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Alfredo R. Huete, University of Arizona
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TASK OBJECTIVES

During the first half of 1998, we continued to work on algorithm testing, code testing and code deliveries. We also were involved in MODIS algorithm testing using SeaWiFS data. Validation related activities emphasized this year include LBA preparation, Maricopa-98 preparation, and light aircraft radiometry development. Specific objectives and tasks included:

- complete version 2.0 and deliver 2.1 code for the 250 m and 1km vegetation index products;
- level 3 algorithm testing and BRDF integration into the level 3 compositing algorithms;
- prototype vegetation index and test VI compositing algorithms with the daily, 1km AVHRR data stream and SeaWiFS data streams;
- anticipate at launch QA and MODIS data analysis, including software tools and network issues;
- end-to-end uncertainty analysis and error propagation analysis;
- radiometric and biophysical validation package development.

## WORK ACCOMPLISHED

### 1. Level 3 Vegetation Index Compositing Algorithms

Kamel Didan, recently hired for MODIS coding tasks, spent 5 weeks at GSFC to become familiar with the MODIS programming effort, use of the SDP toolkit and HDF-EOS, in order to take over the full (input and output) production and maintainance of the vegetation index products. During his trip he was able to work on the V2.0 Code (MOD13A1/MOD13A2) and correct the various bug reports and memory problems. He also worked on the V2.1 Code (MOD13A1), which required extensive optimization to bring up to speed and within allotted time and memory constraints.

- Version 2.1 PGE 25 (MOD13A - NDVI at 250 m and 16 day resolutions) was delivered by Kamel Didan to SDST in collaboration with GSFC in June, 1998 with code optimizations.

- Version 2.1 of PGE 35 (MOD13B - NDVI and EVI at 1km and 16 day resolutions) was delivered in June, 1998 as well.

- The other PGEs will be delivered in the fall, 1998, including:

- PGE 26 (MOD13C - NDVI and EVI at 1km and monthly resolutions); PGE 27 (MOD13D - NDVI and EVI at climate modeling grid (CMG - 25km) and 16 day resolutions); PGE 28 (MOD13E - NDVI and EVI at CMG and monthly resolutions).

## 2. Aggregation Code

We agreed recently (June, 1998) to complete, maintain and optimize the MODIS 1 km aggregation code (used by Boston, Montana and Arizona). An at launch version (2.0) of the algorithm was delivered to SDST but some problems have been encountered during EDAAC integration, which will need to be worked out for a 2.1 delivery. Right now the code is running too slow and parts of the code need to be reworked for significant time savings. The code also produces SDSs that are 4-D, making it difficult to view and QA the data properly without the use of SCF developed tools. Our goal is to complete and submit the 2.1 version of the aggregation code so that it can be included in the final pre-launch certification tests, in September 1998.

## 3. Protyping Efforts

- **1 km AVHRR Prototyping effort:**

NDVI and QA imagery were successfully protyped with the 1 km AVHRR data sets and presented at the MODLAND/SDST (Feb. 11, 1998) meeting. A total of 28 days of atmospherically corrected SeaWiFS data were received from GSFC (collaboration with Nazmi El Saleous). Some cloudmask testing was done to develop a cloudmask for this data, since the MODIS VI composite algorithm requires a cloudmask. Currently, a threshold of the blue channel was used. Software to process these data (HDF files) were developed, including the incorporation of alternative BRDF models (Ross-thick_Li-sparse) beside the Walthall model. The minimum blue channel composite code was also incorporated. An evaluation of all these composite scenario's are in progress.

- **SeaWiFS Prototyping with GAC Data:**

The MODIS Vegetation Index Compositing Algorithm (VICA) was also successfully prototyped with SeaWiFS data. The enhanced vegetation index (EVI) was composited for the first time on a global scale, however, without a reliable cloudmask, the Maximum Value Composite (MVC) algorithm might be more appropriate for SeaWiFS data. The SeaWiFS tilt angle and cloudmask make the interchangeable use and cross-validation of SeaWiFS and MODIS data difficult. View angle distribution results are not favorable to "minimum blue channel" or "maximum value composite" techniques. The 20 degree tilt angle of SeaWiFS changes at the equator to the opposite direction (-20 degrees), such that the sensor basically always looks in the backscatter direction. SeaWiFS has a sun synchronus noon time equatorial overpass time, and the sensor is always pointing away from the sun to avoid sun glint. The sensor - earth geometry causes the view angle distribution to peak at 20 to 25 degrees sensor view angle. An example of reflectance composites (16-days) based on the BRDF compositing algorithm is shown in Fig. 1.

