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On the Surprising Longevity of Jupiter's Centuries-Old Great Red Spot PHILIP MARCUS, UC Berkeley, PEDRAM HASSANZADEH, Harvard — Jupiter's Great Red Spot (GRS) has been observed continuously for 100 years and is possibly older than 350 years. However, the area of its cloud cover is quickly shrinking. Although the areas of the clouds and of the potential vorticity of the GRS might not be well correlated, it motivates us to examine the physics that determines the GRS lifetime. When the GRS is in quasi-equilibrium, the ratio of its potential (i.e. thermal) energy to its kinetic energy is $\sim 2/Ro \simeq 6$, where Ro is the Rossby number. Because the atmospheric radiative decay time is 4-5 years, the overall energy and structure of the GRS would be expected to decay in 4-5 years, as it does in our 2D simulations of the GRS (or with an faster decay rate in the low-resolution 3D simulations by others). We show that in high-resolution, 3D calculations, meridional circulations (consisting of vertical and radial velocities) develop spontaneously in the GRS. The vertical velocity sustains the GRS by drawing energy from the ambient atmosphere: this circulation transports mass downward in the ambient atmosphere, thereby decreasing its potential energy. This released energy, along with kinetic energy from the ambient zonal jets, is carried to the GRS by the meridional circulation, sustaining the GRS for centuries.

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