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A Bézier-Spline-based Model for the Simulation of Hysteresis in Variably Saturated Soil

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Most transient variably saturated flow models neglect hysteresis in the p_c-S-relationship (Beven, 2012). Such models tend to inadequately represent matrix potential and saturation distribution. Thereby, when simulating flow and transport processes, fluid and solute fluxes might be overestimated (Russo et al., 1989). In this study, we present a simple, computationally efficient and easily applicable model that enables to adequately describe hysteresis in the p_c-S-relationship for variably saturated flow. This model can be seen as an extension to the existing play-type model (Beliaev and Hassanizadeh, 2001), where scanning curves are simplified as vertical lines between main imbibition and main drainage curve. In our model, we use continuous linear and Bézier-Spline-based functions. We show the successful validation of the model by numerically reproducing a physical experiment by Gillham, Klute and Heermann (1976) describing primary drainage and imbibition in a vertical soil column. With a deviation of 3%, the simple Bézier-Spline-based model performs significantly better that the play-type approach, which deviates by 30% from the experimental results. Finally, we discuss the realization of physical experiments in order to extend the model to secondary scanning curves and in order to determine scanning curve steepness.

Literature

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