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A Multiscale Dynamo Model Driven by Quasi-geostrophic Convection[1] KEITH JULIEN, MICHAEL CALKINS, University of Colorado at Boulder, STEVE TOBIAS, University of Leeds, JONATHAN AURNOU, University of California at Los Angeles — A convection-driven multiscale dynamo model is discussed for the plane layer geometry in the limit of low Rossby number. The small-scale fluctuating dynamics are described by a magnetically-modified quasi-geostrophic equation set, and the large-scale mean dynamics are governed by a diagnostic thermal wind balance. The model utilizes three timescales that respectively characterize the convective timescale, the large-scale magnetic diffusion timescale, and the large-scale thermal diffusion timescale. It is shown that in limit of low magnetic Prandtl number the model is characterized by a magnetic to kinetic energy ratio that is asymptotically large, with ohmic dissipation dominating viscous dissipation on the large-scales. For the order one magnetic Prandtl number model the magnetic and kinetic energies are equipartitioned and both ohmic and viscous dissipation are weak on the large-scales. For both cases the Elsasser number is small. The new models can be considered fully nonlinear, generalized versions of the dynamo model originally developed by Childress and Soward. These models may be useful for understanding the dynamics of convection-driven dynamos in regimes that are only just becoming accessible to simulations of the full set of governing equations.

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