Asymptotically reduced models for core flows

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Planetary core flows are characterized by extreme parameter regimes which can not be reached with current direct numerical simulations. Asymptotically-reduced models of rapidly rotating convection allow to study the physics of these turbulent regimes with a much lower computational cost. One such model that has often been used is the cylindrical annulus model developed by Busse (1970). Unfortunately, this two dimensional model does formally only apply to a cylindrical geometry with asymptotically small slopes. As a stepwise approach to the full spherical problem, we present a three-dimensional asymptotically reduced system of equations in a cylindrical annulus with sloping endwalls. This new model of quasi-geostrophic convection allows for order one slopes at the endwalls as well as large vertical motions. It is thus better suited to describe convection in a spherical geometry where large slopes are present. We present recent numerical simulations of this reduced set of equations.