Term Information

Effective Term	Spring 2023

General Information

Course Bulletin Listing/Subject Area	Civil Engineering
Fiscal Unit/Academic Org	Civil, Envrnmntl & Geodtc Eng - D1427
College/Academic Group	Engineering
Level/Career	Undergraduate
Course Number/Catalog	3530
Course Title	Learning from disasters: Extreme events and their impact on infrastructure, engineering and society
Transcript Abbreviation	Learn from disast
Course Description	Introduction to six dimensions of sustainability while learning the main impacts and threats caused by various extreme events through the study of academic publications and reports covering six major extreme events. Long term impacts and recovery from extreme events, how historical decisions in planning, engineering and/or urban development, legislation play important roles
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	Yes
Is any section of the course offered	100% at a distance
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites	None
Exclusions	Not open to students with credit for EarthSci 3530
Electronically Enforced	Yes

Cross-Listings

Cross-Listings	Cross-listed in EarthSci

Subject/CIP Code

Subject/CIP Code	14.0801
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Requirement/Elective Designation

Sustainability

Course Details

Course goals or learning objectives/outcomes	• Successful students will recognize and explain the multifaceted impacts that disasters resulting from extreme events have on people, communities, infrastructure, society, and nature. • Successful students will apply multidisciplinary approaches from science and engineering to preparedness and hazard mitigation associated with of extreme events, including community preparedness, vulnerability, infrastructure robustness, resilience • Successful students will analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing and sustainability depends on these interactions; • how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, viable solutions across time.
Content Topic List	• Examples and introduction to sustainability's six dimensions framework Hurricanes (wind and precipitation) Hurricanes (rescue and recovery) Lasting effects of extreme events and measures to increase resilience Global warming and sustainability • Dam failures and flooding Wildfires, landslides and debris flows Earthquakes and tsunamis (hazard and effects) Extreme event disasters in developing countries
Sought Concurrence	Yes

Attachments

- CurriculumChairLetter-newGE-hazards.pdf: Concurrence

  (Concurrence. Owner: Tolchin Jr.,Barry Scott)
- Proposed syllabus of CE course - 2021-12-15.pdf: syllabus

  (Syllabus. Owner: Tolchin Jr.,Barry Scott)
- GE Learning from Disasters - Submission-sustainability 2021-12-15.pdf: GE submission

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- CIVILEN_EARTHSC_2540_interdisciplinary-team-taught-inventory.pdf: team taught inventory

  (Other Supporting Documentation. Owner: Quinzon-Bonello,Rosario)
- CE3530-AU2022 Syllabus - 2022-06-08.docx: updated syllabus - 6/8/22

  (Syllabus. Owner: Tolchin Jr.,Barry Scott)
- GE ASC Contingent Approval.pdf: GE Contingent Approval

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- contingenies for 2540 now 3530.docx: contingencies document

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- CourseRequest_1064564.pdf: updated ASC course request

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- CIVILEN_EARTHSC_3530_interdisciplinary-team-taught-inventory.pdf: updated team inventory

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- CE3530-Panel Response - 2022-09-05 v DP2 EMG1.docx: Panel Response - 9_13_22

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)
- CE3530-SP2023 Syllabus - 2022-09-05 v DP2 EMG1.docx: Updated Syllabus - 9_13_22

  (Syllabus. Owner: Tolchin Jr.,Barry Scott)
- CIVILEN_EARTHSC_3530_interdisciplinary-team-taught-inventory v3.pdf: Team Taught Inventory

  (Other Supporting Documentation. Owner: Tolchin Jr.,Barry Scott)

Comments

- Please see Panel feedback email sent 08/22/2022. *(by Hilty,Michael on 08/22/2022 11:32 AM)*
- Updated syllabus with new course number per GE review. Contingent approval granted, and their requests have been addressed in the updated syllabus. *(by Tolchin Jr.,Barry Scott on 06/08/2022 01:32 PM)*
- The syllabus for the Earth Science version of the course is being reviewed by ASC Office of Distance Education for DL delivery. Once they receive the green light, please make sure that the most recent version of the DL syllabus is uploaded by you as well (indeed it is possible that ASC ODE will suggest revisions). *(by Vankeerbergen,Bernadette Chantal on 04/19/2022 01:07 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Tolchin Jr.,Barry Scott	01/07/2022 02:03 PM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	01/10/2022 12:24 PM	Unit Approval
Revision Requested	Quinzon-Bonello,Rosario	01/10/2022 04:14 PM	College Approval
Submitted	Tolchin Jr.,Barry Scott	01/10/2022 10:06 PM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	01/27/2022 11:15 AM	Unit Approval
Approved	Quinzon-Bonello,Rosario	01/27/2022 11:15 AM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	04/19/2022 01:07 PM	ASCCAO Approval
Submitted	Tolchin Jr.,Barry Scott	06/08/2022 01:32 PM	Submitted for Approval
Approved	Tolchin Jr.,Barry Scott	06/08/2022 01:39 PM	Unit Approval
Approved	Quinzon-Bonello,Rosario	06/08/2022 02:32 PM	College Approval
Revision Requested	Hilty,Michael	08/22/2022 11:32 AM	ASCCAO Approval
Submitted	Tolchin Jr.,Barry Scott	09/13/2022 03:26 PM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	09/16/2022 12:46 PM	Unit Approval
Approved	Quinzon-Bonello,Rosario	09/16/2022 12:46 PM	College Approval
Pending Approval	Cody,Emily Kathryn Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	09/16/2022 12:46 PM	ASCCAO Approval

On Thursday, July 28th, the Themes Panel of the ASC Curriculum Committee reviewed a new GE Theme: Sustainability and High-Impact Practice: Interdisciplinary Team-Teaching request for Earth Sciences/Civil Engineering 3530, and on August 22nd:

a) Unanimously approved the request with four contingencies and one recommendation;
b) Provided feedback about High-Impact Practice: Interdisciplinary Team-Teaching.

This document explains changes made in response to Panel's feedback.

Contingency C1: The reviewing faculty ask that, underneath the GE Goals and ELOs, a brief paragraph/rationale be added that explains how the course will meeting the GE ELOs. This is a requirement of all General Education courses.

Response C1: The following paragraph has been added in Page 5 of the syllabus:

This cross-listed team-taught course fulfills these goals and expected learning outcomes by asking students to research and study case histories of devastating extreme events, including Hurricane Katrina which devastated New Orleans in 2005, Hurricane Maria which destroyed Puerto Rico's power grid in 2017, and the Tohoku Earthquake which resulted in a major Tsunami and meltdown at Fukushima nuclear plant in Japan in 2011, as well as, natural hazards including floods (from natural causes and dam failures), heat waves, droughts and wildfires from a sustainability perspective (as outlined in the course schedule).

Through the study and research of extreme events' case histories students will learn, discuss and make interdisciplinary team presentations about the hazards, mitigation, management and nature of these events (including their findings from diverse disciplines, including climatology, earth sciences, engineering, hydrology, ecology, public health, history and social sciences). Similarly, the study of recovery after extreme events will require research on the impacts of legislation, wealth/poverty, political decisions, local characteristics, and the major impacts that preparedness and design methods/concepts have. At the end of the semester, the course culminates with synthesis in-class discussions that will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance disaster preparedness, and most importantly on students' suggestions to enhance resilience and their reflections on sustainability.

For the continuous improvement of the course and to assess ELOs the instructors anticipate using the "Outcomes" option in Carmen, which allows collective and individual student tracking of ELOs and facilitates their statistical analysis. An important advantage of using Carmen's Outcomes is to provide students throughout the semester with timely and transparent individual feedback (Figures 1 and 2, below, exemplify the use of Carmen's assessment tool and use of outcome specific rubrics).

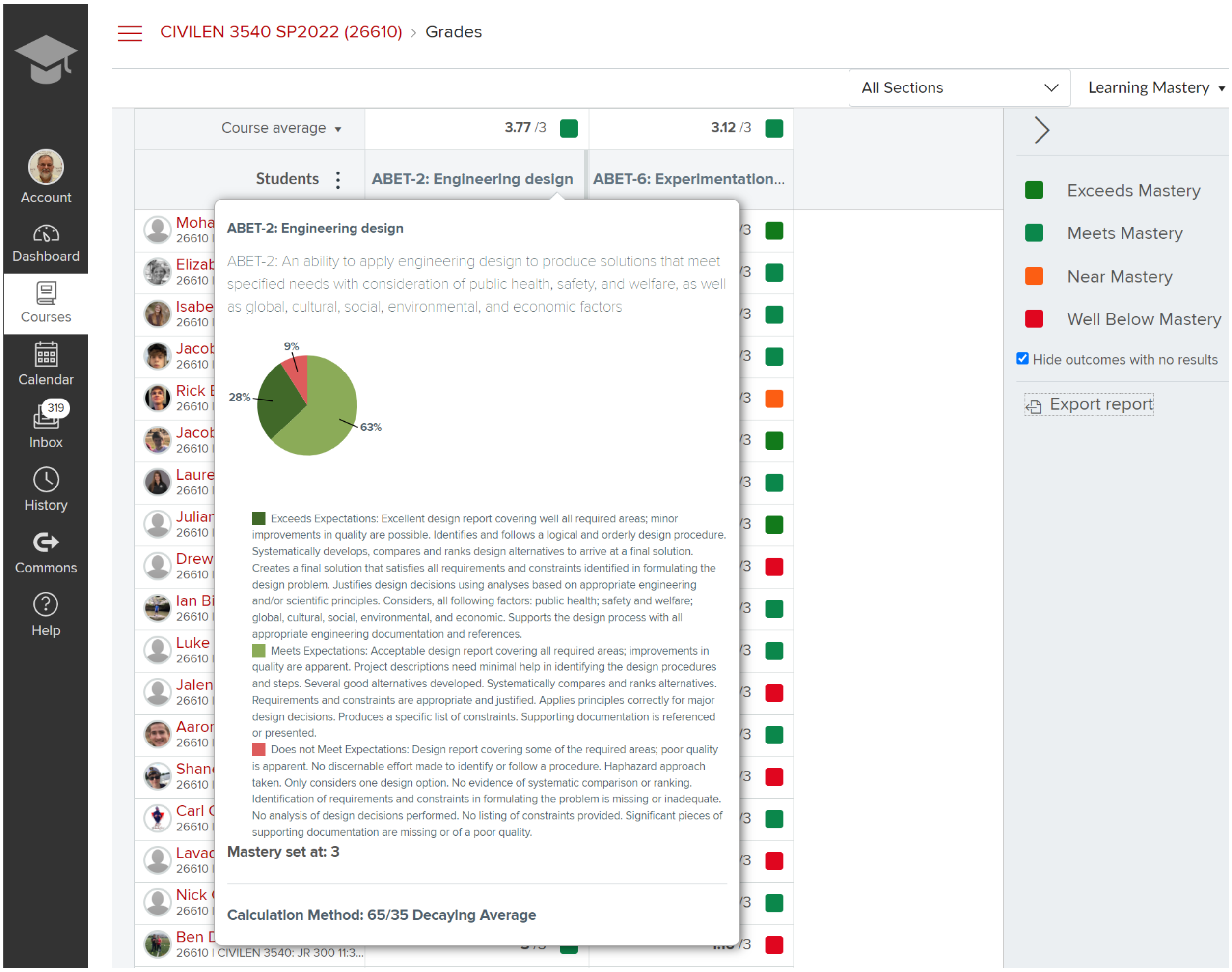

Figure 1: Canvas built-in Assessment Tool, rubric implementation and access to individual students' assessment data

ABET-2: Engineering design

An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
Mastery: 3 Points

Exceeds Expectations:	Meets Expectations:	Does not Meet Expectations:	Total Points
Excellent design report covering well all required areas; minor improvements in quality are possible. Identifies and follows a logical and orderly design procedure. Systematically develops, compares and ranks design alternatives to arrive at a final solution. Creates a final solution that satisfies all requirements and constraints identified in formulating the design problem. Justifies design decisions using analyses based on appropriate engineering and/or scientific principles. Considers, all following factors: public health; safety and welfare; global, cultural, social, environmental, and economic. Supports the design process with all appropriate engineering documentation and references.	Acceptable design report covering all required areas; improvements in quality are apparent. Project descriptions need minimal help in identifying the design procedures and steps. Several good alternatives developed. Systematically compares and ranks alternatives. Requirements and constraints are appropriate and justified. Applies principles correctly for major design decisions. Produces a specific list of constraints. Supporting documentation is referenced or presented.	Design report covering some of the required areas; poor quality is apparent. No discernable effort made to identify or follow a procedure. Haphazard approach taken. Only considers one design option. No evidence of systematic comparison or ranking. Identification of requirements and constraints in formulating the problem is missing or inadequate. No analysis of design decisions performed. No listing of constraints provided. Significant pieces of supporting documentation are missing or of a poor quality.	
5 Points	**3 Points**	**0 Points**	**5 Points**

ABET-6: Experimentation and data

ABET-6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Mastery: 3 Points

Exceeds Expectations:	Meets Expectations:	Does Not Meet Expectations:	Total Points
All experimental procedures are followed, and data collected is carefully documented. Reporting methods are well organized, logical and complete. Relates experimental data to design project well. Consistent use of convincing language, appropriate terminology and grammar structure, and avoids misspellings.	Experimental procedures are mostly followed, and data gathering is acceptable; however, not all data collected is thoroughly documented, e.g., some units may be missing, or some measurements are not reported. Experimental data is adequately organized, logically presented and required properties are obtained. Needs some guidance in relating experimental data to design project. Consistent use of language that supports findings, utilizes appropriate terminology most of the time, and only occasionally uses incorrect grammar structure and/or misspellings.	Does not follow experimental procedure, uses unsafe and/or risky experimental procedures. Makes no attempt to relate data to design project. Experimental data is poorly organized, illogical and/or incomplete. Consistent use of unconvincing language, inappropriate terminology, inappropriate grammar structure and/or has frequent misspellings.	
5 Points	**3 Points**	**0 Points**	**5 Points**

Figure 2: Rubrics used for assessment[1]

[1] Reviewed, discussed and approved by an Industrial Advisory Board

Contingency C2: The reviewing faculty would like an explanation provided surrounding how the course will prepare students who enroll that are outside the disciplines this course engages with (for example, how would a student whose declared major program is English expect to be successful?). As a part of the General Education program, it is expected that courses be accessible to students from all backgrounds, and the reviewing faculty are concerned that there will not be enough background provided to allow any students to be successful if they happen to not be enrolled in a similar major program. Additionally, they ask that the steps being taken to ensure all students are successful be detailed in the course syllabus so students can understand how they will be successful.

