Digital geospatial exploration with Dr. Moulay Anwar Sounny-Slitine and the GIS Lab

Dr. Sounny-Slitine sees GIS as a digital approach to Geography and utilizes the methods to enhance the understanding of the world. His research projects are based on Digital Exploration, creating datasets and analyses that give novel perspectives. Students working with him in the past have spanned all subdisciplines of Geography and other fields. The commonality of his projects is that they are enhanced by digital approaches and would not be possible without technology. Technology utilized included GIS, GPS, RS, Programming, Web Development, AI, and Data Science.

Current Projects Available

- Pronounce Florida - An exploration of place names in Florida, their origins, and Pronunciation. The result will be an Interactive Web Map and Analysis of Place Names. The web map will use Leaflet, JavaScript, HTML, CSS, and Bootstrap. The analysis will include origins of place names, categories of namesakes, and alternative forms that will highlight and enhance the understanding of Florida Geography.
- Florida Environmental Justice Project - The EPA describes Environmental Justice as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. One way to strive for Environmental Justice is to highlight injustice through mapping. This project uses a 'difference of differences' approach of analysis to exhibit populations in Florida that experience unjust burdens of environmental hazards, like superfund sites, flooding, and pollution. The student will work with geocoding environmental hazards and comparing them with census socioeconomic information.
- Earth Engine, Big Data, and Supercomputing applications to hydrological modeling - Students will work with Google Earth Engine to develop the D8 algorithm for flow direction to create supercomputing hydrological modeling. This requires JavaScript programming experience and an understanding of Hydrology, Geomorphometry, and Terrian analysis. The end results will be a set of Hydrology tools for Google Earth Engine, GEE-Hydro.

Desired Research Skills: GIS background, enthusiasm, a strong work ethic, and curiosity.

Climate mediated medical geography of vector borne disease with Dr. Sadie Ryan and the Quantitative Disease Ecology and Conservation (QDEC) Lab

Dr. Ryan's lab currently focuses on climate-health issues, vector borne disease modeling, insecticide resistance, geospatial models of intervention, and quantifying the social-ecological risk of vector borne disease exposure. The QDEC Lab incorporates tools from medical geography, quantitative and applied ecology, and the social sciences to address their research aims. There are several potential projects for a GeoGator Summer Research Program student, including:

- **Early Warning Systems (EWS) analyses for vector borne diseases**. The project would aim to explore operationalized EWS versions and create appropriate forecasting

models using meteorological records. Preferred skills for this project include experience with GIS and MODIS data.

- **Seasonal vector borne disease (VBD) transmission**. This project would involve the incorporation of MODIS LST data with a model for R0 to explore VBD predictions through time. The project outcome would be an ArcGIS Dashboard displaying the results for a variety of diseases (dengue, malaria, West Nile, citrus greening, bluetongue, etc.). Preferred skills include experience with GIS.
- **Florida citrus greening risk**. This project explores potential climate effects of citrus greening (HLB), specifically asking if there are citrus crops that can produce fruit outside of temperature optimums for HLB. The student researcher for this project would look at current Florida cropland and project citrus greening risk into the future under different climate change models. The project outcome would be an ArcGIS Dashboard that could be utilized for citrus crop profit margin planning. Preferred skills include experience with GIS.
- **American livestock and bluetongue disease risk**. This project aims to inform bluetongue vaccination efforts by combining data from the national agricultural databases and bluetongue suitability. The student researcher will distinguish the spatial distribution and scale of American livestock holdings to identify areas of overlap with bluetongue suitability. The project outcome will be an interactive ArcGIS Dashboard accompanied by a Story Map. Preferred skills include experience with GIS.

Additional skills: Important research qualities include enthusiasm, a strong work ethic, and curiosity. No prior research or computing experience is necessary, though you should be enthusiastic about learning computational skills. Experience with GIS is preferred for all potential projects.

Summer Research Opportunity with Dr. Kevin Ash and the Climate Risks & Storm Hazards (CRASH) Lab

Dr. Ash's research interests are in the field of Hazards Geography, which includes topics such as vulnerability, resilience, risk perception, risk communication, and decision-making. Currently, his research activities focus mainly on societal impacts of weather-related hazards such as tropical cyclones, severe thunderstorms, tornadoes, and floods. The scope of a summer research project will likely involve analysis of hazard and population data with a focus on the United States.

Current Project Available:

A Geospatial Awareness Framework for Weather Warning Communication and Decision-Support

Recent technological developments allow the possibility of forecasts and alerts tailored to specific people, locations, and situations. This research explores the potential benefits and limitations of a warning trigger buffer model based on user-defined tornado geospatial awareness and decision thresholds. Warning trigger buffers were previously developed to

model wildfire spread relative to geospatial thresholds (decision arcs) that correspond to the time needed to carry out evacuation and other response behaviors. This approach has promise for the severe local storm context as well, due to the complex integration of spatiotemporal information and storm attributes often required for timely and effective protective behaviors.

