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Modeling Studies of the MODIS Solar Diffuser Attenuation Screen and Comparison with On-Orbit Measurements

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Abstract

The MODIS instrument relies on solar calibration to achieve the required radiometric accuracy. This solar calibration occurs as the TERRA spacecraft comes up over the North Pole. The earth underneath the spacecraft is still dark for approximately one minute and the sun is just rising over the earth's north polar regions. During this time the sun moves through about 3.3 degrees, the scan mirror rotates about 19 times and about 50 exposures (frames) are taken each time the field of view is directed to the approximate center (sweet spot) of the solar diffuser. For some of MODIS's bands the brightness of the diffuser is reduced, to prevent detector saturation, by means of a retractable pinhole screen, which produces approximately 600 pinhole images of the sun, within the field of view of any one detector. Previous attempts at creating a radiometric model of this, reduced intensity, calibration scenario produced intensity variations on the focal planes with insufficient detail to be useful. The current computational approach, gets around these limitations and is fast enough to permit simulation of the motion of the sun and the scan mirror. The results resemble the observed focal plane temporal and spatial intensity variations well enough to be useful. The computational approach is described and a comparison with observational data is presented.

Keywords: TERRA, MODIS, radiometry, solar, calibration, simulation

1. Introduction

The TERRA spacecraft has been in orbit since its launch on December 18, 1999 and the resulting large number of solar calibrations, as the spacecraft goes over the North Pole, fig. 1, has provided insight into the instrument's radiometric accuracy. What were previously, during ground testing, considered small radiometric errors, or were simply not observed because of limitations in the test equipment, are now viewed as limitations to further improvements in radiometric accuracy. The current solar calibration simulation attempts to reproduce these small radiometric effects and thereby, improve the correction algorithms and radiometric accuracy of MODIS. Previous attempts, at simulating the solar calibration, produced results with insufficient, small-scale spatial detail, to be truly useful. The new approach does reproduce the observed small spatial and temporal (due to the motion of the spacecraft and the scan mirror) intensity variations.

Fig. 1: Sunrise

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