USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences
Spatial Sciences Institute

As of June 10, 2020

Spatial Sciences Institute (USC Spatial) is now accepting applications for undergraduate student researchers to work with USC Spatial faculty on their research projects for the 2020-2021 academic year.

We are looking for students who have excellent academic records, show interest in participating in cutting-edge research projects at USC Spatial, and are eager to take advantage of the opportunity to work directly with faculty on their research projects.

Priority will be given to Spatial Science Institute students (Dornsife minors in GIS and Sustainability Science, Human Security and Geospatial Intelligence, and Spatial Studies, and majors in GeoDesign, Global Geodesign, and Human Security and Geospatial Intelligence). However, applications from all majors, minors, and academic programs throughout the University are encouraged. Students of all class standing (including incoming freshmen or transfer students) are welcome to apply.

The projects generally are structured for an average of 5 – 10 hours/week. **Accepted students will work out their specific work schedules for the semester with the supervising faculty or staff member and will be expected to honor the weekly time commitment for the duration of the semester.**

USC Spatial student researchers are expected to submit their research work for presentation. Venues for presentations include such the Spatial Science Institute's Los Angeles Geospatial Summit on February 26, 2021 at the USC Hotel; the USC Undergraduate Symposium for Scholarly and Creative Work held in April on the USC campus; and the Esri User Conference held in July in San Diego. Students also are encouraged to submit their work to appropriate student research competitions, such as the 2021 USC Esri Developer Center Student of the Year Competition and the United State Geospatial Intelligence Foundation 2021 GEOINT Symposium.

Past student researchers have presented their results at international conferences such as the American Association of Geographers annual meeting, the SIGSPATIAL conference, and the GEOINT Symposium, and have co-authored published research.

To apply

Please provide:

- A resume which includes your name, contact information, major/minor, year in school, software and programming language competencies, and relevant course projects/skills;
- A current STARS report (not required for a new incoming student); and
- A statement of interest indicating the project(s) for which you are applying. You may apply for more than one project; please indicate the priority of your preferences. If selected, you will be selected for one project only.

Please email your complete application materials to Susan Kamei, Spatial Sciences Institute Managing Director, at kamei@usc.edu, by **5:00 p.m., Friday, July 17, 2020**.

Students selected by the faculty will be notified by the end of July so the research teams can be organized by the start of the Fall 2020 semester.

Questions?

Please email Susan Kamei or call her at (213) 740-1375, or email Ken Watson, Spatial Sciences Institute Academic Programs Director, or call him at (213) 740-8298.

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Investigating industrial-scale renewables in southeastern California using mixed methodologies

Jennifer M. Bernstein, Ph.D., Lecturer, Spatial Sciences Institute

Project Description

In 2016, the Renewable Energy Action Team[1] identified potential renewable energy development areas in eastern California based on multiple criteria. This includes quality of resources, land ownership, slope, access, transmission, and capacity for production. These criteria were mapped and used as a guide for locating future solar energy installations. However local opposition has resulted in a general attitude of distrust between renewable energy developers, community residents, and government authorities. It raises the question: is there a way to achieve a rapid and massive reduction of CO2 emissions while balancing the needs of local populations and ecosystems? This study proposes to use a novel and interdisciplinary methodology, exploring whether combining multiple types of criteria and visualizing them spatially can assist in reducing contention and controversy regarding the siting of renewables in Eastern California.

This URAP would continue and expand on the work completed during our 2019-2020 URAP, which was inarguably successful. Our student became proficient in spatial analysis, interview techniques and digital science communication. With faculty, she conducted two site visits to Eastern California to learn more about renewable energy development. Ultimately, she created

an ArcGIS story map that merged publicly available data, maps, photographs, and interviews to create an engaging and accessible narrative about the political, cultural, economic, and ecological implications of solar development in the region. She has been accepted to present her work at the following well-regarded conferences: the USC SSI Los Angeles Geospatial Summit, the Association of American Geographers Annual Meeting, and the UCGIS Symposium.

While we have begun to identify and analyze the spatial data and conduct preliminary analysis, we have much work yet to do. Our students would continue to explore the physical, social, and attitudinal factors shaping the current political climate surrounding industrial-scale renewable energy development in southeastern California.

Once again, in addition to gaining proficiency in spatial data analysis, students would engage in field excursions to the Mojave desert and interview stakeholders and members of the general public.

These improvements would be made from 2019-2020 and 2020-2021:

Two student collaborators will work together. Ideally, one student would be from the humanities and/or social sciences, while the second would be from the spatial sciences. This would facilitate the integration of methodologies, sharing of diverse perspectives, and ultimately a stronger narrative.

