SAFARI 2000 MODIS MOD04_L2 Aerosol Data, GRANT Format, for Southern Africa

Abstract

The subset of MODIS MOD04_L2 aerosol product granules provided in this data set represents the swaths that coincide with known times of the South African Weather Bureau/Service (SAWS) Aerocommanders JRA and JRB research aircraft missions. The data should provide an adequate subset of coincident satellite data to support aerosol research and validation activities for the SAFARI region. Aerosols are one of the greatest sources of uncertainty in climate modeling. Aerosols modify cloud microphysics by acting as cloud condensation nuclei (CCN) and, as a result, impact cloud radiative properties and climate. Aerosols scatter back to space and absorb solar radiation. The MODIS MOD04_L2 aerosol product can be used to study aerosol climatology, sources and sinks of specific aerosol types (e.g., sulfates and biomass-burning aerosol), interaction of aerosols with clouds, and atmospheric corrections of remotely sensed surface reflectance over the land.

The MODIS aerosol product monitors the ambient aerosol optical thickness over the oceans globally and over a portion of the continents. Further, the aerosol size distribution is derived over the oceans, and the aerosol type is derived over the continents. Daily Level 2 data are produced at the spatial resolution of a 10 x 10 1-km (at nadir) pixel array. The daily data files cover the period August 21, 2000 through September 26, 2000. For some data collection dates, there are two or more data files.

The MOD04_L2 swath data files included in this data set are from the GSFC DAAC (V4.1.0, Collection 004). The MODIS Level 2 data files were converted from Hierarchical Data Format (HDF) to granule tables (GRANT) format. The GRANT format provides the extracted Scientific Data Set (SDS) in ASCII table form where each pixel (x,y) is represented as a row of data with georeferencing information and each SDS is provided as a separate column in the table. The ASCII tables are in comma-delimited format and should be read with a text editor or spreadsheet software and not an image viewer.

Background Information

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Project: SAFARI 2000

Data Set Title: SAFARI 2000 MODIS MOD04_L2 Aerosol Data, GRANT Format, for Southern Africa

Site: Southern Africa
Westernmost Longitude: -20° 38' 29.80" W
Easternmost Longitude: 50° 31' 12.55" E
Northernmost Latitude: 10° 05' 58.52" N
Southernmost Latitude: -42° 16' 57.42" S

Data Set Citation:

Kaufman, Y. J., D. Tanré, and L. A. Remer. 2005. SAFARI 2000 MODIS MOD04_L2 Aerosol Data, GRANT Format, for Southern Africa. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Web Site: http://modis-atmos.gsfc.nasa.gov/MOD04_L2/index.html

Data File Information

The MOD04_L2 swath data files included in this data set are from the GSFC DAAC (V4.1.0, Collection 004). Collection 4 represents a significant improvement over collection 3, particularly in southern Africa, where there was a known systematic underestimate of aerosol optical thickness that may have exceeded expected uncertainties at very large values of aerosol optical thickness. The underestimate was due to an underestimation of aerosol absorption in the region that was corrected in collection 4.

The Version 4 data for these granules were processed for SAFARI 2000 by MODIS Atmosphere Support Team (GSFC, Climate and Radiation Branch, Code 913). For more information about MOD04 Level 2, please refer to: http://modis-atmos.gsfc.nasa.gov/MOD04_L2/index.html.

GRANT Format

Conversion from Hierarchical Data Format (HDF) to granule tables (GRANT) format was performed by Charles Ichoku (GSFC, Code 913). GRANT files were generated from the MODIS Level-2 aerosol product files, MOD04_L2, version 4. The GRANT format provides the extracted Scientific Data Set (SDS) in ASCII table form where each pixel (x,y) is represented as a row of data with georeferencing information and each SDS is provided as a separate column in the table. The ASCII tables are in comma-delimited format and should be read with a text editor or spreadsheet software and not an image viewer.

Missing data can occur as a result of cloud/ice/snow masking, glint masking, or because the surface properties otherwise do not meet retrieval requirements (as in the case of extremely bright desert surfaces). In these cases, the missing data values in the original HDF files are represented by -9999. In the provided GRANT files, however, these missing values are blank fields in the comma-delimited ASCII files. In addition, when the parameters are extracted for each pixel, if any of the retrieved fields contain a non-missing value, then all the fields for the pixel is extracted to the ASCII file, but if all the parameters for a given pixel contain only fill values, then the record for that pixel is not listed at all in the output GRANT file. For more information about Scientific Data Set, please refer to: http://modis-atmos.gsfc.nasa.gov/MOD04_L2/format.html.

