



**10:05** *A Look at Canadians Accessibility to Healthy Food Retailers Using Food Retail Data from OpenStreetMap and Income Data from Statistics Canada*

Food security is when all people have sufficient and nutritious food to maintain a healthy life, and availability and access to these foods is dependent not only on physical access but also economic accessibility. Currently, inequalities in access to Canada's food retail system exist, and pose serious problems that affect people's health and well being. In this project, food retail data collected from OpenStreetMap (OSM) will be used alongside income data collected from Statistics Canada to calculate the modified retail food environment index (mRFEI) for dissemination areas (DAs) in Canada. This index will allow for patterns of access to different types of food retail to be identified, and the census data will show how average incomes correspond with accessibility to healthy food retailers. Ultimately, the results, produced with open data, will support existing bodies of work in identifying areas with low food accessibility and food insecure areas across Canada.

Presenter(s) Zahra H. Mohamed Undergraduate Student University of Toronto - St. George

Zahra H. Mohamed is in her final year of undergraduate studies at University of Toronto St. George, studying Physical & Environmental Geography and Human Geography. She is from Toronto, Ontario and enjoys watching films, trivia games, and travelling.

**10:25** *Transit Accessibility Analysis in ArcGIS Pro: A Case Study of Code, Functions, and Performance*

Accessibility is the potential to reach opportunities of value while considering the transportation costs involved in reaching them. At present, few integrated workflows exist to calculate accessibility. However, recent advances in ArcGIS Pro enable the analysis of transit accessibility through the incorporation of general transit feed specification (GTFS) networks and greater in-memory performance. Working from this base, the current research presents a Python toolbox for integrated place-based accessibility analysis. Moreover, I test how different code and functions can be used to dramatically improve the performance of this workflow, including the use of multiprocessing. These tests are run using a case study of transit network accessibility in the Toronto region. Combined with ArcGIS Pro, the resulting toolbox enables analysts to realize new levels of performance in their network accessibility analysis tasks.

Presenter(s) Christopher D. Higgins Assistant Professor University of Toronto Scarborough

My research focuses on form and function in cities. Using the tools and methods of GIS/geographic data science, I capture and model the physical form and infrastructure of the city, its urban networks and the flows of people, goods, and information they facilitate, and the use of the city as an area or volume for engaging in activities.

**10:45** *Using GIS to Examine the Socioeconomic Benefits of the Ontario Line*

The objective of this study is to assess how the potential benefits of the Ontario Line, a proposed rapid transit project in Toronto, are distributed across different socioeconomic groups. This analysis is focused on low-income and other low-SES populations who arguably have the greatest need for transit improvements. Specifically, we examine how the Ontario Line improves travel times, walking access to rapid transit, as well as accessibility to education and employment. These are analyzed using GIS methods such as network analysis, areal interpolation, and gravity models. The results are presented in a series of descriptive maps and data visualizations. The main finding, consistent across most facets of the analysis, is that the benefits of the Ontario Line are forecasted to be fairly evenly spread across all levels of socioeconomic status in the region, with modest concentrations specifically among low-income populations.

Presenter(s) Jeff Allen PhD Student University of Toronto - St. George

Jeff Allen is a PhD student in geography at the University of Toronto. He studies transportation, built environments, and spatial analysis. He also works part-time as a freelance cartographer.

**Meeting Room****Accessing Healthcare****13:10** *Mapping the Gendered Differences of Carer-Employees' Travel Behaviour through Time-Space Prisms*

There is a growing body of literature about carer-employees (CE), who are adults that care for another dependent adult(s) while also participating in the labour force. The focus of this research will be around mapping the behavior of CEs in order to produce conceptual time-geography maps, or time-space prisms. ArcGIS, R and Python will be used on primary field data made of both GPS and time diary data from 26 CEs. The outcomes of this research will provide understanding about: (1) how, where, and why CEs navigate their immediate neighbourhoods; (2) how gender impacts this navigation, and; (3) how their caregiving role places a unique burden on their quality of life.

Presenter(s) Nicole Langdon Student McMaster University

Nicole Langdon is a first-year geography master's student at McMaster University. The focus of her current research is centered around building time-space prisms with ArcGIS and Python to map and analyze the behaviour of carer-employees.

Allison Williams Professor McMaster University

Dr. Allison Williams is trained as a social/health geographer and is a Professor at McMaster University. In

**13:30** *Variations in Spatial Accessibility by Race to Acute Healthcare Facilities in Major Canadian Cities*

Past research has found inequities in access to healthcare services in urban locations to be prominent among visible minorities in North America. This reduced access to these services is thought to be related to numerous worse health outcomes, like increased risk of stroke. As one part of access, spatial accessibility to health services has received increasing attention due to its relationship to various forms of intervention planning. In this study, the relationships between an individual's race and the variations in spatial access to acute healthcare facilities are examined across five major Canadian cities: Toronto, Montreal, Vancouver, Calgary, Ottawa-Gatineau. Additionally, temporal variations in spatial access to health services at different times of day, by race, are reported. Ultimately, this study will identify where, when, and for whom equitable access to acute healthcare facilities in Canada has been achieved.

Presenter(s) Kelly Hui Student University of Toronto - St. George

Kelly Hui is currently a fourth-year undergraduate student at the University of Toronto studying Human Geography, GIS, and Industrial Relations and Human Resources. Her research interests lie at the intersections of healthcare, social inequality and urban planning.

**13:50** *Mapping Segregation: Integrating Historical Analysis and GIS*

Mapping Segregation a Partnership Grant with Esri Canada aims to mobilize knowledge of segregated healthcare of Indigenous peoples in so-called Indian Hospitals in new directions while informing historical understandings with spatial insights. By the 1940s Indigenous people's health was characterised as a threat to Canadians. The federal government established Indian Hospitals to remove Indigenous people from community hospitals. By mapping the hospitals we hope to enrich public discourse on the roots of colonialism and health disparities. Preliminary work reveals spatial patterns of relocation from Eastern Arctic communities to racially segregated institutions in Southern Canada. This presentation will outline opportunities and challenges of integrating historical sources and analysis with GIS. It is not an easy process but can result in a rich body of publically accessible material. These approaches may be useful for those working with historical data, GIS, and Indigenous communities

Presenter(s) Rebecca Nickerson Student Brock University

Rebecca Nickerson is a master's student currently studying History at the University of Waterloo. Her research utilizes GIS for historical analysis and digital history applications. She has been working on the "Mapping Segregation" SSHRC funded partnership project with Dr. Maureen Lux at Brock University and Esri Canada since 2019.

Maureen Lux Professor Brock University

Maureen Lux is Professor and Chair of Brock University's History Department. She researches the impact of

#### 14:15 *Reporting Items of Disease Maps*

Background: Although disease maps are ubiquitous and are regarded as important tools in public health, there are no widely agreed upon and established guidelines for proper reporting. Study objectives were to identify reporting characteristics of disease maps. Methods: Published journal articles identified from a search in Medline and other databases from 2017-2018 were screened for disease maps of zoonotic infectious diseases. Reporting characteristics were extracted and summarized as informed by research questions. Results: A sample of 100 articles meeting eligibility criteria suggest a majority of published disease maps do not report map elements such as projection parameters - relevant for reproducibility, and interpretations of geospatial analyses. Conclusions: The findings from this investigation identifies gaps and inconsistencies in the reporting of basic map information in the literature and support the development of an evidence-based reporting guideline for disease maps.

Presenter(s) Inthuja Selvaratnam MSc Candidate University of Guelph

Inthuja Selvaratnam received her Honours Bachelor of Science from the University of Toronto. She is currently completing her Master of Science dissertation at the University of Guelph at the Department of Population Medicine. Her dissertation examines the reporting practices of disease maps in the public health literature.

#### 14:35 *Environmental Effects on the Prevalence of Neurological Disorders*

A range of environmental exposures have well-documented effects on individual health. Emerging evidence suggests it may also contribute to the development and severity of neurological conditions. As such, the connection between ambient air pollution to common neurological disorders like attention deficit hyperactive disorder (ADHD), obsessive-compulsive disorder (OCD), and autism spectrum disorders (ASD) requires further analysis. This study investigates whether environmental exposures (including greenness, NO<sub>2</sub>, and PM<sub>2.5</sub>) are associated with increased risk of these disorders. Exposures were calculated using average ambient exposures drawn from data between 2000-2009 and assigned to individuals using Geographic Information Systems (GIS). We make use of genetic and behavioural data from a large cohort of children aged 7-17 living in the Greater Toronto Area and conduct a negative binomial model to assess and display the relationship between these variables.

Presenter(s) Simon Boushel Master's Student Carleton University

Simon Boushel is a Master's student at Carleton University, in the Spatial Determinants of Health Lab. His research investigates the relationship between the environment and the development of neurological disorders in youth. He is interested in the overlap of environmental epidemiology with topics such as inequality, and epigenetics.

