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

SSCI 383L, Geospatial Modeling and Customization

Syllabus

Units: 4

Term – Day – Time: Spring, 2020, Lectures: Mon and Wed 12-1:20 pm PT; Lab: Wed and Thu 2-3:50 pm PT

Location: Lectures AHF 145D; Lab: AHF 145A

Instructor: Jennifer N Swift, Ph.D. GISP
Office: AHF B57D
Regular Office Hours: Mon and Wed 2-3 pm PT. Also available most days and times by appointment via email.
Contact Info: jswift@usc.edu, 213-740-5841

Laboratory Co-Instructor: Kenan Li
Office: AHF 146
Regular Office Hours: **:** Mon 2:30-3:30 pm PT. Available most days and times by appointment via email.
Contact Info: kenanl@usc.edu, 213-740-7164

Library Help: Andy Rutkowski
Office: VKC 36B
Office Hours: Tue 10 am-12 pm and Thu 4:30-5:30 pm PT
Contact Info: arutkows@usc.edu, 213-740-6390
http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF 145D
Office Hours: By appointment
Contact Info: spatial_support@usc.edu, 213-821-4415

Course Scope and Purpose

The spatial sciences now require professionals with GIS modeling and customization skills, an essential part of the career portfolio. This course provides the fundamentals of spatial modeling, and how to use GIS customization and programming, or scripting, to streamline complex spatial analysis and modeling workflows. An understanding of GIS modeling and how to create and implement customized tools is needed to successfully solve many of the critical societal and environmental challenges we face in today's ever-changing world. Learning to program facilitates understanding of one's use of GIS as well as how to interact with others who use GIS software. Familiarity with a GIS programming language and how it is implemented also provides in-depth insight into how other programmers create and use these tools. Helping you become comfortable with creating, coding and documenting GIS modeling workflows is a fundamental goal of this course.

Numerous examples will be used throughout the course to illustrate how spatial modeling helps us to understand spatial phenomena through expressions of how the natural world works, and the profound influence we have on our environment. The combination of class and laboratory sessions will show how, for example, effective spatial modeling combined with creative coding requires an informed and intelligent user in addition to the appropriate computer hardware and software tools**.**

This course is designed to serve several student audiences given its role as a required course in the B.S. in GeoDesign and Minor in Spatial Sciences. Each audience is encouraged to utilize the laboratory experience and research projects to investigate diverse geospatial resources such as spatial modeling, computer programming, remotely sensed imagery, and 2D and 3D data visualization to advance their own academic and professional goals.

Learning Objectives

Students who excel in SSCI 383L will:

- Understand fundamental spatial science concepts in the context of spatial modeling;
- Explain how spatial models can be used to solve and understand real-world problems from an interdisciplinary viewpoint;
- Program small-scale GIS-based models in Python, integrated within ArcGIS or some other geospatial software ecosystem;
- Streamline complex workflows using GIS customization techniques;
- Describe how many of the complex global challenges we face today can be addressed through the combination of spatial modeling and customization using GIS.

Prerequisite(s): SSCI 301L, SSCI 382L or Instructor Permission
Co-Requisite (s): None
Concurrent Enrollment: None
Recommended Preparation: None

Course Structure

This is a four-credit course comprised of combined lectures (two per week) and labs (one per week). The combined lecture and lab sessions are organized into learning modules that build upon core principles of geographic information science by delving into topics including spatial modeling and GIS customization, and the software systems used to explore these topics. The weekly meetings and projects are designed to broaden your practical experience and deepen your understanding of the concepts and tools of spatial science inquiry and to enhance your problem-solving skills within the framework of the scientific method. The lecture and lab sessions are designed to provide you with sound theoretical reasoning and the technical skills to investigate various physical and social processes. Your weekly assignments will be graded and returned, and the mid-term and both projects will have a laboratory component to them.

Please note that all course materials and correspondence will be posted on the course Blackboard website. As a registered student you will find this course available for you to access at 10 a.m. PT on the first day of classes**.**

Technological and Communications Requirements

The computational software and geospatial data required for course assignments may be accessed using computing resources provided by the Spatial Sciences Institute.

