# Review of Ground-Based Interferometric Synthetic Aperture Radar for monitoring of ground deformation in areas of volcanoes

Senro Kuraoka[1]

1 Research and Development Center, Nippon Koei Co., Ltd.

E-mail: a4982(at)n-koei.co.jp

Ground-based interferometric synthetic aperture radar (GB-InSAR) has been developed and applied over the past two decades for areal monitoring of surficial ground deformation. Lauren et al (2019) notes the potential application of GB-InSAR in detecting ground deformation as precursors of hazardous eruption and/or slope instabilities within volcano hazard areas. However, the monitored surficial deformation is a consequence of compounded mechanisms attributed to ground inflation and/or subsidence associated with magma rise or variations in hydrothermal systems and/or gravity-driven slope movements. Hence, evaluation of the risk and planning the mitigation measures are challenging issues.

Two cases of monitoring by the GB-InSAR in Japan are reviewed herein to further discuss the applicability and future research issues of GB-InSAR. The first case is an observation of long-term gravitational deformation of hardened lava that pose potential risk to the public of Shimabara city in Nagasaki Japan. Monitoring by GB-InSAR helped understand the deformation mechanisms which are needed for planning the early warning (Fig. 1).

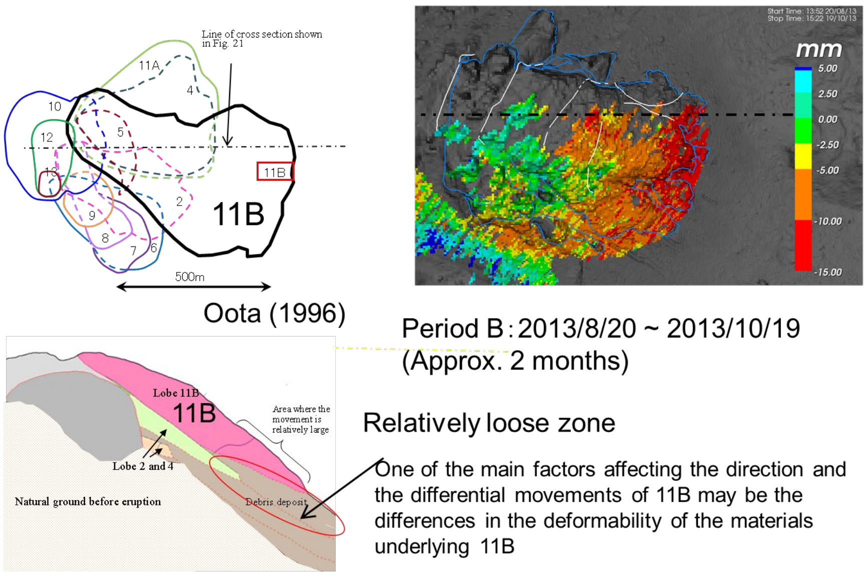


Fig. 1 The structure of lava lobes and the distribution of displacement obtained by GB-InSAR. Areas of relatively large deformation may be, in part, attributed to the consolidation of the debris deposits under the lower half region of the lava 11B (Satou et al. 2014).

The second case presents the monitoring of the deformation of an eruption center during the 2015 phreatic eruption of Hakone volcano, Japan. GB-InSAR was installed 4 days before the eruption of Hakone volcano on June 29th, 2015. The ground deformation observed by the GB-InSAR began suddenly on the morning of June 29th almost coincident with the intrusion of hydrothermal fluid that was inferred by other geophysical observations. The GB-InSAR results indicated significant uplifted area which is approximately 100 m in diameter, and new craters and fumaroles were created by the eruption in and around the area (Kuraoka et al. 2018). The author also notes the blue and green lines in Fig. 2 which indicate possibility of slope movements induced by the variation of underground stresses and/or vibrations.

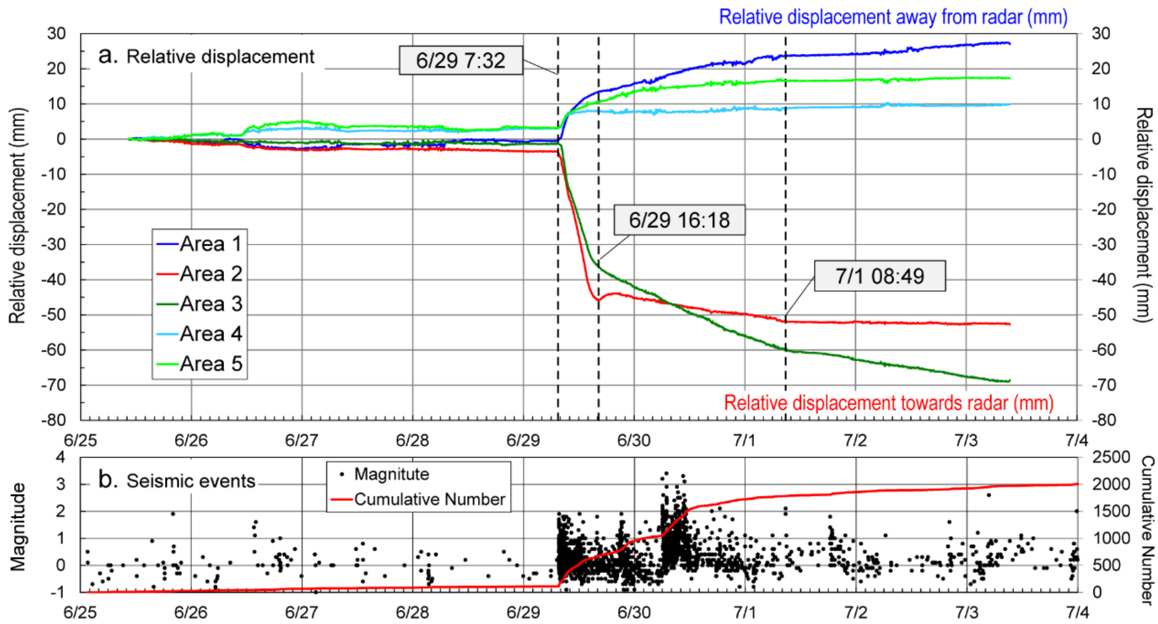


Fig. 2 Time variation of the relative displacements of the five selected areas, magnitude and cumulative number of seismic events (Kuraoka et al. 2018).

Main References

Lauren N S, Federico D T et al. (2019) Monitoring volcano slope instability with Synthetic Aperture Radar: A review and new data from Pacaya (Guatemala) and Stromboli (Italy) volcanoes, Earth-Science Reviews Volume 192, May 2019, Pages 236-257.

Satou Y, Ishizuka T et al. (2014) Deformation Characteristics of Unzen Lava Dome based on Long Range Displacement Monitoring, INTERPREAVENT, Nara Japan.

Kuraoka, S., Nakashima, Y., et al. (2018) Monitoring ground deformation of eruption center by ground-based interferometric synthetic aperture radar (GBInSAR): a case study during the 2015 phreatic eruption of Hakone volcano. Earth Planets Space 70 (1), 181.