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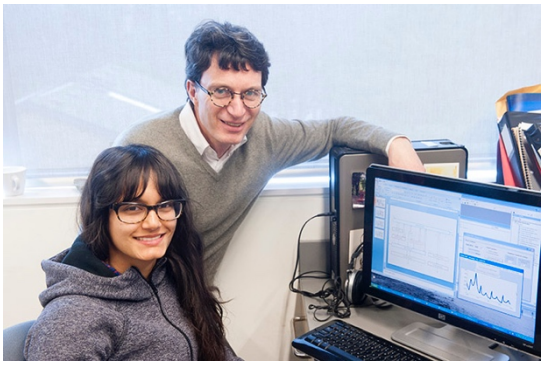
# University of Toronto researchers discuss their oil sands study, Part 1



Abha Parajulee and Frank Wania
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**PART 1 INTRO:** This is an interview with Abha Parajulee about the study done with her PhD supervisor Frank Wania: *Evaluating Officially Reported Polycyclic Aromatic Hydrocarbon Emissions in the Athabasca Oil Sands Region with a Multimedia Fate Model.* This study sheds light on what is really happening with emissions reporting in the region where oil sands production is occurring.

Abha Parajulee is a PhD candidate in the Environmental Sciences program at the University of Toronto Scarborough. Frank Wania is a professor in the Department of Physical & Environmental Sciences at the University of Toronto Scarborough. This study originated as a term project when Abha was taking a modeling course taught by Dr. Wania. Since the preliminary results of the project were quite interesting, indicating that officially reported emissions were too low, the project continued after the course ended to evaluate the findings in more detail.

**GCV: What was the objective of your study http://www.pnas.org/content/early/2014/01/29/1319780111.full.pdf, what group funded your study, and what did you hope to achieve from the results?**

**AP:** The objective of our study was to evaluate officially reported emissions scenarios for polycyclic aromatic hydrocarbons (PAHs), a group of hazardous air pollutants, in the Athabasca Oil Sands Region (AOSR). More specifically, we wanted to: 1) determine if officially reported emissions of PAHs are reasonable considering measured concentrations in the AOSR and similar boreal environments; 2) make first estimates of PAH emissions if the reported emissions were found to be unreasonable; and 3) figure out what the major transport pathways for these chemicals are in this region, with a focus on transport to aquatic systems.

To date, though there have been quite a few descriptions of PAH levels in air, water, snow, or sediments in the AOSR, there hasn't been much characterization of chemical cycling in the AOSR. Thus, we decided to use a chemical transport model to shed some light on the behavior of this particular group of chemicals, PAHs, in the AOSR. The study was funded internally by the University of Toronto.

**GCV: Can you describe the multimedia fate model that you used and why you chose to use it?**

**AP:** Our research group frequently makes use of multimedia fate models to explore cycling of organic chemicals in different environments. These models, in simple terms, represent the different parts of the environment as "boxes". Chemical transport between these boxes, as well as chemical removal, are described by mathematical equations that are determined by lab or field experiments and scientific principles that underlie some of these transport/removal processes. The model we used, CoZMo-POP (Coastal Zone Model for Persistent Organic Pollutants), was developed by Dr. Wania and his colleagues about 15 years ago, and has since been subject to many improvements and modifications. Such multimedia fate models have been used and evaluated for the past 30 years, and so there is a pretty high degree of confidence in the results they provide. It is important to recognize that models should never be used on their own, and should be used more as a tool to guide us towards what important measurements need to be made to improve our understanding of certain environmental processes. This is what we hope we have achieved in our study using CoZMo-POP, by directing attention towards an important aspect of chemical cycling in the AOSR that needs more attention: accurate characterization of emission sources and quantities based on better science than what's been used to date.

