

# GEOG 081: GEOSPATIAL CONCEPTS AND VISUALIZATION

Spring 2020 - CRN 12804, 3 credit hours  
Lectures: MW 10:50 – 11:40am, Lafayette L308  
Labs: F 10:50 – 11:40am, Lafayette L203\*

## Professor

Dr. Ingrid L. Nelson  
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Office: 212 Old Mill

Sign up for Office Hours here:

<https://ilnelson.youcanbook.me/>

Tu 1:15-2:45 (Old Mill 212 - Office); W 12:30-2:00 (L203 - Lab)

## Teaching Assistant:

Harry Marwil  
Harry.Marwil@uvm.edu  
Office Hours: Tu 4:00-5:15; Th 3:00-4:00

**Pre-requisites:** None

**General Education & Major/Minor Fulfillment:** This course does not satisfy any general education requirements. This course is not required for the geospatial technologies minor but it is one of many “Geospatial Technologies in the Disciplines” options including ENSC 130, CE 010, CDAE 101, ENGR 002, GEOG 081, GEOG 144, GEOL 151, 185. Geography majors who opt into the revised 2019-2020 course catalogue are not required to take this course but are required to take one of the following methods course options: GEOG 081, 085, 184, 185, 186, 192, 202, 281, 287.

## Course Overview:

This course introduces students to core geospatial concepts and techniques used by geographers and practitioners from other disciplines interested in exploring spatial patterns and processes. The course provides essential knowledge and skills for all geographical interests. As we learn how to read maps, analyze data, interpret images and use mapping software, we will also work to approach mapping and geovisualization with a critical eye, asking what messages maps portray and how map makers shape perception through their choices of visualization strategies. This course prepares students with the fundamental concepts necessary for beginning to work through geospatial problems and with a basic understanding of map reading, map making, and both quantitative and qualitative analysis methods relevant to those interested in spatial problems. By the end of the semester, students will be prepared to pursue more advanced collegiate studies that utilize geographic information systems (GIS), remote sensing, and cartographic techniques.

\* Some Fridays we will meet in our classroom instead of the lab and on some Mondays and Wednesdays we may work in the lab. Please check Blackboard and your email regularly for the latest announcements.

## Learning Objectives<sup>1</sup>

After completing and reflecting on experiences in this course, students will be able to:

- i. Identify the scope and breadth of geospatial concepts and specific geographical techniques across sub-disciplinary areas of interest in geography (knowledge/integration),
- ii. Apply core geospatial concepts, spatial thinking and cartographic design principles in lab exercises (application/integration/skills),
- iii. Develop introductory technical skills in GIS software and spatial analysis (application/skills),
- iv. Identify the broad scope of potential real-world applications of geospatial concepts and techniques (application/integration),
- v. Explore introductory qualitative and quantitative data interpretation and methods (knowledge/skills),
- vi. Work in small groups to conduct basic analysis in a way that enhances both individual and collective communication of and understanding of specific geographical concepts (knowledge),
- vii. Engage in critical reflection and discussion of the ethical dimensions of mapping with an understanding that mapping is political and requires always considering who maps for whom and with what intentions and agendas (human dimension/personal/values/caring),
- viii. Build an awareness of the on-campus and off-campus resources for geographical analysis as well as the potential career pathways that require geotechnical skills and critical thinking (through this process, students will build a clearer sense of what they would like to learn next and what knowledge and skills will be required to do so) (learning how to learn).

## Required Course Materials

1. **Required Readings** will be available in .pdf format posted to our course Blackboard site (bb.uvm.edu) and these must be read and brought to class (in digital or printed format) on the specified dates in the course schedule.
2. **Software:** Students in the course will learn to use the ArcGIS software package (version varies and is updated on a varying schedule) and Microsoft Excel for data calculations and graphing. ArcGIS can be installed on a personal computer (windows operating system only) using the instructions posted at [http://www.uvm.edu/~gis/?Page=install\\_Desktop.html](http://www.uvm.edu/~gis/?Page=install_Desktop.html). Microsoft products are available for download through instructions posted at <https://www.uvm.edu/it/software/licensing/ees/msoffice.html>. Both software packages are installed in the Geospatial Lab in Lafayette 203.
3. **Disk Storage and Backup:** We will learn to use the university-managed network space (zoo) allocated for each student enrolled at UVM. Students will be introduced to this space and best practices for data management during the second week's lab session, and encouraged to use this space throughout the semester for all assignments. Files stored on zoo are backed up daily. Failure to use your zoo space, and subsequent loss of material via theft or failure of a personal computer, will not constitute an acceptable excuse for late, missed or lost work. You can access your files stored on your zoo space from any campus-configured computer (this space is usually mapped to the Z: drive on campus computers) or via a web browser by navigating to webfiles.uvm.edu and using your netID and password to log in.

