

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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Answer to the short comments of Adrien Guyot

Thanks for the comment and suggestions. In the following, we provide an item-by-item response to the comments.

Specific comments

(i) In the introduction, (10607 L26 to 10608 L6) the author is describing results arising from different techniques. Schuettemeyer et al. involves Large Aperture Scintillometry (LAS) and Eddy Covariance (EC), when most of the other authors used C6173

EC. When EC enables a ‘quality check of the data’ by ‘closing the energy balance’, i.e. by comparing the latent heat flux estimated through an energy balance, and directly by simultaneous measurement by the sonic anemometer and the Licor, LAS only proposes an estimate of the latent heat flux based on an energy balance. This difference makes somehow the LAS technique less robust than the EC. Because of this, I think that the author should either include a few words on these technical differences, or focus on studies involving EC techniques.

Response: We agree with this remark. We added a few words to specify the differences between the two measurements techniques.

Initial version

Few experimental surface-atmosphere exchanges data sets have been analyzed for long periods including the different phases of the monsoon. The Sahelian climate fluxes have been documented for periods of a few weeks (Kabat et al., 1997, Schüttemeyer et al., 2006) and annual periods (Bagayoko et al., 2007; Brümmner et al., 2008), but to the authors’ knowledge, Sudanian climate has been studied only for few weeks in the dry to wet transition period in Nigeria (Mauder et al., 2007). Thus only partial conclusions in the seasonal and daily variability of surface fluxes were drawn for the Sudanian region.

Text modification

Before 2009, few experimental surface-atmosphere exchanges data sets have been analyzed for long periods including the different phases of the monsoon. The Sahelian climate fluxes have been documented for periods of a few weeks (Kabat et al., 1997; Schüttemeyer et al., 2006) and annual periods (Bagayoko et al., 2007; Brümmner et al., 2008), but to the author’s knowledge, Sudanian climate has been studied only for few weeks in the dry to wet transition period in Nigeria (Mauder et al., 2007) and Ghana (Schüttemeyer et al., 2006). Thus, only partial conclusions in the seasonal and daily variability of surface fluxes were drawn for the Sudanian region. Note that, all

these studies used the eddy covariance (EC) method to measure the evapotranspiration fluxes, except Shüttemeyer et al. (2006) which also used the Large Aperture Scintillometry (LAS). The eddy covariance method directly measures the latent heat flux, whereas LAS only provides an estimate of this flux as the residual of energy balance.

(ii) 10614L 18 to 23 In the methodological part, the authors stated that : “During the selected periods (defined below), these tests eliminated 4% of H and 5% of LE in P1, 20% of H and 37% of LE in P2, 35% of H and 55% of LE in P3, 25% of H and 30% of LE in P4.” In order to be achieving “the same number of days, which makes their statistical characteristics as comparable as possible”, wouldn’t that be more adequate to have the same amount of test-validated data for each period instead of the same number of days, if following that reasoning? (I doubt about the argument used to select the periods, but not the size of each of the dataset, which I think is fine).

Response: The idea was first of all to select periods before applying statistical tests. So, we made selection without any prior knowledge about the amount of data which will be eliminated. Anyway, from our experience, the percentage of eliminated data will always be higher in the rainy season, especially during the night. In these conditions we think that it is indeed more relevant to have the same number of days, rather than the same number of test-validated data which will not be regularly spread along the day.

(iii) 10617 Paragraph 3.2 It is not clear to me how the authors estimated the roughness length and the displacement height for the different seasons. Were they derived from manual measurement of the vegetation height (for d) and was then an empirical relation used to go from vegetation height to d? Or were they derived from the EC measurements using a technique such as Martano [2000]? In the later case, footprint estimates, and d and z0 estimates are not independent from each other, which mean there might be a need of a sufficient amount of iterations to reach a stable estimate of the footprint area. Maybe the authors could add a few words or a reference to further

C6175

explain their methodology?

Response: Explanations were inserted in the corrected paper.

Text insertion

The roughness length (z0) and the displacement height (d) used to compute the footprint extension have been derived from vegetation height using the Brutsaert formulation ($d=0.67 h_{veg}$). The roughness length linear relationship has been inferred from local eddy covariance data ($z0 = 0.17+0.097*h_{veg}$). The high residual roughness (0.17) results from the remaining roughness during the dry season (yam bumps and sparse bushes).

Minor comments

10608 L26 “an Eddy Covariance system was”

Response: Done.

10608 L28 “Would you have a REF for the 25%”

Response: The sentence was corrected.

This land use covers 22% of northern Benin (Djougou, Judex et al., 2009) and is in continuous expansion.

10610 L13 “Controlled burning” or “Controlled fires” instead of “bushfire”

Response: Intended bushfire.

10610 L19 “Water table depth”

Response: Done.

10610L22 “Could you specify if “bas-fond” is a soil water saturated area or an area with a higher soil moisture content as compared to the surroundings?”

Response: “Bas-fond” is a seasonally clogged headwater area.

C6176

10611L3 "How was the vegetation height measured?"

Response: The vegetation height was monitored manually each 10 day under the flux tower and at 10 locations in its surrounding area.

10611L24 "Specify "air humidity and pressure"

Response: Done.

10614 L9 "I would suggest to replace "found" by "proposed"

Response: In this context, we think that "found" is more adapted than "proposed" because it relies on observations.

10611 L18 "Daily mean of VPD ~2.3 kPa?"

Response: Yes.

10617 L9 "Replace "the highest" by "at its yearly maximum"?"

Response: Done.

10617 L15 "I would use "Representativeness" instead of "Representativity."

Response: Done.

10617 L18 "It is presented for each period? I do not understand why this sentence appears here. You may point that statement to a figure or a table; otherwise I think this is not useful here.

Response: The sentence has been suppressed.

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