Compressible convection in large solid planets

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Abstract

The very large viscosity of solid planets, together with their large dimensions, makes their inertia negligible (infinite Prandtl number) while also giving them very high Rayleigh numbers (10$ˆ7$-10$ˆ{10}$). For planets with liquid layers (e.g. magma oceans, metallic cores or deep oceans), the Rayleigh and Prandtl number ranges are enormous. The radial density of these planets increases with depth due to compressibility, leading to impacts on their convective dynamics. To account for these effects, including the presence of a depth variation of the thermal expansivity, a quasi-adiabatic temperature profile and entropy sources due to dissipation, the compressibility is expressed through a dissipation number, D, proportional to the planet's radius and gravity. Compressibility effects are moderate in Earth's mantle ($D≈ 0.5$), *butinlargerockyorliquidexoplanets(super−Earths), thedissipationnumbercanbecomeverylarge*($𝒟 ≈ 20$). *Inthispresentation, wewillexplorethepropertiesofcompressibleconvectionwhenthedissipationnumberissign Earthdynamics.Wewillalsodiscussthedifferencesbetweenexactsimulationsandsimulationsusingapproximateda*

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