Transient deformation before the 2021 Mw 7.4 Maduo Earthquake

Lidong Bie (UEA)

The development of geodetic tools, such as Interferometric Synthetic Aperture Radar (InSAR), has revolutionized our exploration of earthquake physics and the estimation of seismic hazard. Over the past 20 years, there has been an increasing application of InSAR to determine the interseismic strain rate across major seismogenic faults. This new paradigm in seismic hazard assessment uses geodetically mapped crustal deformation rates to derive the strain rate tensor, which serves as a proxy for seismic hazard, in alignment with the classic elastic rebound theory. However, the relatively short observation periods compared to often much longer large earthquake intervals raise questions about how well the geodetic strain rate represents long-term strain accumulation on faults. It is therefore critical to understand how strain rate evolves during the interseismic period.

I will present recent research progress from our group, focusing on the 2021 Mw 7.4 Maduo earthquake in northern Tibet. The 2021 Maduo earthquake ruptured a slow-moving, left-lateral strike-slip fault approximately 70 km south of the major block-bounding East Kunlun fault. Using six years of Sentinel-1 data, we explore whether the strain rate changes over time and, if so, whether it increases before the main shock. We derive the maximum shear strain rate for various periods, using either independent time windows or moving time window with overlapping periods. Our analysis suggests that the geodetically derived strain rate may not be constant over time, and strain may not accumulate at a fixed rate throughout the interseismic period in the seismogenic crust. Additionally, strain rate may peak several years before an earthquake occurs, contrary to the assumption of strain rate acceleration prior to large earthquakes.