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Non-Oberbeck-Boussinesq effects on flow structure in Rayleigh-Bénard convection in water KAZUYASU SUGIYAMA, ENRICO CALZAVARINI, University of Twente (The Netherlands), SIEGFRIED GROSSMANN, Philipps-Universitae (Germany), DETLEF LOHSE, University of Twente (The Netherlands) — Non-Oberbeck-Boussinesq (NOB) effects on the flow organization in two-dimensional Rayleigh-Bénard convection are numerically analyzed for water. The Rayleigh number Ra and the temperature difference $\Delta(= T_b - T_t)$ between top and bottom plates are varied up to 10^8 and 60K, respectively. The simulation captures broken symmetry features, i.e., the center temperature T_c shift and the Nusselt number deviation, which are observed in the experiment of Ahlers et al. (2006, J. Fluid Mech., **569**). Beyond $Ra \approx 10^6$ the flow consists of a large diagonal center convection roll and two smaller rolls in the upper and lower corner, respectively. In the NOB case the center convection roll is still characterized by only one velocity scale, while the top and bottom corner flows are of different strength. We find the total energy based Reynolds number $Re^E = \langle \mathbf{u}^2/2 \rangle^{1/2} L/\nu$ scales as $Re^E_{NOB}/Re^E_{OB} \sim (\beta(T_c)/\beta(T_m))^{1/2}$, with β the thermal expansion coefficient and $T_m(= (T_b + T_t)/2)$ the arithmetic mean temperature, corresponding to the ratio of the free fall velocities.

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