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James H. Shirley, Michael A. Mischna

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James H. Shirley[*], Michael A. Mischna

Jet Propulsion Laboratory, Pasadena, California 91109 USA

[*]Corresponding author. jshirley@jpl.nasa.gov

Abstract

A new physical hypothesis predicts that a weak coupling of the orbital and rotational motions of extended bodies may give rise to a modulation of circulatory flows within their atmospheres. Driven cycles of intensification and relaxation of large-scale circulatory flows are predicted, with the phasing of these changes linked directly to the rate of change of the orbital angular momentum, $d\mathbf{L}/dt$, with respect to inertial frames. We test the hypothesis that global-scale dust storms (GDS) on Mars may occur when periods of circulatory intensification (associated with positive and negative extrema of the $d\mathbf{L}/dt$ waveform) coincide with the southern summer dust storm season on Mars. The orbit-spin coupling hypothesis additionally predicts that the intervening 'transitional' periods, which are characterized by the disappearance and subsequent sign change of $d\mathbf{L}/dt$, may be unfavorable for the occurrence of GDS, when they occur during the southern summer dust storm season. These hypotheses are strongly supported by comparisons between calculated dynamical time series of $d\mathbf{L}/dt$ and historic observations. All