Geophysical Research Abstracts
Vol. 19, EGU2017-19168, 2017
EGU General Assembly 2017

Visual Analysis on Tidal Triggering Earthquake: the 2011 M9.0 Tohoku-Oki Earthquake being a case

Lixin Wu (1,2), Wenfei Mao (2), Weiyu Ma (3), and Shuo Zheng (4)

(1) School of Geosciences and Info-Physics, Central South University, Changsha, China(awulixin@263.net), (2) School of Resources and Civil Engineering, Northeastern University, Shenyang, China(maowf2014@126.com), (3) China Earthquake Networks Center, China Earthquake Administration, Beijing, China(weiyuma@163.com), (4) School of Resources and Environmental Engineering, Anhui University, Hefei, China (zhengshuo@mail.bnu.edu.cn)

The lunar-solar tidal stresses due to the gravitational attraction of the Moon and Sun to the Earth change with time and place inside the lithosphere. Although it is probably at least three orders of magnitude smaller than the tectonic stresses upon which they are superimposed, the tidal stress rates may be two orders of magnitude larger than the tectonic stress rate averaged over the recurrence interval for a seismic region, which is possible to trigger an earthquake as the last straw. For more than a century, researchers have sought to detect the effect of tidal stress on individual earthquake or to make statistical analysis on global earthquake-tide correlations. Unfortunately, not all of the reports on tidal stress triggering earthquake are consistent. Some have found that large and shallow earthquakes are more likely to be triggered by tidal stress than deep and small ones, yet there have been many positive correlations noted for shallow small ones. To observe the possible tidal triggering it is necessary to resolve the tidal stress onto the fault surface or subduction zone to determine if the normal component or shear components are compatible with the fault motion. This analysis requires accurate focal mechanisms and detailed geometry of the fault surface.

Although the 2011 Tohoku-Oki Magnitude 9.0 earthquake in Japan was found tend to occur near the time of maximum tidal stress amplitude, the triggering mechanism is not yet clear. After interpolating the irregular triangular network of the subduction zone, produced by Mark Simons et al. (2011), into a regular gridded network, we calculated the tidal stress at each grid in period between 30 days before and 7 days after the great shocking. The dynamical tidal stress were resolved to three components including trend stress, dip stress and normal stress. For the first time, the spatio-temporal evolution of the tidal components on the fault surface or subduction zone are mapped in three dimension. These maps provide good visualization for better understanding the spatio-temporal evolution of tidal stress and easy detecting the tidal triggering mechanism. We discovered with visual analysis: 1) the dip components of tidal stresses on the subduction zone were generally upward at the moment of shocking, which was compatible with the coseismic upward motion of the upper Eurasia block; 2) the trend components of the tidal stresses on the north part of the subduction zone were southward at the moment of shocking, which was compatible with the coseismic southward motion of the upper Eurasia block; 3) the normal components of tidal stresses on the subduction zone beneath the Eurasia block were upward, which reduced the tectonic compressive stress and friction stress on the subduction zone; while the normal components of tidal stresses on the Pacific block were downward, which push the Pacific block downward benefit for subduction. All these particular phenomena were compatible with the fault slip according to Coulomb failure criterion.