ArcGIS is provided online via the GIST Server; hence, you do not need to install it on your own computer. In addition to the SSI computing resources, every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone for use whenever a presentation or meeting is scheduled.
- An up-to-date web browser to access the SSI Server

SSI Server and Tech Support – This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software. If you are unable to connect to the server or experience any type of technical issues, send an email using your USC account to SSI Tech Support at ssi_support@usc.edu, making sure to copy (cc) me on the email.

- *Discussion forums* – On the Blackboard site, I will post discussion threads relevant to the reading and hands-on assignments of the course. Discussions provide a key means for student-to-student discussion and collaboration. Students can also provide support to each other while working on assignments, sharing hints and helpful tips. I monitor the discussion threads and will offer comments when appropriate, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Required Readings and Supplementary Materials

The required textbooks for this course are:

- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. 2015. *Geographic Information Systems and Science*. 4th ed. New York: John Wiley and Sons.

The required tasks will be supplemented with the following materials:

- Law, Michael, and Collins, Amy. 2019. "Chapter 5: Facilitating Workflows". In *Getting to Know ArcGIS Pro*, 189-236. Redlands, CA: Esri Press.
- Li, Linna. 2017. "Spatial Data Uncertainty." *The Geographic Information Science & Technology Body of Knowledge* (4th Quarter 2017 Edition), John P. Wilson (ed).
- Miller, Harvey, and Michael F. Goodchild. 2015. "Data Driven Geography." *GeoJournal* 80, no. 4 (October): 449-461.
- Padmanabhan, Anand, Shaowen Wang, Guofeng Cao, Myunghwa Hwang, Zhenhua Zhang, Yizhao Gao, Kiumars Soltani, and Yan Liu. 2014. "FluMapper: A CyberGIS Application for Interactive Analysis of Massive Location-Based Social Media." *Concurrency and Computation Practice and Experience* 26, no. 13 (September): 2253–2265.
- Steinitz, Carl. 2012. "Chapter 9: Geodesign When Knowing the Rules." In *A Framework for Geodesign: Changing Geography by Design*, 139 - 178. Redlands, CA: Esri Press.
- Tong, Daoqin, and Alan T. Murray. 2012. "Spatial Optimization in Geography." *Annals of the Association of American Geographers* 102, no. 6 (June): 1290-1309.
- Zent, Christopher. 2018. ArcGIS Pro SDK for .NET: "An introduction to Add-Ins and Configurations." Technical workshop. In *Proceedings of the 2018 Esri User Conference*.

In addition, two Lynda.com courses are supplied with this course:

- Marini, Joe. 2018. Learning Python.
- Pierson, Lillian, 2018. Python for Data Science Essential Training.

Description and Assessment of Assignments

Weekly Assignments

There are several different kinds of assignments with at least one due weekly. These are described in the Weekly Folders on Blackboard. Due dates are shown in the summary that follows.

Assignments – 3 worth 15 points: Students will be expected to complete three assignments focused on assigned readings, engagement in lectures, sharing and discussion of course assignments, and in-class "worksheets," among other forms of active engagement in the course.

Laboratory Assignments – 10 worth 3 points. This course includes a laboratory component each week to develop technical competency with geospatial software platforms and analytic tools. There will be a total of ten laboratory assignments over the course of the semester.

Mid-term Exam – 1 worth 15 points. The mid-term exam will consist of multiple-choice, short answer, and simple problem questions. Students will be expected to take the exam at the indicated time.

Individual Project Proposal – 1 worth 5 points. The individual project is a capstone proposal and report for this course, and students will be expected to draw upon course lectures, discussions, lab assignments, readings, and outside sources to organize and deliver a self-directed study on a topic of interest utilizing spatial modeling and geospatial technologies. The proposal will include a brief description of the spatial question(s) you would like to ask or the spatial problem you would like to solve and briefly how you plan to solve it.

Individual Project Repott – 1 worth 15 points. A written report of your individual project (single-spacing for text, 12-point font, 1 inch margins) no more than 15 pages in length that must include one or more maps, tables, and other diagrams as well as citations and references.

