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"Coastal Management to Support SDGs"

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"GEOMATICS SCIENTIFIC MEETING COASTAL MANAGEMENT TO SUPPORT SDG'S"

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KATA PENGANTAR

Segala puji dan syukur dipanjatkan ke hadirat Tuhan Yang Maha Esa atas segala rahmat dan karunia-Nya sehingga Prosiding Seminar Nasional Geomatika 2019 yang bertemakan *Geomatics Scientific Meeting Coastal Management to Support SDGs* dapat terbit online sesuai waktu yang direncanakan. Tema seminar ini dipilih untuk mendorong pemanfaatan data-data spasial dalam pengelolaan wilayah pesisir yang berorientasi pada pencapaian target-target SDGs. Melalui pemanfaatan informasi geospasial diharapkan wilayah pesisir yang menjadi wilayah konsentrasi peradaban dapat menghadapi tantangan pembangunan ke depan yang semakin komplek. Melalui perencanaan yang baik dan komprehensif diharapkan pencapaian target SDGs dapat segera terealisasi.

Prosiding ini diterbitkan setelah melalui proses review terhadap makalah dan dilakukan perbaikan oleh penulis. Beberapa makalah tidak diikutsertakan pada Prosiding ini karena beberapa alasan, diantaranya karena beberapa tulisan terbaik, dengan seizin penulis, akan dimuat pada Jurnal Ilmiah Geomatika dan Majalah Ilmiah Globe. Alasan yang kedua adalah karena beberapa makalah lainnya yang telah melalui proses review tidak dikirimkan kembali ke panitia.

Atas nama panitia saya ucapkan terima kasih kepada seluruh peserta seminar yang telah meramaikan acara seminar ini, khususnya kepada penulis yang telah memperbaiki makalahnya untuk Prosiding ini. Terima kasih juga kepada seluruh panitia dan reviewer yang telah bekerjasama dalam mempersiapkan, mengawasi jalannya acara hingga menyelesaikan Prosiding Seminar Nasional Geomatika ini. Semoga Prosiding ini dapat bermanfaat untuk Penggunaan, Pengembangan produk dan Penyebarluasan hasil riset informasi geospasial.

Akhir kata, mohon maaf atas kekurangan dalam penyelenggaraan Seminar Nasional Geomatika 2019. Kami akan terus berusaha menyelenggarakan Seminar Nasional Geomatika yang lebih baik setiap tahunnya. Semoga Allah Subhanahu wa Ta'ala meridhoi segala niat dan usaha baik kita. Amin.

Cibinong, Desember 2020

Ketua Panitia,

Yosef Prihanto

KATA SAMBUTAN

Puji syukur atas rahmat Tuhan Yang Maha Kuasa kegiatan Seminar Nasional Geomatika 2019: "Geomatics Scientific Meeting On Planning & Disaster yang bertemakan Geomatics Scientific Meeting Coastal Management to Support SDG'S" telah terlaksana dengan baik pada 17-18 September 2019 yang lalu. Seminar Nasional Geomatika ini merupakan kegiatan tahunan yang dilaksanakan oleh Bidang Penelitian, Pusat Penelitian, Promosi dan Kerja Sama.

Selaku Kepala Pusat Penelitian, Promosi dan Kerja Sama, saya menyambut baik terbitnya prosiding ilmiah Seminar Nasional Geomatika ini. Tentunya prosiding ini telah ditunggu-tunggu kehadirannya oleh para peserta Seminar maupun pemerhati kegiatan geomatika lainnya yang tidak sempat hadir pada acara Seminar Nasional tersebut.

Terima kasih disampaikan kepada Panitia Seminar Nasional Geomatika 2019, para *reviewer* dan para Penulis yang telah melakukan review dan perbaikan terhadap makalahnya, sehingga akhirnya dapat dipublikasikan melalui prosiding online ini. Semoga kegiatan ini dapat terus dilanjutkan pada tahun-tahun mendatang dan menyajikan makalah-makalah berkualitas yang dapat dijadikan referensi pada kegiatan geomatika secara umum.

