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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An airborne assessment of atmospheric particulate emissions from the processing of Athabasca oil sands" *by* S. G. Howell et al.

Anonymous Referee #2

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This paper describes aircraft measurements of trace gas and aerosol abundances around oil sand operations in Canada. The work seeks to use the data to explore emissions estimates and investigate transformations in the plume. The key findings are that calculated SO2 and NO2 emissions are consistent with emissions inventories yet CO emissions are significantly higher; and conversion of SO2 to sulfate is considerably faster than estimates of OH oxidation alone would suggest. The measurements do provide useful new data of emissions from oil sand operations which contribute a considerable amount to regional emissions and are worthy of publication in ACP. I do though have some comments that the authors need to consider

Substantive comments There is only one flight across the oil sands at one level. How can the authors be convinced that this one flight represents the average emissions of the industry in the region. There may be considerable day to day and week to week variability. How is the data representative? The discussion of the emissions from oil sands and boreal forest fires on page 21315 seems fraught with ambiguity. I would like to see a much more precise discussion of the assumptions given to the emissions estimates from each of the sources to make sure that like is indeed being compared with like. What are the geographical areas of the calculation, how the measurements scaled to the whole of oil sands emission and so on? Page 21316: there is a discussion of aerosol ageing based on two different days of sampling. The samples are on consecutive days at approximately the same time. Trajectory analysis (figure 13) shows that the advection time from the near source to the far field sampling was around 5 hours. As a result the time at source was different and the observed concentrations may vary because of diurnal variations in the emission or because of changes in boundary layer dynamics throughout the day. How can the authors be sure that the differences are not simply due to changes in emissions or advection from one day to the next rather than, as they have done, conclude that the differences are due to ageing?

Minor comments: Page 21302 line 12: SO4= is used. If these are AMS measurements you cannot assume that this is the sulphate ion. Page 21310 line 16-17 where it is clear the sulphate is not the sulphate ion. Page 21302 Line 19: were clouds present? Page 21302 Line 21-22: over what spatial scale is this true? Page 21304 line 3: cite the web address in the text Page 21 line23-24: what were these sources? Page 21305 line 7 "figure 8" is confusing suggest writing as eight Page 21305 line 26: concentration not plural Page 21306: were the SMPS measurements made by continuously sampling ambient air or by grab sampling? How does this affect analysis of size distribution in plumes? Were the S<PS measurements made in the same way from both aircraft? Page 21307 line 5: why is ion strength supposed from the AMS measurements? As is exemplified by the statement made on line 9. Page 21309 line 8: indicates Page 21309: why is this likely other than there are large concentrations of sulphate observed? Fur-

ther you should explain clearly what it is you propose that is reacting with H2SO4 in this sentence. Page 21312 Fluxes section. It would be good to reference previous work using this approach such as Ryerson et al., 2012 and earlier references. Page 21313 cm3 Page 21313 line 16-17: I would like to see a discussion of the potential oxidation pathways of SO2 to sulphate that explain this deficit? Page 21315 lines 4-13: If the CO emission is so different to the inventory I would not like to see it used as the denominator in the emission ratio calculations without comment or discussion seems. Page 21317: DMA distributions, better to write SMPS as this describes the type of scanning

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21301, 2013.