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Soil roughness: comparing old and new methods and application in a soil erosion model

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This study compared five methods for measuring soil surface roughness, two contact methods: pinboard and roller chain, and three non-contact methods: laser scanner, stereophotogrammetry and the "Kinect". The latter is a 3D depth sensor originally developed for gaming consoles, which recently was proved to be applicable for high-resolution DEM. Roughness was in this study defined as irregularities in the surface related to soil type and tillage practice. The index random roughness (RR), calculated as the standard deviation of a number of elevation recordings, was used for comparison. The methods were compared in terms of accuracy, precision, resolution, ease of use and price. The obtained average random roughness values were used as input in a physical-based spatially-distributed erosion model, LISEM. Results showed that the various methods have different pros and cons and since the methods use different principles to obtain roughness data, they are prone to different errors. The "Kinect" proved to be a useful sensor, both in terms of obtainable resolution ($\sim$90 000 measurements per m2) as well as costs and ease of use. The erosion model was relatively sensitive to the roughness input data, with a 20% and 40% increase in RR yielding approximately 20% and 40% decrease in hydrograph peak discharge [l/s], respectively. Interestingly, roughness data obtained with different methods (laser scanner versus "Kinect"), which in statistical terms were not significantly different from each other did cause a $\sim$50% change in hydrograph peak, indicating that the model sensitivity is not adjusted for the obtainable accuracy of measured roughness data. For improved model performance it is suggested to determine the required accuracy and precision as well as the preferred method of measured random roughness data when used as input to an erosion model like LISEM.

Key words: soil surface roughness, random roughness, erosion modelling, LISEM, the Kinect, data accuracy