Final Exam – 1 worth 20 points. The final exam will consist of multiple-choice, short answer, and simple problem questions. Students will be expected to take the exam at the indicated time.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Assignments	3	5	15
Laboratory Assignments	10	3	30
Mid-term Examination	1	15	15
Final Examination	1	20	20
Individual Project Components			
Individual Project Proposal	1	5	5
Individual Project Report	1	15	15
Total	17	-	100 points

Assignment Submission Policy

Assignments will be submitted for grading via Blackboard by the due dates specified in the Course Schedule below.

Additional Policies

Students are expected to attend and participate in every class session and to complete and upload all assignments before the deadlines detailed in the Course Schedule.

Unless otherwise noted, assignments must be submitted via Blackboard by the due dates specified in the Course Schedule below and on the assignment instructions.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points up to FOUR days late. No points will be given for submissions more than FOUR days late. Note that all assignments worth 2 points will receive 0 points if submitted late.
- Additionally, no written work will be accepted for grading after 5 pm PT on the last day of classes.

Schedule

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 1 1/13 1/15	**Introduction to the Course** Brief introductions coupled with discussions of class goals, lab assignments, projects, and technologies. Review of basic concepts covered in SSCI 301, including geodesy, projections, scale, cartography, and geocoding. **Maps, Spatial Reasoning & Geographic Information Science Review** Review of fundamental concepts covered in SSCI 382, including spatial analysis operations, computational models, space-time modeling, fuzzy classification and uncertainty.	Longley et al. (2015) Ch. 2, pp. 33-53, Ch. 4, pp. 77-98, Ch. 11, pp. 237-265, Ch. 13, pp. 290-317, Li (2017) Assignment 1	Assignment 1: Recap: Maps, Spatial Reasoning & Geographic Information Science Tuesday, 1/21*
Week 2 1/21* *Monday, 1/20 is university holiday 1/22	**Core Concepts of Spatial Modeling & Types of Models** Introduction to the fundamental concepts of spatial modeling. Discussion of the different types of spatial models and why we use them, including linear regression models and geographically weighted regression (GWR).	Longley et al. (2015) Ch. 14, pp. 326-337, Ch. 15, pp. 339-343 Assignment 2	Assignment 2: Comparison of different types of spatial models Monday, 1/27
Week 3 1/27 1/29	**Cartographic Modeling** Exploration of 2D spatial modeling in the context of geographic information systems software that supports modeling. **Remote Sensing** Introduction to remote sensing and geospatial technologies that that support 2D modeling using remote sensing data.	Longley et al. (2015) Ch. 15, pp. 344-345 & 349-351 Lab 1	Lab 1: Introduction to cartographic spatial modeling Monday, 2/3

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 4 2/3 2/5	**3D Visualization** Investigation of core concepts in creating 3D geographic representations of the real world to facilitate understanding our world. **3D Modeling for Design** Introduction to building 3D models for design applications, such as urban, suburban and rural communities.	Longley et al. (2015) Ch. 12, pp. 266-276 Lab 2	Lab 2: Introduction to 3D Visualization using Esri City Engine Monday, 2/10
Week 5 2/10 2/12	**3D Modeling Fundamentals** Visualization using different projections, 3D libraries, materials application and texture mapping. **3D Modeling in GIS** Creating and editing 3D GIS data, 3D data storage, and exchanging 3D data between different software.	Longley et al. (2015) Ch. 12, pp. 277-288 Lab 3	Lab 3: 3D Modeling in GIS using Esri City Engine: Tuesday, 2/18*
Week 6 2/18* *Monday, 2/17 is university holiday 2/19	**3D Spatial Analysis** Introduction to methods to quantitatively analyze the spatial distribution of real and simulated objects within 3D space.	Longley et al. (2015) Ch. 14, pp. 319-326 Individual Project Proposal and Report Instructions Lab 4	Lab 4: 3D Spatial Analysis using Esri City Engine: Monday, 2/24 Individual Project Proposal: Friday, 2/28
Week 7 2/24 2/26	**3D Model Integration** Simulating urban settings and creating high-resolution 3D renderings for presentations **Agent-Based Modeling** Introduction to the fundamental concepts of agent-based modeling.	Longley et al. (2015) Ch. 15, pp. 346-348 & 351-356, Steinitz (2012) Ch. 9, pp. 150-178 Lab 5	Lab 5: Introduction to agent-based modeling: Monday, 3/2
Week 8 3/2 3/4	**Spatial Decision Support** Introduction to methods for developing decision models that can resolve resource allocation decisions, and scenario-based planning for sustainable ecosystem development. **Collaborative Spatial Problem Solving** Exploration of creating and analyzing alternative planning scenarios for informed decision making in spatial studies.	Longley et al. (2015) Ch. 17, pp. 381-409, Steinitz (2012) Ch. 9, pp. 140-149 Lab 6	Lab 6: Collaborative spatial problem solving in interdisciplinary research: Monday, 3/9

