GIS 4324: GIS Analysis of Hazard Vulnerability

Department of Geography

College of Liberal Arts & Sciences, University of Florida

COURSE SYLLABUS

Instructor:	Dr. Kevin Ash		Term:	Fall 2022
Office:	TUR 3128		Class Meeting Days:	Wednesday
Phone:	352-294-6956		Class Meeting Hours:	12:50 – 3:50 pm
Email:	kash78@ufl.edu		Class Location:	TUR 3018
Office Hours:	Mon & Tues, 11-12 pm; Thur, 1-2 pm; or by appt		Course Credits:	3 hours

I.   Course Overview

In this course, students will learn fundamental concepts and widely used methodologies for assessment of hazard vulnerability using geospatial data and analysis techniques. They will benefit from assignments using ArcGIS Pro (primarily) and other geospatial and quantitative analysis software. This course will not use a simple hazard-by-hazard approach, but will integrate perspectives from the physical and social sciences to identify and describe risk and vulnerability with empirical data and real-world examples. This unique course will provide critical training and experience for students interested in hazards geography, GIS, emergency management, risk communication, and urban planning, among many other applications.

The course begins by reviewing key concepts relevant for geospatial analysis of risk and vulnerability such as the definitions of these terms and practical issues such as geographic scale and the modifiable areal and temporal unit problems. Then, we will investigate how different types of hazards are represented spatially and how these differences make multi-hazard mapping and analysis challenging. We will then discuss the advantages and pitfalls of using casualty and economic loss datasets, before introducing students to the wide array of socioeconomic datasets frequently used in social vulnerability analyses. Students will learn several different approaches and methodologies for social vulnerability mapping and analysis, and will learn how physical (risk) and social vulnerability analyses can be integrated into a single quantitative assessment. Students will also be exposed to literature on mapping resilience indices, as well as participatory mapping approaches for risk and vulnerability.

NOTE: This course is co-listed with GIS 6325 which is a graduate course. While the two courses will meet together and complete similar assignments and exams, undergraduate and graduate students will be evaluated on different bases. Graduate students will be required to contribute more frequently in reading discussions, complete a longer and more rigorous final project paper, and deliver a longer and more comprehensive final project presentation.

II.   Course Content Objectives

By the end of the course, students will:
- Discover how the concepts of risk and vulnerability are operationalized for geospatial analyses.
- Demonstrate understanding of how risk and vulnerability indices are constructed and mapped using a GIS and how the indices and maps should be interpreted
- Identify and use appropriate geospatial physical and socioeconomic datasets in risk and vulnerability analyses
- Compare and contrast different geospatial analytic methodologies used in risk and vulnerability analyses
- Apply basic and advanced geographic and geostatistical concepts in the context of disaster risk reduction efforts

III. Student Learning Outcomes

Through the course assignments and exams, students will learn to:
- Define the terms risk and vulnerability and operationalize these concepts with empirical spatial data
- Perform mapping and assessment of physical hazard risks associated with a variety of hazard types using GIS and geospatial analysis techniques
- Understand how the modifiable areal and temporal unit problems, as well as different data smoothing techniques, can influence conclusions about risk and vulnerability in quantitative and geospatial analysis
- Work with data that contain margins of error and visualize uncertainty in maps
- Download, combine, and map secondary socioeconomic data in a social vulnerability index
- Analyze and map data using multivariate statistics
- Map social and physical data using dasymetric techniques
- Combine and map physical hazard and socioeconomic data for a comprehensive risk and vulnerability analysis
- Communicate analysis findings in written, verbal, cartographic, and graphical formats

IV. Materials and Supplies: Computer

This course will be held in TUR 3018 for the Fall 2022 semester. Students must provide their own computer on which to participate in discussions on Canvas prior to class, work on GIS assignments during and outside of class, and take exams via Canvas. Any required software (such as ArcGIS Pro) will be available to students through UF Apps at https://info.apps.ufl.edu or through student licenses provided by the instructor.

V. Required Texts and Useful Online Resources

There is no required textbook for this course. The instructor will assign readings on a weekly basis and these will be available via Canvas. Citations for the required readings are provided at the end of this document.

