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# Water flow through aggregated soils: the role of the contacts

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Top soils are often structured as aggregates separated by large inter-aggregate pores. Under prevalent field conditions, the large inter-aggregate pores are drained and water is mostly stored in the aggregates. Water flows from aggregate to aggregate at a rate which depends on: i) the properties of the individual aggregates and ii) their mutual arrangement. The goals of this report were to identify the relevant factors affecting the water flow and to parameterize the equivalent hydraulic conductivity of the aggregate (micro-pore) domain.

In previous experiments we used neutron tomography to observe water infiltration through soil aggregates. Also, we performed high resolution X-ray tomography of aggregate pairs at equilibrium. We found that the contacts are the key factor controlling the water flow. They can be either conductive or bottle-necks. The abrupt transition between these two limiting cases is caused by the sudden drainage of the contact region.

After having identified the relevance of the contacts, we considered the movement of water in the aggregate region as a flow in series across aggregates and contacts. Thereby, the equivalent conductivity is calculated as the harmonic mean of the conductivities of aggregates and contacts. The conductivity of the contacts is determined by the water-filled contact area, which was measured by flow simulation and X-ray tomography. Also, the equivalent conductivity of series of aggregates was independently measured. Experimental and calculated results match well. We found that the equivalent conductivity decreases as the conductivity of the contacts, and in well-drained conditions it is three orders of magnitude smaller than that of the aggregates.

In this study we showed that the unsaturated conductivity of aggregated media is determined by the small-scale properties of the contacts. They drastically reduce the

conductivity of the aggregate region with respect to the conductivity of the aggregates.