Program

42nd Annual
Applied Geography Conference

HOSTED BY
DEPARTMENT OF GEOGRAPHY AND EARTH SCIENCES
UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE
CHARLOTTE, NC

HOLIDAY INN CHARLOTTE – CENTER CITY
OCTOBER 23-25, 2019

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42nd Annual
Applied Geography Conference

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Welcome from the Executive Director

On behalf of the Applied Geography Conferences, Inc., I am pleased to welcome you to our 2019 meeting. This year's conference is special because we are back in Charlotte, a beautiful city AGC last visited in the 1990s.

The conference venue, at the *Holiday Inn Charlotte Center City*, has much to offer. We thank the tireless efforts of members of the AGC 2019 local arrangements committee and AGC community members from the region. We look forward to a great meeting because of their efforts.

Next year, AGC 2020 will be in Washington, DC. We anticipate a full complement of stimulating session offerings from the many geospatial thought and practice leaders who are based in the national capital region. Please watch for updated conference date and venue information as AGC announces full 2020 meeting details in the coming weeks.

Finally, please watch the Applied Geography Conference's website, http://www.appgeogconf.org/, for updated information on AGC 2020 and everything else happening in our AGC community.

Best wishes for a great 2019 meeting experience in Charlotte.

Murray Rice
Executive Director
Applied Geography Conferences, Inc.

Welcome from the Host Department

Welcome to Charlotte, the Queen City! Continuing with our department's longstanding tradition of involvement with the Applied Geography Conference, we are excited to host the AGC 42nd annual meeting. Along with the rich and exciting array of papers, posters, workshops, and panel sessions, professional networking opportunities abound. This is truly a special conference where longtime colleagues reconnect and new interactions can lead to future collaborations. Student involvement has always played a large role at the AGC and we are thrilled that this tradition continues with numerous students and recent graduates attending, presenting, and organizing sessions.

Charlotte has grown and changed substantially in recent years. As the largest city in North Carolina (really in the Carolinas), Charlotte / Mecklenburg County is wonderfully diverse (47.8% White/Caucasian, 30.7% Black/African American, 12.9% Hispanic/Latino, 5.5% Asian, and 3% All Other Races as of 2017). In addition to the restaurants, retail, and museums in Uptown (yes, this is the downtown), a short 20-minute light rail ride takes you from Uptown to the beautiful UNC Charlotte campus (last stop going north). NoDa (North Davidson Street, 36th Street Stop going north; https://noda.org/) or South End Historic District (East Boulevard or Bland Street stops going south; https://historicsouthend.com/history/) have redeveloped into neighborhood anchors. African American heritage and neighborhoods have a long and rich history (https://www.westendcharlotte.org/). Charlotte-Mecklenburg has incredible online mapping systems (https://mcmap.org/qol/, as one example). We hope you have a chance to explore, either by foot, train, car, or virtually by map!

From all of us, please enjoy the conference, your interaction with colleagues, and your stay in Charlotte. We hope you will come back to visit us soon.

Deborah Thomas, Chair
Department of Geography & Earth Sciences

CONFERENCE SESSIONS AT A GLANCE

Wednesday, October 23

2:00 PM – 3:30 PM

TELLING YOUR STORY WITH ESRI STORY MAPS *[WORKSHOP]*   Mint 1

EMERGENCY PLANNING AND RESPONSE *[PAPER SESSION]*   Mint 2

URBAN MANAGEMENT *[PAPER SESSION]*   Quorum

3:45 PM – 5:15 PM

CRAFT BREWERIES *[PAPER SESSION]*   Mint 1

ECONOMIC & ENERGY ISSUES *[PAPER SESSION]*   Mint 2

7:00 PM – 9:00 PM
CONFERENCE RECEPTION
Opening Mixer
Spirit Room

Thursday, October 24

8:30 AM – 10:00 AM

BUSINESS GEOGRAPHY I *[PAPER SESSION]*   Mint 1

HEALTH GEOGRAPHY *[PAPER SESSION]*   Mint 2

PHYSICAL GEOGRAPHY I *[PAPER SESSION]*   Quorum

STUDENT POSTER COMPETITION *[POSTER SESSION]*   Spirit

SUSTAINABLE DEVELOPMENT GOALS *[PANEL SESSION]*   University

10:15 AM – 11:45 AM

BUSINESS GEOGRAPHY II *[PAPER SESSION]*   Mint 1

STUDENT COMPETITION I *[PAPER SESSION]*   Mint 2

PHYSICAL GEOGRAPHY II *[PAPER SESSION]*   Quorum

REGULAR POSTERS *[POSTER SESSION]*   Spirit

SUSTAINABLE DEVELOPMENT GOALS STORY MAPS *[WORKSHOP]* University

11:45 AM – 1:00 PM
LUNCH ON YOUR OWN

1:00 PM – 2:30 PM

COMMERCIAL REAL ESTATE CONCEPTS *[WORKSHOP]*	Mint 1
STUDENT COMPETITION II *[PAPER SESSION]*	Mint 2
GENDER CONCERNS IN GEOG WORKSPACE *[DISCUSSION]*	Quorum
FOOD *[PAPER SESSION]*	Spirit
GIS APPLICATIONS I *[PAPER SESSION]*	University

2:45 PM – 4:15 PM

FINDING THE RIGHT RETAIL LOCATION *[PANEL SESSION]*	Mint 1
STUDENT COMPETITION III *[PAPER SESSION]*	Mint 2
SUPPORTING WOMEN IN GEOGRAPHY *[PANEL SESSION]*	Quorum
TRANSPORTATION I *[PAPER SESSION]*	Spirit
GIS APPLICATIONS II *[PAPER SESSION]*	University

4:30 PM – 6:00 PM

HOW GEOGRAPHERS INFLUENCE ORGANIZATIONS *[PANEL]*	Mint 1
STUDENT COMPETITION IV *[PAPER SESSION]*	Mint 2
CULTIVATING SPONSORSHIPS *[WORKSHOP]*	Quorum
TRANSPORTATION II *[PAPER SESSION]*	Spirit
GIS APPLICATIONS III *[PAPER SESSION]*	University

Friday, October 25

8:30 AM – 10:00 AM

FOCUS ON FIELD ANALYSIS *[WORKSHOP]*   Discovery

URBAN CASE STUDIES *[PAPER SESSION]*   Quorum

GROUND TRUTH MULTI-SCALAR GENTRIFICATION *[WORKSHOP]* Spirit

STANDARDIZING AND INTEGRATING GEO DATA *[PAPER SESSION]* University

10:15 AM – 11:45 AM

URBAN ENVIRONMENT *[PAPER SESSION]*   Quorum

IT AppEEARS WE HAVE A SOLUTION… *[WORKSHOP]*   Spirit

DENNIS LORD'S CONTRIBUTIONS TO APPLIED GEOG *[PANEL]*   University

11:45 AM – 1:30 PM
CONFERENCE LUNCHEON
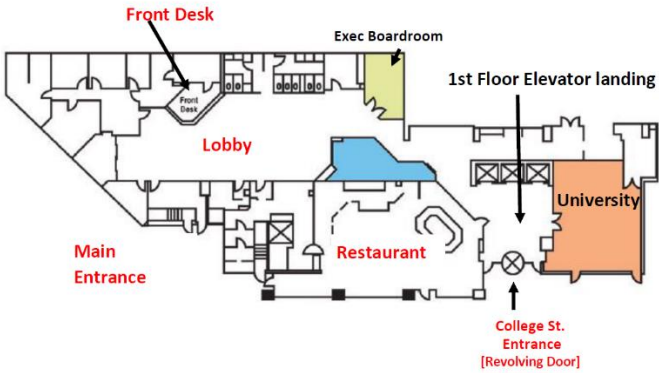Discovery Ballroom

1:45 PM – 3:15 PM
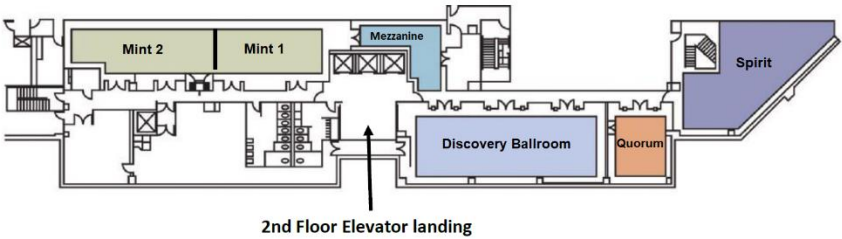### AGC BOARD MEETING
Quorum Room

CONFERENCE AREAS FLOOR PLAN

Holiday Inn Charlotte – Center City

1st Floor Layout

Front Desk

Exec Boardroom

1st Floor Elevator landing

Lobby

University

Main
Entrance

Restaurant

College St.
Entrance
[Revolving Door]

2nd Floor Layout

Mint 2 Mint 1 Mezzanine

Spirit

Discovery Ballroom Quorum

2nd Floor Elevator landing

Detailed Session Listings

All sessions have a total duration of 90 minutes. In general, for paper sessions containing four presentations, we suggest a presentation length of 20 minutes (80 minutes in total), leaving 10 minutes for discussion. In sessions of five papers, 15-minute presentations are suggested, leaving 15 minutes for discussion. The AGC is pleased to provide session participants in such sessions with the opportunity to customize their paper presentation and discussion time allocations to best suit their session needs.

In the following session listings, student poster and paper sessions (where scheduled) are listed first within each timeslot, followed by all other sessions. *The AGC encourages all in our community to attend student paper and poster sessions whenever possible during the conference, in order to recognize and support the next generation of applied geographers.*

A Note on Session Chair Duties

The daily session schedule that follows suggests conference participants to serve as chairs for each session. However, where the presenters in a given session wish, AGC is pleased to provide each session with the opportunity to delegate chair duties to anyone participating in the session. Anyone who is listed as a chair of their session but does not wish to fulfill that role should feel free to request that someone else from the session room take on the chair duties.

Anyone who does fulfill the role of session chair should please watch the time of each presentation and ensure that all presenters receive an equal amount of time to present. AGC thanks all who assist with this vital role for our conference.

WEDNESDAY, OCTOBER 23, 2019
2:00 PM – 3:30 PM

Telling Your Story with Esri Story Maps *[WORKSHOP]*
Room: Mint 1
Session Chair: Joseph Kerski, Esri
Session Description:

> Story maps combine audio, video, narrative, photographs, and interactive web maps that enable the user to use and create immersive experiences that communicate powerfully and creatively. Join Geographer Joseph Kerski for this hands-on workshop where you will be empowered to use these powerful tools for communication. Because story maps are connected to the ArcGIS environment, they can connect to spatial analysis and field collected data. Bring your laptop or tablet and be prepared to be engaged, learn new skills, and gain confidence that you can tell your own story using story maps.

Emergency Planning and Response *[PAPER SESSION]*
Room: Mint 2
Chair: David Trimbach, Oregon State University

> **Perceived Risk and Response to the Ice Throw Hazard: Comparing Community Stakeholders with Operations and Maintenance Personnel in Two Regions of Texas**
>> Denise Blanchard, Texas State University
>> Gregory Klaus, Katoen Natie
>
> **Understanding the Interactions between Shoreline Armoring and Sense of Place to Inform Ecosystem Restoration**
>> David Trimbach, Oregon State University
>
> **The "mystery flood" on the upper San Marcos River, Texas, October 2015**
>> Jack D'Ottavio, Texas State University
>> Rich Earl, Texas State University

Urban Management *[PAPER SESSION]*
Room: Quorum
Session Chair: Michael Commons, U.S. Census Bureau

> **A Community-Engaged Research Approach: Collaborating with Key Tennessee Drinking Water Stakeholders to Understand Public Water Systems Needs**

Yolanda J. Mcdonald, Vanderbilt University
Kayla Anderson, Vanderbilt University

How Local Newspapers Can Influence Receiving Community Perceptions of Refugees

Susan Hume

In-Office Address Canvassing for the 2020 Census: An Overview of Operations and the Final In-Field Universe

Michael Commons, U.S. Census Bureau

3:45 PM – 5:15 PM

Craft Breweries as a Neighborhood Amenity *[PAPER SESSION]*
Room: Mint 1
Session Chair: Neil Reid, University of Toledo

Craft Breweries and Neighborhood Crime Rates: A Case Study of Portland, OR

Julie Wartell, University of California, San Diego
Isabelle Nilsson, University of North Carolina at Charlotte
Neil Reid, University of Toledo

Craft Breweries as a Neighborhood Amenity

Neil Reid, University of Toledo
Isabelle Nilsson, University of North Carolina at Charlotte
Rebekka Apardian, University of Toledo

Economic Impacts of Craft Breweries: On the Relationship between Craft Breweries and Property Values

Isabelle Nilsson, University of North Carolina at Charlotte
Neil Reid, University of Toledo
Ralph Mclaughlin, Corelogic

Going Out for a Pint: Exploring the Relationship Between Craft Brewery Locations and Neighborhood Walkability

Rebekka Apardian, University of Toledo
Neil Reid, University of Toledo

Economic and Energy Issues *[PAPER SESSION]*
Room: Mint 2
Session Chair: Qingmin Meng, Mississippi State University

Characterizing and Modeling Environmental Emergency of Unconventional Oil and Gas Spills

Qingmin Meng, Mississippi State University

Evaluating Sustainable Development in the Sultanate of Oman: Case study of Ad Duqm
> Noura Khalifa Al NasiriAsma
> Sabah Al Mamri
> Noof Said Alghafri
> Fatma Said Al-Belooshi

The spatial threshold effect and its regional boundaries of financial agglomeration on green development: A case study in China
> Huaxi Yuan, School of Economics & Management, Nanchang University and Department of Geography, Kent State University

The Urban System in the Sultanate of Oman
> Montasser Ibrahim Mahmoud Abdelghani, Sultan Qaboos University, Oman & Minia University, Egypt

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CONFERENCE RECEPTION
7:00 PM – 9:00 PM

SPIRIT ROOM

THURSDAY, OCTOBER 24, 2019

8:30 AM – 10:00 AM

STUDENT POSTERS *[POSTER SESSION]*
Room: Spirit

Student Poster Competition Entries

A Spatial Analysis of the Geography of Hypertension in the United States: Beyond Conventional Factors

Zhuo Chen, Kent State University

Jay Lee, Kent State University

Crisis for the University Student: Changing Rents and Growing Campuses

R. Connor Wood, University of North Carolina at Charlotte

Claire Schuch, University of North Carolina at Charlotte

Does geography matter? The case of three informal settlements

Sandra Owusuaah Bempah, Kent State University

Spatial-Temporal analysis of crime in San Francisco, CA

Stephen Osero, University of North Alabama

Dr. Sim Sunhui, University of North Alabama

Studying the Relationship between Transit Systems and Economic Segregation in Three Major MSAs

Vani Singh, University of North Carolina at Charlotte

Todd Doane, University of North Carolina at Charlotte

Luis Martinez, University of North Carolina at Charlotte

Student Posters (Non-Competition)

Digging into spatiotemporal social media data: A dynamic version of segregation index

Qingsong Liu, Kent State University

Jay Li, Kent State University

Xinyue Ye, New Jersey Institute of Technology

The role of biogas technology in emissions reduction from fuelwood consumption in South African households: A Case of Limpopo Province

Solomon Eghosa Uhunamure, University of Venda

Nthaduleni Samuel Nethengwe, University of Venda

David Tinarwo, University of Venda

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UAS and 3D Modeling for Small Scale Farming and Community Garden Precision Agriculture
> Shannon Healy, University of Georgia
> Marguerite Madden, University of Georgia
> Tommy Jordan, University of Georgia
> Sarah Ross

Sustainable Development Goals *[PANEL SESSION]*
Room: University
Session Chair: Linda Peters, Esri
Session Description:
> The SDGs, made up of 17 goals, target a wide range of issues, from poverty to climate change, health, education, environmental degradation, prosperity, and peace. Location and geography are important to most issues, making geospatial data and spatial analysis as important as demographic and statistical data to achieving the goals. In this session we will learn how organizations and nations are sharing data to help us better understand the goals...and have a panel discussion on some of the key challenges being faced in achieving the goals including; education needs, policy, communication and the role of community and citizens in achieving the goals.

Session Keywords: SDGs, Sustainability, Global Goals, GIS

Business Geography I *[PAPER SESSION]*
Room: Mint 1
Session Chair: Tony Hernandez, Ryerson University
From Re-Leasing to Redevelopment: Sears and Target in Canada
> Tony Hernandez, Ryerson University
> Jennifer Nhieu, Ryerson University
Lidl: An Analysis of Store Expansion and Closure Patterns in the Carolinas
> Brett Lucas, City of Cheney
Teaching the spatial analysis of convenience store location, demographics, and behavior
> Joseph Kerski, Esri
The Geography of Dark Stores
> Grant Ian Thrall, Grant Ian Thrall Dba
> Steven Laposa, Alvarez & Marsal Disputes and Investigations LLC., Real Estate & Environmental Services
> Peter Korpacz, Mai, Korpacz Realty Advisors

Health Geography *[PAPER SESSION]*

Room: Mint 2

Session Chair: Michael R. Desjardins, University of North Carolina at Charlotte

Estimating spatial distributions patterns of cancer mortality and natural radioactivity

Peter Siska, Louisiana State University Shreveport

Marek Kudlac, The University of Saint Cyril and Methodius at Trnava, Slovakia

Quantifying spatial and temporal patterns of fine particulate matter (PM2.5) concentrations in California (1998 – 2016)

Kevin A. Butler, Environmental Systems Research Institute

Spatial Variations in the Associations of Mental Distress with Sleep Insufficiency in the United States

Hoehun Ha, Auburn University at Montgomery

Spatio-temporal modeling of neighborhood level risks for dengue, chikungunya, and Zika in Cali, Colombia

Michael R. Desjardins, University of North Carolina at Charlotte

Rajib Paul, University of North Carolina at Charlotte

Eric Delmelle, University of North Carolina at Charlotte

Irene Casas

Physical Geography I *[PAPER SESSION]*

Room: Quorum

Session Chair: Dipanwita Dutta, University of North Carolina at Charlotte

Analysing small-scale farmers' determinant choice and adaptation strategies in response to climatic shocks in Vhembe District

Zongho Kom, University of Venda

Nthaduleni Nethengwe, University of Venda

Sylvester Mpandeli, Water Research Commission, South Africa

Hector Chikoore

Impacts of Land Use and Land Cover Changes on Hydrological Regimes of the Richland Creek Watershed in Southern Illinois using a GIS-based Hydrologic Modelling

Shunfu Hu, Southern Illinois University Edwardsville

Prasanna Shrestha , Southern Illinois University Edwardsville

Mapping invasive species in urban forests using high- resolution aerial image time series and detecting the spatial-temporal change using deep-learning

Dipanwita Dutta, University of North Carolina at Charlotte

Gang Chen, University of North Carolina at Charlotte

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10:15 AM – 11:45 AM

Student Competition I [*PAPER SESSION*]
Room: Mint 2
Session Chair: Jonathan Comer, Oklahoma State University
> **A high-resolution population grid in the CONUS based on Microsoft building footprints and its potentials in hazard studies**
>> Xiao Huang, University of South Carolina
> **An Online GIS-based Data Collection, Management and Analysis System for Private Wells**
>> Yu Lan, University of North Carolina at Charlotte
> **A Scenario-Based Simulation of Urban Growth by Coupling Random Forest and Cellular Automata**
>> Firoozeh Karimi, University of North Carolina-Greensboro
>> Ali Shirzadibabakan, Clemson University
> **Quantifying the Relocation of Greyhound Bus Terminals Over Time**
>> Jesse Andrews, Oklahoma State University

Regular Posters [*POSTER SESSION*]
Room: Spirit
Session Chair: TBA
> **Analysis of distribution characteristics of wind shear in severe convective weather processes**
>> Zhou Shenghui, Henan University
>> Zhang Tianning, Henan University
>> Zhang Yanwen, Henan University
>> Sun Qiaoyang
> **Soil erosion vulnerability and risk mapping using an integrated multi-parametric approach: a case study of Hoffenthal in the Thukela catchment of South Africa**
>> Osadolor Ebhuoma, University of Kwazulu-Natal, Westville Campus
>> Michael Gebreslasie, University of Kwazulu-Natal, Westville Campus
> **The changing garden: using UAV data to analyze a growing season**
>> L. Jesse Rouse, UNC Pembroke
> **Transportation Policy for Elderly Users through the Smart-Card Spatial Autocorrelation Analysis**
>> Junhyung Lee, Korea Institute of Civil Engineering and Building Technology

>Jin-Uk Kim, Korea Institute of Civil Engineering and Building Technology
>Nam Gon Kim, Korea Institute of Civil Engineering and Building Technology

Using Virtual Reality (VR) to deliver an Iceland field geography experience to the on-line classroom
>Dianna Gielstra, National American University
>Dawna Cerney, Youngstown State University
>Ellen J. Foster, University of Mississippi
>Niccole Cerveny, Mesa Community College

Virtual Hampton: an immersive virtual landscape platform as a virtual heritage tool
>Susan Bergeron, Coastal Carolina University

Sustainable Development Goals Story Maps *[WORKSHOP]*
Room: University
Session Chair: Linda Peters, Esri
Session Description:
>In this session - we will invite students who entered the story map competition to present their stories live. We will also share stories from the United Nations and member states as examples of the power that stories have to drive transformation and help us reach the global goals. Student awards will be announced in this session for story map winners.

