33.54°C) (Figure 2 and Table 4). This phenomenon is consistent with the urban heat island concept, where urban areas tend to have higher temperatures due to factors such as building density, use of heat-absorbing materials, and lack of vegetation. This finding is in line with a study reported by SSRN (2024) on the variation of land surface temperature decrease in Java and Bali, which showed that urban areas in Java Island experienced a significant increase in temperature.

In contrast, districts with the lowest LST include Wonosobo (26.11°C), Banjarnegara (27.11°C) and Temanggung (27.64°C). The relatively low temperatures in these areas may be due to geographical factors such as altitude or more vegetation cover. The significant temperature difference between these cities and districts shows a sharp contrast between urban and rural areas, emphasizing the importance of regional planning that considers thermal aspects. This is consistent with the findings of previous studies showing that areas with more vegetation cover tend to have lower surface temperatures.

Some districts show moderate LST, such as Banyumas (28.74°C), Cilacap (29.18°C), and Kebumen (29.71°C). The lower temperatures in these districts compared to larger cities may reflect a better balance between development and environmental preservation. However, the significant difference between the districts and the surrounding cities (e.g. Banyumas 28.74°C vs Purwokerto City 34.34°C) suggests that urbanization continues to have a strong impact on LST, even in areas traditionally known for their cooler climate.

The LST variations observed in this study have important implications for regional planning and climate change mitigation in Central Java. Cities with high LST such as Surakarta, Tegal, and Semarang may need to consider strategies to reduce the urban heat island effect, such as increasing green open space or implementing green roofs. Meanwhile, districts with lower LST such as Wonosobo and Banjarnegara can focus on maintaining their vegetation cover while sustainably managing regional growth. This research provides a strong basis for data-driven decision-making in regional planning and climate change adaptation in Central Java Province, in line with the global trend to address climate change challenges in different types of regions.

Jawa Timur Province

Table 5 presents LST data for 39 cities and districts in East Java Province, with a temperature range from 25.10°C to 36.80°C (Figure 2 and Table 5). The use of the reduceRegions method in Google Earth Engine enables efficient spatial analysis of satellite data for large areas. Results show significant temperature variations between regions, reflecting differences in urbanization levels, land cover, and other geographic factors. These temperature variations are consistent with previous research findings that show significant differences in LST across different regions of Java Island, as reported by Jaelani and Handayani (2022) in their study of LST changes over Java Island using MODIS satellite imagery.

Table 5. Average Land Surface Temperature (°C) Jawa Timur Province

City	Mean Land Surface Temperature 2024
Batu City	25.10
Malang	27.83
Bangkalan	31.85
Banyuwangi	28.21
Blitar	29.78
Bojonegoro	32.57
Bondowoso	28.25
Gresik	32.04
Jember	28.53
Jombang	31.75
Kediri	30.82
Blitar City	32.87
Kediri City	33.29
Madiun City	34.84
Malang City	33.08
Mojokerto City	34.16
Pasuruan City	33.47
Probolinggo City	33.83

Surabaya City	36.80
Lamongan	32.59
Lumajang	27.93
Madiun	31.13
Magetan	30.69
Mojokerto	30.84
Nganjuk	31.47
Ngawi	31.41
Pacitan	28.20
Pamekasan	32.81
Pasuruan	29.95
Ponorogo	29.91
Probolinggo	29.20
Sampang	32.19
Sidoarjo	34.09
Situbondo	31.18
Sumenep	31.25
Trenggalek	27.98
Tuban	33.14
Tulungagung	30.12
Jember City	31.91

Large cities and urban areas show higher LST compared to less developed areas. Surabaya city has the highest LST (36.80°C), followed by Madiun city (34.84°C), Mojokerto city (34.16°C) and Sidoarjo (34.09°C). This phenomenon is consistent with the urban heat island concept, where urban areas tend to have higher temperatures due to factors such as building density, use of heat-absorbing materials, and lack of vegetation. This finding is in line with a study reported by SSRN (2024) on the variation of land surface temperature decline in Java and Bali, which showed that urban areas on Java Island experienced a significant increase in temperature. In contrast, cities and districts with the lowest LST include Batu City (25.10°C), Malang (27.83°C), and Trenggalek (27.98°C). The relatively low temperatures in these areas may be due to geographical factors such as altitude or more vegetation cover. The significant temperature differences between these cities and districts show a sharp contrast between urban and rural areas, emphasizing the importance of regional planning that considers thermal aspects. This is in line with the findings of previous studies that show that areas with more vegetation cover tend to have lower surface temperatures.

Some districts show moderate LST, such as Banyuwangi (28.21°C), Bondowoso (28.25°C) and Jember (28.53°C). The lower temperatures in these districts compared to larger cities may reflect a better balance between development and environmental preservation. However, the significant difference between the districts and their surrounding cities (e.g. Jember 28.53°C vs. Jember City 31.91°C) suggests that urbanization continues to have a strong impact on LST, even in areas traditionally known for their milder climate.

The LST variations observed in this study have important implications for regional planning and climate change mitigation in East Java. Cities with high LST such as Surabaya, Madiun, and Mojokerto may need to consider strategies to reduce the urban heat island effect, such as increasing green open space or implementing green roofs. Meanwhile, districts with lower LST such as Batu City and Malang can focus on maintaining their vegetation cover while sustainably managing regional growth. This research provides a strong basis for data-driven decision-making in regional planning and climate change adaptation in East Java Province, in line with the global trend to address climate change challenges in different types of regions.

CONCLUSION

In conclusion, this research provides a critical analysis of the average Land Surface Temperature (LST) across Java Island in 2024, revealing significant spatial variations influenced by urbanization, vegetation cover, and geographic factors. The findings underscore the importance of integrating green spaces into urban planning to mitigate the urban heat island effect and enhance climate resilience. By identifying areas with high LST, the study offers valuable insights for policymakers and urban planners to develop targeted strategies for heat mitigation and sustainable development. Furthermore, the use of Google Earth Engine's reduceRegions function demonstrates the effectiveness of satellite-based remote sensing in environmental monitoring, paving the way for future research that can further explore the interplay between LST, socio-economic factors, and climate change impacts. Overall, this research contributes to a deeper understanding of Java Island's thermal dynamics and supports the formulation of data-driven approaches to address the challenges posed by rapid urbanization and climate change.

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