Relation between the spatial variation of creep rate and the 2017 Mw 6.5 Ormoc earthquake along the Philippine fault on Leyte Island

Yo Fukushima*[1] and Manabu Hashimoto[2]

[1]International Research Institute of Disaster Science, Tohoku University – 468-1 Aza-Aoba, Aramaki, Aoba-ku, Sendai, 980-8572, Japan

[2]Disaster Prevention Research Institute, Kyoto University – Gokasho, Uji, Kyoto 611-0011, Japan

Abstract

Fukushima et al. (2013, AGU) reported preliminary results on detection of the fault creep using SAR data acquired by ALOS/PALSAR. In this study, the previous results are updated after re-analyzing with a more robust method, and the relation to the 2017 Mw 6.5 Ormoc earthquake that occurred along the fault is discussed.
We used ALOS/PALSAR SAR data obtained between October 2006 and January 2011 from ascending and descending orbits to conduct InSAR analyses. Small-baseline InSAR time-series analyses, which models and removes artificial bilinear trends, were applied to the interferograms of each of the data sets to obtain the mean velocity field on almost the entire island of Leyte. The velocity fields in the two line-of-sight directions were finally decomposed into east-west and quasi-vertical components.

The resulting velocity field clearly showed discontinuity across the Philippine fault. The corresponding creep rates along the fault were roughly consistent with the values with the field survey results (Tsutsumi et al., 2016, AGU fall meeting). High creep rates of 20-30 mm/year were obtained in northernmost and middle parts of the island along the fault. For the southern part, although the uncertainty in our creep estimates was large, no clear across-fault offset was identified in the horizontal velocity.

The Mw 6.5 earthquake occurred on 6 July 2017 in northern Leyte. The largest historical event in and around Leyte since 1589 had been an Ms 6.4 in 1890 (Bautista and Oike, 2000), which is comparable to the 2017 event. Interferometric SAR analysis of the data obtained by ALOS-2/PALSAR-2 was performed to obtain the coseismic displacement maps in both ascending and descending directions. Then we performed a fault slip inversion using the method proposed by Fukahata and Wright (2008) and found that the slipped part well corresponded to the fault locked portion, between the creeping sections, indicating release of the accumulated strain energy. The maximum amount of slip reached 2.5 meters, and the fault was estimated to be dipping northeast with the dip angle of 74 degrees.
Assuming a constant fault slip rate of 20 mm/year, which is about the creep rate estimated adjacent to the section ruptured in 2017, 2.5 meters of slip deficit accumulates in 125 years. Although the precise location of the 1890 Ms 6.4 event cannot be known, it is possible that the 1890 event was the "last one" that ruptured the locked portion before 2017.

*Speaker