Students would expand on the current renewable energy data ArcGIS Projects, adding and cleaning relevant data. Students would also add relevant information from their field studies. This would be added to an improved story map.

The students would dive deeper in proper protocol in employing survey methodologies and mapping them across space. With a second URAP, we would be able to improve the quality of our current data set and transform it into actionable information.

The students would expand the study region beyond San Bernardino County. We would conduct a longer field trip to the eastern Mojave, where many of the largest solar installations are located and being proposed, and the general public has more influence over the public policy process. Further, connections with other researchers made during this last cycle could be capitalized on by staying at the Granite Mountain Research station.

Under the direction of the lead faculty, two students would create the story map and engage in field-based learning. This project would span Fall 2020 and Spring 2021. Each student would receive a stipend of $900. Each student would contribute 2-3 hours per week over the course of 2 semesters.

The project would include the following stages:

Stage 1: Background Research

The student will begin by doing background research on solar development in Eastern California to establish a knowledge base for the Story Map and field experience. This will include, amongst other things:

- Reading the text, *Solar Power*, by Dustin Mulvaney
- Reading government reports, especially those associated with the DCREP (Desert Renewable Energy Conservation Plan)
- Reviewing message boards, public comments, and op-eds to familiarize him or herself with public attitudes towards solar development
- Interviewing relevant decisionmakers and members of the general public in the Mojave region.

Stage 2: Spatial Analysis

Students will identify and process publicly available data sources of criteria that relate to renewable energy development, improving on the existing ArcGIS Project created during the 2019-2020 URAP. They will use survey data to create an attitudinal map of attitudes towards renewable energy development. Using ArcGIS, the students will develop basic maps illustrating the criteria that influence solar siting.

Stage 3: Field study

A multi-day field trip will be conducted to visit areas of interest within Eastern California and Nevada. A number of qualitative interviews will occur to gain a better sense of the underlying motivations behind attitudes towards solar development. Alternative energy sites will be toured to better understand the technical and procedural aspects of solar installation siting.

Stage 4: Story Map

Finally, to communicate the results, the students will create an Esri story map. Story maps are highly flexible templates that enable users to combine text, media, photographs, and maps. This map will expand the ArcGIS Project and story map built by our 2019-2020 URAP student. The students will gain skills in the creation of story maps, a highly marketable skill. It will also be an exercise in synthesizing information from multiple sources and digital storytelling. The resulting story map will be hosted by the Spatial Sciences Institute, and a publicly available web address would communicate student findings to interested parties.

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Homelessness and the Access to Water, Sanitation, and Hygiene (WaSH)

Yao-Yi Chiang, Ph.D., Associate Professor (Research), Spatial Sciences Institute

Project Description

We propose to build on our previous work to conduct both qualitative and quantitative analysis to study the relationship between water access/insecurity and health among the homeless population in Los Angeles.

In 2018, we interviewed a total of 137 participants in three census tracts encompassing the Skid Row community of downtown Los Angeles. We performed an initial analysis to explore the association between a number of demographic attributes, difficulty accessing WaSH resources, and the built environment.

The new proposed study for this project will aim to take place in a different geographic setting to show differences in coping mechanisms to survive in water-scarce environments. These environments are based on the accessibility of resources and services, spaces of survival (sleeping spaces), and neighborhood interference (policing, NIMBYism, etc.). We will integrate these conceptualizations of urban spaces as a means to examine the role different geographies and/or spaces play in the provision of WaSH services to meet homeless persons' basic needs.

Outcomes

The result will be:

(1) interview data collected from field studies;
(2) data analysis methods that jointly study the interview data with the data about the built environment; and
(3) data visualization products such as Story Maps on the web.

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Improving Humanitarian Emergency Response with Cellphone Locational Data

Andrew J. Marx, Ph.D., Associate Professor of the Practice, Spatial Sciences Institute

Project Description

Large-scale humanitarian disasters often disproportionately damage poor communities. This effect is compounded when these communities are remote with limited connectivity because first responders don't know where to send resources first. While humanitarian response organizations are increasingly using a wide range of satellites to detect damaged areas, these images can be delayed several days and may not tell the story of how many or where people are affected.

