



MODIS MOD07 IR Retrieval Products



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MODIS MOD07 Infrared Retrieval Algorithm Overview

The MODIS MOD07 algorithm (Seemann et al., 2003) uses 12 infrared channels (24, 25, 27-36) to retrieve atmospheric profiles of temperature and moisture, total precipitable water vapor (TPW), total ozone, lifted index, and surface skin temperature. The retrieval algorithm uses clear-sky radiances measured by MODIS over land and ocean for both day and night. The algorithm employs a statistical retrieval with an option for a subsequent nonlinear physical retrieval. The synthetic regression coefficients for the statistical retrieval are derived using a fast radiative transfer model with atmospheric characteristics taken from a dataset of 12,208 global profiles of atmospheric temperature, moisture, and ozone profiles.

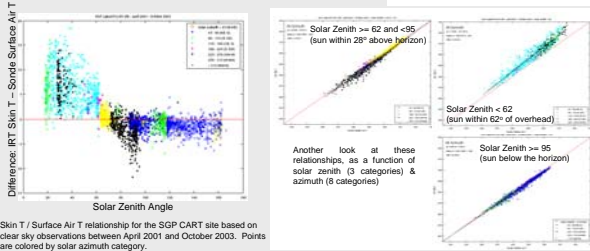
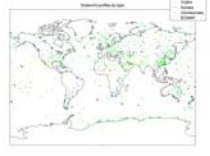
The radiative transfer calculation of the MODIS spectral band radiances is performed for each training profile using the Pressure Layer Fast Algorithm for Atmospheric Transmittances (PFAAST) transmittance model. This model has 101 pressure layer vertical coordinates from 0.1 to 1050 hPa and takes into account the satellite zenith angle, absorption by well-mixed gases (including nitrogen, oxygen, and carbon dioxide), water vapor, and ozone. The MODIS instrument noise is added into the calculated spectral band radiances, and these radiative transfer calculations provide a temperature-moisture-ozone profile / MODIS radiance pair for use in the statistical regression analysis.

Seemann et al., 2003. Operational Retrieval of Atmospheric Temperature, Moisture, and Ozone from MODIS Infrared Radiances. Journal of Applied Meteorology, Vol. 42, No. 8, pp 1072-1091.

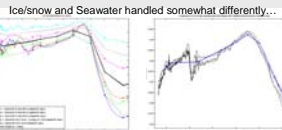
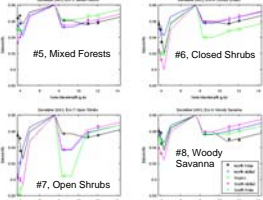
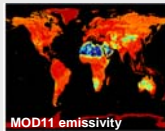
Updates to MOD07 for Collection 5

1. New Training Database of Global profiles: 12,208 global profiles of temperature, moisture, and ozone for training data set. Profiles are taken from the NOAA-88, ECMWF training set, TIGR-3, ozonesondes, desert radiosondes; all with saturation checks and other QC.

2. New Surface Skin Temperature assigned to profiles: Global skin temperature over land is characterized as a function of surface air temperature, and solar zenith (3 categories) and azimuth angles (8 categories). To build the relationship the SGP-CART site, OK skin temperature measurements were used together with radiosonde data during the time period between April 2001 and October 2003.



3. New Surface Emissivity assigned to profiles: New Emissivity in collection 5 further divides the "non-desert land" category into 14 IGBP ecosystem groups, as a function of month and latitude band. New seawater, desert, and ice/snow emissivities also used. MODIS MOD11 emissivity (see example at right) and laboratory measurements (UCSB and JPL emissivity libraries), were used to derive these new emissivities.



Ice & Snow emissivity is based on the average of a number of ice and snow laboratory measurements from USC's emissivity library (Dx. Wan). Seawater emissivity is based on the SmithWu emissivity model, as a function of wind speed and viewing zenith angle.

4. Modified 11mm BT zones to allow for sufficient profiles after partitioning into land and ocean groups.

Land Zone 1:	< 272,	1978 profiles	(< 275)
Zone 2:	272-287,	2538 profiles	(269-290)
Zone 3:	287-296,	2807 profiles	(284-299)
Zone 4:	296-350,	2226 profiles	(293-353)
Ocean Zone 1:	< 283.5,	2214 profiles	(< 286.5)
Zone 2:	283.5-293,	2900 profiles	(280.5-296)
Zone 3:	293-350,	2437 profiles	(290-353)

Partitioned training and retrievals into separate Land/Ocean groups

5. Now applying destriping to L1B data before running the MOD07 algorithm

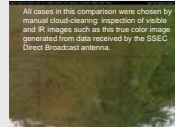
Validation of TPW from Collection 5 Algorithm

Comparison with ground-based observations at the CART sites



Comparison of TPW from MODIS (red dots), GOES-8 (blue diamonds), and radiosonde (black crosses) with the SGP ARM-CART microwave radiometer (green line in time series)

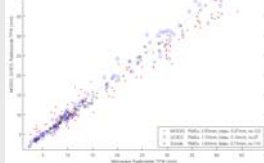
All cases were reprocessed at UW/CIMSS with the Collection 5 MOD07 algorithm.