Session Keywords: SDGs, Sustainability, Global Goals, GIS, Story Maps

Business Geography II *[PAPER SESSION]*
Room: Mint 1
Session Chair: Tony Hernandez, Ryerson University

Application of spatial optimization techniques to the siting of fast food outlets
>Yi Zhang, University of North Carolina at Charlotte

Assessing the spatial relationship between public schools and fast food restaurants in Kuwait by using geographic information system
>Mohammad Alnasrallah, Kuwait

Invisible no more: An exploratory geospatial typology of illicit massage businesses in the Dallas-Fort Worth Metropolitan Area
>Sean Crotty, Texas Christian University
>Mark Daku, Texas Christian University

Physical Geography II *[PAPER SESSION]*
Room: Quorum
Session Chair: Clayton J. Whitesides, Coastal Carolina University
> **A picture is worth a thousand words: The use of strategic figures in the physical geography classroom**
>> Clayton J. Whitesides, Coastal Carolina University
>> Carmen Brysch, Auburn University
>
> **Art, Allegory and Geographic Education: Cultural and Meteorological Lessons from the Sky Deities of Japan**
>> Dennis J. Edgell, University of North Carolina at Pembroke
>
> **Five Years After the 2014 Toledo Water Crisis: What Have We Learned, What Have We Done, What Remains Needed to be Addressed?**
>> Patrick Lawrence, University of Toledo
>
> **The tide and its role in influencing coast line changes, Ras Al-Sawadi and Al-Seefa, Oman, a study in applied Geomorphology**
>> Youssef Sherief, Sultan Qaboos University

LUNCH: 11:45 AM – 1:00 PM
ON YOUR OWN

1:00 PM – 2:30 PM

Student Competition II *[PAPER SESSION]*
Room: Mint 2
Session Chair: Wei Song, University of Louisville
> **A New Classification Scheme for New Immigrant Destinations**
>> Jaeho Ko, University of North Carolina at Charlotte
>
> **Natural amenities and local government public goods: Substitutes or complements?**
>> Kristine Laura Canales, University of North Carolina at Charlotte
>
> **The Role of Geography Space and Place in Social Media Communications: Two Case Studies of Policy Perspectives**
>> Adiyana Sharag-Eldin, Kent State University
>
> **Understanding space and socio-economic differences as a means to a sustainable future**
>> Titiksha Fernandes, University of North Carolina at Charlotte

Commercial Real Estate Concepts for Market Research/Site Section Professionals *[WORKSHOP]*
Room: Mint 1
Session Chair**:** Tom Dwyer, Bank of Hope
Session Description:

> The training, as well as in-office and fieldwork tasks, of market research/site selection professionals tend to focus on non-real estate attributes of locations, such as traffic flows, demographics, and application of sales forecasting models. Consequently, experienced site selection professionals often lack a deep understanding of key commercial real estate concepts that play a crucial role in establishing the final specific site when a general store location is selected. This session provides an overview of key terms and principles to buttress the knowledge base of experienced professionals, and provide a crucial foundation for beginners. Concepts covered include highest-and-best use, variations of property rights, lease types, real estate development considerations, and valuation. All concepts are illustrated with real-world examples from across the United States in a presentation where audience interaction/discussion is encouraged.

Session Keywords: retail, real estate

Gender Concerns in the Geography Workspace *[ROUNDTABLE DISCUSSION]*
Room: Quorum
Session Chair: Dawna Cerney
Session Organizers and Panelists:

> Michael Allen; Jennifer Burrell; Dawna Cerney; Lisa Curll; Richard Earl; Yongmei Lu; Burrell Montz; Michael Ratcliffe

Session Description:

> The #MeToo movement and similar campaigns motivated a group of geographers and business representatives to discuss working conditions faced by female geographers and those who identify as "other" genders. That discussion led to identification of twelve workplace concerns of individuals who are not or do not identify as male, and those support their non-male collogues. Following this dialogue, a survey was conducted to Applied Geography Conference participants and members of the AAG Applied Geography Specialty Group to determine the level of interest for a round table discussion on this theme and to select three specific concerns to be covered during a regular AGC session. The three highest-ranking topics are: "Career sabotage: To speak or not speak up on experiencing or being aware of gender bias and inappropriate behavior in the work place;" "Blind spots: How do we recognize and remove individual and cultural

blind spots associated with gender concerns? What do we do once these are uncovered and there is recognition of gender issues? What societal and work-world dynamics might this result in?" and "Generation-specific challenges versus ongoing prejudices: Are today's gender issues a function of generation or culture or both?"

Session Keywords: Gender, Workplace, Working Conditions, Discussion

Food *[PAPER SESSION]*

Room: Spirit

Session Chair: Colleen Hammelman, University of North Carolina at Charlotte

Access and prices for organic produce in St. Louis

> Gillian Acheson, Southern Illinois University Edwardsville

Constructing sustainable environmental, social and economic landscapes through agroecological practice in Rosario, Argentina

> Samantha Lee, University of North Carolina at Charlotte
> Maria Ysabelle Cruzat, University of North Carolina at Charlotte
> Colleen Hammelman, University of North Carolina at Charlotte

Unpacking the "Local" in a Local Food Store: An Exploration of the Macomb Food Cooperative in Rural Illinois

> Raymond Greene, Western Illinois University
> Sunita George, Augustana College
> Tatsaneewan Phoesri, Western Illinois University

GIS Applications I *[PAPER SESSION]*

Room: University

Session Chair: David Wong, George Mason University

A Geostatistical Framework to Map the Variation of Arsenic found in Private Wells in Gaston County, NC

> Eric Delmelle, University of North Carolina at Charlotte
> Claudio Owusu, University of North Carolina at Charlotte
> Rajib Paul, University of North Carolina at Charlotte
> Samantha Dye, Gaston County

Assessing the Level of Spatiotemporal Clustering among Geographic Events Without No Attribute Information

> Jay Lee, Department of Geography, Kent State University

Assessing Social Vulnerability to Flood Hazards in Canada's Three Largest Census Metropolitan Areas

> Liton Chakraborty, University of Waterloo
> Andrea Minano, University of Waterloo
> Daniel Scott, University of Waterloo
> Jason Thistlethwaite, University of Waterloo

Daniel Henstra, University of Waterloo
How to map in confidence? Mapping (un)reliable data
David Wong, George Mason University

2:45 PM - 4:15 PM

Student Competition III *[PAPER SESSION]*
Room: Mint 2
Session Chair: TBA

Can Social Media Predict Parental Vaccine Choices and Legislations on Mandatory Vaccination?
Weichuan Dong, Kent State University
Identifying Communities at Risk of Opioid-Related Mortalities Utilizing Spatial Rules Based Association Data Mining and Geodemographic Segmentation
Ryan Hanson, University of Memphis
Spatial and Temporal Analysis of Fentanyl and Cocaine Overdose Deaths in Pennsylvania
Marisela Stephanie De La Cruz, Pennsylvania State University
The Geographically Varying Association Between Obesity and Crime: A Case Study of Akron, Ohio
Huiyu Lin, Kent State University

Finding the Right Retail Location With a Complex Scoring Model and a Simple Sales Forecasting Model *[HYBRID PANEL/PAPER SESSION]*
Room: Mint 1
Session Chair: Tom Dwyer, Bank of Hope
Panelists: Tom Dwyer, Bank of Hope; Ben Abrams, Moody's Analytics
Session Description:

Moody's Analytics recently launched Commercial Location Score, an advanced quantitative solution for evaluating commercial real estate. The tool helps commercial real estate investors, lenders, and developers to evaluate the suitability of over 7.2 million commercially-zoned parcels in the United States by computing a numerical score for each parcel based on its suitability for five commercial property asset classes (office, retail, multi-family housing, industrial, and hotel). A panelist thoroughly familiar with the model's underpinnings will explain and demonstrate its strengths and shortcomings, and answer questions. In the second half, the effectiveness of a simple sales forecasting model adapted from a real

estate appraisal-based fundamental market analysis framework and based on drug store sales data from the Economic Census will be benchmarked by comparing forecast results against the actual sales data for the particular chain drug store for which sales were forecasted.

Session Keywords: retail, model, sales forecast, drug store, location score

Opening Papers:

Evaluation of commercial demographic data accuracy: Revisiting the question of input bias in the location analysis process

Robert Gooljar, University of North Carolina at Charlotte

Bill Graves, University of North Carolina at Charlotte

Supermarket Site Selection in South Dallas

Edward T. Rincon, Ph.D., Rincón & Associates LLC

Supporting Women in Geography: Encouraging and Advancing Careers in Academia and Research *[PANEL SESSION]*

Room: Quorum

Session Chairs and Organizers:

Caroline Brinegar, University of North Carolina at Charlotte

Sara Tornabene, University of North Carolina at Charlotte

Panelists:

Deborah Thomas, University of North Carolina at Charlotte

Colleen Hammelman, University of North Carolina at Charlotte

Jamie L. Strickland, University of North Carolina at Charlotte

Claire Schuch, University of North Carolina at Charlotte

Titiksha Fernandes, University of North Carolina at Charlotte

Jan Whitesell, City of Charlotte Planning Department

Session Description:

This panel and open discussion seeks to provide a space for women in the traditionally male-dominated discipline of geography to come together (1) in celebration of women's achievements, advancements, and contributions to the discipline, while (2) illuminating areas in which women can be better supported while pursuing or advancing their career in academia or geographic research. In particular, this discussion will place emphasis on issues of gender within the context of variety of topics including managing a work/ life balance, conducting research and publication, teaching and mentoring, service and leadership expectations, and promoting representation through professional advancement. Panelists represent a broad range of life experiences, objectives, and areas of geographic research. Additionally, perspectives from a variety of career stages, including graduate students, mid career, and late-career faculty members, are included in the discussion. All Applied Geography

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Conference attendees, regardless of gender identity, are invited and encouraged to participate in this discussion through the sharing of personal experiences and generation of ideas, questions, and concerns.

Session Keywords: gender, gender identity, representation, SWIG, women in geography, women in academia, intersectionality

Transportation I *[PAPER SESSION]*

Room: Spirit
Session Chair: Claire Schuch, University of North Carolina at Charlotte

Connecting People with Jobs: Light Rails Effect on Intra-urban Distribution of Economic Activity
> Maryam Khabazi, University of North Carolina at Charlotte
> Isabelle Nilsson, University of North Carolina at Charlotte

The Evolution of Cuba's air transport network in the Embargo era; An analysis of Cuba's lack of air connectivity with the U.S. between 1967 and 2017
> Hilton Cordoba, Marshall University

The Regional Impact of High Speed Rail in China: A Spatial CGE Assessment
> Kingsley E. Haynes, George Mason University
> Zhenhua Chen, The Ohio State University

Who's Moving In? A Longitudinal Analysis of Home Purchase Loan Borrowers in New Transit Neighborhoods
> Elizabeth Delmelle, University of North Carolina at Charlotte
> Isabelle Nilsson, University of North Carolina at Charlotte
> Claire Schuch, University of North Carolina at Charlotte
> Tonderai Mushipe, University of North Carolina at Charlotte

GIS Applications II *[PAPER SESSION]*

Room: University
Session Chair: Jonathan Comer, Oklahoma State University

A GIS-Based Approach to Measuring Diel Habitat Use Patterns
> Rebecca Loraamm, University of Oklahoma
> Kate Goodenough, University of Oklahoma
> Claire Burch, University of Oklahoma

A spatial-social urban development status curve from NPP-VIIRS nighttime light data
> Chengshu Yang, East China Normal University
> Bailang Yu, East China Normal University

Influence of space-time differentiation of frontal area index on surface temperature

Zhangxian Feng, Northeast Normal University
Shijun Wang, Northeast Normal University
Shanhe Jin, Liaoning Normal University
Junyang, Junyang, Liaoning Normal University
Patterns and Processes of Political Factionalism in the US
Jonathan Comer, Oklahoma State University

4:30 PM -6:00 PM

Student Competition IV *[PAPER SESSION]*
Room: Mint 2
Session Chair: Brandon Vogt, University of Colorado Colorado Springs
Effects of hydroelectric dams on tropical forest dynamics in the Brazilian Amazon
Samuel Nickerson, University of North Carolina at Charlotte
Protecting Water Quality in the Texas Hill Country: Opportunities for Beneficial Reuse of Wastewater Effluent
Ty Stonecipher, Texas State University

How Geographers Can Have Influence within their Organizations *[PANEL SESSION]*
Room: Mint 1
Session Chair: Joshua Bova, KFC
Panelists:
Larry Carlson, Carlson & Associates
Gary Gruccio, Signet Jewelers
Lynn Sitler, U.S. Bank
Session Description:
Many organizations realize the value of having a GIS/Geography professional or two within their ranks. However how are these departments viewed in the overall operation of the organization? Are they simply viewed as the "mapping team?" or can they have a broader influence on analytics within an organization? There is a greater realization that everything happens somewhere. How have some within our Geographic community been able to break the mold of simply being the mapping team and become recognized as thought leaders within their organization?
Session Keywords: Thought Leadership, Influence

Cultivating Sponsorship for Your Business, Research, GIS, and Program
[WORKSHOP]
Room: Quorum
Session Chair: Sarah Scher, Esri
Session Description:

Determining and communicating the business and academic value of GIS and geographic deliverables or your research projects is one of the most challenging endeavors to undertake. On top of this, business leaders, committees and the public don't usually speak in the "language of Geography and GIS", which challenges you to interpret business, social and academic goals and challenges, and translate them into clearly understood opportunities that are seen to have value. This workshop session will cover strategies for determining and measuring the target audience of your GIS, business and research and developing considerations for how to communicate that value. You will be guided through the following: 1) how to identify the right sponsors for your goals, and what your relationship with that person/group should look like; 2) Crafting (or tailoring your current) strategy to align with your or your organization's goals by a) developing a shared understanding of your mission/purpose, goals, objectives, and challenges; b) creating a plan that prioritizes opportunities to deliver the goal and the value the goal brings to your yourself and others; and 3) Learn to communicate your successes and outcomes in a way that your sponsor understands the value GIS and geography.

Session Keywords: Sponsors, Funding, Communication, Geography and GIS Value, Goals

Transportation II *[PAPER SESSION]*
Room: Spirit
Session Chair: Eric Suarez, University of North Carolina at Charlotte

Examining the Dynamic Influence of Road Traffic Volumes on Red Deer Movements in GIS

James Anderson, University of Oklahoma
Rebecca Loraamm, University of Oklahoma

Light rail investments and neighborhood change: Perspectives of residents, stakeholders and local media in Charlotte, North Carolina

Johanna Claire Schuch, University of North Carolina at Charlotte
Tonderai Mushipe, University of North Carolina at Charlotte

Rail Transit Investments and Economic Development: Challenges for Small Businesses

Sara Tornabene, University of North Carolina at Charlotte

GIS Applications III *[PAPER SESSION]*
Room: University
Session Chair: Providence Adu

> **Accessibility, Usage and Physical Activity: exploring the correlation using geotagged tweets**
>> Chayanika Singh, Texas State University
>> Yongmei Lu, Texas State University

> **Applying Web GIS to Space Use Assessment**
>> Shirley Li, Purdue University
>> Nicole Kong, Purdue University
>> Karen Hum, Purdue University
>> Nanette Andersson, Purdue University

> **Examination of urban growth in Bangladesh using Google Earth Engine**
>> Pankaj Bajracharya, University of North Carolina at Greensboro
>> Salima Sultana, University of North Carolina at Greensboro
>> Neelopal Adri, Bangladesh University of Engineering and Technology

FRIDAY, OCTOBER 25, 2019

8:30 AM - 10:00 AM

Focus on Field Analysis *[WORKSHOP]*
Room: Discovery
Session Organizer and Chair: Lynn Sitler, U.S. Bank
Session Description:

> Last year's presentation introduced the basics of a geographer's work in banking. This year, we'll focus on field analysis, not just for banking but for the general retail sector as well. Through aerial and streetscape photography, we'll examine sites for various attributes ranging from trade area accessibility to specific components such as ingress & egress. Bring your computer or at least paper & pencil as one of my goals is for you to draft a field form which you can then modify later for specific location analyses or class assignments.

