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A high-resolution, satellite-derived DEM to constrain the slip distribution along the Hebron Fault, Namibia

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The Hebron fault scarp, located in southern Namibia, runs for 45 km with an average height of 4.5 m and a maximum height of 9.6 m. Namibia is a slowly deforming intraplate region with the largest earthquake on the ISC catalogue being M_w 5.4. If the scarp ruptured during a single event the Hebron scarp would represent an earthquake of Mw >7. During the instrumental record, few large earthquakes have occurred in stable continental regions, such as Namibia. Consequently, it is important to study palaeoearthquakes in stable regions in order to understand the characteristics of such events. In particular, these studies may help to refine the M_{max} estimates needed for seismic hazard assessment. Previous work on the Hebron Fault has been limited to field descriptions and ten theodolite-survey scarp heights. Furthermore, there have been several interpretations of the fault mechanism and number of rupture events. We produce a high-resolution digital elevation model (DEM) via stereophotogrammetry using pan-sharpened Worldview3 satellite imagery (0.31 m resolution). This DEM was used to create >100 cross-sections perpendicular to the fault scarp along its 45 km length to determine the scarp height and thus the distribution of slip along the fault. Of particular interest are three generations of alluvial fans which display relatively uniform scarp heights of 4-6 m. In addition, geomorphological analysis of knickpoints in river profiles and lateral stream displacements along the fault plane was also conducted. This indicates that Hebron is a normal, dip-slip fault and ruptured in a single event. In this case, the slip-to-length ratio required for a single earthquake would be quite large ($2x10^{-4}$), however, we show that other continental intraplate events have been observed to have similarly high slip-to-length ratios.