Seasonal seismicity in the Western Branch of the East African Rift System

Liang Xue[1], Christopher W. Johnson[2], Yuning Fu[1] and Roland Bürgmann[3]

1. School of Earth, Environment and Society, Bowling Green State University, Bowling Green, Ohio, 43403, USA

2. Scripps Institution of Oceanography, University of California San Diego, La Jolla, California, 92093, USA

3. Berkeley Seismological Laboratory, University of California Berkeley, Berkeley, California 94720, USA

Abstract

Stress perturbations caused by surface load variations from large water body movement change the stress status on faults and potentially affect earthquake nucleation processes, especially in tectonically active regions. Lake Victoria and rift lakes along the Western Branch are the largest water storage reservoirs along the East African Rift System (EARS). Here, we report observational evidence for seasonal variation of seismicity on the border fault of the Western Branch of the EARS. We compute the displacements and stress changes due to seasonal water loading, using the Pylith finite element model software. We estimate the correlations between the stress variations from water loads of Lake Victoria and rift lakes and the seasonal seismicity changes in the EARS. Our results suggest the seasonal lake storage variation induces seasonal Coulomb stress changes of ~0.2-1.2 kPa on the border faults of Albert-Edward rift, Kivi rift, and Tanganyika rift at 10-km seismogenic depth. Moreover, the primary annual peak in seismicity is coincident with the peak Coulomb stress with an insignificant lag time. The correlation between annual Coulomb stress change and seasonal seismicity presents a Pearson correlation coefficient of 66% and 81% for the Kivi rift and Tanganyika rift, respectively. This significant correlation suggests an elastic response of the upper crust to the surface loading in the Western Branch region. Our results indicate that seasonal variations of seismicity rate in the EARS Western Branch are modulated by the annual hydrological loads of Lake Victoria and other large rift lakes.