Session Keywords: Business Geography, Applied Geography, Location Analysis, Field Work, Site Selection

Ground-truthing multi-scalar approaches to mapping gentrification *[WORKSHOP]*
Room: Spirit
Session Organizers and Chairs:

> Daniel Yonto, University of North Carolina at Charlotte
> Claire Schuch, University of North Carolina at Charlotte

Session Description:

> Gentrification has been widely discussed and studied, but disagreement remains on how best to define and measure it. One challenge is the lack of scholarly research applying smaller scales to undercover more geographically specific patterns of neighborhood change. We address this gap by mapping Charlotte gentrification at the census tract level, using Census and ACS data, to create a social status index combining occupation and education variables, as well as at the tax parcel level, using Mecklenburg County administrative data, to create a gentrification index based on building permits and tax assessments. In this workshop, participants will be shown these maps and asked feedback on how easy maps were to understand and how accurately each approach is according to their topical or local knowledge. Participants will also be asked if and how the maps could inform their work and how they could be improved. Understanding whether more advanced modeling, complex indices, or finer geographic resolutions could give a clearer insight of gentrification

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and capture possible microscale effects across neighborhoods missed by more traditional approaches. Our results will contribute to gentrification debates by using quantitative methods to create indices for gentrification and qualitative methods (ground-truthing) to validate these results.
Session Keywords: Mapping gentrification, Multi-scalar approach, Ground-truthing

Urban Case Studies *[PAPER SESSION]*
Room: Quorum
Session Chair: Wei Song, University of Louisville

An Examination of the Influence of Gentrification on Postindustrial Policing in New York City
Jay L. Newberry, Binghamton University

Application of Geospatial Technologies in Land Cover Dynamics Assessment: A Case Study of Industrialized West Bank, East London Area, South Africa
Ahmed Mukalazi Kalumba, University of Fort Hare, South Africa

Landscape-Based Assessment of Urban Resilience and Its Evolution: A Case Study of the Central City of Shenyang
Wei Song, University of Louisville
Zhimin Liu, Northeast Normal University

Methods of Capturing and Analyzing Blight: Case Study Youngstown, Ohio
Jennifer Burrell, Kent State University

Standardizing and Integrating Geospatial Data to Support National, Regional, and Global Analysis and Decision-Making *[PAPER SESSION]*
Room: University
Session Chair: Michael Ratcliffe, U.S. Census Bureau

Development of Island-Wide Address Data for Puerto Rico
Laura Hogberg, U.S. Census Bureau
David Cackowski, U.S. Census Bureau
Gregory Hanks, U.S. Census Bureau

Integrating Data for Regional Decision-Making: A Statistical and Geospatial Framework for the Americas
Jennifer Zanoni, U.S. Census Bureau

Organizing and Implementing a Hemisphere-Wide Collaborative Effort to Integrate Geospatial and Statistical Data
Paul Riley, U.S. Census Bureau
Jennifer Zanoni, U.S. Census Bureau
Deirdre Dalpiaz Bishop, U.S. Census Bureau

Towards a Global Statistical Geospatial Framework
> Vincent Osier, U.S. Census Bureau
> Joshua Coutts, U.S. Census Bureau

10:15 – 11:45 AM

It AppEEARS we have a solution to many of your data issues! *[WORKSHOP]*
Room: Spirit
Session Chair: Danielle Golon, Innovate Inc.
Session Description:
> How much time have you spent researching, downloading, subsetting, reprojecting, mosaicking, and examining geospatial data in your favorite GIS program, only to realize that the data was not right for your project? This presentation will show you how to take a deep dive into data using the Application for Extracting and Exploring Analysis Ready Samples (AppEEARS), from NASA's Land Processes Distributed Active Archive Center (LP DAAC), to solve these common data problems. This simple tool can help you find, customize, process, analyze, and download federal geospatial data in a matter of hours – not days, months, or years. Using AppEEARS, you'll have access to no cost geospatial data that provides information about surface temperature, elevation, precipitation, fire, snow cover, vegetation, evapotranspiration, population, and more—including the recently released Landsat Analysis Ready Data (ARD)! On top of all that, AppEEARS allows you to visualize and explore data values and associated quality data information via interactive plots and graphs prior to download!

Session Keywords: remote sensing, data access, tools

Urban Environnent *[PAPER SESSION]*
Room: Quorum
Session Chair: Tusar Kanti Roy, Khulna University of Engineering & Technology
> **Evaluating Urban Geography Story-Telling as a Way to Change Perceptions of Space and Place**
> > Barbara Lash, University of North Carolina at Charlotte
> **From Brown to Green: Understanding the Evolution of Pittsburgh's Riverfront Brownfields**
> > Susan Lucas, University of Pittsburgh
> **Spatial Distribution of Parks as Urban Green Space in Khulna City: An Analysis in Context of Equity Planning**

Tusar Kanti Roy, Khulna University of Engineering & Technology, Bangladesh
Md. Mustafa Saroar, Khulna University of Engineering & Technology, Bangladesh
Shamim Mahabubul Haque, Khulna University, Khulna, Bangladesh

Dennis Lord's Contributions to Applied Geography *[PANEL SESSION]*

Room: University
Session Organizers:
> Bill Graves, University of North Carolina at Charlotte
> Harrison Campbell, University of North Carolina at Charlotte

Session Chair: Bill Graves, University of North Carolina at Charlotte
Panelists:
> Larry Carlson, Carlson & Associates
> Dustin Stancil, Trade Area Systems
> Brian Strickland, Signet Jewelers
> Deborah Thomas, University of North Carolina at Charlotte

Session Description:
> This session celebrates the contributions of Dennis Lord to applied geography. During his 35-year career at UNC Charlotte, he trained generations of students and practitioners, mentored scores of graduate researchers, published dozens of refereed journal articles, provided countless hours of service, and was recipient of UNC Charlotte's highest teaching award. An applied economic geographer, he developed a highly visible and successful program in Location Analysis, training academics and industry professionals in the techniques of retail location, store location research and applied quantitative methods. His efforts have been tireless; his impact on the discipline and retail location industry have been substantial; and his contributions to applied geography have been many. This panel recounts some of his accomplishments and their impact on the study and practice of applied geography.

AGC LUNCHEON: 11:45 AM – 1:30 PM
DISCOVERY BALLROOM

1. Announcement of Esri & AGC SDG Story Map Student Competition Awards

2. Announcement of AGC Paper and Poster Student Competition Awards
AGC-SP3 Student/Practitioner Awards

3. Luncheon Keynote Address:
"Preparing for a City's Future Growth"

Taiwo Jaiyeoba
Assistant City Manager/
Director of Planning, Design &
Development
City of Charlotte, NC

Taiwo currently serves as Assistant City Manager and Director of Planning, Design and Development with the City of Charlotte. As Assistant City Manager, he is a member of the City's Executive Leadership team and provides support to Planning, Transportation and Charlotte Area Transit Services Departments. As Director, he directs a staff of more than 100 employees and is responsible for planning activities in the City portions of Mecklenburg County. He currently oversees the City's rewrite of a 20-year comprehensive plan as well as the City's Development Code. Recently, Taiwo led his staff to overhaul the City's Transit Oriented Development (TOD) ordinance, the first time in 15 years.

His vision is for an equitable, livable, sustainable and inclusive Charlotte.

Taiwo has more than 26 years of national and international experience in the public and private sectors. His management experience across the United States is extensive and includes multi-million dollar federally-funded light rail (LRT), bus rapid transit (BRT) and streetcar projects.

1:45 PM - 3:15 PM

AGC Board Meeting
Room: Quorum
Chair: Tom Dwyer, Bank of Hope

Abstracts

All abstracts below are listed alphabetically by the first name of the first author.

The Role of Geography Space and Place in Social Media Communications: Two Case Studies of Policy Perspectives

Adiyana Sharag-Eldin, Kent State University, Department Geography, asharag1@kent.edu

This study evaluates how space and place in geography intersect with social policy in still nascent but developing rapidly. The objective of this research is to integrate the research collected during recent studies of fracking and the death penalty. These two case studies are exemplars of the potential that such research proffers. The primary disciplinary value of this review is to demonstrate the spatial value of communication and social media studies. This study adopted a communication-based theoretical framework as a lens to guide methodological choices in analyzing public perceptions. The social media application from Twitter was used as the engine to capture opinions of social media users engaging public controversies. This review locates connections in the literature between geographers/spatial scientists and communication media theorists.

Keywords: Social-media, public perception, fracking, death penalty

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Application of Geospatial Technologies in Land Cover Dynamics Assessment: A Case Study of Industrialized West Bank, East London Area, South Africa

Ahmed Mukalazi Kalumba, Department of Geography And Environmental Science, University of Fort Hare, South Africa, akalumba@ufh.ac.za

South Africa's nationwide socio-economic industrial development zone drive focuses on alleviating of the apartheid social ills legacy. To ensure sustainable industrial ecological development, land-cover monitoring is needed though limited attention has been accorded. This study, aimed at assessing the influence of East London Industrial Development Zone (ELIDZ) on land-use/land-cover (LULC) drivers and detecting LULC changes for 15 years over the West Bank East London. An integration of remote sensing with qualitative approaches was adopted to provide

robust temporal and spatial LULC change analysis. Object-based classification was performed on the satellite images for 1998, 2007 and 2013. Normalised Difference Vegetation Index (NDVI) and Normalised Difference Built-up Index (NDBI) complemented and validated observed land cover changes. The study reveals that industrial development has been a key driver for land-use changes in West Bank. The classification indicated that vegetation (5.97%) and bare land (-9.06%) classes had the highest percentage increase and decrease respectively. Water (0.02%) and bare land (-0.6%) classes had the lowest annual rate of change. Built-up and bare land classes varied considerably. An overall land-cover classification mean accuracy assessment of 97.24% and a mean Kappa coefficient of 0.95 were attained for the entire study period. This study offers the value of integrated methods in monitoring land-cover change to enhance informed decision-making, especially in rapidly changing landscapes for conservation purposes.

Keywords: Industrial Zone Development, LULC, Object-based classification, NDVI, NDBI, ELIDZ, South Africa

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Evaluating Urban Geography Story-Telling as a Way to Change Perceptions of Space and Place

Barbara Lash, University of North Carolina At Charlotte, blash1@uncc.edu

Neighborhood stigmatization is often a result of low socioeconomic status, crime, the perception of crime, and negative news coverage. Prolonged stigmatization negatively affects the distribution of resources, development, and property value leading to a reduced quality of life, and a devalued idea of place and space. Charlotte, North Carolina's Hidden Valley neighborhood is one example. It started as a White middle-class community, then became an affluent Black neighborhood. But the dynamics changed in the 1980's with gang activity. Although police dismantled the gang in 2013, the negative image remains today, guiding how stories about the neighborhood are shared.
This paper summarizes research aimed to change neighborhood perceptions using the participatory method of producing a documentary based on original story-telling from residents. The story-lines from the lived experience uncovered a counter narrative of a family-orientated neighborhood with little crime, or fear of crime. To gauge change in perceptions, the documentary will be shared at community forums, with pre and post questionnaires, panel discussions and focus groups.

The broader goal is to examine urban geography story-telling as a way to change perceptions of space and place; and to create a research model that can be repeated in other stigmatized communities.

Keywords: removing neighborhood stigmatization, redefining space and place, changing perceptions with original story-telling, urban geography documentary

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Lidl: An Analysis of Store Expansion and Closure Patterns in the Carolinas

Brett Lucas, City Of Cheney, brett.lucas@yahoo.com

Lidl is a large German discount grocer with over 10,000 stores across Europe. In June of 2017, Lidl entered the US marked with much fanfare locating its first 7 stores in the Carolinas. Within Lidl's first year, they opened just over 50 stores; however, stores were scattered amongst several different markets in the Southeast and Mid-Atlantic, never achieving any agglomeration to be a threat to other grocers such as Aldi, Walmart or Food Lion which already have a large presence. The Carolinas were selected as an entry market as many felt Food Lion would be slow to react. In May of 2019, Lidl announced their next round of expansion as well as the closing of two stores (Rockingham and Kinston) in the Carolinas. This paper looks at Lidl's entry into the Carolina market from both a macro and micro perspective in select markets. At the macro level (county), this paper will investigate different market factors within the competitive landscape using Location Quotients. At the micro level, this paper will use Factor Group Modeling to see which attributes (i.e. distance from competing retailers, AADT's, etc.) have led to closures and expansion opportunities in select markets.

Keywords: Retail, Grocery, Lidl, Factor Group Modeling, Applied Geography

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Accessibility, Usage and Physical Activity: exploring the correlation using geotagged tweets

Chayanika Singh, Texas State University, c_s618@txstate.edu
Yongmei Lu, Texas State University, ymlu@txstate.edu

Physical activity (PA) has well-known benefits for human health and wellbeing. Having location-based textual content when people share their health behavior and

activities, Twitter presents a promising opportunity for public health-related researches. This study explores this opportunity by investigating the potential association between the proximity of exercise opportunities and the likelihood of their usage. By examining the geotagged PA related tweets from Travis County, Texas, we found a strong correlation between the locations of indoor and outdoor recreational activity centers and the number of PA-related tweets in proximity. An Accessibility score is derived for each geotagged tweet based on its distance to the various physical activity facilities. A weighted summary is applied to capture the distance decay effect of proximity to the facilities. The statistical results show (p< 0.001) higher accessibility score for the PA related tweets within 1-mile distance from the various exercise facilities. Study results also indicate a significant association of usability of physical activity facilities with the lesser educated Hispanic/Latino population of low-to-medium income level and among unmarried college students of age 18-24. Such findings help us to gain useful insight on the health behaviors of various population groups with regards to accessibility and usability.

Keywords: physical activity, twitter, accessibility

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A spatial-social urban development status curve from NPP-VIIRS nighttime light data

Chengshu Yang, East China Normal University, yjack90824@gmail.com
Bailang Yu, East China Normal University, blyu@geo.ecnu.edu.cn

Urban development status is closely related to the urban economy, environment, ecology, and health. Spatial and social processes are the two key aspects of urban development. In this study, using nighttime light data and both spatial and socioeconomic information, we proposed an exponential model, Spatial-Social Urban Development Curve (SSUDC), to provide a quantitative expression of the relationship between the two key processes of urban development and analyze urban development status. We generated SSUDCs for 330 prefecture-level cities in mainland China, 208 of which had coefficients of determination (R^2) greater than 0.6. The coefficients α and β of SSUDC were shown to indicate the base intensity socioeconomic activity and the efficiency of socioeconomic growth with the urban expansion, respectively, and can be used to reveal the urban socioeconomic development status and functional type at both city and urban agglomeration scales. At the internal urban level, the residuals of SSUDC can imply the demand for urban physical or economic construction, and even the urban growth type, together

with the distribution of the artificial surface ratio. In summary, this new curve can provide a simple way to combine the spatial and social processes of urban development, which is beneficial for the analysis of urban development at different scales and a rewarding tool for urban planning.

Keywords: Spatial-Social Urban Development Curve; Nighttime light; NPP-VIIRS; Urban development

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A picture is worth a thousand words: The use of strategic figures in the physical geography classroom

Clayton J. Whitesides, Coastal Carolina University, cwhitesid@coastal.edu
Carmen Brysch, Auburn University, cpb0022@auburn.edu

A successful student of physical geography must be able to identify important figures in current, figure-heavy physical geography textbooks. Accurate identification must be rapid, given that today's college student spends more time on leisure/sport activities than on educational activities. Students in an introductory physical geography class were asked to identify the 5 most important figures in an arid environments chapter of a textbook at the beginning of the semester. Students highlighted how content, aesthetics, etc. affected their decision. During the regular semester, the instructor taught using only figures to train students on figure importance and interpretation. At the end of the semester, students identified the 5 most important figures in a glacial environments chapter. Student results were compared to physical geography figures that transcend six current textbooks. Results suggest that although identification improved between the start and end of the semester, students were not capable of identifying the most important figures, despite receiving an entire semester of training. Student comments suggest that size and a pleasing color scheme hinder a student's ability to identify the correct figures. Therefore, in the limited time students study outside of class, they cannot identify the most critical content, requiring instructors to optimize classroom instruction.

Keywords: physical geography, textbook figures, study time, teaching

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Workshop: It AppEEARS we have a solution to many of your data issues!

Danielle Golon, Innovate Inc. - Usgs Contractor , dgolon@contractor.usgs.gov

How much time have you spent researching, downloading, subsetting, reprojecting, mosaicking, and examining geospatial data in your favorite GIS program, only to realize that the data was not right for your project? This presentation will show you how to take a deep dive into data using the Application for Extracting and Exploring Analysis Ready Samples (AppEEARS), from NASA's Land Processes Distributed Active Archive Center (LP DAAC), to solve these common data problems. This simple tool can help you find, customize, process, analyze, and download federal geospatial data in a matter of hours not days, months, or years. Using AppEEARS, you'll have access to no cost geospatial data that provides information about surface temperature, elevation, precipitation, fire, snow cover, vegetation, evapotranspiration, population, and more including the recently released Landsat Analysis Ready Data (ARD)! On top of all that, AppEEARS allows you to visualize and explore data values and associated quality data information via interactive plots and graphs prior to download!

Keywords: remote sensing, data access, tools

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Workshop: Ground-truthing multi-scalar approaches to mapping gentrification

Daniel Yonto, UNC Charlotte, dyonto@uncc.edu
Claire Schuch, Phd, UNC Charlotte, claire.schuch@uncc.edu

Gentrification has been widely discussed and studied, but disagreement remains on how best to define and measure it. One challenge is the lack of scholarly research applying smaller scales to undercover more geographically specific patterns of neighborhood change. We address this gap by mapping Charlotte gentrification at the census tract level, using Census and ACS data, to create a social status index combining occupation and education variables, as well as at the tax parcel level, using Mecklenburg County administrative data, to create a gentrification index based on building permits and tax assessments. In this workshop, participants will be shown these maps and asked feedback on how easy maps were to understand and how accurately each approach is according to their topical or local knowledge. Participants will also be asked if and how the maps could inform their work and how they could be improved. Understanding whether more advanced modeling, complex indices, or finer geographic resolutions could give a clearer insight of

gentrification and capture possible microscale effects across neighborhoods missed by more traditional approaches. Our results will contribute to gentrification debates by using quantitative methods to create indices for gentrification and qualitative methods (ground-truthing) to validate these results.

Keywords: Mapping gentrification, Multi-scalar approach, Ground-truthing

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Understanding the Interactions between Shoreline Armoring and Sense of Place to Inform Ecosystem Restoration

David Trimbach, Oregon State University, david.trimbach@oregonstate.edu

Shoreline armoring is recognized as a major obstacle to ecosystem recovery in the State of Washington's Puget Sound region. Coastal communities have installed seawalls, bulwarks, and other hard armor to prevent erosion, reduce flooding, and foster shoreline stabilization, yet these infrastructures negatively impact natural nearshore processes, wildlife, and ecosystem health. While much is known about the impacts of shoreline armoring on the ecosystem, the relationship between shoreline armoring and sense of place among coastal communities remains limited. The gap in our understanding of the interactions between these two aspects of recovery is problematic for policy-making and programmatic interventions. This project addresses this gap using a mixed-method approach, including a 12-county survey, semi-structured interviews, and a cognitive mapping activity to solicit resident perceptions of shorelines and shoreline armoring in the Puget Sound as it relates to sense of place. Resident responses illustrate how shoreline armoring influences their place attachment, identity, dependence, and meaning to their local place-based communities and the Puget Sound. The results from this study are crucial to better equip scientists, policy-makers, and communities alike in their collective efforts to recover the Puget Sound's ecosystem.

