MODIS Science Team Member

Semi-Annual Report

(Jul - Dec 2001)

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A. FOCUS ACTIVITIES DURING THE REPORTING PERIOD

The most important activities undertaken during this reporting period are the following:

1. Land surface reflectance code development, testing and delivery.
2. Internal products evaluation (cloud, fire).
3. Atmospheric correction validation.
4. MODIS Adaptive Processing System (MODAPS)/PI Processing/250m system

1. Land surface reflectance code development, testing and delivery

Several corrections were done to the code for generating Level 2, Level 3 land surface reflectance and thermal anomaly products (MOD_PR09, or PGE 11).

1.1 Level 2 surface reflectance

Processing issues:

- Increase the level of warning generated by the PGE 11 to help production locate bad input data (files corrupted by disk crashes on the production system).

- Eliminate specific detector in the aerosol algorithm (e.g. band 5, detector 4) independent of input product QA.

- Improve testing of validity of ancillary data prior to use.

- Developed a Linux version for use in MODAPS Version 3.

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- Introduced platform Metadata.

- Developed the Aqua version.

Algorithm improvements

- New surface pressure algorithm using the 1km elevation provided in MOD03

- Internal water vapor computation instead of NCEP using simple band 18 and 19 ratio (critical in the middle infrared).

- Improved internal 1km cloud mask using 500m bands

- Improved aerosol inversion in sun glint area (dynamic computation of sun glint using 6S routine)

- Improved internal mask by adding heavy dust flag

- Introduced internal QA bits for reporting internal masks results to downstream products

- Improved polarization correction in band 8 (using the corrections developed by the Ocean group). Band 8 (412nm) when usable might be critical to improve aerosol product over land.

- Introduced band 26 correction from Chris Moeller (atmosphere group) to enable to reduce the threshold used in band 26 for internal cloud filtering.

- Introduced run time parameters in the PCF to allow rapid changes of internal fire detection threshold.

- Added code for generating brightness temperatures for bands 21, 22, 23 and 29, to output these bands into the MOD09CRS product (in addition to 20,31,32) in order to prototype middle/thermal inversion as outlined in the previous report and in the forthcoming Remote Sensing of Environment paper (Petitcolin and Vermote, 2002).

- Removed sun-earth distance correction in TOA reflectance

1.2 Level 3 surface reflectance

- Simplified the algorithm that was used to generate coarse resolution outputs (using straight average instead of filtering prior to average) to simplify analysis of output results.

- Modify the level 3 composite algorithm by re-computing a simple internal cloud mask when obvious failure of MOD35 occurs (persistent cloudiness), necessitated by the lack of a reliable cloud shadow mask. Also introduced better handling of the atmospheric correction QA (aerosol loading). Those changes in the level 3 are transitory since the internal cloud mask results are now available in L2G and the geometrical cloud shadow algorithm will be implemented in level 2, nevertheless they considerably improved the composite in areas of high cloudiness and high aerosol (see LDOPE QA note: JB_MOD09_01202)

1.3 Tools development

- Created a standalone script, MOD09CRS_Msky_check.csh, which allows the user to compare average aerosol optical thickness values in a MOD09CRS file with AERONET measurements of aerosols at the same place and time. This script uses two older programs, SDSreader (previously developed by the SCF) and Msky (courtesy Louis Gonzalez, Univ. Lille).

- Improve interpretation of validation results by adding computation of geometrical conditions.

2. Internal products evaluation (cloud, fire)

2.1 Internal cloud mask

The internal cloud mask has been compared once in operation to the latest delivery of test granules provided by the atmosphere group for MOD35. Three granules were provided by the atmosphere team. The bottom line is that this first version of the internal cloud mask performed pretty well for the intended use (data useful for atmospheric correction at acceptable sun solar zenith angle) given its simplicity. Later on LDOPE conducted some more analysis after production run and found out some remaining issues in MOD35 that were not present in the internal cloud mask

2.2 Internal fire mask/ 3.75 reflectance

The internal fire mask was evaluated in several cases where burning activities were known to have occurred. In particular, during Safari 2000 over the Timbavati prescribed fire, results of the performance of the internal fire mask which relies primarily on the 3.75mic reflectance were presented at the MODIS Science Team meeting in January and are reported here as well (figures 1,2 and 3). A simplified version of the middle infrared reflectance has been coded in the HDFLook_MODIS software that enables it to generate on the fly the thermal anomalies composite, an example is below of this new RGB over Australia during some very intense burning (January, 2002) on figure 4.

