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Debris thickness and surface topography on Ngozumpa Glacier, Nepal

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The ablation zones of many Himalayan glaciers are partially to completely covered with a layer of rock debris, the thickness of which is a key control on surface melt rates. Although it is commonly assumed that supraglacial debris is redistributed by gravitational processes due to variable surface topography, the nature of such a relationship has not been fully explored. Here we present locally extensive debris thickness data collected on Ngozumpa Glacier, Nepal, using ground-penetrating radar (GPR), and investigate, by comparison with a high-resolution digital terrain model (DTM), the relationship between debris thickness and surface topography. We compare debris thickness with slope, aspect, and hillslope curvature and look at how debris thickness relates to features of interest on the glacier surface.

The existence of a relationship between debris thickness and surface topography has potentially important implications for remote sensing estimates of debris thickness made using thermal band satellite imagery because DTMs are commonly available at relatively high spatial resolution. For this reason, we assess whether or not debris thickness and surface topography covary. Further, due to the typically non-linear relationship between debris thickness and surface temperature, remote sensing estimates of debris thickness are affected by sub-pixel scale debris thickness variability. To see how debris thickness varies at sub-pixel scale, and the extent to which such variability should affect remote sensing-derived debris thickness estimates, we explore the effects of resampling our debris thickness data to the resolution of the thermal bands of ASTER and Landsat satellite images.