Type of Report: Semi-annual, January to June 2001
University of Arizona/ NAS5-31364

TASK OBJECTIVES

The focus and objectives for this period were mostly placed on adjustments to the MODIS VI algorithms and the coordination between our algorithm and MODIS upstream products. The MODIS reprocessing plans required a redesigning of our MODIS VI algorithms and sciences changes were made to the algorithms to allow for proper processing of the newly modified, upstream surface reflectance algorithm. Generating MODIS global and regional VI maps was also a major task conducted in part, to fulfill the overall MODIS outreach program. Research on the MODIS 250m resolution effects, VI application, surface reflectance aggregation, and the combination of vegetation index and quality metrics was also initiated. We also concentrated our efforts on quality assessments (QA), in-house data management, planning, and implementation, as well as field validation activities.

Specific tasks included:

- Coordinate MODIS VI work with MODLAND and land products,
- MODIS algorithm development, maintenance, and enhancements,
- MODIS VI compositing research,
- Generation of MODIS VI global and regional maps,
- SCF maintenance and in-house code development,
- Science and applications research,
- Investigation of artifacts and anomalies in MOD13Q1, MOD13A1, and MOD13A2,
- Documentation of the MODIS VI product QA known issues for a public release purpose,
- Preliminary analyses of the MODIS VI long-term stability monitoring results,
- Planning, development, and implementation of the in-house MODIS operational production and core site extraction system.

WORK ACCOMPLISHED

1. Algorithm development

Three new versions of the of the MODIS VI Algorithms were submitted:
The February 5, 2001 delivery included,

a. MOD13A1, and MOD13A2 Version 2.2.4
b. MODAGG Version 2.2.5
c. MOD13A3 Version 2.1.0
d. MOD13Q1 Version 2.2.4 (New 250m algorithm)

The April 6th, 2001, delivery included,

a. MOD13A1, and MOD13A2 Version 2.2.5
b. MODAGG Version 2.2.6
c. MOD13A3 Version 2.1.1

d. MOD13Q1 Version 2.2.5 (Adjusted 250m algorithm)

The May 21st, 2001 delivery included,

a. MOD13A1, and MOD13A2 Version 2.2.7
b. MODAGG Version 2.2.7
c. MOD13A3 Version 2.1.2
d. MOD13Q1 Version 2.2.7 (Modified to work on MODAPS and bug fix)

2. SCF Maintenance

- A new set of hard disks (RAID) were installed, configured and mounted for MODIS data processing. This task required coordinating with both ANACAPA (RAID disk provider) and SGI to overcome problems integrating the fiber channel controller into the current hard ware. A new file system (TBRS_8) provided us with much needed disk space, and enhanced our in-house processing and storage capabilities.
- System upgrade and maintenance, our SGI system is now running IRIX 6.5.11, which is a more stable operating system. All servers and workstations are now using the new operating system.
- Our SCF is still performing very well, except for the increased need for disk space, which is being met by a newly ordered RAID system.
- In house code development to serve several MODIS VI and research purposes, including a stitching algorithm modified to handle all MODIS VI products and resolutions, conversion software between the ISINUS projection and Lat. Lon. for TBRS internal use, special Extraction software for the Aggregation product used for research.
- Installation of a Windows 2000 server with a 100 GB disk storage space as a Web server
- IRIX operating system upgrades to IRIX 6.5.11
- ENVI software upgrade from version 3.2 to version 3.4

3. Science research

Snow/ice problems in the EVI:

The EVI snow/ice problem was addressed in the latest set of algorithm deliveries. Early global VI maps and QA evaluation indicated that the EVI equation was not working correctly over snow and ice, and was generating misleadingly high values (Fig. 1). We found that the use of the blue channel in the EVI equation was the cause of this problem. Taking advantage of the normally linear relationship between EVI and SAVI, we simply replaced EVI with SAVI, whenever this problem occurred (Fig. 2). The correction was based on the assumption that the use of the blue channel over very bright snow/ice targets is not necessary due to the poor performance of the atmosphere correction algorithm. The following two images illustrate the EVI before and after this production fix (Fig. 1).

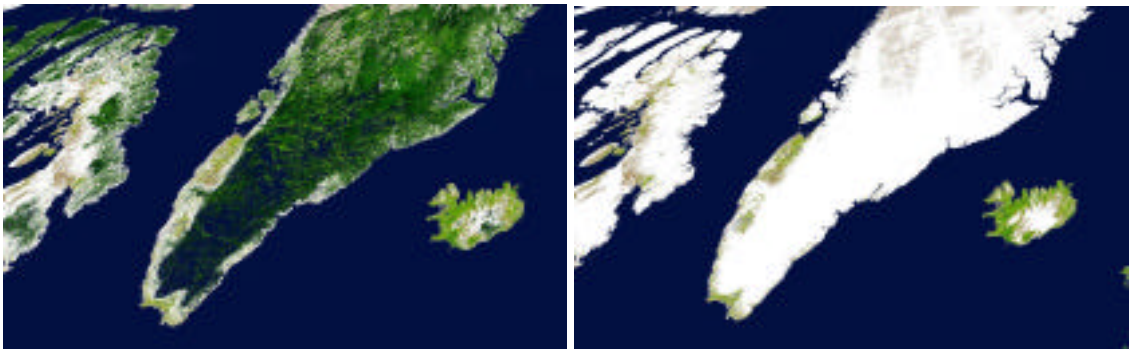

Figure 1: MODIS early EVI product before and after the fix

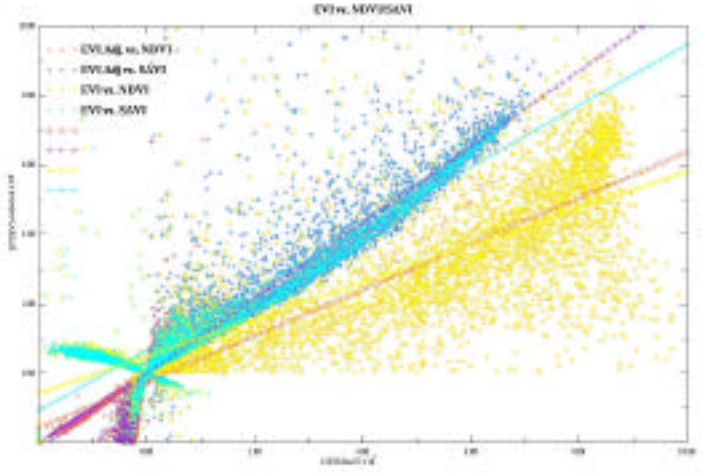

Figure 2: Linearity of the relationships between different VIs.

