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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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THEME: 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

IDENTIFICATION OF PM10 AIR POLLUTION DISTRIBUTION USING SATELLITE LANDSAT IMAGES IN BANDUNG, INDONESIA

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ABSTRACT

Population, one of the harmful pollutants for the health is PM10 (Particulate Matter 10) because its size is less than 10 μm which can penetrate through the deepest parts of the lungs. The study of Particulate Matter (PM) concentrations is usually based on spatial data and temporal data series determined at the location of air pollution monitoring stations which are only effective in small spaces with associated observer stations, and it can't provide the spatial distribution obtained from Particulate Matter (PM) in a large area. Measurement of pollutants in a large area can be done using satellite imagery. This research allows determining the distribution of PM10 air pollution in Bandung using Landsat8 satellite images and PM10 concentration values obtained from Air Quality Monitoring System (AQMS) for validation with the field measurement, so as the distribution of PM10 is expected to be correctly identified. The stages implementation includes geometric correction, radiometric calibration, masking, and input the algorithm of PM10 to get the concentration value. The results showed that the estimation of the distribution of PM10 through satellite imagery was an efficient and suitable technique for the study area.

Keywords: Landsat, PM10, remote sensing, air quality

ABSTRAK

Populasi, salah satu polutan berbahaya bagi kesehatan adalah PM10 (Particulate Matter 10) karena ukurannya kurang dari 10 μm yang dapat menembus bagian terdalam paru-paru. Studi konsentrasi Particulate Matter (PM) biasanya didasarkan pada data spasial dan seri data temporal yang ditentukan di lokasi stasiun pemantauan polusi udara yang hanya efektif di ruang kecil dengan stasiun pengamat terkait, dan tidak dapat menyediakan distribusi spasial yang diperoleh dari Particulate Matter (PM) di area yang luas. Pengukuran polutan di area yang luas dapat dilakukan menggunakan citra satelit. Penelitian ini memungkinkan penentuan distribusi polusi udara PM10 di Bandung menggunakan gambar satelit Landsat8 dan nilai konsentrasi PM10 yang diperoleh dari Air Quality Monitoring System (AQMS) untuk validasi dengan pengukuran lapangan, sehingga distribusi PM10 diharapkan dapat teridentifikasi dengan benar. Implementasi tahapan meliputi koreksi geometris, kalibrasi radiometrik, masking, dan input algoritma PM10 untuk mendapatkan nilai konsentrasi. Hasil penelitian menunjukkan bahwa estimasi distribusi PM10 melalui citra satelit adalah teknik yang efisien dan cocok untuk area studi.

Kata kunci: Landsat, PM10, penginderaan jauh, kualitas udara

INTRODUCTION

Air pollution is a major problem that becomes increasingly important in major urban centers throughout the world (Saleh and Hasan, 2014). One of the major cities in Indonesia is the city of Bandung. The problem of air pollution in Bandung causes a decrease in air quality which can cause disruption of human health and environmental life. One index that can be used as a determinant of air quality is the Air Pollution Standards Index. The ambient or air quality parameters used for the ISPU value study are PM10, SO2, CO, O3, and NO2. PM10 (Particulate Matter 10) is an air particle that is less than 10 μm and very dangerous because it can penetrate through the deepest parts of the lungs and heart system which will cause health problems (Mukhtar et al, 2013). The daily threshold value of the average concentration of PM10 fine particles in Indonesia is 150 μg/m3 listed in the Appendix to Government Regulation No. 41/1999 concerning national ambient air quality standards. Air pollutants can be measured from the central air pollution monitoring station with various types of instruments. But these instruments are quite expensive and the number of air pollution measuring stations is limited in each region. The limited number of air pollutant observer stations causes uneven distribution of data, so the air pollution cannot be mapped properly (Saleh

and Hasan, 2014). Air pollution monitoring stations in Bandung are spread over four points including: Dago, Gedebage, Pajajaran and Ujung Berung with air pollution measurement parameters namely PM10, O3, SO2, CO.

Studies on PM concentrations are usually based on spatial data and temporal data series measured at the location of air pollution monitoring stations in cities and rural areas (Retalis et al, 1999). Field observation measurements require high costs for installation and maintenance and the data collected is only effective in small spaces with coverage around the observer station. Thus, measurements at the observer station cannot provide detailed spatial distribution of pollutant particulate matter (PM) over large areas (Wald and Baleynaud, 1999). Measurement of pollutants over large areas can be done using satellites which are one of the remote sensing instruments. Remote sensing techniques are widely used for environmental pollutant applications such as air pollution (Ung et al, 2001). Several studies have shown that satellite data may be useful in uncovering the implications of global climate and environmental air pollution (Akimoto, 2003). Measurement using satellites clearly has advantages and is the only measurement device that provides broad coverage. This research was conducted because the results of PM10 observations at the observer station could not provide detailed spatial distribution of Particulate Matter (PM) pollutants over large areas, so observations on large areas were carried out using satellites.

