2017 GIS in Education and Research Conference

October 11, 2017

Hart House, University of Toronto

Contents

Geodesign

3D Visualization Plan for the City of Mississauga

Czajka, Steve
Planning and Building, City of Mississauga

Our city is not only growing outwards, but is predominantly growing upwards. The 3D Visualization Plan for the City of Mississauga outlines the data and service offerings for our Planning and Building Department. Our clients will be able to understand the services we plan to offer, while appreciating that this is a long term plan that we will work towards. We will demonstrate key products and services that are currently offered and planned to be offered to staff and the public alike.

Biography:

GIS/IT Professional with over 20 years experience in management, consulting, and development of leading edge ESRI based business solutions. Recognized for vision, innovation, creativity, enthusiasm, team motivation and a client focused approach. Manager of the Data + Visualisation Studio within the Planning and Building Department. The unit is responsible for the management of statistical geospatial data. This data and analysis includes: population, demographics, census, development monitoring/activity, growth forecasts, housing, employment survey, office, land use, vacant lands, and environmental data. The results of our analysis are posted on our Open Data Portal mississauga.ca/data.

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Proceedings: PDF and video

Using Geodesign To Commuicate the Effects of Bioswales on Urban Stormwater Management

Pierre, Adele
Landscape Architecture, University of Guelph

With increases in storm frequency and intensity, municipalities need to find new ways of managing stormwater. Solutions require collaboration across planning disciplines and input from an informed public. This study compares a system of bioswales to existing curb and gutter infrastructure in a post-industrial streetscape of Hamilton, Ontario. Using the geodesign process, a section of Ottawa St. North was modelled to show how green infrastructure can ease the burden on aging, combined sewer systems. Qualitative data was gathered from residents of the neighbourhood through field notes, and quantitative geospatial data through GIS. Parametric modelling was used to generate a design, and scenarios created to show resulting impacts on stormwater runoff. The model was posted online as an interactive presentation, accessible to all stakeholders for review and comment. The results of the study demonstrate powerful new tools that can assist landscape architects in designing, collaborating and communicating stormwater strategies. Keywords: green infrastructure, combined sewers, surface hydrology, rainwater, Low Impact Development, GIS

Biography:

Adele Pierre completed a Masters of Landscape Architecture degree from the University of Guelph in 2017, returning to studies after a rewarding career as a violinist. Working in Toronto and surrounding municipalities, she became concerned with the lack of green space in downtown areas, and the impact of the urban setting both on people and the environment. Her research uses the geodesign process and geospatial tools to design street side bioswales for a postindustrial neighbourhood in Hamilton, Ontario. As a facilitator for urban projects she has used geodesign principles to bring together multiple stakeholders; residents, landscape contractors and affiliated professionals in the design and implementation of community building initiatives. Adele Pierre is a 2017 University Olmsted Scholar.

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Proceedings: PDF

Optimizing Building Designs based on Spatial Analysis

Berseth, Glen[1]; Khayatkhoei, Mahyar[2]; Usman, Muhammad[3]; Haworth, Brandon[3]; Kapadia, Mubbasir[2]; Faloutsos, Petros[3]
[1]Computer Science, University of British Columbia; [2]Computer Science, Rutgers University; [3]Electrical Engineering and Computer Science, York University

The layout of a building and the placement of architectural elements within a building have great impact on a wide variety of potentially competing objectives, such as space utilization, accessibility, visibility of certain areas, and safety regulations. An architect must balance these objectives, while at the same time exercising artistic and creative control. A number of computer-aided design tools use automation to provide useful analytical data and optimal designs with respect to certain fitness criteria. However, this automation can come at the expense of a designer's creative control. We introduce µDOME, an interactive computer-aided system that balances automation and control by efficiently exploring, analyzing, and filtering the space of environment layouts to better inform an architect's decision-making. µDOME uses three spatial measures defined by Space Syntax (Bafna 2003), a framework and infrastructure to analyze the relationship between human utilization and spatial forms of environments. The fundamental principle of Space-Syntax is that use of space can be analysed by examining the environment configuration. These spatial measures, in general terms, capture the way people interact with an environment by quantifying the visibility, accessibility, and organization of the space. At each design iteration, µDOME provides a set of diverse designs which satisfy user-defined constraints and optimality criteria. The user then selects a design and performs a similar optimization with the same or different parameters and objectives. This exploration process can be repeated as many times as the designer wishes. We have integrated µDOME within professional CAD pipelines for demonstration and evaluation purposes.

Biographies:

Glen Berseth is a PhD student in the Department of Computer Science at the University of British Columbia. He received the BSc degree in Computer Science from York University in 2012 and his MSc from York University under

the supervision of Petros Faloutsos in 2014. His research interests include robotics, reinforcement learning, machine learning, character animation, crowd simulation and cognitive agents.

Mahyar Khayatkhoei is a PhD student in the Department of Computer Science at Rutgers University. He received his BSc degree in Electrical Engineering-Control Systems from University of Tehran in 2015. His research interests include machine learning, visual semantics learning, intelligent systems and optimization.

Muhammad Usman is a PhD candidate in the Department of Electrical Engineering and Computer Science at York University. He received his MSc degree in Computer Science from York University in 2016 and his BSc degree in Computer Science from University of the Punjab in 2013. His research interests include Crowd Simulation, Crowd Steering Behavior, Design Architecture Analysis in Virtual Reality, and Assistive Technologies.

Brandon Haworth is a PhD student in the Department of Electrical Engineering and Computer Science at York University. He received the BSc degree in Computer Science from York University in 2013, and MSc in 2016. His research interests include crowd steering behaviours, architectural optimization, assistive technologies, rehabilitative technologies, digital game design, serious games, and articulator kinematics.

Mubbasir Kapadia is an Assistant Professor in the Computer Science Department at Rutgers University. Previously, he was an Associate Research Scientist at Disney Research Zurich. Kapadia's research aims to develop integrated solutions for full-body character animation, planning based control, behavior authoring, and statistical analysis of autonomous virtual human simulations.

Petros Faloutsos is a Professor at the Department of Electrical Engineering and Computer Science at York University, and an affiliate Scientist at the Toronto Rehabilitation Institute. Before joining York, he was a faculty member at the Computer Science Department at the University of California at Los Angeles, where in 2002 he founded the first computer graphics lab at UCLA. Faloutsos received his PhD degree (2002) and his MSc degree in Computer Science from the University of Toronto, Canada and his BEng degree in Electrical Engineering from the National Technical University of Athens, Greece.

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Proceedings: PPTX

Facilities Planning and Management with BIM and GIS at York University

Saavedra, Patrick; McCleary, Rhonda
Planning & Renovations, York University

York University is the third largest University in Canada as has two campuses covering over 540 acres of land and 104 buildings in Toronto. As the University continues to grow and develop, Facilities Planning and Asset Management is more important than ever. With the use of BIM (Building Information Modelling) and GIS, York is harnessing technology to ensure better campus design and planning decisions; to maximize efficiencies during all phases of design and construction; and to create efficiencies in operations and reduced maintenance costs. The current technological environment utilizes a variety of software and databases for CAFM, BIM, Asset Management and GIS, however as we continue to generate increasing volumes of data, the need for system integration and enhanced visualization of data is driving York towards the ultimate goal of a comprehensive virtual campus for

Facilities Management. In this presentation, we will discuss the benefits of utilizing BIM and GIS, the steps York has taken during implementation of these technologies as well as challenges faced with integration.

Biographies:

Patrick Saavedra is York University's architect and the Director of Planning, Architecture and Renovations in Campus Services and Business Operations (CSBO). Patrick has been with York for 8 years directing a team at CSBO, overseeing from 150 to 200 renewal projects annually and providing advice on design and architecture for major capital projects. He has been instrumental in leading York University's drive to embrace leading edge building information modelling tools. He has 26 years professional experience as an architect, a planner and an educator and is licensed to practice both in Canada and the United States.

Rhonda McCleary is York University's Space Information and Planning Systems Coordinator. Rhonda has over 10 years' experience in Computer Aided Facilities Management gained from working with large organizations such as Shaw Communications and The Regional Municipality of York. Since joining York University just over a year ago, she has worked closely with Patrick advancing the use of CAFM, BIM and GIS at technology at CSBO.

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Proceedings: PPTX

Applications of 3D Printing in Education and Geospatial Decision Support

Rinner, Claus; Oswald, Claire
Geography and Environmental Studies, Ryerson University

Over the last 2-3 years, a few scholars in the geosciences and others in the field of rapid prototyping have started reporting on geospatial applications of 3D printing. Some 3D printing companies now include geospatial applications in their online product galleries. Nevertheless, these applications are still scarce and are met with a great deal of interest and curiosity. In our ongoing research, we distinguish two types of outputs with different approaches to data processing: landscapes and cityscapes. Using digital elevation models, we created numerous terrain models of the Toronto region. In general, these models require significant exaggeration of the vertical dimension, often by a factor of 10 or greater, in order to be appealing and understandable to a broad audience. Based on building footprints and heights, we also created several models of City of Toronto neighbourhoods and the City of Barrie downtown area. We have also combined the two realms by placing buildings on top of terrain.

The initial motivation for this research was to explore serious professional applications of 3D printing and specifically to examine its use in education about urban hydrology. In a classroom module on urban water a group of undergraduate students included a 3D model of the Don River watershed in Toronto to explain to middle and high school students where the water flows and why upstream areas require specific protections. We also created a model of the Oak Ridges Moraine which is used for environmental teachers education. Another model of the Toronto region was presented at ScienceRendezvous in conjunction with a rainfall simulator created by colleagues in civil engineering. We have received positive feedback from numerous community partners about the use of 3D-printed

geospatial models in their education planning and decision-making activities. For example both Toronto and Barrie planning departments are exploring the use of 3D-printed and other physical models for neighbourhood and lakefront planning purposes including in internal and public meetings. Toronto Region Conservation Authority and Central Lake Ontario Conservation Authority both received 3D-printed puzzles of their (sub)watershed terrain for public outreach. And the Downtown-Yonge Business Improvement Area in Toronto uses a 3D-printed cityscape of the Yonge Street corridor to illustrate their jurisdiction and ongoing development projects to their stakeholders and community partners.

In this presentation we will outline the process of turning GIS data into 3D-printable files and demonstrate select applications. While the ability to physically interact with the models seems to excite everyone we observed that some individuals prefer the landscape models while others are more receptive to the city models. Beyond this divide the potential of geospatial applications of 3D printing across various fields of interest seems great and largely untapped.

Biographies:

Dr. Claus Rinner is Professor and Chair @RyersonGeo. He holds a Bachelor's degree in Mathématiques appliquées et sciences sociales from Université Paul-Valéry Montpellier 3, France, a Master's degree in Applied Systems Science from the University of Osnabrück, Germany, and a PhD in Geography from the University of Bonn, Germany. His research expertise includes geovisualization, participatory GIS, and spatial decision support. Recently, he also became interested in open geospatial data and 3D printing. Dr. Rinner is the author of 30 peer-reviewed journal articles and other widely cited publications within Geographic Information Science. He is also deeply engaged in promoting the discipline of Geography and teaching and supervising undergraduate and graduate students.

Dr. Claire Oswald is an Assistant Professor in the Department of Geography and Environmental Studies at Ryerson University. She graduated with an Honours BSc and an MSc from McMaster University and a PhD from the University of Toronto. Her expertise links watershed-scale hydrological and biogeochemical processes to better understand the controls on pollutant mobility through soils and waterways. She incorporates spatial analysis methods into this work through the use of geographic information systems (GIS). Dr. Oswald has extensive experience leading and integrating field-, laboratory-, and GIS-based research and supervising graduate students. Her peer-reviewed publications have appeared in top journals such as Environmental Science & Technology and Water Resources Research and she has presented her research at numerous conferences, workshops and invited talks.

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Proceedings: PPTX

Developing Esri-Based Mixed and Augmented Reality Applications for Microsoft Hololens

Asgary, Ali
Disaster and Emergency Management, York University

Augmented reality (AR) and mixed reality (MR) have demonstrated successful applications and specialized niches in a number of sectors, including manufacturing and construction, transportation and entertainment, defense, education, public health and medicine. Map-based applications are among the

growing application areas of AR and MR. Esri solutions such as city engine are being used in AR and MR applications and can have significant uses for Microsoft HoloLens applications. Microsoft HoloLens is the first fully self-contained, holographic computer, enabling users to interact with high definition holograms that are very much different from the existing AR and MR technologies. According to Microsoft, HoloLens results are the best mixed-reality experience to date by a standalone, untethered device. This presentation demonstrates some of the emerging HoloLens applications in public safety, and disaster and emergency management fields using Esri mapping and 3D visualization products and tools. Participants will learn how Esri products and tools can be used to develop AR and MR applications for Microsoft HoloLens using some of the applications that are being developed at York University's HoloDisaster Lab.

Biography:

Ali Asgary is an Associate Professor of Disaster and Emergency Management in York University's Disaster and Emergency Management program. He is a Principal Investigator and Program Lead for York University's ADERSIM program. He is an expert in disaster, emergency, and business continuity management. His extensive research and effective teaching are enhanced by his active contributions to the profession and by translating them into real world practices at different levels. His research has been funded by SSHRC, NSERC (Real-time oil spill detection using Laser-Induced Fluorescence LIDAR, Internet-based Temporal-GIS, and Mobile Emergency Asset Management; Advanced Disaster, Emergency and Rapid Response Simulation), GEOIDE (REAL-TIME MULTI-CRITERIA SPATIAL DECISION SUPPORT SYSTEMS: IMPROVING FIRE RESPONSE IN CANADIAN COMMUNITIES), PreCarN (Development of a Rule-Based Structural Fire Threat Assessment System for Canadian Fire Departments, Co-investigator), AIF, YUFA, etc. He is the author or co-author of numerous scholarly and practitioner articles in fire incident analysis using, and his fire related papers have been extensively cited and referenced by other researchers. Dr. Asgary has received various awards for his research, teaching and other contributions, including the International Association of Emergency Management Award and the outstanding paper of the year award by the Journal of Disaster Prevention and Management. He obtained his PhD in Urban & Regional Planning at University of Newcastle upon Tyne in England. He was one of the faculty members who established the disaster and emergency management discipline in Canadian universities, including York University and Brandon University. Dr. Asgary has been working with Hololens since its first release and has written and presented his works at the Bulletin of International Association of Emergency Managers and the UN Conference on Disaster Risk Reduction Ignite Stage.

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Single View 3D Manhattan Lines Reconstruction using Linear Perspective

Qian, Yiming; Elder, James
Electrical Engineering and Computer Science, York University

Humans are capable of estimating depth with monocular vision with linear perspective cues. Inspired by the human visual system, we propose a novel method to reconstruct a 3D façade model from a single image, using vanishing points, linear perspective, computational geometry, and a probabilistic optimization that arranging the surfaces extracted from our algorithm in 3D space. We first detect the Manhattan line segments in the image and classify them into three categories (x, y, z). The junction

point that two lines from different category interests at defines a plane in one of (xy, yz, xz) three directions. In our work, junctions in the image are found by applying the Hungarian algorithm to connect lines of different category. The cost function between two lines is the Euclidian distance of two closest end nodes. The intersecting point of two connected lines is a junction point. At this stage, we can obtain a graph with junction point as vertices and line segments as edges. A minimal spanning forest(MSF) algorithm is applied on to this graph structure to extract a collection of small graph structures. Each small graph structure defines a façade model lines in 2D, we then apply a linear perspective algorithm to project it into a 3D façade model at random scales. Finally, we deploy a Markov Chain Monte Carlo (MCMC) algorithm to find the optimal arrangement to combine the collection of small graph structures into one unified 3D façade model.

Biographies:

Yiming Qian is currently a Ph.D. student in Computer Science at York University, Canada specialized in texture classification, deep learning and statistical machine learning. He received his both Bachelor degree (Power Engineering) and Master degree (Electrical Engineering) from Ryerson University, Canada. Prior to his Ph.D study, from 2012 to 2015, he was a licensed R&D Engineer (P.ENG) in Siemens Energy Management high voltage instrumental transformer lab (Canada) specialized in electromagnetic field modelling, power system analysis and manufacturing process optimization. From 2011 – 2014, he was a part-time digital colour specialist in an industry printing technology startup – ColorXTC Inc specialized in colour theory and printing.

James H. Elder received the BASc degree in electrical engineering from the University of British Columbia in 1987 and the PhD degree in electrical engineering from McGill University in 1995. From 1995 to 1996, he was with NEC Research Institute in Princeton, New Jersey. He joined the faculty of York University, Canada, in 1996, where he is presently a full professor. His research interests include computer and human vision. Recent work has focused on natural scene statistics, perceptual organization, contour processing, attentive vision systems, and face detection. He is a member of the IEEE.

