Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "Rainfall intermittency and vegetation feedbacks in drylands" *by* M. Baudena and A. Provenzale

Anonymous Referee #2

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General Comments

The paper addresses common shortcomings in the modeling of soil-vegetation interactions in drylands. By developing and applying a simple, conceptual model of soil water dynamics in two layers and of vegetation cover, the role of water-vegetation feedbacks is assessed. Here, the paper focuses on the effects of enhanced infiltration and the reduced evaporation due to shading effects at vegetated sites. Although these feedbacks, especially the role of infiltration, have been analyzed by other conceptual models, assessments of the role of rainfall intermittency have been widely neglected. To my knowledge, analytical water-vegetation models generally assume constant rainfall. Thus, the paper offers new and interesting insights into the combined effects of rain-

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fall intermittency and water-vegetation feedbacks. These insights might especially be useful to assess the impact of altered precipitation patterns under climate change. The paper is easily understandable and the overall model description is logical and consistent. With this interdisciplinary analysis of the interactions of soil water and vegetation dynamics, the paper falls well into the scope of this journal. I thus recommend this paper for publication in Hydrology and Earth System Science.

Specific Comments

Although, I generally like the paper, I have some questions and some issues, which I would like you to discuss.

The model: - How deep are the soil layers? - Why does the vegetation have no access (= transpiration) to the upper soil layer - What about the limitation of infiltration speed? You speak about loamy soils, where the hydraulic conductivity can be a limiting factor for infiltration. In your model, infiltration is only limited by saturation (or the factor f for soil crusts at bare sites) - Evaporation: suddenly, the value sw comes into play which is not defined here (but later) - Why is there no infiltration into the deeper layer of bare sites? I know that you assume water to be lost from the system, when it goes into the deeper layer of bare sites. And that you therefore neglect this layer (which I find valid). However, if there was infiltration into the lower layer, it would also be lost from the system and could not be redistributed to other sites. So it might still be important. - A clear description of Ew is missing

Analyses: - You speak about including or excluding the positive feedback of vegetation on infiltration. However, in your model infiltration is not directly positively affected by vegetation. You only change the factor f, which reduces infiltration at bare sites and thus increases runoff to the vegetated sites. This also results water availability at vegetated sites but only because of the limited infiltration are bare sites and not because of a better infiltration at vegetated sites. - You come to the conclusion that each, shading and infiltration, have a positive influence on water availability, but if you introduce both

feedbacks, the results do not improve any further. However, this could be an effect of your parameterization. Additionally, if you included evaporation of surface water (when it is redistributed by runoff from bare to vegetated patches) this could also change. Testing for the latter would be beyond the scope of the publication, but you could discuss this. And did you check for different parameter combinations? - p. 4254 ll.10-12: this should be explained

Arrangement of the model description: - The order of the model description is a bit confusing: First, the equations for bare sites are introduced, then the ones for vegetated sites. But for the latter, only processes are described that differ from those of bare patches. If you do it that way, you should already mention at the description for bare sites that these equations hold as well for vegetated sites.

Technical Corrections

- I am not a native speaker. However, some parts seem to be written in colloquial language or imprecise, e.g. p. 4243, l. 15 "in which it lives in many different ways";. - I am also not sure, if you can use "differential infiltration" (e.g. p. 4244, l. 23, but also elsewhere) in this context or if it would not be better e.g. to write "differing infiltration for bare soil and vegetated patches". - p. 4250, under equation 13: substitute "where plants grow" by "on vegetated sites" - Caption of Fig3: "Symbols represent the average vegetation cover for" If I understand the figure correctly, it should be average soil moisture and not vegetation cover

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