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Time series analysis of strain accumulation along the Haiyuan fault (Gansu, China) over the 1993-2009 period, from ERS and ENVISAT InSAR data

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We use SAR interferometry to measure the strain accumulation along the left-lateral Haiyuan fault system (HFS), that marks the north-eastern boundary of the tibetan plateau. The last major earthquakes that occured along the HFS are the M$\sim$8 1920 Haiyuan earthquake (strike-slip mechanism) and the Ml=8-8.3 1927 Gulang earthquake that ruptured a thrust fault system. No large earthquake is reported on the central section of the HFS, the "Tianzhu seismic gap", since $\sim$1000 years.

We first analyze the complete ENVISAT SAR data archive along 4 descending and 2 ascending tracks for the 2003-2009 period and construct an InSAR-based mean Line-Of-Sight (LOS) velocity map around the HFS from the eastern end of the Qilian shan (102° E), to the west, to the Liupan shan (106° E), to the east. Data are processed using a small baseline chain type. For each track, all radar images are coregistrated to a single master and interferograms are produced using a local adaptative range filtering. Residual orbital and atmospheric delays are jointly inverted and corrected for each unwrapped interferogram. Atmospheric corrections are validated using the ERA40 global atmospheric model (ECMWF). The interferograms series on each track are then inverted to obtain the increments of LOS radar delays between acquisition dates, adapting the Lopez-Quiroz et al. 2009 time series analysis. The obtained LOS mean velocity maps show a dominant left-lateral motion across the fault with along-strike variations: some fault sections are locked at shallow depth while others are creeping and local vertical movements are observed (subsidence in the "Jingtai" pull-apart basin).

For various fault slip rates imposed below 20 km (4-10 mm/yr), we model the shallow velocity by inverting the mean LOS velocity maps for both strike-slip and dip-slip motion on vertical, 5km x 2.5km discretized patches, using a least-square method with an appropriate degree of smoothing. The fault geometry follows the surface trace of the fault from SPOT images, with two main segments, on both sides of the Jingtai basin: one along the M$\sim$8 1920 rupture to the east and one along the creeping section to the west. For a far-field velocity of 6 mm/yr, the creeping rate is estimated to be up to 4 mm/yr on the western segment. We assess the influence of atmospheric noise on our velocity solution.

Finally we compare the ENVISAT time series analysis with that obtained using the ERS dataset spanning the 1993-1998 period to investigate for potential time variations of the strain accumulation across the Haiyuan fault.