Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SVC50-P02 Room:Convention Hall Time:May 20 18:15-19:30

Immediate estimating plume height of volcanic eruption by not using visual observation

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In order to reduce volcanic disaster, it is important to detect the eruption and estimate the plume height of volcanic eruption. Taller plume obstructs aircraft flight paths, and lapilli lifted upward in the growing plume fell to a long way by upper wind effect. In the case of the Shiomoedake eruption, February 2, 2013, the lapilli reached up to 16 km from the vent. This time, the plume was not able to be seen by low-level clouds. So it is necessary to estimate plume height by not using visual observation.

Sparks et al. (1997) showed that plume height is proportionate to 0.25-th power of mass flux empirically by analyzing many eruptions. Lighthill (1978) showed that excess pressure due to an acoustic source is proportionate to the rate of change of mass flux. Base on the above studies, by using the infrasound-pressure data we try to estimate the time variation of plume height during the Shinmoedake eruption, January 26 - 27, 2011. Result analyzed by using the infrasound pressure corresponds to plume height variation estimated by weather radar (Shimbori et al., 2013) with high correlation. Best fitting power index is estimated not to be 0.25 but to be 0.35 - 0.41. And coefficient of weight density for plume volume is estimated to be 150 - 300 kg/m^3. If these coefficients could be determined appropriately, infrasound pressure data might be able to estimate the plume height.

Actual successive discharge of pyroclast has two components of mass flux, steady flow and pulsative flow. Steady flow contributes to plume height more than pulsative flow. In this study, even though we estimate it only by pulsative flow's component, calculated result is consistent with observed plume height. It is guessed that there is some kind of linear relation between the two components.

Acknowledgements
We would like to thank Prof. M. Iguchi and Dr. M. Ichihara for precious suggestions.

Keywords: plume height, immediate estimating, infrasound pressure, mass flux, Shinmoedake