Compositing Algorithm

Due to changes in the upstream MODIS products (see the MODIS VI status page) and the in-house evaluation of the VI algorithm, some science changes were implemented to further enhance the VI product. A new set of filtering and processing rules were implemented. The following figure details the compositing algorithm as of Collection 3.0.

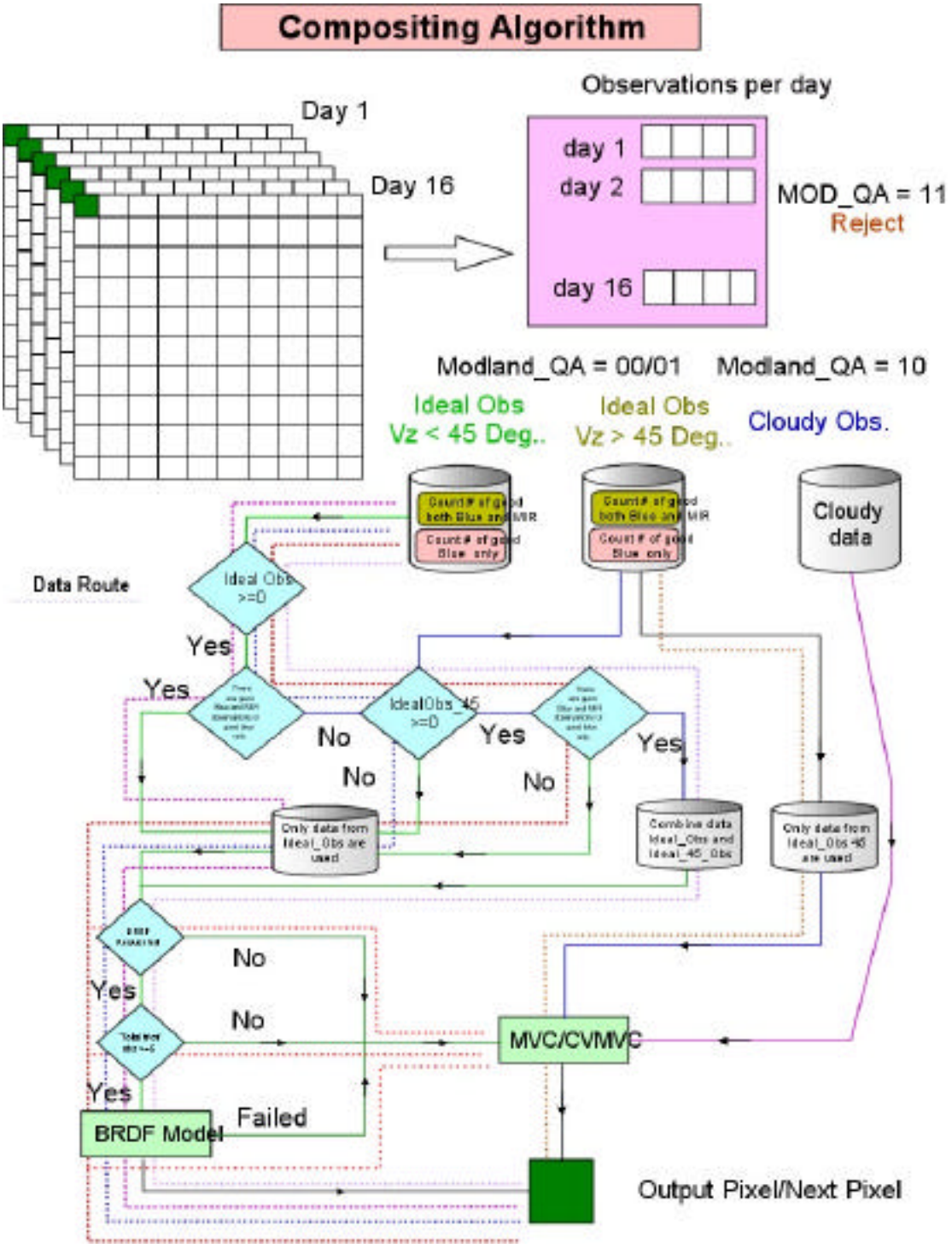

Figure 3: Current MODIS VI compositing scheme.

This new scheme will be used for the consistent 1-year reprocessing, and is expected to enhance the data set tremendously due to its filtering rules and its independence in interpreting QA bits in upstream products. In-house evaluation of the current compositing scheme indicates

that it is performing very well and many early problems were reduced (check the MODIS global imagery posted on http://tbrs.arizona.edu).

We evaluated the performance of the MODIS VI compositing algorithm as to whether the algorithm is selecting the cloud-free observations and whether it is producing and selecting observations with view zenith angles closest to nadir. The analyses were conducted over two biomes, including a tropical rainforest and desert biomes in both dry and wet seasons. For these specific sites chosen for this study, we found the MODIS VI compositing algorithm to work fairly well in both dry and wet seasons. A combination of two criteria in the MODIS VI compositing algorihtm, i.e., the per-pixel QA-based initial data screening and the view zenith angle constraint, resulted in nearly all of the composited pixels being cloud-free with view zenith angles closer to nadir than the conventional maximum value composite (MVC) results. The results of this study was summarized into a proceeding paper for the IGARSS 2001 conference (Miura et al., 2001).

