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Volcanic and Lava Activity Detection using MODIS Data

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There are a lot of active volcanoes in the world. And up to now, a lot of volcano-related disasters have been reported. In order to reduce these diseases, monitoring of volcanoes is essential. But it is very difficult to monitor all volcanoes on the ground because of costs. However, we can monitor efficiently a lot of volcanoes using satellite remote sensing techniques, because a volcanic activity will cause the increase in surface temperature and satellite (whose sensor can observe the surface temperature) remote sensing can cover a large area on surface at high frequency. Therefore, the purpose of this study is to develop an adequate algorithm continuously to detect thermal anomalies related to volcanic activities (especially lava activity which causes serious damages involve human lives) using MODIS (Moderate Resolution Imaging Spectroradiometer) infrared sensor onboard Aqua satellite.

We investigate spatial-time changes in thermal infrared in the statistical way. In order to detect only hotspots related to lava activities without faints, the developed algorithm investigates the difference temperature behavior between a target point and reference points, and we get spatial difference of brightness temperature (S). The presence of cloud causes large value of S that doesn't related to volcanic activities[(1)]. Therefore, removing cloud is essential in the proposed algorithm. To remove cloud, we use some BTD (Brightness Temperature Difference) which is sensitive to cloud.

In the previous study, BTD between band31 (11μm) and band32 (12μm) were used to remove cloud. If BTD is lower than Monthly average of BTD – 1σ, then that pixel will classified as cloud[(1)]. The method is effective to remove thick clouds like cumulonimbus. But it is invalid to remove other clouds such as cirrus. In order to conquer the difficulty, we perform multiple BTDs (band20-band31, band31-band27, band34-band35) application with adequate thresholds for each band's radiation property in this study. The new results provide rather better performance to remove clouds. Then, temporal variation of "singularity (δ)" is investigated, where $\delta = S/\bar{S}$, $\bar{S}$ is averaged value of S.

The developed algorithm has been applied to Mt. Merapi in Indonesia, Mt. Shinmoedake, in Japan, and so on. It is found that the effectiveness in detection of volcano-related infrared activities and in reduction of faint changes due to clouds. The details will be given in our presentation.

Reference

[1.] Noguchi, T., Ohno, N., Hattori, K., and Oyama, K., Detection of thermal changes associated with volcanic activity and discrimination of faint changes from MODIS data, Journal of Asian Earth Sciences 41, 467-475, 2011 (doi:10.1016/j.jseaes.2011.02.005)

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