An attempt at quantification of starting eruption cloud at Sakurajima volcano

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Behavior of eruption cloud has a variety corresponding each stage in a sequence of an eruption. An eruption cloud (or column) during continuous ash emission is often modeled as a steady flow (e.g., Woods, 1988). Contrary, behavior of an eruption column in its starting stage is characterized as expansion and ascending, because the eruption cloud ascends into atmosphere with entraining surrounding air (e.g., Woods and Kienle, 1994). Ishihara et al. (1983) revealed that starting eruption cloud emerges from the crater rim with vertical velocity of promotional to altitude to the power of -3. After the cloud reached certain height, the velocity turns to a constant value of 21-28 m/s. Such a sequence is often explained by transition of driving force of starting eruption cloud. Eruption cloud emerges from the vent with gas thrust. As the eruption column ascend, the cloud obtains alternative driving force of the buoyancy with entraining surrounding air (Patrick, 2007).
The starting stage of an eruption cloud is also accompanied with considerable geophysical signals, such as strain change (Iguchi, 2009), seismic (Tameguri et al., 2002), and infrasound (Yamada et al., 2017). These previous studies examined source process of each geophysical signals, but few study focus on the relationship between the source dynamics of starting eruption cloud and the signals. Our goal in here is to understand how the source process of each geophysical signals can be connected to the dynamics of starting eruption cloud, and propose a method to constrain the behavior of stating eruption cloud with geophysical data. In this poster, some characteristics of starting eruption cloud revealed by still images at Sakurajima volcano are presented.
We installed a visual camera of DFKZ12GX236 with a resolution of 1920x900 pixels and an interval of 4 fps at station KUR (Sakurajima Volcano Research Center, Disaster Prevention Research Institute, Kyoto University) where about 5 km away from active Minamidake vents of Sakurajima volcano. Each pixel location is converted vertical- horizontal plane crossing the vent following a method by Terada et al (2003). Following this conversion, observed still images cover apparent height of 2.5 km above the crater rim, where about 0.9 km above the sea level. The location of KUR does not provide direct view of crater bottom of the Minamidake vents, where is located at 250 m beneath the Source-West crater rim on October 2018 (MLIT, 2018). We also refer data of radial extensometer and vertical short period seismometer at Arimura observation tunnel, and an infrasound microphone at station HAR.
To understand fundamental characteristics of starting eruption cloud, we examined time history of the top height of eruption column as a representative eruption cloud velocity of 12 events since October 2018. Most (10) events have a constant ascending velocity of 5-20 m/s during its ascending stage. Contrary, two events emerge from the crater rim with faster ascending velocity of 50-100 m/s. Velocity decrease to 20-40 m/s following 20 seconds. Radial strain change and the maximum value of seismic and infrasound records of the latter two events (65-122 nano strain, 71-84 μm/s, 57.8-72.2 Pa) are greater than that of events having a constant ascending velocity (38-63 nano strain, 0.3-86 μm/s, <48.9 Pa). In case of an event having the maximum ascending velocity (December 24, 2018), the radial strain and volume change rate estimated with infrasound signal (e.g., Oshima and Maekawa, 2000) have time history that well correlated with that of ascending velocity.
Those characteristics suggest that certain relation can exist between the excitation of the geophysical signals and gas thrust region of eruption cloud. Hence, the behavior of staring eruption cloud can be

constrained with analyzing enough number of events.
Acknowledgement: Strain and seismic data at Arimura tunnel is provided by the Osumi Office of River and National Highway, MLIT.

Keywords: Eruption cloud, Eruption dynamics, Sakurajima volcano