4. MODIS 250m VI

Although the MODIS 250m VI is still suffering from a consistent production medium, some headway was made in terms of porting the current 250m MODLAND algorithm to the central processing system (MODAPS). Our standard 500m algorithm was modified to handle both 250m NDVI and 250m NDVI/EVI. Spatial coverage for this product is still limited and will only cover North America initially and parts of the Amazon region. The new plan is to expand this limited (10%) coverage to 25% (mostly South America and parts of Boreal Europe) and finally reach a complete 100% coverage. To accommodate these circumstances and fulfill our needs for the 250m MODIS VI, we are currently processing 250m in-house but only on a limited basis. The MODIS 250m VI algorithm was standardized to both the 1km and 500m product such that differences in pixel content could be safely attributed to resolution. This effort is still ongoing, and we hope to reach full production so that a thorough evaluation of this enhanced resolution VI product could be made. It is also important to mention that the product name has changed to MOD13Q1.

5. MODIS Vegetation Index Status page

As part of the public release, we were tasked to develop a web page that lists and explains problems with the MODIS VI product. LDOPE developed a known issues web page that covered all the problems up to date, however, this page was very generic and mostly covered the VI products anomalies. Our MODIS VI status page is more thorough:

http://tbrs.arizona.edu/projects/modis/documents/qa/EVI_QA/MODIS_VI_Status.html

The above page details the most serious product problems and explains them to the public. Moreover, this page will be updated continuously as new problems, or science issues are discovered in our product.

MODIS VI long term stability report

We investigated the stability of the MODIS VI over desert areas to establish a possible VI baseline. We noticed a temporal decrease in this baseline that neither was related to seasonality nor vegetation activities, but rather seemed to be a persistent decrease based on the data set available and analyzed thus far. LDOPE on the other hand was alerted and they performed their own analysis, but on 16 day MODIS VI products. Their conclusions were that the sun zenith angle played a role in this decrease. We performed a more thorough analysis on daily MODIS VI products (in-house production) using a full year worth of data, and our preliminary analysis seems to refute the role of the sun zenith angle, but rather points to a sensor decline that we neither can ascertain nor deny at this point. Three additions were made to the stability monitoring data analyses. First, another time series plot was made for the Atacama desert, Chile in addition to the Tunisian site. Second, daily VI values were added to the 16-day composite plots. Finally, a correlative analysis between VI and solar zenith angles were made, as suggested by the LDOPE. The preliminary results of this study is accessible at http://gaea.fcr.ariozona.edu/~tomoaki/LTSM/LTSM_SSh.html. Plans are underway to extend the original analysis to the most current data. We are cooperating with LDOPE to have a good answer to this issue.

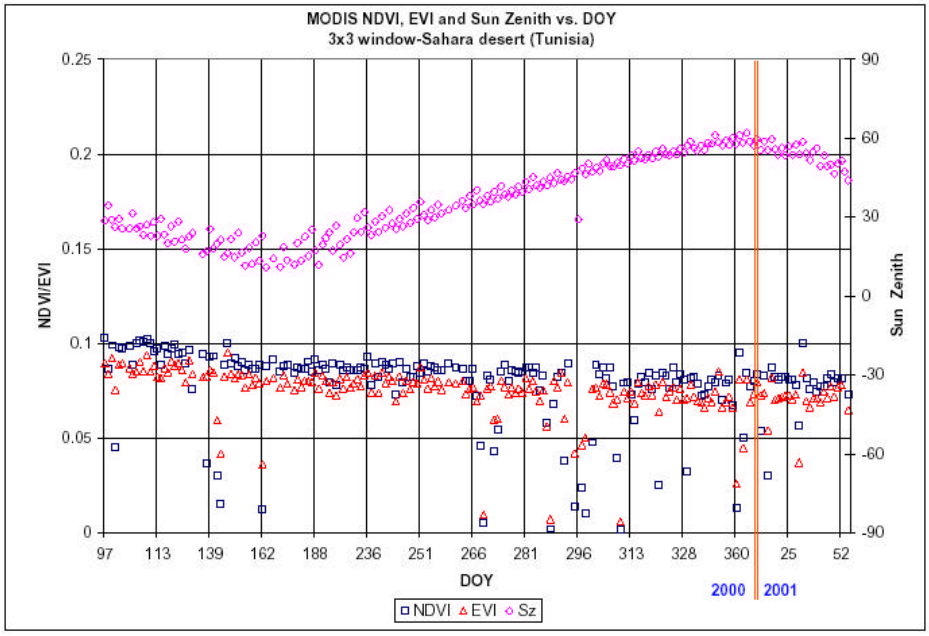

Figure 4: MODIS VIs and Sun zenith angle vs. DOY, showing the VI decline.

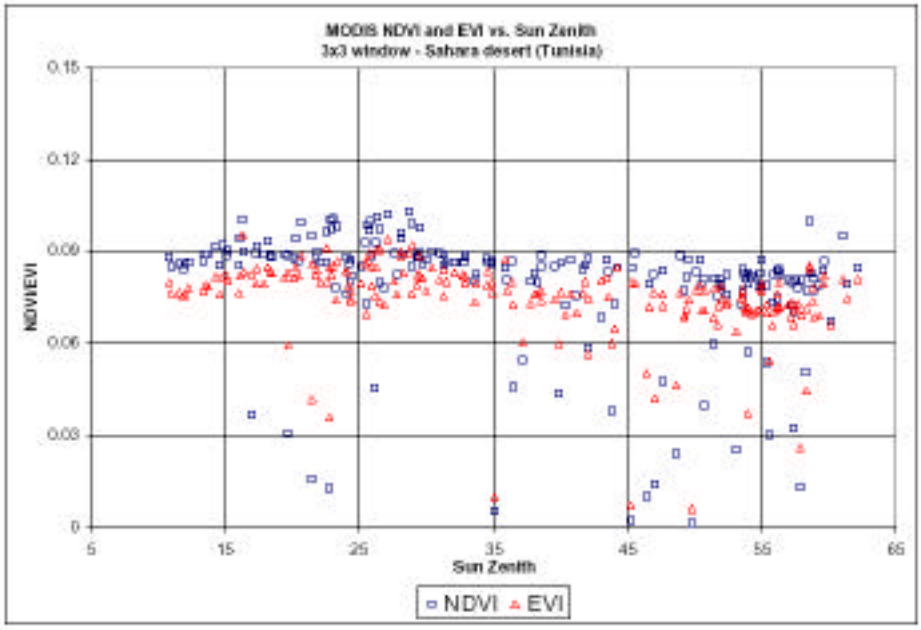

Figure 5: MODIS VIs vs. Sun zenith, the sun zenith effects are not clear.

