TEC and pressure changes by the 2015 Kuchinoerabujima eruption: comparison with energy distribution by ray-tracing

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Our objective is to interpret atmospheric perturbation excited by a Kuchinoerabujima volcano eruption on 29 May 2015. We observed a large GNSS-TEC and near-surface pressure perturbations at the same time. In this talk, we will show comparing the observation results with energy distribution expected by ray-tracing.

Kuchinoerabujima is a volcanic island that is located to the 100 km south of Kyushu. The volcano erupted at 0:59 UT (9:59 LT) May 29, 2015, with the eruption magnitude VEI 3. The volcanic eruption caused significant pressure changes. The lowest frequency part of them (less than ˜0.01 Hz) can go up and reach the ionosphere due to less viscosity attenuation. Such waves are sometimes detected as ionized atmosphere perturbations, and various kinds of responses to near-surface phenomena including volcanic eruptions have been reported so far.

We use the broadband seismometer array, F-net deployed by NIED, and the barometer array installed by AIST to find the wave propagating in the lower atmosphere. At the same time, we succeeded to detect ionospheric perturbation by GNSS-TEC derived from the 1 Hz sampling GNSS carrier phase data from Japanese dense GNSS array, GEONET. The three observations show similar perturbation signals in 0.01–0.02 Hz band, which come from the one volcanic air blast. However, observations near the surface and in the ionosphere have different physical units (Pressure and TECU), and it is difficult to compare them directly.

We are now trying to estimate energy distribution using ray-tracing from the source to the ionosphere to interpret the whole of the observation quantitatively and simultaneously. The ray-tracing method is assumed high-frequency approximation and seems slightly hard to use in our project. Nevertheless, we checked and already reported in past meetings, the travel time curve drawn by that is consistent with the propagation observed in the ionosphere and near the surface. From the calculation of the energy, we can estimate pressure changes and electron density perturbations. The quantitative comparison will characterize the further physical processes of the eruption.