<sup>1</sup> These learning objectives draw from the Department of Geography's Learning Goals and pedagogical approaches in L. Dee Fink's *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses* (2013).

## Course Structure and Assessments

**Course Engagement and Fundamentals (30%):** Attendance, class participation and in-class activities are worth 10% of the total course grade. The lab assignments include Assignments 1, 3-5; 7-9; 11-15 and 17 (20%). Students may be able to complete these assignments during our lab instruction sessions, but in the majority of instances, students will need to devote time outside of class to complete these assignments. A schedule of open lab hours with a proctor on duty is posted on the lab door for you to plan additional time in the lab. As with any computer-based lab work, there can be multiple reasons for error messages and I appreciate your patience and good humor as I work with you and as you work with your classmates to identify errors and work through technical difficulties. One of the best ways to help me help you is to ensure that you maintain a highly organized file system in your zoo space.

This course is lecture- and project-based. Ideally, students should attend every lecture. You can miss up to 2 lectures for the entire semester without penalty to your grade (the negative effects of absences on your exam results and assignments, however, are fairly inevitable). This should cover any issues with unforeseen weather, illness, family or work emergencies, etc. Thus, DO NOT EMAIL PROF. NELSON about any of these types of reasons for lecture absences. If you miss a class, it is your responsibility to obtain notes from another student. Note that office hours are for working through specific questions, advising, project guidance or other specific inquiries and not an occasion for a professor to repeat an entire missed lecture.

To minimize distraction, please do not engage in any noisy or distracting activities in class (beverages in closed containers and a small snack such as a granola bar are allowed in our classroom but do not bring breakfast or lunch to class. FOOD AND OPEN DRINKS ARE NOT ALLOWED IN THE LAB. Cell phone use is not permitted in any UVM class, including this one except as part of class engagement or other assigned activities. Do not make work for others by leaving your garbage behind. Please respect the instructor and guest speakers by giving them your full attention.

**Examinations (40%):** There are 2 course exams (see the dates listed on the course schedule). The exams will cover information from lectures, readings and assignments. Exams will include short-answer, multiple-choice, matching, fill-in-the-blank and essay questions. The exams will take place in our classroom. While there are no lab components to the exams, you can expect questions about our course software (ArcGIS and Excel) and a few 'screen shots' asking you to explain a step-by-step process. There will be no make-up exams and missing an exam means failing the exam. If you cannot take an exam on the scheduled day and time, you must present correspondence citing your reason with support from your college dean of students office. Students with registered learning accommodations should make alternative exam arrangements in the Exam Proctoring Center.

**Semester Project (30%):** The semester project includes several stages of preparation on both an individual and a group basis. Stages of the project include Assignments 2, 6, 10 and 16, a final presentation, a final product with essential components, an individual write-up and self/peer evaluations according to contracts established by each group. All project topics must be pre-approved by Professor Nelson. A full assignment description will be available early in the semester and we will allocate time during class to brainstorm project ideas.

## Course Grading\*

A+: 98-100%; A: 93-97.9%; A-: 90-92.9; B+: 88-89.9; B: 83-87.9; B-: 80-82.9; C+: 78-79.9%; C: 73-77.9%; C-: 70-72.9%; D+: 68-69.9; D: 63-67.9; D-: 60-62.9; F: below 60%

\**Warning letters:* If a student is on track to earning a D or lower in class, they and their advisor will receive a warning letter via email suggesting they seek out ways to improve their work. If you receive a letter, please ask your instructor and academic advisor for guidance on improving your work.

