Creep motion along Chaman Fault, Pakistan, as detected by Interferometric Synthetic Aperture Radar Data

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The Chaman fault, Pakistan, covers a 700-km-long, 200-km-wide segment of the plate boundary in the western edge of the Indian plate and the Eurasian plate.Plate motion model NUVEL1 shows that the relative velocity between those two plates is ˜40 mm/year. However, there is currently no recent geodetic data that tells us the spatial extent and amplitude of the slip rate. The Chaman fault is known to be a left-lateral fault, and there has been historically a number of disasterous earthquakes along the fault. The mean slip rate estimated from the seismicity records over the past 100 years turns out to be ˜13 mm/year (Ambraseys and Bilham, BSSA, 93(4), 1573-1605, 2003), which is significantly lower than the NUVEL1 value. Moreover, in view of the geographic distribution of the estimated slip, the values are far below the NUVEL1 velocity except in the segment that includes 1935 Quetta earthquake. In particular, the seismic moment release north of latitude 31N is order(s) of magnitude smaller than the area south of latitude 31N. These obviously very small estimated slip rate suggests that up to 4 m of potential slip is currently available to drive one or more future big (greater than M7) earthquakes. If the seismic coupling is strong enough, it is likely that significantly localized strain accumulation is taking place at some places. On the other hand, if the seismic coupling is not as strong as to generate disasterous earthquakes, it is possible that non-seismic creep is ongoing over these area. In either case, the slip distribution between the two plates, if successfully derived, has an important implication for the seismic hazard analysis over the region.

We generated interferograms using SAR images acquired by of the European Remote Sensing satellites ERS-1 and ERS-2 (C-band, wavelength 5.67 cm) from descending tracks 406, 134 & 363 and ascending track127 that cover almost the entire fault from about 34-27 deg N and 64.5-68.5 degE.The data spans the time interval 1992-2002 but the longest interval was of 6.5 years for interferogram with the smallest baseline. The arid land cover permitted good coherence over almost the entire area for baselines smaller than about 100m.

A clear signal of possible creep could be seen as a discontinuity of phase along a portion of the Chaman Fault in the interferograms formed from descending track 134 and ascending track 127.The estimated creep rate is 1-1.5 cm/yr.We will discuss implications for a possible seismic hazard.