Biogeosciences Discuss., 5, S3329–S3332, 2009
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Biogeosciences Discussions

Interactive comment on "Leaf isoprene emission in a subarctic wetland sedge community" *by* A. Ekberg et al.

A. Ekberg et al.

Received and published: 16 March 2009

We would like to express our sincere thanks to all reviewers and to the editor of the paper, Georg Wohlfahrt, for their careful reading of the manuscript and the constructive suggestions.

All reviewers expressed their concern regarding the relatively small number of measurements. This is an important point and we clearly see the limitations with respect to sample number. To address this we added the following paragraph to the Concluding section: We are aware of the limits of our analysis that arise from the relatively small number of samples and further studies will be required to substantiate (or refute) our observations. Nonetheless, the number of studies on leaf emissions under field conditions over two consecutive growing seasons is limited, as is data on isoprene emissions from remote subarctic locations. This is a region that currently undergoes

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rapid changes in response to warming, but has not yet been characterized in terms of its BVOC emission patterns. The correlations identified from the field observations are at the same time of possible general value to refine BVOC emission models (e.g., response to short-term weather history, response to changes in leaf N). It is clear that better mechanistic understanding of relevant processes is required to ensure the applicability of simulations in future or past environments that lie outside of the range of conditions for which semi-empirical models have been developed.

All reviewers also asked for clarification of our standardization of basal emission rates to 20 degree C instead of the commonly applied 30 degree C (Guenther et al. 1993). This is an important point. As also supported by the reviewers, normalization of emissions (and indeed emission measurements) should be done within the normally encountered range of temperatures, which justifies our choice of 20 degree C. In the discussion, we recalculate our standard rates (using the G93 algorithm) to 30 degree C for reference to other published literature, including studies published from high northern environments. This was a purely numerical exercise for easier comparison between sites and species but must be regarded with caution since we apply for this calculation the G93 temperature response well outside the range of the growth environment of the sedges. We clarify this aspect in the discussion.

Another issue brought up all reviewers was the relationship between emission capacity and short term weather history. In figure 3, we show that instantaneous emissions respond very strongly to instantaneous changes in temperature which also is one of the underlying principles of e.g., the G93 algorithm. Standard emission rates, on the other hand, have the chief objectives to remove short term, instantaneous effects of temperature. In an ideal world, the Is (emission rates standardized to a given instantaneous T) would not change. In reality, however, it is observed that Is still fluctuates over certain periods. One of the main explanatory effects is introduced by short term weather history, where it has been found that Is (when standardized to same temperature) is smaller following cool periods compared to warm periods. But, no clear consensus

BGD

5, S3329–S3332, 2009

exists yet on how long of a weather history should be looked at. Guenther et al. (2006) uses a time span of 24 and 240 hours, while Boissard et al. (2008) found that a 3-week temperature average explained most of the emission variation in a neural network approach. In our study, we found the best correlation with the average temperature of the previous 48 hours when gradually moving the period from t=0 to t=96h. We did investigate also instantaneous temperature but no clear influence emerged there (and it shouldn't since Is already standardizes to instantaneous T). Thus, no uniform picture emerges so far, but with our results and references to the above studies, we would like to emphasize the importance of weather history nonetheless. Since the response is of relevance for possible temperature acclimation of Is in response to climate change it should be represented in emission models (Guenther et al., 2006), but a larger number of studies specifically devoted to this respect appear necessary to identify the appropriate time period that needs to be considered and the appropriate algorithm to be used.

Response to referee 1: Thank you for your comments on our manuscript and for your suggestions on how to improve it. In addition to the comments above, you raised several methodological issues which we have now clarified in the revised manuscript. To improve structure of the paper, we followed your advice and reorganized the paper into two separate sections describing aspects of measurements and modeling, respectively. To provide further guidance to the reader we also included a summary of chief environmental constraints in section 5.

Response to reviewer 2: We would like to thank the reviewer for an extensive and constructive review. As mentioned in our overall statement above we acknowledge the limitations due to the small number of data sets, and the reviewer is correct in his assumptions that this was largely due to constraints by the remote location (campaigns, variable weather conditions, etc). Still, the value that also arises from observations of two growing seasons in environments where such data is scarce in our view holds. We have revised the manuscript according to your editorial suggestions and added

BGD

5, S3329–S3332, 2009

methodological clarifications to the text according to raised questions. We have also expanded table 1 to include average Is20, Asat, leaf N, SLA, Jmax20, Vmax20 and Rd20 in the respective field campaigns in 2005 and 2006. Please also see the above general comments about standardization of emission capacities to a common temperature, as well as the relationship between emission capacity and short term weather history.

Response to reviewer 3: Thank you for the helpful comments and suggestions how to improve our manuscript. In addition to the general comments above, we have changed the title to -Leaf isoprene emission from subarctic wetland sedges- and added clarifications to the text regarding aspects of the physiology of the investigated species, as well as technical information about sampling and analysis strategies. You further make some important points about the inter-annual differences in both early and late emission magnitudes and we have added explanatory paragraphs about those issues to the text.

Interactive comment on Biogeosciences Discuss., 5, 5061, 2008.