The electrical properties on the plantation fires at Liang Anggang Village in the South Kalimantan in Indonesia

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Abstract. Electrical properties were used to analysis soil characteristic such as conductivity electric, resistivity and dielectric permittivity. The aim of this study is characterization of electrical properties at plantation fires at Liang Anggang village, Banjar Regency, South Kalimantan, Indonesia. The geo-electric resistivity of Wenner-Schlumberger configuration was conducted in field with 1 meter electrode spacing. The result of resistivity section which the length is 52 meter varies from 149 to 1436 ohmmeter. In the surface from 0 to 5 meter is higher resistivity (1039 – 1436 ohmmeter) and the lower 5 m is lower resistivity (149 – 752 ohmmeter). Resistivity of plantation fires has high resistivity, because there are many organic matters and less water content moreover those impact up to 5 meter the depth.

1. Introduction

The environmentalists in the world very concentrated to the global warming issue and the impact. The global warming is produced by increasing the emission carbon and generate of emission carbon is a fires plantation. The researchers have been studying the fires plantation because it can change the million ecosystems in the world [1,2].

Indonesia is the one of the country that has the largest peatlands and tropical forests in the Southeast Asia. The peatlands and tropical forests are flammable areas such as in Riau, in Jambi, in the South Sumatera, in the West Kalimantan, in the South Kalimantan and in the Center Kalimantan. They are frequently flammable areas in Indonesia [3]. There are a lot of plantation fires because El Nino usually occurs in the southeast of Sumatera and in the southern of Kalimantan [3]. The plantations fires not only change many ecosystems but also change chemistry properties as well as change physics properties. In the result of changing the properties in plantations fires are not significantly seen [4]. The soils can be characterized based on physico-chemistry properties such as texture, grain size, organic matter and electrical properties [5]. In this study is characterized of plantations fires by electrical properties, especially electrical resistivity properties.
2. Methods
The study was done in the dry season on May, 2015 at Liang Anggang village in Banjar Regency in the South Kalimantan with 03° 25’ 21”, 9” S, 114° 45’ 57’’ 2” E geography coordinate. The profile of research location shown in ‘Figure 1’, there are much shrubs that were fires.

![Figure 1. The research area in Liang Anggang Village](image)

The electrical resistivity properties of the data were collected using Mc Ohm OYO type 2115 A, with a track length of 50 cm North to South with 53 electrodes. The current electrode was injected then the voltage difference was measured, so that the collected data were the voltage, the current and the datum of each measurement points. In this study the electrode configuration was used Wenner-Schlumberger with 1 m electrode spacing. This configuration was used because it was sensitive in describing layers vertically and horizontally [6,7]. The Wenner-Schlumberger configuration shown in ‘Figure 2’ and the formulation was used in this configuration. it is shown in equation 1-7. These data are processed using res2div software [6] to produce a resistivity cross section.

![Figure 2. The Wenner-Schulmberger configuration](image)

In ‘Figure 2’, there are parameters C1 and C2 which are current electrodes injected into the earth’s surface, for P1 and, P2 is a voltage difference electrode that can be measured by the tool, na is the distance or electrode space potential difference and current, while a is a space voltage difference electrode. The formulation for the Wenner Schlumberger configuration is derived from equations (1)-equation (7):

\[
\Delta V = \frac{4\pi}{2\pi} \left[ \left( \frac{1}{c_{1P1}} - \frac{1}{c_{1P2}} \right) - \left( \frac{1}{c_{2P1}} - \frac{1}{c_{2P2}} \right) \right] \\
K = 2\pi \left[ \left( \frac{1}{c_{1P1}} - \frac{1}{c_{1P2}} \right) - \left( \frac{1}{c_{2P1}} - \frac{1}{c_{2P2}} \right) \right]^{-1}
\]
\[ K = 2\pi \left[ \frac{1}{n_\alpha} \frac{1}{n_\alpha + a} \frac{1}{n_\alpha + a} \right] \]  
(3)

\[ K = 2\pi \left[ \frac{(n_\alpha + a) - n_\alpha}{n_\alpha(n_\alpha + a)} \right] \]  
(4)

\[ K = 2\pi \left[ \frac{1}{(n_\alpha)^2 + n_\alpha a} \right] \]  
(5)

\[ K = 2\pi \left[ \frac{1}{(n_\alpha^2 + n_\alpha a)} \right] = 2\pi \left[ \frac{1}{(n_\alpha + a)^2} \right] = \left[ \frac{2\pi}{a(n_\alpha + a)} \right] \]  
(6)

\[ K = \pi n_\alpha(n + 1)a \]  
(7)

In equation (7), \( K \) is a configuration value will be used for processing resistive inversions, \( n \) is an integer, and it is the distance of the electrode spacing.

3. Results and Discussion
The result of electrical resistivity data processed into a cross section 2D resistivity as shown in ‘Figure 3’. The results of processing the data show the depth that can be reached in this study was 9.25 m. In ‘Figure 3’, there are three cross sections that are produced, in ‘Figure 3(a)’ is a cross section of inversion of the data taken or measurement resistivity, while ‘Figure 3(b)’ is a cross section of the result of inversion from calculated resistivity data based on theory and ‘Figure 3(c)’ is the results of inversion from data images in ‘Figure 3(a)’ and ‘Figure 3(b)’. In this process it is carried out an iteration of 4 times to obtain the inversion results as shown in ‘Figure 3(c)’ and the RMS (Root Means Square) value of the error is 6.4%. This shows that the observation data with calculation data has an error of 6.4% that it means that the measurements are categorized accurately.

Figure 3. The Cross section of 2D North to South

The cross section shows resistivity range from 149 to 1436 ohmmeter and the results are divided into low, medium and high resistivity. The low resistivity is in the range of 149 to 285 ohmmeter and the low resistivity is on the surface in the North to a depth of 0.5 meters and resides at a depth of more than 7 meters. The medium resistivity is range of 394 to 544 ohmmeters have estimated to be at a depth of 5
meters to 7 meters. While the high resistivity with ranges from 752 to 1436 ohmmeter scattered in all places from the surface to a depth of 5 meters. As a whole, the 2D cross section results in a layer of soil, the first layer has a medium to high resistivity is located on the surface to a depth of 5 meters and the second layer is a low layer at a depth of more than 5 meters.

The flammable plantation is on the surface, namely organic soil layers. Organic soil is the soil from the decay of organic material. In the tropics, the higher the organic content in the soil, the higher the resistivity value [8]. This is reinforced by the study of resistivity in The Sag pond region with the upper layer being organic soil which has high resistivity [9]. Based on this, the first layer is burning organic soil which is on the surface to a depth of 5 meters. Based on the soil outcrop in the area that was burned under the organic soil layer there is a soil with high clay content, so that in this cross section the second layer which has low resistivity is associated with the clay layer. From the cross-section results show that the burned area is very even to a depth of 5 meters, except the northern part on the surface to a depth of 0.5 meters.

4. Conclusion
The electrical resistivity properties can be used as the depth of plantation fires. The Wenner-Schlumberger configuration is an effective configuration making decision of the thickness and the heading of burned soil. In this study that the burned soil layer is an organic soil that has higher electrical resistivity properties.

5. References

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