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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "An application of GLEAM to estimating global evaporation" *by* D. G. Miralles et al.

**D. G. Miralles et al.**

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## Response to Editor

Firstly, we would like to thank Dr. Bart van den Hurk for his interest in our work and also for his comments and corrections; we are really glad about the positive feedback on our work. We have incorporated all the suggested changes into our manuscript.

## Editor

You have very well contributed to and made use of the constructive HESSD discussions regarding your manuscript. The open review discussions have changed the presentation and focus of the paper into its currently very informative and valuable piece of



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Discussion Paper

work, and there is no doubt that this manuscript should be published in HESS. Apart from a few technical corrections (see below) there is one result that is inconsistent with my own knowledge of hydrological budgets of different continents. Your estimates of precipitation over Africa and the evaporative fraction are very different from textbook estimates from e.g. Peixoto and Oort (1992; Physics of Climate; AIP New York; page 172 added as pdf), who report only 696 mm/yr of precipitation of which 84% is evaporated. It may be worth discussing this large discrepancy with your results.

**Authors**

True. The most plausible reason that we can think of has to do with how unreliable gauge-based estimates of total precipitation over Africa are. We believe that the precipitation estimates of Baumgartner and Reichel (1975) and Sellers (1965) may be underestimated due to the sparse cover of gauge observations in the continent (especially at the time those studies took place).

To check this hypothesis we have run the entire methodology over Africa for the period 2003–2007 using three different precipitation products:

a) CMORPH: only satellite-based (full use of TRMM observations).

b) GPCP-1DD: less satellite-based but gauge-corrected.

c) CPC-Unified: based on rain gauges only.

Figure 1 shows the results of this analysis. The average annual precipitation (in mm) for each of the three products over Africa is very different. While CMORPH estimates an average 930 mm/yr (as stated in the manuscript), the fully gauge-based product estimates 504 mm/yr only. Given that there is not a linear relation between precipitation and evaporation in GLEAM and that the estimates of evaporation are also sensitive to other variables (especially the net radiation), the calculated average evaporation over Africa does not vary so much when the precipitation input is changed. This causes very large differences in the estimated evaporative fraction, which ranges between



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58% when CMORPH is applied and 85% when CPC-Unified is used. Therefore, the discrepancy the editor is mentioning seems to respond to uncertainties in precipitation over Africa and not to a systematic error in the methodology. The use of satellite information is important to reduce uncertainties in precipitation over areas of sparse ground observations like Africa (see also Love et al. (2004) that dealt with the use of satellite information to improve gauge-based estimates of precipitation over Africa). Consequently we are prone to believe that the estimate of the evaporative fraction for Africa reported in the manuscript may be more reliable than previous ones based on the use of ground observations only.

A new paragraph has been added to the Discussion to incorporate the results from Baumgartner and Reichel (1975) and Sellers (1965) and comment this discrepancy.

**Editor**

P.4, last sentence section 1: rephrase to "...are analysed in detail"

**Authors**

Corrected

**Editor**

P.5: I don't exactly understand what you mean with "the number of common estimates has to be sufficient"

**Authors**

We acknowledge that in this context the sentence may be misleading and reader may think that we mean the number of products (which is always three). What we mean is – for a given pixel – the number of "triplets", so the number of days in which the three products give an estimate of evaporation during the period of study (after having



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removed all the days in which at least one of the tree products is missing). Unlike when dealing with satellite soil moisture in which gaps in the dataset are common at daily time-step, in our case the number of triplets is generally equal to the number of days in the 4-years period because the three products give a daily estimate at every pixel. So for this study the number of common estimates is in almost every land pixel 1461.

We have rephrased this sentence to make clearer what we mean (see also the extended paragraph starting in line 5 of page 6).

**Editor**

P.6 (last line): "thee" -> "three"

**Authors**

Corrected

**Editor**

P.8: insert "in" before "Table 1"

**Authors**

Corrected

**Editor**

"11% of global evaporation": surely you don't mean to include evaporation from the ocean in this number. So it is again "continental evaporation".

**Authors**

Corrected



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**Editor**

Same page: a large part of the Amazon land mass happens to lie within the ITCZ, which explains the large amount of precip per unit land area. This is very different from the geometry of Africa

**Authors**

True. The last sentence of that paragraph now reads “Fluxes are larger in South America due to the faster dynamics of the hydrological cycle over Amazonia which results from the majority of South America’s land mass being located within the ITCZ; this is more easily recognised when the fluxes are expressed per unit area”.

