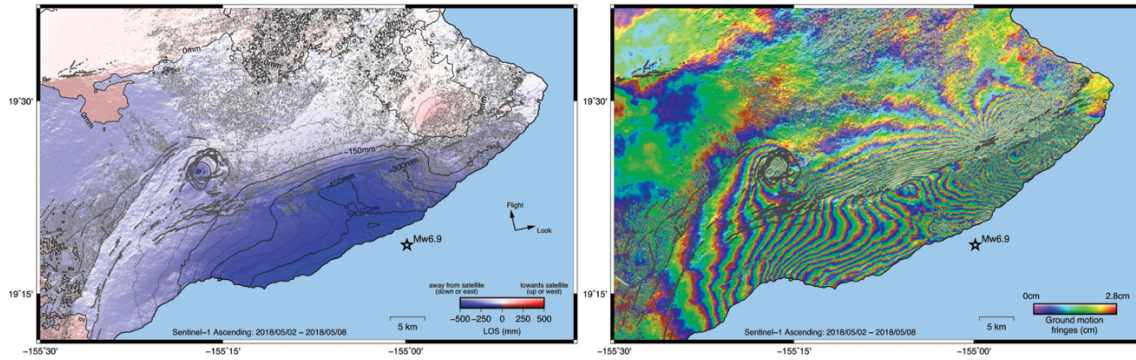


ERTH451 – Earthquakes and Crustal Deformation - Spring 2024



M6.9 earthquake (5/4/18) + summit collapse

Instructor: Bridget Smith-Konter

Lecture: Tues/Thurs 9:00 - 10:15 am

Email: brkonter@hawaii.edu

COURSE DESCRIPTION: This course will explore the fundamentals of earthquakes and tectonic crustal deformation through modern seismological and geodetic observations. In this course, we will focus on elastic properties of rocks in the context of earthquake and crustal deformation mechanics. We will explore the role of plate tectonic stress and strain in earthquake generation and crustal motions associated with the earthquake cycle. Geodetic methods for remotely sensing crustal deformation (i.e., GNSS and InSAR) will be emphasized in this course. Relevant planetary observations of “quake” like events will also be discussed.

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.

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

| | |
|---------------------------------|----------------|
| Problem sets (homework) | 40% |
| Geophys Image of the Day | 10% |
| Class participation, attendance | 10% |
| Midterm Exam | 15% |
| Crustal Deformation Project | 25% [10% /15%] |

COURSE TOPICS

- Basic Earth observations: Realizing plate tectonics
- Plate tectonics in motion, global seismicity
- The earthquake cycle, stress and strain
- Tectonic geodesy: observing crustal deformation
- Seismic waves, seismograms, earthquake location
- Earth structure, seismic velocities, density
- Ray theory, seismic phases, estimating travel times

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- Plate Boundary Observatory, GNSS models
- USArray, 3D Earth structure
- Faults, focal mechanisms, moment tensors
- Earthquake magnitudes, source parameters
- InSAR crustal deformation observations, applications
- Coulomb failure mechanics
- Hawaiian earthquakes and crustal deformation
- Episodic tremor and slip
- Planetary quakes and tectonics: terrestrial planets, icy satellites

COURSEWORK

- **Assignments:** Homework assignments will be assigned approximately weekly, and are due at the beginning of class exactly 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 homework. 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 me 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:

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- **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 EARTH451, you should attempt to contribute readily to class discussions and conversations. EARTH451 students will also be expected to show interest in and respect for others' contributions. Active participation and cooperation in groups will also be expected.

FINAL PROJECT

In lieu of a Final Exam, you will be expected to research and present (oral presentation and short paper) a major earthquake or crustal deformation event of your choice. More details will be provided throughout the semester, stay tuned. Presentations and paper should reflect both scientific data and societal impact.

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! There will also be a daily in-class quiz (Question of the Day) that will count toward your grade (see grading policy below).
- **Homeworks:** Do *each* homework assignment, and submit each one on time. Homework assignments 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.

STUDENT LEARNING OBJECTIVES

This course will aim to meet the following EARTH 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.

COURSE LEARNING OBJECTIVES

This course will introduce fundamental concepts related to the physics of earthquakes, such as stress, strain, the seismic wave equation, wave propagation, earthquake focal mechanisms, earthquake moments and magnitudes, frequency magnitude relationships, and earthquake hazards. The following course learning objectives will be emphasized:

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1. Develop skills in applying physics, mathematics, and computational analyses to problems in earthquake seismology and geodesy.
2. Develop problem-solving and critical thinking skills using geophysical data and proven geophysical theories.
3. Illustrate the impacts of earthquakes on society, focusing on past notable earthquakes and our ability to forecast seismic hazards.

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*

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

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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.