Cibinong, Desember 2020

Kepala Pusat Penelitian, Promosi dan
Kerja Sama

Wiwin Ambarwulan

DAFTAR ISI

A CORRELATION ANALYSIS OF THE RELATIONSHIP BETWEEN AIR POLLUTION PARAMETERS PM10 WITH LAND SURFACE TEMPERATURE (LST) BASED ON LANDSAT 7ETM+ AND LANDSAT 8OLI/TIRS SATELLITE IMAGES IN BANDUNG CITY

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ABSTRACT

Bandung is one of the cities that are currently developing in terms of population, economy, and infrastructure in Indonesia. These developments will affect the ecological side by declining of the quantity and quality of land cover, especially vegetation. This condition is correlated with increasing air pollution in Bandung City. Therefore, doing research regarding a correlation analysis of the relationship between LST and Particulate Matter (PM) 10 in Bandung is important to do. This research aims to provide information about the conditions and changes in LST and PM in the Bandung by using primary data from Landsat 7 ETM+ and Landsat 8 OLI/TIRS images in 2008, 2018 and 2019 which have been corrected in terms of atmospheric radiometric and geometric. In the calculation of LST was using the Mono Window method that utilizes the thermal to find out the brightness of the temperature and multispectral bands found in Landsat images also used to determine the vegetation index, proportion of vegetation and land surface emissivity whereas to determine. To estimation of PM10 algorithm using RGB reflectance and AOT, data can be concluded as a result between PM10 and LST. PM10 estimation results obtained the highest value of 299,7 ug/m3 in 2018 included in the dangerous category while the value of LST from 2008 to 2019 was increased in 1,8^{o}C. The relation was positive relation in the year 2008, 2018 and 2019, which means that the assumption of the estimated LST value is low then the result of PM10 is small, while the assumption value of the estimated LST is high, then the resulting of PM10 calculation is large.

Keywords: Landsat, LST, AOT, PM10

ABSTRAK

Bandung merupakan salah satu kota yang saat ini berkembang dari segi kependudukan, perekonomian, dan infrastruktur di Indonesia. Perkembangan ini akan mempengaruhi sisi ekologis dengan menurunnya kuantitas dan kualitas tutupan lahan, terutama vegetasi. Kondisi ini berkorelasi dengan meningkatnya polusi udara di Kota Bandung. Oleh karena itu, melakukan penelitian terkait analisis korelasi hubungan antara LST dan Particulate Matter (PM) 10 di Bandung penting dilakukan. Penelitian ini bertujuan untuk memberikan informasi mengenai kondisi dan perubahan LST dan PM di Kota Bandung dengan menggunakan data primer dari gambar Landsat 7 ETM+ dan Landsat 8 OLI/TIRS tahun 2008, 2018 dan 2019 yang telah dikoreksi dalam hal radiometrik atmosfer dan geometris. Dalam perhitungan LST menggunakan metode Mono Window yang menggunakan termal untuk mengetahui kecerahan suhu dan pita multispektral yang ditemukan dalam gambar Landsat juga digunakan untuk menentukan indeks vegetasi, proporsi vegetasi dan emissivitas permukaan tanah sedangkan untuk menentukan. Untuk memperkirakan algoritma PM10 menggunakan refleksi RGB dan AOT, data dapat disimpulkan sebagai hasil antara PM10 dan LST. Hasil estimasi PM10 memperoleh nilai tertinggi sebesar 299,7 ug/m3 pada 2018 yang masuk dalam kategori berbahaya sedangkan nilai LST dari 2008 hingga 2019 meningkat di 1.8oC. Kaitannya positif pada tahun 2008, 2018 dan 2019, yang berarti asumsi nilai LST yang diperkirakan rendah maka hasil PM10 kecil, sedangkan nilai asumsi LST yang diperkirakan tinggi, maka hasil perhitungan PM10 besar.

Kata kunci: Landsat, LST, AOT, PM10

INTRODUCTION

Bandung is a developing city in terms of population, economy, and infrastructure. These developments will hypothetically be inversely proportional to the ecological side where the increasing population, economy, and development of infrastructure development will affect the quantity of vegetation land which will have an impact on air pollution and other global warming parameters such as an increase in Land Surface Temperature (LST). Like areas that are overgrown with trees,

they are turned into trade areas, settlements, industries, transportation networks, and other urban facilities and infrastructure. Air is an important factor in life. But in this modern era, in line with the development of the physical development of cities and industrial centers as well as the development of transportation, air quality has also undergone changes caused by the occurrence of air pollution or as changes in one of the air compositions from normal conditions; namely the entry of pollutants (in the form of gases and small particles/aerosols) into the air in a certain amount for a long period of time, so that it can interfere with human life, animals and plants (BPLH, 2013).

