Geophysical Research Abstracts
Vol. 15, EGU2013-10199, 2013
EGU General Assembly 2013

An adaptive staggered grid, finite difference method for modeling geodynamic Stokes flows with strongly variable viscosity

Taras Gerya (1), Dave May (1), and Thibault Duretz (2)

(1) Department of Earth Sciences, Swiss Federal Institute of Technology, Zurich, Switzerland (taras.gerya@erdw.ethz.ch), (2) Institute of Earth Sciences, University of Lausanne, Lausanne, Switzerland

We developed and tested a new 2D staggered grid method which is designed specifically for use on adaptive quad-tree meshes. The key to our new adaptive staggered grid (ASG) stencil is in the form of the stress conservative finite difference constraints which are enforced at the “hanging" velocity nodes between resolution transitions within the quad-tree mesh. We demonstrate numerically that the ASG stencil is (i) stable and does not produce spurious pressure oscillations across regions of grid refinement which intersect discontinuous viscosity struc-tures and (ii) possess the same order of accuracy as the classical non-adaptive staggered grid discretization. Additionally, we investigate the applicability of several pragmatic error indicators to demonstrate the superior performance of the ASG stencil over traditional non-adaptive grid approaches. We envisage broad applicability of this new numerical method for simulating mantle convection and lithospheric dynamics. Simplified examples of geodynamic applications are provided in the form of (a) extensional deformation of visco-plastic rocks with free surface and (b) planetary deformation.