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Open Spatial Data

High-Quality 3D Representation of the Toronto Waterfront

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This paper presents the workflow and outcome of the development of a high-quality 3D representation of Toronto's Waterfront (i.e., Queen St to the shoreline, and Shaw St in the west to the Don River in the east). The intention of this model is to provide contextualized data and associated information for the visualization not only of the built form but also of transportation and transit demand and use in the present and projected into the future. In general, the project will produce a digital laboratory in the form of a 3D model that will allow politicians, city planners, developers, and members of the public, to experiment with and visualize proposed changes to the waterfront. The research forms part of the ongoing iCity/Urban Informatics for Sustainable Metropolitan Growth" translational research undertaken at the Ontario College of Art and Design University (OCADU) and the University of Toronto's Transportation Research Institute (UTTRI) with technical support from Esri Canada and oversight from Waterfront Toronto. The modeling work uses Esri's CityEngine software and incorporates aspects of David Wasserman's Complete Street ruleset supplemented with custom rules and methods. Data sources for this model's development include the city of Toronto's open data portal Esri's community map of Canada on-site data gathering

Biography:

Michael Carnevale received his M.A. in Psychology (Brain, Behaviour, & Cognitive Science) from York University and an MDes in Digital Design from OCAD University. In the final year of Michael's master's program at OCAD U he was awarded a MITACs grant to work with ESRI Canada to develop a high-quality 3D representation of Toronto's Waterfront region. This model will be used as part of the multi-stakeholder (i.e., city of Toronto, university partners, industrial partners, etc.) iCity project to provide visualization support for re-development projects, transit simulation, and policy decision-making. Michael's research interests include multisensory perception, human-computer interaction, and the arts.

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Proceedings: PDF

Detecting Depth Edges in Spherical Imagery with LiDAR Ground Truth

Ehinger, Krista[1] A.; Adams, Wendy[2] J.; Graf, Erich[2] W.; Elder, James[1] H.
[1]Centre for Vision Research, York University; [2]Psychology, University of Southampton

Edge detection is an important early step in many computer vision models. However, edges are produced by multiple causes, including changes in 3D surface depth or orientation, as well as changes in surface illumination or reflectance. Distinguishing edges caused by a change in depth from other types of edges is important for object segmentation and 3D scene reconstruction. We use the Southampton-York Natural Scenes (SYNS) 3D dataset to build a ground-truth dataset for depth edge classification. This

dataset consists of spherical HDR imagery and LiDAR range data for a variety of outdoor locations. We use a standard computer vision edge detector to identify visible luminance edges in the HDR images and depth edges in the LiDAR range map. We build a probabilistic model to associate the image edges with depth edges, which allows us to correct for small alignment errors between the two imaging systems. We compare various computational models for classifying depth from non-depth edges in small images patches and achieve the best performance (86%) with a convolutional neural network classifying 32 x 32 pixel image patches. We find that performance increases with patch size and depends on both color and edge orientation information. However, a network without color or orientation cues can achieve an accuracy of 78%, probably by using texture, junction, and/or shape cues.

Biography:

Krista A. Ehinger is a VISTA postdoctoral fellow in the Centre for Vision Research at York University, where she works with James Elder on human perception and computer vision models of depth in natural images. She received her Ph.D. from the Massachusetts Institute of Technology, where she studied scene perception. She previously worked as a postdoc at Harvard Medical School, where she studied human perception of shape and decision-making processes in visual search tasks.

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Proceedings: PPTX

Open Geospatial Data: Evolving from Portal to Program

Johnson, Peter A.
Geography and Environmental Management, University of Waterloo

Despite the general enthusiasm for the expansion of government open data programs across North America, many programs continue to exist largely as a static repository of data. This situation demonstrates the challenge government faces with not only launching an open data sharing platform, but maintaining, growing, and integrating open data into government functioning and processes. This presentation addresses these challenges facing municipal open data programs as they mature purposefully, stall, or possibly decline. Drawing on recent interviews with several Canadian municipal governments facing this transition, strategies are identified to better bridge open data with specific functions and goals of open government. Key amongst these is the development or adoption of open government polices that demand or inspire action from all parts of government for their realization, and the application of more accessible technologies to leverage open data across user groups and types.

Biography:

Peter Johnson is an Associate Professor in the Department of Geography and Environmental Management at the University of Waterloo. His research evaluates the affordances that geospatial technology creates for communications and information sharing, identifying emergent adoption challenges and constraints.

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Open Data and Canadian Rural Communities

Parfitt, Ian
Selkirk Geospatial Research Centre, Selkirk College

Most open data in Canada is created and provided by national, provincial, or big city agencies, and research into development and use of open data in Canada generally assumes an national, provincial or urban focus. There is almost a complete gap of Canadian rural open data research in the literature. In 2016 the SGRC secured a Social Sciences and Humanities Research Council (SSHRC) of Canada grant to explore "Open Data for Open Government in Rural BC" in collaboration with Columbia Basin Rural Development Institute (RDI), the Regional District of Central Kootenay (RDCK), the Open Data Society of BC, Open North, Urban Opus, University of British Columbia- Okanagan (UBC-O), McGill University and Esri Canada. We are investigating the dimensions of rural open data with respect to open data typologies, providers, users, roles, sources, resources, and governance. This presentation will provide an overview of the project goals and objectives and then discuss project status after one year. In particular, some key differences between data created and used by governments in a rural context versus data generated in urban settings will be described. Challenges for rural open data provision and use, including agency capacity and cost, will also be highlighted, as well as some possible solutions.

Biography:

Ian joined Selkirk College as a GIS Instructor in 2002. His background is in conservation GIS including work for the Long Beach Model Forest on Vancouver Island and for the Fish & Wildlife Compensation Program in Nelson. In 2010 Ian became coordinator of the Selkirk Geospatial Research Centre (SGRC), a leading geomatics applied research unit in the Canadian college system. Ian has led the development of the centre's research infrastructure and capacity in internet mapping and unmanned aerial systems. He is also an instructor in the Advanced Diploma in GIS and Bachelors Degree in GIS programs at Selkirk.

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Proceedings: PPTX

City of Toronto Open Data Overview

McGhie, Andy
City of Toronto

The Open Data Program at the City of Toronto was launched in 2009 and is delivered through the partnership of the City Clerks Office, the Information and Technology Division and the many business units who contribute to the data catalogue. To ensure efficient service delivery and to capitalize synergies and city resources the Open Data team within the Information and Technology Division now reports to the Geospatial Competency Centre (GCC). An overview of the past, current and planned activities of the Open Data Program will be outlined as they relate to the themes of Open Government, addressing civic issues and co-development and input from the Community. In recognition of the

importance of accessible, current, and trustworthy information to support decision making and solving civic issues opportunities and challenges will also be outlined. A brief overview of work in progress for the "Beta Open Data Portal" and the "Open Data Master Plan and Implementation Roadmap" will be discussed.

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The Brampton GeoHub: Moving Beyond Data Downloads

Pietryszyn, Matthew; Commeford, Adam
City of Brampton

Brampton built a hub for the City's Open Data and made it available to Staff, Citizens, Businesses and Students. The hub makes discovering and using the City's data more purposeful and promotes transparency, fostering innovation everywhere. The City leveraged ArcGIS Open Data to transform the Portal into a community hub, effectively increasing the usage of Open Data, Geospatial Tools while enhancing engagement. Learn how to access Brampton's Open Data, and how to put it to work using the City's GeoHub.

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Transit / Transportation

Conscious Commuter

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[1]Geography and Earth Sciences, McMaster University; [2]Geography & Planning, University of Toronto

From our app challenge 2017, Conscious Commuter is a web application that allows intra-city commuters within the city of Toronto to explore how their daily commute can have a large impact over time. Work-Commuting, the process of driving a vehicle (often containing a single occupant) is a primary contributor to congestion issues and pollutant release in major urban centers such as Toronto. Often times, the distance of a typical intra-city commute is well within the bike-able range yet this option is frequently ignored as the detrimental effects of a short work commute are thought of as being insignificant. This application provides users the opportunity to quantify the cumulative effects of their daily work commute over weekly and annual time scales It is hoped that quantifying these effects will empower users to investigate alternative methods of commuting. In doing so, the app provides the opportunity to explore comparative statistics that would be achieved if the same route was undertaken by bike instead of car. By demonstrating the financial, health, and environmental benefits of choosing to bike to work instead of driving. The application hopes to empower Torontonians to make sustainable commute choices. The Application consists of two primary components: Shiny web application framework (written in R) and an Esri ArcGIS Online Cascading Story Map.

Biographies:

Anastassios is currently a 3rd year PhD student at McMaster University, specializing in spatio-temporal health geography. He believes that by integrating the disciplines of GIS and data science together can develop more effective decision-making process and predictions. During his free time, he enjoys hiking, playing ultimate frisbee, coaching crew, hanging out with friends, and doing Tough Mudder.

Karl is a 1st year master's student in Geography & Planning at University of Toronto. He's interested in using GIS for the environment, health and planning as well as data visualization. In his spare time he enjoys home brewing, disk golf, and gardening.

Spencer is a 1st year master's student in Geography & Planning at University of Toronto. His main interests lie in data visualization and GIS for Urban Planning. In addition to his GIS interests, he is interested in mountain biking, hiking and historical cartography.

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Proceedings: PDF

Transit Big Data: Analysis and Visualization

Jadidi, Mojgan; Karon, Josh
Earth & Space Science & Engineering, York University

Intelligent transit has become a priority for many transit agencies. Recent advancement in data collection (Autonomous Vehicle Location or AVL data) enables agencies such as GO Transit to constantly collect data, which includes information about location, velocity, delay, and ridership. Informed decision-making requires a clear picture of geospatial data via visualizations. The main objective of this project is to make transit data valuable by examining key transit indicators through aggregation and visualization. The volume and variety of AVL data present challenges that are characteristic of Big Data applications. For example, GO collects data on each bus every second, therefore one day of operation results in over 8 million data points. Analyzing and visualizing this amount of data is not possible using traditional GIS methods. To overcome this issue, the AVL data was stored in a relational database, making the data accessible via SQL queries. As a preliminary outcome, time series plots of ridership were created in order to understand ridership patterns. Next, software was developed using Datashader open source software, to aggregate and visualize the data in terms of location. An interactive and user-friendly dashboard was developed to make the software accessible to the end user. This dashboard can be deployed by transit planners to examine variations in ridership, bus velocity, and schedule delay across the Toronto area. Additionally, an interface was developed that allows the comparison of transit variables across different time periods. The preliminary results and demo of the visualization system will be presented.

Biographies:

Dr Mojgan Jadidi, PEng PhD, is assistant lecturer in Geomatics Eng/Sce program at Department of Earth and Space Science and Engineering, Lassonde School of Engineering at York University. She is co-director of Esri Canada Centre of Excellence at YorkU. She is an active member of ISPRS Commission IV- WG IV/2: Ontologies, Semantics, and Knowledge Representation for Geospatial Information. Her main research interest is Geospatial Big Data Modelling and Visualization, BIM and 3D GIS Integration, Spatial Graph and Spatial Online Analytical Processing (SOLAP), Geospatial Knowledge discovery and Data Analytics, 3D Web Mapping.

Josh Karon is a forth year student of Geomatics Engineering at York University and is assisting Dr. Jadidi on the GO Transit project.

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Proceedings: PDF

An Implementation of Intelligent Transportation Systems of Systems using ArcGIS Enterprise

Elshenawy, Mohamed; El-Darieby, Mohamed; Abdulhai, Baher
Civil Engineering, University of Toronto

The influence of information and communication technologies (ICT) on improving the efficiency and effectiveness of city operations has increased significantly within the past few years. The dramatically

increasing rates of urbanization and the need for more innovative and integrated approaches to managing transportation resources have resulted in several intelligent transportation applications that provide a wide variety of monitoring and management capabilities. A contemporary challenge in large metropolitan areas is to amalgamate segregated intelligent transportation applications into an integrated intelligent transportation system of systems (ITSoS) capable of managing the ever-increasing transportation needs more efficiently. Comprehensive ITS operations in larger metropolises often need to cross the organizational boundaries where business processes enacted by different organizations may interact. In this presentation, we demonstrate how ArcGIS Enterprise tools can achieve such integration by facilitating the creation and management of transportation information. The implementation is based on a three-pillar framework that enables semantic interoperability amongst interacting intelligent transportation components and allows transportation stakeholders to create integrated applications seamlessly and transparently.

Biography:

Mohamed Elshenawy is a postdoctoral fellow at the Faculty of Engineering – University of Toronto. He received his PhD degree in Civil Engineering from the University of Toronto. His research focuses on using of advanced computing and communication technologies to improve the efficiency and sustainability of urban areas. He is a member of the IEEE Intelligent Transportation Systems Society and the IEEE Computer Society.

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Proceedings: PPTX

Road Segmentation based on the Combination of Geometry and Appearance

Cheng, Gong; Qian, Yiming; Elder, James
Electrical Engineering and Computer Science, York University

We propose a novel road segmentation method based on the fusion of geometric and appearance cues. Modeling colour cues using Gaussian mixtures allows the fusion to be performed optimally within a Bayesian framework, avoiding ad hoc weights. To make the proposed method adapt to varying scene conditions, we apply the nearest-neighbour appearance model selection over a mixture model dictionary learnt from the training data. Moreover, the problem of deciding the number of mixture components in each mixture model is solved by a novel cross-validation approach. Quantitative evaluation shows that the proposed road segmentation method significantly improves segmentation accuracy compared with a state-of-the-art road segmentation method which uses geometric cues alone.

Biography:

Gong Cheng is a Ph.D. student from Department of Electrical Engineering and Computer Science, York University. He is supervised by Professor James Elder. His research interest involves Computer Vision, Machine Learning (especially, Deep Learning), and Image Processing. He is currently working on the computer vision-based traffic analysis.

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Proceedings: PPTX

Temporal Assessment of Critical Road Links in Hamilton, Ontario

Brown, Matthew
School of Geography and Earth Science, McMaster University

Traditional road planning efforts have relied on techniques to identify highly congested or critical links in a transportation network that provide localized solutions. In a 2006 paper by Scott et al., the Network Robustness Index was presented, which considers system-wide impacts. This measure was demonstrated to identify critical links in a network that provide greater system-wide benefits in travel-time savings compared to traditional localized measures. This paper explores an alternative application of this index by using it to quantitatively compare the benefits and detriments to travel-time savings in a real-life road network before and after major highway developments. Using a topologically-corrected road network for Hamilton, Ontario and origin-destination matrices from years before and after the creation of the Lincoln M. Alexander and Red Hill Valley Parkways, the Network Robustness Index was used to evaluate changes in critical links. The criticality of road segments was found to increase over time, in relation to rising populations and changing worker distributions. Roads which became replaced by superior transportation solutions saw decreases in road criticality. The Network Robustness Index was also used to model the effects of highway removal on the network. Changes in roadway criticality over time by municipality were also assessed. Furthermore, the population distributions surrounding these highway developments are examined before and after construction. The trip distributions for different occupations are presented to provide reasoning for criticality changes.

Biography:

I am a MSc Candidate in the Geography program at McMaster University under the supervision of Dr. Darren Scott. My graduate thesis (although in very early stages) will examine data obtained from the bicycle sharing program in Hamilton called SoBi. I graduated with an Honours Bachelor of Science in the field of environmental science from McMaster University in 2017. I am passionate about GIS technology and applications, particularly in the fields of transportation and the environment.

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Traffic Hazard Monitoring Application

Brunson, Benjamin; Kosmachuk, Stephen; Abdelshahid, Justine
Earth and Space Science and Engineering, York University

Deteriorating transportation infrastructure has become a critical issue in aging cities, which significantly complicates urban planning and creates large expenses that are often difficult for municipalities to

sustain. It is essential to have a current and accurate knowledge of issues contributing to deterioration in order to develop and maintain a logistically, economically, socially, and environmentally responsible transportation system. As part of the 2017 Esri Canada Centres of Excellence (ECCE) App Challenge, our team developed a simple web-based application that facilitates public reporting of "traffic hazards," (e.g. dangerous road conditions, speeding issues, etc.) as well as a means of intuitively organizing and analyzing this information for city planning officials. Crowd-sourcing information about traffic hazards allows for near real-time monitoring of transportation routes, without the need to rely as extensively on expensive and logistically challenging fieldwork. It also allows for the identification of less obvious systematic defects in the transportation system, since those who are most familiar with specific routes are given the opportunity to voice their concerns. Our application is designed to help city planners better address the needs of residents, ultimately contributing to more livable and sustainable cities.