## 4. QA Document:

A previously drafted QA document was updated in February (Vegetation Index product Quality Assurance (QA) Plan; Version 1.1) to anticipate QA needs including accuracy assessment and validation activities for MOD13 products and direct the SCF development. Product specific QA plans were presented at the MODLAND/SDST (Feb. 11-13) meeting to:

- anticipate quality related problems that may be found in products,
- consider product specific QA tools necessary to detect these,
- consider the feasibility of implementing these as software,
- consider the order/hierarchy of product specific QA tool application.

Currently, IDL routines are being evaluated and written to do Quality Assurance analysis on MODIS VI products and related science issues (Multiple Vegetation Index issues, Quality flag visualization) including inputs of the MOD09 reflectance product.

## 5. Science Computing Facility:

The Science Computing Facility moved to a new building where it was connected to the vBNS. Science computing facility hardware and software upgrades were performed to make a 100 BaseT internal network with one 100BaseT going out. 100 BaseT and 10 BaseT switch boxes were installed and servers, workstations and PC's appropriately connected. An Origin 2000 server and an Octane workstation were set up and integrated into the network. 256 MB of memory was installed in the Origin 2000. SGI 5.3 operating systems on workstations were upgraded to 6.2. An Origin data vault 6 (18 GB) and 4 (18 GB) disks were ordered and scheduled to be integrated by the end of July to cope with data and processing demands. ENVI and IDL are being used to write modules to set up Quality Assurance tools and evaluate prototype products. A DLT library (DLT7000 10 cartridge autoloader $11,200) and data management software (Irix Networker Network edition with archive and autochanger option, $ 8,580) were evaluated and identified for data archiving and data management and scheduled to be bought in the next budget year do to current limited funds.

We are currently resource limited, unable to efficiently conduct multiple compositing cycles. Each task basically runs solo at the moment and all files (from multiple research tasks) must be copied to disc to allow space for a single composite run.

- **Personnel Changes:** Brad Castalia (tasked with coding and system administration) resigned from the MODIS project in February, 1998. Kamel Didan took over the MODIS coding tasks and Wim van Leeuwen took over ad hoc system administration tasks and facility move until Farideh Farhanak was hired in April to do system administration and SCF hardware and software implementations to be ready for MODIS validation, VI processing and Quality assurance tasks.

## 6. Error and Uncertainty Analysis

Tomoaki Miura, Ph.D. student has been working on establishing the "end-to-end" uncertainty analysis approach for the MODIS Vegetation Index (VI) products. He was recently accepted into the 1998 USRA-NASA/GSFC, Graduate Student Summer Program (GSSP), and will be evaluating aerosol effects as part of his "end-to-end" accuracy assessment of the MODIS VI compositing procedure, which includes calibration, atmosphere, and sun-target-sensor geometries.

The impacts of MODIS calibration uncertainties on the performance of the VI's are being quantified through a set uncertainty propagation equations which allow us to estimate uncertainties on a pixel by pixel basis. The performance of the VI's are being evaluated in both a radiometric and biophysical sense. We assumed the combined relative uncertainties in the MODIS calculated reflectances to be 2.0% (i.e., the uncertainties in the algorithm as well as in the laboratory calibration of the BRDF characteristics of the solar diffuser, and in the effects of polarization, crosstalk, and scatter within the instrument). Top-of-atmosphere (TOA) reflectances were derived from MODIS level 1B reflectances via a cosine view zenith angle adjustment (negligible uncertainty).

The standard uncertainty on TOA reflectances propagates through the atmospheric correction algorithm and into the atmospherically-corrected, surface reflectances. Vegetation indices are then calculated and a propagation equation of uncertainty carried from the calibration through atmospheric correction was derived. Finally, the resultant calibration uncertainty propagated onto the VI's are translated and expressed in LAI units via existing empirical VI-LAI relationships.