Terra

125 clear sky cases from April 2001 to September 2003

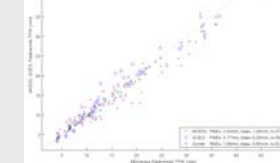
All cases: bias = 0.87mm, rms = 2.6mm, n = 125
 Dry cases: bias = -0.11, rms = 1.6, n = 107
 Wet cases: bias = 2.5mm, rms = 3.5mm, n = 48



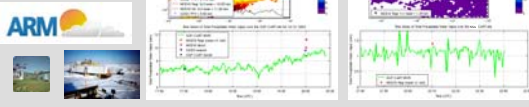
Aqua

57 clear sky cases from December 2003 to October 2003

All cases: bias = 1.0mm, rms = 2.8mm, n = 57
 Dry cases: bias = 0.02mm, rms = 1.9mm, n = 36
 Wet cases: bias = 2.86mm, rms = 3.9mm, n = 21



Sample Cases from Southern Great Plains (left) and North Slope of Alaska (right) ARM CART sites

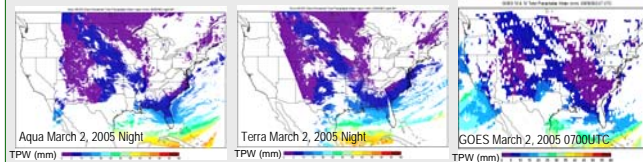


Near-real time comparisons with GOES and MWR: Collection 5 MOD07 code through UW/SSEC Direct Broadcast

MOD07 Terra (blue o) and Aqua (red +) products computed from direct broadcast data are used to generate near-real time comparisons with the MWR (green x), and GOES (black x) at the SGP CART site (at right) and with GOES at SSEC.

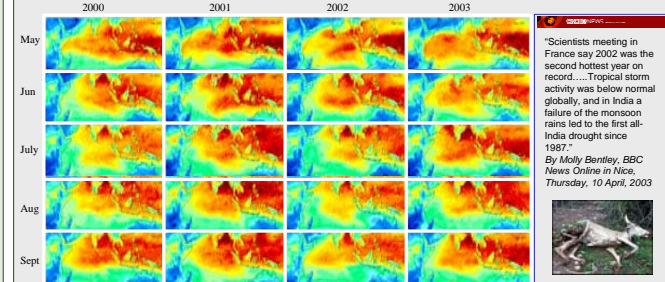
See the near-real time images and comparisons, including temperature, lifted index, ozone, and mixing ratio at:

<http://cimss.ssec.wisc.edu/modis/mod07>

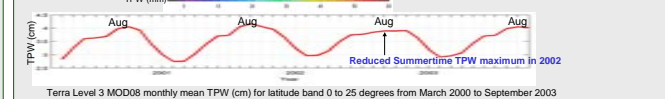


Applications of the MOD07 Products

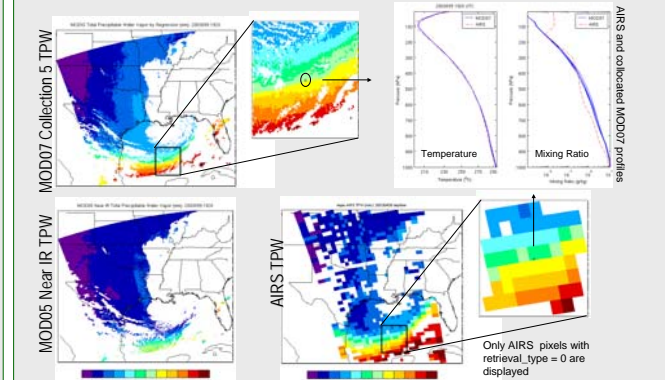
Level 3: Tropical Monsoon Anomalies



"Scientists meeting in France say 2002 was the second hottest year on record.... Tropical storm activity was below normal globally, and in India a failure of the monsoon rains led to the first all-India drought since 1987."
 By Molly Bentley, BBC News Online in Nice, Thursday, 10 April, 2003



Aqua AIRS / MODIS MOD07 & MOD05 Comparison



Ongoing and Future Algorithm Work

Profile improvements: Handling of upper atmosphere above levels of existing radiosonde data, adding more global radiosondes including improved desert radiosondes and more ozonesondes.

Surface: Use Clean emissivity map to derive ecosystem emissivity instead of IGBP, and include more days and years. In emissivity calculation, expand skin temperature parameterization to include other areas of the globe.

Radiance Bias: Improve upon current radiance bias estimates using global clear sky radiance bias maps (now running as an operational product).

Forward model: Replace PFAAST with NOAA's pCRTM (formerly OPTRAN). Preliminary studies show large differences between the two (see figure at right).