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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Radical chemistry at night: comparisons between observed and modelled HO_x, NO_3 and N_2O_5 during the RONOCO project" *by* D. Stone et al.

Anonymous Referee #1

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The observations including HO2, NO3, and N2O5 from the RONOCO aircraft campaign were simulated with a box model. As in previous studies, heterogeneous losses of NO3 and N2O5 and unsaturated VOCs not measured are the largest uncertainties in model simulations. The main conclusion seems to be that the observations cannot be simulated well after model uncertainties are considered.

The paper is informative and written well. It would have been a good read as a thesis chapter or a conference paper. For an ACP paper, it falls short. This paper addresses relevant scientific questions within the scope of ACP but did not present novel concepts, ideas, or tools. The observation data have already been published elsewhere. The

conclusions reached are tentative. I cannot recommend the publication of this paper.

The budget analysis in section 6 is presented quite well. However, the model performance presented in section 5 clearly shows that the model does not simulate well the observations. For example, the Rˆ2 value for model vs. observed HO2* is only 0.1 with a large bias. Simulated NO3 and N2O5 also have large biases with better Rˆ2 values. Since NO3 and N2O5 interconvert rapidly as stated in Line 11-13 on P. 9533, the Rˆ2 values for simulated NO3 and N2O5 should be similar or at least the two errors should be highly correlated. Instead, Figure 2 shows that the model errors of NO3 or N2O5 from the observations clearly have different patterns. Either the model has a problem or there are unknown issues in the measurement data.

The budget analysis in section 6, which is the bulk of science content of this paper, provides little new science information. It would have been useful if the model performance were better. Section 7 is more interesting. But neither tweaking the sticking coefficient nor putting in specific unsaturated VOC species would improve the model simulations of HO2, NO3, and N2O5 at the same time. To be sure, it is not a new problem and it may be understandable that this paper cannot solve the problems also seen in previous studies. But for ACP publication, the level of new science in this paper is inadequate.

There is an error in model formulation. Equations (1) and (2) are appropriate only when Knudson number is > > 1 such as the stratospheric conditions. For RONOCO, the first order aerosol loss should be considerably lower than calculated using these equations.

The discussion of potential RO2 interferences also seems problematic. Line 16 on P. 9540 states that "An increase of approximately 4 times the total observed C=C reactivity results in significant improvements to model simulations for HO2* and simultaneously improves the modelled NO3x." If that much unsaturated VOCs are added, the RO2 interference could be quite significant.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 9519, 2013.