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May 26, 2017

Spatial Sciences Institute (SSI) is now accepting applications for undergraduate student researchers to work with SSI faculty on their funded research projects for the 2017-2018 academic year.

We are looking for 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 USC Dornsife Spatial Studies minors, Human Security and Geospatial Intelligence minors, and GeoDesign majors. 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 research stipend is $11/hour, and the projects generally are structured for an average of 5 – 10 hours/week. Accepted students will work out their specific work schedules for each semester with the supervising faculty or staff member.

SSI student researchers are encouraged to submit their research work for presentation at events such as the Esri Geodesign Summit held in January in Redlands; the Spatial Science Institute’s LA Geospatial Summit on February 23, 2018 in Los Angeles; 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 2018 USC Esri Developer Center Student of the Year Competition.

**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 21, 2017**.

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**Dr. Yao-Yi Chiang, Associate Professor (Research) of Spatial Sciences**

**“Unlocking Maps: Automatic and Streamlined Metadata Creation for Digital Collections”**

Under partial support from the National Endowment for the Humanities, we are currently working in collaboration with the USC Digital Library and the Western Michigan University to generate metadata from collections of thousands of historical map scans automatically. While the world is moving towards storing and displaying geographic information electronically, paper maps are still the most readily available geographic source that is carefully prepared by professionals. Also, paper maps are very often the only source containing historical geographic datasets, such as the locations of underground gas pipelines and sewer systems built in the 1950s and abandoned oil wells, railroads, and mining sites, etc. These datasets from historical maps are important for a variety of studies such as cancer and environmental epidemiology, urbanization, and landscape ecology. However, finding relevant maps is difficult, and the map content is not machine-readable. Today, converting geographic features in map images into a vector format (i.e., map digitization) is still a labor-intensive task. We will build on our previous map processing software, Strabo, to support the efficient and accurate generation of metadata (e.g., the map location, publication date, publisher) from a large number of map scans.

This project seeks undergraduate students from computer science and geodesign to help develop algorithms, implement the algorithms in our current open source tools, and design and conduct a comprehensive experiment. The result will be map processing tools that allow libraries and map archives to efficiently and robustly build meaningful metadata from paper maps and make the maps easily discoverable.

**Dr. Su Jin Lee, Lecturer of Spatial Sciences**

**“Impact of land use policy on urban development and human-environment systems change in Los Angeles County”**

This project is to visualize consequences of the impact on land cover changes in Los Angeles County. The undergraduate researchers will (1) build a model to classify land use by types (single-family home, multi-family home, commercial, industrial, institutional, recreational, and vacant areas) using a GIS system; (2) extract property information such as building footprints, year built, lot size, etc., and spatially join them with the classified parcel boundaries using a GIS system; (3) identify community, neighborhood and areas plans that have been approved by the Los Angeles County Regional Planning Commission and adopted by the Board of Supervisors; (4) analyze data to explore a spatial pattern or relationship between the parcels and plans; and (5) present and summarize major findings. The undergraduate researchers will produce a poster to present their work at the annual USC Undergraduate Symposium for Scholarly and Creative Work and write a research paper to submit a conference.

**Dr. Travis Longcore, Assistant Professor of Architecture, Spatial Sciences, and Biological Sciences**

**“Park Light: Trends in Night Sky Brightness and Upward Radiance From and Near National Parks”**

National Parks such as Death Valley, Bryce Canyon, and Glacier have adopted the slogan, “Half the park is after dark,” and have begun promoting their dark, starry skies as attractions just as worthwhile as the rest of the park visible during the day (Manning et al. 2015). Unfortunately, national parks find themselves increasingly threatened by light pollution (Duriscoe et al. 2016), which threatens species and habitats (Longcore and Rich 2004, Bennie et al. 2015, Davies et al. 2015), astronomical observation (Riegel 1973), and cultural resources (Lyytimäki 2013). The National Park Service set up a Night Sky Team in 2000 and it both conducts and the NPS supports research on the extent and impacts of light pollution in its parks (Moore 2001, Duriscoe et al. 2007, Manning et al. 2015, Gillespie et al. 2016,

Longcore and Rich 2016). A new opportunity presented itself with the availability of data from the polar-orbiting Suomi NPP satellite with its Visible Infrared Imaging Radiometer Suite with the Day-Night Band (VIIRS DNB) (Miller et al. 2012). These new high-resolution data can provide a picture of the nocturnal light environments across the National Park System that has previously not been possible.

