UF | UNIVERSITY of FLORIDA

GIS 6325: GIS Analysis of Hazard Vulnerability
Department of Geography
College of Liberal Arts & Sciences, University of Florida

COURSE SYLLABUS

Instructor:	Dr. Kevin Ash	Term:	Spring 2025
Office:	TUR 3128	Class Meeting Days:	Wednesday
Phone:	352-294-6956	Class Meeting Hours:	1:55 – 4:55 pm
Email:	kash78@ufl.edu	Class Location:	TUR 3006
Office Hours:	Mon & Tues, 2–3 pm; Thur, 10-11 am; or by appt	Course Credits:	3 hours

Catalog Course Description: Instruction on geographic and cartographic techniques for geospatial analysis of risk, vulnerability, and resilience using ArcGIS. Students learn to utilize physical and human geographic datasets for multiple hazard contexts including hydrometeorological, climatological, and geophysical hazards.

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 4324, an undergraduate course. While the two courses will overlap 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 (including leading one class period) during the 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
- Summarize 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
- Analyze 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 applying 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 3006 for the Spring 2025 semester. Students should provide their own computer on which to participate in discussions on Canvas prior to class and work on GIS assignments during and outside of class. 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. Instructional materials for this course consist of only those materials specifically reviewed, selected, and assigned by the instructor(s). The instructor(s) is only responsible for these instructional materials.

Policy for use of Artificial Intelligence (AI) Language Models

AI language models, such as ChatGPT, may NOT be used for the following course assignments: Reading Discussions and GIS Assignments. AI language models may be used in a limited fashion for the Final Project, with appropriate citation. Examples of appropriate use for the research project include editing of text written by the student for improving organization, word choice, and grammar, as well as recommendations for code or tools to use in GIS, spatial, and statistical analyses. If you are not sure whether you are using AI language models appropriately in the course, please discuss your situation with the instructor. Students are responsible for fact-checking any statements composed by AI language models. Examples for how to cite or report use of AI language models are available at: https://ics.ifas.ufl.edu/media/icsifasufledu/docs/edis/EDIS-AI-Factsheet-v-1.pdf

VI. Course Format, Activities, and Basis for Evaluation

The class will meet once per week for a three-hour time block on Wednesdays from 1:55 pm to 4:55 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 3006 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 3006 unless they have documented reasons for absence. The only exceptions to this are UF Online students who will participate remotely in all aspects of the course.

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.

Evaluation and Grading

Reading Discussions: Discussion of the weekly readings in written format on Canvas and verbally during class will comprise 30% of the course grade. Students will be required to post online their own summaries and critiques the day before class and discuss the papers further during class periods. An evaluation rubric is provided below.

Evaluation Criteria	Ratings Descriptions				Points
Summary of Concepts (On Canvas & In Class)	**6 pts, 100%** Student demonstrates an excellent level of understanding of key concepts from the assigned readings.	**5 pts, 83%** Student demonstrates a satisfactory level of understanding of key concepts from the assigned readings.	**3 pts, 50%** Student demonstrates poor level of understanding of key concepts from the assigned readings. This may be evidenced by fact errors and/or misconceptions of ideas or processes.	**0 pts, 0%** Student did not contribute at all to in-class or Canvas discussion.	6 pts
Evaluation & Synthesis of Concepts (On Canvas & In Class)	**6 pts, 100%** Student constructs valid generalized judgments and/or arguments about key concepts which are clearly supported by specific instances from the texts.	**5 pts, 83%** Student constructs generalized judgments and/or arguments about key concepts that have some validity but may not be clearly drawn from specific instances from the texts.	**3 pts, 50%** Student constructs a weakly generalized judgment and/or argument, or constructs one that is not at all supported by specific instances from the texts.	**0 pts, 0%** Student did not contribute any comments indicative of evaluation & synthesis of concepts from readings.	6 pts
Critique Strategies (On Canvas & In Class)	**6 pts, 100%** Student critiques reading material using strategies such as compare/contrast, deconstruction of language/logic, or demonstrating methodological flaws. Evidence or information is presented clearly, is specific, and is relevant to critique.	**5 pts, 83%** Student critiques reading material using strategies such as compare/contrast, deconstruction of language/logic, or demonstrating methodological flaws. Evidence or information presented is somewhat clear, is general, and is relevant.	**3 pts, 50%** Student seldom critiques reading material using strategies such as compare/contrast, deconstruction of language/logic, or demonstrating methodological flaws. Any evidence or information presented is unclear, incomplete, and/or irrelevant.	**0 pts, 0%** Student did not contribute any comments indicative of constructive critique of the readings.	6 pts

