**2016 CREATE-AAP Symposium on
Atmospheric PM Research**

February 9, 2016
UBC Vancouver

Symposium Schedule

Thea's Lounge, Thea Koerner House (Graduate Student Centre)
6371 Crescent Road, UBC, Point Grey Campus, Vancouver

Tuesday, February 9th

9:00 – 9:30	**Coffee & Check-in**	
9:30 – 9:45	**Welcome address** Chris Carlsten Allan Bertram	
9:45 – 10:25	**Gordon McTaggart-Cowan** *(Westport Innovations Inc.)*	Why would a natural gas engine need a particulate filter?
10:25 – 11:05	**Gregory J. Smallwood** *(National Research Council Canada)*	Development of a standard for the measurement of nonvolatile PM mass and number concentration for use in aircraft engine certification
11:05 – 11:20	**Break**	
11:20 - 12:00	**Gregory R. Carmichael** *(University of Iowa)*	Improving PM predictions through closer integration of observations and models
12:00 – 1:00	**Lunch & Posters** *lunch will be provided for registered participants*	
1:00 – 1:40	**Karen Bartlett** *(University of British Columbia)*	Biologic Aerosols – some occupational and environmental sources
1:40 – 2:20	**Boris Stoeber** *(University of British Columbia)*	A Microfluidic Aerosol Monitor
2:20 – 2:30	**Break** *light refreshments will be provided*	
2:30 – 3:10	**Lyatt Jaeglé** *(University of Washington)*	Sources and distributions of sea salt aerosol from the Tropics to the Poles
3:10 – 3:30	**Final Remarks**	

Poster Session Overview

Household and personal air pollution monitoring in two communities in rural India using established and prototype devices
Presenter: **Aaron Birch**
Affiliation: School of Population and Public Health, UBC (MSc - OEH candidate)
Supervisor: Prof. Michael Brauer

Impact of Environmental Tobacco Smoke on Membrane-Based Energy Recovery Ventilators: Water Vapor Transport and Contaminant Crossover
Presenter: **Alex Sylvester and Amin Engarnevis**
Affiliation: Mechanical Engineering, UBC (MASc / PhD)
Supervisor: Prof. Steven Rogak

Fast Oxidation Box (FoxBox) to Accelerate Aging of Fresh Traffic-Related Aerosol
Presenter: **Andrew Lee**
Affiliation: Chan-Yeung Center for Occupational and Environmental Respiratory Disease (MSc Experimental Medicine)
Supervisor: Prof. Chris Carlsten

Modeling the spatial variability in Air Quality in Hong Kong
Presenter: **Martha Lee**
Affiliation: School of Population and Public Health, UBC (MSc)
Supervisor: Prof. Michael Brauer

Assessing Cardiovascular Disease Risk from exposure to Household Air Pollution in the PURE-AIR Study
Presenter: **Matthew Shupler**
Affiliation: School of Population and Public Health, UBC (PhD)
Supervisor: Prof. Michael Brauer

Possible sources of ice nucleating particles over Inuvik during springtime 2015
Presenter: **Meng Si**
Affiliation: Chemistry, UBC (PhD)
Supervisor: Prof. Allan Bertram

Fast Exhaust Nephelometer (FEN): a new instrument to determine cycle-resolved particulate emissions
Presenter: **Pooyan Kheirkhah**
Affiliation: Mechanical Engineering, UBC (PhD)
Supervisor: Prof. Steven Rogak & Prof. Patrick Kirchen

Morphology and Mobility of Soot Particles
Presenter: **Ramin Dastanpour**
Affiliation: Mech. Engineering, UBC (PhD)
Supervisor: Prof. Steven Rogak

*(Cancelled)***Clouds influence on atmospheric ozone from GOME-2 satellite measurements**
Presenter: **S. M. Samkeyat Shohan**
Affiliation: Institute of Environmental Physics, University of Bremen, Germany (MSc)
Supervisor: Dr. Luca Lelli

Measurements of dust and particulate matters at Burns Bog, Delta, B.C.
Presenter: **Yimei Li**
Affiliation: Earth, Ocean, and Atmospheric Sciences, UBC (MSc)
Supervisor: Prof. Ian McKendry

About the Speakers

Gordon McTaggart-Cowan (Westport Innovations Inc.)
Why would a natural gas engine need a particulate filter?

