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T. Tampubolon and J. Yanti

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Remote Sensing for Disaster Mitigation of Sinabung

T. Tampubolon[a)] and J. Yanti

State University of Medan, Sumatera Utara, Indonesia

[a)]Corresponding author: topartam@gmail.com

Abstract. Indonesia, a country with many active volcanoes, potentially occur natural disaster due to eruptions. One of volcanoes at Indonesia was Sinabung mountain, that located on Karo Regency, North Sumatera 3°10'12" N 98°23'31“ E, 2,460 masl. A fasile and new observation method for mapping the erupted areas was remote sensing. the remote sensing consisted of Landsat 8 OLI that was published on February 8th 2015 as input data ENVI 4.7 and ArcGIS 10 as mapping tools. The Land surface temperature (LST) was applied on mapping this resulted. The highest LST was 90.929657 °C. In addition, the LST distribution indicated that the flowing lava through south east. Therefore, the south east areas should be considered as mitigated areas.

INTRODUCTION

Indonesia is a country which composes of thousand islands and includes a state that circles point earthquake the most active in the world, the path of volcano and the line of plate collision that stretches 40,000 kilometers (Pacific Ring of Fire), as well as the earthquake belt very active number two in the world, belt Alpide (Alpide belt) [1]. This condition is exacerbat by the collision of three continental plates, the Indo-Australian of the south, Eurasia from the north, and the Pacific from the east. Flanked by two extreme geophysical lines, Indonesia is home to some of the strongest natural disasters that have occurred on Earth, one of them is a volcanic eruption.

Volcano in Indonesia as many as 127, one of the volcanoes that are still active is the eruption of Mount Sinabung. The eruption of the volcano Mount Sinabung is located in Karo district of North Sumatera Province with the geographical coordinates 3°10'12" N and 98°23'31" E, 2.460 masl. Sinabung first eruption on September 2013. Until now incandescent lava and hot clouds glide up to a radius of 3 kilometers is still going on everyday. Geological Agency predicts Sinabung eruption is still going through the next five years [2].

With this prediction we need a monitoring activity, impacts and mitigation temporally in run. Remote sensing is a new technology that can monitor a change temporally in the long term, wide regional coverage, more efficient way to assess the impact, and can quickly provide assistance in accordance with the impact which is caused by the disaster, to the people who are affected by the disaster. Several studies on volcano eruptions, mitigating the impact of the volcanic eruption, volcanic eruption modeling using remote sensing [3, 4, 5, 6, 7, 8]. the remote sensing is expected to be petrified mitigation of the eruption impact of Mount Sinabung.

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DATA AND METHOD

Research methods which are used to look for the vegetation changes and temperature estimates, as follows:

Location Research

The observation area in this study was Mount Sinabung located in Karo district of North Sumatra province with coordinates 3°10'12" N 98°23'31" Eand an altitude of 2,460 meters.

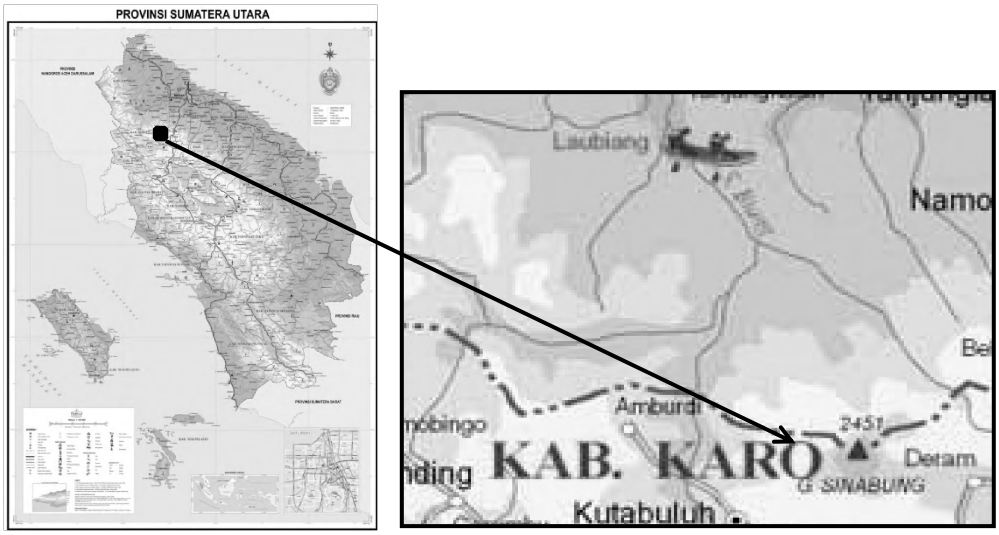

FIGURE 1. Research location

Tools and Data

Tools and data was used to find LST value and NDVI value, which combined some tool and data. The tools used for this study could be seen in Table 1.

Table 1. Table of tool research

No	Name	Spesification	Total
1.	Laptop 1. ArcGIS 10.0 2. ENVI 5.0	Intel core i3 HDD 500 MB RAM 2GB	1

The data used for this study can be seen in Table 2.