Keywords: sense of place, shoreline management, shoreline armor, ecosystem restoration, coastal communities, Puget Sound

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How to map in confidence? Mapping (un)reliable data

David Wong, George Mason University, dwong2@gmu.edu

Almost 20 years ago, Stan Openshaw called for learning how to live with error in (spatial) data. However, our progress along this direction has been minimal. Today, most analyses, ranging from simple mapping to spatial pattern detection, still assume spatial data are reasonably reliable. Unfortunately, this assumption is the exception rather the norm, as most spatial data are statistical estimates derived from sampled observations and therefore each estimate is associated with an error level. These data include popular socioeconomic datasets such the American Community Survey (ACS) and data from the Surveillance, Epidemiology, and End Results (SEER) Program for public health research. They are often used in various mapping exercises. Introduced in 2015, the class separability classification method was the first framework that explicitly considers error of estimate in compiling a choropleth map. This paper discusses the tool that implements the class separability classification method. It demonstrates how data, SEER data and shapefiles, can be ingested into the tool, and how classes can be determined heuristically. Critical elements of the resultant map are the confidence levels associated with each class break values, as we can no longer be 100% sure that mapped values assigned to different classes are statistically different.

Keywords: Class separability classification method, data reliability, choropleth map, confidence level

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Discussion: Gender Concerns in the Geography Workspace

Dawna Cerney, Youngstown State University, dlcerney@ysu.edu
Michael Allen, Old Dominion University, mallen@odu.edu
Jennifer Burrell, Youngstown State University, jlburrell@ysu.edu

The #MeToo movement and similar campaigns motivated a group of geographers and business representatives to discuss working conditions faced by female geographers and those who identify as "other" genders. That discussion led to identification of twelve workplace concerns of individuals who are not or do not identify as male, and those support their non-male collogues. Following this dialogue, a survey was conducted to Applied Geography Conference participants and members of the AAG Applied Geography Specialty Group to determine the level of interest for a round table discussion on this theme and to select three specific concerns to be covered during a regular AGC session. The three highest-ranking topics are: "Career sabotage: To speak or not speak up on experiencing or being aware of gender bias and inappropriate behavior in the work place;" "Blind spots: How do we recognize and remove individual and cultural blind spots

associated with gender concerns? What do we do once these are uncovered and there is recognition of gender issues? What societal and work-world dynamics might this result in?" and; "Generation-specific challenges versus ongoing prejudices: Are today's gender issues a function of generation or culture or both?"

Keywords: Gender, Workplace, Working Conditions, Discussion

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Perceived Risk and Response to the Ice Throw Hazard: Comparing Community Stakeholders with Operations and Maintenance Personnel in Two Regions of Texas

Denise Blanchard, Texas State University, rb06@txstate.edu
Gregory Klaus, Katoen Natie, klausgreg@hotmail.com

Risk managers who work directly with wind energy know that accumulations of ice on wind turbine blades pose a substantial risk to wind farm employees as well as community residents in surrounding areas. As we continue to install more and more turbines, the level of risk exposure to residents and workers alike increases accordingly. Thus, the goals of this research, guided by the Protective Action Decision Model (PADM), were threefold: 1) to understand the extent to which the two major groups at-risk—community residents and operations and maintenance personnel at local wind farms—might differ in their perceived levels of risk to the ice throw hazard; 2) to understand the degree to which community residents and operations and maintenance might differ on choosing measures of protection for their affected areas; and 3) to identify protective action measures that all stakeholders—community citizens, wind farm employees, contractors, and land owners—are willing to undertake to reduce their risk exposure from the hazards associated with wind turbine ice throw. Findings demonstrated statistically significant differences between the two groups on: observed risk, perceived personal risk, risk to the community, levels of trust in safety leaders, best protective actions, and preferred warning systems.

Keywords: Ice Throw Hazard; Wind Turbine Hazards; Protective Action Decision Model (PADM); Hazards Risk Perception

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Art, Allegory and Geographic Education: Cultural and Meteorological Lessons from the Sky Deities of Japan

Dennis J. Edgell, University of North Carolina At Pembroke, dennis.edgell@uncp.edu

Folklore and mythology are not proper history or science fact, however there is a reasonable basis for why regional culture myths persist. Japan's Shinto religion holds Raijin as a god of lightning storms, and Fujin as a god of windstorms and tornadoes. These sky deities were depicted as demonic, destructive forces of nature in traditional Japanese art, iconography and cultural landscapes. Educational modules were developed for teaching geography, weather and climate concepts to students in general education, arts and humanities. Shinto and Buddhist art and allegory were used to explain and exemplify concepts in physical and cultural geography. Myths such as Raijin's penchant for eating the navels of children, or why Fujin's skin is green, were used to illustrate principles of meteorology, and characterize culture. Geographic pedagogy explained why Japanese painters of the Edo Period depicted lightning flashes as red in color, even though lightning clearly is not red. Educational modules also elucidated weather phenomenon such as gust fronts, nitrogen fixation by lightning, cyclonic winds, and others. Human geography concepts, such as diffusion and syncretism were also utilized as teaching points. Geography students reinforced their understanding of physical geography and gained an appreciation for Japan's art and culture

Keywords: Geographic Education, Cultural Geography, Meteorology, Japan

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Using Virtual Reality (VR) to deliver an Iceland field geography experience to the on-line classroom.

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Increasing student enrollments in on-line education presents a number of challenges in delivering field geography content to the on-line classroom. A significant challenge is providing an engaging, interactive and tactile experience to maximize student engagement though a rich sensory experience that classroom

and field experiences provide. Virtual Reality (VR) is a computer-generated simulation of a three-dimensional image or environment which offers the student a more robust learning environment. VR images or environments can be designed with interactive hotspots that offer on-line students enhanced immersive environments to experience geography. Students are able to interact with VR geographic content in a "seemingly real or physical way" that excites the senses. During a National Council for Geographic Education (NCGE) trip to Iceland the Geocamp participants captured three-dimensional, 360 degrees field site images from the Southwest, the Golden Circle and Southeast Iceland. These three-dimensional images were each embedded with hotspots of information that include lessons targeted to site specific biotic and abiotic features and human geography attributes to bring a full Iceland field experience into the online classroom. This poster provides the overall integration of that content with featured geographic lessons to showcase the advantages of VR in the online classroom.

Keywords: virtual reality, immersive experience, geographic content, human geography attributes, physical geography attributes

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Mapping invasive species in urban forests using high- resolution aerial image time series and detecting the spatial-temporal change using deep-learning

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Invasive plant species have been a problem in the Mecklenburg County, North Carolina, where extensive anthropogenic disturbances and habitat fragmentation have facilitated the colonization and propagation of invasive plant species; at the cost of local vegetation. A robust and efficient method for detecting invasive species is crucial for risk assessment and the development of effective mitigation practices. This study aims to develop a fine-scale remote sensing model to map invasive plant species i.e. Autumn Olive (ElaeagnusumbellataThunber) in the Mecklenburg County from 2012 to 2018, using multi-temporal high-resolution (0.1 m) visible band time series aerial images, and textural classification methods in a deep learning environment. The study presents an opportunity to monitor the current and historical extent of Autumn Olive and analyzing their propagation and dispersal dynamics overtime. Further, the study will also assess the efficacy of not only high resolution images, but also the textural classification method using deep learning method, in terms of mapping accuracy of Autumn Olive. The study will hopefully help to identify the hotspots of invasive species presence and potential

spread, which, in turn, will assist local policy makers and land-use managers to formulate, prioritize and implement mitigation measures against the spread of the invasive Autumn Olive.

Keywords: Invasive species, remote sensing, high-resolution image, deep-learning

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Supermarket Site Selection in South Dallas

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Over the past years, the City of Dallas has struggled to recruit a mainstream supermarket into South Dallas, a lower-income community of color. The depth of this reluctance by supermarket retailers is underscored by their rejection of a $3 million incentive program to operate in South Dallas, a decision that has been reinforced by recognized disparities related to median household income, poverty rates, and lingering perceptions of high crime rates. Past studies that have evaluated market conditions in the South Dallas community, however, have overlooked key economic indicators that have more relevance in understanding food-at-home expenditures. The absence of a market demand study in South Dallas has further added to this vacuum of objective information. Using data from the American Community Survey, Department of Agriculture, and the Food Marketing Institute, we conducted geospatial and statistical analyses to develop a non-traditional site selection approach that identified various census tracts and block groups that showed the economic potential to sustain the estimated annual sales of a mainstream supermarket. The results of our analysis have engaged community advocates and offers some promise for using non-traditional approaches in site location decisions that involve lower-income communities of color.

Keywords: Food deserts, blacks and Hispanics, site location analysis, communities of color

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Who's Moving In? A Longitudinal Analysis of Home Purchase Loan Borrowers in New Transit Neighborhoods

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This paper examines the characteristics of residents moving into new rail transit neighborhoods using longitudinal, individual-level data from the Housing Mortgage Disclosure Act. To disentangle the role of transit from other neighborhood amenities that may give rise to shifts in the socioeconomic or demographic profile of homebuyers, an exploratory text analysis is first performed on property advertisements in transit-adjacent neighborhoods. This informs the creation of variables for our models that estimate the probability of an applicant applying for a loan by race and income, and highlights where light rail is most prominently advertised as an amenity. We do not find that the announcement of a new light rail line significantly alters the income profile of loan applicants. Rather, proximity to the center city is a more important determinant in attracting higher-income applicants. We do find that the announcement of the transit line is significant in explaining changes in the racial profile of applicants. Post-announcement, White applicants are significantly more likely to apply for loans in transit-adjacent neighborhoods, while Blacks are significantly less likely to. As for other amenities, the walkability of a neighborhood is significant in predicting where White applicants are more likely to apply for home purchase loans.

Keywords: Transit, Neighborhood Change, Residential Mobility

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A Geostatistical Framework to Map the Variation of Arsenic found in Private Wells in Gaston County, NC

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The management of water quality from private wells faces challenges due to low testing rates and limited knowledge of treatment options from well users. These challenges are exacerbated with known presence of contaminants.
We propose a geostatistical framework to monitor water quality from private wells. Specially, we predict the variation of arsenic at unknown locations, based on limited set of samples. Ultimately, these results help to determine the most at risk regions to target for well testing education.

We illustrate the benefit of our approach using inorganic test results of private water wells from 2011 to 2017 in Gaston County, NC. We use indicator kriging to determine areas exceeding a threshold for contaminants across Gaston County. Our approach is portable to other regions facing similar issues of small samples, and the functionality can further be embedded into a real-time surveillance system for the management of water quality from private wells.

Keywords: geostatistics, water quality, indicator kriging, environmental health

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A Scenario-Based Simulation of Urban Growth by Coupling Random Forest and Cellular Automata

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Sustainable urban growth management requires more sophisticated and elaborative models with different urban growth scenarios. An innovative integration of Random Forest and Cellular Automata (RF-CA) is proposed in this paper to simulate urban development under three urban growth scenarios including current trends, controlled urban development, and environmentally sustainable urban development. While the scenario of following current trends allows the urban fringe to be uncontrollably developed, the controlled and environmentally sustainable urban development scenarios constrain future developments and reduce the environmental implications. A variety of data sampling strategies, predictor variables, and model configurations are explored to enhance the accuracy and predictability of the proposed model. The model is calibrated using spatiotemporal data of 1992-2011 and is applied to simulate future urban developments in 2021 and 2031 for rapidly urbanizing city of Charlotte, NC, USA. The accuracy and reliability of the model are evaluated by apposite evaluation metrics and the simulated urban development patterns are examined using several cost indicators from the perspective of sustainable development. The results demonstrate that the proposed model is a fast, high-performance and accurate model with low uncertainty; therefore, it can be effectively utilized for evaluating a wide range of urban development policies and scenarios.

Keywords: Urban Growth, Machine Learning, Random Forest, Cellular Automata, Scenario-Based Simulation, Sustainable Development

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Panel: How Geographers Can Have Influence within their Organizations

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Many organizations realize the value of having a GIS/Geography professional or two within their ranks. However how are these departments viewed in the overall operation of the organization? Are they simply viewed as the "mapping team?" or can they have a broader influence on analytics within an organization? There is a greater realization that everything happens somewhere. How have some within our Geographic community been able to break the mold of simply being the mapping team and become recognized as thought leaders within their organization?

Keywords: Thought Leadership, Influence

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Access and prices for organic produce in St. Louis

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The purpose of this study is to examine (1) access to organic produce at select St. Louis area grocery stores and (2) price differences between organic and conventional items. Twelve grocery stores, primarily located in the Metro East and St. Louis City, were visited in April 2019. Prices were recorded for both organic and conventional variety of the 2019 "dirty dozen" items. The so-called "dirty dozen" are 12 produce items identified annually by the Environmental Working Group as having the highest pesticide residue; consumers are often urged through news and social media to consider purchasing these 12 items in organic form in order to avoid possibly harmful exposure to pesticides. Consequently, these 12 items were investigated for availability and price as compared to conventional versions. Findings indicate that organic options at the 12 stores were limited. Strawberries, kale, celery and apples were widely available while the remaining 8 items were either found only at a few stores or not at all. Prices for organic items were higher, usually 50 cents to $1.00 per pound higher than their conventional counterparts.

Keywords: Organic produce; Conventional produce; Price; Food access

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The Geography of Dark Stores

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Dark stores are retail properties that are vacant, the lights are off. Why do individual stores and retail centers go dark? With changes in technology, omnichannel adoption, consumer preferences, demographics, propensity for reuse, customer shopping habits, transportation networks and cost, some retailers continue to perform well with brick and mortar stores, while other retailers have faced store closures through bankruptcies, restructurings, mergers, shareholder activism, or having adopted smaller retail store footprints with reduced number of SKUs.

This research focuses on single-tenant big box retailers. Our contribution addresses how changes in trade area demographics, economics, and retail stock characteristics —particularly, supply, demand, and rents — collectively contribute to big box retailers going dark.
One possible result of our experiment is that the trade area demographics are similar for both the subject property and sale comparables. On the other hand, and generally found with dark store methodologies, trade area demographics for the sale comparables are significantly different from the subject property thus lack foundation to support any valuation conclusions.

Keywords: Key Words: big box retail, location viability, omnichannel, trade area analytics

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The Evolution of Cuba's air transport network in the Embargo era; An analysis of Cuba's lack of air connectivity with the U.S. between 1967 and 2017.

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Prior to August 2016, there were no regularly scheduled commercial flights between the United States and Cuba. With improved relations between both countries, U.S. based airlines were given the green light to resume regularly scheduled operations. However, the enthusiasm resulting from the renewed

relations casted a shadow on the ramifications that the lack of U.S. connectivity had on Cuba's transportation network in the first place. This paper examines the impact of Cuba's lack of connectivity with the U.S. air transport network using data from historical airline schedules between 1967 and 2017. Origin and destination matrices were created to reconstruct and map Cuba's air transport network. Then, aggregate connectivity measures were used to assess the efficiency of the air transportation system, and total connectivity measures were calculated to assess the changes in accessibility for Havana in comparison to other major gateways in the region that had access to the U.S. Results indicate that although a lack of connectivity to the U.S. was a huge economic limitation, from an air transport perspective, this lack of connectivity to the U.S. could be interpreted as beneficial because it forced Cuba to broaden its network and as a result it made it less U.S. dependent.

Keywords: Transportation, Cuba, Airlines, Networks

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Spatial Variations in the Associations of Mental Distress with Sleep Insufficiency in the United States

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Mental health incorporates our emotional, psychological and social well-being and it is critical at each phase of life, from youth and pre-adulthood through adulthood. Insufficient sleep plays a significant role in worsening depressive and anxiety disorders. A number of epidemiological studies have indicated that sleep disorders in participants with no depression is an important risk factor for later development of depression and anxiety. We assessed the association between mentally unhealthy days (MUDs) and series of its confounding factors on the basis of cross-county studies. Data on poor mental health days and insufficient sleep for the U.S were based on health-related telephone surveys conducted by Behavioral Risk Factor Surveillance System (BRFSS). Other potential covariates including health behavior, clinical care, socioeconomic, and demographic statistics are collected from various data sources (e.g. CDC diabetes interactive atlas). This paper shows the methods and results of a spatial cluster analysis of MUDs and insufficient sleep in 2014. Moreover, Principal Component Analysis (PCA) is adopted to help identify geographic patterns of insufficient sleep with other covariates subsequently to identify components sharing a similar distribution pattern. The analyses are likely to demonstrate how MUDs is associated with insufficient sleep in the United States. These findings suggest a need for further investigation into the extent that insufficient sleep may serve as a triggering factor for mental distress and have

major implications in our understanding of the etiology of mental distress by medical professionals.

Keywords: insufficient sleep, mental distress, spatial cluster analysis, Principal Component Analysis, BRFSS

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The spatial threshold effect and its regional boundaries of financial agglomeration on green development: A case study in China

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Although financial agglomeration is a key approach to the green development transition of China's economy and society in the new era, its economic benefits are far more concerned than its environmental benefits in existing researches. Moreover, there are few studies have examined the spatial threshold effect and its regional boundaries of financial agglomeration on green development from the perspective of time-space, which may resulting in conflicting conclusions. We first theoretically analyze the spatial threshold effect of financial agglomeration on green development based on agglomeration economies theory, polarization-trickle-down theory and information asymmetric theory; then empirically employ modified Super_Slack Based Measure (SSBM) model to measure the current status of green development, adopt Spatial Panel Durbin Model_ Panel Threshold Regression (SPDM_PTR) combined model to identify the spatial threshold effect and its regional boundaries of financial agglomeration on green development by using panel data of 272 prefectural-level cities in China from 2003 to 2014. The results show: (1) Financial agglomeration has a "leap-forward" promoting effect on local green development, that is, high-level financial agglomeration > medium-level financial agglomeration > low-level financial agglomeration; (2) There are stage differences in the spatial spillover effect of financial agglomeration on green development, specifically, the spatial spillover effect of high-level financial agglomeration is significantly stronger and opposite to medium-level and low-level; (3) The regional boundary of the spillover effect changes with the financial agglomeration level, for instance, the regional boundary of high-level financial agglomeration is 1480km, which is significantly larger than 860km of medium-level and 700km of low-level. Accordingly, to achieve the goal of using financial agglomeration to promote green development, the leading financial cluster should be built on the premise of combining the development advantages of each region,

thus form a dense financial agglomeration network covering different levels of the whole country. It is also important to develop differentiated financial agglomeration strategies and improve financial agglomeration level through internal reform and external leverage, hence promote financial agglomeration to exert positive spatial spillover effect on a larger scale.

