**Book of Abstracts, IACPES Symposium Day, June 13, 2016**

T1: **Characterization of Tunable Diode Laser (TDL) and preliminary assessment of rogue methane emissions**

**William Fujs**, Centre for Atmospheric Chemistry and Department of Chemistry, York University

Methane mixing ratios have been increasing globally since 2008 but the direct cause(s) remains undetermined. Atmospheric methane mixing ratios stabilised between approximately 2000 and 2008 but since has continued the previous trend of increasing. This rise is attributed to increased methane emissions by currently unidentified sources. A Tuneable Diode Laser (TDL) system can be used to assess various known methane sources. Characterization of the instrument and preliminary results from monitoring on York University campus will be presented. The overall aim of this study is to deploy the TDL during field-studies in order to identify and quantify the emissions of methane from sources where open path measurements are advantageous. This study will provide insight into unknown sources of methane emissions.

T2: **Determining emission factors from marine vessels employing differential optical absorption spectroscopy (DOAS) and tunable diode laser spectroscopy (TDLS)**

**Aida Khanbabakhani**, Centre for Atmospheric Chemistry and Department of Chemistry, York University

My research will focus on estimating emission factor (EF) of $SO_2$ and $CO_2$ from various sources such as ship plumes using a combination of two different spectroscopic instruments: tunable diode laser spectroscopy (TDLS) to measure $CO_2$ and Differential Optical Absorption Spectroscopy (DOAS) to measure $NO_2$ and $SO_2$ using one retro-reflector. An EF represents the relationship between the amount of pollutants produced and the amount of raw material processed. EFs are important since they are used to calculate the total emission from a source as an input for emission inventories, which are typically used in Air Quality Management Plans. This research develops and demonstrates a new method that could be used by others to monitor emissions from ships in areas where a beam can transect ship plumes. This will ensure compliance to International Maritime Organization (IMO) regulations on controlling sulphur content in fuel.

T3: **Separation and quantitation of nine atmospheric alkyl amines by ion chromatography**

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Amines are emerging as important drivers in particle formation and growth. Thus they may influence Earth's radiative forcing through both direct and indirect effects. However, there is still a paucity of rigorous quantitative measurements of amines in the atmosphere. In this work, a method for separating and quantifying alkyl amines (monomethylamine (MMA), dimethylamine (DMA), trimethylamine (TMA), monoethylamine (MEA), diethylamine (DEA), triethylamine (TEA), propylamine (PA), isopropylamine (iPA), and butylamine (BA)) was developed using ion chromatography (IC) to analyze atmospheric gas, aqueous, or particulate samples. This method reports the first successful separation of DEA and TMA by ion chromatography using a ThermoScientific/Dionex CS19 column assembly. The developed method ensures no interferences from six common inorganic cations ($Li^+$, $Na^+$, $NH_4^+$, $K^+$, $Mg^{2+}$, $Ca^{2+}$) with all 15 cations being >95% baseline resolved in a runtime of 35 minutes. The method detection limits for the alkyl amines were in the picogram per injection range. The precision of the method ($\pm 1\sigma$) was within 10% for the mono- and di-substituted amines and was within 20% for the tri-substituted amines. The method quantified methyl and ethyl amines in $PM_{2.5}$ from a forest fire in British Columbia with an ammonia to amines ratio near 1000. Furthermore, the method was applied to size-resolved particle extracts from an aged biomass-burning plume that originated from Quebec. These extracts contained MMA, DMA, TMA, DEA and TEA and had an ammonia to amines ratio above unity. Implications of these observations will be discussed during the presentation.

T4: **Enhancements in secondary organic aerosol formation in the presence of ambient or directly emitted organic particles**

**Jianhuai (Jackie) Ye**, Arthur Chan, Department of Chemical Engineering and Applied Chemistry, University of Toronto

Secondary organic aerosol (SOA) produced from atmospheric oxidation of organic vapors, comprises a large fraction of ambient particulate matter. Currently, SOA modeling makes one key assumption that all organic species form a well-mixed phase. Oxidation products are assumed to partition into primary organic aerosol (POA) similarly as into SOA; and it follows that SOA yields (mass of SOA formed per mass of hydrocarbon reacted) must be enhanced in the presence of preexisting organic aerosol. Recently, our study showed that yield enhancements of α-pinene SOA were only observed with selected organic aerosol surrogates, such as tetraethylene

glycol and citric acid, indicating that not all organic species are mixable and the partitioning between organic phases is not ideal in all cases.

In this work, the validity of "single phase" assumption is further examined with "real" ambient organic aerosol. The enhancements of SOA yields from α-pinene ozonolysis are investigated in the presence of organic aerosol that is collected from sources including cooking emission, biomass burning and vehicle exhaust. Hansen Solubility Parameters will be used to predict organic miscibility and SOA yield enhancements. And the prediction results will be compared to experimental observations. Contribution of SOA enhancements from different POA sources will also be discussed. In conclusion, there is a strict mixing criterion for organic aerosol in the atmosphere. Our results will help to provide a better understanding of aerosol phase state in the atmosphere and better parameterize SOA formation.

