Prediction of the Forest Fire Danger in Indonesia using Remote Sensing and Spectral Measurements

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To minimize forest fires in tropical area is extremely important, because the fire has a large influence on global warming or biodiversity. Although most of the forest fires are caused artificially, the surface soil water, reflecting the amount of precipitation in the area, would be also related to the fire. Furthermore, plants under a drying stress can be the cause of fire. If we observe the degrees of surface soil water and the level of the stress, we can predict where the forest fire occurs.
 In the previous study, Furumoto et al. showed that NDVI (Normalized Difference Vegetation Index) values differ between the wet and the dry season in Kalimantan Island in Indonesia. They found the correlation between the NDVI values and the amount of precipitation in the area. They also pointed out there's a time lag of 1-2 months between the change of rainfall and NDVI values. However, this makes it difficult for us to judge immediately whether the forest fire will occur. On the other hand, the degrees of surface soil water are also related to the fire; since Indonesia is covered with peat moss, the soil also burns when the fire occurs. The degrees of surface soil water have been detected by infrared satellite images with a poor spatial resolution so far, which is not enough to discuss in detail the correlation between the degrees of surface soil water and the cause of the forest fires. Thus, we have to consider the degrees of surface soil water in a high spatial resolution for the prediction of the fire.
 The purpose of this research is to predict the region of the forest fires in Indonesia using satellite imaging and spectral measurements. To develop a new index of higher correlation with the forest fires, we actually grow Indonesian plants in a different degree of soil water condition.
 First, using Landsat 7 and 8 images, we calculated the NDVI and SAVI (Soil Adjusted Vegetation Index). The study area was 100x250 m around Martapura, in South Sumatra Island in Indonesia. We found that the vegetation indices obtained from the areas covered with grass are lower than those of tree area. In addition, both indices dropped significantly in the year of El Niño happened. The fact indicates that the decrease of precipitation can be influenced on the vegetation indices around the area. There was a meaningful difference between SAVI and NDVI values. Moreover, the change rate of vegetation indices from the grass was larger than that of the tree, which is suggested that the reflection spectra obtained from the grass is strongly affected by the drying stress.
Next, we compared the forest fire regions in 2015, using the website of NGO "Eyes On The Forest", with the area having low vegetation index. The satellite images having 0-0.3 values of SAVI corresponded to the area that forest fire happened.

Keywords: Indonesia, forest fire, vegetation index, surface soil water, spectrum, remote sensing