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2.5 Dimension Analysis of Ground Deformation in the Kyoto Basin and Osaka Plain Detected with SAR Interferometry

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We have been conducting an interferometry of SAR images acquired by ALOS/PALSAR and TerraSAR-X to reveal ground deformation and the configuration of basement of the Kyoto basin and the Osaka plain. We have analyzed PALSAR ascending images and applied a 2.5 dimension analysis to the stacked interferograms from both the ascending and descending orbits.

We analyzed 24 SAR images from the path 414 and frame 680 acquired during the period from October 8, 2006 to October 19, 2010. Pairs of images that have as short perpendicular baselines and long temporal intervals as possible were selected for interferometry. After that, interferograms were stacked to obtain average rate of line-of-sight (LOS) changes. During the interferometry, we applied flattening in order to reduce long-wavelength noise, which might have been originated by ionospheric disturbances. We used PALSAR images from descending orbit (path 65, frame 2920).

Last year, we detected LOS decrease in the southern part of Kyoto basin and LOS increase along the Arima-Takatsuki Tectonic Line (ATTL) from the analysis of descending images. Furthermore, analyses of TerraSAR-X images also gave similar results, which suggests that these observations revealed real ground deformations. In this study, we also recognized LOS decrease in southern part of Kyoto basin and LOS increase along the ATTL.

Then we applied 2.5 dimension analysis to these stacked interferograms to decompose LOS velocities in two directions into E-W and quasi-vertical components. Finally, we obtained about 1 cm/yr uplift in the southern part of Kyoto basin and 5 mm/yr subsidence along ATTL. In these areas, we did not recognize notable horizontal components, which suggests that they are purely uplift or subsidence. Interestingly, uplift in Kyoto is bounded by two active faults (Katagihara and Haibara faults). It is worth noting that more than 1 cm/yr subsidence were observed at the western edge of ATTL in the Toyonaka city. Other notable features are (1) subsidence in the reclaimed area on the coast of the Osaka Bay, (2) subsidence north of the Yodo River, and (3) subsidence west of the Osaka Prefectural Office.

The origin of these ground deformation remains hypothesis, but it is speculated that changes in groundwater table may affect the ground deformation in the Kyoto basin, since there is a big reservoir. Subsidence along ATTL may also be related to change in groundwater level and associated compaction of soil. One possibility is the postseismic effect of the 1995 Kobe earthquake, since the feature of the subsidence is quite similar to that observed during the postseismic period of the 2006 Mozambique earthquake.

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Keywords: InSAR, ground deformation, Kyoto Basin, Osaka Plain, ground subsidence, Arima-Takatsuki Tectonic Line