The file naming convention is: **MOD04_L2.AYYYYDDD.HHMM.grnt**

Where: **MOD04_L2** = MODIS product and level
A = Platform code (A= Terra)
YYYYDDD = Year and Julian day of acquisition
HHMM = Time of acquisition
.grnt = Suffix denoting GRANT-format data file

The typical structure of a GRANT file is given below, where the first several lines

provide header information that precedes the data records.

line 1 Title	MODIS Aerosol Products Granule Tables (GRANT)
line 2 HDF name	Name of the original hdf file
line 3 SDS names	Scientific Data Set names
line 4 SDS units	Units for each SDS
line 5 SDS number of layers	Number of layers
line 6 Geolocation #rows	Size of the input image in lines (y, usually 203)
line 7 Geolocation #cols	Size of the input image in samples (x, usually 135)
line 8 Pixel size (km)	spatial resolution (10 km)
line 9-15 Contact Information	Contact informaton for this product file
line 16 List of SDS extracted	abbreviated names of extracted SDS (see table below)
line 17-->End of file	pixel values, one line per pixel (row/column)

Column headings are as follows:

SDS Name	SDS Short Name (column headings)	Wavelength or other identifiers for multi-layer SDS names (replaces '#' in the SDS short name)
Pixel Location	rwo, column	--
Longitude	lon	--
Latitude	lat	--
Solar_Zenith	solz	--

Solar_Azimuth	sola	--
Sensor_Zenith	senz	--
Sensor_Azimuth	sena	--
Scattering_Angle	scang	--
Optical_Depth_Land_And_Ocean	AOT0550	--
Optical_Depth_Ratio_Small_Land_And_Ocean	rAOTse0550	--
Continental_Optical_Depth_Land	AOT####cont-l	0470, 0660
Corrected_Optical_Depth_Land	AOT####corr-l	0470, 0550, 0660
Angstrom_Exponent_Land	Aexp0470-0670-l	--
Cloud_Fraction_Land	cfrac-l	--
Mean_Reflectance_Land	mref####-l	0470, 0660, 0870, 2100, 3750
Solution_Index_Ocean_Small	solindx-s#-o	b, a (model fit values, b=best, a=average)
Solution_Index_Ocean_Large	solindx-l#-o	b, a (model fit values, b=best, a=average)
Effective_Optical_Depth_Average_Ocean	AOT####ea-o	0470, 0550, 0660, 0870, 1200, 1600, 2100
Optical_Depth_Small_Average_Ocean	AOT#####sa-o	0470, 0550, 0660, 0870, 1200, 1600, 2100

Effective_Radius_Ocean	effr0550#-o	b, a (model fit values, b=best, a=average)
Optical_Depth_Ratio_Small_Ocean_0.86micron	rAOTse0860#-o	b, a (model fit values, b=best, a=average)
Angstrom_Exponent_1_Ocean	Aexp0550-0860#-o	b, a (model fit values, b=best, a=average)
Angstrom_Exponent_2_Ocean	Aexp0860-2130#-o	b, a (model fit values, b=best, a=average)
Least_Squares_Error_Ocean	lsqerr-#-o	b, a (model fit values, b=best, a=average)
Cloud_Fraction_Ocean	cfrac-o	--
Backscattering_Ratio_Average_Ocean	bsr####a-o	0470, 0550, 0660, 0870, 1200, 1600, 2100
Cloud_Condensation_Nuclei_Ocean	CCN0550#-o	b, a (model fit values, b=best, a=average)
Mean_Reflectance_Ocean	mref####-o	0470, 0550, 0660, 0870, 1200, 1600, 2100
Mean_Reflectance_Land_All	mrall####-l	0470, 0660, 2100