**GCV: How different was your study from the John P. Smol's study posted on Digital Journal last year? (Review: John P. Smol — Oil sands and lake ecosystems study — Part 1 and Op-Ed: John P. Smol — Environmental oil sands commentary — Part 2?**

**AP:** Though the two studies focus on the same group of chemicals, we had very different objectives. The Kurek et al. (2013) study was more about providing scientific evidence for historical patterns of contamination by oil sands development, and gave us some much-needed insight into "natural" vs. anthropogenic delivery of chemicals to the AOSR. Our study, on the other hand, was focused on evaluating officially reported emissions for their plausibility, and has shown that we need much better accounting of emissions sources and quantities. The danger of poor emissions accounting is that any estimates of future risk to human and wildlife health due to the intensification of oil sands development in the coming decades are also inaccurate.

**GCV: Was there any conclusive evidence that showed the health of people living in the area were at risk or are more studies needed to prove this?**

**AP:** The purpose of our study was simply to evaluate the emissions for their plausibility, not to conduct a health risk assessment. But, to put things into perspective, the PAHs that were the main focus of our study are present in the AOSR air at levels that are on par with those in Toronto, so there is no cause for alarm at present if considering only this group of PAHs. Finally, health is affected by a myriad of factors other than PAHs levels, so it is well beyond the scope of our expertise to make any definitive statements about the health of people living in the region.

**GCV: How can further studies in conjunction with monitoring done now mitigate any further damage imposed upon the land, water, air and the health of the people who live in the vicinity as well as the workers? Should this have been done sooner prior to intense production?**

**AP:** Before we come up with mitigation strategies to protect ecosystem health, we need a better understanding of the problems requiring mitigation, all the way from source to receptor. To achieve this improved understanding, we need a monitoring program based on sound science, with a holistic focus

that aims to link observations related to air, water, health, etc. Fortunately, this is one of the key objectives of the Joint Oil Sands Monitoring Program established a few years ago by the governments of Alberta and Canada. In fact, our study would not have been possible without the air quality data that came out of this program. We hope that the results of the program will soon be used to inform effective management strategies for the region.

Of course, in an ideal world, prior to the start of intense industrial development, we would 1) implement a holistic monitoring infrastructure to understand baseline or predevelopment conditions, and 2) also do our due diligence in predicting potential impacts to human health and wildlife so that we could take preventive measures accordingly. Unfortunately, I don't believe we've taken these steps as best as we could in this case (which is the reality with most industrial operations), but it is better late than never!

**GCV: If you were to do a series of studies after this one, what would you investigate especially after seeing the results of this study?**

**AP:** Since emissions estimates are the first step towards conducting exposure assessments, particularly those that estimate future risk, we are going to use our emissions estimates to conduct such an assessment for PAHs. We will again be using our multimedia models, and will focus on two populations: the out-of-province working population that likely experiences greater occupational exposure and the residential aboriginal community that might experience greater exposure due to their relatively high consumption of locally sourced food that may be susceptible to greater contamination than store-bought food. Once we finish developing the model so that it is suitable for the AOSR population, we hope that it can be used for other semi volatile chemicals that might pose a risk to human and wildlife health, not just PAHs.

**GCV: Do you think that reducing oil sands production will help the concentrated pollution occurring in the region until some concrete solutions are presented to protect the environment and people in northern Alberta?**

**AP:** Certainly, in a general sense, if there is a reduction in emissions from a major source, then there will be a consequent reduction in chemical levels in the environment, though it may take a while to see these reductions. However, the fact remains that oil sands production will only increase in the coming decades, so it is important that we carry on with our characterization of oil sands impacts so that we can come up with these "concrete solutions".

**GCV: As a scientist, do you have any suggestions to improve this situation or in your estimation, will the area be further compromised beyond repair as a result of increased expansion if solutions are not forthcoming now?**

**AP:** Again, I think any initiative for positive change is better late than never, and the Joint Oil Sands Monitoring Program is a good example of this. Since this program is now at least a couple of years old, I hope this means we can start making some of those important links between observations in different environmental media, and identifying important sources of various chemicals including PAHs that will allow us to start formulating some of these solutions. In addition to studies and monitoring, I also feel there needs to be better scrutiny of the data that is produced; more specifically, how it is produced. During the course of our study we found that some of the assumptions underlying the emissions estimates were not based in very sound science. There needs to be a change in terms of oversight so that we can get the most accurate data possible, otherwise the time, effort, and money that goes into

data collection and analysis, and development and execution of management strategies is a bit of a waste.