Assessment	% Final Grade
<b>Course Engagement and Fundamentals</b> <ul style="list-style-type: none"><li>• Attendance, class participation, in-class activities (10%)</li><li>• 'Lab' Exercises (Assignments 1, 3-5; 7-9; 11-15, 17 (20%)</li></ul>	30%
<b>Examinations</b> <ul style="list-style-type: none"><li>• Exam 1 (15%)</li><li>• Exam 2 (25%)</li></ul>	40%
<b>Semester Project</b> <ul style="list-style-type: none"><li>• Assignment 2 – Letter of interest and CFP (2%)</li><li>• Assignment 6 – Draft group description and plan (1%)</li><li>• Assignment 10 – Final group project description, plan and contract (3%)</li><li>• Assignment 16 – Draft map clinic (4% individual, 3% group)</li><li>• Final group presentation (5%)</li><li>• Final group project, work flow chart and complete metadata (6%)</li><li>• Final individual write-up and self/peer evaluations (6%)</li></ul>	30%
<b>Total</b>	<b>100%</b>

### General Course Policies:

**UVM's Definition of a credit hour:** This is a 3-credit course. The UVM Faculty Senate defines a University of Vermont credit hour as, "One hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester hour of credit or the equivalent amount of work over a different amount of time..." (p. 425; See this link: [https://www.uvm.edu/~rgweb/zoo/archive/catalogue/1718cat\\_ug.pdf](https://www.uvm.edu/~rgweb/zoo/archive/catalogue/1718cat_ug.pdf)). I have designed this course such that ***your work outside of class (readings, lab assignments and other work) will average out to 6 hours per week over the course of the semester in addition to our time in class.***

**Communication:** Please be sure you check your email regularly or ensure that you forward your UVM email to an address you check regularly. When emailing me or our TA, please type GEOG 081 in the subject line. Class announcements and assignment grades will be posted on our course Blackboard site.

**Late work:** All assignments must be submitted by their deadlines to receive any credit. Unexpected circumstances happen, so plan to complete work as early as possible. Students may have an extra 24 hours to submit one of their Assignments for the course (**except the project assignments 10, 16 and all final project work**), should the need arise. No questions asked. But, this option will only be extended once per student unless there are other formal arrangements via the Student Accessibility Services (SAS) office process. In cases where students are working with their Dean of Students Office

to coordinate serious matters, please ask your contact in your Dean of Students to email me as soon as possible.

**SAS** (formerly ACCESS): Students with documented disabilities should contact me in the first two weeks of classes to discuss and arrange accommodations in coordination with the Student Accessibility Services (SAS) office. In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, which works with students and faculty in an interactive process to explore reasonable and appropriate accommodations via an accommodation letter to faculty with recommended accommodations as early as possible each semester. Contact SAS: A170 Living/Learning Center; 802-656-7753; [access@uvm.edu](mailto:access@uvm.edu); or [https://www.uvm.edu/academicsuccess/student\\_accessibility\\_services](https://www.uvm.edu/academicsuccess/student_accessibility_services).

**Academic Integrity:** Plagiarism is defined as any time that you present another's work as your own, and it will not be tolerated in this course. All submitted work must be your own, except in the specific instances when an assignment calls for collaboration. Be sure to distinguish your own words and ideas from those of others by utilizing proper citations and references. If you have any questions about how to avoid plagiarism, please ask your instructor, consult [UVM's Code of Academic Integrity](#) and the [Academic Integrity Program in The Center for Student Ethics and Standards](#) for further clarification and also consult reference librarians for assistance.

**Fostering a Critical and Responsible Learning Environment:** Throughout the course, please feel free to express your ideas and enter into dialogue with your fellow students. We encourage you to express your views and share your experiences. We expect you to be courteous to others, respect different views, and refrain from personal attacks—in class, outside of class and on-line. Failure to abide by these expectations will result in a reduced class engagement grade or disenrollment. During class, all phones must be turned off (no texting allowed). Laptops may be used for taking notes or engaging in class activities only and must not be connected to the Internet during class unless otherwise directed during specific activities. All students must arrive on time. *Some of the software that we will use in this course has a steep learning curve. Be sure to support one another through this learning process by problem solving together. You can always take a break and come back to it later with a clear and rested mind if a task becomes too frustrating in the moment.*

**Supporting Health and Wellbeing:** In this course we will acknowledge mental health struggles and the need for a supportive classroom space. However, this course cannot and should not replace licensed one-on-one and group mental health services. The Center for Health & Wellbeing (CHWB) offers a wide range of services to support your mind, body, and spirit while you're at UVM. The Student Health Services staff of physicians, physician assistants, nurse practitioners, nurses, and dietitians work with patients and collaborate with other CHWB providers to ensure personalized and timely care to UVM students. Counseling & Psychiatry Services (CAPS) offers short-term individual counseling, urgent needs counseling, group counseling, outreach and education, psychiatry, referrals, and consultation services. For more information, check out the CHWB website at <http://www.uvm.edu/~chwb/>.

