Microclimate controls on weathering and erosion in a temperate forest

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We aim to quantify the rates of regolith production and downslope transport, test transport rules, and quantify the processes responsible for landscape evolution at the Susquehanna Shale Hills Critical Zone Observatory (SSHO) in the Appalachian Mountains of the eastern United States. Toward this end, we use a combination of high resolution, LiDAR-derived digital topography, the cosmogenic radionuclide meteoric ^{10}Be, and shallow seismic P-wave surveys along six hillslopes in three *en echelon* watersheds. Topographic observations reveal a systematic asymmetry at SSHO, with consistently steeper north-facing hillslopes than south-facing hillslopes. Despite this asymmetry, systematic downslope increases in meteoric ^{10}Be suggest that regolith flux is equal along all hillslopes and reflects steady lowering at ~ 20 m/My. These data suggest that downslope regolith transport is depth-dependent at SSHO, and that transport efficiency is higher on south-facing hillslopes than north-facing hillslopes by a factor of two. Our results imply that subtle differences in insolation between north- and south-facing slopes impact the frequency of dilational regolith transport processes (i.e., wetting-drying cycles, freezing-thawing cycles), which in turn affect the efficiency of downslope regolith transport. This interpretation is supported by geophysical observations, which reveal thick layers of regolith mantling north-facing slopes. We contend that the differences in regolith transport efficiency between north- and south-facing slopes at SSHO have conspired to drive the evolution of asymmetric topography over geologic time.