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The temporal dynamics of a scaling relationship between soil grading and landscape geomorphology using a pedogenesis model

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Using the mARM3D pedogenesis model (which simulated armouring and weathering processes on a hillslope) previous work by Cohen and the coauthors of this abstract found a strong log-log linear relationship between the particle size distribution of the soil (e.g. d50), the contributing area and the local slope. In recent work using our SSSPAM pedogenesis model (a generalisation of mARM3D) we have confirmed this relationship is robust against changes in climate and geology and is also true for more general grading properties of the soil at the surface (e.g. d10, d90). However, this previous work was for equilibrium soils and time invariant landforms. In this presentation we will extend this work to show the effect of temporal dynamics in the pedogenesis model by exploring the spatial organisation of the time varying behaviour of soil grading. We will show how the within-profile weathering processes change the variation with depth of the soil grading, and how the spatial variation of the soil surface and depth averaged grading properties change with the temporal dynamics. These results strengthen our confidence in the generality of the log-log linear scaling relationship between area, slope and soil grading. The paper will present the results of our simulations and will highlight the potential uses of the relationship for digital soil mapping and better characterization of soils in environmental models.