MODIS BRDF/ALBEDO PRODUCTS

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MODIS BRDF/ALBEDO PRODUCT

The MODIS BRDF/Albedo Product uses multidate, multispectral, cloud-cleared, atmospherically-corrected MODIS surface reflectances and a BRDF model to provide global measures of albedo, nadir surface reflectance and surface anisotropy every 16 days at a 1km gridded spatial resolution.

1. BRDF model parameters describe the anisotropy of the surface.
   Albedo and surface reflectance measures can be computed at any desired view and illumination geometry.

2. Bihemispherical albedo (white-sky) and directional hemispherical albedo (black-sky) at local solar noon are computed.
   Actual albedos can be estimated by interpolating the diffuse and direct beam albedos as a function of diffuse skylight.

3. Nadir BRDF-adjusted Reflectances (NBAR) at mean overpass.
   Surface reflectances corrected to a common nadir viewing geometry.
MODIS BRDF/ALBEDO PRODUCT

The primary BRDF retrieval algorithm is bolstered by a robust back-up algorithm.

1. The full model inversion is used when sufficient high quality MODIS observations are available to sample the BRDF.

2. The lower quality magnitude inversion couples a priori knowledge of the surface anisotropy with any MODIS observations that are available.

3. Extensive Quality Assurance Flags are supplied with the product indicating both the quality of the product and the processing method used.
MOD43B MODIS BRDF/ALBEDO PRODUCT

Products at 1km
MOD43B1: MODIS/Terra BRDF/Albedo Model-1 16-Day L3 Global 1km ISIN Grid
MOD43B3: MODIS/Terra Albedo 16-Day L3 Global 1km ISIN Grid
MOD43B4: MODIS/Terra Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 1km ISIN Grid (NBAR)

Products at 5km
MOD43B1C: MODIS/Terra BRDF/Albedo Model-1 16-Day L3 Global 5km ISIN Grid
MOD43B3C: MODIS/Terra Albedo 16-Day L3 Global 5km ISIN Grid
MOD43B4C: MODIS/Terra Nadir BRDF-Adjusted Reflectance 16-Day L3 Global 5km ISIN Grid

Products at _ degree
MOD43C1: MODIS/Terra Albedo 16-Day L3 Global 0.25Deg CMG
MOD43C2: MODIS/Terra BRDF/Albedo Parameters 16-Day L3 Global 0.25Deg CMG

CMG Broadband White-Sky Albedo (0.3-5.0μm)
6 - 21 March, 2001

No Data
CMG Broadband White-Sky Albedo (0.3-5.0µm)
9 - 24 May, 2001
CMG Broadband White-Sky Albedo (0.3-5.0\(\mu\text{m}\))
14 - 29 September, 2001
MOD43B MODIS BRDF/ALBEDO PRODUCT

AQUA code (actually AQUA + TERRA code) is delivered and baselined:

Gridded surface reflectances from both the TERRA MODIS sensor and the AQUA MODIS sensor are used to retrieve the 16-day BRDF parameters and compute albedos at local solar noon.

NBARs at both the TERRA overpass time and the AQUA overpass time are computed.

The TERRA only version and the TERRA+AQUA version will run in parallel during the shakeout period.

MODIS + MISR code has also been successfully proto-typed on several regional case studies.
STATUS of the MOD43B MODIS BRDF/ALBEDO PRODUCT

The MOD43B 1km products:

   Operational production began in April 2000.

   Beta Products were released in July 2000.

   Provisional Products were released in November 2000.

   The MOD43C CMG _ degree Products are just entering production (July 2001 onward).

Currently awaiting evaluation of the reprocessed data for final characterization of the product variability and for final comparisons with field data before assigning product quality assessments and releasing the data as Validated Products.
North American Nadir BRDF-Adjusted Reflectance (NBAR)
31 October - 15 November, 2000

No Data

NIR (0.1-0.4) Red (0.0-0.16) Green (0.0-0.18)
North American Nadir BRDF-Adjusted Reflectance (NBAR)
31 October - 15 November, 2000
Reprocessed
MOD43B MODIS BRDF/ALBEDO PRODUCT EVALUATION

The Team Evaluation is focused on:

MOD43B Quality Assurance Flags.

Variability of products by cover type.

Temporal stability and consistency of products.