The research will result in the development of a new conceptual framework for tornado warning communication in the United States through creation and preliminary evaluation of a spatially explicit geospatial awareness and decision-support tool. This framework and tool will extend the growing body of knowledge on geospatial risk communication and add to the interdisciplinary scientific toolkit for further research in the direction of flexible and user-specific decision support systems for weather and climate hazards. Dr. Ash is looking for a student to work with data from several tornado case studies that will serve to demonstrate the advantages (and possible disadvantages) of this new decision-making framework and tool.

Desired Research Skills: familiarity with GIS and geospatial analysis software (such as ArcGIS Pro or QGIS) and common GIS data formats; ability to work with quantitative data and data science tools (R, Python, Excel, or Tableau); familiarity with basic statistics such as descriptive statistics or inferential statistics (comparison of means, regression). All skills are not required; if a student has basic familiarity or experience in one skill area, that may be sufficient if the student is willing to learn 1-2 new skills.

Summer Research Opportunity with Dr. Katy Serafin and the Climate Risk and Storm Hazard (CRASH) Lab

Dr. Serafin researches extreme sea levels and coastal hazards to better understand how our coastlines are changing and the resultant consequences for people and places. Her current research interests are: compound flooding hazards, coastal processes and geomorphology, flood risk management in a changing climate, human-natural coupled systems, and climate adaptation and resilience.

Possible research topics could link to ongoing projects or methods in the lab such as:

1. Evaluating the drivers of minor and major flooding events
2. Characterizing the impacts of nuisance flooding events
3. Communication and compound flooding hazards
4. Storm surge method comparisons
5. Beach morphology and extreme coastal water levels

Additional skills: Important research qualities include enthusiasm, a strong work ethic, and curiosity. No prior research or computing experience is necessary, though you should be enthusiastic about learning computational skills. Experience with MATLAB or R is preferred.

Summer projects available with Dr. Joann Mossa and the STAR (Spatial and Temporal Analysis of Rivers) Lab

Current Projects Available Include:

Historical River Impacts Databases: There are national or international databases for dams and national databases for artificial levees. There are also some noteworthy compilations of snag removal in large rivers in the United States (Wohl, 2014). The geographic nature of other river modifications such as artificial cutoffs, dikes (wing dams or spur dikes), rock and shoal removal, and other impacts are less well known. Sources of this information include literature searches, historical government reports, Google Earth, and other venues.

Table 1. Compilation of some river engineering modifications.

Modification	Database	Type
Dams	https://globaldamwatch.org/grand/	International, 6862 records, Lehner et al., 2011
Dams	https://nid.sec.usace.army.mil/#/what-is-nid/closer-look	National, 91000 dams
Artificial levees	https://levees.sec.usace.army.mil/#/	National and U.S. territories, 6,920 Levee Systems, 24,491 Miles of Levees, 58 years Average Levee Age
Snag removal	Wohl, 2014	Partial, Compiled from Chief of Engineers reports

The goal of summer research is to compile evidence of some of these less documented impacts in rivers (artificial cutoffs, dikes, or rock removal) using Google Earth, historical sources, and internet searches. Up to three students can assist with this project.

Mapping sand bar changes on large rivers: Large sandbars are a sign of possible drought and human disturbance. This work intends to uncouple the role of streamflow or discharge, which drowns sandbars, from human activity and other disturbances that bring sediment to the riparian corridor. This project is targeted to a student interested, preferably with a background in hydrology, geomorphology, sedimentology, or environmental science who has skills in remote sensing, especially Google Earth Engine and/or GIS and aerial photo interpretation.

Evaluating the use of AI for landform and hazard interpretations. Artificial intelligence tools have potential applications for interpreting geomorphic aspects of landforms and landscapes, and flood or damage assessments following storms. This student would be co-supervised by Drs. Mossa and Sounny-Slitine. They would be exploring what AI does and does not do well in such applications in a structured way. Students should have had a basic course in geography or geology where landforms and landscape interpretation are discussed.

Additional skills: Important research qualities include curiosity and interest in historical work and understanding the human transformation of the Earth. Experience with spreadsheets, aerial photo interpretation, archives, and GIS (geographic information systems) is preferred.

Undergraduate opportunities in medical geography and the SEER Lab

The Spatial Epidemiology and Ecology Research Laboratory (SEER Lab) is jointly housed in the Department of Geography and the Emerging Pathogens Institute at the University of Florida. The lab is focused on pathogens with environmental reservoirs, primarily bacterial pathogens. The lab uses a bookends approach of studying pathogens at the molecular and cellular level in biosafety laboratories and spatial modeling of landscape-level environmental conditions that support pathogen persistence in the environment. We link environmental data, animal movement and population data, and epidemiological data with laboratory results to study the spatial epidemiology and disease ecology of anthrax, brucellosis, and melioidosis. These studies are currently focused on Vietnam, Kazakhstan, West Africa, East Africa, southern Africa, and the US. We also have several projects focused on the spatial patterns of several deer diseases in the state of Florida.

