Dispersive and Non-dispersive Components in the L-band InSAR Image Associated with Heavy Rain Episodes

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Interferometric synthetic aperture radar (InSAR) is known to be a powerful technique to detect surface displacements with unprecedented spatial resolution, and has been applied to numerous earthquakes, volcanic eruptions, glaciers and ice sheets. Meanwhile, the effects of microwave propagation through ionosphere and troposphere can generate non-negligible phase anomaly in InSAR data, which often keeps from detecting small-amplitude displacements. Correcting for the ionsphere and troposphere is therefore a long-standing issue for high-precision geodetic measurements. However, if ground displacements are negligible, InSAR image can tell us the details of the atmosphere.
Kinoshita and Furuya (2017, submitted) detected phase anomaly in ALOS/PALSAR InSAR data associated with heavy rain over Niigata area, Japan, and performed numerical weathr model simulation to reproduce the anomaly; ALOS/PALSAR is a satellite-based L-band SAR sensor launched by JAXA in 2006 and terminated in 2011. The phase anomaly could be largely reproduced, using the output data from the weather model. However, we should note that numerical weather model outputs can only account for the non-dispersive effect in the phase anomaly. In case of severe weather event, we may expect dispersive effect that could be caused by possible presence of free-electrons.
In contrast to GNSS system, SAR imaging is based on a single carrier frequency, and thus no operational ionospheric corrections have been performed in InSAR data analyses. Recently, Gomba et al (2016) detailed the processing strategy of split spectrum method (SSM) for InSAR, which splits the finite bandwidth of the range spectrum and virtually allows for dual-frequency measurements.
We apply the SSM to the heavy rain signals detected by L-band InSAR, and report the presence of phase anomaly in both dispersive and non-dispersive components. While the original phase anomaly turns out to be mostly due to the non-dispersive effect, we can recognize local anomalies in the dispersive component as well. We will discuss its geophysical implications, and may show other case studies.

Keywords: InSAR, Heavy rain, dispersive media, InSAR split spectrum method