This year’s project continues a project funded by the USC Undergraduate Research Associates Program (URAP) in 2016–2017 to complement work done by the National Park Service with ground-level measurements of light pollution (Duriscoe et al. 2007) by implementing a system-wide assessment using satellite-measured night lighting data. These data have much higher spatial and dynamic resolution than previous datasets. We are negotiating access to a derivative product of the VIIRS DNB, which is a modeled estimate of night-sky brightness that is currently in review for publication by colleagues that updates the World Atlas of Artificial Night Sky Brightness (Cinzano et al. 2001).

We have achieved the following objectives so far:

1. Characterize the upward radiance at each NPS unit using a time series of VIIRS DNB images spanning from January 2014 to December 2015;

2. Characterize buffer zones of 1, 10, and 100 km surrounding each park using the time series of VIIRS DNB data.

By the end of the 2016–2017 academic year we will have achieved the following objectives:

3. Develop summary statistics for existing park typologies (e.g., historic sites, national recreation areas, national parks) and regions, including time series showing seasonal changes;

4. Classify each park unit by the unique “signature” of lighting characteristics found in

and around it and over time, for the purpose of identifying sets of park units that might be managed in a similar manner. Techniques for classification will include principal components analysis and/or agglomerative clustering methods.

The objectives for the 2017–2018 academic year are:

1. Obtain the raw data for the updated World Atlas of Artificial Night Sky Brightness (Falchi et al. 2016);

2. Characterize night sky brightness inside and within 1, 10, and 100 km buffers around each NPS unit;

3. Select 10 NPS units in conjunction with NPS staff to develop detailed reports showing trends in light pollution, documenting conditions at various known locations and identifying species likely to be sensitive to light pollution within each park.

This project has been a collaboration with undergraduate researchers from the start and all work is done by students with weekly support and guidance.

The undergraduate workers will perform the following tasks in close collaboration with me:

1. Obtain Night Sky Brightness data from collaborators.

2. Run zonal statistics tools for park service units and buffers in ArcGIS.

3. Manage spreadsheet to compile results for all units.

4. Select 10 NPS units for in-depth reporting in collaboration with NPS Night Sky Team and local collaborators.

5. Create summaries of upward radiance and night sky brightness at each selected NPS unit and at selected landmarks within each unit.

6. Conduct literature review to identify sensitive species susceptible to light pollution at each example NPS unit.

7. Draft research poster and manuscript for publication.

**Dr. Laura C. Loyola, Lecturer of Spatial Sciences**

**“Determining Habitat Partitioning by Tortoise Species in Madagascar Through Geo‐referenced Field Data and Remotely Sensed Data”**

We are currently examining data that Dr. Andrea Currylow of the Jane Goodall Research Center, USC Department of Human and Evolutionary Biology, acquired while working in Madagascar for her dissertation research. We aim to determine various aspects of habitat partitioning, including longitudinal changes in microhabitats and variations by age and sex class, seasonality, and captive-bred versus wild tortoises. Existing data range over various Malagasy tortoise species in six unique study sites and spanning up to 20 years. These data allow for a multitude of projects and numerous analyses related to habitat use as associated to changes due to climate change (long‐term) and human encroachment (short- and long-term). We aim to examine the relationships between habitat type and ranging patterns over the course of multiple years at these six sites and parse out confounding factors that may contribute to variation such as age and sex class. We are also interested in a longitudinal comparison over twenty years within one site for which past ranging data is available. This will require remotely sensed historical data at a fine scale resolution (preferably 10m) to determine changes in habitat quality/vegetation density. Captive-bred and re-introduced rehabilitated tortoises have also been studied and we aim to assess variations in ranging patterns between these tortoises and native individuals over time to investigate site fidelity. These varied research questions may potentially be answered through similar methodologies, which will allow for automation of the processes.

These varying research questions all aim to examine habitat changes over time as they relate to the ranging and diel patterns of multiple tortoise species across Madagascar. These investigations will culminate with results that will elucidate the impact of habitat change on the ecology of tortoises in Madagascar, and more importantly automated integration of remotely sensed data and spatial analyses workflows in the GIS for future research.

Each undergraduate researcher will be assigned to tasks related to data correction and organization, remotely sensed data acquisition, the development of methodologies for spatial analysis, automation of spatial analysis methods, visualization (mapping) of data and results, and preparing initial drafts of manuscripts for publication.

