Global Seismology
CERI 7105/8105
Fall 2018
3 credits

Overview: This course provides the foundation for advanced graduate research in global seismology. Essential fundamentals of continuum mechanics, vector calculus, and solutions of the vector wave equation in homogeneous, vertically and radially inhomogeneous media will be covered toward understanding current theories of earthquake occurrence and wave propagation within the earth. Theoretical development will be supported by examples of data from national seismological data centers, practical experience with seismic instruments, and current research problems in the field. A term project will also provide experience in scientific writing and presenting scientific oral presentations.

Prerequisite: Calculus through differential equations.

Grading:

Homework : 40%
Term Project: 35%
Final Exam: 25%

Text: Class notes. Also refer to a variety of available textbooks

Homework will differ occasionally depending on course registration (7105 vs 8105).

Weeks 1, 2, and 3 – Fundamentals

Review of continuum mechanics: Stress, strain, Equations of motion, vector wave equation, important coordinate systems.
Manipulation of 2^{nd} degree tensor fields applied to stress, strain, rotation
Seismic wave propagation: plane waves, spherical waves, cylindrical waves
Time Domain/Frequency Domain: Fourier transforms, generalized functions
Seismic Instruments, ground motion measurement, and instrument responses

Weeks 4 and 5– Waves and Rays

Snell's Law
Computation of travel times in vertically and radially inhomogeneous earth models
Body waves and surface waves
Seismic waves in the Earth and travel time curves for local, regional, teleseismic distances
The velocity structure of the Earth
Seismogram Interpretation

Weeks 6 and 7– Seismic Source Theory

Isotropic point source in a homogeneous wholespace
Directed point force source in a homogeneous wholespace – Love's tensor
Single couples, double couples, dislocations, and moment tensors
focal mechanisms
Seismic sources in the Earth

Weeks 8 and 9– Seismic Sources

Earthquake Location
Magnitude and Intensity Scales
Kinematic Finite Fault Models and Dislocation Theory
Stress in a viscoelastic lithosphere
Subduction zone, Transform fault, Spreading center events
Non volcanic tremor and slip
Intraplate earthquakes
Benioff/Wadati Zones and earthquake occurrence

Weeks 10 and 11– Theory of Wave Reflection in Elastic Media

Boundary conditions
Plane wave reflection and transmission coefficients
Propagator matrices
Receiver Function Techniques for earth structure

Week 12 – Theory of Surface Waves

Rayleigh, Love wave development
Group velocity, phase velocity
Surface wave propagation in the earth and earth structure

Week 13 – Theory of Free Oscillations of the Earth

Mathematical development
Standing waves vs propagating waves
Spheroidal and Toroidal modes of the earth

Week 14 – Heterogeneity of the Earth

Vertical structure and composition
Tomography and Horizontal velocity heterogeneity

Week 15 – Project Presentations