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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new feedback mechanism linking forests, aerosols, and climate" *by* M. Kulmala et al.

Anonymous Referee #2

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General Comments

The authors of this paper have proposed a mechanism linking biogenic aerosol concentrations to the response of forests to increasing CO_2 levels. Measurements from a pine forest in south Finland suggest that an increase in BVOC emissions would lead to enhanced nucleation and growth of biogenic aerosol. The authors discuss the potential climatic effects from the increased aerosol load.

The authors postulate an interesting mechanism. Indeed, land-atmosphere interactions are complex, numerous, poorly represented in current global models, and potentially very important for climate change assessments. As interesting as the mechanism may be, the reviewer feels that the manuscript lacks compelling observations to support the statements presented in this paper.

The authors focus primarily on the BVOC response to changes in temperature. This is not the only response expected. It is quite possible that, because of the increase of temperature and atmospheric moisture (i.e. precipitation), other greenhouse gases will be released (such as CH_4 and N_2O, from anaerobic processes within the soil). Large scale transport of water vapor will change as well, which can either increase or decrease forest cover. In addition, the flora speciation may change in response to environmental stresses (e.g., changes in precipitation, pestilence). These (and other) effects will certainly affect the composition and amounts of BVOCs emitted. I understand that these processes are not the primary focus of the paper, but still must be discussed, particularly since all of these effects are the composite response to changes in atmospheric CO_2 levels.

The authors present a two year dataset of particle formation and gas-phase BVOC. Nucleation rates and condensational growth is correlated to the absolute value of BVOC concentration. This correlation is then used to support that CCN and BVOC concentrations will increase as a result of global warming. Although qualitatively this makes sense, it is still unclear what the expected change in aerosol number concentration would be. This is not the only parameter influencing CCN concentration; the chemistry of the particles matter as well. It is possible that the shorter growth times will lead to the formation of less oxidized organics, which in turn, could be less hygroscopic. Such issues could be resolved if in addition to aerosol size/chemistry, a measurement of CCN concentrations (at supersaturations representative of the clouds in the forest of interest) would provide a direct link between biogenic emissions and clouds.

Specific comments

1. Page 6, bottom of page “Note that we ignore . . . significantly stronger”. It is not clear whether the response will be “much stronger”.

2. Page 7, line 9. “C_{CCN} will increase by a factor of 2 to 4 . . .” Is this based upon the presumption that accumulation mode aerosol concentration will increase by a factor of

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2 to 4? That will not necessarily translate to a CCN increase by the same amount. This should be made clear in the text.

3. Page 7, line 20. “Therefore, assuming . . . increase by 10% ”. The authors should point out that the cooling effect from a 10% increase in CCN is rather small compared to warming from a doubling of CO_2.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 6093, 2003.