A Markov Chain Approach for Modeling Polarized Infrared Radiative Transfer in Optically Anisotropic Media

Feng Xu[1], **W. Reed Espinosa**[2], **Olga V. Kalashnikova**[3], **Anthony B. Davis**[3], **David J. Diner**[3], **Michael J. Garay**[3], **Jie Gong**[2], **Benting Chen**[1], **Lan Gao**[1], **Jens Redemann**[1], **and Zhao-Cheng Zeng**[4]

[1] *School of Meteorology, The University of Oklahoma, Norman, USA*
[2] *NASA Goddard Space Flight Center, Greenbelt, MD, United States, USA*
[3] *Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA*
[4] *Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, USA*

The polarization state of atmospheric radiation contains abundant information about aerosol and cloud particle properties. To assist in the combined use of reflected and emitted radiation for dust and cloud remote sensing, we developed a Markov chain approach to model polarized infrared radiative transfer in an optically isotropic or anisotropic medium (e.g. Earth atmosphere). A multi-steam scheme is adopted to resolve the angular dependence of total radiance and polarized radiance. Our model accounts for atmospheric emission, scattering, and absorption, as well as directional surface emission and reflection. Non-spherical particles with random and preferred orientations are considered. Simulation is performed for three reference Earth atmospheres (mid-latitude summer, sub-arctic winter, and tropical) which contains dust particles, water droplets, and ice particles of preferred or random orientations. These reference atmospheres overly an ocean or a land surface which contributes both surface emission and reflection. The numerical simulation shows a) remarkable impact of particle orientations, non-sphericities, and the linear and circular polarization components of infrared extinction matrix on the infrared polarimetric signals. By contrast, the infrared radiances are much less impacted.

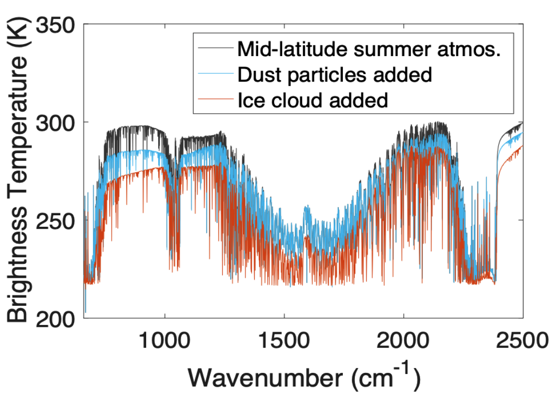

Figure 1 Sensitivity of Infrared Brightness Temperature to Dust and Ice Cloud

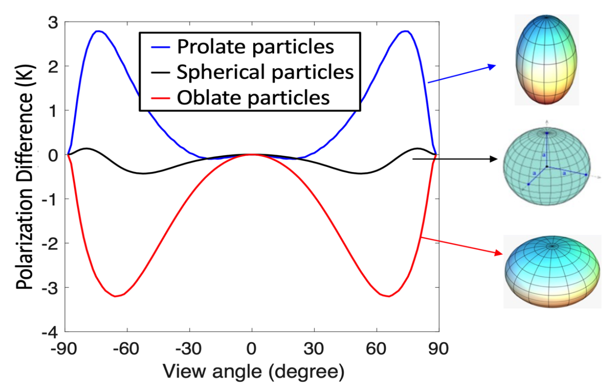

Figure 2 Sensitivity of Polarization Difference to Atmospheric Dust Particle Shape (1000cm^{-1})

+Author for correspondence: fengxu@ou.edu