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

As of 6/14/24

The USC Spatial Sciences Institute (SSI) is now accepting applications for undergraduate student researchers to work with SSI faculty on their research projects for the 2024-2025 academic year.

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

Priority will be given to SSI 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. **Applicants must be enrolled as full-time USC students in good standing during the research semesters.**

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. These are paid/funded research positions (except for the LA Coliseum project as is noted below).**

SSI student researchers are expected to submit their research work for presentation. Venues for presentations include such the SSI's Los Angeles Geospatial Summit in February 2025 at the USC Hotel; the USC Provost's Undergraduate Symposium for Scholarly and Creative Work held in April on the USC campus; and the Map Gallery of 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 USC Esri Innovation Program Student of the Year Competition and the annual United States Geospatial Intelligence Foundation GEOINT Symposium.

Past student researchers have presented their results at international conferences such as the Annual Meeting of the American Association of Geographers, the GIS-Pro Conference of URISA, and the AMC SIGSPATIAL conference. They also have co-authored published research.

To apply
Please provide:

- Your resume which includes your name, USC email address, cell phone number, major/minor, year in school, software and programming language competencies, and relevant course projects/skills;
- Your current STARS report (not required for a new incoming student); and
- **One** statement of interest indicating the project(s) for which you are applying. You may indicate your interest in more than one project; please indicate the priority of your preferences. If selected, you will be selected for **one** project only. You do not need to submit multiple statements of interest; one statement of interest document suffices.

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 12, 2024**. If you expect your application to be considered, do not miss this deadline.

Students selected by the faculty will be notified no later than the week of July 29 – August 2, 2024, so the research teams can be organized by the start of the Fall 2024 semester.

Questions?
Please email Susan Kamei, USC Spatial Sciences Institute Managing Director.

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Leveraging Spatial Epidemiology to Reduce Hypertension Disparities
Dr. Hoda Abdel Magid, Assistant Professor of Population and Public Health Sciences and Spatial Sciences

Research Project Description
Hypertension affects half of American adults but disproportionally affects racial/ethnic minorities. Hypertension is most common, most severe, and has the earliest age of onset in the Black population. Incidence of hypertension is 10-30% higher among Black compared to White adults. Disparities in hypertension diagnosis, treatment, and control outcomes are spatially patterned. This spatial patterning is hypothesized to be due to area-level socioeconomic risk factors and area-level structural resources (e.g., healthy foods, recreation, healthcare, and housing). The underlying mechanisms by which area-level factors produce hypertension disparities remain unclear. Leveraging detailed spatial data, therefore, provides unique opportunities to identify modifiable mechanisms by which area-level factors produce hypertension disparities.

Moreover, leveraging detailed spatial data provides unique opportunities to drill down below common area- level studies and elucidate the mechanisms by which area-level factors produce hypertension disparities. Spatial social polarization (SSP) indices are potentially key to understanding hypertension disparities. SSP indices measure the extent to which populations are distributed at extremes of privilege and deprivation of socioeconomic domains. SSP indices can be meaningfully expanded to measure structural resources, representing key opportunities to examine hypertension disparities. Despite such promise, little research has evaluated the
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association between socioeconomic SSP and hypertension; and no prior research has quantified structural SSP or its relationship with hypertension disparities.
The objective of this study (R00HL161479) is to estimate the impact of eight SSP domains on hypertension disparities, evaluating both socioeconomic SSP (race/ethnicity, income, education, residential segregation) and structural SSP (food, recreation, healthcare, and housing) domains. The central hypothesis is that living in areas with high SSP increases hypertension disparities. This innovative project will leverage data from (1) the Cardiovascular Health Study (CHS); (2) the REasons for Geographic and Racial Differences in Strokes (REGARDS) study; (3) public claims data from Medicare; and (4) spatial data from the Retail Environment and Cardiovascular Disease (RECVD) study with geographic linkages to CHS and REGARDS cohorts.

Research aims will (1) estimate the population-level effects of socioeconomic SSP predictors of hypertension prevalence, incidence, treatment, and control outcomes among Black and White adults; (2) develop a structural SSP index using measures of structural resources, and estimate the association between structural SSP and hypertension among Black and White adults; and (3) evaluate the extent to which socioeconomic and structural SSP mediate Black-White hypertension disparities. The proposed research will improve public health surveillance of hypertension disparities, provide the evidence required to inform the development of SSP interventions, and invite further research on the causal pathways linking concentrations of privilege and deprivation to health disparities.

Student Roles & Hours per Week
The objective of this proposal is to provide hands on training and research experience in epidemiology and population health research to undergraduates. Students will be directly involved in research projects working alongside other lab members including PhD students, postdoctoral fellows, and research coordinators. Students will contribute to every aspect of the research process while also developing independent research interests and skills in population health sciences. Student tasks will include literature reviews, data preparation from publicly available datasets such as the Census, data cleaning of NIH/NHLBI cohort data, secondary data analysis in Stata and/or R, contributing to peer-reviewed publications and serving as a co-author on peer-reviewed publications. Although students will broadly learn about all aspects of research, each student will fill specific roles on the research team that will contribute to its overall completion.

Specific tasks include, but are not limited to:

- Completing required human subjects training: take relevant training courses
- Data processing: Cleaning spatial data from the RECVD study and publicly available data from the Census.
- Data linking and statistical programming in R
- Abstract submission to an Epidemiology/Population Health Science conference

Literature reviews and future grant proposals
Student researchers will be expected to complete 20 hours/week during the Summer 2024 semester and 10 hours/week during the Fall 2024 semester. A discussion of the specific tasks and

hour alignment will be discussed at the beginning of each month during the project, and re-assessed every two weeks to confirm that hours are being allocated as expected and needed.

Selection Criteria
Dr. Hoda Abdel Magid will select two student researchers after reviewing their resumes, transcripts, and writing samples and conducting 30-minute interviews with the top candidates. Primary selection criteria will be strong grades (3.0 GPA and above) in relevant courses (STEM), past research and work experience, interest in the research, motivation for pursing the research in terms of career goals, and commitment to Summer 2024 and Fall 2024 semesters and expected tasks.