VI. Course Format, Activities, and Basis for Evaluation

The class will meet once per week for a three hour time block on Wednesdays from 12:50 pm to 3:50 pm. The three hour period will be a mix of lecture, discussion of assigned readings, and time to work on each week's GIS assignment. NOTE: The instructor will give the lectures live in TUR 3018 but will also record these lectures using Zoom and make them available via Canvas to all students in the class for study & review purposes only; these recordings are not to be distributed publicly or made available to anyone outside the course without the written permission of the instructor. To clarify: this is not a HyFlex course. Students are expected to attend class in TUR 3018 unless they have documented reasons for absence.

The camera will remain on the instructor during lecture recordings. Students are still encouraged to ask questions during the lectures. The best method for doing so is to log in to Zoom with cameras and microphones off on a laptop computer and pose questions using the chat window to avoid being heard or seen on the recordings. The reason for recording lectures is to provide students the opportunity to re-watch lectures to better learn the material in the course, as there is no textbook for this course.

Regarding the risk of the spread of COVID-19 and variants: UF expects students, faculty, and staff to limit exposure and spread of COVID-19 on campus within the current guidelines in which we are operating. This includes an expectation of wearing masks in the building and during class, encouragement to get vaccinated to reduce likelihood of severe health impacts of COVID-19, and reminders to consider social distancing in the classroom, where possible. These policies are subject to change according to university and government guidelines.

Evaluation and Grading

Class Participation & Reading Discussions: Class participation will be evaluated based on two components. The first is attendance which will count for 5% of the final grade. Students are expected to attend class for each of the 15 class periods during the semester. Students may be excused from absences with appropriate documentation according to the university policy (more information provided in Section IX below). The other 25% in class participation will be discussion of the weekly readings in written format on Canvas and verbally during class. Students will be required to post their own summaries and

critiques the day before class online and discuss the papers further during class periods. An evaluation rubric is provided below.

Rubric for Evaluation: Online Readings Summaries/Critiques

Task: Write a 300-500 word summary and critique of the weekly assigned readings and submit it via Canvas the before class. Consult the rubric below to make sure you include all required elements to receive full credit.
(Adapted from two sources: Solan & Linardopoulos 2011, http://jolt.merlot.org/vol7no4/linardopoulos_1211.htm; Reflection/Discussion Critique Rubric, http://www.rcampus.com/rubricshowc.cfm?sp=yes&code=D97AAC&.

Evaluation Category	Standards for Excellent Work	Points	Instructor Comments
Summary of Key Concepts	-Demonstrate comprehension of key concepts from readings -Recognize & define key concepts in summary -Use terms & concepts appropriately in context	/4	
Evaluation & Synthesis of Key Concepts	-Construct generalized judgments and/or arguments about key concepts in readings -Support arguments using specific instances or examples from the readings	/6	
Critique Strategies	-Employ one or more critique strategies such as: ▪ Compare/contrast between readings ▪ Deconstruction of language or logic ▪ Identification of methodological shortcomings	/6	
Writing & Communication Proficiency	-Organize writing with clear structure: ▪ Introduction ▪ Body ▪ Conclusion -Avoid spelling, grammar, syntax, punctuation, or other writing errors	/4	

GIS Assignments: There will be 10 GIS assignments which will amount to 50% of the final grade. GIS assignments will be due one week after they are assigned; exceptions to this are noted in the course schedule.

Final Project: For the final project, students will use one or more of the GIS methods for analysis of hazard risk and vulnerability covered in the course to perform their own analysis for a location and hazard context of their choosing. The final project paper should be about 2000 words in length and include citations, data tables, and maps and graphs as appropriate. The class project will be worth 20% of the total grade. The majority of the points (15 out of the 20 percentage points) will be related to the paper which each student will write and turn in by December 15th. The remaining 5 percentage points will be for a 10 minute presentation given on December 7th. Students will write a short project proposal that will be due Oct 26th and will receive

constructive feedback and guidance about the proposed research. More detailed instructions about the final project will be provided to students via Canvas and during class meetings.

