

Interactive comment on “A simple global Budyko model to partition evaporation into interception and transpiration” by Ameneh Mianabadi et al.

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Dear Michael Roderick,

We are very grateful for your detailed review on our manuscript, where we apply the Gerrits 2009 WRR-model on the global scale with parameters estimated from remotely sensed data sources.

The underlying reasoning of the Gerrits model is indeed to recognise the characteristic time scales of the different evaporation processes (i.e. interception daily and transpiration monthly). In Gerrits 2009 WRR (and in the current paper as well) this has been done by taking yearly averages for the interception ($D_{i,d}$, mm/day) and transpiration

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threshold ($D_{t,m}$, mm/month) in combination with the temporal distribution functions for daily, and monthly (net) rainfall. Hence the seasonality is incorporated in the temporal rainfall patterns, and not in the evaporation thresholds. We agree that this is a limitation of the currently used approach and could be the focus of a new study by investigating how seasonal fluctuating thresholds (based on LAI and/or a simple cosines function) would affect the results. This could be a significant methodological improvement of the Gerrits-model, but will have mathematical implications on the analytical model derivation. For sure it will improve the monthly evaporation estimates, but we expect that the consequences at the annual time scale (which is the focus of the current paper) will be less severe.

Firstly, the consequences of using a constant interception threshold ($D_{i,d}$). We modelled the daily interception storage as the minimum of the storage capacity (S_{max}) and the daily potential evaporation ($E_{p,d}$), see Equation 15. For most locations S_{max} is smaller than $E_{p,d}$ even if we consider a daily varying potential evaporation. S_{max} (based on LAI) could also be changed seasonally, however many studies show that the storage capacity is not changing significantly between the leafed and leafless period (e.g., Leyton et al., 1967; Dolman, 1987; Rutter et al., 1975). Furthermore, Gerrits et al (2010) showed with a Rutter-like model that interception is more influenced by the rainfall pattern than by the storage capacity, which was also found by Miralles et al. 2010. Hence, in interception modelling, the value of the storage capacity is of minor concern.

We expect that the consequence of a constant transpiration threshold ($D_{t,m}$) is more important, especially in energy constrained areas. But in those, relatively wet, areas we will underestimate the transpiration in summer and overestimate it in winter, which will cancel out on the annual scale.

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We agree with you this is a limitation of the Gerrits model and are grateful for your suggestion. In the revised manuscript we propose to add a detailed discussion on the implications of using a constant interception and transpiration threshold on the annual time scale.

Furthermore, it seems there is some confusion on whether soil evaporation (E_s) is taken into account in our model or not, since it is not considered in equation 3 anymore. We do consider 'soil evaporation', however we consider what many researchers call 'evaporation from the soil' as forest floor or ground interception (as part of total interception). Hence we define interception broader than only canopy interception. We define interception as "the amount of evaporation from any wet surface including canopy, floor, understory and the top layer of the soil, occurring within a day from the rainfall event". Hence interception evaporation is the fast feedback of moisture to the atmosphere originating from wet surface. Soil evaporation is then defined as "evaporation of soil moisture that is connected to the root zone (De Groen and Savenije, 2006)" and is therefore different from evaporation of the top layer of the soil (several millimetres of soil depth, which is here considered as part of the interception evaporation). Gerrits et al (2009) assumed that evaporation from soil moisture is negligible (or can be combined with interception evaporation). As a result equation 2 becomes $E = E_i + E_t$ for land surfaces, where E_i is direct feedback of moisture stored on vegetation, ground, and top layer, while E_t is evaporation from soil moisture storage in the root zone, which includes soil moisture that evaporates directly to the air by capillary rise.

We understand your confusion, and therefore propose to replace the first paragraph of the Methodology section with the definitions as given above. We hope these definitions clarify your question.

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Lastly, we like your suggestion to add a list of symbols. We agree that this will help the reader understanding the paper more easily. Also the issue with Figure 1c (LAI) will be fixed. The maximum LAI is indeed not 60, but 6.

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