Final Report
The deliverable will be at least one co-authored abstract using data from the Abdel Magid Lab, with the goal of presenting this work at an Epidemiology or Public Health conference such as the annual meetings of the Society for Epidemiologic Research (SER) and the Interdisciplinary Association for Population Health Science (IAPHS). I co-chair the D&I committee of SER in which we have several programs to engage undergraduate researchers with SER and the field of epidemiology including the SERVisits program, which allows for more than 60 undergraduate students from all over the country to participate in the annual meeting by mentoring them through the abstract submission process and throughout the annual meeting to continue engaging relationships with researcher from a diverse range of institutions. Many scholars of SER visits have gone on to pursue graduate school in public health or epidemiology.

Student researchers' final research report will be a formal poster presentation. Students will be encouraged submit their work to the USC Undergraduate Research Symposium for Scholarly and Creative Work, as well as to professional conferences. Those who contribute substantively to the proposed research will be included as co-authors on scholarly manuscripts.

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The USC Sustainability Data Hub Phase 4: Further Development of the USC Sustainability Data Hub and Campus Collaborations
Dr. Laura Loyola, Assistant Professor (Teaching) of Spatial Sciences

Research Project Description
Over the course of the last two years, the USC Spatial Sciences Institute and the Office of Sustainability have developed the USC Sustainability Data Hub, an online source of spatial data for student research projects and experiential learning activities focused around sustainability at USC. This project promotes two of President Folt's and the University's ongoing goals: making our campuses sustainable and supporting experiential learning for students. Since its inception, the sustainability data hub has promoted collaboration across campus departments and programs such as Facilities and Planning Management (FPM), Information Technology Service (ITS), Environmental Studies (ENST), Architecture, and across both the University Park Campus (UPC) and Health Sciences Campus (HSC).

This project will continue to offer undergraduate students the opportunity to research the meaning and importance of sustainability on a university campus while developing their skills in creating and working with spatial data and building online cartographic displays. The students gain experience in working with a team, including members of the Office of Sustainability, FPM, ITS, the Office of Institutional Accessibility and ADA Compliance (OIA), the WorkWell Center, and across disciplines from spatial sciences to environmental studies and architecture.

Under the leadership of President Carol Folt, USC has instituted a variety of lasting changes, including Assignment: Earth, to make our campuses more sustainable. In 2021, the Office of Sustainability put together USC's first Sustainability Tracking, Assessment & Rating System (STARS) report and earned a STARS Silver rating.[1] The university also announced that it will freeze investments to and divest current investments from the fossil fuel industry[2]. Ongoing structural efforts include zero-waste through waste diversion, construction of "purple pipe" systems to maintain landscaping with recycled water, LEED certification of all buildings constructed since 2010, and a stormwater retention and filtration system installed at USC Village[3]. Socially, we incentivize public transit use with a subsidy for employees. These efforts have been recognized and recorded via spatial data that is now available to the USC community on the sustainability data hub (Waste Bin locations, LEED buildings, LED lighting fixture replacement and parking permit tracking). Previous research and data collection by student researchers and volunteers brought attention to areas on campus where hydration stations were either lacking or in need of repair[4], which was utilized by FPM to update and repair hydration stations – a necessary component of eliminating the resale of single-use plastic bottles on campus.[5]

The USC Sustainability Data Hub is a one-stop shop for spatial data – data that can be mapped – that relates to sustainability across disciplines at USC. The data hub is updated regularly and interest in the research and spatial data on the data hub has increased over the last two years. We are currently collaborating with professors in Environmental Studies to spatialize data related to storm water capture research projects and in Architecture to develop spatial methods that will be incorporated in a course on native plant bed plots on the USC campuses (UPC and Wrigley), as well as administrative offices such as the Office of Institutional Accessibility and ADA Compliance and the WorkWell Center on different research initiatives to create a more sustainable campus for faculty, staff, and students. Data (both spatial and aspatial) that are included in the Data Hub align with the UN Sustainable Development Goals (SDG), including but not limited to: good

[1] Association for the Advancement of Sustainability in Higher Education. The Sustainability Tracking, Assessment & Rating System, University of Southern California. https://reports.aashe.org/institutions/university-of-southern-california-ca/report/2021-07-29/

[2] Polakovic, G. 2021, February 17. "USC ups commitment to sustainability with new, fossil fuel-free investment strategy". USC News. https://news.usc.edu/182493/usc-sustainability-fossil-fuel-free-investment-strategy/

[3] Lindberg, E. 2019, January 15. "USC's green guru tackles myths about sustainability". USC News. https://news.usc.edu/153302/uscs-green-guru-tackles-myths-about-sustainability/

[4] Makmak, N. April, 2023. USC's Hydration Stations – Increasing Water Access. StoryMap accessible Here

[5] USC's Office of Sustainability website describes the variety of sustainability initiatives across campus. See https://green.usc.edu/programs/

health and well-being (SDG 3), access to clean water (SDG 6), access to affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), responsible consumption (SDG 12), and peace, justice and strong institutions (SDG 16).[6]

Experiential learning is a key part of a Dornsife education. It is the goal of Dornsife's Office of Experiential and Applied Learning for each Dornsife student to take part in at least one experiential learning project before they graduate.[7] These "learn by doing" projects can take a variety of forms, but they always involve direct student involvement in a project, rather than indirect learning about it after the fact. The USC Sustainability Data Hub supports experiential learning in two ways. First, the students who are supported by a URAP award will work first-hand on this project to continue to build out the architecture, content, and data of the Sustainability Data Hub. Second, all USC students will benefit from the Data Hub as it will give them access to spatial data about USC campuses that they can then directly study and analyze.

In the first year of this project, three URAP students helped create a first iteration of the Hub and prepared five spatial data sets which were shared via a beta version of the data hub. In the second year, URAP students worked with the SSI Systems Admin and ITS to build out a new infrastructure that is accessible behind Shibboleth, assemble additional data, and create new components of the data hub. This past year, students supported by SSI research funds and the Office of Sustainability worked with the above mentioned USC departments and student organizations to promote the data hub, lead volunteer data collection efforts, develop training materials and technical documentation, and conducted the spatial analysis for story maps for the Data Hub and conference and summit presentations (Spatial Science Institute's LA Geospatial Summit and the USC Undergraduate Symposium for Scholarly and Creative Work this semester).

