

Interactive comment on “Isotopic fractionation corrections for the radiocarbon composition of CO₂ in the soil gas environment must include diffusion and mixing” by Jocelyn E. Egan et al.

Anonymous Referee #1

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The reviewed manuscript proposed new corrections for ¹⁴C measurements in soil air, to account for diffusion and mixing. Experimental study, and modeling are used to illustrate the point, and recommendation for best practice are given. The logic of the authors is clear, and usually the manuscript is well written. My main concerns are as follows:

1) The authors writes that the problem with the traditional method of ¹³C based correction, is that it works only for biological process like photosynthesis and do not apply for example to fractionation in diffusion. This is not correct. The correction based on ¹³C should work for any mass-dependent fractionation (i.e most fractionation processes).

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However, they are correct the traditional correction will not work for mixing. Because this is not a fractionating processes and no mass-dependent can be assumed. This error should be corrected in the text, abstract, and in the title (i.e. correction for mixing is not correction for fractionation).

2) Another point that can be mentioned in the text: In soils that contain carbonates, isotopic exchange of CO₂ with the carbonates can introduce additional error which is not mass-dependent.

3) It is stated that: “Graham’s law of effusion (rate of diffusion $\sim 1/\sqrt{\text{mass}}$) provides us with an expected difference in diffusion rate of isotopologues.” In fact, as it is written few lines before, this is a binary diffusion of CO₂ in air and hence binary diffusion equation (a one that invokes reduce-mass of CO₂ and air) should be used.

Minor comment: Please give a better description of the soil than just “clay”.

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