Deformation monitoring using the ALOS PALSAR

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Abstract PALSAR is an L-band synthetic aperture radar, which is being operated onboard the ALOS since March 2006. During the last one-year and a half, PALSAR acquired more than 500,000 scenes using different modes (FBS, FBD, SCANSAR, POL) and almost collected 5 times global coverages in mainly 34.3 degrees off nadir angle. Since the operation termination of the JERS-1 SAR on Oct. 12 1998, L-band SAR has been long waited because L-band SAR is only capable of monitoring the deformation of even the vegetated or forested region. Out of the PALSAR image pairs, we conducted the performance evaluation of the L-band SAR interferometry, especially the coherence and the phase detection performance depending on the incidence angle. This paper summarizes the PALSAR InSAR potential and the current results acquired for the crustal deformation monitoring. L-band SAR potentially contains higher coherence for the longer temporal and spatial separation. The PALSAR data showed that it has quite high performance for detecting the deformation even in the dense forest region.

Keywords PALSAR, ALOS, InSAR, DinSAR

The Advanced Land Observing Satellite (ALOS), JAXA's flagship Earth-observation satellite, was launched on January 24, 2006 to an altitude of 691.5km in a Sun synchronous orbit with a 46-day repeat cycle. It carries two high-resolution optical sensors and one radar for land monitoring (JAXA web). PALSAR is an L-band synthetic aperture radar onboard the satellite, with a high resolution, a high-quality imaging capability allowing an average ground resolution of 10m, a high transmission power of 2Kw, and the ability to change the incidence angle (from 7.7 degrees to 60 degrees). PALSAR has five observation modes, 1) Fine-Beam Single mode (FBS), with a high slant range resolution of 5m, a 70km imaging swath, and single polarization, 2) Fine-Beam Dual mode (FBD), with a medium-range resolution of 10m with a 70km swath, and two orthogonal polarizations for reception, 3) Polarimetry mode (PLR) with a 35km swath, 10m slant range resolution, and full polarizations for transmission and reception, 4) SCANSAR mode (SCAN) with 100m resolution, a 350km swath, and single polarization, and 5) Direct Single downlink mode (DSN) with 10m resolution, and a 70km swath with single polarization. The PALSAR has been radiometrically and geometrically calibrated using the corner reflectors deployed worldwide (Shimada et al., 2006).

The radar wavelength is 23.6cm, almost the same as the one used by GPS, so the Synthetic Aperture Radar (SAR) can observe the Earth's surface penetrating the aboveground biomass of tree trunks and canopies, independently of the weather and day-night conditions. Thus, an interferometric SAR analysis is advantageous and robust for providing quantitative deformation and height maps for even the highly vegetated land areas. With regard to the calibration of the PALSAR, it has been conducted successfully [3]. We analyzed the incidence angle dependence of the PALSAR INSAR for five different off nadir angle of 9.9, 21.5, 34.3, 41.5, and 50.8 degrees. High incidence angle gives higher coherence. Although the high incidence has a demerit in SNR and range ambiguity, the results overcome this disadvantage. In the future satellite, the high incidence angle may give us the good signal for obtain the coherence and the surface imaging (less foreshortening and the lay over as well.

References

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