Biography:

Benjamin Brunson is currently a Master's student of Earth and Space Science at York University, researching land deformations in Northern Ontario and the Greater Toronto Area using satellite RADAR imagery. He completed his undergraduate degree in Geomatics Engineering at York University.

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Interactive Metro Transit-Centric Map Visualization for City Tour Planning

Claudio, Pio
Electrical Engineering & Computer Science, York University

A recent tourism study finds that a tourist map has three basic functions: discover points-of-interest (POI), plan routes and give spatial information. In the age of ubiquitous mobile devices and digital maps, it is essential that these functions be implemented in modern tourist maps. We demonstrate an interactive framework that holistically combines presentations of a POI map and a metro network including annotations. This framework helps users identify popular POIs based on visual worth computation, and discover POIs within reach of a metro. The map is deformed into an octilinear schematic layout which highlights the metro network. Representative POI images of a region are shown in the layout space, visualized within a user-specified viewing window. To help users reorient their location, a fast seamless transition of the deformation from a geographic map to a schematic map and vice versa is used. Prior map deformation techniques mainly based on uniform grids can be insufficient for such real-time demands. For higher flexibility of allocating resolutions, using an adaptive approach is needed. A proposed content-aware non-uniform grid leads to adaptive resolutions on the map deformation. In other words, finer subdivisions on more significant regions such as guide patterns, and coarser subdivisions with less quad edges on less significant regions are applied. This adaptive approach results in both higher deformability and performance.

Biography:

Pio Claudio is currently a postdoctoral fellow at York University. He received his B.S. degree in Computer Science from the University of the Philippines in 2006. He received his M.S. and Ph.D. degree in Computer Science from the Korea Advanced Institute of Science and Technology in 2010 and 2017 respectively. His research interests include visualization, interactive rendering and map layout optimization.

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Big Data / Citizen Science

A Framework for Detecting Spatiotemporal Local Events using Geosocial Media Data

Xu, Shishuo; Li, Songnian
Civil Engineering, Ryerson University

A local event is an event usually happening non-recurrently in a small part of geographic space, such as road jams, concerts and football games. Detecting local events in a real-time manner is important to help people make right decisions to deal with what is going on at a specific place. Twitter, where users post their perceptions and experience of a local event with time and geolocation information (if the location-based service is turned on), provides rich and alternative data for detecting local events. This paper proposes a framework for the real-time detection of local events using Twitter data from spatial, temporal, and semantic perspectives. The methodology depends on analyzing tweets text and estimating the geographical regularities of number of tweets and number of users, all of which are deduced from the usual behavior patterns of crowds with geo-tagged tweets. The spatiotemporal outlier detection is fulfilled by comparing real-time number of tweets and number of users with the regularities, and their text similarity is calculated to identify whether it is non-recurrent. If it is non-recurrent and both number of tweets and number of users are detected as outliers, a local event, happening in the monitored geographical area, can be detected. Future work will be carried out to implement the framework in Downtown Toronto, Canada.

Biographies:

Shishuo Xu, PhD student in the Department of Civil Engineering, Ryerson University. She is working on detecting abnormal events using geosocial media data.

Songnian Li, professor in the Department of Civil Engineering, Ryerson University. Dr. Li has been working on research projects related to geocollaboration, geospatial web, moving object data mining and knowledge discovery, spatio-temporal dynamics, public participation GIS, and solar energy potential mapping.

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Proceedings: PPTX

Road Surface Anomaly Detection using GPS and Sensor Data from Smartphones

Sattar, Shahram; Li, Songnian
Civil Engineering, Ryerson University

Road surface hazards affect the driving safety and comfort to various road users. For a responsible government, it is vital to monitor and maintain road surface conditions. Traditional approaches to monitor the condition of road surfaces, such as drivers' report, statistical data and field visual inspections not only are time consuming and costly, but are also not accurate and reliable. More recently, mobile mapping equipped with laser scanning has been used to monitor road roughness through the detection of road anomalies (e.g., potholes, cracks, and bumps) on the road surface.

Geotagged images or videos from the roadways were also used to detect the road anomalies. However, existing studies are limited to identifying roadway anomalies mainly from a single source, or lack the usage of combined and integrated multi-sensors in terms of accuracy and robustness, especially in real-time mode. However, continuous monitoring of road surface condition is necessary due to the dynamic changes on the road surface, such as the development of potholes and cracks over time. To address this issue, a real-time Gaussian mixture model based method has been developed to detect and categorize road surface anomalies from smartphone sensors data with higher level of accuracy and more robustness. The method has been developed in MATLAB and ArcGIS has been used widely to geocode, geo-visualize and query the data for performance evaluation part. The proposed algorithm has self-adopting and self-updating capabilities to reconcile itself to any platforms and dynamic behavior of various vehicles and road surface conditions.

Biography:

Shahram Sattar received the B.Eng. degree in Geomatics Engineering from Isfahan University, in 2010. He received the MASc. degree in Civil Engineering (GIS) from Ryerson University, in 2014. Currently, he is working toward the PhD degree in Civil Engineering (GIS) at Ryerson University. His research interests are GIS, web mapping, machine learning, big data, and spatial analysis.

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Proceedings: PPTX

Non-Uniform Spatial Downscaling of Climate Variables

Mouatadid, Soukayna[1]; Easterbrook, Steve[1]; Erler, Andre
[1]*Computer Science, University of Toronto; Aquanty Inc.*

The goal of this study is to present a scalable and robust approach to spatial downscaling of climate variables. We explore the ability of artificial neural networks to downscale a climate variable to a given location of interest. More specifically, the study presents a new downscaling method for two specific tasks: downscaling at locations where past observations are available to train the models, and downscaling for locations where there is no past record, using neighbouring stations to train the models. We illustrate our proposed method in a downscaling application of monthly mean air temperature and precipitations at twelve stations located across the topographically complex province of British Columbia, Canada. Our method generalizes well to different locations and leads to high downscaling accuracy. The performance of the models is measured based on four statistical metrics, including the coefficient of determination, and the root mean square error.

Biographies:

Soukayna Mouatadid is a 2nd year PhD student in the Department of Computer Science at the University of Toronto. Her research interests lie at the intersection of machine learning and climate modelling. Her research uses machine learning to downscale the simulation output from physics-driven climate models, in order to study local climate change effect decades into the future. More generally, she is interested in machine learning-based predictive modeling with applications in regional climate prediction, agricultural forecasting and extreme weather

events intensity and frequency. Prior to enrolling in her PhD, Soukayna completed a master's degree at McGill University where she worked on hydrological modelling and energy systems modelling.

Steve Easterbrook is a Professor in the Department of Computer Science at the University of Toronto. His research focuses on climate informatics, and more specifically, the applications of computer science and software engineering to the challenge posed by global climate change. He has completed a series of case studies of the software development processes used by computational scientists for development of Earth System Models. He is also investigating the role of computational models in teaching key concepts in climate science, and the application of web-based collective intelligence tools to the development of consensus solutions to climate change. Some of this work focuses on the idea of Systems Thinking as a key strategy in understanding.

Andre Erler is a Climate Scientist at Aquanty Inc. His main expertise lies in regional climate modeling and applications to hydrology and hydro-climatic extremes. Originally from Germany, he received the equivalent of a M.Sc. in Meteorology from the University of Mainz in 2008 and a Ph.D. in Physics from the University of Toronto in 2015. Other interests also include open source software, sustainable development, and food security. For his dissertation he performed high resolution climate simulations for western Canada and studied hydrological impacts of climate change in the Athabasca and Fraser river basins, as well as changes in precipitation extremes due to climate change.

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The RinkWatch Citizen Science Project: Past, Present, and Future

Robertson, Colin; McLeman, Robert; Lawrence, Haydn
Geography & Environmental Studies, Wilfrid Laurier University

The RinkWatch Project was started in the winter of 2012-13 as an informal web application that allowed users to map and record daily outdoor skating conditions on their backyard rinks. Over the past five years, the application has grown in membership and functionality, to encompass a wider range of web mapping and data collection fields, and to support research into changing opportunities for outdoor skating under climate change scenarios and to understand social and cultural reasons for making rinks. In this presentation we will describe the project's successes, challenges and opportunities, and identify lessons relevant for environmental citizen science projects generally. We conclude with a detailed overview of future planned expansion of the project and identify new research opportunities that have emerged.

Biographies:

Dr Colin Robertson is a geographer broadly trained in Geographic Information Science and Spatial Analysis. His research interests centre on four inter-related areas; 1) developing methods and tools for spatial-temporal analysis, 2) spatial modelling at the animal/human health interface, 3) citizen science and user-generated spatial data for enhancing community engagement in environmental research, and 4) landscape scale spatial pattern analysis.

Dr. Robert McLeman is an environmental geographer at Laurier, who researches the human impacts of climate change. He also co-directs the NatureWatch.ca citizen science initiative.

Haydn Lawrence is a PhD student at the University of Waterloo. He received his completed his Master of Science in Geomatics at Wilfrid Laurier University and his Bachelor of Computer Science (Information Systems) from the University of New Brunswick in 2002. His research interests are in the understanding of the underlying aspects of VGI on a global scale irrespective of technological platform or content.

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Geotopics: Natural Language Processing Techniques and Big Spatial Data Analysis for Social Media Content

Tenney, Matthew[1]; Hall, Brent[2]
[1]Geography, McGill University; [2]Education and Research, Esri Canada

Over recent years there have been increasing efforts to understand the spatial patterns of social media platforms including Twitter, Yelp, Facebook, and others. At the same time, the 'smart city' rhetoric has promised to utilize big data models and methods to give human decision-makers a better way to understand the needs of their constituents. In this presentation, we compare several different natural language processing (NLP) topic-modelling techniques on geotagged social media posts to make sense of these data. Using a corpus of geotagged social media posts from Twitter and Yelp from within the city of Toronto, we examine the coherence and utility of "geotopic" (topic modelling) techniques to reveal correlations between users' movements and community interests, while also explaining the variation of location. Several open-source programming libraries for NLP and spatial analysis are used to examine dynamic, large, and complex datasets so they can be visually and thematically displayed for exploratory purposes and comparative analysis.

Biography:

Matthew Tenney is a PhD Candidate in the Department of Geography at McGill University. Matthew's research on "Coded Engagement" takes a broad look at how society and technology are converging with transformative impacts on nearly every aspect of everyday life, as well as how these forces are redefining the practice and study of geography more generally.

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The CAnadian Surface Prediction ARchive (CaSPAr): A Platform to Enhance Environmental Modelling in Canada and Globally

Mai, Juliane[1]; Kornelsen, Kurt[2]; Tolson, Bryan[1]; Coulibaly, Paulin[3]; Anctil, François[3]; Fortin, Vicent[3]; Leahy, Michael[4]; Hall, Brent[4]
[1]Civil and Environmental Engineering, University of Waterloo; [2]Geography & Earth Sciences, McMaster University; [3]Civil and Water Engineering, Laval University, [4]Education and Research, Esri Canada

Environmental models are tools for the modern society for a wide range of applications such as flood and drought monitoring, carbon storage and release estimates, predictions of power generation amounts, or reservoir management amongst others. Environmental models differ in the types of processes they incorporate, where land surface models focus on the energy, water, and carbon cycle of the land and hydrological models concentrate mainly on the water cycle. All these models, however, have in common that they rely on environmental input data from ground observations such as temperature, precipitation and/or radiation to force the model. If the same model is run in forecast mode, numerical weather predictions (NWPs) are needed to replace these ground observations. Therefore, it is critical that NWP data be available to develop models and validate forecast performance.

These data are provided by the Meteorological Service of Canada (MSC) on a daily basis. MSC provides multiple products ranging from large scale global models (~ 33km/grid cell) to high resolution pan-Canadian models (~ 2.5km/grid cell). Operational products providing forecasts in real-time are made publicly available only at the time of issue through various means with new forecasts issued 2-4 times per day. Unfortunately, long term storage of these data are offline and relatively inaccessible to the research and operational communities. The new Canadian Surface Prediction Archive (CaSPAr) platform is an accessible rolling archive of 10 of MSC's NWP products. The 500TB platform will allow users to extract specific time periods, regions of interest and variables of interest in an easy to access NetCDF format. CaSPAr and community contributed post-processing scripts and tools are being developed such that the users, for example, can interpolate the data due to their needs or auto-generate model forcing files. We will present the CaSPAr platform and provide some insights in the current development of the web-based user interface (frontend) and implementations used to retrieve MSC's data and provide the data to the user in the inquired shape (backend).

Biographies:

Dr. Juliane Mai is a Post-Doctoral Fellow at the University of Waterloo. She studied Business and Applied Mathematics at the University of Applied Science HTWK Leipzig, Germany. She received the Dipl.-Math. and M.Sc. degree in 2005 and 2007, respectively. In 2007 she joined the Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany, for her PhD in Systems Biology and received the Dr. rer. nat. in 2011 at the Friedrich-Schiller University of Jena. From 2011 to 2016 she was a Research Fellow at the Helmholtz Centre for Environmental Research - UFZ mainly focussing on hydrologic modelling, model calibration, sensitivity and uncertainty analysis. Since 2016 she has been a Research Fellow at the University of Waterloo, Ontario, Canada, working on multi-objective calibration, sensitivity analyses, high-performance computing and Big Data management.

Dr. Kurt Kornelsen is the Network Manager of the NSERC FloodNet hosted at McMaster University. He holds a Bachelor of Science and Bachelor of Education from Brock University and a Ph.D. in Geography from McMaster University. Dr. Kornelsen's research has focussed on the role of soil moisture in hydrology with particular emphasis on downscaling observations from the Soil Moisture and Ocean Salinity (SMOS) satellite of the European Space

Agency. His other research interests big data for environmental applications, uncertainty analysis in hydrological models.

Dr. Bryan Tolson is an Associate Professor in the Department of Civil and Environmental Engineering at University of Waterloo. He holds a B.Sc. in Environmental Science from the University of Guelph, a M.A.Sc. from the Civil Engineering Department at University of British Columbia and a Ph.D. from the School of Civil and Environmental Engineering at Cornell University. Professor Tolson's current research interests include the field of environmental and water resources systems analysis, the development and testing of heuristic algorithms for efficient single- and multiple-objective optimization, and uncertainty estimation as well as risk-based or probabilistic assessment of environmental and water resources systems. These research interests have been applied to a variety of application areas including hydrologic model calibration, water distribution network calibration and optimal design and Great Lakes water level management.

Dr. Paulin Coulibaly holds a PhD in Civil Engineering from Laval University. He is Professor jointly in Civil Engineering Department and the School of Geography and Earth Sciences. He is the Scientific Director of NSERC Canadian FloodNet - a Strategic Research Network for Enhancing Flood Forecasting and Management Capacity in Canada.

Dr. François Anctil holds a Ph.D. degree in civil engineering from Université Laval where he acts as a Professor of water engineering. He is specialized in hydrology, hydrometeorology, micrometeorology, forecasting, climate change, and sustainable development. More specifically, he has promoted the use of multiple hydrological models for various applications, such as for the reduction of the bias and the reliable estimation of the uncertainty of forecasts issues by hydrologic ensemble prediction systems. He also leads a team that deploys micrometeorological equipment within the Eastern Canadian Boreal Biome, mostly to improve our understanding and modelling capacity of the evapotranspiration fluxes within hydrological and land surface models.

Dr. Vincent Fortin is Research scientist in hydrological forecasting with Environment and Climate Change Canada. He is also Adjunct professor at Université Laval, Department of Civil Engineering. Dr. Fortin holds a Ph.D. in hydrology, Institut National de la Recherche Scientifique, Quebec City (1997) and was awarded the Geoff Howell Citation of Excellence for Innovation (2012) for leading the work that led to the operational implementation of the Canadian Precipitation Analysis (CaPA). Dr. Michael Leahy is a graduate of the Geography doctoral program at Wilfrid Laurier University. In his initial role at Esri Canada, he was the primary developer of the technical architecture used for the GeoFoundation Exchange project. Currently, as a member of the Higher Education group at Esri Canada, he manages the Esri Canada GIS Centres of Excellence program and contributes to a range of ongoing academic research and development projects.