**Athletic and religious schedule accommodations** follow UVM policy, which can be viewed at <http://catalogue.uvm.edu/undergraduate/academicinfo/rightsandresponsibilities/>. Students participating in inter-collegiate athletics should plan their schedules with special care, recognizing the primary importance of all of their university academic responsibilities. Each semester, members of UVM varsity and junior varsity teams are responsible for documenting in writing any conflicts between their

planned athletic schedule and the class schedule to their instructors by the end of the second full week of classes. Students and instructors should then discuss potential conflicts between course requirements and intercollegiate competitions. When an unavoidable conflict exists, the student and instructor should seek a resolution, which permits the student to address the course requirement and participate in the athletic competition. The instructor has final authority on this matter. Regarding religious holidays: Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors by the end of the second full week of classes their documented religious holiday schedule for the semester. Instructors must permit students who miss work for the purpose of religious observance to make up this work.

**Recording and Transmission of Course Materials:** Consistent with the University's policy on intellectual property rights, teaching and curricular materials (including but not limited to classroom lectures, class notes, exams, handouts, and presentations) are the property of the instructor. Therefore, electronic recording and/or transmission of classes or class notes is prohibited without the express written permission or request of the instructor. Such permission is to be considered unique to the needs of an individual student (e.g. ADA compliance), and not a license for permanent retention or electronic dissemination to others.

**Use of student work:** This course may use course participation and documents created by students for educational purposes. In compliance with the Federal Family Educational Rights and Privacy Act, works in all media produced by students as part of their course participation at UVM may be used for educational purposes. It is understood that registration for and continued enrollment in a course where such use of student works is announced constitutes permission by the student. After the course has been completed, any further use of student works will meet one of the following conditions: (1) the work will be rendered anonymous through the removal of all personal identification of the work's creator/originator(s); or (2) the creator/originator(s)' written permission will be secured.

## GEOG 081 Course Schedule Spring 2020

Note: Exam dates are firm. Specific lectures, readings and topics are subject to change due to scheduling logistics and solicited student input. Dates marked with '\*' indicate we will meet in the lab (L203).

WEEK	DATE	TOPIC	READINGS & ASSIGNMENTS
<b>SECTION 1: COURSE INTRODUCTION, CARTESIAN MAPPING AND MANY OTHER PHILOSOPHIES (MOPs) OF MAPS</b>			
1	Mon. 1/13	L1: Course introduction; <i>Begin Assignment 1</i>	Course Syllabus – Bring your questions to class; Monmonier 2018 p.1-4
	Wed. 1/15	L2: Cartesian mapping and many other philosophies (MOPs) of mapping	Read Krygier & Wood 2016 p. 13-17; 20-25; Harmon 2004 p.8-13
	Fri. 1/17*	Flash map presentations in lab (A1)	<b>Assignment 1 (A1) Due</b> by 9:00am (Bb)
<b>SECTION 2: SPATIAL RESEARCH, PROJECT DESIGN, CARTOGRAPHY AND GEOVISUALIZATION</b>			
2	Mon. 1/20	<b>NO LECTURE — MARTIN LUTHER KING JR. HOLIDAY</b>	
	Wed. 1/22	L3: Knowing when you need a map, determining audience, standards and final medium; Intro to Map design	Krygier & Wood p. 34-55, 142-153; Feeney 2017 (Bb); Read the Course Project Description (Bb); <i>Begin Assignment 2</i>
	Fri. 1/24*	Assignment 3: Data characteristics, databases and analytics lab	Krygier & Wood p. 60-81; <i>Begin Assignment 3</i>
3	Mon. 1/27	L4: Key principles for displaying quantitative data	Krygier & Wood p. 124-139; Tufte 2001 (p. 52-109)
<b>SECTION 3: COORDINATE SYSTEMS, MAP PROJECTIONS, SCALE AND GENERALIZATION</b>			
	Wed. 1/29	L5: Coordinate systems	Krygier & Wood p.14-15; Kimerling et al. 2010 p. 5-20; <b>Assignment 2 Due</b>
	Fri. 1/31*	Assignment 4: Projections lab	Krygier & Wood p.98-111; <i>Begin Assignment 4</i> ; <b>Assignment 3 Due</b>
4	Mon. 2/3	L6: Map projections – Part 1	Krygier & Wood p.118-119, Slocum et al. 2009 p.130-152; Read all Assignment 2 letters and cfps posted in the discussion board;
	Wed. 2/5	L7: Map projections – Part 2; Scale and generalization	Krygier & Wood p.112-113, 162-169; Slocum et al. p. 96-112
	Fri. 2/7*	Assignment 5: Data queries lab	Monmonier 2018 ch.3; <i>Begin Assignment 5</i> ; <b>Assignment 4 Due</b>
5	Mon. 2/10	L8: Synthesis of sections 1 - 3	Review prior material for today; <b>Assignment 5 Due</b>
	Wed. 2/12	<b>EXAM 1</b> (in class)	Study for Exam 1
<b>SECTION 4: NAVIGATION AND GPS</b>			
	Fri. 2/14*	Assignment 6: Project proposal; Assignment 7 Part A	Shellito 2014 p. 80-99; <i>Begin Assignment 6 &amp; 7</i>
6	Mon. 2/17	<b>NO LECTURE — PRESIDENTS' DAY HOLIDAY</b>	
	Wed. 2/19	Guest Lecture: Dr. Beverley Wemple Navigation and GPS	Ceruzzi 2018 p. 1-18, 123-156; <i>Begin Assignment 8</i>
	Fri. 2/21*	Assignment 7 Part B: GPS and georeferencing lab	<b>Assignment 7 Part A Due</b> ; <i>Begin Assignment 7 Part B</i>
7	Mon. 2/24	L9: Infrastructures of global connection	Satariano 2019 (link in Bb); <b>Assignment 6 Due</b>