**GCV: Simply, can you summarize what you discovered by doing this study and how environmental toxins in the area were reflected in the results?**

**AP:** We found that officially reported emissions scenarios for PAHs in the oil sands region are likely too low, which means that estimates of future risk to humans and wildlife due to PAHs are also likely too low. We were able to identify what might be a missing source of some of the more volatile PAHs to the AOSR, i.e. the tailings areas, which have previously been neglected or deemed negligible sources of these chemicals. However, the tailings ponds were not enough to account for missing emissions of more involatile PAHs. Though we were not able to confirm this with our study, it has been confirmed in other studies that blowing dust from open mine faces may be a key source of PAHs, and thus may be the "missing" source of these more involatile PAHs. Essentially, we have found that we need better characterization of emissions quantities and sources. The good news is that this is one among the many ongoing activities of the Joint Oil Sands Monitoring Program.

**GCV: After looking at the results of this study, if you could say anything to First Nations and the people who live in the vicinity of oil sands expansion, what would it be?**

**AP:** I would say that they express valid concerns about the influence of oil sands development on the air they breathe, water they drink, and locally sourced food they consume, and that these concerns are not being ignored as there are studies and monitoring being conducted to address these concerns.

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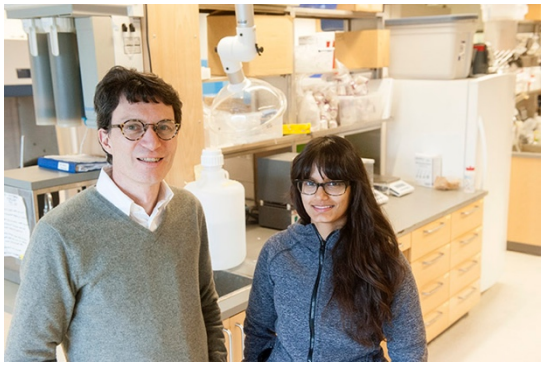
# University of Toronto Study on PAH Emissions in Oil Sands Region, Part 2



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**PART 2 INTRO:** This is Part 2 of an Interview with Abha Parajulee about the study done with University of Toronto PhD supervisor Frank Wania: *Evaluating Officially Reported Polycyclic Aromatic Hydrocarbon Emissions in the Athabasca Oil Sands Region with a Multimedia Fate Model.* This study sheds light on what is really happening with emissions reporting in the region where oil sands production is occurring.

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**Study Excerpt - Significance:** "Our study shows that emissions of polycyclic aromatic hydro-carbons estimated in environmental impact assessments conducted to approve developments in the Athabasca oil sands region are likely too low. This finding implies that environmental concentrations in exposure-relevant media, such as air, water, and food, estimated using those emissions may also be too low. The potential therefore exists that estimation of future risk to humans and wildlife because of surface mining activity in the Athabasca oil sands region has been underestimated."

**GCV: How could years of supposed monitoring cause this to happen? Since the situation is more serious now, is it too late to enforce solutions to make a difference considering sizable expansion is immediately forthcoming?**

**AP:** The "years of monitoring" have been deemed inadequate by a few review panels in recent years. As an optimist, I would say it is not too late to implement solutions to mitigate the adverse effects of industrial development. However, I would also say that before coming up with solutions, we need to have a good, i.e. accurate, idea of what these impacts are in the first place.

**Study Excerpt:** In addition, the quantities of PAHs reported by oil sands developers in the Athabasca oil sands region (AOSR) to the Canadian government's National Pollutant Release Inventory (NPRI) (8) as disposal to tailings ponds are up to five orders-of-magnitude larger than quantities reported as direct

atmospheric emissions, highlighting the possibility of volatilization of PAHs from these ponds and their subsequent deposition to soils and waters.

