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

# SSCI 584, Spatial Modeling

*Syllabus*

**Units:** 4

**Term — Day — Time:** Spring 2018, Online

**Location:** Online

**Instructor:** Karen K. Kemp, PhD GISP
**Office:** Kailua-Kona, Hawaii
**Regular Office Hours:** Mon 12-1 pm PT and Wed 3-4 pm PT via Blue Jeans – please contact me via email in advance to ensure I will be online. Also available most days and times by appointment via email.
**Contact Info:** kakemp@usc.edu, 808-322-9430 (Hawaii), www.bluejeans.com/8081234567

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

**IT Help:** Richard Tsung
**Office:** AHF 146
**Office Hours:** By appointment
**Contact Info:** spatial_support@usc.edu, 213-821-4415

## Course Scope and Purpose

The use of spatial analytical models has become increasingly common in the study of social and environmental systems. Such models are used to help us learn about the systems we are interested in, to help guide future research by identifying knowledge and data 'gaps', to aid in the design of management and monitoring strategies, and to make predictions about unmeasured patterns and processes. This course will take you beyond the basic understanding of spatial analysis tools taught in SSCI 583 Spatial Analysis.

This course will provide you with an understanding of a range of spatial modeling concepts, approaches, and applications, as well as methods for determining the suitability of a particular modeling approach for a given task. Designed as an online version of an advanced studio course and graduate seminar, you will work individually and in groups to explore, learn, and teach about several different solutions to geospatial modeling challenges. Students are encouraged to customize their learning experience to address individual career and education goals.

Expectations in the workplace for today's GIS professionals include the ability to learn continuously, work with many different kinds of data and with other professionals in other disciplines, domains, and agencies. There are many unique and deep skill sets needed in today's world. However, they do not stand alone; the ability to collaborate, to learn from others and to expand opportunities jointly are essential. The collaborative component of this course is essential.

This is an elective course for students in the M.S. in Geographic Information Science & Technology (GIST), the M.S. in Human Security and Geospatial Intelligence, the M.S. in Transportation Systems Management, and the M.S. in Spatial Economics and Data Analytics. It is also an elective in the Graduate Certificate programs in GIST, Geospatial Intelligence, and Geospatial Leadership.

### *Learning Objectives*

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

- Explain how complex spatial models can be used to help solve and understand environmental and social problems and management challenges.
- Describe the diversity of tools and techniques that fall within the collection of spatial analytical models.
- Represent spatially and temporally dynamic social and environmental processes using spatial modeling tools.
- Assess the validity, uncertainty, and sensitivity of model results, both in the research literature and in your own work.
- Use and integrate with ArcGIS, alternative modeling solutions including open source GIS options, R tools, and external software applications.
- Solve spatial analytical modeling tasks of moderate complexity independently with the help of various online resources.
- Collaborate with others to develop team expertise in advanced modeling tools.

- Working with domain experts, outline possible modeling solutions for their loosely specified spatial problems.
- Convey complex technical information and modeling results to a non-technical audience through presentations, reports, and graphics.
- Describe how different GIS, modeling, mathematical, and statistical software packages can be integrated to produce results that none of these systems in isolation is able to produce.

**Prerequisite(s)**: SSCI 581 Concepts of Spatial Thinking, or permission of the instructor
**Co-Requisite(s)**: None
**Recommended Preparation**: SSCI 583 Spatial Analysis

## Course Structure

The main theoretical concepts are provided through text readings and self-directed research you will do in the published literature and on the web and through hands-on experimentation with various tools and technologies.

The course will generally unfold on a biweekly basis. Each set of weeks will be focused on a particular aspect of spatial modeling. During some weeks, the class will be divided into small groups, each of which will be charged with learning about a different modeling solution or environment. Group members will support each other as you learn your assigned topic, completing some intermediate assignments. At the end of collaborative modules, each student will present what they have learned to the remainder of the class in a brief tutorial (written or online). In this way, you will learn some of the material deeply while also learning something about related topics. You will finish the course by completing a spatial modeling project on a topic of your choice either on your own or in a self-identified group.

*Workload* – This is a four credit, one semester course. Students should expect to spend 10-15 hours per week completing the work in this course.

## Technological and Communication Requirements

ArcGIS is provided online via the SSI Server; hence, you do not need to install it on your own computer. Instead, every student must meet 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 spatial_support@usc.edu, making sure to copy (cc) me on the email.

*Communications* – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard. It is each student's responsibility to stay informed about what is going on in our course. In addition to email about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. Be sure to check these each time you log onto Blackboard.

I will send via email through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all email sent from Blackboard or from me. Do not ignore course email until the day before assignments are due. Also double check to be sure that email sent from the USC blackboard account does not go into your junk mail!

While I am usually online all day and will probably respond to emails from students very quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72 hours delay. In the rare case when I expect to be off-line for more than 72 hours, I will post an announcement on the Blackboard site.