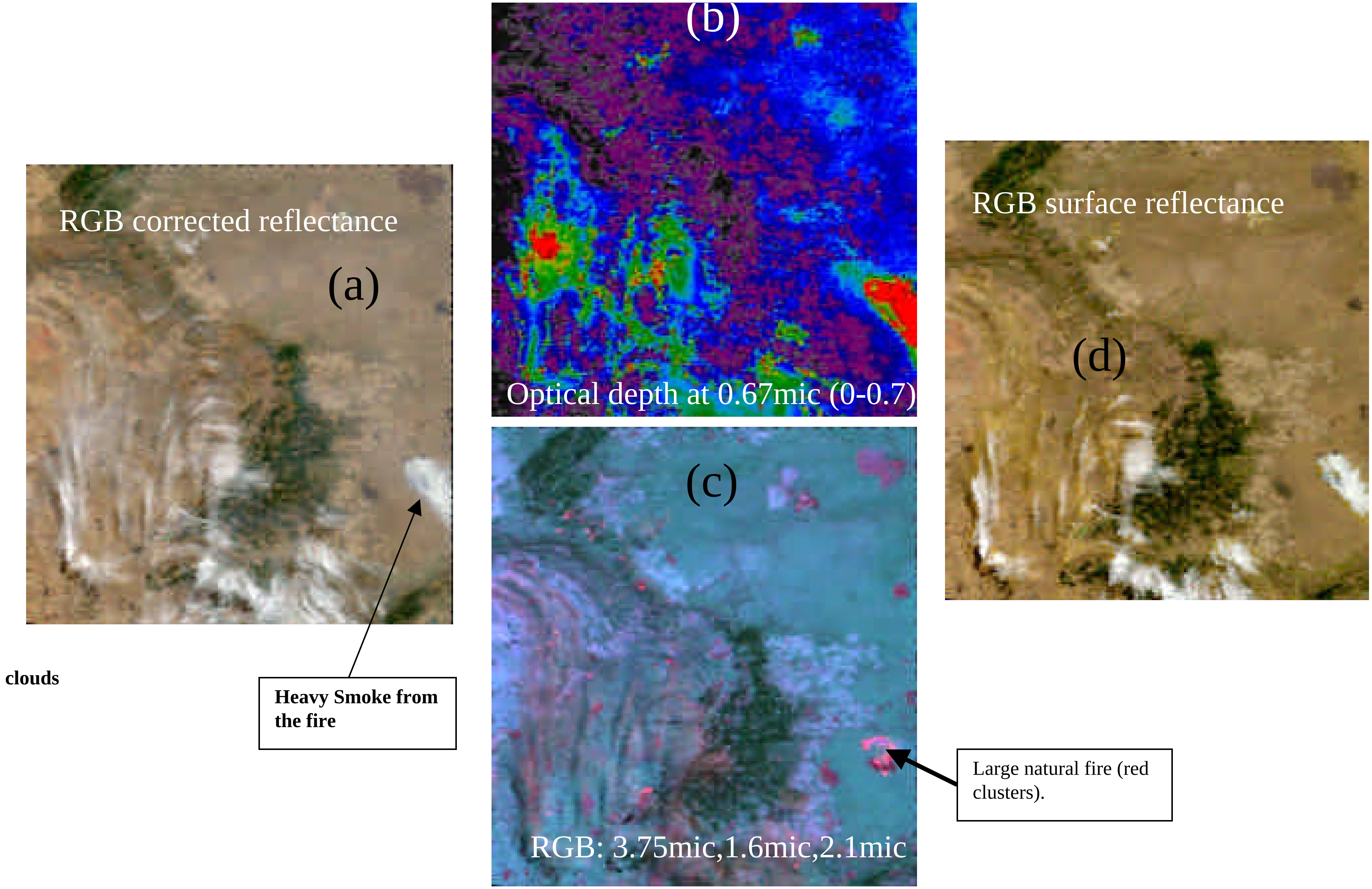


Figure 1 (a,b,c,d): August 30, 2000, start of fire activities in the region of South Africa near Kruger National Park, the aerosol loading is low except in the direct vicinity of active fires, in particular very heavy smoke is generated by a group of fires in the bottom right of the image. In this series **(a)** is the reflectance not corrected for aerosol**, (b)** is the aerosol optical thickness scaled between 0 and 0.6 (red) **(c)** is a false RGB composite using the reflectance at 3.75mic in the red to show the fire activies and **(d)** is the surface reflectance product.

