TEN YEARS OF EARTH OBSERVATIONS FROM MODIS: WHAT HAS BEEN ACCOMPLISHED?

Michael D. KING,[1] Steven PLATNICK[2], Christopher O. JUSTICE[3], and Charles R. McCLAIN[2]

ABSTRACT

The Moderate Resolution Imaging Spectroradiometer (MODIS) was developed by NASA and launched onboard the Terra spacecraft on December 18, 1999 and Aqua spacecraft on May 4, 2002. It achieved its final orbit and began Earth observations on February 24, 2000 for Terra and June 24, 2002 for Aqua. Among the remote sensing algorithms developed and applied to this sensor for nearly 10 years of Earth observations are spectral and spatial distribution of albedo and surface reflectance, land surface temperature, snow and sea ice mapping, land cover, vegetation index, fire products, including burn scars, leaf area index, vegetation continuous fields, cloud amount, cloud and aerosol optical properties, precipitable water, atmospheric profiles of temperature and water vapor, sea surface temperature, and chlorophyll-a, calcite, and fluorescence line height concentration from ocean color. The archived products from these algorithms have applications in climate change studies, climate modeling, numerical weather prediction, biogeochemistry studies, fundamental atmospheric research, and ecosystem studies of sources and sinks of carbon.

The cloud and aerosol optical properties algorithm has undergone extensive improvements and enhancements between Collection 4 and Collection 5 (the current version), and a complete reprocessing of the Terra record with Collection 5.1 has been completed. These changes have included, but are not limited to, (i) improvements in the cloud thermodynamic phase algorithm, (ii) improvements and substantial changes in the ice cloud light scattering libraries, (iii) vastly improved spectral surface albedo maps, including the spectral albedo of snow by ecosystem, and the (vi) addition of pixel-level uncertainty estimates for cloud optical thickness, effective radius, and water path, based on uncertainties in calibration, above-cloud water vapor correction, and surface albedo, and taking into consideration the sensitivity of the retrieval algorithm to solar and viewing geometries. Improvements in the aerosol algorithm, which include the implementation of a new Deep Blue algorithm for aerosol retrievals over bright reflecting surfaces, such as desert, has enabled extensive improvements in the global distribution of aerosol optical properties.

With the complete reprocessing of land products using Collection 5 algorithms, many improvements were also made, including (i) producing albedo and BRDF

[1] Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado.
[2] NASA Goddard Space Flight Center, Greenbelt, Maryland.
[3] Dept. of Geography, University of Maryland, College Park, Maryland.

2010 IGARSS Symposium, July 26-30, 2010, Honolulu, HI

products at 500 m and 8-day time periods (rather than 1 km and 16-day), using a combination of Terra and Aqua data, when available, (ii) producing vegetation indices on 16-day periods, but staggering Terra and Aqua results, (iii) improving the leaf area index quality with a major focus on woody vegetation, (iv) adding a fractional snow algorithm and a limit on surface temperature to reduce false detection of snow, and (v) adding a burned area product. Many of the MODIS products have already been adopted by agencies concerned with natural resource and environmental management. For example the MODIS fire products are used by a large number of fire agencies around the world for strategic fire management and a number of value added data services have built upon the standard product. Similarly the MODIS vegetation index product is used extensively for agricultural monitoring.

For ocean products, the entire Terra record has also been recently reprocessed, including ocean color products that have not been produced for many years. This enables chlorophyll-a products from Terra, Aqua, and SeaWiFS to be intercompared. Sea surface temperature products are also available, with some work at merging them with AMSR-E on Aqua to fill in areas obstructed by cloud cover. Finally, calcite and fluorescence line height products are available and contributed added insights into the carbon efficiency in the world's oceans.

A sampling of what has been accomplished and the breadth of new, often unanticipated, applications will be highlighted and discussed.