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A stochastic rainfall-runoff model explains Schreiber's (1904) empirical equation

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A parsimonious model is presented leading to Schreiber's (1904) aridity-runoff relation as equilibrium solution of the rainfall-runoff chain. The chain commences with a fast stochastic water reservoir of small capacity representing interception and wetted ground in short time intervals. It feeds a slow (almost stationary) soil moisture reservoir of large capacity balancing its runoff after long-term averaging. Parameterizing the fast reservoir's capacity by the water equivalent of net radiation available for evaporation leads to a biased coin-flip surrogate for its 'full' or 'empty' states, when rainfall is larger or smaller than the capacity. Rainfall surplus from the fast reservoir's 'full' state feeds the slow (almost stationary) soil moisture reservoir; with the residual evaporating the fast reservoir starts anew as 'empty'. Rainfall below capacity evaporates completely and, leaving the energy surplus for sensible heat, the fast reservoir also starts anew 'empty'. Employing coin-flip occurrence probabilities from exponentially distributed precipitation yields Schreiber's equation of state.