Assignments and Exams	Percent of Final Grade
Participation & Reading Discussions	30%
GIS Assignments	50%
Final Project Presentation	5%
Final Project Paper	15%

Grading Scale (%)	
92.5 – 100	A
89.5 – 92.4	A-
86.5 – 89.4	B+
82.5 – 86.4	B
79.5 – 82.4	B-
76.5 – 79.4	C+
72.5 – 76.4	C
69.5 – 72.5	C-
66.5 – 69.4	D+
62.5 – 66.4	D
59.5 – 62.4	D-
< 59.5	E

VII. **Important Dates to Remember:** The due dates below are tentative and can be changed at the discretion of the instructor.

Drop/Add Ends:	Fri, Aug 30th 2022
Final Project Proposal Due	**Wed, Oct 26th 2022**
Thanksgiving Holiday	Wed-Fri, Nov 23-25th 2022
Reading Days	Thurs-Fri, Dec 8-9th 2022
Final Project Paper Due	**Thurs, Dec 15th 2022**
Fall 2022 Grades Available on https://one.uf.edu/dashboard/	Wed, Dec 21st 2022

VIII. **Weekly Topic Schedule, Assignments, and Exams (Schedule is provisional and subject to change)**

Date	Day	Class Topics & Assignments	Read Before Class
Aug 24	Wed	Course Introduction; Assignment #1	None
Aug 31	Wed	Physical Hazard Risk Mapping; Assignment #2; #1 due	Elsner et al. 2012; Deng et al. 2016
Sep 7	Wed	Multi-Hazard Risk Mapping; Assignment #3; #2 due	Buck and Summers 2020; Iglesias et al. 2021
Sep 14	Wed	Geospatial Analysis of Damage & Casualties; Assignment #4; #3 due	Borden & Cutter 2008; Hahn et al. 2017
Sep 21	Wed	Demographic & Geospatial Data Sources; Visualizing Uncertainty; Assignment #5; #4 due	Wong & Sun 2013; Folch et al. 2016
Sep 28	Wed	Social Vulnerability Index: Deductive & Hierarchical Models; Assignment #6, #5 due	Cutter et al. 2000; Flanagan et al. 2011
Oct 5	Wed	Social Vulnerability Index: Inductive Models; Assignment #7; #6 due	Cutter et al. 2003; Rabby et al. 2019
Oct 12	Wed	Introduction & Discussion of Final Project; Project Proposal Assignment; #7 due	None
Oct 19	Wed	Validity of Social Vulnerability Indices; Work on Project Proposal (due Oct 26)	Rufat et al. 2019; Spielman et al. 2020; Flanagan et al. 2021; Rufat et al. 2021
Oct 26	Wed	Dasymetric Mapping & Social Vulnerability Analysis;	Nelson et al. 2015; Tate et al. 2021

		Assignment #8; Project Proposal due	
Nov 2	Wed	Clustering Methods & Social Vulnerability Analysis; Assignment #9; #8 due	Rufat 2013; Wood et al. 2015
Nov 9	Wed	Risk/Vulnerability Integrated Analysis; Assignment #10; #9 due	Koks et al. 2015; Guillard-Goncalves & Zezere 2018
Nov 16	Wed	GIS-Based Disaster Resilience Index, #10 due, Work on final project	Cutter and Derakhshan 2018; Al Rifat and Liu 2020
Nov 23	Wed	*No lecture or discussion this week, work on final project & readings for Nov 30*	
Nov 30	Wed	Vulnerability Analysis Using Participatory & Qualitative GIS Methods, Work on final project	Yusuf et al. 2018; Sullivan-Wiley et al. 2019; Brandt et al. 2020
Dec 7	Wed	Student presentations on final project; Work on final project papers	None
Dec 15	Thurs	*Final Project Papers Due by 5 pm on Dec 15*	

IX. Course Policies: Attendance, Make-Ups, and Grades

Attendance: Students are expected to attend each class period. Absences can be excused with proper documentation according to university policy. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Make-Up Exams and Assignments: Requirements for make-up exams, assignments, and other work in this course are consistent with university policies that can be found at https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

Examination Policies and Reading Days: Course policies are consistent with University policies on during-term exams, final exams, reading days, and make-up exams. Students must notify the instructor as soon as possible in case of absence during an exam and provide documentation as to the reason for the absence. If deemed an excused absence, the student will be permitted a reasonable amount of time to make up the missed exam. More details can be found at https://catalog.ufl.edu/UGRD/academic-regulations/examination-policies-reading-days/.