Based on the regulation of the Minister of Environment, it can be concluded that Particulate matter (PM) 10 with a diameter of less than 10 μm is one of the causes of pollutants. PM is the term for solid or liquid particles found in the atmosphere. Solid particles in this smoke will scatter sunlight so that it disturbs the view. PM10 is an aerodynamic particle with a diameter of fewer than 10 micrometers resulting from many human activities originating from motor vehicles and industry (Haq et al., 2002). This research refers to Lim, H.S., 2004 and Nadzri, 2010 and focused on using Landsat 7 ETM+ and Landsat 8 OLI / TIRS image data. The coefficient of AOT was using AERONET for estimating PM_{10} and correlated with LST.

METHOD

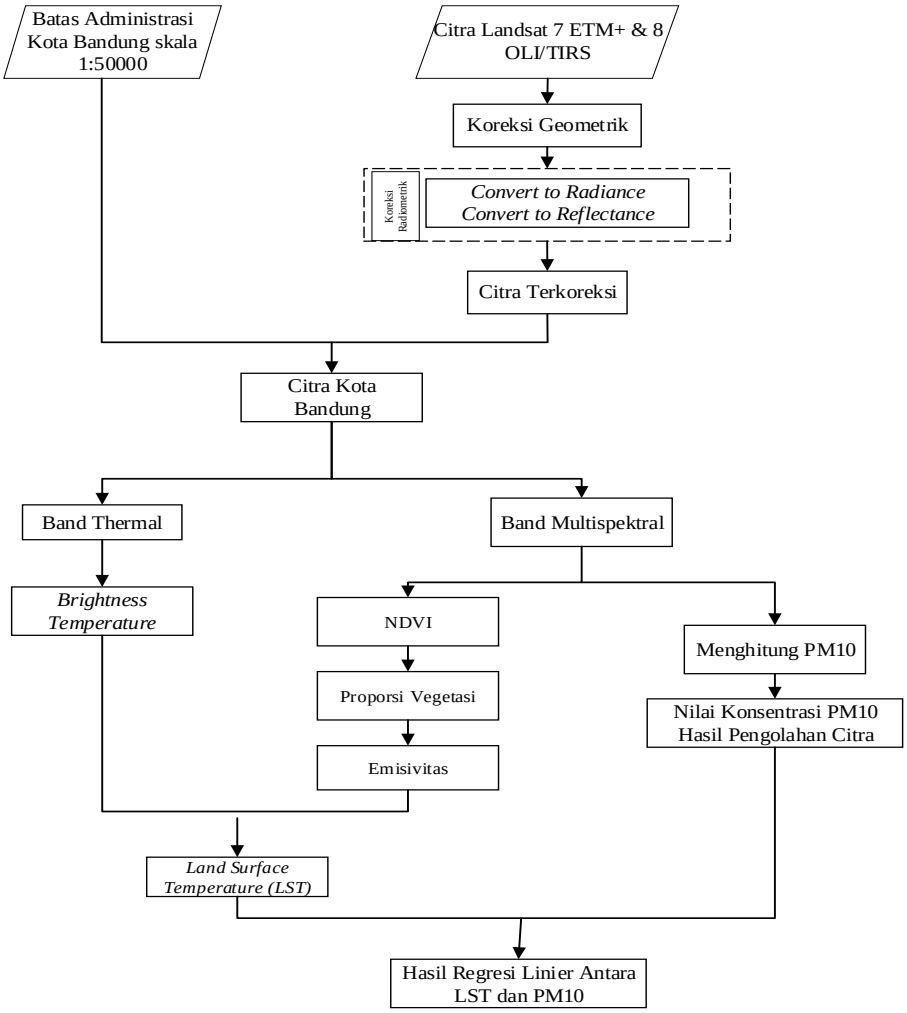


Figure 1. Flow chart of research methodology.

This section describes the process of conducting research which consists of determining the location of the study in the city of Bandung, West Java Province, collecting data consisting of trial results from field validation and image data downloaded from the USGS site, digital image processing in the form of geometric correction and radiometric correction. Geometric and radiometric corrected images can be used to process Land Surface Temperature (LST) and PM10 In this research, LST and PM10 maps and the relationship with regression form analysis between LST and one of the pollution parameters named Particulate Matter 10 (PM10) were produced. The research methods can be more easily understood through the flow of research in **Figure 1.**

Data and Location

In this research data used consisted of 7 ETM, 8 OLI/TIRS, etc (**Table 1**). This research located in Bandung city, West Java with 167.7 Km^2 in area. This region was chosen because it has a high population density, rapid economic development, and infrastructure so that hypothetically it will affect the quality and quantity of vegetation land cover which will affect soil surface temperature and PM_{10} concentrations. The location of the study is presented in **Figure 2**.