Role of the Undergraduate in the Research for Maintaining and Growing the USC Sustainability Hub

Work in the coming year will focus on furthering collaborations across campus administrative departments and academic departments from various Schools at USC to improve access to spatial data for sustainability related research and experiential learning.

For the URAP students, this will involve:

- taking part in weekly meetings with faculty and staff of the Spatial Sciences Institute,
- bi-semester meetings with the staff of the Office of Sustainability and other administrative departments and centers as needed,
- researching data that promote USC's sustainability work and communicating with potential source offices, such as FPM and ITS,
- collaborating with source offices to learn about and gain access to the data,
- data wrangling as needed prior to publishing datasets,
- creating spatial datasets that do not yet exist,

[6] United Nations, Department of Economic and Social Affairs, Sustainable Development. 2018. "The 17 Goals". https://sdgs.un.org/goals

[7] Anderson, T. December, 2019. Introductory letter for Experiential Learning Newsletter, Issue 1. USC Dornsife Office of Experiential and Applied Learning

- communicating with the USC Office of Culture, Ethics and Compliance and USC ITS Office of Information Security to assess safety and ethics issues related to sharing each dataset,
- if necessary, filter, or modify data to address any safety or ethics issues prior to sharing with the broader USC community,
- drafting metadata and text for the Data Hub for each data set that contains a data dictionary of the data's attributes and information about the temporal and spatial quality of the data,
- mapping each data set to visualize its spatial extent and support understanding by Data Hub users of what the data contains.

Process and Criteria for Selecting Student Researchers
For this project, key attributes sought include:
- Interest in sustainability or data management
- Understanding of key spatial concepts, including data models and spatial data quality parameters
- Experience with ArcGIS Pro and ArcGIS Online, including collection, creation, and processing of spatial data
- Experience on a prior project that involved the bringing together of many types of spatial data
- Experience in assessment of spatial data quality
- Experience with development of web mapping interfaces with ArcGIS Online, including customization of web mapping templates
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In general, we will look for students who have excellent academia records, are experienced in data transformation, and show interests in an advanced degree in spatial sciences, environmental sciences, or anthropology. Special considerations will be given to minority students and female students in science.

Nature of the Final Research Report
The USC Sustainability Hub is its own ongoing deliverable. The initial iteration of the Hub was completed in January 2022. Two URAP student researchers collaboratively presented a poster at the Spatial Science Institute's LA Geospatial Summit in Spring 2022 and the USC Undergraduate Symposium for Scholarly and Creative Work, Spring 2022 and in Spring 2023 two different student researchers presented a poster at the USC Undergraduate Symposium for Scholarly and Creative Work. This year, a student will once again present a poster at the Spring 2024 USC Undergraduate Symposium for Scholarly and Creative Work highlighting the current academic and administrative collaborations through the data hub. For the 2024-25 URAP deliverable, it is expected that the students funded through URAP will present at the LA Geospatial Summit, the USC Undergraduate Symposium for Scholarly and Creative Work and have the option to submit abstracts to the Esri UC, the Association for the Advancement of Sustainability in Higher Education (AASHE), or other conferences.

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Enabling Experiential Teaching in Spatial Sciences and Global Security: Case Studies in Detecting Opium Cultivation with Satellite Imagery
Dr. Yi Qi, Associate Professor (Teaching) of Spatial Sciences, with Dr. Darren M. Ruddell, Professor (Teaching) of Spatial Sciences and Director of Graduate Studies

Research Project Description
Afghanistan supplies more than 80% of the world's opium. Changes in Afghanistan opium production have far-reaching consequences for trafficking activities and the flow of illicit money as well as for the high dependency users of heroin and opium. Understanding and monitoring opiate production is therefore of great importance for the international community and the United Nations Office on Drugs and Crime (UNODC) conducts annual opium cultivation and production surveys [1].

Satellite imagery can be used to map agricultural land as it provides a synoptic view of the landscape that can be timed to coincide with the presence of crops. The UNODC uses a combination of image classification and visual image-interpretation to create their annual survey of opium production in Afghanistan [2]. However, mapping agricultural land accurately and rapidly is challenging, as current methods use medium-resolution satellite imagery (such as Landsat-8 and Sentinel-2) and require resource-intensive and time consuming manual image-interpretation. The recent progress on artificial intelligence and high-resolution satellite data have shown promising potentials to improve the work [3]. There is a critical need for international community to advance the monitoring capacity with better accuracy and higher resolution satellite imagery.

The goal of this research is to educate students on developing a deep learning-based image classification method on high-resolution satellite imagery for an automatic workflow to monitor Afghanistan opium production with better accuracy and reproducibility. More specifically, the students will leverage a collaboration between two USC faculties and a private satellite vendor. Faculties will supervise the technical development, and the industrial partners will provide satellite data with an educational license. The intellectual merit of the study is to focus on integrating the latest artificial intelligence method and one of the best high-resolution satellite imagery sources. The educational merit of the project is to provide mentorship in the multidisciplinary field where students can learn a diverse topics and skillsets.

Role of Student Researchers
The URAP student will play an important role in this collaborative research project. The student will be expected to spend up to 10 hours per week for at least 10 weeks in one semester in the research. The activities will include but not limited to attending regular group meetings, reading literatures, participating training in relevant topics, learning professional GIS and remote sensing software, writing code and debugging, writing reports and publications, attending conferences, and giving oral presentations.

Criteria for Selection
The URAP student will be selected based on the following preferences:

- Current standing in an SSI academic program or relevant programs;
- Academic performance in degree program (high GPA);
- Aptitude and experience with technical/computer-based tasks; and
- Evidence of successful teamwork, attention to detail, and willingness to learn (based on letters of reference).

Final Report
At the conclusion of the research project, the undergraduate student will share the results of this collaborative work in the form of a research report to be submitted to the USC Office of Undergraduate Programs in addition to preparing a research poster to be presented at the USC Undergraduate Symposium for Scholarly and Creative Work in Spring 2025. SSI faculty advisors will also discuss options to submit abstracts for paper and/or poster presentations to professional conferences such as the American Association of Geographers (AAG), or USGIF GEOINT Symposium in Spring 2025.

Finally, SSI faculty advisors will work with the student to showcase project through the industrial partner Planet Lab's global network to highlight and promote the outcome.

