Geophysical Research Abstracts
Vol. 21, EGU2019-2040, 2019
EGU General Assembly 2019

Source estimation of the large seasonal displacement using InSAR time series analysis

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The space geodesy techniques like GPS reveal that there are many areas occurring the seasonal ground displacements. In Ojiya city, Japan, there is well-known as a very large subsidence occurring in winter since GSI (Geospatial Information Authority of Japan) induced GEONET (GNSS Earth Observation Network System). And it is considered as groundwater pumping for snow melting devices. In addition, the long-term monitoring shows that there is the uplift of the ground from spring to fall.
But the detail process of this seasonal displacement is NOT clear because the GNSS station installed only one point so that estimated the very limited source and there is no spatial resolution. In such a case, InSAR is the only tool to detect the whole deformation situations and measure historical movements with no instrument installed. And the ESA's Sentinel-1 observes around Japan every 12 days, which make us be able to measure more complex displacement time series.
In this study, we apply the InSAR time series analysis to Ojiya city using 38 Sentinel-1 images from April 2017 to August 2018 to determine the uplift process, especially when, where and how begins and terminates. In this result, the uplift occurs from April to November in entire of the target area, similar to the observed signal by one GEONET point. In addition, although the signs are opposite, the displacement distributions are almost the same between winter and the other seasons. This strongly suggests that the source of this seasonal deformation causes by elastic in- and deflation at the aquifer. So we estimated the Mogi source parameters (depth and amount of volume change) using InSAR-GNSS joint inversion technique.
In the presentation, we show that how the source volume and position change across seasons and compare the accumulate deformation caused in winter and the other seasons. In addition, these displacements do not cause significant land subsidence over years because the recovery exists by the uplift. But from the point of the view of infrastructure management, it is very important to know seasonal displacements that affect infrastructure design lives. And we discuss how we can monitor and control like this deformation in the future.