Table 1. Research data

Data
7 ETM+ Landsat Image year 2008
8 OLI/TIRS Landsat Image year 2018, 2019
Bandung city administrative boundary with 1:50.000 scale
Sub-district administrative boundary with 1:50.000 scale
Aerosol Optical Thickness (AOT) using AERONET

Figure 2. Research location, Bandung city.

Pre-Processing

Conversion to TOA Radiance

The first thing to do is to convert the digital number on Landsat 8 becomes spectral radiance by using the following equation (USGS, 2015).

$L\lambda = ML.Qcal + AL$……..(1)

Where:

$L\lambda$ = TOA spectral radiance (Watts/(m2 * srad * μm))

ML= Band-specific multiplicative rescaling factor from the metadata RADIANCE_MULT_BAND_x, where x is the band number)

AL= Band-specific additive rescaling factor from the metadata (RADIANCE_ADD_BAND_x, where x is the band number)

Qcal = Quantized and calibrated standard product pixel values (DN)

Conversion to TOA Reflectance

The following equation is used to convert DN values to TOA reflectance as follows (USGS,2015):

$\rho\lambda' = M\rho.Qcal + A\rho$……..**(2)**

Where:

$\rho\lambda'$ = TOA planetary reflectance.

Mρ = Band-specific multiplicative rescaling factor from the metadata (REFLECTANCE_MULT_BAND_x, where x is the band number)
Aρ = Band-specific additive rescaling factor from the metadata (REFLECTANCE_ADD_BAND_x, where x is the band number)
Qcal = Quantized and calibrated standard product pixel values (DN)

Processing

Land Surface Temperature (LST)

First of all, to estimate LST, the brightness of the image is determining the temperature by utilizing thermal bands contained in Landsat images. This aims at obtaining the value of the brightness temperature before surface temperature counting. The result of spectral radiance conversion is then processed with brightness temperature by using the following equation (USGS, 2015):

$$T_b = \frac{K_2}{In(+\frac{K_1}{L\lambda}+1)} \quad \textbf{(3)}$$

Where :

Tb = Satellite brightness temperature (C)
Lλ = TOA spectral radiance (Watts/(m2 * srad * μm))
K1 = Band-specific thermal conversion constant from the metadata (K1_CONSTANT_BAND_x, where x is the thermal band number)
K2 =Band-specific thermal conversion constant from the metadata (K2_CONSTANT_BAND_x, where x is the thermal band number

Furthermore, a vegetation index is needed to determine the greenness level of existing vegetation by using NIR and RED bands. The method used in determining the vegetation index is NDVI. The equation used to calculate NDVI is as follows (Burgan, 1993).

$$\mathrm{NDVI} = \frac{\mathrm{NIR}-\mathrm{RED}}{\mathrm{NIR}+\mathrm{RED}} \quad \textbf{(4)}$$

NDVI that has been obtained is used to calculate the proportion of objects using the vegetation cover fraction method (Pv) recorded by the sensor so that it can be done for LSE calculations which aim to describe the ability of an object to radiate the energy absorbed. The equation used to calculate Pv is as follows (Carlson and Ripley, 1997) while the equation used to calculate LSE is as follows (Weng, 2001).

$$\mathrm{Pv} = \frac{\mathrm{NDVI}-\mathrm{NDVI}_{\min}}{\mathrm{NDVI}_{\max}-\mathrm{NDVI}_{\min}} \quad \textbf{(5)}$$

$$(\mathrm{LSE})\ \varepsilon = 0.985\mathrm{Pv} + 0.960\ (1-\mathrm{Pv}) + 0.06\mathrm{Pv}\ (1-\mathrm{Pv}) \quad \textbf{(6)}$$

If all the required parameters have been obtained, then LST can be calculated by combining the results of brightness temperature obtained from the thermal band with LSE obtained from the results of visible band processing. The equation used to calculate LSE is as follows (USGS, 2001).

$$\mathrm{Ts} = \frac{Tb}{1+(\frac{\lambda Tb}{\delta})ln\varepsilon} \quad \textbf{(7)}$$

Where:

Ts = Land Surface Temperature (LST) °C
λ = wavelength of emitted radiance (= 11.5 μm)
δ = h×c/ (1.438 ×10-2 m K)
σ= Boltzman constant (1.38 ×10-23 J/K)

h = Planck's constant (6.626×10-34 J s)
c = velocity of light (2.998 ×108 m/s)

LST processing results are classified as follows:

Table 2. Estimation class LST.

