Research on observation method of volcanic ash-fall accumulation using spaceborne SAR

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Volcanic ash often causes heavy disaster due to debris flow. To mitigate such disaster, rapid observation of the volcanic ash distribution and forecast of debris flow from such observation are important. However, rapid observation of the volcanic ash distribution has been carried out mainly by on-site survey, and it is difficult to observe it rapidly. Then development of more rapid observation method are required. As one of solutions resolving such problem, utilization of satellite remote sensing technique is expected. Then, we began research on observation method of volcanic ash distribution using spaceborne SAR in “Cross-ministerial Strategis Innovation Promotion Program (SIP)-2nd season” as one of development items. In this presentation, we show results related to this development and explain the overview of this project.

In this development, we use InSAR coherence analysis. In InSAR results, clear fringes are seen if the coherence is high. On the other hand, noise is dominant if the coherence is low, and fringe becomes unclear. Generally, loss of coherence (decorrelation) is caused by difference of radar scatter at the pixel for InSAR pair. In a result from an interferometric pair including the eruption occurrence, decorrelation due to radar scatter change caused by volcanic ash accumulation is generally seen around the crater. For example, we analyzed PALSAR-2 InSAR pairs acquired before and after the Kuchinoerabujima eruption on January 17, 2019 and revealed that decorrelation area due to volcanic ash accumulation was seen within the range of about 1 km from the Shin-dake crater. Furthermore, decorrelation area extended to a range of about 1.5 km along the southwest and northwest valleys, which is consistent with the direction of pyroclastic flow.

Additionally, we analyzed InSAR pairs for December 18, 2018 and January 29, 2019 eruptions, and revealed the similar decorrelation around the crater. However, they were obviously small relative to that for January 17, 2019 eruption. Especially, that for January 17, 2019 eruption was limited to the vicinity of the crater. Thus, we could clearly see the difference in the volcanic ash accumulation area from InSAR coherence analysis.

If the relation between decorrelation and the amount of volcanic ash accumulation becomes clear quantitatively, the amount of volcanic ash accumulation will be obtained from InSAR coherence analysis. Then, in this development, we estimate decorrelation only due to volcanic ash accumulation, using a temporal coherence change model without volcanic ash effect constructed from InSAR coherence time-series analysis. Furthermore, we estimate coefficient converting coherence to the amount of volcanic ash accumulation from case studies. However, coherence basically saturates easily and thin accumulation of volcanic ash is difficult to detect, and therefore, it is difficult to detect the spatial distribution of volcanic ash accumulation. So, we attempt to estimate spatial distribution of volcanic ash accumulation by combining InSAR coherence analysis and ash-fall simulation in this development.

Keywords: ash-fall distribution, SAR, coherence