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Correction on ionospheric delay in ALOS/PALSAR interferogram using dense GPS data

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Interferometric Synthetic Aperture Radar (InSAR) is a space geodetic technique using radar images to map surface displacement. Recent technical development has enabled us to detect interseismic steady deformation of a few mm/year by stacking multiple images acquired by C-band SAR images. However, the technique has not been applicable to vegetated areas like Japan because of low coherency in the C-band SAR images. Instead, a similar technique for L-band SAR data is necessary. Thus we investigate applicability of stacking technique to data obtained by the Phased Array type L-band Synthetic Aperture Radar (PALSAR) on the Advanced Land Observation Satellite (ALOS). We processed 18 images of the area including the Atotsugawa Fault in central Japan. There are mainly two obstacles to perform stacking analysis of InSAR in this area. Firstly, the total number of coherent pairs is too small to resolve interseismic deformation in this area because of the large distances between satellite locations due to the orbital control and low coherency in the mountain areas due to snow. The second obstacle is a systematic long wavelength noise appearing in the interferograms. The amplitude of the long wavelength noise exceeds 10 cm and it is mandatory to make a correction on it. It is considered that this long wavelength noise is caused by ionospheric delay since the L-band SAR is 16 times more sensitive to such disturbance than the C-band SAR. Thus we try to establish methodology to correct ionospheric delay in the SAR interferogram by using continuous GPS data. We estimate spatio-temporal distribution of Total Electron Content (TEC) over the ionosphere using dual-band GPS phase measurement data and project it onto the ground along the line of sight of the SAR satellite to estimate phase delay or apparent crustal deformation. The estimated TEC distribution is verified and calibrated through a comparison with the International Reference Ionosphere (IRI) model. The obtained phase delay distribution on the ground resembles the original interferogram before the correction. Such an ionospheric correction is indispensable to obtain significant signals from L-band SAR analysis.

Keywords: InSAR, Ionospheric delay, GPS