**GCV: Explain how this volatile situation is with respect to tailings ponds disposals being "up to five orders-of-magnitude larger than quantities reported as direct atmospheric emissions?"**

**AP:** To provide some background: the NPRI states that quantities of chemicals reported as "disposal" are reported as " 'disposals' and not 'releases' as they are contained within managed disposal sites and are not being released directly into the environment". Thus, knowing that some PAHs can be quite volatile (i.e. high tendency to escape into the air), we suspected the NPRI's characterization of disposals was not entirely realistic or reasonable when seeing those high numbers that were reported as disposal. And indeed, we found that the indirect emissions from tailings ponds could be a more significant contributor of some PAHs to the AOSR when compared to "direct" emissions. The blanket assumption that all chemicals are well confined within tailings areas needs to be reevaluated.

**Study Excerpt #1:** "Furthermore, indirect emissions of PAHs from secondary sources, such as tailings ponds to the atmosphere, may be a more significant contributor of oil sands PAHs to the AOSR atmosphere relative to direct emissions to air."

**Study Excerpt #2:** "The relatively low proportion of tailings pond BaP that volatilizes from the tailings areas does not render BaP emissions to tailings ponds insignificant, as the mass balance suggests that most of the remaining BaP in the region is in the tailings pond sediment, which may have serious implications for ongoing efforts to reclaim tailings areas."

**GCV: In the two study excerpts above regarding the impact of tailings ponds, it is inferred that not only do tailings ponds contribute more of some hazardous air pollutants to the AOSR than previously thought, but also that there may be "serious implications" from a toxicological perspective for the reclamation of this land. Would the area be less toxic if the method of oil extraction involved another proprietary method or is it too late to alter the path of the environmental degradation already occurring?**

Though a large fraction of oil sands operations to date are open-pit mines, most of the oil sands deposits in Alberta are actually too deep to be extracted by open pit mining, and must be extracted using in-situ techniques. These techniques use heat and pressure to soften the viscous bitumen deposits deep underground such that they can then be piped up to the surface. I am no expert on in-situ operations and their impacts, but it seems they also present a set of pros and cons. Perhaps they might result in less dust production relative to open pit mines per unit area, but they will also result in waste materials left over from bitumen processing that will need to be disposed of somehow. A major concern associated with in-situ oil sands operations is widespread land fragmentation that warrants just as much concern as toxicity of air and water.

**Study Excerpt:** A thorough understanding of contaminant cycling in the AOSR is currently absent from the tapestry of environmental studies that include several investigations into land reclamation and process water toxicity and treatment.

**GCV: Can you explain further?**

**AP:** Most of the studies concerning environmental impacts in the oil sands region have been focused on characterization of the present state of the environment, e.g. toxicity of oil sands process water to different fish species, concentrations of certain chemicals in different media. The present state of the environment is only a small piece of the larger picture that illustrates oil sands impacts from source to receptor. Fortunately, an increasing number of studies in recent years, including ours, have turned their attention to this bigger picture. It is only with this more complete understanding of impacts, from source to receptor, that effective management strategies can be developed.

**Study Excerpt:** A recent long-term monitoring plan outlined by the Alberta and Canada governments attempts to address this lack of understanding with a more holistic
monitoring scheme that aims to characterize chemical presence and cycling across various environmental media (52).

**GCV: Describe this "holistic monitoring scheme" and how long do you think it will take to create better management strategies for the region?**

**AP:** After the various review panel findings that the state of monitoring in the oil sands region was subpar, the Joint Oil Sands Monitoring Program was established jointly by the governments of Alberta and Canada. It seeks to use science-based monitoring to connect observations in air, water, and land, and better understand how these observations affect human and ecosystem health. It's quite ambitious, and preliminary results are just starting to come in. Because of this, I think it might take at least a couple of years to even begin to come up with better management strategies since these strategies should be based on a scientifically sound, holistic understanding of environmental impacts in the region that we are still lacking.