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Convection-driven shear and decreased heat flux DAVID GOLUSKIN, University of Michigan, HANS JOHNSTON, University of Massachusetts, GLENN R. FLIERL, Massachusetts Institute of Technology, EDWARD A. SPIEGEL, Columbia University — When Rayleigh-Bénard convection is simulated in a horizontally periodic domain, there may spontaneously arise horizontal mean flow that is vertically sheared. We simulate such "shearing convection" in conditions that are especially conducive to its formation—a 2D domain with free-slip top and bottom boundaries—for Prandtl numbers between 1 and 10 and Rayleigh numbers (Ra) up to 10^{10}. At sufficiently large Ra, the horizontal mean flow is very strong in our simulations, accounting for over 99% of the fluid's total kinetic energy. Vertical heat transport, quantified by the Nusselt number, is greatly depressed by this mean flow. As Ra is raised, the Nusselt number grows much more slowly than in ordinary (non-shearing) Rayleigh-Bénard convection and can even decrease. Shearing convection can assume two very different forms, depending mainly on the Prandtl number; the convective heat transport can be either significant at all times or significant only during bursts. We mention an analogy with tokamak plasmas and suggest ways to produce shearing convection in the laboratory.

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