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Geospatial Workflows to Advance Biodiversity Research: A Non-Profit- Educational Partnership for Experiential Learning
Dr. Darren M. Ruddell, Professor (Teaching) of Spatial Sciences and Director of Graduate Studies, with Dr. Laura C. Loyola, Assistant Professor (Teaching) of Spatial Sciences, and Dr. Siqin (Sisi) Wang, Associate Professor (Teaching) of Spatial Sciences

Research Project Description
The San Diego Society of Natural History is a private non-profit (501(c)(3)) scientific organization founded in 1874 that operates the San Diego Natural History Museum (SDNHM) located in Balboa Park in the City of San Diego, California. The SDNHM's mission is to: 1) interpret the natural world through research, education, and exhibits; 2) promote understanding of the evolution and diversity of southern California and the peninsula of Baja California; and 3) to inspire respect for nature and the environment. T he organization works to achieve this mission through extensive fieldwork to collect past and present scientific specimens (i.e., flora and fauna) and their associated characteristics to share with researchers, students, collaborators, interested community members, and natural resource management agencies on the federal, state, and local levels.

Within the SDNHM's extensive research division that includes a range of scientific disciplines, the Biodiversity Research Center of the Californias (BRCC) is a major biodiversity repository in Southern California and directs a leading natural sciences research program. The current BRCC staff have over 600 years of collective experience documenting and researching specimens throughout the region; however, one of the major challenges they face is the development and
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integration of geospatial workflows to acquire and catalog spatial and temporal reference details in the data collection process.

This research project proposes to work collaboratively with two USC undergraduate students and the BRCC to develop and implement geospatial solutions to existing operational research challenges. Implementation of the following geospatial workflows will actively engage two USC undergraduate students in critical thinking, technical development and application in a real-world research setting while also benefiting the SDNHM by developing solutions to: 1) visualize and share the results of the BRCC's work with public and scientific communities; 2) streamline data collection in the field; 3) enhance data management; and 4) enable collaborative review and analysis of data collections.

The SSI Faculty Research Team and the BRCC worked to identify three specific active and high priority research projects that would provide a valuable learning experience for two USC undergraduate students while also helping develop and advance geospatial workflows for the SDNHM.

The research projects include:

Project 1: Interactive Map of BRCC Project Locations

While the BRCC has numerous projects throughout the study area, they currently lack the capacity to conduct spatial queries to essential questions, such as:

- How many projects is the BRCC currently working on and where?
- Where has the BRCC focused their work the most?
- Are there understudied areas within the mission region that should be examined?

The task for Project 1 would be to create a Science and Conservation Projects Directory consisting of a spatial database with accompanying metadata to be visualized in an interactive map. The students would build the infrastructure for this database and interactive map using a subset of BRCC's data, document the workflow, and then train BRCC scientists to update and expand the spatial database. This project would help to improve BRCC project management and communication and could also serve as a tool for the SDNHM marketing and development teams to communicate our work to the public and potential funders.

Project 2: Streamline GIS Workflows of BioServices and PaleoServices for Consulting

Building on Project 1 (the creation of an interactive map), the goal is Project 2 to improve data collection, data organization, and project integration through the use of different spatial data collection techniques such as: ArcGIS Pro, ArcGIS Online (AGOL), Field Maps, and Survey123. The USC Research Team would work with data provided by the BRCC's BioServices and PaleoServices research departments and the undergraduate student researchers would conduct an assessment of workflows to evaluate and improve spatial data collection processes. Opportunities include, but are not limited to, improving efficiency in project workflow (e.g., stepwise notification, review and automation of tasks), consistency in data collection and storage methods (e.g., create templates, create scripts to back up data hosted on AGOL), accessibility of data, and coordination amongst departments.

Project 3: 3D Mapping of the Broadway Faunal Horizon in Downtown San Diego

As technology advances, field data collections are aiming to enrich the capture of X,Y coordinate data with a 3 dimensional (3D) profile featuring elevation (data observation height; coordinate Z). Project 3 would serve as a BRCC pilot program to work with scientists from the Paleontology department to use 3D datasets of fossil location field observations from downtown San Diego. The fossil locations of interest would be restricted to a 500,000-year-old marine shell bed called the "Broadway Faunal Horizon" (BFH) that occurs in the subsurface throughout the downtown area. The goal of the project is to plot the BFH localities in 3D, use the data points to produce a 3D surface, and to produce documentation for this workflow.

Taken together, the proposed collaborative research projects offer multiple high-value outcomes and deliverables such as the training and development of two USC undergraduate students in addition to advancing the active research profile of the SDNHM through the implementation of geospatial workflows to improve data collection, data management, and data accessibility

Role of Undergraduates Researchers & Deliverables

The URAP student will play an essential role in this proposed collaborative research project by working with SSI faculty advisors (Drs. Ruddell, Loyola, and Wang) and research scientists from the SDNHM BRCC throughout the 2024-2025 academic year. The URAP research team will engage in weekly meetings to share updates, discuss technical work, and strategize on deliverables and deadlines. SSI faculty advisors will provide technical training and trouble-shooting sessions to the undergraduate researchers on an as-needed basis throughout the project.

The undergraduate researcher will be expected to work an average of 8-10 hours per week. Some of the research activities that students will complete include:

- Collating and manipulating spatial data provided by the BRCC - which includes data formatting, cleaning, merging, as well as quality assurance and quality control to build a spatial database.
- Creating spatial workflows and documentation with metadata standards of the process for data collection and manipulation. Student researchers will investigate, discuss, and, in consultation with faculty advisors and BRCC collaborators, select the appropriate methods for digitization of all spatial data.
- Creating an online interactive map using ArcGIS Online for data presentation, visualization, storage, and download.
- Automating analytical workflows through the use of ArcGIS Pro's ModelBuilder to create 3D surface models and 3D analyses. This task will require students to develop and compile technical documentation for the workflows and web applications produced.

Process and Criteria for Selecting Student Researchers

One URAP student will be selected based upon the following criteria:

- Current standing in an SSI academic program;
- Academic performance in degree program (high GPA);

- Aptitude and experience with technical/computer-based tasks; and
- Evidence of successful teamwork, attention to detail, and willingness to learn (based on letter of recommendation).

