Hydrol. Earth Syst. Sci. Discuss., 11, C3853–C3856, 2014
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Controls of macropore network characteristics on preferential solute transport" *by* M. Larsbo et al.

Anonymous Referee #2

Received and published: 18 September 2014

1 General comments

The manuscript presents a study on the relationships between macropore network characteristics, hydraulic properties and state variables and measures of preferential transport in columns sampled from different macroporous agricultural topsoils. The macropore network characteristics are inferred from 3-D X-ray tomography images. Non-reactive transport experiments are performed in the columns with different flow rates, in condition of near-saturated flow. Two measures of preferential transport are considered: the normalised 5% arrival time and the Eulerian apparent dispersivity. Such measures depend only on the results of a transport test, differently from other model-dependent measures that have been proposed in the literature.

The main conclusion of the work is that soils with large macroporosities correspond to macropore networks with large sample-scale and pore-scale connectivities and are generally characterised by a low degree of preferential transport. The authors nicely highlight that this conclusion is valid at the pore scale and that it is consistent with the conclusion of other studies carried out at the macroscopic Darcy-scale, according to which preferential transport is more important in porous media characterised by a strong connectivity of the high-permeability material.

This study is definitely of interest to the scientific community: the relation between the macropore network characteristics - inferred from X-ray tomography - and the other hydraulic and transport properties is investigated under unsaturated flow conditions, which is a novelty in the scientific literature. Moreover, the discussion on the different correlation between connectivity and preferential transport occurring at pore and macroscopic scale is very interesting and may be useful to researchers studying the effects of heterogeneity on solute transport in porous media characterised by heterogeneity at different scales.

The methods applied to perform the experiments and analyse the data are rather accurate, particularly concerning the statistical indicators employed to show the different correlations. In general, the manuscript is well organized and quite clearly written; the tables are appropriate and the figures are fundamental to support and understand the text.

Therefore, I recommend this manuscript for publication, after some minor revisions suggested in the following sections.

2 Specific comments

- Abstract: The methods, analysis and results are well summarized; however, the objectives are not clearly stated. I suggest to explain the reason why "the relation-

ships between macropore network characteristics, hydraulic properties and state variables and measures of preferential transport" are examined, and to highlight the near-saturated conditions of the experiments, as clearly done at the end of the Introduction.

- Page 9554, line 1-2: Some references would be useful here.
- Page 9558, line 16 and 20: Justify equations (1) and (2), or give bibliographic references.
- Page 9559, line 11: Although references are given, the sentence would be clearer if you could provide examples for the "other model independent measures".
- Page 9562, line 19: The motivation of equation (10) is not clear: why the values 60 and 80 are chosen? How the reference values are estimated?
- Page 9566, line 14 and Figure 5: It would be interesting to explain why the correlations observed at 1 cm tension are not observed at 5 cm tension.

3 Technical corrections

- Page 9560, line 13: L is already defined at page 9959, line 19.
- Page 9560, line 15: the exponent 2 of the factor (t-μ_1) is missing.
- Figure 3: indicate the scale.
- Figure 5 (caption): I think p=0.05 should be p<0.05.
- Figures S1, S2, S3, S4 (captions, line 4): the sentence is incomplete for μ_1; however, I think it is enough to state that T is dimensionless time, which is defined in the text.

- Page 9567, line 9: the value of 0.04 can be seen in Table S4, but not in Figure 7.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 9551, 2014.