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GIS Curriculum Development / Teaching with GIS

Enhancing GIS Curricula with Programming Skills at UNB

Stefanakis, Emmanuel
Geodesy and Geomatics Engineering, University of New Brunswick

Geospatial information science and technology (GIS&T) has rapidly evolved over the last few decades. This evolution has created a highly demanding job market for GIS professionals. Recently, students, graduates, and professionals are more and more forced to complement GIS competence with programming skills. On the flip side, University departments feel the urge to adjust and enrich their curricula accordingly. To address this demand, starting the winter term 2017, a new technical elective course, entitled Geospatial Development, has been added to the undergraduate program of Geodesy and Geomatics Engineering (GGE) at the University of New Brunswick, Canada. The main scope of this course is to get the students acquainted with geospatial programming. This paper presents the syllabus of the course; comments on the learning paradigms used; and highlights the experiences gained by both the students and instructor after teaching the course.

Biography:

Emmanuel Stefanakis, Ph.D., PEng., is an Associate Professor of Geographic Information Systems and Science and the Director of Graduate Studies in the Department of Geodesy and Geomatics Engineering at the University of New Brunswick. In 2017 he received the UNB Teaching Scholar Award ("This is one of the highest recognitions of teaching excellence within UNB"). Home Page: http://www2.unb.ca/~estef/

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Proceedings: PDF

Using Planetary Satelllite Data to Engage the Next Generation

Shankar, Bhairavi
BeSpatial Consulting

The acquisition of satellite imagery has resulted in increased knowledge of the geological history of our solar system and increased the frequency of ongoing space exploration. Access to high quality spatial scientific data provide several opportunities for analysts to better understand our own planet and engage in space exploration. Skilled spatial analysts compile and look through large datasets, mapping observations for disaster response; understanding weather patterns on Earth, planning for rover or human exploration on near-Earth asteroids and planetary surfaces, etc. The need for analysts and critical thinkers is paramount for continuing to investigate key scientific questions. This begins with introducing and training students in using spatial and big data for informed decision making. In partnerships with teachers from the Peel District School Board and Toronto District School Board, BeSpatial Consulting develops digital educational content that match curriculum requirements to 1) provide teachers with current Earth, Space Science, and Geography themed teaching content, and 2) engage students in interacting with data from recent space missions through data analyses and

visualizations. We present the various initiatives and tools we have created thus far in reaching these goals that use ArcGIS Desktop, Online, and mobile applications. The aim is to assist educators and students in understanding the roles and uses of satellite data. It also provides students opportunities to think critically, collaborate, gain skills in working with big data, and communicate effectively, becoming qualified analysts and inspiring them to pursue a career in space science and geomatics.

Biography:

Dr. Bhairavi Shankar is a Planetary Scientist and Remote Sensing Analyst. Her research interests focuses on the development and applications of data analysis techniques through geomatics. She works with data fusion techniques to understand geological processes on solid planetary bodies. She is the founder of BeSpatial Consulting where she is involved in the development of teaching materials to engage students and educators in the field of Planetary Science. She enjoys promoting space science to the general public at various outreach events.

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Proceedings: PPTX

Twenty Years of GIS Teaching -Migrating from Hong Kong to Windsor, Ontario

Brian, David
Geography, Académie Ste-Cécile International School, Windsor

Utilizing GIS in the teaching of Geography has been a powerful tool in raising student's spatial literacy of their surrounding environments. Having done so in Hong Kong for 15+ years has allowed for the development of in-depth GIS based curriculum, with a wealth of resources and experiences to back it. Migrating to Ontario to teach high school Geography would be a completely new experience and challenge, in curriculum, locality and GIS resources. The author is happy to report after one year of teaching and with a strong support network, ESRI Ambassador program and local experts, GIS has been introduced and implemented in his new school. This paper will present on the process of bringing GIS to a school and the range of GIS projects introduced, both successful and and not so successful ones. Additionally, the challenges and how important it is in having a support network will be discussed. Finally, how GIS meets both the Ontario and IB Middle Years Program requirements will touch on.

Biography:

David Brian has been a Geography educator for 30+ years. Twenty Nine years in Hong Kong, teaching in international schools and has returned to teach Geography in an international school in Windsor Ontario in 2016. David has been an avid user if GIS in his teaching as a primary tool in getting his students out of the classroom and into the field exploring their surroundings.

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Proceedings: Story Map

An Effective Web-Based Platform for Geospatial Learning

He, Yuhong; Mui, Amy; Huang, Bruce; Wilson, Kathi
Geography, University of Toronto Mississuaga

As an enhancement to traditional practicums, virtual computer laboratories may offer a means for students not only to improve upon their laboratory grades, but also to address different components of the learning cycle, satisfy individual styles of learning, and build practical and lasting skills in geospatial analysis. Geospatial course topics such as remote sensing, geographic information systems (GIS), and spatial analysis are intrinsically computer-based disciplines, and thus especially appropriate for adaptation to virtual laboratories. In this project, we describe the development and assess the effectiveness of a web-enabled geospatial learning platform designed to improve the quality of the learning experience for undergraduate students. This project reflects our effort to respond to the growing demand for GIS education and to use technology to achieve academic excellence. The growth of GIS-related courses is especially rapid because of the wide employment opportunities for GIS majors or Geography majors with GIS skills. In a GIS core course alone (GGR276) at University of Toronto Mississauga, student's enrollment has increased from 60 in 2009 to 150 in 2013. Yet the pace to increase class size in GIS programs, and the effort to integrate GIS into the broader curriculum remains slow.

The major obstacle is the availability of GIS lab facility, which cannot satisfy the current increasing demand for GIS programs. The recent development of web technology such as Citrix XenApps and VMware View has made it possible for students to remotely access geospatial software packages and data files from on-campus server folders to complete GIS exercises. This project utilizes a web-based geospatial learning platform to provide increased opportunities to access virtual geospatial labs when physical labs are not available or not easy to access. The benefits of this platform include an improvement in our teaching abilities and transfer of knowledge, and better quality learning strategies and skill acquisition for students. The platform was piloted in a second year GIS course and a third-year Remote Sensing course in past three years. Students' evaluation of the platform was overwhelmingly positive: 78.3% of students in the third year course commented on the convenience of the platform and expressed their enthusiasm about being able to avoid crowded computer labs, and not having to travel to campus to do assignments. 73% of students in the second year course found the platform to be equally or more efficient compared to using software in a computer lab. Our long term goal is to develop a tri-campus multi-disciplinary web-based learning platform for enabling data-rich/computationally-intensive learning and applications.

Biographies:

Dr. Yuhong He is an Associate Professor and GIS program advisor in the Department of Geography at University of Toronto Mississauga. She has taught courses on introductory and advanced remote sensing, remote sensing-GIS integration, and spatial data analysis and mapping. Dr. He's research focuses on the use of remote sensing techniques, spatial analysis, climate data, and ecosystem modelling in studies of natural or managed systems, and on the linkages between observed changes and environmental and anthropogenic driving factors at multiple spatial and temporal scales. Dr. He received Early Researcher Award of Ontario in 2015 and Early Career Scholar Award from Remote Sensing Specialty Group, AAG 2011 annual meeting.

Dr. Amy Mui is an Instructor in the Environmental Science Program at Dalhousie University where she teaches courses in environmental informations, spatial statistics, and GIS research methods. Dr. Mui attained her PhD from the University of Toronto, and her MSc from the University of Sydney in Australia. An avid educator, Amy uses active learning techniques and innovative methods of student engagement to train the next generation of scientists. A conservation biologist trained in remote sensing and geographic information systems, Dr. Mui has undertaken field research in regions across the globe, to examine the plight of species at risk in areas where humans and wildlife coexist in altered landscapes.

Mr. Bruce Huang is the Geographic IT specialist in the Department of Geography at University of Toronto Mississauga. His responsibilities entail working as the systems administrator, maintaining map servers including open source map services and ArcGIS Server, supports student GIS learning, helps students and professors with any IT problems or inquiries. Apart from his daily responsibilities, Mr. Huang has started multiple projects to support his department. His most successful project is a web-based geospatial learning project that he collaborated with Dr. Yuhong He and Dr. Amy Mui which utilizes the internet to improve GIS teaching and learning. Mr. Huang received the Department Appreciation Award in 2015 from the Department of Geography in UTM for his outstanding IT support.

Dr. Kathi Wilson is a Professor in the Department of Geography at University of Toronto Mississauga. Dr. Wilson's research examines the links between health and place using both quantitative and qualitative research methods. Dr. Wilson is an advocate of community-based, collaborative research and has strong relationships with various community partners through the Healthy City Stewardship Centre.

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Using Geo-Technologies at COGS: Activities & Projects by Students & Faculty

MacLean, Dave
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Geo-technologies: how do they feature in student learning & ongoing research at COGS & within NSCC? How do students learn & apply relevant technologies representative of those they'll use in industry, government, academia, or NGOs post graduation? This session is about integrating ArcGIS Pro, ArcGIS Online, along with Desktop, python, Oracle, PCI, Erdas, GPS, etc into courses, assignments, and term-long projects at COGS within two of our programs: the two-year Geographic Sciences and our nine-month Advanced Geographic Sciences diplomas.

Biography:

Dave MacLean obtained his Diploma in Scientific Computer Programming from the Nova Scotia Land Survey Institute (now COGS) in 1986, his Bachelor of Mechanical Engineering from the Technical University of NS (now Dalhousie University) in 1985, and his Bachelor of Science (Math) from Acadia University in 1983. He spent 15 years in industry designing and implementing Geographic Information Systems (GIS) in Prince George, BC; Doha, Qatar; and Saint John, NB. Part of the GIS Faculty at COGS since 2001, his interests include design, programming, and use of large spatial databases; mapping photographs from the International Space Station; and atlases "in general."

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Proceedings: Story Map

Using Problem-Based Learning in Teaching Geographic Information Science at the University Level

Peacock, Heather
Geography, Western University

Geographic Information Science (GIS) is a decision support tool used to solve a diverse array of real-world problems. Undergraduate students learning GIS struggle to relate GIS theory to technical practice, struggle to learn the software and the wide variety of different GIS tools available, and especially struggle to problem solve and determine an appropriate series of processes (tools) to perform geoprocessing tasks without prompts. Currently students are given very detailed step-by-step instructions on how to execute various geoprocessing tools and solve an example problem. The goal is to enable them to perform the same or similar problem solving tasks without those detailed instructions. I have developed a workshop that will focus on how to teach effectively both the technical and problem solving skills required for GIS by employing a problem-based learning (PBL) model. PBL is an active learning method that increases understanding and competency. The approach focuses on problem solving, self-directed learning, and team participation/cooperation (Pawson et al. 2006). PBL encourages students to use critical thinking, engages their curiosity to solve "real-world" problems, and promotes inquiry and interest in the subject matter (Pawson et al. 2006). Using a PBL approach and encouraging students to first conceptually solve GIS problems – i.e. the general steps to solve the problem – and then solve them technically, by establishing the specific tools that are needed to process the data to come to a solution (Melero 2010), on their own and through peer collaboration, will enable students to use GIS to solve a larger variety problems, promote stronger retention of GIS skills and theory, and better prepare them for future professional opportunities and/or academic research.

Biography:

Heather is a PhD student at Western University; her research focuses on global primate biogeography, habitat loss, and extinction risk using conservation GIS tools and models. She is an NSERC Canada Graduate Scholar, a recipient of the inaugural ACM SIGHPC/Intel Computational and Data Science Fellowship, as well as the 2015 Esri Canada Scholarship. Heather is also an Esri Canada GIS Ambassador and strives to make teaching and learning GIS more accessible.

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Proceedings: Please contact the author.

Personalized, Problem-based Learning using a Blended Course Model

Boyes, Don
Geography and Planning, University of Toronto

I have implemented a blended course model in my introductory and intermediate undergraduate GIS courses this year, with the goal of providing "the best of both worlds" between online and face-to-face learning. Topics are taught in two-week modules, in which students watch lecture and software demonstration videos, complete a quiz, and start an assignment, all online. This not only provides flexibility and convenience, but also allows for a tighter connection between theory and practice. With this approach, students can learn about one concept, watch a video that demonstrates how that concept is implemented in the software, and then try it for themselves. This can be done on their own schedule and at their own pace. The class meets every second week, well in advance of the assignment deadlines, so that students can have efficient discussions with the instructor and teaching assistants, focused on the concepts, tools, and data sources with which they are having difficulties. Freeing up class time to provide this type of structured guidance allows for a more self-directed, problem-based learning approach, where students are encouraged to find their own data and develop their own project scenarios related to their interests. They are also encouraged to form learning communities with other students who share their interest in particular applications of GIS. All of this is designed to provide deeper and more meaningful learning opportunities for students.

Biography:

Don Boyes is an Assistant Professor, Teaching Stream, in the Department of Geography and Planning at the University of Toronto. He specializes in teaching the theory and application of geographic information systems (GIS) and has a strong interest in educational technology and associated pedagogical development.

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Proceedings: PPTX

Health GIS

Mapping Children's Perspectives on Neighbourhood Barriers and Enablers to Active Travel

Wilson, Katherine; Gilliland, Jason
Geography, Western University

During Geography Awareness Week 2016, a total of 123 children (aged 10- 12 years) in London, Ontario expanded their knowledge of their neighbourhood geographies through a participatory mapping exercise and child-led walking tours with a group of researchers and community collaborators from planning, engineering and public health. Participating students were recruited from Grade 5 and 6 classes from two schools: one urban and one suburban. The mapping exercise was a 45-minute interactive discussion using aerial maps of each participant's school neighbourhood. Using these maps children took researchers through their journey to and from school every day, by drawing routes taken and identifying and annotating the places that students enjoy, dislike, feel unsafe in, and would like to see improved. The child-led walking tours were then used for participants to show researchers areas of enjoyment and concern in their everyday environments. Discussions and locations were used to allow for an in-depth look into why children choose certain modes of transportation to get to and from school every day. By giving a voice to children, this project adds to current policy, practice and research supporting active and safe routes to school.

Biography:

Katherine joined the HEAL as a Masters student in September 2015. Her research interests are spread across physical activity, children's health, the built environment and active travel. Currently she is working on the Active and Safe Routes to School project. Her research focuses on barriers and enablers to children's active travel from the children's perspective. Other interests include public health, health promotion, and physical activity.

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Proceedings: PDF

Using a Novel Geospatial Approach to Assess the Impacts of Environmental Exposures on Children's Sleep

Gilliland, Jason
Geography, Paediatrics, Health Studies, Epidemiology & Biostatistics, Western University

Inadequate sleep among school-aged children is a critical public health issue in many countries which has been linked to a variety of physical health problems, including obesity. Lack of quality sleep can also negatively impact cognitive functioning and social behaviours. A growing body of research suggests that exposure to urban green spaces and other natural environments can have positive benefits for children's physical health, emotional well-being, and cognitive development. The purpose of this study is to examine the impacts of children's daily exposure to different environments (built and natural) on their nighttime sleep duration. Data was collected for 614 children (aged 9-14 years) recruited from 22 elementary schools throughout the City of London, Ontario, Canada. Participants completed the novel

STEAM (Spatial Temporal Environmental Activity Monitoring) protocol which involved completion of a survey, daily activity diary, and directly tracking the time they spent in different environments with a portable GPS for a two-week period. Hierarchical multiple linear regressions were used to explore the relationship between children's sleep duration and exposure to different environmental variables (as measured in ArcGIS). In addition to a number of important individual-level variables, analysis revealed that the amount of time spent in urban green spaces during the day had a statistically significant positive impact on children's sleep duration. The findings of this study have implications for municipal policy and planning practice related to the development and distribution of urban green space.

Biography:

Jason Gilliland is Director of the Urban Development Program and Professor of Geography, Paediatrics, Health Studies and Epidemiology & Biostatistics at Western University. He is a Scientist with the Children's Health Research Institute and Lawson Health Research Institute. His primary research examines environmental influences on children's health (nutrition, physical activity, sleep…). He is Director of the Human Environments Analysis Lab, which specializes in community-based research and identifying interventions to public policy and neighbourhood design to improve the quality of life of vulnerable populations. This work is supported by Children's Health Foundation, Lawson Foundation, Heart and Stroke Foundation, SSHRC and CIHR.

