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The role of high-resolution microtopographic grids in validating the RillGrow model

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Soil erosion by water is a major global environmental problem: one that may, in some regions, be exacerbated by future climate change. However, models for water erosion on hillslopes are, in general, rather weak regarding the spatial aspects of erosion. Results for total runoff and soil loss on a hillslope area may be acceptable, even while the model does a poor job of identifying the location of erosion hotspots within that area.

High resolution topographical data has a clear role to play in improving the spatial performance of erosion models. The RillGrow series of soil erosion models represent an eroding hillslope area as a self-organizing system on a microtopographic grid. Elevational differences on this grid determine the spatial pattern of overland flow and hence of surface lowering. Such lowering then modifies the path of subsequent flow. This simple iterative relationship generates rill networks emergently, i.e. as a collective whole-system response to many local interactions. In contrast, conventional erosion models require the user to 'pre-specify' rill characteristics even for an unrilled surface. However, computational constraints currently confine RillGrow to simulation of small, plot-sized, areas.

Here, a series of validation studies of RillGrow is summarized. High-resolution DEMs of real soil surfaces, including both laboratory flumes and hillslope plots, were created using a range of techniques including laser scanning and close-range photogrammetry. These were used as inputs to the RillGrow model. Model-simulated rill networks were then compared with those which developed on the real soil surfaces. Other model outputs (e.g. hydrographs and sedigraphs at the outlet; water depths and velocities at points on the surface) were similarly compared.