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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Chisholm firestorm: observed microstructure, precipitation and lightning activity of a pyro-Cb" *by* D. Rosenfeld et al.

D. Rosenfeld et al.

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The authors thank Referee 2 for the meticulous review and constructive comments.

Following are our responses to the comments of Referee 2, which are replicated here in *italic text.*

Comment: *Figures 6-7 should appear before Figures 4-5, for temporal consistency.*

Response: Figures 6-7 are discussed later in the manuscript, and therefore cannot be moved forward.

Comment: *The authors use the terms 'upshear' and 'downshear' repeatedly. According to Figure 3, above there is hardly any wind shear above 600 hPa.*

Response: The low tropospheric wind shear is sufficient to determine the orientation and side of preferred growth for the clouds.

Comment: *Page 9880, line 25: What do you mean by 'atmospheric instability'? Are you talking about static stability? If so, are you sure that the atmosphere was truly statically unstable, or do you mean conditionally unstable? Can you document that? I suggest to replace by something like'weak static stability'.*

Response: The context of the statement is "increasing winds and atmospheric instability just ahead of the frontal passage". We simply mean to state that the atmospheric static instability is increased closer to the front. It is equivalent to the statement that the atmospheric stability is decreased closer to the front. The text will be changed to "increasing winds and decreasing atmospheric stability just ahead of the frontal passage".

Comment: *Page 9881: The authors must show weather charts here, to allow the reader to follow the discussion concerning the approaching cold front!*

Response: Such a figure will be added.

Comment: *Page 9883, line 7: 'The emissivity of such ice clouds...'. Here we are not dealing with a pure ice cloud, but rather a mixture of an ice cloud and a smoke cloud. How does that affect this assumption?*

Response: The emissivity of smoke particles in the thermal IR is negligible.

Comment: *Page 9883, lines 10-11: '-60 to -62 C, in agreement with the temperature at 1300-1600 m above the tropopause'. This is inconsistent with the sounding in Figure*

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3, which indicates temperatures of -58 to -60 C at these levels.

Response: According to the numerical values of the sounding, the tropopause is at 10,974 m and temperature of -58.1. The temperatures at heights of 12,300-12,600 m vary between -59.7 and -60.5 C. The interpretation will be revised based on the more accurate sounding data.

Comment: *Page 9884, line 1: It sounds reasonable that the ascending cloud would cool adiabatically below the ambient stratospheric temperatures. The question that arises is: Why was this not a topic in the discussion of points C and K earlier?*

Response: This consideration will be added to the discussion of points C and K.

Comment: *Page 9886, lines 10-11: Please explain the reasoning behind the following: 'According to the sounding in Fig. 3, the anvil top at 00:00 UTC was at a height of 12.5 km'. How is this inferred from the sounding?*

Response: This is the height of the sounding where the ambient temperature is similar to that of the cloud top. This explanation will be added to the text.

Comment: *Page 9899, Fig. 4: Points D and F have a 0.65 micron reflectance greater than 1. How is this possible? Please explain.*

Response: The satellite measures the bidirectional reflectance, which varies as a function of the geometry. The albedo is the hemispherical average of the bidirectional reflectance, which can reach unity at the most. However, accepting that at some angles the bidirectional reflectance of an object with albedo approaching unity can be less than unity implies that in other geometries the bidirectional reflectance can exceed unity.

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EGU

Comment: *Abstract, line 2, page 9878: 'and' must be inserted before 'devastated'.*

Response: Will be corrected as suggested.

Comment: *Page 9879: 'Fromm et al. (2006a)' should be given as 'personal communication' or, by the time it is submitted, as 'Fromm et al. (2007)'.*

Response: The status of "in preparation" will be retained.

Comment: *Page 9879 and 9893: 'Fromm et al. (2006b)' should be 'Fromm et al. (2006)'.*

Response: Will be corrected as suggested.

Comment: *Page 9879, line 18: Please define the acronym 'TOMS'.*

Response: Total Ozone Mapping Spectrometer. Will be added to the text.

Comment: *Page 9879, lines 18 and 21: Explain AI; e.g., what does an aerosol index of 'between 25 and 32' mean, physically?*

Response: The qualitative physical meaning of AI between 25 and 32 is: 1. the plume is optically opaquein the UV (and likely in visible), highly absorbing, and high in altitude. Such high AI values were first documented by Fromm et al. (2005) for smoke plumes of pyro-Cb.

Comment: *Page 9880, lines 6 and 10: Approximately what height does a potential temperature of 450 K correspond to?*

Response: 450 K is about 18 km in the event we mention.

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Comment: *Page 9880, lines 20-21: 'occurred fortunately' should be 'fortunately occurred'.*

Response: Will be corrected as suggested.

Comment: *Page 9880, line 23: After 'Edmonton', add: 'in Alberta, Canada'.*

Response: Will be corrected as suggested.