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Understanding of Spatial Accessibility to Primary Care Providers with regard to the Degree of Rurality: A Geospatial Study across the South West Local Health Integration Network, Ontario

Shah, Tayyab; Clark, A; Gilliland, Jason
Geography, Western University

Canada faces unique challenges in the delivery of health care across the urban-rural continuum. Health care accessibility tends to decrease as distance to health care services increases. To gain a better understanding of geographic proximity of primary care across South West Local Health Integration Network (LHIN), this research explores geographical accessibility to all primary care providers (PCPs) and team based PCPs with regard to the degree of rurality. We applied an enhanced 2-step floating catchment area (E2SFCA) method with distance decay effect within a global service catchment of 30-minute drive time to calculate access scores, a local form of the provider to population ratio, for all PCPs and team based PCPs separately. Information about PCP practices (year: 2015) was extracted from the College of Physicians and Surgeons of Ontario Corporate Provider Database. Spatial layers (dissemination block, dissemination area, census subdivision, DMTI CanMap StreetFile) and related population values were obtained from the Statistics Canada (2016 Census of Population). A geospatial mapping approach was used to analyze the patterns of the resultant access scores across Metropolitan Influenced Zones (MIZs) that revealed disparities in the distribution of PCPs with a clear tendency of higher spatial accessibility in or around major urban areas in South West LHIN. Next, comparative analyses were performed in association with seniors population to understand how access scores mismatch with the population needs. The outcome of this study could assist LHIN managers and

researchers to understand the distribution of existing primary health providers as well as in the development of recommendations to address the inequalities particularly in rural areas. Accessibility measures are an important policy tool for managing healthcare provision and reducing health inequality.

Biography:

Tayyab Shah (Ph.D. Geography): His background is in human geography and quantitative social research with an interest in analyzing geographical access to health care services and to food sources, locating health services and facilities mapping. Dr. Shah, an ESRI Canada GIS Scholarship recipient (2013), is a postdoctoral research associate under the supervision of Dr. Jason Gilliland in the department of geography at the Western University. In 2015, he was awarded a Research Grant from Saskatchewan Health Research Foundation (SHRF) to investigate the availability and geographic accessibility to family physicians, nurse practitioners, and physiotherapists in three Canadian Prairie Provinces.

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How Accessible is the York University Keele Campus for People with Disabilities?

Sahni, Sejal; Jadidi, Mojgan
Earth and Space Science and Engineering, York University

About 2% of the York University Keele campus's population has a physical disability. This means that there are more than 500 people out of 60,000 individuals who require extra support and/or assistance to get from one area to another. The research focuses on identifying the key accessibility indicators, collecting/analyzing data, and preparing the dataset. The available data was very inefficient in terms of considering the accessibility criteria from the perspective of people with disabilities. In this regard, more than 90 features were identified both indoor/outdoor at the buildings and parking lots based on an experimental checklist that measures the accessibility of urban infrastructures. The experimental checklist included measurements of the height and width of doors, the length of the ramps, accessibility of parking areas, elevators, classrooms, cafeterias, etc. An accessibility percentage is then calculated and associated to each building and parking lot using ArcGIS. The result shows that Keele campus accessibility ratio is varied from the range of 52% to 94% for individuals in wheelchairs. The variation could be due to the advancements in technology, the building construction time, or building designs. The ongoing goal of this research is to develop a routing application to guide the affected individuals through an accessible route that best meets their needs both indoors and outdoors.

Biographies:

Sejal Sahni is Grade 12th student and part of International Business and Technology program at North Park Secondary School in Brampton. She was honoured to be one of selected students at the Lassonde School of Engineering Women in Engineering pilot project. She explored the Geomatics discipline by participating in research that used geospatial data collection and analysis. She loves coding and working on geospatial data in order to reveal the story behind the data. (sejalsahni@icloud.com)

Dr Mojgan Jadidi, PEng PhD, is assistant lecturer in Geomatics Eng/Sce program at Department of Earth and Space Science and Engineering, Lassonde School of Engineering at York University. She is co-director of ESRI Canada Centre of Excellence at YorkU. She is an active member of ISPRS Commission IV- WG IV/2: Ontologies, Semantics, and Knowledge Representation for Geospatial Information. Her main research interest is Geospatial Big Data Modelling and Visualization, BIM and 3D GIS Integration, Spatial Graph and Spatial Online Analytical Processing (SOLAP), Geospatial Knowledge discovery and Data Analytics, 3D Web Mapping. (mjadidi@yorku.ca)

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Proceedings: PDF

Understanding the use of GIS and Spatial Analysis Methods in Children's Physical Activity Research: A Rapid Systematic Review

Buttazzoni, Adrian[1]; Shah, Tayyab[2]; Gilliland, Jason[2]
[1]Faculty of Health Sciences, Western University; [2]Geography, Western University

Physical activity (PA) and the built environment is a key priority area within health promotion that deals with improving children's health and well-being in different settings. In health geography research, the role of different places (built environment) has been recognised historically as one of the leading influences on children's PA levels. Contemporary GIS methods and technologies are providing novel and innovative ways to examine spatial aspects related to PA and the built environment. To date, GIS has been utilized in studies researching PA, the built environment, and children's health both as a data collection tool and an analytical method, however, its primary usage has been for the purposes of obtaining spatial data. The primary research aim of this rapid review is to investigate the multiplicity of ways in which GIS technologies and spatial data analysis methods have been utilized to examine PA, the built environment, and children's health. Through utilizing a rapid systematic review approach, this review will explore primary research articles published from January 2012 to August 2017 to better understand the use of GIS and spatial analysis in the existing relevant literature, as well as identify gaps where GIS tools can be applied in future study.

Biographies:

The primary author, Adrian Buttazzoni, is a master's student in the Faculty of Health Sciences at the University of Western Ontario, and a research associate in the Human Environments Analysis Laboratory in the Department of Geography. His research focuses primarily on children's health and the built environment, specifically the impacts of a local Active and Safe Routes to School (ASRTS) program on children's participation in active school travel. Additional research aims include examining the real and perceived barriers to active school travel among both children and parents, as well as investigating ways to promote the sustainability of the ASRTS program.

Tayyab Shah is a postdoc conducting research as a member of the Human Environments Analysis Laboratory in the Department of Geography at the University of Western Ontario (UWO). Prior to UWO, he has experience working as postdoc at the University of Saskatchewan in the School of Physical Therapy, an Information Management Specialist for Unicef, Iraq, and a GIS Specialist for Mission Geospatial Ltd.

Dr. Jason Gilliland is Director of the Urban Development Program and Full Professor in the Department of Geography at Western University. He is also cross-appointed to Western's School of Health Studies (Faculty of

Health Sciences) and Department of Paediatrics (Schulich School of Medicine & Dentistry), and is a Scientist with the Children's Health Research Institute and the Lawson Health Research Institute based in London, Ontario.

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How do Urban Activity Spaces and Food Environments Affect the Food Shopping Behaviours and Health of Young Canadian Adults

Widener, Michael; Minaker, Leia; Kamal Ahmadi, Tara; Patterson, Zachary; Reid, Jessica; Hammond, David
Geography and Planning, University of Toronto - St. George

Urban activity patterns can facilitate or restrict a person's ability to acquire and consume different types of foods, and thereby their health. Given this, it is important to develop a thorough understanding of how exposure to urban food retail environments over time and across space influences dietary decisions for various demographic groups. This talk will begin by exploring the ways time, mobility, and geographic context all affect what we eat - and what that means for healthy cities. This will be followed by a presentation of recent work by Dr. Widener and colleagues using data from the first year of the Canada Food Study. In this research, GPS and food purchasing data of approximately 450 young adult participants, collected for one week across five Canadian cities (Toronto, Montreal, Vancouver, Edmonton, and Halifax) are used to explicitly address the links between activity patterns, the food retail environment, and food shopping behaviours. In addition, we have variables from an in-depth survey on participants' dietary history and health. With this integrated dataset, three primary questions will be answered: First, what socioeconomic variables affect the count of different types of food retailers in participants' activity spaces? Second, does exposure to a larger quantity and variety of food retailers affect participants' use of particular types of food retailers? Third, is there a significant relationship that exists between access to different types of food retailers, use of those retailers, and health?

Biography:

Dr. Michael Widener is an assistant professor of geography and planning at the University of Toronto - St. George. He specializes in health, transportation, and food geographies, and uses a wide range of quantitative methods.

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Historical GIS

Was the Battle of Hastings Really Fought on Battle Hill? A GIS Assessment

Hewitt, Christopher
Geography, Western University

Fought on a hillside in southern England in the fall of 1066, the Battle of Hastings has long been regarded as a seminal moment in British history, due to the profound changes the invading Norman conquerors brought to the British Isles. As such, the conflict has been the subject of significant historical analysis. One aspect of the battle that has not drawn much attention in academic accounts, however, relates to its location. To this point, observers have generally accepted that the site of the conflict was "Battle Hill," pointing as evidence to the nearby presence of Battle Abbey, erected by the Norman leader, William the Conqueror, to commemorate his victory. Yet to this point, no archaeological evidence has been found to support the fact that a battle once occurred here. Furthermore, there are some local historians who believe that other sites are plausible. This study retests the case for Battle Hill as the site of the Battle of Hastings through a re-examination of historical data using a GIS-based multicriteria decision analysis (MCDA) model. The results indicate that while Battle Hill is indeed a likely site for the conflict, another nearby location—Caulbec Hill is an equally if not more plausible contender. The study concludes by discussing the implications of this investigation for interdisciplinary research.

Biography:

Christopher Macdonald Hewitt received his doctorate in Geography from the University of Western Ontario in 2016. His thesis examined the role of the environment in the development and outcome of the Battle of Hastings. Beyond historical GIS, Chris also done work on urban transit with an article in the Journal of Public Transportation.

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New Uses for Old Maps – Exploring Transforming Landscapes Online using Historical Topographic Maps

Handren, Kara; Worthington, Kevin
Scholars Portal, Ontario Council of University Libraries

The Ontario Council of University Libraries (OCUL), collectively made up of 21 University Libraries, holds and preserves large volumes of Canadian topographic maps. However, few OCUL universities have complete sets of these map series, and almost none have been digitized. In 2014, OCUL received permission to undertake a digitization project of two of the older topographic map series, the 1:63,360s and 1:25,000s, in order to make these maps available online through the Scholars Portal Geoportal. This work has recently been completed. In time for Canada's 150th birthday, this collection of over 1100 historical topographic maps of Ontario has been made available for public use. These maps, published between 1904 and 1977 provide historical snapshots that can be used to identify and highlight issues

such as erosion, urban sprawl, transportation growth and disappearing waterways. This project was accomplished by a dedicated team of librarians, programmers and students from various OCUL institutions, working together to locate, digitize, georeference, describe and transplant these maps into the GeoPortal. The complete, public-domain collection will be an excellent resource for researchers, students and the general public alike to explore Ontario's past, and examine its growth over time. The project will also serve as a guide for future digitization projects. Our ultimate goal is to create and provide access through Scholars Geoportal to high quality, consistent digital collections that preserve historical data and meet the needs of current and future users.

Biographies:

Kara Handren holds a M.I. in Library and Information Science from the University of Toronto, and is a Metadata Librarian at Scholar's Portal, a service of the Ontario Council of University Libraries (OCUL). She works on a variety of metadata management projects involving eBooks, eJournals, and Geospatial data, and is interested in tools and projects for enhancing information discovery, access and literacy among the wider community.

Kevin Worthington works as an Applications Programmer for the Data & GIS Services Team at OCUL Scholars Portal. He maintains several applications including odesi, Dataverse and Scholars Geoportal. He has a Masters of Applied Science and a degree in Information Technology Management, with a major in Application Development. His interests include open data, data visualization, data mashups, and web mapping.

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Proceedings: GoogleSlides

New Uses for Old Maps: Openly Accessible and Georeferenced Historical Topographic Maps for Exploring Ontario's Changing Landscapes.

Brodeur, Jason[1]; Leahey, Amber[2]; Handren, Kara[2]; Woods, Cheryl[3]
[1] Maps, Data, GIS Centre, McMaster University Library; [2]Scholars Portal, Ontario Council of University Libraries; [3]Western University Library

Just in time for Canada's 150th birthday, the OCUL Historical Topographic Map Digitization Project has digitized and made available for public use a collection of over 1100 topographical maps for Ontario. These maps, published between 1904 and 1977, provide historical snapshots that allow researchers, students, and the general public to explore changes to an area over time. Join members of the project team for a discussion and live demo of these maps in the Scholar's Portal GeoPortal, and learn how they can be used to identify and highlight issues such as erosion, urban sprawl, transportation growth and disappearing waterways.

Biographies:

Jason Brodeur holds a Ph.D. in Geography and Earth Sciences from McMaster University and manages the Maps, Data, GIS Centre at McMaster University Library. His interests include projects that improve access to cartographic and geospatial information and integrates them into research, teaching and learning, and public use.

Amber Leahey is the Data and Geospatial Librarian at Scholars Portal, the digital library project of the Ontario Council of University Libraries (OCUL). She supports SP data services including 'odesi', Scholars GeoPortal, and Scholars Portal Dataverse.

Kara Handren holds a M.I. in Library and Information Science from the University of Toronto, and is a Metadata Librarian at Scholar's Portal, a service of the Ontario Council of University Libraries (OCUL). She works on a variety of metadata management projects involving eBooks, eJournals, and Geospatial data, and is interested in tools and projects for enhancing information discovery, access, and literacy among the wider community.

Cheryl Woods is the Map Librarian at Western University. She received her BA (honors Geography) and MLS from UWO. Her favourite professional responsibilities are acquisition and reference work. She is passionate about historical maps and Canadian fire insurance plans. When she isn't at the Map and Data Centre, Cheryl enjoys traveling, biking, walking, listening to music and reading.

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Visualizing Subtle Forms in the Historic Landscape in ArcGIS Pro: Insights from Lammefjord, Denmark

Laszczuk, Michal
School of Environmental Design and Rural Development, University of Guelph

Lammefjord, on the island of Zealand in Denmark, is a reclaimed fjord agricultural landscape that features one of the lowest dry elevations in Europe, measuring 7 m below sea level. Before the fjord was drained, from the late 19th century onward, there existed a chain of islands that each held a distinct identity and only rose a few metres above seal level. As Lammefjord witnessed urban and rural development following its progressive drainage, the forms of these islands have been partly concealed and today are difficult to distinguish overtly as historic landscape features.

This presentation explores the application of open source GIS data from the Danish Data Agency within ArcMap, visualising the subtle, yet distinct, forms of the former islands within Lammefjord. Historic maps, dating from the second half of the 19th century, overlain with contemporary orthophotos with a resolution of 12.5 cm and a digital elevation model at a 0.4 m grid are used to visualise the characteristics of each of the former islands in Lammefjord. These characteristics will be compared with the contemporary morphology of the former island landscape to demonstrate how present land uses reflect the underlying historic landscape within the reclaimed fjord.

This application of open source GIS data has the potential to be a powerful asset in landscape architectural and planning work, as it would foster design frameworks that would further reveal the embedded historic landscape in Lammefjord.

Biography:

Michal Laszczuk is a Master of Landscape Architecture candidate at the University of Guelph, currently in his third year and working on his thesis project. Earlier this year, he completed a semester abroad, studying a Master of Science in Landscape Architecture at the University of Copenhagen. Michal graduated from the University of

Toronto in 2014 with a Specialist in Archaeology and a Minor in Near and Middle Eastern Civilizations and now integrates his interest in archaeology and cultural landscapes into contemporary design in his MLA. Michal also explores digital applications in design work, including GIS, 3D modelling, and parametric programs.

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Proceedings: PDF plus text

Methods and Opportunities in Mapping Early Modern Cities

Rose, Colin; Walden, Justine
DECIMA, University of Toronto and Brock University

This presentation will describe a long-term, multiphase HGIS project and its research challenges and solutions. DECIMA: The Digitally Encoded Census Information and Mapping Archive is an Historical GIS project based at the University of Toronto and Brock University. Phase I of DECIMA consisted of geolocating three sixteenth-century censuses of Florence, Italy onto an historical map of the city. This phase faced the methodological challenges of disorderly and fragmented datasets and a map characterized by cartographical inaccuracies. Phase II of the project, launched in 2017, consisted of modelling the historical city in three dimensions, incorporating DECIMA into classroom pedagogy, and continuing to foster new research. Developing a 3D model presented new challenges, as did incorporating student learning and individual project development. In this presentation, we examine the project's challenges, successes, and goals for the future.

Biographies:

Dr. Colin Rose, Assistant Professor of European and Digital History, Brock University, Co-Principal Investigator, DECIMA.