**Dr. Jennifer Swift, Associate Professor (Teaching) of Spatial Sciences, and**

**Dr. Darren M. Ruddell, Associate Professor (Teaching) of Spatial Sciences**

**“SunSmart and GeoDesign: A Pathway for Human and Community Health—Phase 2”**

 USC and the Keck School of Medicine seek real-world impact of the outreach program, “SunSmart”, in USC-affiliated schools aimed at improving sun exposure behaviors among children and adolescents. This work is designed to reduce risk of skin cancers, particularly melanoma. Building upon the 2016-2017 SunSmart URAP project that successfully identified potential locations for and types of shade structure most desired, the Phase 2 URAP project aims to implement SunSmart strategies to provide safer and healthier schoolyards for students and educators. There are two main goals of SunSmart 2: 1) to research how best to carry out feedback strategies with stakeholders and adhere to building codes, and 2) to select and/or build new shade structures in school playgrounds that facilitate SunSmart behaviors. This proposal seeks to provide USC GeoDesign majors with this practical, applied experience in the role of spatial science in public health interventions. Research activities will include utilizing the previous URAP SunSmart data gathered, analyzed and mapped, use of Geographic Information Science technology to support design, planning and project management activities, and faculty/student-led workshops aimed at executing schoolyard SunSmart GeoDesigns.

The student researchers will:

* Use the results of the previous SunSmart and URAP research projects and 2-D and 3-D spatial technologies available through Geographic Information Systems (GIS), to support the development of construction management plans for proposed GeoDesigns of shade structures in schoolyards for presentation to stakeholders.
* Define all aspects of the implementation plans, such as who the stakeholders are and what communities are involved, funding opportunities to construct and install the shade structures, construction materials required and permitted, subcontractors required for the construction and installation, all building and land use codes that must be adhered to, and the time frame required for construction to be carried out at each participating school.
* Iterate the proposed designs toward implementation of the methodology of the GeoDesigns generated in the previous URAP study. This process is inevitably unique, specific to the members of the team – faculty, student interns, stakeholders, contractors, funding entities – in each schoolyard. Iterations will take the form of workshops and/or presentations to stakeholders that highlight the importance of SunSmart approaches that incorporate realistic GeoDesign options for new shade structures for each school.
* Produce a final presentation for each of the three participating schools, and for all stakeholders. The presentations will highlight the importance of SunSmart approaches and the long-term benefits of the shade structures. The intention would be to both further educate children in tangible solutions and to illustrate to the schools, i.e. School Boards and PTSA’s, concrete steps taken to solve the problem.

The research will culminate in a three-day workshop at which the GeoDesign students will present their alternative plans for implementing specific design scenarios aimed at reducing sun exposure among children at the five partner schools. The students, as a team, will produce the project management plans and final results of the designs implemented in the real world, including presentations at schools and for other stakeholders as needed, and prepare a final technical report on the methodology and results of this summer project. This report will detail information about the final designs chosen for each school, implementation plans including construction management schedules, costs and funding sources identified and/or obtained, and PDF’s of any final presentations.

 **Dr. An-Min Wu, Lecturer of Spatial Sciences**

**“Upscaling effects on soil carbon prediction in the depressional landscapes in Minnesota”**

A hillslope-based soil organic carbon (SOC) model previously built for a land-locked depressional landscape in Minnesota has proven soil carbon was not lost, but accumulated since the European Settlement. It is essential to ensure the model applicable at the regional scale so they can be of great benefits to our society in understanding soil processes and carbon dynamics under agricultural disturbance. This research project aims to understand the effect of spatial scales on the performance of the SOC model and to develop an improved SOC model for regional application. The student and I will use legacy soil samples in Southern Minnesota to build a regional model using the same methods in the hillslope-scale SOC model and compare the performances of the two models. Moreover, to identify proper spatial resolutions in regional SOC modeling, my student and I will develop the models with covariates in various spatial resolutions (1m, resampled 10m, and resampled 30m). Once the performance and accuracy of the models have been evaluated, we will apply the best fitted regional SOC model in appropriate spatial resolutions to estimate SOC storage in mass (kg C/m2) in the depressional landscapes in Southern Minnesota.

All necessary soil data has been collected and measured and therefore students will focus on geoprocessing and statistical analysis. The student will learn the important environmental processes in soils and the geospatial techniques necessary for handling the spatial data. The student should have completed SSCI 382 with GPA of 3.0 or above. Interest in environmental processes is a plus.

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

**“3D Visualization and Decision-making: Applications for the USC University Park Campus”**

Enhanced virtual environments coupled with 3D data models of the physical and built environment are transforming spatial analysis. Extraordinary ‘windows’ into dynamic real-world processes are provided by Geospatially Referenced Virtual Environments (GRVEs); GRVEs can incorporate information from a variety of sensors to model contemporary processes in real time or can be used to embed historical or experimental data (Lin et al. 2015). To support the collaborative and interdisciplinary research necessary to investigate and understand complex problems, these new-generation geographic analysis tools can incorporate natural, social, and behavioral factors and build simulations based on shared knowledge and rules derived from real environments (Chen et al. 2015).

