Spatial Structures in the Social Sciences
2024 Summer GIS Institute

Final Presentation Program

June 14, 2024

PSTC Seminar Room (Mencoff Hall 205)
68 Waterman Street, Providence RI 02912

9:30 – 10:00 am	Breakfast & **Opening Remarks**
10:00 – 11:00 am	**Session I:** GIS and Health
11:00 – 11:20 am	*Break*
11:20 – 12:00 pm	**Session II:** Historical GIS
12:00 – 1:00 pm	**Lunch**
1:00 – 1:40 pm	**Session III:** GIS for Resilience
1:40 – 2:00 pm	*Break*
2:00 – 2:40 pm	**Session IV:** GIS in the Earth Sciences
2:40 – 3:00 pm	*Break*
3:00 – 3:40 pm	**Session V:** GIS in Society
3:40 – 4:00 pm	Certificate Presentation & **Closing Remarks**

PARTICIPANTS

Aakash Arora (Dermatology, Warren Alpert Medical School)

Anahi Carrera (Earth, Environmental and Planetary Sciences)

Esther Krupp (School of Engineering)

Han Liu (Population Studies and Training Center)

Ashley May (Anthropology)

John Nicklas (Earth, Environmental and Planetary Sciences)

Torben Parker (Population Studies and Training Center)

Ambuj Suri (Division of Biology & Medicine)

Meeghan Truelove (Landscape Architecture, RISD)

Liam Van Vleet (Business Administration & Oceanography, URI)

Ernesto Zaldivar (Computer Science)

PROGRAM

SESSION I: GIS AND HEALTH

[10:00am] John Nicklas, *Preliminary Exploration of Temperature-Related Mortality among US Residents from 1989-2020*

[10:20am] Ambuj Suri, *Mapping Access to Anti-Venom to Counteract Fatal Snake Bites in Nepal*

[10:40am] Aakash Arora, *Spatial Analysis of Melanoma Patient Outcome Factors in MA*

SESSION II: HISTORICAL GIS

[11:20am] Ashley May, *May God Keep Us Close: Tracing Arsi Oromo Nearness to the Sacred Landscapes of Dirre Sheikh Hussein*

[11:40am] Meeghan Truelove, *When an Island Is Not an Island: The Dynamic Kaleidoscope of Coney Island's Spatial History*

LUNCH BREAK, 11:40AM – 1:00 PM

SESSION III: GIS FOR RESILIENCE

[1:00pm] Esther Krupp, *WaveGuard - Flood Relief & Energy Resilience – Initiative*

[1:20pm] Torben Parker, *Hot Spots: A Spatial Analysis of Extreme Heat Resiliency in Rhode Island*

SESSION IV: GIS IN THE EARTH SCIENCES

[2:00pm] Anahi Carrera, *Rapid exhumation of the Aleutian Islands 5-7 Million Years Ago. What was the Exhumation Driver; Tectonics or Climate?*

[2:20pm] Liam Van Vleet, *Surveying the survey's interactive data: Alternative mappings of Eelgrass abundance in Narragansett Bay and Block Island Sound*

SESSION V: GIS IN SOCIETY

[3:00pm] Han Liu, *Transmission Dynamics of the 1918 Spanish Flu: Patterns and Racial Differences*

[3:20pm] Ernesto Zaldivar, *Utilizing GIS Methods for Physical Security Elements of Cybersecurity: An Examination of Los Angeles's Hermosa Beach Submarine Cable Landing Station*

PRESENTATION ABSTRACTS

Aakash Arora – Spatial Analysis of Melanoma Patient Outcome Factors in MA

Every hour of every day, one American dies of melanoma – almost 10,000 deaths per year. This research project seeks to understand how incidence and mortality of this deadly skin cancer are correlated with primary care physician location, dermatologist location, socioeconomic index, and ultraviolet ray index in Massachusetts. By analyzing these variables at a county level and employing spatial analysis, I seek to understand which factors further drive melanoma late-stage diagnosis and which counties in Massachusetts are in most need of attention by policymakers and health professionals. Here, I will create maps that showcase geographical incidence, mortality, and mortality over incidence of melanoma across Massachusetts as well as employ both linear and spatial regression models to explain key data outcomes. I hope to highlight trends and patterns that can inform specific interventions to address health disparities in access to melanoma treatment and ultimately reduce poor melanoma patient outcomes.

Anahi Carrera – Rapid exhumation of the Aleutian Islands 5-7 Million Years Ago. What was the Exhumation Driver; Tectonics or Climate?