#### 14:55 *Developing New Inspection Zones for Southwestern Public Health Using ArcGIS Pro*

Public health inspections of water sources, food outlets, recreational facilities, animal bites, and disease outbreaks is a core function of public health units (PHUs) in Ontario. In 2018, two PHUs, Oxford County Public Health and Elgin-St. Thomas Health Unit, merged into Southwestern Public Health. This merger created the demand for new public health inspection zones to balance the workload across the two counties. The Human Environments Analysis Lab (HEALab) at Western University was asked to provide technical expertise and facilitate the creation of these new zones. The HEALab embarked on a collaborative exercise with Southwestern Public Health staff to identify the workload drivers and constraints on creating the zones. The HEALab team then leveraged ArcGIS Pro, including the Build Balanced Zones tool, to develop compact and efficient inspection zones that balanced the workload across members of Southwestern Public Health's inspection team.

Presenter(s) Jason Gilliland Professor University of Western Ontario

Dr Gilliland is Director of the Human Environments Analysis Lab ([www.theheal.ca](http://www.theheal.ca)), Director of the Urban Development Program and Full Professor of Geography, Paediatrics, Health Sciences and Epidemiology & Biostatistics at Western University. He is also a Scientist of the Children's Health Research Institute and the Lawson Health Research Institute.

**15:30** *A Child's Space-Time Continuum? Spatiotemporal Analysis of How Children Use Their Neighbourhoods*

Initiatives to get children outdoors are critical due to unhealthy levels of sedentary behavior. We use novel GIS methods to study children's frequented spaces. Engagement within diverse spaces is examined by day (weekdays vs weekends, fair vs poor weather days) to identify spatiotemporal patterns of children's mobility and use of outdoor spaces. Children aged 9-14 from across London, Ont. participated in a study which included logging 2 weeks of locations via GPS. Data were processed with a GIS-Python tool that extracted routes/stops from GPS tracks, based on kernel density principles. Hexagonal bins containing environmental variables informed our spatial analyses. Findings from 516 weeks of data from 449 unique participants revealed interactions centered on schools, homes, parks, malls, and recreation spaces. Findings fill gaps in understanding how children use their neighborhoods, and can inform policies promoting outdoor activities.

Presenter(s) Malcolm Little

Graduate Student

Western University

Masters of Science candidate, member of the Human Environments Analysis Laboratory at Western University Geography. Specializes in GIS, geospatial analysis, and children's health.

**15:50** *ActivScore: A Physical Activity Score for Nova Scotia*

Physical activity is an important factor in reducing the impact of chronic disease on populations. There are many features of the built and natural environment that can impact the levels of physical activity. The purpose of this project is to create a tool (ActivScore) to evaluate the potential for physical activity in Nova Scotia based on characteristics of the built and natural environment. This tool centers the idea of a ten-minute neighbourhood in which all the services that people need to access are available within a ten-minute walking distance of their home. The final product is an online map service (e.g. a website) where users can search for their home or work address and find the associated score. Rural residents are statistically less likely to be physically active and have less access to structured resources for physical activity than urban residents. This will be done specifically for the Nova Scotia context and the unique mix of urban and rural settings in the province.

Presenter(s) Lilian Barraclough

Student

University of King's College

Lily is an honours Environmental Science and History of Science and Technology student at the University of King's College. She is also a student associate at the Dalhousie Esri Canada Centre of Excellence.

**16:10** *How Affordable Is Walking: Linking Walkability Measures to Housing Costs*

Walkability indices quantify the ability of a space to facilitate walking. More walkable urban environments often correlate to better health and less GHG emissions. However, since there are financial gaps to access valuable urban land, it is likely that not all residents have equal access to live in walkable neighborhoods. Vancouver is one of the most walkable cities in Canada and affordability is one of the most frequently mentioned urban issues both by the city and by local residents. This presentation investigates relations between housing costs and walkability in Vancouver. Urban walkability indices were correlated to property value and rental costs across the city. Our results suggest that there is a positive correlation between housing costs and walkability in Vancouver. By understanding these relationships, results can inform the design of a more walkable and affordable neighborhood.

Presenter(s) Nicholas Martino

PhD Student

University of British Columbia

First year PhD student at the School of Architecture and Landscape Architecture of the University of British Columbia with a background in Architecture and Urbanism. Research is mostly focus in the application of complexity theory and machine learning techniques to analyze spatial networks, urban form and livability.

**13:10** *Does Air Pollution in Global Megacities Fit an Environmental Kuznets Curve?*

In this paper, we are exploring temporal changes in air quality, specifically in particulate matter (PM<sub>2.5</sub>) pollution in global megacities since 1998-2016. Megacities are defined as urban agglomerations with a population of 10 million or more. 30 global megacities are included in this analysis. By using GDP per capita as an indicator of development, we examine the relationship between air quality and income. Specifically, if megacity growth follows the Environmental Kuznets Curve. We use GIS to extract annual air pollution estimates for each of the global megacities from a remote sensing product. Economic growth is based on country level estimates for GDP per capita obtained from the UN Human Development Reports. City boundaries and definitions vary, so we identify the mean and maximum air pollution values within 10km buffers from the city centre. These values are then plotted against GDP by time to examine their fit to the EKC.

Presenter(s) Ayesha Hassan

Student

University of Toronto Mississauga

Fifth year student specializing in Environmental Management and a minor in Sustainability.

**13:30** *A Land-Use Regression Approach for the Spatial Modeling of Ambient Air Pollution in the City of Hamilton*

This study examines the efficiency of using mobile monitoring methods to produce LUR models that can predict the spatial variation of ambient air pollution in Hamilton, Ont. The pollutants include nitrogen dioxide and ozone which were sampled using bicycles with low-cost air pollution sensors and a mobile air pollution laboratory with research-grade instruments. Mobile monitoring was utilized to obtain spatially-varying air pollution estimates across a mix of land-use conditions and socioeconomic regions. The LUR models produced from this study could be used to generate interpolated continuous pollution surfaces across the city to identify exposure levels at unobserved locations. The prediction surfaces will be compared to assess the effectiveness of pollution modeling using low-cost sensors. This research provides an evidence-based assessment of air pollution exposure which could be used for administrative purposes or designing local air pollution monitoring systems.

Presenter(s) Felix Massey

Graduate Student

University of Toronto Mississauga

Felix Massey is a Graduate Student in the Department of Geography at the University of Toronto Mississauga. He is currently pursuing an MSc degree in Spatial Information Systems and also holds an HBSc degree in Environmental Science from University of Toronto Mississauga. His research examines spatial modeling of air pollution in Canadian cities.

**13:50** *Spatial Distribution of Air Pollutants Near Roadways*

Twenty-eight percent of Canadians live near highways and major roads. Aiming to alleviate the adverse health impact of traffic-related air pollutants, this study is motivated to advance the understanding of the spatial distribution of roadway air pollutants. Traffic-related pollutants are both tailpipe pollutants and particles resulting from tire, break, and road interactions. Specifically, tailpipe pollutants come from internal combustion engine-powered vehicles. Studies found near-road particles either decay or remain stable over distances. Furthermore, NO, NO<sub>2</sub> and NO<sub>x</sub> concentrations near suburban areas can reduce exponentially with distance to the road edge. Ninety percent of the total traffic emissions come from non-exhaust by 2020. Even with zero tailpipe emissions, traffic will continue to contribute to non-exhaust emissions. These emissions are of particular concern due to its toxic trace metals content, which causes a need for a comprehensive source apportionment study.

Presenter(s) Siliang Cui

Student

University of Toronto Mississauga

I am a first year Ph.D student from the Department of Geography and Planning, University of Toronto.

<https://www.utm.utoronto.ca/geography/students/jenny-siliang-cui>

Matthew Adams

Assistant Professor

University of Toronto Mississauga

Dr. Matthew Adams is an Assistant Professor from the Department of Geography and Planning, University of

## Meeting Room

## Autonomous Mapping

### 15:30 *The Use of Mobile Robotics in Mapping Contamination*

Recent growth in the commercial availability of mobile robotics such as unmanned aerial vehicles (UAVs or drones), autonomous underwater vehicles (AUVs) and rovers have presented the potential for collecting detailed spatial information in real time across a wide range of situations. Due to their ability to be controlled remotely, and sometimes function autonomously, these solutions have been particularly useful in monitoring contaminated areas that are hazardous for human investigation. This paper will review case studies in the literature where mobile robotics were used to monitor ambient radiation, air pollution, water pollution and soil contamination. Through critically analysing the outcomes and shortcomings of each technology, we are able to identify where such solutions may aide in improving monitoring procedure. This research is part of an effort to reduce unnecessary human exposure during routine environmental assessment through the introduction of autonomous solutions.

Presenter(s) Chandula Fernando                      PhD Student                      University of Toronto Mississauga

I'm a PhD student at the University of Toronto's Department of Geography, currently looking to develop a pipeline through which new monitoring techniques developed during disasters can convert to routine environmental assessment protocols. I have a background in Radiation Biology and Medical Physics.

### 15:50 *Interactive Guide to Autonomous Magnetic and Bathymetric Surveys of Canadian Lakes*

Advancements in autonomous controls have made it possible to acquire bathymetric and magnetic field data in lakes from uninhabited, autonomous vessels, capable of expanding data coverage and ensuring the safety of field personnel. To ensure autonomous surveys are conducted effectively while maximizing data resolution and minimizing in situ error sources, a guide for designing/planning and executing surveys is presented. These guidelines consider challenging survey environments and limitations including, accessibility, land use, lake ice, vegetation patterns and regional magnetic and bathymetric data. Related datasets were aggregated and analyzed using ArcMap spatial analysis tools to provide estimates of site conditions. Results exemplify the added value in designing surveys for shallow draft, autonomous vessels to survey various lakes and tailing dams while reducing the gap between terrestrial and bathymetric elevation models and increasing high resolution magnetic data coverage.