Maps	Classification	Source
LST	Very low (15-20) Low (20-25) Moderate (25-30) High (30-35)	*Climate-data.org*

Particulate Matter (PM_{10})

To determine PM_{10} an algorithm is used as specified below (Lim, 2004 dan Nadzri, 2010):

PM_{10} = ao Rλ1 +a1 Rλ2 + a2 Rλ3……**(8)**

The reflected RGB band is extracted with coefficient AOT. The AOT coefficient is obtained from the AERONET website (https://aeronet.gsfc.nasa.gov/). PM_{10} processing results are classified as follows (PP,1999):

Table 3. Estimation maps classification.

Maps	Classification	Source
PM_{10}	Good (0-50) Moderate (51-100) Unhealthy (101-199) Very unhealthy (200-299) Dangerous (>300)	ISPU

RESULTS AND DISCUSSION

Land Surface Temperature (LST)

Based on the class area diagram in **Figure 3** obtained significantly different class distribution area for high class, where on the image of July 18, 2008, obtained a high-class distribution of 1.25km^2, while on the image of July 6, 2018, an increase in distribution amounted to 37.32 km^2. Based on the provisional hypothesis, several factors in increasing LST estimation in Bandung City are a large number of population and infrastructure development that allows changes in land cover that initially contained vegetation or greenery replaced by asphalt and concrete for roads, buildings and other structures needed to accommodate the growing amount high population. The replaced soil surface will absorb more heat from the sun and reflect it, causing the surface temperature of the land in the city to rise (Adiyanti, 1993). The same thing was conveyed (Wisnawa, 2008) which states that in general the increase in temperature occurs due to radiation from the sun that reaches the earth's surface directly received by the face of the earth. This phenomenon usually occurs inland conditions that initially have the potential to control heat (sensible heat) naturally, becoming less potential or even no potential. In this section, **Figure 4** shows the results of LST assessment maps for 2008, 2018 and 2019 imagery using the methods given in Section 2.

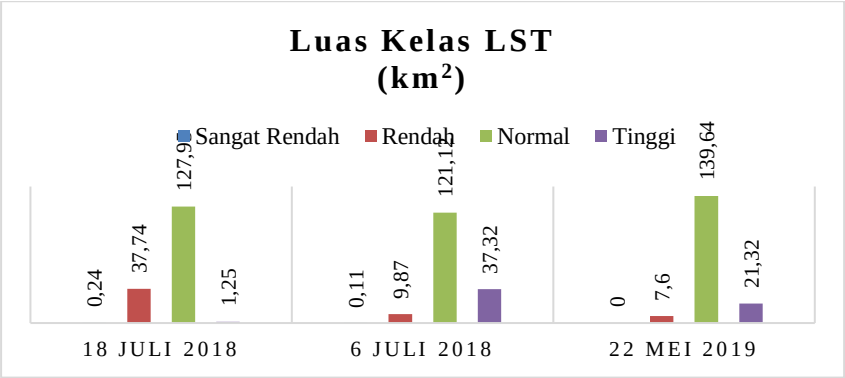


Figure 3. Area of each class.