Response C2: Individual students are not expected to have field related advantages in the proposed ES/CE3530 course, regardless of the student's major. This lack of overall advantage is directly connected to the interdisciplinary nature of the study of extreme events, which involves multiple and diverse fields of study, including economy, public policy, human health, law, social sciences, climatology, earth sciences, engineering, hydrology, ecology, technology, probability/risk, management, and government. Nevertheless, on specific assignments certain students may encountered a slight advantage related to their major and/or individual interests, e.g., when discussing recovery from hurricanes students from History, Political Science, English and Pre-Law majors will be better suited to compare the fast rebound of Houston, TX, after Harvey in 2017, versus the stalled recovery of Puerto Rico after Maria in 2017, since:

- Texas benefited from the pressure in Washington, DC, of two highly vocal Senators and 36 U.S. House members, and a sympathetic White House;
- Puerto Rico is not a State and has a single non-voting delegate in the U.S. House of Representatives;
- The 1920 Jones Act restricted transportation of emergency supplies to Puerto Rico by requiring that all goods be transported on American built, owned, flagged and crewed vessels[2];
- The Puerto Rican government was bankrupt prior to Maria and in 2015 (two years before Maria) declared its debt "unpayable" following decades of mismanagement, corruption and excessive borrowing[3].

Because, extreme events are widely reported in the news (as shown below), students from all backgrounds tend to be deeply interested in the subject. In the instructors' experience, students want to learn more about the impacts of extreme events, and are willing to research subjects outside their major, and thus be successful in a course such as ES/CE3530. The importance of extreme events in the news is illustrated by listing some of ones reported in August, 2022 alone, by the news media:

- Flooding in St. Louis, Eastern Kentucky, Virginia, and Illinois. In total, five U.S. cities experiencing instances of 1,000-year rain events;
- Record Monsoon rains, major flooding and landslides across India and Bangladesh, including what has been called a "climate catastrophe," in Pakistan;

[2] https://www.chicagotribune.com/nation-world/ct-jones-act-puerto-rico-20170927-story.html
[3] https://www.nbcnews.com/news/latino/close-puerto-rico-ending-bankruptcy-are-3-things-know-rcna12657

- Scorching high temperatures in Europe, Middle East, China, and U.S.A., including record temperatures across many cities worldwide;
- Parched riverbeds, unnavigable rivers and/or shrinking reservoirs in Western U.S.A., France, Germany, etc.;
- Glaciers melting at record rates across the globe, including Greenland and Antarctica.

The course does not require that students have a science or engineering background and instructors are committed to make the proposed ES/CE3530 course accessible to students from all backgrounds. Furthermore, instructors have extensive experience teaching courses where students from multiple disciplines are enrolled and teaching them basic concepts in their respective fields.

The proposed course is an expanded version of a course that was previously taught as a 1 credit hour freshman seminar (ARTSCI-1137.24-010: Learning from disasters) between AU2019 and AU2020 and was selected/funded by the American Council on Education (ACE)[4] to be taught remotely, allowing students from multiple disciplines at OSU to work in teams with Japanese students in 2020. Importantly, less than 10% of students enrolled in ARTSCI-1137.24-010 were engineering majors, and enrolled students reported being most interested in paths leading to careers in business, journalism, administration, or government; regardless of their major, students in ARTSCI-1137.24-010 were successful and reported the course to be intellectually stimulating (Question 2 in Figure 3).

Question	Instructor		Department (ASC Administration)		College (Arts and Sciences S)		University (1208 S)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
1. The subject matter of this course was well organized	3.80	0.79	4.42	0.81	4.40	0.88	4.42	0.87
2. This course was intellectually stimulating	4.40	0.52	3.87	1.12	4.43	0.85	4.44	0.84
3. This instructor was genuinely interested in teaching	4.60	0.70	4.48	0.75	4.60	0.75	4.61	0.74
4. The instructor encouraged students to think for themselves	4.40	0.70	4.37	0.81	4.57	0.75	4.58	0.73
5. The instructor was well prepared	4.50	0.71	4.50	0.74	4.48	0.85	4.49	0.84
6. The instructor was genuinely interested in helping students	4.30	0.67	4.59	0.71	4.60	0.77	4.61	0.75
7. I learned a great deal from this instructor	4.20	0.63	4.23	0.93	4.38	0.93	4.40	0.91
8. The instructor created an atmosphere conducive to learning	4.00	0.87	4.35	0.81	4.44	0.88	4.45	0.86
9. The instructor communicated the subject matter clearly	4.20	0.63	4.45	0.77	4.39	0.94	4.42	0.91
10. Overall, I would rate this instructor as	4.10	0.99	4.53	0.75	4.54	0.84	4.56	0.82

Figure 3: Pradel's SEIs of precursor course ARTSCI-1137.24-010: Learning from disasters

[4] https://oia.osu.edu/news/ohio-state-and-university-of-tsukuba-awarded-coil-partnership/ and https://ceg.osu.edu/news/2020/07/geotechnical-engineering-faculty-develop-course-japanese-colleagues

A strategy that will be used to stimulate learning in ES/CE3530 is to create interdisciplinary student teams (students grouped in order to have multiple different majors in each team) where they are encouraged to draw from each other area of strength, discuss their findings, and present their consensus as a team. This approach was used very successfully in the precursor ARTSCI-1137.24-010 course, where as an example students were asked in an assignment to review and discuss estimates of fatalities immediately after an extreme events by the following techniques:

- Research and review of news articles (an area of strength for an English major)
- Statistical analysis of similar events (an area of strength for Math or Engineering majors)
- Predictive numerical models (an area of strength for a Business majors)

To address the concern that steps are being taken to ensure all students are successful and explain how students can improve their chances of success, the following paragraph has been added on Page 1 of the syllabus:

Course Prerequisites

None. *As a general education cross-listed team-taught course, all interested students are encouraged to enroll and all students can succeed in this course irrespective of their major or prior background. The study of extreme events is truly interdisciplinary and involves multiple and diverse fields of study, including law, economy, public policy, human health, social sciences, climatology, earth sciences, engineering, hydrology, ecology, technology, probability/risk, management, and government.*

And Page 7 of the syllabus:

Regardless of the student's major, individual students are not expected to have discipline/field related advantages (or disadvantages) in the course. This lack of overall advantage is directly connected to the interdisciplinary nature of the study of extreme events, which involves multiple and diverse fields of study, including law, economy, public policy, human health, social sciences, climatology, earth sciences, engineering, hydrology, ecology, technology, probability/risk, management, and government. ***All students can succeed in this course.*** Nevertheless, on specific assignments certain students may find a slight advantage related to their major, background, experiences and/or individual interests; in such instances, students are strongly encouraged to share their knowledge with their team and with the entire class during in-class discussions/presentations.

Contingency C3: The reviewing faculty ask that the GE Goals and ELOs be placed within the course syllabus as they appear on the ASC Curriculum and Assessment Services website, which can be found here: https://asccas.osu.edu/curriculum/syllabus-elements. Currently, on pages 8-10 of the syllabus, the GE Goals and ELOs have been customized for the individual course.

Response C3: The sustainability theme GE Goals and ELOs from https://asccas.osu.edu/new-general-education-gen-goals-and-elos are reported verbatim on page 4 of the syllabus and the source is referenced by a footnote.

Contingency C4: The reviewing faculty request that a cover letter be provided that details all changes made in response to this feedback.

Response C4: The present document provides a detailed explanation of all changes made in response to the Panel's feedback.

Recommendation R1: The reviewing faculty recommend adding more information to the course syllabus about which of the six dimensions of Sustainability will be discussed during any given individual class meeting.

Response R1: The Course Schedule has been expanded in Pages 19 to 22, and coverage of six dimensions of Sustainability clarified within the schedule; a copy of the revised course schedule is attached, below:

Week No.	Class Title / Topic / Sustainability's six dimensions framework[5]
1	**Introduction:** Scope and organization of the course, discussion of Syllabus and student deliverables; group assignments. Introduction to sustainability's six dimensions framework including examples: • *#1 Systems: coupled human-natural systems, integrating environmental, economic and social factors, systems thinking, resilience* • *#2 Environment: environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, geology, ecology; understanding of how these systems impact human well-being (e.g., health, and economy)* • *#3 Economic-political: economic and political factors of sustainability (economy/consumption/production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)* • *#4 Social-cultural: social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, citizenship, power, behavior and decision making, cultural critique...)* • *#5 Technology & design: engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)* • *#6 Well-being: human health, safety, risk, sustainable livelihoods, social welfare and well-being*
2	**Hurricanes (wind and precipitation):** Instructor presentation on the effects of Hurricanes Irma and Maria in Puerto Rico and US Virgin Islands. Assignment of specific topics related to hurricanes for student presentations. • *#1 Systems: effects of wind and landslides on Puerto Rico's power grid collapse, damaged water infrastructure, concentrated vs. decentralized electric power generation (vulnerability/resilience)...* • *#2 Environment: debris flows, erosion, silt in reservoirs, construction debris collection/storage, effect of landslides on transportation infrastructure…* • *#3 Economical-political: lack of effective pollical representation in DC (Puerto Rico is not a state), bankrupt local government, 1920 Jones Act .* **Hurricanes (rescue and recovery):** Instructor presentation on rescue efforts and recovery after a major hurricane and Puerto Rico's recovery after Hurricane Maria. • *#4 Social-cultural: complex history and relation with mainland (language, religion, tax status, pro-independence movement)* • *#6 Well-being: combination of poverty, high cost of living, high percentage of population on social welfare and difficult to access populations.*

[5] listed in italics in the table, together with specific topics of discussion and examples

	Lasting effects of extreme events and measures to increase resilience: Instructor presentation on the short and long term effects of Hurricane Katrina in New Orleans, and measures taken at the local and federal level to decrease New Orleans vulnerability of levees and buildings. Assignment of specific topics related to global warming for student presentations. • *#5 Technology & design: aged infrastructure and technology, centralized power generation and vulnerable infrastructure, lack of steel and cement factories.*
3	**Thematic student presentations No.1 (hurricanes) / submission of report No.1**
4	**Global warming and sustainability:** Recent experience along the Gulf Coast, from Katrina in 2005 to the historical 2020 season (which ran out of hurricane names and had to use Greek letters); increased number of devastating hurricanes in recent decades and predictions from global warming models. • *#2 Environment: evidence of global warming and its connection with increase number/magnitude of extreme events such as hurricanes, droughts, heat waves, floods, and sea rise.*
5	**Thematic student presentations No.2 (rescue, recovery and global warming) / submission of report No.2**
6	**Dam failures and flooding:** Instructor presentation on the causes and effects of the 1928 St Francis Dam Failure (California), 1976 Teton Dam Failure (Idaho) and 2020 Edenville Dam Failure (Michigan). Assignment of specific topics related to dam failures for student presentations • *#1 Systems: use of dams for hydroelectric power generation, levees and dams for flood control, costs and risks resulting from an aged and poorly maintained infrastructure…* • *#3 Economic-political: impact of global warning on spillways' design floods, impact of federal and state regulations, cost of improving/manage aging dams and hydroelectric power plants…* • *#5 Technology & design: reduction of vulnerability resulting from increased number and magnitude of extreme events, sensors and remote sensing, improved warning systems, technological innovation.*
7	**Thematic student presentations No.3 (dam failures and flooding) / submission of report No.3**
8	**Wildfires, landslides and debris flows:** Instructor presentation on the 2005 landslide at La Conchita in California and 2014 Oso Landslide in Washington; deforestation caused by wildfires followed by erosion and debris flows. Assignment of specific topics for student presentations regarding landslides and mudflow disasters. • *#2 Environment: contamination, impact of mudflows and debris flows on homes, road networks, rivers and reservoirs…*