Presenter(s) Mitchell Wootton                      Master's of Applied Science Stude                      Queen's University

Mitchell is an MAsc. candidate working in the Geophysics and Geodesy Research Group at Queen's University, Department of Geological Sciences and Geological Engineering. Mitchell's research focuses on the use of an autonomous surface vessel in bathymetric and total magnetic field intensity surveys in Canadian lakes.

### 16:10 *Use of Reinforcement Learning for UAV Mapping*

The use of Unmanned Airborne Vehicles (UAVs) has become widespread. With their versatility, speed, low-cost, multiple sensor payloads, and ability to access regions often inaccessible by humans, UAVs are a commonly used aerial mobile platform for photogrammetric mapping activities. However, their use for such a purpose still requires a great amount of human involvement and knowledge – including for mission/path planning and operation. Recent interest in and the development of techniques in machine learning, mainly in Reinforcement Learning (RL), can greatly benefit UAVs and enable their mapping tasks such as area coverage, optimal flight path determination and trajectory matching/following to be completed autonomously. Our current research on the implementation of RL to enable a UAV to identify and follow an optimal path that allows it to efficiently map a target feature (ex. road) will be presented.

Presenter(s) Agata Szeremeta                      Student                      York University

Agata Szeremeta is a MSc candidate in the Department of Earth & Space Science & Engineering at York University. Her research focuses on the use of UAVs for mapping and involves studying methods of increasing and improving their autonomy. She completed her undergraduate degree in Geomatics Engineering in 2018 at the Lassonde School of Engineering.

**10:05** *Validation of a Forest Insect Infestation Model with the Method of 3-Map Comparison at Multiple Resolutions*

One of the challenges of land change simulation is the validation of spatiotemporal models. In this study, we validated a model of outbreaks of the Mountain Pine Beetle in the forests of British Columbia, Canada, using 3-map comparison at multiple resolutions. The model classifies each pixel as 'infested' or 'not infested' and produces a prediction image based on multiple past images of the study area. Model validation involved the analysis of components of the figure of merit. Compliance of prediction and observation images is not sufficient to validate the model because it does not consider the amount of change from initial state. The method of 3-map comparison enabled us to analyze the areas of change. In addition, comparison at multiple resolutions allowed us to distinguish quantity and location errors. Lastly, we gained better insight about model performance by considering the irreversibility and spatial autocorrelation of infestation as the simulated process.

Presenter(s) Saeed Harati

Student

Université de Montréal

Saeed is a PhD candidate at Université de Montréal (UdeM) department of geography. After completing his MSc in environment and sustainable development at UdeM he joined Dr. Liliana Perez' Laboratoire de Géosimulation Environnementale (LEDGE) to study the complexity of social-ecological systems. He likes music, mathematics and vegan cooking.

**10:25** *Application of the Generalized Linear Mixed Models with Different Spatial Effects to Analyze the Spread of the Emerald Ash Borer in Southern Ontario*

This talk will present a case study of the Asian Emerald Ash Borer beetle (EAB, *Agrilus planipennis* Fairmaire), which can cause damage to all species of ash trees (*Fraxinus*). This research seeks to analyze the risk factors and predict the future EAB spread in Southern Ontario. The sampled EAB data collected across the specified study region may retain similar features and present evidence of spatial autocorrelation. We propose the use of a generalized linear mixed model in this research. This model combines the features of the generalized linear model and random effect model, which are more powerful and capable of analyzing a dataset with intraclass correlation. As an extension of the conventional likelihood-based method, we conducted statistical inference and model selection to identify the most significant risk factors associated with the distribution of the EAB. The prediction results showed that 95% of the testing data were correctly classified through the proposed model, and the risk map validation was produced based on the model prediction.

Presenter(s) Adam Zhong

Student

York University

**10:45** *GIS and Multi-Source Remote Sensing Data Based Urban Tree Species Mapping Using a Fusion Approach*

With progress in these technologies, the benefit to having access to GIS and remote sensing data can prove to be more time efficient and effective in urban forest management and planning, especially for tree species mapping. In this study, a map coupled with tree inventory data containing tree species, size, and location, airborne Light Detection and Ranging (LiDAR) data with an average density of 10 points/m<sup>2</sup>, Worldview-2 panchromatic imagery with a resolution of 0.4m as well as 8-band multispectral imagery of 1.6m resolution were combined to generate a street tree species (five dominant tree species) map of York University Keele Campus in Toronto, Canada. Exploiting the complementary information derived from high resolution multispectral imagery and LiDAR data, we developed a fusion approach to improving individual tree species mapping by integrating the spectral, textual and structural information at both feature and decision levels based on GIS and multiple remote sensing data.

Presenter(s) Qian Li

Graduate student

York University

Qian Li graduated from the major of Civil Engineering in 2011 and had five years work experience after graduation. In 2014, she became a licensed Assistant Engineer. She started her graduate program in September 2018 at York University and worked as a research assistant of Remote Sensing and teaching assistant.



**11:10** *Case of Study: Millar Western Forest Company LiDAR Streams Classification – Whitecourt, Alberta*

Modern forest harvested operation and conservation practices require DEM to have a clear picture of the geomorphology of the land operation that forest companies have. As a result, The Millar Western Forest Company (MWFC) required to classify streams according to the Alberta government. The Province of Alberta has a national hydrographic (cartographic, derived from 1:20,000) with a draining density of 1.1 km km<sup>-2</sup> and Rivers of 20 m width are well represented, but less width than 20 are poorly distinguished. The MWFC has been using 1-m LIDAR DEMs (tiles of 14 km x 16 km) data recently to identify streams and accurately map them. MWFC produced a stream network using LiDAR data. Data was completed using ARC Hydro (Esri software) running the Strahler Stream methodology on the predicted stream network in which the current methodology for translating the Strahler Stream Classification into the Alberta Ground Rule classification system has been matching for modern effective operation.

Presenter(s) Paul Benalcazar                      PhD Candidate student                      Lakehead University

Paul is a Ph.D. Candidate student in Forest Science at Lakehead University. Paul has his Master in Geographical Information Systems and Science at Salzburg University. His research focuses on water management and soil health using GIS and soil assessments for improving Water and Soil quality.

**11:30** *Who's Responsible for Managing the Lake?: A GIS Analysis of Lake Athabasca*

GIS is an excellent tool for visualizing how humans impact the land. This spatial information paired with an environmental governance case analysis can help government decision-makers, business leaders, and local communities understand how they are unknowingly working together to create environmental impacts. My presentation will use a case study on Lake Athabasca, a large northern lake that crosses the Alberta-Saskatchewan border, to demonstrate how using GIS can connect the dimensions of demographics, land use cover, and the presence of different institutions to fill a knowledge gap. In my analysis, I describe who has a stake in governing the water quality of Lake Athabasca, ranging from international to federal to provincial to local governments to Indigenous nations to private resource extraction companies. The results from this spatial analysis can be given to stakeholders to inspire better coordination of their projects on or near Lake Athabasca to improve its water quality.

Presenter(s) Danielle Scepanovic                      GIS - Cartographic Specialist student                      Fleming College

Danielle Scepanovic is currently a GIS – Cartographic Specialist student at Fleming College. She recently graduated from the University of Guelph with a BAH in Environmental Governance, an interdisciplinary major focusing on human and physical geography, political science, economics, and anthropology.

**10:05** *Urban Tree Detection and Mapping Using Airborne LiDAR*

The automatic creation and update of tree inventory provides an opportunity to better manage tree as a precious resource in both natural and urban environment. The goal of this project is to provide a method for automatic single tree crown delineation which will be used as in input for training tree species classification with Deep Learning. Our study area is at the York University Keele Campus, Toronto. Airborne LiDAR data was acquired in 23rd September 2018 with Teledyne Optech's Galaxy-PRIME. Field data (tree labeling) was collected during the years of 2014, 2016 and 2017. 5717 trees on campus were recorded with species name, tree crown width [m], and locations obtained by a handheld GPS. We used a marker controlled watershed segmentation method to over generate detected local maximums (tree tops) and watersheds (tree crown boundaries). Using the GPS locations and recorded tree crown radii, we merge the representative watershed candidates to produce 5717 tree crown boundaries.

Presenter(s) Connie Ko Adjunct faculty member, Research York University

Dr. Connie Ko: Adjunct faculty member, York University, Department of Geography; cko@yorku.ca. PhD (York University) Dr. Gunho Sohn: Associate Professor, York University, Department of Earth and Space Science and Engineering; gsohn@yorku.ca. LEL, PhD (University College London)

**10:25** *Measuring Coastal Wetland Area and Volume at Five Lake Levels in Eastern Georgian Bay*

Historical and projected climate data suggest precipitation events will increase in intensity and frequency, threatening wetlands and people. Changes in lake levels in the Great Lakes impact a plethora of ecosystems and lakeshore owners. Its lake level trends show a major variability, with periods of record high's and low's, demonstrating the need for understand the hydrogeomorphology and implications on coastal ecology and flood zones. Particularly, Georgian Bay holds many pristine wetlands which are of interest to researchers, owners, and tourists. To oversee hydrogeomorphic impacts at the local scale, an atlas will be created for every coastal wetland along Georgian Bay. The atlas will include wetland area and volumes at five different lake levels. This requires manipulating a large DEM to clip to a wetland shapefile for depths of 0 to 5 m at each lake level. The atlas can be used to assess flooded areas and marsh zones, which are especially important to assess species habitats.