METHODS

Material and Methods of this reasearch contain by study are, particulate matter 10 ground measurement, Air Quality Monitoring System (AQMS) and methods. The location of this research is in Bandung, West Java Province which is one of the third largest cities after Jabodetabek and Gerbangkertosusila in Indonesia (Nugroho and Syaohid, 2015). Bandung City consists of 30 Subdistricts with a land area of 167.67 km^2. Bandung is located at 107º36 'E longitude and 6º55' S latitude (**Figure 1**).

Figure 1. Administrative Area of Bandung.

Particulate Matter (PM10) Ground Measurements

PM10 concentrations were collected simultaneously with the image acquisition date at several points of streets in Bandung. It is a small, handheld, mobile operated and completely portable unit. This unit named Pocket Sensor PM2.5 which provides both particle counts and mass PM measurements of PM2.5 and PM10 as stored data logged values, real-time networked data. The distribution of PM10 values based from ground measurement in Bandung can be seen in **Figure 2.**

Figure 2. Distribution of PM10 values based from ground measurement in Bandung.

The calculation of PM10 with satellite Imagery is used in the following formula (Saleh and Hasan, 2014).

$$PM10 = ao\ R\lambda1 + a1R\ \lambda2 + a2R\ \lambda3 + a3R\ \lambda4 \quad \text{.....(1)}$$

The parameters used in the algorithm are;
ao= Algorithm coefficient (Aerosol Optical Thickness)
Rλ1 = Band reflectance value used (corresponding to satellite bands)
The value of Aerosol thickness was obtained from NASA's official website AERONET. The reflectance values used are the reflectance values of the red, green, and blue (RGB) bands.

Air Quality Monitoring System (AQMS)

Air Quality Monitoring System (AQMS) is a system to determine the level of air pollution, one of which is for the Air Pollution Standard Index (ISPU). In addition to find out the concentration of pollutants in real time, especially for areas with pollution levels that are expected to be higher than the quality standard (BPLH, 2016).

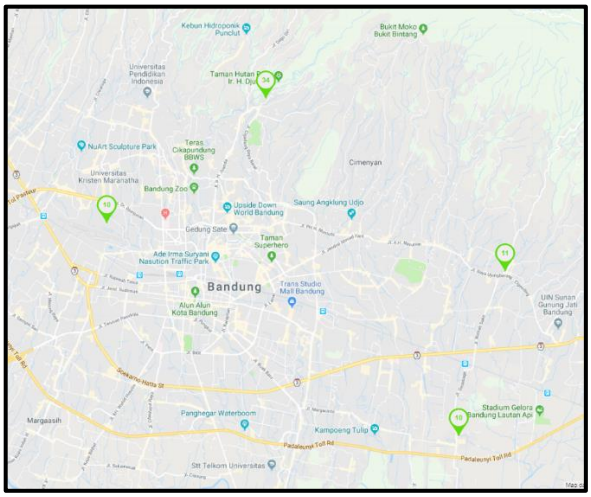

Figure 3. Ground Station of AQMS.

The development of an ambient air quality monitoring system (AQMS) to develop an integrated ambient air quality monitoring network using automated communication equipment designed to controversy ambient air quality in the area / city at a certain time is carried out by the central government, regional governments and the private sector. AQMS placed in several cities, one of them is in Bandung. Observation stations in Bandung are spread over four points in Bandung, including: Dago, Ujungberung, Gedebage and Pajajaran. Location of observer stations in Bandung can be seen in **Figure 3**. The parameters monitored are PM10, PM2.5, SO2, NO2, O3, HC, and CO. Data received from the air quality monitoring station is processed into ISPU data in the AQMS KLHK

access room (main center), then the measurement data and ISPU are brought to indoor and outdoor displays in each area. This concentration and ISPU data are used as air quality information to the public that can be seen directly through a display board (public display outside) which is installed on the roadside. In addition, the data from monitoring coordination results that are well managed can be used as material for developing policies on the implementation of air pollution coordination in the regions (Directorate of Air Pollution Prevention, 2018).

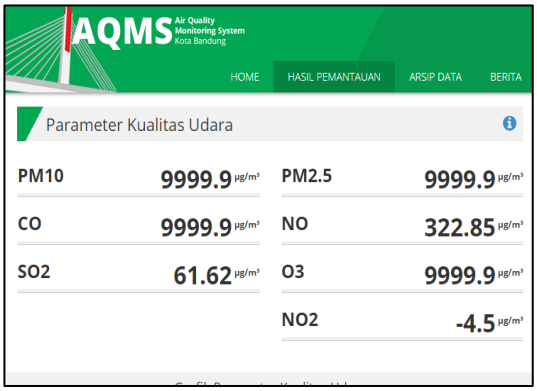

Figure 4. Parameters of Pollutant that has been Saved by AQMS.