6. Quality Assessments (QA) of the MOD13 Products

QA activities during this period included the continued investigation of artifacts and anomalies in MOD13Q1, MOD13A1, and MOD13A2; evaluation of the VI compositing algorithm; prototyping / preliminary analyses of the VI long-term stability monitoring; and documenting the VI product QA known issues for public release purposes. The major findings / fixes about the VI product quality issues during this period include the following:

- We found that several VI tiles were missing from the EDC-DAAC archive, but existed in the MEBDOS. A number of missing tiles varied from 16-day compositing period to the next period. QA flags and metadata of those missing tiles were retrieved from the LDOPE QA database and inspected, but no indications of errors and/or bad quality were found. We suspected some possible problems with data transfer from MODAPS to EDC-DAAC and contacted Robert Wolfe and Nazumi El Saleous at the MODLAND SDDT, and David Roy at the LDOPE for advice (2000-Feb-21).
- The land aerosol correction, which became operational on September 29, 2000 at a coarser resolution (10km) with incomplete land coverage (some land area did not get corrected for aerosol), led to spatial anomalies in the VI products. We are currently investigating the impact of this spatial discontinuity due to aerosol correction on the VI product quality.
- Another change in the QA/QC bit coding scheme of the surface reflectance product led to false interpretations of the bits by the MODIS VI algorithm. As a result, low quality data were used in the compositing. This problem can be observed in the products from 2000-321 through 2001-001. This problem was addressed to allow ingestion of both the old

QA/QC bits and a new QA/AC bit. This problem was not visible in the VI data sets, but rather in the VI QA/QC layers.

In-house Production and Data Management Planning / Implementation

In support of the QA and validation activities, we have developed an in-house production system. Figure 6 shows a general data flow within the system. The in-house production system consists of a combination of perl scripts, c-codes, LDOPE QA tools, and MOD_PR13A1 and MOD_PR13A2 codes. Currently, the system has the following capabilities:

- Automatic production of 16 day VI composites (in-house version of MOD13A1 and MOD13A2) over the MODIS VI golden tiles,
- Automatic production of daily VI composites (in-house version of MOD13A1 and MOD13A2 computed from single day surface reflectance products, namely, MOD13A1D and MOD13A2D, respectively) over the golden tiles and tiles that cover the validation core sites,
- Automatic generation of quick look images from both MODAPS and in-house versions of the MOD13 products,
- Automatic generation of global mosaic (browse) images from MODAPS version of the MOD13A1 and MOD13A2 products,
- Automatic subsetting and extraction over the validation core sites from both MODAPS and in-house versions of the MOD13 products and the upstream products (MODIS surface reflectance products).

We are currently developing a database to manage metadata, in-house production status, and backup status. One M.S. student from the Computer Science Department, Yuan Yin, was hired to work on a database and backup system development with a search capabilities. As the system becomes stable, this student will implement and maintain the whole, in-house production system.

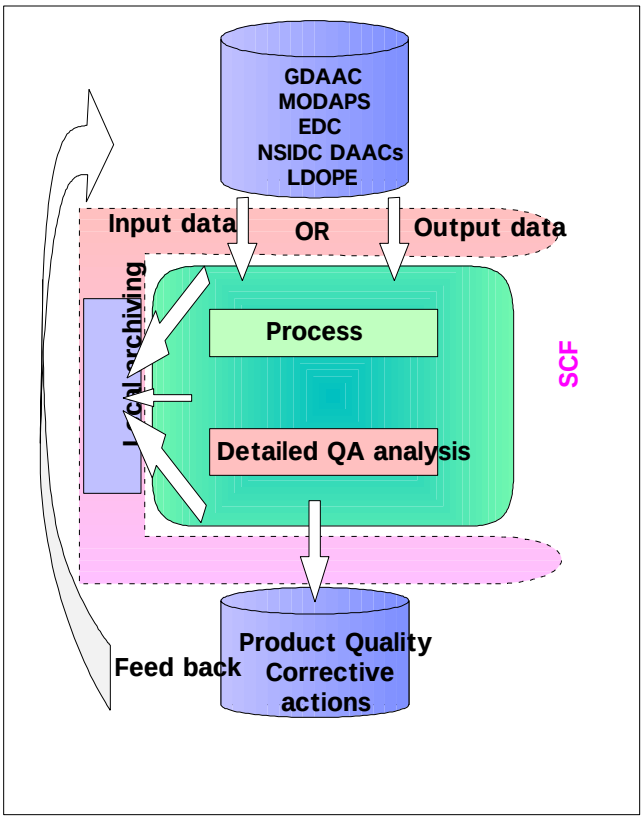

Figure 6. General Data Flow in the In-house Production System.

7. MODIS VI presentations and public outreach

Part of our work is to make available and help generate MODIS global and regional maps for both the larger MODIS outreach program, in cooperation with other MODIS team members, for internal use, and for public display. Three major tasks were accomplished:

- MODIS global VI map for the MODIS brochure and EOS data handbook (Fig. 7).
- MODIS VI presentation material for group use and for MODIS science team members.
- MODIS VI maps of the southwest USA to be made available through the Arid Land web server at the University of Arizona.
- Conducted a case study on the use of MODIS VI for drought assessment. This analysis was accomplished using near-real time data in cooperation with the MODIS Land rapid response system. This case study will be later published on the NASA observatory.

Most of our presentation material is stored on our system for internal use and archiving (/TBRS_5/Press_Release):

Figure 7a: MODIS EVI, 2000-273

Figure 7b: MODIS NDVI, 2000-273
The most complete MODIS EVI and NDVI global maps, specially processed in our TBRS facility and used for the MODIS brochure.

