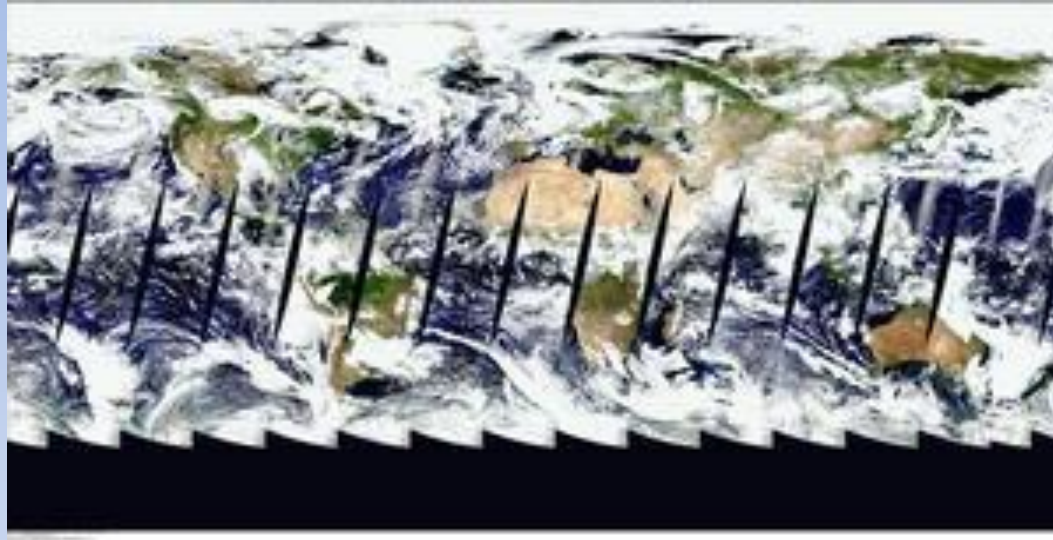


# MODIS – MOD09CMG



The MODIS Surface Reflectance products provide an estimate of the surface spectral reflectance as it would be measured at ground level in the absence of atmospheric scattering or absorption. Low-level data are corrected for atmospheric gases and aerosols, yielding a level-2 basis for several higher-order gridded level-2 (L2G) and level-3 products.

# MODIS– General Information

- Daily Global Data
  - AQUA : 2002 – Current
  - TERRA: 2000 - Current
- Resolution: CMG, 0.05 degrees (5600 meters)
- Projection: Unprojected, Latitude/Longitude
- Image dimensions: 3600 Rows, 7200 Cols
- Spectral bands:
  - Band 1 : 620 - 670nm
  - Band 2 : 841 - 876 nm
  - Band 3 : 459 - 479 nm
  - Band 4 : 545 - 556 nm
  - Band 5 : 1230 - 1250 nm
  - Band 6 : 1628 - 1652 nm
  - Band 7 : 2105 – 2155 nm)

