Contributions of Transient Rheology to Geophysical Deformation: Examples from the Deep to Shallow Earth

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Abstract

In this talk, we first examine how microphysical models of transient deformation might manifest at the macroscale which may be summarized as a distinct frequency dependence of dissipation that extends beyond typical models used within geophysics (e.g., Maxwell and Burger viscoelastic models). We will explore several seismological, geodetic, and geological observations that show a strong indication of the activation of transient deformation. These examples include seismic normal modes and tides that span minutes to decades, and observations of viscoelastic rebound in the response to melting ice sheets at time scales from weeks to thousands of years. For these, we will feature examples from Antarctica and Greenland. In all our cases we demonstrate that laboratory derived constitutive laws describing a full spectrum of deformation mechanisms can help to reconcile different inferences of viscoelastic structure.To arrive at these conclusions, theoretical and observational insights from a wide range of spatio-temporal data (the microphysical and planetary-scale) and disciplines (rock physics, seismology and geodynamics) have been combined. The talk will end with implications of the importance of considering transient deformation in other examples of Earth dynamics and associated challenges that remain.

Several Examples – from the deep to shallow Earth – of Detecting Deformation as a Result of Transient Rheology

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