Presenter(s) Sherry Chen Student McMaster University

Fifth year student at McMaster University, majoring in Biology and Environmental Sciences and minoring in GIS and chemistry. Main research interests include ecology, waste management, and geochemistry.

**10:45** *Developing Low Impact Development (LID) Site Selection Tool Using Model Builder and Python*

LID manages urban flooding through sustainable urban planning and provides socioeconomic and environmental benefits. Identifying sites wherein implementing LIDs maximizes all benefits is a physical-based and spatial decision-making problem, which was not addressed in previous studies. Thus, the objective of this study is to develop a geospatial tool using model-builder and python to target the sites which need LID. This was carried out through developing a geospatial tool using available open data, analyzing physical-based model along with a hierarchical weighted sum model. Three indices were developed to determine the LID demand map including hydrological-hydraulic, socioeconomic, and environmental indices using a heuristic relationship. The developed framework was applied to the city of Toronto, as a case study and the results demonstrated a good compliance with the historical flood records.

Presenter(s) Sahereh Kaykhosravi Student York University

Sarah is currently a third year PhD candidate in the Department of Civil Engineering at Lassonde, York University. My research interest is urban flood risk reduction using Low Impact Development (LID) techniques. I received my BSc and MSc in Civil Engineering from the Amirkabir University of Technology, Iran.

**11:10** *Study on Urban Flood Scenarios Using Flood Modeling and GIS*

Nowadays, urban flood modeling is an important part in a comprehensive flood management. The knowledge on the consequences of different scenarios in terms of the predicted flooded areas and associated risk is key. Therefore, the objective of this work is to simulate and map the flood extents with different model inputs, focusing on the impacts of urbanization and the sizes of studied watersheds on pluvial flooding. Regarding to the urbanization conditions, land use maps extracted from satellite images and simulated with uniform impervious surface percentage are input into urban flood models. Depending on the availability of data, the size of studied watersheds often need to be manually adjusted. This work has found that the two mentioned variables play a significant role in the final prediction of flood inundation extents.

Presenter(s) Boyu Feng Post Doctorate Researcher University of Western Ontario

I am currently a post doctorate researcher in University of Western Ontario with the financial support from an NSERC Engage Plus project collaborated with Esri Canada. My current research relates to urban flooding analyses.

**11:30** *Discrete Global Grid Systems: An Emerging Data Model for Science/Community Integration*

Discrete global grid systems have been proposed as a data model for an emerging digital earth framework capable of integrating heterogeneous types of spatial data. In northern communities experiencing rapid environmental change, a mix of locally produced and globally managed data are often required. While models and satellites produce spatially explicit representations of environmental processes, communities are also being engaged in monitoring through citizen science and community-based monitoring. In this report, we outline a new data model based on a DGGS for integration of these two forms of spatial data. A relational hybrid data model is presented and sample applications for monitoring change presented. Preliminary results indicate significant performance gains over traditional spatial data architectures. Given the need for a mix of local and cloud-based storage in many applications in small communities, further research is needed to identify optimal application configurations.

Presenter(s) Colin Robertson Associate Professor Wilfrid Laurier University

Colin Robertson is an Associate Professor in the Department of Geography and Environmental Studies.

**11:50** *Distributed In-Memory Spatio-Temporal Query Processing*

Location-based services (LBS) are a widely adopted technology that produces large volumes of spatio-temporal data at high velocity. Spatial data is also being generated from many other geo-spatial applications. To address the challenge of data volume, we present DISTIL+, a distributed spatio-temporal data processing system designed for high velocity location data. Our system achieves high update throughput and low query latency by leveraging the APGAS (Asynchronous Partitioned Global Address Space) architecture to build a multi-level distributed in-memory index. We present extensive experimental evaluation of our system, comparing several indexing and data placement schemes, as well as competing systems. Our results show that DISTIL+ excels at supporting high throughput location updates, and low latency spatio-temporal range queries and kNN queries, while offering better performance than existing approaches.

Presenter(s) Suprio Ray Associate Professor University of New Brunswick

I am an Associate Professor at the Faculty of Computer Science, University of New Brunswick. I lead the Big Data Systems and Analytics Lab. I received my Ph.D. in Computer Science from the University of Toronto, an M.Sc. from the University of British Columbia and a Bachelor of Engineering (Computer Science and Engineering) from NIT, Trichy.

## Committees Room Demo Session

### 10:05 *Applying Data Science Tools in ArcGIS Insights*

ArcGIS Insights is a data analytics and visualization application used to customize data science with spatial and non-spatial data. What you will learn from this workshop are the following characteristics: a) become more familiar with ArcGIS Insights; b) how to clone R and Python kernels in the same Anaconda environment; c) how to integrate both kernels in ArcGIS Insights; d) parallel processing data in Python, and; e) how to perform some data science in Python, R, and Python + R (piping) in ArcGIS Insights.

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Presenter(s) Dr. Tasos Dardas Higher Education Developer/Anal Esri Canada

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### 15:30 *Developers*

Learn more about ArcGIS developer tools.

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Presenter(s) Dr. Tasos Dardas Higher Education Developer/Anal Esri Canada

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### 15:30 *3D and Geodesign*

Learn more about 3D and geodesign tools in ArcGIS.

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Presenter(s)	David Kossowky	GeoDesign Specialist	Esri Canada
	Michael Luubert	Developer - Desktop/Web	Esri Canada

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**15:30** *Signs with a Side of Fries: Using ArcGIS Pro to Analyze Exposure to Outdoor Ads among Teenagers in London, Ontario*

Consumption of food and beverages high in fat, sodium, and free sugars have been linked to a wide range of chronic health conditions including heart disease, hypertension, cancers, and diabetes. The diets of Canadian adolescents unfortunately contain many of these foods and beverages in large quantities. These consumption patterns result in lower academic performance, negative mood, and increase the risk of chronic disease in later life. Other research would suggest the availability of outdoor advertising in a local area has an effect on the dietary choices of adolescents, though little explores the mechanisms that link exposure to outdoor advertising and dietary choices. Using a novel spatiotemporal approach in ArcGIS Pro, this study leverages individual-level spatial data collected through a bespoke smartphone application (SmartAPPetite) to track exposure to outdoor advertising, and link to number of visits to retail food outlets by adolescents in the London, Ontario, Canada area.

Presenter(s) Alexander Wray MA Geography Student Western University

Alexander is a Canada Graduate Scholar (Masters) and Ontario Graduate Scholar researching at the intersections of childhood health and wellbeing, urban geography, and municipal governance. He is completing a Master of Arts in Geography at Western University under the supervision of Dr. Jason Gilliland in the Human Environments Analysis Lab.

**15:50** *Association between Time-Weighted Activity Space-Based Exposures to Fast-Food Outlets and Fast-Food Consumption among Young Adults in Urban Canada*

Despite the increased attention on retail food environments and fast-food consumption, results from previous studies have been inconsistent. This study examines the association between exposure to fast-food environment and fast-food consumption among young adults, and explores possible associations between built environment and fast-food consumption in a population of young Canadian adults. Significant positive associations are found in the negative binomial regression models between time-weighted number of fast-food outlets and count of fast food meals. However, time-weighted ratio of fast-food outlets is only significantly associated with count of fast-food meals when a radius of 500 m is used. Built environment density is significantly negatively related to count of fast food meals across all models. These results imply that both food retail composition and activity spaces in urban areas are important factors when studying diets.

Presenter(s) Bochu Liu Student University of Toronto - St. George

A Ph.D. student majoring in health geography and time geography at the Department of Geography and Planning, University of Toronto.

**16:10** *Combining GPS and Time-use Data to Study Dietary Behaviours*

Food purchasing and dietary behaviours are influenced by many factors, including financial security, geographic location, household characteristics, and time availability. Past research has examined the impact of spatial access to food retailers using GPS data on food purchasing, but geographers have yet to take an integrated approach to understanding how spatial context and time-use influence food purchasing/dietary behaviours. In the Food Activities Socioeconomics Time-use & Transportation Study, we attempt to address this by taking a systems approach to understanding what factors influence the food purchases/diets of parents in 2 Toronto communities. Seven days of GPS data and time-use diaries were collected, alongside a survey on diet, transportation, SES, and time stress. This presentation presents the study's data collection strategy and preliminary results, emphasizing the ways these data can capture how geography and healthy behaviours influence and are influenced by time-use.

Presenter(s) Michael J. Widener Assistant Professor University of Toronto - St. George

Michael Widener is an Assistant Professor in the Department of Geography and Planning at the University of Toronto - St. George, and Canada Research Chair (Tier 2) in Transportation and Health.

