SSCI 684, Spatial Modeling with GIS

Syllabus

Units: 4

Term Day Time: Spring 2021, Hybrid
Thursdays 2:00-4:50pm PT

Note: Until further notice by USC, Dornsife, and SSI this class will be held entirely online. If/when LA County, City of Los Angeles and USC health and safety protocols allow, the course will resume in a streaming-hybrid format.

Location: USC Zoom Meeting link accessibly via course Blackboard.

Instructor: Laura C Loyola, PhD
Office: AHF B55A
Regular Office Hours: Tues 11 am-12 pm and Wed 2-3 pm PT. Also available most days and times by appointment via email.
Contact Info: loyola@usc.edu, 213-740-5612; 323-457-3504 (remote office)

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

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

This course explores how geographic information systems and related technologies (global positioning systems, remote sensing, etc.) can be used to promote and support the construction and simulation of dynamic models of coupled human-environment systems. The fundamental feature of such systems involves diffusion over time and space, and individual cases may range from diffusion of pollutants and invasive species across landscapes to the diffusion of disease by contact between individuals. The approaches used to model these phenomena may range from the continuous representation of system dynamics to the discrete interactions of individual elements of agent-based models. The measurement and modeling techniques used to describe spatial and temporal processes and patterns affecting human and environmental systems will be introduced with an assortment of weekly readings, discussions, and technical work. The course is aimed at doctoral students and a series of individual and group projects allow class participants to develop and use their own models for more detailed research. Calculus and programming experience may be helpful but are not required. In addition to the textbooks, exercises and readings will be provided from a variety of sources as required.

Learning Outcomes

On completion of this course, students will be able to:

- Describe the fundamental building blocks (data sources, data models, spatial analysis methods, programming tools, etc.) used in geographic information technologies and spatial models.
- Discuss how dynamic spatial models have been implemented to both simulate the functioning of coupled human-environment systems and understand their behavior under altered conditions.
- Explicate the ways in which advances in our knowledge of coupled human-environment systems on the one hand and computer technologies on the other hand have combined to allow more realistic and detailed representations of the spatiotemporal variability of these systems in spatial models.
- Discuss the impact of sampling, resolution, uncertainty, and error on spatial model outcomes and some of the new opportunities afforded by modern instrumentation and measurement techniques.
- Critically evaluate the types of models that will be required in the future to effectively manage land, water, air and biotic resources, assess environmental risks, and promote human health and well-being.

Students may vary in their competency levels on these abilities. You can expect to acquire these abilities only if you honor all course policies, attend classes regularly, complete all assigned work in good faith and on time, and meet all other course expectations of you as a student.

Prerequisite(s): None
Co-Requisite(s): None
Concurrent Enrollment: Students must be enrolled in an existing USC PhD program
Recommended Preparation: Some GIS experience or permission of instructor

Class Conduct

Harassment, sexual misconduct, interpersonal violence, and stalking are not tolerated by the university. All faculty and most staff are considered Responsible Employees by the university and must forward all information they receive about these types of situations to the Title IX Coordinator. The Title IX Coordinator is responsible for assisting students with supportive accommodations, including academic accommodations, as well as investigating these incidents if the reporting student wants an investigation. The Title IX office is also responsible for coordinating supportive measures for transgender and nonbinary students such as faculty notifications, and more. If you need supportive accommodations you may contact the Title IX Coordinator directly (titleix@usc.edu or 213-821-8298) without sharing any personal information with me. If you would like to speak with a confidential counselor, Relationship and Sexual Violence Prevention Services (RSVP) provides 24/7 confidential support for students (213-740-9355 (WELL); press 0 after hours)

Course Structure

The course will be taught as a seminar and class meetings will be split between presentations and discussions of the assigned readings and any questions and related topics that arise from the readings. The learning and teaching strategies are student-centered. They aim to encourage a deep-learning approach by using reflection and self-evaluation. The course readings are designed to provide the essential background and framework for study. Students will be required to reflect on their learning through in-class discussions and a series of carefully crafted assignments.

Technological and Communication Requirements

Students are expected to have a working knowledge of GIS. The modeling software programs and geospatial data required for course assignments will be accessed using computing resources provided by the Spatial Sciences Institute.

SSI Server and Tech Support – At times 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 spatial_support@usc.edu, making sure to copy (cc) me on the email.

Required Readings

Students are expected to acquire the textbooks on their own, electronic versions are acceptable when available. Most journal articles are accessible through the USC Libraries system. If a student is unable to access the textbooks, please speak with the instructor at the start of the semester to establish a workaround.


Description and Assessment of Assignments

Students must participate in class discussion on a regular basis, prepare written assignments in the form of discussion boards and model reports, and complete technical exercises and presentations.

Class Participation (15%): A class participation grade for the semester will be assigned based upon how actively students engage in the course. Students will be required to read all material outlined for each week of the course, and be prepared to lead and participate in group discussions about the readings in class. Failure to attend or to be adequately prepared to discuss the readings will lead to the assignment of a lower grade for that week. Students should
also maintain a written log of insights and observations from the classroom discussions and accompanying homework projects that will assist in completing the final project.

**Modeling Exercises (40%)**: Throughout the semester students will complete four exercises that provide students the opportunity to utilize and reflect upon the technical aspects of various modeling software. Students will implement the model design to health issues/projects of their own. These exercises will require independent background research of the models and/or modeling software and incorporate written reviews of supporting documentation. The modeling exercise may take some time to work through and deliverables will consist of final model outputs plus a write up of 5-6 pages.

