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Scale-by-scale energy budget in turbulent convection RUDIE KUNNEN, HERMAN CLERCX, Eindhoven University of Technology — Turbulent free convection is driven by buoyancy. A footprint of buoyancy is thus expected in the energy cascade. The existence of this so-called Bolgiano–Obukhov (BO) scaling is a long-standing open question. We use DNS of Rayleigh–Bénard convection in a horizontally periodic domain to address this question. Moderate Rayleigh numbers 2.6×10^6 and 2.5×10^7 are applied, at three different Prandtl numbers 1, 3 and 10. We show that the length scale bounding the convective scaling regime from below, the Bolgiano scale L_B, is typically large relative to the domain size. Scale-by-scale energy budgets are calculated based on Yakhot's equivalent of Kolmogorov's isotropic four-fifths law for convection. They reveal that buoyancy is active on many scales, obscuring the classical Kolmogorov scaling for scales smaller than L_B. Only at very large separations a buoyancy-dominated scaling range could exist. Close to the plates, where L_B is smaller, anisotropy complicates the detection of scaling.

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