In response, this research proposes creating location-based algorithms from personal electronic devices (cellphones) to detect when there is a massive outflux of residents from a village. This research will focus on identifying villages that evacuated after the 2017 Puebla earthquake in central Mexico. Data for this research has will be provided by Cuebiq (www.cuebiq.com), who has agreed to provide all data for 2017 in central Mexico, and has already provided a week's worth of sample data of the area for the week of the earthquake. In the United States, this data is collected on 1 in 3 cellphone owners, providing their location 100 times/day to within 30 feet. A city the size Atlanta can produce more than 1 million rows of location data/day on individual movements. It is hoped that this research will demonstrate an approach to alert humanitarian organizations of the size and severity of a humanitarian disaster, detect which villages are most severely damaged and prioritize them for response.

Undergraduate Researcher Role

Students will follow a structured path of analysis under the direction of Dr. Marx. They will join Dr. Marx's Human Security and Geospatial Intelligence Lab (hsgi.usc.edu) and will operate under its current practices. Specifically, they will meet weekly (as a group) with Dr. Marx in SSI for an hour lab session where they will go over weekly progress and next steps. In the intervening period, students use a shared Google Drive folder to record their 'worklog'. In this log they write how much they worked, when and what they did. Students not abiding by the policies are removed from the lab. Students share an $8,000 computing environment housed in the lab providing data storage, processing and software necessary for the research project.

While the following steps deal with tasks, weekly meetings will sure address larger issues such as why people flee in earthquakes, what are the ethical implications of surreptitiously using cell-phone locational data, principles of signal-to-noise and algorithm development.

- Download, unzip and populate data into PI's server (requires python scripting);
- Identify 20 villages severely effected by the earthquake and 20 controls not effected;
- Create preprocessing algorithms to only select needed data;
- Create algorithm to detect what cell-phone 'pings' are village residents;
- Create algorithm to detect when a large portion of the village flees the village;
- Validate on 20 experimental and control villages; and

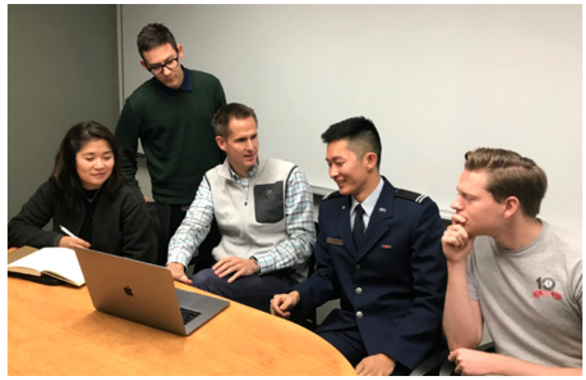
- Write manuscript

In selecting the students, the lab is looking for students with three traits (a student's school or department is not considered):

- Passion for reduction of human suffering in the developing world;
- Some background in Python coding; and
- The ability to think spatially and temporally about high volumes of locational data.

Integrative and Group Activities

Undergraduate researchers will have several opportunities to collaborate. Students will meet weekly with other graduate and undergraduate researchers as part of the Human Security and Geospatial Intelligence Lab (hsgi.usc.edu). The lab also regularly interacts with others on campus interested in human rights work including the Shoah Foundation and the USC Levan Institute for Humanities and Ethics (Dr. Boyd-Johnson).



Weekly meetings of the HSGI Lab

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Analyzing Urban Change and Inequality in India and China

Jefferey Sellers, Ph.D., Professor of Political Science, Public Policy and Spatial Sciences

Project Description

This project, supported by the Provost's Undergraduate Research Associateship Program and other sources, employs a variety of geocoded data from diverse sources to analyze spatial inequality in the rapidly developing urban areas of India. Soon to be the largest country in the world, India is undergoing a remarkably fast transition to an urban society. As the Subcontinent urbanizes, the juxtaposition of new development with rural settlement is creating dramatic disparities in the built environment between upscale development clusters and emerging slums. The project combines online real estate listing data with remote sensing images, other geospatial data and a variety of administrative, planning, electoral and demographic data. The analysis includes comparison of Indian regions with a parallel selection of Chinese urban regions.

This project is part of a wider research program that analyzes spatial data on social, economic, political and spatial change in urbanizing regions around the world. The aim of the project will be to compare patterns of urban settlement and its development, with an emphasis on the expansion of urban settlement into rural areas, the role of informal settlement and the survival of rural village structures. The project revolves around analysis of high and middle resolution remote sensing images to compare matched urbanizing districts in selected cities of each country. The project builds on previous research that has generated comparative citywide

metrics of urban form in China and India (Sellers et al. 2020), classifications of the built structures in urbanizing neighborhoods, and analyses of real estate listings data (Sellers and Wang 2018; Sellers and Li 2019). This project will draw on newly available data to analyze and compare urban expansion among several Indian regions, and extend the methods to comparison with Chinese urban regions.