The uncertainty propagation equations were tested on a controlled field data set as well as with a Landsat TM scene, both over cotton canopies. The magnitudes of the error in VI's were significantly controlled by atmospheric conditions and solar zenith angles (path length). The inclusion of the blue band in the enhanced vegetation index (EVI) increases calibration uncertainties in LAI estimates. This is a tradeoff with the atmosphere-noise reduction obtainable with use of the blue band in the atmosphere resistance concept. This study successfully shows how MODIS radiometric calibration uncertainty propagates, accumulates, and combines into the MODIS VI product uncertainties. This study is currently in manuscript preparation stage. More work is needed in investigating the uncertainties produced by atmosphere correction and is the focus of current studies.

## 7. Canopy Simulation Models and Theoretical Analysis

- **Myneni 3-dimensional Canopy Radiative Transfer Model, Disord**:

As a part of validation, this work is aimed at testing the MODIS VI algorithm by examining the relationship between Vegetation Indices (NDVI, EVI, SAVI, PVI, SR) and canopy biophysical parameters ( LAI, fAPAR) over a diverse range of six biome types (cereal crops & grasses, shrub, broadleaf crops, savanna, broadleaf forest and needle forest). The effects of several sets of parameters (illumination geometry, soil background, ground cover, understory leaf area index, etc.) on the canopy BRF are performed by varying one variable at a time and setting the remaining variables at nominal values which are believed to represent an average state of each biome. Some preliminary results about the differences in the relation of LAI/fAPAR to VI's among those biomes have been obtained. Many problems have been encountered in trying to run the model over forested and savanna canopies, and we are trying to learn how to resolve this with Ranga Myneni. We are also having problems obtaining predictable sun angle behavior for both reflectances and vegetation indices.

With emphasis on the two agricultural biomes, (broadleaf and cereal) further analyses are performed on plant canopy spectra free of soil influence, two-way global transmittance, and corresponding relationships mentioned above over zero soil background. Two methods of obtaining zero soil reflectance were adopted: model output and regression-derived. For broadleaf crops, the field-measured cotton data was also used to test the properties of interest. In addition, based on the Disord output, the optimal correction factor, L value of SAVI for these two biomes was analyzed to reduce soil background effect. In comparison, model output from SAIL for these two biomes will also be analyzed.

- **Vegetation Isoline Equation:**

We continued to work on reducing the canopy background influences on the vegetation indices through modeling of the first-order vegetation-background interactions. The background signal intimately mixes with that of the vegetation, reaches a maximum at about 50% green cover, and unlike atmosphere and BRDF effects cannot be externally removed. The vegetation isoline equation depicts spectra of equal vegetation amounts over varying background conditions associated with soils, litter, snow, and moisture. The Cooper-Smith-Pitts model was utilized to generate isoline equations and evaluate the truncation of higher order interaction terms. The resulting equations were found to be totally independent of background optical properties. The results were tested with SAIL simulated adat and we plan on conducting further testing with in-situ field data as well as with 3-d canopy models.

## 8. MODIS Quick Airborne Looks (MQUALS):

We are currently developing a light aircraft-based radiometric package for "MODLAND Quick Airborne Looks" (MQUALS) over validation test sites. The package is for MODLAND use. The airborne radiometric system (instrument and protocol) is for rapid and low cost product validation over a diverse and complex range of global biome types. The light airborne package can be flown 'below the atmosphere' at low altitudes of 100m to 300m AGL for accurate characterization of top-of-canopy reflectances. We propose to characterize a wide range of canopy types and conditions in a consistent manner with the same radiometric package. The same package has the flexibility of flying at higher altitudes (500 - 1000m AGL) for a range of scaling studies. The basic package consists of well calibrated and traceable "transfer radiometers", digital spectral cameras, and an albedometer, all attached to a laptop computer for synchronized and timed measurements. Typical spatial coverage would be in the range of ten kilometers or less at a 'pixel' resolution between 1 and 2 meters. Pixel size could be increased to 100 m or more at higher flying altitudes. A key feature of MQUALS is the rapid processing, "turn-around" of the airborne measured results to within 7 - 10 days.