Dr. Justine Walden, Post-Doctoral Researcher, DECIMA

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Info-Archeo: Exploring the Impact of Access to Archaeological Data in an Urban Area

Naud, Alexandre[1,2]; Pouliot, Jacynthe[1]; Auger, Reginald[2]; Hall, Brent[3]; Amolins, Krista[3]
[1]Géomatique, Université Laval; [2]Sciences historiques, Université Laval; [3]Education and Research, Esri Canada

Humans have occupied the area around Quebec City for thousands of years. Part of the city's old quarter is a UNESCO World Heritage site, showcased in a network of more than forty museums, and there are more than 1000 known archaeological sites. , A system was developed in 2012, called SIGMA II, to manage archaeological data, provide the capacity to evaluate the city's archaeological potential from archival maps and help with the decision-making process.. This system is accessible only to city

archaeologists. However, access to such a system offers a tremendous opportunity for the development of knowledge and the promotion of archaeology.

The main objective of this project is to assess the interest in and benefit to making archaeological data available to a wider audience. Web GIS has been identified as a potential means for disseminating archaeological data to citizens, specifically certain data from the current SIGMA database. A prototype Web application named Info-Archeo was developed during an internship sponsored by MITACS-Accelerate and Esri Canada. It allows selection and viewing of heritage data relating to urbanization and land titles. Info-Archeo also provide access to old photographs, historical records, archaeological documentation, etc. The next step in the research project is to conduct usability testing with various categories of end-users and thus verify its usefulness and relevance.

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Lightning Talks

Semantic Alignment Technique Evaluation of Ontology Graph Matching Algorithm For BIM-GIS Integrated Model

Hor, Abdel-hadi; Sohn, Gunho
Earth and Space Science and Engineering, York University

Graph mapping is a critical process for seamless information sharing between BIM and GIS models. However, given the complexity of BIM and GIS schemas, models and their differences, a manual mapping between these two domains has been always time consuming and erroneous. In this research paper, we present a framework to facilitate graph-based mapping between BIM and GIS schemas and validation using system alignment techniques. An Ontology-based matching methodology is used to generate mapping between IFC (BIM standard data format) and CityGML (3D GIS standard data format) using Resources Description Framework (RDF) bipartite graph approach. This allows an accurate mapping between these two schemas considering the difference and richness of each. To do so, an evaluation methodology was designed and implemented to investigate the relationships between IFC and City GML RDF graphs based on their semantic models. The most suitable results have been achieved using Association Rule Ontology Matching Approach (AROMA) matching technique. The results are presented and discussed to such integration employing the proposed method on multiple datasets.

Biography:

A-Hadi Hor a PhD student at Earth and Space Science and Engineering at York University in Toronto working BIM-GIS Integration, semantic modeling, Semantic web technologies, geospatial data analysis, spatial statistics, location-based social networks, 3D GIS, Internet of Things, decentralized and cloud based geospatial computing, building information modelling (BIM) and geovisualization.

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Proceedings: PPTX

Combinatorial Urbanism Through LiDAR Collage

Byrne, Ultan
Daniels Faculty of Architecture, Landscape, and Design, University of Toronto

Collage has a long tradition as a popular technique of representation in urban-scale design propositions. In part, its usefulness derives from the ease with which urban form, use, and atmosphere can be synthetically described by drawing on existing imagery. Especially at the master-planning scale, when civic and architectural details remain largely unresolved, collage acts as a gesture towards a desired outcome by combining and blending elements of different urban scenes. At the same time, the static character and single vantage point of these images limits the opportunity to evaluate the proposal in terms of analytical measurements; limits their translation into other kinds of representation, such as physical models; and even limits testing the proposal in terms of additional viewpoints. This paper describes a three-dimensional extension of the pixel manipulation techniques of image collage that

seeks to preserve the quick, loose, and intuitive process that designers are familiar with from tools such as Adobe Photoshop. The research is situated relative to the current discourses surrounding both voxelization and point-cloud data structures in order to motivate the concept of a recombinant approach to the design of existing cities. Building on these sources, and with reference to recent developments in mesh shape composition techniques, the paper presents the resulting software implementation, "Point-Cloud-Paint": a tool that enables collage-based combinatorial experimentation with urban point-cloud data.

Biography:

Ultan Byrne is a researcher with previous degrees in architecture and philosophy. In a combination of teaching, writing, and programming, Ultan considers the relationships between technologies of digital networking, new design software, and enduring questions of architectural/urban design. Ultan is a lecturer at the John H. Daniels Faculty at the University of Toronto.

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Disaster Mutual Assistance Management Application for Canadian Electricity Companies

Asgary, Ali; Selvadurai, Arun; Pantin, Benjamin
Disaster & Emergency Management, York University

In the 21st century we have become very much dependent on electric power. In order for electricity to be available 100% of the times, electricity companies invest in their infrastructure, as well as in their people to ensure outages can be fixed in relatively short periods of time. Typically, local outages are restored within minutes to hours. During large scale emergency events capabilities of a company's own resources will be limited, specially when multiple neighbouring organizations are affected by the same event. These events, whether caused by natural, technological or a human caused sources, result in large numbers of people to be without power for extended periods of time. In order for electricity companies to support each other under these conditions, mutual assistance agreements are formulated between companies, to pre-arrange how resources can be shared in the event of an emergency. Mutual assistance has become an essential part of the electric power industry's service restoration process and contingency planning. In order to better manage this process, a web-map application using ESRI ArcGIS Online has been developed. The purpose of this web application is to provide the end-user (electricity companies) a dashboard from which they can coordinate mutual assistance efforts. The application is intended to supplement the conference call currently held by mutual assistance group members. Electricity companies will be able to declare their current status, and the resources available. The Chairperson will be able to then determine best resources from which to support mutual assistance. The application is browser based and anyone with the correct credentials can login to update their company's status without the need to download software. This presentation provides some details about the need and use of this application.

Biographies:

Ali Asgary is an Associate Professor of Disaster & Emergency Management and Managing Director of advanced Disaster, emergency & Rapid Response Simulation (ADERSIM) at York University.

Arun Selvadurai is a recent master of disaster and emergency management alumni from York University's Disaster & Emergency Management program.

Benjamin Pantin is the Supervisor, Power System Planning and Logistics at Toronto Hydro.

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Developing Effective 3D Interior and Exterior Models

Chastko, Karl; Elford, Spencer; Gigliotti,T
Geography and Planning, University of Toronto

Using drone technology and various optical systems this pilot project by Geographers Without Borders has focused on developing a high resolution 3D interior and exterior model of relatively complex structures. By leveraging drone based exterior imagery capture as well 3D cameras (compatible with software such as google street view and mapillary) to capture the interior of building, it was possible to develop an immersive and integrated model of the structures used in this pilot project. By capturing high resolution interior and exterior imagery and presenting it in a 3D environment this project allows for the development a 3D model to service first responders, security services and provide information to the public about accessibility services. Future applications of this project could include developing 3D models for select buildings on GWB's partner campuses.

Biographies:

Karl Chastko is a McMaster alumni and MSc in Geography candidate at the University of Toronto studying air pollution exposure modeling. Karl's interests include, web gis, and 3D.

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Proceedings: PPTX

Mapping Stories: Ethnographic Approaches to Socio-Spatial Research with Syrian Families Living in Lebanon

Akesson, Bree; Myles, Allison; Badawi, Dena; Doherty, Sean
Faculty of Social Work, Wilfrid Laurier University

Approximately 6.5 million Syrians have been displaced within Syria and an additional three million have been exiled as refugees in neighboring countries. Due to the sudden arrival of large numbers of Syrian

families, refugee sites have developed rapidly, without attention to the socio-spatial implications of the refugee camp for children and families. This research explores the everyday mobilities of children and families living in Lebanon. Using a variety of data gathering methods including collaborative family interviews, GPS-tracked neighborhood walks, and GPS-tracking of everyday mobility, the research methodology encourages children and family voices, allowing for an exploration of family networks, relationships, and environments that are impacting their lives in the context of war and displacement. In addition to shedding light on the everyday realities of refugees, this research suggests solutions to the challenges impeding physical and psychosocial well-being for war-affected children and families.

Biography:

Bree Akesson is an Assistant Professor at Wilfrid Laurier University's Faculty of Social Work. Her research focuses broadly on child protection, ranging from micro-level understandings of the experiences of children and families affected by war to macro-level projects to strengthen social welfare systems. She has conducted an evaluation of psychosocial programs for children in Chechnya and northern Uganda, a mapping of the social work education system in West and Central Africa, and a place-based study of the experiences of Palestinian families in the West Bank and East Jerusalem. She is currently working on projects in Ghana, Lebanon, and Afghanistan.

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ECCE App Challenge 2017 - Team EarthLink

Mistry, Jaydeep; Lee, Stephanie; Kong, Carmen
Geography and Environmental Management, University of Waterloo

The app called Urth-Routes was made by the team EarthLink for the ECCE App Challenge 2017. The app was awarded as the 1st runner up for the challenge out of 17 other teams from across Canada. The app was made by three University of Waterloo students: Jaydeep Mistry, Stephanie Wen, and Carmen Kong. Urth-Routes is a navigation app focused on sustainable solutions to transportation by promoting the use of alternate transportation modes to stay healthy and reduce your carbon footprint. By informing users of their estimated emissions released for their trip when driving a vehicle, users can reflect on their contribution to their carbon footprint and climate change. Additionally, the user can see how many calories they would burn if they were to walk, run, or bicycle the same distance instead. We encourage the use of alternative transportation modes such as walking, running, and bicycling, which release zero emissions. By showing the convenience and accessibility of biking, with the inclusion of Community Access Bikeshare stations and bicycle parking locations across the region of Waterloo, communities can be empowered to have more active and greener lifestyles. Link to ECCE webpage for team EarthLink: https://esricanada-ce.github.io/appchallenge/2017/teams/uw/Team_Earth_Link/ Link to Urth-Routes app: https://esricanada-ce.github.io/ecce-app-challenge-2017/Team_Earth_Link/app/

Biographies:

Jaydeep Mistry is now a Masters of Geography student at the University of Waterloo, researching the uses of Open Data with his advisor Dr. Peter Johnson. During the time of taking the ECCE app challenge 2017, he was in his undergraduate at University of Waterloo as a 4th year Geomatics Major. He enjoys travelling and photography.

Stephanie Wen is now a 4th year Geomatics student at the University of Waterloo. She is from Kitchener, Ontario, and enjoys geo-tagging her Instagram photos.

Carmen Kong is a 4th year Geography and Environmental Management Student at the University of Waterloo. She is from Scarborough, Ontario. She enjoys the great outdoors and good puns.

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Proceedings: PPTX

An Immersive Binaural Horizon for Sonic Information Design

Windeyer, Richard[1,2]; Coppin, Peter[3,4]; MacDonald, Dan.; Steinman, David[4].
[1] Centre for Drama, Theatre and Performance Studies, University of Toronto; [2]Perceptual Artifacts Lab, OCAD University; [3]Faculty of Design, OCAD University;[4]Mechanical and Industrial Engineering, University of Toronto

As contemporary society wrestles with the growing deluge of (big) data, its reliance on visual design practices has only increased. Yet as more and more data is presented visually, accessibility for populations who cannot access it through visual means only decreases. Existing guidelines claim to make visual media accessible through text-to-speech translation, yet fail to translate the iconic (visual, spatial, and topological) properties of visual shapes into sound, thus reducing the affordances of shape-based pattern recognition as an essential component of data analysis. Attempts at providing access to data analytics in the form of auditory and tactile experiences poses a fundamental challenge to the interaction design community, particularly as providing access is fast becoming a human rights requirement. Human hearing is optimized for localizing sonic events across an immersive, horizontal plane. Our approach to designing multisensory data analytics tools and instruments attempts to recruit this optimization by binaurally encoding non-linguistic data sonifications within an immersive horizontal plane. We suspect that this approach can provide a means of facilitating non-visual pattern recognition within a cartographic model. This presentation will also demonstrate our interdisciplinary approach to user-centred multisensory design through several case studies in which different cartographically-related structures are mapped and translated into sonic information — an early infographic map, the page layout of a printed book, various 2-dimensional visual shapes, and a computational simulation of fluid dynamics.

Biography:

Richard Windeyer is a Ph.D candidate in a Collaborative Degree Program between the Centre for Drama, Theatre and Performance Studies and the Knowledge Media Design Institute at the University of Toronto. He is also a student trainee in the NSERC Create Program in Data Analytics and Visualization and a Research Assistant in the

Perceptual Artifacts Lab at OCAD U. His principle areas of research are multi-sensory data analytics, sonic information design and interaction, participatory performance design and simulation, experiential prototyping, soundscape ecology and design, music and sound design for immersive theatre and performance. His teaching specializations are music technology, digital signal processing and interactive electroacoustic music composition.

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A GIS Based National Flood Risk Assessment

Elshorbagy, Amin[1]; Raja, Bharath[1]; Kornelsen, Kurt[2] C.
[1]Civil & Geological Engineering, University of Saskatchewan; [2]NSERC Canadian FloodNet, McMaster University

In Canada, floods are one of the costliest natural disasters with damages since 2010 costing approximately $10 billion. Flood analysis and water resource management in Canada are conducted at the provincial level; therefore, a national unified approach to flood related problems is uncommon. Flood risk can be defined as the product of flood hazard, exposure, and vulnerability, where the hazard is represented by the probability of a flood event and exposure is the value of exposed properties, whereas the vulnerability is the state of susceptibility to harm due to floods. Traditionally flood hazard maps are produced using data and computationally expensive hydraulic models and are therefore only produced at small scales. We will present an alternative GIS-based approach for flood risk mapping using topographic information, remotely sensed nightlight data, and optionally local vulnerability information. Flood hazard was estimated from a digital elevation model (DEM) by determining the elevation above the nearest drainage (EAND) and the distance from the nearest drainage (DFND). To determine the exposure of human settlements to flood hazard, nightlight satellite imagery and land-use data were used to create an exposure index. Risk was then calculated in this study as a product of hazard and exposure. The national flood risk assessment compares well with the results from hydrodynamic models and when compared against recent flood extent maps.

Biographies:

Dr. Amin Elshorbagy, a professor of hydrology and water resources engineering at the University of Saskatchewan. The research and expertise of Dr. Elshorbagy are focused on, and link, the areas of hydrologic and water resources systems modeling and decision analysis through synthesizing the results of various modeling tools and techniques to support the decision making process. Dr. Elshorbagy also works extensively on integrated water resources systems modeling of trans-boundary rivers, attempting to address the challenges of sustainable utilization of water resources in light of the past hydroclimatic conditions as well as possible future changes.

Bharath Raja is currently a Postdoctoral Fellow working with Professor Amin Elshorbagy in the Department of Civil and Geological Engineering, University of Saskatchewan. He holds a Ph.D. in Water Resources Engineering from the Department of Civil Engineering at Indian Institute of Science, Bangalore and a Masters in Water Resources Engineering from Bangalore University. Bharath's work in the FloodNet project mainly focuses on developing a systematic approach for quantification of flood risk under uncertainty, and to arrive at effective flood risk indicators to assist in decision making.

Dr. Kurt Kornelsen is the Network Manager of the NSERC FloodNet hosted at McMaster University. He holds a Bachelor of Science and Bachelor of Education from Brock University and a Ph.D. in Geography from McMaster University. Dr. Kornelsen's research has focussed on the role of soil moisture in hydrology with particular emphasis on downscaling observations from the Soil Moisture and Ocean Salinity (SMOS) satellite of the European Space Agency. His other research interests are big data for environmental applications, uncertainty analysis in hydrological models.

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Physical Processes / Modelling

Evaluating Badland Susceptibility in Basilicata, Italy through the Integration of GIS and Multicriteria Decision Analysis

Leipe, Sean; DeLuca, Patrick
School of Geography and Earth Sciences, McMaster University

Calanchi-type badlands are spectacular forms of accelerated erosion that affect many parts of Italy, and are common in arid and semiarid areas such as the Basilicata region. This work aimed to assess susceptibility to calanchi erosion in the Basilicata region of Italy through multicriteria decision analysis (MCDA) implemented in a geographic information system (GIS). A badland inventory was created by identifying calanchi landscapes within the study area through satellite imagery and was split into a training set and validation set. Through a thorough review of the literature and examination of the badland inventory, eight predisposing factors were found to be important for calanchi encroachment. These were taken from known databases and transformed into operational data layers in ArcGIS 10.4.1 then combined using 3 different MCDA decision rules: the Analytical Hierarchy Process (AHP), the Ideal Point method, and the Fuzzy Weighted Overlay method. The results of this study are 3 badland susceptibility maps of the study area, each created using a different MCDA technique. Over 49% of the entire Basilicata region was determined to be highly or very highly susceptible to badland encroachment by at least 2 of the 3 maps, while the Ideal Point Method gave the greatest amount of high or very high area. Each susceptibility model's effectiveness was evaluated through prediction rate and success rate curves created using susceptibility values from the badland inventory. Through receiver operating characteristics (ROC) analysis and area under curve (AUC) computations, the AHP model was found to have the greatest precision and predictive capacity.

