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

SSCI 402, Geospatial Technology Management for Sustainability Science and Sustainable Development

Syllabus

Units: 4

Term Day Time: Fall 2020, Monday and Wednesday, 2:00 -3:50 p.m.

Location: SLH 200 & Online

Instructor: Leilei Duan, Ph.D.
Office: AHF B55G
Office Hours: Monday 10:30 – 11:30 a.m., Wednesday 9:00 – 10:00 a.m. Also available by appointment via email.
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Office: AHF 145D
Office Hours: By appointment
Contact Info: spatial_support@usc.edu, 213-821-4415

Course Scope and Purpose

Environmental sustainability in the context of ongoing global economic development is among the most pressing challenges of our time, and there is a well-established field of sustainability science that produces knowledge needed to meet this challenge. Concurrently, accelerating advancements in geospatial sciences, technologies, and information present significant opportunities to improve linkages between human and natural systems, as required in the context of sustainability science to explain ecological stress and formulate solutions (e.g., as recognized in the UN's initiative on Global Geospatial Information Management). However, to realize these opportunities, it is not enough to "know GIS" – successful professionals must know how to manage geospatial technologies and information in the social, economic, and political contexts of sustainable development to provide useful guidance on transitions to sustainability, support adaptive management in specific places, and enhance the ability of society to collaborate for sustainability.

Since 1987 when the sustainability policy discourse was formalized at the global level in the Brundtland Commission's *Our Common Future* report, the United Nations (UN) has followed with several rounds of goal-setting around sustainable development. Eight key millennium development goals (MDGs), for example, covered the period 2000 to 2015, which saw impressive, albeit incomplete progress on anti-poverty goals in the context of rapidly expanding global trade. Yet, the net loss of natural capital threatening future generations – seen in interconnected problems such as global climate change, ocean degradation, deforestation, habitat loss, and species endangerment -- continues nearly unabated.

In 2015, the UN followed-up on the MDGs with a new set of 17 key goals called the sustainable development goals (SDGs) targeted for 2030. These goals are a central organizing principle in this course. Thus, the course covers the implementation of geospatial technologies in public, private sector (for profit), and non-governmental organizations. This class also takes a global view to mirror the intent and pursuit of the SDGs.

The volume, variety, and velocity of spatial data, along with capabilities to manage, analyze, and share such data is accelerating –this much is known to students who have taken the 300-level suite of GIS courses offered by the Spatial Sciences Institute. Geospatial information is key to linking human and natural systems to understand how humans create stress on ecosystems and make informed decisions about how to alleviate stress or restore damaged ecosystems. As just one example, with data collected from various types of sensors on an increasing number of satellites and a variety of unmanned aerial and underwater vehicles, we can make detailed measurements of changes in the ocean, land cover, and to economic development in various places around the globe. With appropriate analysis and modeling, we can forge an understanding of the ways human economic activity is linked to natural systems at various scales and in the context of a wide variety of places around the globe.

This course is designed to serve as the capstone in USC's GIS and Sustainability Science minor and an elective for majors in the Geodesign and Global Geodesign B.S. degree programs. This particular class focuses on how the foundational knowledge for the acquisition, management, analysis, modeling, and visualization of spatial information acquired in SSCI 301L, 382L, and 383L can be used to support sustainability science and sustainable development.

Learning Outcomes

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

- Understand and apply concepts of sustainability science and sustainable development in managing and developing geospatial information and technologies.
- Identify and analzye the issues involved in organizing, planning, implementing, and monotoring geospatial technology projects in support of sustainability sicence.
- Perform implementation, decision-support, financial, and risk analysis to build the case for and ensure the success of using geospatial technology for sustainable development.
- Design a geospatial technology project that contributes to achieving the UN's sustainable development goals (SDGs).

Prerequisite(s): None
Co-Requisite (s): None
Concurrent Enrollment: None
Recommended Preparation: SSCI 165Lgw or SSCI 265Lg plus SSCI 301L, SSCI 382L, and SSCI 383L

Course Structure

This course begins by introducing GIS project planning methods in the context of sustainability science. The first part of the course reviews the UN's 17 Sustainable Development Goals. The second part of the course reviews applications of geospatial information and technology in projects that address each of the sustainable development goals (SDGs). The last part of the course covers aspirational ideas which address important natural and social issues, focusing on the challenges and opportunities of implementing geospatial technology in projects in relatively technology and data scarce contexts in the developing world.