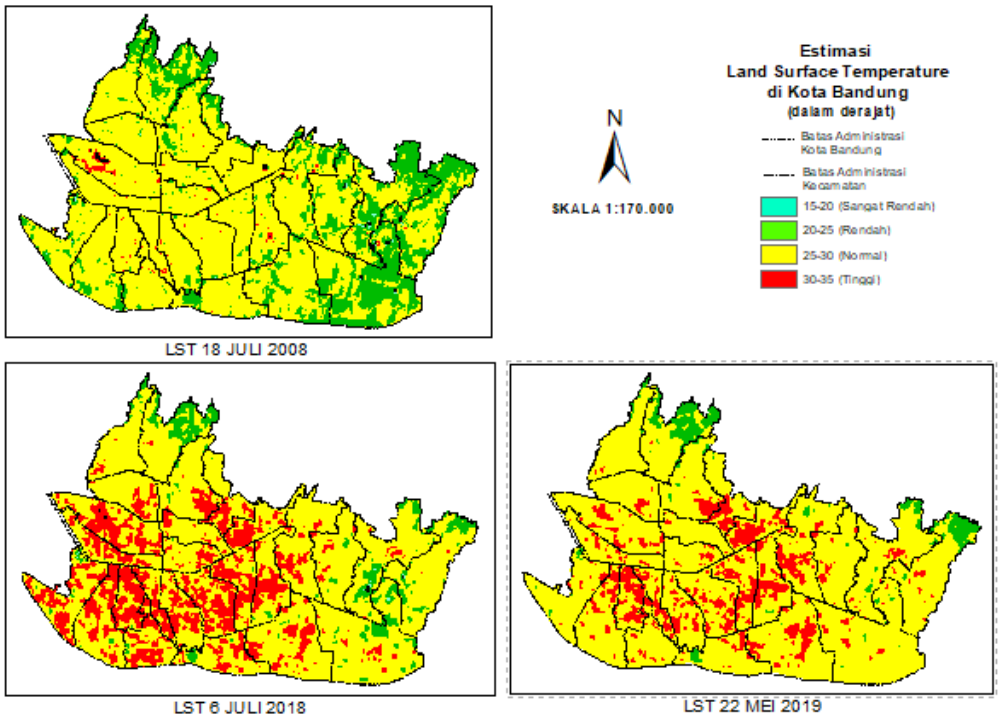


Figure 4. LST assessment maps in Bandung.

Table 4. Result *Compute Statistic* Estimasi LST.

Citra	Nilai Minimum	Nilai Maksimum	Nilai Rata-rata
18 Juli 2008	18.2ºC	32.1ºC	26.4ºC
6 Juli 2018	18.1 ºC	33.9ºC	28.5ºC
22 Mei 2019	20.1 ºC	33.9ºC	28.4ºC

Particulate Matter 10

The estimation of PM_{10} concentration in the implementation of this study was obtained from the results of atmospheric reflectance in the visible (multispectral) band. The concentration of PM_{10} determining in Bandung city refers to the research conducted by Lim, 2004 and Nadzri, 2010. The following are the results of PM_{10} concentrations estimation in Bandung City in 2008, 2018, and 2019.

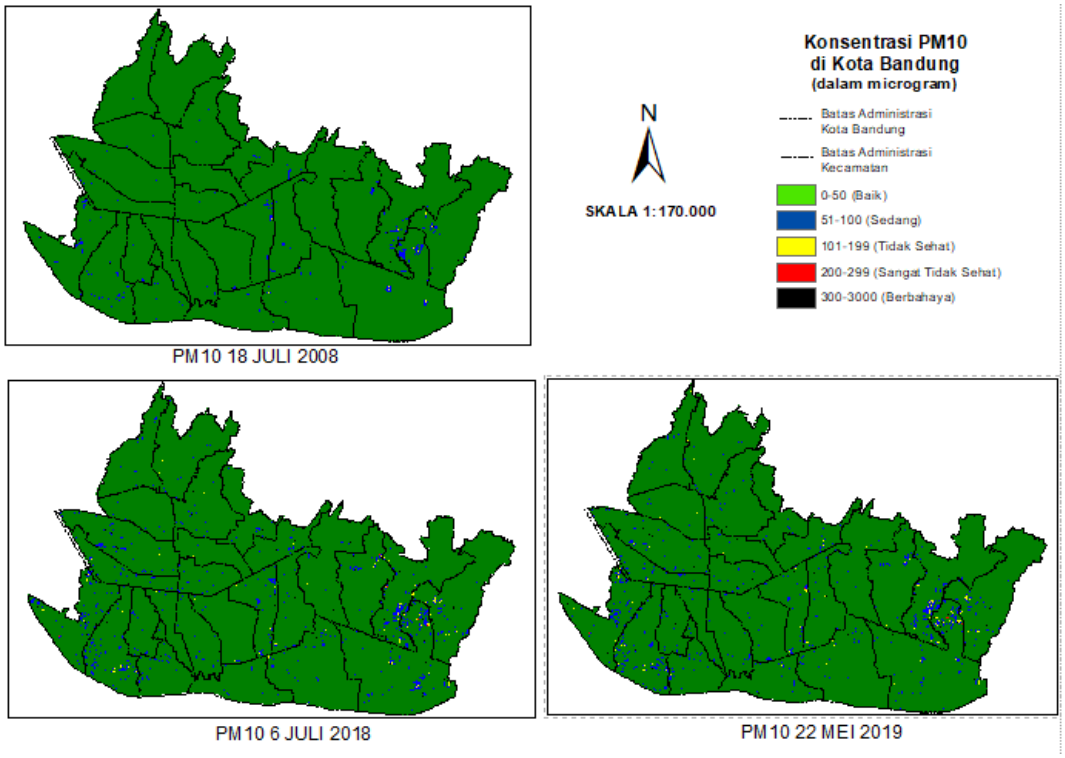


Figure 5. Estimation of PM_{10} concentrations maps in Bandung city.