	6 pts, 100%	5 pts, 83%	3 pts, 50%	0 pts, 0%	
Quantity of Discussion (In Class)	Student contributed multiple substantive comments during discussion of the week's topic.	Student contributed one substantive comment and multiple minor comments during discussion of the week's topic.	Student contributed only minor comments during discussion of the week's topic.	Student did not contribute at all to in-class discussion.	6 pts
Quantity of Writing (On Canvas)	**6 pts, 100%** Student submitted one substantive first post discussing the week's topic. Student submitted at least one substantive reply to at least three classmates' posts. Total posts number at least four with word count for the first post of at least 300 words and total of 500 words.	**5 pts, 83%** Student submitted one substantive first post discussing the week's topic. Student submitted at least one substantive reply to at least two classmates' posts. Total posts number at least three with word count for the first post of at least 150 words and a total of 300 words.	**3 pts, 50%** Student submitted one substantive first post discussing the week's topic, but did not engage in any further discussion. Total word count for the week is at least 100 words.	**0 pts, 0%** Student did not contribute at all to online discussion.	6 pts
Quality of Content in First Canvas Post	**6 pts, 100%** Student's first post demonstrates substantial evidence of critical and original thinking about the topic through, for example, application, analysis, evaluation, critique, and/or synthesis.	**5 pts, 83%** Student's first post demonstrates moderate evidence of critical and original thinking about the topic through, for example, application, analysis, evaluation, critique, and/or synthesis.	**3 pts, 50%** Student's first post demonstrates little evidence of critical and original thinking about the topic.	**0 pts, 0%** Student's first post demonstrates no evidence of critical and original thinking about the topic.	6 pts
Quantity & Quality of Canvas Reply Posts	**6 pts, 100%** Student posts 2 replies that engage thoughtfully and respectfully with classmates about the week's topic. Student's replies	**5 pts, 83%** Student posts 2 replies that engage thoughtfully and respectfully with classmates about the week's topic.	**3 pts, 50%** Student posts 1 reply that engages thoughtfully and respectfully with classmates about the week's topic.	**0 pts, 0%** Student does not post any replies.	6 pts

	8 pts, 100%	6 pts, 75%	4 pts, 50%	2 pts, 25%	
	often take the discussion in an interesting and/or fruitful new direction.	Student's replies occasionally take the discussion in an interesting and/or fruitful new direction.			
Writing & Communication Proficiency (On Canvas)	**8 pts, 100%** Student's posts do not contain spelling, grammar, syntax, punctuation, or other writing errors.	**6 pts, 75%** Student's posts contain one to five spelling, grammar, syntax, punctuation, citation, or other writing errors.	**4 pts, 50%** Student's posts contain six to nine spelling, grammar, syntax, punctuation, citation, or other writing errors.	**2 pts, 25%** Student's posts contain ten or more spelling, grammar, syntax, punctuation, citation, or other writing errors.	8 pts

GIS Assignments: There will be 9 GIS assignments which will amount to 35% of the final grade. GIS assignments will be due one week after they are assigned; any exceptions to this are noted in the course schedule and on Canvas.

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 3000 words in length and include citations, data tables, and maps and graphs as appropriate. The class project will be worth 35% of the total grade. The majority of the points (30 out of the 35 percentage points) will be related to the paper which each student will write and turn in by April 30th. The remaining 5 percentage points will be for a 10-minute presentation given on April 23rd. Students will write a short project proposal that will be due April 2nd and will receive constructive feedback and guidance about the proposed research from the instructor. 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	35%
Final Project Presentation	5%
Final Project Paper	30%

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, Jan 17th 2025
Spring Break	Mon-Fri, Mar 17–21st 2025
Final Project Proposal Due	**Wed, Apr 2nd 2025**
Final Project Presentations	**Wed, Apr 23rd 2025**
Reading Days	Thurs-Fri, Apr 24-25th 2025
Final Project Paper Due	**Wed, Apr 30th 2025**
Spring 2025 Grades Available on https://one.uf.edu/dashboard/	Wed, May 7th 2025

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

Date	Day	Class Topics & Assignments	Read Before Class
Jan 15	Wed	Course Introduction; Assignment #1	None
Jan 22	Wed	Physical Hazard Risk Mapping; Assignment #2; #1 due	Trepanier et al. 2015; Allen et al. 2021
Jan 29	Wed	Multi-Hazard Risk Mapping; Assignment #3; #2 due	Buck and Summers 2020; Iglesias et al. 2021
Feb 5	Wed	Geospatial Analysis of Damage & Casualties; Assignment #4; #3 due	Al Rifat et al. 2021; Sharpe and Wolkin 2022
Feb 12	Wed	Demographic & Geospatial Data Sources; Visualizing Uncertainty; Assignment #5; #4 due	Folch et al. 2016; Koo and Chun 2022
Feb 19	Wed	Social Vulnerability Index: Deductive & Hierarchical Models; Assignment #6, #5 due	Lehnert et al. 2020; Cutter 2024
Feb 26	Wed	Social Vulnerability Index: Inductive Models; Assignment #7; #6 due	Rabby et al. 2019; Derakhshan et al. 2020
Mar 5	Wed	Dasymetric Mapping & Social Vulnerability Analysis; Assignment #8; #7 due	Nelson et al. 2015; Tate et al. 2021
Mar 12	Wed	Clustering Methods & Social Vulnerability Analysis; Assignment #9; #8 due	Wood et al. 2015; Sumy et al. 2023
Mar 19		*Spring Break*	
Mar 26	Wed	**NO CLASS, INSTRUCTOR AT AAG MEETING** Instructor will record an Introduction of the Final Project and Project Proposal; Assignment #9 due	None
Apr 2	Wed	Validity of Social Vulnerability Indices; Project Proposal due	Rufat et al. 2019; Spielman et al. 2020; Flanagan et al. 2021; Rufat et al. 2021
Apr 9	Wed	Risk/Vulnerability Integrated Analysis; Work on final project	Zuzak et al. 2022; Seeteram et al. 2023
Apr 16	Wed	GIS-Based Disaster Resilience Index; Work on final project	Cutter and Derakhshan 2018; Al Rifat and Liu 2020
Apr 23	Wed	Student Project Presentations	None
Apr 30	Wed	*Final Project Papers Due by 11:59 pm on Apr 30*	

