Unusual displacement observed in InSAR analysis results of fumarolic area of active volcanos: An example of the Kamiyu district in Hakone Volcano

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In this presentation, we report on the characteristics and causes of displacements observed in the InSAR analysis results of ALOS-2/PALSAR-2 data for the fumarolic area in the Kamiyu area of the Hakone volcano.

The Kamiyu fumarolic area is in the northern slope of the central cone of the Hakone volcano and located about 500m north of the Owakudani fumarolic area that had phreatic eruptions in 2015. The Kamiyu fumarolic area was formed around 2003 after the 2001 swarm earthquake occurred at the Hakone Volcano (Tsujiuchi et al., 2003). The most active fumarole in the Kamiyu area is the area called E region, which was activated after the earthquake swarm induced by the 2011 Tohoku Earthquake (Yukutake et al., 2011; Harada et al., 2012). The scale of the E region is about 200m north to south and about 150m east to west. Moreover, the heat flux from the E region is estimated to be 7 to 8 MW (Mannen et al., 2018).

The observation by ALOS-2/PALSAR-2 for the Hakone volcano has been carried out repeatedly, mainly in four orbits, and each orbit is performed almost once every several months. From October 2014 to the end of 2018, data from descending orbit with right looking angles were obtained 22, and 15 scenes in Path 18 and 19, respectively, and data from ascending orbit with right looking angles were obtained 11 scenes in Paths 125 and 126, respectively. In this study, we performed DInSAR analysis with the latest interference pairs for all these data and clarified the displacement of the ground surface in the Kamiyu E region.

In the observation from the east side (Paths 18, 19), the Kamiyu E region displaced about 3 to 5 cm toward the satellite with respect to a reference point outside the fumarolic area during about four years. Moreover, in the observation from the west side (Paths 125, 126) displaced about 10 to 13 cm away from the satellite during the same period. These results suggest that the E region steadily displaces in the northeast direction in the long term, which also coincides with the inclination direction of the E region so that it is considered that the landslide displacement is occurring.

On the other hand, the analysis results of Paths 18 and 19 observed from the east side show the seasonal displacement that the area moved toward the satellite in the summer seasons and away from the satellite in winter seasons. In Paths 125 and 126 observed from the west side, such seasonal displacement is not observed, but these Paths have few observations in the summer and cannot judge the actual seasonal displacement. One of the possible causes of this seasonal displacement is a seasonal change in contrast between the vapor amount inside of the fumarolic area and that of the outside. The amount of water vapor near the ground changes seasonally outside of the fumarolic area whereas it is almost saturated throughout the year in the fumarolic area. Such contrast between the summer and winter is possibly affecting the DInSAR results. Another possible cause is an effect of the difference of soil moisture between summer and winter season because the fumarolic area is almost bare land and surface scattering is more dominant than forest area. Other factors are also conceivable, but we are considering the possibilities to evaluate the fumarolic activities from this seasonal displacement, in addition to accurately evaluate the

landslide movement in the fumarolic area.

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