Penetration thickness of convection in rapidly rotating spherical shells and generation of mean zonal flow of Jupiter

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Penetration of columnar convection in rapidly rotating spherical shells into a stably stratified layer near the outer shell is investigated.

An analysis of a plane layer model shows that the penetration thickness is in proportion to the Coriolis parameter and the horizontal scale of the convection cells, and in inverse proportion to the Brunt-Vaisala frequency in the stratified layer.

Structures of critical convection in rotating spherical shells against basic states with a stably stratified layer are calculated. The dependency of penetration thickness on the extent of stratification is consistent with the results of the simple model.

Our results suggest that the horizontal scale of deep convection which produces mean zonal flow in Jovian atmosphere should be more than 2000km.