Table 5. PM_{10} Concentration Value for Every Image.

Citra	Nilai Minimum	Nilai Maksimum	Nilai Rata-rata
18 Juli 2008	0.495 ug/m^3	155.7 ug/m^3	21.5 ug/m^3
6 Juli 2018	0 ug/m^3	299.7 ug/m^3	17.7 ug/m^3
22 Mei 2019	0 ug/m^3	276.4 ug/m^3	17.9 ug/m^3

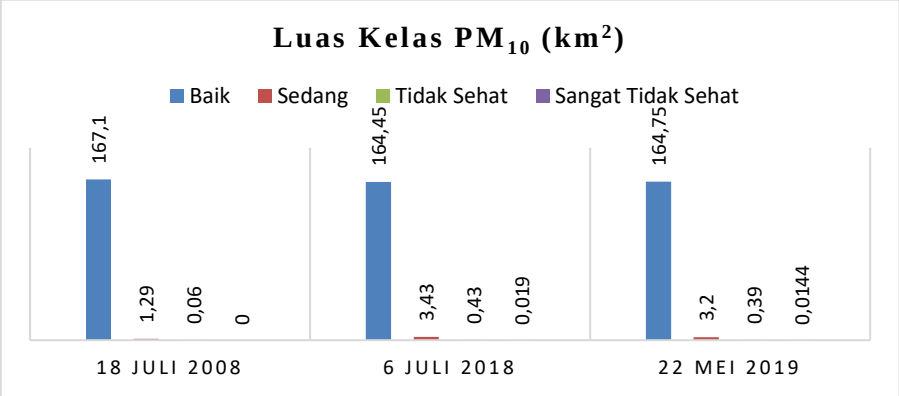


Figure 6. Area of each class.

Based on **Figure 6** it can be seen that there is a decrease in good classes and an increase in medium, unhealthy and very unhealthy classes. In the image dated July 18, 2008, the area of a good class is 167.1 km^2, the medium class is 1.29 km^2, the unhealthy class is 0.06 km^2 and concentration is not obtained for very unhealthy classes. In the image on July 6, 2018, the area for good class was 164.45 km^2, the moderate class was 3.43 km^2, the unhealthy class was 0.43 km^2 and the very unhealthy class was 0.019 km2 and in the image, on May 22, 2019, the area for good class was 164.75 km^2, moderate class is 3.2 km^2, unhealthy class is 0.39 km^2 and very unhealthy class is 0.0144 km^2.

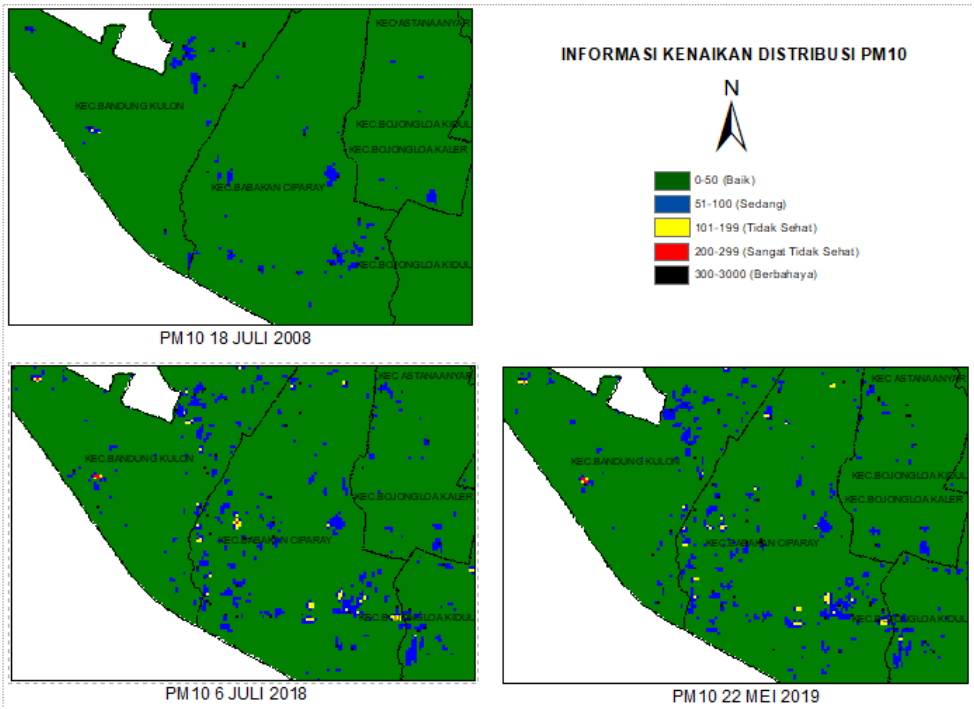
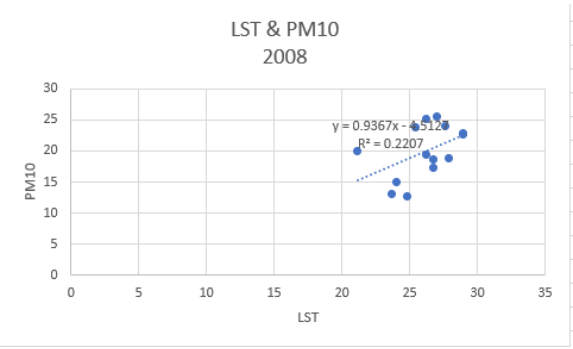


