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Biogeosciences Discussions

Interactive comment on "A process-based model to estimate gas exchange and monoterpene emission rates in the mediterranean maquis – comparisons between modelled and measured fluxes at different scales" *by* M. Vitale et al.

M. Vitale et al.

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Paper: A process-based model to estimate gas Exchange and monoterpene emission rates in the Mediterranean maquis 8211; comparisons between modelled and measured fluxes at different scales8221; by M. Vitale et al.

Answers to Referees8217; Comments

Referee 1

Referee 1. 8220;In the first reading of the MS I made it clear that before the publication of the discussion paper, the figures and language of the MS has to brought up to

standards required for publication, while other issues can be corrected later. Now, for my big disappointment, essentially nothing has been changed. The figures are still of inferior quality with no clear axis labels. Also, the language is still not good. This is surprising given that a native speaker is on board.8221;

Figure quality has been improved during the 2nd revision of the paper; in fact, actually all figures in the JPEG format have a resolution of about 600 dpi. In general, it would be better to refer directly to figures in graphic format rather than figures embedded in the PDF document file because their resolution is reduced during the JPEG to PDF conversion. Furthermore, the axis of the figures showed in the paper are properly labelled. The corresponding author assumes all responsibility for incorrect sentences that are still present in the current version of the text. However, the reviewed manuscript will take into considerations the suggested language corrections and will be checked by an English native speaker.

Specific

Referee 1. P1748, L6. hypothetical, but realistic. In my reading, I do not see any inclusion of canopy architecture into the model at all. Whole canopy LAI is driving the flux in the big leaf model, no?

Yes, this sentence will be re-written without 8220;but realistic8221;.

Referee 1. L16 vs. L17. The abstract contains statements that are overtly specific, and statements that are too general (first versus second). If you want to make a statement about the importance of structure, clearly 8220;some8221; is too general. On the other hand, orientation of the site is not what the readers likely want to learn from the abstract.

Yes. Abstract has been re-written and now contains basic information and results.

Referee 1. L20. I am not sure that being 30-40

The agreement between modelled and measured GPP fluxes has now improved sig-

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nificantly after than measured GPP has been weighted according to the contribution of the three modelled species to leaf biomass and total photosynthesis. Monoterpene emission has been calculated by the Guenther8217;s algorithms (eqns. 7 and 8). The calculation (ex eqn. 9, now it is eqn. 7) took into consideration structural parameters such as projected leaf mass per area (D(t)) that was dynamically related to the LAI (ex eqn. 11, now it is eqn. 9) as reported in Simon et al. (2006). In that respect, the proposed model was not a new one but rather included a module to calculate monoterpene emissions. Different results could be attributed to the overall BVOC emissions of the plant species and to site-based features, given the fact that MOCA was implemented to simulate BVOC emission just for the three main species and it did not take into consideration sudden variations of climatic parameters, as discussed in the text. We performed the exercise in order to show how a general, big-leaf model was able to simulate fluxes (GPP, BVOC) at a challenging site.

Referee 1. P1749. Introduction is too long. The review of big-leaf models is lengthy and contains errors. Why not to more efficiently move towards the main aims of the paper?

Introduction has been shortened.

Referee 1. Overall, the point is that due to non-linearity, single big-leaf model will always be incorrect as the arithmetic mean of two photosynthesis values estimated at two different PPFD-s will always be less that the photosynthesis value estimated at the average PPFD of these two light values. The thing is that big-leaf models use various fudge factors to cope with this problem, and these fudge factors have no theoretical founding. So, I see this also a problem in this paper that apparently a single big-leaf model is used that we know already is wrong, and then there is some attempt to include canopy traits, but it remains completely unclear how.

Conceptual models can be indefinitely and arbitrarily complicated. However, a compromise between accuracy and easy-to-use need to be done. A single big-leaf model

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has some limitations that have been discussed in the text, but the assumption about homogeneous PPFD distribution and its LAI-dependent attenuation surely introduces an error. The fudge factors indicated by referee 1 are necessary to represent a particular aspect of reality. In this big-leaf model LAI is dynamically linked to the canopy productivity by iterative time steps. This approach can be questionable, but authors deem that it is useful when applied in the frame of the low Mediterranean maquis. The latter is generally well characterised at leaf level for each plant species but, at the same time, is rather difficult to model as a canopy due to patchiness of vegetation coverage and overlapping of species within the area. Under these conditions the determination of vertical LAI distribution and its inclusion in models is very difficult. Multi-layer approach or sun-shaded leaves distinction could be used here but, they require, however, the introduction of fudge factors which could simplify their application in canopies of the Mediterranean maquis.

Referee 1. P1752. Honestly, I do not see why you say 8220;process-based8221;. All functions used are poorly empirical. It must be said 8220;empirical model8221;.

