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Using the mARM3D soil-landscape model to study the affect of climate dynamics on soil processes and properties

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Soil erosion and weathering rates can vary significantly in both time and space. Therefore the interaction between erosion and weathering has a complex spatio-temporal effect on soil properties. However, so far, our ability to quantitatively describe the erosion-weathering dynamics was extremely limited.
Here we simulate the affect of long-term (Quaternary) climate fluctuations on distributed soil evolution. We use our mARM3D soil-landscape model which explicitly calculates three-dimensional soil evolution as a function of surface erosion and profile weathering. A simple assumption is made about the impact of climate on weathering and erosion rates. Hillslope and catchment-scale soil evolution were simulated over a 400,000 year period using the Vostok (Antarctica) ice-core data as a climatic input. The results consistently show that:
(1) The effect of climatic forcing on soil evolution vary considerably in space to the point were different parts of a hillslope have opposite trends.
(2) Soil evolution will continue long after a sharp climatic change (adjustment lag).
(3) Soil adjustment lag to climatic changes vary in space.
These findings have significant implications to our understanding of this complex system.
This study demonstrates the attractiveness of using mARM3D as a virtual-laboratory as it is capable of complex desktop studies of erosion and weathering dynamics.