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Calibrating SoilGen2 for interglacial soil evolution in the Chinese Loess Plateau considering soil parameters, and the effect of uncertain forcings'

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To better understand interglacial paleosol formation by quantifying the paleosol formation processes on the Chinese Loess Plateau (CLP), we need a soil genesis model calibrated for long timescales. Here, we calibrate a process-based soil genesis model, SoilGen2, by confronting simulated and measured soil properties for interglacial soils formed in the CLP for various parameter settings. After the calibration of the intrinsic soil process parameters, the effect of uncertainty of external forcings (e.g. dust deposition) on calibration results was assessed.

This calibration comprises three major soil process formulations, represented by various process parameters. Sequentially : [1]. decalcification by tuning (i) the dissolution constant of calcite (ii) the interception evaporation fraction [2]. clay migration by tuning (iii) the volume of clay in-contact with macropores (iv) the filter coefficient (v) physical weathering (vi) the ectorganic layer thickness [3]. soil organic carbon by tuning the decay rates of (vii) humus and (viii) resistant plant material, and (ix) the ratio of ectorganic/endorganic litter (natural vegetations) (x) the ratio of carbon mineralized (CO₂) over that still in the food web (biomass and humus) during decomposition. The order of the tuned parameters was based on sensitivity analyses on parameters for modelling (de-)calcification and clay migration done for West European leaching climates, and on C-cycling parameters done for both West European and Chinese circumstances. These parameters, [1 and 3] and [2] were successfully calibrated to the Holocene and the Marine Isotope Stage (MIS) 13 climate evolution of the CLP, respectively. After calibration, soil properties show a strong response to 10 reconstructed dust deposition scenarios reflecting the propagation of uncertainty in dust deposition.

Our results emphasize the equal importance of calibrating soil process parameters and defining correct external forcings in the future use of soil models. Nevertheless, this calibrated model permits interglacial soil simulation in the CLP over long timescales.