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Biogeosciences Discussions

Interactive comment on "Analyzing the major drivers of NEE in an alpine Mediterranean shrubland" *by* B. R. Reverter et al.

B. R. Reverter et al.

borja@ugr.es

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REPLY TO REFEREE#3

Reply to general comments:

We agree that an uncertainty analysis will improve the consistency of the manuscript, and are currently assessing uncertainties following the methodology described by Moffat et al. (2007; Ag. For. Meteorol.). We will include this in the revision.

We thank the referee for the opportunity to expand on the discussion of the results and the impact and validity of the Burba correction, which we will add to the revised manuscript as directed by the editor. In particular, as a result of comments from other referees, we will expand upon the magnitude of the correction as a function of air

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density (altitude), and wind speeds, in Section 3.7 of the paper.

Reply to specific comments:

Reply to comment on P673L2: We agree with the referee and will change this sentence to include other applications of the eddy covariance technique.

Reply to comment on P673L26-L28: Given that there are two kinds of tundra - Arctic tundra and alpine tundra - we could establish a relationship between high altitude ecosystems and tundra. We agree that our ecosystem is not “extreme cold”. We will remove the label “extreme”.

Reply to comment on P676L10: Consistent with the referee’s comment, we will eliminate the sentence regarding soil heat flux plates.

Reply to comment on P677L24-P678L3: We disagree with the referee’s assessment on this point. The CO2 fluxes are more negative during this period of 2007 when compared to 2008. In fact, this is quite evident in Figure 3, where early March shows a stronger photosynthetic signature for 2007 versus 2008, supporting our interpretation for an early onset of the growing season. Nonetheless, we agree that the manuscript was not particularly clear regarding the dynamics of spring NEE, and will clarify on these points.

Reply to comment on P679L15-L16: We disagree, zooming in on the figure, which has sufficient resolution in the pdf file, the lower values of PPFD in 2008 are clearly visible.

Reply to comment on P680L1: We will correct this error.

Reply to comment on P680L1-L24: We have computed canopy conductance at our experimental site following Penman-Monteith equation as the referee suggested. Canopy conductance shows a slight decrease during the afternoon, which corresponds to the decrease in carbon uptake evident in the light response curve of figures 5 and 6b (hysteresis). We will add text to the manuscript describing the results of these analyses, and thank the referee for this constructive suggestion.

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Regarding the universality of hysteresis, asymmetry in carbon uptake with respect to midday has been observed at numerous experimental sites from FLUXNET (Wilson et al., 2003), but only recently described in terms of hysteresis (Pingintha et al., 2010; final revised paper published after our discussion paper). We think that such behaviour can be explained as a response to drought stress with afternoon depletion of SWC and resulting enhancement of Bowen ratio (Lasslop et al., 2010), or possibly as a consequence of endogenous behaviour. We will incorporate such discussion and references in the revised manuscript.

Reply to comment on P681L5-L7: We agree that this would be an interesting aspect to quantify. However, beyond performing rain-exclusion experiments or artificial irrigation, comparing treatments with a "control", we do not see how this could be achieved. In the context of tower measurements at the ecosystem scale, it seems to be beyond the scope of our present research objectives.

Reply to comment on P681L8: We will remove the word ‘large’

Reply to comment on P682L1-L2: We agree with the referee that the statement “and also introduce a nearly constant increment” may be somewhat confusing for the reader as later on, in line 14, we mention that “the Burba correction has its greatest impact during extreme cold”. We will remove the words “nearly constant”. Consistent with the referee’s general comment, we will add text here discussing the non-negligible magnitude of the Burba correction during summer for high-altitude sites.

Reply to comment on P682L12-L13: We disagree. Since each mm of water corresponds to one liter per square meter (equal to one kg per square meter), the corrections seen in figure 8 for water (40 mm per year) are exactly equivalent to 40 kg m-2 per year, many orders of magnitude greater than the 170 g m-2 per year for the case of CO2.

Reply to comment on P682L18-L19 (not L12-13): These endogenous factors are enumerated at the end of section 3.5. Since we do not see any way of concisely listing

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them again in the conclusions, we propose to simply place a reference to the previous text in the conclusions.

Reply to comment on P683L14-L19: We agree with the fact that this paragraph is somehow a discussion rather than a conclusion extracted from our analysis. Thus, we will delete it from the conclusions, but add commentary regarding the impact of climate change on the source/sink status of sensitive ecosystems at the end of section 3.6.

Reply to comment on Fig2: We will include a zero line.

Reply to comment on Fig2 and Fig3: We agree with the referee and will change the captions.

Reply to comment on Fig3: We think that these plots add further information since data were not averaged as in Fig2 and Fig4. Indeed, data from this figure clarify a separate point raised by the referee (see reply to comment on P677L24-P678L3). To some extent, we agree that it may be somewhat redundant for summer months, but not universally. Events like snow fall, rain pulses, second growing season phenomena or processes such as hysteresis or the evolution of the amplitude of the daily CO2 uptake are clearly visible on this plot. We think that there is no need to remove it.

Reply to comment on Fig4: We will change to UTC.

Lasslop, G., Reichstein, M., Papale, D., Richardson, A. D., Arneth, A., Barr, A., Stoy, P., and Wohlfahrt, G.: Separation of net ecosystem exchange into assimilation and respiration using a light response curve approach: critical issues and global evaluation, Global change biology, 16, 187-208, 2010.

Pingintha, N., Leclerc, M. Y., Beasley, J. P., Durden, D., Zhang, G., Senthong, C., and Rowland, D. L.: Hysteresis response of daytime net ecosystem exchange during drought, Biogeosciences, 7, 1159-1170, 2010.

Wilson, K. B., Baldocchi, D., Falge, E., Aubinet, M., Berbigier, P., Bernhofer, C., Dolman, H., Field, C., Goldstein, A., Granier, A., Hollinger, D., Katul, G., Law, B. E., Mey-

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ers, T., Moncrieff, J., Monson, R., Tenhunen, J., Valentini, R., Verma, S., and Wofsy, S.: Diurnal centroid of ecosystem energy and carbon fluxes at FLUXNET sites, Journal of geophysical research, 108, 4664, doi:4610.1029/2001JD001349, 2003.

Interactive comment on Biogeosciences Discuss., 7, 671, 2010.