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Jupiter's Zonal Winds: Are They Bands of Homogenized Potential Vorticity and Do They Form a Monotonic Staircase? PHILIP MARCUS, University of CA at Berkeley, SUSHIL SHETTY, Schlumberger-Doll Research — It has been hypothesized that the potential vorticity (PV) in Jupiter's atmosphere is mixed in a manner that is analogous to the Phillips effect in the ocean. When the upper ocean is mixed, the salt density distribution changes from a smoothly increasing function of depth to a nearly monotonic *staircase* with regions of nearly uniform salt density separated from each other by sharp interfaces where the density gradient is large. It is hypothesized that the profile of PV in Jupiter's east-west zonal winds (visible stripes) is a staircase, decreasing from north to south. Measurements of the Jovian zonal velocity are sufficiently precise to determine vorticity, but the PV also depends on unknown parameters that cannot be observed directly. Therefore, the distribution of PV cannot be tested directly. By using new high-precision observations of Jupiter, we have solved numerically the *inverse problem* between the latitudes of 9°S and 39°S and found the PV (and its uncertainties) that best fits the observations. Although we find that the PV distribution is approximately piecewise-constant, the zonal PV is not monotonic. We show that this non-monotonicity is necessary to make the Great Red Spot nearly round (aspect ratio of 1.6), and that without the non-monotonicity, the Red Spot would be highly elongated in the east-west direction and probably unstable.

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