Dr. McTaggart-Cowan is the Engine R&D Applications Lead at Westport Innovations Inc., a company headquartered in Vancouver, B.C. that creates some of the world's most advanced natural gas engines and vehicles. Dr. McTaggart-Cowan holds a PhD in Mechanical Engineering from the University of British Columbia. He has also spent several years as a lecturer at Loughborough University in the UK, where he led research into advanced diesel combustion strategies, diesel fuel systems, and engine and vehicle system modeling. Dr. McTaggart-Cowan's research activities at Westport have focused on medium- and heavy-duty engines fuelled by natural gas. Since 2003, Dr. McTaggart-Cowan has authored 38 peer-reviewed technical publications and holds five patents in advanced engine and combustion systems.

Greg Smallwood (National Research Council Canada)
Development of a standard for the measurement of nonvolatile PM mass and number concentration for use in aircraft engine certification

Dr. Smallwood is Program Leader, Metrology for Industry and Society with Measurement Science and Standards at the National Research Council Canada (NRC). He has been invited as the keynote speaker at several international conferences, and has contributed to over 200 refereed publications. Dr. Smallwood is a co-founder of the International Workshop series on Laser-Induced Incandescence, current Board Member of the Combustion Institute, and holds several other outreach positions. He is a Mercator Fellow at the University of Duisburg-Essen, and received a B.Sc. degree in Mechanical Engineering from Queen's University, a MSc from the University of Ottawa, and a PhD from Cranfield University.

Greg Carmichael (University of Iowa)
Improving PM predictions through closer integration of observations and models

Dr. Carmichael is currently the Karl Kammermeyer Professor of Chemical and Biochemical Engineering at the University of Iowa. He also serves as the Director of the University of Iowa Informatics Initiative (campus wide activity related to big data involving 160+ faculty) and as co-director of the Center for Global and Regional Environmental Research (a large interdisciplinary centre with more than 80 faculty members). He holds a BS, MS and PhD in chemical engineering and has done extensive research related to air quality and its environmental impacts. He is a leader in the development and application of chemical

transport models at scales ranging from local to global. Dr. Carmichael has over 330 journal publications.

Karen Bartlett (University of British Columbia)
Biologic Aerosols – some occupational and environmental sources

Dr. Bartlett is a Professor in the School of Population & Public Health, Occupational and Environmental Health Division, in the Faculty of Medicine, University of British Columbia. She holds a Masters degree in Occupational Hygiene and a doctorate in Interdisciplinary Studies from the University of British Columbia. She received post-doctoral training in inhalation toxicology at the University of Iowa School of Public Health. She was a British Columbia Michael Smith Foundation for Health Research Scholar from 2002 to 2007. Dr. Bartlett's research interests include indoor air quality, bioaerosol exposures in work and community environments, particularly in rural or agricultural settings. In addition to being an author of 90 peer reviewed publications, she is the executive producer of an animated video on ticks, and has appeared in Discovery Channel, CBC and PBS documentaries.

Boris Stoeber (University of British Columbia)
A Microfluidic Aerosol Monitor

Dr. Stoeber is an Associate Professor in the Department of Mechanical Engineering and in the Department of Electrical and Computer Engineering in the Faculty of Applied Science, University of British Columbia. He received his Electrical Engineering Diploma from the Technische Universität Darmstadt, Darmstadt, Germany, his General Engineering Diploma from the École Centrale de Lyon, Écully, France, and his PhD in mechanical engineering from the University of California, Berkeley. He was a Postdoctoral Scientist in Chemical Engineering at the University of California, Berkeley. Dr. Stoeber's research interests include sensing technology, biomedical microdevices, microoptical devices, microflow control strategies, flow physics of complex microflows, and fabrication techniques for microelectromechanical structures. Dr. Stoeber is a Canada Research Chair in Microfluidics and Sensing Technology.

