



Using Digital Elevation Models and Image Processing to Follow Clod Evolution under Rainfall

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Abstract

Soil surface roughness plays an important role in determining how the soil will interact with its environment. Analysis of soil roughness at small scale matters both for preparation of soil in order to allow for plant emergence, and for decisions to favor soil conservation. Indeed, soil roughness may be shaped by tillage operations and then changes with time, under rainfall impact. Soil surface roughness is usually estimated by various indices, computed on measured profiles or images of elevations. Another approach is focusing on soil cloddiness, either by sieving or by image segmentation. The objective of this study is to monitor the evolution of clods under rainfall with Digital Elevation Model (DEM) recording and image processing.

We prepared two trays of artificial soil surfaces in the laboratory with silt loam soil topped by pre-sieved clods. They were designed to look like a seedbed. Soil surface evolution was achieved by subjecting the trays to controlled artificial rainfalls, and DEM were recorded at each stage. We performed automatic clod segmentation and measurement of the volume of individual clods. Under rainfall impact, we could see smoothing and leveling of clods until disappearance of the smaller ones. We focused on the larger clods greater than 12 mm in diameter that remained till the last rainfall. They showed swelling (volume increase) followed by erosion (volume decrease), these two phenomena being size dependent. Clod volume decrease was modeled by an exponential function. Now, the slope and the amplitude parameters decreased according to a power law, as a function of mean volume of clods.

Monitoring of clod volume with cumulated precipitation with the help of DEM measurements is able to differentiate the dynamics of clod depending on their size. This technique improves the usual roughness description and allows for a better understanding of the processes.

Keywords: Soil surface roughness; Digital elevation model; Monitoring; Cloddiness; Modeling; Rainfall impact; Erosion.

Biography:

Edwige Vannier has her expertise in Data Analysis and Processing and her interest in Soil Science. Her research focuses on soil surface roughness characterization and modeling. She graduated from the Ecole Nationale Supérieure de l'Électronique et de ses Applications, France in 1997. She received her PhD degree in Biomedical Engineering from the University of Paris-Est Créteil in 2001. From 2003, she is an Assistant Professor at the University of Versailles-St Quentin.