	• *<u>#3 Economic-political:</u> economic impact on affected communities, land prices and future use of individual and public lands, impact of fire insurance, …* • *<u>#4 Social-cultural:</u> lawsuits between neighboring property owners and against power companies, loss of natural and cultural resources...* • *<u>#6 Well-being:</u> sustainable hillside developments and architecture, acceptable risk, insurance coverage.*
9	**Thematic student presentations No.4 (wildfires, landslides and mudflows) / submission of report No.4**
10	**Earthquakes and tsunamis (hazard and effects):** Instructor presentation on the effects of the 2011 Tohoku Earthquake and tsunami in Japan and on the geological record of past Earthquakes and tsunami events offshore of Japan. Assignment of specific topics related to earthquakes for student presentations. • *<u>#1 Systems:</u> effects of Tsunami of Fukushima nuclear reactor meltdown, damaged electric/road/water/gas/sewer infrastructure from ground liquefaction around Tokyo, failure of Fujinuma dam...* • *<u>#2 Environment:</u> geology and seismicity of Japan, impact of debris on ecology and landfills…* • *<u>#3 Economic-political:</u> economic and political impacts of the Fukushima nuclear reactor meltdown, comparison of post-earthquake measures at Dai-Ichi and Dai-Ni nuclear plants…* • *<u>#5 Technology & design:</u> impact of building codes on structural engineering performance; technological innovation for building and bridge construction, new methods to repair damaged buildings…* • *<u>#6 Well-being:</u> sustainable earthquake resisting architecture, acceptable risk, self-sustained power generation options, insurance coverage.*
11	**Thematic student presentations No.5 (Earthquakes and Tsunamis) / submission of report No.5**
12	**Extreme event disasters in developing countries:** Instructor presentation on the effects of the 2010 Haiti Earthquake and 2015 Gorkha Earthquake in Nepal. Assignment of specific topics for student presentations • *<u>#2 Environment:</u> geology and seismicity of Nepal and Haiti, impact of reusing debris in new construction.* • *<u>#3 Economic-political:</u> economic and political impacts of a major event on poor countries, international assistance, emigration (brain drain), impacts on hospitals and public health, affordability of preparedness measures.* • *<u>#5 Technology & design:</u> impact of obsolete and/or poorly enforced building codes on structural engineering performance; low cost alternatives for shoring buildings and restoring bridges, new methods to restore potable drinking water.* • *<u>#6 Well-being:</u> lack of earthquake resisting critical structures, high acceptable risk, poverty, diseases, large proportion of vulnerable populations.*

13	**Thematic student presentations No.6 (disasters in developing countries) / submission of report No.6**
14-15	**Discussions and conclusions:** In-class discussions on topics including: vulnerability to extreme events, effects of global warming, lessons learned from case histories, preparedness, infrastructure robustness, and measures to enhance flexibility and resilience. Students suggestions to enhance resilience and reflections on sustainability. • *#1 Systems: coupled human-natural systems, integrating environmental, economic and social factors, systems thinking, resilience* • *#2 Environment: environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, geology, ecology; understanding of how these systems impact human well-being (e.g., health, and economy)* • *#3 Economic-political: economic and political factors of sustainability (economy/consumption/production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)* • *#4 Social-cultural: social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, citizenship, power, behavior and decision making, cultural critique...)* • *#5 Technology & design: engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)* • *#6 Well-being: human health, safety, risk, sustainable livelihoods, social welfare and well-being*

High-Impact Practice: Interdisciplinary Team-Teaching

Earth Sciences/Civil Engineering 3530 was not voted on as the Panel would like the following feedback items addressed:

1. The reviewing faculty are unable to see how the instructors co-teaching the course will engage in Interdisciplinary Team-Teaching as defined by the High-Impact Practice forms created by the Office of Academic Affairs (see here: https://oaa.osu.edu/sites/default/files/uploads/general-education-review/new-ge/interdisciplinary-team-courses-description-expectations.pdf)

2. While they acknowledge that the course is being co-taught, in order to count within the Interdisciplinary Team-Teaching category, a course must establish that an interdisciplinary co-teaching style will be developed and introduced, as defined by the Office of Academic Affairs. For example:

    a) "In multidisciplinary courses, faculty present their individual perspectives one after another, leaving differences in underlying assumptions unexamined and integration up to the students. In interdisciplinary courses, whether taught by teams or individuals, faculty interact in designing a course, bringing to light and examining underlying assumptions and modifying their perspectives in the process. They also make a concerted effort to work with students in crafting an integrated *synthesis* of the separate parts that provides a larger, more holistic understanding of the question, problem or issue at hand. Smith's iron law bears repeating: 'Students shall not be expected to integrate anything the faculty can't or won't' (quoted in Gaff, 1980, pp. 54-55). (Klein & Newall, 12)."

    b) "A team-taught course requires that two or more faculty from different disciplines, programs or departments develop and offer a course together. Team-taught courses must be taught collaboratively by faculty who integrate distinctly separate disciplines, model interdisciplinary academic exchange, and demonstrate the interdisciplinary nature of the course. This includes explicitly synthesizing across and between the disciplines that each instructor brings to the team-taught, interdisciplinary course."

    c) "Teaching partners are expected to collaborate on defining the objectives for the course, putting together the course materials, conducting the formal instruction of students, and evaluating student performance. Note that courses in which one faculty member of record convenes the course and invites one or more guest speakers to take part in the class are not considered team-taught courses."

3. Additionally, they would like the Interdisciplinary Team-Teaching aspect of the course to be fully integrated and explained in the course syllabus. Students should be able to clearly understand how they can expect to be instructed and how this will fulfill the High-Impact Practice.

4. The reviewing faculty request that a cover letter be provided that details all changes made in response to this feedback.

Response HIP1 & HIP2: The team-taught inventory was modified to address the concerns detailed above and expanded on here: The study of extreme events is interdisciplinary by nature and many disciplines are engaged in the research and mitigation of these devastating events, including climatology, earth sciences, engineering, hydrology, ecology, public health and social sciences. Furthermore, recovery after extreme events and management of resources is often highly impacted by political decisions, legislation, wealth/poverty, local characteristics, and the major contributions that preparedness and design methods/concepts have on damage. The new cross-listed team-taught course centers on a number of specific case studies of natural hazards, each of which include inquiry into the fundamental scientific principles involved for each hazard, and feedbacks between societal, political, and engineering challenges; hence, the nature of the subject is multidisciplinary. **Given that this course is taught by two instructors from two very different disciplines (Civil Engineering and Geology), in different colleges at Ohio State, and the subject covers multiple disciplines, it is a truly interdisciplinary course.**

Students will learn about hazards caused by extreme events (including hurricanes, droughts, heat waves, wildfires, floods, earthquakes, and tsunamis) through case studies (e.g., 2005 hurricane Katrina in New Orleans, and 2017 hurricane Maria in Puerto Rico, and 2011 Tsunami in Japan) in the following manner:

a) School of Earth Sciences Instructor: will present the scientific aspect of each hazard, including the natural processes involved (e.g., tectonic movements, propagation of seismic waves, global warming), methods of monitoring (e.g., seismographs, remote sensing, river gauges and sensors) and hazard analysis.

b) Dept. of Civil Engineering Instructor: will present engineering challenges, including impacts on structures, infrastructure, disaster assistance, economy, recovery, public policy, society and ramifications of political decisions.

c) Guest lectures by Specialist: Students will benefit from additional perspectives provided by external speakers from government agencies (e.g., FEMA, USACE), private industry (e.g., Batelle), and university researchers who will discuss their real-world experience studying and/or mitigating effects of natural hazards covered in the course. These guest speakers will have a range of backgrounds and disciplinary expertise.

d) In-class discussions: Each case history or extreme event will be followed by interdisciplinary discussions throughout the semester. At the end of the semester, synthesis in-class discussions with both instructors will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance preparedness, and most importantly on students' suggestions to enhance the resilience of our society and their reflections on sustainability.

e) Student interdisciplinary team work: The instructors will create interdisciplinary teams of students (grouped in order to have multiple different majors in each team) where they are encouraged to draw from each other area of strength, discuss each other findings, and present their consensus opinions and recommendations as a team. Each case study will culminate in sessions where students will make thematic presentations, participate in interactive synthesis discussions (see section below), and submit reports where they synthesize information across and between disciplines covered in this interdisciplinary course.

Note that in a through c , above, the instructors will leave some underlying assumptions unexamined (e.g., the connection between earthquake hazard and seismic damage/vulnerability) and integration/synthesis will be done during in-class discussions with both instructors present and by the students working in interdisciplinary teams. Furthermore, the last two weeks of the course are reserved to provide an integrated synthesis of the course's separate elements and provide a larger, more holistic understanding of the overall impacts of extreme events on society, as well as, for students to suggest economic, political and/or technology mitigation measures to improve resilience and reduce risks.

It is the instructors' opinion that the approach described above is consistent with " Klein and Newell (1997) definition of interdisciplinary integration, as well as, meets the following criteria for interdisciplinary courses:

- "Address a topic that is too broad or complex to be dealt with adequately by a single discipline or profession"
- "Draw on different disciplinary perspectives"
- "Integrate their insights through construction of a more comprehensive perspective"

- **Response HIP3:** The Syllabus has been revised to better explain how the material will be covered by the Earth Science and Civil Engineering instructors, how the content and student work interdisciplinary, how and how the course will fulfill the High-Impact Practice definitions/requirements. The following paragraph has been added on Page 23:

INTERDISCIPLINARY NATURE OF THE COURSE AND How multiple perspectives will be presented and discussed

The course centers on a number of specific case studies of natural hazards, each of which include inquiry into the fundamental scientific principles involved for each hazard, and feedbacks between societal, political, economic, legal and technological challenges; hence, the course is truly interdisciplinary in nature. In this course, the instructors will keep the content interactive and interdisciplinary in the following manner:

a) School of Earth Sciences Instructor: will present the scientific aspect of each hazard, including the natural processes involved, methods of monitoring and hazard analysis.
b) Dept. of Civil Engineering Instructor: will present engineering challenges, including impacts on structures, infrastructure, disaster assistance, economy, recovery, public policy, society and ramifications of political decisions.

c) Guest lectures by Specialists: Students will benefit from additional perspectives provided by external speakers from government agencies (e.g., FEMA, USACE), private industry (e.g., Batelle), and university researchers who will discuss their real-world experience studying and/or mitigating effects of natural hazards covered in the course. These guest speakers will have a range of backgrounds and disciplinary expertise.

d) In-class discussions: Each case history or extreme event will be followed by interdisciplinary discussions throughout the semester. At the end of the semester, synthesis in-class discussions with both instructors will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance preparedness, and most importantly on students' suggestions to enhance the resilience of our society and their reflections on sustainability.

e) Student interdisciplinary team work: The instructors will create interdisciplinary teams of students (grouped in order to have multiple different majors in each team) where they are encouraged to draw from each other area of strength, discuss each other findings, and present their consensus opinions and recommendations as a team.

Response HIP4: The present document provides a detailed explanation of all changes made in response to the Panel's feedback.

CIVILEN & EARTHSC 3530: Learning from disasters: Extreme events and their impact on infrastructure, engineering and society

SPRING SEMESTER 2023

Class time and location: Mondays, Tuesdays, Wednesdays, and Thursdays @ 4:10-5:05PM (**ZOOM**)

Course credit hours: 4

COE Instructor: Dr. Daniel Pradel (Civil Engineering)

Email address: pradel.1@osu.edu

Phone number: 614-688-2708

CAS Instructor: Dr. Cristina Millan (Earth Sciences)

Email address: millan.2@osu.edu

Zoom link: https://osu.zoom.us/my/pradel (password: geo)

Office hours: Monday through Thursday 10:00–11:00AM via Zoom.
Additional office hours at alternative times or days are available by appointment (please request appointment 24hrs in advance).

Course Prerequisites

None. *As a general education cross-listed team-taught course, all interested students are encouraged to enroll and all students can succeed in this course irrespective of their major or prior background. The study of extreme events is truly interdisciplinary and involves multiple and diverse fields of study, including law, economy, public policy, human health, social sciences, climatology, earth sciences, engineering, hydrology, ecology, technology, probability/risk, management, and government.*

COURSE OVERVIEW

Course description

The cross-listed team-taught course is an introduction to the multidisciplinary study of extreme events and sustainability. The course will cover natural hazards, such as hurricanes, heat waves, flooding, earthquakes, landslides, volcanic eruptions, and tsunamis, which are of great importance because of their potential to cause extensive damage and their impacts on people, infrastructure, and nature. The course centers on a number of specific case studies of natural hazards, each of which include inquiry into the fundamental scientific principles involved for each hazard, and feedbacks between societal, political, economic, legal and technological challenges; hence, the course is truly interdisciplinary in nature.

The course is structured in a seminar type format, where students will first perform individual scholarly research about a specific case history, then work with other students on a thematically organized presentation, and lastly, participate in class discussions with both instructors. Through their study of case histories, students will gain in-depth multidisciplinary knowledge about extreme events, their relationship with our environment, their consequences, and the different approaches that societies have implemented to mitigate disasters.