Keywords: financial agglomeration; green development; spatial threshold effect; regional boundary; SSBM model; SPDM_PTR model

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The Geographically Varying Association Between Obesity and Crime: A Case Study of Akron, Ohio

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Existing research on the associations between obesity and crime often revealed inconsistent results. This could be due to the misleading implied assumption of spatial stationarity and the inconsistent measurement used to assess neighborhood safety and health. This article reports a study that uses geographically weighted regression (GWR) models to further explore the spatial associations between obesity and crime in Akron, Ohio. The study uses the body mass index (BMI) calculated from drivers' licenses and police records to describe levels of local obesity prevalence and safety, respectively. Findings include that neighborhood's violent crime, socioeconomic status (SES), and environmental characteristics explain 50.82% of the levels of local obesity prevalence, though the associations vary spatially. The GWR model produces better results than the conventional Ordinary Least Square (OLS) regression method. Thus, different strategies should be applied to improve neighborhood safety and health according to local conditions.

Keywords: Obesity, crime, geographically weighted regression

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Economic Impacts of Craft Breweries: On the Relationship between Craft Breweries and Property Values

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In recent decades, the American craft beer industry has experienced impressive growth. Between 1980 and 2018, the number of craft breweries in the United States increased from 8 to 7,346. This has made craft breweries an economic force at the local, state and national levels. Recent literature and public discourse emphasize the tendency of craft breweries to engage in adaptive reuse and their effect on revitalization of economically distressed neighborhoods. With this, many are reporting rising property values in neighborhoods where craft breweries have located. This research examines the impacts of craft breweries on residential property values. Hedonic estimators are applied to 48 cities of varying sizes across the United States using detailed data on all properties sold between 2000 and 2017. To identify the effect of brewery openings on property values, we estimate both the effect of distance to a brewery as well as a difference-in-difference estimator. In addition to controlling for changes in neighborhood characteristics at the block group level which may affect property values, we also control for neighborhood level unobservables and sub-market-to-city relative change in property values. Our hypothesis is that the effect of craft breweries on property values is contingent upon overall city growth.

Keywords: craft breweries, property valuation, local economic development, neighborhood revitalization

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The "mystery flood" on the upper San Marcos River, Texas, October 2015

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The Memorial Day 2015 flood in central Texas that led to over $1 Billion in damages and at least 8 deaths received national attention. Five months later an even larger flood occurred on the San Marcos River and caused considerable damage in San Marcos, Texas. The October flood was produced by the spill of upstream flood control dams, only the second spill since the 1991, and was only 1 ½ feet lower than the October 1998 spill with a USGS discharge of 21,500 ft 3 /sec (gage 08170500). This latter flood does not show up on the USGS website under "peak streamflow," but under the "mean daily" data shows an estimated 5400 ft 3 /sec, that is greater than all the "peak streamflow" values since 1995 except the October 1998 flood. The NWS weather station for San Marcos shows a total of only 6.20 in. and 3.05 in. for Oct. 30 and 31, whereas nearby CoCoRaHS stations have daily values of over 10 in. and two-day totals over 12 in. Employing the USGS slope area method, regression analysis of stage to peak discharge, and

the relationships between mean daily flow and peak discharge, the authors estimated that actual peak was approximately 17,000
ft 3 /sec., the second largest flood since 1985. After reviewing time of observation and recorded precipitation values, the authors conclude that some sort of observation, recording, or reporting error was made in the NWS data.

Keywords: Texas Floods, flood estimation, precipitation measurement

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A New Classification Scheme for New Immigrant Destinations

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Since the 1990s, the United States has witnessed the proliferation of immigrant communities in metros that immigrants were traditionally indifferent. Following the trend, research on new immigrant destinations has boomed in a relatively short period. Various classification schemes have been introduced to distinguish new immigrant destination metros from the traditional ones, and most of those are based on two standard criteria: change in share of immigrants and the growth rate of immigrants in recent decades. The current classification standard is, however, problematic in two respects. First, each researcher is arbitrarily applying thresholds for immigrant share or immigrant growth rates, so sometimes one metro is classified into two opposite types of categories. Second, more importantly, the existing classification schemes do not reflect the Pareto distribution of immigrant destination at the metro level. The immigrant community is not merely formed by the socioeconomic factors of the single metro area but is formed in competition with immigrant communities in other regions. This paper presents a methodology for new immigrant destination classification using the head/tail scheme of Jiang (2013). It reflects the heavy-tailed distribution of the study subject while rejecting arbitrary criterion selection.

Keywords: new immigrant destination, classification scheme, Pareto distribution

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Examining the Dynamic Influence of Road Traffic Volumes on Red Deer Movements in GIS

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New developments from time-geography have expanded the study of animal movement and interactivity towards an examination of environmental context as an influence on animal movement behaviors. Specifically, the probabilistic estimation of animal position at temporal intervals between those observed (via GPS, radio telemetry, etc.) has enabled researchers to quantify animals' interaction with their context at temporal scales finer than previously possible. Applications for these methods include quantification of wildlife-road interactions, although these studies do not currently incorporate traffic conditions in their presentations. This paper applies and extends methods from time-geography, including the probabilistic space-time prism (PSTP) and the comprehensive probability surface (CPS) towards an analysis identifying serial and cross-correlation between hourly patterns of animal-roadway interaction and traffic volumes for Red Deer (Cervus elaphus) in Banff National Park, Alberta, Canada. This approach represents further development on quantifying wildlife-road interactions, treating hourly traffic volume as a dynamic element of the environment and an influence on animals' use of roadside habitat. Implications for wildlife management are discussed.

Keywords: Red Deer, Road Ecology, Time Geography, Traffic Counts

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Assessing the Level of Spatiotemporal Clustering among Geographic Events Without No Attribute Information

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Several spatial analytics have been extended to measuring spatial and temporal clustering levels among geographic events. However, these spatiotemporal analytics typically need the events to have some quantitatively measured attribute values. For example, the spatiotemporal Moran's Index that falls into this category. In real-world research, however, we often come across needs to know how geographic events cluster across space and in time, such as data recording burglaries or data recording observations of animal/plant habitats, that recorded only locations and times but without attribute information of these events.
To provide a way to assess the level of spatiotemporal clustering among events, this presentation discusses an index for spatiotemporal nearest neighbor analysis. This index needs only the coordinates and time stamps of each event. A simple set of equations have been developed from extending the spatial case of nearest

neighbor index. The equations were reasoned from mathematical equations so it allows quick and precise calculation of the assessment. Finally, statistical significance of the calculated index value can be evaluated using the equations.

Keywords: spatiotemporal clustering, GIS

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An Examination of the Influence of Gentrification on Postindustrial Policing in New York City

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This presentation concerns the testing of the postindustrial policing concept which posits that cities implement economic growth strategies designed to increase the presence of upper-class residents in financially depressed areas. This strategy typically creates conflict between the poorer older residents and the wealthier newcomers (gentrifiers) whose economic power facilitates the adoption of punitive policing tactics to aid the process of place-remaking. Using New York City as the focus of study, an examination of spatially oriented demographic, gentrification, and police stops data tends to statistically support the claims of a significant association between policing and the gentrification process.

Keywords: Policing, Gentrification, Residential Inequality, Race and Place

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Methods of Capturing and Analyzing Blight: Case Study Youngstown, Ohio.

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Previous methods for capturing fine-scale neighborhood built environments centered around surveys of residents and/or property inventories. Typical surveying is not only time consuming and costly, it potentially places the survey taker, often a volunteer, in a vulnerable position. The subject matter dictates that these surveys often occur in areas with high crime rates and where many "residents" are not inclined to be recorded or having their activities detailed. Spatial video (SV) surveys can be thought of as the next generation in fine-scale assessments and provides an alternative way of capturing a neighborhood, quickly, for multiple time periods and from the safety of a vehicle. Advances in SV technology has allowed for increased utilization in field applications to record

environments. SV surveys were conducted in Youngstown, OH over a three-year period to capture changes in neighborhood blight. Three developed coding systems are utilized to analyze and track the changes in blight and overall built environment of two neighborhoods in Youngstown.

Keywords: Spatial Video, Built Environment, Blight

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Integrating Data for Regional Decision-Making: A Statistical and Geospatial Framework for the Americas

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National, regional and global decision-making necessitates the integration of geospatial and statistical data. One of the goals of the Regional Committee of the United Nations on Global Geospatial Information Management for the Americas (UN-GGIM:Americas) is developing the framework for such integration. The Statistical and Geospatial Framework for the Americas (MEGA) was developed as a result of this goal and standardizes the integration of housing and population data (disaggregated by sex) to three levels of geography. In this session, I will explain the MEGA standard, the data submitted by the United States Census Bureau and the challenges associated with submitting data in this format.

Keywords: Census, Geospatial Data, International

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Quantifying the Relocation of Greyhound Bus Terminals Over Time

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After experiencing a marked decline during the previous forty years intercity bus travel has experienced an increase in ridership and service levels in the past decade. Much of this increase is due to new intercity bus companies with curbside drop off. However, during this period legacy intercity bus operators such as Greyhound have continued to operate dedicated bus terminals, often occupying valuable real estate in central business districts (CBD). In this study, historical source materials are used to reconstruct the location of urban Greyhound bus terminals in 70 cities from the 1930s until the present. Next using a regression model, the study quantifies bus terminal relocations. The study concludes,

controlling for population area and multimodal transportation hubs, that current operating Greyhound bus terminals are approximately 24 percent further away than terminals no longer in operation.

Keywords: Central Business Districts, Bus Terminals, Intercity Buses, Historical Geography, Urban Geography, Infrastructure

<p style="text-align:center">*****</p>

Light rail investments and neighborhood change: Perspectives of residents, stakeholders and local media in Charlotte, North Carolina

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Rail transit impacts on adjacent neighborhoods are contested. We investigate the socioeconomic and physical neighborhood changes following rail investment and the impacts on local residents. We conducted interviews with 12 local stakeholders in planning, transportation, and real estate; 11 focus groups with 75 residents living close to a light rail station; and a content analysis of 86 local news articles in Charlotte, NC, where a 9.2-mile light rail extension opened in March 2018. The light rail is a transportation tool as well as a private investment attractor. Multi-family, luxury apartments built along the rail are attracting younger, higher income residents, and investors are approaching homeowners to buy and remodel or tear down and rebuild single family homes. That said, changes are not the same around each station and long-term (mostly African American) residents do not have a uniform response to these trends. Long-term residents are trying to stay put in the face of rising rents and property taxes, but displacement pressures are high for lower-income residents. Because of a nation-wide renewed interest in living close to downtown, public transit and local businesses, and overall Charlotte metropolitan growth, it is difficult to measure the exact role of the light rail.

Keywords: rail transit, neighborhood change, transportation, mixed-methods

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Patterns and Processes of Political Factionalism in the US

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Schisms in American society and politics seem to be widening, with political factions entrenching on policies and goals that further separate the two dominant parties while leaving many in the middle struggling to identify with either party. At the same time, economic inequality is growing, and religious identity contributes to this rift even as the number of "nones," those professing no faith or congregation at all, are on the rise.

Within this framework, this paper explores the linkages between religion, politics, and socioeconomics in the US. Using data from the Pew Research Center on religious beliefs, voting and voter registration data, and socioeconomic data from the American Community Survey, this paper identifies the traits that define certain regions of the country via regression and cluster analysis and looks for signs that these divisions are either widening or narrowing. These clusters of like-minded citizens, if sufficiently strong and different from other parts of the country, pose a possible threat to the cohesiveness of the US. Given the rapid changes taking place in US society, the disintegration of the union into smaller, more homogenous states seems more possible. Such devolution would have profound economic, political, and social impacts for the country.

Keywords: Political factionalism, Religiosity, Multivariate Analysis

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Teaching the spatial analysis of convenience store location, demographics, and behavior.

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Teaching the spatial analysis of business location, demographic characteristics and trends, and consumer behavior can be effectively accomplished using Business Analyst Web and a lesson created and tested in many settings and universities. In this session, the author will explain not only how and why the lesson was created, but how you can use the same lesson and develop your own based on similar data and tools for different businesses or different locations. The aim of the lesson and for using the tool in business, sociology, and geography courses is to foster critical and spatial thinking and meaningful work with real-world data. The lesson activity includes mapping regional business patterns and demographic characteristics, and ends with site selection for a single community at the local scale, including the computation of drive times, infographics, and the detailed study of potential sites. Esri's Business Analyst Web contains millions of business locations and thousands of

demographic and behavioral variables for over 100 countries in a cloud-based set of tools that require no installation.

Keywords: business, site selection, convenience stores, teaching, GIS

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Craft Breweries and Neighborhood Crime Rates: A Case Study of Portland, OR

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There are over 7,000 craft breweries in the United States. Their popularity is driven primarily by the millennial cohort, who are attracted to the diversity of beer styles offered by craft breweries. Their popularity is also attracting the attention of local economic development agents, who see potential economic benefits of a successful craft brewery. In their search for inexpensive real estate, many craft breweries have located in buildings in economically distressed neighborhoods. In many cases, craft breweries have contributed to the revitalization of neighborhoods. However, as a business that serves alcohol, some people are concerned with potential negative externalities associated with craft breweries. One concern is a possible increase in crime rates. Using Portland, OR as our case study, our purpose in this paper is to quantitatively assess whether neighborhood crime rates significantly change after the opening of a craft brewery. In our analysis, we control for changes in neighborhood characteristics (which may occur simultaneously) that may also have an effect on crime

Keywords: craft breweries

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Transportation Policy for Elderly Users through the Smart-Card Spatial Autocorrelation Analysis

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Smart-card transactions contain user information and travel patterns. Thus in this study, elderly smart-card transactions were analyzed to derived elderly captive rider's hotspots which need appropriate social services for them. There has been scarce focus on the spatial autocorrelation of smart card big data when developing new traffic policy. Therefore, in this study, spatial autocorrelation analysis was performed using Seoul's smart card data for six weeks. In the collected data, 76.3% of the elderly trips were concentrated on the subway, which offers free tickets. For this reason, this study examined elderly captive bus riders. Moran's I was 0.277 for the elderly smart-card transactions and it has positive spatial autocorrelation under the significance level 0.01. Local Indicator of Spatial Association analysis used to identify areas where spatial autocorrelation occurred. 50 administrative units (dong) in Seoul were hotspots, and spatial clustering was confirmed; 61 dongs were cold spots. The distribution of hotspots and coldspots seems to be closely related to subway supply level rather than the elderly population. 28 hotspots seriously need appropriate social services for elderly bus users because those hotspots do not operate subway service. First, barrier-free bus stops should be installed at 28 hotspots. Second, 64 bus lines which pass the 28 hot spots, need to get high priority when supply low-floor buses. Third, propose the low-floor bus shuttle service from/to 28 hotspots by analyzing the top nine origins and destinations of elderly. To propose more developed public transport policy for the elderly, smart-card spatial autocorrelation analysis can be used.

Keywords: Spatial Autocorrelation; Elderly; Smart Card; Big Data; Social Service

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Quantifying spatial and temporal patterns of fine particulate matter (PM2.5) concentrations in California (1998 – 2016)

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Elevated levels of fine particulate matter (PM2.5) are associated with premature death, increased risk of cardiovascular and pulmonary disease and according to the World Bank, cost the global economy over 225 billion US dollars in lost labor annually. While the overall air quality in California has improved over the last several decades, local and regional anomalies exist. Due to the sparseness of monitoring stations, trends in air quality are often reported at coarse areal units such as counties or air basins making it difficult to assess local health impacts on vulnerable populations. Using North American Regional Reanalysis (NARR) climate data and satellite aerosol optical depth derived PM2.5 concentrations, this paper

shows the variations in annual PM2.5 concentration at a fine spatial scale (50 square kilometers) across time using time series trend analysis and time series clustering. A taxonomy was developed that synthesizes the spatial and temporal patterns. Using areal interpolation, demographic data were downscaled to the same 50 square kilometer areal unit as the air pollution data and used to identify disparities in air pollution exposure among vulnerable populations.

Keywords: air pollution, health, time series, clustering

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The Regional Impact of High Speed Rail in China: A Spatial CGE Assessment

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High-Speed Rail (HSR) has experienced a rapid development in many countries in the world, but how can planners and decision makers better understand the regional economic impact of the gigantic system remains a challenge. This paper introduces a comprehensive framework to assess the regional economic impacts of HSR using China as an example. The regional economic impacts of HSR are evaluated under a dynamic and spatial computable general equilibrium-modelling framework. Such a framework provides a comprehensive assessment of the impacts in terms of both temporal and spatial variations. The assessment provides an ex post evaluation of the impacts based on the actual data reflecting the infrastructure development and operation in the period 2002–2013. The research findings confirm that HSR infrastructure development in China has generated a positive regional economic impact. The growth rate of the real GDP stimulated by rail infrastructure investment were found particularly substantial in the southwest, but relatively small in the developed eastern regions. Conversely, the real GDP level change was found to be relatively large in the developed regions, such as the south and the east. The disaggregated analysis shows that the contributions to regional economic growth are primarily derived from the productivity increase in rail transport sector and the stimulus effect of rail infrastructure capital investment. The research findings provide implications for future HSR development in both Europe and China

Keywords: High Speed Rail, CGE, Spatial Analysis, China

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Natural amenities and local government public goods: Substitutes or complements?

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The attractiveness of a location depends on the combination of natural amenities and local government public goods. I propose that locations differ in their stock of local government public goods because of differences in existing natural amenities. Some local government public goods are either necessary to overcome natural characteristics or less costly to provide in certain locations. More specifically, I propose that some local government public goods are substitutes to natural amenities while others are complements. Using county governments as my unit of analysis, I explore how a county's tax policies and expenditures vary with respect to natural amenities. Analyzing county-level data on climate, topographic type, coastal vulnerability, water body types, recreational areas, and tax policies and government expenditures for the period 1972-2012 using simultaneous autoregressive (SAR) spatial regression models, I explore which natural characteristics of locations are important for the determination of tax policies and levels of county expenditures. My preliminary estimation results show that some local government public goods are substitutes to natural amenities while some are complements. Moreover, my results show that there are spillover effects among adjacent counties in the provision of certain local government public goods.

Keywords: spatial regression, regional development

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Development of Island-Wide Address Data for Puerto Rico

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As Hurricane Irma headed for the U.S. island territories in the Caribbean in the early days of September 2017, Federal Emergency Management Agency staff realized that the absence of island-wide authoritative address data would require modifications of standard geospatial practices and procedures to carry out response and recovery efforts. The large number of ungeocoded addresses and lack of a standard addressing system across Puerto Rico meant that aerial assessments for households filing for assistance were often impossible to link to a mailing or

location address on the ground. Hurricanes Irma and Maria highlighted the challenges for Federal agencies that rely on residential addresses to supply services in Puerto Rico. Recognizing the need for a federal response to the addressing challenges in Puerto Rico, the White House National Science and Technology Council's Subcommittee on Disaster Reduction (SDR) hosted the Puerto Rico Address Data Workshop in October 2018 with 39 participants from 12 federal agencies. This led to formation of the Puerto Rico Address Data Working Group. In this presentation, we discuss the challenges posed by the lack of island-wide address and housing location data for Puerto Rico and the efforts underway to develop and maintain the address and geospatial data needed to respond effectively to future events and natural disasters.

