Draft

USC Dornsife
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College of Letters, Arts and Sciences

GEOL599: Seismo-Tectonics Research Clinic

Units: 3.0
Autumn 2024
Time: Thurs 3:00-5:20 PM
Room ZHS 118

Instructor: Heidi Houston
Office: ZHS 101
Office Hours: Wed 3-5PM or by appt.
Contact Info: houstonh@usc.edu

Seismo-Tectonics Research Clinic - A space to learn and apply techniques relevant to your research in seismology, particularly relating to earthquake sources, seismicity, stresses, and tectonic setting.

Course Description

This class aims to build on your knowledge of geophysics and seismology and give you experience with analysis tools that may be helpful for investigating relationships between earthquakes, stresses, and seismicity in both shallow and deep earthquake settings. Proposed topics include seismicity declustering techniques, intermediate and deep earthquake properties, advanced study of stress inversions and absolute stresses including the necessary conditions and limitations of the methods. In addition, the instructor and class will brainstorm near the start of the semester to identify further topics of particular relevance to students' research interests, goals, and current and anticipated projects. Students will apply available software codes to earthquake data from regions of their choice in collaborative projects.

Learning Objectives

At the end of the course, students will:

- be able to critically read, analyze and discuss key scientific papers about the topics and analysis techniques
- be familiar with some of the interactions between seismicity, stresses, and tectonic settings
- understand the approach and basic assumptions of a popular declustering method
- be familiar with various intermediate and deep earthquake properties
- be able to formulate tests of different rupture mechanisms and consider the role of simulations in providing synthetic data for testing hypotheses
- understand the principles and apply codes to determine the stress state implied by suites of earthquakes, and to determine the static stress tensor due to a slip distribution
- use the above results to infer the absolute level of stress
- understand the limitations of stress inversion methods and the necessary conditions for them to be applicable and formulate tests of the validity of stress inversions

Required Reading

Relevant papers from the literature, some of which are listed in the schedule. Additional papers will be assigned to illustrate and provide examples for the projects in the latter part of the course.

Class Format

Instructor will introduce topics followed by an in-depth discussion of aspects important to successful application of the techniques or concept. Class will review and present published literature in depth to develop or extend research ideas. We will review and apply some key methods of analyzing seismicity and studying stresses associated with faulting. Instructor lectures will introduce background concepts and previous observations to provide context for the projects. We will also pay close attention to the conditions under which various methods can legitimately be applied.

Grades

Students will be evaluated on participation, 2-3 exercises on seismicity rate and declustering, multiple presentations, and a project. All students will submit a short report (4-6 pages) on their project at the end of the course (Dec 12), with an outline due Nov 14, and an abstract due Nov 28. Grading breakdown - 15% participation, 15% HW assignments, 30% student-led presentation/discussion, 20% project report, 20% presentation of project.

Weekly Schedule of Topics

	Topics	Sampling of readings
Week 1	Aug 29: Introduction. Beta-statistic for earthquake rate changes	Guest John Vidale How to get ideas for research
Week 2	Sep 5: Discuss research interests. Declustering seismicity.	Reasenber & Simpson (1992, Science) Zaliapin and BenZion (2020, JGR)
Week 3	Sep 12: Declustering seismicity - applications, best practices and pitfalls	Reasenberg (1985, JGR), Matthews and Reasenberg (1988)
Week 4	Sep 19: Further applications to intermediate and deep earthquakes	Wimpenny et al (2023, JGR)
Week 5	Sep 26: Deep earthquake processes and properties	Houston (2015) review paper and others
Week 6	Oct 3: Deep earthquakes - Largest events	Recent literature on specific earthquakes
Week 7	Oct 10: Fall recess - no class	
Week 8	Oct 17: Trends with depth. Implications for rupture mechanisms, how to test	Zhan (2020) and others
Week 9	Oct 24: Advanced issues in stress inversion	Beauce et al (2022, BSSA)

Week 10	Oct 31: Role of heterogeneity in stress inversion. Implication of low stresses.	Smith & Heaton (2011, BSSA)) Hardebeck reply (2015) Behr & Platt(2014)
Week 11	Nov 7: TBD - Student-driven topics Fracture Mechanics	TBD
Week 12	Nov 14: TBD - Student-driven topics	TBD
Week 13	Nov 21: TBD - Student-driven topics	TBD
Week 14	Nov 28: Thanksgiving - no class	
Week 15	Dec 5: TBD - Student-driven topics	TBD
Week 16	Dec 12: Student project presentations	Project Report due Dec 12

Student Accessibility Services

Students requesting academic accommodations based on a disability are required to register with the Office of Student Accessibility Services (OSAS) each semester. A letter of verification for approved accommodations can be obtained from OSAS. Please be sure the letter is delivered to the instructor as early in the semester as possible. OSAS is located in Room 120 Grace Ford Salvatori Hall, and is open 8:30 am – 5:00 pm, Monday through Friday. The phone number is (213) 740-0776; their email is ability@usc.edu. The website is osas.usc.edu.

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support
Incidents of bias, hate crimes, or aggression need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. dps.usc.edu