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# Multiple seismic terrace uplift along Himalaya's Main Frontal Thrust imaged by a 100 km-long Lidar survey in Eastern Nepal

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Understanding the seismic behavior of plate boundary thrusts has proved to be difficult due to the scarcity of data on the source, size, recurrence time and surface expression of large seismic events over long distances. Recent work along the front of the Himalayas in Eastern Nepal, demonstrated that the 1934 Mw∼8.2 Bihar-Nepal earthquake and the AD 1255 event produced a surface rupture of at least 150 km long. This work emphasized the need to use a multi-methodological approach (geomorphology, paleoseismology, cosmogenic surface dating, subsurface 14C dating) over significant distances (tens of kilometers) in order to better document the surface trace of large earthquakes. To do so, a first airborne Lidar survey of the Main Frontal Thrust (MFT) was performed along the south side of the Siwaliks in eastern Nepal. The targeted area (∼100 km long, ∼10 km wide), from east of Lahan to west of Bardibas, encompassed a sizable fraction of the surface ruptured by the great 1934 and 1255 earthquakes. The survey provided a high-resolution (∼4 data points/m2) digital elevation model of cultivated/forested terrain over a surface area of more than 1000 square kilometers. We use this high quality topographic dataset to build a regionally integrated interpretation of the tectonic geomorphology of the thrust front. More specifically, the data enables us to refine our mapping of the thrust trace at a half-dozen site (Mahara, Ratu, Charnath, Suklaha, Khutti and Chapin-Kharak rivers) and to obtain a longer slip history of the fault. Five to seven hanging-wall fluvial uplifted terraces (ranging from 5 to 75-80 m above riverbed) have been identified and mapped at each site. Topographic profiles transverse to the thrust trace combined with 14C and OSL ages at 3 of the sites help build a first order regional correlation of the uplifted surfaces. That correlation suggests characteristic increments of terrace throw during a sequence of 5 to 7 events of co-seismic riverbed uplift followed by abandonment and incision by the river. An average return period of 700-800 years since ∼4200 years BP with an overall slip rate between ∼9 to 11 mm/yr depending on the geometry of the MFT (segmentation and dip) trace are estimated.