Estimating surface displacement in the Hanshin area, Japan, by PS-InSAR analysis using satellite Sentinel-1 data

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The 2018 northern Osaka earthquake with a magnitude 6.1 earthquake struck on June 18, 2018 in northern Osaka, causing enormous damage. SAR interferometry using satellite synthetic aperture radar (SAR) data can detect surface displacement distribution over a wide area and is effective for observing surface displacement during an earthquake. On the other hand, it is also important to observe the tendency of long-term surface displacement around active faults on a yearly basis in order to monitor the deformation at and around active faults. In this study, we used persistent scatter SAR interferometry (PS-InSAR) to clarify the recent surface displacement including before and after the 2018 northern Osaka earthquake near the Arima-Takatsuki Fault Zone and the Mt. Rokko active segment, near the epicenter of the earthquake. PS-InSAR analysis is a method that analyzes coherent pixels only, and can extract surface displacements with less noise than the conventional two-pass SAR interferometry. By using Sentinel-1 data, we expect to understand a long-term surface displacement and temporal changes in displacement pattern by comparing with the results using other satellites in previous studies. As a result of our analysis, we found that (i) ground subsidence occurred near the Mt. Rokko active segment, (ii) subsidence or eastward displacement occurred in the eastern part of the Takarazuka GNSS station, (iii) surface displacement in the wedge-shaped area located between the Arima-Takatsuki Fault Zone and the Mt. Rokko active segment is suggested to be caused by groundwater level changes, (iv) groundwater level changes may have caused surface displacement considered to be uplift in the wide area between the Ikoma Fault Zone and Uemachi Fault Zone, and (v) slip of the source fault may have caused surface displacement around the epicenter of the 2018 northern Osaka earthquake. Furthermore, we validated the estimated surface displacements by comparison with GNSS measurements and previous studies. These results suggest that surface displacement near the Arima-Takatsuki fault zone was caused by the 2018 northern Osaka earthquake. In order to reveal the mechanism of surface displacement in the vicinity of the fault, it is necessary to continue to monitor the surface displacement in this area using time-series SAR interferometry.

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