

ABSTRACT

This study aims to monitoring the characteristics of post-seismic deformation of Tarlay earthquake with also attention on stress change on Mae Chan fault. The study area is covered with dense vegetation and accessing to the study area is very difficult, so InSAR time-series technique is an attractive technique to measure surface deformation. Radarsat-2 data acquired from June 2011 to May 2012 have been processed by PSInSAR and Small Baseline techniques. The initial results with mean LOS deformations reveal the potential of Radarsat-2 data to estimate the surface deformation which occurred around Mae Chan fault. Further study will be performed on longer time-series Radarsat-2 data and modeling of post-seismic motion.

INTRODUCTION

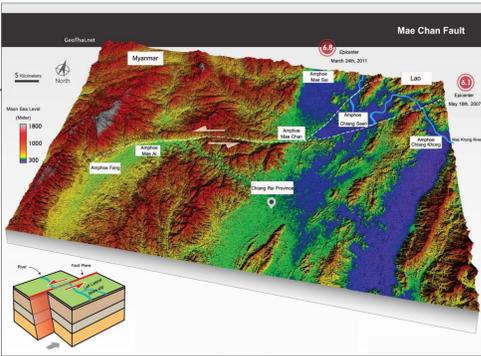


Figure 1: Location map of Mae Chan fault (Taken from a figure in <http://geothai.net/gneiss/?p=204>).

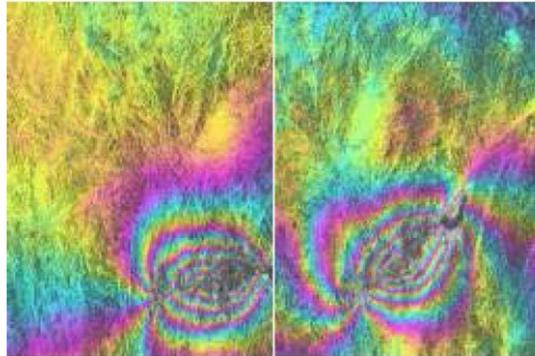


Figure 2: Unwrapped interferogram from ascending (left) and descending SAR image pair (Trisirisatayawong et al., 2011)

There was Mw = 6.8 Tarlay earthquake in a segment of Nam Ma fault located in Myanmar on March 24th, 2011. The hypocenter of this occurrence is approximately 10 kilometers below surface (McCaughey and Tapponnier, 2011). Most of fault sets in the Golden Triangle area at the junction of Myanmar, Laos, and Thailand borders lineated north-eastern and south-western. Mae Chan fault which is situated in the northern part of Thailand was a left-lateral strike-slip fault with 101 kilometers long and was lineated from Fhang District to faults in Laos as shown in figure 1. (Jitmahantakul, 2011) A previous study of Tarlay earthquake using 4 ALOS PALSAR imageries, both ascending and descending orbits, revealed a rupture of more than 20 kilometers [figure 2]. From the interferograms, there is approximately 1.2 meters left-lateral offset in line-of-sight direction across the fault (Trisirisatayawong et al., 2011). From the result, it could be inferred that the earthquake could also have an influence on Mae Chan fault.

SAR DATA

Radarsat-2 both ascending and descending orbits Imageries from June, 2011 to May, 2012 covering the Mae Chan fault area and Nam ma fault in Myanmar were brought into the process. All interferograms are relative to the master image of 15 December, 2011 (Beam type: F3N, Incidence angle: 42°) and 19 November, 2011 (Beam type: F21F, Incidence angle: 36°) respectively.

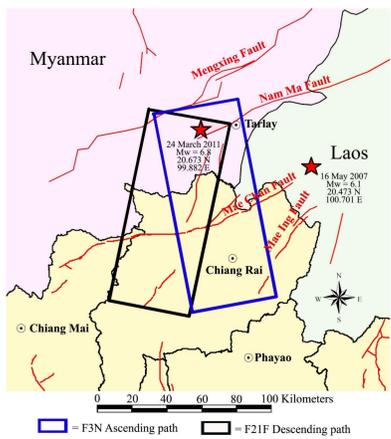


Figure 3: Location map of left-lateral fault system in the Golden Triangle area and footprint of Radarsat-2 SAR imagery both in ascending and descending orbits.

DATA PROCESSING USING TIME-SERIES INSAR TECHNIQUES

In this study, StaMPS/MTI software which associated with time-series InSAR technique was applied to analyze time-series data from Radarsat-2. The initial part of the processing step has been done for interferograms generation using DORIS software. This part, the 3 arc-second (90 meter) resolution of SRTM DEM was used to remove topographic phase. Phase noise which is existed in each candidate pixel of every interferogram was estimated and selected base on their noise characteristics. After that, the pixels selected in the previous step are weeded and corrected for spatially-uncorrelated look angle error (SULA) and master atmosphere and orbit error (AOE). Values of Spatially-Correlated Look Angle Error (SCLA) which is occurring from DEM and AOE were calculated and eliminated using measure of the phase noise level equation (1) as shown below (Hooper et al., 2007).

$$\gamma_x = \frac{1}{N} \left| \sum_{i=1}^N \exp(i(\Delta\phi_i - \beta_i \Delta h)) \right|$$

When N = Number of interferogram
 $\Delta\phi_i$ = Phase differential in each Pixel
 β_i = Baseline
 Δh = Height differential

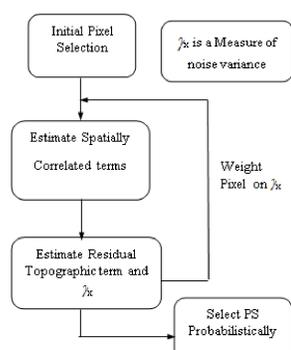


Figure 4: PS selection Algorithm (Hooper, 2009).

