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Drainage and leaching dynamics in a cropped hummocky soil landscape with erosion-affected pedogenesis

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Hummocky soil landscapes are characterized by 3D spatial patterns of soil types that result from erosion-affected pedogenesis. Due to tillage and water erosion, truncated profiles have been formed at steep and mid slopes and colluvial soils at hollows. Pedogenetic variations in soil horizons at the different hillslope positions suggested feedback effects between erosion affected soil properties, the water balances, and the crop growth and leaching rates. Water balance simulations compared uniform with hillslope position-specific crop and root growths for soils at plateau, flat mid slope, steep slope, and hollow using the Hydrus-1D program. The boundary condition data were monitored at the CarboZALF-D experimental field site, which was cropped with perennial lucerne (Medicago sativa L.) in 2013 and 2014. Crop and root growth was assumed proportional to observed leaf area index (LAI). Fluxes of dissolved organic and inorganic carbon (DOC, DIC) were obtained from simulated water fluxes and measured DOC and DIC concentrations. For the colluvic soil, the predominately upward flow led to a net input in DIC and DOC. For the truncated soils at steep slopes, a reduced crop growth caused an relative increase in drainage, suggesting an accelerated leaching, which in the long term could accelerate the soil development and more soil variations along eroding hillslopes in arable soil landscapes.