

## ***Interactive comment on “Energy fluxes and surface characteristics over a cultivated area in Benin: daily and seasonal dynamics” by O. Mamadou et al.***

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Reply to the review of Pierre Gentine

Firstly, we warmly thank the reviewer for his deep work in this review and for the helpful comments and suggestions. In the following, we provide an item-by-item response to the comments.

P10619: Could you point for other type of errors like boundary layer entrainment and inactive eddies penetrating till the surface layer: in your case I think this can be discarded and seems to be more related to vegetation and possible ground heat flux but

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may be worth a discussion given the boundary layer depths in those regions.

Response: We agree on this. Discussion inserted in the text.

Initial version

However, this canopy storage effect is known to account for one or two tens of  $W/m^2$ , which does not explain the hundreds ( $W/m^2$ ) of non-closure errors observed. Text insertion. This only can explain a part of the energy imbalance observed in P4 and P3. Considering that the net radiation was unbiased during these periods, the three other energy budget terms cumulate the imbalance proportionally to their absolute values.

Text insertion

Previous studies have shown that the secondary circulations seriously affect the eddy covariance flux measurements and thus, may contribute to the unclosed energy balance, in particular above heterogeneous terrains (Inagaki et al., 2006; Kanda et al., 2004; Steinfeld et al., 2007). Finally, in our climatic context, Lohou et al. (2010) showed that the entrainment at the boundary layer top affected the entire boundary layer down to the surface. We argue that such situation cannot explain the energy imbalance observed in P3 and P4 because entrainment impacts have been identified at night during transition periods when northern and southern wind conditions alternate. During the day, convective situations dominate and the thickness of the boundary layer remained large (2 km) as shown by Doukouré (2011). Thus, considering that the net radiation was unbiased during these periods, the three other energy budget terms cumulate the imbalance proportionally to their absolute values.

P10622: Reformulate sentence: The soil evaporation was also able to contribute as the 0-30cm soil water storage was still slightly decreasing during this period (Fig. 2g). and During P3 (Fig. 8c), the occurrence of rainfalls changed drastically both atmospheric and surface conditions; the annual vegetation has grown.

Response: The sentence was reformulated.

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However, the slight decrease observed in the 0-30cm soil water content during this period suggests a possible contribution of soil evaporation (Fig. 2g). During P3 (Fig. 8c), the occurrence of rainfalls changed drastically both atmospheric and surface conditions. The soil remained wet due to regular rainfalls and the annual vegetation had grown.

P10623: You might be interested in this review showing how stomata can be open at night in C3 and C4 plants: Caird, M.A., J.H. Richards, and L.A. Donovan (2006), Night-time Stomatal Conductance and Transpiration in C3 and C4 Plants, *Plant Physiology*, 143 (1), 4-10, doi:10.1104/pp.106.092940. – space missing between 2 sentences: This explained the out-of-phase pattern already observed on energy budget closure (Fig. 5d).

Response: OK, thanks for suggestion. We inserted a sentence about nighttime stomatal conductance.

Text insertion

On the other hand, incomplete stomatal closure during the night in C4 species can occur in response to water vapor deficit, temperature, water or nutrient availability (Caird et al., 2007). This can lead to substantial nighttime transpiration (Snyder et al., 2003). Nevertheless, stomatal conductances have to be measured directly to confirm this assertion and to quantify the transpiration contribution observed in the latent heat fluxes at night.

–The space is inserted between sentences.

P10626: Explain why the conductances are in series.

Conductances are not in series but in parallel. Indeed, it is considered that a part of the surface remains bare (in between vegetation seedling) then, following the electric analogy, equivalent conductance is the sum of parallel conductances: bare soil and canopy conductance. The latter regroups soil to root, trunk and leaves.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 10605, 2013.

**HESD**

10, C6178–C6181, 2013

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