Biogeosciences Discuss., 4, S1696–S1698, 2007
www.biogeosciences-discuss.net/4/S1696/2007/

Biogeosciences Discussions

Interactive comment on "Environmental controls over methanol emission from leaves" *by* P. Harley et al.

P. Harley et al.

Received and published: 25 October 2007

Referee #2 expresses disappointment that our modeling approach does not allow one to develop regional or global scale estimates of methanol fluxes. As our title suggests, this was not our primary goal, although, as stated in the manuscript, we intend to develop a model of methanol emissions from forests and other ecosystems suitable for inclusion in regional and global scale atmospheric chemistry models. Our intent is to include methanol in MEGAN, the Model of Emissions of Gases and Aerosols from Nature (Guenther et al., 2006), using information contained in this manuscript related to temperature and light controls over production to drive methanol emissions. The model will also require estimates of average methanol production rates for various plant functional types (e.g., crops, grasses, broadleaf vs. needleleaf trees, etc.) and the reviewer is quite right in pointing out that the existing observational database is inadequate to ef-

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fectively constrain our current estimates. However, except for rapidly expanding leaves, in which rates of production can be substantially higher, rates of production at 30oC generally range from 0.2 to 3 ug g-1 h-1. Additional measurements will be needed to better characterize average rates of production and determine whether it is reasonable to assign different production rates to different plant functional types.

A different, and perhaps more promising strategy, is to rely on the expanding number of above-canopy flux measurements of methanol being made in a variety of ecosystem types to constrain estimates of regional or global fluxes. Use of PTR-MS in above-canopy flux determinations is becoming increasingly common, and measurements of methanol emissions, integrating over a large number of species and individuals, can be compared with up-scaled estimates based on leaf-level measurements, and used to provide inputs to MEGAN, which can then scale these estimates to regional or higher scales, using detailed information on plant functional type distributions and highly resolved estimates of leaf area index and biomass.

Another way of making regional/global scale estimates is to refine the method proposed by Galbally and Kirstine (2002), discussed briefly in the manuscript, in which global production of methanol was assumed to be proportional to global net primary productivity. The amount of methanol released per unit of NPP rests on a number of assumptions, some not terribly well constrained. A comparison of canopy scale NPP determinations with canopy scale methanol emissions would allow us to better evaluate the potential of this approach.

Referee #2 also asks us to discuss possible impacts of methanol sinks, in particular methylotrophic bacteria growing on leaf surfaces. We clearly did not consider this phenomenon when designing our experiments, and have no way of knowing the populations of such bacteria growing on our experimental leaves, or their potential impact. However, the presence of so-called pink pigmented, facultative methylotrophs (PPFMs) is widespread, reported from the leaf surfaces of over 70 plant species, and such organisms are capable of sustaining themselves on a methanol diet. I'm aware of no

BGD
4, S1696–S1698, 2007

EGU

estimates of rates of methanol consumption except under controlled laboratory conditions, and it is unclear how much of the methanol emitted through the stomata is accessible to these organisms. Nevertheless, a subsequent draft will mention their potential role in mediating methanol fluxes from leaves. Subsequent experiments comparing methanol emissions before and after removal of surface bacteria might allow one to estimate their potential significance.

Interactive comment on Biogeosciences Discuss., 4, 2593, 2007.