T5: **Air quality measurement in Northeast BC using satellite and ground based data**

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The Peace River district of Northeastern British Columbia, Canada is a region of natural gas production that has undergone rapid expansion since 2007. In order to assess air quality implications of this a satellite air quality study in Northeastern B.C., using multiple data products (from 2005 to 2013) for Nitrogen dioxide ($NO_2$) and sulfur dioxide ($SO_2$), is presented. The long term average and spatial distributions among all data products illustrate consistently high values in both pollutants (max $NO_2$: ~ $9\times10^{14}$ molecule $cm^{-2}$; max $SO_2$: ~ 0.1 DU) over the Montney formation which has experienced an increase in unconventional natural gas activities.

T6: **Bi-directional exchange of ammonia in a pine forest ecosystem – a model sensitivity analysis**

**Alexander Moravek**, Amy H. I. Hrdina, Jennifer G. Murphy, Department of Chemistry, University of Toronto, 80 St. George Street, Toronto, ON, M5S 3H6, Canada

Ammonia ($NH_3$) is a key component in the global nitrogen cycle and of great importance for atmospheric chemistry, neutralizing atmospheric acids and leading to the formation of aerosol particles. For understanding the role of $NH_3$ in both natural and anthropogenically influenced environments, the knowledge of processes regulating its exchange between ecosystems and the atmosphere is essential. A two-layer canopy compensation point model is used to evaluate the $NH_3$ exchange in a pine forest in the Colorado Rocky Mountains. The net flux comprises the $NH_3$

exchange of leaf stomata, its deposition to leaf cuticles and exchange with the forest ground. As key parameters the model uses in-canopy $NH_3$ mixing ratios as well as leaf and soil emission potentials measured at the site in summer 2015. A sensitivity analysis is performed to evaluate the major exchange pathways as well as the model's constraints. In addition, the $NH_3$ exchange is assessed for an extended range of environmental conditions to test, e.g. the effect of droughts on stomatal uptake or the influence of atmospheric pollutants on the net exchange.

SP1: Climate policy consequences of value judgements inherent to widely-used global warming potential

**Sabour Baray**, Centre for Atmospheric Chemistry and Department of Chemistry, York University

SP2: Ontario's offshore wind industry policy issues

**Soudeh Afsharian**, York University

SP3: Methane regulation in Alberta compared with other fossil fuel economy states and provinces: A fugitive in question

**Travis Tokarek**, University of Calgary

SP4: The importance of collaboration between universities, industry and governmental agencies: Lessons from Canadian space missions

**George Nikolakakos**, York University

SP5: Evidence-based policy for air quality in the Alberta oil sands: Engaging with and leveraging indigenous communities and industry stakeholders

**Zoe Davis**, Centre for Atmospheric Chemistry, York University

Developing good public policy for air quality in the Alberta Oil Sands is essential for the health and long-term resilience of the communities in this region but is complicated by the highly politically charged nature of the region and the multiple important stakeholders. A major theme of the 2015 Canadian Science Policy Conference was evidence based decision making: the

challenge of connecting science and policy making. Although it is generally agreed upon that policy should be based on evidence, what constitutes evidence and who should participate in production and assessment, remains unresolved. Public distrust and dissatisfaction with science-based decision making seems to have only increased during the last decade. One suggestion to improve evidence-based decision making, public engagement and satisfaction with public policy in the Alberta Oil Sands is to engage with both the Indigenous communities and industry for co-production and assessment of the evidence used to inform policy.

The benefits of including Indigenous peoples' understandings as evidence for informing policy and co-producing science with Indigenous communities will be examined. Community engagement methods, including citizen science and community-based air quality monitoring programs, will be described. Methods of engaging with industry stakeholders while preventing conflict of interest in evidence generation and evaluation will be discussed. Suggestions for how evidence to inform Canadian Oil Sands air quality policy can be co-produced through engaging both these important stakeholders will be made.

SP6: Traffic-Related air pollution: Heath consequences and mitigation strategies

**Stefan J. Miller**, York University

Stefan Motor vehicles release large amounts of pollution into the atmosphere, such as nitrogen oxides, particulate matter and mobile air toxins. Pollution generated in this manner is often referred to as traffic-related air pollution (TRAP). The health consequences from exposure to TRAP can be devastating, with evidence showing that living within 150m of a major road can increase the risk of developing asthma, coronary artery disease and lung cancer. These adverse health effects can be mitigated by governments through the proper use of public policy. Some jurisdictions have already developed land use policy or made land use recommendations aimed at reducing TRAP exposure. In 2002 California introduced a land use policy that prohibits public schools within 150m of a road that has annual average daily traffic greater than 100,000 vehicles. In many cases however, relocating infrastructure to satisfy a setback requirement is impractical. To remedy this, new methods to reduce TRAP exposure should be implemented. High-efficiency particulate arrestance (HEPA) filtration systems combined with properly placed air intake systems can reduce TRAP exposure indoors, regardless of setback distance. Further protection can be achieved by soundproofing and developing land barriers to increase the absorption and deposition of TRAP. Furthermore, limiting emissions at the source can decrease exposure through reduced TRAP concentrations. This can be accomplished by changing emission standards, introducing transportation management and providing incentives to reduce the dependance on vehicles.

