NONLINEAR DUST CYCLE BEHAVIOR LINKED TO DUST RADIATIVE EFFECT IN MARS ATMOSPHERE SIMULATIONS WITH GISS ROCKE-3D. J. P. Perlwitz[1,3,7], K. Tsigaridis[2,3,7], Igor Aleinov[2,3,7], S. D. Guzewich[4,7], M. J. Way[3,5,7], and Eric T. Wolf[6,7], [1]Climate, Aerosol and Pollution Research, LLC, Bronx, NY 10471, USA (jan.p.perlwitz@caprllc.com), [2]Center for Climate Systems Research, Columbia University, New York, NY 10025, USA, [3]NASA Goddard Institute for Space Studies, New York, NY, 10025, USA, [4]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, [5]Theoretical Astrophysics, Department of Physics & Astronomy, Uppsala University, Uppsala SE-75120, Sweden, [6]University of Colorado, Boulder, USA, [7]Sellers Exoplanet Environments Collaboration, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA.

Introduction: We present simulation results of the dust cycle on Mars using the NASA Goddard Institute for Space Studies (GISS) ROCKE-3D [1] general circulation model with radiatively active dust aerosol tracers. Dust aerosols are represented by a sectional scheme that partitions the simulated dust mass into eight size classes, covering a total size range from 0.1 to 32 μm particle diameter. The model simulates emission from sources, advection, and turbulent, gravitational, and wet deposition of dust. The strength of the dust cycle can be calibrated with a global factor for the dust emission. ROCKE-3D is coupled to the Suite of Community Radiative Transfer codes based on Edwards and Slingo (SOCRATES) [2,3], which applies Mie theory to calculate scattering and absorption of radiation by aerosols.

We carried out a series of experiments over 11 Mars years, for which we varied the strength of the dust cycle, and for radiatively active and inactive dust. The simulated dust aerosol optical depths were compared to gridded retrievals of the dust AOD from measurements over 11 years [4, 5]. We find that the dust cycle displays nonlinear behavior with the strength of emission, when the dust is radiatively active, which is absent for radiatively inactive dust. When the dust cycle strength exceeds a certain threshold the simulated mean annual cycle of dust starts to exhibit features that are similar to the observed mean annual cycle. We hypothesize that feedbacks involving the dust radiative effect introduce important non-linearities which are essential for reproducing and understanding the observed dust cycle on Mars.

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