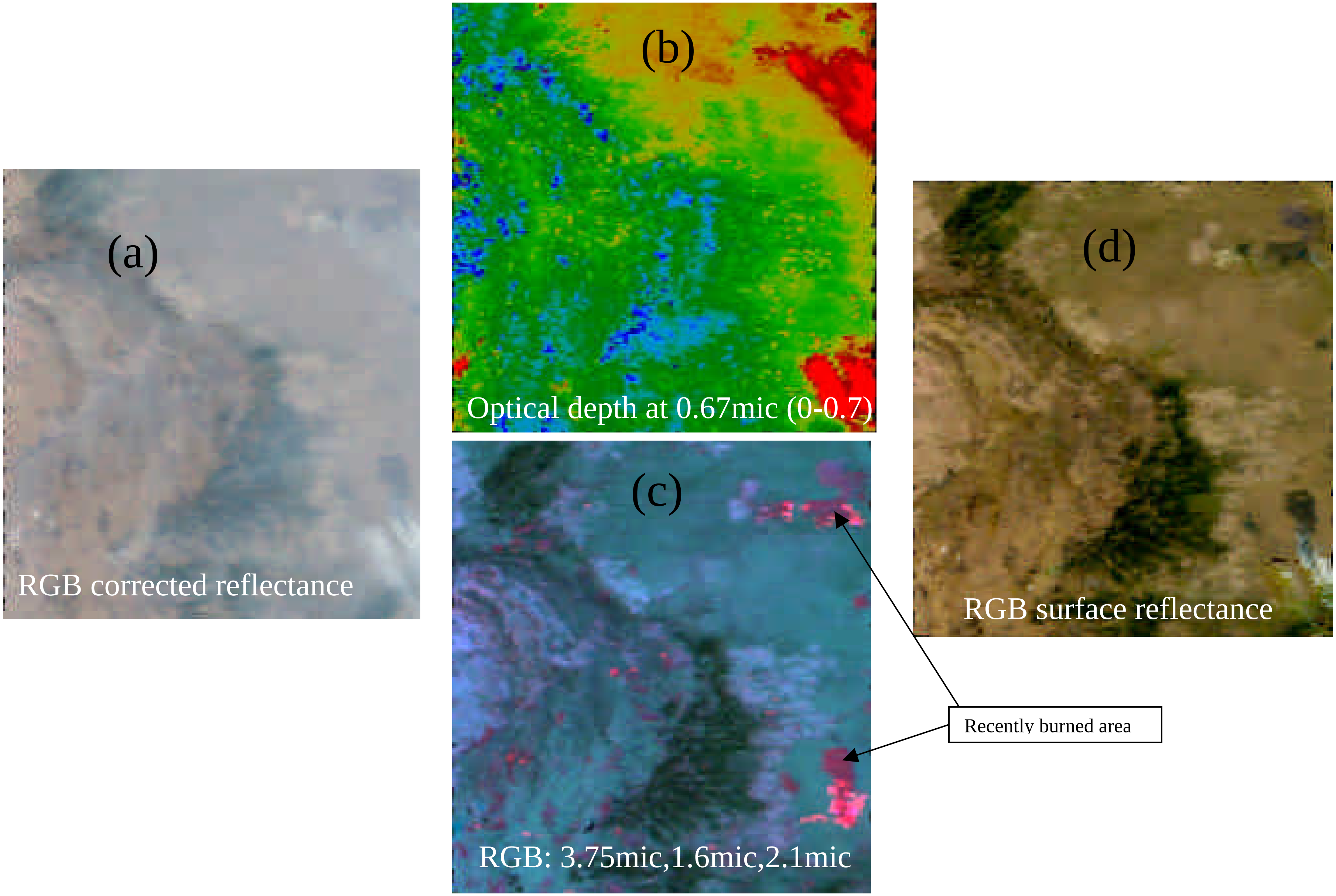


Figure 2 (a,b,c,d): The same area as in figure 1 but on September , 3, 2000, you can notice the higher aerosol background both in (a) and (b) after several days of burning, also in (c) and (d) you can locate the area recently burned.