Comment: *Page 9880, line 26 and page 9894, line 8: 'Luderer et al., 2006b' should be 'Luderer et al., 2006'.*

Response: Will be corrected as suggested.

Comment: *Page 9881, lines 2-9: It would be valuable to the reader if the sensible heat flux were provided in W m-2. Also, how were the fuel consumption and specific combustion energy estimated?*

Response: The estimations of the energy release are based on ASRD (2001). It was calculated at 200 Kw/m of fire head, for a fire front 25 km long.
ASRD: Final Documentation Report - Chisholm Fire (LWF-063), Forest Protection Division, ISBN 0-7785-1841-8, Tech. rep., Alberta Sustainable Resource Development, 2001.

Comment: *Page 9881, line 11: 'heights' appears twice.*

Response: Will be corrected as suggested.

Comment: *Page 9881, lines 26-27: Once again a map would improve the readability*

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greatly. A weather chart with Chisholm and the sounding site clearly indicated would do.

Response: That figure will be added.

Comment: *Page 9882, lines 11-12: There is something wrong with the sentence 'An new analysis..'.*

Response: Line 13 should read: 'Ěstratosphere (Fromm et al. 2006a) foundĚ'. This will be changed in the text.

Comment: *Page 9883, line 17: 'Luderer et al., 2006a' should be 'Luderer et al., 2007', or 'Luderer et al., pers.comm.'*

Response: It will be changed to 'Luderer et al., 2007'.

Comment: *Page 9883, lines 17-23: What is the conclusion here??*

Response: Arguments are presented here for both alternative mechanisms, so that there can't be a sharp conclusion here.

Comment: *Page 9884, lines 6-7: Please explain better the following: 'According to the length of the shadow and the illumination and viewing geometry..' Is there a reference for the methodology used here?*

Response: This is a simple geometric calculation that takes into account the solar zenith and azimuth angles, No reference is required for that.

Comment: *Page 9884, lines 11-12: What do you mean by 'but not at their peak magnitude'?*

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Response: The cross section does not cut through the points of the most extreme values anywhere at the cloud top.

Comment: *Page 9884, line 15: As was the case for the sounding, the position of the radar needs to refer to a map, which currently is missing.*

Response: Same response as for Page 9881, lines 26-27.

Comment: *Page 9885, line 29: 'sill' should be 'still'.*

Response: Will be corrected as suggested.

Comment: *Page 9886, line 4: What do you mean by 'the saturation value of 35 microns'?*

Response: Large ice particles absorb almost completely the 3.7 micron radiation, so that the largest possible retrieved particle size is smaller than 35 micron.

Comment: *Page 9886, line 19: 'is so also' should be 'is also'.*

Response: Will be corrected as suggested.

Comment: *Page 9887, lines 4-5: The sentence 'Figure 7 shows clearly .' is repetitive, and should be removed.*

Response: Will be corrected as suggested.

Comment: *Page 9888, line 14: 'have' should be 'has'.*

Response: Will be corrected as suggested.

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Comment: *Page 9888, line 25: 'were' should be 'have been'.*

Response: Will be corrected as suggested.

Comment: *Page 9889, line 7: 'Latham and Williams (2001)' does not appear in the reference list.*

Response: The reference will be added.

Comment: *Page 9889, line 12: 'Comet, 2002' does not appear in the reference list.*

Response: The reference will be added.

Comment: *Page 9890, line 25: 'in spite' should be 'despite'.*

Response: Will be corrected as suggested.

Comment: *Page 9897, Figure 2: The figure is so small that it is not possible to see any of the features that the authors describe. Perhaps the upper panel can be skipped, and the lower panel substantially enlarged. Also, in line 2 of the caption, 'upper part' and 'lower part' need to be swapped.*

Response: The figure will be expanded to a full page in the ACP manuscript. The captions will be corrected.

Comment: *Page 9898: The caption for Figure 3 is inadequate. What are the blue, green and red lines?*

Response: It is not clear what the reviewer is commenting on. There are no such

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lines in Figure 3 or in the adjacent figures.

Comment: *Page 9899, Fig. 4: For clarity, it needs to be mentioned that the southern-most cloud is what is called 'phase-2' in the text.*

Response: Will be added as suggested.

Comment: *Page 9901, Fig. 6: The figure is rather small for readability, especially the inlets ('Area 1' and 'Area 2').*

Response: The figure will be expanded to a full page in the ACP manuscript.

Comment: *Page 9901, Fig. 6: In A-B reflectances (at 0.65 microns) of well above unity are shown. Please explain.*

Response: See our response to the referee comment on Page 9899, Fig. 4.

Comment: *Page 9902, Fig. 7: The lower two panels are far too small for readability.*

Response: The figure will be expanded to a full page in the ACP manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9877, 2006.