Keywords: Addresses, Puerto Rico, Emergency Management

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Assessing Social Vulnerability to Flood Hazards in Canada's Three Largest Census Metropolitan Areas

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This paper analyzes the spatial distribution of social vulnerability to flood hazards in Canada's three largest census metropolitan areas (CMA) - Toronto, Montréal and Vancouver. Following the Cutter's hazard-of-place model approach, microdata from the 2016 Canadian census of the population was utilized to construct a national-scale social vulnerability index (SoVI) over 5739 census tracts. The index comprised of theoretically significant and policy-relevant factors that represent diverse aspects of socioeconomic, demographic, and ethnicity status of Canadians. The 2018 JBA flood hazard extents (undefended) data and the JBA river flood defence data from JBA risk management were exploited in the study to estimate the total percentage of land area in a census tract subject to combined pluvial, fluvial, and coastal flood hazard exposure at the 100-year flood return period. Flood hazard extents data was superimposed on the social vulnerability index to highlight spatial patterns of social vulnerability and to identify geographic flood disadvantaged groups of communities within a CMA. GIS-based social vulnerability mapping is recognized as a useful tool for hazard mitigation, adaptation and flood risk management planning which helps reduce flood losses and strengthen flood

disaster response as well as a recovery mechanism. Research findings recommend designing custom-made flood risk mitigation policies to enhance community resilience on the one side and to reduce social inequality on the other.

Keywords: Flood hazards, Social vulnerability, GIS analysis, Hazard mitigation, Flood risk management

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The changing garden: using UAV data to analyze a growing season

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The University of North Carolina at Pembroke has an ongoing garden and apiary project to provide experience and training not only to university students, but also to local middle and high school students. As part of the Kids in the Garden project, regular low-altitude UAV flights have been conducted during the 2019 growing season of the small campus garden area. The collected data will be used to better understand the garden and to demonstrate to future participants how geospatial technologies can be used to support agriculture, even for a relatively small garden. Traditional image analysis methods such as mosaicking, orthorectification, and NDVI have been applied to the data. Furthermore, off-axis oblique data was collected to generate 3D models to track the vertical growth in the garden. Change detection, both in the surface and vertical data, was made possible through the repeated data collection over the course of the growing season. This paper will review the collection of the data by students and faculty, as well as the ways that the data has been analyzed.

Key Words: UAV, DSM, imagery

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Spatial and Temporal Analysis of Fentanyl and Cocaine Overdose Deaths in Pennsylvania

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The United States is experiencing an increase in fentanyl and cocaine overdose deaths. These overdose deaths are attributed to two factors: China's recent upsurge in fentanyl manufacturing which is later distributed to Mexican transnational crime organizations (TCO's) and a decreased effort by the Colombian

Government eradicate Colombia's coca crops. On average, United States' fentanyl and cocaine deaths have tripled between 2016 and 2017. According to the CDC, in 2017 Pennsylvania was one of the top five states with the highest drug overdose deaths, and one of the states with a statistically significant increase in drug overdose deaths rates from 2016 to 2017.

This research analyzed the spatial and temporal trends in the reported fentanyl and cocaine overdose related deaths in Pennsylvania from 2016 to 2017. Specifically, this analysis examined how income, age, and race correlated with fentanyl and cocaine overdose deaths according to urban and rural settings. This analysis showed that rural areas present a statistically significant higher number of fentanyl and cocaine deaths compared to urban settings. In addition, overdose deaths saw a steady increase throughout the study period. These results were also used to re-prioritize existing drug addiction programs.

Keywords: Fentanyl, Cocaine, Overdose Deaths, Pennsylvania, Drug Addiction, Rural Settings, Urban Settings, China, Mexican Transnational Crime Organizations (TCOs), Colombia, Crop Eradication Efforts, Drug Addiction Programs, Increase in Availability, Demography, Spatial Analysis, Temporal Analysis, Geostatistics, Clusters, Hot Spots, Trends, Statistics, Geospatial, GEOINT, Geographic Analysis

<p style="text-align:center">*****</p>

Connecting People with Jobs: Light Rails Effect on Intra-urban Distribution of Economic Activity

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This paper examines the impact of light rail investment on the types of jobs (i.e., industrial, occupational, and wage composition) accessible by transit, in adjacent neighborhoods in a case study on Charlotte, North Carolina. Applying a quasi-experimental approach, this research aims to address: (1) To what extent does rail transit affect the industrial and wage composition of jobs in neighborhoods adjacent to fixed rail stations?; and (2) To what extent does rail transit affect the industrial and wage composition of workers in neighborhoods adjacent to fixed rail stations? For this analysis, we use data from the Longitudinal Employer-Household Dynamics (LEHD) Origin–Destination Employment Statistics (LODES) for the time period of 2002 to 2014. The results show no significant increase on employment in

adjacent neighborhoods after opening of the light rail. However, the light rail connects higher-wage neighborhoods to areas with significant shares of higher-wage jobs. Hence, low- and medium-wage workers in light rail accessible neighborhoods have not seen a significant change in the spatial separation between their work place and place of residence after the opening of the light rail, which may conflict with goals of increasing accessibility for the most transit dependent population.

Keywords: Light rail investment, Economic activity, Difference-in-difference, Employment

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In-Office Address Canvassing for the 2020 Census:An Overview of Operations and the Final In-Field Universe

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For the 2010 Census, research indicated the housing inventory, and therefore addresses, in many neighborhoods did not change from one census to the next, and that physically walking each area to review the address list is unnecessary. Research also indicated that the Census Bureau can reliably detect and identify housing stability and change through a combination of imagery and address data sources. Therefore, for the 2020 Census, the Census Bureau conducted the review and update of the address list in the office and targeted fieldwork only where necessary.
In-Office Address Canvassing (IOAC) provided a rich and detailed profile for each block, indicating housing changes that have occurred since the last census and how well the Census Bureau's address list reflects the changes. This assessment enhances the Census Bureau's ability to review and update its address list to ensure a complete and accurate census, and reduces the expensive in-field workload.
This paper describes the major IOAC operations, including an imagery-based interactive review of the 11.1 million census blocks in the United States (first completed in June, 2017). Blocks identified as potentially experiencing change were re-reviewed until March 31, 2019, when the final universe for the In-Field Address Canvassing operation was created.

Keywords: Census, Address Canvassing, 2020

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Spatio-temporal modeling of neighborhood level risks for dengue, chikungunya, and Zika in Cali, Colombia

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Vector-borne diseases (VBDs) affect more than 1 billion people a year worldwide, cause over 1 million deaths, and cost hundreds of billions of dollars in societal costs. Recently, dengue fever, chikungunya, and Zika have been responsible for the majority of the burden caused by VBDs. These three diseases are primarily transmitted by the Aedes mosquitoes. Vector surveillance should begin at the neighborhood level, where many local factors may increase the transmission risk. Dengue has been endemic in Colombia for decades, while chikungunya, and Zika first appeared in 2013. For this study, we examine weekly cases of three VBDs in Cali, Colombia from 2015-2016. Space-time conditional autoregressive models were developed to quantify how disease risk is influenced by socioeconomic, environmental, and accessibility factors - monitoring the progression of each disease over time. Our model is capable of identifying regions with high risk clusters at the neighborhood-level. The results can provide detailed insight about the spatial heterogeneity of disease risk and the associated risk factors at a fine-level, while informing public health officials and community leaders to motivate at-risk neighborhoods to take an active role in vector surveillance and control, while improving educational and surveillance resources throughout the city of Cali.

Keywords: Vector-borne disease, space-time modeling, medical geography, epidemiology

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Assessing the spatial relationship between public schools and fast food restaurants in Kuwait by using geographic information system

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Clustering of fast food restaurants is one of the biggest factors that affect childhood obesity. This study examines the spatial relationship between public schools and fast food restaurants in Kuwait by using a geographic information system (GIS). Buffer and Service Area tools were used at three levels 500, 1,000, and 1,500

meters around fast food restaurants locations to examine the accessibility of schools to fast food restaurants in the study area. Geographically weighted regression (GWR) was also performed to assess the spatial relationship between the fast food and public schools. The study results show a higher percentage of schools that have access to fast food restaurants for both the Buffer and Service Area tools. The GWR results shows also high correlation between fast food and public schools. The use of these geospatial tools could be effective an effective way to assess the spatial relationship between public schools and fast food restaurants; this, in turn, could help the policymakers adapt the necessary measures and lawmakers adopt potential regulations that might limit fast food restaurants from operating near or close to schools.

Keywords: GIS; Fast food; Obesity; spatial analysis, Food environment

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The Urban System in the Sultanate of Oman

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The urban system in the Sultanate of Oman has witnessed remarkable development since the 1970s. This development has two major components: the first component is related to the distribution and ranking of Omani cities according to their size and importance. Some cities are growing very quickly in area and significance. The second component is related to the city as a system and includes all internal elements of cities like their physical and social environment (urban growth and its trends, urban morphology, etc.). This research was based on the theoretical framework of Brian Berry 1964, as he points out in his paper, "cities as systems within systems of cities."

The study examines the urban system in the Sultanate of Oman. It will detect the change in the hierarchy of Omani cities, the phenomenon of urban primacy, and to what extent the city of Muscat exercises the urban primacy over the urban system in Oman. Some Indexes, such as the rank-size rule and the urban primacy index are used in the study, based on the analysis of census data for 1993, 2003 and 2010. The paper will also investigate the internal structure of Omani cities and the changes that have occurred to that structure since the 1970s. Some Omani cities with different population sizes have been taken as case studies (Muscat, Nizwa and Barkaa)

Keywords: Urban System, Sultanate of Oman, Muscat

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Craft Breweries as a Neighborhood Amenity

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There are over 7,000 craft breweries in the United States. An estimated 83% of Americans live within ten miles of a craft brewery. Many urban dwellers, however, live much closer to such an establishment. Inspired by Oldenburg's work on Third Places, this presentation argues that craft breweries are a neighborhood amenity, whose presence can have a positive impact on the quality of life of urban residents. This paper provides the conceptual framework for the other papers in this session, which will explore craft breweries from the perspective of property values, walkability, and crime.

Keywords: Craft Breweries, Neighborhoods, Amenities

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Evaluating Sustainable Development in the Sultanate of Oman: Case study of Ad Duqm

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Sustainable development is a buzzword that has gained attention recently all over the world. There have been efforts by national and international organizations to evaluate sustainable development. This paper focuses on evaluating sustainable development of a city called 'Ad Duqm', a city in the Sultanate of Oman boarded by the Arabian Sea from the east. Ad Duqm is a Special Economic Zone that is newly developed in Oman to diversify the income sources because of its strategic location. To achieve the aim of the study, the paper adopted a framework/indicators developed by the United Nation in 2016 to evaluate the sustainable development in Ad Duqm with some modification.

Overall, this paper was successful in modifying international indicators using historical deductive method to end up with a framework that suits the Omani social, economic, and cultural context. Descriptive and quantitative approaches were used to evaluate the sustainable development indicators in Ad Duqm. The results show that economic and environmental indicators in the area seems to be sustained in achieving positive outcomes. It also reveals that while there have been noticeable and containable efforts in the social aspects, sustainable social outcomes have not yet been met in the area.

Keywords: United Nations, Sustainable Development, Sustainable Development frameworks, Oman, Special Economic Zone of Ad Duqm

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Soil erosion vulnerability and risk mapping using an integrated multi-parametric approach: a case study of Hoffenthal in the Thukela catchment of South Africa

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Soil erosion remains one of the main causes of soil degradation across South Africa and it possess threat to food security. As an implication, adequate assessment of areas prone to soil erosion is an important step towards formulating control measures. Therefore, the purpose of this study was to assess and model soil erosion vulnerability based on an integrated multi-parametric approach in Hoffenthal in the Thukela catchment of South Africa. The Analytic Hierarchy Process was employed to derive the percentage weights of the relevant soil erosion influencing parameters such as precipitation (18.00%), slope (29.02%), drainage density (7.11%), soil type (13.10%), vegetation cover (23.20%) and landuse/landcover (9.55%). The model revealed that over 45% of Hoffenthal had severe to high risk of soil erosion, and the north central areas are most vulnerable to soil erosion. Therefore, the developed soil erosion vulnerability model can serve as an important planning tool to prioritize conservation and control measures based on erosion severity.

Keywords: Erosion vulnerability, Soil loss, Analytical Hierarchy process, geographical information system, Remote sensing.

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Examination of urban growth in Bangladesh using Google Earth Engine

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Despite the free availability of data with high spatial and temporal resolution such as the Landsat data, the accessibility to these datasets, particularly in the developing countries, has been challenging due to the requirement of high-speed internet connection, high-performance computers and software necessary to obtain and process the data. The introduction of Google Earth Engine (GEE) powered by its cloud infrastructure has provided a solution to this problem by allowing users to run geospatial analysis on large earth observation datasets using Google's infrastructure. In this study we use GEE to classify and examine land cover change within Bangladesh during the course of the last 17 years while particularly focusing on urban growth. While previous studies on urbanization of Bangladesh have largely concentrated on bigger cities, the aim of this study is to take advantage of the GEE's computing platform to examine the trajectory and the dynamics of urban expansion for the whole of Bangladesh. The goal of this study is to provide a high-resolution multi-temporal urban growth map for of Bangladesh that could be used by researchers, planners and other stakeholders while highlighting the applications of GEE within the constraints of a developing country.

Keywords: Bangladesh, Google earth engine, urban growth, South Asia

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Five Years After the 2014 Toledo Water Crisis: What Have We Learned, What Have We Done, What Remains Needed to be Addressed?

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From August 1-3, 2014 levels of the water borne toxin Microsystin, released from the Harmful Algae Bloom (HAB) blue-green algae located in the western Lake Erie basin, were detected in the municipal drinking water system that serves in the

Toledo Area of NW Ohio. The result was a health advisory that impacted the ability of over 500,000 residents to access their potable drinking water until treatment could remove the contaminant. Over the last five years a range of research, scientific, policy and legal approaches have been undertaken to address the sources, causes, and impacts focusing on the formation of HABs, largely a function of excess nutrient loading from land activities within the Maumee River Watershed draining into Lake Erie. This paper will review the range of efforts taken to resolve this critical environmental and human health threat including nutrient management, forecasting and monitoring/prediction of HABs each subsequent summer, detection of Microsystin, addressing improved water treatment technologies, and examining potential human health impacts resulting from exposure to the toxin. The implications of such a review provide an opportunity to identify the successes and positive improvements and challenges and remaining unresolved aspects from geographic and planning perspectives.

Keywords: Water Resources, Great Lakes

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Organizing and Implementing a Hemisphere-Wide Collaborative Effort to Integrate Geospatial and Statistical Data

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Recognizing the need for integrated geospatial and statistical data to support measurement of progress toward sustainable development goals, the Pan American Institute of Geography and History (PAIGH) has funded the Integration of Statistical and Geospatial Information in Central America. Executed by Mexico and the United States, the project aims to build the knowledge base for the integration of statistical and geospatial information in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. This project is part of a variety of initiatives at the global and regional levels such as the United Nations 2030 Agenda for Sustainable Development and the Pan American Agenda from the PAIGH. The overall purpose of this project is to conduct a series of workshops focused on building on the geospatial work completed. In this presentation, we provide background and an overview of the project, discuss the process of organizing a collaborative effort between multiple national statistical and geospatial agencies, and provide a report on progress.

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Estimating spatial distributions patterns of cancer mortality and natural radioactivity

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Cancer is one of the deadliest diseases on this planet. Over nine million people lose their lives every year to a different type of cancer. In this article we propose using spatial coincidence to evaluate contribution of natural radioactivity to cancer mortality. The study area is located in the Western Carpathian Mountains where rock radioactivity is significant. The spatial patterns of cancer mortality and rock radioactivity were revealed using kriging interpolation methods, and a coincidence model has been produced using Geographic Information Systems. This model combines both previously created spatial patterns and evaluates the level of coincidence between cancer incidents and the natural radioactivity of these rocks. The results portray the different levels of coincidence between both sources of spatial information. The results indicate that there is moderately strong evidence that natural radioactivity contributes to cancer mortality. However, the presence of radioactivity is only one factor in this analysis; a perfect match between the spatial distribution of cancer and rock radioactivity would be possible if natural rock radioactivity were the only factor explaining the variability of cancer in the studied area. There are other factors such as genetics, smoking, nutrition, etc. that have not been accounted for in this analysis. Nevertheless, this research makes a substantial contribution to the understanding of spatial distribution patterns of cancer mortality and natural rock radioactivity.

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Characterizing and Modeling Environmental Emergency of Unconventional Oil and Gas Spills

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Significantly reducing consumers' electric bills and producing more jobs in USA, the remarkable growth of unconventional oil and gas (UOG) especially shale gas production in the last decade has made an impressive accomplishment. However, threatening the environment caused by UOG spills, UOG has caused enormous concerns about public health risks. Using two states Colorado (CO) and New Mexico (NM) in the USA with detailed UOG spill observations from 2005 to 2014, this study designs multi-categorical statistical tests and models to examine the factors that characterize UOG spills including spilled volume, life-year, cause, pathway, and spilled material. There is no significant differences in spilled volume among different life-years in either CO or NM, but cause, pathway, and spilled material show significant life-year characteristics in CO and NM; such as, cause does not significantly distinct among life-years in CO, while it is significantly different between mature life-years and life-year 0 or 1. Designing a series of Poisson regression models for multivariate analysis of the association between pathway and spilled material and conditional association given causal mechanism, this study reveals that in both CO and NM, the association between pathway and spilled material and their conditional associations significantly affect the occurrences of UOG spills. The spatial clusters of spills' life-year patterns are analyzed and mapped in CO and NM. This study is the first to analyze and model the multivariate factors of UOG spills, which provides the first-hand insight to the characteristics of spills and to the monitoring and mitigation of potential risks in the lifetime of UOG operations.

Keywords: Fracking spills; life-year; causal factors; Poisson regression

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Digging into spatiotemporal social media data: A dynamic version of segregation index

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Most measures of segregation can be regarded as static measures. They have one summary index over the entire study period. However, the level of segregation is not constant within a period, and therefore, the dynamic measures are warranted. In this paper, we try to use the spatiotemporal social media data to extend the static exposure index to the dynamic version in a global and local perspective. Also, an empirical study in Chicago city is used to demonstrate the utilities of this extension. In the empirical study, we conclude that 1) different groups have

different mobility patterns; 2) the daily mobility of the Chicago population contribute to three types of dynamic pattern of exposure index, i.e., negative, positive, and no effect, compared to static version; 3) the daily mobility leads to a significant increase of exposure of minority group to the majority group; however, a significant negative effect can be recognized for the peripheral area of groups.

