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Mapping mean monthly runoff pattern using EOF analysis

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Abstract. Runoff generation in a forested catchment (0.18 km^2) was simulated using a quasi-three-dimensional rainfall-runoff model. The model was formulated over a finite grid where water movement was assumed to be dominantly vertical in the unsaturated soil zone and horizontal in the saturated soil. The vertical soil moisture distribution at each grid cell was calculated using a conceptual approximation to the one-dimensional Richards equation. The approximation allowed the use of a simple soil surface boundary condition and an efficient solution to the water table elevation over the finite grid. The approximation was coupled with a two-dimensional ground water model to calculate lateral soil water movement between the grid cells and exfiltration over saturated areas, where runoff was produced by the saturation-excess mechanism. Runoff was an input to a channel network, which was modelled as a nonlinear reservoir. The proposed approximation for the vertical soil moisture distribution in unsaturated soil compared well to a numerical solution of the Richards equation during shallow water table conditions, but was less satisfactory during prolonged dry periods. The simulation of daily catchment outflow was successful with the exception of underprediction of extremely high peak flows. The calculated water table depth compared satisfactorily with the measurements. An overall comparison with the earlier results of tracer studies indicated that the modelled contribution of direct rainfall/snowmelt in streamflow was higher than the isotopically traced fraction of event-water in runoff. The seasonal variation in the modelled runoff-contributing areas was similar to that in the event-water-contributing areas from the tracer analysis.

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