During class discussions, students will examine the case histories in terms of preparedness, vulnerability, effects, robustness, flexibility, and resilience, which are important from a sustainability perspective. Students will also discuss the impact of local legislation, wealth/poverty, political decisions, local characteristics, and the major impacts that various engineering design methods/concepts have on damage. The case histories will include extreme weather events that had devastating environmental effects and long lasting economic as well as social consequences, e.g., hurricanes Katrina (2005) and Maria, Irma and/or Harvey in 2017. Natural hazards will include the 2011 Tohoku earthquake and tsunami in Japan, the 2010 Haiti earthquake, and/or the 2015 Gorkha earthquake in Nepal. The case histories will also include man-made disasters, such as dam and levee failures, the damage to the power grid in Puerto Rico in 2017, and/or the melt-down of the Dai-Ichi nuclear plant in Japan in 2011.

Through the study of case histories, students will gain an understanding of the long-term impacts and difficult recovery from extreme events, which are important from a sustainability perspective. Students will also examine the effects of extreme events in developing countries, where limited resources often result in medical threats from infectious diseases due to lack of clean water and emergency medical services (e.g., 2010 Haiti and 2015 Nepal earthquakes); similarly, students will examine how historical decisions in planning, engineering and/or urban development, as well as legislation play important roles that often magnify the destructive effects of extreme events (e.g., levee construction/design methods and urban planning used in New Orleans, the urban planning in the center of Kobe in Japan, the Jones Act that restricts the boats and crews that delivered emergency supplies to Puerto Rico after Maria).

Lastly, students will learn about the six dimensions of sustainability (listed below) and how most global warming models predict a sharp increase in the number, as well as severity, of extreme events.

Sustainability Six Dimensions Framework

1) **Systems:** coupled human-natural systems, integrating environmental, economic & social factors, systems thinking, resilience

2) **Environment:** environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, aquatics, soils, forests, wildlife, geology, ecology, agriculture; understanding of how these systems impact human well-being (e.g., health, economy, social justice, future generations)
3) **Economic-political:** economic and political factors of sustainability (economy/consumption/production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)
4) **Social-cultural:** social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, the arts, citizenship, power, behavior and decision making, cultural critique...)
5) **Technology & design:** engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)
6) **Well-being:** human health, safety, risk, sustainable livelihoods, social welfare and well-being

ASSESSMENT AND LEARNING OUTCOMES

ABET Accreditation Program Learning Outcomes:

None

Engineering learning outcomes:

By the end of this course, students should successfully be able to:

- Identify the main impacts and threats caused by extreme events.
- Identify methods used to prevent and/or mitigate extreme events, and their immediate as well as long-term consequences.
- Identify how regulations, building codes and mitigation methods change following extreme events, and evolve through time.
- Understand how managers, designers and engineers apply mitigation and design procedures intended to reduce the impacts caused by extreme events.
- Understand the importance of resilience in the development of infrastructure.

Earth Science learning outcomes:

By the end of this course, students should successfully be able to:

- Describe the physical, chemical, and/or biological processes that drive extreme events.
- Understand feedback loops between natural and anthropogenic factors that cause extreme events.
- Identify precursory phenomena that allow scientists and engineers to monitor and/or predict extreme events.
- Describe monitoring methods for extreme phenomena.

OSU GENERAL EDUCATION PROGRAM STRUCTURE

This course fulfills the GE Sustainability Theme as an interdisciplinary team-taught course.

General Education Sustainability Theme Goals[1]:

GOAL 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than in the Foundations component. [Note: In this context, "advanced" refers to courses that that are e.g., synthetic, rely on research or cutting-edge findings, or deeply engage with the subject matter, among other possibilities.]

GOAL 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

GOAL 3: Successful students will analyze and explain how social and natural systems function, interact, and evolve over time; how human well-being depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multifaceted potential solutions across time.

General Education Sustainability Theme Expected Learning Outcomes[1]:

Successful students are able to:

ELO 1.1 Engage in critical and logical thinking about the topic or idea of the theme.

ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme.

[1] https://asccas.osu.edu/new-general-education-gen-goals-and-elos

ELO 2.1 Identify, describe, and synthesize approaches or experiences as they apply to the theme.

ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.

ELO 3.1 Describe elements of the fundamental dependence of humans on Earth and environmental systems, and on the resilience of these systems.

ELO 3.2 Describe, analyze, and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, present, and future.

ELO 3.3 Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.

This cross-listed team-taught course fulfills these goals and expected learning outcomes by asking students to research and study case histories of devastating extreme events, including Hurricane Katrina which devastated New Orleans in 2005, Hurricane Maria which destroyed Puerto Rico's power grid in 2017, and the Tohoku Earthquake which resulted in a major Tsunami and meltdown at Fukushima nuclear plant in Japan in 2011, as well as, natural hazards including floods (from natural causes and dam failures), heat waves, droughts and wildfires from a sustainability perspective (as outlined in the course schedule).

Through the study and research of extreme events' case histories students will learn, discuss and make interdisciplinary team presentations about the hazards, mitigation, management and nature of these events (including their findings from diverse disciplines, including climatology, earth sciences, engineering, hydrology, ecology, public health, history and social sciences). Similarly, the study of recovery after extreme events will require research on the impacts of legislation, wealth/poverty, political decisions, local characteristics, and the major impacts that preparedness and design methods/concepts have. At the end of the semester, the course culminates with synthesis in-class discussions that will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance disaster preparedness, and most importantly on students' suggestions to enhance resilience and their reflections on sustainability.

HOW THIS COURSE WORKS

Mode of delivery:

The lectures are 100% online and will be conducted on Zoom at their scheduled time.

Participating in online activities for attendance:

Instructor will hold Zoom live lectures, where students are expected to attend and participate (e.g., make group presentations). There will be Top Hat quizzes on a regular basis during lectures and students must be connected in order to answer them. The live lectures will be recorded and links to lectures will be available shortly thereafter.

Office Hours and Live Sessions:

Office hours will be held at their scheduled time via Zoom. For students on the Columbus campus, in-person office hours are optional.

Credit hours and work expectations:

According to Ohio State policy, students should expect to have 1 hour of direct instruction and 2 hours of out-of-classroom work (for a total of 3 hours) per every 1 credit hour earned to receive a grade of (C) average.

Required Activities and Deliverables:

- Students are expected to attend all Zoom sessions (live lectures) and participate in seminar discussions.
- Weekly readings, student presentations, and individual research are expected.
- We expect that students will have the opportunity of working with peers from foreign universities (e.g., the University of Tsukuba[2], in Japan, where a similar course is approved). The type, format and extent of outside participation will depend on the respective enrollment from other universities and will be detailed once the semester has begun.

[2] http://www.tsukuba.ac.jp/en/

SAMPLE ASSIGNMENT

Introduction: Thematic Student Reports, Presentations and Discussions

For each thematic topic, students will be divided into groups and assigned a specific topic of research (a sample assignment with a list of thematic topics is provided below). During student presentations instructors will act as moderators and encourage questions from other teams and group discussions. The format of the sessions will be similar to that of a graduate student seminar where challenging each other opinions is encouraged. The instructors will moderate sessions according to their area of expertise (e.g., disaster assistance and recovery will be moderated by the instructor from Civil Engineering), and/or their field reconnaissance experience.

Regardless of the student's major, individual students are not expected to have discipline/field related advantages (or disadvantages) in the course. This lack of overall advantage is directly connected to the interdisciplinary nature of the study of extreme events, which involves multiple and diverse fields of study, including law, economy, public policy, human health, social sciences, climatology, earth sciences, engineering, hydrology, ecology, technology, probability/risk, management, and government. ***All students can succeed in this course.*** Nevertheless, on specific assignments certain students may find a slight advantage related to their major, background, experiences and/or individual interests; in such instances, students are strongly encouraged to share their knowledge with their team and with the entire class during in-class discussions/presentations.

Example of Thematic Topic: Puerto Rico's Recovery from Hurricane Maria

Individual reports (single bullet) and thematic group presentations shall concentrate on the 2018-2021 recovery period from Hurricane Maria in Puerto Rico. Hence, submissions should only discuss briefly emergency actions taken between October and December 2017.

Thematic Group 1: Infrastructure topics (#2, 5 and 6)[3].

- Power generation and electric distribution (electric grid, hydroelectric dams, renewable sources, etc.)
- Water treatment and distribution of drinkable water.
- Transportation (airports, bridges, freeways, traffic lights, etc.)
- Short vs. long-term building repairs (e.g., blue roofs), differences between residential and commercial building repairs, etc.
- Emergency and long-term repairs of hospitals and other public buildings; impact on services

[3] Highlighted numbers, indicate the dimensions of sustainability that are primarily covered.

Thematic Group 2: Effects of federal legislation and political setting (#3 and 4).

- Impact of the "1920 Jones Act" legislation
- Political representation in Washington (impact of US territory vs. state)
- FEMA's funding, warehouses and asset allocation
- Distribution of federal funds between Texas, Florida and Puerto Rico after the 2017 hurricanes (Harvey, Irma and Maria)

Thematic Group 3: Economic topics (#1 and 3).

- Destruction of sources of income (e.g., tourism before vs. after Maria)
- Effect on manufacturing (e.g., pharmaceutical industry) both in Puerto Rico and on the mainland
- Impact of laws such as the "1920 Jones Act" on recovery in Puerto Rico
- Impact of public debt, fiscal policies and corresponding austerity measures of Puerto Rico's government during the decade prior to Maria

Thematic Group 4: Public health/wellbeing (#2, 4 and 6).

- Impact of damaged schools, hospitals, pharmacies on Puerto Ricans
- Estimated vs total death toll, and suicide rate
- Environmental impacts from mold and fungi on Puerto Ricans living in damaged buildings
- Impact on the island of residents' migration to the continental USA

Deliverables:

- Prior to each student presentation session, students will submit a research report regarding an aspect (assigned by instructor) of a case history and their group's PowerPoint presentation (an assignment example is provided above). The text portion of the research reports should be about ~500 words long (title and references excluded). There is no limit to the number of figures and/or photos that can be attached in a separate appendix.
- Student presentations will be in groups of two to four students (depending on course enrollment) and will focus on a particular impact (assigned by instructor) of an extreme event (e.g., economic impact, flooding, transportation, power generation, clean water, impact of legislation, political setting, economics, medical needs, etc.). An assignment example is attached at the end of the syllabus; depending on the topic assigned by the instructor, student presentations will address some or all the following:
    - A brief description of the assigned topic and its main effects (e.g., type of devastation, health threats, economic impacts);
    - Preparedness of the city/region/country prior to the extreme event;
    - Remedial measures implemented after the extreme event;

- Short vs. long term consequences of the extreme event;
- Prevalence of the impact and increased risks following the event;
- Societal and behavioral impacts;
- Inequalities in disaster preparedness, data collection, emergency response and allocated resources;
- Impact of local legislation and/or political setting;
- News coverage, what is commonly remembered, and urban myths associated with the events;
- Strategies for reducing similar threats (e.g., implemented at location or elsewhere).
- **Important:** all student Presentations should have:
    - A “title” slide that identifies team members;
    - A slide where the main sources/references are listed;
    - A “conclusion” or “summary of findings” slide(s) at the end of the presentation.

COURSE MATERIALS

Required textbooks:

None

Suggested Readings/Resources

To research a topic the preferred source of information for students’ research papers are academic/scholarly publications, professional societies reports, government reports. Examples of such publications are presented below:

Weeks 1-3:

2005 Hurricane Katrina (New Orleans only)

FEMA (2006) “Hurricane Katrina in the Gulf Coast Mitigation Assessment Team Report Building Performance Observations, Recommendations, and Technical Guidance” FEMA 549 report

NIST (2006) “Performance of Physical Structures in Hurricane Katrina and Hurricane Rita: A Reconnaissance Report” NIST Technical Note 1476

2017 Hurricane Irma & Maria (Puerto Rico only)

GEER/NSF report from:
http://www.geerassociation.org/administrator/components/com_geer_reports/geerfiles/180629_GEER_PR_Report_No_GEER-057.pdf

Weeks 4-6:

1928 St Francis Dam Failure (California)

Rogers, J. D. (2006, 6:2). Lessons Learned from the St. Francis Dam Failure. Geo-Strata, 14-17.

Rogers, J. D. & Hasselmann, K. F. (2013). The St. Francis Dam Failure: Worst American Engineering Disaster of the 20th Century. AEG Shlemon Specialty Conference: Dam Failures and Incidents. Denver: Association of Environmental and Engineering Geologists.

VandenBerge, D. R., Duncan, J.M., & Brandon, T. (2011). Lessons Learned From Dam Failures. Virginia Polytechnic Institute and State University.

2020 Edenville and Sanford Dam Failures (Michigan)

Pradel D. and Lobbestael A. (2021) Edenville and Sanford Dam Failures, Field Reconnaissance Report. ASCE GSP327.

Weeks 7-9:

2005 La Conchita landslide (California)

Pradel D. (2014), "The Progressive Failure Reactivation of La Conchita Landslide in 2005", ASCE Geo-Congress 2014: Geo-Characterization and Modeling for Sustainability, ASCE GSP 234, 3209-3222.

