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Intermittency and large-scale winds in horizontally anisotropic convection

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We simulate three-dimensional, horizontally periodic Rayleigh-Bénard convection, confined between free-slip horizontal plates and rotating about a distant horizontal axis. When both the temperature difference between the plates and the rotation rate are sufficiently large, a strong horizontal wind is generated that is perpendicular to both the rotation vector and the gravity vector. The wind is turbulent, large-scale, and vertically sheared. Horizontal anisotropy, engendered here by rotation, appears necessary for such wind generation. Most of the kinetic energy of the flow resides in the wind, and the vertical turbulent heat flux is much lower on average than when there is no wind. Convection takes place in irregular, strongly intermittent bursts and the flow alternates between wind-dominated longer stages and convection-dominated events. Our findings support the conjecture that the upscale cascade of energy in anisotropic turbulent convection, which here drives sheared winds, drives differential rotation in the equatorial regions of planetary atmospheres and stellar convective zones, with interesting consequences associated with the strong intermittency of the convective events.