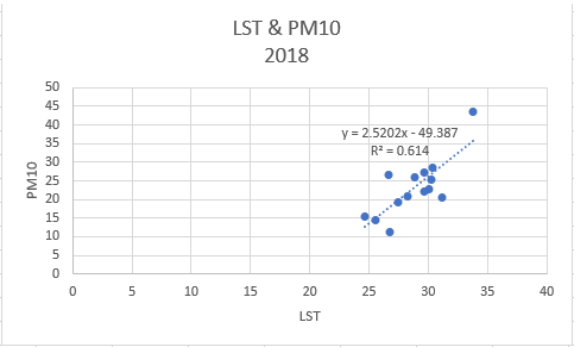
Figure 7 The increasing of PM_{10} concentration information.

Figure 7 shows that the distribution of PM10 concentrations in Bandung Kulon, Babakan Ciparay, Bojongloa Kaler and Bojongloa Kidul Subdistrict has increased based on the imagery in 2008, 2018 and 2019. This is seen from the expanding distribution in blue (Medium), yellow (yellow) classes Unhealthy) and even red (Very Unhealthy). With this increase, it is possible that in the future PM10 generated exceeds the NAB so that it is not in the good/healthy category to be inhaled. One of the factors that caused an increase in PM10 in Bandung was the number of motor vehicle users. The statement, in line with what was conveyed by Chrisdayanti (2015) which states that one of the factors that influence the PM10 content is motor vehicle smoke.

Regresi LST & PM_{10}

The picture below shows the regression results between LST and PM_{10} with varied categories. Based on the table above, linear regression is obtained for images July 18, 2008 with R2 = 0.2207 (Weak), Image July 6, 2018 with R2 = 0.6314 (Good) and imagery May 22, 2019 with R2 = 0.2915 (Medium).





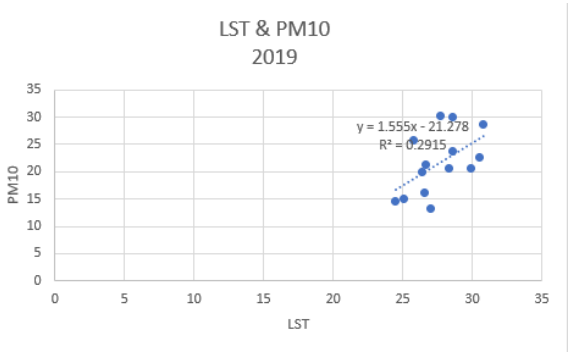


Figure 8. Linear regression of LST and PM_{10}.

CONCLUSIONS

The conclusion of this research are PM10 concentration values obtained from three images are included in the safe/healthy category for inhalation. This can be seen based on the average value of each treatment which is below the permissible NAB (NAB PM10 = 150 ug/m3). In 2008 the average yield was 21.5 ug/m3, in 2018 it was 17.7 ug/m3 and in 2019 it was 17.9 ug/m3. When reviewed based on the results of the visualization, there was an increase in distribution in several districts. It is not impossible, this will continue to increase and the resulting PM10 will depend on NAB. Based on the results of the regression between LST and PM10, it was concluded that the correlation results obtained are positive, which means that if the estimated LST value is low, the estimated PM concentration value is small while if the estimated LST value is high, then the estimated PM concentration value is large.

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