Preferred credentials

GPA of at least 3.5, basic knowledge of statistics and familiarity with geographic information systems and one or more related programs (ArcGIS, Python, Google Earth, Excel, and Stata, SPSS or R). Knowledge of comparative international politics, urban issues or developing country settings (particularly India or China) a plus but not essential. Interested students should be prepared to provide informal transcript, a brief statement of interest and background and the name of one faculty reference.

Student responsibilities and supervision

As Provost's Undergraduate Research Associates, students working on the project will be expected to carry out some combination of the following responsibilities:

- map, catalogue and analyze the built environment and its evolution in selected sites on the urbanizing periphery of Indian and Chinese cities;
- construct comparative databases of land use metrics, administrative and planning data, census data, electoral data and economic data to compare governance arrangements for urban regions;
- collect additional data through the internet, Google Maps and Google Earth on the character of the main firms, institutions and other establishments in the study site; and
- analyze the variations between the selected sites in each country, along with the differences between different regions and countries.

Hours are negotiable, averaging 8-10 hours/week, and work may be carried out remotely. Students will meet weekly with the supervising professor to discuss progress, trouble-shoot problems, and agree on next steps. Prior to meeting each week the student will submit a report on their hours worked and what they did.

Parts of the project will integrate teamwork with other undergraduate and graduate researchers active in the project at USC, and in some cases with the researchers from India and China in the wider research team.

Final research products

The work of the undergraduate researchers will be geared toward preparation of a poster for the Undergraduate Research Symposium in the Spring of 2021, and an eventual peer-reviewed article manuscript. The research will ultimately contribute to a longer, coauthored book manuscript comparing the governance of urban development in India and China.

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3D Geovisualization and 3D Spatial Analysis of Ice Age Fossils Excavated From La Brea Tar Pits, Los Angeles CA – Phase 2

Jennifer N. Swift, Ph.D., GISP, Associate Professor (Teaching), Spatial Sciences Institute,
and **Emily L. Lindsey, Ph.D.**, Adjunct Assistant Professor, Department of Earth Sciences

Project Description

USC and the La Brea Tar Pits Museum (LBTPM) seek to further current research efforts into the real-world impact of Ice Age fossil research. This work is designed to substantially build out 3D geospatial educational tools for the LBTPM to bring fossil provenance investigations and 3D geovisualization of the LBTPM complex below ground to the general public. Building upon previous LBTPM projects successfully completed by USC Spatial Sciences students that resulted in a methodology for managing fossil collections as high-resolution 3D objects displayed in 2D and 3D maps in their pre-excavation, in-situ locations, and most recently development of 3D subsurface geovisualization of the geology and fossil deposits beneath La Brea, this project aims to improve our understanding of Ice Age animals and the environments in which they lived and died.

There are two main goals: 1) to develop online 3D geospatial, interactive and educational tools such as 2D and 3D web maps supporting storytelling and geogameing, and 2) conduct research into connecting visualizations of the geology beneath La Brea to the positions of radiocarbon dated fossils to provide a new and unique understanding of asphaltic fossil deposit formation and asphalt-animal interactions. This proposal seeks to provide USC undergraduates with practical, applied experience in the role of spatial science in a comprehensive 3D geovisualization project.

Research activities will include preparing and managing 3D data, designing, planning and developing interactive research as well as educational tools for the LBTPM, and a faculty/student-led workshop to gain feedback on the results from the LBTPM.

Role of Student Researchers

The students will be given the opportunity to:

- expand upon the results of the previous research projects using GIS and other advanced geospatial tools, such as geogaming engines and developing Story maps (e.g., DeMers 2017; Alquist and Schlieder 2018);
- support further development of unique digital educational tools that focus on inspiring and engaging the general public in the museum's research activities;
- work closely with museum scientists to create innovative designs of online geospatial educational tools in the form of interactive scientific stories that make use of the 3D spatial

data structures and GIS-enabled tools created during Phase 1 to continue the collaboration with current projects related to future 3D virtual museum exhibits (Huisman et al. 2020);

- produce a final report and presentation about project outcomes. The presentation will highlight the importance of the online educational tools that utilize both 2D and 3D geovisualization, storytelling and geoplay to explain 3D spatial analysis of real-world 3D objects. The ultimate intention of this project is to continue to support La Brea Tar Pits Museum's ongoing research into Ice Age fossils and development of educational activities.

