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Early On-orbit Calibration Results from Aqua MODIS

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ABSTRACT

Aqua MODIS, also known as the MODIS Flight Model 1 (FM1), was launched on May 4, 2002. It opened its nadir aperture door (NAD) on June 24, 2002, beginning its Earth observing mission. In this paper, we present early results from Aqua MODIS on-orbit calibration and characterization and assess the instrument's overall performance. MODIS has 36 spectral bands located on four focal plane assemblies (FPAs). Bands 1-19, and 26 with wavelengths from 0.412 μ to 2.1 μ are the reflective solar bands (RSB) that are calibrated on-orbit by a solar diffuser (SD). The degradation of the SD is tracked using a solar diffuser stability monitor (SDSM). The bands 20-25, and 27-36 with wavelengths from 3.75 μ to 14.5 μ are the thermal emissive bands (TEB) that are calibrated on-orbit by a blackbody (BB). Early results indicate that the on-orbit performance has been in good agreement with the predications determined from pre-launch measurements. Except for band 21, the low gain fire band, band 6, known to have some inoperable detectors from pre-launch characterization, and one noisy detector in band 36, all of the detectors' noise characterizations are within their specifications. Examples of the sensor's short-term and limited long-term responses in both TEB and RSB will be provided to illustrate the sensor's on-orbit stability. In addition, we will show some of the improvements that Aqua MODIS made over its predecessor, Terra MODIS (Protoflight Model - PFM), such as removal of the optical leak into the long-wave infrared (LWIR) photoconductive (PC) bands and reduction of electronic crosstalk and out-of-band (OOB) thermal leak into the short-wave infrared (SWIR) bands.

Keywords: MODIS, sensor, calibration, thermal emissive bands, reflective solar bands, blackbody, solar diffuser

1. INTRODUCTION

The MODERate Resolution Imaging Spectroradiometer (MODIS) Flight Model 1 (FM1) has been on-orbit for more than 3 months since its launch on-board the NASA Earth Observing System (EOS) Aqua spacecraft on May 4, 2002. The first image of Aqua MODIS was acquired on June 24, 2002 when the instrument opened its nadir aperture door (NAD). MODIS provides close to daily coverage of the Earth in 36 spectral bands with wavelengths ranging from 0.412 μ (VIS) to 14.5 μ (LWIR) and spatial resolution at nadir of 250m (bands 1-2), 500m (bands 5-7), and 1km (bands 8-36). The Aqua spacecraft crosses the equator at about 1:30 pm (local time), while the MODIS Protoflight Model (PFM) instrument launched on-board the Terra spacecraft on December 18, 1999 is in a 10:30 am equator-crossing orbit. Working together, the two MODIS instruments can view the same area of the Earth in the morning and afternoon, enabling diurnal observations of parameters for global long-term studies of the land, oceans, and atmosphere^{1,2,3}. Following a brief review of MODIS on-orbit calibration, we will present Aqua MODIS early on-orbit calibration results, such as detector's noise characterization and response stability. We will also show the improvements made in the Aqua MODIS over its predecessor, Terra MODIS, by comparing the results from on-orbit observations.

2. OVERVIEW OF MODIS ON-ORBIT CALIBRATION

MODIS on-orbit calibrators (OBCs) include a flat panel v-grooved blackbody (BB), a solar diffuser (SD) panel made of SpectralonTM, and a spectroradiometric calibration assembly (SRCA). The 16 thermal emissive bands (bands 20-25 and 27-36) with wavelengths above 3.75 μ are calibrated on-orbit by the BB with its temperature scale traceable to NIST standards. Calibration of the 20 reflective solar bands is accomplished by using the coefficients derived from SD observations. The BRDF of the SD was pre-launch determined with reference to NIST calibrated reflectance samples. An