Development of the quasi-real-time monitoring of volcanic lava activity using MODIS

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It is possible to quasi-realtime monitoring of volcanic lava activity could be possible if we can detect the thermal anomalies related to the exposure and lava dome of magma by satellite sensors such as MODIS. And it can be used to help for the volcano disaster prevention. In this study, we deal with seven volcanoes in Indonesia. First, we define the infrared radiation caused by the eruption and then, we use the statistical analysis for the radiation, and remove the cloud effects. Finally, we investigate the abnormal values against the background level of the temperature.
 We introduce an evaluation function S to remove the spatial and temporal variation from the spatial difference of the brightness temperature data between the target point and reference point (5 km distance). When we compute the differences, we need to eliminate cloud effects adequately. To achieve this, we use the brightness temperature difference between bands of MODIS (BTD). In this study, we select the following combinations ; (1) Band34-Band35 ($BTD(t)-\mu < k\sigma$, k=-2.0:), (2) Band31-Band27 ($BTD(t)-\mu < k\sigma$, k=-2.6), (3) Band31-Band32 ($|BTD(t)-\mu| < k\sigma$, k=-3.0), and (4) Band20-Band31 ($|BTD(t)-\mu| < k\sigma$, k=-3.0). Where t, k, m, and s are the season, threshold for cloud identification, average, standard deviation for each distribution of BTD. Until the distribution satisfy the equation, we repeat the test. Then, we move to the next test. We perform this procedure up to test 4. Then we get the pixels without cloud. The result is evaluated using LIDAR data onboard CALIPSO, which has the almost same orbit and constellated with AQUA. After removing the cloud effect, we compute the deviation rate d. As results for 15 years data analysis for 7 volcanoes in Indonesia, when the deviation rate exceeds in target volcanoes 6σ, there is a tendency to have a lava volcanic activities. However, without removing the cloud effects, we find it is difficult to identify the anomaly related to the lava activities. Therefore, it is highly suggestive of the proposed method is valid for monitoring volcanoes and volcanic risk reduction.

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