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Multiscale numerical simulations of magnetoconvection at low magnetic Prandtl and Rossby numbers STEFANO MAFFEI, MICHAEL CALKINS, KEITH JULIEN, Univ of Colorado - Boulder, PHILIPPE MARTI, ETH Zurich — The dynamics of the Earths outer core is characterized by low values of the Rossby (Ro), Ekman and magnetic Prandtl numbers. These values indicate the large spectra of temporal and spatial scales that need to be accounted for in realistic numerical simulations of the system. Current direct numerical simulation are not capable of reaching this extreme regime, suggesting that a new class of models is required to account for the rich dynamics expected in the natural system. Here we present results from a quasi-geostrophic, multiscale model based on the scale separation implied by the low Ro typical of rapidly rotating systems. We investigate a plane layer geometry where convection is driven by an imposed temperature gradient and the hydrodynamic equations are modified by a large scale magnetic field. Analytical investigation shows that at values of thermal and magnetic Prandtl numbers relevant for liquid metals, the energetic requirements for the onset of convection is not significantly altered even in the presence of strong magnetic fields. Results from strongly forced nonlinear numerical simulations show the presence of an inverse cascade, typical of 2-D turbulence, when no or weak magnetic field is applied. For higher values of the magnetic field the inverse cascade is quenched.

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