## Committees Room      Historical Landscapes

### 15:30 *The Battle of Hastings, A Cartographic Narrative*

The Battle of Hastings (1066) is one of the most widely studied battles in medieval history. However, despite the importance of geography in the outcome of such conflicts, few studies have investigated the landscape of the battle or the role the landscape played in its eventual outcome. This study, consequently, seeks to map the battle to examine the impact of geographic factors in understanding the events that shaped the battle. The analysis was undertaken using historical and current data which were combined in a series of detailed maps to bring an entirely new perspective to the literature on the battle. Factors considered in the study included cartographic depictions of units, viewshed analysis, historical maps and a cartographic narrative of the battle. Among the findings of this study were the introduction of techniques to assess the size of medieval battlefields as well as a firm demonstration of the importance of cartographic analysis in understanding a literary account.

Presenter(s) Christopher Macdonald Hew      Sessional Instructor / GIS Analyst      University of Western Ontario

Christopher Macdonald Hewitt completed his doctorate in Geography in 2016 on the Battle of Hastings. Since then he has contributed to sociological and political science projects as a GIS analyst using Statistics Canada data.

### 15:50 *GIS in Surface Survey and Excavation: The Metaponto Archaeological Project*

This paper will explore current applications of GIS in the study of the ancient city and countryside of Metaponto, an Achaean foundation located in southern Basilicata, Italy. A study of the 8th-century (BCE) Greek colony founded on the Ionian coast, The Metaponto Archaeological Project is an initiative which aims to identify patterns of ancient life in the Greek countryside and both to utilize legacy data and to carry out new archaeological field survey in order to determine the nature of land use in the area that became the countryside of Metaponto. Recent applications of GIS in this project include the creation of DEMs cataloguing the excavations of 'Incoronata Greca', a site of both Greek and indigenous Italian frequentation, and typifying survey sites using GIS-based queries. The purpose of this paper is to demonstrate the application of such technologies in the study of ancient material culture and to prove their value based on the current findings at Metaponto.

Presenter(s) Christine Davidson      Doctoral Candidate, Classics      McMaster University

Christine Davidson is a doctoral candidate in the field of classics and is completing her dissertation titled, "Greco-Indigenous Connectivity in the Chora of Ancient Metaponto: an investigation using Geographic Information Systems". She completed her M.A at the University of Waterloo (2016), and her B.A. at Mount Allison University (2014).

Patrick DeLuca      GIS Specialist/Sessional      McMaster University

Patrick DeLuca has over 25 years of experience using GIS in a variety of settings. He is a GIS Specialist and

### 16:10 *Moving Archaeology Forward: New Methods and Tools for Landscape Archaeology*

Landscape Archaeology is a highly debated subject in academia. In the Fall 2019 term I dedicated my time to this field of study and trying to develop new advancement in the field. In a Landscape Archaeology class I learned about the critiques of this topic; learning that many scholars believe that the scope of GIS is limited for their purposes. From my studies I found that the use of GIS is limited to Viewshed and Least cost paths. Using my new found knowledge of ArcPY and knowledge gained from previous classes I was able to develop tools from both python and Modelbuilder. Using a series of basic tools and lines of code I created several tools that are easy to use for untrained archaeologist wanting to use GIS for their studies. These tools are geared towards establishing settlement patterns through different statistic types. From this we are able to establish settlement patterns from raster files that can be used in further analysis such as Multi criteria Data Analysis and much more.

Presenter(s) Todd Wong      Student      McMaster University

I am a fifth year student associate seeking a degree in Honours Anthropology & Geography with specializations in GIS & Archaeology. My passion in GIS stems from a love for conservation and the environment. I have used my skills in GIS in the field of archaeology; specifically in Greece.

**14:15** *Investigating the Relationship between Environmental Cues and Spatial Memory in Real-World Navigation Using Virtual-Reality*

The ability to find one's way in an environment is crucial to daily functions. Navigation depends on the retrieval of spatial knowledge which facilitates orienting oneself in space, moving towards a destination, and tracking progress throughout the journey. In clinical settings, spatial memory is assessed using qualitative tools such as sketch-mapping. There is a gap in knowledge of the relationship between spatial memory tasks and navigation in familiar environments. Whether the type of spatial cues used in navigation relates to dissociable aspects of spatial memory is an open question. Here we present preliminary results of a study exploring these relationships using a novel virtual-reality paradigm that allows participants to navigate a familiar neighbourhood while visual fixation patterns are analyzed. Results will inform neuropsychological recommendations tailored to individuals' specific vulnerabilities, particularly, for older adults who are at risk of cognitive impairment.

Presenter(s) Delaram Farzanfar Graduate Student York University  
Graduate Student in Clinical Psychology Program at York University

**14:35** *Extreme Heat Cooling Centres in Downtown Hamilton*

In light of climate change, Ontario has seen an increase in extreme weather - namely, prolonged heat events. This has significant implications for public health and service provision in the City of Hamilton as the City is called upon to create more cooling services, ranging from offering water bottles to offering free public pools. In addition to formal cooling centres provided by the City, residents find informal places and ways to cool down, such as going to the mall or parks. Hamilton residents living in older homes and apartment buildings have first-hand experience living in extreme heat during the summer. Residents have been very engaged in the issue of extreme heat and cooling centres in their neighbourhood. The purpose of this study is to determine where people go during extreme heat events, what characterizes the places they choose to go to, document and map local knowledge and gain detailed accounts of their experiences at these informal cooling centres.

Presenter(s) David Zaslavsky Student McMaster University  
Undergraduate student at McMaster University, degree in Biology with a minor in GIS. 2019-2020 Esri Canada Student Associate.

**14:55** *Measuring Toronto's Vital Signs Through Global and Local Ideal-Point Analysis*

Multiple Criteria Decision Analysis (MCDA) offers a unique lens for examining socioeconomic inequity in cities. Interrelated criteria are combined to produce a weighted score for each spatial unit. Global MCDA methods conceal variation, while local methods account for spatially relevant characteristics. The Vital Signs Report provides a snapshot of Toronto's quality of life, using 10 indicator categories. While the report is published at a city scale, a spatially explicit approach offers a deeper interpretation of results. In this paper, a localized Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) will be applied to the Vital Signs Report. Results show more variation and less spatial autocorrelation than the global approach, while the method provides a simplified representation of the report. GIS researchers are increasingly exploring local MCDA approaches using vector data, but more complex techniques such as TOPSIS are relatively underdeveloped; our case study aims to fill this gap.

Presenter(s) Mayah Obadia Student Ryerson University  
Mayah Obadia is a BA candidate (2020) at Ryerson University. She has investigated spatially explicit MCDA methods, and is currently analyzing urban heat islands in Toronto using Landsat 8 imagery. Research interests include remote sensing for natural resources and emergency response support, and wayfinding and orientation in natural environments.

## South Dining Room Investigating Urban Areas

### 11:10 *Bridging the Gap between BIM and GIS Using Semantic Web*

BIM and GIS are conventional representations of respective AEC and geospatial domains, fundamentally designed for discrete purposes. However, with technological advancements and user specifications they have developed individually with overlapping features. Bridging between these domains to incorporate heterogeneous data representations becomes critical. Indeed integration using semantic web has shown promising results, most approaches are limited to manual operations towards defining semantic web core, ontology. We propose a framework implementing a model for semi-automatic generation of ontology from XML-based data, ifcXML and CityGML of BIM and GIS domains, respectively. Further NLP techniques are used for mapping of generated domain-ontologies to achieve interoperability following cross-domain integrated graph representation. These interlinked heterogeneous BIM-GIS graph representations in a common format (RDF) will nurture knowledge discovery in urban environments.

Presenter(s) Aman Ullah Usmani

Student

York University

### 11:30 *Investigating the Retail Competition Processes Based on Agent-Based Models in Geospatial Perspectives*

Agent-based models (ABM) have been used to formalize our knowledge of the drivers of Land-Use and Land-Cover Change (LULCC) over the past decades. Among these ABMs, most of them focus on investigating residential or agricultural-related problems, whereas fewer are designed to represent commercial and retail developments. Although some ABMs have been built to represent processes between industries and customers, few of them have constructed models based on real-world environments and developed their research from a geospatial perspective. We utilize the empirical research results on consumer spending and retail location site selection to create a model of the processes of retail agents competing for store sales. By incorporating ABM and geospatial software (ArcGIS), the real-world landscape can be digitized. Our overarching goal is evaluating whether real-world patterns of store locations can be generated by ABMs to enrich future LULCC models by better simulating commercial development.

Presenter(s) Jiaxin Zhang

Student

University of Waterloo

Jiaxin Zhang is a second-year graduate student in the Department of Geography and Environmental Management at the University of Waterloo. His research interests center around spatial analysis, modeling and data mining. His current research is incorporating ABM and GIS techniques to investigate the commercial industry competition processes.

