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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 goal of this paper was to present results of real-time measurements of inorganic aerosol species and their precursor gases for the first time in a tropical region- namely the Amazon Basin. Therefore, the paper mainly focuses on the performance, evaluation and validation of the measurement method, which is accompanied by first general results. High temperatures and high relative humidities in this tropical region make the operation of a wet-annular denuder and Steam-Jet Aerosol Collector in combination with IC and FIA a challenging task. It was referred to a subsequent paper which will present more detailed analyses of charge balances and gas/aerosol interactions, therefore these details were excluded in this study.

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Reply to specific comments:

The paper has scientific merit and presents novel data; however, I do believe that with minimal effort the analysis could be strengthened. For example, correlations (r^2) between various gases and gases and particles could be presented in a table. Correlations are alluded to in the manuscript but not specifically given. For example, during the biomass burning season correlations between various gases may suggest a similar biomass source (e.g., NH₃, HCl, and HNO₃). Similarly, correlations between NH₄₊ and NO₃⁻ etc. may help demonstrate a similar biomass source for these compounds.

Response: - Simply by showing correlations of gases and aerosols a detailed investigation on their biomass burning sources does not seem to be sufficient. The measured gases are either primarily emitted by fires or they are secondary products. Therefore, chemical conversion, transport and meteorological conditions are the main factors influencing aerosol and trace gas mixing ratios. A presentation of correlations appears to be inappropriate in this case. However, a subsequent paper may give more details on this.

Another area of interest would be associations between particulate anions and cations. It is stated that NH₄₊ concentrations are greater than all other ions. This leads to the question of whether NH₄₊ is greater than SO₄⁼ plus NO₃⁻ (when concentrations are in equivalence). A plot of the ratio of NH₄₊/(SO₄⁼ + NO₃⁻) with time along with other compounds (NH₃, NO₃⁻etc.) may be insightful. These types of ion balances could provide some interesting insights, such as, could there be NH₄₊ associated with organic acids, a compound also thought to be emitted in biomass burning. Unfortunately, by only measuring the cation NH₄₊, this type of analysis may be limited.

Response: - Ionic balances are also not subject of this paper, but will be analyzed in a subsequent paper. However, the authors will include a general remark regarding the excess of aerosol NH₄₊ and will refer to the subsequent paper in this context.

For the most part the scientific methods are sound. However, there is an issue relating

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to the sampling efficiency calculations of section 3.2.2. The calculated HNO₃ losses in the sampling inlet are highly questionable given that the Reynolds number is 4500 and Gormley & Kennedy is used to estimate the diffusional wall losses. This equation only applies for laminar flow that is when Reynolds numbers are less than ~2000. At the very least it should be pointed out that turbulence will enhance the losses, and thus considering this, the given HNO₃ losses are a lower estimate. The best solution would be to calculate the losses under turbulent conditions to give a range in calculated losses (laminar versus turbulent).

Response: - As stated in the paper, a Reynolds number of 4500 indicates the transition between laminar and turbulent conditions. It is well known, that, for example in annular denuder tubes Reynolds numbers are higher than pure laminar flow allows ($Re > 2300$), but in practice no turbulent flow behavior is observed, e.g. no deposition of aerosol particles takes place in these denuder tubes. This may be applicable also for our circular inlet conduit. However, we will allude to the possibility of higher HNO₃ losses in case turbulence was present.

The paper would also be strengthened if other data were also available and presented, including total particle mass and any other compounds that could serve as a biomass burning tracer.

Response: - Since the main goal of this paper was to report on first measurements of inorganic aerosol species and their gaseous precursors in a tropical environment- as stated above- the importance of other biomass burning tracers do not play a role for this study; total PM and other compounds will be included also in a subsequent paper.

Many of the equations presented are well known and could be excluded from the paper and only referenced. For example, equations 1, 2, 3, and 5. Just summarizing the results would likely be sufficient.

Response: - These equations were included because they are considered to be an important complement for the transparency of the paper. The reader should be informed

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about mathematical procedures in order to entirely understand the paper.

It is unclear from the text if the aerosol measurements were of fine particles (PM2.5) or total (fine plus coarse mode). Apparently a cyclone was used at times, or was it all the time? This is unclear. The size of particles quantified should be presented with the aerosol data (e.g., the authors could include "fine particle" in the appropriate figure captions).

Response: - This is not completely true. The figure captions for aerosol measurements contain the information about fine or coarse PM. However, for the seasonal variations this information was not included since data of bulk and PM 2.5 aerosol fraction were summarized. A remark about this will be made in the corresponding figure caption.

Overall, the paper is well written and well organized and easy to read.

Response: - no comment

Reply to technical corrections:

Pg 5, end of 1st paragraph "Are little sensitive to artifacts, do you mean, not prone to Artifacts?"

Response: - This is right and will be changed.

Pg 5 end of section 2. After the discussion of various limitations/artifacts associated with the various measurement methods, a brief discussion or reference to any instrument intercomparison studies would be of interest.

Response: - To our opinion, a discussion of performed intercomparison experiments regarding the measurement of these species would go beyond the scope of this paper. Main measurement techniques are mentioned and discussed.

Pg 7, was polyethylene actually one of the plastics tested by Neuman et al. for HNO₃ loss?

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Response: - no, it was not.

Last paragraph of section 3.2.2. on pg 9. Observing no changes in the diel variation doesn't really prove the accuracy of the measurement (a systematic error would not be observed). Did the concentrations not change significantly from inlet on to no inlet? Maybe the sampling time is too long for a comparison between consecutive measurements.

Response: - The concentrations did not change from inlet Šonč to inlet Šoffč; the formulation of this sentence will be improved for a better understanding.

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

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