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Landscape controls on long-term fluxes of water, energy and soil formation in a Mediterranean catchment

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Soil formation is a complex process that depends on factors such as bedrock, climate, relief, vegetation and time. Despite of the great effort dedicated to explore these processes, little is known there is not a precise about the quantitative relationship between geomorphology and soil formation, especially on long timescales. In order to understand this complex interaction is important to investigate some quantitative aspects of the processes that drive pedogenesis. The integration of quantitative aspects by means of modeling will help us to understand better the soil formation upscaling this information at large scales of time.

In this study the effect of aspect and relative elevation on long- term soil formation has been studied on two converging slopes. The geometry generates microclimates that can structure ecosystems and affect depth and surface processes regimes.

In our study area, located in Sierra Morena, in Cordoba, S Spain, we studied 10 soil profiles along a catena distributed in various topographic conditions: plateau area, north and south facing slope. These profiles were sampled each 10-20 cm depth in order to study the quantitative differences in physical and chemical soil properties.

A new, spatially explicit model is presented of water infiltration and redistribution, temperature coupled to soil forming processes as a function of properties such as topographical variables, like aspect, slope, climate variables and vegetation. This model is based on a simple soil water balance model and runs at a daily time step. As paleoclimate data for rainfall and temperature is generally only available at the yearly or seasonal time scale, a weather generator was used in order to generate the necessary input data. Model output, for example mean annual water percolation, are then compared against field observations to evaluate whether the model can explain important soil properties, such as for example total weathered soil depth or texture.

This model allows to compare for different topographical positions the importance of water and energy fluxes, erosion and soil formation and incorporate in a simple way their interactions quantitatively.