Table 2. Research Data

No	Name	Spesification	Total
1.	Landsat 8 OLI path 129 row 058	Band 10 Thermal Infrared – 100 m	1
2.	Administration boundaries	Mt. Sinabung	1

Procedure of Research for calculating temperature estimation, as follows Thermal infrared image of Thermal Infrared Sensor (TIRS) will use to calculate Land surface temperature for finding highest temperature area which effects of eruption Sinabung and Onbroad Land Images Sensor to find directs of lava eruption Sinabung. This research will use Landsat 8 OLI with path 129 and row 58 cloud cover <5%. Direction of Lava Sinabung will be seen with combining 3 Band of RGB (Red Green Blue), R to Band 10, G to Band 6 and B to Band 5. Thermal infrared image will be cropping with study area (Mt. Sinabung) and then calculating with correction radiometric formula, calculating land surface temperature (Kelvin) value, converting LST value with Kelvin to Celcius.

Futhermore, it will be classified from low to highest temperature value of LST. Finally, directs of lava eruption Sinabung and highest temperature area can be found and used to identify the wide dangerous area of effect eruption of Sinabung for disaster mitigation.

RESULT

Monitoring research areas was used remote sensing method requires a Landsat satellite image data, the data Landsat which would be processed to produce a value of LST. MtSinabung, located in Karo district in the distribution of Landsat images located on Path 129 and Row 058 [8]. Eruption of Mount Sinabung was viewed by utilise a combination of RGB Color on satellite images Landsat 8 OLI, where R was used Band Thermal Infrared (Band 10), G used Band Short Wave Infrared (Band 6), and G used Band Near Infrared (Band 5), The result of combination was called Infrared Light, this served to see directs area of the lava eruption of Mount Sinabung and could be seen in Figure 2.

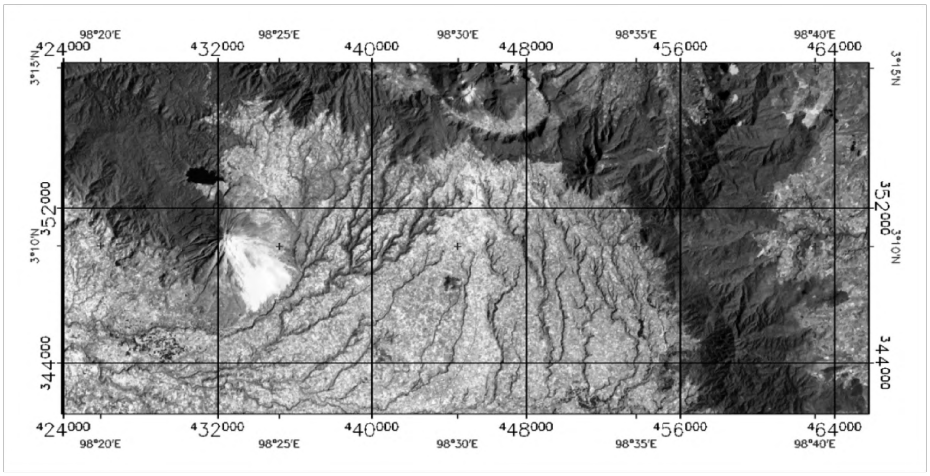

FIGURE 2. Mt. Sinabung in InfraRed Light (Band 10,6,5)

LST values obtained by remote sensing methods were calculated radiometric correction and then LST (Land Surface Temperature) calculated use Band 10 TIR. The maximum value of research results LST 363.929657 K (90.929657 °C), minimum 286.206665 K (13.206665 °C) and the average value of LST 297.163873 K (24.163873 °C). LST's digital value lava on Mount Sinabung eruption could be seen in the Figure 3.

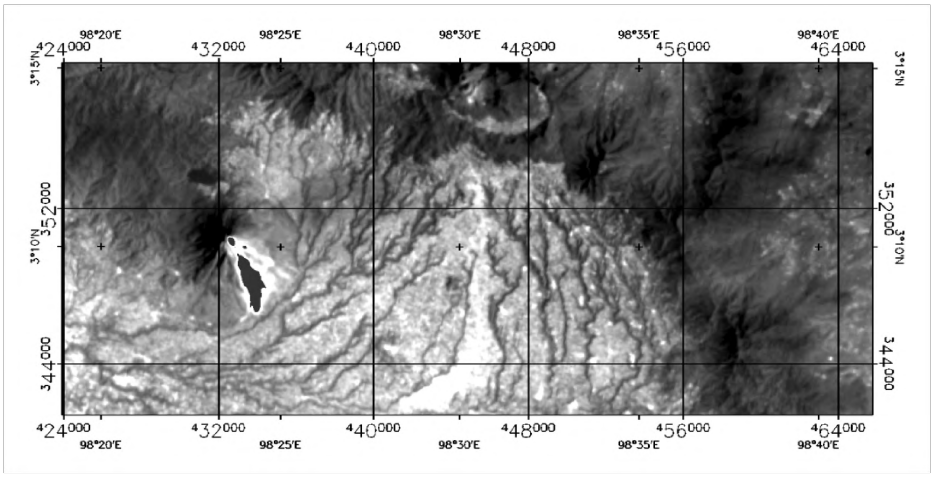

FIGURE 3.LST with Interval of LST (40 – 95 °C)

Red in the image were classified as very high temperature with a temperature range of 40 °C – 95 °C, with a number of points as much as 2,377. From Figure 4, could be highest temperature at 90.929657 °C which was located at coordinates UTM Zone 47 North, Map: 432615.00E, 350385.00N Meters, LL: 3°10'11.40" N, 98°23'36.66" E, with Disp # 1 (4262.2852) Scrn: R: 255 G: 0 B: 0 identified in red. LST point maximum value could be seen in Figure 4.

