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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Vertical advection and nocturnal deposition of ozone over a boreal pine forest" *by* Ü. Rannik et al.

**Anonymous Referee #1**

Received and published: 23 December 2008

This paper investigates controls on nocturnal ozone fluxes over a forest. Such an analysis has not previously been done on reactive trace gases, providing an opportunity to contrast chemically-affected species with the more well-characterized CO2 literature. Overall, this paper is concise and well-written, providing needed commentary on reactive trace gas fluxes.

Specific Comments.

Among the aspects of nocturnal O3 fluxes identified, the most unique from CO2 is the potential for chemical reactions. However, some questions remain. Should a chemically-driven flux be included as a separate term in Eqn.4? Separation and quantification of chemical vs. turbulent drivers of the observed flux would be helpful. As part

of the chemical flux discussion, the authors discuss timescales for turbulent transport time. Their approach seems sound, but I am confused as to what exactly the calculated times refer to: are these lifetimes for an O3 molecule in the forest canopy, similar to the chemical kinetics sense (e-folding time), or do they refer to an average residence time for an O3 molecule in the canopy? This needs to be made more explicit in the paper, and could have significant weight on how the potential for chemical destruction of O3 is calculated. On that note, Table 1 includes only turbulent transport times for one u*, ranging from 30-120s. However, the paper refers to transport times ranging between 3-15 minutes. Unless there is a typo, the table needs to be updated to remove this inconsistency.

Further, the authors summarize the contributions of chemistry to the flux in a single number for O3+sesquiterpene reactions and another number for O3+NO reactions. As the result that these are minor contributions to the flux is different from previous studies (Goldstein et al. 2004), and is key to the conclusions over the relative importance of storage terms vs. turbulent fluxes, these numbers and calculations need to be put in perspective. Namely, only an average sesquiterpene flux is used for the calculation, but there is inevitably a diurnal cycle to sesquiterpene emissions. How will this affect night-time vs. day-time O3 chemical fluxes? The calculations that were used to make these estimates need to be explicitly included in the paper - namely, what reaction rates were used? Sesquiterpene + O3 rates vary over an order of magnitude depending on the identity of the sesquiterpene, so providing a bound on the contribution seems essential. Further, are there other VOCs (MBO, other terpenes) that could contribute to a chemical flux? There is a significant body of literature of VOC emissions for this forest, so back-of-the-envelope estimates should be easy for the authors to perform, and would add significant weight to their contention that chemical fluxes are a negligible component of O3 fluxes.

The paper would be greatly strengthened if the Conclusions section included a more explicit contrast of the results for O3 and CO2. What exactly are the differences be-



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Interactive Comment



tween nocturnal reactive and non-reactive trace gas fluxes?

Technical Corrections.

p. 18447, l.2 - should read "For a range of friction..."

p. 18448, 2nd paragraph. Reaction rates used in the calculations should be included and referenced.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18437, 2008.



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Interactive Comment