Part of making our MODIS VI product public required making the users aware of the problems in the current data sets. A web page representing the most relevant issues with our VI product could be found under:
http://gaea.fcr.arizona.edu/projects/modis/documents/qa/EVI_QA/MODIS_VI_Status.html

MODIS VI application: Indian drought case study

As a result of the drought occurrence in western India, we were tasked to look into the possibilities of using the MODIS VI products to analyze drought. Although MODIS data does not yet have the necessary temporal resolution (less than one year produced) to answer such time dependent questions (i.e., we had no 'reference baseline' year), we bypassed the regular production channels and acquired near-real time L1B data, later processed to Level 2 atmosphere corrected surface reflectances. This data was processed into the MODIS VI products using a specially designed algorithm, that is, similar in science to the standard products. To assess the drought, the two data sets from May 2000 and May 2001 were used to compute the VI differences and percent differences between the two dates. The assumption is that the drought will manifest itself through a reduction in vegetation activity, and subsequently lower VI values. We assumed that the percent relative difference would provide insight into the drought and a quantitative measure of the its severity. We also performed visual evaluation of water bodies in the affected areas to further assess the drought. The results were published in an internal report:

http://gaea.fcr.arizona.edu/~kamel/Gujarat/Drought.html

The NASA observatory will use these results to publish a case study on MODIS VI applications. Similar case studies will be pursued to further illustrate the applications of the MODIS VI product.

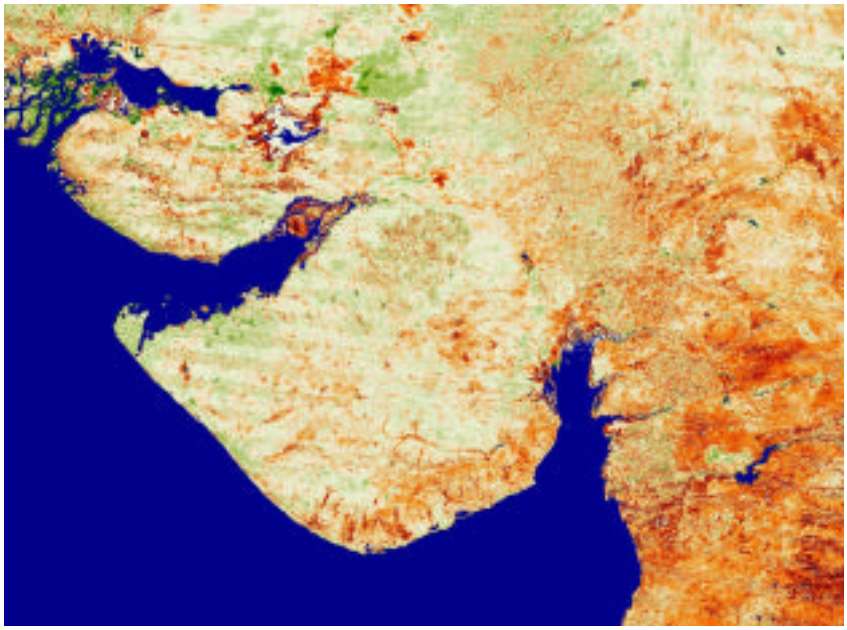

Figure 8: Percent difference in MODIS EVI between May 2001 and May 2001. Red color indicates decline.

8. Validation

MQUALS Activities

Three MQUALS airborne data campaigns have taken place. On February 19th and April 8th, 2001, MQUALS flew the Walnut Gulch Experimental Watershed, Arizona. Data collected included airborne Exotech, ASD, Dycam pictures, and pyranometer data. The second MQUALS overflight took place at the Jornada Experimental Range in New Mexico on May 11-12, in conjunction with USDA-ARS joint activities and included all measurements mentioned above except for the pyronometer measurements.

Jornada Experimental Range

We established several permanent transects over four land cover types (grassland, transition, mesquite, and creosote bush) within the Jornada Experimental Range (JER). We are characterizing the radiometric and biophysical properties of these land cover types for multitemporal validation of the MODIS VI products. Starting from May 12, 2001, we have visited Jornada Experimental Range every 16 days to coincide with MODIS/ETM+ overpass.

During each visit, we measure all the point cover transects and record cover information by component, crown cover, species, and understory at 20cm intervals. Pairs of landscape and oblique nadir pictures are also taken at each transect for long-term monitoring purpose. We have made some LAI measurements at the transition site. When weather conditions were favorable, we also collect full-range ASD spectroradiometer data, currently mainly at transition site, including 100 m transects and pure spectral signatures over all the major shrub species.

Walnut Gulch Experimental Watershed

A similar set of field-based multitemporal measurements are also being conducted at the Walnut Gulch site in Arizona. This experiment was started on January 2, 2001 and every 16-days thereafter. This also has included 2 MQUALS overflights. All measurements include field based radiometric and biophysical measurements.

Argentina field campaign

We participated in a special field campaign in Argentina from Jan 28th to Feb 7th, 2001, in support of EO-1 validation activities, which included Hyperion and ALI satellite imagery as well as airborne AVIRIS imagery and field-based ASD spectroradiometer data. The hyperspectral data sets are part of our efforts at establishing NDVI continuity across sensor systems with variable bandpasses as well as EVI translation coefficients for variable sensors. Field and satellite image data sets were collected at various ecological sites within the Mendoza and Cordoba regions in Argentina, including the protected Nacunan and Chancani Reserves, composed of floristically diverse vegetation communities, including mesquite shrub and open mesquite forest (algorrobos), savanna, and creosote bush (jarillales). We sampled these vegetation communities in their original, undisturbed state as well as at various stages of degradation with both an optical and biophysical sampling scheme. Our ground-based radiometric measurements included 100 m transects through each type of canopy as well as pure spectral signatures over all the major vegetation species, soils, and non-photosynthetic vegetation (NPV) materials. Biophysical measurements included percent cover by component and leaf area index (LAI) measurements. Nacunan Reserve is an important site for the development of indicators of desertification and can help assess the capability of hyperspectral data in discriminating the gradient of vegetation types and land cover conversions (desertification) in such semi-arid, low vegetation conditions. It is also an interesting “parallel” counterpart site to the Jornada Experimental Range in New Mexico, U.S.A. The hyperspectral data sampled in this campaign can also be used to scale up the ground measurements to MODIS pixel sizes for MODIS VI product validation puspose (ground – AVIRIS – Hyperion – MODIS).