The Aleutian Islands are a chain of volcanic islands that make up the northern segment of the Ring of Fire. It is poorly understood what mechanisms lead to volcanic island exhumation. We applied thermochronology, a method that allows us to date the timing when rocks that formed deep in the earth's crust at high temperatures were cooled to near surface temperatures, to investigate volcanic island exhumation mechanisms. We found that all of the islands experienced rapid exhumation at around 5-7 million years ago. At around this time, there were coeval tectonic and climatic shifts that could have driven rapid exhumation; the motion of the Pacific plate rotated clock-wise causing increased faulting and there was a climatic shift that led to North Pacific glaciation. Both tectonic activity (leading to increased faulting and rock deformation) and glacial erosion can exhume rocks rapidly. To unravel whether tectonic deformation or climatic cooling/increased glaciation caused fast exhumation at around 5-7 million years ago, I used geologic data from the United States Geologic Survey and ArcGIS Pro to create geologic maps that showed fault location. I plotted my sample locations and their associated data to reveal whether there is extensive faulting near the samples that could explain rapid exhumation. I found that there is poor correlation between fault and sample location, pointing to glacial erosion being the likely driver. However, some samples yielded ages that were younger and those samples are located near a fault, suggesting that there was likely local, fault driven exhumation occurring later, at around 3 million years ago.

Esther Krupp – WaveGuard - Flood Relief & Energy Resilience - Initiative

This renewable energy project explores wave hydrodynamics for electricity generation, focusing on flexible two-dimensional plate-style converters. While this technology is being studied, the novel proposal is to adapt circular plates for wave energy extraction, specifically for small-scale emergency response systems in flood-prone urban areas. These modular devices, easily deployable and remotely controlled, aim to provide immediate electrical support post-disaster, aiding in community resilience and recovery. They can power medical equipment, communication systems, and essential services, both on individual and community scales. Strategically placed on existing infrastructure like bridges and harbors, or integrated into marine architecture, they offer versatile solutions for emergency preparedness and response in coastal and river delta regions. GIS analysis can provide valuable insights into optimal placement strategies, considering factors such as wave intensity, coastal topography, and infrastructure vulnerability, enhancing the effectiveness of these emergency energy systems.

Han Liu – Transmission Dynamics of the 1918 Spanish Flu: Patterns and Racial Differences
As the most widely known historic pandemic, the 1918 Spanish Flu has attracted scholarly attention from a wide range of disciplines since the start of COVID-19. However, existing studies have not paid adequate attention to the spatial pattern of this pandemic and how the spatial pattern is related to social inequality. Using individual-level data from the 1918 death certificates and the 1920 census in Brooklyn, this study (1) explores the spatial pattern of Spanish Flu deaths, (2) compares the pattern between Whites and Blacks, and (3) contextualizes the racial differences in the segregated residential pattern.

Ashley May – May God Keep Us Close: Tracing Arsi Oromo Nearness to the Sacred Landscapes of Dirre Sheikh Hussein
This project traces the spatial histories of Dirre Sheikh Hussein, a sacred landscape in the Bale zone of southeastern Ethiopia dating back to the 12th century. Utilizing Sheikh Hussein's migration from Hadramout, Yemen to the Horn of Africa as my point of origin, I chart not only the regimes of empire, warfare, and catastrophe that have taken shape within the Bale zone more broadly, but also attempt to visualize how the sacred landscapes of Dirre Sheikh Hussein might be understood as sites of sanctuary and cultural resistance practices dispersing alongside regimes of containment. Mapping coordinates of key historical moments and sacred places as my points of inquiry, I ask: what might we learn about the Bale zone, and Dirre Sheikh Hussein particularly, through quantifying and visualizing the textures of its spatial histories?

John Nicklas – Preliminary Exploration of Temperature-Related Mortality among US Residents from 1989-2020
This study investigates the association between extreme heat exposure and excess monthly mortality across the United States. The analysis covers 5,976 areas, defined by a combination of county, sub-county, and place shapefiles obtained from the US Census. These areas correspond to the CDC's Multiple Cause of Death database, which lists ~78,900,000 mortality events across the 32 years of this study (1989-2020). I adopt the definition of an extreme heat day from Khatana et. al. (2021): ≥90°F and in the 99th percentile of heat index for each area. Weather data is obtained from NASA's Daymet, which interpolates and extrapolates daily observations onto a 1km raster grid. Deviations from the expected monthly mortality are correlated with the number of such extreme heat days in each of the 160 summer months (May – September).
My findings confirm that each additional extreme heat day is associated with approximately 0.07 additional deaths per 100,000 adults. Spatial analyses using Local Indicators of Spatial Association (LISA) and Getis-Ord Gi* reveal significant clusters of stronger association. Further subgroup analyses indicate varying patterns across age cohorts and evolving trends over the three decades. These results suggest that certain places are more resilient to the impact of heat from climate change. In the future, I plan to investigate the factors underlying heat resiliency.