Weeks 10-13:

2015 Gorkha Earthquake (Nepal)

Tiwari B., Pradel D., et al. (2018), "Landslide Movement at Lokanthali, during the 2015 Earthquake in Gorkha, Nepal ASCE Journal of Geotechnical and GeoEnvironmental Engineering, 10.1061/(ASCE) GT.1943-5606.0001842

GEER/NSF reports from:

http://www.geerassociation.org/administrator/components/com_geer_reports/geerfiles/Nepal_GEER_Report_V1_15.pdf

2011 Tohoku earthquake and tsunami (Japan)

Pradel D., Tiwari B., and Wartman J. (2011), "Landslides Triggered by 2011 Tohoku Pacific Earthquake: Preliminary Observations", Geo-Strata (ASCE's Geo-Institute) Sept./Oct. 2011, 28-32

Pradel D., Wartman J., and Tiwari B. (2014), "Impact of anthropogenic changes on liquefaction along the Tone River during the 2011 Tohoku Earthquake", ASCE Natural Hazards Review. Vol.15, 13-26.

Pradel D., Wartman J., and Tiwari B. (2013), "Failure of the Fujinuma Dams during the 2011 Tohoku Earthquake", ASCE Geo-Congress 2013: Stability and Performance of Slopes and Embankments III, GSP 231, 1566-1580.

GRADING AND FACULTY RESPONSE

Grade	Point %
A	100% - 93%
A-	90% - 92%
B+	87% - 89%
B	83% - 86%
B-	80% - 82%
C+	77% - 79%
C	73% - 76%
C-	70% - 72%
D+	67% - 69%
D	60% - 66%
E	0% - 59%

Grading:

Boundaries between grades are firm (there will be no rounding up).

- Research reports 40%
- Group presentations 40%
- Class participation 15%
- Top Hat quizzes 5%

Materials and submissions:

Lectures: Instructor's PowerPoint slides will be posted ahead of the Zoom live lectures. In advance of each lecture, students are expected to have researched the subject topic and studied the slides.

Assignments: A total of 6 research reports are anticipated, that require constant and continuous effort throughout the semester. Hence, students should plan ahead, and it is their responsibility to budget their time appropriately.

Presentations: A total of 6 group presentations are anticipated. Students' PowerPoint slides will be posted on Carmen ahead of the discussion session. Students are expected to have researched the discussion topic or extreme event case history in advance of the meeting.

Important: Potential problems (e.g., computer problems, cell phone or internet outages, etc.) can be anticipated by working/submitting ahead of time; furthermore, it is student's responsibility to verify that his/her files have been properly uploaded on Carmen. Hence, no penalty reduction will be provided for uploading issues or problems.

Attendance:

Attendance is expected to all Zoom live lectures, so that students can obtain the information necessary to comprehend the course material, make relevant presentations, participate in group discussions, etc. Attendance should enable students to successfully complete assignments and/or improve performance. Instead of taking attendance, there will be multiple-choice quizzes administered through ***Top Hat*** during most live lectures. The Top Hat quizzes will contribute to the grade and help instructor assess students' learning.

Assignments

- Students will have a week to complete their assignments, and all submissions will be due 3 hours before the relevant discussion session or lecture (e.g., if student presentations are assigned during lectures on a Monday, all Carmen submissions will be due 3 hours ahead of the meeting on the following Monday).
- Late submission will not be accepted (grade = zero). In case of severe illness, the student shall notify the instructor as soon as possible of the extenuating circumstance.
- Handwritten submissions are not allowed, and all assignments are to be submitted electronically in CARMEN. Students shall submit their reports and presentations as a single PDF file. Emailed assignments and/or different formats will not be accepted, nor receive points (grade = zero).

Grading and feedback:

- Feedback on homework and lab reports will be provided on Carmen, typically within a week.
- Instructor typically replies to emails within 24 hours
- Excused absences from quizzes and exams include illnesses or similar extenuating circumstance.

Tone and civility:

Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. The instructors are committed to making the classroom a comfortable space for all of us, and we ask that we all work toward this goal in all of the course's online spaces. We will respect each other and practice civility at all times. Disrespectful language will not be tolerated.

Academic integrity policy:

Quizzes: You must complete quizzes yourself, i.e., without any external help or communication.

Written assignments: Your written assignments, should be your own original work. Copy/paste from the internet will be severely punished.

Reusing past work: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on previous work or revisit a topic you've explored in previous courses, please discuss the situation with instructor.

Falsifying data or results: All the analyses you will conduct in this course are intended to be a learning experience; you should never feel tempted to adjust or modify data/results.

Collaboration and informal peer-review: The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of written projects is encouraged, remember that the written reports you submit must be your own work.

Ohio State's Academic Integrity Policy: Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's *Code of Student Conduct*, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If we suspect that a student has committed academic misconduct in this course, we are obligated by university rules to report our suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact instructors.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- The Committee on Academic Misconduct web pages (COAM Home)
- *Ten Suggestions for Preserving Academic Integrity (Ten Suggestions)*
- *Eight Cardinal Rules of Academic Integrity* (www.northwestern.edu/uacc/8cards.htm)

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COURSE TECHNOLOGY

General

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- Self-Service and Chat support: ocio.osu.edu/help
- Phone: 614-688-4357(HELP)
- Email: servicedesk@osu.edu
- TDD: 614-688-8743

Proctoring:

During lectures, some questions (e.g., Top Hat quizzes) may be graded using automatic proctoring tools.

Baseline technical skills for online courses:

- Basic computer and web-browsing skills
- Navigating Carmen: for questions about specific functionality, see the Canvas Student Guide

Required technology skills specific to this course:

- Zoom virtual meetings
- Microsoft Office 365, especially Excel for graphs and PowerPoint for drawings

Required equipment:

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Other: a mobile device (smartphone or tablet) or landline to use for BuckeyePass authentication, as well as Top Hat quizzes.
- Webcam: built-in or external webcam, fully installed and tested
- Microphone: built-in laptop or tablet mic or external microphone

Required software:

- Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Full instructions for downloading and installation can be found at go.osu.edu/office365help.

Carmen Website:

All course material will be posted on the Carmen site at http://www.carmen.osu.edu.

Carmen access:

You will need to use BuckeyePass multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click "Enter a Passcode" and then click the "Text me new codes" button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Your mental health

A source available at s a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you find yourself feeling isolated, anxious or overwhelmed, please know that there are resources to help: ccs.osu.edu. You can reach an on-call counselor when CCS is closed at (614) 292-5766 and 24 hour emergency help is also available through the 24/7 National Prevention Hotline at 1-(800)-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource go.osu.edu/wellnessapp.

Accessibility accommodations for students with disabilities

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that you register with Student Life Disability Services (SLDS). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

SLDS contact information: slds@osu.edu; 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Carmen Canvas accessibility
- Streaming audio and video
- Zoom accessibility
- Collaborative course tools

Classroom Safety and Respect

CEGE Buckeyes take pride in masking up and physically distancing to protect others in public spaces. As members of the Ohio State University community, these actions are part of our personal and ethical responsibility to protect public health and safety.

COURSE SCHEDULE

Week No.	Class Title / Topic / Sustainability's six dimensions framework[4]
1	**Introduction:** Scope and organization of the course, discussion of Syllabus and student deliverables; group assignments. Introduction to sustainability's six dimensions framework including examples: • *#1 Systems: coupled human-natural systems, integrating environmental, economic and social factors, systems thinking, resilience* • *#2 Environment: environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, geology, ecology; understanding of how these systems impact human well-being (e.g., health, and economy)* • *#3 Economic-political: economic and political factors of sustainability (economy/consumption/production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)* • *#4 Social-cultural: social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, citizenship, power, behavior and decision making, cultural critique...)* • *#5 Technology & design: engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)* • *#6 Well-being: human health, safety, risk, sustainable livelihoods, social welfare and well-being*
2	**Hurricanes (wind and precipitation):** Instructor presentation on the effects of Hurricanes Irma and Maria in Puerto Rico and US Virgin Islands. Assignment of specific topics related to hurricanes for student presentations. • *#1 Systems: effects of wind and landslides on Puerto Rico's power grid collapse, damaged water infrastructure, concentrated vs. decentralized electric power generation (vulnerability/resilience)...* • *#2 Environment: debris flows, erosion, silt in reservoirs, construction debris collection/storage, effect of landslides on transportation infrastructure…* • *#3 Economical-political: lack of effective pollical representation in DC (Puerto Rico is not a state), bankrupt local government, 1920 Jones Act .* **Hurricanes (rescue and recovery):** Instructor presentation on rescue efforts and recovery after a major hurricane and Puerto Rico's recovery after Hurricane Maria.

[4] listed in italics in the table, together with specific topics of discussion and examples

	• *<u>#4 Social-cultural:</u> complex history and relation with mainland (language, religion, tax status, pro-independence movement)* • *<u>#6 Well-being:</u> combination of poverty, high cost of living, high percentage of population on social welfare and difficult to access populations.* **<u>Lasting effects of extreme events and measures to increase resilience:</u>** Instructor presentation on the short and long term effects of Hurricane Katrina in New Orleans, and measures taken at the local and federal level to decrease New Orleans vulnerability of levees and buildings. Assignment of specific topics related to global warming for student presentations. • *<u>#5 Technology & design:</u> aged infrastructure and technology, centralized power generation and vulnerable infrastructure, lack of steel and cement factories.*
3	**Thematic student presentations No.1 (hurricanes) / submission of report No.1**
4	**<u>Global warming and sustainability:</u>** Recent experience along the Gulf Coast, from Katrina in 2005 to the historical 2020 season (which ran out of hurricane names and had to use Greek letters); increased number of devastating hurricanes in recent decades and predictions from global warming models. • *<u>#2 Environment:</u> evidence of global warming and its connection with increase number/magnitude of extreme events such as hurricanes, droughts, heat waves, floods, and sea rise.*
5	**Thematic student presentations No.2 (rescue, recovery and global warming) / submission of report No.2**
6	**<u>Dam failures and flooding:</u>** Instructor presentation on the causes and effects of the 1928 St Francis Dam Failure (California), 1976 Teton Dam Failure (Idaho) and 2020 Edenville Dam Failure (Michigan). Assignment of specific topics related to dam failures for student presentations • *<u>#1 Systems:</u> use of dams for hydroelectric power generation, levees and dams for flood control, costs and risks resulting from an aged and poorly maintained infrastructure…* • *<u>#3 Economic-political:</u> impact of global warning on spillways' design floods, impact of federal and state regulations, cost of improving/manage aging dams and hydroelectric power plants…* • *<u>#5 Technology & design:</u> reduction of vulnerability resulting from increased number and magnitude of extreme events, sensors and remote sensing, improved warning systems, technological innovation.*

7	**Thematic student presentations No.3 (dam failures and flooding) / submission of report No.3**
8	**Wildfires, landslides and debris flows:** Instructor presentation on the 2005 landslide at La Conchita in California and 2014 Oso Landslide in Washington; deforestation caused by wildfires followed by erosion and debris flows. Assignment of specific topics for student presentations regarding landslides and mudflow disasters. • *#2 Environment: contamination, impact of mudflows and debris flows on homes, road networks, rivers and reservoirs…* • *#3 Economic-political: economic impact on affected communities, land prices and future use of individual and public lands, impact of fire insurance, …* • *#4 Social-cultural: lawsuits between neighboring property owners and against power companies, loss of natural and cultural resources...* • *#6 Well-being: sustainable hillside developments and architecture, acceptable risk, insurance coverage.*
9	**Thematic student presentations No.4 (wildfires, landslides and mudflows) / submission of report No.4**
10	**Earthquakes and tsunamis (hazard and effects):** Instructor presentation on the effects of the 2011 Tohoku Earthquake and tsunami in Japan and on the geological record of past Earthquakes and tsunami events offshore of Japan. Assignment of specific topics related to earthquakes for student presentations. • *#1 Systems: effects of Tsunami of Fukushima nuclear reactor meltdown, damaged electric/road/water/gas/sewer infrastructure from ground liquefaction around Tokyo, failure of Fujinuma dam...* • *#2 Environment: geology and seismicity of Japan, impact of debris on ecology and landfills…* • *#3 Economic-political: economic and political impacts of the Fukushima nuclear reactor meltdown, comparison of post-earthquake measures at Dai-Ichi and Dai-Ni nuclear plants…* • *#5 Technology & design: impact of building codes on structural engineering performance; technological innovation for building and bridge construction, new methods to repair damaged buildings…* • *#6 Well-being: sustainable earthquake resisting architecture, acceptable risk, self-sustained power generation options, insurance coverage.*
11	**Thematic student presentations No.5 (Earthquakes and Tsunamis) / submission of report No.5**