Students in this course will complete a series of exercises throughout the semester to analyze various aspects of geospatial technology projects in support of sustainability science and sustainable development. These will be short writing and diagramming assignments that will be rapidly graded and returned. Following this, students will lead discussions of geospatial technology and information cases centered on the UN SDGs, elucidating the ways that the principles of geospatial technology project management covered in the opening weeks of the course explain failures and successes in these projects. For the final project, each student will design a geospatial technology project that contributes to one or more sustainable development goals.

Workload – This is a four credit, 13-week semester course. The course will meet twice each week for 1-hour and 50-minutes at each class meeting. In addition, students will need to plan for 6-7 hours per week of work time outside of class. On balance, students will have lighter outside of class loads at the start of the course, and higher outside of class workloads in the middle and end of the course.

Technological and Communication Requirements

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through assigned readings. Students in this course should have at minimum a basic, working knowledge of the ArcGIS software suite. The computer technologies required for this course will be accessed through the SSI server at the student's own desktop or laptop computer, provided that a fast Internet connection is available (DSL at a minimum).
Relative to other undergraduate courses in the spatial sciences institute, work on ArcGIS or other GIS software is not expected to be a major component of activity in this course. However, when it is required, you can access the Spatial Sciences Institute server at: https://gistonline.usc.edu/. If you are unable to connect to the server or experience any type of technical issues in starting the software, send an email to Richard Tsung (ctsung@usc.edu) and make sure to copy (cc) me on the email. Please be sure to be specific with respect to the problem you are experiencing as technical issues often vary. Richard Tsung is responsible for making sure the hardware and software is operating properly, but questions about how to use the software are answered by the 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).

Required Readings and Supplementary Materials

The required textbooks for this course are:

- United Nations. (2020). *The Sustainable Development Goals Report 2020*.
- United Nations Statistical Commission. (2019). *The Global Statistical Geospatial Framework.*
- United Nations Committee of Experts on Global Geospatial Information Management. (2015). *Future Trends in geospatial information management: the five to ten year vision, Second Edition December 2015*.

Supplementary readings will be assigned from various sources including:

- Bunruamkaew, K., & Murayama, Y. (2012). Land use and natural resources planning for sustainable ecotourism using GIS in Surat Thani, Thailand. *Sustainability*, *4*(3), 412-429.

- Cai, G., Wang, H., & MacEachren, A. M. (2003, September). Communicating vague spatial concepts in human-GIS interactions: A collaborative dialogue approach. In *International conference on spatial information theory* (pp. 287-300). Springer, Berlin, Heidelberg.
- Clark, W. C., & Dickson, N. M. (2003). Sustainability science: The emerging research paradigm. *Proceedings of the National Academy of Sciences* 100, no. 14: 8059-8061.
- Cochran, F., Daniel, J., Jackson, L., & Neale, A. (2020). Earth observation-based ecosystem services indicators for national and subnational reporting of the Sustainable Development Goals. *Remote Sensing of Environment*, 244, 111796.
- Crowther, T. W., Glick, H. B., Covey, K. R., Bettigole, C., Maynard, D. S., Thomas, S. M., ... & Tuanmu, M. N. (2015). Mapping tree density at a global scale. *Nature*, 525(7568), 201-205.
- Friedlander, A. M., Brown, E. K., & Monaco, M. E. (2007). Coupling ecology and GIS to evaluate efficacy of marine protected areas in Hawaii. *Ecological Applications*, *17*(3), 715-730.
- Gao, S., Mioc, D., Anton, F., Yi, X., & Coleman, D. J. (2008). Online GIS services for mapping and sharing disease information. *International Journal of Health Geographics*, 7(1), 8.
- Hellweg, S., & i Canals, L. M. (2014). Emerging approaches, challenges and opportunities in life cycle assessment. *Science*, 344(6188), 1109-1113.
- Hodza, P. (2014). Appreciative GIS and Strength-Based Community Change. *Transactions in GIS*, *18*(2), 270-285.
- Janelle, D. G., & Gillespie, A. (2004). Space–time constructs for linking information and communication technologies with issues in sustainable transportation. *Transport Reviews*, 24(6), 665-677.
- Khomenko, S., Nieuwenhuijsen, M., Ambros, A., Wegener, S., & Mueller, N. (2020). Is a liveable city a healthy city? Health impacts of urban and transport planning in Vienna, Austria. *Environmental research*, 183, 109238.
- Koh, L. P., & Ghazoul, J. (2010). Spatially explicit scenario analysis for reconciling agricultural expansion, forest protection, and carbon conservation in Indonesia. *Proceedings of the National Academy of Sciences*, 107(24), 11140-11144.
- L.A.' Green New Deal – Sustainable city plan. (2019)
- Lim, S. S., Allen, K., Bhutta, Z. A., Dandona, L., Forouzanfar, M. H., Fullman, N., ... & Kinfu, Y. (2016). Measuring the health-related Sustainable Development Goals in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. *The Lancet*, 388(10053), 1813-1850.
- Mace, G. M., Barrett, M., Burgess, N. D., Cornell, S. E., Freeman, R., Grooten, M., & Purvis, A. (2018). Aiming higher to bend the curve of biodiversity loss. *Nature Sustainability*, 1(9), 448-451.
- Opoku, A. (2019). Biodiversity and the built environment: Implications for the Sustainable Development Goals (SDGs). *Resources, conservation and recycling*, 141, 1-7.