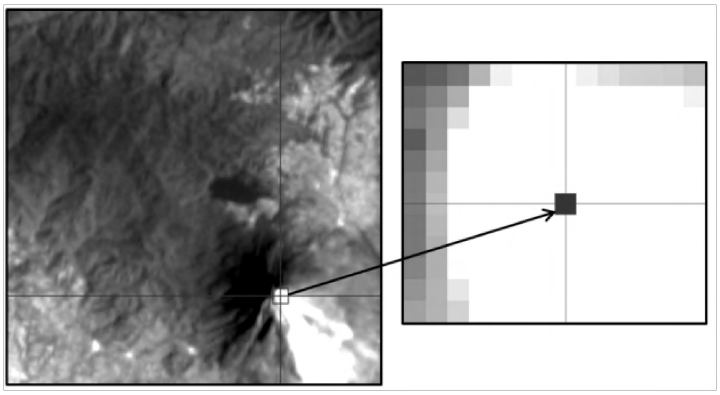

FIGURE 4. LST Maximum Value point

From the results obtained to wave number of LST Maximum point (1/λ) for each vertical and horizontal, which showed the maximum value was > 300 cm^{-1} and < 300 cm^{-1}. Each wave number could be seen in Figure 5.

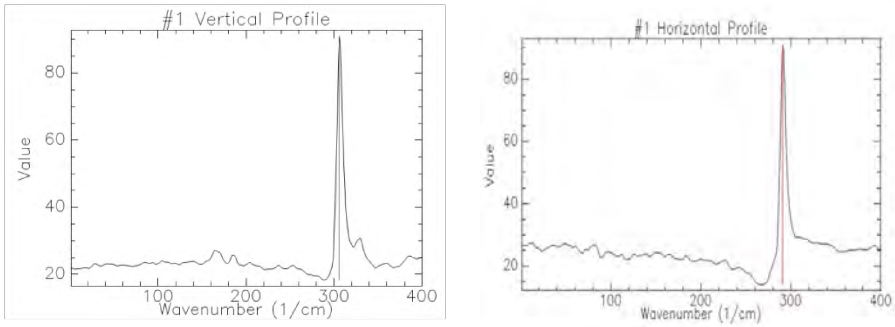

FIGURE 5. Vertical and Horizontal wavenumber of LST Maximum point

From the results obtained LST carried region classification based on the value of LST. This could be seen in Figure 6.

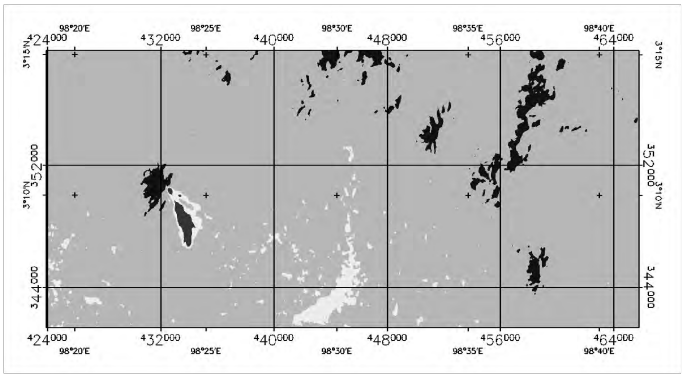

FIGURE 6. Classification of LST

Table 3. The classification and interval color

Classification	Color	Interval
Low		< 20°C
Moderate		20°C – 30°C
Height		30°C – 40°C
Very high		>40°C

To a temperature of smaller 20 °C were classified into LST low category in blue, for temperatures ranging between 20 °C to 30 °C were categorized as LST medium, for the temperature range 30 °C to 40 °C were categorized as LST high, and LST categorized as very high with LST value greater than 40 °C. From the results of the classification obtained the number of points for each type of classification, among others, could be seen in Table 4.

Table 4. Total Pixels from Classification

Classification	Interval	Pixels	Area (ha)
Low	< 20°C	25.427	2288.43
Moderate	20°C – 30°C	796.767	71709.03
Height	30°C – 40°C	20.799	1871.92
Very high	>40°C	2.377	213.93
Total			76083.31

CONCLUSION

The maximum value of research results was 363.929657 K (90.929657 °C), the minimum value was 286.206665 K (13.206665 °C) and the average value of LST was 297.163873 K (24.163873 °C). The Land surface temperature (LST) was applied on mapping this resulted. In addition, the LST distribution indicated that the flowing lava through south east. Therefore, the south east areas should be considered as mitigated areas.

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