From equation (1), an acquired result can be calculated into radar line-of-sight direction. After finished this procedure, Persistent Scattered (PS) will be displayed as position of point detected with the deformations value of measurement.

PHASE OF THE EARTHQUAKE CYCLE

Earthquake could be described as a result of a sudden release of energy in the earth's crust that creates seismic waves. Due to information of Nam ma fault and Mae Chan fault which are left lateral fault trending, the moving trend of these faults are shown in figure 5 where earthquake cycle are explained.

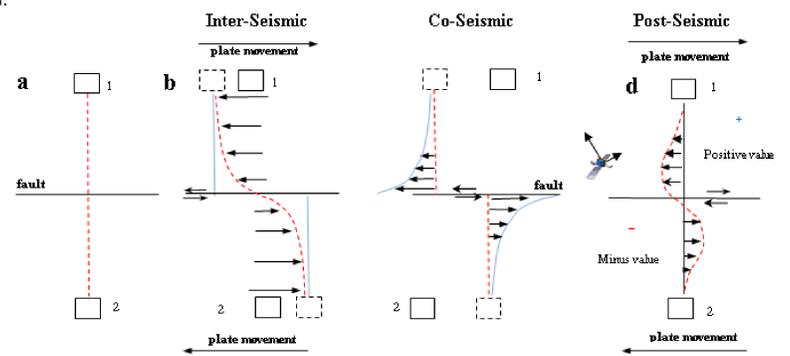


Figure 5: Earthquake cycle as explained by elastic model (modified from Wright, 2002).

Figure 5a reveals a fault plane which is located between two crusts (red-dashed line in a figure). Figure 5b shows in the red-dashed has become curved as this is known as inter-seismic motion. Figure 5c shows a procedure of co-seismic motion when the stress accumulation reaches a breaking point (the shear stress larger than frictional forces). The energy will be abruptly released and the earthquake is occurred. (Thatcher, 1993) The blue lines in figure 5 indicate the sum of deformation before and after earthquake. The figure 5d was supposed that the direction of satellite in ascending orbit movement is forwarding to radar platform, so displacement rates is indicated as a positive value while the contrary is indicated as a minus value. In this procedure, SAR imageries would be brought into an analyzing process to detect a displacement in the study area.

RESULT AND CONCLUSION

The initial result which is analyzed by time-series InSAR technique reveals the post-seismic interferometric deformation of Tarlay earthquake spanning approximately one year. There are more than 147,000 PS points of ascending path with LOS displacement rate between -60.6 to 63.8 millimeters per year as shown in figure 6 while there are approximately 232,700 points of descending path with LOS displacement rate between -219.3 to 86.4 millimeters per year as shown in figure 7.

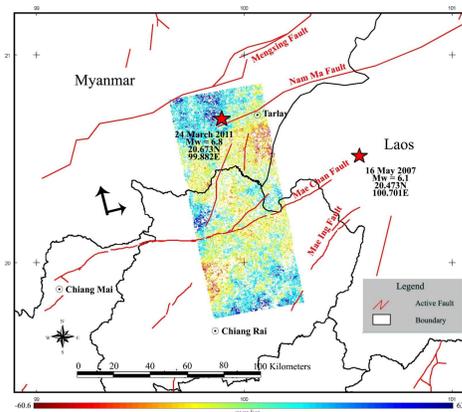


Figure 6: Post-seismic LOS displacement rate (mm/year) in Mae Chan and Nam Ma faults from Radarsat-2 imagery beam type: F3N ascending path using time-series InSAR method.

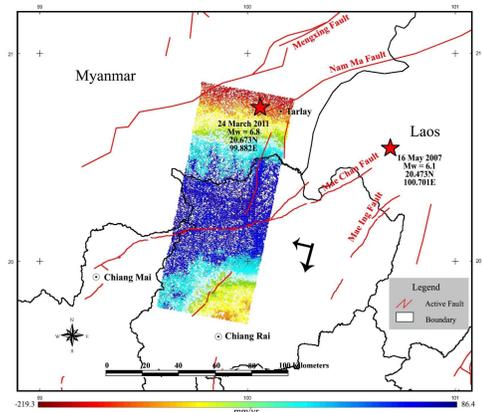


Figure 7: Post-seismic LOS displacement rate (mm/year) in Mae Chan and Nam Ma faults from Radarsat-2 imagery beam type: F21F descending path using time-series InSAR method

The mean velocities are calculated in radar line-of-sight direction. The results indicated a procedure of stress accumulation in this area could be probability of earthquake in the future and provided detail on how crust movements continued after co-seismic previous studies. Although the whole pattern of PS point is complicated due to decorrelation and atmosphere errors, but remarkable surface deformation can still be observed. Hanssen (2005), presented standard deviation of estimated deformation and topography graph in his research and the result revealed that the precision standard deviation of velocity and topography improve with increasing number of acquisitions. Thus, to improve accurate post-seismic deformation, more Radarsat-2 imageries are required for reducing the causes of inaccuracies from the technique.

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