Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06000, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06000
EGU General Assembly 2008

Infiltration of a Fluorescent Dye in Allophanic Soils using Image Analysis: Calibration Procedure

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Over the years, exhibiting solute transport pathways have become a very active research area. Still, visualising active flow paths in soils with an accurate quantification of dye tracer distribution at high spatial resolution is quite recent. We propose a low-cost and fairly easy experimental procedure to map dye tracers concentrations in 2D. A fluorescent dye was leached through an intact cylindrical soil core of volume 0.14 m^2 extracted at 350 mm depth from an agricultural volcanic soil profile in Mexico. Each core profile (sliced at 100 mm increments) was photographed under constant set-up and illumination conditions. We corrected the anisotropic illumination conditions comparing several techniques as outlined in the relevant publications. The traditional calibration procedure relies on analysing dye concentration from soil samples extracted from the core and having homogeneous colour characteristics. We found this difficult to obtain for samples of reasonable volume (1 cm^3). Instead, we conducted an independent calibration experiment: known amounts of water, dye and dried soil material were homogeneously mixed and packed into boxes that were photographed under exactly identical conditions as the core profiles. Both horizontal and vertical positions of pixels were used as variables, along with six colour channels (Red, Green, Blue, Hue, Saturation, and Luminance). The calibration images were analysed using three different correlation strategies, e.g. multiple regression alone or preceded by PCA or PCA+LDA procedures. The 2D maps of dye concentration obtained from each core section achieved fine spatial resolution (e.g. 0.09 mm^2per pixel) and satisfactory dye concentration localization and estimation. The interpolated 3D map offered an inter-

esting visualisation of fractures and fissures networks in the soil core.