PM10 distribution map in Bandung is divided into five classes. According to ISPU the healthy class has a PM10 range of 0-50 µg / m³ shown as green, the moderate class has a range of values of 51-100 µg / m³ shown as blue, the unhealthy class has a range of 101-199 µg/m³ shown as yellow, the very unhealthy class has a range of 200-300 µg/m³ shown as red and hazardous classes have values above 300 µg/m³ shown as black. The value of air pollutants recorded by the observer station can be accessed on the official website of AQMS in Bandung, the recorded values are not only PM10 but also CO, SO2, NO, NO2, PM2, PM2.5 and O3 as can be seen **Figure 4.**

Flow Chart

The methods for this research is using PM10 algorithm from Saleh and Hasan (2013) but with AOT provided by AERONET. The flow chart of this research can be seen in **Figure 5.**

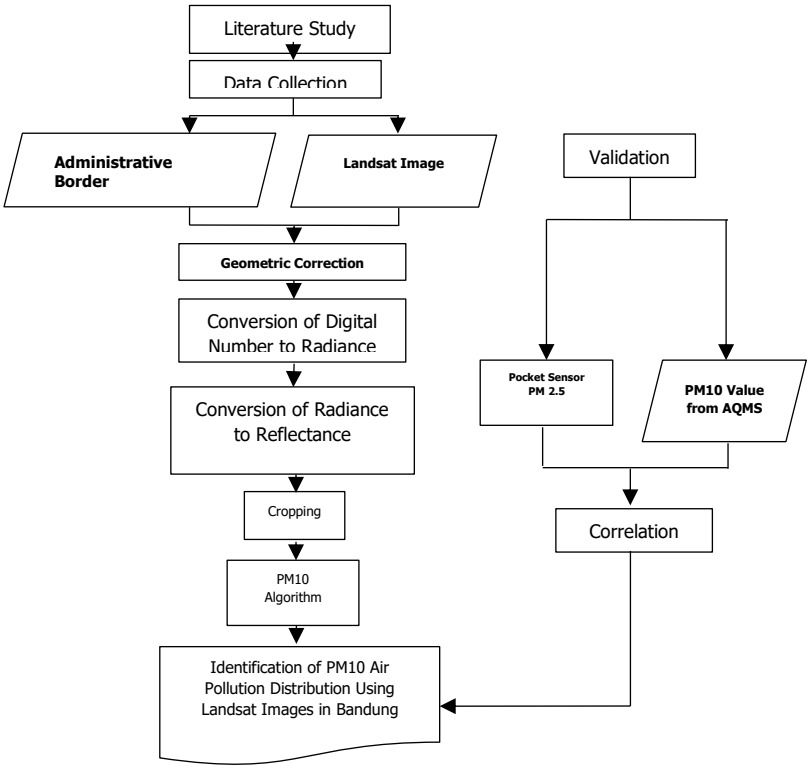

Figure 5. Flow Chart

RESULTS

PM10 value is obtained by entering the PM10 algorithm in the band math using ENVI 5.1. The PM10 algorithm consists of reflectance values of red, green and blue bands, and AOT parameters obtained from AERONET. The AOT parameter used is obtained simultaneously with the image acquisition date. PM10 distribution map Bandung divided into five classes. According to ISPU the healthy class of PM10 has a range of 0-50 µg/m³ shown as green, the moderate class has a range of values of 51-100 µg/m³ as blue, the unhealthy class has a range of 101-199 µg/m³ as yellow, the very unhealthy class has a range of 200-300 µg/m³ as red and hazardous classes have values above 300 µg/m³ as black. Following distribution of PM10 based on Landsat satellite image processing in 2019 can be seen in **Figure 6.**

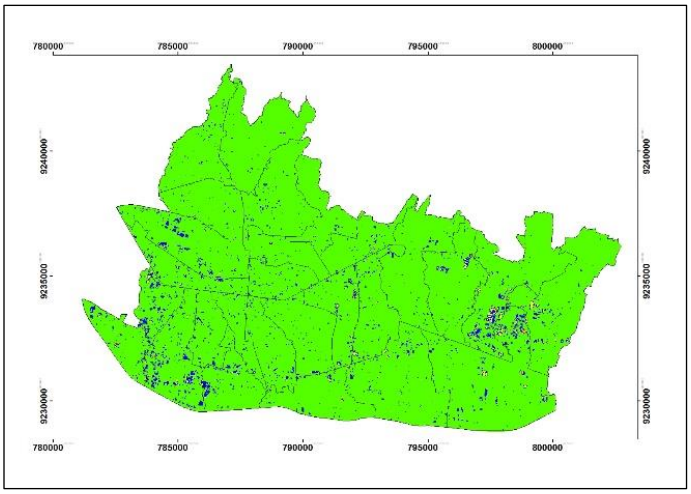

Figure 6. Distribution of PM10 in Bandung, May 2019.