12	**Extreme event disasters in developing countries:** Instructor presentation on the effects of the 2010 Haiti Earthquake and 2015 Gorkha Earthquake in Nepal. Assignment of specific topics for student presentations • *#2 Environment: geology and seismicity of Nepal and Haiti, impact of reusing debris in new construction.* • *#3 Economic-political: economic and political impacts of a major event on poor countries, international assistance, emigration (brain drain), impacts on hospitals and public health, affordability of preparedness measures.* • *#5 Technology & design: impact of obsolete and/or poorly enforced building codes on structural engineering performance; low cost alternatives for shoring buildings and restoring bridges, new methods to restore potable drinking water.* • *#6 Well-being: lack of earthquake resisting critical structures, high acceptable risk, poverty, diseases, large proportion of vulnerable populations.*
13	**Thematic student presentations No.6 (disasters in developing countries) / submission of report No.6**
14-15	**Discussions and conclusions:** In-class discussions on topics including: vulnerability to extreme events, effects of global warming, lessons learned from case histories, preparedness, infrastructure robustness, and measures to enhance flexibility and resilience. Students suggestions to enhance resilience and reflections on sustainability. • *#1 Systems: coupled human-natural systems, integrating environmental, economic and social factors, systems thinking, resilience* • *#2 Environment: environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, geology, ecology; understanding of how these systems impact human well-being (e.g., health, and economy)* • *#3 Economic-political: economic and political factors of sustainability (economy/consumption/production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)* • *#4 Social-cultural: social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, citizenship, power, behavior and decision making, cultural critique...)* • *#5 Technology & design: engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)* • *#6 Well-being: human health, safety, risk, sustainable livelihoods, social welfare and well-being*

INTERDISCIPLINARY NATURE OF THE COURSE AND HOW MULTIPLE PERSPECTIVES WILL BE PRESENTED AND DISCUSSED

The course centers on a number of specific case studies of natural hazards, each of which include inquiry into the fundamental scientific principles involved for each hazard, and feedbacks between societal, political, economic, legal and technological challenges; hence, the course is truly interdisciplinary in nature. In this course, the instructors will keep the content interactive and interdisciplinary in the following manner:

a) School of Earth Sciences Instructor: will present the scientific aspect of each hazard, including the natural processes involved, methods of monitoring and hazard analysis.
b) Dept. of Civil Engineering Instructor: will present engineering challenges, including impacts on structures, infrastructure, disaster assistance, economy, recovery, public policy, society and ramifications of political decisions.
c) Guest lectures by Specialists: Students will benefit from additional perspectives provided by external speakers from government agencies (e.g., FEMA, USACE), private industry (e.g., Batelle), and university researchers who will discuss their real-world experience studying and/or mitigating effects of natural hazards covered in the course. These guest speakers will have a range of backgrounds and disciplinary expertise.
d) In-class discussions: Each case history or extreme event will be followed by interdisciplinary discussions throughout the semester. At the end of the semester, synthesis in-class discussions with both instructors will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance preparedness, and most importantly on students' suggestions to enhance the resilience of our society and their reflections on sustainability.
e) Student interdisciplinary team work: The instructors will create interdisciplinary teams of students (grouped in order to have multiple different majors in each team) where they are encouraged to draw from each other area of strength, discuss each other findings, and present their consensus opinions and recommendations as a team.

Interdisciplinary Team-Taught Course Inventory

Overview

The GE allows students to take a single, 4+ credit course to satisfy a particular GE Theme requirement if that course includes key practices that are recognized as integrative and high impact. Courses seeking one of these designations need to provide a completed Integrative Practices Inventory at the time of course submission. This will be evaluated with the rest of the course materials (syllabus, Theme Course submission document, etc). Approved Integrative Practices courses will need to participate in assessment both for their Theme category and for their integrative practice.

Please enter text in the boxes below to describe how your class will meet the expectations of Interdisciplinary Team-Taught courses. It may be helpful to consult the Description & Expectations document for this pedagogical practice or to consult your Director of Undergraduate Studies or appropriate support staff person as you complete this Inventory and submit your course.

Please use language that is clear and concise and that colleagues outside of your discipline will be able to follow. You are encouraged to refer specifically to the syllabus submitted for the course, since the reviewers will also have that document Because this document will be used in the course review and approval process, you should be *as specific as possible*, listing concrete activities, specific theories, names of scholars, titles of textbooks etc.

Accessibility

If you have a disability and have trouble accessing this document or need to receive it in another format, please reach out to Meg Daly at daly.66@osu.edu or call 614-247-8412.

Pedagogical Practices for Interdisciplinary Team-Taught Courses

Course subject & number: CivilEng & EarthSc 3530

Performance expectations set at appropriately high levels (e.g. Students investigate large, complex problems from multiple disciplinary perspectives). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Disasters caused by extreme events and the impact of anthropogenic changes to our environment are challenging communities worldwide. The proposed new cross-listed team-taught course is an advanced study of both earth sciences and engineering as it addresses the interaction of humans and the environment through the study of recent disasters caused by extreme events; it focuses on various aspects of sustainability, including vulnerability, preparedness, robustness, flexibility, and resilience. The study of extreme events is not only very complex but multidisciplinary in nature, involving fields such as public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, and hazard mitigation. This course encourages students to explore how the intersection of content in earth sciences and engineering are both needed to understand and learn from disasters caused by extreme events.

Students will investigate the immediate effects and long-term impacts on people, infrastructure, and nature, resulting from extreme events, such as hurricanes, heat waves, flooding, earthquakes, landslides, volcanic eruptions, and tsunamis. The course is structured in a seminar type format, where students will first perform individual scholarly research about a specific case history (e.g., Hurricane Maria in Puerto Rico), then work with other students on a thematically organized presentation, and lastly participate in class discussions. At the end of the semester, synthesis in-class discussions with both instructors will focus on our society's vulnerability to extreme events, effects of global warming, measures to enhance preparedness, and most importantly on students' suggestions to enhance the resilience of our society and their reflections on sustainability.

Through the study of case histories, students will gain in-depth multidisciplinary knowledge about extreme events, their relationship with our environment, and the different approaches that societies have implemented to mitigate disasters and their consequences. During class discussions, students will discuss specific case histories in terms of preparedness, vulnerability, effects, robustness, flexibility, and resilience, which are important from a sustainability perspective. Students will also examine the impact of legislation, wealth/poverty, political decisions, local characteristics, and the major impacts that various engineering design methods/concepts had on damage.

The case histories will include extreme weather events that had devastating environmental effects and long lasting economic as well as social consequences, e.g., hurricanes Katrina (2005), Irma (2017) and Harvey (2017), the 2011 Tohoku earthquake and tsunami in Japan, the 2010 and 2021 Haiti earthquakes, etc. The case histories will also include man-made disasters, such as dam and levee failures, and the melt-down of the Dai-Ichi nuclear plant in Japan in 2011. Students will also examine the effects of extreme events in developing countries, where limited resources often result in medical threats from infectious diseases due to lack of clean water and emergency medical services (e.g., 2010+2021 Haiti and 2015 Nepal earthquakes); similarly, how historical decisions in planning, engineering and/or urban development, as well as legislation play important roles that often magnify the destructive effects of extreme events (e.g., the levee construction/design methods and urban planning used in New Orleans, the urban planning in the center of Kobe in Japan, the Jones Act that restricts the boats and crews that could deliver emergency supplies to Puerto Rico).

The sample assignment on Hurricane Maria in page 7 of the proposed syllabus exemplifies the scope and multidisciplinary nature of the course assignments.

Significant investment of time and effort by students over an extended period of time (e.g., engage the issue iteratively, analyzing with various lenses and seeking to construct an integrative synthesis). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Using case histories of hurricanes, heat waves, wild fires, dam/levee failures, floods, earthquakes, and tsunamis, as context, students will research using academic and scholarly publications the nature and effects of specific extreme events, and present in-depth studies of the disasters' emergency response and recovery. For each disaster, students will examine the impact of legislation, wealth/poverty, political decisions, climate and geography, and their interconnection, as well as their larger societal implications. Students will also study and discuss the impacts that public policies and engineering design methods/concepts have on disaster damages, as well as their effects on recovery.

The course is structured as a seminar meeting 4 times per week for 55 minutes each period, in which students are first introduced to a topic through one or more case histories of disasters caused by an extreme event, where the instructor was a member of the reconnaissance mission (e.g., NSF sponsored mission to Puerto Rico after hurricane Maria, ASCE missions to Nepal and Japan after major earthquakes) and provides students first-hand account of the conditions immediately after the event. Students are then assigned to groups where they work individually on an assigned specific topic belonging to a theme (see example on page 7 of the syllabus). Students prepare a research report on their specific topic and work with their group on a thematic class presentation. In-class discussions follow the student presentations. During the semester, students' research will be multidisciplinary and involve fields such as: public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, hazard mitigation, etc. At the end of the semester, the course culminates with discussions led by both instructors, where students integrate/synthesize the knowledge they gained during the semester as they evaluate the preparedness of the USA to extreme events, discuss the applicability of foreign approaches, and most importantly propose suggestions to enhance the resilience of our society and their reflections on sustainability

Interactions with faculty and peers about substantive matters including regular, meaningful faculty mentoring and peer support about conducting interdisciplinary inquiry. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Given that this new cross-listed course is taught by instructors from two different disciplines (Civil Engineering and Geology), in different colleges at Ohio State, it is a truly interdisciplinary course. The course centers on a number of specific case studies of natural hazards, each of which include inquiry into the fundamental scientific principles involved for each hazard, and feedbacks between societal, political, legal, economic, and engineering challenges. Using case histories of hurricanes, wild fires, heat waves, dam/levee failures, floods, earthquakes, and tsunamis, as context, students will research using academic and scholarly publications the nature and effects of specific extreme events, and present in-depth studies of the disasters' emergency response and recovery. For each disaster, students will examine the impact of legislation, wealth/poverty, political decisions, laws, climate and geography, and the interconnection of these impacts as well as their larger societal implications. They will study the impacts that certain policies and engineering design methods/concepts had on damage, as well as their effects on recovery. Assignments include: individual reports, group presentations (requiring peer feedback) and in-class discussions (faculty and peer feedback).

As mentioned, the course is interdisciplinary and will be co-taught by dedicated faculty from two different colleges (the College of Engineering and the College of Arts and Sciences) that will present material, mentor students, and direct in-class discussions. Guest speakers from industry, federal agencies, emergency response organizations, and other universities will make presentations, interact with students, and provide support on specific topics.

Both will be present for each class period so that they can contribute to the other's lectures and in class conversations about the content.

Students will get frequent, timely, and constructive feedback on their work, scaffolding multiple disciplinary perspectives and integrative synthesis to build over time. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Students will research and prepare six individual research papers (see format below) on specific topics related to extreme events (as exemplified in the syllabus). Research topics will be thematically organized into groups of students that will make in-class presentations (see format below), leading to discussions. Students will receive timely feedback on their research papers in Carmen, orally in during office hours, from peers during the preparation of group presentations, after presentation from instructors, and end of semester synthesis in-class discussions. Both instructors will work together to provide feedback.

FORMAT:
- Student papers: research papers will be multidisciplinary and involve fields such as: public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, hazard mitigation, etc.
- Group assignments: students will prepare thematic class presentations that will be followed by in-class discussions.
- Synthesis: the course culminates, during the last two weeks of the semester, in instructor led in-class discussions, where students use what they have previously learned to evaluate and discuss the overall preparedness of our country to extreme events; during these last meetings, students are encouraged to use their research to critique constructively the structure of our emergency response system (FEMA, USACE, etc.), the effectiveness of programs such as the National Flood Insurance Programs), mitigation needs, and challenge damage expectations from historical global warming models. During these final meetings, students are highly encouraged to suggest solutions at the federal and local levels, propose mitigation measures, discuss their benefits, costs and/or need for taxation, share their reflections on resilience and sustainability while challenging each other opinions.

Periodic, structured opportunities to reflect and integrate learning (e. g. students should work to integrate their insights and construct a more comprehensive perspective on the issue). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Through in-class discussions students will gain in-depth multidisciplinary knowledge about extreme events, our relationship with the environment, and different approaches that societies have implemented to mitigate disasters. Students will be encouraged to reflect on what was reported in the news and use critical thinking when examining the reported data. During discussions, students will share points of view, and suggest solutions and mitigation measures individually as well as in groups. For example, during the course students will discover and discuss specific measures by which building codes have been modified after each major effort to reduce loss of life in certain communities, how laws were passed in certain seismically vulnerable countries that mandate earthquake insurance prior to obtaining a home mortgage, how man-made decisions taken immediately after the 2011 Tohoku earthquake resulted in saving the Dai-Ni Nuclear Plant instead of the melt-down experienced by the similarly built Dai-Ichi Nuclear Plant a few miles away.

Because journalists are generally not specialized in covering extreme events, and have access to very limited information after an event, their news articles often contain substantial inaccuracies. Through their research students will learn that collecting and analyzing data after a natural disaster is resource intensive and time consuming (as shown by the example, below); hence, governmental agencies reports, scholarly articles and comprehensive academic studies, often appear months or years after a major extreme event. During the course, students will be encouraged to review authoritative/scholarly sources and compare them with early news reports and announcements by government officials.

EXAMPLE: the death toll in Puerto Rico from hurricane Maria in 2017 was originally reported by the government at 13, two weeks later the official number was revised to 16, and revised again two months later to 64. Independent investigations reported the likely number of deaths between 499 (CNN) and 1,052 (NY Times); meanwhile, universities developed statistical models predicted between 793 and 8,498 deaths. Ten months after hurricane Maria a comprehensive study by researchers from George Washington University indicated 2,975 as the most-likely number of deaths.

