

Response to Reviewers' comments

We would like to thank both reviewers for their constructive comments and suggestions on the manuscript. The modifications have been accomplished by replying to both reviewers general, major and minor comments. The following is a detailed list of our responses and the changes we have made.

Answer on **Referee #1 comments:**

1. To general comments:

AA: As suggested by the reviewer, we now emphasize the importance of accounting for water stress conditions on the NEE-PAR relationship. We hope that our research will be a stepping stone to further research as mentioned by the reviewer. In the results and discussion section, we address some of the questions of relevance in future research.

2. To major comments:

AA: Page 10719; line 11-12 with our premature conclusion. The sentence has been removed. Moreover, the text in section 3.3 (Response of daytime NEE to water stress) has been modified. Additional results (shown in Figure 7) and a related discussion have been added to support the cause of hysteresis. We focus the manuscript on the underlying variables (T_a and VPD) rather than on the resultant hysteresis as a criterion for analysis of NEE in water-stressed conditions. Therefore, Figures 8 and 9 in the previous manuscript have been removed. We made no attempt to construct the model, but mention this as a logical next chapter to this research in the results and discussions section.

3. To minor comments:

RC: P 10708 L 10 ff.: Mention the direction / kind of hysteresis observed.

AA: The direction of hysteresis has been added on Page 2, line 8.

RC: L 21: Though "many" will never be exactly wrong, this statement may be misleading. In fact the latest IPCC report (e.g. Fig. 3.3 of synthesis report) indicates increases or an uncertain fate of precipitation for larger parts of the globe than decreases. It does, however,

state that droughts will affect larger areas (e.g. Table 3.2 in the synthesis report). Maybe the difference may be attributed to the role of changing evapotranspiration as well as the localization of precipitation decreases at the border of already semi-arid regions (including many regions important in agriculture in general and peanut cultivation in particular). So a slight rewording should be sufficient to avoid misunderstandings and a reference would surely be helpful.

AA: This part in the text has been modified (Page 3, line 2). References have also been added.

RC: P 10709 L 21: After giving quite some references for the various gap-filling methods mentioned above, no reference at all is given for what is described as the traditional standard method(s) and the one(s) of particular interest for this manuscript. Some references that might fit here are given elsewhere in the manuscript, more might be found e.g. in Ruppert et al. (2006).

AA: References have been added and the text has been changed to “However, one of the conventional methods to replace missing data in NEE data in daytime conditions.....” Page 4, line 9

RC: P 10710 L 12: This sentence needs clarification, I (and presumably a large part of the readership) am not sure what it aims at.

AA: The sentence has been removed.

RC: L 21: Add a hint to the different methodology used at that scale (e.g. clamp-on leaf chambers, if applied).

AA: The information has been added. Page 5, line 12

RC: P 10711 L 14: To increase the value of the treatment description for the world-wide readership, indicate if it was typical of the region and crop studied.

AA: This has already been shown in the text on Page 4, line 17.

RC: L 18: A measurement height of 1.5 m above ground (and thus still lower above the crops displacement height) is near the low edge of reported measurement heights (e.g. Neftel et al. 2007, Wohlfahrt et al. 2008). It can be justified by small footprint requirements (which was obviously not the case in this study, with a minimum fetch of 210 m in all directions) or other particular research questions. But it should be noted that it will result in a considerable underestimation of fluxes due to the role of small eddies, if no correction for attenuation in the short-wave range of the turbulence spectrum is applied (e.g. Moore 1986, Massman 2000). Fortunately the manuscript conclusions mainly rely on relative contrasts between fluxes (such as the Bowen ratio) or during the day, but even these values may be systematically affected e.g. if the separation between anemometer and gas analyzer (which is not reported here) is much larger than the measurement path of each of these instruments. Either a report on the energy balance closure (if possible with the available sensors) or a rough estimation of the overall magnitude of the underestimation according to one of the above references would be helpful to get an idea of the uncertainties in further parameters relying on these flux data, such as stomatal conductance.

AA: This remark has been addressed. Uncertainties in eddy-covariance measurements were assessed by analyzing the energy balance closure and have been added in the revised manuscript. Page 10, line 9

RC: P 10714 L 3, see also Table 1: A disadvantage of determining R as a constant (for each subperiod, that is) is that its short-term dependence on temperature is neglected. This will affect e.g. the analysis in Fig. 4a and 7, where any variation of R with T or hour of the day changes the apparent sensitivity of photosynthesis to PAR and its hysteresis. It would have been preferable to first estimate $R(T)$ based on nighttime CO_2 flux and temperature data, and then apply Eq. 1 without the offset to the resulting estimate of GPP. $R(T)$ may show its own hysteresis effects, which may be attributed either to the fact that temperature is out of phase

between the different levels from leaf to deep soil contributing to R (Gaumont-Guay et al. 2006, Pavelka et al. 2007, Reichstein and Beer 2008, Graf et al. 2008), to a lagged response of root respiration to light (Tang et al. 2005, Moyano et al. 2008), or both (Bahn et al., 2008) . If this is not possible due to infrequent valid nighttime flux data as indicated in the previous section, this source of uncertainty should at least be discussed and maybe the average R (Table 1) and some common first-approximation estimate of R(T), e.g. $Q_{10} = 2$, can be used to prove that even without such confounding effects, a considerable part of the hysteresis in Fig. 7 would still be found (of which I am quite convinced).

