Ups and downs in the Osaka metropolitan area, Japan, detected by LiCSBAS InSAR time-series analysis

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Osaka metropolitan area, composed of cities of Osaka, Kyoto, Nara and the suburbs, is the second largest metropolitan area in Japan. There are approximately twelve million habitants living mainly on flat areas of the Osaka plain, and Kyoto and Nara basins. Some parts of the flat areas are characterized by a dense network of rivers and associated alluvial plains. Recently, Morishita et al. (2020, Remote Sensing) developed LiCSBAS, an open source InSAR time-series analysis package integrated with an automated Sentinel-1 InSAR processor called LiCSAR. The analysis package is surprisingly easy to use, one can run the processing and get the results even without any knowledge about InSAR. As of February 2020, relatively large number of interferograms have been computed and are made open to the public through their portal website (https://comet.nerc.ac.uk/comet-lics-portal/). In this study, I made a preliminary analysis on the Osaka metropolitan area using LiCSBAS processor, with a main purpose to evaluate the usefulness of LiCSBAS.

I processed 369 interferograms having formed from 128 Sentinel-1 SAR descending data (Frame ID: 017D_05514_131312, mean incidence angle 38.6 degrees looking from ESE) acquired between 23 November 2014 and 8 January 2020. The coherence was generally good in the urban areas, whereas the forest areas were automatically masked by the processor based on multiple criteria including coherence. The average LOS (line-of-sight) velocity in the area of interest (135/136/34.5/35.1) showed that the velocity fluctuation was within 10 mm/year (peak to trough) on most of the parts (Figure a). There are fluctuations of ups and downs (precisely, decrease and increase in the LOS displacements in a relative sense) in circular areas of typical diameter of 1-2 km. Since the time-series of displacements of all of these deformed areas exhibit clear secular trend and seasonal variations (Figure b), the signals probably reflect the real deformation. It was found that most of the subsiding areas (blue in the figures) was rice fields in the alluvial plain, possibly indicating the location of marsh areas before habitation (Figure c). Across the Arima-Takatsuki fault zone, a LOS velocity contrast of approximately 1.5 mm/year is observed across the fault (Figure d), but the sense of displacements is opposite to the long-term right-lateral displacements of the fault. Since the fault is located on the edge of a mountain region, there may be significant amount of atmospheric noise causing artifacts.

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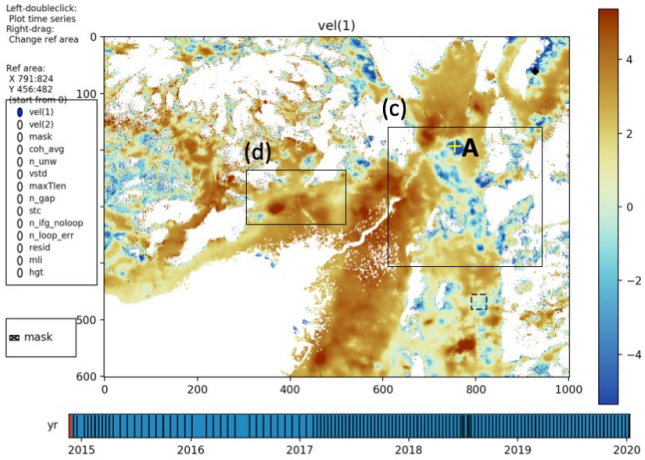
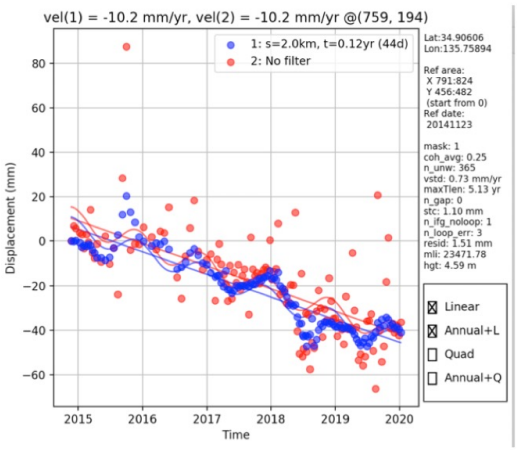
Keywords: InSAR, Osaka Plain, Crustal Deformation

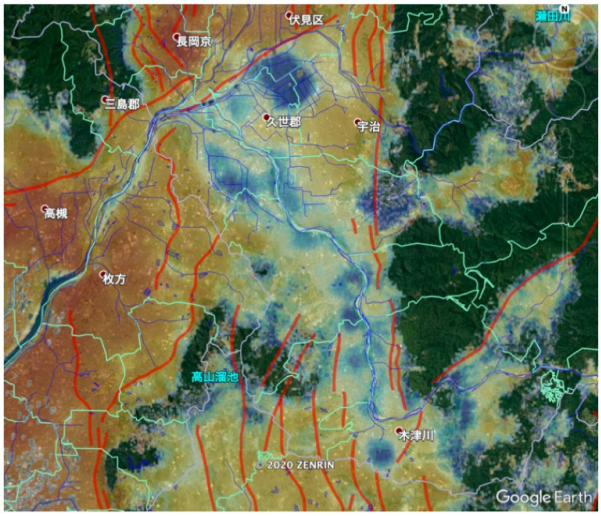
(a) Average LOS velocity (red: toward the satellite)



(b) Displacement time-series at point A (ancient lake floor of Ogura-ike)



(c) Zoomed-up figure of (a), superimposed on the Google Earth (red traces: active faults from AIST database)



(d) LOS velocity profile across the Arima-Takatsuki fault