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How segmented is your fault? Deciphering fault relationships from low resolution data

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Current understanding of the maximum displacement/length (D_{max}/L) relationship of faults results from the consolidation of numerous published studies. Many of these studies attempt to constrain the power law exponent, n, where $D_{max} \propto L^n$, and provide rationale to the spread in results in the cumulative published data. Variations in n across studies are widely acknowledged as being due to differences in rock type, tectonic environment and limitations on fault size range and sample size, both of which can be affected by the acquisition resolution. The extent of the contribution of data resolution to the spread in D_{max}/L results is not currently constrained. This study examines the effect of varying data resolution on the length-displacement relationship to determine this contribution. We have created a 0.5 m resolution digital elevation model (DEM) of the Krafla fissure swarm, NE Iceland, using airborne LiDAR and measured the displacement/length profiles of 775 faults, with lengths ranging from 10s to 1000s of metres. The LiDAR data was additionally downsampled to create 10 m and 30 m resolution DEMs from which we measured the displacement/length profiles of 90 and 40 faults respectively. Additionally we selected three major fault systems, measured as single faults at 30 m resolution, measuring all the component faults observed at 10 m and 0.5 m resolution. We suggest that the variation in resolution can account for a substantial amount of the spread observed in the published dataset. Additionally we propose that it is possible to establish whether a measured fault is likely to be a single fault, without segmentation, regardless of the resolution it has been measured at, based on its location within the distribution of the published D_{max}/L dataset.