Grade Dissemination: You can access your scores at any time using the Grade function in Canvas. The instructor will post grades within about one week of the due date of each assignment and reading discussion.

Grading Policies for Assigning Grade Points: Information on current UF grading policies for assigning grade points may be found at https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx.

Grades of "Incomplete": The current university policy concerning incomplete grades will be followed in this course. An incomplete grade may be assigned at the discretion of the instructor as an interim grade for a course in which you have completed a major portion of the course with a passing grade, been unable to complete course requirements before the end of the term because of extenuating circumstances, and obtained agreement from the instructor and arranged for resolution of the incomplete grade. Instructors are not required to assign incomplete grades.

X. Course Policies: Technology and Media

Email: Each of you has a UF email address. It is vital that you maintain an active UF email account and that you **check it often**. This tentative syllabus is **subject to change**, and any changes will be transmitted to you via your UF email account and Canvas (see below). Students should email the instructor if they have questions about any of the lectures, readings, assignments, or exams. You should expect a response within about 24 hours during weekdays. On holidays or weekends, expect a response on the next business day. The instructor will reasonably expect similar time frames for responses to emails sent to students.

Canvas: Course materials such as lectures, readings, the syllabus, and assignment instructions will be available through Canvas (https://elearning.ufl.edu). You will also find all due dates and grades on Canvas. Students must activate their UF GatorLink account in order to use Canvas. If you need help learning how to perform various tasks related to this course or other courses that utilize Canvas, please consult the above webpage. You may also contact the UF Computing Help Desk at (352) 392-HELP(4357) or helpdesk@ufl.edu.

Online Course Evaluation: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing online evaluations via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording: Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

XI. Course Policies: Student Expectations

Disabilities Statement:
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center (352-392-8565, https://disability.ufl.edu/get-started/). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Academic Honesty & Conduct Policy: UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code." On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor code (https://sccr.dso.ufl/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor.

XII. Campus Resources for Students:

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via email at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services at career.ufl.edu/.

Library Support: http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring. http://teachingcenter.ufl.edu/

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. http://writing.ufl.edu/writing-studio/

Student Complaints On-Campus: sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

On-Line Students Complaints: distance.ufl.edu/student-complaint-process/

Health and Wellness Resources

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit https://counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit https://shcc.ufl.edu/.

University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center.

XIII. Assigned Readings Citations:

Al Rifat, S.A., and W. Liu, 2020. Measuring Community Disaster Resilience in the Conterminous Coastal United States, *ISPRS International Journal of Geo-Information*, 9: 469.

Borden, K.A., and S.L. Cutter, 2008. Spatial patterns of natural hazards mortality in the United States, *International Journal of Health Geographics*, 7:64, doi:10.1186/1476-072X-7-64.

Brandt, K., L. Graham, T. Hawthorne, J. Jeanty, B. Burkholder, C. Munisteri, and C. Visaggi, 2020. Integrating sketch mapping and hot spot analysis to enhance capacity for community-level flood and disaster risk management, *The Geographical Journal*, 186: 198-212.

Buck, K.D., and J.K. Summers, 2020. Application of a multi-hazard risk assessment for local planning, *Geomatics, Natural Hazards and Risk*, 11: 2058-2078.

Cutter, S.L., J.T. Mitchell, and M.S. Scott, 2000. Revealing the Vulnerability of People and Places: A Case Study of Georgetown County, South Carolina, *Annals of the American Association of Geographers,* 90(4): 713-737.

Cutter, S.L., B.J. Boruff, and W.L. Shirley, 2003. Social Vulnerability to Environmental Hazards, *Social Science Quarterly*, 84: 242-261.

Cutter, S.L., and S. Derakhshan, 2018. Temporal and spatial change in disaster resilience in US counties, 2010-2015, *Environmental Hazards*, DOI: https://doi.org/10.1080/17477891.2018.1511405.

Deng, Y., B. Wallace, D. Maassen, and J. Werner, 2016. A Few GIS Clarifications on Tornado Density Mapping, *Journal of Applied Meteorology and Climatology*, 55: 283-296.

Elsner, J.B., R.E. Hodges, and T.H. Jagger, 2012. Spatial grids for hurricane climate research, *Climate Dynamics*, 39: 21-36.