SECTION 5: GEOGRAPHIC DATA MODELS, SPATIAL RELATIONSHIPS, ACCESSING EXISTING GIS DATA AND METADATA			
	Wed. 2/26	L10: Geographic data models	Review Krygier & Wood p.60-91; <b>Assignment 8 Due</b>
	Fri. 2/28*	Assignment 9: Vector raster lab	<i>Begin Assignment 8</i> ; <b>Assignment 7 Part B Due</b>
8	Mon. 3/2	L11: Finding GIS data, metadata and in-class project work	Bolstad 2016 p.25-63; <i>Begin Assignment 10</i>
	Wed. 3/4	L12: The politics of polygons - gerrymandering and other mappings	Monmonier 1995 p.189-219; Sadler 2016 (link in Bb)
	Fri. 3/6*	Assignment 11: GIS data analysis lab	<i>Begin Assignment 11</i> ; <b>Assignment 9 Due</b>
<b>MON. 3/9 – FRI. 3/13 NO LECTURES — SPRING RECESS</b>			
SECTION 6: REMOTE SENSING, IMAGE INTERPRETATION AND ANALYSIS			
9	Mon. 3/16	L13: Histories of remote sensing and earth observation	Aronoff 2005 p.9-51; Kimerling et al. 2012 p.185-203
	Wed. 3/18	L14: Remote sensing fundamentals	Aronoff p.53-108
	Fri. 3/20*	Assignment 12: Remote sensing lab	<i>Begin Assignment 12</i> ; <b>Assignment 11 Due</b>
10	Mon. 3/23	L15: Image interpretation and classification	Campbell & Wynne 2011 p.132-139, 335-341; Monmonier 2018 p.179-187
	Wed. 3/25*	In-class/lab project work	Bring drafts of Assignment 10 & 16 to lab
	Fri. 3/27*	In-class/lab project work	Bring drafts of Assignment 10 & 16 to lab; <b>Assignment 12 Due</b>
11	Mon. 3/30	L16: Synthesis of Sections 4 - 6	Review prior material for today; <b>Assignment 10 Due</b>
	Wed. 4/1	<b>EXAM 2</b> (in class)	Study for Exam 2
SECTION 7: MIXED RESEARCH METHODS (STATISTICS, QUALITATIVE, PARTICIPATORY, CRITICAL)			
	Fri. 4/3*	Assignments 13 & 14: Joins	Nelson 2016
12	Mon. 4/6	Group project work (lab, library, etc.)	Wainwright 2019
	Wed. 4/8	Guest Lecture: Walter Keady	Krygier & Wood p.170-183, 218-229
	Fri. 4/10*	Assignment 15: Statistics and visualization lab	<i>Begin Assignment 15</i> ; <b>Assignments 13 &amp; 14 Due</b>
SECTION 8: APPLICATIONS AND MAPPING IN PRACTICE			
13	Mon. 4/13	L17: Mapping ethics and dilemmas	Review Nelson 2016 and Wainwright 2019
	Wed. 4/15	Assignment 16: Group map critique	<b>Assignment 16 Due</b> : Review key concepts for effective feedback
	Fri. 4/17*	Assignment 17: Overlay lab	<i>Begin Assignment 17</i> ; <b>Assignment 15 Due</b>
14	Mon. 4/20	L18: Map symbolization, visual variables and graphical excellence with color and text	Krygier & Wood p.186-217, 234-251, 254-277
	Wed. 4/22*	In-lab project work	Final project work; Earth Day + 50 Events
	Fri. 4/24*	In-lab project work	Final project work; <b>Assignment 17 Due</b>
15	Mon. 4/27*	In-lab project work	Final project work
	Wed. 4/29	<b>Final Project Presentations Part 1</b>	Final project work
	Fri. 5/1	<b>Final Project Presentations Part 2</b>	Final project work
16	Mon. 5/8	<b>ALL FINAL PROJECT WRITTEN WORK DUE BY 10:30AM (THE START OF OUR EXAM PERIOD)</b>	

