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**A systematic investigation of the inverse cascade and flow speed scaling behavior in rapidly rotating Rayleigh-Benard convection**[1]

MICHAEL CALKINS, University of Colorado, Boulder, STEFANO MAFFEI, University of Leeds, MITCHELL KROUSS, KEITH JULIEN, University of Colorado, Boulder — Rotating convection is a robust driving mechanism for the inverse kinetic energy cascade, which is characterized by the transfer of energy from small-scale convective motions to large-scale motions. One of the consequences of this process is the formation of so-called large-scale vortices (LSVs) that fill the entire flow domain. However, the domain of existence for these vortices and the behavior of their saturated amplitude is not well-constrained. A systematic set of simulations of the asymptotically-reduced governing equations show that: (1) the presence of LSVs is characterized by a critical small-scale Reynolds number over a wide range of Prandtl numbers; (2) the amplitude of the LSVs scales predictively with the horizontal dimensions of the flow domain; and (3) the amplitude of the LSVs saturates with increasing Rayleigh number. Furthermore, we find that LSVs are present in flow regimes not previously known to harbor them. A scaling law is developed for the convective Reynolds number as a function of Rayleigh number and Prandtl number, which can be used to predict the presence of LSVs.

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