The airborne package can be easily shipped and mounted on a variety of light airplanes. The package is equipped with simple instrumentation so that with minimal training any person can conduct a rapid deployment.

- **Objectives**

The main purpose is to develop a portable and inexpensive airborne radiometric system (instrument and protocol) for "ground truth" characterization of bidirectional reflectances and albedo of diverse land cover surface types within the major global biomes for MODIS product validation. The wide range of land cover types and conditions will be characterized in a consistent manner with an identical and 'traceable' radiometric package. In conjunction with simultaneous, field biophysical sampling, the proposed system will allow us to collect a self-contained set of biophysical and radiometric data from the same ground pixels at MODIS scale, covering all basic biome types.

MQUALS has the following primary objectives related to MODLAND product validation:

- a complete top-of-canopy reflectance characterization, including measurement of "true" radiances, reflectances, and albedo of vegetation canopies and desert surfaces over transects up to 10 kilometers,

- use of a consistent, well-calibrated and "traceable" instrument package, coupled to MCST vicarious calibration activities, for radiometric accuracy analysis of MODIS data,

- extension, coupling and scaling of “tower” footprints and ground-based biophysical sampling to larger footprint (250m - 1 km) MODIS pixels,

- documentation of surface condition with high resolution, spectral-digital camera imagery, providing qualitative checks of MODIS data,

- provide feedback on L1B processing differences and effects on land products,

- quantitative assessments of atmospheric correction, surface reflectance, albedo, and vegetation index products over a range of surface conditions.

In addition, MQUALS can provide the following specific needs to aid in MODLAND validation:

- sampling of landscape variability, including land cover subtypes,
- analysis of dependencies of sampling geometry, target scene, sun angle, atmosphere on MODIS data,
- quality assessment, uncertainty analysis and generation of error bars with respect to product performance.
- coupling to fAPAR and LAI measurements and extension of such measures to larger footprints.

The entire package is currently budgeted at $50K.

| **System** |
|---|
| ***Capital Equipment*** |
| 2 Exotech radiometer with MODIS filters |
| 1 set of digital cameras with red/NIR filters |
| 1 Laptop for data logging |
| 1 set of K&Z albedometer |
| 1 Spectralon reference plate |
| |
| ***Extra expenses:*** |
| Aircraft rental and pilot charge |
| Foam filled wheeled cases (4, for shipping |
| Instrument mount |
| 1 package of software and PC cards |

## 9. LBA Activities:

I am representing the MODland team on LBA through a no-cost proposal entitled "VALIDATION AND EVALUATION OF MODIS DATA PRODUCTS IN THE LARGE SCALE BIOSPHERE-ATMOSPHERE EXPERIMENT IN AMAZONIA (LBA)" , Alfredo Huete (P.I.), Christopher Justice, Jan-Peter Muller, Ranga Myneni, Steven Running, Alan Strahler, John Townshend, Eric Vermote, and Zhengming Wan.

Yosio Shimabokuro, of INPE, represents the Brazilian team of this joint MODland - Brazil cooperative venture.

The MODIS Instrument Land Science Team (MODLAND) plans to apply and test the time-series data products useful for moderate resolution land surface monitoring and ecology over Amazonia. MODland plans to provide, evaluate, and validate this array of standard data products, representing various terrestrial geophysical parameters, over the Large Scale Biosphere-Atmosphere experiment in Amazonia (LBA). The LBA experiment and sites will enable us to evaluate the quality and performance of our products in conjunction with in-situ measures of various ecological parameters. MODLAND will make available level 2 and level 3 gridded MODIS data products to the LBA-Ecology Science Team so as to maximize data usefulness and evaluation by the broader scientific community. We plan on working over the primary field sites and both LBA transects, encompassing dry and wet tropical forests, cerrado, and various classes of land use conversions.

