

ERTH 303 – Natural Hazards and Geomechanics



INSTRUCTOR: Bridget Smith-Konter

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CLASS MEETINGS: Tues/Thurs 1:30-2:45pm online

OFFICE HOURS: TBA and upon request

COURSE DESCRIPTION: Natural hazards, or geohazards, are geological conditions and events resulting from active geological and/or geophysical processes, such as earthquakes, volcanic eruptions, tsunamis, and landslides. Geohazards are capable of causing widespread damage to the environment, or loss of property and life, and can also result from human activities. Thanks, in part, to the advances of satellite-based technologies and geohazard observatories, global monitoring of geohazards is possible through high-quality data that are continuously collected and made available to scientists (and students!) to improve our understanding of geohazard conditions, causes, and implications.

This course in geohazard analysis explores the dynamic behavior of Earth's surface, the geological and physical processes that drive geohazards, our understanding of their frequency and intensity, and how we quantify the risks they pose to society. Theory, practical techniques, and visualization of large data sets will be emphasized as a means to understand, measure, analyze, and interpret hazard deformation and implications. This course will also explore topics on hazard monitoring, early warning systems, geohazard risk assessment, and geotechnical methods to mitigate geohazards.

PREREQUISITES: MATH 241(Calc I) and PHYS 170 (Gen. Physics I), or instructor consent

TEXT: Relevant lecture and reading material will be provided on [Laulima](#).

MEETING TIMES AND FORMAT: ERTH303 will meet online and synchronously (Tues/Thurs 1:30-2:45 pm HST) via Zoom. A recurring Zoom meeting link for ERTH303 will be used for all class meetings:

<https://hawaii.zoom.us/j/98132282563>

Meeting ID: 981 3228 2563

Passcode: (check email)

COURSE LEARNING OBJECTIVES

ERTH 303 students successfully completing this course should have a basic understanding of:

- the theory of plate tectonics and the structure of the Earth's crust and interior
- the physical and geological processes causing earthquakes, tsunamis, volcanic eruptions, and landslides

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- applications of tectonic geodesy and crustal deformation measurements (InSAR, GPS, tilt, strainmeter)
- earthquake monitoring and introductory seismologic principles
- the causes and effects of tidal and human-induced seismicity
- how these processes impact humans and society
- methods for quantifying geological hazard and risk, and factors controlling their uncertainty
- geotechnics and what mitigation measures can be used to reduce risk related to different geohazards

SKILL DEVELOPMENT

ERTH 303 students successfully completing this course should be able to:

- visualize, analyze, and interpret data related to geohazards, consider technologies to mitigate their effects, and use evidence to strengthen understanding
- recognize deposits and landforms related to geohazards
- evaluate high-precision, scientific-grade geodetic data and tools (GPS, InSAR, Lidar, aerial imagery) to formulate scientific estimates about the impacts of geohazards
- use map-based applications for exploring, visualizing, and analyzing global and regional seismicity and geodetic data
- use web-based 3D dynamic models of plate motions to understand Earth's surface as a dynamic system
- recognize and discuss risk mitigation measures for catastrophic geohazard events

GRADING: Grades will be formed based on a combination of homework, participation (attendance, preparation, inquiry), Question of the Day, a Midterm exam, and a final geohazards project (paper and presentation):

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|-----------------------------------|----------------|
| • Problem sets (homework) | 40% |
| • Question of the Day | 10% |
| • Class participation, attendance | 10% |
| • Midterm Exam | 15% |
| • Geohazards Project | 25% [10% /15%] |

COURSE TOPICS

- Earth as a dynamic and layered planet
- Plate tectonics in motion, relationship to landforms, global seismicity, volcanic hazards
- Geohazard observatories, global monitoring
- The earthquake cycle, stress and strain, faulting and deformation
- Tectonic geodesy, crustal deformation measurements (InSAR, GPS, tilt, strainmeter)
- Earthquake locations, magnitudes, and source parameters (beach balls)
- Earthquake seismic waves, phases, seismograms, estimating travel times
- Earthquake ground motions, seismic shaking, liquefaction
- Global seismic hazards and earthquake recurrence
- Hawaiian earthquakes, causes, seismic hazard models
- Episodic tremor and slip, tidal triggering of earthquakes
- Fracking and human-induced seismicity
- Volcanic hazard monitoring (deformation, seismicity, remote sensing, gas emissions)
- Volcano-hazard assessment
- Landslide mechanics, rock/soil strength, slope failure, bench collapse

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- Geotechnical methods to mitigate geohazards (soil and rock property assessment)
- Tsunami generation, monitoring, and hazard modeling
- Early warning systems

COURSEWORK

- **Assignments:** Homework exercises will be assigned approximately every other week, and will be due at the beginning of class, approximately 1 week after they are assigned (unless otherwise stated - the due date will be stated on the assignment).
- **Working Together on Homework:** Studies have shown that students learn best when they work together. You are encouraged to work with each other on assigned homework. However, each student must turn in his or her own assignment, written using his or her own words. Any student who fails to follow this rule will receive zero credit for the question, and if the offense is severe, for the assignment.
- **Format:** Neatness, clarity of expression, and completeness are essential to obtain full credit on exams and exercises. Please make sure to:
 - (1) Write out the equations, or derive new ones, that you will use to solve the problem, and explain (in words) your reasoning. Specify known and unknown information.
 - (2) Draw illustrative figures that describe the problem.
 - (3) Show clearly how you solved the problem.
 - (4) Check your answer – does your solution make physical sense? Check units! Explain why you think your answer is correct.