Lyatt Jaeglé (University of Washington)
Sources and distributions of sea salt aerosol from the Tropics to the Poles

Dr. Jaeglé is a Professor in the Department of Atmospheric Sciences, University of Washington. She holds a Masters degree and a doctorate in Environmental Engineering from the California Institute of Technology. Dr. Jaeglé's research interests include atmospheric chemistry modeling; global simulations of the long-range transport of air pollutants; surface emissions of trace gases and particulates; and, biogeochemical cycling of mercury. She has received numerous awards throughout her career for her work, including both the prestigious NSF Faculty Early Career Development Award, and a NASA New Investigator Award.

Poster Abstracts

Household and personal air pollution monitoring in two communities in rural India using established and prototype devices

Presenter: **Aaron Birch**
Affiliation: School of Population and Public Health, UBC (MSc - OEH candidate)
Supervisor: Prof. Michael Brauer

Household air pollution, primarily from the burning of solid fuels for cooking and heating, was the fourth-highest risk factor for global disease burden in 2010, with an estimated ~3.5 million attributable deaths per year. Exposure to household air pollution in low income countries and effects on chronic disease, especially cardiovascular health, has been understudied, in part due to the logistical, technical, and cost constraints of exposure monitoring.

Recently newly available measurement devices offer the potential to provide small, light, relatively inexpensive, easy to use approaches to assess exposure to household air pollution in large population studies. We evaluated the use of a prototype integrated micro-pump and cyclone sampler, the Ultrasonic Personal Aerosol Sampler (UPAS) (Access Sensor Technologies), to assess household air pollution exposure in two rural communities, one in southern and one in northern India.

In each of 54 households (27 in each community), we measured PM2.5 levels in the kitchen area over 24 and 48-hour time periods with the prototype sampler and reference samplers (Harvard Impactor, TSI DRX). Additionally, in each household personal exposure samples were collected with the UPAS from the primary male and female household members over the same time period. Primary and secondary cooking fuels and simple characterization of household ventilation were recorded along with the administration of questionnaires describing household characteristics, income and assets for use in modeling exposures.

The relationships between survey responses, household and personal exposures (stratified by gender) will be used to design future exposure assessment strategies and to evaluate feasibility of large-scale UPAS deployment in an extensive multi-country prospective cohort study.

Impact of Environmental Tobacco Smoke on Membrane-Based Energy Recovery Ventilators: Water Vapor Transport and Contaminant Crossover
Presenter: **Alex Sylvester and Amin Engarnevis**
Affiliation: Mechanical Engineering, UBC (MASc / PhD)
Supervisor: Prof. Steven Rogak

From substantial epidemiologic studies that have assessed the risks of passive smoking, it is well known that Environmental Tobacco Smoke (ETS) exposure in indoor environments is a health risk to non-smokers and causes odor discomfort issues and respiratory irritation. Although ASHRAE and many other international institutions have determined smoking bans are the only effective control strategy to minimize the indoor ETS exposure (and its associated health risk) for non-smokers, there are still public places, such as entertainment venues, that are exempted from smoking bans. HVAC systems in such spaces require a significant amount of outdoor air (up to 30 ACH) to dilute ETS and to achieve the typical building code mandate, making them extremely demanding of energy. The use of an Energy Recovery Ventilator (ERV) in such a setting has the potential to substantially reduce the energy cost of the ventilation system.

This work investigates the influence of ETS on the performance of paper- and polymer-based materials used in plate-type ERVs via accelerated ETS exposure tests. Results are reported for the transport of water vapor, oxygen gas crossover, odor crossover, and pressurized air leakage through three different types of commercially available ERV membranes. Comparisons were also made between the ETS loadings on coated and uncoated sides of polymer membrane samples to examine the impact of the particular membrane surface exposed (ERV installation direction) with respect to the ETS-laden exhaust airstream.

We have found that, as a result of ETS loadings equivalent to about two years of operation in a typical casino in North America, the water vapor performance of polymer membrane and paper-based samples were reduced to 70%-34% of the initial value. For polymer membranes, ETS loading on the uncoated side of membrane samples tends to have a higher impact on water vapor transport than identical loading on the coated membrane side. Preliminary results from pressurized air leakage and crossover tests show that paper-based samples tend to have a significantly higher crossover of odors and other contaminants and therefore less selectivity for water vapor transport.

