

General comments:

The present study investigated the scavenging ratios of PACs in rainfall and snow at an oil sands region. It provides a set of comprehensive and scientifically sounding data for future assessment of PAC emission from oil sands areas. Given some chemicals such as alkylated PAHs have not been well studied in previous reports, this work is very important for future studies on PACs. The observation verified previous assumption that the scavenging ratios in snow exceed those in rain, which can be regarded as the innovative finding of this manuscript. The discussion is based on previous knowledge on PAC scavenging. As section 3.6 and 3.7 stated, there are some uncertainties haven't addressed yet. Also, some issues should be discussed clearly in the manuscript.

Method

Section 2.1.2 "The wet deposition sampler does not include a filter unit for separating the particulate phase from the dissolved phase in precipitation."

The authors also mentioned the repartitioning problem in the following section. If the sampler can't separate the two phases, the uncertainties may influence the final results on scavenging. Also, is there any measurement to prevent the exchange between air and XAD resin during each sampling procedure?

The sampling volume of air sampler is large, which may lead to breakthrough. I noticed that a pair of PUF plugs was applied. Do the authors test the two PUF plugs separately? Is there any breakthrough, especially for those low molecular weight compounds like NAP?

Section 2.1.4 "Samples with surrogate recoveries beyond this range were excluded from the calculation of scavenging ratios."

The recoveries of d8-NAP were lower than other compounds. Did the authors use those recoveries to correct alkylated NAP? Is that reasonable considering the physicochemical properties of them are different?

The reported detection limits refers to method detection limits (MDLs) or

instrumental detection limits (IDLs)? According to the units, it seems to be IDLs, so how about MDLs?

## Results and Discussion

Section 3.4 “No relationship between the Henry’s Law constant and total scavenging ratios was observed for rain samples, and might be due to a lack of temperature-corrected Henry’s Law constants. ”

The authors have already mentioned that the snow samples are associated with lower air temperatures, which may increase the partitioning of gas-phase PACs to the particulate phase. So they shouldn’t neglect the effect of temperature on the environmental behavior of PACs. Relevant data can refer the *Hand Book of Physical-Chemical properties and Environmental Fate for Organic Chemicals*. Although the information is limited, temperature-dependence of the Henry’s Law constant and other physical-chemical properties of some PAHs is included. After checking those data, the statement of no relationship between the Henry’s Law constant and total scavenging ratios will be better. Also, that information will help authors to illustrate their ideas in section 3.5, such as the decrease in water solubility or particulate mass fraction with increase alkyl substitutions.

Some grammar error should be checked carefully. For example, P24, Zhang et al. (2013) predicted *that* the range of scavenging coefficients are up to two orders of magnitude for snow and one order of magnitude for rain.

## Section 3.6

Due the limitation of method, some problems can’t be well discussed, such as the effect of temperature, colloids, repartitioning and properties of particles. Therefore the application of reported scavenging ratios seems to be limited at similar areas like oil sand region.

SI:

The concentrations of some compounds were 0 while some were blank. Do the authors mean that blank was compounds cannot be quantified (no peak) and 0 is below method detection limits, or the concentration was below 0 after blank correction? Blank correction will influence the results of the compounds with high background (or blank) concentrations such as NAP, which will finally underestimate the values.