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Large-scale cell formation in turbulent Rayleigh-Bénard convection PHILIPP VIEWEG, JÖRG SCHUMACHER, TU Ilmenau, Germany, JANET SCHEEL, Occidental College Los Angeles, USA — The gradual aggregation of turbulent plumes and circulation rolls to a large-scale cell which eventually fills the whole periodic, horizontally extended layer of aspect ratio $\Gamma = 60$ is reported in high-resolution spectral element simulations of three-dimensional turbulent Rayleigh-Bénard convection. It is shown that this final state of the flow is reached in extraordinary long simulations of the order of 10^4 convective time units and proceeds only when the turbulence in the convection layer is driven by a constant heat flux at the bottom and top boundaries, independently of velocity boundary conditions. The formation takes place for fixed Prandtl number $Pr = 1$ and varying Rayleigh number in a range from $Ra \sim 10^4$ to $Ra \sim 10^7$. This implies that even though the convection is in the (fully) turbulent regime – far beyond the linear stability threshold – the most unstable mode at onset of convection with a critical wave number of $k = 0$ still seems to dominate the long-term dynamics. Our present study might have interesting implications for atmospheric and stellar convection processes where heat fluxes are typically prescribed at the boundaries of the convection zone.

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