SP7: Towards a low-emissions energy system in Canada: Energy, technology and policy options

**Youssef M. Taha**, Department of Chemistry, University of Calgary

The United States Department of Energy's Carbon Dioxide Information Analysis Centre currently lists Canada as the 13$^{th}$ largest $CO_2$ emitter contributing 1.4 % of the global $CO_2$ emissions. According to the most recent Intergovernmental Panel on Climate Change report, energy related emissions account for over 70 % of all greenhouse gas emissions globally. Canada's energy related emissions amount to 74 % of Canada's total. Efforts to curb greenhouse gas emissions must therefore focus on transitioning to a low-emission energy system. A low-emission energy system must rely on ongoing improvements in energy efficiency, carbon capture and storage, as well as the increased use of renewables and lower emission energy sources. A recent report by the Council of Canadian Academies found that although transitioning to a low-emission energy system in Canada was possible, change is hindered by technological, economic and behavioural barriers; barriers that can only be overcome with the implementation of policy. The case for the use of compulsory policy will be presented. The talk will focus on policy related to energy usage in four key areas: electricity, transportation, industry, and heating.

SP8: Alberta's new carbon tax and climate leadership plan: the provincial response to climate change

**Natasha Garner**, Department of Chemistry, University of Calgary

Alberta has traditionally been viewed as Canada's energy province, with an economy that has been heavily based on the oil and gas sector. In 2015, the oil, gas and mining industry represented 18.3% of Alberta's $333.1 billion GDP1. Since the election of Alberta's NDP government in May 2015, the province has brought forth legislation to reduce emissions of greenhouse gases (GHG) by 2030 through the introduction of the provincial Climate Leadership Plan. In 2013, emissions from coal-fired power plants accounted for 17% of Alberta's GHG emissions. Per year, Alberta produces more coal-related pollution than all of the other Canadian provinces combined2, the majority of which comes from the generation of electricity. Emissions from the oil sands account for approximately 25% of annual provincial GHG emissions2. In 2014, the oil and gas industry emitted 31.4 Mega tonnes of CO2 equivalents of methane2. The proposed legislation aims at reducing the emission of methane, the province's dependence on coal-fired power plants, along with the diversification of the energy sector and incentives for Albertans, businesses and communities through carbon tax funded rebates. This talk will explore the legislation as part of the Alberta Climate Leadership Plan and what this means for industry, legislators and the residents of Alberta.

References
1: Alberta Treasury Board and Finance and Alberta Economic Development and Trade, Government of Alberta, http://www.albertacanada.com/
2: Government of Alberta, http://www.alberta.ca/climate-leadership-plan.cfm

SP9: Modelling low-carbon scenarios that would yield social/health benefits

**Angela Hong**, University Toronto

SP10: International effort for improved management of transboundary air pollution

**Connie Ye,** University of Calgary, Chemistry Department

Air pollution is a dynamic problem that does not abide to international boundaries. Canada, as a consequence of sharing a common environment along a 5500 mile border with the United States, suffers major impact on air quality from transboundary air pollution and emissions originating from the U.S. A tradition of environmental cooperation exists on an international platform through the development of the ECE Contention on Long-Range Transboundary Air pollution of 1979, which to date consists of 51 parties and has legally delivered eight protocols to address transboundary fluxes of sulphur and nitrogen oxides emissions as well as emission control of VOCs, persistent organic pollutants, and heavy metals. Between Canada and the U.S, a bilateral Air Quality Agreement was signed in 1991 to address transboundary air pollution issues such as reduction in $SO_2$ and $NO_x$ emissions associated with acid rain and later updated to include an ozone annex in 2000 to address ground-level ozone as a mean to reduce smog. As a continuation of this cooperative effort between the two countries, the Canada-US Border Air Quality Strategy was initiated. Led by Environment and Climate Change Canada (ECCC) in collaboration with the U.S. EPA, three joint projects have been successfully completed, including development of policies and implementation plan for cleaner fuels and creation of emissions cap and trading programs for $SO_2$ and NOx. Policies that have contributed to the success of these joint agreements will be discussed. Current regulatory efforts dedicated to developing similar emission standards as those set by the US EPA to solve pollution problems along the common border will also be described.

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