Yes, we are using empirical models and, as a consequence, we would change the title of the paper as follow: Modelling of gas exchange and monoterpene emission rates in the Mediterranean maquis 8211; comparisons between measured and modelled fluxes at different scales.

Referee 1. P1753. It is also highly confusing to see symbols presented with and without subscript, in italics and in Roman, units presented as micromol and micromole etc. Such careless presentation is highly annoying and should have been corrected before publication of the Discussion paper as I have requested.

All equations showed in the text have been checked and corrected when needed

Referee 1. L14. Respiration rate is by no means a constant. This is too bold assumption that cannot be tolerated in a modelling study.

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The Rd value represents an average value between 0.5 and 1.5 μmolCO2 m-2 s-1 derived from literature and values measured at the site. On the other hand, the comparison between measured vs. modelled GPP demonstrates the goodness of the choice of Rd value. Furthermore, during the measurement campaign, nightime ecosystem respiration was relatively constant.

Referee 1. Eq. 3. We can do better today. At least it must be discussed that canopy is highly clumped in Mediterranean canopies.

This is correct but, under the big-leaf assumptions, the clumping of leaves is meaningless. To fulfil the referee 1 request, it may be useful to consider recent applications of the random field theory to calculate the light distribution into the canopy, generating thus an internal heterogeneity factor, avoiding a very complicated 3D description of canopy, but it is out of the aims of this paper.

Referee 1. Eq. 4. I do not understand this equation. Seems like a key component of the model. Yet, it is not internally consistent with Eq. 3 where k and LAI are independent. P1754 L1. Well coverage has nothing to do with k. I guess that the authors may want to rethink basic radiative transfer concepts at that point.

Referee 1 is right. Eqn. 4 has been removed and k = 0.7.

Referee 1. L9, well, then a second equation with 8220;if8221; is needed

m is an empirical coefficient which represents the composite sensitivity of gs to PNET(t), Ca and RH(t). It is represented by angular coefficient between gs vs. [PNET(t) RH(T) Ca-1]. These coefficients have now been inserted in a new Table 1.

Referee 1. P1755. Eqn. 9. This equation contains five factors not defined before, and defined quite a bit later in the following pages. Presentation of an equation should be better rethought. All these empirical factors are highly speculative, and even with all these, it is hard to understand why the model fails to get a numerically coherent

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estimate.

This eqn. has been re-written. Because eqn. 6 has been deleted, the first part of eqn. 9 is not useful. Application of fudge factors is important to adapt the big-leaf concept to the real world. More, their importance has been demonstrated by the comparison of modelled and measured monoterpene fluxes (135.78 956;g m-2 h-1 vs. 162.92 956;g m-2 h-1).

Referee 1. Eq. 10. Another fudge factor. Why do we need this equation? This is based on a French site, how can such a factor be justified?

The Mediterranean maquis growing in the French study area is centred on Berre Pond-Marseilles, that has a typical Mediterranean vegetation and hot and sunny Mediterranean climate. Those factors are likely to be applicable also to the Mediterranean maquis of Castelporziano

Referee 1. L19. What evidence is there that the emission factor is the same for these species?

Phillyrea latifolia 8211; Keenan et al. (2009); Arbutus unedo 8211; Keenan et al. (2009); Simon et al. (2006)

Referee 1. L21. density is mass per volume. I guess that you have leaf dry mass per unit ground area, or what?

Yes. Projected leaf mass per area D(t) has units gdry weight m-2.

Referee 1. L11. What evidence is there that the emissions in Phillyrea and Arbutus depend on light?

Both species have been reported to be non-storing plant (Arbutus unedo, Keenan et al. (2009), Lluisià Penuelas (2000); Owen et al. (1997); Phillyrea latifolia, Keenan et al. (2009), Owen et al., (1997; 2001)).

Referee 1. P1758 L20. Why not to show the actual correlation. L21. the correlation is

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bad

The agreement between modelled and measured GPP fluxes has now improved significantly after than measured GPP has been weighted according to the contribution of the three modelled species to leaf biomass and total photosynthesis. In the previous version, the weighting was done only on the basis of their percent coverage/presence. Furthermore, in the final revision we have performed a non parametric analysis based on the 967;2 test. Statistical test highlights a not significant difference between modelled and measured values (967;2 = 7.053, df=18, p<0.9896).

Referee 1. 1762 L20-22. I have been there, and I simply do not believe that the proportion of old foliage is that small.

Data from several papers, reporting measurements performed at the site, sustain the assumed proportion for the Mediterranean maquis.

Referee 1. Discussion should be shortened, and it should be discussed in very simple manner why we do need an additional model and what are the advantages simulating the emissions this way.

Yes. Discussion has been shortened and points have been properly discussed.

Interactive comment on Biogeosciences Discuss., 6, 1747, 2009.