Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2018-73-SC1, 2018

Biogeosciences Discussions

Interactive comment on "Ecosystem responses to elevated CO_2 using airborne remote sensing at Mammoth Mountain, California" *by* Kerry Cawse-Nicholson et al.

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Received and published: 20 April 2018

Review: Ecosystem responses to elevated CO2 using airborne remote sensing at Mammoth Mountain, California

In this analysis Cawse-Nicholson use a volcanically active site where elevated CO2 fluxes have been monitored as a natural experiment to test vegetation response using remote sensing approaches. Given the contradictory results from previous studies at this site, it seems logical to revisit using new approaches. The rationale and methods for this study seemed logical and it provides a nice testing ground for testing a range of remote sensing techniques. I was quite surprised by the results showing the ap-

parent suppression of growth (i.e. negative relationship between NDVI and soil CO2 flux), especially because this main conclusion was not clearly stated in the title or the abstract. It seems that the forests in this volcanic setting are responding adversely to something, but it is not clear why it would be elevated CO2 concentrations. I think that most folks reading the title, perhaps the abstract and looking at the figures will be a bit perplexed as I was. This is a really fascinating study system that is fairly complex in terms of terrain and gases emitted.

General Comments: The authors go to great lengths to control for distance from these hotspots of CO2 to derive a gradient over which to investigate vegetation responses, which is no easy task, especially using remotely derived metrics over complex terrain. In particular, I wonder how cold air drainage at night affects CO2 concentrations at these sights (Pypker et al. 2007). It is conceivable that much higher CO2 concentrations are found downslope than upslope or adjacent to these CO2 efflux hotspots (Fig. 2a). In fact, biomass hotspots appear to be adjacent or downslope from the CO2 hotspots (Fig. 2b); although it is difficult to discern without elevation contours.

Where on the A-Ci curve are we operating? The vegetation at these sites is responding to the partial pressure of CO2 in the atmosphere, among other gases at this site. Figure 1 suggests that the CO2 flux was maybe 2 orders of magnitude greater than typical estimates at non-volcanic sites (Jensen et al. 1996), but what is the partial pressure of CO2 in the atmosphere at these stites. I suspect that we are operating well above the asymptote on the A-Ci curve(Tissue, Griffin, and Ball 1999), such that we would see very little vegetation response to even large changes in the partial pressure of CO2.

What are the other gases are being emitted from this volcanic field? The negative relationship between CO2 soil flux and NDVI is perplexing and needs explaining. Are these particularly sulfur rich volcanic fields? Has anyone developed a 'rotten egg' remote sensing index? No but seriously, if there are significant sulfur emissions this could be leading to sulfuric acid deposition and cation loss from the soils, such that the negative response to soil fluxes could actually be the result of another gas that is

detrimental to plant growth other than CO2.

Specific Comments: The abstract is a bit vague reporting statistical relationships but not the apparent negative response to increased soil CO2 flux and without any response numbers (change in NDVI per change in Soil CO2 flux).

P2 L14 to 26 Perhaps the most fundamental flaw of FACE studies is very few have concomitant warming, which greatly limits our insight for the real world.

P3 What other gases are being emitted from these volcanic fields.

P3 L37 'can be applied'

P4 L20 is this g C or g CO2 per day...you might want to make this absolutely clear in the units

P4 L27 why were these data not just aggregated to a coarser resolution. Further smoothing of already smooth data may lead to loss of meaningful variance.

P5 L20 some discussion of cold air drainage important in this mountainous terrain (see Pypker below).

P7 L 12 as demonstrated by the authors- where?

P11 L 18 Why not use a random forest model to identify variables of greatest importance.

P12 L3 'well modeled' be more descriptive precisely or accurately?

Fig. 1 could benefit from a log y-scale or even better some estimate of pCO2

Fig. 3 the caption seems to be incomplete in describing all the panels.

References: Jensen, L. S., T. Mueller, K. R. Tate, D. J. Ross, J. Magid, and N. E. Nielsen. 1996. "Soil Surface CO2 Flux as an Index of Soil Respiration in Situ: A Comparison of Two Chamber Methods." Soil Biology & Biochemistry 28 (10): 1297–1306. Pypker, Thomas G., Michael H. Unsworth, Alan C. Mix, William Rugh, Troy Ocheltree,

Karrin Alstad, and Barbara J. Bond. 2007. "Using Nocturnal Cold Air Drainage Flow to Monitor Ecosystem Processes in Complex Terrain." Ecological Applications: A Publication of the Ecological Society of America 17 (3): 702–14. Tissue, David T., Kevin L. Griffin, and J. Timothy Ball. 1999. "Photosynthetic Adjustment in Field-Grown Ponderosa Pine Trees after Six Years of Exposure to Elevated CO2." Tree Physiology 19 (4-5). Oxford University Press: 221–28.

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