Workshop and Final Report

The research will culminate in a one-day workshop at which the undergraduate students will present outcomes of their research and receive feedback from LBTPM scientists. The students, as a team, will produce 2D and 3D data visualizations of online web maps and geogames integrated into a story map, as well as a data management plan in the form of a technical report documenting the spatial data structures and educational geospatial tools developed as results of this project. These products will be Angeles Geospatial Summit held in Los Angeles, CA, the Esri User Conference held in July in San Diego, CA, and appropriate competitions.

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Using Geospatial Analysis for the City of Los Angeles to Make Data-Driven Decisions, Impact Policy, and Advance Resilience, Sustainability, and Civic Engagement

John P. Wilson, Ph.D., Professor of Spatial Sciences, and **Beau MacDonald**, GIS Project Specialist

Collaboration with the LA Mayor's Data Science Team

To enhance undergraduate student research opportunities, the USC Spatial Sciences Institute (USC Spatial; SSI) initiated an ongoing partnership in 2016 with the City of Los Angeles Mayor's Office Data Science Team and the Esri geospatial enterprise. SSI interdisciplinary research teams are designed to encourage students to collaborate as equal partners with faculty and staff to conduct actionable applied research, often with public agencies as clients. Competition for these experiential learning positions is strong; selection is based on personal statements, academic achievements, and creative accomplishments; and expectations for participants are high. Five USC Spatial student teams have worked directly with the LA Mayor's Data Science Team, Deputy Mayors, Chief Sustainability and Resilience Officers, and representatives from an array of City agencies. Students received outstanding reviews for innovative work, creative mapping applications, and excellent presentations. Each year, participants are selected for jobs and internships based on their involvement and the quality of their work.

The LA Mayor's Data Science Team is planning now with SSI and various City entities to identify specific partnerships for our SSI student team research for the 2020-2021 academic year.

We are at a special moment in our city: willingness to confront serious local, regional, and global issues; bond funds to support transportation, green space, and housing initiatives; and extra motivation with the 2028 Olympics on the horizon. Mayor Garcetti now chairs the C40 Cities Climate Leadership Group, an international network of the world's largest cities re-committed to the "Global Green New Deal" (United Nations 2009) to combat climate change — concrete actions that address four principles: recognition of a Climate Emergency; a commitment to keeping global heating below the 1.5°C Paris Agreement goal; a promise to build more equitable economies and advance environmental justice; and a pledge to work with a range of parties disproportionately impacted by climate change and poverty — from youth, communities, workers, and scientists to businesses and governments.

The Mayor's "Resilient Los Angeles" (City of Los Angeles Mayor's Office 2019) plan underscores the need for neighborhoods to prepare for urban resilience — a concept that encompasses geography, ecology, engineering, socio-economic issues, and politics (Meerow & Newell 2016). Mayor Garcetti's "Sustainability pLAn" (City of Los Angeles Mayor's Office 2015) contains complementary visions intended to transform the city within the next two decades, with long-term aspirations grouped by topics that include Air Quality; Housing & Development; Mobility & Transit; Livable Neighborhoods; and Urban Ecosystems. Goals, objectives, and inspiration from the local reports plus the United Nations Sustainable Development Goals (SDGs; United Nations

2015) have guided our recent work for the City of Los Angeles, the LA Mayor's Data Science Team, and the Los Angeles GeoHub.

The goal of the LA GeoHub is to share data between City departments and create applications that allow users — including residents, private industry, and decision-makers — to get information about systems that interact with one another to target their work more effectively and to improve strategic planning. LA Mayor Eric Garcetti and Esri founder and president Jack Dangermond announced the 2016 launch of the LA GeoHub open data platform. One of the nation's most comprehensive municipal mapping platforms, it is a core component of the Mayor's effort to make LA a world leader in civic innovation and open data, and incorporates a multifaceted geographic information system (GIS) platform that makes >1,000 geospatial datasets publicly available for real-time analysis.

Our 2019–2020 "Resilience" project is a collaboration between the Department of Neighborhood Empowerment (DONE), the LA Mayor's Chief Resilience Officer and Data Science Team, and SSI. It supports the "Resilient Los Angeles" initiative that stresses disaster preparedness and recovery, supports economic security of residents, guards against threats of climate change, and assesses the city's aging infrastructure. According to DONE, "local engagement is important because no one understands a neighborhood better than the people who live, work and play there"; LA Neighborhood Councils (NCs) also "strengthen democracy [in LA] by embracing and supporting the diversity of neighborhoods." Neighborhood Councils are the smallest political entity within the city, and consist of residents, business owners, and property owners, with participants empowered to advocate directly for change to make a positive impact in their communities. Our project goals include helping the 99 NCs to organize and develop resilience plans to prioritize, prepare for and recover from major shocks or stresses. The SSI student team developed four geospatial web applications to assist with data collection and visualization of these issues; apps incorporate data from NC resilience priority surveys and the LA GeoHub, and are in beta testing with NC representatives. Public outreach with the student team is scheduled for March-early April 2020.

