Publications

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Relationship Between Soil Moisture Storage and Deep Percolation and Subsurface Return Flow

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- Full Text

A simulation study was performed to analyze the relationship between the volume of moisture stored in a soil profile and the rate of percolation and subsurface return flow. The simulation study was derived on the basis of the Richards equation. The one-dimensional form of the Richards equation was used for the percolation process and the two-dimensional form of the Richards equation was used for the subsurface return flow process. In each case the Richards equation was transformed to a set of nonlinear algebraic equations using the finite element method to transform the space derivatives and the finite difference method to transform the time derivatives. The system of nonlinear algebraic equations were solved using the Gaussian elimination procedure and an under-relaxation procedure.

To characterize the percolation and subsurface return flow processes a sensitivity analysis was performed by varying parameters of the soil systems. It was found that the relationships between stored soil moisture and deep percolation and between stored soil moisture and subsurface return flow each form hysteresis loops. The percolation loops were most sensitive to soil texture class, and water application rate. Soil layering, soil evaporation, water table depth, and evapotranspiration did not greatly influence the percolation loop. The subsurface return flow loops were sensitive to soil texture, soil slope angle, length of the soil slope relative to soil depth, and water application rate. The subsurface return flow loops were not greatly influenced by soil layering.

The resulting percolation and subsurface return flow characteristics suggest the possibility of utilizing the derived characteristics in the physical representation of these processes in comprehensive hydrologic models.

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