IX. **Course Policies: Attendance and Grades**

Attendance, Make-Up Exams & Assignments
Students are expected to attend each class period. 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/UGRD/academic-regulations/attendance-policies.

Grades and Grading Policies
All grades and grading policies are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/.

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/.

Recordings and Notes: Students are allowed to record video of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal education 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 deliver by an 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 presentation 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 guest 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 their-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 accommodations should connect with the Disability Resource Center. See the "Get Started With the DRC" webpage on the Disability Resource Center site. 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 Conduct code specifies a number of behaviors that are in violation of this code and the possible sanctions. See the UF Conduct Code website for more information. 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://uflib.ufl.edu. Various ways to receive assistance with respect to using the libraries or finding resources. Call 866-281-6309 or email ask@ufl.libanswers.com for more information.

Teaching Center: 1317 Turlington Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring. http://umatter.ufl.edu/office/teaching-center.

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

Academic Complaints: Office of the Ombuds; Visit the Complaint Portal webpage for more information.

Enrollment Management Complaints (Registrar, Financial Aid, Admissions): View the Student Complaint Procedure webpage for more information.

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; https://ufhealth.org/locations/uf-health-shands-emergency-room-trauma-center/.

GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the GatorWell website or call 352-273-4450.

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.

Al Rifat, S.A., J.C. Senkbeil, and W. Liu, 2021. Assessing Influential Factors on Inland Property Damage from Gulf of Mexico Tropical Cyclones in the United States, *ISPRS International Journal of Geo-Information,* 10: 295.

Allen, M.J., T.R. Allen, C. Davis, and G. McLeod, 2021. Exploring Spatial Patterns of Virginia Tornadoes Using Kernel Density and Space-Time Cube Analysis (1960–2019), *ISPRS International Journal of Geo-Information*, 10: 310.

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., 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.

Cutter, S.L., 2024. The origin and diffusion of the Social Vulnerability Index (SoVI), *International Journal of Disaster Risk Reduction*, 109: 104576.

Derakhshan, S., M.E. Hodgson, and S.L. Cutter, 2020. Vulnerability of populations exposed to seismic risk in the state of Oklahoma, *Applied Geography*, 124: 102295.

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.

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.

Koo, H., and Y. Chun, 2022. GIScience: Addressing Aggregation and Uncertainty. In *The Routledge Handbook of Methodologies in Human Geography*, pp. 207–226, Routledge.

Lehnert, E.A., G. Wilt, B. Flanagan, and E. Hallisey, 2020. Spatial exploration of the CDC's Social Vulnerability Index and heat-related health outcomes in Georgia, *International Journal of Disaster Risk Reduction*, 46: 101517.

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., 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.

Seeteram, N.A., K. Ash, B.F. Sanders, J.E. Sanders, K.J. Mach, 2023. Modes of climate mobility under sea-level rise, *Environmental Research Letters*, 18: 114015.

Sharpe, J.D., and A.F. Wolkin, 2022. The Epidemiology and Geographic Patterns of Natural Disaster and Extreme Weather Mortality by Race and Ethnicity, United States, 1999–2018, *Public Health Reports*, 137: 1118–1125.

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.

Sumy, D.F., O.O. Drakes, S.K. McBride, and M.R. Jenkins, 2023. Social vulnerability and geographic access barriers to earthquake early warning education in museums and other free choice learning environments, *International Journal of Disaster Risk Reduction*, 97: 104011.

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.

Trepanier, J.C., K.N. Ellis, and C.S. Tucker, 2015. Hurricane Risk Variability along the Gulf of Mexico Coastline, *PLoS ONE*, 10: e0118196.

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.

Zuzak, C., M. Mowrer, E. Goodenough, J. Burns, N. Ranalli, and J. Rozelle, 2022. The national risk index: establishing a nationwide baseline for natural hazard risk in the US, *Natural Hazards*, 114: 2331-2355.