Another student team is investigating "Superblocks" feasibility in LA, siting pilot projects at NC scale for streets, schools, and residences, using Geodesign strategies (Steinitz 2012; Wilson 2014) to assess development scenarios and potential impacts of their implementation upon achievement of the UN SDGs (United Nations 2015; 2019). "Superblocks" — defined as people-oriented public spaces and single- or multi-family residences contained within clusters of city blocks, bounded by a perimeter of arterial roads, with through-traffic limited on smaller interior streets — are part of a larger planning strategy implemented in Barcelona, integrated with rerouted bus and bike lane systems (Rueda 2019). Overarching goals are transformation of the city's relationship with cars and safer, more-sustainable urban mobility, yet other objectives are equally ambitious: benefits to health and well- being through greater reliance on human-powered transport options, improved environmental quality, increased biodiversity and urban green space; revitalization of public space; resource self-sufficiency; improved social interaction, cohesion, and local governance (Ramirez-Rubio et al. 2019; Mueller et al. 2020). Green spaces, for example, can be created or enhanced by planting trees, which residential neighborhoods in greater LA have lost as infill redevelopment replaces buildings with smaller footprints (Lee et al. 2017).

Last year, one of our teams created a Community Science Tree Inventory mapping application, working with the LA Bureau of Street Services Urban Forestry Division to iteratively create and test an app which we envision will be most valuable as a tool for community outreach to promote neighborhood-level street tree stewardship in our city. LA has ~700,000 street trees, with many in need of care. The app included features requested by Urban Forestry, collects uploaded photos plus specific attributes based on tree inspection and hazard evaluation forms, and integrates existing City street tree data. The app can be deployed in the field on a smart phone or tablet using a map-, smart-forms-, or browser-based interface; builds on several data capture platforms; and displays data using one GIS-based hosted feature service that can also be accessed, mapped, and edited on a desktop computer, and shared with the LA GeoHub. The team demonstrated their app to City representatives that included executives from the Board of Public Works, a Deputy Mayor, and the Mayor's Directors of Infrastructure and Sustainability, and they were invited back to continue their collaboration this past fall. These students also received an Undergraduate Research Associates Symposium Interdisciplinary First Prize for their work.

A second student team worked with the Mayor's Office of Community Business to conduct a geospatial exploration of economic development's effects on small business vitality in selected regions of particular interest to the City of Los Angeles. "The Macro of Micro" examined micro and small business resilience across a fifteen- year time frame, 2003–2018, looking at the effects of big businesses on small business growth, as well as exploring whether the level of development in the neighborhood surrounding the retail environments influenced small business growth and persistence; community-level factors considered included income and other economic indicators, demographic data, transportation, and overall gentrification. The team selected commercially zoned corridors along Crenshaw Blvd., Van Nuys Blvd., East First St., and Larchmont Blvd., each representing a different level of development. Site visits and extensive data analysis of historical business data suggested that big business growth played a part in small business decline, specifically through business revenue, and that development level was correlated with small business growth, revenue, and persistence. The City enthusiastically received the team's recommendations to increase the resiliency of small and micro businesses.

The prior year's research drew from the Mayor's Sustainable City pLAn — the transformative strategy to address environmental concerns over the next 20 years within a sustainability framework that includes a social equity and a healthy economy. One vision is to lead the nation in water conservation; by capturing seasonal rainfall for irrigation or to recharge groundwater, we increase local availability, reduce imported water dependence, and create sustainable alternatives to routing rainwater to streets, where debris accumulates to become urban runoff that drains to the river and ocean. USC Spatial was asked to recommend ways to disseminate information about holistic values of enhanced stormwater capture for a public engagement campaign. Students explored green infrastructure; parameterized selected scenarios and solutions; and created maps, apps, visualizations, and videos. We focused on simple ways to capture stormwater and showed potential impact that one home or neighborhood can have to help achieve conservation goals. We used an online "Story Map" to explain benefits of rainwater-capturing containers and to incorporate interactive maps and geospatial analyses that allow users to enter an address or click on their home or neighborhood to calculate potential

catchment and savings. Students presented at professional GIS conferences, spoke at the Los Angeles Geospatial Summit, and demonstrated their app at the City of LA Sustainability Tools Launch. At the Provost's Undergraduate Symposium for Scholarly and Creative Work, they received the USC Schwarzenegger Institute for State and Global Policy First Place Award.

