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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ambient sesquiterpene concentration and its link to air ion measurements" *by* B. Bonn et al.

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Bonn et al. have produced a very interesting and significant paper. The authors have used ion measurements made in a Finnish boreal forest to estimate ambient concentrations of sesquiterpenes. Although the ion measurements do not provide directly any information about the ion's chemical composition they were able to link the measurements of negative air ions to stabilized Criegee biradicals. Stabilized Criegee biradicals are formed from sesquiterpenes through their reactions with ozone. The authors present three years of data and compared their estimated sesquiterpene concentrations with chemical measurements made at the shoot level. They found that both followed the same seasonal pattern giving further confidence in their ion derived

estimates of sesquiterpene measurements.

Bonn et al.'s research findings have important implications for atmospheric chemistry over spatial scales that range from local to global. Their results show that although there is a significant flux of sesquiterpenes their concentrations within the canopy are very low and that a negligible fraction of the emissions are emitted to the airshed above the forest canopy. Their conclusion is in accord with several previous studies. Forkel et al. (2006) performed measurements within and above a Norway spruce forest in Germany and used a coupled canopy-chemistry model to analyze the results. Forkel et al. examined the concentrations of biologically emitted species within and above forest canopy and the effects of chemical reaction and dynamical processes on the concentrations. Forkel et al found that chemical reactions reduced fluxes of isoprene and monoterpenes from the canopy by 10 - 15 % relative to their emission fluxes from the branches.

The effects of chemistry on the concentrations of biologically emitted organic compounds within and above a mixed deciduous forest in the southeastern United States were investigated in more detail by Fuentes et al. (2006). They were able to measure isoprene, a-pinene, and d-limonene but the concentrations of sesquiterpenes were too low to be measured. Through chemical modeling Fuentes et al. found that there was a considerable amount of nitrate (NO3) and hydroxyl (HO) radical formation within the forest canopy. The measured ozone mixing ratios of 60 ppbv and the modeled maximum NO3 and HO mixing ratios were near 1 and 0.05 pptv, respectively. These mixing ratios are sufficient to rapidly remove the emitted sesquiterpenes in accord with the observations of Bonn et al.

Bonn et al. have shown, in agreement with Forkel et al. and Fuentes et al., that active chemistry occurs in within the forest canopies. Although the emission rates of sesquiterpenes and monoterpenes may be quite high, it is not valid to use biogenic emissions estimated from measurements made at the branch level for global and regional scale air quality modeling. Global and regional scale air quality models will

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need to include chemical preprocessing of biogenic hydrocarbons as a subgrid scale process to account for reaction within the forest canopy. Accurate treatment of the in-canopy processing biogenic emissions will be required in order to accurately represent the photochemical production of pollutants on the global and regional scale.

References

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