Atmos. Chem. Phys. Discuss., 9, S22–S24, 2009
www.atmos-chem-phys-discuss.net/9/S22/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Process-based modelling of biogenic monoterpene emissions: sensitivity to temperature and light" *by* G. Schurgers et al.

Anonymous Referee #2

Received and published: 13 January 2009

Firstly, I would like to point out that in my opinion the title is somewhat unfortunate. It leads to the assumption that the manuscript may contain a review about process-based monoterpene emission modeling which is clearly not the case. A new title which indicates the real message would be required (see remarks in the next paragraph).

This article describes a procedure to model monoterpene emission that distinguishes between production and emission of monoterpenes and explicitly describes both. The production is of monoterpenes is simulated by the Niinemets model that is based on electron transport rate which is closely related to photosynthesis and thus depends on light and temperature. Produced monoterpenes serve to fill storages from which monoterpene emission is calculated based on a traditional Q10 relationship. The really new and interesting idea is that the emission now depends not only on temperature

but on the amount of monoterpenes available in the size of storages (so this should somehow be put in the title too). This dependence is characterized by a 'residence time' parameter that is used to weight the Q10 relationship.

The proposed method is implemented into the LPJ-GUESS model with which a case study of a ponderosa pine plantation is carried out. Given the boundary conditions provided by the model, the sensitivity to temperature and radiation is investigated. Furthermore, a range of 'residence times' is used in order to find the best fit to emission measurements obtained in the case study forest. Interestingly, but not surprisingly I might say, is that the best results are obtained when emissions are only partly calculated from storages and partly are directly emitted from production. This is in good accordance with literature findings and species differences might be largely explained by in the fraction of terpenoids that is directly emitted compared to the allocation into specific or unspecific storages. A further investigation of this differentiation, however, is not carried out. This is somewhat unfortunate but might be subject to further research where differently performing species could be compared.

Finally, the authors take the enterprise to investigate what impact the application of their new approach might have on global emission estimate. Therefore, LPJ is applied in the global mode using various plant functional types (PFT's) with only those calculated according to the new method that are supposed to form significant monoterpene storages. This is a quite challenging task given the enormous uncertainties related to the definition of PFT properties, particularly when the estimate of residence time for emission from storages is based on one case study with one species only. Thus the global estimate presented here is not a revised update of previous estimates but rather an argument for being careful presenting such numbers. In this sense it is a paper well in the context of other publications of this group (see Arneth et al. 2008).

The manuscript presents a clear step forward in the efforts to link VOC emissions with whole plant physiology to account for plant responses that can not be covered with the traditional (empirical) Guenther model. It furthermore opens the possibility

ACPD

9, S22–S24, 2009

to simulate disturbance-related emissions as occur for example when insects release terpenoids from storages by feeding on plant leaves or bark. Therefore, I hope that the approach will be adopted by other groups dealing with process-based terpenoid modeling. However, it should be mentioned - and perhaps also better stated in the manuscript - that accounting for storage dynamics will perhaps mitigate but not solve the problem of seasonal emission variability. For example activities of isoprene and monoterpene enzymes show a distinct seasonality that is related to temperature and light and perhaps other physiological traits too. This fact will require either empirical adjustment or further explicit modeling.

Overall, I assume that the article, which is generally well written, will be of interest for the entire scientific community dealing with modeling the emission of volatile organic compounds.

Technical remarks:

Please note that residence time = 0 as stated in line 4 of page 284 is not possible according equation 5. The formulation has to be corrected).

There are a couple of typing errors. Please check.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 271, 2009.