Toward the lab's mission, we have several opportunities for undergraduate students to become involved in research on pathogen genetics and linking those genomic characteristics to outbreak timing and geographic location. We also have projects focused on how individual populations of humans, livestock, and wildlife encounter pathogens in the environment. Many of these studies focus on the use of Geographic Information Systems and remote sensing. We have several studies that link the location and timing of disease outbreaks with environmental conditions. The goal of these projects is to better predict the distribution of where we think outbreaks might happen. We also aim to study whether different pathogen genetic characteristics are associated with higher intensity of disease outbreaks.

Students working in a biosafety laboratory may work on DNA extraction, DNA sequencing using next generation technology Including Illumina short-read and Oxford Nanopore long-read platforms. For these analyses, students will be introduced to DNA extraction and sterility testing, real-time PCR, DNA quantification, DNA quality checks, and library preparation. Students will also be introduced to loading libraries onto either of the two sequencing platforms. With data from these sequencing platforms students will learn how to do genome alignments and several techniques for building phylogenetic relationships between strains. This work introduces students to several AI-routines for genome alignment (for long-read data) and relies on the HiPerGator supercomputer. These data often populate our spatial models about pathogens.

For students interested in working in a GIS/remote sensing environment, students can work on projects that map outbreak distributions, outbreak timing, and outbreak intensity. These data would be compared in a modeling environment to conditions that describe soil characteristics, vegetation indices, precipitation patterns, temperature, and elevation. These types of studies would introduce students to machine learning algorithms such as boosted regression trees, random forests, ecological niche models, and count models.

Students interested in working on projects in the lab should provide a brief background on their experience in a biology wet lab or biology classes or experience in GIS and remote sensing, again with some background on previous coursework. The lab has pathogen collections and projects from all over the world and students are assigned to projects based on previous skills,

current interests, and current project priorities for the lab. SEER Lab is a diverse and dynamic research group representing several cultural backgrounds and an interdisciplinary training environment. Currently the lab has a staff of 12 including faculty, research staff, postdoctoral associates, graduate students, and undergraduate students. Students can expect to work in our dedicated space in either Turlington Hall or the Emerging Pathogens Institute depending on the project they are assigned to.

You can learn more about the lab on our website: http://seerlab.geog.ufl.edu

For more information or details on project ideas, please contact SEER Lab Director, Dr. Jason Blackburn via email (jkblackburn@ufl.edu) or using Microsoft Teams (jkblackburn). Please identify the **GeoGator Summer Research Program** in your email heading or Teams chat.

Meteorology, remote sensing, and AI research with Dr. Berry Wen and the Meteorology and AI (MAI) Lab

Lab Description

The MAI Lab applies the advanced machine learning models to massive radar and satellite datasets to study the water related natural hazards, including tornadic storms, tropical cyclones, flooding, and drought. We use a combination of high-performance computing, geospatial tools, AI, and remote sensing in our research.

GeoGator Summer Research projects with the MAI Lab include:

1. **Cross-validating ground weather radar and Global Precipitation Measurement (GPM) Mission on Amazon Web Service (AWS)**. Open Data/Open Science is an urgent goal for NASA. Student researchers will learn the cloud computation on AWS. No prior research or computing experience is necessary. Experience with MATLAB or Python is preferred.
2. **Analyzing the mobile radar RaXPol observations of Hurricane Ian**. This project utilizes newly collected data from Hurricane Ian's FL landfall. There are many directions this project could be taken, therefore the student researcher should be curious, enthusiastic, and not be afraid to ask questions. No prior research or computing experience is necessary. Experience with MATLAB or Python is preferred.
3. **Machine learning in radar and satellite precipitation retrieval.** Have you wondered how to get rainfall information from weather radar or satellite? Will the advanced AI models (e.g. Reinforcement learning) help to improve the current rainfall products? Student researchers involved with this project will learn all different kinds of AI/ML models and apply the models to retrieve rainfall information. Good computing experience is necessary.

Geography education research with Drs. Hamerlinck, Good, and Serafin

Project description: Undergraduate education often exposes students to interdisciplinary Wicked Problems, which are social or cultural problems that are difficult or impossible to solve because of their complex and interconnected nature. Wicked problems in introductory geography courses here at UF include climate change, disease outbreaks, and sea level rise. This project aims to assess student perceptions of anxiety, responsibility, and risk related to the wicked problems posed in four courses using a mixed methods approach that analyzes qualititative data from submitted reflections, and quantitative survey results. The summer research student working on this collaborative project will be advised by Dr. Hamerlinck with input and additional guidance from Dr. Ryan Good and Dr. Katy Serafin.

Students interested in working on this project should contact Dr. Hamerlinck to discuss how to get involved. The ideal student would have experience with human subjects research, an interest in

discipline based education research, and/or experience or a willingness to learn qualitative data analysis.