Final Research Report Submitted to the Office of Undergraduate Programs
At the conclusion of the 9-month research project, the undergraduate student will share the results of this collaborative work with the SDNHM in the form of a research report to be submitted to the USC Office of Undergraduate Programs in addition to preparing a research poster to be presented at the USC Undergraduate Symposium for Scholarly and Creative Work in Spring 2025.

SSI faculty advisors will also discuss options to submit abstracts for paper and/or poster presentations to professional conferences such as the Society for Conservation GIS (SCGIS), the American Association of Geographers (AAG), or Esri User Conference.

Finally, SSI faculty advisors will work with the student to showcase project outcomes in student research competitions (e.g., LA Geospatial Summit ArcGIS StoryMap competition) as well as popular press outlets (e.g., *The Conversation*) where they will be listed as lead authors.

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Analyzing Urban Change and Inequality in the Global South
Jefferey M. Sellers, Professor of Political Science, International Relations and Spatial Sciences

Research 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 and governance in the rapidly developing urban areas of India and a selection of other sites across the Global South. 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, remote sensing images, and demographics with administrative, fiscal, and electoral data. The current phase of the project will focus on 1) comparing urban governance and its consequences for sustainable development and social equity, drawing on metrics for progress toward the UN Sustainable Development Goals and other sources; and 2) expanding the comparison of Indian regions to matched urban regions in China, elsewhere in Asia, and Africa.

This project is part of a wider research program that analyzes spatial data on social, economic, political and spatial change and governance in urbanizing regions around the world. The aim of the project will be to compare patterns of urban settlement and its development, along with efforts to meet challenges of bringing prosperity, basic services and environmental sustainability to urban regions of the Global South. The project revolves around analysis of high and middle resolution remote sensing images to compare matched urbanizing regions 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., 2021), classifications of the built structures in urbanizing neighborhoods, and analyses of real estate listings data (Ramachandra, Sellers, Bharath, & Setturu, 2020; Ramachandra, Sellers, Bharath, & Vinay, 2020; Sellers et al., 2019;
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Sellers et al., 2018). This project will draw on high resolution satellite imagery, the Global Human Settlements Layer, other global datasets, and selected data on planning, policy, real estate markets, civic activity, elections and infrastructure.

Preferred Credentials

GPA of at least 3.5, basic knowledge of statistics and familiarity with geographic information systems and one or more related programs (Arc/GIS, Python, Google Earth, Ecognition, Excel, and Stata, SPSS or R). Knowledge of comparative international politics, urban issues, developing country settings (particularly India or China), or Mandarin 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 to Professor Jefferey Sellers at sellers@usc.edu.

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 selected 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, official documents, Google Maps and Google Earth on the character of the main firms, institutions and other establishments in the study sites
- 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 Storymap for the Los Angeles Geospatial Summit in 2025, or a poster for the Undergraduate Research Symposium in the Spring of 2025, and one or more peer-reviewed article manuscripts. The research will ultimately contribute to a longer, coauthored book manuscript comparing the governance of urban development in the developing world.

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Applications of spatial science and analytics to improve pediatric health at the Children's Hospital Los Angeles

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Research Project Description

Social and environmental determinants of health including, education, access to care, socioeconomic status, the built-environment, and environmental exposures are major factors in pediatric health, health care delivery, and health care disparities. Social determinants of health can be difficult to study due to limitations in standard electronic health record systems. For example, while it is known that some children have an increased risk of severe asthma, important factors such as air pollution exposure and neighborhood level risk factors are not standardly measured, collected, and thereby not used in clinical decision making. Improving, innovating, and reducing disparities in health care needs to incorporate the social determinants of health.

This research project twill use spatial linkage and analysis of social, economic, and environmental data with individual patient electronic health records at the Children's Hospital Los Angeles, to provide a deeper understanding of the social determinants of health risk factors that patients experience. USC URAP students who are involved in this proposal will be joining a diverse, talented, innovative, and interdisciplinary team of graduate students, clinical informaticists, data scientists, spatial scientists, environmental health scientists, and healthcare professionals who are working to improve health, health care delivery, and reduce disparities in pediatric care.

Student Roles

- Understanding the role of environment in pediatric health: integrating spatiotemporal models into clinical care
- Access to care for children at the Children's Hospital Los Angeles: modeling drive time analysis and risks of "late or no-shows" for medical appointments
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- Spatial analysis of food deserts and children across a pediatric health care system
- Spatial analysis of access to pharmacies for children in a pediatric health care system
- Epidemiology of social determinants of health measures among children visiting the Children's Hospital Los Angeles
- Access and proximity to green space and risk of obesity among children seen at the Children's Hospital Los Angeles
- Epidemiology of social vulnerability and child opportunity across a pediatric health system

URAP student researchers will engage in will expand upon foundational research work that the faculty lead has conducted with current grant supported work from the Anesthesia Patient Safety Foundation, the Foundation for Anesthesia Education and Research, and the Southern California Environmental Health Sciences Center. The studies proposed are new studies that will provide URAP students an opportunity to learn about health systems, electronic health records, health care delivery, and the role that spatial science has toward innovating clinical care delivery. Furthermore, URAP students will be involved in research, data analysis, spatial linkage, spatial analysis, and will see first-hand how their work will contribute to policy decisions, planning and real-world applications into patient care delivery.

The general steps students involved in these projects will be to:

- Conduct geocoding of electronic health record data and visualize where patients come from.
- Spatially link social determinant of health data with individual electronic health records for the purposes of exploration and statistical analysis.
- Analyze the spatial epidemiology of social determinant of health factors with pediatric patients.
- Create maps to visualize patients in the electronic health record that receive care at a children's hospital to effectively communicate research findings.
- Discuss methods and results in a multidisciplinary spatial health research team comprised of undergraduate and graduate students at USC Spatial Sciences Institute and physicians at the Children's Hospital Los Angeles.
- Share spatial analysis and visualizations with clinicians and hospital leadership to improve clinical care and operational pathways.
- Learn how spatial models and thinking is influencing policy decisions, planning, and real-world applications in pediatric patient care.

The research each student will contribute to during the URAP year will be critically important to expanding our knowledge of the spatial dynamics that influence health and health care delivery. Students will work collaboratively with Dr. Tan throughout the summer and/or academic year (July 2024-June 2025). Work location is flexible with research team meetings occurring virtually and in-person on the USC campus, and at CHLA depending on the purpose and need.