*Discussion forums* – On the Blackboard site, I will post a series of discussion threads relevant to various sections of the course. Discussions provide a key means for student-to-student discussion and collaboration that can replicate the face-to-face contact you may have experienced in traditional classrooms. Here students can provide support to each other while working on your assignments, sharing hints and helpful tips, as you would in a classroom laboratory. Please post your questions about assignments there, as you would ask them publicly in the classroom. I monitor the discussion threads and offer comments when necessary, 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:

- O'Sullivan, D., and G. L. W Perry. 2013. *Spatial Simulation: Exploring Pattern and Proces*s. Oxford, UK: Wiley-Blackwell.
- Mitchell, A. 2012. *The Esri Guide to GIS Analysis, Volume 3: Modeling Suitability, Movement, and Interaction*. Redlands, CA: Esri Press.

Additional readings will be assigned from sections of the following books, all available online at the USC library, on the course Blackboard or on the public web.

- Bivand, R., E. J. Pebesma, and V. Gómez-Rubio. 2013. *Applied spatial data analysis with R*. Second edition. New York, NY: Springer.
- Brimicombe, A. 2009. *GIS, Environmental Modeling and Engineering*, Second Edition. Boca Raton, FL: CRC Press.
- de Smith, M. J. 2011. *STATSREF: Statistical Analysis Handbook: A Web-based Statistics Resource*. Winchelsea, UK: The Winchelsea Press.

- Kemp, K. K. 1993. *Environmental Modeling with GIS: A Strategy for Dealing with Spatial Continuity*. National Center for Geographic Information and Analysis, Technical Report 93-3. Santa Barbara, CA: University of California, Santa Barbara.
- McElreath, R. 2015. *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*. Boca Raton, FL: Chapman and Hall–CRC Press.
- Phillips, S.J., R. P. Anderson, and R. E. Schapire. 2006. "Maximum entropy modeling of species geographic distributions." *Ecological Modelling*, 190 (3-4): 231-259.
- Steinitz, C. 2012. *A Framework for Geodesign: Changing Geography by Design*. Redlands CA: Esri Press.
- Westervelt, J. D., and G. L. Cohen, eds. 2012 *Ecologist-Developed Spatially Explicit Dynamic Landscape Models*. New York, NY: Springer.
- Zuur, A. F., E. N. Ieno, E. Meesters. 2009. *A Beginner's Guide to R*. New York, NY: Springer.


Additional readings that focus on topics relevant to course themes selected by students will be identified as part of the literature search components of each course section.

## Description and Assessment of 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.

- *Resume Assignment* – 1 worth 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Prepare your resume in the SSI template which will be provided to you. Unless you opt out, your resume will be included in the Spatial Sciences Institute Graduate Programs Resume Book. This resume book is compiled annually and, along with our web presence, is used to promote our programs, and more importantly, your skills, experience and professional aspirations.
- *Graded Blogs and Wikis* – 4 worth 5 points, a total of 20 points. Throughout the term the class will explore a variety of topics through graded blogs and wikis. These tasks are designed to engage you in the material and to expand your research results beyond what you are personally able to uncover. Requirements for participation by way of comments and responses will be provided in detail in the assignment instructions.
- *Modeling Assignments* – 6 worth 5 points, a total of 30 points. The modeling assignments will give you hands-on experience with several different modeling tools and environments (including ArcGIS, NetLogo, Maxent and R).
- *Lesson Presentation* – 1 worth 10 points. One module ends with the presentation of a brief lesson through which you will teach your classmates what you have learned (teaching is the best way to learn!).
- *Responses to postings* – 5 worth total of 3 points. To ensure that everyone learns from everyone else, each student is required to be active in responding to the wiki and blog

postings and lesson presentations from other students. Responses must be substantial, informative or probing.

- *Final Project* – 4 components worth a total of 32 points. To integrate your learning of all the material covered in the course, you will design, undertake and report on an individually chosen spatial modeling project. The Final Project will have four components including a brief topic statement so that we can discuss your idea (2 points), a proposal with theoretical context and model conceptualization (10 points), a public presentation (5 points, made online via Blue Jeans) and a fully annotated and illustrated project report on your model implementation (15 points).
- *Summative Assignment* – 1 worth 3 points. A final summative written assignment to be completed during the final examination period is required. In this assignment, you will reflect on the course learning outcomes and explain how the assigned work completed during the semester address these.