Fast Oxidation Box (FoxBox) to Accelerate Aging of Fresh Traffic-Related Aerosol
Presenter: **Andrew Lee**
Affiliation: Chan-Yeung Center for Occupational and Environmental Respiratory Disease (MSc Experimental Medicine)
Supervisor: Prof. Chris Carlsten

Background: Particulate air pollution is the third-leading cause of disability adjusted life years globally. Exhaust produced by diesel-powered vehicles is the primary source of ultrafine (UF) particles in most urban environments. Diesel engines directly emit primary particles and volatile organic carbons (VOC) into the atmosphere, where they are oxidized, condensed and coagulated into secondary particles. The purpose of this study is to assess the effect of oxidative aging by ultraviolet (UV) light on diesel exhaust (DE) toxicity, specifically in the contribution of the resulting secondary organic aerosols (SOA).

Methods: Thermo Models 48C, 43i, 49 and 42c analyzers measure [CO], [SO2], [O3] and [NOx] respectively. A Tapered Element Oscillating Microbalance (TEOM, R&P 1400ab) is used to make near-continuous PM2.5 measurements. Fresh diesel exhaust (DE) is supplied by an EPA Tier 3-compliant, 6.0 kW diesel generator under incrementally increasing loads to 2500W. A portion of raw exhaust is diluted approximately 25:1 by high efficiency particulate air (HEPA)-filtered air (FA) before entering the $4 \times 6 \times 7$-foot exposure booth. A Scanning Mobility Particle Sizer (SMPS, TSI Model 3936) is used to measure the size distribution of aerosols in the size range from 2.5 nm to 1000 nm. Two, four and six UV lamps were activated sequentially to simulate atmospheric aging. Two UV lamps wrapped in teflon tape were activated separately to select for wavelengths that cause ozone destruction reactions. Five minutes of data is recorded after the system reaches observable stability, corresponding to N=34 samples per data point for PM2.5, NO and NO2 and N=61 for TVOC. P-values for all reported data did not exceed p > 0.03. Pollutants levels were translated to the Air Quality Index scale by converting PM2.5, [NO2], [O3] and [SO2] to their individual AQI score. Simulated aging time was estimated by measuring the concentration of SO2 (ppb) relative to that of fresh diesel exhaust and using Equation 1 for the reaction between SO2 and OH. OH exposure = $\ln([SO_2]_0/[SO_2]_f)/(9.2*10^{(-13)})$ (1) 1 day OH exposure $\approx 1.3 * 10^{11}$ ((molecules*s)/cm^3)

Results: As two, four and six UV lamps were activated sequentially, OH exposure increased to 3–4, 7–8, and 12–13 days aging equivalent; PM2.5 increased from 291 µg/m^3 to 462 (+59%), 516 (+77%), and 531 (+82%) µg/m^3; AQIPM2.5 increased from 335 "Hazardous" to 449, 507 and 520; [O3] increased from 65 ppb to 65(+0%), 76 (+18%), and 84 (+31%) ppb; AQIO3 increased from 47 "Good" to 53 "Moderate", 81 and 100; [SO2] decreased from 72 ppb to 48 (-33%), 30 (-57%), and 16 (-78%) ppb; AQISO2 decreased from 103 "Unhealthy for Sensitive Groups" to 59 "Moderate", 40 "Good" and 21; [NO2] increased from 163 ppb to 1528 (+43%), 1835 (+52%) and 2252 (+64%) ppb relative to [NOx]; AQINO2 increased from 114 "Unhealthy for Sensitive Groups" to 223 "Very Unhealthy", 292 and 446 "Hazardous", [NO] decreased from 2685 ppb to 1602 (-43%), 1289 (-52%), and 756 (-70%) ppb relative to [NOX]; TVOC decreased from 1594 ppb to 1242 (-22%), 978(-39%), and 774 (-51%) ppb; $\bar{D}$p increased from 115 nm to 123 (+7%), 126 (+10%), and 128 (+12%) nm; total AQI increased from 600 to 853

