Geophysical Research Abstracts
Vol. 20, EGU2018-11906, 2018
EGU General Assembly 2018

Fundamental insights concerning deep earth viscosity derived from high-quality relative sea level data and the theory of global glacial isostatic adjustment

Keven Roy (1) and William Richard Peltier (2)

(1) Asian School of the Environment, Nanyang Technological University, Singapore (kroy@ntu.edu.sg), (2) Department of Physics, University of Toronto, Toronto, Canada (peltier@atmosp.physics.utoronto.ca)

Models of the Glacial Isostatic Adjustment (GIA) process play a fundamental role in our continuously developing understanding of Earth-Ice-Ocean interaction processes. Such analyses enable us not only to predict the evolution of sea level through time (given a detailed model of Late Quaternary and modern glaciation history), but also to strongly constrain the variation of the effective viscosity structure of the Earth's interior. Whereas the connection to glaciation history relates strongly to our understanding of past climate variability, the ability of such analyses to provide estimates of the depth variation of the effective viscosity of the deep Earth connects strongly to our understanding of the mantle convection process that drives continental drift. The recent availability of high-quality relative sea level constraints from regions of forebulge collapse outboard of previously ice-covered regions has provided a further improved basis on which to constrain these models. In particular, a joint optimization of the deep Earth viscosity and surface mass loading components of the model, employing both high-quality sea level data from the U.S. East coast (Engelhart & Horton, QSR, 2012; Engelhart et al., Geology, 2011) and the vast network of precise space-geodetic observations of crustal motion over North America documented in Peltier et al. (JGR Solid Earth, 2015), has led to the latest ICE-7G_NA (VM7) model (Roy & Peltier, GJI, 2017). The latter model has been successfully tested against an extensive suite of GIA-related observables, not only from the North American continent, but also from regions to which it was not tuned, such as the Mediterranean basin.

This paper will report on recent further progress in our understanding of the effective viscosity structure of the deep earth that has been enabled by the high temporal and spatial resolution relative sea level data from the U.S. East coast. It is found that data from this region of forebulge collapse associated with the former Laurentide ice sheet are enabling a further refinement of our understanding of mantle rheology. This is based upon further application of the iterative procedure that we continue to employ to refine these global models.