新潟県中越地震・中越沖地震震源域でのEnvisat画像を用いたInSAR時系列解析

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InSAR time-series analysis using Envisat images: application on the region of two earthquakes in Niigata, central Japan

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Introduction

One of the major advances in SAR interferometry is the development of time-series analysis techniques of permanent/persistent scatterer (PS) and small baseline (SB) approaches. This study applies these two different kinds of InSAR time-series analysis method on the region of two earthquakes, Mw 6.5 in October 2004 and Mw 6.6 in July 2007, which occurred in Niigata Prefecture, Japan. Since the source faults of the two earthquakes are only 30 km apart, it is likely that the first event in 2004 influenced the occurrence of the second one. A key factor for investigating on this possible scenario is to precisely map the deformation in the period between the two earthquakes.

Method

I used StaMPS/MTI (Stanford Method of PS/Multi-Temporal InSAR) software to perform both PS and SB analyses. StaMPS/MTI is a package that uses, in addition to its own codes, other public-domain software of SAR and InSAR processing. It can start processing from either raw or SLC data, where for the first case ROI_PAC software is used for SLC generation. Interferogram computations are done using Doris software. The PS analysis of StaMPS performs, as other PS algorithms do, phase analysis to identify phase-stable pixels; a significant difference is that StaMPS does not assume any approximate model of displacements (such as linear or periodic). The SB analysis of StaMPS/MTI uses amplitude difference dispersion values in the coherent pixel identification method, which is not done in other SB methods. Both PS and SB methods of StaMPS/MTI use a 3D unwrapping algorithm, which is advantageous over 2D algorithms for compensating a limited spatial density of coherent pixels.

Data

In this study, I used 29 Envisat ASAR raw images acquired between March 2003 and July 2007. All of these images were used to identify coherent pixels, but the phase modeling, or estimation of the temporal evolution of line-of-sight (LOS) displacements, was done using interferograms formed using 13 images acquired between the two earthquakes (13 and 35 interferograms for the PS and SB analyses, respectively).

Results

Both PS and SB methods identified enough numbers of coherent pixels (77,521 for PS and 249,871 for SB) that enabled further processing. The obtained LOS displacements were compared with GEONET GPS displacements (F2 solution) projected to the LOS direction. The signal amplitudes are comparable, while the signals are not correlated for some GPS stations. Removing outliers in StaMPS/MTI results improves correlation with GPS data. StaMPS/MTI may not be able to provide more precise displacement data than GPS, but it provides much spatially denser data. A reasonable approach would therefore be to use GPS data to stabilize the phase analysis, then PS and SB analysis results become more precise on all the pixels, even on those far from GPS stations, and we can obtain precise time-series of displacements with a dense spatial sampling.