

GEOL585 – Science of Hazard Prediction (3 units)

T. H. Jordan (Fall, 2021)

Course Syllabus

Catalog description: Advanced treatment of probabilistic forecasting of natural hazards: physical-process modeling, statistical forecasting, representations of uncertainty, proper scoring, testing, and use in risk analysis and decision-making. Prerequisites: MATH 407, MATH 408.

Academic rationale and learning objectives: Earth's natural hazards—ranging from windstorms, droughts, floods and landslides to earthquakes, tsunamis and volcanic eruptions—are notoriously difficult to predict owing to the scale and complexity of the geosystems that produce them. Nevertheless, the proper functioning of society demands ever-more-informative hazard predictions that are *scientific*; i.e., formulated to describe measurable events, respectful of physical laws, as accurate as possible, and testable against observations. The purpose of this course is to prepare students for advanced research in the science of hazard prediction. Students who complete this course will learn how to develop probabilistic hazard forecasts, calibrate and test forecasts against observations, and communicate forecasting results to end-users.

Instructor: Tom Jordan (tjordan@usc.edu); office hours: Mon 07:00-09:00 or by appointment, ZHS-267.

Format: in-person 3-unit class with a mix of formal lectures (75%) and student presentations on assigned readings and term projects (25%), 2 meetings per week, 1.4 hours per meeting.

Class sessions for Fall 2021: In-person at 09:00-10:20, Tuesday and Thursday, in ZHS 118.

Grades: Based on in-class presentations (40%), homework (20%), and term project (40%).

In-class presentations: Each classroom session will include a lecture by the instructor (60 min) and a student-led discussion of the readings (20 min). Students assigned as discussion leaders on a rotating basis will begin the discussion with a brief (5-10 min) summary of the reading materials. All students are expected to be active participants in the discussions of the course readings.

Homework: Students are expected to spend approximately 6 hours per week on reading the assigned material, answering study questions, and working on their term projects.

Term project: Each student will prepare a 10-15 page paper on a global or regionalized hazard forecasting enterprise, such as Pacific tsunami forecasting, California earthquake forecasting, or Cascadia volcano forecasting. The paper will summarize forecasting methodology, operational forecasting models, and validation procedures, and it will assess forecasting performance and the potential for forecasting improvements. Draft papers will be due two weeks before the end of classes. Students will present their projects orally in 15-minute presentations during the last week of classes. Final drafts of the term papers will be due on the last day of classes. Project grades will be based on the written paper (70%) and oral presentation (30%).

Covid FAQ: <https://www.provost.usc.edu/covid-19/fall-2021-faculty-faq/>

Lecture Schedule – Fall 2021

#	Date	Lecture	Notes
1	Aug 24	Course introduction	
2	Aug 26	Hazard, risk, and decision-making	
3	Aug 31	Elements of probabilistic hazard analysis	
4	Sep 02	Earthquake forecasting: long-term	
5	Sep 07	Uniform California Earthquake Forecast (UCERF3)	K. Milner
6	Sep 09	Earthquake forecasting: short-term	
7	Sep 14	No lecture	SCEC Annual Meeting
8	Sep 16	Lessons of L'Aquila for hazard forecasting	
9	Sep 21	Measure-theoretic concepts and notation	
10	Sep 23	Weather forecasting 1	
11	Sep 28	Weather forecasting 2	
12	Sep 30	Forecasting processes	
13	Oct 05	Assessing forecasting quality	
14	Oct 07	Proper scoring rules	
15	Oct 12	Student term-project proposals	Midterm assessment
16	Oct 14	No lecture	Fall recess
17	Oct 19	ENSO forecasting 1	J. Emile-Geay, THJ away
18	Oct 21	ENSO forecasting 2	J. Emile-Geay, THJ away
19	Oct 26	The Anti-Prediction Critique	
20	Oct 28	Debris-flow forecasting	
21	Nov 02	Forecast testing and validation	W. Savran
22	Nov 04	Bayesian forecasting 1	
23	Nov 09	Bayesian forecasting 2	
24	Nov 11	Model selection using AIC and BIC	
25	Nov 16	Volcanic eruption forecasting	W. Marzocchi
26	Nov 18	Testing the ontological null hypothesis	
27	Nov 23	Ensemble forecasting	
28	Nov 25	No lecture	Thanksgiving holiday
29	Nov 30	Course summary	
30	Dec 02	Student term-project presentations	

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 and microaggressions 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