- Ramirez-Rubio, O., Daher, C., Fanjul, G., Gascon, M., Mueller, N., Pajín, L., ... & Nieuwenhuijsen, M. J. (2019). Urban health: an example of a "health in all policies" approach in the context of SDGs implementation. *Globalization and Health*, 15(1), 1-21.
- Schleicher, J., Schaafsma, M., & Vira, B. (2018). Will the Sustainable Development Goals address the links between poverty and the natural environment? *Current opinion in environmental sustainability*, 34, 43-47.
- Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Polsky, C. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the national academy of sciences*, *100*(14), 8074-8079.
- Vanham, D., Hoekstra, A. Y., Wada, Y., Bouraoui, F., De Roo, A., Mekonnen, M. M., ... & Kummu, M. (2018). Physical water scarcity metrics for monitoring progress towards SDG target 6.4: An evaluation of indicator 6.4. 2 "Level of water stress". *Science of the total environment*, *613*, 218-232.
- Xu, C., Kohler, T. A., Lenton, T. M., Svenning, J. C., & Scheffer, M. (2020). Future of the human climate niche. *Proceedings of the National Academy of Sciences*, 117(21), 11350-11355.
- Yue, C. D., & Wang, S. S. (2006). GIS-based evaluation of multifarious local renewable energy sources: a case study of the Chigu area of southwestern Taiwan. *Energy Policy*, *34*(6), 730-742.

Description and Assessment of Assignments

Weekly Assignments

The following assignments in this course will be assessed quickly and thoroughly to ensure progress and confidence in the classroom.

Exercises – 4 worth a total of 20 points. A set of exercises to perform stakeholder, implementation, decision-support, financial, and risk analysis of geospatial technology projects in support of sustainability science and sustainable development. The exercises will be provided in carefully structured cases from the instructor. These will involve some calculations, some short writing, and some diagramming, but very little research per se.

Discussion Cases– total of 20 points. In these assignments, students will research and prepare cases for oral presentation and discussion in class. The instructor will provide worked examples of such discussion cases, research strategies, and a structure for presentation.

Midterm Exam – 1 worth a total of 15 points. A midterm exam is scheduled using a combination of multiple choice and short answer questions to assess retention and application of key geospatial technology management principles in the domain of sustainability science.

Final Examination- 1 worth a total of 20 points. The final exam will consist of essay questions. Students will be expected to take the exam at the appointed time.

Final Project

The final project in this course will consist of a designing a medium- to large-scale geospatial technology implementation in support of sustainability science and sustainable development.

These projects will be structured as proposals, suitable to submit to potential conventional funders or for crowd-sourced funding. They may use GIS software for spatial analysis, database development, or as a platform for sharing visualizations or analysis. However, in general, the use of GIS software will be constrained to proof of concept and, if students choose, for oral presentations of projects using Esri's story map software. Instead, the focus of the final project should be on creating a plan that is sufficiently motivated and robust so that if implemented it could be expected to meet with success.

Final Project Topic Proposal – 5 points. Students will produce a 2-3 pages written sketch laying out an idea for the topic and initial outline for the plan.

Written Final Project - 15 points. Students will provide a 10-15 page (~4,000- 5,000 words) written plan with appropriate figures. The instructor will provide a detailed assignment outlining the precise planning aspects to be covered and the expected structure of the writing. To create the plan, students will research published literature and interview professionals in the fields of sustainable science and GIS.

Oral Presentation of Final Projects – 5 pts. Students will produce a 10-minute oral presentation of the plan using either a traditional slide presentation software (e.g., Powerpoint) or using Esri's story map platform, to be delivered at the final class session.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Weekly Assignments			
Exercises	4	5	20
Discussion Cases	-	-	20
Midterm Exam	1	15	15
Final Exam	1	20	20
Final Project Components			
Final Project Topic Proposal	1	5	5
Final Project (Written)	1	15	15
Final Project (Oral Presentation)	1	5	5
Total	9	-	100

Additional Policies

A successful capstone course depends on the preparation and participation of students at each class meeting. Students are expected to prepare readings before each class session where they are listed and to attend every class session. Late work results in a grade of zero for the assignment in question.