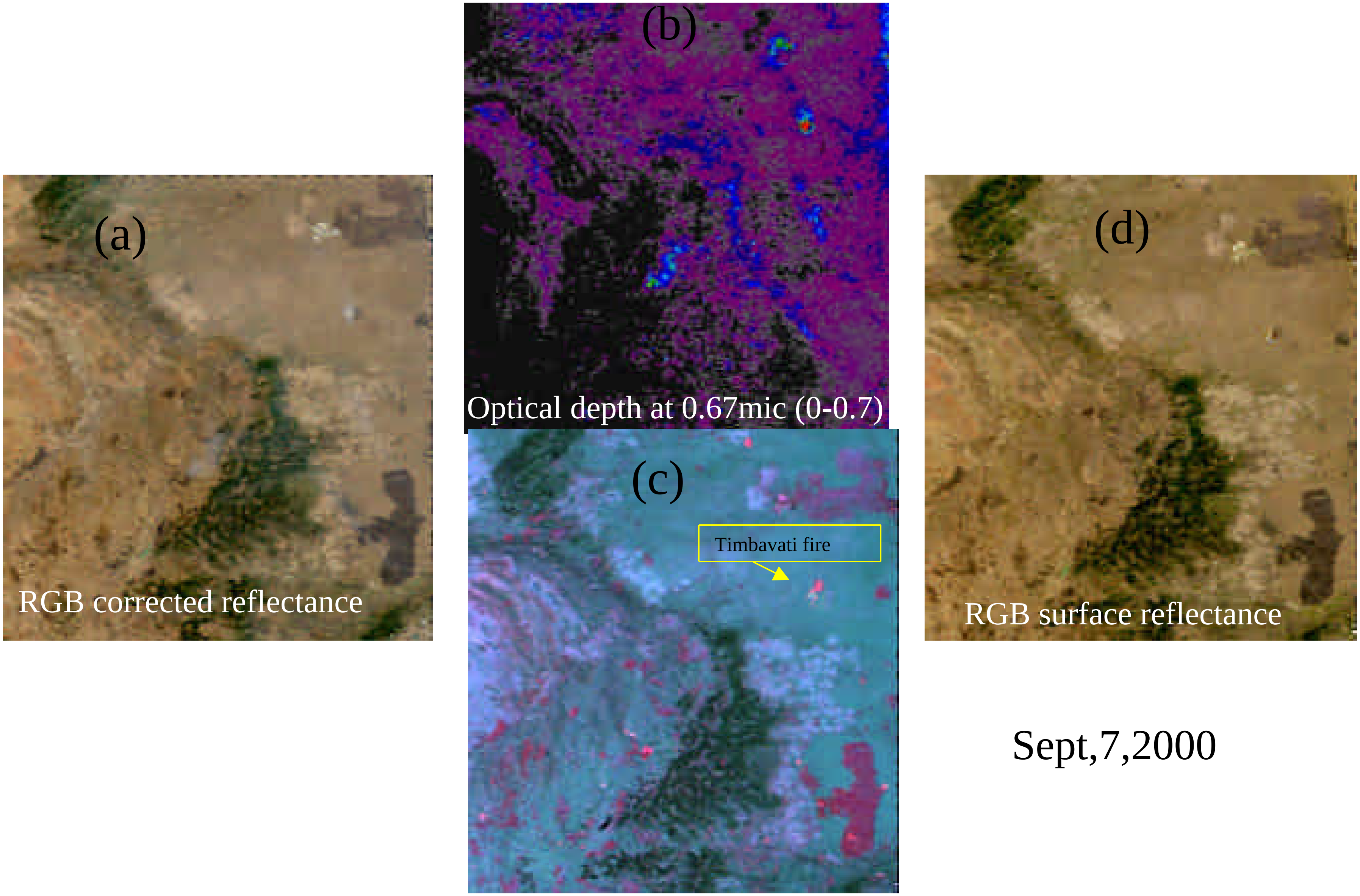
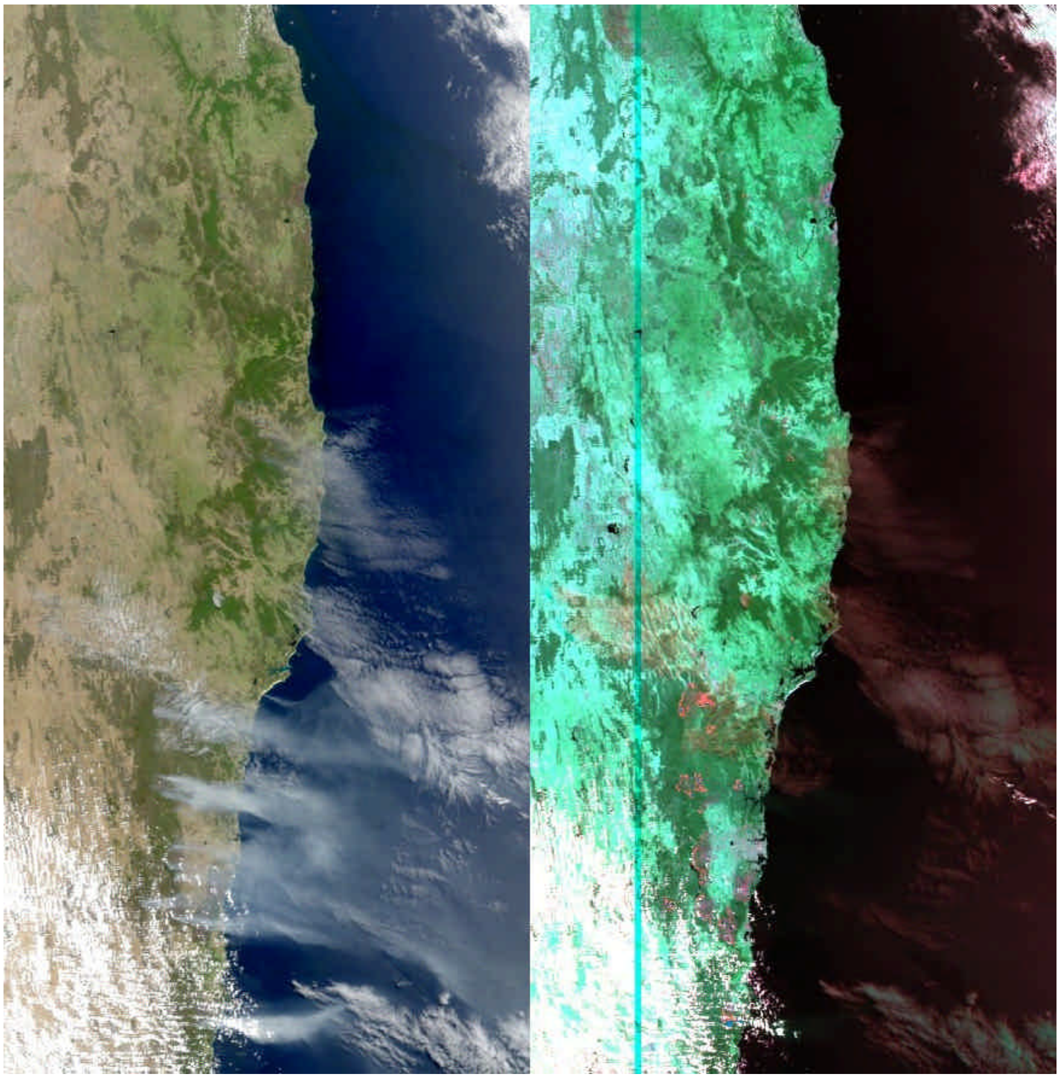


