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Discussions

Interactive comment on "Potential evaporation estimation through an unstressed surface energy balance and its sensitivity to climate change" *by* A. Barella-Ortiz et al.

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Your manuscript addresses a very important topic of how to conceptualise, formulate and assess the sensitivity of potential evapotranspiration to climate change. Being such a central topic to hydrology and earth system sciences there is extra weight on the authors to ensure that concepts are clearly documented, and there are several instances identified below where clarifying expression would improve the utility of this important manuscript.

1) P8198, L10 and many other instances elsewhere, Allen et al. (1998) formulates a

crop reference evapotranspiration (ETo) this is NOT a formulation of potential evapotranspiration (ETp). Simply put ETo is primarily used for water scheduling of irrigation areas and has some fixed (or reference) land surface parameters derived for a generic (or reference) crop. An obvious way to consider that ETo is not a ETp formulation is to consider the surface resistance (rs). In Allen et al.'s (1998) ETo the rs has the value of 70 s/m, this is much larger that what is implied in the meaning of a ETp, where rs = 0 s/m. Hence in the expression it appears there is some confusion regarding the concepts of crop reference evaporation and potential evaporation; it would be best to remove all possible confusion with explicit, succinct sentences.

2) P8199, L4, in the abstract you have the statement "... in most actual evaporation estimations." yet here in the Introduction you state " ... of most evaporation estimations." In the latter if you qualified the type of evaporation by adding the term actual to distinguish from others that would be preferable. As pointed out by McVicar et al (2012 a,b) atmospheric evaporative demand (AED) can be measured by (i) pan evaporation (Epan); (ii) estimated by fully physically-based models of potential evapotranspiration (ETp); (iii) estimated by fully physically-based models of crop reference evapotranspiration (ETo); and (iv) may apply to actual evapotranspiration (ETa) depending on water availability. For ETa note the may, as if an area is severely water-limited (e.g., a dryland farm in drought) then changing atmospheric conditions may negligibly change ETa rates – as in this case ETa rates are already limited by water availability.

3) P8199, L5, we are facing 'climate change' not only 'warming climates' (aka global warming), with climate change being broader. When climate change is considered, variables other than air temperature governing the evaporative process, including wind speed, net radiation and atmospheric water vapor pressure, must also be considered (as you state in several places in your manuscript). McVicar et al (2012 a) showed that observed trends in AED (by assessing measured Epan trends; their Table 5 and by assessing fully physically-based estimates of ETo (i.e., FAO-56) trends; their Table 6) are declining in a warming world and have clearing illustrated that declines wind

speed, and other variables, are important causes of this decline of AED (their Table 7, see especially the attribution class). Observed declines of wind speed are widespread McVicar et al (2012 a; their Table 2 and Figures 2 and 3). It would be best if all instances of ‘when the climate warms’ (P8220, L25) were changed to something like ‘when the climate changes’ as the latter includes all processes impacting AED.

4) P8201, L8, the paper by Donohue et al (2010) clearly supports your statement that ‘variables determining ETp and affected by climate change’. In that study 5 formulations of ETp were calculated and monthly trends in the various ETp forms were compared monthly precipitation trends (their Table 4). Noting that as Australia is primarily water limited a complementary relationship would is expected, and the results provided a means to assessing the utility of the various ETp formulations to capture dynamics when considering climate change. As the data used in this manuscript is global, the opportunity exists to assess changes in water-limited locations with large precipitation trends for several regions across the globe and use these results to assess which formulation best captures the expected complementary trends.

5) P8204, L12, in the thermal remote sensing literature to estimate ETa rates, several authors (e.g., McVicar and Jupp, 2002; Kustas et al 2003; Kalma et al 2008) have inverted resistance energy balance models to calculate two surface temperatures, one associated with dry conditions (rs = infinite s/m) and the other with wet conditions (rs = 0 s/m), and have then calculate the moisture availability using the observed surface temperature which lies within this envelope. Hence while use of this approach may be new in ORCHIDEE, and possibly more widely in the land-surface modelling community, it has been widely used in the thermal remote sensing community for about a decade and it might be worthwhile mentioning this.

6) Your use of explicit subscript notation so readers know exactly which form of ETp you are referring to (e.g., P8203, L15 and P8205, L4) is excellent, and is to be widely encouraged in the literature.

7) P8207, L14, Hargreaves and Samani (1985), as their title suggests, is addressing ETo not ETp.

8) P8210, heading 2.5.2 (and elsewhere in the text) most likely you mean relative humidity here as opposed to other forms of humidity, such as specific humidity and absolute humidity, and while they are obviously related it might be best to explicitly qualify which form of humidity you mean.

9) P8212, L1-8, you may wish to add qualification of water-limited and energy-limited to assist with interpretation here.

10) P8217, L26-27, yes CGM output can have considerable errors and thus modelled estimates of AED can be very biased. This is clearly shown in McVicar et al (2012 b, Figure 4) where many GCMs get the wrong answer, some get the right answer for the wrong reasons, and only one get the right answer for the right reason. This is performed when assessing how well GCM output can be used in a model of Epan trends and is compared to observed Epan trends across Australia. Both the GCM output forced model of Epan and observed Epan trends are attributed to their relative radiometric and aerodynamic components, with the aerodynamic component being further partitioned into the wind, VPD and air temperature components (Johnson and Sharma 2010; Roderick et al 2007).

11) P8221, L19, would be good to mention wind speed in here too.

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