Development of multi-type portable radar interferometer for volcano observation

Taku Ozawa[1], *Yuji Himematsu[1]

1. National Research Institute for Earth Science and Disaster Resilience

Recent advances in spaceborne SAR and its analysis techniques have enabled us to detect volcano deformation in a detailed. As a result, spaceborne SAR has been used as a useful tool in the evaluation of volcanic activity and the study of mechanisms. However, the frequency of spaceborne SAR observation is limited to the recurrence period satellite, and therefore, it is difficult to detect volcano deformation that its distribution changes greatly within a short time. Then, we are developing “multi-type portable radar interferometer” for detecting volcano deformation in the task B sub-theme 2 of the “Next Generation Volcano Research” project. It transmits radar wave from the ground, and then, can detect volcano deformation with high temporal resolution. By this sensor, we want to be able to observe a wide area as frequently as once a day by repeat observations. For this purpose, it is necessary to use a system that does not cause a decrease in coherence due to vegetation. Therefore, in this sensor, we adopted an L-band radar wave with high permeability to vegetation, and fabricated an experimental sensor. We carried out an experiment measurement within 1-hour by its sensor in the Asama-yama for 1 hour, and it was confirmed that high coherence was obtained. Furthermore, a phase change considered to be an atmospheric delay was detected (Ozawa and Himematsu, 2019).
Since it is necessary to carried out repeat observation in this system, it is necessary to confirm whether appropriate coherence can be obtained by the repeat path observation. Therefore, we carried out experiment measurements at the southwestern foot of the Tsukuba-san on October 16 and October 17, 2019. The slant distance to the summit is about 4 km. In this experiment, the rail was installed on the concrete part of the riverside of the Sakura-gawa, and the observation by the ground-based type was performed. Applying SAR interferometry to a data pair that observation interval was one day, a high coherence was obtained in the region where strong scattering intensity was obtained. At the summit, a phase change of about half a cycle is detected, which may be an atmospheric delay component. From this result, it was confirmed that the repeat path observation by the multi-type portable radar interferometer for volcano observation can be applied successfully. Furthermore, in order to investigate the continuity of coherence, a measurement experiment at the Tsukuba-san was performed every about once a month. High coherence was obtained in the result of data pair with an observation interval of one month. However, decorrelation became remarkable in the result of the data pair with the observation interval of 2 months, and in that with the observation interval of 3 months, the area where coherence was obtained was limited to around the summit where the vegetation was relatively sparse. From the above, it can be said that the continuity of coherence for the present version of experimental sensor is about two months. Tsukuba-san is covered by relatively dense vegetation, it may have caused such short continuity of coherence. However, its improvement is necessary, because longer continuity of coherence is preferable for volcano observation. Significant noise sometimes superimposes on the SAR image obtained from the current experimental sensor, and it may cause decorrelation. Now, we are improving hardware and software to solve this problem, and we will investigate whether these improvements can improve the continuity of coherence in the future.