**Full citations for select additional required readings posted in Blackboard:**

- Aronoff, S. 2005. *Remote Sensing for GIS Managers*. Redlands, CA: ESRI Press.
- Bolstad P, 2016. Chapter 2: Data Models *in GIS Fundamentals: A First Text on Geographic Information Systems*, 5<sup>th</sup> edition. Acton, MA: Eider Press. ISBN: 9781506695877.
- Campbell, J.B. and R.H. Wynne. 2011. *Introduction to Remote Sensing*, 5<sup>th</sup> Edition. New York: The Guilford Press.
- Ceruzzi, P.E. 2018. *GPS*. Cambridge, MA: The MIT Press.
- Feeney, A.E. 2017. Beer-trail Maps and the Growth of Experiential Tourism. *Cartographic Perspectives* 87, 9-28.
- Harmon, K. 2004. *You are here: Personal geographies and other maps of the imagination*. Princeton, NJ: Princeton Architectural Press.
- Kimerling, A.J., Buckley, A.R., Muehrcke, P.C. and Muehrcke, J.O. 2010. *Map Use: Reading and Analysis, Sixth Edition*. Redlands, CA: ESRI Press Academic.
- Krygier, J. and D. Wood. 2016. *Making maps: A visual guide to map design for GIS*. Third Edition. New York: The Guilford Press, ISBN-13: 978-1462509980.
- Monmonier, M.S. 1995. *Drawing the Line: Tales of Maps and Cartocontroversy*. New York: Henry Holt & Co. ISBN: 0805025812.
- Monmonier, M. 2018. *How to Lie with Maps*. Third Edition. Chicago: University of Chicago Press, ISBN-13: 978-0-226-43592-3.
- Nelson, I.L. 2016. Responding to Technologies of Fixing 'Nuisance' Webs of Relation in the Mozambican Woodlands (Section Four: Gender, science, ecology; A response to Dianne Rocheleau's 'Rooted Networks, webs of relation, and the power of situated science bringing the models back down to Earth in Zambrana' (2007). In W. Harcourt (ed.) *The Palgrave Handbook on Gender and Development: Critical engagements in feminist theory and practice*. New York and London: Palgrave Macmillan.
- Sadler, R.C. 2016. How ZIP codes nearly masked the lead problem in Flint. *The Conversation: Academic rigor, journalistic flair*, September 19, <https://theconversation.com/how-zip-codes-nearly-masked-the-lead-problem-in-flint-65626>.
- Satariano, A. 2019. How the Internet Travels Across Oceans. 10 March 2019, <https://www.nytimes.com/interactive/2019/03/10/technology/internet-cables-oceans.html>.
- Shellito, B.A. 2013. *Introduction to Geospatial Technologies*. Second Edition. New York: W.H. Freeman and Company.
- Slocum, T.A., McMaster, R.B., Kessler, F.C. and H.H. Howard. 2009. *Thematic Cartography and Geovisualization* (3<sup>rd</sup> Edition). Upper Saddle River, NJ: Prentice Hall.
- Starosielski, N., Loyer, E. and S. Brennan. 2015. Surfacing. 21 November 2019, <http://www.surfacing.in/>.
- Tufte, E.R. 2001. *The Visual Display of Quantitative Information*. Second Edition. Cheshire, CT: Graphics Press.
- Wainwright, J. 2019. Human geography, indigenous mapping, and the US military: A response to Kelly and others' "From cognitive maps to transparent static web maps". *Cartographica: The International Journal for Geographic Information and Geovisualization* 54(4), 288-296.