Biography:

5th year undergraduate student in the Honours Earth and Environmental Sciences program at McMaster University, minoring in GIS. Main research interests at the moment are integrating traditional earth science fields such as hydrogeology, geophysics, and geomorphology with GIS as I enjoy working in both fields and believe each can add value to the other.

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Detecting Land Cover Change in the Badlands of Basilicata, Italy

Tsang, Michele; DeLuca, Patrick
School of Geography and Earth Sciences, McMaster University

The further development of badlands has strong impacts on the reclamation efforts of erosional landforms employed in Basilicata, Italy. Badlands are characterized by their steep, unvegetated slopes, high drainage densities, high rates of erosion and tendencies for the formation of regolith profiles with desiccation cracks. Historical agriculture reforms and the European Union Common Agriculture Policy

have attempted to reclaim the badlands of Basilicata and Tuscany for agricultural purposes. The reclamation aims to transform the harsh and inhospitable environments to areas of rich, agricultural value. To determine the appropriate decisions and policies regarding the land use of badlands, their behavior and change over time will be analyzed. On a local scale, the presence of vegetation cover and physico-chemical soil properties play an important role. NDVI differences, clay indices and PCA will be used to map land cover change. The clay index showed an overall increase of clay composition in the surface throughout all years. NDVI and PCA both showed moderate loss of vegetation from 1993 to 2009. The greatest change was found in 2009 to 2015, where the loss of vegetation cover dominated the south, in the areas of the badlands. The combination of the clay abundant surface and loss of vegetation concludes the badlands to be expanding, as well as increasing in susceptibility to further development of these erosional landforms.

Biography:

I will begin graduate studies at McMaster University in September 2017 as a masters student, mainly utilizing GIS. I graduated from McMaster in April 2017 from the Honors Earth and Environmental Sciences program with a minor in GIS. While I was an undergraduate student, I was most interested in the classes involved with my minor degree. The problem solving required in GIS labs was challenging but enjoyable from how many solutions to real world problems that could be determined. This has lead me to further pursue an education involving GIS.

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Individual Tree Crown Delineation Using Multi-Wavelength Titan LiDAR Data

Naveed, Faizaan
Earth and Space Science and Engineering, York University

The inability to detect the Emerald Ash Borer (EAB) at an early stage has led to the enumerable loss of different species of ash trees. Due to the increasing risk being posed by the EAB, a robust and accurate method is needed for identifying Individual Tree Crowns (ITCs) that are at a risk of being infected or are already diseased. This study attempts to outline an ITC delineation method that employs airborne multi-spectral Light Detection and Ranging (LiDAR) to accurately delineate tree crowns. The raw LiDAR data were initially pre-processed to generate the Digital Surface Models (DSM) and Digital Elevation Models (DEM) using an iterative progressive TIN (Triangulated Irregular Network) densification method. The DSM and DEM were consequently used for Canopy Height Model (CHM) generation, from which the structural information pertaining to the size and shape of the tree crowns was obtained. The structural information along with the spectral information was used to segment ITCs using a region growing algorithm. The availability of the multi-spectral LiDAR data allows for delineation of crowns that have otherwise homogeneous structural characteristics and hence cannot be isolated from the CHM alone. This study exploits the spectral data to derive initial approximations of individual tree tops and consequently grow those regions based on the spectral constraints of the individual trees.

Biography:

Faizaan Naveed is a graduate student in Dr. Hu's lab at the Department of Earth and Space Science, York University. His background is in Geomatics Engineering with special interests in image processing, computer vision, remote sensing and machine learning. Currently he is pursuing research in exploiting multi-spectral LiDAR data to enhance Individual Tree Crown delineation techniques.

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Urban Flash Flood Risk Mapping Using Hydrodynamic and GIS Models

Feng, Boyu; Zeng, Chuiqing; Wang, Jinfei; Zhang, Ying
Geography, Western University

Rapid urbanization and climate change have resulted in severe urban flash flood events during severe rainstorms. Aiming to produce reliable urban flash flood risk map, we combined the two main approaches in current urban flooding studies: hydraulic and GIS models in a case study in London, ON, Canada. The hydraulic models employ a series of hydraulic equations to calculate the motion of water from sources. The inputs of the hydraulic models are often composed of detailed hydrological parameters. For end-users who do not have hydrological background, this impedes the easy access to hydraulic models. In addition, the hydraulic models involve heavy calculation and are often difficult to run with high spatial resolution data. On the other hand, GIS models can be easily equipped with series of high spatial resolution GIS layers. But the key parameters in GIS models are often generated from historical flooding events or empirical models, introducing errors. In this study a bond between hydraulic and GIS models was made. This study used the maximum water level result derived from the hydraulic model (PCSWMM) as a known flooding event to generate the parameters that the GIS model requires. In this way, the GIS model can be considered as a simplification of the hydraulic model. The logistic regression model we used to derive the parameters achieves ~80% accuracy. We successfully implemented the hydraulic-model-based GIS model to a large urban area in London to produce an urban flash flood risk map.

Biography:

Boyu Feng received the B.E. degree in geomatics from China University of Geosciences, Wuhan, China, 2012. From 2013 to 2014, she worked with the Center for Remote Sensing of Ice Sheet (CReSIS), University of Kansas, Lawrence, KS, USA, where she obtained her M.S. degree. She is currently a Ph.D. candidate in the department of geography in University of Western Ontario, London, Canada.

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Using High-frequency Coastal Radars for Calibration of AIS Based Ocean Vessel Tracking Models

Friedrich, Ben; Roberts, Steven
Geography and Environmental Studies, Wilfrid Laurier University

Most of the world relies on ships for transportation of cargo and people. Automatic Identification System messages are transmitted from ships and provide a wealth of positional data. This data is being utilized to determine the optimal path for ships as well as predicting where a ship may be going. It has only been in the past decade that Automatic Identification Systems signals have been easily received with satellites so there have been few studies that look at using available information and pairing it with the new abundance of ship positional data. Previously established systems and datasets can be paired with the Automatic Identification data to help develop ship prediction models. One of these established systems is the high frequency radar data network that tracks the velocity of surface ocean currents. Networks of high frequency radars are located on coasts around the world and measure wave velocities up to 200km from the coast. Near real time measurements allow for wave velocity data to be paired with near real time Automatic Identification System messages. The aim of this study is to explore the relationship between error in prediction models and wave velocities derived from coastal high frequency radar signals. This study creates a model that predicts a ship's location and calculates the error from that prediction, then is compared to corresponding high frequency radar data to detect a statistical relationship between the displacement and prevalent waves. The high frequency data can then potentially be incorporated back into the model as a calibration to predict a ship's future location.

Biography:

Ben Friedrich is a MSc.Geomatics candidate at Wilfrid Laurier University. He received his undergraduate degree at Wilfrid Laurier University in Geography and Geomatics completeing a thesis in spatial decision support systems with adviser Dr. Steven Roberts.

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Identifying Hydroecological Impacts of Climate-Induced Northern Landscape Changes using Integrated Field and Remotely Sensed Data

Turner, Kevin; Hughes, D; Thorne, BW; McDonald, I
Geography and Tourism Studies, Brock University

Lake-rich permafrost landscapes occupy significant areas across northern Canada and other circumpolar countries. These regions are ecological hotspots and provide important resources for northern communities. Changing climate conditions have induced widespread, yet variable responses across many of these landscapes including drastically fluctuating lake water levels, unpredictable weather, increasing shrub growth, shoreline thaw slumping, and fire. Concerns have been raised of how these ongoing changes will impact local traditional lifestyles and the carbon budget that influences global temperatures. My research program integrates multiple field measurements and remote sensing to refine our knowledge of the influence of changing catchment characteristics on lake and downstream

hydroecological conditions. Old Crow Flats, Yukon is a key study site where we have maintained hydroloecological monitoring of lakes and rivers for the past 11 years in collaboration with Parks Canada and the Vuntut Gwitchin First Nation. Additional measurements of ground conditions and land cover were acquired in multiple terrain types (i.e., tundra, taiga, wetland, and burnt) to refine our knowledge of the relations that exist among catchment features and downstream conditions. We have also been using unmanned aviation vehicles to monitor permafrost thaw slumps (landslides), which are altering downstream biochemistry. Findings from our field studies during 2017 will be used in conjunction with remote sensing datasets from NASA's Arctic Boreal Monitoring Experiment airborne campaign 2017 to model hydrology and water biochemistry based on land cover and ground conditions across OCF. Findings are helping to improve predictions of how the hydrology and biogeochemistry (e.g., carbon mobility) climate-sensitive areas will respond to future change.

Biography:

Dr. Kevin Turner is an Assistant Professor in the Department of Geography and Tourism Studies at Brock University. Kevin has maintained a research program in Old Crow Flats (OCF), northern Yukon where his lab group focuses on identifying climate-induced landscape changes and associated impacts on hydroloecology and carbon balance. He has led 15 field-sampling campaigns in northern Yukon since 2007 and has integrated multiple approaches including water isotope tracers, paleolimnology, dendrochronology, and remote sensing (including the use of unmanned aviation systems), to characterize hydroecological conditions and their responses to landscape and climate changes over multiple spatial and temporal scales. As an affiliate of the NASA-ABoVE program, he will be evaluating the utility of leading-edge remote sensing datasets for modeling catchment characteristics and lake and river hydrological conditions in OCF.

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Remote Sensing of Fire Severity and Vegetation Recovery: A Case Study for the Fort McMurray Wildfire

Shadrova, Anna; Dauginis, Alicia; He, Yuhong
Geography, University of Toronto Mississauga

Assessing the effects of wildfires on vegetation distribution is essential in developing conservation and restoration techniques. Remote sensing is a particularly useful method in analyzing severity and extent of a wildfire as fires produce apparent changes in land cover composition. The objective of this study is to assess burn severity and post-fire vegetative regrowth following the 2016 Fort McMurray wildfire. Pre-and post-fire images were acquired from Landsat 8 OLI and were used to compute Normalized Difference Vegetation Index (NDVI) and Differenced Normalized Burn Ratio (dNBR) maps. The results showed that densely vegetated areas underwent the most severe burning and exhibited sparse vegetative regrowth. Areas that were previously covered by sparse vegetation did not experience high burn severity and showed little post-fire regrowth. The results from this study can be applied to post-fire recovery monitoring and help develop better management and conservation practices.

Biographies:

Anna Shadrova is an undergraduate student at the University of Toronto Mississauga, majoring in Geographic Information Systems (GIS) and Physical Geography. Her research interests are GIS and Remote Sensing integration, change detection, and spatio-temporal dynamics.

Alicia Dauginis is an undergraduate student at the University of Toronto Mississauga, majoring in Physical Geography and Geographic Information Systems (GIS), with special interests in spatial analysis, remote sensing, and change detection.

Dr. Yuhong He is an Associate Professor and GIS program advisor in the Department of Geography at University of Toronto Mississauga (UTM). Dr. He's research focuses on the use of remote sensing techniques, spatial analysis, climate data, and ecosystem modelling in studies of natural or managed systems at multiple spatial and temporal scales. Her work has been supported by major grants from various internal and external sources. Dr. He received Early Researcher Award of Ontario in 2015 and Early Career Scholar Award from Remote Sensing Specialty Group, AAG 2011 annual meeting.

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Spatial Analysis I

Spatial Statistical Analysis of Italy's Low Fertility

Pitt, Yorgan; DeLuca, Patrick
Geography and Earth Sciences, McMaster University

Fertility decline is a difficult phenomenon to understand because no two declines are the same and human behaviour changes involve multi-level processes and feedback (Colleran, 2016). The Italian fertility rate is considered among the lowest in the world, and models estimate that it will continue to decline (De Iaco and Maggio, 2016). The goal of this study is to further understand the relationship between fertility rate and the distribution of Italian socioeconomic characteristics. Spatial regression models were constructed using recent Italian socioeconomic data. The spatial autocorrelation of these variables was analysed using Moran's I and Local Moran LISA statistics. Linear regression analysis indicated that the average maternal age, the percentage of households that believe that housing costs are too high, the percentage of young people that are unemployed and still living at home, the percentage of municipalities that offer the services and the male employment rate were statistically significant socioeconomic variables. Future research could focus on the implementation of different spatial regression techniques and higher resolution spatial data to ratify these findings. Factor analysis could be applied to identify the underlying factor structure of the variables. There is also additional study potential with a specific focus on the foreigner TFR decline. This decline remains an area of concern as it has significant demographic and economic implications (Istat, 2016a). This study provides further insight into the cause of this decline and can guide areas of public policy reforms and development for the remediation of this trend in the TFR.

Biography:

Yorgan Pitt is a current McMaster graduate student, pursuing a Master of Science. His research focuses on the implementation of spatial statistical analysis and remote sensing techniques in the field of archeology. He is a former McMaster Undergraduate with keen interests in emerging technology and analysis methods. Patrick DeLuca is a GIS Specialist, Instructional Assistant and Lecturer at the School of Geography and Earth Sciences at McMaster University.

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Characterizing the Dispersal Trends of the Emerald Ash Borer (EAB) in Ontario using Geospatial Methods

Tasneem, Farah
Earth & Space Science and Engineering (Geomatics Engineering), York University

Since the introduction of the Asian invasive insect specie in Ontario known as the emerald ash borer beetle (EAB, Agrilus planipennis) in 2002, the state of all species of ash trees (Fraxinus) is currently at risk. Attempts to eradicate the EAB includes restricting the movement of infected logs from regulated

zones and the injection of the insecticide treeAzin in infected ash trees. However, the use of geospatial methods to visualize the current spread and predict future spread of the EAB using species distribution models (SDMs) is quite a novel procedure and was investigated in this project. EAB dispersal is mediated by two mechanisms: short-distance dispersal by flight(environmental) and long-distance dispersal by human transport(anthropogenic). To analyze the impact of environmental and anthropogenic predictors on the distribution of the EAB, logistic regression and a hybrid between random forest and generalized linear model known as randomGLM were used on EAB spread from 2006-2010. EAB points from 2013 were used as prediction to test the accuracy of the models. Both logistic regression and randomGLM identified the distance from population centres to EAB presence points as being the most significant predictor. RandomGLM outperformed logistic regression by 2.94% in terms of correctly predicting 73.53% of EAB presence and absence points whereas logistic regression correctly predicted 70.59%. The equation of the models with the variables identified as being the most important were used to create EAB risk maps for 2013, 2015, and 2017.

Biography:

Farah Tasneem did her Bachelors at the University of Toronto Scarborough in Environmental Sciences and Technology. In her 4th year, she did her final project in the GIS field performing feature extraction. She was intrigued by the capability of GIS to solve spatial problems at such a large scale. She is currently doing her Masters in Geomatics Engineering at York University specializing in invasive species modelling.

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Deploying Spatial-Structural Sensitive Metrics in Spatial Pattern Comparison

Malik, Karim; Robertson, Colin
Geography and Environmental Studies, Wilfrid Laurier University

Spatial pattern comparison is a research area encompassing algorithms and metrics from disparate disciplines with the aim of detecting and quantifying change underlying spatial processes. In this paper, two state-of-the-art metrics, the structural similarity (SSIM) index and the complex wavelet structural similarity (CW-SSIM) index were deployed in comparison of simulated maps from gaussian markov random surfaces. To generate the random surfaces, separate simulations were performed with different scale and spatial dependency parameter settings. CW-SSIM was more sensitive to slight perturbations in spatial process parameters compared to SSIM. For each corresponding image pairs generated as realizations under disparate spatial process parameters, the CW-SSIM index values remained consistently higher than that of SSIM. Thus, CW-SSIM appears to be a robust spatial pattern comparison and change detection method in simulated data. As well, CW-SSIM may have potential in assessing or validating spatial model outputs, and detecting goodness-of-fit in spatial models. The index can potentially distinguish between model outputs or map pairs that possess subtle structural differences, as it yields relatively large variance between successive image-reference pairs. Further research is required to explore the utility of these approaches for empirical comparison cases of different forms of landscape change and in comparison to human judgments of spatial pattern difference.

Biographies:

Karim Malik received his MSc from King Fahd University of Petroleum and Minerals, Saudi Arabia in 2015. He is currently a PhD student in Wilfrid Laurier University. His research interest resolves around spatial pattern comparison and landscape change detection. The deployment of spatial-structural sensitive metrics represents an integral component of his research.