Our first year, we completed an innovative street-segment-level network analysis of violent and property crime (2012–2017 data) in the City of LA. Students conducted spatial and statistical analyses and produced an app for the Los Angeles Police Department and the LA Mayor's Office of Budget and Innovation. Crime patterns were categorized by their change over time; by time of day; and by day of the week. The mapping app is a descriptive tool to allow stakeholders involved in public safety to understand temporal and spatial patterns of crime and their determinants at a small but meaningful geographic level. The tool allows users to overlay street-segment and census block group layers related to the city's built and socioeconomic environment onto the street network. In this case, the app can be used not just to examine the spatial distribution of crime in the city, but also to examine associations between increasing and decreasing crime and environmental factors including place-based programs. This knowledge enhances the ability of the Mayor, LAPD, and other stakeholders to deploy resources and make policy changes to improve public safety. Students participated in multiple meetings with LAPD and Mayor's Office teams; presented their app at City Hall, at USC, and at the Los Angeles Geospatial Summit; and were contributing authors on a "Methods Protocol for the Los Angeles City Crime Street Network" (Brazil et al. 2017).

The 2020-2021 Project

Based on recent conversations with the City of Los Angeles Mayor's Office Data Science Team and experience with civic entities who have collaborated with our student research teams over the past four years, our next project will be specifically framed for student research involvement, and will address some measures of sustainability and resilience in the City of Los Angeles. Students will need to understand and apply underlying principles of ecology, geography, architecture, landscape architecture, urban planning, computer science, and spatial sciences.

This research would be particularly appropriate for our Geodesign majors, but would appeal to talented students from other most disciplines including environmental studies, earth sciences, and health-related majors. Geodesign provides new opportunities to use the spatial sciences to guide design across a variety of scales ranging from specific sites to neighborhoods, watersheds, regions, and the world as a whole (Wilson 2014). Geodesign functions simultaneously at multiple levels as a collaborative, iterative, non-linear process. It is a force for good that helps people to become more aware of their environment and understand landscapes can be multifunctional: it encourages all participants to help identify local needs and desires, establishes the scope of a project, and introduces scientifically-based geospatial models and digital tools to assess trade-offs required and the impacts of change, which are then related to local values (Steiner & Shearer 2016). The framework uses a model series – representation, process, evaluation, change, impact, and decision – to understand the study area and scope, design the methodology, and to carry out the study. Given a desired outcome – determining project suitability, for example –

multi-criteria evaluations with stakeholder input are created and the options combined into alternative designs (Steinitz 2012).

Student research teams work in an environment that emphasizes creative problem solving through collaborative effort and individual innovation, valuable skills for all future endeavors. They learn to collect and analyze data from multiple sources and develop a portfolio of work that enhances their future job placement. They employ a scientific paradigm to conduct primary research and learn about the process, including how to identify the problem, work on a team, and share findings and creative accomplishments.

Team meetings are held biweekly, with presentations. In addition to the symposium presentation, we will encourage students and help to facilitate their submission of results to a scholarly venue (i.e. academic journal, blog, white paper), with target audiences most likely from environmental planning, urban design, and environmental health realms. Research teams are directly supervised by SSI Director Dr. John Wilson and GIS Project Specialist Beau MacDonald. Dedicated research lab space is provided and students are encouraged to consider it their work environment.

For 2020–2021, we envision another extraordinary student collaboration with the City of Los Angeles. Students will use geospatial techniques and interdisciplinary skills that will require them to acquire, represent, organize, analyze, model, and visualize spatial information. Field research includes data-gathering and outreach in local communities, along with high-level presentations to City officials and other stakeholders. Tools include web-based survey and mapping tools and applications along with various advanced techniques to create models. Students evaluate parameters, build geodatabases, and learn modeling and code-based cutting-edge technologies that enable integration of multiple data sources. Visualizations begin with a small-scale model and proceed to larger-scale detail with high accuracy. The process is iterative with feedback loops for all members of the team.

