Interactive comment on "Process-based simulation of seasonality and drought stress in monoterpene emission models" *by* R. Grote et al.

Anonymous Referee #2

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General comments

This manuscript is describing a model comparison on the effect of environmental drivers and the seasonality on BVOC emissions, in particular the monoterpene emission responses to drought. Four models which are in use for describing emissions in global context are evaluated. The process-based, leaf-scale models (Niinemets, BIM) are compared with the semi-empirical ones (Guenther, Megan), and the model sensitivities to seasonally varying emission strengths and environmental drivers are tested. The data used for model parameterization is derived from Quercus ilex trees in southern France.

The topic of developing process-based models that are able to take into account the dynamics in BVOC production and emissions is very important and timely, and I fully agree with Ref 1 that the authors are to be commended for taking the task. The semi-empirical models currently in use in global simulations have been shown to produce emissions in a reasonable accuracy under normal conditions, but one of their main problems is inability to mechanistically describe the temporal emission dynamics, important in locations where the environmental drivers change in a regular or irregular manner. This manuscript presents a model comparison and shows how the properties of the models may influence their outcome. Significant effect of a dynamic emission potential is clearly shown. It is generally well written and fluent. The models are mostly described and discussed in a comprehensive manner (but see my comments below).

However, the naming and/or referring to different models is sometimes unclear, e.g. I was several times puzzled with whether the model discussed was SIM or BIM2. The use of SIM as a submodel in other models should be more clearly written. Figures are rather messy and unclear. The basic reasons why models do not differ more in their results regarding drought effects are left open. They should be analyzed more in the light of whole tree physiological responses to drought. These are reasons why I suggest significant revisions, before the manuscript can be accepted for publication in Biogeosciences.

In addition to these, many small details should be written in a more open manner for the reader to be able to understand what is meant. These are listed in my detailed comments below.

Specific comments

p. 4, line 32: Where was the eddy covariance measurement site?

line 38- 43: How many trees were sampled (i.e. is the deviation in Fig 3 between trees or sampling occasions)?

line 44-45: How many samples were taken for the enzyme analyses?

p. 5 Even though Figure 1 provides an overview of how the model framework is constructed, some clarifications are needed, and actually a table might be better in the comparison of different models and their submodels. It is not clear to me what is the difference between SIM and PSIM, and where is PSIM used?.

p. 7: line 12: Equation 3: Fd should be F_d (with d as an index) as in the text?

line 44: Why is FPGA set to 0.375 – experimental evidence or sophistigated guess?

p. 8 line 1-2: Why should the concentrations of photosynthetic products and intermediates be declining in time? During drought? Are these steady-state models or are they run in a steady state ?

line 7-9: It is not at all clear to me how the loss rate is derived from data presented in Fig 3. Please clarify.

line 43: Equation 6 should be 6a and 6b.

p. 9 line 10: EF is not determined anywhere (Eq 7).

line 35: shouldn't this be BIM2?

p. 10 line 1: the insect attack is not shown in Fig 2.

line 26: Missing word 'Fig.'

p. 11 line 5-11: This is confusing and unclear. I don't find the data supporting these results.

line 24-27: it is really hard to see this from Fig 7.

Reference list: There are two Niinemets et al 2002, Grote et al 2009 and Keenan et al 2009 articles listed – please mark in the list which one is a and b.

Figures: Figure 2 is referred to later than Figs 3 and 4. Where does data to Fig 2

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come from? There is too few information on GPP measurements or simulations earlier. Figure 3 and 5 should have units in all axes. Figure 4: unclear legend. Are the dots monoterpene activity and lines EF? Figure 7 should include arrows or something to point out the exact dates 150 and 260. What happens on day 220 when the emissions suddenly drop down?

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