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Interactive comment on "Contrasting roles of interception and transpiration in the hydrological cycle – Part 1: Simple Terrestrial Evaporation to Atmosphere Model" *by* L. Wang-Erlandsson et al.

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We thank Richard de Jeu for his comments and questions. We will address the raised concerns below. Richard's comments are in italics, and our responses are in upright font. Unless otherwise stated, sections and equations referred to are those of the manuscript.

1) pg 211, ln19: because over 24 hours it is small, ground heat flux is neglected. The former is true but the latter does not follow. Energy goes into the soil during the day,

thereby making it unavailable for evaporation and releases it at night when stomata are closed and evaporation is zero.

Ground heat flux can be significant over a few hours, but is normally small at daily scale. It is also incorrect that stomata are closed at night. The review of (Wang and Dickinson, 2012) found nocturnal transpiration to make up a significant fraction of total transpiration (Novick et al., 2009) and to be widespread among trees and shrubs across a range of ecosystems (Dawson et al., 2007; Snyder, 2003).

Neglecting ground heat flux at the daily scale is considered acceptable by e.g., the ASCE Hydrology handbook (Allen et al., 1996): "the daily value of G normally can be neglected for most practical estimates involving energy balance". In STEAM, the potential evaporation is calculated on a daily basis and the 3 hour time step is derived based on fitting the potential evaporation to ERA-I evaporation (as explained at p. 213, L4-5). Although we do not explicitly calculate subdaily or daily ground heat flux, the heat released during night to drive nocturnal evaporation is implicitly taken into account. Thus, we may also have evaporation during night as is supported by the literature.

However, referee #2 correctly pointed out that seasonal variations of ground heat flux can be important to take into account. In the revised manuscript, we will incorporate approximation of monthly ground heat flux as a function of monthly mean air temperatures.

2) Eq. 6. This equation describes the soil moisture decreasing velocity (as a combined effect of infiltration and evaporation). This highly empirical relationship is actually based on observations from just 3 locations in West Africa (Pellarin et al., 2013). In reality this relationship is also sensitive to solar radiation, wind speed, *and the presence of vegetation amongst other things. I think scientific justification is needed here to apply such a locally derived equation at a global scale.*

The relationship is **semi-empirical** (based on an Antecedent Precipitation Index model) and **evaluated against observations** in semi-arid West Africa (Pellarin et al., 2013). We think it is acceptable to use the relationship because it is tested in the type of area where soil evaporation is most important. The effect of neglecting soil evaporation is significant when leaf are index (LAI) is smaller than 1, and less when LAI exceeds 1.5 (Allen et al., 1996).

We acknowledge that the use of this equation is pragmatic. Also Pellarin et al., (2013) acknowledged that the "relationship should potentially be improved including other factors that play a significant role in infiltration/evaporation such as the solar radiation, the presence of vegetation or the wind velocity." In the revised manuscript, we will acknowledge the limitation of this relationship.

3) Eq. 7 to 10. I worry about this set of equations as they seem to ignore the need for energy to be conserved. The net radiation can only be used once. Is energy conserved in these equations when they are taken as a set?

Energy is conserved in this set of equations. In each equation, the evaporation flux of concern is taken as the minimum of available moisture and the available energy for evaporation. Available energy for evaporation is reduced by evaporation fluxes of the antecedent layer, i.e.:

1. In Eq. 7, the available energy for vegetation interception evaporation E_{v} is equal to the potential evaporation E_{p}.
2. In Eq. 8, the available energy for transpiration E_{t} evaporation is E_{p} reduced by

E_{v} (and reduced by stomatal resistance).

3. In Eq. 9, the available energy for floor interception evaporation E_{f} is E_{p} reduced by E_{v} and E_{t}.
4. In Eq. 10, the available energy for soil moisture evaporation E_{sm} is E_{p} reduced by E_{v}, E_{t} and E_{f} (and reduced by soil moisture resistance).

Thus, the total actual evaporation can never exceed the total available energy for evaporation.

4) pg 216, ln 18 and Eq 7: "The storage capacity determines the maximum water availability for the evaporation flux of concern." If I understand this statement and the Eq. 7 correctly the daily evaporation of intercepted water cannot exceed the canopy storage capacity? This can only be true if the evaporation during rainfall is zero. It is well established by measurement (e.g. by Bowen ratio and eddy-covariance measurements), and can be predicted by theory (i.e., the physics-based Penman-Monteith equation with above-canopy met data) that evaporation from a wet canopy is considerable (generally about 0.2 mm per hour). Thus, if I understand this correctly then it follows that the rest of the paper is based on a false premise and is therefore flawed.

This is a misunderstanding. The actual evaporation is calculated at 3 hour time step (specified at e.g., p. 213 L. 5, and time step is defined also in Table A1), not daily. Interception evaporation is also allowed during time steps with rainfall.

We will add a sentence at the beginning of Sect. 3.2 to make clear that the set of equation is run at 3 hour time step.

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