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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Australian bush fires of February 2009: MIPAS observations and GEM-AQ model results" *by* N. Glatthor et al.

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We thank referee 1 for her/his helpful comments.

Reply to general comments:

The referee states that the "choice of exactly what to present and how the data was presented seemed strange to me" and that "the exact details of the plume dispersion do not seem to me to be the most scientifically interesting aspect". It is suggested to make this part of the paper more compact, namely to discuss the plume dispersion in one section and not separately for three gases and to reduce the discussion on three altitudes to a presentation of partial columns, or to give an explanation for our form

of presentation. Instead to focus on the spatial expansion of the plume only, she/he suggests an additional discussion of the temporal evolution of enhancement ratios of the minor trace gases to CO to study "the changing composition of the plume as it ages".

The authors were aware that the discussion of plume dispersion using the three gases C_2H_2, HCN and HCOOH at the height levels 15, 18 and 21 km is somewhat redundant. But since this paper is the first publication on MIPAS biomass burning gases using single-scan measurements without any averaging, we wanted to document the reliability of these data by showing the good agreement between plume tracking by either MIPAS C_2H_2, HCN or HCOOH and by demonstrating the compliance with GEM-AQ model data. We assumed that a comprehensive presentation tracking the dispersion of a well-defined plume over weeks by measured and model data has a significant scientific value, and disregarded a discussion of the temporal evolution of the plume composition to avoid an overloaded paper.

However, since the second referee also critisises that the discussion of the plume dispersion is "repeated for each analyzed molecule", we will combine the general description of the plume evolution (Secs. 4.1, 4.2 and 4.3) into one section discussing MIPAS C_2H_2, HCN and HCOOH at a certain height level only. Further, since both referees request an investigation of the chemical evolution of the plume, we will add a section discussing the temporal evolution of the enhancement ratios of C_2H_2 versus HCN and of C_2H_2 versus HCOOH etc., both for measured and model data. We will not use correlations with MIPAS CO, since these exhibit a larger scatter. For comparison with enhancement ratios from other measurements, which are usually given using CO as reference, we will transform these into C_2H_2 versus HCN and to C_2H_2 versus HCOOH ratios. We will not convert MIPAS data into partial columns as suggested, because this would be rather unusual for a limb-sounder. The papers of Young and Paton-Walsh (2011) and of Alvarado et al. (2011) cited by referee 1 discuss column amounts obtained by nadir-viewing experiments, for which this kind of data presentation is much

more common. We can derive enhancement ratios from volume mixing ratios at certain altitudes as well, since the vertical resolution of MIPAS C_2H_2, HCN and HCOOH is rather similar.

Reply to specific comments:

Page 15012, line 1:

We can not find a number or figure indicating a burned area of 4300 km^2 in the Royal Commissions final report (Teague et al., 2009). To be more precise, we will change the wording into "On 7 February 2009 and during the following weeks Southeast Australia was devastated by large bush fires, which burned an area of 3000 km^2 on February 7 only (Tolhurst, 2009)."

Page 15014, lines 24-25:

We did not present additional horizontal distributions of C_2H_6, PAN and CO, because this would have resulted in even more, mostly redundant plots, which referee 1 already critisises for the C_2H_2, HCN and HCOOH distributions presented.

Page 15017, lines 26-27:

We will provide Kaminski et al. (2008), which is already in the bibliography, as reference.

Page 15018, lines 1-2:

The model was run to simulate the Kilmore East fire only. We focused on this fire, because it was the largest of the Victorian bush fires. We can not definitely state that the main plumes that penetrated to the stratosphere resulted from the Kilmore East fire. However, as this fire was the largest one, it is rather probable that it caused the major part of the stratospheric plumes. It does not seem that Raffuse et al. (2012) is

relevant to our context, as we did not attempt to explicitly model pyroconvection.

Page 15018, lines 3-13:

The listed emissions reflect the amount of combustion products calculated for the Kilmore East fire on February 7. Therefore the given numbers are less than one third of the GFED3 numbers and less than the FINNv1 numbers (Wiedinmyer et al., 2011).

Direct comparison for our species of interest (HCN, C_2H_2, HCOOH) with Paton-Walsh et al. (2012) is not feasible, as their data in Table 1 are total emissions for the whole fire region and the full month of February, whereas our emissions are estimated for Kilmore East and for the day of February 7 only. As an aside, Figure 5 in their paper shows daily emissions of CO. For February 7, the amount estimated by the FEEV-AOD method is $\sim$600 Gg. We estimated $\sim$300 Gg of CO emissions for the Kilmore East fire for the same day. For a comparison, it has to be taken into account that the total area burned on February 7 was $\sim$3000 km^2, of which slightly more than one third at Kilmore East.

Page 15018, lines 23-24:

The referee's question is a good point. The time period was chosen to roughly cover the period when initial lofting to high altitudes seemed to us most likely to occur. We will check, if a shorter time delay between the injection of the pollutants into the upper troposphere and the outbreak of the fire will cause significant changes of the model output.

Page 15018-15019:

We will change the sentence into "Except for the resulting altitude distribution, the initial plume release details as e.g. the lofting mechanism appear to be of secondary

importance."

Page 15023, lines 5-6 and page 15024, lines 10-12:

As already mentioned above, this is the first publication on MIPAS single-scan measurements of biomass burning gases, which exhibit low to medium spectral signatures only. Thus, a separate discussion of the dispersion of different pollutants was performed to confirm the results obtained by each single species. However, as announced above, the discussion of the dispersion will be combined into one section.

Conclusions:

We will present a shorter and more concise summary of the major conclusions of the paper.