Dr. Colin Robertson received his PhD from the University of Victoria in 2011. The unifying theme of his research is the development and application of spatial analysis and GIScience techniques in spatial ecology and epidemiology. Specifically, he is interested in understanding the role that environmental change has on the health of human and animal populations and how geographical tools can help to understand the complex interactions giving rise to new diseases and risks. Currently Dr. Colin's research is exploring the use of volunteered geographic information in environmental research, spatial and space-time modelling of emerging disease risk, and spatial model validation techniques. The intersection of data-intensive computing, novel geographical analyses, and open source technologies forms the basis for much of his research.

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Proceedings: PDF

Investigating Influences of Environmental Factors on Vegetation Growth using UAV-Acquired Imagery

Lu, Bing; Dao, P.; He, Yuhong
Geography, University of Toronto Mississauga

Vegetation characteristics, such as species distribution and plant growth condition, are highly influenced by various environmental factors (e.g., solar radiation, elevation, and water availability). Remote sensing is a valuable data source for investigating these underlying influences. Past studies using satellite- or airplane-based imagery have focused on studying the interactions between vegetation and environmental factors from landscape to global levels, but few have been conducted at plant functional group level due to the coarse spatial resolution of the images. This study utilized ultra-high spatial resolution images that were acquired by unmanned aerial vehicle (UAV) to explore the influence of environmental factors on vegetation properties at fine scales. UAV imagery was collected at a grassland site, where there are mixed species and complex terrains, during the growing season of 2015. A digital elevation model (DEM) was built using UAV imagery based on Structure-from-Motion (SfM). The DEM was then utilized to produce an area solar radiation map and a wetness index map in ArcGIS. UAV imagery was also applied to generate species distribution maps and vegetation density (i.e., leaf area index (LAI)) maps. Spatial analysis was then conducted to evaluate the contribution of environmental factors (e.g., wetness and solar radiation) on vegetation characteristics (e.g., species distribution and vegetation density). Results show that solar radiation controlled sprouting (i.e., early growth) of vegetation and wetness highly influenced spatial variations of vegetation density at the middle growing stage. Some species tend to cluster in lower lying and wet areas.

Biographies:

Dr. Bing Lu currently is a course instructor at the Department of Geography, University of Toronto Mississauga. He teaches Quantitative Methods I in Geography and Environmental Remote Sensing in 2017, and involves a lot of GIS

in his class. His research interests are investigating vegetation biophysical and biochemical properties (e.g., species composition, vegetation density, and chlorophyll) using multi-source remote sensing data (e.g., satellite-, airplane-, and UAV-based imagery). He also uses many GIS tools in his research, such as spatial analysis and modelling. His current research focuses on investigating influences of environmental factors on spatio-temporal variations of vegetation growth.

Dr. Yuhong He is an Associate Professor and GIS program advisor in the Department of Geography at University of Toronto Mississauga (UTM). She received her Ph.D. degree in geography from the University of Saskatchewan in 2008 and joined UTM as an assistant professor in 2009. Since then, she has taught courses on introductory remote sensing, advanced remote sensing, remote sensing-GIS integration, spatial data analysis and mapping, and geographical analysis of land resources, and has mentored 6 doctoral students, 4 master students, and numerous undergraduate research assistants. Dr. He's research focuses on the use of remote sensing techniques, spatial analysis, climate data, and ecosystem modelling in studies of natural or managed systems, and on the linkages between observed changes and environmental and anthropogenic driving factors at multiple spatial and temporal scales. Dr. He's work has been supported by major grants from various internal and external sources, including NSERC, CFI, ERA, et al. Dr. He received Early Researcher Award of Ontario in 2015 and Early Career Scholar Award from Remote Sensing Specialty Group, AAG 2011 annual meeting.

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Proceedings: PPT

Spectral-Temporal Modelling of Bamboo-dominated Forest Succession in the Atlantic Forest of Southern Brazil

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With access to collections of continuous satellite imagery over a 40-year period, spectral-temporal patterns extracted from multi-temporal imagery offer a potential new tool to monitor forest succession and changes in forested landscapes. In this paper, Landsat time-series are used to examine the spectral-temporal signatures of bamboo-dominated forest succession occurring within the critically threatened Araucaria Forest, a pine-dominated subtype of the Atlantic Forest in southern Brazil. Alteration of canopy structure through ongoing anthropogenic disturbance has increased understorey light climate and given opportunity for native invasive bamboos to flourish, resulting in drastic reduction of tree regeneration and loss of biodiversity. We aimed to evaluate how spectral-temporal signatures could be used to (1) characterize stages of bamboo-dominated forest succession and (2) classify regions of bamboo-dominance. Best-Available-Pixel composites were generated to ensure the time-series stack was spectrally consistent. A changepoint analysis was performed using an extracted sample spectral-temporal pattern and linear models were fit to the resulting segments. Based on slope values, four broad phases of bamboo-dominated forest succession were identified: pioneer predominance, mature bamboo, dieback and pioneer regeneration. A hybrid spectral-temporal model was then used to assess the ability of spectral-temporal patterns to identify bamboo-dominated regions. The hybrid model was developed by combining the modelled time-series segments and compared to a 32-year Landsat time-series of vegetation indices by calculating root-mean square error between each pixel in the study area.

It was found that the developed hybrid spectral-temporal model proficiently classified regions of bamboo-dominance, achieving between 77% and 90% accuracy.

Biography:

Clara is currently a MSc student in the Geography Geomatics program at Wilfrid Laurier University. Clara's research is centered around spatial ecology, with an interest in invasive species and forest ecology. Clara performed a geographical analysis of the influence of temperature on mountain pine beetle infestation spread in western Canada for her undergrad thesis. Currently her research involves examining the spatial-temporal lifecycle dynamics of native invasive bamboo in the Atlantic Forest of Southern Brazil. Through her research, Clara hopes to promote proper management of forest ecosystems in all corners of the world.

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Proceedings: PPTX

Realized Habitat Preferences of Crowned Lemurs (Eulemur coronatus) in Disturbed Forest Fragments: A Case Study of Flexible Human and Non-Human Interactions?

Mercado Malabet, Fernando
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In primate species, habitat preference is a scale-dependent process that can be influenced by a number of different resources and conditions, including: the distribution of ecological and environmental resources and the intensity of anthropogenic impact. Understanding the realized aspects of habitat preferences provides novel and interesting opportunities to the study of primate biogeography and conservation in deteriorated and heterogenous habitats. By defining the effective characteristics that structure the habitat sections where a species is or is not found, we provide the basis to explain the range of conditions and resources that are needed to supply that species' niche expression, as well as the factors that may possibly limit it. The study of habitat preference, then, can be used as an useful approach to understand how the distribution and viability of endangered primate populations is influenced by environmental and/or anthropogenic disturbance. In addition, it permits the opportunity to explore how adaptable the habitat choice process of primates is in poor-quality habitats. In the present study, I use ecological niche modelling (ENM) to examine how habitat structure inform us on the adaptive strategies that crowned lemurs (Eulemur coronatus) employs to navigate disturbance. This study uses field data gathered Oronjia Conservation Park in N. Madagascar in combination with multispectral satellite data to build an ENM of realized habitat preference for this population. My research shows that E. coronatus exhibits a mixed response to disturbance; where it navigates high levels of anthropogenic disturbance and poor environmental quality by maximizing their use of the forest sections capable of supporting their population.

Biography:

Fernando Mercado Malabet is a PhD student in the Department of Anthropology and the School of the Environment at the University of Toronto. He completed his BSc in Biology and Anthropology at Trent University and his MA in anthropology at the Western University. For his MA research, Fernando studied how anthropogenic

and environmental disturbance on forests influences the habitat choices of primates. For his doctoral research, Fernando will seek to understand the ecological and biogeographic mechanisms driving population-decline in ecologically small populations, by studying two sympatric lemur species: the common brown lemur (Eulemur fulvus) and the mongoose lemur (E. mongoz).

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Spatial Analysis II

Land Use Regression: Extrapolating the Interpolation

Adams, Matthew
Geography, University of Toronto Mississauga

Land use regression (LUR) modelling associates pollution levels to land cover characteristics for spatial interpolation. It is commonly applied in the domains of air and noise pollution and less commonly for soil and water pollution mapping. During the model development, land use attributes such as land cover and transportation network characteristics are calculated within buffers of the monitoring data locations. These new attribute data are used as model predicators (independent variables) to predict the pollution values. Once the model is calibrated it can be applied to predict values at unknown locations. Monitoring locations are often selected using techniques that exclude prior knowledge of land use. It is accepted that extrapolation beyond the spatial domain is inappropriate during spatial interpolation; however, research has yet to address that without ensuring monitoring data were collected in all land use classes and conditions, it is possible with LUR to actually be extrapolating data within the spatial boundaries of the monitoring locations. In this paper, we outline the problem of ensuring LUR models interpolate within both the 2-D spatial domain and the multi-dimensional space that it hosts. We then define a potential solution to the problem. Ensuring interpolation opposed to extrapolation is necessary for the continued successful use of LUR.

Biography:

Dr. Matthew Adams is an Assistant Professor in the Department of Geography at the University of Toronto Mississauga. Matthew obtained his PhD from McMaster University in the School of Geography and Earth Sciences, he also holds a HBESc degree and MES degree from Lakehead University. His research focus is to increase our understanding of human exposure to environmental pollutants. He relies on geospatial technologies that include GIS, GPS technology and remote sensing. Dr. Adams' primary focus is modelling individuals' exposure to air contaminants in the urban environment.

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Understanding and Reducing Spatial Bias in Species Distribution Models: The Case of White Nose Syndrome in Bats in Ontario

Yee, Lauren; Robertson, Colin; Stephen, C; Parmley, J
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Spatial data related to wildlife and wildlife diseases is often limited, sparse, and may be biased geographically and temporally which can lead to difficulties understanding the distribution and spatial characteristics of health outcomes and determinants. The timeliness of surveillance data being received can also influence how quickly disease information is disseminated and conservation and disease mitigation plans are implemented. Factors that influence timeliness in surveillance data are examined.

Further, this paper reports results using MaxEnt to model the habitat suitability for bats and suitability for white nose syndrome in Ontario from wildlife surveillance data, examining in detail how settings and parameters can influence the resulting models. Accessibility (proximity to roads, cities, parks) can influence the predicted probability of occurrence in species distribution models. Methodologies to reduce accessibility bias in ecological data and models is examined. An ecological model at the process level was created using environmental covariates such as distance to hibernacula and abandoned mines, minimum temperature of the coldest month, precipitation seasonality and maximum NDVI. Area under the receiver-operator curve for the ecological model and biased models were both >0.90. Sensitivity analysis showed that model results varied significantly. The agency submitting wildlife data, as well as the condition of the sample (frozen or fresh) can influence timeliness. Examining the biases in wildlife surveillance sample collection, timeliness and related health outcomes can help gain insights into vulnerable populations that may be under sampled or inaccessible and where surveillance efforts can be improved prior to emergence or re-emergence of disease.

Biography:

I am currently a MSc. Candidate in the joint Geography program at the University of Waterloo and Wilfrid Laurier. Previous to my MSc. I graduated from the University of Windsor in Earth & Environmental Sciences and worked for a local municipality in their GIS department for 2.5 years. I have worked on research projects for citizen science initiatives with Esri and MITACS accelerate internship program and published two papers related to wild birds and avian influenza. I am interested in One Health and EcoHealth perspectives in conducting research. I have a passion for learning and research, specifically in epidemiology, wildlife health, emerging zoonoses, health equity, and spatial analysis. Currently, I am enamored with all things bats and the growing the body of knowledge of bat distributions, populations and white nose syndrome. I am hoping to broaden my range of skills to include field work, working with wildlife, epidemiology and web development.

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Using ArcGIS to Define the Ground Area Sampled by a UAV Flown Pushbroom Sensor

Proctor, Cameron; He, Yuhong
Geography, University of Toronto

Technological advancements have significantly lowered the cost of cameras and sensors, placing hardware into the hands of researchers who continuously push the boundaries of the sensor use case. In particular, the rise of Unmanned Aerial Vehicles has led to remote sensing data collection at non-traditional distances and angles. Since vegetation canopies are complex three dimensional structures, alterations in the data collection area and orientation can introduce viewing artifacts. Light reflectance from grassland is particularly sensitive to the sun-viewer angle and specular reflection. In severe cases these viewing artifacts can considerably hinder the usability of aerial surveys. In order to access whether these effects are prominent in the aerial survey data, users require simple tools to investigate the ground area sampled post data collection. Using ArcMap spatial analyst tools, a workflow was constructed to calculate the ground instantaneous field of view from recorded flight data. The developed tools were utilized to assess the heterogeneity in the ground area sampled with a pushbroom

hyperspectral sensor mounted on a helicopter platform. These GIS tools provided useful insight into the performance of the sensor-platform combination and the variability in the ground area sampled within the flight due to wind and other forces that prevented data collection under uniform flight conditions

Biographies:

Dr. Cameron Proctor, Lecturer, University of Toronto Mississauga (UTM), Department of Geography: My research focuses on quantifying peatland fluxes of trace gasses such a methane and the vegetation drivers that influence its spatial and temporal patterns. I continually strive to develop new hardware such as UAVs to offer insight into the inner workings of these complicated ecological systems.

Yuhong He, Associate Professor, University of Toronto Mississauga (UTM), Department of Geography: My research focuses on the use of remote sensing techniques, spatial analysis, climate data, and ecosystem modelling in studies of natural or managed systems (grassland, forest, wetland, and agriculture), and on the linkages between observed changes and environmental and anthropogenic driving factors (e.g. climate, topography, grazing, and oil and gas exploration) at multiple spatial and temporal scales. Much of this work has been interdisciplinary, innovative, and collaborative in its nature.

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Working with UAV/Drone Imagery in ArcGIS for Individual Plant Mapping

Robinson, Derek; Ridge, Jennifer; Nishikawa, Kevin
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The potential for a remotely piloted aircraft system (RPAS) to be used to identify individual plants is evaluated using Milkweed. Milkweed are used as a test species due to their unique size and shape as well as their role as a food source for Monarch larvae, a butterfly species that has seen recent declines of up to 90%. A Leica GS CS15 global navigation satellite system receiver and base station were used to establish permanent plots (n=29; 4m2). Plot corners were used as ground control points for image registration in ArcGIS. Field measurements were taken over 9 visits from July 29th to September 26th, 2016, whereby milkweed height, leafspan, and plant count were measured. Immediately after field measurements were taken, the Aeryon Labs SkyRanger RPAS with a visible spectrum payload was flown at multiple heights over each plot. Preliminary results show milkweed leafspan had little correlation to plant height, and a Pearson correlation coefficient = 0.64 between milkweed field sample count and image interpretation count was attained without coregistration of field plots and RPAS imagery. In this presentation we will discuss how RPAS data were used within ArcGIS and our findings to date. While the presented research assesses the use of RPAS as conservation strategy to map and monitor Monarch habitat, it is situated within a broader project seeking to evaluate the capacity of RPAS derived imagery to quantify pollination, erosion, carbon storage, and biodiversity in agricultural landscapes and link RPAS data to biophysical models and models of human decision-making.

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Analysis and Visualization of Shipping Noise Exposure on Whales in Canada

Cominelli, Simone; Leahy, Michael; Luubert, Michael; Devillers, Rodolphe; Hall, Brent
Geography, Memorial University; Esri Canada

Ocean vessel noise is increasing worldwide and is known to impact marine life, especially in coastal environments. This project focuses on analysis of the impacts of ship noise on southern resident killer whale distribution in the Salish Sea, BC, Canada. A custom add-in developed for ArcGIS Pro integrates a geoprocessing toolbox that simulates and compares shortest navigable routes and lowest-impact routes for shipping traffic relative to known whale populations. The project was implemented through a partnership between Memorial University, University of Victoria, and Esri Canada.

Biographies:

Simone Cominelli is a MSc student at Memorial University, Canada. His research focuses on the study and conservation of cetacean populations. He holds a BSc (Biology) and MSc (Ecology and Nature Conservation) from Parma University, Italy.

Dr. Michael Leahy is a graduate of the Geography doctoral program at Wilfrid Laurier University. In his initial role at Esri Canada, he was the primary developer of the technical architecture used for the GeoFoundation Exchange project. Currently, as a member of the Higher Education group at Esri Canada, he manages the Esri Canada GIS Centres of Excellence program and contributes to a range of ongoing academic research and development projects.

Rodolphe Devillers is Professor of Geography at Memorial University where he specializes in geographic information sciences in support of marine sciences and conservation. Devillers is the President of the Canadian Institute of Geomatics (CIG) and associate editor of several academic journals.

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