

Interactive comment on “The use of radiocarbon ^{14}C to constrain carbon dynamics in the soil module of the land surface model ORCHIDEE (SVN r5165)” by Marwa Tifafi et al.

Anonymous Referee #1

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Review of the manuscript The use of radiocarbon ^{14}C to constrain carbon dynamics in the soil module of the land surface model ORCHIDEE (SVN r5165)

Improvement of the soil modules in global carbon cycle models is a recurrent need, claimed by the scientific community. The land surface model Orchidee is one of the important tools to analyse and predict future changes of the Earth's climate and biosphere. A recent study highlighted that current Earth system models predict a too young age for soil organic carbon. The present work introduces the radiocarbon isotope in the model to better constrain Orchidee. Based on the use of radiocarbon, the study furthermore improved the model itself, and model prediction, through a better

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representation of carbon movement within the soil profile. The article is fully relevant, clearly written and illustrated, and worth publication in GMD.

But one point requires a significant change. Once this point fixed, the paper could be acceptable with only minor corrections.

Important point. (parameterization of the 'Model_Test_He') Line 233 authors state "... multiply by 14 the turnover rate and by 0.07 the flux...". And later Line 236 and in Table 2 : "decrease the flux from 0.07 to 0.049. Consistency would either decrease the flux from 0.07 to 0.0049, or multiply it by a factor 0.7. I suppose that the initial intention of authors was to multiply by 0.07 the flux, so that the steady state stock of passive would be kept similar (multiplied by $14 \times 0.07 = 0.98$), but with a F14 much lower. Here it seems from the results that the stock of the passive pool was multiplied by a factor almost 10 (less than 10 because of the duration of the spin-up), as expected by a factor $\times 0.7$ for the flux. The over estimation of both carbon content and age is obviously expected with such a parameterization. In the present state, I further recommend not to use the name of a person in the surname of the model.

Finally, I recommend that the authors either (i) remove this model_test from the paper, which would then be accepted with minor revision, or (ii) recalculate using a flux to passive 0.0049 instead of 0.049. Option (ii) is preferred, but is not mandatory, since the other parts bring significant results; note that option (i) would not affect the summary nor the conclusion.

Minor and typographical points.

Table 1. Be clear in the legend on what was averaged. Do "over the profiles" means a calculated mean for (0- 2.0 m) ?

Table 3 Data are in kg C m^{-3} , which is a unit for local concentration, not for carbon stock. Is it: (a) kg C m^{-2} , i.e., the carbon stock per unit area; or (b) the average concentration over the 0-2.0 m profile (then the Stock would be 2 times the mean

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concentration value) ? Option (a) would be preferred.

Line 786 Legend fig.6: indicate the variable in object (= F14C).

Line 143. A brief statement of the formalism and parameterization of the priming would be welcome.

Line 179. In Eq(6), STRUC was excluded of total 14C. Was it ? In the Century model, STRUC usually accounts for 10- 20% of C in 0-20 cm layer, and is therefore non negligible (your figure 7). It is considered as retrieved as material < 2mm (for a large part) and therefore often included in the "measured" total carbon. This exclusion may affect the comparison between observed and modelled values of F14.

Line 218. "OCC (wt/wt)" would be better than "OCC (wt %)"

Line 232. "turnover rate" is an unclear term (might be the reciprocal of turnover time). Here turnover time ?

Lines 314-326 and throughout: MSD values aren't in kg C m⁻³, but in kg² C m⁻⁶ (variance not standard deviation); or use squareroot(MSC)

Line 325. Arenosols are not very specific and are broadly represented on the planet. Remove "for such specific conditions". Replace by " Probably due to an overestimation of decay rates by ORCHIDEE in sandy soils ?

Lines 367-401. See Major comment.

Do is the boundary condition at depth 2.0 for constant diffusion affect the base of the profiles ?

Typography

Line 71. "this"

Line 158. verify in the final edition the greek symbol delta (not ok in my pdf)

Line 186. "1.5_m" (= separate the units throughout)

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Line 227. "(2016) (=no square brackets)

Line 242. "et al. (2014)" (spaces)

Line 255. Point missing; also lines 326, 337 ... check.

Line 315: spaces before and after "=" (throughout the text)

Line 447 'processes'

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