Effect of atmospheric-related noise reduction using numerical weather model -Application to the 2015 Sakurajima dike intrusion event -

*Tomokazu Kobayashi[1]

1.GSI of Japan

One of the cause of phase errors for InSAR is an effect of atmosphere. An error reduction approach using a correlation between phase change and elevation is often employed. Kobayashi et al. (2014) have developed an error reduction tool using numerical weather model, named AtmDeRay. In this presentation, I report the effect of the atmospheric-related noise reduction using numerical weather model, which is demonstrated by the analysis for the 2015 Sakurajima magma intrusion event. The magma intrusion got started on August 15, 2015. The intrusion was inferred to occur beneath the summit area based on seismicity and geodetic observations. The anomalous activity stopped on the same day, and no remarkable crustal deformation was observed. Emergency observations of ALOS-2 satellite were done for the volcanic activity. The observations are from the east side by ascending/left-looking (path 125) and descending/right-looking (path30) orbits, and from the west by ascending/right-looking (path131) and descending/left-looking (path 23) orbits. The first interferogram produced by the data acquired on August 16 has been strongly affected by atmosphere, in which there are a strong elevation-correlated phase change of about 9 cm in and around Kirishima volcano. In this interferogream, a clear crutal deformation signal with a LOS shortening of about 16 cm is observed in and around Nabeyama which is located in the east of the Sakurajima volcano, and in addition, it should be noted that a LOS shortening signal of about 7 cm is clearly identified at the Minamidake summit. The phase change estimated from AtmDeRay is about 8 and 6 cm at maximum in Kirishima volcano and Minamidake summit, respectively. On the other hand, the predicted phase change around Nabeyama is up to 1 cm at most. Using this phase error model, the phase changes in and around Kirishima and Minamidake summit are suppressed in the range of about 1cm, while the phase change in and around Nabeyama remains as it is. In other inteferograms obtained by the observations from the east side (path 23), there is little effect of atmosphere in and around Kirishima area, and we cannot identify any significant LOS shortening signals at the Minamidake summit. It suggests that the phase change corrected by AtmDeRay possibly reflects the true crustal deformation. The atmospheric noise has a serious effect on the source modeling. When inverting GNSS data and/or other three noise-less interferograms except for path 125, a dike opening beneath the Showa crater is obtained as the possible model. This model cannot account for the LOS shortening at the Minamidake summie seen in the original interferogram of path 125. If using the interferogram before the noise reduction for the source modeling, a crack opening with a low dip angle is determined as the best model, and the model fitting gets rather bad. It suggests that atmospheric noise reduction is indispensable for InSAR-based volcano observations, otherwise there is a possibility that we misinterpret the deformation source and wrongly assess volcanic activity.
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