### 11:50 *Validation of the TanDEM-X DEM Using Airborne LiDAR and Spaceborne SAR in the Dallas-Fort Worth Metroplex, Texas, USA*

The Dallas-Forth Worth metroplex (DFM), Texas, is one of the largest urban areas in the United States. Founded along the Trinity River, 80% of the city is covered in residual soils and expansive clays. Coupled with these geologic conditions, frequent flooding and development of oil and gas surrounding the city create a dynamic terrain system that affects infrastructure. TanDEM-X (2010–present) is a spaceborne radar interferometry mission that delivered a global Digital Elevation Model (DEM) with a spatial resolution up to 12 metres and a vertical accuracy of ~1-2 metres clearly surpassing previous global DEMs. Data of a mixed landcover area of 4250 km<sup>2</sup> are integrated using ArcGIS and Python to validate the TanDEM-X DEM with airborne LiDAR (2009) and Sentinel-1 SAR DEMs (2014–2019). In addition, a time series of Sentinel-1 observations is used to identify areas with ground deformation using StaMPS (Stanford Method for Persistent Scatterers) and SNAP (SentiNel Application Platform).

Presenter(s) Daniela Iribe-Gonzalez

MASc Student

Queen's University

Iribe-Gonzalez is a MASc student at Queen's University since 2018 who works on analysing dynamic terrain systems with satellite data. Graduated from the BS in Geodetic Engineering at the Autonomous University of Sinaloa, Mexico. She was awarded the Mitacs Graduate Fellowship 2018 and participated in the Mitacs Globalink Research Internship 2017.



**13:10** *Interpreting Electric Vehicle Charging Event Data Using Spatial Interpolation and Topic Models*

Fostering EV adoption outlines significant concerns primarily centered on vehicle range and costs. Therefore, an understanding of EV charging patterns is crucial for optimizing charging infrastructure placement and managing costs. This research proposes to integrate spatial interpolation and topic modelling for understanding the impact of public electric vehicle charging infrastructure on EV adoption. Towards this end, the Inverse Distance Weighted interpolation is combined with the Latent Dirichlet Allocation topic modelling for uncovering EV charging patterns through space, time and context. The IDW ArcGIS tool and Spark's MLlib library were used for the implementation. The proposed approach is evaluated using event data from 580 public charging stations across Ireland from 2017 to 2018. Preliminary results suggest a complimentary overlap in charging behavior captured with both methods. Findings are discussed in terms of interpretable insights in an early EV adoption context.

Presenter(s) Rene Richard Student University of New Brunswick

Rene Richard is currently pursuing his Master of Science in Engineering at the University of New Brunswick where he is specializing in data science. He is a member of the People in Motion Lab at the University of New Brunswick, which is at the forefront of Data Science for a sustainable world.

**13:30** *Geometry-Guided Adaptation for Road Segmentation*

We propose a novel adaptation method for generalizing road segmentation to novel weather, lighting or viewing geometries. The method assumes a source domain consisting of an ensemble of labeled training datasets and an unlabeled target test dataset that deviates substantially from the training ensemble. The training dataset is used to compile a geometry-anchored prior over the road pixel locations and to train a fully convolutional network (FCN) road segmentation system. At inference, a probabilistic Houghing method is used to detect line intersections in the test image and thereby estimate the vanishing point of the road, thus anchoring the learned geometric prior. Leave-one-out evaluation across five diverse road segmentation datasets demonstrates substantial improvement in generalization across changes in viewing geometry and weather conditions, yielding results that are on average comparable and in some cases superior to a more complex GAN-based domain adaptation approach.

Presenter(s) Gong Cheng Student York University

Gong Cheng is a computer science Ph.D. student supervised by Prof. James Elder at York University. His research interests involve computer vision, machine learning, and image processing. Currently, He is working on the topic of vision-based road analysis using geometry information.

**13:50** *Modeling Taxi Trips on a Spatial Graph Using Random Shortest Path*

Taxis have been used as probes in intelligent transportation systems to dynamically sample local attributes of a road network, such as speed. The sampling locations exhibit uneven distribution, because locations visited in taxi trips are subject to destinations of passengers and route choices of drivers. With origins and destinations extracted from archived tracking data, we modeled taxi trips using random shortest paths to estimate visit probabilities of edges in a road network. These probabilities associated with street segments were aggregated over all OD pairs by weighted sum, to derive expected edge visit counts of taxis. We visualized the results in 3D by extrusion and explored temporal variation of expected counts. The outcome may serve as a null model to identify absence of expected taxis in case of temporary network structure failures.

Presenter(s) Chang Ren PhD Student Western University

Chang Ren is a PhD student from State Key Lab of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS) at Wuhan University. He is visiting Geospatial Analysis Lab at Western University in the academic year of 2019/20 to collaborate in probabilistic movement models and time geography.

**14:15** *Using Deep Neural Networks for Automatic Building Extraction with Boundary Regularization from Satellite Images*

The building footprints from the satellite images have always played a substantial role in extensive applications like urban planning or 3D modelling. However, extraction of building footprints with boundary regularization automatically has always been challenging. Here, we formulate the major problems into spatial, semantic & geometric learning and propose a deep learning based framework to address these problems. The framework consists of the backbone network and the building extraction network. Two types of building extraction networks are designed, one is the polygon shape-prior integration models. The other one is Region-based Polygon GCN. Extensive experiments show that our models can properly achieve the localization, recognition, semantic labeling and geometric shape extraction simultaneously. In terms of building extraction accuracy, computation efficiency and boundary regularization performance, our models are at par with the state-of-the-art baseline model, Mask R-CNN.

Presenter(s) Muhammad Kamran Student York University

I am doing PhD in Earth and Space Science from York University, Canada. I did my Undergrad in Communication Systems Engineering from NUST, Pakistan. I did my Masters in Computer Science from NUST, Pakistan.

**14:35** *(De)composing the City Using Machine Learning*

Cities are complex configurations of landscapes. Simplifying cities into constituent parts helps us to better understand the processes that shape their evolution. Fractal models of cities can identify different urban form archetypes based on land use patterns, density, and street configurations. Archetypes can account for the interaction and configurations multiple land uses. While archetypes simplify planning challenges at hand, it remains difficult to accurately identify archetypes in real urban environments given the vast number of cross-scale variables. Machine learning, in particular convolutional neural networks (CNN), offer a new opportunity to reliably decompose complex urban systems. This work systematically classifies different archetypes present in the Metro Vancouver region using a CNN model. In this presentation we will demonstrate a CNN derived bias free map of urban form archetypes, providing a comprehensive method to examine urban forms for describing Metro Vancouver.

Presenter(s) Xi Peng Student University of British Columbia

Xi Peng is a PhD student at the College of Architecture and Urban Planning, in Tongji University of Shanghai, China. She is currently visiting the School of Architecture and Landscape Architecture of the University of British Columbia focusing on research related to urban design and landscape architecture.

**14:55** *Augmented Reality Assisted Modeling*

As more and more cities support initiatives toward sustainability, it is becoming a necessity to monitor infrastructure usage through the design and installation of various sensors to make a building "smart". This process begins with a digital 3D representation of urban scenes. However, many buildings have been designed and built decades ago, without BIMs and usually only having floor plans. We propose a quick-deploy system to create models and track users in a building. We develop an AR app to automatically align floor-plan with the real-world point cloud scan automatically. We use these to create a real-world grid coordinate system for indoor geolocation. From there, we can locate a user in its digital twin for interactive AR modeling of building interiors. This system integration can serve as a future platform for more smart applications like indoor navigation, layout planning, asset management.

Presenter(s) Pio Claudio Post Doctorate York University

Pio is a PostDoc working at York University. His interests are computer graphics and visualization.

**15:30** *Mapping Erosion and Deposition in an Agricultural Landscape with UAV SfM-MVS*

Structure-from-motion (SfM) and multi-view stereo (MVS) algorithms coupled with the use of unmanned aerial vehicles (UAVs) have become a popular tool in the geosciences for modelling complex landscapes on-demand. The high spatial and temporal resolution of UAV imagery enables topographic change-detection studies to be conducted at minimal cost across a range of spatial scales. In this study we used UAV imagery and SfM-MVS to quantify erosion rates across a 15.9-hectare agricultural field. Over the course of one year we spatially quantified the movement of 159.52 tonnes of sediment. Key aspects of UAV flight planning are addressed including: (1) ground control points, (2) image orientation, and (3) UAV flight planning.

Presenter(s) Benjamin Meinen

PhD Student

University of Waterloo

Benjamin Meinen is currently a PhD candidate at the University of Waterloo. He was awarded the most outstanding student for the Esri Canada Center of Excellence at the University in Waterloo in 2017. His PhD research focuses on measuring and modelling agricultural erosion with a specific focus on incorporating very-high resolution UAV datasets.

**15:50** *Improvement of Soil Texture Classification Using LiDAR Data*

Models predicting soil texture for the Abitibi River Forest region in the District of Cochrane in Ontario were created from environmental covariates generated from remotely-sensed data as soil formation factors. A novel approach of incorporating LiDAR (Light Detection and Ranging) retrievals for the entire study area to derive covariates of canopy height model (CHM) and gap fraction was investigated. CHM and gap fraction had high variable importance for the soil texture models fitted for the region, with CHM being the most important variable out of a set of 104 predictors, and gap fraction among the top predictors. Random forest and support vector machine approaches were utilized for the soil texture classification. The inclusion of CHM and gap fraction with other environmental predictors improved upon the accuracy of soil texture models, with accuracy scores exceeding 0.7 and Cohen's kappa greater than 0.5. Prediction maps for soil texture were generated for the study region.

