

Review of

**Aerosol dynamics and gas-particle conversion in dry deposition of inorganic reactive nitrogen in a temperate forest**, by Katata et al.

### **General Comments**

This work presents an analysis of size-resolved aerosol and gaseous species concentration data from a mixed forest canopy near Tokyo using a multi-layer atmosphere-soil-vegetation model with aerosol dynamics and dry deposition. In particular, the authors hope to explain observed apparent fluxes of  $\text{NO}_3^-$ ,  $\text{NH}_4^+$  and  $\text{HNO}_3$  above vegetative canopies by within-canopy evaporation of ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ).

In general, I believe this to be important work and interesting, valuable data, and I also agree with their major conclusion that 3-D chemical transport models need to better incorporate the within-canopy aerosol dynamic/equilibrium processes that are the focus of this work. However, I believe that this article needs additional polishing to make its presentation more effective and the results more accessible to ACP readers. I offer my suggestions for this presentation enhancement below.

I recommend that the article be published after additional measures are taken to enhance its presentation.

### **Specific Comments**

One concern is that the model used in this study is not adequately described. The paper does reference other published articles (Katata et al., 2013; Katata et al., 2014) where portions of the model are described in some detail; however, the full model used here seems to have been described in a gray literature document (Katata and Ota, 2017). It would be better if the authors included more model description in this paper, especially providing information on model setup for this particular application (e.g., model inputs, number of layers, time resolution, model outputs, etc.), referring to the other publications (or an Appendix) for details.

A second major concern is the presentation of some of the Figures, as follows:

- Figures 2 & 3 – The figures are very small and cannot be adequately evaluated, especially with respect to the agreement between the measurements and model results. Some way needs to be found to present the figures in a larger, clearer way.
- Figure 5 – The colors chosen for the vertical profiles are very difficult to distinguish between some species. Bolder color differences would be a great improvement in understanding this very important figure.
- Figure 9 – The y-axis title is so small as to be illegible. Please increase.
- Figure 10 – As mentioned below, this figure (and the discussion that goes with it) is very confusing. I don't really understand what point is being made with this figure (ratios as a

function of RH, but under “high RH conditions” and “low RH conditions” – this doesn’t make sense as explained).

p. 4, lines 90-91, line 104, line 111: There seem to be two definitions of “a”, one which I believe is the leaf area density, and the other a constant in Eq. (4).

p. 4, lines 90-91: The term “R” is not defined.

p. 4, line 96: Should be “perfect absorption”.

p. 4, line 104: “ $T_c$ ” is not defined.

p. 4, Eq. (4): A reference should be provided for this formula, which is Massad et al. (2010), ACP, 10, 10359-10386.

p. 6, line 148: Was it really a “grass” fiber filter or was this supposed to be a “glass” fiber filter?

p. 6, line 150: If I understand the intention of the sentence, both instances of “reading” could (and should) be deleted – “We obtained 5 daytime data sets and 6 nighttime data sets.”

p. 8, Section 3.3: The description of the simulation scenarios is somewhat confusing on first reading. The phrases “ $\text{NH}_4\text{NO}_3$  equilibrium” or “no  $\text{NH}_4\text{NO}_3$  equilibrium” might lead someone to believe that non-equilibrium thermodynamics is being modeled here, when actually it’s just that no  $\text{NH}_4\text{NO}_3$  gas-particle exchange is being allowed in the “no  $\text{NH}_4\text{NO}_3$  equilibrium” scenario. A possible suggestion might be something like “ $\text{NH}_4\text{NO}_3$  gas-particle conversion” and “no  $\text{NH}_4\text{NO}_3$  gas-particle conversion”.

p. 8, line 235: Should read “... on both  $\text{NH}_3$  and **fine**  $\text{NH}_4^+$  concentrations ...”

p. 8, line 239: Should be “... competing shrinkage mechanism, ...”.

p. 9, line 252: Should be “... evaporation has less impact on ...”.

p. 9, line 269: Should be “among”, not “amoung”.

p. 11, first paragraph in Section 5.3: This discussion here (and Figure 10) is very confusing. How can the ratios be plotted as a function of RH, but distinctions still made between “high RH conditions” and “low RH conditions”? Whatever the subject is here, it needs to be more clearly explained.

p. 11, line 334: There are two instances of “typically” in this sentence, which is awkward.

p. 12, in “Author contributions”: Should be “... developed the model with support from MK,”.