Role of the Undergraduate Researchers

As Undergraduate Research Associates, each student will be expected to work independently and collaboratively with the supervising faculty and the broader research team. Some of the responsibilities that students can expect include:

- Fill out the appropriate paperwork and standard hospital clearances to work with patient electronic health records.
- Conduct accurate geocoding of patient records.
- Spatially link US Census, environmental exposure, CDC data, and other spatially enriched datasets with patient clinical records for the purposes of statistical analysis and spatial exploration.
- Create maps and analyze socioeconomic and environmental factors in the context of clinical care.
- Present research updates in weekly/bi-weekly interdisciplinary team meetings. Teams are comprised of undergraduate students, graduate students, and physicians. The team is also comprised of a dedicated spatial data analyst dedicated to the research work of this team. This spatial data analyst was a recent graduate of the USC Spatial Sciences Institute and previous URAP recipient.
- Contribute their experience, education, and problem-solving skills in individual and group collaborative research planning sessions with the goal of improving pediatric health care delivery.
- Improve their analytical skills, problem solving skills and communication skills as they build a portfolio of work for future endeavors.
- Collaborate on poster presentations and on a manuscript for publication.
- Work collaboratively to lead and support other research work and discussion across the team.
- Present research at regional and national scientific conferences.

Expectations of hours for each student can be flexible depending on the work and stage of research. A general guideline expectation will be as follows:

Each of the undergraduate researchers involved in the academic semesters will be expected to average 8-10 hours/week with much of the work carried out remotely. Work hours will vary with the project cycle throughout the academic year and in consideration of the undergraduate researcher's academic schedule.

Previous Undergraduate and URAP Success and Experience

In addition to leading a multidisciplinary research team at CHLA and USC, Dr. Tan has a successful track record with working with five previous URAP students over the past three years (2021-2024). The URAP students were successful in integrating with our research team, advancing their analytical skills, and have (or will be) presenting their own work at scientific conferences. Examples of regional and national conferences that have been presented at include, the Los Angeles Geospatial Summit, the CHLA Research Day, The Society for Technology in Anesthesia Annual Meeting, The Society for Pediatric Anesthesia Annual Meeting, and the Society for Pediatric Pain Medicine Annual Meeting. Previous URAP students have received training in human subject's research required for working with patient information, information retrieval

and management, 1:1 educational sessions on how health care delivery systems operate, and have practiced their written and oral scholarly communication skills.

All students were provided an encrypted CHLA laptop, necessary software, and remote work technology. Below are some examples of the regional and national presentations with the URAP students as *presenting author* that have or are scheduled to take place with the current two URAP students in 2023 to 2024.

Kwok K, Kampfschulte A, Robinson K, Duan J, Adiwidjaja A, Tan JM. Spatial Analysis of Children with Asthma and Air Quality in a Pediatric Health System. *Los Angeles Geospatial Summit.* Los Angeles, CA. February 23, 2024.

Robinson K, Kampfschulte A, Kwok K, Duan J, Adiwidjaja A, Tan JM. Green Space Accessibility of Patients in a Pediatric Health System: A Spatial Analysis of Electronic Health Records. *Los Angeles Geospatial Summit.* Los Angeles, CA. February 23, 2024.

Kwok K, Kampfschulte A, Robinson K, Duan J, Adiwidjaja A, Tan JM. Spatial Analysis of Children with Asthma and Air Quality in a Pediatric Health System. *CHLA Research Day*. Summer 2023.

Robinson K, Kampfschulte A, Kwok K, Duan J, Adiwidjaja A, Tan JM. Green Space Accessibility of Patients in a Pediatric Health System: A Spatial Analysis of Electronic Health Records. *Los Angeles Geospatial Summit. CHLA Research Day*. Summer 2023.

The URAP students will be co-authors on peer-reviewed publications that are being drafted for submission. They have also had an opportunity to present their work to hospital leadership, including the Chief of Diversity, Equity, and Inclusion, and leadership in the Department of Anesthesiology Critical Care Medicine at the Children's Hospital Los Angeles. The proposed studies for this 2024-2025 URAP are new studies for this year's students using large patient datasets that build upon the research directions of the previous URAP students and the faculty advisors grant supported research from the Southern California Environmental Health Sciences Center, the Anesthesia Patient Safety Foundation, and the Foundation for Anesthesia Education and Research. The expansion from two students to three students in this proposal reflects the established foundation, previous success with URAP students, and increased availability of research opportunities that the faculty lead can provide.

Of note, the PI's current research team has a new member that recently joined as full-time staff at the USC Spatial Sciences Institute that is dedicated as a spatial data analyst for work at USC and CHLA. This spatial data analyst was a recent graduate of the USC Spatial Sciences Institute and previous URAP recipient with the PI.

Criteria for Selecting Student Researchers
Student researchers will be selected based on having important skills that are necessary for the project. Familiarity and experience with geographic information systems, spatial analysis, and management of datasets, will be important. Some content knowledge or interest in learning

about public health, pediatric health care, social determinants of health, health care policy, and/or environmental health would be welcome although not necessary. Knowledge about healthcare is not essential for this role. Students who are motivated to innovate health care through spatial analytics would be a great fit.

Final Research Report Submitted to Office of Undergraduate Programs
Students will provide a final research summary report of their work to the Office of Undergraduate Programs. In addition, the undergraduate work will be conducted with the expectation that the student participates in the presentation of the work at an academic conference. Identified conferences to present the research work includes the Los Angeles Geospatial Summit (organized by USC SSI) in 2025, the CHLA Research Day, the Society for Pediatric Anesthesia Annual Meeting (2024/2025), the American Public Health Association Annual Meeting, and/or the ESRI User Conference held in July 2025. In addition, we will encourage students to support their work at appropriate student research competitions. Students will also be a co-author on peer-reviewed publications that stem from the student research work and contributions.