	Topics	Readings and Assignments	Deliverables/Due Dates
Week 9 3/9 3/11	**Mid-Semester Review** **Mid-Term Exam**		No Lab
3/16 *3/15-3/22 is Spring Recess	*Spring Recess*		
Week 10 3/23 3/25	**Introduction to GIS Customization** Introduction to customizing GIS applications to streamline spatial analyses, models and workflows. **Types of Customizations** Exploration of different proprietary and open source options for developing GIS applications, including use of data portals and other web resources.	Longley et al. (2015) Ch. 6, pp. 131-134	Assignment 3: Investigation of options for customizing GIS applications: Monday, 3/30
Week 11 3/30 4/1	**Fundamentals of Programming** Introduction to programming in Python in geographic information science and systems. **Programming Tools for GIS** Exploration of Jupyter Notebooks and Python to create and share code, equations, visualizations, and programming documentation.	Marini (2018), Pierson (2018) Lab 7	Lab 7: Introduction to Python and Jupyter Notebooks for spatial science problem-solving in GIS: Monday, 4/6
Week 12 4/6 4/8	**GIS Automation and Customization** Introduction to spatial modeling methods using Esri ArcGIS to process spatial data to handle important social, economic, and environmental challenges faced today and in the future. **Open Source Automation and Customization** Exploration of open source GIS programing options for developing automated and customized solutions, such as Whitebox GAT, GRASS and QGIS.	Zent (2018), Padmanabhan et al. (2014) Lab 8	Lab 8: Introduction to programming and customization using open source GIS tools: Monday, 4/13

Week 13 4/13 4/15	**Extending GIS Through Programming** Introduction to GIS programming that can extend the software to bundle spatial analyses and models into convenient tools. **Wrapping Models in GIS Add-Ins** Exploration of how programming can enhance development of functionality add-ins in geographic information systems.	Longley et al. (2015) Ch. 6, pp. 135-147, Law and Collins (2018) Ch. 5, pp. 189-236 Lab 9	Lab 9: Designing Python and Esri Modelbuilder Monday, 4/20 Components for Final Individual Projects: Monday, 4/20
Week 14 4/20 4/22	**Portals** Overview of geospatial web portals, from setup and design, to data collection, formatting, archiving, and dissemination. **Web Services** Overview of different data formats that are often used in geospatial Web services to transport geospatial feature information between Web services and clients.	Longley et al. (2015) Ch. 10, pp. 217-235, Miller and Goodchild (2015) Lab 10	Lab 10: Demonstration of programmatic use of geospatial web maps and web services: Monday, 4/27
Week 15 4/27 4/29 Friday, 5/1 is last day of class	**Individual Projects** Students work on individual projects. Complete individual spatial modeling project and report. **Final Individual Reports** Students complete individual project reports.		Individual Project Lab Work Individual Project Reports. All projects must be submitted no later than 5:00 PM PT on 5/1
Exam Week 5/6	**Final Examination**		Final Examination: Friday, 5/8, 11 a.m. – 1 p.m. PT

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255 – 24/7 on call
www.suicidepreventionlifeline.org
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) – (213) 740-5086 |Title IX Compliance – (213) 821-8298
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Reporting Incidents of Bias or Harassment– (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs – (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy – (213) 821-4710
uscsa.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.