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The range of flow structures fitting Jupiter's asymmetric gravity field

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Jupiter's North-South asymmetric gravity field, measured by the Juno spacecraft, allowed estimating the depth of the zonal jets trough the relation between the measured density anomaly and the flow. This analysis was based on a combination of all four measured odd gravity harmonics, so the direct effect of each of them on the flow profile has not been investigated. Moreover, past calculations assumed that the cloud-level zonal wind maintains its meridional structure with depth; However, the Juno microwave radiometer measurements imply that a vertically dependent meridional profile might be more suitable, due to the reasonable relation between the Nadir brightness temperature profile and the zonal wind. In this study, we analyze in detail the possible range of structures of Jupiter's deep jet-streams, fitting each of the Juno's measured asymmetric gravity harmonics. Specifically, we examine the possible vertical structure of Jupiter's deep jet streams, different meridional structures of the cloud-level zonal wind and depth-dependent meridional profile compatible with the Nadir temperature tendency. We find that each odd gravity harmonic constrains the flow at a different depth, with J3 being the most dominant at depths below 3000 km, where the electrical conductivity becomes significant. J5 is the most restrictive harmonic overall, and J9 does not constrain the flow at all if the other odd harmonics are within the measurement range. Deep flow profiles constructed from perturbations to the cloud-level winds allow a more extensive range of solutions, yet when the patterns differ substantially from the cloud-level observed wind profile, the ability to match the gravity data reduces significantly. Random zonal wind profiles, unconnected to the cloud-level profile allow almost no solutions for the gravity data, and only 1% of the tested wind profiles yield any solution. Overall, we find that while interior wind profiles that diverge considerably from those at the cloud-level are possible, they are statistically unlikely. Finally, we find that meridional smoothing of the wind with depth, according to the Juno MWR brightness temperature profile, still allows fitting the measured gravity signal within the uncertainty range.