Keywords: Segregation, Spatio-temporal social media data, Dynamic index

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Unpacking the "Local" in a Local Food Store: An Exploration of the Macomb Food Cooperative in Rural Illinois

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For customers seeking alternatives to global industrial food provisioning systems, consuming locally grown foods has emerged as an appealing alternative. But, what does 'local' actually mean in operational terms? We investigated the meaning of 'local' for the Macomb Food Cooperative, an alternative food retail store in rural Illinois, whose brand is built, in part, on bringing local foods to market. Using data on their suppliers provided to us by the Coop, we used the traditional 100 miles buffer around the outlet as the starting point of our investigation. To get a more nuanced understanding of 'local', we expanded our analyses, taking advantage of ArcGIS Online's built-in database, to compare the Euclidean 100 mile buffer to 1) a 100-miles-network service area, 2) network service areas defined for travel times, and 3) a discrete form of 'local-ness' according to location within Illinois, and the neigbouring states of Iowa and Missouri. In the next level of analyses, using data from an online survey, we will capture customer perceptions of 'local-ness', to compare with supplier 'local-ness', and thus develop a full understanding of the term for the Macomb Food Cooperative.

Keywords: Local Foods, Alternative Food Networks

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Crisis for the University Student: Changing Rents and Growing Campuses

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The U.S. Department of Education reported that the cost of higher education has more than doubled in the last three decades (2016). Still, university enrollment has increased by 27% increase from 2000 to 2017 (Condition of Education). With rising tuition and greater demand for housing close to growing campuses, students' task to find affordable housing options is increasingly more difficult. According to College Data (2018), 40% of the college cost burden is housing. This substantial burden has already forced 36% of college students to be housing insecure and 9% to be homeless (Goldrick-Rab et al, 2018). This crisis of student housing is felt around the country and the University of North Carolina at Charlotte is no different. As such, it is essential to understand changes in the housing supply and prices surrounding the university. This study investigates how UNC Charlotte off-campus student housing rents have changed since 2000, what factors are driving these potential changes, and what the implications of these changes are for students. I do this by examining rent price changes in comparison to UNC Charlotte enrollment changes and changes in overall Charlotte rent, and conducting a student survey to understand cost burden of students.

Keywords: UNC Charlotte, Higher Education, Student Housing, Affordable, Rent, University, Cost Burden, Charlotte

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A GIS-Based Approach to Measuring Diel Habitat Use Patterns

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Analyzing fine-scale movement patterns of animals is particularly useful in determining not only where animals may spend their time, but when and how likely they may be to interact with or utilize specific habitat resources. Incorporating a temporal dimension in animal tracking data has led to new methodological developments in GIS, but for practical conservation purposes, it is important to apply these recent advances towards an understanding of animal habitat use patterns at the population level. This research applies and extends two approaches from GIS movement analysis literature, the probabilistic voxel-based space-time prism and the comprehensive probability surface, towards quantifying diel habitat interaction probabilities for a Black skimmer (Rynchops niger cinerascens)

population traversing Manu National Park, Peru and surrounding areas. Habitat interaction graphs were constructed summarizing animal interaction by habitat type and time of day for all individuals tracked. By applying these methods to a given population, this research demonstrates the utility of GIS-based methods for related conservation research.

Keywords: GIS, animal interactions, habitat utilization

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Going Out for a Pint: Exploring the Relationship Between Craft Brewery Locations and Neighborhood Walkability

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The purpose of this research is to explore the relationship between neighborhood walkability and craft brewery locations. Craft breweries are emerging as Third Places across the United States as a part of a broader neolocalism movement. Walkable places can also reflect neolocalism, attracting people and amenities who share similar values It is reasonable, then, to expect a relationship to exist between craft brewery locations and neighborhood walkability. Using the city of San Diego as a case study, craft breweries are mapped within San Diego neighborhoods. Walk Scores are used as a measure of walkability and correlation coefficients computed to test the existence of a relationship. Three correlations are computed with relation to Walk Scores: one each for microbrewery locations, brewpub locations, and all craft breweries (microbreweries and brewpubs combined). Results indicate that there is a positive correlation between neighborhood Walk Scores and brewpub locations, but not microbreweries or all craft breweries. Brewpubs, by definition, sell the majority of their beer on-site, which may necessitate location criteria such as walkability that are not as necessary for microbreweries. This research is the first to date that explores the relationship between craft breweries and walkability.

Keywords: Walkability, craft breweries, Third Places, neighborhoods

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Evaluation of commercial demographic data accuracy: Revisiting the question of input bias in the location analysis process

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Graves and Gerney (2018) found significant underestimation bias in current year, vendor-provided demographic data estimates (relative to the ACS). Questions remained about the persistence of these estimation biases and their impact on the urban retail landscape. This paper updates Graves and Gerney (2018) by examining the change in estimation errors in the population and median household income data provided by five vendors (Experian, Synergos/ PopStats, ScanUS, ESRI and EASI) between 2015 and 2017. The dynamic aspects of these errors were explored in 80 Census tracts in the 40 fastest-growing US metropolitan areas. Half of the tracts were stable, suburban neighborhoods, half revitalizing urban neighborhoods. The change in Mean absolute percent error (MAPE) (benchmarked against the ACS) was evaluated across the sample for population and median household income in each tract. Categories of tracts with decreasing and increasing error are identified, informing a discussion of the source of this estimation bias. The role of persistent estimation bias on the under-provision of retail in urban settings will be discussed. Finally, we will touch on strategies for minimizing the impacts of these biases in the location analysis process.

Keywords: Retail location, urban form, modeling inputs

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Identifying Communities at Risk of Opioid-Related Mortalities Utilizing Spatial Rules Based Association Data Mining and Geodemographic Segmentation

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Background: The United States is experiencing an opioid crisis that has evolved over the last three decades. The nation is currently in what is considered the third wave of the crisis, which is associated with increased mortality rates due to synthetic opioids. The first and second waves were related to prescription opioid and heroin deaths. These different classes of opioids have impacted populations with varying demographics and locations. This paper presents an exploratory methodology for using non-health-related data intended for marketing to conduct more effective health interventions for several opioid drug classes. Mortality data from the CDC's Multiple Causes of Death database and ESRI's Tapestry marketing data are analyzed using spatial rules based association data mining.

Results: Two ESRI Tapestry segmentations are found to be strongly associated with mortality from Heroin, Other Opioids, and Other Synthetic Narcotics drug classifications, Salt of the Earth and Rooted Rural.

Conclusions: This methodology identifies Tapestry geodemographic segmentations that are at higher risk of opioid mortality and where these groups live. Additionally, it uncovers marketing preferences such as preferred media and consumer choices that can be used to conduct improved health outreach for different population segmentations and types of opioids.

Keywords: Opioid Epidemic, Geodemographic Segmentation Systems, CDC NVSS-M, ESRI Tapestry, Spatial Rules Based Association Data Mining

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Constructing sustainable environmental, social and economic landscapes through agroecological practice in Rosario, Argentina

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Rosario, Argentina, a city of more than one million people strategically located on the Paraná River in the heart of a fertile agricultural region, is home to one of the country's most important ports through which soy and wheat produced on industrial farms are transported for consumption in Argentina and beyond. At the same time, the city is changing food production and consumption outcomes through thriving urban and peri-urban agriculture programs rooted in agroecology. This paper describes the integrated approach to environmental, social, and economic sustainability embedded in these programs. The research included formal and informal interviews with more than 30 stakeholders in government, civil society, and agricultural production in May-June 2019. The integrated approach focuses on providing an alternative to the industrial agricultural production that dominates the region, turns spaces deemed unfit for other uses into productive community spaces, integrates peripheral producers into central city markets where they can commercialize their goods, and produces positive health outcomes through less reliance on chemical pesticides and fertilizers in production. This paper contributes to literature in food geographies, sustainable development, and public health through examining environmental, economic, and social outcomes of long-standing agroecological approaches to urban and peri-urban agriculture in Rosario.

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Effects of hydroelectric dams on tropical forest dynamics in the Brazilian Amazon

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Anthropogenic deforestation has resulted in the loss of approximately half of the Earth's tropical closed canopy forests, with Infrastructure such as hydroelectric dams acting as a significant contributor. It is understood that dams harm local ecology, however past studies have only focused on specific dams, and the general patterns of landscape change (particularly forest dynamics) following the construction of hydroelectric dams in the tropics remains relatively unknown. In this study MODIS EVI data from 2000-2018 was used to quantify deforestation in several watershed's containing hydroelectric dams in Brazil's legal Amazon region. The generic time series decomposition method of Breaks for Additive Seasonal and Trend (BFAST) was utilized to detect forest loss within each study area. Landscape metrics were calculated using the FRAGSTATS software to understand changes in forest dynamics. This study aims to guide policy makers by answering the following questions; (1) is there a positive correlation between dam capacity and area of deforestation? (2) In cases where multiple dams occur along a singular river, are the subsequent levels of deforestation and forest degradation less than that of one mega dam? (3) What are the spatial-temporal patterns of deforestation in watershed's containing dams?

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Does geography matter? The case of three informal settlements

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Slums and informal settlements (SIS) pose considerable health challenges to their residents. The local environment poses multiple infectious disease threats including mosquito vectored diseases such as malaria, enteric diseases like diarrhea and cholera, and diseases associated with trash accumulations such as leptospirosis. While the disease risk is great, the challenging nature of these environments result

in scarce available data, especially at the fine scale needed for effective intervention.

In this work, I assess the health environment of three SIS in three geographically distinct locations: Ghana, Kenya and Haiti. Spatial videos, which are coordinate enhanced ground imagery, were collected in these SIS. These videos were used as a source in coding and digitizing risks such as trash, stagnant water, overgrowth and other risks as observed per SIS.

In this presentation I will outline the use of the method, and then draw connections between all three study sites. Similar risks were present at all sites; standing water, mud, trash, animals, children playing on the ground, though at different intensities. One striking similarity was the presence of open drains, which are not only a disease risk factor but can also be linked to flooding during rain events. However, in all three environments, these data reveal that there is considerable heterogeneity with potential disease risk varying across the SIS.

Keywords: Slum/Informal Settlement, Health environment, Health risks, Infectious diseases

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Rail Transit Investments and Economic Development: Challenges for Small Businesses

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This research explores and uncovers local economic development challenges faced by small business owners along the North Tryon commercial corridor in Charlotte (NC) as a consequence of infrastructure construction works. North Tryon street represents one of the most important corridors in the city of Charlotte for its strategic role as Charlotte-Mecklenburg's premiere gateway to the northeastern area of the city. The recent opening of the Blue Line light rail extension that connects downtown to the UNC Charlotte main campus has had a significant impact on North Tryon small business owners' ability to stay in business. Findings show that the construction of the light rail extension has permanently altered accessibility and visibility along the corridor, which were the main business-location criteria used by business owners. Drawing on surveys and in-depth interviews with business owners, this research highlights the importance of small businesses in highly diverse areas and offers directions for the improvement and the creation of mitigation programs able to support businesses during and after infrastructure

construction works.

Keywords: economic development, displacement, small businesses, light rail

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Invisible no more: An exploratory geospatial typology of illicit massage businesses in the Dallas-Fort Worth Metropolitan Area

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Illicit massage businesses (IMBs) make up the largest sector of the commercial sex industry in the United States. To date, very little research examining the spatial dimensions of this industry exists, and what limited research exists treats all IMBs as equivalent features in space. This research addresses this shortcoming of previous research by drawing on analysis of landscape photographs of more than 150 IMB storefronts in the Dallas-Fort Worth Metro area, attribute data for each IMB drawn from online review websites, and neighborhood demographic profiles, this paper presents the first geospatial typology of illicit massage businesses in North America.

Keywords: Illicit Economy, Business Geography, Landscape

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UAS and 3D Modeling for Small Scale Farming and Community Garden Precision Agriculture

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Precision agriculture has a long history of applying geospatial techniques and technologies for large scale operations, often overlooking small scale productions - such as community gardens or family-owned farms. As important contributors to sustainable and local agriculture they have the added benefits of providing positive social connections, multiple health benefits and cultural connections. Using an unmanned aerial system to acquire imagery, combined with structure from motion technology this study creates digital surface models to temporally assess crop

growth. Assessing important factors such as cost, processing time and plant physiology, this work will provide small scale farm managers and owners with streamlined toolsets they may use to improve the monitoring and yield of their crops.

Keywords: Precision agriculture, unmanned aerial systems, structure from motion

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Applying Web GIS to Space Use Assessment

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Web Geographic Information Systems (GIS) has substantially changed the way spatial data is acquired, published, accessed and visualized. In this study, we designed a web GIS application to collect in-library use data and proposed an integrated framework for assessing and reporting space usage. In August 2017, Purdue University opened Wilmeth Active Learning Center (WALC), a new concept building to fully integrate library space with active learning instructional spaces. To closely monitor the usage of the building, a mobile tablet GIS app, Purdue Libraries Observation Tool (PLOT), was developed to collect space usage data using Esri ArcGIS Server and JavaScript API. In addition, daily usage reports are generated automatically for interested parties. This data collection system has greatly improved the efficiency of collecting and reporting data for library space assessment. It can potentially be expanded to include assessment for other libraries and buildings on campus. This study provides a general workflow for collecting and assessing space usage using web GIS technologies.

Keywords: web GIS, space use assessment, data collection

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Impacts of Land Use and Land Cover Changes on Hydrological Regimes of the Richland Creek Watershed in Southern Illinois using a GIS-based Hydrologic Modelling

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Rapid economic growth and urbanization have caused land use changes in different parts of the United States. An intensive land use change can occur due to urbanization, thus increasing impervious surfaces and altering the hydrological regimes in watersheds. The objective of this project is to study how changes in land use and land cover (LULC) can impact the hydrological processes in the Richland Creek Watershed (RCW) located in Metro St. Louis area. The North part of RCW has increased impervious surfaces due to increasing suburban land uses. A rainfall-runoff simulation was done using the Hydrologic Engineering Center- Hydrologic Modelling System (HEC-HMS) and its GIS extension Geospatial Hydrologic Modeling Extension (HEC-GeoHMS). Physical parameters, along with precipitation data and Soil Conservation Service (SCS) curve number method, were used for rainfall-runoff simulation for high storm events of 2001 and 2011, respectively. The simulated hydrographs obtained from HEC-HMS were calibrated and validated using observed discharge data for the same periods of the study. SCS lag time, initial abstraction and Muskingum coefficient were adjusted for the calibration of simulated hydrographs. Spearman's rank correlation coefficient (r) and linear regression (R2) analysis were applied to ensure agreement between simulated and observed hydrographs. In addition, for the performance evaluation of model percent error in peak flow and volume will be determined. It is anticipated that at the subbasin level, subbasins of highly developed and with high impervious surface will generate more runoff compared to those of mainly agricultural lands. This research enhances the understanding of the interactions between LULC changes and hydrological regimes in the RCW.

Keywords: Land Use and Land Cover Changes, Hydrological Regimes, Hydrologic Modeling, Richland Creek Watershed

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The role of biogas technology in emissions reduction from fuelwood consumption in South African households: A Case of Limpopo Province

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Tropical Africa largely depends on fuelwood because it is still a cheaper form of energy than most available alternatives forms. For these households, to meet their

energy needs and demands through fuelwood, large portions of land are cleared, along with its vegetation, thus creating environmental degradation and deforestation. Fuelwood consumption contributes to greenhouse gas emissions through unstainable harvest and in the process of incomplete combustion. Biogas technology offers a viable, cheap and renewable solution to the energy problems confronting most households, particularly with the merit of using feedstock from traditional waste that has been considered useless. This article examines the role of biogas technology in emissions reduction from fuelwood consumption in South African households. From the sampled households, to calculate the amount of greenhouse gases emitted, the amount of fuelwood used was by households was obtained using a spring balance, to measure the daily amount of fuelwood likely to be consumed by the household and the mass recorded in the questionnaire. The methodological generic formula, as outlined by the Intergovernmental Panel on Climate Change was used to estimate the Greenhouse gas emissions. The calculated daily values of CO_2, CH_4 and N_2O emissions from the surveyed households installed with and without biogas digesters, the respective daily outcomes are 54.87, 0.23 and 0.00159 t.

Keywords: Energy; Environment; Greenhouse gases.

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Spatial-Temporal analysis of crime in San Francisco, CA

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Analyzing crime majorly focuses on spatially identifying and grouping serial crimes and criminals from a set of crime reports and other information that is provided by state and local law enforcement agencies. In this project, crime rate was calculated for each district in San Francisco area since crime rate determines how many crimes occur relative to the population. Three variables were used to check on the causes of crimes (proximity, poverty and population), which allowed for better comparison of crime counts between areas. Larceny and theft were the most common crime in San Francisco between January 1st, 2009 and July 31st, 2015, with a total of 193,497 reported incidents, Vehicle theft (35,125 reported incidents), Burglary (31,483 reported incidents). Crime distribution is even throughout the week. Majority of the crimes occurred on Friday (112,351 reported incidents), followed by Saturday (107,510 reported incidents) and Wednesday (104,773 reported incidents). Among the high crime categories, larceny and theft crimes exhibit the most prominent increase in occurrences (by approximately 5,000 incidents per

year) after 2011. Poverty and proximity had a positive correlation to crime Linear regression for Larceny, the R-squared is 0.3065, which was too small.

Keywords: Crime, San Francisco, Crime distribution, Police districts

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Virtual Hampton: an immersive virtual landscape platform as a virtual heritage tool

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This poster discusses the development of Virtual Hampton as an immersive virtual landscape reconstruction for Hampton Plantation, a former rice plantation along the South Santee River and now a South Carolina State Park and Historic Site. The goal of this project is to develop a virtual landscape platform to be deployed at the park to allow users to explore the past landscapes and stories of Hampton before touring the park. In addition, the platform has the flexibility to update content as new information is made available and will allow park staff to highlight specific stories and content.

The completed prototype of Virtual Hampton includes the virtual recreation of the early 19th-century plantation landscape, and demonstrations of the embedded media content that provides information about select features within the recreated landscape. The current phase of work focuses on spatial narrative elements to present the intertwined stories of the people who lived and worked at Hampton Plantation. This multimedia narrative content consists of short, themed spatial stories that are being termed "spatial vignettes." These vignettes will enhance Virtual Hampton with the historical, archaeological, and ethnographic information that inform our knowledge of Hampton's past cultural landscapes.

Keywords: virtual heritage, virtual landscapes

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How Local Newspapers Can Influence Receiving Community Perceptions of Refugees

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Local media coverage can play a powerful role in shaping how a receiving

community perceives the arrival, presence, and integration of refugees. This case study focuses on how St. Louis, Missouri's leading city newspaper, the St. Louis Post-Dispatch, depicts local refugees. Rather than simply covering breaking news events, the Post-Dispatch has taken an active role in educating the receiving community about refugees' lived experiences, cultures, and contributions through feature articles and editorials. This sample from a content analysis begins with the Post-Dispatch's coverage of Bosnian refugees in south St. Louis City in the late 1990s and continues through the newspaper's more recent focus on the city's small but growing Syrian refugee population. An awareness of the role local media can play in easing a receiving community's tolerance and acceptance of refugees may provide a useful tool for refugee advocates and resettlement agencies in other places in the United States and beyond.

