Long-Term Variations in Terra/MISR Angular Radiance Differences: Solar or Aerosol Influences on Polar Cloudiness?

Dong L. Wu [1] *[dong.l.wu@nasa.gov], Tamás Várai* [1,2]*, and Jae N. Lee* [1,2]

[1] *NASA Goddard Space Flight Center, Greenbelt, MD, USA*

[2] *Joint Center for Earth Systems Technology, University of Maryland, Baltimore County, Baltimore, MD, USA*

There has been a long outstanding debate on whether global cloud cover is influenced by solar variability. Detection of such signals has been controversial and challenging, largely because of difficulty and fidelity associated with inter-sensor calibration. In addition, attribution of any quasi-decadal variation to the solar cycle influence requires careful consideration of other internal variabilities in the Earth's system that oscillate with the similar period (e.g., Pacific Decadal Oscillation) or disrupt solar influences (e.g., volcano eruptions). In this paper we present an angular differential analysis of the monthly radiance data from 17-year Terra/MISR (Multi-angle Imaging SpectroRadiometer) sun-synchronous observations. MISR takes simultaneous images from 9 view angles at nadir and 26.1°, 45.6°, 60.0°, and 70.5° angle pairs in the forward and aftward directions. By differencing the radiances between 70.5° forward and aftward, radiometric calibration error is greatly reduced or eliminated and in the meantime reflective cloud signals are enhanced in the polar region where low clouds produce strong forward scattering. There is a significant quasi-decadal variation in the 70.5° forward and aftward radiance differences. The differences do not appear to have any trend at low latitudes where the pair of view angles have roughly symmetric about the solar incidence, indicating systematic errors of instrument radiometric calibration are mostly removed. The quasi-decadal variations are found in the polar region from all four MISR spectral bands, but stronger in the blue and green bands than in the red and near-IR. They are out of phase with the 11-year solar cycle, but these enhancements also appear to correlate with volcanic aerosol activities. By examining the MISR radiances closely, we find that these large angular radiance differences are dominated by the scattering from low-level clouds dominates, compared to the surface contribution.