Abstract*

There are more than 300 active volcanoes within the field of view of the Geostationary Meteorological Satellite (GMS). Most of the active volcanoes make explosive eruptions accompanied by eruption clouds, and therefore, the occurrence of volcanic eruptions can be monitored by detection of volcanic eruption clouds. Generally, eruption clouds change their extent in a short time and disperse quickly, and the instantaneous field of view of GMS is not sufficient for the detection of small-sized eruption clouds. But the image - taking intervals of GMS, ranging from 30 minutes to 4 hours, is very effective in detecting eruption clouds which are likely to disperse in a short time, compared with the longer intervals of orbital satellites. The author carefully investigated GMS image data, mainly the photograph materials taken during late-1977 - 1985 and could detect eruption clouds on the GMS images for 23 volcanoes.

In this paper, many image photographs of eruption clouds taken by GMS are compiled to promote the understanding of eruption clouds. Observations of volcanic eruptions at several volcanoes and estimations of thermal energy releases based on eruption cloud data of several volcanic eruptions are processed. Fundamental analyses of rising and dispersing eruption clouds are also conducted. Besides, some problems for future satellite monitoring of volcanic eruptions are discussed. The GMS image data are examined on the basis of the reported eruptive activities in the field of view of GMS. There are 227 eruptions from 73 volcanoes during the above-mentioned period, and eruption clouds are detected in 31 eruptions from 23 volcanoes. The rate of detection of eruptions by eruption clouds in the GMS images is about 14 %, while the rate of detection of good-quality eruption cloud data unhampered by surrounding atmospheric clouds is about 7 %. The smallest domain and the lowest altitude of eruption clouds are about 20 km and 4 km, respectively. Judging from the recent ground resolution or instantaneous field of view of the GMS sensor, the image - taking intervals and the usual weather conditions around and over erupting volcanoes, the above-mentioned results are considered to be the upper limit of detection capability for eruption clouds by GMS image data. It is not easy to distinguish eruption clouds from

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atmospheric clouds only with T_{BB}, namely surface temperature data and albedo values of the GMS data, except some examples. Eruption clouds tend to show lower albedo values compared with atmospheric clouds at the same altitudes. However, large explosive eruptions with eruption clouds of altitudes higher than 10 km are almost all found in GMS images, and the time variations of domains of eruption clouds dispersed in a wide area are well monitored by GMS images. With analyses of time variations of altitudes of eruption clouds estimated from their surface temperature data and air-temperature profiles obtained by radio-sounding data at nearby volcanoes, the decays and reactivations of eruptions are well judged.

In order to understand the strength or magnitude of eruptions, released thermal energies based on eruption clouds data are estimated by applying the equation for plume rise proposed by Briggs (1969). Proportional relationships are recognized between the thermal energy releases estimated from eruption cloud data and those estimated from the mass of juvenile ejected materials by using the method proposed by Yokoyama (1957). This shows that the strength or magnitude of eruptions can be estimated from dispersing eruption cloud data obtained from GMS images.

Concerning the behavior of dispersing eruption clouds, it was noticed that some eruption clouds show slightly higher velocities than surrounding wind speed at respective altitudes. Expansions of eruption clouds several hours after the eruptions are also noticed. These phenomena may show that eruption clouds carry some heat sources inside and can expand during the dispersion. However, more detailed analyses of eruption cloud data including the physical or optical features and precise visual observational data of dispersing eruption clouds are needed.

The results given above show that the observations of eruption clouds by GMS image data are useful and effective for monitoring volcanic eruptions, estimating thermal energy releases of eruptions and investigating dynamic mechanisms of rising and dispersing eruption clouds.