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Complexity of source fault of inland earthquakes revealed by SAR interferometry

HASHIMOTO, Manabu[1*]

[1]Disaster Prevention Research Institute, Kyoto University

Since the Landers earthquakes of 1992, SAR interferometry (InSAR) has been utilized to detect coseismic deformations and estimate configuration of source fault and slip distribution. In Japan, studies of conseismic deformation and fault model have been conducted using mainly L-band SAR sensors (JERS-1 SAR and ALOS/PALSAR) since the Kobe earthquake of 1995. Especially, ALOS/PALSAR observed coseismic deformations of earthquakes all over the world since 2006 and had successful results. Among of all, the complexity of source fault is the most important. In this report, I review some of important results and discuss their significance in earth and disaster sciences.

For example, Hashimoto et al. (2010) and other group revealed slip on parallel faults, heterogeneous slip distribution and variation of configuration of faults along strike for the Wenchuan earthquake of 2008. Takada et al. (2010) clarified the existence of an eastward dipping sub-fault in addition to the westward dipping main fault for the Iwate-Miyagi earthquake of 2009. Anti-correlation of coseismic deformation to the topography was detected during the Haiti earthquake in 2010. Hashimoto et al.(2011) concluded that the source fault is not a vertical left lateral sinistral fault, the Enriquillo fault, but a buried one in the crust. In the same year, more than 5 small segments ruptured during the Darfield, NZ, earthquake (Hashimoto, 2012). Obliquely crossing faults ruptured during the Iwaki earthquake of 2011 (Fukushima et al., 2013). Of course, there are earthquakes with a simple plane fault such as L'aquila, Italy, in 2009 and Yushu, China in 2010, but they are minority during the 5 year operation of ALOS/PALSAR.

The present long-term forecast by the Headquater for Earthquake Research Promotion is mainly based on so-called characteristic earthquake model that assumes repetition of unit slip on the same fault plane. However, the above results contradict this simple model. Propagation of rupture between segments such as the Darfield and Iwaki earthquakes makes it difficult to estimate final moment release. Modeling research of such complicated fault behaviors should be hastened including the effect of subsurface structure. We cannot deny that faulting contribute to the formation of topography, but it is a big issue in Earth science how faulting occurs that is uncorrelated to the topography such as Haiti earthquake. It is also important to take this kind of earthquakes into hazard evaluation from the viewpoint of disaster mitigation.

Keywords: InSAR, ALOS/PALSAR, inland earthquake, active fault, crustal deformation