(+42%), 1074 (+80%) and 1195 (+99%). As two UV lamps wrapped with teflon were activated and compared to activating two unmodified UV lamps: OH exposure increased to 1–2 days, 50% less of an increase; PM2.5 increased from 279 to 355 µg/m3 (+28%), 32% less of an increase; $\bar{D}p$ increased from 111 to 115 µm (+4%), 3% less of an increase; [O3] decreased from 67 to 59 ppb (-12%), compared to 0% change with two unmodified UV lamps; [SO2] decreased from 88 ppb to 72 (-18%), 45% less of a decrease; [NO] decreased from 3162 ppb to 2506 (-21%*), 49% less of a decrease relative to [NOX]; [NO2] increased from 229 ppb to 784 (+20%*), 23% less of an increase relative to [NOX]; TVOC decreased from 1826 ppb to 1630 (-11%), 11% less of a decrease when compared to two unmodified lamps; The total AQI from teflon-wrapped UV lamps is 10% less than that of unmodified UV lamps.

Discussion: By wrapping two UV lamps with teflon tape, a method was introduced to control the level of ozone in the aged DE. However in this experiment nitrogen dioxide (and not ozone) was observed to be the primary pollutant when 3 pairs of UV lamps were activated. To establish an aged DE exposure model comparable to other ongoing studies, PM2.5 ought to remain the primary pollutant attributed to health effects. Activating two pairs of unmodified UV lamps produced 7–8 days of equivalent aging while PM2.5 remains as a primary pollutant according to the AQI scale. These significant increases in mass concentration are attributed to the decrease in TVOC as nucleation, condensation and coagulation phenomena occur during the aging process.

Conclusion: Using the AQI scale as a predictor for the magnitude of health effects attributed to aged DE, 12–13 days of oxidative aging by UV light caused the AQI to increase by 99% and causes NO2 from NO photo-oxidation to replace PM2.5 as the primary pollutant.

Modeling the spatial variability in Air Quality in Hong Kong
Presenter: **Martha Lee**
Affiliation: School of Population and Public Health, UBC (MSc)
Supervisor: Prof. Michael Brauer

Background: Knowledge of spatial variation in air quality facilitates understanding of the potential population health burden and provides a direction for management. Land use regression (LUR) modeling is a common method used for estimating pollutant concentrations in unmeasured locations and providing insight into the relationship between concentration variability and geospatial features. Hong Kong is a densely populated city with complex topography and diverse air pollution sources. Poor air quality is a known health risk in Hong Kong, though currently little is known about spatial variability in concentrations.

Objective: Create two-dimensional LUR models for NO, NO_2, $PM_{2.5}$, and black carbon (markers for combustion related air pollution) for Hong Kong. These models are components in the development of a dynamic 3-dimensional air pollution exposure model.

Methods: Diffusion samplers were deployed during two sampling campaigns (warm and cool season). Measurements were averaged, temporally adjusted, and included in a multiple linear regression model with geospatial predictor variables. Possible predictors (created from 25 geospatial metrics) included land use, road length, street canyon aspect ratio, elevation, distance to specific features (e.g. port, shipping lanes) and population, feature points, intersection, and building density.

Results: The current preferred models, i.e. annual road length models, have the following parameters: a) NO_2 ($R^2 = 0.46$; adj. $R^2 = 0.43$); b) NO ($R^2 = 0.53$; adj. $R^2 = 0.48$); c) $PM_{2.5}$ ($R^2 = 0.59$; adj. $R^2 = 0.54$); and d) ($R^2 = 0.50$; adj. $R^2 = 0.44$).

Assessing Cardiovascular Disease Risk from exposure to Household Air Pollution in the PURE-AIR Study
Presenter: **Matthew Shupler**
Affiliation: School of Population and Public Health, UBC (PhD)
Supervisor: Prof. Michael Brauer

