

EGU2020-2539

<https://doi.org/10.5194/egusphere-egu2020-2539>

EGU General Assembly 2020

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Joint inversion of InSAR and GPS for fine slip rate and locking degree distribution along the Haiyuan fault zone

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The left-lateral strike-slip Haiyuan fault system is a major boundary fault zone on the northeast margin of the Qinghai-Tibet Plateau separating active Tibet block and stable Alaxan & rdos blocks, and accommodating the eastward motion of Tibet Plateau. It consists of several sections, including Lenglongling segment (LLL), the Jinqianghe segment (JQH), the Maomaoshan segment (MMS), the Laohushan segment (LHS) and the rupture of the Haiyuan earthquake in 1920 from the west to the east. In 1920, a M8.5 Haiyuan earthquake occurred in the eastern segment of the fault zone, resulting in a surface rupture zone of about 240 km, with a maximum left-lateral coseismic displacement of 10 m. In the past 100 years after the earthquake, Haiyan fault is in a state of calm, no destructive earthquake of M 6.0 or above occurred. It is worth studying that how the fault activity and seismic hazard of each section of Haiyuan fault zone are at present.

We use geodetic data (High density InSAR and wide scale GPS) to study the present slip rate and locking degree of Haiyuan fault zone. we first use the Envisat/ASAR long-strip data of five tracks and the PSInSAR time series processing technology based on high coherence point target to obtain the average deformation rate field of the fault system during 2003~2010, and transform the deformation rate from line-of-sight (LOS) direction to the parallel fault direction. Then, we use two-dimensional screw dislocation model to fit the cross-fault deformation rate profiles, and obtain the fault kinematic parameters such as the fault slip rate and the locking depth. At the same time, we adopt the three-dimensional block model to invert the distribution characteristics of fault locking degree and slip rate deficit along the Haiyuan fault zone. We compare the difference of inversion results of different data individually and jointly, including large-scale sparse GPS data, high-density InSAR data and the combination of them. Finally we get the continuous strain accumulation state of the fault zone. The results show that from west to east, the slip rate decreases gradually, while the locking depth changes along the fault. The Laohushan section shows shallow surface creep. The analysis of the high-density cross-fault deformation rate profile of the Laohushan segment indicates that the creep length is about 19 km. Other segments in a locked state. But in the middle of the 1920 earthquake fracture section, the locking degree is weaker and shallower than other segments. These results are helpful to understand the present activity and assess regional seismic risk of Haiyuan fault zone.