Review: Wang-Erlandsson et al. ESD-D

General comments

It is still difficult to ascertain what the original contribution of this paper is. The paper describes the 'STEAM' evapotranspiration model with some evaluation of its performance compared to other land surface models and measured values. The model finds that canopy evaporation is quicker than transpiration by an order of magnitude. The difference in persistence between water in the canopy and water transpired is already well established, and in this case is inevitable because of the model structure. There is still not a compelling argument given for why a new model is needed and what original scientific contribution it makes, compared to existing offline land-surface models.

This paper is still primarily a model description. If a good rationale for the need for this model can be made, then the paper may be suitable for publication, in for instance Geoscientific Model Development. GMD would make providing the model code to the reviewers compulsory, which would be very beneficial in this case given the questions surrounding the structure of the model that many of the reviews have raised.

Specific comments:

1. The authors have made a good effort to establish what the motivation of the model and the research is. The motivation is quite different from the first version, which seemed to be focused on differences of evapotranspiration partitioning over different land uses. It now aims to explore the temporal differences in partitioning over land. Unfortunately, there are some issues with the way this has been done. The research aims listed on lines 150 – 154 all involve the residence time of the individual parts of terrestrial evapotranspiration. However, the rationale for the new model STEAM (lines 157 – 164) does not include any temporal aspect. Since the model has not been designed to answer the research questions stated in the paper, it's impossible to have any confidence in the suitability of, or indeed the need for, the new model.
2. One of the key findings is how long each of the different fluxes takes to evaporate (lines 1009 – 1015). However, the timings of these fluxes and the separation in the timings of the fluxes in entirely determined by the model structure, set out in lines 275 – 278. The description fails to note that the transpiration that occurs after the canopy evaporation is clearly not water from the same rainfall event. The very long residence time of transpiration and soil moisture is just a function of the fact that the sequence is entirely linear, and all the water from the "floor" must evaporate before the water from the soil can evaporate, and etc.. The author's response to my previous questions about the evaporation sequence is inadequate. To say that soil moisture cannot evaporate before litter moisture "by definition" assumes that litter is an impermeable homogeneous layer (which it clearly isn't). Similarly, to put transpiration second in the "logical sequence" in the model description mixes up water from a particular rainfall event with water already within a store in the model, making it confusing that transpiration then has the longest residence time.
3. The authors also should note that simple is a feature of a model, not a benefit. Model benefits are something that enables better science. For instance, a model feature might be that it is quick to run; the benefit is that

this enables large ensembles to be run and therefore the uncertainty associated with the model can be better understood. It is not enough to say that a model has new features – the new features must have science benefits in order to be a useful contribution.

4. The stated aims of the paper are, as previously mentioned, to do with the residence time of the partitioned evaporative fluxes. However, the literature review (lines 37 – 134) is all to do with the relative partitioning of the evaporative fluxes, and barely mentions the temporal aspect, except to (incorrectly) say that it has not been considered. Therefore the introduction is totally irrelevant to the research questions. Not only that, the temporal aspect of evapotranspirative fluxes has been considered, for instance by Entekhabi *et al* 1992, Yeh *et al* 1984, Dirmeyer *et al* 2009, Yepez *et al* 2003, Priestley and Taylor 1972, Farah *et al* 2004, Maurer *et al* 2001, Brubaker *et al* 1993, Scott *et al* 1995a, Yepez *et al* 2005, Raz-Yaseef *et al* 2012, Dirmeyer and Brubaker 2007, Trenberth 1999, Huang *et al* 1996). Moreover, aim 3 of the paper, 'how robust are the temporal characters to uncertainties in storage capacities' has been substantially answered by Scott *et al* (1995). In the abstract, the authors claim that moisture recycling studies have only considered the fluxes' "lumped total"*. This is clearly not the case. (* "combined total" would be a more elegant phrase here.)
5. It is still not clear what the rationale is for this paper being part of a pair. The other paper uses a different model, appears only vaguely connected by the topic of evaporative fluxes, and is not mentioned outside of the introduction and the conclusions.

Brubaker K L, Entekhabi D and Eagleson P S 1993 Estimation of continental precipitation recycling *J. Clim.* **6** 1077–89

Dirmeyer P A and Brubaker K L 2007 Characterization of the global hydrologic cycle from a back-trajectory analysis of atmospheric water vapor *J. Hydrometeorol.* **8** 20–37

Dirmeyer P A, Schlosser C A and Brubaker K L 2009 Precipitation, recycling, and land memory: An integrated analysis *J. Hydrometeorol.* **10** 278–88

Entekhabi D, Rodriguez-Iturbe I and Bras R L 1992 Variability in large-scale water balance with land surface-atmosphere interaction *J. Clim.* **5** 798–813

Farah H O, Bastiaanssen W G M and Feddes R A 2004 Evaluation of the temporal variability of the evaporative fraction in a tropical watershed *Int. J. Appl. Earth Obs. Geoinformation* **5** 129–40

Huang J, van den Dool H M and Georgarakos K P 1996 Analysis of model-calculated soil moisture over the United States (1931-1993) and applications to long-range temperature forecasts *J. Clim.* **9** 1350–62

Maurer E P, O'Donnell G M, Lettenmaier D P and Roads J O 2001 Evaluation of the land surface water budget in NCEP/NCAR and NCEP/DOE reanalyses using an off-line hydrologic model *J. Geophys. Res. Atmospheres 1984–2012* **106** 17841–62

Priestley C H B and Taylor R J 1972 On the assessment of surface heat flux and evaporation using large-scale parameters *Mon. Weather Rev.* **100** 81–92

Raz-Yaseef N, Yakir D, Schiller G and Cohen S 2012 Dynamics of evapotranspiration partitioning in a semi-arid forest as affected by temporal rainfall patterns *Agric. For. Meteorol.* **157** 77–85

Scott R, Koster R D, Entekhabi D and Suarez M J 1995a Effect of a canopy interception reservoir on hydrological persistence in a general circulation model *J. Clim.* **8** 1917–22

Scott R, Koster R D, Entekhabi D and Suarez M J 1995b Effect of a Canopy Interception Reservoir on Hydrological Persistence in a General Circulation Model *J. Clim.* **8** 1917–22

Trenberth K E 1999 Atmospheric moisture recycling: Role of advection and local evaporation *J. Clim.* **12** 1368–81

Yeh T C, Wetherald R T and Manabe S 1984 The effect of soil moisture on the short-term climate and hydrology change-A numerical experiment *Mon. Weather Rev.* **112** 474–90

Yepez E A, Huxman T E, Ignace D D, English N B, Weltzin J F, Castellanos A E and Williams D G 2005 Dynamics of transpiration and evaporation following a moisture pulse in semiarid grassland: A chamber-based isotope method for partitioning flux components *Agric. For. Meteorol.* **132** 359–76

Yepez E A, Williams D G, Scott R L and Lin G 2003 Partitioning overstory and understory evapotranspiration in a semiarid savanna woodland from the isotopic composition of water vapor *Agric. For. Meteorol.* **119** 53–68