Web-based Validation Page

This involved the development of a web page for posting the data collected during the field campaigns for each of the sites and for each date. The idea is to have all the processed data collected online within a week maximum after collection. Figure 9 shows the layout of the website for the Mquals data collected by TBRS.

Figure 9: Data gateway web site

At this point all the MQUALS airborne data collected for the years 2000 and 2001 are online and available for download. The data include:

a) Exotech or ASD Data (Extracted over specific sites, and full dataset)
b) Dycam images
c) GPS data
d) Metadata
e) Landscape pictures
f) Field report (when available)

The data are in Excel, text and comma separated value format for easy use.
We are working on a way to post all the ground data that has been collected on the web so far for internal use. Also the PROVE data from 1997 was posted on the web. Figure 10 shows a snapshot of a page for Dycam images.

La Jornada Experimental Ranch, May 11, 2001

DyCom Images Information collected during the Flight survey

Flight line surveyed and Dycom images position along the flight transect

Image	Mst time	Decimal time	Lat	Long	Easting	Northing	Altitude
	10:31:08	10.517500	32.592317	-106.844000	326941	3607592	173
	10:31:10	10.519167	32.596300	-106.844400	326911	3608035	172
	10:31:16	10.521111	32.600800	-106.844767	326886	3608535	168
	10:31:19	10.521667	32.602117	-106.844883	326876	3608681	167
	10:31:22	10.523278	32.604717	-106.845117	326860	3608969	165
	10:31:25	10.523611	32.607250	-106.845383	326844	3609250	164
	10:31:28	10.524444	32.609117	-106.845467	326836	3609458	162
	10:38:01	10.633333	32.612533	-106.868517	324579	3609875	156
	10:38:04	10.634444	32.615050	-106.868550	324580	3610154	157
	10:38:07	10.635000	32.616183	-106.868667	324581	3610279	157
	10:38:10	10.636833	32.618400	-106.868817	324581	3610535	158
	10:38:13	10.636944	32.620867	-106.868700	324579	3610776	158
	10:38:16	10.638056	32.623000	-106.868833	324569	3611036	157
	10:38:22	10.640000	32.627767	-106.869017	324561	3611564	156
	10:42:00	10.700000	32.588600	-106.844350	326800	3607385	196
	10:42:04	10.700833	32.590517	-106.844350	326804	3607640	195
	10:42:08	10.701944	32.592533	-106.844333	326805	3607908	194
	10:42:12	10.703056	32.594683	-106.844300	326808	3608161	192
	10:42:17	10.704722	32.596133	-106.844267	326802	3608378	188
	10:42:20	10.705278	32.597800	-106.844300	326805	3608608	187
	10:42:23	10.706111	32.599483	-106.844600	326845	3608814	187
	10:46:56	10.782778	32.649367	-106.870067	324836	3613861	183
	10:47:01	10.783333	32.648017	-106.870033	324836	3613712	182
	10:47:04	10.784444	32.646267	-106.870000	324833	3613506	180
	10:47:45	10.795944	32.611783	-106.870133	324828	3609794	184

Figure 10: Sample of data

Figure 11 shows the layout of the ground data web site that is being developed at this time. In the first stage, the ground data from year 2000 and year 2001 will be posted, then the data from previous years will also be posted.

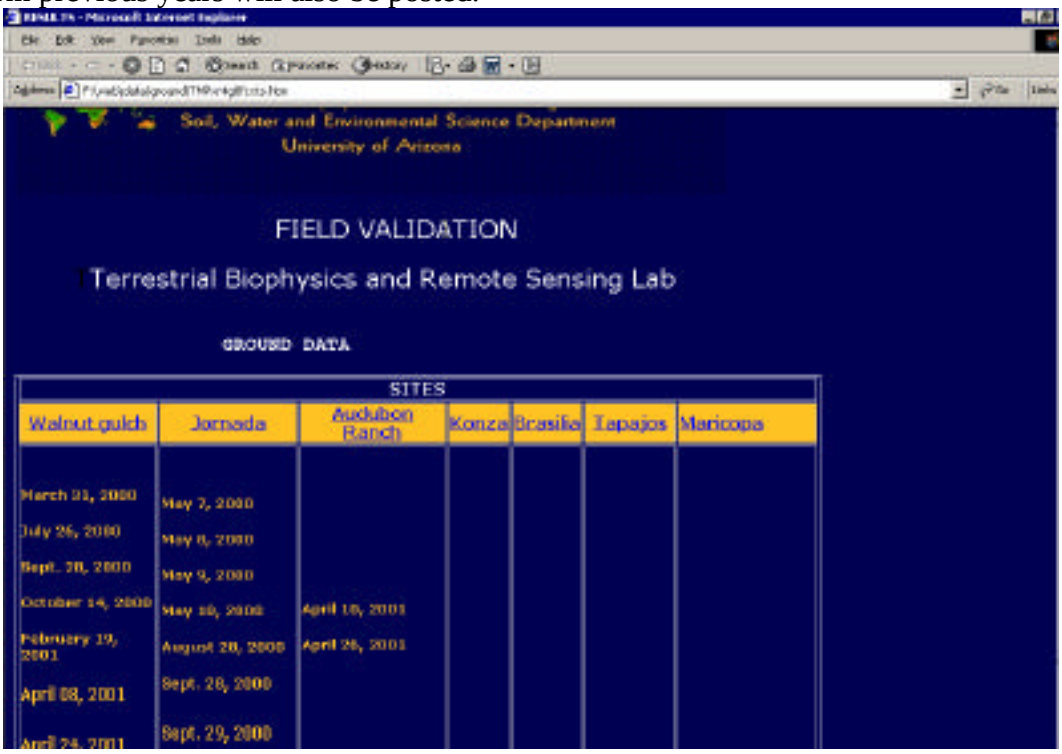

Figure 11: Ground data web site

We are also working on implementation of a 'Search Based Archive'. The idea is that as the TBRS ground and airborne data is growing, we would like to provide to the users the ability to search through our data set archives. The search can be done by date, site, data type (Exotech, Dycam,…) or based on keywords. The'Search' program has been already implemented and is functional. The figure below shows a snapshot of the user interface:

