AGU FALL MEETING
San Francisco | 12–16 December 2016

T23C-2946: Benchmark Results Of Active Tracer Particles In The Open Souce Code ASPECT For Modelling Convection In The Earth's Mantle

Tuesday, 13 December 2016
13:40 - 18:00
Moscone South - Poster Hall

We present the results of three standard benchmarks for the new active tracer particle algorithm in ASPECT. The three benchmarks are SolKz, SolCx, and SolVI (also known as the 'inclusion benchmark') first proposed by Duretz, May, Gerya, and Tackley (G Cubed, 2011) and in subsequent work by Theilman, May, and Kaus (Pure and Applied Geophysics, 2014). Each of the three benchmarks compares the accuracy of the numerical solution to a steady (time-independent) solution of the incompressible Stokes equations with a known exact solution. These benchmarks are specifically designed to test the accuracy and effectiveness of the numerical method when the viscosity varies up to six orders of magnitude. ASPECT has been shown to converge to the exact solution of each of these benchmarks at the correct design rate when all of the flow variables, including the density and viscosity, are discretized on the underlying finite element grid (Krobichler, Heister, and Bangerth, GJI, 2012). In our work we discretize the density and viscosity by initially placing the true values of the density and viscosity at the intial particle positions. At each time step, including the initialization step, the density and viscosity are interpolated from the particles onto the finite element grid. The resulting Stokes system is solved for the velocity and pressure, and the particle positions are advanced in time according to this new, numerical, velocity field. Note that this procedure effectively changes a steady solution of the Stokes equaton (i.e., one that is independent of time) to a solution of the Stokes equations that is time dependent. Furthermore, the accuracy of the active tracer particle algorithm now also depends on the accuracy of the interpolation algorithm and of the numerical method one uses to advance the particle positions in time. Finally, we will present new interpolation algorithms designed to increase the overall accuracy of the active tracer algorithms in ASPECT and interpolation algotithms designed to conserve properties, such as mass density, that are being carried by the particles.

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