Response To Anonymous Referee # 1 Comments

Specific Comments:

Page 31630, Abstract: Although the abstract is well written, it says very little about the results of the paper, focusing instead on a description of the BORTAS campaign. Some additional information should be provided, summarizing the conclusions of the work.

Additional information has been appended to the abstract.

Page 31635, line 14: The choice of 100 times the MAD as the filter threshold for the retrieval error seems very large. Why choose 100? Would retrievals with errors of, e.g., 10xMAD or 50xMAD, still converge?

A failed convergence will inherently generate an extremely large value in the retrieval error, but these are not common. The MAD filter was added as an almost redundant extra measure in the filtering process. 100xMAD is an arbitrarily chosen number, but is sufficiently small enough to filter out any retrievals with a failed convergence. Retrievals which may have a failed convergence are going to produce profiles with erroneous VMR values which are going to be caught by the median filter anyway. The threshold value for the median filter was chosen by first plotting spaghetti plots of ACE-FTS HCN vertical profiles and then incrementally changing the the values and visually inspecting the resulting plots until all erroneous profiles were filtered out.

Page 31636, line 7: What determines the accuracy of +-1 day for the age of the plume as determined using HYSPLIT?

This is really my own defined temporal restriction. Unlike the straightforward backtrajectory seen in Figure 1, often the calculated path of the backtrajectory will show the air masses circling around areas with fire activity for many hours, which puts into doubt at what point was the biomass burning outflow actually incorporated into the air mass that is eventually measured by ACE-FTS? So realistically the temporal resolution for the age of the measured biomass burning plume can be confidently assigned to a particular day.

Page 31639-31644: Section 3 (Enhancement ratios) is long (six pages) and covers several topics. It would help the reader if this were divided into subsections, such as one dealing with the derivation of enhancement ratios and one with the discussion of ozone in biomass burning plumes.

Additional section created.

Page 31640, para 2: Define the errors on the enhancement ratios given in Table 1. What are they and how are they calculated?

The error represents the 1-sigma uncertainty of the slope in the linear regression calculation. Explanation added to the manuscript.

Page 31640, para 3: Here (or elsewhere, e.g., end of para 1 on page 31635) add some discussion of how consistent the enhancements of other gases are for the occultations that have HCN > 0.3 ppb.

Additional discussion added to the manuscript.

Page 31640, lines 25-29 and page 31641, lines 1-7: No results are given for the computation of emission factors that were derived assuming that the enhancement ratios for the long-lived species can be used as effective emission ratios, only that they agree with two other studies. For which species were emission factors derived in this work and what were the values?

This section of the manuscript was reworded for clarity. The calculation of emission factors and validation of the ACE-FTS data was performed in the preliminary study published in Tereszchuk et al. (2011), not for this work.

Page 31644, line 13: What is the altitude or altitude range for the monthly median ozone VMRs shown in Figure 4?

The altitude range information of the occultations has been included in the figure caption.

Page 31644, para 2: Discussion of the annual cycle of ozone and the impact of other seasonal effects is limited. The sentence "As expected, O3 concentrations are at their lowest during the Winter months when biomass burning activity is minimal, but elevated concentration are clearly noted during the Spring and Summer months." implies that this annual cycle is entirely due to the presence or absence of biomass burning, which is not true. This discussion should be strengthened to include other factors that determine the annual cycle, and better address causation vs. correlation for ozone and biomass burning.

The only other important source of tropospheric O3 is from anthropogenic pollution, which is mostly confined to the lower troposphere (ground level, boundary layer). ACE-FTS measurements are limited to middle to upper troposphere (above 5 km) and O3 at these altitude will be from the production in the lofted emissions from biomass burning activity.

Page 31646, para 2: Add a reference to, and some discussion of, Figure 7 to the text.

Reference made to Figure 7.

Page 31654, Table 1 (and corresponding discussion in the text): How good are the matches to age? Does ACE-FTS sample the same plume more than once or are all these results independent? Are detections of enhancements of all 15 gases significant? What are the error budgets on the ACE-FTS VMRs used to derive these values? What are the uncertainties given in the table? Could also plot these data as enhancement ratio vs. day to clearly show the time evolution.

The values for the age-dependent enhancement ratios demonstrated reproducibility compared to the calculated values obtained in the preliminary work in Tereszchuk et al. (2011). Data used in the calculations are combined from both the individual sampling of plumes and from the occasional instances of sequential measurements where ACE-FTS has sampled the same plume more than once. Citation provided for the error budget associated with ACE-FTS retrievals. Uncertainties represent the 1-sigma uncertainty of the slope in the linear regression calculation. Plots could be generated of the enhancement ratios vs day, but it would be redundant to have both the tabulated data and plots of the data trends. The tabulated data is what is of interest to modelers as the constraints for CTMs. Additional information included the manuscript.

Technical Corrections:

Page 31632, lines 26-29: This sentence appears to be missing a verb.

Changes made to the sentence accordingly.

Page 31634, line 16: "data HAVE been"

Correction made.

Page 31634, line 25: change "concentration values" to VMRs. Also, throughout the manuscript, concentration should be changed to VMR when [ACE-FTS] VMR is the quantity being discussed.

Corrections made.

Page 31637, line 1: "was used as A visualization tool"

Correction made.

Page 31637, line 8: "the type OF biomass material"

Correction made.

Page 31637, line 11: "from Boreal forests IS contributing"

Correction made.

Page 31638, line 8: "to determine the origin of the plumes and whether there is convergence from . . ."

Correction made.

Page 31641, line 9: "species take place"

Correction made.

Page 31642, lines 3 and 8: ozone has been used here but O3 elsewhere

Correction made.

Page 31643, line 2: This sentence is ungrammatical – perhaps ". . . sources or the likelihood of confinement within . . ."

Correction made.

Page 31643, line 12: "IS elevated"

Correction made.

Page 31645, line 2: "O3 production occurs"

Correction made.

Page 31645, line 10: "permitTING"

Correction made.

Page 31645, line 14: As noted above, "HCN VMR profiles", not concentration

Correction made.

Page 31646, line 2: "plumeS"

Correction made.

Page 31647, line 8: Why redefine ACE-FTS?

Correction made.

Page 31647, line 12: "enhancement ratios"

Correction made.

Page 31648, line 13: "subsequent mixing"

Correction made.

Page 31655, Figure 1 caption, line 2: "from ACE-FTS occultation". Define the significance of the purple circle.

Purple icon in figure defined.

Page 31656, Figure 2 caption, line 3: "during ACE-FTS occultation". Define the significance of the black dot – use the same symbol as in Figure 1?

Black diamond in figure defined.

Page 31657, Figure 3: Change concentration to VMR in top (ozone) and bottom (HCN) x-axis labels. Also change in figure caption.

Corrections made.

Page 31658, Figure 4: Change concentration to VMR in y-axis label. Also change in figure caption. Line 2: "four-year".

Corrections made.

Page 31659, Figure 5: Change concentration to VMR in all x-axis labels. Line 3: "demonstrateS". Line 4: "intrudING".

Corrections made.

Page 31660, Figure 6: Change concentration to VMR in all x-axis labels. Also change in figure caption. Line 7: "which give AN indication".

Corrections made.

Page 31661, Figure 7: Change concentration to VMR in y-axis label. Also change in figure caption.

Corrections made.