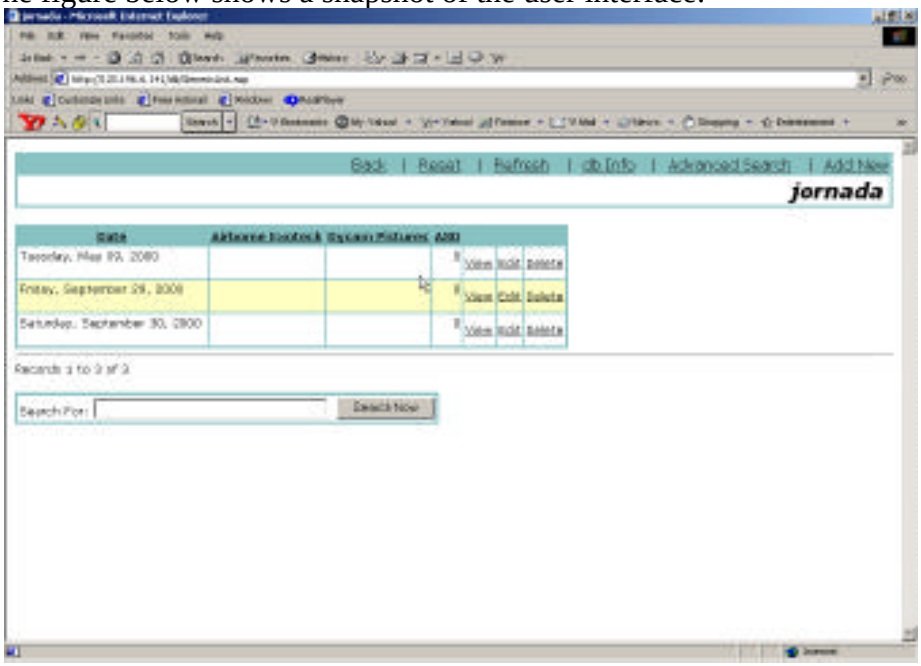

Figure 12: Search Tool Page

This program will help to better manage the high volume of data that the TBRS team will be collecting and the present dataset that is available.

9. MODIS – LBA

As part of our "Large Scale Biosphere-Atmosphere Experiment in Amazonia" (LBA) initiative we have been preparing for the field campaign that will be conducted from July 9th to August 2nd in Brasilia - DF (Brasilia National Park), Palmas - TO (Araguaia Ecological Station), and Santarem – PA (Tapajos National Forest).

Tomoaki Miura and Laerte Ferreira attended the LBA Open Team Meeting held in Atlanta, Georgia, USA on February 12-14 and gave a presentation about MODIS land products over the Amazon. Regional Amazon mosaics of MODIS land products used in the presentation were ordered and generated.

We also participated in the U.S. Airborne Science in LBA-Ecology / I Science Meeting (Foz do Iguacu, Parana, Brazil, April 19-20, 2001) and the X Brazilian Remote Sensing Symposium (Foz do Iguacu, Parana, Brazil, April 21-26, 2001). The purpose of the AVIRIS meeting was to establish the flight lines for next years' deplyment of AVIRIS in Brazil. We were selected as

one of the teams to be involved in using AVIRIS to scale-up field based ecologic data to coarse resolution MODIS.

10. GLI – MODIS Activities

We delivered two versions of the GLI code. In June 2001 we delivered three separate algorithms; _LTSK_1, LTKS_9, and LSK_10, which represent the atmosphere corrected surface reflectances, the reflectance compositing algorithm, and the vegetation index algorithms, respectively. These are MODIS adaptations designed to ingest GLI data and output various products. We also provided an Algorithm Description report and a User Manual. We are working now on a plan to assess the GLI atmosphere correction algorithm using MODIS L1B data.

11. AVHRR-MODIS continuity:

This project is an extension of last year's comparison of MODIS and AVHRR NDVI data products to assess the improved sensitivity of MODIS-NDVI, and evaluate the continuity of MODIS-NDVI as a precise tool in temporal monitoring of the Earth's global vegetation. MODIS and AVHRR data products were acquired through the 2000 growing season over a wide range of biome types in the USA. In 2000, MODIS underwent several adjustments. During the first months, it switched from different algorithms to improve data filtering, and by the end of September the aerosol correction algorithm was integrated to the MODIS data production. On the other hand, the NOAA-14 AVHRR satellite orbit was deteriorating towards the end of 2000. Due to this decline the sun angles were not good and the data became unreliable around the end of October. Given these adjustments and irregularities, it was decided that the AVHRR-MODIS project should continue for at least another year, to cover a complete growing season, where data for both systems are continuously reliable datasets.

AVHRR for 2001 has been downloaded every week. Since the extraction for core sites in North America is parallel to data extracted for MODIS, AVHRR sites have been updated to have both datasets for North America and continue with the AVHRR-MODIS project. Effort has been focused mainly on creating a semi-automated extraction, distribution and statistical computation of the data. The extraction of AVHRR data includes extraction and distribution of data at 51x51, 5x5, 3x3, and 1x1 windows, following the file structure designed for data archiving. The semi-automated extraction for statistical data and time series analysis plot for AVHRR data is still being completed. Extraction of data is over MODIS and AVHRR data products at 1 km resolution to maintain a continuity of a time series covered during 2000 growing season of the sites. Original data products per period included the MODIS 16-day composited period and bi-weekly AVHRR composited images. The NOAA-16 AVHRR products for 2001 include two new bands, ch10 and ch11, which correspond to ch1 and ch2 with water vapor correction. Statistical data will be extracted over several windows, but data plotted will correspond to the 3x3 window, like 2000 data, to represents the sites accurately, and at the same time prevent miss registrations of the two sensors. Data comparison of multitemporal seasonal profiles and

different conventions of cross-plots, to evaluate the response of each sensor, and to see how each sensor captured the seasonal dynamics of vegetation will be similar to the procedures followed for 2000, but will include the corrected water vapor channels. Meteorological data will be included when available.