Approximately three billion people, primarily residing in rural areas of low-income Asian, African, Central and South American countries, burn solid fuels (wood, cow dung, coal and other forms of biomass) for cooking on a daily basis. The burning of solid fuels in an 'unimproved' cookstove (predominantly an unventilated, open fire pit) generates household air pollution (HAP). The most recent Global Burden of Disease (GBD) project in 2010 estimated HAP exposure from cooking with solid fuels to contribute to 3.9 million premature deaths annually, making HAP the number one environmental risk factor for global mortality. Over half (52%) of the 3.9 million estimated deaths attributed to HAP in the 2010 GBD analysis were estimated to be related to cardiovascular disease (CVD). However, previous epidemiological studies have only linked HAP exposure ($PM_{2.5}$ exposure) to surrogate measures of CVD like hypertension, but not directly to CVD outcomes. To the authors' knowledge, the Prospective Urban and Rural Epidemiology (PURE)-AIR study would be the first to relate $PM_{2.5}$ exposures from cooking with solid fuels directly to CVD incidence and mortality. A direct association between cooking with solid fuels and CVD outcomes will provide a direct estimate of CVD risk attributable to HAP in order to properly position HAP exposure among other environmental, nutritional and psychological risk factors on the global health agenda.

Possible sources of ice nucleating particles over Inuvik during springtime 2015
Presenter: **Meng Si**
Affiliation: Department of Chemistry, UBC (PhD)
Supervisor: Prof. Allan Bertram

Ice nucleating particles (INPs) are a subset of aerosol that can cause heterogeneous ice nucleation in the atmosphere. INPs play an important role in the formation of mixed-phase clouds and ice clouds. The Arctic is one of the most sensitive regions in the world to climate change (ICPP, 2014). A small change in INP concentrations in the Arctic can alter climate in the region (Prenni et al., 2007). Our research focuses on INP properties over the Canadian Arctic. Possible sources of INPs were identified by looking at correlations with different particle types and back trajectories.

Fast Exhaust Nephelometer (FEN): a new instrument to determine cycle-resolved particulate emissions
Presenter: **Pooyan Kheirkhah**
Affiliation: Mechanical Engineering, UBC (PhD)
Supervisor: Prof. Steven Rogak & Prof. Patrick Kirchen

Soot emissions from direct-injection engines are highly sensitive to the fuel-air mixing process, which may not be perfectly repeatable from cycle to cycle, due to turbulent fluctuations and injector instability. Conventional instruments to measure exhaust emissions cannot resolve inter or intra cycle variations in particle emissions. The Fast Exhaust Nephelometer (FEN) is introduced here to use light scattering to measure particulate matter concentration and size near the exhaust port of an engine with a time resolution of a few milliseconds. The FEN uses a blue laser diode (l=405 nm) to illuminate a small volume (~10 mm^3) with different optical power levels in the range of 100-400 mW. Single lenses gather scattered light from around 45 and 135 degrees from the laser beam. The scattered light is focussed on two amplified photodiodes, sampled synchronous with engine crankshaft encoder at a 0.5° resolution. The FEN operates at atmospheric pressure, sampling exhaust from a position near the engine exhaust port. For the exhaust pressures typical of our experiments, the transit time from the exhaust port to the FEN optical volume is a few milliseconds. Proof of concept tests were conducted on heavy-duty single-cylinder research engine built from a Cummins ISX-400. This engine uses the Westport HPDI pilot-ignited direct-injection natural gas fuel system. Although approximately 95% of the fuel energy comes from the natural gas, at high load the particulate emissions are dominated by soot, as they would be for a conventional diesel engine. The time-averaged values of the FEN signals correlate with the conventional exhaust PM measurements. The time-resolved FEN signals show a spike (several times the average) after the exhaust valve opens. After this peak, the signal drops to a plateau for the remainder of the cycle. The magnitude of the peak and the plateau varies by a factor of 2 or more from cycle to cycle, depending on the engine operating mode.

Morphology and Mobility of Soot Particles
Presenter: **Ramin Dastanpour**
Affiliation: Mechanical Engineering, UBC (PhD)
Supervisor: Prof. Steven Rogak

