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Initial results for the depth of the winds on Jupiter as inferred from the Juno gravity measurements

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Abstract

One of the primary goals of the Juno mission, now in orbit around Jupiter and performing close flybys of the planet, is to obtain a high precision gravity spectrum of the planet. Such data can be used to estimate the depth of Jupiter's observed cloud-level wind, and decipher the possible internal flows within the planet. Here we present the initial results from these gravity measurements which allow calculation of the depth and vertical profile of the observed zonal flows. We use a hierarchy of models including a layered Concentric Maclaurin Spheroid model for determining the static component of the gravity spectrum, and an analysis of the geostrophic balance for inferring the dynamical contribution to the gravity spectrum. In order to invert the gravity measurements into flow fields we use an adjoint based inverse model. The model is constructed to be as general as possible, allowing for both cloud-level wind extending inward, and a decoupled deep flow that is constructed to produce cylindrical structures with variable width and magnitude, or can even be set to be completely general. In light of the Juno gravity measurement first results, we discuss the Juno gravity experiment and the implications regarding Jupiter's differential rotation and atmospheric flows. Particularly we focus on the odd gravity moments, which reflect asymmetries between the northern and southern hemispheres and therefore are a pure signature of the dynamics with no contribution from the static planet. We also discuss the contribution of the flow to the even harmonics and it's implications to the study of Jupiter's density structure and shape.