

Interactive comment on “Simplified stochastic soil moisture models: a look at infiltration” by J. Rigby and A. Porporato

Anonymous Referee #3

Received and published: 20 July 2006

This paper compares two models of soil moisture dynamics: (1) an analytical stochastic model of the soil water balance with instantaneous rainfall occurrences and (2) a numerical model of soil water dynamics with rainstorms of finite duration. By accounting for the duration of rainfall events the second model is able to resolve the temporal dynamics of infiltration and to calculate possible losses of soil water associated with Hortonian runoff. To this end the authors use Philip’s (1957) infiltration theory. On the other hand, the analytical model accounts only for saturation-excess runoff, which can be calculated without resolving soil moisture dynamics in the course of rainfall events. The general goal of this study is to assess whether the probability distributions of soil moisture calculated with the more detailed (numerical) model is significantly different from those provided by the analytical simplistic model of stochastic soil moisture dy-

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namics. It is found that only minor differences exist between these two probabilistic structures of soil moisture. Thus, in most cases the simplistic analytical framework provides a sensible representation of the stochastic dynamics of soil moisture at the daily time scale.

The main merit of this study is to assess the effects of a major simplification underlying the analytical model, i.e., the assumption that rainfall is instantaneous (this assumption was necessary to obtain an analytical expression for the probability distribution of soil moisture). The manuscript is technically sound, well written, and provides an important contribution to the field of soil moisture modeling. I definitely recommend it for publication in HESS.

I only have a few minor points:

- Page 1, line 10 of the Introduction << these are complex, nonlinear systems>>
- Page 1, column 2, line 15: << and that of Horton>>
- Page 2, first line of section 2: <<vertically-averaged probabilistic models>>
- Equation 17 needs to be reformatted.
- Page 6 end of section 2: <<by numerical simulation>>

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1339, 2006.

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