Figure 3 (a,b,c,d): The same area as in figure 1 but on September , 7, 2000, the aerosol background is small again. The area burned is considerable. The new fire outlined in yellow is the Timbavati prescribed fire, for which several instrument data sets including MAS are available.

Figure 4: Level1B (1km) RGB composites over Sydney on January , 1, 2002 using HDFLook_MODIS.



Corrected reflectance's | **Thermal anomaly RGB (R=3.75mic, G=1.6mic, B=2.13mic)**

3.0 Atmospheric correction validation

The atmospheric correction validation strategy is to validate both the critical input for atmospheric correction (aerosol) and the results of the correction by comparison of the MODIS surface reflectance to independent measurements.

The first part of the validation could be achieved by comparing the internal aerosol product retrieved to sun photometer measurements, the results are presented in figure 5. The agreement is very good and well within the error bars on the aerosol product which are half what they were before launch.

For the second part of validation, because of the size of MODIS pixels (250m and 500m at nadir), it is not practical to directly compare them to ground measurements; Therefore some intermediate high spatial resolution data set is used to perform the validation. We used ETM+ data almost coincident with MODIS. We use AERONET measurements to correct ETM+ using code that also accounts for adjacency effects and first validate our correction on ETM+ by comparing the reflectance values to ground measurements for 3 different cover types (grass, harvested corn field and bare soil), figure 6 shows the comparison between the ETM+ derived surface reflectance and ground measurements collected using a field spectrometer (ASD) for the harvested corn field case. Once the ETM+ standard is established for that case it can be used to validate the MODIS reflectance, the comparison is done for an area free of clouds and for pixels which comply with some homogeneity criteria at the ETM+ scale. The comparison is shown on figure 7. There are still possible systematic difference between ETM+ and MODIS reflectance due to the fact the spectral bands are different and this is investigated further in an in-press RSE paper on atmospheric correction (Vermote et al., 2002), but the agreement is well within the error bars of the atmospheric correction algorithm.

