A CHANNEL NETWOK MODEL AS A FRAMEWORK FOR CHARACTERIZING VARIABLY-SATURATED FLOWS IN BIOFILM-AFFECTED SOILS: CONCEPTUAL MODEL

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Summary. Conductivity alteration in soils and aquifers due to bacterial activity has been a subject of growing interest. Numerous works have studied the hydraulic conductivity reduction under saturated conditions, also known as "bioclogging". These include experimental as well as theoretical works which proposed conceptual models for the saturated hydraulic conductivity of bacteria-affected soils.

Up to date there has been very limited research regarding the effect of bacteria on soil hydraulic properties under unsaturated conditions. In the current work we present a new framework for simulating the combined water flow, solute transport, and biofilm growth under unsaturated conditions. The unsaturated medium is modeled as a network of channels having a triangular cross-section. The channel cross section is filled with water for saturated conditions and partially filled to represent unsaturated conditions. The flow in each channel is unidirectional where the water-filled fraction is related to the matrix potential. Flow rates and matrix head distribution within the network are obtained by solving the Stokes equation along the channels and satisfying mass balance at each of the network nodes. By applying different scenarios for the biofilm spatial distribution, the effects of the medium properties, saturation degree, and biofilm characteristics are examined.

At this stage the flow in the network is solved for given biofilm distributions. This however can be readily extended to include the full biofilm dynamics, if nutrient transport and biofilm growth are incorporated in the model.