Flanagan, B.E., E.W. Gregory, E.J. Hallisey, J.L. Heitgerd, and B. Lewis, 2011. A Social Vulnerability Index for Disaster Management, *Journal of Homeland Security and Emergency Management*, 8: 3.

Flanagan, B., E. Hallisey, J.D. Sharpe, C.E. Mertzlufft, and M. Grossman, 2021. On the Validity of Validation: A Commentary on Rufat, Tate, Emrich, and Antolini's "How Valid Are Social Vulnerability Models?" *Annals of the American Association of Geographers*, 111: 4.

Folch, D.C., D. Arribas-Bel, J. Koschinsky, and S.E. Spielman, 2016. Spatial Variation in the Quality of American Community Survey Estimates, *Demography*, 53: 1535-1554.

Guillard-Goncalves, C., and J.L. Zezere, 2018. Combining Social Vulnerability and Physical Vulnerability to Analyse Landslide Risk at the Municipal Scale, *Geosciences*, 8: 294, DOI:10.3390/geosciences8080294.

Hahn, D.J., E. Viaud, and R.B. Corotis, 2017. Multihazard Mapping of the United States, *Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering*, 3: 04016016.

Iglesias, V., A.E. Braswell, M.W. Rossi, M.B. Joseph, C. McShane, M. Cattau, M.J. Koontz, J. McGlinchy, R.C. Nagy, J. Balch, S. Leyk, and W.R. Travis, 2021. Risky Development: Increasing Exposure to Natural Hazards in the United States, *Earth's Future*, in press, https://doi.org/10.1029/2020EF001795.

Koks, E.E., 2015. Combining hazard, exposure and social vulnerability to provide lessons for flood risk management, *Environmental Science & Policy*, 47: 42-52.

Nelson, K.S., M.D. Abkowitz, and J.V. Camp, 2015. A method for creating high resolution maps of social vulnerability in the context of environmental hazards, *Applied Geography*, 63: 89-100.

Rabby, Y.W., M.B. Hossain, and M.U. Hasan, 2019. Social vulnerability in the coastal region of Bangladesh: An investigation of social vulnerability index and scalar change effects, *International Journal of Disaster Risk Reduction*, 41: 101329.

Rufat, S., 2013. Spectroscopy of Urban Vulnerability, *Annals of the American Association of Geographers*, 103: 505-525.

Rufat, S., E. Tate, C.T. Emrich, and F. Antolini, 2019. How Valid Are Social Vulnerability Models? *Annals of the American Association of Geographers*, 109: 1131-1153.

Rufat, S., E. Tate, C.T. Emrich, and F. Antolini, 2021. Answer to the CDC: Validation Must Precede Promotion. *Annals of the American Association of Geographers*, 111: em-vii-em-viii.

Spielman, S.E., J. Tuccillo, D.C. Folch, A. Schweikert, R. Davies, N. Wood, and E. Tate, 2020. Evaluating social vulnerability indicators: criteria and their application to the Social Vulnerability Index, *Natural Hazards*, 100: 417-436.

Sullivan-Wiley, K.A., A.G. Short Gianotti, and J.P. Casellas Connors, 2019. Mapping vulnerability: Opportunities and limitations of participatory community mapping, *Applied Geography*, 105: 47-57.

Tate, E., M.A. Rahman, C.T. Emrich, and C.C. Sampson, 2021. Flood exposure and social vulnerability in the United States, *Natural Hazards*, 106: 435-457.

Wong, D.W., and M. Sun, 2013. Handling Data Quality Information of Survey Data in GIS: A Case of Using the American Community Survey Data, *Spatial Demography*, 1: 3-16.

Wood, N.J., J. Jones, S. Spielman, and M.C. Schmidtlein, 2015. Community clusters of tsunami vulnerability in the US Pacific Northwest, *Proceedings of the National Academy of Sciences,* DOI: https://doi.org/10.1073/pnas.1420309112.

Yusuf, J.E., P. Rawat, C. Considine, M. Covi, B. St. John, J.G. Nicula, and K.A. Anuar, 2018. Participatory GIS as a Tool for Stakeholder Engagement in Building Resilience to Sea Level Rise: A Demonstration Project, *Marine Technology Society Journal*, 52: 45-55.