Gridded MODIS Active Fire products

The gridded MODIS active fire products present gridded statistical summaries of fire pixel information (Giglio et al., 2003). These products are intended for use in Giovanni system focused on regional (NEESPI) analysis of surface processes and climate modeling. The products are generated at 1 degree spatial resolution for time period of one calendar month from MODIS CMG 0.5 degree products (Giglio et al., 2006). The active fire products are available from the MODIS instrument on Terra satellite beginning from January 2001 and from the MODIS instrument on Aqua satellite beginning from July 2002.

File naming convention

SSS14CM1.YYYYMM.CCC.VV.hdf

Where

SSS14 is a three letter identification of the satellite: MOD for Terra (e.g. MOD14) and MYD for Aqua (e.g. MYD14)
CM1 indicates Climate Modeling 1 degree grid
YYYY is a four digit number for year (e.g. 2003)
MM is a two digit number for month (e.g. 01)
CCC is a three digit number for MODIS collection (e.g. 004)
VV is a two digit number of the version within a collection (e.g. 03)

e.g. MOD14CM1.200101.004.03.hdf

File format

Format: HDF
Data type: floating point
Dimension: 360 x 180
Resolution: 1 x 1 degree
Upper Left Corner: (-180.0, 90.0)
File Size: depends on the number of attributes
Fill Value: -1.00

Product descriptions

The gridded MODIS fire products include four individual data sets within one file: CorrFirePix (overpass corrected fire pixel count), CloudCorrFirePix (overpass and cloud corrected fire pixel count), MeanPower (mean Fire Radiative Power), and MeanCloudFraction (mean Cloud Fraction). The products have valid values only over the grid cells with less than 100% water (see 1 degree gridded land/water mask). Grid cells where water constitutes 100% are assigned a "_FillValue" of -1.0.

CorrFirePix data product

The raw fire pixel counts obtained from polar orbiting satellites present a considerably biased view of fire activity between different latitudes due to non-uniform spatial and temporal sampling. Over high latitudes overlapping swaths result in multiple observations of the same area from consecutive orbits, which artificially increases fire counts in these areas. The *CorrFirePix* product presents the total number of fire pixels observed in each 1 degree grid corrected for multiple satellite overpasses and missing observations. This is accomplished by normalizing the raw fire pixel counts by the expected equatorial coverage in a complete calendar month containing no missing observations. The overpass-corrected fire pixel count in the grid cell located at row *i* and column *j*, denoted as $N'_{fire}(i, j, t)$, is given by

$$N'_{\text{fire}}(i, j, t) = \frac{N_{\text{fire}}(\text{i, j, t})\, N_{\text{days}}(\text{t})\, A(\text{i})\, N_{\text{eq}}}{N_{\text{total}}\,(\text{i, j, t})\, A_{\text{eq}}}$$

where

N_{fire}(i, j, t) number of active fire pixels detected in the grid cell over a given calendar month indexed by *t*

N_{total} (i, j, t) the total number of MODIS pixels that fell within the grid cell during the calendar month

N_{days}(t) the number of days in the calendar month

A(i) the area of the grid cell (solely a function of *i* due to the equal-angle grid used to composite pixels)

A_{eq} area of a grid cell along the Equator

N_{eq} the expected number of MODIS pixels within a grid cell located along the Equator during a full 24-hour day of no missing observations (this value was determined empirically using one year of observations from 2001).

The 1 degree grid is created by summing up values from four 0.5 degree cells. If all of the included 0.5 degree cells are flagged as "missing data", then the 1 degree grid cell received the "_FillValue" of -1.00.

CloudCorrFirePix data product

The *CloudCorrFirePix* product presents the number of fire pixels observed in each grid cell, corrected for multiple satellite overpasses, missing observations, and variable cloud cover. The cloud correction is based on calculations of the *mean cloud fraction* (see below). The cloud and overpass corrected fire pixel count, denoted as $N''_{\text{fire}}(i, j, t)$, is given by:

$$N''_{\text{fire}}(i, j, t) = \frac{N'_{fire}(i, j, t)}{1 - f_{\text{cloud}}\,(i, j, t)}$$

where

$N'_{fire}(i, j, t)$ overpass-corrected fire pixel count

f_{cloud} *(i, j, t)* mean cloud fraction

Grid cells with mean cloud fraction of 1 are assigned a cloud-and-overpass corrected fire pixel count of zero. It should be noted that the definition of a "cloud" in this context is a cloud that is optically thick enough to make the active fire detection impossible.

The 1 degree grid is created by summing up values from four 0.5 degree cells. If all of the included 0.5 degree cells are flagged as "missing data", then the 1 degree grid cell received the "_FillValue" of -1.00.

MeanPower data product

The *MeanPower* product presents the mean fire radiative power (FRP – Kaufman et al., 1998) of all fire pixels in each grid cell during a calendar month. Pixels for which the estimates of background temperature in the immediate vicinity are unavailable are not included in the calculation of the mean. Such cases occur when the majority of the pixels surrounding the fire pixel represent cloud cover, fire (i.e. large fire complex) or water (i.e. small islands and narrow peninsulas). Additionally, pixels detected at scan angles above 40^{o} are excluded as they are affected by a significant off-nadir bias.

The 1 degree grid is created by averaging the mean fire radiative power of four individual 0.5 degree grid cells. If all of the included 0.5 degree cells are flagged as "missing data", then the 1 degree grid cell received the "_FillValue" of -1.00.

MeanCloudFraction data product

The *MeanCloudFraction* presents the average fraction of each grid cell obstructed by cloud during a given calendar month. The *mean cloud fraction* (f_{cloud}) is defined as:

$$f_{cloud}(i, j, t) = \frac{N_{cloud}(i, j, t)}{N_{total}(i, j, t)}$$

where

N_{cloud}(i, j, t) the total number of pixels within the grid cell during calendar month *t*

N_{total} (i, j, t) the total number of MODIS pixels that fell within the grid cell during the calendar month *t*

The 1 degree grid is created by averaging the mean cloud fraction of four individual 0.5 degree grid cells. If all of the included 0.5 degree cells are flagged as "missing data", then the 1 degree grid cell received the "_FillValue" of -1.00.

Additional Sources:

MODIS_Fire_Users_Guide_2.2 http://maps.geog.umd.edu/products/MODIS_Fire_Users_Guide_2.2.pdf

References:

Giglio, L., I. Csiszar and C.O. Justice, 2006: Global Distribution and Seasonality of Active Fires as Observed with the Terra and Aqua MODIS Sensors. *Journal of Geophysical Research – Biogeosciences*, 111, G02016, doi:10.1029/2005JG000142.

Giglio, L., Descloitres, J., Justice, C. O., and Kaufman, Y., 2003: An enhanced contextual fire detection algorithm for MODIS. *Remote Sensing of Environment*, 87:273-282.

Justice, C.O., Giglio, L., Korontzi, S., Owens, J., Morisette, J.T., Roy, D.P., Descloitres, J., Alleaume, S., Petitcolin, F., Kaufman, Y. 2002. The MODIS fire products. *Remote Sensing of Environment*, 83:244-262.

Kaufman, Y.J., Justice, C.O., Flynn, L.P., Kendall, J.D., Prins, E.M., Giglio, L., Ward, D.E., Menzel, W.P., and Setzer, A.W., 1998. Potential Global Fire Monitoring from EOS-MODIS. *Journal of Geophysical Research,* 103(D24):32215-32238.