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Global Positioning System (GPS)-based crustal deformation of the Darjiling-Sikkim Himalaya, India

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Global Positioning System (GPS) based crustal deformation measurements allow the estimation of very short-term deformation from the day measurements are started. The three-dimensional Bangalore (IISc: 13.02 N; 77.57 E) – Lhasa (LHAS: 29.66 N; 91.10 E) baseline is a good proxy for the very-short term active tectonics in the Darjeeling-Sikkim and Western Bhutan Himalayas. The ITRF 2000 model for IISc and Lhasa IGS stations for the period 1997-2004 predicts a convergence of ~ 10 mm/year in contrast with the ~ 20mm/year convergence measured from central Nepal and postulated for the entire Himalayas. Campaign-mode GPS studies carried out in the Darjiling-Sikkim Himalayas between 2000 and 2003 were aimed at resolving the ~10mm/year convergence observed along the IISc-LHAS baseline. The IISc-KYON baseline is a good proxy for convergence accommodation in the Darjiling-Sikkim Himalayas because Kyongnosla (KYON: 27.36 N; 88.714 E) is located along the IISc-LHAS line near the Indo-Tibet-Bhutan border. This line shortened by 5.33 ± 2.9 mm/yr during 2000-2003 indicating that only half of the ~10mm/yr convergence is taken up in the Darjiling-Sikkim Himalayas; this is corroborated by the 6.59 ± 2.85 mm/yr convergence observed along the KYON-LHAS line. The station at Delo Hill (DELO: 27.09 N; 88.50 E) has been monitored in campaign mode since 1997 and a statistically insignificant convergence of 3.07 ± 5.4 mm/yr was measured between 1997 and 1999 between IISc & DELO. 2000-2003 measurements on DELO also revealed a statistically insignificant convergence of 1.29 ± 1.76 mm/yr between IISc & DELO during 2000-2003. The convergence between LHAS and DELO during the same period was 5.67 ± 1.68 mm/yr. This low convergence suggests that although most of the convergence is being taken up north of Delo in the Higher Himalayas, there is probably some convergence being taken up south of Delo that could be resolved through a baseline shorter than the IISc-DELO line. The Mungpu (MUNG: 26. 98 N; 88. 40 E) station was, therefore, set up south of Delo. IISc-MUNG convergence over 2000-2003 was statistically insignificant 1.66 ± 1.94 mm/yr whereas LHAS-MUNG convergence over the same period was 10.1 ± 1.87 mm/yr. The 2000-2003 DELO-MUNG convergence was measured to be 3.83 ± 2.07 mm/yr and, therefore, some convergence is being accommodated between the MUNG and DELO stations. The above results indicate that the frontal part of the Darjiling-Sikkim Himalayas is not accommodating much convergence and most of the 4-5 mm/year convergence is being taken up between 27°N and 27.5°N latitudes. Also, the observed convergence in the Darjiling-Sikkim is significantly lower than that observed in Nepal and western Himalayas.