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Scaling laws for internally heated Newtonian fluids in three-dimensional spherical geometry

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In a series of three-dimensional spherical simulations the effects of purely internally heated convection was studied to yield updated scaling laws for parameterized mantle convection models. The upper Rayleigh number and the viscosity contrast due to temperature were varied in over 56 cases to study the influence of these parameters on the quasi steady-state. A viscosity contrast up to the order of 10^9 was observed. The simulations were carried out using the new GAIA framework, consisting of a highly parallel solver for mantle convection in arbitrary geometries. Updated values for the Nusselt – Rayleigh scaling are presented together with a new mobility criterion to specify the stagnant lid regime. Furthermore, the parametric ranges of degree-one convection are presented along with appealing double-convective system effects.