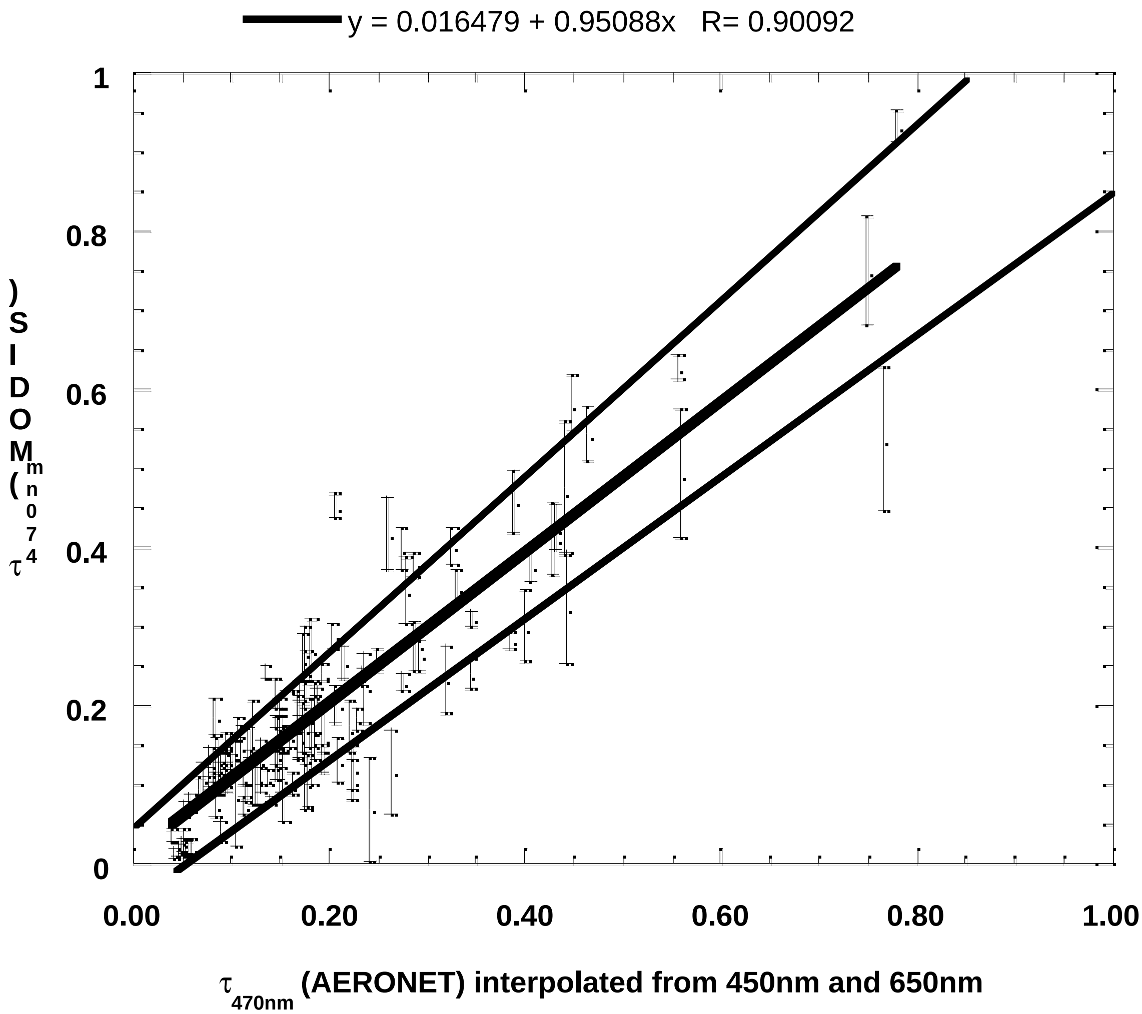


Figure 5: Comparison of 1km operational aerosol optical thickness retrieved by MODIS blue channel (~120 matches) with AERONET sun photometer measurements during the March, April, May 2001 period.

