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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Microwave Limb Sounder observations of biomass-burning products from the Australian bush fires of February 2009" *by* H. C. Pumphrey et al.

Anonymous Referee #2

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This paper presents stratospheric observations from the MLS sounder in the highly polluted fire plume from the large Australian fires in February 2009. In addition to retrievals of CO, presented as the most robust, fire tracers HCN and CH3CN are detected by the instrument. The spectra measured in the fire plume are selected and analysed in order to attribute enhancements to contributing species. Clear enhancements in the ClO spectral region have been observed and attributed to CH3OH. The availability of 6 years of MLS observations highlights the unusual character of such highly polluted plume in the stratosphere.
The manuscript is clearly written and most figures are relevant and clear. It demonstrates the interest of limb sounders for the analysis of the composition of plumes

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Interactive Discussion
Discussion Paper

injected in the upper troposphere and in the stratosphere. However, there are a few points that need to be detailed before publication.

General comments

In general, the discussion of the results should provide more references and comparison to previous published work on the detection of species in fresh biomass burning plumes using satellite observations or in situ measurements. Rinsland et al. (2007) provides and analysis of boreal fires for a large series of detected species, not only CO and CH3OH. Another example, Coheur et al. (ACE-FTS observation of a young biomass burning plume: first reported measurements of C2H4, C3H6O, H2CO and PAN by infrared occultation from space, ACP, 7 5437-5446, 2007.) provide a similar IR spectral analysis of a fire event in South Africa, which may be closer in terms of vegetation burned, etc. Or, more recently, the IASI IR observations allowing the detection of large CO and short lived species, including CH3OH (Coheur et al., ACP 2009, Turquety et al., ACP, 2009). It would be interesting to compare the magnitude of the events and the detection limits of the instruments. Could other species detected by ACE-FTS or IASI be detected with MLS? Could CH3OH be an MLS operational product under specific conditions?
The last part on "The wider context" is really short compared to the potential of the data to show the statistical importance of high altitude injection of fire plumes. The strength of the MLS sounder compared to other satellite missions is to provide a long record of profiles of trace gases in the UTLS and above with a relatively good coverage. While the Australian fire event clearly stands out, it would be interesting to quantitatively check other events (for CH3OH in particular).

Specific comments

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P. 5534, l.6: The authors state that only CO is robust, and that the other operational products “have obvious problems and must be used with some cautionÂăÂż. Here the authors should be more specific, and provide numbers for the expected error for all species used in the following. Also, is the performance of the retrieval equivalent for all levels (mentioned that there are biases for CO but what about the other gases)? Some readers may want to check whether these data could be useful to test emission inventories and model simulations. . .

Section 2.1: When reading this section, the reader wonders whether the transport pathway is consistent with the meteorological conditions. This is discussed in section 3 after the data analysis. Maybe this section could be moved right after the mapping of the fire plume with the CO observations.

Section 2.2: Would a retrieval of CH3OH be possible in these conditions? Could it be included in the distributed products?

Section 3: Does the altitude of the air masses change during long range transport for the different trajectories (are the air masses lofted to higher altitudes during LRT as suggested by the data analysis)?

Section 4: Figure 11 should be summarized by a clearer figure. It is presently very difficult to read, and the interesting information can not be separated. This part is, to my point of view, the most interesting but would need to be developed a little. Even if the magnitude is lower than for the Australian fires event, could a statistic of the injection of fire plumes in the stratosphere be derived from this product? Do the large enhancements in the seasonal South African and South American fires mean that these fires are injected at high altitudes or are these enhancements only related to

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large circulation patterns?

For the large events in the UTLS, can CH3OH also be identified in the radiances? (e.g. event at the end of 2006, and other seasonal contributions)

P.6539, L. 21-22: “we found no events in any way similar to the Black Saturday event.” Again, are there any evidence for injection in the UTLS that could be used statistically?

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