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Transition to geostrophic convection: the role of boundary conditions RUDIE KUNNEN, Eindhoven University of Technology, RODOLFO OSTILLA-MÓNICO, ERWIN VAN DER POEL, University of Twente, ROBERTO VERZICCO, University of Rome "Tor Vergata", DETLEF LOHSE, University of Twente — The so-called geostrophic regime of rapidly rotating Rayleigh–Bénard convection is dominated by rotation with strong enough thermal forcing to attain a turbulent flow. It is the appropriate regime for the description of the large-scale geophysical and astrophysical convective flows. Only very recently, numerical simulations and experiments have become able to enter into this regime with distinctly different scalings than the traditional rotation-affected regime, with many open questions remaining. We explore the transition to the geostrophic regime using direct numerical simulations of the Navier–Stokes and heat equations by varying the rotation rate (Ekman number Ek) at two constant values of the thermal forcing (Rayleigh number $Ra = 1 \times 10^{10}$ and 5×10^{10}) and constant Prandtl number $Pr = 1$. We focus on the differences between the application of no-slip or stress-free boundary conditions on the horizontal plates. We find the transition as changes in heat transfer, boundary-layer thickness, bulk/boundary-layer distribution of dissipation and bulk mean temperature gradient. The transition is gradual: many statistics reveal a change in scaling, but not sharp and not at exactly matching Ek.

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