Opportunities to discover relevance of learning through real-world applications and the integration of course content to contemporary global issues and contexts. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Through the news, students are regularly exposed to disasters caused by extreme events such as tsunamis, hurricanes, volcanoes, wild fires, etc. Unfortunately, news reporters have limited data, concentrate on aspects that are visually or emotionally appealing and rarely cover disasters more than a few weeks after an event. Long term impacts, as well as, topics related to disasters' preparedness and recovery, which are important from a sustainability perspective, are rarely considered newsworthy and thus not covered adequately by journalists. Additionally, because journalists are generally not specialized in covering extreme events, their news articles often contain substantial inaccuracies.

Through their individual research, group work and in-class discussions, students will reevaluate preconceived ideas as they gain in-depth multidisciplinary knowledge about natural disasters and our environment, the consequences on man-made decisions, and the various actions that different societies have implemented to mitigate extreme events. For example, during the proposed course students will discover country specific measures by which building codes have been incrementally modified to reduce loss of life, how laws have been enacted in some seismically vulnerable countries that mandate earthquake insurance prior to obtaining a home mortgage, how man-made decisions taken immediately after the 2011 Tohoku earthquake resulted in saving the Dai-Ni Nuclear Plant instead of the melt-down experienced by the Dai-Ichi Nuclear Plant a few miles away.

Students will research and prepare six individual research papers on a specific topic related to extreme events (as exemplified in the syllabus). Their research will be multidisciplinary and involve fields such as: public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, hazard mitigation, etc. In interdisciplinary groups, students will also prepare thematic class presentations that will be followed by in-class discussions. The course is structured as a graduate seminar which culminates, during the last two weeks of the semester, in instructor led synthesis in-class discussions, where students use what they have previously learned to evaluate and discuss the overall preparedness of our country to extreme events; during these last meetings, students are encouraged to use their research to critique constructively the structure of our emergency response system (FEMA, USACE, etc.), the effectiveness of programs such as the National Flood Insurance Programs), mitigation needs, and challenge damage expectations from historical global warming models. During these final meetings, students are highly encouraged to suggests solutions at the federal and local levels, propose mitigation measures, discuss their benefits, costs and/or need for taxation, and challenge each other opinions on resilience and sustainability.

Public Demonstration of competence, such as a significant public communication of their integrative analysis of the issue. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Public demonstration of competence will be achieved by students through submission of in-depth reports (six in total), group presentations, regular in-class discussions on specific topics, and end of semester synthesis discussions. The course is structured in a seminar type format, where students will first perform individual scholarly research about a specific case history, submit an in-depth report, work in interdisciplinary teams with other students on a thematically organized presentation, present their findings to the class, and lastly participate in class discussions.

The course main goals are:

1: Students will recognize and explain the multifaceted impacts that disasters resulting from extreme events have on people, communities, infrastructure, society, and nature.
2: Students will apply multidisciplinary approaches from science and engineering to preparedness and hazard mitigation associated with of extreme events, including community preparedness, vulnerability, infrastructure robustness and resilience.
3: Students will analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing and sustainability depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, viable solutions across time.

Students will achieved the stated goals through the study of case histories, more specifically, students will research and gain in-depth multidisciplinary knowledge about extreme events, their relation with our environment, and the approaches that different societies around the world have implemented to mitigate disasters and recover from their consequences.

Experiences with diversity wherein students demonstrate intercultural competence and empathy with people and worldview frameworks that may differ from their own. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

To provide a worldview perspective of how extreme events affect different communities around the planet, students will examine case histories of extreme events that had devastating effects not only in the USA (e.g., 2005 Hurricane Katrina in New Orleans and 2017 Hurricane Maria in Puerto Rico), but also in foreign countries (e.g., 2010 & 2021 Haiti Earthquakes, 2011 Tohoku Earthquake/Tsunami, and the 2015 Nepal Earthquake). To exemplify the multidisciplinary nature of student reports, below is a list of topics for the assignment on Puerto Rico's Recovery from the 2017 Hurricane Maria:

1: Infrastructure topics
- Power generation and electric distribution (electric grid, hydroelectric dams, renewable sources, etc.)
- Water treatment and distribution of drinkable water.
- Transportation (airports, bridges, freeways, traffic lights, etc.)
- Short vs. long-term building repairs (e.g., blue roofs), differences between residential and commercial building repairs, etc.
- Emergency and long-term repairs of hospitals and other public buildings; impact on services

2: Effects of federal legislation and political setting
- Impact of the "1920 Jones Act" legislation
- Political representation in Washington (impact of US territory vs. state)
- FEMA's funding, warehouses and asset allocation
- Distribution of federal funds between Texas, Florida and Puerto Rico after the 2017 hurricanes (Harvey, Irma and Maria)

3: Economic topics
- Destruction of sources of income (e.g., tourism before vs. after Maria)
- Effect on manufacturing (e.g., pharmaceutical industry) both in Puerto Rico and on the mainland
- Impact of laws such as the "1920 Jones Act" on recovery in Puerto Rico
- Impact of public debt, fiscal policies and corresponding austerity measures of Puerto Rico's government during the decade prior to Maria

4: Public health/wellbeing
- Impact of damaged schools, hospitals, pharmacies on Puerto Ricans
- Estimated vs total death toll, and suicide rate
- Environmental impacts from mold and fungi on Puerto Ricans living in damaged buildings
- Impact on the island of residents' migration to the continental USA
- Cultural impacts (impact on traditions, music, historical and religious sites, etc.)

Explicit and intentional efforts to promote inclusivity and a sense of belonging and safety for students, e.g. universal design principles, culturally responsive pedagogy, structured development of cultural self-awareness. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Extreme events such as hurricanes, heat waves, flooding, earthquakes, landslides, volcanic eruptions, and tsunamis, affect disproportionately poor and underserved communities in the USA and around the world. In assignments and during class discussions, students will examine the impact of wealth/poverty, government systems, political decisions, local geologic/environmental characteristics, and the major impacts that various engineering design methods/concepts have on impacts from extreme events.

The case histories will not only include extreme weather events that had devastating environmental effects and long lasting economic as well as social consequences in the USA (e.g., 2005 Hurricane Katrina in New Orleans and 2017 Hurricane Maria in Puerto Rico), but importantly, students will also study the effects of extreme events in developing countries, where limited resources often result in medical threats from infectious diseases due to lack of clean water and emergency medical services (e.g., 2010 & 2021 Haiti Earthquakes and the 2015 Nepal Earthquake).

Using case histories, students will examine how historical decisions in planning, engineering and/or urban development, as well as legislation, aid, culture and poverty/wealth, play important roles that often magnify the recovery from extreme events and/or their destructive effects (e.g., the levee construction/design methods and urban planning used in New Orleans, the urban planning in the center of Kobe in Japan, the Jones Act that restricts the boats and crews that could deliver emergency supplies to Puerto Rico).

Clear plans to promote this course to a diverse student body and increase enrollment of typically underserved populations of students. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

This class will be heavily promoted by the College of Engineering and the College of Arts & Sciences and School of Earth Sciences. The instructors are committed to engaging in outreach to students in these colleges, as well as others. All marketing materials will make it clear that while this course is cross-listed with civil engineering and earth sciences, there is no expectation that students will have an engineering or science background - and all students are welcome.

Historically, extreme events affect disproportionately poor and underserved communities for a multitude of socioeconomic reasons including: (a) having limited property and flood insurance coverage, (b) living in more vulnerable, older and poorly maintained residential structures, (c) neighborhoods located in less affluent flood-prone urban areas, (d) losses/damages that are undercounted by emergency agencies such as FEMA, and thus have lesser access to federal emergency/recovery funding, etc.

In the instructors' experience, Latinx students are very aware of the devastating effects that Hurricane Maria had in Puerto Rico; similarly, African-American students know well the terrible pain inflicted in New Orleans by Hurricane Katrina, as well as, in Haiti by the 2010 and 2021 earthquakes... The civil engineering instructor has taught similar courses at both OSU (ARTSCI-1137.24-010: Learning from disasters between AU2019 and AU2020) and UCLA and has found the topic of the proposed course to be of significant interest to African-American, Desi and Latinx students, resulting in high enrollments compared to other courses taught by engineering professors.

Because extreme events have devastating immediate effects and long-term socioeconomic consequences on their communities, the interest of students from underserved populations, align especially well with the goals of the course, and these students tend to be some of the most motivated and outspoken students in the course; hence, wanting to learn about preparedness, vulnerability, and mitigation techniques, as well as, sharing anecdotal information. Although, the course subject is of special interest to students from underserved populations, if approved, the instructors will notify its availability to relevant OSU student chapters such as SHPE (Society of Hispanic Professional Engineers) in order to increase enrollment.

GE THEME COURSES

Overview

Courses that are accepted into the General Education (GE) Themes must meet two sets of Expected Learning Outcomes (ELOs): those common for all GE Themes and one set specific to the content of the Theme. This form begins with the criteria common to all themes and has expandable sections relating to each specific theme.

A course may be accepted into more than one Theme if the ELOs for each theme are met. Courses seeing approval for multiple Themes will complete a submission document for each theme. Courses seeking approval as a 4-credit, Integrative Practices course need to complete a similar submission form for the chosen practice. It may be helpful to consult your Director of Undergraduate Studies or appropriate support staff person as you develop and submit your course.

Please enter text in the boxes to describe how your class will meet the ELOs of the Theme to which it applies. Please use language that is clear and concise and that colleagues outside of your discipline will be able to follow. You are encouraged to refer specifically to the syllabus submitted for the course, since the reviewers will also have that document Because this document will be used in the course review and approval process, you should be *as specific as possible*, listing concrete activities, specific theories, names of scholars, titles of textbooks etc.

Course subject & number Learning from disasters: ext

General Expectations of All Themes

GOAL 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than the foundations.

Please briefly identify the ways in which this course represents an advanced study of the focal theme. In this context, "advanced" refers to courses that are e.g., synthetic, rely on research or cutting-edge findings, or deeply engage with the subject matter, among other possibilities. *(50-500 words)*

INTRODUCTION: The proposed course focuses on the interaction of humans and their environment through the study of recent disasters caused by extreme events. The study of extreme events is not only very complex but multidisciplinary in nature, involving fields such as: public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, hazard mitigation, etc. The course is entitled "Learning from disasters: extreme events and their impact on infrastructure, engineering and society" and through the study of case histories concentrates on advanced topics of sustainability, including vulnerability, preparedness, robustness, flexibility, and resilience.

SIGNIFICANCE: During the 2017 hurricane season alone, three storms were responsible for over 4000 deaths and $265 billion in damages in the U.S. Southeast and Caribbean. Climate change projections indicate that extreme events such as droughts, wild fires, floods, hurricanes and typhoons are increasing in number, and importantly also in severity. Hence, it is extremely important from a sustainability perspective, to understand the hazards resulting from extreme events on our societies and the specific vulnerabilities of our various communities, in order to develop measures that improve disaster preparedness, emergency response and resiliency.

COURSE FORMAT: Using major disasters caused by extreme events as context, students will research the nature and effects of specific extreme events, and present in-depth studies of the disasters' emergency response and recovery. For each disaster, students' individual studies will examine the impact of federal and local legislation, wealth/poverty, sociopolitical conditions, climate and geography, and the interconnection of these impacts as well as their larger societal implications; they will also study and discuss the impacts that policies and engineering design methods/concepts have on disaster damages, as well as their effects on recovery. The course is structured as a graduate seminar, in which students are first introduced to a topic through one or more case histories of disasters caused by an extreme event, where the instructor was a member of the reconnaissance mission (e.g., NSF sponsored mission to Puerto Rico after hurricane Maria, ASCE missions to Nepal and Japan after major earthquakes) and provides first-hand account of the conditions immediately after the event. Students are then assigned to groups where they work individually on an assigned specific topic belonging to a theme (see example in syllabus). Students prepare a research report on their specific topic and work with their group on a thematic class presentation. In-class discussions follow the student presentations. At the end of the semester, the course culminates with instructor led discussions, where students evaluate the preparedness of the USA to extreme events, propose solutions, discuss the applicability of foreign approaches, etc.

Course subject & number Learning from disasters: ext

ELO 1.1 Engage in critical and logical thinking about the topic or idea of the theme. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. (50-700 words)

PRECONCEIVED IDEAS: Through the news, students are regularly exposed to disasters caused by extreme events such as tsunamis, hurricanes, wild fires, etc. Unfortunately, news reporters concentrate on aspects that are visually or emotionally appealing and rarely cover disasters more than a few weeks after an event. Long term impacts, as well as, topics related to preparedness and recovery, which are important from a sustainability perspective, are rarely considered newsworthy and thus not covered adequately by journalists. Additionally, because journalists are generally not specialized in covering extreme events, their news articles often contain substantial inaccuracies.

CRITICAL THINKING: Through their individual research, group work and in-class discussions, students will reevaluate preconceived ideas as they gain in-depth multidisciplinary knowledge about natural disasters and our environment, the consequences on man-made decisions, and the various actions that different societies have implemented to mitigate extreme events. For example, during the course student will discover country specific measures by which building codes have been incrementally modified to reduce loss of life, how laws have been enacted in some seismically vulnerable countries that mandate earthquake insurance prior to obtaining a home mortgage, how man-made decisions taken immediately after the 2011 Tohoku earthquake resulted in saving the Dai-Ni Nuclear Plant instead of the melt-down experienced by the Dai-Ichi Nuclear Plant a few miles away.

