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Dendrogeomorphic evidence of hillslope erosion in response to climate variation AD 1600 to present: Colorado Plateau, northeastern Arizona, USA.

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Dendrogeomorphology was used to study hill slope erosion and valley floor dynamics in a small drainage basin in the Colorado Plateau of northeastern Arizona, U.S.A. Root exposure of Pinyon pine (Pinus edulis) indicates that hillslope erosion averaged 1.9mm/yr over the last 400yr, but that this erosion has been highly episodic. In the early 1900's erosion exposed most of the roots severely limiting moisture to these precipitation sensitive trees. Even though this was a very wet period in the southwest United States the trees on the eroded slopes show evidence of "geomorphic drought" with significantly reduced growth while those on stable surfaces a short distance away (100-500 meters) show a large increase in growth between 1906 and 1930 synchronous with regional precipitation trends. The anomalous climate-growth response of the slope cohort returns to normal when the trees are able to establish a new deeper root system and regain access to moisture.

Negative increment growth anomalies in hill slope trees are interpreted as the consequence of rapid aerial exposure of roots by erosion. Multiple lines of evidence (tree-ring records, root exposure, rapidity of weathering and sediment production) indicate that episodic sediment losses from the hill slopes we studied have occurred at intervals of 80-120yr during the last several centuries. Decadal changes in precipitation regimes, most notably shifts from multi-year droughts to wet intervals, apparently triggered those erosion episodes. The post-1905 negative growth anomalies in hill slope trees were associated with the largest precipitation shift in the last 400yr. Approximately 100 years have elapsed since the last major erosional episode indicated by negative tree growth anomalies.