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The effect of bioturbation on soil formation; Simulations and measurement in a Belgian loess area

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Spatial patterns of soil often do not reflect those of topographic controls. We attempted to identify possible causes of this by comparing observed and simulated soil horizon depths. Observed depths of E, Bt, BC, C1, and C2 horizons in loess-derived soils in Belgium showed a weak to absent relation to terrain attributes in a sloping area. We applied the soil genesis model SoilGen2.16 onto 108 1 $\times$ 1 m2 locations in a 1329 ha area to find possible causes. Two scenarios were simulated. Model 1 simulated soil development under undisturbed conditions, taking slope, aspect, and loess thickness as the only sources of variations. Model 2 additionally included a stochastic submodel to generate tree-uprooting events based on the exposure of trees to the wind. Outputs of both models were converted to depths of transitions between horizons, using an algorithm calibrated to horizon depths observed in the field. Model 1 showed strong correlations between terrain attributes and depths for all horizons, although surprisingly, regression kriging was not able to model all variations. Model 2 showed a weak to absent correlation for the upper horizons but still a strong correlation for the deeper horizons BC, C1, and C2. For the upper horizons the spatial variation strongly resembled that of the measurements. This is a strong indication that bioturbation in the course of soil formation due to treefalls influences spatial patterns of horizon depths.