GOALS AND ELOs: The preparation of six individual research papers, group presentations by students, and discussions is best aligned with OSU's “Goal 1 Intellectual and Cognitive Skills” and is linked to the following GE and Sustainability Theme ELOs:
• GE 1.1 Locate and select information sources that are credible, relevant and appropriate to the context.
• GE 1.2 Demonstrate critical and logical thinking by analyzing and integrating information from multiple sources and disciplines.
• GE 3.3 Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world.
• GE 4.5 Work collaboratively with others to achieve shared goals.
• ELO 1.1: Engage in critical and logical thinking about extreme events.
• ELO 1.2: Engage in an advanced, in-depth, scholarly exploration of extreme events.
• ELO 2.1: Identify, describe, and synthesize approaches or experiences as they apply to extreme events.

ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

ACTIVITIES/ASSIGNMENTS: Students will research and prepare six individual research papers on a specific topic related to extreme events (as exemplified in the syllabus). Their research will be multidisciplinary and involve fields such as: public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, hazard mitigation, etc. In groups, students will also prepare thematic class presentations that will be followed by in-class discussions. The course is structured as a graduate seminar which culminates, during the last two weeks of the semester, in instructor led discussions, where students use what they have previously learned to evaluate and discuss the overall preparedness of our country to extreme events; during these last meetings, students are encouraged to use their research to critique constructively the structure of our emergency response system (FEMA, USACE, etc.), the effectiveness of programs such as the National Flood Insurance Programs), mitigation needs, and challenge damage expectations from historical global warming models. During these final meetings, students are highly encouraged to suggests solutions at the federal and local levels, propose mitigation measures, discuss their benefits, costs and/or need for taxation, and challenge each other opinions.

GOALS AND ELOs: The activities/assignments described above are best aligned with the goal: "Successful students will apply multidisciplinary approaches to the study of extreme events, including community preparedness, vulnerability, infrastructure robustness and resilience", and are linked to the following GE and Sustainability Theme ELOs:
• GE 1.2 Demonstrate critical and logical thinking by analyzing and integrating information from multiple sources and disciplines.
• GE 1.3 Read, listen, compose and speak in a variety of genres and modalities for a range of purposes and audiences.
• GE 2.2 Use methods of research, inquiry, creativity and discovery across disparate disciplines to generate and respond to socially and ethically important topics.
• GE 3.3 Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world.
• ELO 2.2: Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.

Course subject & number Learning from disasters: ext

GOAL 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

ELO 2.1 Identify, describe, and synthesize approaches or experiences as they apply to the theme. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

OUT-OF-CLASSROOM EXPERIENCE: The typical out-of-classroom experience that our students have about extreme events is through the news, as they report disasters such as tornadoes, droughts, wild fires, flash floods, dam/levee failures, tsunamis, and hurricanes. Unfortunately, journalists generally concentrate on aspects that are visually or emotionally appealing and rarely cover the topic beyond a few days or weeks. Furthermore, long term impacts, as well as, topics related to preparedness and recovery, which are important from a sustainability perspective are rarely covered by the news media adequately. Additionally, because journalists are generally not specialized in covering extreme events, news articles often contain substantial inaccuracies and/or report poorly supported estimates without quantifying and discussing the uncertainties of the supporting data.

RESEARCH AND SYNTHESIS: Collecting and analyzing data after a natural disaster is resource intensive and time consuming (as shown by the example, below); hence, governmental agencies reports, scholarly articles and comprehensive academic studies, often appear months or years after a major extreme event. During the course, students are encouraged to review authoritative/scholarly sources and compare them with early news reports and announcements by government officials. EXAMPLE: the death toll in Puerto Rico from hurricane Maria in 2017 was originally reported by the government at 13, two weeks later the official number was revised to 16, and revised again two months later to 64. Independent investigations reported the likely number of deaths between 499 (CNN) and 1,052 (NY Times); meanwhile, universities developed statistical models which predicted between 793 and 8,498 deaths. Ten months after hurricane Maria a comprehensive study by researchers from George Washington University indicated 2,975 as the most-likely number of deaths in Puerto Rico, i.e., a number that is very different from governmental and news sources.

IN-CLASS EXPERIENCE: Through in-class discussions students will gain in-depth multidisciplinary knowledge about extreme events, our relationship with the environment, and different approaches that societies have implemented to mitigate disasters. Students will be encouraged to reflect on what was reported in the news and use critical thinking when examining the reported data. During discussions, students will share points of view, and suggest solutions and mitigation measures individually as well as in groups. For example, during the course student will discover and discuss specific measures by which building codes have been modified after each major effort to reduce loss of life in certain communities, how laws were passed in certain seismically vulnerable countries that mandate earthquake insurance prior to obtaining a home mortgage, how man-made decisions taken immediately after the 2011 Tohoku earthquake resulted in saving the Dai-Ni Nuclear Plant instead of the melt-down experienced by the Dai-Ichi Nuclear Plant a few miles away.

GOALS AND ELOs: The activities/assignments described above are best aligned with OSU's “Goal 1 Intellectual and Cognitive Skills” and is linked to the following GE and Sustainability Theme ELOs:
• GE 1.1 Locate and select information sources that are credible, relevant and appropriate to the context.
• GE 1.2 Demonstrate critical and logical thinking by analyzing and integrating information from multiple sources and disciplines.
• GE 2.2 Use methods of research, inquiry, creativity and discovery across disparate disciplines to generate and respond to socially and ethically important topics.
• GE 3.3 Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world.
• GE 4.1 Describe and apply skills needed to maintain resiliency and personal well-being in contemporary society.
• ELO 1.2: Engage in an advanced, in-depth, scholarly exploration of extreme events.
• ELO 2.2: Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.

ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

ACTIVITIES/ASSIGNMENTS: The course is structured as a seminar which culminates, during the last two weeks of the semester, in instructor led discussions, where students use what they have previously learned in their research to evaluate and discuss the preparedness of our country to extreme events; students are encouraged to reflect on preconceived ideas (often based on news reports), self-assess their research reports based on information from peer presentations and in-class discussions, as well as critique constructively the government's disaster response, and prevention/mitigation programs. During these concluding meetings, students are highly encouraged to suggests solutions and/or mitigation measures, discuss their benefits, costs and/or need for taxation, share different points of view, and challenge each other opinions.

GOALS AND ELOs: The activities/assignments described above are best aligned with the goal: "Successful students will apply multidisciplinary approaches to the study of extreme events, including community preparedness, vulnerability, infrastructure robustness and resilience", and are linked to the following GE and Sustainability Theme ELOs:
• GE 1.1 Locate and select information sources that are credible, relevant and appropriate to the context.
• GE 1.2 Demonstrate critical and logical thinking by analyzing and integrating information from multiple sources and disciplines.
• GE 2.2 Use methods of research, inquiry, creativity and discovery across disparate disciplines to generate and respond to socially and ethically important topics.
• GE 3.3 Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world.
• GE 4.1 Describe and apply skills needed to maintain resiliency and personal well-being in contemporary society.
• ELO 1.2: Engage in an advanced, in-depth, scholarly exploration of extreme events.
• ELO 2.2: Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.

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Specific Expectations of Courses in Sustainability

GOAL 1: Students analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, potential solutions across time.

1.1 Describe elements of the fundamental dependence of humans on Earth and environmental systems and on the resilience of these systems. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

INTRODUCTION: Disasters caused by extreme events and the impact of anthropogenic changes to our environment are challenging communities worldwide. The proposed course addresses the interaction of humans and the environment through the study of recent disasters caused by extreme events; it focuses on various aspects of sustainability, including vulnerability, preparedness, robustness, flexibility, and resilience. The study of extreme events is not only very complex but multidisciplinary in nature, involving fields such as public health, economics, engineering, urban planning, public policy, law, politics, climate studies, seismology, and hazard mitigation.

Using case histories of hurricanes, wild fires, dam/levee failures, floods, earthquakes, and tsunamis, as context, students will research using academic and scholarly publications the nature and effects of specific extreme events, and present in-depth studies of the disasters' emergency response and recovery. For each disaster, students will examine the impact of local legislation, wealth/poverty, political decisions, laws, climate and geography, and the interconnection of these impacts as well as their larger societal implications. They will study the impacts that certain policies and engineering design methods/concepts had on damage, as well as their effects on recovery.

The course will introduce and incorporate the Sustainability Six Dimensions Framework, i.e.:
1) Systems: coupled human-natural systems, integrating environmental, economic & social factors, systems thinking, resilience;
2) Environment: environmental, earth, and natural resource systems; knowledge of planetary/natural systems, e.g., climate, aquatics, soils, forests, wildlife, geology, ecology, agriculture; understanding of how these systems impact human well-being (e.g., health, economy, social justice, future generations)
3) Economic-political: economic and political factors of sustainability (economy/consumption/ production; laws/policy/governance/institutions; business/strategy/management; costs/benefits/tradeoffs)
4) Social-cultural: social/cultural factors of sustainability (justice, equity, values, ethics, history, religion, the arts, citizenship, power, behavior and decision making, cultural critique...)
5) Technology & design: engineering; technological innovation; systems design; human-machine interface; manufacturing processes; life cycle; product design (design of technology and infrastructure to promote sustainability and human well-being)
6) Well-being: human health, safety, risk, sustainable livelihoods, social welfare and well-being

ACTIVITIES/ASSIGNMENTS: The format of the course will be that of a traditional seminar type course, where students are first introduced into the topic by the instructor, then research specific topics (individually and in groups), write six papers, make group presentations, and finally have in-class discussions moderated by the instructor. Examples of topics discussed in class will include:
• The impact of the 1920's Jones Act on the Puerto Rico's recovery after hurricane Maria in 2017 (the Jones Act is a federal law that requires all goods transported by water between U.S. ports to be carried on U.S.-flag ships, constructed in the United States, owned by U.S. citizens, and crewed by U.S. citizens and U.S. permanent residents).
• Impact of urban planning on the fires that followed the 1995 Kobe Earthquake in Japan.
• Medical threats from infectious diseases in developing countries (e.g., after the 2010 Haiti and 2015 Nepal earthquakes and the 2020 super typhoon Goni in Philippines).
• FEMA's response after the hurricane Katrina in 2005 and the long term mitigation measures around New Orleans implemented by the US Army Corps of Engineers.

GOALS AND ELOs: The preparation of six individual research papers and group presentations by students is best aligned with "Goal 3: Students analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, potential solutions across time." and is linked to the following Sustainability Theme ELOs:
• ELO 1.2: Engage in an advanced, in-depth, scholarly exploration of extreme events.
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.
• ELO 3.2: Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.

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1.2 Describe, analyze and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, currently, and in the future. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

INTRODUCTION: Human activities, such as the burning of fossil fuels, have resulted in global warming, and as a result, we have seen an increase in the number and severity of extreme events such as droughts, wild fires, flash floods, hurricanes and typhoons. Anthropogenic changes to our environment (e.g., the channeling of the Mississippi River and the construction of levees in New Orleans) to protect communities also result in significant man-made hazards from extreme events and long term challenges to human societies. The effect of extreme events on lifelines often present significant challenges in affected communities, as exemplified by the power grid destruction in Puerto Rico by hurricane Maria in 2017, and polar vortex winter storms that resulted in the Texas power crisis of February 2021.

ACTIVITIES/ASSIGNMENTS: Through individual research (reports), group presentations and in-class discussions, students will gain in-depth multidisciplinary knowledge about extreme events, human relation with the environment, and different approaches that leaders, engineers, urban planners and societies have implemented to mitigate disasters. For example, during the course student will discover and discuss specific measures by which building codes have been incrementally modified after each major effort to reduce loss of life in certain countries, how laws were passed in certain seismically vulnerable countries that mandate earthquake insurance prior to obtaining a home mortgage, how man-made decisions taken immediately after the 2011 Tohoku earthquake resulted in saving the Dai-Ni Nuclear Plant instead of the melt-down experienced by the Dai-Ichi Nuclear Plant a few miles away.

GOALS AND ELOs: The activities/assignments described above are best aligned with OSU's "Goal 1 Intellectual and Cognitive Skills" and is linked to the following Sustainability Theme ELOs:
• ELO 1.2: Engage in an advanced, in-depth, scholarly exploration of extreme events.
• ELO 2.2: Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.

1.3 Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

ACTIVITIES/ASSIGNMENTS: The course is structured as a seminar which culminates, during the last two weeks of the semester, in instructor led discussions, where students use what they have previously learned to evaluate and discuss the preparedness of the USA to extreme events; students are encouraged to reflect on preconceived ideas (often based on news reports), self-assess their previous reports (e.g., based on information from peer's presentations and in-class discussions), as well as critique constructively the government response structure and programs. During these concluding meetings, students are highly encouraged to share points of view, suggests local/federal solutions and/or mitigation measures, discuss their benefits, costs and/or need for taxation, and challenge each other opinions.

GOALS AND ELOs: The activities/assignments described above are best aligned with the goal: "Successful students will apply multidisciplinary approaches to the study of extreme events, including community preparedness, vulnerability, infrastructure robustness and resilience", and are linked to the following Sustainability Theme ELOs:
• ELO 2.2: Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts
• ELO 3.1: Describe, analyze and critique the roles and impacts of human activity on both human society and the natural world currently and in the future.
• ELO 3.2: Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.