Keywords: refugees, receiving community, Bosnian, Syrian

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From Brown to Green: Understanding the Evolution of Pittsburgh's Riverfront Brownfields

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Since the inception of Pennsylvania's Land Recycling Program in 1995, all but one of Pittsburgh's riverfront brownfields have been redeveloped. Using a variety of policy documents, imagery and Sanborn maps this paper examines trends in the redevelopment of Pittsburgh's riverfront brownfields and uses the results to evaluate the on-going re-development of Hazelwood Green, the city's last riverfront brownfield. The results of the analysis of completed brownfields shows that all are large scale mostly mixed-use 'flagship' projects that include some green infrastructure and open space. These redeveloped brownfields have been criticized for not serving local populations, being out of character with surrounding neighborhoods, having few physical connections to those neighborhoods and providing limited access to the rivers.   As soon as plans for the redevelopment of Hazelwood Green were announced in 2001 criticisms quickly mounted. Using the analysis of completed brownfields as a framework, the examination of the plans for Hazelwood Green shows it fails to address criticisms made of older brownfield projects. The site is physically disconnected from the surrounding street grid, neighborhood and river. The layout of site is out of character with the neighborhood's traditional street grid and it is unclear how local residents will benefit from the project.

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Understanding space and socio-economic differences as a means to a sustainable future

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Clean air, water, and other natural resources lie within the domain of public goods, making active government intervention essential to the protection of the environment across the globe. However, government intervention is most fruitful when policies are designed effectively keeping in mind citizen preferences, specifically their level of concern for the environment. This means an increasing acceptance of moralistic and value differences across individuals based on socio-economic, geographic, and political characteristics. It is now widely accepted that studying and understanding environmental attitudes is complex and further careful investigation is required to tease out the nuances that hinder our comprehension of it. This paper employs spatial and economic theories combined with key variables from the socio-economic literature to identify the factors that affect people's perception of the environment. The results from the study highlight the understanding required to design policies which take into consideration varied individual preferences, rooted in economic, spatial, and social differences.

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From Re-Leasing to Redevelopment: Sears and Target in Canada

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This paper compares the failure of two major US-based department stores in Canada. The demise of long-standing Sears Canada and the short-lived entry and sudden departure of Target Canada created shockwaves across the Canadian retail and real estate landscape. The net result was a large amount of retail space being placed back into the marketplace. We examine how the process of absorption has worked itself out in bringing some of these properties back to permanent income generating uses and what tenant mix and space changes have taken place to date

to make this possible. Beyond the quick fixes associated with short-term frictional vacancy, we look to the more significant long-term structural vacancies and the significant real estate challenges that these combined retail failures have generated. The paper tracks the journey of retail failure through phases of retail re-leasing and re-configuration, and over time, to major redevelopment and adaptive re-use of former department store locations.

Keywords: Retail, Canada, Department Stores, Real Estate

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Spatial Distribution of Parks as Urban Green Space in Khulna City: An Analysis in Context of Equity Planning

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Equal distribution of parks as urban green space over a city area can provide recreational, health and environmental services to all city people. Khulna is the 3rd largest industrial and 2nd largest port city of Bangladesh. It has 1.5 million people in 45.65 sq km area. There are only 8 parks in Khulna City. The mostly small parks cover only 0.15% of the total Khulna City Corporation (KCC) area. Among the 31 KCC Wards, only 7 i.e. 23% Wards have parks. Rapid urbanization and population increase is causing tremendous pressure on the existing parks. KCC and Khulna Development Authority (KDA), the city planning and urban service providing organizations have not followed equity planning principles while implementing the park proposals of City Master Plans of 1961 and 2001. The parks are mostly found in the Wards having planned neighborhood and old built up area. Locational suitability and demand of parks is assessed through Buffer, Network and Threshold Population analysis using GIS. Park users and related key informants are also consulted. The existing parks are unable to fulfill the city recreational demand. According to the analysis, about 19 to 46 more parks are needed for 1000m and 500m service radius respectively.

Keywords: GIS, Locational suitability, Urban Green Space, City Master Plan, Khulna City

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Protecting Water Quality in the Texas Hill Country: Opportunities for Beneficial Reuse of Wastewater Effluent

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The Texas Hill Country is a unique and treasured landscape. Beyond breathtaking vistas, historic towns and ranches, and numerous endangered species, the Hill Country is also the source of dozens of clear-running, spring-fed streams that have been shown to have two-way interaction with the Edwards-Trinity aquifer system beneath them. The region is also one of the fastest growing areas in the United States. Due to population growth, new municipal water demand in the region is taxing many existing systems of both drinking-water supply and wastewater treatment and disposal. While some communities practice land application of wastewater effluent, capacity expansions and discharge of greater volumes of effluent pose a significant threat to stream-water quality, private wells and groundwater, and other iconic resources in the region. This research considers several Hill Country cities in terms of their average daily effluent production relative to their permitted flows. Three cities that are close to the threshold for planning facility expansion are given additional analyses including land use/land cover analysis within specific radii of the treatment plant for new land-application sites. Results show the potential of greater wastewater reuse for these target cities and provide a potential framework for analyzing reuse viability in other areas.

Keywords: Texas, Wastewater, Reuse, Water Quality, Water

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Studying the Relationship between Transit Systems and Economic Segregation in Three Major MSAs

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This project examines geographic patterns of income segregation in relation to the opening of transit systems. We analyzed the spatial distribution of income classes

across the Metropolitan Statistical Areas of Washington DC, Minneapolis, and St. Louis, using decennial median household income data at the census tract level and coordinate data for transit stations opened between 1970 to 2010. We conducted hot-spot (Getis-Ord Gi*) analysis of each MSA for each decennial census year and compared them with opening dates of each station. Through the hotspot analysis, we are able to visualize and quantify the changes in income segregation through time. Our results demonstrate similar patterns of economic segregation in each MSAs. In general, patterns did not change much. However, after the opening of stations, some neighborhoods saw higher-income residents moving away from station neighborhoods, creating areas lower-income. Therefore, the new stations seem to be a factor in the change. However, it is important to note that spatial correlation does not necessarily imply causation, and that other factors may be playing a role in causing the change.

Keywords: Transportation Geography, Income Distribution, Light Rail System, Economic Segregation

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Towards a Global Statistical Geospatial Framework

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The United Nations' 2030 Agenda for Sustainable Development has pointed to a need for integrated statistical and geospatial information to support regional and global comparative analysis related to economy, society, and environment. The Global Statistical Geospatial Framework (GSGF) provides the underlying mechanism to achieve this integration. Efforts to improve the integration of statistical and geospatial information occur in an environment where national statistical organizations (NSOs) are seeking to collectively modernize their statistical production systems and processes, to transform their operations, and to derive new relevant metrics and indicators for statistical purposes. Critically, this includes the introduction of standards-based, metadata-driven infrastructure and processes. In this presentation, we report on the current status of efforts to document and develop the GSGF.

Keywords: Geospatial, Integrated Data, Sustainable Development

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Can Social Media Predict Parental Vaccine Choices and Legislations on Mandatory Vaccination?

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For years, researchers have been examining trends of public opinion through social media and their implications in human behavior in the physical space. This study uncovers the structure of Twitter on the controversial topic of vaccination exemption in California from the perspectives of content, social network, and geography of social media. By discussing the retweet relationship along with authors and disseminators, we measured the magnitude of anti-vaccine and pro-vaccine debates, discovered the hub of the information diffusion on both opinion groups, and analyzed the spatial distribution of those opinions. Finally, we compared our findings with the state legislative district voting results on the California vaccination exemption senate bill, and the kindergarten immunizations records before and after the bill passed. The results showed that Twitter, as a representative of social media, was able to be used to predict human behaviors, such as policy voting and vaccination choice, in the real world.

Keywords: Social Media, Social Network, Spatial Analysis, Vaccination

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Landscape-Based Assessment of Urban Resilience and Its Evolution: A Case Study of the Central City of Shenyang

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Urban resilience is increasingly considered a useful approach to accommodate uncertainties while achieving sustainability in urban systems, especially in the context of rapid urbanization and global environmental change. This study employed the concept of urban landscape to measure urban resilience and established connections between resilience potential and landscape characteristics. Specifically four proxies of urban resilience were introduced, including diversity, connectivity, decentralization, and self-sufficiency. Using multi-source data and landscape-based analysis methods, urban resilience was investigated from 1995 to 2015 in the central city of Shenyang. The results reveal a slight overall increase in Shenyang's resilience level and a declining trend in the city's internal differences. The composition and configuration of the urban landscape changed significantly during the study period, which had a great impact on the city's resilience.

Directional preferences and an evident distance effect are also evident when analyzing the temporal and spatial evolution of Shenyang's urban resilience. The four landscape characteristics appear to be important aspects in shaping urban resilience. The adjustment and trade-offs of these aspects could enhance the city's responsiveness to shocks and stresses and help maintain sustainable ecosystem services.

Keywords: Urban resilience; quantitative assessment; landscape pattern; ecosystem services; social-ecological systems; Shenyang

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A high-resolution population grid in the CONUS based on Microsoft building footprints and its potentials in hazard studies

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A better knowledge of where people live is of great importance for a wide range of hazard studies. Given the increasing demand for high-resolution population grid with improved quality, this study presents a 100m population grid in CONUS, disaggregated from ACS 5-year estimates (2013-2017) using 125 million building footprints released by Microsoft. Land use dataset from OSM was applied to remove footprints that are not likely residential. Layers derived from trimmed footprint statistics were designed and considered as weighting scenarios for a dasymatric method, which was further applied to disaggregate ACS census tract population estimates into 100m population grid. The population grid was evaluated using ACS block group population as aggregated ground-truth and further compared with three popular population grid products: LandScan, GPW-V4 and GHS. Finally, the applied potential of proposed population grid is demonstrated using selected hazard cases. The results suggest that proposed population grid outperforms current grid products in 5 out of 6 assessment metrics. The high spatial-explicit population distribution well captures the heterogeneity of population distribution at a rather micro level, greatly facilitating the estimation of population at risk for a wide range of hazard studies.

Keywords: High-resolution population grid, building footprints, hazards, dasymetric mapping

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Application of spatial optimization techniques to the siting of fast food outlets

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Spatial optimization models have generally been applied in public facility location problems, such as the siting of healthcare facilities, fire stations and bus stops. The application of spatial optimization techniques to establishments in the private sectors, however, has not been sufficiently published so far. This paper uses pizza delivery service in Mecklenburg County as an example to explore which spatial optimization models can help private chain companies to locate their outlets, and how these technical models can be applied to the business context.

Spatial optimization models that have been generally applied involve the p-median approach, the Maximal Covering Location Problem (MCLP), the Location Set Covering Problem (LSCP), and the Backup Coverage Problem. While most researches generally rely on the p-median approach, business location modeling typically involves the notion of maximizing market coverage and profit. Accessibility, market coverage and profitability are three major criteria of the strategic market expansion for private chain businesses. Are these spatial optimization models widely applied in public sectors also helpful to private businesses? Which specific models deal with the three major criteria? Are there any difficulties when applying these models to the real business world? These are the main problems that this paper focuses on.

Keywords: spatial optimization, site selection, fast food industry

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A Community-Engaged Research Approach: Collaborating with Key Tennessee Drinking Water Stakeholders to Understand Public Water Systems Needs

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Safe drinking water is fundamental for building a culture of health but the technical, financial, and managerial (TFM) challenges associated with resilient and sustainable public water systems (PWS) are understudied by academic researchers. Vanderbilt University developed a collaborative partnership with key drinking water stakeholders (i.e. non-profit and governmental agencies) in Tennessee, the University of Rochester School and Medicine and Dentistry, the University of Missouri, and Sandia National Laboratories to understand TFM challenges faced by

PWS at multiple scales of analysis. The analysis groups are geographic region (i.e. West, Middle, and East Grand Divisions), rural versus urban, and size of population served by PWS. We engaged PWS operators, an underserved voice in US drinking water research, to be a part of our research team. PWS Operators will participate in a statewide survey and representative members will serve on an Operators Advisory Committee (OAC). The OAC will assist in the interpretation of results and dissemination of findings. The survey is based on a summer 2018 pilot study; the statewide survey to all PWS operators (N=3,019) will be sent late summer 2019. The findings will elucidate how TFM challenges impact the resiliency of PWS from the perspective of front-line experiences of PWS operators.

Keywords: drinking water, community-engaged research, infrastructure, public water systems operators

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The tide and its role in influencing coast line changes, Ras Al-Sawadi and Al-Seefa, Oman, a study in applied Geomorphology

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Ras Al-Sawadi and Al Seefa are a coastal area along the coast line in Sultanate of Oman, Ras Al-Sawadi area is characterized by wide sandy beaches formed over thousand years due to the deposits of valleys flowing into Oman Sea and Al-Seefa has a narrow sandy beach formed by short wadies. Both areas are considered a tourist area, but its coast is currently being relegated to erosion. Both areas are tourist areas, but their coast is currently eroding. Remote sensing and fieldwork investigations indicate a change in the coastline in both regions over the past 20 years. Geomorphological studies trace the causes of this change to several factors, such as coastline shape, marine currents, waves, and engineering installations.

This study aimed to determine the role of tides as the main reason for coast line changes in the study area during the last 20 years using, IKONOS, QuickBird, DEM images and hydrography data. The principal results showed that the coastline in both study areas progresses sometimes and sometimes declines. These changes related to moon rise and tides whereas human activities are the second reason, and the geomorphological reasons are considered the third reason. However, the study recommends that the tides and the time of the moonrise should be considered a major factor in coastal changes, especially when observing these changes using remote sensing.

Keywords: tide, Coastline changes, SLR, Moonrise.

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An Online GIS-based Data Collection, Management and Analysis System for Private Wells

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This paper presents a GIS-based system to collect, manage, and analyze private wells information and contaminants results. By using this system, it provides a connected and circulating process among data collection, management and analysis. It allows users download wells information of certain extend under a GIS mode from published services through ArcGIS server to their devices, then users can update or add new wells records in the device during field work. These new records can be synchronized after the access to internet is available. The management and analysis portions are built and combined into a WebGIS system based on the ArcGIS Server and ArcGIS application programming interface (API). The database of this system consists of private wells record from 2011 to 2018 in Gaston County, NC. For safety reasons, the system is also implemented different privileges for users to manage and analyze data. Functions in the WebGIS system allow users to create, update, and delete content, and also perform common spatial analyses. Unlike outdate paper-based workflow, the government agency managing local private wells can easily collet, update, view, and analyze wells records using this online GIS-based system.

Keywords: Web GIS, Spatial analysis, Health, Private wells

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Influence of space-time differentiation of frontal area index on surface temperature

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The urban heat island effect has received an increasing attention recently with the acceleration of urbanization. However, so far few studies have focuses on the

effects of urban morphology and wind conditions on land surface temperature (LST). This study utilizes a range of multi- source data including architecture and remote sensing and applies a GIS spatial method combined with urban building frontal area index (FAI) and LST. This research aims to evaluate spatiotemporal differences in the FAI of urban built-up areas as well as to explore the influence of urban form on surface temperature. Results initially reveal that building FAI conforms to a spatial trend comprising outward diffusion from the city center and shows that high density, higher elevation buildings hinder the wind strongly. Data show that FAI values for the north of Chaoyang District are the largest, reaching a maximum of 15.1, while those for edge areas for each district are the smallest, falling to a minimum of 0.01. Secondly, the results of this analysis reveal large differences in surface temperature between day and night within the study area, ranging between 18.15 ℃ and 31.73 ℃ and between 4.27 ℃ and 18.43 ℃ , respectively. Spatial distribution values exhibit the same characteristics as those for the FAI; the urban central city is characterized by high temperature, which gradually spreads out in a concentric manner. The range of high temperature areas during the day is also larger than that at night as these values are influenced by other variables including urban architectural form and artificial heat sources. Thirdly, the data assembled here show that FAI is related to surface temperature to a certain extent; recorded correlations between day and night are 0.371 and 0.355, respectively, both significant at the 0.01 level. It is also the case that building spatial shape is distinct in both vertical and horizontal directions and that the influence of surface temperature varies. Wind environmental data is an important component of quantitative research on building form and is necessary if urban climate scientists and planners are to explore and enhance potential ventilated corridors within cities.

Keywords: frontal area index; MODIS; urban heat island; urban wind condition; Changchun

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Analysis of distribution characteristics of wind shear in severe convective weather processes

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Wind shear reflects that the wind field is not uniform, which is one of the primary factors make the retrieval of the wind field difficult. Based on wind field retrieval technique, the distribution characteristics of wind shear are identified in this paper. Because of the non-uniformity in wind shear areas, the difference of retrieval results between surrounding analysis volumes can be used as a measurement to show how strong the wind shear is. According to the analysis of a severe convective weather process, it can be found that the areas where wind shear appeared with the strength significantly larger than in other regions and the magnitude generally larger than 4.5m/(s•km). Besides, by comparing the variation of wind shear strength during the convection, it can be found that new cells will be more likely to generate when the strength is above 3.0m/(s•km). Therefore, the analysis of strong wind shear's moving and development is helpful to forecasting severe convections.

Keywords: Wind shear, Wind field retrieval, Conventions

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A Spatial Analysis of the Geography of Hypertension in the United States: Beyond Conventional Factors

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Hypertension as one of the most prevalent cardiovascular diseases in the United States causes hundreds of thousands of deaths each year. Current literature provides very limited spatial analyses of the geography of hypertension in the U.S. In addition, because of limited data source, traditional studies often rely on personal medical records and common socio-economic factors to explain the different risks of hypertension. Nowadays, however, we are blessed with multisource information that may potentially help identifying the levels of risk for hypertension. In this study, we first use data mining techniques to identify risk factors among 25 factors collected from different data sources. Then we analyzed the spatial disparity of the risk of hypertension using both conventional and un-conventional factors. We found there is a significant spatial discrepancy of hypertension hospitalization rate in the U.S. by using county level data. The results of geographically weighted regression model identified 6 factors relating to various hypertension rates with certain degrees respectively. Our contribution in this study is the exploratory analysis with both conventional and un-conventional factors which may be useful for health policymaking.

Keywords: spatial analysis, geography of hypertension, data mining, geographically weighted regression

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Analysing small-scale farmers' determinant choice and adaptation strategies in response to climatic shocks in Vhembe District

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Climate change is one of the major threats to sustained agricultural leading to extended low yield for rain-fed agriculture in semi-arid regions in sub Saharan Africa. Rain-fed agriculture will remain the principal source of staple food production and the livelihood foundation of the rural communities in South Africa. The aim of this paper is to explore the impacts of climate variability on small-scale farming and enhance adaptation strategies used in Vhembe District. A survey of primary data was collected through questionnaires administered to 180 farmers and secondary meteorological data from South Africa Weather Services. A Multinomial Logistic (MNL) was   employed to analyse the determinants used by farmers' as adaptation option. The result revealed that all the climate variables has had significant impacts on crops production. Further, the finding showed that MNL model was used to analyze the drivers affecting household farmers' choice of climate adaptation strategies. Empirical finding reveal that most farmers had witness precipitation and temperature variability and were taking tactical measures to reduce its negative effects on their crop yield. The study recommended that the stakeholders should put up an educational system tailor to meet the climatic information needs for farmers to enhance their crop production.

Keywords: Climate change, Vhembe District, Multinomial Logistic (MNL), Smallholder farmers and adaptation strategies.

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