Based on the **Figure 6**, the healthy classes range from 0 – 50 µg/m3 are found in almost all over the cities of Bandung, there are only a few unhealthy class spots and there are no very unhealthy and dangerous classes. Which means Bandung is still healthy from the danger of PM10.

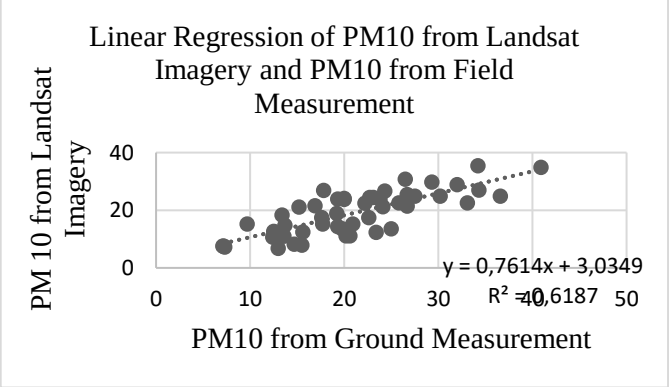

Figure 7. Linear Regression of PM10 from Landsat Imagery and PM10 from Field Measurement.

Based on the linear regression relationship above (**Figure 7**), the equation of the coefficient of determination on the regression relationship above is 0.6187, this means that the relationship between PM10 from the results of field measurements and Landsat image processing is 61,87%. According to Boediono and Koster (2001), with a correlation value when 0.70 <r <0.90 or -0.90 <r <- 0.70, it means a strong relationship. It can be concluded that the relationship between PM10 results in field measurements with satellite image processing is quite strong.

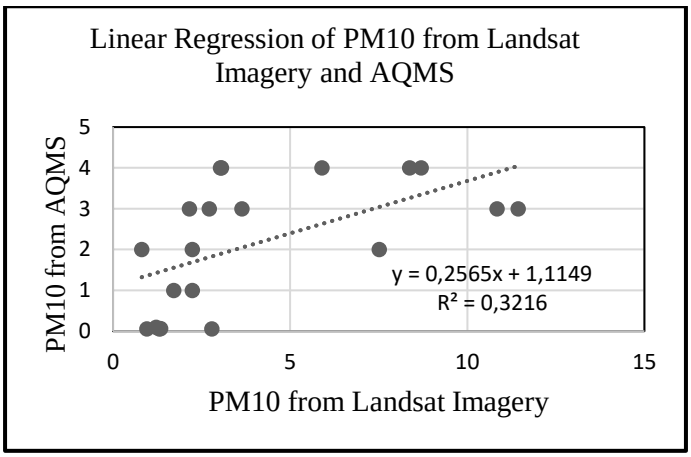

Figure 8. Linear Regression of PM10 from Landsat Imagery and AQMS.

Based on the linear regression relationship above (**Figure 8**), the equation of the coefficient of determination on the regression relationship above is 0.3216, this means that the relationship between PM10 from the results of field measurements and Landsat image processing is 32,16%. According to Boediono and Koster (2001), with a correlation value when 0,50 < r < 0,70 atau -0,50 < r < -0,70, it means a moderate relationship. It can be concluded that the relationship between PM10 results in field measurements with satellite image processing is moderate. The working principle of the AQMS tool on PM10 is filtration, in which there is a device called a filter tape which filters the collected particulates of 10 ug/m3. Air pollutants with a radius of five kilometers can be drawn on an AQMS device. Based on the reviews that have been reviewed, four air monitoring stations in the city of Bandung can already represent the air quality of the entire city. The data of Landsat imagery within 5km is used to see the regression of both data.

CONCLUSION

The results of the wide distribution of PM10 values in Bandung based on healthy classes in 2019 with an area of 161,296 km2. Whereas the medium class in this 5 year period only has an area of 1 to 6 km^2. Based on the wide distribution of PM10 concentration values, it can be concluded that PM10 air pollutants in Bandung are still in the healthy category.

Based on the linear regression coefficient equation the relationship between PM10 from the results of field measurements and Landsat image processing has a strong relationship, amounting to 61.87% while the relationship between PM10 values based on AQMS and PM10 values from Landsat images has a moderate / moderate relationship of 32.16 %.

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