Atmos. Chem. Phys. Discuss., 14, C6167–C6169, 2014
www.atmos-chem-phys-discuss.net/14/C6167/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Forest canopy interactions with nucleation mode particles" *by* S. C. Pryor et al.

Anonymous Referee #1

Received and published: 25 August 2014

This paper describes aerosol size distribution measurements at three different heights inside the canopy in a mixed deciduous forest in southern Indiana over two contrasting years (drought and normal). Nucleation mode particle concentrations show a decreasing trend vertically within the canopy at different sampling heights, and this may indicate some losses of these small particles on trees. But growth rates are relatively constant through the canopy, perhaps because of the homogeneously mixed BVOCs. In the drought year, the growth rates are smaller than in the normal year, due to less emissions of BVOCs. Formation of secondary aerosols and their growth in biogenic environments can have climate effects, via formation of cloud condensation nuclei. There are a large number of measurements of particles in forests at the ground level, but measurements of the vertical distribution of aerosol sizes are relatively rare.

General Comments:

(1) It would be nice to give a general context how nuclei mode particles distribute vertically, also in other forests (Introduction). Is it common that small particles are deposited on the foliage inside the canopy and show this kind of vertical trends in forests?

(2) What is the plant physiological mechanism for capturing nanoparticles through the foliage? Or, are these particles just deposited on the large surfaces presented by trees (simple dry/wet deposition loss)?

(3) The frequency of new particle formation at this site is very high, compared to other mixed forests (e.g. in Michigan; Kanawade et al., ACP 2011). Is this because these nuclei mode particles are transported from polluted regions with high sulfur plumes, as opposed to locally formed in the forest? So, they show lower concentrations near the top canopy than near the ground?

(4) The measurements from 3 different heights are interesting. How are the inlet transmission efficiencies different in these sampling locations (with different inlet lengths) (Figure 2)?

(5) With regard to the MEGAN-predicted BOVC emissions, especially monoterpenes: Because missions and ambient concentrations of monoterpenes show different diurnal trends, one should not necessarily expect a positive correlation of monoterpene emission with growth rates, as seen in 2013 normal year, as opposed to 2012 drought year. How did you assume monoterpenes are more important for the growth than isoprene, in this forest? The arguments of monoterpene-driven growth presented in this work seem not very convincing.

Other comments:

Page 18184. Line 10. Isoprene can suppresses new particle formation in forests, but the mechanisms are not known at present. At least, it is clear that in real forests, these

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mechanisms do not involve the oxidants reduction by isoprene (Kanawade et al., ACP Table 1). This is the difference between what is happening in the plant chamber and what is in real forest environments.

Page 18185. Line 25. Is the linear relationship of 100 nm particles and temperatures (Paasonen 2013) directly relevant to growth of new particles?

Page 18188. Line 25. “associated with” should be “due to”?

Page 18189. Line 20. Dp=6.04 nm. Isn’t this too precise for the instrument used here?

Page 18193. Line 4. Change “significant” to “some”.

Page 18193. Line 18. “tress” should be “tree”?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 18181, 2014.