For decades soot has been modeled as fractal-like aggregates of nearly equiaxed spherules. In such simulations, primary particle size is uncorrelated with aggregate size, as all aggregates contain primary particles drawn from the same population. Examination of transmission electron micrographs of soot samples from various sources shows that primary particle sizes are not well mixed within an aerosol population. Larger aggregates tend to contain larger primary particles and the variation in size is much larger between aggregates than within aggregates. The observed variations in primary particle size can be explained if soot aggregates are formed and grew by coagulation in small zones of the combustion chamber, prior to dilution and transport to the sampling system. Properties of soot particles are influenced by both size variation and polydispersity of their constituting primary particles. Accurate estimation of the mobility-equivalent diameter d_m in different flow regimes is essential in many industrial processes and measurements. Using numerically-generated agglomerates it is shown here that the radius of gyration, surface area, and mass of the agglomerates increase with primary particle polydispersity (given constant geometric mean primary particle size d_{pg}). Application of the stochastic projections and Stokesian dynamic methods shows that the mobility-equivalent diameter of fractal aggregates increases with the primary particle polydispersity in both free-molecular and continuum regimes (>20% for large particles at high polydispersity). Considering an aerosol population with polydisperse primary particles, this increase is found to depend on whether the variations in primary particle size occur within aggregates or between aggregates; this can be important in the interpretation of measurements.

Clouds influence on atmospheric ozone from GOME-2 satellite measurements
Presenter: **S. M. Samkeyat Shohan**
Affiliation: Institute of Environmental Physics (IUP), University of Bremen, Germany (MSc)
Supervisor: Dr. Luca Lelli

This study is mainly focused on the determination and analysis of the photolysis rate of atmospheric, specifically tropospheric, ozone as function of cloud properties throughout the year 2007. The observational basis for ozone concentrations and cloud properties is the measurement data set of the Global Ozone Monitoring Experiment-2 (GOME-2) sensor on board the polar orbiting Metop-A satellite. Two different spectral ranges are used: ozone total column are calculated from the wavelength window 325 – 335 nm, while cloud properties, such as cloud top height (CTH) and cloud optical thickness (COT) are derived from the absorption band of molecular oxygen centered at 761 nm. Cloud fraction (CF) is derived from measurements in the ultraviolet, visible and near-infrared range of GOME-2. First, ozone concentrations above clouds are derived from ozone total columns, subtracting the contribution of stratospheric ozone and filtering those satellite measurements which have thin and low clouds. Then, the values of ozone photolysis derived from observations are compared with theoretical modeled results, in the latitudinal belt 5˚N - 5˚S and 20˚N - 20˚S, as function of CF and COT. In general, good agreement is found between the data and the model, proving both the quality of the space-borne ozone and cloud properties as well as the modeling theory of ozone photolysis rate. The found discrepancies can, however, amount to approximately 15%. Latitudinal seasonal changes of photolysis rate of ozone are found to be negatively correlated to changes in upper-tropospheric ozone concentrations only in the autumn and summer months within the northern and southern tropical belts, respectively. This fact points to the entangled roles of temperature and nitrogen oxides in the ozone production, which are superimposed on its sole photolysis induced by thick and high clouds in the tropics.

Measurements of dust and particulate matters at Burns Bog, Delta, B.C.
Presenter: **Yimei Li**
Affiliation: Department of Earth, Ocean, and Atmospheric Sciences, UBC (MSc)
Supervisor: Prof. Ian McKendry

Burns Bog is a raised bog ecosystem covering approximately 3,000 hectares of land, which is about eight times bigger than Vancouver's Stanley Park. For many years, the land was used for peat mining and farming, which resulted in slow devastation of the bog. The Corporation of Delta joined with the Province of B.C., the Government of Canada and Metro Vancouver to preserve the ecological integrity of the bog. On March 24, 2004, a binding purchase agreement was reached that protects 2,042 hectares of Burns Bog as an Ecological Conservancy Area. However, Burns Bog is surrounded by urban development such as the new South Fraser Perimeter Road, a landfill for the city of Vancouver, and coal trains running in close proximity. The health of water, soil, wildlife, and vegetation of Burns Bog may be affected by a variety of air pollutants. At this point, it is in our interest to conduct air quality monitoring at Burns Bog to gain a better understanding of the air quality inside of this unique ecosystem.

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CONTACT US:

CREATE-AAP Office
Allan Bertram (Director of CREATE-AAP)
createaap@chem.ubc.ca
Department of Chemistry
2036 Main Mall
Vancouver, BC V6T 1Z1

Symposium Organizers
Chris Carlsten
Jason Curran
Maki Sumitani