Presenter(s) Rory Pittman

Graduate Student

York University

M.Sc. Student, Dept. of Earth and Space Science and Engineering, York University  
M.Sc. Applied Mathematics  
University of Alberta  
Edmonton, Alberta  
September 2009 - November 2012

**16:10** *Evaluating Vegetation Change in a Subarctic Catchment through Fusion of Remotely Sensed Data*

High-latitude ecosystems have experienced substantial warming over the past 40 years, causing an increase in vegetation growth throughout the circumpolar North. Changes in shrub and other vegetation properties are critical to document due to their first-order controls on water, energy and carbon balances. Understanding these changes is critical for predicting the future of northern watersheds under a rapidly changing climate. This work uses a combination of LiDAR, optical imagery, and field methods to measure temporal changes in vegetation properties over a well-studied subarctic mountain basin. Terrain indices are used for quantitative comparisons of vegetation change over different landscape positions. LiDAR-derived vegetation models of the study area show clear increases between 2007 and 2018 surveys. Results from this study will help: 1) quantify the rates of vegetation change in an alpine subarctic ecosystem, and 2) link these changes to ecotone and physiographic variables.

Presenter(s) Sean Leipe

MSc Student

McMaster University

I'm a 2nd year MSc student in the McMaster Watershed Hydrology Group, working under Dr. Sean Carey. My research focuses on using multi-temporal LiDAR and optical imagery to evaluate vegetation change in the Wolf Creek Research Basin, a well-studied subarctic mountain basin in the Yukon.

**13:10** *Home Range Analysis of Feral Swine in Oklahoma, USA*

Studying the movement of animals can shed light on many of their behaviours, such as territoriality, interactions and range formation. This research uses GPS collar tracking data to model the home ranges of 16 female feral swine from eight groups along the Oklahoma-Texas border. Home ranges are modelled from utilization distribution surfaces, which represent likelihood of animal occurrence based on least-cost path models applied to consecutive GPS fixes. Home range overlap methods are used to investigate concurrent space use between individuals and groups. Areas of overlap are compared with underlying landscape features derived from available topographic data. The results of this research will highlight landscape features associated with concurrent space use by feral swine, which can be used to better understand sounder dynamics, ultimately informing their management. Preliminary results indicate individuals remain in their groups, and occur most frequently in close proximity to water.

Presenter(s) Jack McIlraith

Student

Western University

Jack McIlraith is a master's student in the Western University Geospatial Analysis Lab, under the supervision of Dr. Jed Long. Jack's research is on the movement behaviour of feral swine, including group (sounder) assignment, territoriality and habitat analysis using GPS collar tracking data. Jack is interested in environmental modelling using GIS.

**13:30** *Spatial Interactions between White-Tailed Deer and Hunters in Love County, Okla.*

White-tailed deer (*Odocoileus virginianus*) are the most widely distributed game species in North America and hunting is key to managing populations. However, hunters also indirectly influence deer behavior, which may have implications on management success. Using a novel dataset containing simultaneous high-resolution GPS tracking data of 83 hunters and 37 White-tailed deer during the 2008 and 2009 hunting seasons, I identify encounters between hunters and deer to show how these encounters influence deer behaviour, flight response, and resource selection. The results highlight how deer alter movement in response to encounters with human hunters, but habitat and resource changes following encounters showed no real patterns.

Presenter(s) Rhiannon Kirton

MSc candidate student

University of Western Ontario

Rhiannon Kirton is an MSc candidate in Geography at The University of Western Ontario. She holds a BSc in Zoology from The University of Manchester, UK and has previously worked in ecology, wildlife management and conservation biology in BC, Montana and Australia.

**13:50** *Evaluating Potential for Salamander Reintroduction ~ Vernal Pools and Connectivity*

This project was developed for the Northumberland Land Trust (NLT) to assess and determine the suitability of the Laurie Lawson Education Centre property in Cobourg; for possible salamander introduction. Though there are many factors which might affect survival of salamanders in an established population (and that would affect the suitability of habitat for translocation of salamanders); connectivity and suitable ground or water conditions were of the highest priority. The substantial number of vernal pools on the property was the main reason for the Northumberland Land Trust's request for an assessment into the property's suitability. This project was completed as part of Trent's Community Based Research program. It has been a springboard for interest in utilizing GIS to locate other land for acquisition and help increase habitat connectivity and sustaining biodiversity. Further opportunities to increase use in planning for protecting areas that support endangered species.

Presenter(s) Sarah Bencic

Student

Trent University

Currently completing a post grad at Fleming College in GIS Cartography. Graduate of Trent University in Environmental Science and Biology. Experience in managing environmental dept. for power line construction & reforestation. When not at work or at school enjoys hiking with her dog Frederick, snow shoeing & curling up at home with a good book.

**11:10** *GIS-Based School Transportation Model for Swing Site in Vancouver*

Since 2016, the Vancouver School Board has been fast-tracking school seismic upgrades and replacements. Replacements require temporary accommodation of students to off-site 'swing' facilities. Case in point, the Killarney Secondary (largest high school in Vancouver) will be relocated to the Eric Hamber School site. Transportation options to/from the swing site become critical. Since the VSB does not have a school bus program, the City is concerned that a large number of parents may drive children to the 'swing' school. The VSB relies on available transportation options including, driving, transit, cycling, and walking. A GIS-based model was developed to estimate travel mode shares, based on student's location (point-data), travel times (Google), and accessibility to bus routes. A probable scenario identified 65% transit trips, followed by 34% vehicles, and 1% walking/cycling trips. Results also yield potential ridership uptake of key bus routes for transit planning purposes

Presenter(s) Andres Baez Transportation Planning Engineer Morrison Hershfield

Andres is a transportation consultant with MH. Civil Engineer with a Master in Urban Planning, and 14 years career in transportation and land development, with focus on multimodal solutions. He has led and participated in numerous school mobility plans, traffic and parking studies and related neighborhood mobility plans in Canada and overseas

May Panikom GIS Specialist Morrison Hershfield

Nattawadee (May) Panikom is a GISP certified with 12 years experience in GIS project management, data

**11:30** *Designing a Bus Bridging Tool for Team iCity*

Bus Bridging occurs when there are unforeseen disruptions to transit services, most commonly along rail lines. Buses are withdrawn from regular routes to service a disrupted segment. A majority of transit agencies use improvised strategies to solve this problem. This project presentation focuses on designing a tool that would aid in estimating the total user delay associated with specific bus bridging scenarios. Researchers at the Visual Analytics Lab were given the task of assessing and visualizing the features and benefits of an existing bus bridging tool designed by the iCity team at University of Toronto. This tool is designed to optimize bus bridging techniques and influence the design choice of bus bridging routes. We created this modelling tool with the use of the ArcGIS Operations Dashboard to handle geospatial data and statistics fluidly, and the prototype takes advantage of ArcGIS workflow in ArcGIS Pro, ArcGIS Online and the functionality of ArcGIS Operations Dashboard.

Presenter(s) Olufunbi Disu-Sule Research Assistant OCAD University

Olufunbi Disu-Sule is a research assistant in the Visual Analytics Lab at OCAD U and is currently completing his undergraduate work at Fanshawe College through the cooperative education program. He is working on both the iCity project, and the Canadian Urban Transit Research & Innovation Consortium (CUTRIC) projects.

Alaa Itani PhD Candidate

Alaa Itani, Dept. Of Civil Engineering, Master of Science, University of Toronto, Ontario. Her research at the



**14:15** *Using a Story Map as a Community Engagement Tool to Enhance Pollinator Conservation in Hamilton, Ont.*

Environment Hamilton and Hamilton Naturalists' Club have been working together on a Pollinator Paradise initiative aimed at providing habitat and resources for wild pollinators across Hamilton, ON. The main goal of this initiative is to increase the number of eco-conscious and biodiverse gardens across the city to support local biodiversity and native pollinators. This is in response to the significant declines in wild pollinator species demonstrated globally and the growing threat of habitat and connectivity loss for pollinator populations. This community-based program enables Hamilton residents to certify their pollinator gardens online and input relevant information used to verify their garden's pollinator friendliness. This information was used to create a story map that combines text, multimedia, and interactive functions to display several garden attributes in the hopes of educating and inspiring people about why pollinators are important and how citizens can support them.

Presenter(s) Briann Dorin Student York University

Briann Dorin is a graduate student at York University where she is studying pollinator conservation. Her research focuses on determining how agricultural management techniques affect native bee biodiversity and abundance. She has previously researched remote sensing applications in agriculture and lichen biodiversity conservation in urban parks.

**14:35** *The Impact of Spatial Scale: Exploring Urban Butterfly Abundance and Richness Patterns Using Multi-Criteria Decision Analysis and Principal Component Analysis*

Modelling changes in biodiversity has become a necessary component of smart urban planning practices. Complex concepts such as urban biodiversity are often evaluated using area-based composite indices, the results of which are heavily reliant on specific parameters chosen. In this presentation, we explore the design and implementation of a composite index to model spatial variation in urban butterfly populations across the City of Toronto, Canada. Using two widely accepted indexing techniques (i.e., principal component analysis and spatial multi-criteria decision analysis), this research examines the concept of spatial decision-making and statistical frameworks to model urban environmental conditions. We discuss the inherent trade-offs of both approaches, the impact of scale in urban environmental studies, and the use of area-based composite indices to manage spatial ecological data in general.

