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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Scavenging ratio of polycyclic aromatic compounds in rain and snow at the Athabasca oil sands region" *by* L. Zhang et al.

Anonymous Referee #1

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General comments:

Characterization of chemical transport and fate in the Athabasca oil sands region has increased in recent years due to controversy over oil sands development and its poorly characterized environmental impacts. Zhang et al. add to this body of knowledge by describing the deposition of a particular group of hazardous air pollutants, PACs, in this region. The authors do a thorough job placing their results in the context of other similar work. Recent measurements of PACs in the Athabasca oil sands environment highlight the necessity of including alkylated PAHs in any study concerning PAC transport and fate as they are present in much higher quantities in this region relative to unsubstituted

PAHs, and Zhang et al. accordingly include these PACs in their work. The authors' inclusion of alkylated PAHs is notable considering these chemicals remain relatively poorly characterized despite suspicions that they may be more toxic than their parent homologues. Though the data are notable in this respect, the work as presented in its current form is not substantial with respect to new concepts, ideas, or methods. As the other reviewer noted in their initial review, reporting and comparing values is not enough, and the novelty in the work needs to be better stressed. Finally, though Zhang et al. present a manuscript that makes good use of the English language, there are some key methodological details missing that take away from the flow of the manuscript.

Specific comments:

Title: "ratio" should be "ratios".

What is the meaning of the names of the chemicals given in parentheses next to reported e.g. precipitation and air concentrations as in Line 10? Clarify.

Line 37: Is it really the number of rings and molecular weight or more the structure of a PAC that affects its phys-chem properties and, in particular, bioaccumulation potential and toxicity?

The introduction in general is not concise – the expected narrowing of focus leading up to the statement of objectives is lacking, and thus there is not such a clear link between context and objectives.

As noted, PAHs vary widely in terms of their phys-chem properties, and thus also their behavior. For this reason, please specify which deuterated PAH surrogates were used during sample extraction. Provide also recoveries in a table, and as other reviewer noted, detection limits.

The separation between gas and particulate phases in the HVAS is clear, but not so clear with the deposition samplers. Please clarify in description of sampler itself and in

lines 139-150 describing extraction.

In section 2.2, it is stated that air concentrations were estimated for a period of a little over a year while earlier in the introduction, it is stated that wet deposition samplers were deployed for two years. Why the discrepancy? Also, is it common practice to use air samples taken every 6 days, and averaging them over a month, and using them in conjunction with precipitation samples resolved on a monthly basis?

Line 197-199: How representative is AMS5 when it comes to particulate fractions at the other two sites, in addition to the locations of the other passive samplers in the AOSR that are intended to be used in future for estimating deposition? Also, provide more details about the measurements used to estimate these fractions. . .e.g. was it five measurements taken in one month, or a few measurements every 3 months? These fractions likely vary seasonally for many PACs.

Line 223: what kind of environment were these snow samples taken in? Urban? Rural? Suburban? It might also be important to note how your measurement methods differ from the studies referenced and how, if at all, this might influence the differences between your data and the references.

Table 1: There are a lot of numbers here. It might make for more intuitive digestion of patterns or lack thereof/comparisons to literature if these were somehow presented in graphical format that also includes literature values. This would also allow for a more concise description of these patterns and comparisons in the lines following. The info contained in Tables 2 & 3 might also be more easily digested if presented in graphical format.

Again, measurement methods and how these compare to methods used in other studies – could these perhaps account for "high" ratios described in lines 244-253?

To what extent do the three sites with wet deposition samplers allow for accurately estimating wet deposition at the other air quality monitoring sites in the AOSR considering

the limited geographical extent of the wet deposition samplers in this study relative to the passive sampling network (and perhaps AOSR in general)? Can you also be clearer about how to go from using the scavenging ratios determined using HVAS to estimating wet deposition at these other sites that only have passive air samplers?

Lines 288-290: Clarify whether the particulate and gas fractions in precipitation samples were separated in the present study in the methods section. Lines 311-313 make this clear too late.

Lines 454-456: Couldn't the seasonal differences in temperature and thus vapor pressure and chemical partitioning also have an influence on the variability in scavenging ratios?

Technical corrections:

Titles of sections 3.2 and 3.3. e.g. 3.2 reads Comparison of gas-phase dominant and particulate-phase dominant PACs by snow scavenging. Would something like "during" be a better replacement for "by"?

Line 358, replace is with "are".

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 19395, 2014.