AA: The revised manuscript shows the importance of not only soil moisture and VPD, but discusses the importance of temperature on NEE as well. Fig. 7 attributes to the importance of temperature as contributor to the hysteresis loop observed in water stressed conditions. This is reinforced using citations from previous studies showing temperatures control on respiration. The presence of a hysteresis effect in respiration is also discussed in the text.

RC: L14: Maybe replace "air conductance" by "aerodynamic conductance"

AA: Text has been replaced. Page 10, line 4

4. To Detailed technical, linguistic, and formal comments:

RC: P 10709 L 17: "look-up tables" or "a look-up table"

AA: Text has been changed to look-up tables. Page 4, line 4

RC: L 24: "a non-linear equation" or "non-linear equations"

AA: Text has been changed to a non-linear equation. Page 4, line 13

RC: P 10712 L 5: Replace "were" by "was"

AA: Word has been replaced.

RC: L 10: Delete "then"

AA: Word has been deleted.

RC: L 17: Delete 2nd "to"

AA: Word has been deleted.

RC: L 20-22: The second sentence seems to provide the reference of how the u^* threshold determination was done while the first one names the particular implementation tool, therefore they should be reverted and maybe can be united.

AA: The sentence has been modified. Page 9, line 3

RC: L 22: The sentence about gaps in radiation etc. would be more easier understood after introducing how these data were mainly measured, which is done in the next paragraph.

AA: We change the order of sentences. Page 8, line 6

RC: L 24: Drop a "D"

AA: Character has been deleted.

RC: P 10713 L 3: Replace "was" by "were"

AA: Word has been replaced.

RC: L 8: Replace "measurements" by "measurement"

AA: Word has been replaced.

RC: L 9: Replace "The" by "An"

AA: Word has been replaced.

RC: L 25: Use either a blank or a dot vertically centered to indicate the multiplications

AA: Vertical dots have been added in the equation.

RC: P 10715 L11: Check grammar ("due to...by")

AA: The sentence has been changed. Page 11, line 23

RC: L 22: "considered with respect.." is unclear. Maybe "determined separately for each growing stage, using bins of about 10 consecutive days of data".

AA: The sentence has been modified. Page 12, line 11

Some of the suggested references have also been added in the revised manuscript.

Answer on **Referee #2 comments:**

1. To general comments:

RC: For the EC system can some estimate of measurement uncertainties be assessed? Can energy closure be assessed? This might be difficult without an estimate of ground heat flux.

AA: The information of soil heat flux measurements has been added (Page 7, line 15). The energy balance closure was analyzed for assessing the uncertainties in eddy-covariance measurements and has been added in the revised manuscript. Page 10, line 9

RC: How well does the water balance between precipitation and ET and is there an estimate of runoff or infiltration from this field?

AA: Since the runoff or infiltration was not estimated in our study site, there is no information on the balance between precipitation and ET.

RC: How do your estimates compare with previous estimates of peanut leaf physiology, for example (Hammer and Wright 1994)?

AA: The results from previous studies in peanut leaf physiology were added to support our findings. Page 17, line 1

2. To minor comments:

RC: Pg 3 ln 3-5: Citation for recent definitions of NEE (Chapin et al. 2006).

AA: Reference has been added. Page 3, line 16

RC: Pg 3 ln 15-20: The use of mechanistic models is left out of this list and combined with inversion procedures, these can also be used to generate integrated measurements (Braswell et al. 2005, Luo et al. 2009).

AA: The mechanistic models including references have been added. Page 4, line 7

RC: Pg 6 ln 5: Subject-verb agreement.

AA: The sentence has been changed.

RC: Pg 6 ln 24: “DDuring”

AA: Character “D” has been deleted.

RC: Pg 7 ln 3: Subject-verb agreement

AA: “was” has been replaced by “were”.

RC: Pg 7 ln 14: Was the LAI meter calibrated against other measurements at this site?

AA: The LAI meter was not calibrated against other measurements in our study site.

However, estimation of LAI with the LAI-2000 Plant Canopy Analyzer was made using the recommendations made by LI-COR (1990) and de Jesus (2001) for measuring row crop canopies.

RC: Pg 9 ln 11: Check grammar after “due. . .”

AA: Grammar has been checked and the sentence has been changed. Page 11, line 23

RC: Pg 11 ln 25: kPa is more commonly used.

AA: The unit of VPD has been changed to kPa in the revised manuscript.

References:

de Jesus, W. C., Jr., do Vale, F. X. R., Coelho, R. R., and Costa, L. C.: Comparison of two methods for estimating leaf area index on common bean, *Agron J*, 93, 989-991, 2001.

LI-COR: LAI-2000 plant canopy analyzer. Instruction manual. LI-COR, Lincoln, NE. 1990