Presenter(s) Emily Hazell Student Ryerson University

Emily Hazell is a PhD candidate in the program of Environmental Applied Science & Management at Ryerson University. She holds a BA in Geography from Guelph University; and a MA in Spatial Analysis from Ryerson University. Her graduate work focuses on spatial decision support systems, with applications in urban and environmental planning.

**14:55** *The Impact of Urban Agriculture on Food Accessibility in the McQuesten Neighbourhood of Hamilton, Ontario*

Urban agriculture has been identified as a long-term sustainable alternative to traditional grocery stores in improving food access to vulnerable urban populations. McQuesten, an east-end neighbourhood in Hamilton, Ontario recently built an urban farm for this purpose. Research was conducted to understand how McQuesten's urban agriculture project impacted the residents' access to fresh food. Data from Statistics Canada, the City of Hamilton, DMTI, and Environics Analytics were used to generate Origin-Destination Cost Matrices and Service Areas to assess the physical accessibility of the farm to McQuesten residents when compared to nearby grocery stores. The farm was found to be far more accessible to residents than any other grocery store. It was also found to be the \*most\* accessible to parts of the neighbourhood with the lowest income brackets and where access to a grocery store was lowest.

Presenter(s) Nicole Langdon Student McMaster University

Nicole Langdon is a first-year geography master's student at McMaster University. The focus of her current research is centered around building time-space prisms with ArcGIS and Python to map and analyze the behaviour of carer-employees.

## South Dining Room Urban Land Use

### 15:30 *Implementation of an Enhanced Entropy Computation Algorithm for Measuring Urban Land Use Diversity*

Increasingly in urban transportation studies, land use diversity is being recognized as a significant built environment feature that impacts travel patterns. High levels of diversity provide multiple activity destinations within an easy access area which increase accessibility levels and positively impact land values. A diverse urban environment makes non-motorized transportation feasible, facilitates trip chaining and supports efficient public transit performance. This paper presents a novel method to compute the land use diversity index using an enhanced entropy approach. This method takes into account both positive and negative impacts of different land use types towards the overall diversity levels. Our model has been implemented as a GIS toolbox using Esri's ArcPy library. It provides an intuitive GUI, where users have the ability to set up model parameters. Using our method we analyzed Region of Waterloo land use data provided by Municipal Property Assessment Corporation (MPAC).

Presenter(s) Pedram Fard PhD Candidate University of Waterloo

Pedram Fard is a PhD Candidate at University of Waterloo, School of Planning. He graduated with an MSc in Geoinformatics from the University of Twente, The Netherlands, in 2013. Since 2014, Pedram has joined Waterloo Public Transportation Initiative (WPTI), where he studies land use impacts of investment in public transit in Waterloo Region.

### 15:50 *A 'Big Data' Textual Analysis of Transportation Infrastructure and Amenity Access in Qualitative Adjustments Residential Property Appraisals*

The benefits of transportation infrastructure increases residential property prices, while transport system externalities, may decrease property prices. The manifestation of transport accessibility on residential property markets is well established. However, the role of transportation in appraiser's more subjective assessments of neighbourhood quality is not well understood. This paper explores the role transportation plays in real estate appraisals through textual analysis of 80% of residential property appraisals in Canada from 2009 through 2019. Specifically, we examine the relationship between key words in used appraisers' qualitative comments—e.g. 'traffic,' 'access'—and qualitative adjustments the appraisers make when estimating property values for loan underwriting purposes. Our findings will help illuminate the extent to which appraiser's subjective judgments on the impact of transportation on neighbourhood quality adhere to modeled impacts derived from observed data.

Presenter(s) Matthew Palm Postdoctoral Research Fellow University of Toronto

### 16:10 *Spatio-Temporal Analysis of Housing Market Transactions in the Greater Toronto-Hamilton Area (GTHA): Predicting Land Use Classes*

Land use-transportation interactions, driven by economic development led travel demand, influence the location of firms and households, thereby playing a role in the distribution of land use and land values in a metropolitan region. This paper discusses the development of a comprehensive housing market database for longitudinal analysis of real estate transactions in the GTHA, which includes the collection and spatial manipulation of time-series urban data, computation of spatial measures of accessibility and neighborhood amenities, and merging of datasets through spatial joins. It further proposes a machine learning algorithm to classify land use based on the Teranet property sales dataset spanning 1986-2017, since none of the available land use data sources cover the complete time period. The attributes engineered from the housing market dynamics have a strong predictive accuracy in classifying land use at the parcel level, when combined with socio-economic and urban form variables.

Presenter(s) Stepan Oskin Student University of Toronto - St. George

Master of Applied Science in Civil and Mineral Engineering, University of Toronto.

Shivani Raghav Researcher University of Toronto - St. George

Masters of Engineering in Cities Engineering and Management student and researcher, University of Toronto





## East Common Room Workshop

### 10:05 *Enhancing Geostatistical Analyses with the R-ArcGIS Bridge*

This workshop will introduce the R-bridge for ArcGIS, a tool that enables you to integrate the advanced data science and statistical capabilities of the open source R project with the geospatial analysis and visualization capabilities of the ArcGIS platform. The learning outcomes of this workshop are to achieve a basic understanding of writing programs in the R statistical environment, how to read, write, and use ArcGIS vector and raster geospatial datasets for analysis in R scripts, and how to integrate R analysis tools seamlessly within geoprocessing workflows and visualize analysis outputs in ArcGIS Pro.

Presenter(s) Dr. Mike Leahy Higher Education Developer / Ana Esri Canada

### 10:05 *Designing User Interfaces for Geospatial Applications*

Providing user-friendly interfaces in your applications is crucial for increasing task completion and user satisfaction. This can be particularly important for geospatial applications, as these may include a high degree of complexity or may be used by the public or non-GIS professionals. This workshop will discuss the factors involved in designing highly usable interfaces, as well as how these relate specifically to geospatial applications. You will learn how to create interface wireframes and prototypes as part of a design process, as well as how to test these with users to determine an interface's effectiveness prior to implementation.

Presenter(s) Jonathan Van Dusen Higher Education Developer/Anal Esri Canada

### 10:05 *Animating CityEngine Models with the Unity Game Engine*

This workshop will demonstrate how to import a procedurally generated CityEngine model into the Unity game engine for further visualization and simulation. The sample model we will use is the futuristic city from the 2017 Education and Research Conference's CityEngine workshop. Once the model is imported into Unity, participants will learn how to apply lighting to the scene, add animated vehicles between buildings, and control the movement of the viewing camera to create an interactive fly through.

Presenter(s) Michael Luubert Developer - Desktop/Web Esri Canada

### 13:10 *Applied Deep Learning in ArcGIS Pro & Python*

In narrow artificial intelligence, deep learning (DL) is a specialized subset of machine learning that "emulates" the way humans learn on a daily basis. What you will learn in this workshop is how to: a) clone your ArcGIS Pro Python environment, install fast.ai, and script in Jupyter Notebooks; b) identify what tools exist for implementing DL in ArcGIS Pro and Python, and; c) use one of the DL methods, Single Shot Detector (SSD). Available in the ArcGIS API for Python, SSD is a DL method to detect specific objects in high resolution satellite imagery / live cameras. Additionally, Keras/TensorFlow will be used to create customized SSD models and be implemented in ArcGIS Pro.

Presenter(s) Dr. Tasos Dardas Higher Education Developer/Anal Esri Canada

### 13:10 *Building Android Apps for Smartphones and Tablets*

The ArcGIS Runtime SDK for Android allows you to build interactive smartphone and tablet mapping applications quickly and easily. This workshop teaches you how to build your own mapping applications in Android Studio using the ArcGIS Runtime SDK for Android.

Presenter(s) Dr. Hossein Hosseini Higher Education Developer/Anal Esri Canada

### 13:10 *Bringing GIS Analysis to Life using Python Notebooks*

This workshop will introduce how to use Python Notebooks, a tool that has become vital to the Python and Data Science communities, to enhance your workflows for GIS data management, analysis, and visualization. The learning outcome of this workshop is to gain an understanding of the basics for working with Python Notebooks to describe/document workflows, execute Python code, and visualize data and analysis outputs, with a focus on integrating with more advanced geospatial capabilities of ArcGIS Pro and ArcGIS Online via arcpy and arcgis Python modules.

Presenter(s) Dr. Mike Leahy Higher Education Developer / Ana Esri Canada

**13:10** *Designing Urban Futures*

ArcGIS Urban is Esri's newest solution to assist in 3D urban planning and public engagement. This interactive workshop will focus on urban design and visualization using ArcGIS Urban and CityEngine. Attendees will learn about and test out various ways to implement and create design parameters, visual indicators and zoning guidelines in the ArcGIS Urban environment. Workflows between CityEngine and ArcGIS Urban will also be demonstrated to explain how building features can be updated, and additional building details can be added to urban scenarios.

Presenter(s) David Kossowky

GeoDesign Specialist

Esri Canada

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