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Creation of the urban built environment dataset using repeatable, replicable, and reproducible (RRR) workflow to better study population-health-environment interactions
Dr. Siqin (Sisi) Wang, Associate Professor (Teaching) of Spatial Sciences, Associate Chair of Spatial Data Lab, Center of Geographic Analysis, Harvard University, Vice Chair of International Young Scientist Network, International Society of Digital Earth

Research Project Description
Urban built environment refers to the man-made neighborhood environment with urban infrastructure, configurations, and facilities—where urban dwellers reside and their daily lives are immersed. According to the classical Social Ecological Theory (SET)[8], the health outcomes of populations are influenced by the broader ecological environment surrounding human beings, and the prevalence of health problems and diseases not only links to the demographic and socioeconomic characteristics of populations, but also mingles with the urban built environment (e.g., walkability, street design, building density, and greenspace coverage) as the complex confounders which gradually affect people's daily activities, living style, and their exposure to environmental problems. However, quantification of the urban built environment is a challenging task for governments, urban planners and policymakers, given urban built environment contains a wide range of complex factors in different dimensions—which are hard to systematically measure and collect, and thereby not widely used in the environment health studies.

Compared to the social environment of populations (e.g., their demographic and socioeconomic characteristics) that can be readily obtained from the US census, the urban built environment is difficult to measure based on one single data source. Conceptually, the built environment can be

[8] Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American journal of health promotion*, *10*(4), 282-298.
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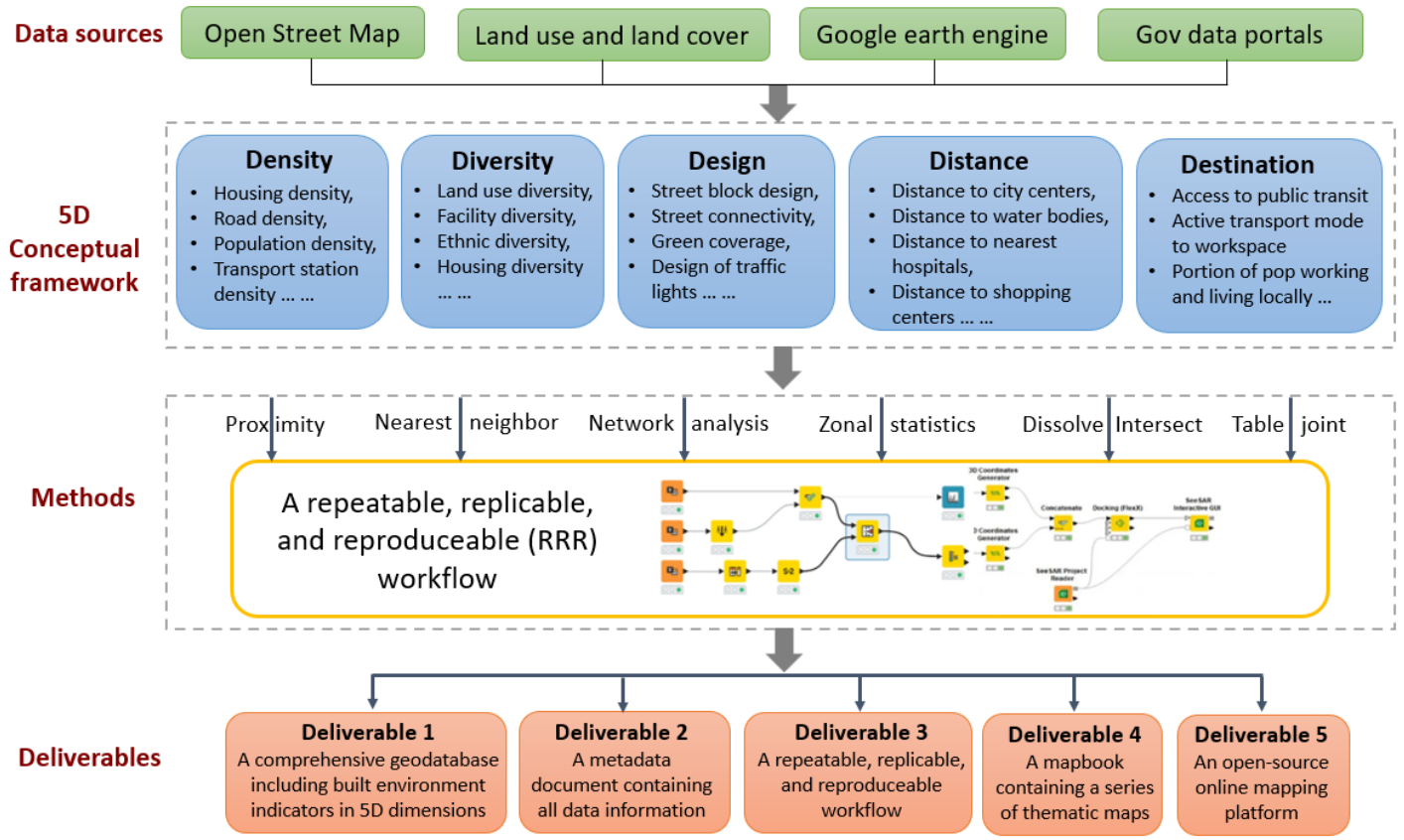
measured as 3D factors[9], including *Design* (e.g., street block design, design of footpath, water pumps, and other street facilities, etc), *Density* (e.g., building density, road density, etc), *Diversity* (e.g., the diversity of housing, facilities and land use types). It was further extended in recent studies to 5D factors with additional 2D factors[10], including *Distance* (e.g., the distance to public transit) and *Destination* (e.g., access to destinations like hospitals and metros). The complexity involved in the measure of the built environment requires data producers with strong geospatial thinking, skills and practices.

As such, this research proposal aims to contribute a comprehensive open-source database to quantify the urban built environment systematically in Los Angeles County—which can be readily used by end users in various public and private sectors, and can be further applied to address population-health-environment interactions in cross-disciplinary studies. Drawing on the theoretical foundation of SET and the 5D conceptual framework, this study will measure urban built environment in five dimensions (i.e., design, density, diversity, distance and destination) based on multiple datasets including land use and Points of Interest data from Open Street Maps, land use maps and remote sensing imageries from Google Earth Engine, and road network data from the transport department. The workflow of data collection, creation and manipulation is shown in Figure 1.



[9] Saelens, B. E., & Handy, S. L. (2008). Built environment correlates of walking: a review. *Medicine and science in sports and exercise*, *40*(7 Suppl), S550.

[10] Liu, Y., Wang, S., & Xie, B. (2019). Evaluating the effects of public transport fare policy change together with built and non-built environment features on ridership: The case in South East Queensland, Australia. *Transport Policy*, *76*, 78-89.

