

Interactive comment on “Simulating ectomycorrhiza in boreal forests: implementing ectomycorrhizal fungi model MYCOFON into CoupModel (V5)” by Hongxing He et al.

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1 General remarks

This paper addresses an important but often neglected aspect of boreal forests (and indeed many temperate and even tropical forests): ectomycorrhizal fungi. These fungi control the nutrient uptake of the infected roots and the relationship of the host tree with the soil organic matter. I was very interested to see what these authors are doing to rectify this omission in their model.

The work seems generally sound, and most of the points made below can be addressed without too much difficulty I should think. however, I think submission must have been rushed as the manuscript is riddled with grammatical and typographical errors. I started to make a list of these (included below) but lost the will to continue midway through; the authors need to have a fluent English speaker go through the text.

C1

Introduction Consider putting in a table showing clearly what the different models described on line 48 through 69 do.

Line 128 ECM growth is driven by sink strength of what?

Line 141 I had to read this sentence twice as I thought the authors were comparing the approach for ECM and root respiration to the approach of something else. however I think they have just treated ECM respiration the same way they have treated root respiration. Perhaps it would be clearer to say that there are two components (maintenance and growth) for both ECM and root respiration.

Line 159 Is $\text{NUPT}_{\text{FRACMAX}}$ the fraction of total soil N available for uptake, or is it the fraction of mineral N available for uptake? Please clarify.

section 2.1.5 My first reaction was that degree of mycorrhization had not been taken into account; then I realised mycorrhization degree was covered in section 2.1.6. Consider switching these two sections.

Line 166 Please add the scientific name for spruce. As this is Sweden it is probably *Picea abies*.

Line 211 I see the point of spinning up the vegetation from the time of establishment over the lifetime of the trees (100 years in this study), but soil C pools may take considerably longer than that to come to equilibrium. For example, 500 years is a more typical spinup to initialise soil C pools in dynamic vegetation models (DVMs). The legacy of recalcitrant C from previous forest growth in the soil must

C2

be accounted for by the initial standing C stock and C/N initial values in Table 2 which the footnote says are calibration parameters; maybe make this clear in the text. Unlike the calibration parameters of Table 1, the initial values assumed for soil C pools shown in Table 2 do not have minimum and maximum values associated with them, and standing stock does not appear in Table 3.

Line 212 I do not understand what is meant by this sentence: *A minimum of specific regional data were used at input values*. Does this refer to the number of driving variables input to the model (six in Table 2 plus two calibration parameters) or the amount of data used in the Bayesian analysis for each driving variable (30-year averages rather than time series or multiple values for each region)? I also don't understand at input values; does this mean *as input values* or does it mean something else? What is specific about the regional data?

Line 230 *The data likelihood function which determines the parameter sets being candidate of the posterior distribution* sounds odd; I assume that this sentence refers to the likelihood function determining **acceptance** of the parameter sets which will comprise the posterior distribution?

Line 235 Please make clear that ω_i is a vector.

Line 244 Replace $q_i + 1 = q_i + \varepsilon$ with $\theta_i + 1 = \theta_i + \epsilon$, using the same ϵ on lines 244 (the equation) and 245. Also, consider numbering the equations.

Line 280 Surely it is just parameters that are being calibrated and not processes?

Line 306 Do fungi take up the same amount of organic N when there is sufficient mineral N available?

Line 333 should *thus* be *and*? Is the sentence referring to N mineralisation? A higher organic matter turnover should mean higher N mineralisation.

C3

Section 3.2.3 Is it necessary to list all these correlations? The figures are better for this; perhaps only discuss the most interesting ones?

Section 4 I take the authors' point that there is a dearth of comparison data, especially related to ECM, but are there really zero data? is there not one observation that can be compared with the model results? What about the Lindroth *et al* paper cited on line 419? How does the coupling of Mycofon to CoupModel affect the simulated soil respiration, for example? it is a bit difficult to claim that the model delivers "accurate" results (line 464) without any comparison to observations. Table 4 shows the Svensson *et al* model results so consistency with this other model could be worth showing in a figure.

2 General remarks on figures

Please include units and self-explanatory axes labels in all figures. Many readers will look at the abstract and figures before deciding to read the text; don't make readers go searching through the text for basic information. Where possible, don't even make readers read the captions carefully. In general, don't make readers do more work than absolutely necessary to understand what is being shown in the figures.

Figure 3 Is *total N litter production* the N released during decomposition or the N being added to the litter pool with fresh litter?

Figure 4 There is room to add *implicit model* and *explicit model* to the right of the figure so that readers can see immediately what the upper and lower graphs mean.

Figure 5 Is GPP in this figure simulated or measured? Any possibility of showing both simulated and measured GPP?

C4

Figure 6 There is room to add *nonlim*, *implicit* and *explicit* to the right of the three panels, and to show the north-south gradient to the left of the Y axis of each panel.

Figure 7 Show the N-S gradient to the left of the panels (*ie* N next to L_y , and an arrow leading to S next to L_j). Thanks for adding *implicit* and *explicit*; please also add the meanings of the parameters on the X axis (*eg* K_H is the humus decomp. coeff.) so that readers can see at a glance what is going on without having to search the text and tables.

Figure 8 Please give the units, especially for the rates. What is fungal litter rate, the rate of uptake from litter, or the rate at which hyphae die and contribute to the litter pool?

Figure 9 Does *C assimilates* mean NPP? Please make clear what parameters are being shown, so readers don't have to go searching (they probably won't have read the paper and won't realise the information is in one of the tables). Is the colour scheme here the same as in previous figures?

3 Tables

Table 2 Can it be made clearer that soil C/N and standing stock of C are calibration parameters and the other data are all driving data?

