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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Real-time measurements of ammonia, acidic trace gases and water-soluble inorganic aerosol species at a rural site in the Amazon Basin" *by* I. Trebs et al.

I. Trebs et al.

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General comment:

The authors would like to thank the Editor S. Martin for his very valuable comments on the paper. An extension of the paper by all the mentioned topics would certainly strengthen the analyses; however, the already significant length as well as the complexity of the paper would increase substantially. Although most of the additional information will be presented in an almost completed forthcoming publication, some suggestions made by the editor will be considered and included in the paper for final publication in ACP (see below).

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Reply to specific comments:

The authors report that the concentration of NH4+ exceeded the concentrations of the acids by a factor of 4 to 10. Some additional discussion of the ionic balance is necessary. Can organic acids explain the apparent excess of ammonium?

Response: - Organic acids certainly play a role for balancing excess aerosol ammonium. As stated in the reply to anonymous referee 2, the authors will allude to the anion deficit; however, a detailed discussion of this matter follows in a subsequent paper.

The site has significant local ammonia sources (the 200 Blanco cattle) and therefore the measurements are not representative of Amazonia in general. This should influence the partitioning of nitrate and chloride in the area (their aerosol concentrations should be higher than in the surrounding area). These issues should be discussed. It would be great if the authors could use their semi-continuous ammonia measurements to separate the local contribution from the background for the three periods examined.

Response: - It was explained in the manuscript that ammonia mixing ratios present during the wet season might be entirely attributed to emissions from cattle manure. Up to now, approximately 12 % of the original Amazonian rainforest has been deforested, and the conversion to cattle pastures was the most common fate of these areas. Hence, grazing of cattle at these pasture sites is very characteristic for deforested areas in the Amazon region, which implies that our measurements are representative for pasture sites in the Amazon Basin. Mixing ratios would be different in/over tropical rainforests and further measurements are required to acquire information about background ammonia levels. The authors will make some short statements regarding this; however, detailed analyses of this matter will not be carried out within the frame of this paper.

Ammonium nitrate is often encountered at its aqueous form at RH below 60 % in the atmosphere. Without the help of ammonium sulfate it remains as a metastable solution down to almost zero RH (Martin, S.T., Schlenker, J.C., Malinowski, A., Hung, H.M., and

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Rudich, Y. "Crystallization of atmospheric sulfate-nitrate-ammonium particles," Geophysical Research Letters, 2003, 30, 2102). The statement in page 1205 about the state of NH4NO3 should be corrected.

Response: - This will be corrected.

The ammonia spikes observed during the study are quite interesting. They could be due to the wind direction or they could be revealing something about the details of ammonia emission in the area. The authors propose that the spikes were due to the evaporation of NH3 from wet surfaces after sunrise. Given the variability of the time of the peak is there any correlation between the temperature change that day and the time of the peak. Is there some correlation with wind direction or speed? These patterns are a major feature of the data set (they affect the other aerosol components too) so some additional analysis is necessary.

Response: - Ammonia peaks were occurring every day at the same time when temperature was increasing after sunrise between 8:00 and 9:00 LT. This pattern did not change much throughout the measurement period. Observed ammonia spikes are not correlated with wind speed or direction. The authors will add some more (minor) statements on this matter in the paper.

The changes in HNO3 and nitrate are determined both by chemistry and losses and also by changes in the partitioning. It is worth examining the sum of the two (the total nitrate) in order to remove the partitioning from the picture. A graph and some discussion of the total HNO3 could be a useful addition to the paper. The same should be the case for chloride. Is the diurnal pattern of HCl related to chemistry, emission/removal, or just transport from the aerosol to the gas phase and vice versa?

Response: - This is a very valuable suggestion and it fits well within the scope of this paper. The authors will add graphs of total ammonium, nitrate and chloride in order to exclude partitioning and evaluate the role of production and loss processes. Gas/aerosol partitioning itself will be analyzed in the forthcoming paper.

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Interactive Comment

The discussion of the diurnal patterns focused on September 17-20 and I am assuming that these days are representative of the dry season. There is little information presented about the patterns during the wet season.

Response: - This is true; however, besides much lower mixing ratios during the wet season; general diel patterns did not change significantly. Results from September 17-20 were chosen exemplary to show the reliability of the measurements compared to studies that have been carried out e.g., in the Northern Hemisphere.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 1203, 2004.