- **LBA-Ecology Science Team Meeting, April 27-29, 1998**

At this meeting I chaired a Satellite Data Breakout Session with Thelma Krug. The purpose of this breakout session was to delineate requirements for satellite images for LBA-Ecology. The aim is to achieve a coordinated plan of satellite data acquisitions and anticipated products. Discussion was centered on what types of satellite sensors and data were needed; at what scales and resolutions; and who would be responsible for the collection, processing, subsetting and dissemination of the data. We also discussed common registration of the satellite data; historical satellite data; and ways in which we could prioritize and categorize satellite data acquisitions and data buys. We agreed on drafting a questionnaire to survey the satellite data needs and science applications of the data from the LBA-Ecology team.

The main categories of satellite data deemed essential to LBA-Ecology science included:

- Wall to wall coverage of the Amazon region with lower resolution and higher temporal frequency monitoring satellites, such as the AVHRR, SeaWiFS, MODIS, LightSAR, GOES, and TRMM.

- High resolution satellite imagery acquired predominantly over the primary and secondary study sites and transects. This may include seasonal data sets to capture temporal dynamics as well as wall-to-wall detailed coverage of the

Basin at specific periods. Sensors in this category include, Landsat (TM & ETM+), SPOT, ASTER, and Space Imaging.

- Historical data sets are needed especially over field sites.

- Ancillary data sets and missions such as the SRTM Topo missions.

We agreed to hold a satellite data workhop at INPE this fall in the November time frame.

- **Cerrado test sites:**

The Brazilian Cerrado is the second largest biome in South America (~2,000,000 $km^2$) and consists of evergreen woodland, grassland and seasonal savanna with a layer of herbaceous species with scattered trees and bushes that can sometimes form continuous canopy. The cerrado is a very complex and fragile biome. It is estimated that approximately 40 % of the Brazilian Cerrado have been already converted into cultivated pastures, field crops (mainly soybeans, corn and rice), urban areas and degraded areas. There is a strong herbaceous component during the rainy season (1,000 to 2,000 mm of precipitation) from October to March. However, during the dry season, the accumulation of dead herbaceous vegetation facilitates fire occurrence.

This area, along with the tropical forests of the Amazon, is thus very important to monitor and to test MODIS satellite products. A Ph.D. student from Brazil, Laerte Guimaraes, is working on site selection for field validation work in conjunction with LBA activities and objectives. Landsat TM and AVHRR data are currently being extracted over various cerrado land cover types. A set of TM data was collected at different locations along the Araguaia River – Goias State (See Figure 2) showing the vegetation variations in the Cerrado as well as the transition from the Cerrado into more densely vegetated canopy types. The TM scenes were converted to MODIS 250 m spatial resolution, atmospherically corrected and translated into the NDVI, SAVI, and EVI. All three VI's showed a good dynamic range and appear useful for vegetative cover monitoring in both natural and disturbed cerrado conditions.

A 1-year (1995) data set of 10-day composite LAC data (1.1 km; atmospherically, radiometrically and geometrically corrected) was extracted over the test sites to acquire an insight on cerrado dynamics. We located major national parks, with known vegetation types and conditions, as well as pasture and agricultural sites (Figure 2). The preliminary analysis of the NDVI profiles confirm distinct temporal and spectral signatures for each of the major land cover types (grassland savanna, shrub savanna, woodland savanna, arboreous savanna, contact deciduous / broadleaf forest, opened broadleaf forest, pasture sites and agricultural areas). We expect this analysis to guide us into future processing and analysis of higher quality images such as the SeaWiFS and MODIS data.

## 10. Maricopa 98' Validation Test Site:

Susan Moran, USDA-ARS & myself are coordinating a seasonal field experiment at Maricopa Agriculture Center in Arizona.

- **General Experimental Plan**

A seasonal data set of airborne and field radiometric measurements are being made at the Maricopa Agricultural Center, Arizona (32.9N 112W) along with biophysical measurements of various crops at different phenological stages. The NASA Stennis Space Center has arranged for the *Airborne Terrestrial Applications Sensor* (ATLAS) sensor to fly Maricopa Agriculture Center (MAC) on the following dates:

May 4; June 9; June 23; July 7; August 4
*September 9 (primary MODLAND validation campaign)

The ATLAS sensor has 6 bands in VIS/NIR, 3 bands in SWIR and 6 bands in TIR. FOV=72 degrees. All 6 shortwave TM bands are represented, along with a 0.60-0.63 um and a 0.69-0.76 um band. Ground resolution is 2.5 m.

