POST-SEISMIC CRUSTAL DEFORMATION DETECTION ON COHERENT TARGETS: A CASE STUDY IN KUNLUN FAULT AFTER 2001 KOKOXILI EARTHQUAKE

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ABSTRACT

The 14 November 2000, Ms8.1 Kokoxili earthquake is of huge influence in the world, which ruptured more than 400 km of the western end of the left-lateral Kunlun fault. The Kunlun fault is active and also after the heavy earthquake, it will definitely undergo an adjusting and balancing process.

SAR Intereferometry (INSAR) is an effective measure for crustal deformation measurement even for minor displacement on the look-of-sight direction. INSAR has been widely used for co-seismic deformation application, however for pre- and pro-seismic deformation, very less successful case has been reported. The complexity and out-breaking of seismic deformation makes the detection often difficult. Also, long time difference and totally different seasons make the correlation between INSAR pairs decrease greatly.

The Coherent Targets Monitoring technique is providing superior ground deformation mapping compared with standard interferometry based on one pair of Master/Slave scenes. This is because using a larger data set it is possible to estimate and correct for additional phase error sources. Also the point targets detected as coherent targets are generally characterized by stronger signal that provides more accurate phase information than the clutter present in the rest of the scene.

This paper concentrates on the coherent point target analysis of long-term ENVISAT data set of east Kunlun fault, where the Ms 8.1 Kokoxili earthquake bursted in 2001. The data starts from 2003-4-3 and ends at 2007-8-30, which is more than 5 years. Altogether 16 scenes of ENVISAT ASAR images are chosen. The related information of the ASAR data is given in Tab.1.

Tab.1 Information of chosen ENVISAT ASAR data

No	Orbit	Track	Acq. Date	Swath
1	5698	133	2003-4-3	I2
2	6199	133	2003-5-8	I2
3	7201	133	2003-7-17	I2
4	9706	133	2004-1-8	I2
5	14215	133	2004-11-18	I2
6	15718	133	2005-3-3	I2
7	17722	133	2005-7-21	I2
8	18724	133	2005-9-29	I2
9	20728	133	2006-2-16	I2
10	23734	133	2006-9-14	I2
11	24235	133	2006-10-19	I2
12	24736	133	2006-11-23	I2
13	25237	133	2006-12-28	I2

14	26740	133	2007-4-12	I2
15	27742	133	2007-6-21	I2
16	28744	133	2007-8-30	I2

An example ASAR image of the research area is given in Fig.1. A lake named Kusai is at the right-center of the imagery and the fault boundary could be clearly seen.

Fig.1 An example image of the research area (ENVISAT ASAR, 2004-11-18)

The IPTA package is selected for data processing. The Interferometric Point Target Analysis (IPTA) package is developed by Gamma Remote Sensing. IPTA is a collection of tools to exploit the temporal and spatial characteristics of interferometric signatures collected from point targets to accurately map surface deformation histories, terrain heights, and relative atmospheric path delays. The advantage of using point targets is that these do not exhibit geometric decorrelation such as distributed targets, permitting a more complete use of the data as even pairs with very long baselines can be interpreted, resulting in improved accuracies and temporal coverage.

Since the regression is rather time-consuming, a small area covering Kusai lake is subset for further research.

Using the methods of stacked point targets, results from this area show that the measured phase/deformation errors at the point target positions are within the estimated range, the phase series along time series due to atmospheric differences can be decreased through iterative procedures, and the deformation velocity can be measured on flat coherent targets along the fault.

KEYWORD: Coherent targets, differential SAR Intereferometry, post-seismic deformation, Kokoxili earthquake