Table 3 Why are there no mean and uncertainty columns for soil C standing stock? according to Table 2 it's a calibration parameter.

Table 4 The Lindroth *et al* data shown here are means of the highest and lowest estimates, but the full ranges are shown for the Mycofon results. Would it not be better to show ranges for both?

C5

Table 4 The Svensson *et al* data generally fall within the Mycofon model ranges; are these the ranges from the posterior distributions? why is the implicit approach shown for one site and the explicit approach for the other, and what are the results for the mean of the posterior? Could this material (Svensson *et al.* vs. model approaches) be presented as a figure? If Lindroth *et al.* measured respiration, surely that is a CoupModel output which could be compared to those measurements?

4 Grammatical or typographical errors

Here is a partial list of lines with errors, including suggested corrections.

In some cases I suggest rewordings of awkward clauses, in others I try to show the grammatical/typographical error and how to fix it. Original text is to the left of the arrow, and the replacement text to the right of the arrow. Actual changes (deletions to the left of the arrow, additions to the right of the arrow) are in **boldface**. I have tried to include enough text to make it clear why the change is necessary, such as where a grammatically plural noun is coupled with a grammatically singular verb.

Generally, models and approaches are preceded by *the*, which is omitted repeatedly throughout the text. A global change is not possible because there are a few occasions where *the* is present, or where it is OK to leave it out.

27 ... Coup-Mycofon model provide → Coup-Mycofon model provides

43 known as → which are

46 the ecosystem → ecosystem

48 research show → research shows

C6

56 Moore → **the** Moore

60 ANAFORE → **the** ANAFORE

68 ECM models ... **simulate**s → ECM models ... simulate

70 that coupled → that **is** coupled

78 approach which → **approaches** which

79 The “ECM implicit” does not → The “ECM implicit” **approach** does not

79 **incorporating** → **incorporates**

80 Plants ... **does** not → Plants ... **do** not

100 **in** Meyer → **by** Meyer (NB this is my personal preference but check the journal's policy: are citations considered to be the name of the paper, in which case *in* is fine, or do they refer to the authors who wrote the paper, in which case *by* makes more sense?)

118 **are distinguished** between → **distinguish** between

131 follow → **follows**

132 **to prevent fungi to die** → **preventing fungal death**

159 ... as fungi **have** are more efficient → as fungi are more efficient

193 plant **uptaking of** organic N → plant **taking up** organic N

203,213 **Tab. 2** → **Table 2** (likewise Table 3 in section 3.1.1; check the journal's policy, but in any case be consistent as *Table* is spelled out earlier in the manuscript)

205 **managements** → management

C7

206, see 100 in Svensson → by Svensson

212 effects **is** not → effects **are** not

237 both, the → both the

239 **for a better constrain of** posterior → **to better constrain** posterior

241 using the **Markov chain Monte Carlo method, also the Metropolis-Hastings walk** → using the **Metropolis-Hastings random walk Markov Chain Monte Carlo algorithm** (and please cite van Oijen et al 2005 here too)

245 The **random numbers are generated normally distributed having** a mean of zero → The **normally distributed random numbers** **have** a mean of zero

252 **parameter: ConstantNsupply for the spruce tree, is selected as calibration parameters** → **parameter ConstantNsupply for the spruce tree is a calibration parameter**

257 (C/Nmyc), → (C/Nmyc)

268 The posterior model ... show → The posterior model ... **shows**

272 than that **of** using the “implicit” **and** “explicit” approach → than that using the “implicit” **or** “explicit” approach

275 generally **N more** limited → generally **more N** limited

277 southern site, Ljungbyhed than → southern site, Ljungbyhed, **than**

278 **show overestimation** by “implicit” approach but **change to underestimation** when “explicit” approach is used → **is overestimated** by **the** “implicit” approach but **colorredunderestimated** when **the** “explicit” approach is used

C8

281 the more processes and parameters included for calibration, less likely of
 finding an accept combination of parameter sets → as more parameters
 are included for calibration, acceptable combinations of parameter sets be-
 come less likely

286 approach show a much larger uncertainties than that of ECM “implicit” and
 “explicit” approaches → approach shows much larger uncertainties than ei-
 ther the “implicit” or “explicit” approaches

287 approach simulate soil sequestration of N up to 2 g N m⁻² y⁻¹ → approach
 simulates up to 2 g soil N m⁻² y⁻¹

292 Besides the simulated soil C balance by “nonlim” approach → The simulated
 soil C balance by the “nonlim” approach

293 the soil sequesterate C at most north site, Lycksele but → the soil sequesters
 C at the most northerly site, Lycksele, but

294 and decoupled → and are decoupled

297 and “implicit” approach → and the “implicit” approach

297 sites overall loss soil C by 6 and 5 g C m⁻² y⁻¹ → soils lose 6 and 5 g C m⁻²
 y⁻¹, respectively

298 sites gain soil C by 3 and 13 g C m⁻² y⁻¹ → soils gain 3 and 13 g C m⁻² y⁻¹,
 respectively

299 For “explicit” approach → For the “explicit” approach

300 in “implicit” approach → in the “implicit” approach

301 show an overall minor C and N losses → show overall minor C and N losses

C9

305,306 in “explicit” model → in the “explicit” model

309 using “implicit” approaches → using the “implicit” approaches

310 favour climate → favourable climate

311 but “explicit” approach show a → but the “explicit” approach shows a

312 in “explicit” approach → in the “explicit” approach

314 show explicitly account for ECM → shows that explicitly accounting for ECM

326 except a larger uncertainties in the “explicit” . → except for larger uncertainties
 in the “explicit” approach.

327 than that of the southern → than for the southern

The rest of the manuscript is riddled with errors like the ones above; please go through
 and fix them.

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2017-170>,
 2017.