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A first attempt to reproduce basaltic soil chronosequences using a process-based soil profile model: implications for our understanding of soil evolution

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Soils are complex systems which hold a wealth of information on both current and past conditions and many biogeochemical processes. The ability to model soil forming processes and predict soil properties will enable us to quantify such conditions and contribute to our understanding of long-term biogeochemical cycles, particularly the carbon cycle and plant nutrient cycles. However, attempts to confront such soil model predictions with data are rare, although increasingly more data from chronosquence studies is becoming available for such a purpose. Here we present initial results of an attempt to reproduce soil properties with a process-based soil evolution model similar to the model of Kirkby (1985, *J. Soil Science*). We specifically focus on the basaltic soils in both Hawaii and north Queensland, Australia. These soils are formed on a series of volcanic lava flows which provide sequences of different aged soils all with a relatively uniform parent material. These soil chronosequences provide a snapshot of a soil profile during different stages of development. Steep rainfall gradients in these regions also provide a system which allows us to test the model's ability to reproduce soil properties under differing climates.

The mechanistic, soil evolution model presented here includes the major processes of soil formation such as i) mineral weathering, ii) percolation of rainfall through the soil, iii) leaching of solutes out of the soil profile iv) surface erosion and v) vegetation and biotic interactions. The model consists of a vertical profile and assumes simple geometry with a constantly sloping surface. The timescales of interest are on the order of tens to hundreds of thousand years. The specific properties the model predicts are, soil depth, the proportion of original elemental oxides remaining in each soil layer, pH of the soil solution, organic carbon distribution and CO_2 production and concentration.

The presentation will focus on a brief introduction of the model, followed by a description of novel methods using tracers such as optically stimulated luminescence (OSL) dates and meteoric ^{10}Be to evaluate the modelled processes of bioturbation and surface erosion. We will also discuss comparisons of modelled properties with observations and conclude with implications on our understanding of soil evolution.