PS-INSAR TIME SERIES ANALYSIS FOR MEASURING SURFACE DEFORMATION BEFORE THE L'AQUILA EARTHQUAKE

Bin Liu[1,2], Yi Luo[2], Jingfa Zhang[2], Lixia Gong[2], Wenliang Jiang[2], and Liyan Ren[3]

1. Institute of Engineering Mechanics,China Earthquake Administration, 150080,Haerbin,P.R.China.
2.Institute of Crustal Dynamics,China Earthquake Administration, 100085,Beijing,P.R.China.
3.China University of Mining and Technology(Beijing), 100083,Beijing,P.R. China

1. INTRODUCTION

The Mw 6.3 earthquake, which struck L'Aquila, the medieval capital city of the Abruzzo region of Italy on the 6*th* April 2009. 307 people were killed, 1,000 injured, 66,000 made homeless, and many thousands of buildings were destroyed or damaged[1]. There have been several thousand foreshocks and aftershocks since December 2008, more than thirty of which had a Richter magnitude greater than 3.5. The earthquake was felt throughout central Italy[12].

Occurrence of earthquake is the result of a long-term accumulation of stress and a sudden release of energy. After the release of energy, a certain amount of elastic recovery will happen. In this process, different forms and characteristics of the surface deformation will spread over the vicinity of seismogenic fault. According to the nature of different faults, the characteristics of horizontal or vertical movement may be displayed near the fault. In this study, the permanent scatterers InSAR (PS-InSAR) is used to monitor the surface deformation before the L'Aquila Earthquake. The seismogenic process and earthquake prediction of L'Aquila area will be understood in depth.

2. DATA AND METHOD

The PS-InSAR technique is an extension of conventional InSAR, which has the advantage of overcoming the traditional InSAR problems of temporal and spatial decorrelation and atmospheric signal contributions. The PS-InSAR technique puts emphasis on processing time series of SAR interferograms by recognizing and analyzing single scatterers with a stable backscatter intensity or reliable phase behavior in time, which is being used to study the deformation history of the earth's surface in a long time series.

Persistent Scatterers usually correspond to solid or man-made structures which commonly have a high radar backscatter (for example, buildings, lampposts, street or road edges, exposed rocks, solid surfaces etc.)[9]. The number of detected PS is usually higher in a naked rocks area in comparison to a vegetated area. L'Aquila area is fruit of naked rocks, and the surface is very coarse. So it is suitable for PS-InSAR application, and also a perfect test area for the fault’s activity study using PS-InSAR. 79 ENVISAT ASAR images (Track 79 descending, and Track 129 ascending) over this region have been obtained between 2003 and 2009, the process of local deformation in the L'Aquila region is revealed by the PS-InSAR technique. The PS-InSAR processing is performed using the StaMPS (Stanford Method for persistent Scatterers) software[5,7]. The

interferograms are corrected for differences in satellite position using preliminary DORIS satellite orbits from the European Space Agency (ESA). Effects of topography were removed from the interferograms using a 3-arc-second (~90 m) resolution Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) [3].

3. RESULTS AND DISCUSSION

This may be the first time that the PS InSAR technique is applied to derive surface deformation in the L'Aquila region before the L'Aquila Earthquake. In this paper, PS InSAR technique can monitor the fault activity before the L'Aquila Earthquake, which may reveal its relation to L'Aquila Earthquake and nearby mid-strong earthquakes. Our study indicates that along the locked thrust fault, uplist may be its primary characteristic before the earthquake, which can serve as a line of evidence for earthquake prediction.

4. REFERENCES

[1]S.Gehlot,V.B.H.Ketelaar,E.Verbree,and R.F.Hanssen,"Conceptual framework for PS-InSAR deformation interpretation assisted by geo-information technology,"*High Resolution Earth Imaging for Geospatial Information,Hannover, Germany*,pp.17-20, May.2005.

[2]Ferretti.A,C.Prati,and F.Rocca,"Permanent scatterers in SAR interferometry,"*IEEE Transactionson Geoscience and Remote Sensing*,vol.39,no.1,pp.8-20,2001.

[3]Farr.T.G,P.A.Rosen,E.Caro,R.Crippen,R.Duren,S.Hensley,M.Kobrick,M.Paller,E.Rodrigu-ez,L.Ro-th,D.Seal,S.Shaffer,J.Shimada,J .Umland,M.Werner,M.Oskin,D.Burbank,and D.Alsdorf, "The Shuttle Radar Topography Mission,"*Rev.Geophys.*,45,doi:1029/2005RG 000183,2007.

[4]Hooper.A,Zebker.H,Segall.P,Kampes.B,"A new method for measuring deformation on volcanoes and other natural terrains using InSAR persistent scatterers,"*Geophysical Research Letters*, 31, L23611, doi:10.1029/2004GL021737,2004.

[5]Hooper.A,Zebker.H,Segall.P,Kampes.B,"Persistent Scatterer InSAR for Crustal Deformation Analysis, with Application to Volcán Alcedo, Galápagos,"*Journal of Geophysical Research*, 112,B07407,doi:10.1029/2006JB004763,2007.

[6]Hooper.A,"A multi-temporal InSAR method incorporating both persistent scatterer and small baseline approaches,"*Geophys. Res. Letters*, doi:10.1029/2008GL034654,2008.

[7]Joaquim J.SOUSA,Antonio M.RUIZ,Ramon F.HANSSEN,Zbigniew PERSKI,Luisa BASTOS, Antonio J. GIL and Jesús GALINDO-ZALDÍVAR,"PS-InSAR measurement of ground subsidense in Granada area(BETIC CORDILLERA,SPAIN),"*13th FIG Symposium on Deformation Measurement and Analysis,4th IAG Symposium on Geodesy for Geotechnical and Structural Engineering*,LNEC,LISBON,12-15 MAY.2008.

[8]S.Usai,"A least squares database approach for SAR interferometric data,"*IEEE Transactions on Geoscience and Remote Sensing*, vol.41,no.4,pp.753-760,2003.

[9]Yun Zhang,Pingping Xie,and Hui Li,"Data rusion for multi-scal colour 3D satellite image generation and global 3D visualization,"ISPRS Commission VII Mid-term Symposium "Remote Sensing: From Pixels to Processes,"*Enschede, the Netherlands*,pp.8-11,May.2006.

[10]Zhang Jingfa,Gong Lixia,and Jiang Wenliang,"Application of PS InSAR technique on movement monitoring of active fault,"*Recent Developments in World Seismology*,vol.6,pp.1-6,2006.

[11]Yi Luo,Jingfa Zhang,Qiming Zeng,Jianqiang Wu,Lixia Gong,Wenliang,Jiang,and Yaqiong Dai, "PS InSAR monitoring of land subsidence in Suzhou,"*Proc.Dragon 1 Programme Final Results 2004–2007, Beijing, P.R. China*,pp.21– 25,April.2008.

[12] "http://en.wikipedia.org/wiki/2009_L'Aquila_earthquake," 2009.