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Exploring associations between historical redlining and current children’s blood lead levels in Los Angeles County

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Project Description

In 1933, the Home Owners' Loan Corporation (HOLC) was formed under the New Deal initiative as a depression-era measure to refinance defaulted home mortgages and prevent foreclosures. To efficiently assess applicants’ risk, HOLC generated security maps that categorized urban neighborhoods into one of four perceived risk groups. Neighborhoods that were predominantly inner city, black, and immigrant were systematically graded as hazardous and outlined in red, whereas neighborhoods with higher property value, better housing quality, and predominant native-born white were considered lower risk (Michney and Winling 2020). This practice of residential redlining that was derived, systematized, and disseminated by the federal government and adopted by the private sector has had extended effects by

entrenching racial segregation and diminishing the appreciation of home values and accumulation of wealth (Nardone et al. 2020). The legacy of redlining is noted nearly a century later nationwide as 3 out of 4 redlined neighborhoods continue to struggle economically and are predominantly people of color.

Inorganic lead is a potent neurotoxin that can cause damage to almost all organs. While acute lead poisonings are now rare in the United States, exposures remain widespread (Jones et al. 2009). Even at low levels, lead can cause cognitive deficits, neurodevelopmental delays, and psychological impairments (Levin et al. 2008). The annual economic toll from lead exposure in California alone is estimated to result in lost earnings of $8–$11 billion dollars over the lifetime of children (Johnston and Hricko 2017). Compelling scientific evidence concludes that there is no "safe" threshold of childhood lead exposure (Jusko et al. 2008; Lanphear et al. 2016). Children in the US do not face equal risk. Particularly vulnerable are children in communities with older housing stock, increasing the risk of lead in paint or plumbing, and in communities near industrial lead sources (Tong et al. 2000). These disparate burden is often found in community of color in the low-income urban neighborhoods (White et al. 2016).

The goal of this project is to assess the association between historical redlining in Los Angeles County and current incidence of elevated blood lead levels among children <6 years old. Our students will work on digitizing historical records and compiling blood lead data at the census tract level from the Los Angeles Department of Public Health using Geographic Information Systems (GIS). The students will assess the distributions of elevated blood lead level (concentration >4.5 ug/dL) among children and other confounding variables, such as median age of home, population density, and percent of the population living below 2 times of the federal poverty level, both statistically and geospatially.

Each census tract will be categorized one of four risk levels (A, B, C, or D) on the basis of the location of population-weighted centroids on security maps, with the worst risk level (D) indicating historical redlining. We will investigate the relationship between elevated blood lead levels among children (concentrations >4.5 ug/dL) using ordinary least squares regression and spatial regression models. Our student will work with us to learn how to handle imperfect real-world datasets for proper spatial data analysis and visualization. The research outcomes will provide important understanding on the connections between a historical policy decision to a serious public health issue in the region we live in, and thus help shape the future policies for possible mitigation strategies in a long run.

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Student Involvement

One undergraduate student will work with Dr. Johnston in understanding the sample data structure and handling data cleaning and processing for this important public health question. Dr. Johnston will oversee the analysis of the blood lead data. The student will be working closely with Dr. Wu in tackling GIS-related problem solving and geoprocessing. The student will learn to apply both statistical and geospatial analytical skills to understand spatial datasets, which in turns help them to critically think about social and environmental justice around health disparity in our own society. The student will work on the proposed research for 9 hours per week on the task basis using software ArcGIS, MS Excel, and MS Access during Fall 2020 and Winter 2021.

Student Group Activities and Faculty Supervision

The student will be mainly housed in Spatial Sciences Institute. The student will start the project by meeting Dr. Johnston to understand data source structure, handling, cleaning and management. Dr. Johnston will explain the important environmental health background on this project. The student will then work with Dr. Wu in weekly basis. Dr. Wu will provide guideline for the GIS and statistical tasks and walk through important concepts and techniques with the student on the computer. The student will report project progress and discuss geospatial problems encountered during the meetings.

The student will be encouraged to join the seminars in the Spatial Sciences Institute (Brown Bag Series) and attend the Population, Health and Place (PHP) colloquium. The student will also be encouraged to attend the annual Los Angeles Geospatial Summit to meet fellow students and learn about emerging technologies and research projects in GIScience.

Project Report

The student will present the project research results as a poster in the Undergraduate Research Symposium toward the end of Spring 2021.

Student Selection Criteria and Process

The student should be interested in environmental pollution and environmental health issues, have knowledge about GIS fundamentals and some experiences in ArcGIS with an averaged GPS of 3.0 or above. Ideally students should have taken 1-2 courses involved in hands-on GIS practices (e.g. GIS labs) by the start date. Interested students will contact Dr. Wu and Dr. Johnston to set up a time for interview by end of July 2020 and the final decision will be made by mid-August.