Figure 1. Conceptual framework and workflow of this proposed project

The URAP student in this project will be supervised by Dr Siqin (Sisi) Wang with rich experience in creating the Australian-wide geodatabase of the built environment at the fine-grained level for the Australian government and planning authorities. The student will also join a diverse, innovative, and interdisciplinary research team via the collaboration between Spatial Sciences Institute, USC and Spatial Data Lab, Harvard University[11] which has organized a series of training workshops for US-wide undergraduates to use repeatable, replicable, and reproducible workflow in their research.

Specific tasks and studies that URAP students (2024-2025) can be involved in, include:

- Understand the 5D conceptual framework for measuring the urban built environment
- Collect data from multiple sources including Open Street Map, Google Earth Engine, and government websites and data portals.
- Generate 5D built environment indicators using geospatial analytical software (e.g., ArcGIS)
- Build repeatable, replicable, and reproducible workflow using ModelBuilder or KNIME
- Create the built environment geodatabase and a mapbook containing a series of thematic maps
- Create metadata containing all data information
- Upload and maintain the built environment geodatabase in the open-source online mapping platform (e.g., Kepler.org) for data presentation and visualization, and public access

The proposed studies that URAP student will engage in will expand upon foundational research work that Dr Wang as the faculty lead has conducted in the Australian and US context, with the grant funded by Australian Research Council (ARC), Australian Urban Research Infrastructure Network (AURIN), and US National Science Foundation (NSF). Dr Wang has published extensively in the domain of built environment and environment health studies (see the later section "Previous Funding Grant Success and Experience"), supported by the fine-grained Australian-wide built environment geodatabase her research team established. The proposed project will provide URAP students with an opportunity to learn about the built environment, spatial data mining, geodatabase creation and maintenance, online mapping, and the role that geospatial science plays in innovating environmental health studies. Furthermore, URAP students will be trained in data collection and manipulation, RRR workflow building, and spatial analysis in the training workshops organized by Harvard Spatial Data Lab where Dr Wang has been involved.

The deliverables of this project include:

- A comprehensive geodatabase including built environment indicators in 5D dimensions;
- A metadata document containing all data information;
- A repeatable, replicable, and reproducible workflow built by ModelBuilder or KNIME that can be further applied to other geographic contexts.

[11] https://projects.iq.harvard.edu/chinadatalab/introduction-cdl

- A mapbook containing a series of thematic maps visualizing the multi-dimensional built environment;
- An open-source online mapping platform built by Kepler.org for data storage, visualization and download.

Role of the Undergraduate Researcher(s)
Under the supervision of Dr Siqin (Sisi) Wang, one student will be involved in the above research endeavors and work collaboratively with Dr. Wang throughout the academic year 2024-2025. Work location is flexible with meetings occurring virtually and in person on the USC campus, and at SSI depending on the purpose and need. The undergraduate researcher involved in the academic semesters will be expected to average 8-10 hours/week with some of the work carried out remotely. Work hours will vary with the project cycle throughout the academic year and in consideration of the undergraduate researcher's academic schedule.

Some of the responsibilities that students can expect include:

- Use pre-provided codes to obtain remote sensing imaginaries from Google Earth Engine;
- Retrieve Point of Interest data from Open Street Map and other spatial data from government websites and data portals;
- Generate 5D built environment indicators using ArcGIS Pro;
- Attend the RRR workflow training workshop organized by the Harvard Spatial Data Lab;
- Build repeatable, replicable, and reproducible workflow using ModelBuilder or KNIME;
- Collate map layers to build environment geodatabase;
- Create a mapbook containing a series of thematic maps;
- Write a metadata document containing all data information;
- Establish an open-source online mapping platform via Kepler.org for data presentation, visualization, storage and download;
- Present research updates in interdisciplinary team meetings;
- Communicate and update with the supervisor and team members effectively and efficiently;
- Collaborate on poster/oral presentations at regional and national scientific conferences;
- Work on a manuscript for publication.

Criteria for Selecting Student Researchers
The URAP student researcher will be selected based on the below important skills. The successful candidate must have:

- Demonstrated skills with geographic information systems (e.g., ArcGIS Pro or QGIS) including spatial analysis, geodatabase creation and management, mapping and data visualization;
- Basic experience in searching, obtaining, collecting and collating data from multiple sources;
- Preferable skills in using ModelBuilder or KNIME, though not essential;
- Python / R coding skills that are welcome though not essential;

- Preferable skills in creating online interactive maps, including uploading, storing and manipulating online data layers;
- Basic knowledge or interest in learning about the built environment, RRR workflow, and environment health;
- Capacity to be self-motivated and highly efficient, handle multi-tasks, and work in a teamwork atmosphere;
- Sound writing and communication skills in English.

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In addition to the funded research project opportunities described above, here is a volunteer, non-funded research opportunity:

Geospatial Applications of Reality Capture and Human Security at the LA Memorial Coliseum
Dr. Yi Qi, Associate Professor (Teaching) of Spatial Sciences and Dr. Diana Ter-Ghazaryan, Associate Professor (Teaching) of Spatial Sciences

Research Project Description
We are looking for two student volunteers to join an exciting pilot research project that focuses on reality capture and human security at the LA Memorial Coliseum. The LA Memorial Coliseum, managed by USC, is a Los Angeles landmark, and currently serves as a multi-purpose stadium for sporting and other events, both internal and external to USC. It will also serve as one of the venues for the 2028 Summer Olympics in Los Angeles.

The aim of this research project is to collect geospatial data related to the Coliseum and to develop geospatial applications focused on facility operation, emergency management and human security. We will start this project with three specific research objectives: 1) to produce a high-resolution 3D model with drone remote sensing technology; 2) to construct a geospatial database containing comprehensive facility information; 3) to conduct geospatial analytics and develop applications.

Preferred Qualifications:
- Knowledge of drone remote sensing, image processing and analysis
- Experience in spatial data collection, administration and analysis
- Experience with Esri software such as ArcGIS Pro, ArcGIS Online, ArcGIS Drone2Map, ArcGIS Storymaps, etc.
- Experience with computer programming languages related to website design and application development.

Candidates who have only introductory or no related experience are also welcome to apply. Training and mentorship will be provided.
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