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Latitudinal Variation in Internal Heat Flux in Jupiter's Atmosphere: Effect on Weather Layer Dynamics

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Conventional weather layer General Circulation Models (GCMs) typically simulate over a height range extending only a short distance beneath the water cloud base, constrained by computational resources. Due to the limited knowledge about the environment at depth, the conditions specified at the bottom boundary of the domain are usually greatly simplified. Consequently, the influence of deeper atmospheric dynamics on cloud-level phenomena remains poorly understood. Recent observations from the Juno mission have provided new insights into the complex conditions prevailing within Jupiter's deep atmosphere. Given these advances, it is timely to re-evaluate the simple assumptions regarding the deep atmosphere currently employed in weather layer GCMs.
In this study, we challenge the conventional approach by introducing latitudinal variations in internal heat flux into a GCM of Jupiter’s atmosphere. Our model incorporates a heat flux profile that decreases from the equator to the poles, with additional complexities such as belt-and-zone contrast and hemispheric asymmetry. Preliminary results show significant deviations in weather layer atmospheric dynamics when compared to constant flux models, particularly in the equatorial regions. We discuss the underlying mechanisms driving these differences, providing insights into the coupling between Jupiter's visible weather layer and its obscured deeper layers. This work represents a step towards developing a more comprehensive GCM for Jupiter, which could also enhance our understanding of other giant planets, by incorporating more realistic conditions at the bottom boundary.