EXAM POLICY

- **Make-Up Exams/Early Exams.** Make-up exams will not be given except when a student misses the exam for a legitimate reason such as illness or family emergency (a doctor's note or other documentation is required). Please get in touch with your instructor as soon as possible if such a situation arises. Anyone with sporting event conflicts must provide at least 2 weeks notice with appropriate signed paperwork.
- **Note that make-up and/or early exams will be essay format.**

CLASS PARTICIPATION

General stuff:

- **Come to class prepared.**
- Read class-related emails and announcements to enhance your participation and stay current; pay attention to course-related documents and deadlines.
- Watch any online lectures (as applicable).
- Read the assigned readings.
- Complete all assignments on time.
- Ask relevant questions.

In-class contributions:

- Attendance: attendance will be taken and you will earn credit for physically (or virtually) taking part in class each day.
- Class preparation: you should not only bring your body to class, but your mind and your concentration as well; complete and review pre-class assignments *before class begins*.
- Class contribution: as a student of EARTH303, you should attempt to contribute readily to class discussions and conversations. EARTH303 students will also be expected to show interest in and respect for others' contributions. Active participation and cooperation in groups will also be expected.

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FINAL PROJECT

In lieu of a Final Exam, ERTH303 students will be expected to research and present (oral presentation and brief scientific paper (5 pages, excluding figures and references) on a geohazard topic of their choice. More details will be provided throughout the semester. Presentations and report should utilize and effectively communicate scientific data, models, and estimates, and impacts of geohazards.

TIPS FOR SUCCESS

- **Lectures:** Attend *every* lecture, as they are the key to your success in this course. Some aspects of the course material will be covered in more detail in class than is provided the text, so it is highly recommended that you not only bring your body to class, but your mind and your concentration as well!
- **Module exercises and reports:** Do *each* assignment and submit each on time. Module exercises help you learn the material and are a great study guide for the exams.
- **Exams:** Do not miss an exam. Study. Read. Review.
- **Questions:** Questions are welcome and encouraged. Your questions are likely to help other students as well, so you should never feel intimidated to ask questions about course material.
- **Read:** Any assigned reading material will reinforce lecture material, so do complete each reading assignment.

ERTH STUDENT LEARNING OBJECTIVES

This course will aim to meet the following ERTH undergraduate degree program student learning objectives, as established by the Department of Earth Sciences:

1. Students can explain the relevance of Earth science to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in Earth science.
3. Students use the scientific method to define, critically analyze, and solve a problem in Earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of Earth science, including the fundamental tenets of the sub- disciplines, and their context in relationship to other core sciences, to explain complex phenomena in Earth science.

STUDENT CONDUCT AND ACADEMIC INTEGRITY

University guidelines for acceptable student conduct are very specific and will be strictly followed. Academic integrity is a basic principal that requires all students to take credit for the ideas and efforts that are their own. Cheating, plagiarism, and other forms of academic dishonesty are defined as the submission of materials in assignment, exams, or other academic work that is based on sources prohibited by the faculty member. Academic dishonesty is defined further in the [UHM Student Code of Conduct](#). In addition to any adverse academic action, which may result from the academically dishonest behavior, the University specifically reserves the right to address and sanction the conduct involved through student judicial review procedures and the Academic Dispute Resolution Procedure specified in the University catalogue. In a nutshell:

- Cheating, of any form, will not be tolerated.
- Blind copying of intellectual material (text) from resources such as books, journals, and the internet is plagiarism and is illegal. Instead, you should write things in your own words with a proper reference to your source. If any homework exercises require you to look up an answer in something else than the class textbook, I will expect you to reference the source and write it in your own words. *Any plagiarized work will receive "0" for the whole assignment and cannot be re-done or made up.*

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DISABILITY ACCESS The Earth Sciences Department will make every effort to assist those with disability and related access needs. If you need disability-related accommodations, please notify the Office for Students with Disabilities (known as “Kokua”), located in the Queen Lili'uokalani Center for Student Services (Room 013). <http://www.hawaii.edu/kokua/>

TITLE IX The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the confidential resources available here: <http://www.manoa.hawaii.edu/titleix/resources.html#confidential>

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Unwood Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.

BASIC NEEDS Basic needs include food and housing, childcare, mental health, financial resources and transportation, among others. Student basic needs security is critical for ensuring strong academic performance, persistence and graduation and overall student well-being. If you or someone you know are experiencing basic needs insecurity, please see [UH System Basic Needs](https://www.hawaii.edu/student-basic-needs/) (<https://www.hawaii.edu/student-basic-needs/>).

EMERGENCIES In the event of an emergency, this course syllabus may be modified and updated as needed. You will be notified of any changes that occur or modifications to the course schedule.