Laboratory model for Rotating Rayleigh–Bénard convection with latitudinal variation

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Abstract

We present a novel experimental study of rotating thermal convection with varying latitudes. The convection cell on a rotation table is offset from the rotation axis by a distance d to generate a directed centrifugal acceleration. When this is combined with the Earth's gravity , the resulting equivalent gravity becomes inclined to the rotating axis. When the convection cell is tilted at an appropriate angle, the temperature gradient then becomes parallel to the gravity as in a standard Rayleigh–Bénard configuration. This setup satisfies the f-plane approximation, enabling us to investigate rotating thermal convection with varying latitudes ranging from 90∘ (polar region) to 10∘ (low-latitude region). For each fixed Ra, the Ekman number (Ek) could be varied continuously by synchronously adjusting rotation speed and the offset distance at a given latitude. The latitudinal interval between different experimental sets was typically 15∘, but could be reduced to 5∘ if necessary. We gratefully acknowledge support of this work by the National Natural Science Foundation of China through Grants: 12402253, 12232010, 12594530010, 12595302.

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