**Editor**

P.14: rephrase as "...process, known changes in the controlling factor may be translated..."

**Authors**

Changed

**Editor**

in 4.2.3: replace "winter" by DJF (or "boreal winter") and "summer" by "JJA"

**Authors**

Replaced (except for when we did mean summer and winter).

**Editor**

Fig 1: explain that "soil moisture" is a remotely sensed top soil moisture (to distin-



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guish it from the soil moisture profile), and be consistent in the use of "Interception" or "Interception Loss" (in the PT box)

**Authors**

True; figure corrected.

**References**

Baumgartner, A. and Reichel, E.: The World Water Balance: Mean Annual Global Continental and Maritime Precipitation, Evaporation and Runoff, Elsevier Scientific Publishing Company, Amsterdam, The Netherlands, Oxford, UK and New York, USA, 1975.

Love, T. B., Kumar, V., Xie, P. and Thiaw, W.: A 20-year daily Africa precipitation climatology using satellite and gauge data. In Proceedings of the 84th AMS Annual Meeting, P5.4. Conference on Applied Climatology, Seattle, WA, 2004.

Peixoto, J. P. and Oort, A. H.: Physics of Climate, American Institute of Physics, New York, USA, 172 pp, 1992.

Sellers W. D.: Physical Climatology, University of Chicago Press, Chicago, IL, USA, 1965.

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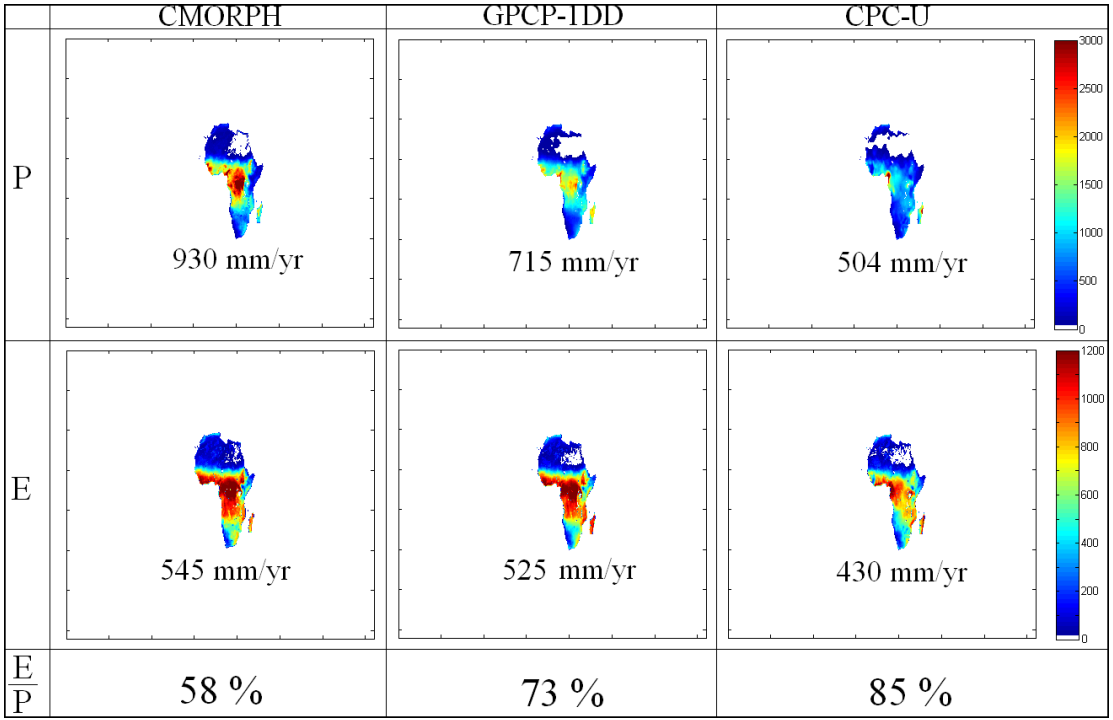


**Fig. 1.** Effect of using different precipitation products in the resulting evaporative fraction in Africa. Units are mm/yr and the period is 2003-2007 (like in the manuscript).



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