
An experimental study of rotating thermal convection with latitudinal variation

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Abstract

At different latitudes Φ , the angle between gravity and the rotation axis (i.e. the co-latitude $90^\circ - \Phi$) changes correspondingly. This latitude variation significantly impacts heat transport and flow dynamics across geophysical and astrophysical systems. However, previous experimental studies have primarily focused on the polar regions ($\Phi=90^\circ$). Here we present results from a novel experiment that allows the latitude Φ to be varied from 10° to 90° . In the experiment, water was used as the working fluid ($Pr=4.3$), and measurements were made at two Rayleigh numbers ($Ra=3.3e7$ and $1.3e8$). It is found that, compared to the polar regions, the heat transfer efficiency in the low-latitude regions can be significantly enhanced at certain Rayleigh numbers and dropped sharply at others, which are consistent with previous observations and numerical simulations. We also observed that the $Nu-\Phi$ relationship at fixed Ra is strongly modulated by the Ekman number (Ek).

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