Earthquake potential evaluation in the Himalayan Frontal Zone using space geodetic technique

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Nepal is located in the Indian-Eurasian plate convergent zone and earthquakes have always been a direct threat for the whole of the country. We have deployed 10 continuous GNSS stations in central and mid-western Nepal since 2016 under the project of “Integrated Research on Great Earthquakes and Disaster Mitigation in Nepal Himalaya (NERDiM)” (2016-2021). The main purpose of the geodetic group is to estimate earthquake generation potential in the Himalayan Frontal Zone using spatio-temporal variation of displacement field and converted strain accumulation pattern. We focus especially on the “Central Seismic Gap” located just west of the source region of the 2015 Gorkha earthquake (Mw 7.8), where no destructive event has been recorded since 1505. Data collected at each NERDiM GNSS station are transmitted to a data server at Kathmandu on a semi-daily basis via domestic cell phone network and then processed together with data from the pre-existing domestic GNSS stations and IGS reference stations.

We collect all available GNSS data in Nepal through UNAVCO DAI v2 and process them with NERDiM data using PPP-AR method of GIPSY/OASIS II ver.6.4. Preliminary result shows that the north-south contraction in Nepal is as large as 10-15 mm/yr, equivalent to a strain rate of 0.1 ppm/yr, implying that about 30-40% of the relative Indian-Eurasian plate motion (36-37 mm/yr) is taken up in crustal shortening of the Himalayan Frontal Zone due to strong coupling on the plate boundary. The NERDiM GNSS stations clearly contribute to improve spatial resolution especially near the Indian border, that agrees roughly with the updip limit of the plate boundary. Occurrence of the 2015 Gorkha earthquake disturbs deformation field around the source region in central Nepal but does not seem to affect further west. It means that large amount of accumulated strain has remained unreleased in “Central Seismic Gap”. As the next step, we are preparing estimation of plate locking distribution using the latest plate boundary model (Hubbard et al., 2016). Strain build-up monitored by our system, in conjunction with data from other pre-existing GNSS stations in and around Nepal, will provide fundamental and important information for evaluating earthquake generation potential in the near future.

Keywords: Nepal, Earthquake, GNSS

