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Spatial variability of Soil Surface Roughness

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Runoff generation depends on rainfall, infiltration, interception, and surface depressional storage. Surface depressional storage depends on surface microtopography, usually quantified trough soil surface roughness (SSR). SSR is subject to spatial and temporal changes that create a high variability. In an agricultural environment, tillage operations produce abrupt changes in roughness. Subsequent rainfall gradually decreases roughness. Beside it, local variation in soil properties and hydrology cause its SSR to vary spatially at different scales.

The methods commonly used to measure it involve collecting point elevations in regular grids using laser profilers or scanners, digital close range stereo-photogrammetry and terrestrial laser scanning or LIDAR systems. In this case, a laser-scanning instrument was used to obtain representative digital elevation models (DEMs) at a grid resolution of 7.2x7.2mm that cover an area of 0.9x0.9m. The DEMs were obtained from two study sites with different soils. The first study site was an experimental field on which five conventional tillage methods were applied. The second study site was a large olive orchard with trees planted at 7.5x5.0m and bare soils between rows. Here, three tillage treatments were applied.

In this work we have evaluated the spatial variability of SSR at several scales studying differences in height calculated from points separated by incremental distances h were raised to power values q (from 0 to 4 in steps of 0.1). The q = 2 data were studied as a semivariogram model. The logarithm of average differences plotted vs. log h were characterized by their slope, $\zeta(q)$. Structure functions [$\zeta(q)$ vs. q] were fitted showing that data had nonlinear structure functions typical of multiscale phenomena. Comparisson of the two types of soil in their respective structure functions are shown.

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