**In-Class Presentation (15%)**: Students will conduct a seminar on a topic determined in consultation with the instructor in the second half of the classes scheduled in Weeks 10 and 11. A one-page summary will be distributed in advance of the class itself and the topic may be an evaluation of a model or software (Caline, RePast, etc.), a complex systems subject (fractals, modifiable areal unit problems, neural networks, etc.) or some specific technique or application that is relevant but not otherwise covered in the course.

**Final Project (30%)**: In the second half of the course, students will work on projects determined in consultation with the instructor. Students will construct a spatial model to address some geographically relevant health problem, or problem of their own choosing. The final report and class presentation will summarize insights from each phase of the modeling process as experienced in the problem context.

**Grading Breakdown**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Number</th>
<th>Points Each</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>15</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Conceptual Model</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Modeling Exercises</td>
<td>4</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>In-Class Presentation</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Final Project</td>
<td>1</td>
<td>30</td>
<td>30</td>
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<tr>
<td><strong>Total</strong></td>
<td>22</td>
<td>-</td>
<td>100</td>
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**Assignment Submission Policy**

Assignments will be submitted for grading via Blackboard using the due dates specified in the Course Schedule below. Students are expected to attend and participate in every class session and to complete and upload all assignments by the deadlines detailed in the Course Schedule. Late work will be assessed a penalty of 10% per day and zero grades will be assigned for work that is more than one week late.
## Schedule

<table>
<thead>
<tr>
<th>Week 1</th>
<th>1/21*</th>
<th>Introduction to Class</th>
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<tbody>
<tr>
<td>*Monday, 1/18 is university holiday</td>
<td>Maglio et al. (2014); Wilson &amp; Burrough (1999); Crooks et al. (2019) Forward, Ch1; Skidmore (2002) Ch 1 (optional, as needed)</td>
<td>No deliverables.</td>
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<thead>
<tr>
<th>Week 2</th>
<th>1/28</th>
<th>Why Use Models and Differentiating Spatial Models</th>
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<tbody>
<tr>
<td></td>
<td>O'Sullivan &amp; Perry (2013) Ch. 1; Aung et al. (2019); Stewart et al. (2013); Brimicombe (2010) Ch. 2; Longley et al. (2015) Ch. 14, 15 (as needed); Skidmore (2002) Ch. 2 (as needed)</td>
<td>Conceptual Model</td>
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</tbody>
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<thead>
<tr>
<th>Week 3</th>
<th>2/4</th>
<th>The Art of Modeling and Avoiding Bias in Models:</th>
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<td></td>
<td>Alexandrov et al. (2011); Jakeman et al. (2006); Schmolke et al. (2010a, b); O'Sullivan &amp; Perry (2013) Ch. 3; de Vos et al. (2013); Weisberg (2007);</td>
<td>No deliverables.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Week 4</th>
<th>2/11</th>
<th>Rethinking and Preparing Models in a GIS:</th>
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<tbody>
<tr>
<td></td>
<td>Boulton et al. (2011); Bhaduri et al. (2007); Thomson et al. (2017); Graham et al. (2004); Li et al. (2019) Martin (2008) (optional) Green et al. (2017) Ch. 3, 4, 7, and 9 (if unfamiliar with Remote Sensing)</td>
<td>Modeling Exercise #1</td>
</tr>
<tr>
<td>Week</td>
<td>Topic</td>
<td>Readings and Assignments</td>
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<tr>
<td>2/18*</td>
<td><strong>Patterns and Processes:</strong> A discussion of some of the ways forces of attraction and segregation, individual mobile entities, and processes of spread are featured in models of social and environmental systems.</td>
<td>O’Sullivan &amp; Perry (2013) Ch. 2; Brimicombe (2010) Ch. 9; Jarvis &amp; Stuart (2001a, b); Jones et al (2018); Briggs (2005); Buzzelli et al. (2006)</td>
</tr>
<tr>
<td>3/4</td>
<td><strong>Model Calibration &amp; Validation:</strong> An introduction to the special challenges and issues that are confronted when using GIS tools to describe and model place-based exposures and the spatial distributions of phenomena of interest.</td>
<td>Liburne and Tarantola (2009) O’Sullivan &amp; Perry (2013) Ch. 7; Zhai et al (2016); Hijmas (2012); Huang (2019); Zhai et al (2016)</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Topic</td>
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<tr>
<td>9</td>
<td>3/18</td>
<td>Agent-Based Models: A discussion of some of the ways which agents have been used to represent mobile individuals in dynamic models of human and environmental systems, and how complex system dynamics may be agent/individual-based or differential equation-based or both.</td>
</tr>
<tr>
<td>11</td>
<td>4/1</td>
<td>Presentations: In-class presentations on model or software evaluation.</td>
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<tr>
<td>12</td>
<td>4/8</td>
<td>Modeling the Built and Social Environments: Discussion of the interactions of our dynamic built environment and social environment with health outcomes and various forms of exposure</td>
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<tr>
<td>13</td>
<td>4/15</td>
<td>Spatial and Computational Models: Discuss the distinction between spatial and computational models and an introduction to how spatially explicit models can be transformed.</td>
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<tr>
<td>14</td>
<td>4/22*</td>
<td>No Class Meeting. No deliverables.</td>
</tr>
<tr>
<td>15</td>
<td>4/29*</td>
<td>Final Presentations: Students will present their projects, summarizing the insights garnered from each phase of the modeling process as experienced in their specific problem context.</td>
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<tr>
<td></td>
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<td>Final Exams</td>
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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

Counseling and Mental Health – (213) 740-9355 – 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
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 someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

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 Campus Support and Intervention – (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
Emergency assistance and avenue to report a crime. Latest updates regarding safety, 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.

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link https://libraries.usc.edu/. Also, the USC Libraries have many important resources available for distance students through the link: https://libraries.usc.edu/faculty-students/distance-learners. These include instructional videos, remote access to university resources, and other key contact information for distance students.