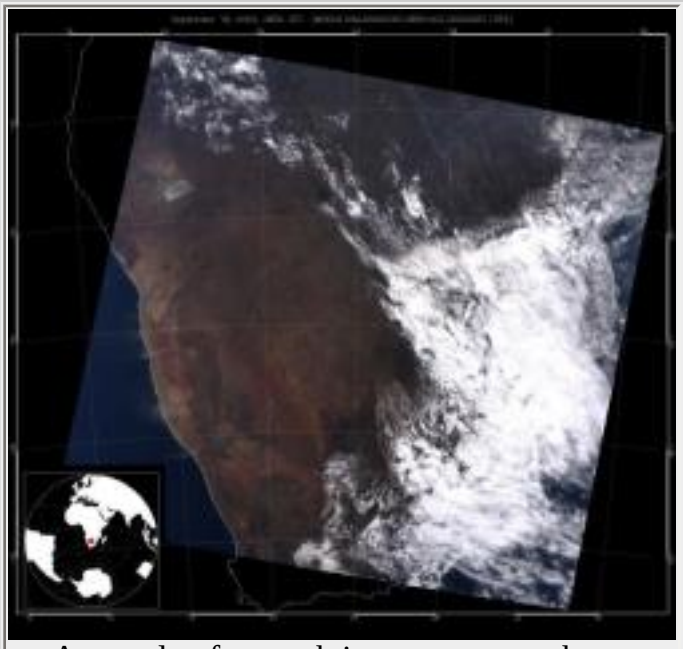
Standard Deviation_Reflectance_Land_All	srall####-l	0470, 0660, 2100
Path_Radiance_Land	pathrad####-l	0470, 0660
Error_Path_Radiance_Land	errprad####-l	0470, 0660
Critical_Reflectance_Land	critref####-l	0470, 0660
Error_Critical_Reflectance_Land	errcref####-l	0470, 0660
QualityWeight_Path_Radiance_Land	qwtprad####-l	0470, 0660
QualityWeight_Critical_Reflectance_Land	qwtcref####-l	0470, 0660
Optical_Depth_by_models_ocean	AOT0550m##-o	01, 02, 03, 04, 05, 06, 07, 08, 09

NOTE: There are 96 total columns for each data entry in the data files.

MOD04 Aerosol Data Overview

Product Description

The MODIS aerosol product monitors the ambient aerosol optical thickness over the oceans globally and over a portion of the continents. Further, the aerosol size distribution is derived over the oceans, and the aerosol type is derived over the continents. Daily Level 2 data are produced at the spatial resolution of a 10 x 10 1 km (at nadir) pixel array.



A sample of a swath image over southern Africa.

Research and Application

Aerosols are one of the greatest sources of uncertainty in climate modeling. Aerosols vary in time in space and can lead to variations in cloud microphysics, which could impact cloud radiative properties and climate. The

MODIS aerosol product is used to study aerosol climatology, sources and sinks of specific aerosol types (e.g., sulfates and biomass-burning aerosol), interaction of aerosols with clouds, and atmospheric corrections of remotely sensed surface reflectance over the land.

Data Set Evolution

Prior to MODIS, satellite measurements were limited to reflectance measurements in one (GOES, METEOSAT) or two (AVHRR) channels. There was no real attempt to retrieve aerosol content over land on a global scale. Algorithms had been developed for use only over dark vegetation. The blue channel on MODIS, not present on AVHRR, offers the possibility to extend the derivation of optical thickness over land to additional surfaces. The algorithms use MODIS bands 1 through 7 and 20 and require prior cloud screening using MODIS data. Over the land, the dynamic aerosol models are derived from ground-based sky measurements and used in the net retrieval process.

Over the ocean, three parameters that describe the aerosol loading and size distribution are retrieved. Pre-assumptions on the general structure of the size distribution are required in the inversion of MODIS data, and the volume-size distribution is described with two log-normal modes: a single mode to describe the accumulation mode particles (radius < 0.5 μm) and a single coarse mode to describe dust and/or salt particles (radius > 1.0 μm).

Additional Sources of Information

For more information about MOD04 level 2, please refer to:
http://modis-atmos.gsfc.nasa.gov/MOD04_L2/index.html

Algorithm Theoretical Basis Document (ATBD): Algorithm for Remote Sensing of Tropospheric Aerosol from MODIS:
http://modis.gsfc.nasa.gov/data/atbd/atbd_mod02.pdf

References:

Kaufman, Y. J. and D. Tanré. 1998. Algorithm for Remote Sensing of Tropospheric

Aerosol from MODIS Products: MOD04_L2, MOD08_D3, MOD08_E3, MOD08_M3. ATBD Reference Number: ATBD-MOD-02. [http://modis.gsfc.nasa.gov/data/atbd/atbd_mod02.pdf]

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