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Asymptotic analysis of strongly nonlinear Rayleigh–Bénard convection and Langmuir circulation[1] GREG CHINI, University of New Hampshire — Matched asymptotic analysis and global conservation constraints are used to obtain a semi-analytic yet strongly nonlinear description of two related flows: (i) Rayleigh–Bénard convection at O(1) Prandtl number, and (ii) Langmuir circulation (LC), a wind- and wave-driven convective flow. The analysis, which is carried out in the strong-forcing/weak-diffusion limit, extends previous studies of large Rayleigh number, infinite Prandtl number (i.e. fast but viscous) convection and related analyses of magnetic flux expulsion by eddies. Here, the velocity field is obtained by solving the full nonlinear momentum equation rather than by integrating a linear version or by being specified *a priori*. In marked contrast to weakly nonlinear convection cells, the laminar roll-vortex solutions furnished by the analysis exhibit flow features relevant to turbulent convection, including the complete vertical redistribution of the basic-state temperature (or, for LC, downwind velocity) field. Comparisons with well-resolved pseudospectral numerical simulations confirm the accuracy of the asymptotic results.

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