Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

STT057-16 Room:105 Time:May 24 16:00-16:15

Concentrated heavy rain detected by InSAR Part2 : Ionospheric model estimated from azimuth offset data

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The ionospheric effects have a significant impact on the space geodetic technique based on lower frequency microwave like GPS or L-band InSAR. Due to the dispersive nature of the medium, dual-frequency observations can remove the effects almost completely. However it is impossible for a single-frequency SAR observation to separate the ionospheric signals from other signals like crustal deformation, tropospheric delay and so on. Therefore it is necessary to develop a method that can somehow correct for the ionospheric effects in the L-band InSAR data.

In the previous report (Kinoshita et al., Geodetic Society of Japan 2010 meeting), we could detect localized signals in InSAR data and we validated this point, having shown other InSAR images as well as azimuth component of pixel-offset data. Then we concluded that the signal was due to neither ground deformation nor DEM errors. However, although we considered that the signal was probably not due to ionospheric effect, the influence of ionospheric effect remained to be isolated. Therefore, in order to disprove the possible influence of ionosphere on the derived InSAR data, some other approach to correct for the ionospheric signals is necessary.

Gray et al. (2000) first reported that ionospheric anomalies became obvious as streaking in azimuth component derived from offset tracking. Offset tracking is a method to detect ground displacement using two SAR amplitude images. Then Meyer et al. (2006) showed that azimuth streaking was proportional to the gradient of differential total electron density (TEC) along the ray path. Wegmuller et al. (2006) also described the same approach. Based on the relation by Meyer et al. (2006), Raucoules and Michele (2010) applied the Meyer's approach to the case of InSAR data including the 2008 Wenchuan earthquake signal and showed the effectiveness of the approach.

Based on that relation, we also tried to correct ionospheric effect in InSAR data. This correction method consists of the following steps; 1) calculating azimuth offset field from offset tracking technique that uses two SAR amplitude images; 2) numerically integrating azimuth offset field along the azimuth direction to generate differential TEC model in InSAR; 3) Multiplying this model by some factor and subtracting multiplied model and one offset parameter from observed InSAR data. The factor and offset parameter is estimated by least square method to minimize the residual. To validate the efficiency of this, we applied the correction described above to two InSAR data, which location is Tokachidake and Niigata respectively. The strong ionospheric effect appears in both two InSAR data and azimuth streaking is clearly seen in both two azimuth offset data. After correction, we achieved the good result in both two sites. Therefore we also applied this correction to the InSAR data including the localized signal. We will show that results and discuss about the efficiency of this correction.

Now we newly tried to model the ionospheric effect using azimuth offset data with the method proposed by Meyer et al. (2006). As a result, we concluded again that the ionospheric effect hardly correlated with the signal. Besides above, we compare the tropospheric delay in InSAR data with that in GEONET data, the Japanese GPS network. The principle of atmospheric propagation delay in GPS is inherently same as that of InSAR, so it is worth to compare of tropospheric delay between GPS and InSAR. At the lecture, we will discuss what we can learn from the InSAR image and GPS zenith wet delay data.

References

[1] Meyer, F., R. Bamler, N. Jakowski, and T. Fritz (2006): Methods for small scale ionospheric TEC mapping from broadband L-band SAR data, in Proc. IGARSS, Denver, CO, Jul. 31-Aug. 4., 3735-3738.

Keywords: InSAR, ionosphere, azimuth offset