

RADIATION, CLOUD AND AEROSOL DATA FROM THE
MULTI-ANGLE IMAGING SPECTRORADIOMETER (MISR) INSTRUMENT

Linda A. Hunt*, R. K. Seals, Nancy A. Ritchey
Science Applications International Corporation,
NASA Langley Atmospheric Sciences Data Center, Hampton, VA

1. INTRODUCTION

The Multi-Angle Imaging SpectroRadiometer (MISR) instrument obtains precisely calibrated images at nine different angles and four wavelengths to provide radiance, aerosol, cloud, and land surface data. MISR was launched on December 18, 1999 on the NASA Earth Observing System (EOS) Terra satellite.

The NASA Langley Atmospheric Sciences Data Center (ASDC) produces, archives and distributes MISR data products. Data, tools and information are available at the ASDC web site, <http://eosweb.larc.nasa.gov>.

2. MISR INSTRUMENT

MISR uses nine cameras pointed at fixed angles, one viewing the nadir direction and four each viewing the forward and aftward directions along the spacecraft ground track. In addition to the nadir, the cameras image Earth at 26.1, 45.6, 60.0, and 70.5 degrees forward and aftward of nadir. It takes about seven minutes for a location in the instrument's path to be viewed by all nine cameras.

Each of the nine MISR cameras obtains images in four spectral bands: blue, green, red, and near-infrared. The center wavelength of each of these bands is 446, 558, 672 and 867nm, respectively.

The nadir camera radiance data and the red bands of the off-nadir cameras have a pixel resolution of 275 m. The other three bands of the off-nadir cameras have a resolution of 1.1 km. MISR's swath width is 360 km. There are 233 distinct orbits which repeat every 16 days. Adjacent paths overlap, so global coverage is obtained every nine days at the equator and every two days near the poles.

3. MISR DATA PRODUCTS

MISR data products are grouped according to three levels of processing. Level 1 processing provides calibrated instrument data. Level 2 processing provides retrieval of derived scientific quantities, such as atmospheric aerosol and cloud measurements. Level 3 processing will produce data aggregated over various time scales (monthly, seasonally, annually) on a global map grid.

While raw data products are available, the data sets described below are of more interest since they have been calibrated and geolocated. These products are stored in HDF-EOS (the National Center for Supercomputing Applications' Hierarchical Data Format, with the EOS extensions that add data structures for geolocated data) grid format, with the exception of the browse image product, which is written in JPEG format. Within each product, the data are organized into files, with each file containing the information from one orbit.

Each data product undergoes quality assessment and is assigned one of four quality designations: Alpha, Beta, Provisional, and Validated. MISR products are first released publicly at the Beta stage, and then progress through the Provisional to the Validated stage. A Quality Summary document is provided for each version of a product to describe its validation status and other data quality information. Additional QA information is contained within the data files.

3.1 Level 1 Products

Level 1B2: Georectified Radiance

The sets of imagery from the nine cameras are calibrated and registered to one another and to the ground. This product is mapped into a standard map projection called Space Oblique

* Correspondence address: Science, User and Data Services; Atmospheric Sciences Data Center; NASA Langley Research Center; MS 157D, 2 S. Wright St.; Hampton, VA 23681-2199; e-mail: larc@eos.nasa.gov

Mercator (SOM). There are separate files for each of the nine cameras which contain the red, green, blue, and NIR radiances. There are two Level 1B2 radiance products: one in which the radiances are projected to a reference ellipsoid, and the second, in which radiances are projected to the actual terrain elevation.

Radiometric Camera-by-camera Cloud Mask

This cloud and sun glint mask is derived as part of the Level 1B2 processing.

Geometric Parameters

Sun and camera azimuth and zenith angles are recorded in this product.

Browse Imagery

A color browse image is created using the red, green, and blue bands from each Level 1B2 ellipsoid file at a resolution of 2.2 km. An image is created from each of the nine cameras.

3.2 Level 2 Products

Level 2 Aerosol/Surface product

This product includes two data sets. The aerosol data set contains aerosol optical depth, aerosol composition and size, ancillary meteorological data and related parameters on a 17.6 km grid. The land surface data set includes bihemispherical and directional-hemispherical reflectance (albedo), hemispherical directional and bidirectional reflectance factor, and normalized differential vegetation index on a 1.1 km grid.

Level 2 Top-of-Atmosphere/Cloud Product

There are three data sets available in this category. The cloud stereo data set parameters include a stereoscopically-derived cloud mask and cloud height on a 1.1 km grid, reflecting level reference altitude on a 2.2 km grid, and cloud-derived winds on a 70.4 km grid. The cloud albedo data set contains local albedo values, and the cloud classifiers data set contains altitude-binned cloud classifications and angular cloud fractions.

3.3 Ancillary Products

Several ancillary data sets are available, including the Ancillary Radiometric Product, which contains pre-flight and in-flight calibration parameters, instrument characterization, and configuration information; the Aerosol Climatology Product; the Terrestrial Atmosphere and Surface Climatology; and the Ancillary Geographic Product, which

contains terrain information including latitude, longitude, and elevation information for each of the 233 discrete orbits on a 1.1 km grid.

4. MISR TOOLS AND INFORMATION

Several tools have been developed for working with MISR data in particular and HDF and HDF-EOS data in general. The `misr_view` tool, written in Research Systems, Inc. Interactive Data Language (IDL), provides a rich interface for creating and manipulating images using the data in MISR files. HDF-EOS utilities are available to convert the data to other formats, such as binary or Geo-TIFF.

The MISR web pages at the NASA Langley ASDC provide links to these tools and to many sources of MISR information, such as the MISR Data Products Specification and the Algorithm Theoretical Basis Documents. A Frequently Asked Questions list is maintained at the site, and representatives are available to answer questions about MISR data and tools via e-mail (larc@eos.nasa.gov), phone (757-864-8656), or fax (757-864-8807). All of the data and tools are available free of charge.