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Meandering of the large-scale circulation of turbulent convection in a cylindrical cell[1] ERIC BROWN, DENIS FUNFSCHILLING, ALEXEI NIKOLAENKO, GUENTER AHLERS, Dept. of Physics and iQUEST, UC Santa Barbara — The large-scale circulation (LSC) in cylindrical cells of aspect ratio $\Gamma \equiv D/L = 1$ (D = diameter, L = height) filled with water at a mean temperature of 40°C and heated from below was studied for Rayleigh numbers R in the range 10^9 to 10^{11}. We measured the temperatures of the cell side-wall as a function of time t at eight azimuthal locations on the horizontal mid- plane and from them deduced the azimuthal orientation $\theta(t)$ of the LSC. We found that $\theta(t)$ varied irregularly in time. Although it had a preferred value, on average there was a long-term continuous rotation of the LSC. From the data for $\theta(t)$ we derived $\dot{\theta} \equiv \Delta\theta/\Delta t$ (Δt is the time interval between measurements). The time averages of $\dot{\theta}(\theta)$ gave a deterministic force $-\partial V/\partial\theta$ corresponding to a potential of the form $V = V_0[-\cos(\theta - \theta_0) + v_1\theta]$, and its probability distribution-function $P_{\dot{\theta}}(\dot{\theta})$ yielded a Langevin force $f(t)$. Integrations of the corresponding stochastic model equation $\partial\theta/\partial t = -\partial V/\partial\theta + f(t)$ produced time series $\theta(t)$ and distribution functions $P_\theta(\theta)$ remarkably similar to the experimental data. We attribute $f(t)$ to the action of the turbulent background fluctuations on the LSC, and found that its intensity depended on R.

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Eric Brown
UC Santa Barbara

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