Surface deformation of a mud volcano in azerbaidzhan detected by InSAR and its source modeling

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Interferometric synthetic aperture radar (InSAR) allows us to observe a wide area and two-dimensional information of Earth’s surface without a need for ground-based measurement tool with a precision on the order of a few centimeters. This technique has been mainly used to investigate ground deformation associated with earthquakes and volcanic eruptions. However, there have been fewer cases that applied the technique to the deformation related to the activity of mud volcano. The purpose of this study is to detect surface deformation of a mud volcano in Azerbaizhan by L-band InSAR and to estimate its source modeling.
Azerbaidzhan, located on the western edge of the Caspian Sea in Central Asia, is one of the most abundant countries in term of the population of mud volcanoes over the land. We used the SAR images derived from two L-band satellites, ALOS/PALSAR and ALOS-2/PALSAR-2, launched by JAXA in 2006 and 2014 respectively. As a result, we could obtain 31 interferograms and detect surface deformation mostly uplifting signals at more than 10 mud volcanoes. These observations indicate that the mud volcanoes around the studied areas are highly active. In particular, we focused on a large and unique, Ayaz-Akhtarma mud volcano. Benedetta et al. (2014) also detected the ground deformation of this mud volcano, using ENVISAT/ASAR C-band SAR data, spanning from 2003 to 2005, only along descending path; InSAR observes the surface from nearly the north to the south in a slant direction along this path. Although the ground displacement at the mud volcano was 20 cm in Line of Sight (LOS) for the two years, subsequent displacements were not clear. However, the results of our study, using ALOS data from ascending path that is opposite look direction from the previous study and ALOS-2 data for ascending and descending paths, indicated more active and larger horizontal displacements. The cumulative LOS displacement is up to nearly 300 cm for five years by ALOS and 100 cm for two years by ALOS-2. Thus we performed the source modeling to explain the displacement, assuming an elastic half-space. The modeling showed this deformation consists of normal slip and tensile opening components.

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