12. Publications and Meetings

Peer-reviewed publications

Miura, T., Huete, A. R., Yoshioka, H., and Holben, B. N. (2001), An error and sensitivity analysis of atmospheric resistant vegetation indices derived from dark target-based atmospheric correction, *Remote Sens. Environ*. (forthcoming).

Gao, X., Huete, A., Miura, T., "Validation of MODIS Vegetation Indices Using Multi-scale High Spatial Resolution Data at Jornada Experimental Range" submitted to *Remote Sensing of Environment.*

FERREIRA Jr., L.G. and HUETE, A.R. 2001. Assessing the seasonal dynamics of the Brazilian Cerrado vegetation through the use of spectral vegetation indices. *Submitted to the International Journal of Remote Sensing (March, 2001).*

FERREIRA Jr., L.G., YOSHIOKA, H., HUETE, A.R., and SANO, E.E. 2001. The seasonal response of vegetation indices in the Brazilian Cerrado: An analysis within the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA). To be s*ubmitted to the Remote Sensing of Environment (June, 2001).*

FERREIRA Jr., L.G., YOSHIOKA, H., HUETE, A.R., and SANO, E.E. 2001. On the use of the EOS MODIS vegetation indices for monitoring the Cerrado region, Brazil: Preliminary assessments from an airborne campaign over an LBA core site. To be s*ubmitted to the Journal of Arid Land (June, 2001).*

Rodriguez, E P, Huete, A R, Miura, T, and Didian, K, Yoshioka, H Comparison and Evaluation of the MODIS-VI and AVHRR-NDVI Products,. (in preparation).

Reports

- Report on the MODIS VI status published on the web
- MODIS VI application for drought evaluation, published on the web
- MODIS EVI snow/ice report published on the web
- Long Term Stability Monitoring report with Tomoaki Miura
- GLI "Algorithm User Manual" submitted to NASDA
- GLI "Algorithm Description" submitted to NASDA
- Miura, T. (2001), MODIS: In-house operational processing procedures, *TBRS Internal Report*.
- Miura, T. (2001), ASD FieldSpec Pro FR: Quick user's guide, *TBRS Internal Report*.

Symposia and Conferences

Submission of abstract titled "Biophysical and Radiometric Validation of MODIS Vegetation Indices at Parallel Sites in Argentina and New Mexico, U.S.A" to *International Geoscience and Remote Sensing Symposium (IGARSS)*

Huete, A., Ferreira, L., Miura, T., Didan, K., and Shimabukuro, Y. (2001), MODIS land products over the Amazon: Preliminary insights, *LBA-Ecology Open Meeting, Atlanta, Georgia, USA, February 12-14*.

FERREIRA Jr., L.G., HUETE, A.R., YOSHIOKA, H., and SANO, E.E. 2001. **Monitoring the Brazilian Cerrado land cover types and associated ecological processes with AVHRR and MODIS spectral vegetation indices**. *LBA-Ecology Open Meeting*, February 12-14, 2001, Atlanta, Georgia (http://lba-ecology.gsfc.nasa.gov/cgi-bin/conference/abstract_rep_sel.pl).

FERREIRA Jr., L.G., HUETE, A.R., YOSHIOKA, H., and SANO, E.E. 2001. **On the Use of the EOS - MODIS Vegetation Indices for Monitoring the Cerrado Region, Brazil: Insights and Perspectives**. *X Brazilian Remote Sensing Symposium*, April 21-26, 2001, Foz do Iguacu, Parana, Brazil (CD ROM version).

SANO, E.E., FERREIRA Jr., L.G., and HUETE, A.R.. 2001. **A Comparative Analysis on the Use of Optical and SAR Data for Monitoring the Brazilian Cerrado**. *X Brazilian Remote Sensing Symposium*, April 21-26, 2001, Foz do Iguacu, Parana, Brazil (CD ROM version).

Miura, T., Didan, K., Huete, A. R., and Rodriguez, E. P. (2001), A performance evaluation of the MODIS vegetation index compositing algorithm, *Proceedings of IGARSS 2001 Symposium, July 9-13, Sydney, Australia*.

13. Future Activities for the next 6 months (July – December 2001)

- Complete manuscript on the Aggregation algorithm and its impact on MODIS VI, authored by Kamel Didan.

- Evaluation of the MODIS 250m VI product
  Data analyzed, poster will serve as the basis for the paper
- Using Quality Assurance for long term trend analysis
  Data analyzed, need to start the manuscript

In-house rapid response system and value added MODIS VI product

Due to the continuous time lag (> 3 month as of now) in producing MODIS L3 products, including the 16 day VIs, we are currently investigating the feasibility of designing a real

time response system based on the currently functional MODLAND rapid response system. The idea is to port all the necessary L1B, L2, and L2G algorithms to our SCF and be able to directly process L1B data that is being produced within 90 minutes of acquisition. Once in place such system will enable us to independently produce near-real time MODIS VI products for internal research and for public outreach.
Since we are also currently archiving all the MODIS VI product to date, it is equally crucial to investigate new application possibilities for these products. This data will eventually enable us to perform time series analysis, and in establishing a strong application component in areas such as drought assessment, desertification, vegetation seasonal changes, land cover change, and other 'global change' related issues.

Comprehensive Analysis of the Compositing Algorithm

This effort will evaluate the robustness of the currently used CV-MVC compositing scheme. Initial results indicate that the current algorithm is performing very well. However, a quantitative analysis needs to evaluate the following factors, which will compare the 16-day composited VI with daily VI results:

Geometric factors: Preliminary analysis indicates that the geometry plays a minor role during compositing, except when data is missing.

Atmospheric factors: These factors will actually introduce an error in the VI values that will depend on the atmosphere quality. In certain areas the clouds cannot be removed even when using sixteen days. These factors should be used to perform the initial data filter during compositing.

Biophysical factors: Choosing one day to represent the sixteen-day cycle might create accuracy problems as to missing crucial vegetation activities. This factor could be serious over crops and agriculture areas.

Validation Activities

- Brazil Field Campaign & MQUALS (July-August, 2001)
- Harvard Forest Field Campaign & MQUALS (August 4-8, 2001)