Specialists in 3D visualization model climate change scenarios and illustrate other human-caused environmental changes, create tsunami or flood simulations for disaster planning, incorporate geospatial intelligence and remotely-sensed imagery to prepare battle-space infrastructure, create brain maps and medical technology, engage with civil engineers, historical ecologists, and design and entertainment industry professionals, and help make critical decisions which will shape our planet. Landscape and building models in 3D have become essential components for a diverse array of applications, including land-use models for regional planning, architectural design, transportation projects, environmental

restoration, archaeological excavations, and emergency response (Kim & Wilson 2015). Building models have evolved from simple building blocks to textured buildings with roof structures, to efficient procedural models that re-create vast cities (Parish & Müller 2001) and detailed architectural representations that can include interior spaces (Talton et al. 2011). Until very recently, 3D models were more difficult to render and share in an online environment, and often required multiple levels of detail to provide a reasonable viewer experience; currently evolving technologies construct lattice mesh matrices to allow complex 3D visualizations to efficiently be served over the internet (Chen et al. 2016).

This research team has worked to develop a state-of-the-art 3D visualization of the University Park campus with the capability to generate real-time interior and exterior routes for strategic planning, emergency responder, disability access, and other essential services. Nearing completion, this multi-year project has received industry and academic recognition for its conceptualization and use of the Esri CityEngine modeling, visualization, and data integration program in producing 3D renderings of University Park Campus buildings. Two of our students, Ziyu Ouyang and Shan Yu Chuan, took second place in the 2015 Provost’s Undergraduate Symposium for Scholarly and Creative Work for their research on the CityEngine project. We are very proud that several undergraduate students that spent part of their early careers on this project were able to leverage their new skills, knowledge, abilities, and confidence to obtain exciting summer research internships as well as compete for and obtain research scholarships.

This coming year, we plan to meld together all the components of our virtual campus environment – buildings, fountains, trees, and other elements – using the newest technology to make the models available online. We further envision a testbed environment for actionable research on the various ways that our 3D visualization can assist in decision-making at USC. Examples include space planning, building condition assessments, public safety applications, and digital storytelling, as well as other applications that incorporate the ability to visualize and query building components and generate routes.

Students will 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. The Spatial Sciences Institute’s strong partnership with Esri provides particular value to this research opportunity, as these students also are working directly with Esri’s leading professionals in the spatial sciences, and we will continue to collaborate with the Esri 3D Development Team to help them create and refine their new online ‘Campus Viewer’ application.

**Dr. John P. Wilson, Professor of Spatial Sciences and Sociology, and Dr. Brian Finch, Professor (Research), Department of Sociology**

**“Using spatial analysis to investigate the impact of gangland residence on birth outcome disparities”**

Los Angeles County is home to more than 1,300 gangs with over 150,000 members. Within Greater Los Angeles, there are more than 400 separate gangs and an estimated 39,000 members. Previous research has studied the direct effects of crime and violence on public health in Los Angeles. Few studies, however, have investigated the gangland residency’s birth outcome implications. The issue of gangland residency on public health and birth outcome has a far-reaching impact on the wellbeing of a community. We are interested to understand how gangland residency accounts for life outcome disparities.

In this research, we use birth outcomes – a highly sensitive social barometer for population health – as an indicator to assess the unique health impact of the gangland residency. Socioeconomic data, individual crime data, birth certificate data, gang injunction information, health service location, and meaningful neighborhood boundaries are all applied to further studying the spatial relationship between birth outcomes and gangland residency.

Spatial analysis, network analysis, geo-visualization methods, and other statistical methods are adopted to test our hypothesis. We will conduct the Moran I analysis and Hot Spot Analysis to answer several questions, such as whether there are significant spatial clusters of Low Birth Weight (LBW) rates; and where the hot spots of LBW rates are. We will conduct an overlay analysis to get a general understanding of the involved area and direction, such as the percentage of hot spots area covered by gangland territory. We will then analyze the birth data, such as standardized LBW rates (adjusted by mothers’ age and race) at census tract level to obtain a fair comparison, calculate the Odds Ratio as the basic analytic tool to analyze whether gangland has an impact on the LBW rates, and model standardized LBW rates using a multilevel regression model.

Student researchers will help to prepare literature review about spatializing the social networks of gangs. They will also help in data preparation, such as digitizing the Gangland territory maps, aggregating census data such as poverty, income, race, and education, geocoding birth data at different geographic scale, joining the aggregated birth data and census data by location. They will also help to map the spatial distribution and analyze the spatial autocorrelation of birth outcomes at census tract level for Los Angeles County. They will conduct Moran’s I analysis and Hot Spot Analysis and will conduct an overlay analysis to get a general understanding about the involve area and direction around a compass, such as the percentage of hot spots area covered by gangland territory.

**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.