A Joint Seismic and Geodynamic Study of Three-Dimensional Earth Structure and Thermal Convection in Earth's Mantle

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Course Outline

This course will provide an introduction to a the fundamental physical and mathematical principles required to understand the very long time scale transport of mass and heat in Earth's mantle. This basic introduction to thermal convection dynamics will be employed to interpret the latest seismic tomographic reconstructions of global three-dimensional (3-D) Earth structure. We will study the present-day dynamics of the mantle by directly using these global tomography models to determine the 3-D mantle convective flow and the effect of this flow on surface geophysical processes, such as the global gravity field, the plate tectonic motions, and the global variations in continental elevation and oceanic bathymetry. We will also consider how these tomography-based mantle convection models may be used to study the time dependent evolution of the mantle in the geological past and the implications for the time-dependent surface topography, gravity and Earth rotation variations.

Student participation in this course will be evaluated with a number of practical problem assignments which will test their understanding of the basic principles of mass and heat transfer. These problems will also include a calculation of three-dimensional mantle flow.

Prerequisites: It is assumed that all students have an understanding of three-dimensional calculus, including the solution of partial differential equations in Cartesian and spherical geometry. An understanding of basic thermodynamics and continuum mechanics will also be helpful.