Course Schedule

	Topic	Readings and Assignments	Deliverables/ Due Dates
Week 1 8/17	**Introduction:** Introduction to the course, discussion of learning objectives and assignments. Theories of sustainability science and sustainable development.		
8/19	**Guiding Principles:** Key concepts of geospatial technology management and sustainability science.	Clark and Dickson (2003) United Nations (2020)	
Module 1 | Sustainable Development Goals			
Week 2 8/24	**UN Sustainable Development Goals:** Goal 1 – 6 No poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation	Schleicher et al. (2018)	
8/26	**UN Sustainable Development Goals:** Goal 7 - 12 Affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production	Hellweg and Canals (2014)	
Week 3 8/31	**UN Sustainable Development Goals:** Goal 13 - 17 Climate action; life below water; life on land; peace, justice and strong institutions; partnerships	Opoku (2019)	

	Topic	Readings and Assignments	Deliverables/ Due Dates
9/2	**C40 City Network:** Structure and organization; goal and objectives; C40 and SDG; C40 in the actions	Janelle and Gillespie (2004)	Exercise #1
Week 4 9/7*	Labor Day, USC Holiday, no class meeting		
9/9	**Sustainability in Los Angeles:** Green Plan LA Background; goals and initiatives; projects around LA under the initiative	L.A.' Green New Deal (2019)	Exercise #2
Week 5 9/14	**Health in All Policies (1):** HiAP and SDG	Ramirez-Rubio et al. (2019)	
9/16	**Health in All Policies (2):** HiAP and daily activities. Class discussion about what LA might change if it adopted the HiAP.	Lim et al. (2016)	Exercise #3
Module 2 | Applications of Geospatial Information and Technology in the UN SDGs			
Week 6 9/21	**GIS as System Record (1)** The GIS platforms as record keeping system; how the GIS platforms utilize stakeholders' opinions.	Yue and Wang (2006)	
9/23	**Midterm Exam**	Closed Book Exam During Class	Exercise #4
Week 7 9/28	**GIS as System Record (2)** Class discussion about examples where GIS is used as a system record.	Hodza (2014)	Final Project Topic Proposal

	Topic	Readings and Assignments	Deliverables/ Due Dates
9/30	**GIS as System Insight (1)** GIS is widely used to provide insightful view; examples of GIS as system insight.	Bunruamkaew et al. (2012)	
Week 8 10/5	**GIS as System Insight (2)** Class discussion about examples where GIS is used as a system insight.	Friedlander et al. (2007)	
10/7	**GIS as System of Engagement (1)** The methods to use GIS to communicate and share.	Cai et al. (2003)	
Week 9 10/12	**GIS as System of Engagement (2)** Class discussion about examples where GIS is used as a system of communication and sharing.	Gao et al. (2008)	
10/14	**GIS in Action** Class discussion about projects where GIS is used for all three usages.	United Nations Statistical Commission (2019)	
Module 3 | Aspirational Ideas in GIS and Sustainability			
Week 10 10/19	**Social equity and Sustainable Development** Discuss the social equity situations and problems; how sustainable development helps with social equity	Turner et al. (2003)	
10/21	**Sustainable Cities** Criteria of sustainable cities. Discussion on sustainable cities vs. healthy cities	Khomenko et al. (2020)	

	Topic	Readings and Assignments	Deliverables/ Due Dates
Week 11 10/26	**Agriculture and Sustainable Development** Class discussion with students how do we change it to SDG, and how GIS helps us to do that	Koh & Ghazoul (2010)	
10/28	**Ecosystem Services and SDG** Ecosystem services and related SDG. Understand the problems with ecosystem services at all scales.	Cochran et al. (2020)	
Week 12 11/2	**Sustainable Cities** Criteria of sustainable cities. Discussion on sustainable cities vs. healthy cities	Mace et al. (2018)	
11/4	**Water Resources** Water resource distribution situation; water resource allocation pressure under population growth.	Vanham et al. (2018)	
Week 13 11/9	**Climate Restoration:** Carbon sink; carbon cycles	Crowther et al. (2015) Xu et al. (2020)	
11/11	**Climate Restoration and Final Review** Global tree restoration; review for final exam.	United Nations Committee of Experts on Global Geospatial Information Management (2015)	
11/17 – 11/24	**Final Examination (Date and Time TBD)**		

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 that 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.