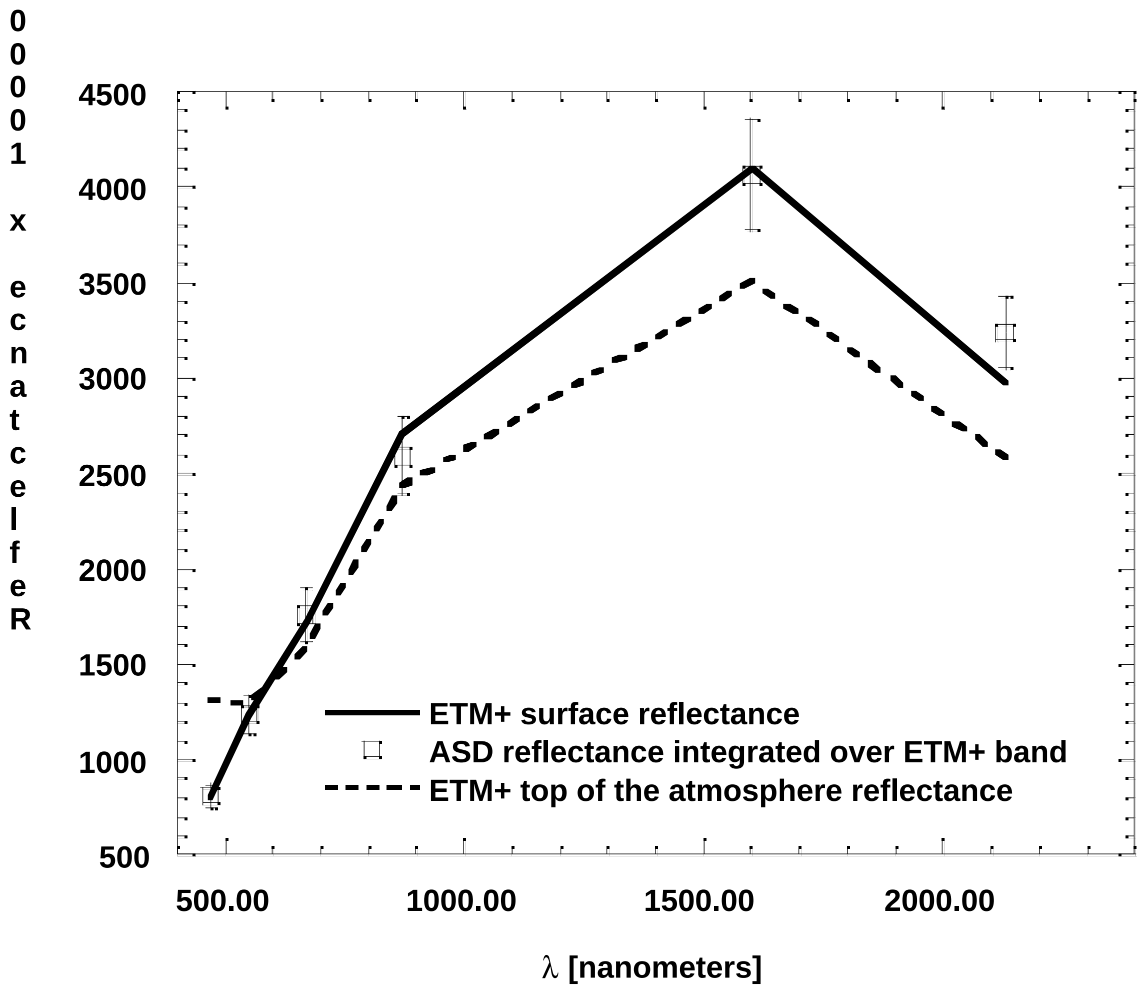


Figure 6: Comparison of the ETM+ surface reflectance with ground measurements (ASD) for the harvested corn plot.

