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## ***Interactive comment on “Implications of CO<sub>2</sub> pooling on $\delta^{13}\text{C}$ of ecosystem respiration and leaves in Amazonian forest” by A. C. de Araújo et al.***

### **Anonymous Referee #1**

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#### General comments

The authors reports on a comprehensive study on stable carbon isotopes composition (d13C) of respiration and leaves in an Amazonian forest. They compare measurements from a topographical gradient covering a dry site on a plateau, an intermediate site on a slope, and a wet site in the valley. They find - following theory - more depleted d13C of leaves in the wet valley site compared to the dry plateau site. Isotopic composition of respiration does, however, not show a consistent pattern. The authors argue that a combination of biotic (nitrogen and water availability) and abiotic factors (i.e. CO<sub>2</sub> drainage and formation of CO<sub>2</sub> pools) explain the observed pattern.

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Even though the individual parts of the dataset and the analysis are not particularly unique, the study provides a comprehensive dataset from an interesting study sites and give insights into carbon cycling in a multi-layered Amazonian forest canopy over uneven terrain. The study fits well into the scope of Biogeosciences. I recommend accepting the manuscript after major revisions.

My major comments concern the length and the quite descriptive nature of the manuscript. I suggest tightening the result and discussion part and to emphasis the most relevant observations without describing every single data point. Furthermore, I am not sure if all tables and figures (e.g. Table 1 and Fig. 4) are of enough relevance to be included.

Another concern is related to figure 8. Part 8a is trivial as is derives directly from equation (1). For Part 8b-d carbon isotope discrimination of the leaf is calculated from bulk  $\delta^{13}\text{C}$  of leaves and  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$ . The presentation of variation in carbon isotope discrimination over the course of a day seems to be - in my view - a mismatch of time scales.  $\delta^{13}\text{C}$  of leaves is an integrated value over the entire life span of the individual leaf, while  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$  reflects instantaneous measurements at a 3 min sampling time. Consequently, the presented leaf discrimination arrives mostly from variation in  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$  and hence does not reflect an ecophysiological process. I suggest omitting figure 8 including its text

## Specific comments

Page 4460, "The observed pattern of  $\delta^{13}\text{C}_{\text{leaf}}$  suggests that wateruse efficiency (WUE) may be higher on the plateaus than in the valleys.": The statement is not fully supported by the data as it remains unclear how much of the difference in  $\delta^{13}\text{C}_{\text{leaf}}$  is driven by physiology (and hence WUE) or by source  $\text{CO}_2$ .

Page 4461, equation 1: please cite the appropriate reference by Farquhar et al. 1982

Page 4466 Sampling of foliage and litter: How often were leaf samples taken in August

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2004 and October 2006? What were the heights for the vertical gradient?

Page 4467, equation 2: may be omitted in order to save space.

Page 4468 3.5: I disagree that averaged  $\delta^{13}\text{C}_{\text{leaf}}$  and daytime values of  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$  will give meaningful time series of leaf carbon isotope discrimination. In my view it could only be used to get an average discrimination based on average  $\delta^{13}\text{C}_{\text{leaf}}$  and average  $\delta^{13}\text{C}$  of atmospheric  $\text{CO}_2$ .

Page 4471 Spatial variability of  $\delta^{13}\text{C}_{\text{leaf}}$  and  $\delta^{13}\text{C}_{\text{litter}}$ : Please explain, why there is a difference among sites in  $\delta^{13}\text{C}_{\text{leaf}}$  but not in  $\delta^{13}\text{C}_{\text{litter}}$ ? Was the vertical representation (samples taking in different heights) similar at all sites?

Page 4473 line 25 to page 4474 line 10: Please rephrase or add figure. This paragraph is unclear but might be important to explain why  $\delta^{13}\text{C}_{\text{CR}}$  does not show a consistent pattern across sites.

Page 4476: 4.5: see above, I suggest omitting or completely rephrasing this part.

Page 4477 5.1: Delete WUE in title as it is not mentioned in the paragraph.

Page 4478, line 16: Is horizontal stratification correct or vertical stratification?

Page 4480 line 2/3: Please give a reference for the first sentence.

Page 4480 line 14/15: According to Fig. 5,  $\delta^{13}\text{C}_{\text{soil}}$  was higher than  $\delta^{13}\text{C}_{\text{CR}}$  only for the plateau. At both other sites it was the opposite. Please rephrase.

Page 4481 and 4482, 5.4: Wouldn't we expect that the tree at the plateau have a longer time lag than the trees in the valley since they are taller? It might be good to add a few sentences on uncertainty of this kind of analysis as there are only 3 data points in each regression.

Page 4482, 5.5: see above, I suggest omitting this part.

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