Predictive capability of BRDF parameters.
NBAR from Land Cover Training Sites in the Southern US

Snow versus Non-snow Albedos 40-50°N Nov00-Jan01

Using BRDF Parameters to Predict Future Surface Reflectances

Observed 1km Surface Reflectances
20 November, 2000 (Day 325)

Predicted 1km Surface Reflectances for 20 November, 2000, using BRDF Parameters from 31 Oct - 15 Nov, 2000

NIR (0.1-0.35) Red (0-0.12) Green (0-0.12)
<table>
<thead>
<tr>
<th></th>
<th>Observed</th>
<th>Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Inversions (Red)</strong></td>
<td>0.0</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Full Inversions (NIR)</strong></td>
<td>0.10</td>
<td>0.35</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Magnitude Inversions (Red)</strong></td>
<td>0.0</td>
<td>0.12</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Magnitude Inversions (NIR)</strong></td>
<td>0.10</td>
<td>0.35</td>
</tr>
</tbody>
</table>

\[ r = 0.823 \]

\[ r = 0.750 \]

\[ r = 0.893 \]

\[ r = 0.794 \]
MOD43B MODIS BRDF/ALBEDO PRODUCT VALIDATION

BARC Field Campaigns -- S. Liang (UMD)

SAVE/SAFARI Field Campaigns -- J. Privette (GSFC)

Barton Bendish Field Campaigns -- M. Barnsley (UWales, Swansea)

China Field Campaigns -- X. Li (BU & Beijing Normal U.)

SURFRAD Comparison -- Y. Jin (BU)
Albedometer measurements from a 10m tower and sun photometer measurements are routinely collected at the USDA Agricultural Research Service Beltsville Agricultural Research Center (BARC) in Beltsville, Maryland, USA.

A number of ground campaigns (ASD, LAI, leaf optics) have been completed.
ETM+ imagery is used to scale Ground and Tower measurements up to MODIS spatial resolutions.

Initial validation results from November and December 2000 show that these products are quite accurate with less than a 5% error.

South African Validation of EOS (SAVE)

Tower data are being collected at the Mongu, Zambia woodland site and the Skukuza, South Africa savanna site.

Ground measurements were collected during the SAFARI IFCs.

Comparisons with MODIS Surface Reflectance and Albedo Products are currently underway.
South African Validation of EOS (SAVE)
South African Validation of EOS (SAVE)

NIR Albedo from the Mongu Tower

Diurnal and Seasonal Variability

Quality Control

Time Series: March 2000 to present
LAI and albedo data were collected at the agricultural site at Barton Bendish, East Anglia, UK during the 2000 and 2001 growing seasons.

ETM+ data are used to scale up to coarser spatial resolutions.
Barton Bendish Field
Validation Efforts

BRDF Model Parameters
Composite -- derived from
SPOT-VGT data of the UK.

Reprocessed MODIS data
from summer 2001 has just
become available for
validation effort.
Barton Bendish Field Validation Efforts

Additional hyperspectral imagery of Barton Bendish and other EOS core validation sites is being obtained from the Compact High Resolution Imaging Spectrometer (CHRIS) launched on the Project for On Board Autonomy (PROBA) in Oct 2001.
Field Campaign for Quantitative Remote Sensing in Beijing (2001)

Institute of Remote Sensing Application (Chinese Academy of Sciences) and Beijing Normal University.

Agricultural field sites in Shunyi, Yucheng, and Luncheng, China.

Extensive ground measurements, some airborne data and various satellite imagery have been collected since October, 2000.
Field Validation
Efforts in China
Surface Radiation Budget Network
(SURFRAD)

Six instrumented sites continuously measuring solar radiation (including PAR, direct and diffuse).

Data packaged and distributed as half hour values by the CERES/ARM Validation Experiment (CAVE).
Initial evaluations indicate that the MOD43B algorithms have performed well throughout 2000 and 2001. Data (particularly the reprocessed data) appear temporally stable and consistent.

Initial validations and comparisons are very encouraging with errors of less than 10%.

Team is awaiting completion of the reprocessed data to have a relatively consistent annual cycle before finalizing validation efforts and posting error and variability estimates.

We expect to upgrade reprocessed data to “Validated” status during the first half of 2002.
MOD43B MODIS BRDF/ALBEDO PRODUCT

Provisional and Reprocessed Products (starting with the 16 day period beginning on Day 305 -- 31 October 2000) are available from EDC at http://edcdaac.usgs.gov/main.html

Users Guide is available at http://geography.bu.edu/brdf/userguide/index.html

Browse images (based on 5km resolution products) can be viewed at http://modland.nascom.nasa.gov/browse/

Global CMG Products on a _ degree resolution Geographical Grid will be available from EDC in the new year.