3 MODIS Level-1B Products

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3.1 Introduction

A key instrument of the NASA's Earth Observing System (EOS) Terra and Aqua missions, the Moderate Resolution Imaging Spectroradiometer (MODIS) was designed to take measurements in a broad spectral range at three spatial resolutions and with a wide field of view. In addition to many new features, MODIS extends a number of heritage sensors' data sets that are essential for understanding global environmental changes (Salomonson et al., 1989; Barnes and Salomonson, 1992). Algorithms developed by the researchers and scientists of the MODIS Science Team are used to generate approximately 40 science products that are used in formulating a wide range of parameters that are needed for the short- and long-term studies of the Earth's land, oceans, and atmosphere. Both Terra and Aqua MODIS are currently operating on-orbit and making continuous global observations (Salomonson et al., 2002; Barnes et al., 2003).

As illustrated in Fig. 3.1, the sensors' raw data are transmitted to the ground stations, such as the one at the White Sands in New Mexico, through the Tracking Data Relay Satellite System (TDRSS) and then sent to the EOS Data and Operations System (EDOS). At the Goddard Space Flight Center Distributed Active Archive Center (GDAAC), the sensor's original binary data files (Level-0)

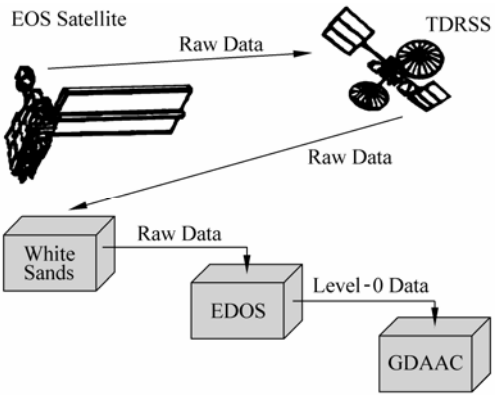

Figure 3.1 Data path from satellite to GDAAC

from the EDOS are first reformatted and separated into Level-1A (L1A) data sets in Hierachical Data Format (HDF). Each L1A data set (referred to as a "granule") contains 5 minutes' worth of data, consisting of the sensor's response in digital numbers (DNs) as well as other engineering and telemetry information. These are the principal inputs to the Level-1B (L1B) process. Other inputs include a geolocation file and a set of L1B Look-Up Tables (LUTs), which provide many calibration parameters determined from pre-launch and on-orbit calibration and

characterization. The higher level MODIS data processing is done at the MODIS Data Adaptive Processing System (MODAPS). The MODIS products, including L1B products, are distributed through the GDAAC.

MODIS Level-1B algorithms convert raw data from the sensor's observations (in the L1A format) into radiometrically calibrated and geometrically located data sets. The MODIS L1B algorithms are developed and maintained by the MODIS Characterization Support Team (MCST) under the direction of the MODIS Science Team Leader. Because of the differences in the Terra MODIS and Aqua MODIS sensors' characteristics, operational configurations, and response changes, two separate versions of L1B software and associated LUTs are maintained and updated as necessary based on the instrument calibration and characterization performed by the MCST. Working closely with the MODIS Science Team representatives, MCST analysts and L1B code developers perform initial evaluations before a new version of L1B software or LUTs is sent to the GDAAC for additional testing and subsequent data production.

This chapter describes the MODIS L1B data products and the calibration algorithms used to generate them. The emphasis is on the implementation of the MODIS calibration algorithms in the L1B code. The code standards and associated properties, data processing, and data product retrieval are also discussed. The instrument characteristics and discussions of the radiometric calibration algorithms are presented in Chapter 5 MODIS Calibration and Characterization of Vol.2 and in other documents about MODIS calibration and characterization (Guenther et al., 1998; Xiong et al., 2002a; Xiong et al., 2002b; Xiong et al., 2003). Additional instrument background information is given in Chapter 2 (Introduction to MODIS and an Overview of Associated Activities). The MODIS instrument scan cavity and its on-board calibrators are illustrated in Fig. 2.1.

3.7 Summary

The MODIS Level-1B processing code has worked well throughout the years to efficiently generate Earth View products which are of great use to the scientific community. A large measure of its success is due to the fact the code was deliberately designed to be easily modified when necessary and to have almost no hard-coded calibration values. In addition, human error in calculation and conversion to program input of calibration coefficients has been minimized through a series of checks and duplications at almost every step in the process. LUT updates are accomplished smoothly through cooperation between the MCST and the GDAAC, resulting in a relatively short length of time between when a MODIS instrument change is detected by analysis of on-board calibration data and when the consequent change to the calibration coefficients is implemented in Level-1B processing. As a result the code serves in the most versatile manner possible to process data from two different satellite platforms and from any phase of a satellite mission simultaneously.