# Layers in a HDF File

| Science Data Sets                                           | UNITS       | BIT TYPE                | FILL   | VALID RANGE   | SCALE FACTOR |
|-------------------------------------------------------------|-------------|-------------------------|--------|---------------|--------------|
| Coarse Resolution Surface Reflectance Band 1 (620–670 nm)   | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Surface Reflectance Band 2 (841–876 nm)   | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Surface Reflectance Band 3 (459–479 nm)   | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Surface Reflectance Band 4 (545-565 nm)   | Reflectance | 16-bit signed integer   | -28672 | -100 - 16000  | 0.0001       |
| Coarse Resolution Surface Reflectance Band 5 (1230–1250 nm) | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Surface Reflectance Band 6 (1628–1652 nm) | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Surface Reflectance Band 7 (2105–2155 nm) | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution Solar Zenith Angle                        | Degree      | 16-bit signed integer   | 0      | 0–18000       | 0.01         |
| Coarse Resolution View Zenith Angle                         | Degree      | 16-bit signed integer   | 0      | 0–18000       | 0.01         |
| Coarse Resolution Relative Azimuth Angle                    | Degree      | 16-bit signed integer   | 0      | -18000–180000 | 0.01         |
| Coarse Resolution Ozone                                     | cm atm      | 8-bit unsigned integer  | 0      | 0–255         | 0.04         |
| Coarse Resolution Brightness Temperature Band 20            | Kelvin      | 16-bit unsigned integer | 0      | 0–40000       | 0.01         |
| Coarse Resolution Brightness Temperature Band 21            | Kelvin      | 16-bit unsigned integer | 0      | 0–40000       | 0.01         |
| Coarse Resolution Brightness Temperature Band 31            | Kelvin      | 16-bit unsigned integer | 0      | 0–40000       | 0.01         |
| Coarse Resolution Brightness Temperature Band 32            | Kelvin      | 16-bit unsigned integer | 0      | 0–40000       | 0.01         |
| Coarse Resolution Granule Time                              | HHMM        | 16-bit signed integer   | 0      | 0–2355        | 1.0          |
| Coarse Resolution Band 3 Path Radiance                      | Reflectance | 16-bit signed integer   | -28672 | -100–16000    | 0.0001       |
| Coarse Resolution QA                                        | Bit Field   | 32-bit unsigned integer | 0      | 0–1073741824  | na           |
| Coarse Resolution Internal CM                               | Bit Field   | 16-bit unsigned integer | 0      | 0–8191        | na           |
| Coarse Resolution State QA                                  | Bit Field   | 16-bit unsigned integer | 0      | 0–65535       | na           |
| N pixels averaged                                           | none        | 8-bit unsigned integer  | 0      | 0–40          | na           |

# Data QA Description

| Bit No. | Parameter Name                | Bit Comb. | Coarse Resolution State QA           |
|---------|-------------------------------|-----------|--------------------------------------|
| 15      | internal snow algorithm flag  | 1         | yes                                  |
|         |                               | 0         | no                                   |
| 14      | BRDF correction performed     | 1         | yes                                  |
|         |                               | 0         | no                                   |
| 13      | Pixel is adjacent to cloud    | 1         | yes                                  |
|         |                               | 0         | no                                   |
| 12      | MOD35 snow/ice flag           | 1         | yes                                  |
|         |                               | 0         | no                                   |
| 11      | internal fire algorithm flag  | 1         | fire                                 |
|         |                               | 0         | no fire                              |
| 10      | internal cloud algorithm flag | 1         | cloud                                |
|         |                               | 0         | no cloud                             |
| 8–9     | cirrus detected               | 00        | none                                 |
|         |                               | 01        | small                                |
|         |                               | 10        | average                              |
|         |                               | 11        | high                                 |
| 6–7     | aerosol quantity              | 00        | climatology                          |
|         |                               | 01        | low                                  |
|         |                               | 10        | average                              |
|         |                               | 11        | high                                 |
| 3–5     | land/water flag               | 000       | shallow ocean                        |
|         |                               | 001       | land                                 |
|         |                               | 010       | ocean coastlines and lake shorelines |
|         |                               | 011       | shallow inland water                 |
|         |                               | 100       | ephemeral water                      |
|         |                               | 101       | deep inland water                    |
|         |                               | 110       | continental/moderate ocean           |
|         |                               | 111       | deep ocean                           |
| 2       | cloud shadow                  | 1         | yes                                  |
|         |                               | 0         | no                                   |
| 0–1     | MOD35 cloud                   | 00        | clear                                |
|         |                               | 01        | cloudy                               |
|         |                               | 10        | mixed                                |
|         |                               | 11        | not set, assumed clear               |

# DATA REPROCESSING

## a) Vegetation Indices

A new dataset for TERRA and AQUA was generated. Using RED and NIR surface reflectance bands, NDVI and EVI2 SDS were estimated and added to this dataset.

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

$$EVI2 = 2.5 \frac{(NIR - RED)}{(NIR + 2.4 RED + 1)}$$

# DATA REPROCESSING

## b) Cloud Free Data

A new dataset for TERRA and AQUA Cloud-free-data was generated. Using the QA SDS information, clouds were removed from the VIS sds.