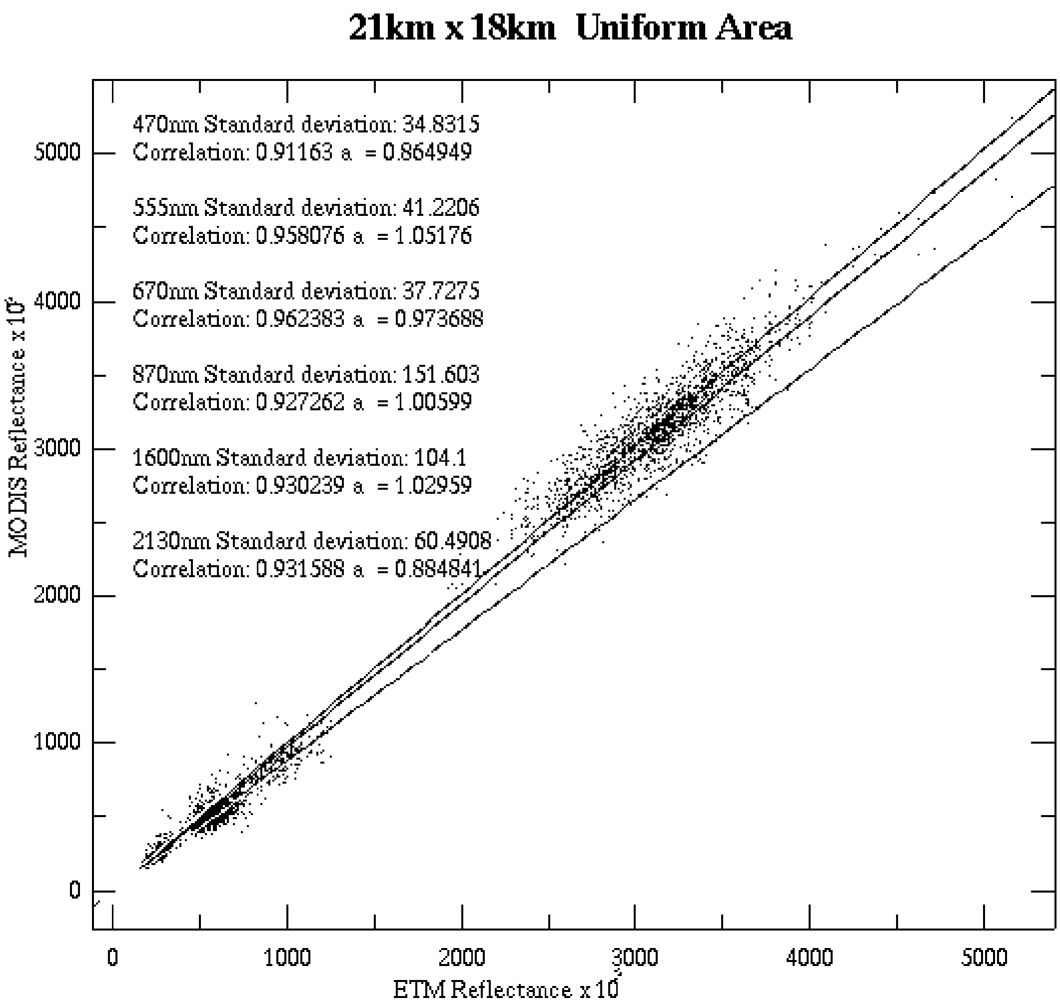


Figure 7: Comparison of the surface reflectance derived from ETM+ (using AERONET data) with the operational MODIS surface reflectance product.

4.0 MODIS Adaptive Processing System (MODAPS) / PI Processing /250m system

The Land Surface Reflectance SCF remains actively involved in the PI-led processing activity ranging from making sure that PI's needs are accurately perceived by the MODAPS development team and by management, as well as participating in the development of the processing system and various phases of testing.

The SCF participated in the weekly PI-Processing meetings where Eric Vermote represented the land group.

The SCF also participated in all of the weekly MODAPS meetings/telecons, where problems were discussed to identify solutions and where progress in the new development was tracked.

B. **MEETINGS ATTENDED**

- MODIS Science Team Meeting (Dec, 01) Greenbelt, MD.
- Weekly PI Processing Status Meetings, NASA/GSFC.
- Weekly Technical Team Meetings, NASA/GSFC.
- Bi-Weekly SDDT (Science Data Discipline Team) Meetings.
- Weekly MsWG (MCST Science Working Group) Meeting

C. **PUBLICATIONS**

Ouaidrari H., El Saleous N., Vermote E. F., Townshend J. R., Goward S. N., "AVHRR Land Pathfinder II (ALP II) data set: Evaluation and inter-comparison with other data sets", *International Journal of Remote Sensing* (In press)

Vermote E.F., El Saleous N, Justice C, 2002, Atmospheric correction of the MODIS data in the visible to middle infrared: First results, *Remote Sensing Of Environment*, (In press).

Vermote, E. F. and Roy, D.P., Land Surface Hot-Spot observed by MODIS over Central Africa, *International Journal of Remote Sensing*, Cover Letter, (In Press)

Petitcollin F. and Vermote E. F., Land Surface Reflectance, Emmisivity and Temperature from MODIS Middle and Thermal Infrared data, *Remote Sensing Of Environment*, (In press).

Vermote E.F., "Adjacency effect on Remotely Sensed Data: Theory and Correction", contribution to the *Encyclopedia of optical engineering*, Driggers R.G. and E. Lichtenstein (Eds.), publisher Marcel Dekker, Inc., (Accepted)

Privette J.L. and Vermote E.F., "The Impact of Atmospheric Effects on Directional Reflectance Measurements", Chapter 6 of Reflection properties of Vegetation and Soil - with a BRDF Data base, Maria von Schönermark, Bernhard Geiger, and Hans-Peter Röser (Eds)), 2002, publisher Wissenschaft & Technik Verlag (In press).

Ouaidrari, H., Goward, S.N. , Czajkowski, K.P. , Sobrino, J.A., Vermote, E.F., 2002, Land Surface Temperature Estimation from AVHRR Thermal Infrared Measurements: An Assessment for the AVHRR Land Pathfinder II Data Set, Remote Sensing of Environment, (In Press)

Wang Y.J., Tian Y.H., Zhang Y, El Saleous N, Knyazikhin Y., Vermote E.F., Myneni R.B., 2001, Investigation of product accuracy as a function of input and model uncertainties - Case study with SeaWiFS and MODIS LAI/FPAR algorithm, *Remote Sensing Of Environment*, 78: (3) 299-313 DEC 2001.

Chris Justice, Robert Wolfe, Nazmi El-Saleous, Jacques Descloitres, Eric Vermote, David Roy, John Owens, Ed Masuoka and the MODIS Land Science Team (MODLAND), The Availability and Status of MODIS Land Data Products, Earth Observer, 2001.

Vermote E.F., C. O. Justice, J. Descloitres, N.El Saleous, J. Ray, D. Roy, B. Margerin, L. Gonzalez, A global monthly coarse resolution reflectance data set from SeaWiFS for use in Land, Ocean and Atmosphere applications, *International Journal of Remote Sensing* 22: (6) 1151-1158, 2001.