Torben Parker – Hot Spots: A Spatial Analysis of Extreme Heat Resiliency in Rhode Island
With climate change bringing increased extreme heat events to New England, we must analyze how to efficiently allocate resources to mitigate its effects. This project asks, "how are populations vulnerable to extreme heat events, and extreme heat events themselves, historically distributed in Rhode Island?" with the end goal of determining if correlations exist between the two. In a previous analysis by Khatana et al. (doi:10.1001/jamanetworkopen.2022.12957), they analyzed the association between all-cause mortality and extreme heat events at the national level, while this project focuses on the more granular census tract level.
Population demographics are drawn from the 2020 Census, sourced from the IPUMS National

Historical Geographic Information System database. The 2020 Census is used for parity with data on extreme heat events, which are on the census tract level. This data is sourced from the CDC's National Environmental Public Health Tracking Network. Spatial analysis is done through the ArcGIS Pro Software, where bivariate thematic maps will be created to visualize distribution of heat events and demographics. The expected results are unknown, but I am hopeful that this analysis can identify target areas in Rhode Island that have high vulnerability to extreme heat events.

Ambuj Suri – Mapping Access to Anti-Venom to Counteract Fatal Snake Bites in Nepal
Timely administration of anti-venom is crucial to mitigate morbidity and mortality from snake bite envenomation. In Nepal, snake bite centers have been established by the Nepali government to address the fatality associated with snake bites and universalize access to anti-venom across regions with high burdens of envenomation. Data from epidemiological work in western and southeastern Nepal describe delays to accessing treatment, especially among vulnerable populations, due to a lack of understanding of the geographic distribution of snake bite centers. Working with partners from the newly established Poison Information Center (PIC) in Kathmandu, Nepal, our research team aims to describe the availability of anti-venom geographically and model ways in which GIS can help map access to antidotes to deliver more prompt emergency care.

Meeghan Truelove – When an Island Is Not an Island: The Dynamic Kaleidoscope of Coney Island's Spatial History
My work at the institute has been focused around a mapped-out investigation of the Coney Island neighborhood in New York City through the unique capacities of GIS. I am engaged in a long-term project about Coney Island as a site fraught with meaning in the context of American culture, and GIS has allowed me to examine several significant facets of this landscape in exciting new ways. Working with both raster and vector files, I've accreted visual representations of the topographic changes that have been imposed on Coney Island over the past 100-plus years. I've also overlaid land-use patterns, property ownership and zoning changes in the most recent decades—a period of intense upheaval in Coney Island—in order to gain a more finely grained understanding of how these factors played out across the region and impacted the city at large.

Liam Van Vleet – Surveying the survey's interactive data: Alternative mappings of Eelgrass abundance in Narragansett Bay and Block Island Sound

Seagrasses play a key role in ecological systems of the coastal oceans; they provide habitat and food for juvenile shellfish and finfish, their roots hold sediments and prevent erosion, and they are a major sink of carbon. In Narragansett Bay, the dominant species is Eelgrass (zostera marina) and it was once abundant. A wasting disease wiped out much of the Eelgrass in the Northeast in the 1930s, and nitrogen input and higher turbidity from sediment have allowed for minimal recovery. For a long-term time series, the Rhode Island Eelgrass Mapping Taskforce have created a polygon dataset based on orthophotography, that describes the position and extent of eelgrass beds in the bay and coastal ponds in 2006, 2012, 2016, and 2021. The taskforce have then developed an interactive GIS microsite using the polygon and imagery data. In this project, we have utilized those same eelgrass shapefiles to develop a set of small multiples maps, as an alternative and differently arranged way to communicate the shifts in position and abundance. An analysis of available sediment transport imagery, turbidity and nutrient input data in relation to the spatial and temporal shifts in eelgrass is also under consideration.

Ernesto Zaldivar – Utilizing GIS Methods for Physical Security Elements of Cybersecurity: An Examination of Los Angeles's Hermosa Beach Submarine Cable Landing Station

Our increasingly interconnected and global world is often connected by physical cables and not simply local signals such as those from cell phone towers. Our world's internet and telecommunications infrastructure are composed of numerous parts. One major component is a substantial series of submarine cables—cables that run underneath the ocean. These cables enable data to travel at high speeds between continents. It is technologically possible for a malicious actor to cut a submarine cable to prevent its use or to modify it to eavesdrop on its signals. Each end of a submarine cable connects to a landing station. These stations are physical structures that house cables and connect them to other portions of the telecommunication network. Like submarine cables, landing stations are susceptible to intentional physical attack as well as natural disasters. This research aims to explore ways that geographic information systems methods could help cybersecurity practitioners and governments study physical security threats to landing stations.