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Large Scale Vortices in the Rotating Rayleigh-Benard setup with no-slip boundaries[1] ANDRES AGUIRRE-GUZMAN, MATTEO MADONIA, JONATHAN CHENG, Eindhoven University of Technology, RODOLFO OSTILLA-MONICO, University of Houston, HERMAN CLERCX, RUDIE KUNNEN, Eindhoven University of Technology — In rotating Rayleigh-Bénard (RRB) convection, the buoyancy-driven flow between two horizontal plates subject to rotation, different regimes are accessible depending on the strength of buoyancy and rotation. Under intense forcing (high Rayleigh number Ra), turbulent convection is obtained and, if rotation is strong enough (low Ekman number Ek), vertical motions are greatly suppressed. This allows for a quasi-two-dimensional turbulent state. In such conditions an inverse energy cascade is possible, leading to large-scale vortices (LSVs) in the flow. LSVs have been observed for stress-free top/bottom boundaries, but not yet for the no-slip case until now. In the latter, Ekman pumping from the viscous layer induces vertical velocities that affect the 2D flow. This vertical component however is attenuated when rotation is increased. We directly simulate RRB flow at $Ek \sim 10^{-7}$ and $Ra \sim 10^{10} - 10^{12}$ in a horizontally periodic box with no-slip boundaries for two fluids with Prandtl number $Pr = 0.1$ (towards liquid metals) and 5.2 (water). We show that LSVs are possible when viscous effects are strongly confined to the boundaries and no longer influence the bulk flow. At both Prs, the flow is quasi-2D and a domain-filling vortex dipole is observed.

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