## Grading Breakdown

| Assessment | Number | Points Each | Total Points |
|---|---|---|---|
| Resume Assignment | 1 | 2 | 2 |
| Wikis and Blogs | 4 | 5 | 20 |
| Modeling Assignments | 6 | 5 | 30 |
| Lesson Presentation | 1 | 10 | 10 |
| Responses | 5 | - | 3 |
| Summative Assignment | 1 | 3 | 3 |
| *Project Components* | | | |
| Topic Statement | 1 | 2 | 2 |
| Proposal | 1 | 10 | 10 |
| Presentation | 1 | 5 | 5 |
| Final Report | 1 | 15 | 15 |
| | | | |
| Total | 22 | - | 100 points |

## Assignment Submission Policy

Unless otherwise noted, all Reading Assignments and Tutorials are *due by 11:59 pm Pacific Time (PT) on Mondays*. Responses are *due by 11:59 pm PT on Wednesdays* following the submission of relevant materials. Project components have different due dates as indicated on the Course Schedule below. Your attention to on-time assignment submission is essential if I am to meet my goal to return comments on your submitted assignments before the next one is due. Sometimes this is impossible, so I will post a notice on anticipated delays if needed.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points for up to FOUR days late. No points will be given for submissions more than FOUR days late.

- Additionally, no written work will be accepted for grading after 5 pm PT on the last day of classes.

## Course Schedule

| | Topic | Readings and Assignments | Deliverables (Due Dates) |
|---|---|---|---|
| **Week 1**<br>1/7 | Modeling Foundations | Readings: O&P Ch 1, Mitchell Ch 1, Additional articles and websites about spatial modeling<br>Assignments: Resume Assignment, Intro Blog | No deliverables |
| **Week 2**<br>1/14 | | Readings: O&P Ch 2, 6<br>Assignments: Intro Blog response, Wiki 1 | Resume Assignment (1/14)<br>Intro Blog (1/14)<br>Intro Blog response (1/16) |
| **Week 3**<br>1/22*<br>*Monday, 1/21 is university holiday | Process Models: Modeling with ArcGIS | Readings: Mitchell Ch 4,5,6<br>Assignments: Wiki 1 response, ArcGIS Model Assignment | Wiki 1 (1/22)<br>Wiki 1 response (1/24) |
| **Week 4**<br>1/28 | | Readings: * from Library Research<br>Assignment: Lesson | ArcGIS Model Assignment (1/28) |
| **Week 5**<br>2/4 | Simulation Models: Agent-based Models | Readings: O&P Ch 3,4,5<br>Assignments: Lesson response, NetLogo Assignment | Lesson (2/4)<br>Lesson response (2/6) |
| **Week 6**<br>2/11 | | Readings: * from Library Research<br>Assignment: Wiki 2 | NetLogo Assignment (2/11) |
| **Week 7**<br>2/19*<br>*Monday, 2/18 is university holiday | Machine Learning: MaxEnt | Readings about Maxent<br>Assignments: Wiki 2 response Maxent Assignment | Wiki 2 (2/19)<br>Wiki 2 response (2/21) |
| **Week 8**<br>2/25 | | Readings: * from Library Research<br>Maxent Research Blog | Maxent Assignment (2/25) |
| **Week 9**<br>3/4 | Getting Started with R | Readings: Various websites, blogs and articles<br>Assignment: R Assignment 1<br>Project Topic Statement | Maxent Blog (3/4)<br>Maxent Blog Response (3/6) |
| **3/10-3/19** | Spring Recess | | |
| **Week 10**<br>3/18 | Documenting Models | Readings: O&P Ch 7,8,9<br>Assignments: Maxent Blog response, Project Topic Statement, Project Proposal | Project Topic Statement (3/18)<br>R Assignment 1 (3/18)<br>Project Topic Discussion |
| **Week 11**<br>3/25 | Spatial data and spatial analysis with R | Readings: Various websites, blogs and articles<br>Assignment: R Assignment 2 | |
| **Week 12**<br>4/1 | | | Project Proposal (4/1) |
| **Week 13**<br>4/8 | Regression Models: R | Readings: Various websites, blogs and articles | R assignment 2 (4/8) |

| | Topic | Readings and Assignments | Deliverables (Due Dates) |
|---|---|---|---|
| | | Assignment: R Assignment 3 | |
| **Week 14**<br>4/15 | Project | Assignments: Project presentation, Project report | R assignment 3 (4/15) |
| **Week 15**<br>4/22*<br>Friday, 4/26 is last day of class | | | Project presentation (4/24)<br>Project report (4/26, 5 pm PT) |
| **Final Exams**<br>5/1-5/8 | Summative Assignment | Summative Assignment | Summative Assignment (5/3, 5 pm PT) |

"O&P" is O'Sullivan and Perry (2013). *Spatial Simulation: Exploring Pattern and Process*.
"Mitchell" is Mitchell (2012), *The Esri Guide to GIS Analysis, Volume 3.*
* indicates documents students will discover through original research on assigned topics.

## 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) 740-4900 – 24/7 on call*
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086*
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.

*Bias Assessment Response and Support – (213) 740-2421*
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation 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.

*Student Support and Advocacy – (213) 821-4710*
studentaffairs.usc.edu/ssa
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.

***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.