In addition, we hope to have the MODIS Quick Airborne Looks (MQUALS) package ready and flying on a light aircraft, flying below the atmosphere (150 m AGL) with Exotech radiometers, albedometers, and a GPS-digital camera. The MQUAL package will be flown at the August and September dates.

- **Crop Experimental Studies**

Various experiments are being conducted during these overpasses including;

- Crop rotation study
- FACE Sorghum
- Cotton nitrogen/water

There are also fields with bare soil, a pecan orchard, and alfalfa and lesquerella fields.

- **Additional information (to be updated)**

Yoke-based gridded transects have been set up for image calibration.
Plant measurements will be made in cotton, alfalfa, pecans, and sorghum and include LAI (LiCOR LAI2000) and fAPAR (using an accuPAR Ceptometer) measurements; % cover, biomass, and height.
Ground and airborne-based reflectances will be measured for various sun angles.
Calibrated tarps and Spectralon panels are set up.
A micro-met station is located on site.

Samples of TM imagery at 30m and 250 m (MODIS-like) resolution and samples of ATLAS imagery at 2-3m resolution can be viewed at:
ftp://sylva.fcr.arizona.edu/pub/MAC/
ftp://sylva.fcr.arizona.edu/pub/MAC/MAC2.jpg

- Because of the delay in the EOS-AM1 launch, the scheduled AVIRIS overflight at Maricopa was postponed.

## 11. Test Site Development and Validation Protocols

For validation work we have been organizing the global sites which are to be used for making measurements and/or monitoring. Secondly, we are also developing vegetation sampling and measurement protocols so that a consistent set of data can be accumulated over a wide range of conditions. The validation sites are organized by priority based on landcover class. These sites are summarized in a spreadsheet with categories for latitude/longitude, Landsat and SPOT scene ID’s, Path/Row, and coordinates. There are also general biome descriptions and a first cut attempt at assessing what instrumentation, and what possible dates exist for site visits. Two sites for each landcover class are considered the minimum number required for producing a regression of the biophysical and radiometric measurements; hence, a critical list of 12-16 sites (due to duplicate sites) resulted, another 12 sites are desirable for measurement collection, and 24 more sites for monitoring purposes alone.

## 12. LaJornada, PROVE, Validation Activity

A manuscript has now been produced from the La Jornada campaign last summer. The title, authors, and abstract are listed below:
Title: *"A Light Aircraft-Based Approach for Optical Characterization of Land Cover at La Jornada Experimental Range"*

A. F. Rahman, A. R. Huete, W. J. D. van Leeuwen, T. Miura, K. Batchily .

Abstract
In this study we utilized low flying, aircraft-based radiometers for optical characterization of 'top of the canopy' reflectances at La Jornada Experimental Range in New Mexico. The objective was to examine the usefulness of low-flying aircraft for Moderate Resolution Imaging Spectroradiometer (MODIS) validation of land products. Multiband radiometers were flown at 100 m above ground level along transects encompassing several land cover types within this semi-arid biome, land community validation site. A pointable radiometer acquired data at nadir, 15˚, 30˚, and 45˚ viewing angles along the principal and orthogonal planes. The sequence of measurements involved two separate sun angle-based overflights coinciding with ground-based radiometric and biophysical measurements, namely fraction of absorbed photosynthetically active radiation (fAPAR) and leaf area index (LAI). The low flying set of radiometers did not require atmosphere correction and could rapidly cover a 3 km transect in less than a minute. The view and sun angle measurements were made to

encompass the range of sun-target-sensor conditions encountered with moderate and coarse-resolution sensors such as AVHRR and MODIS over a compositing cycle. Reflectance and vegetation index variations attributed to sun and view angles were found to be much greater than those due to land cover differences. Differences among land cover types were greater at the larger solar zenith angle. Strong and positive fAPAR relationships with vegetation indices were encountered but differed with land cover type. Satellite land products must be normalized for view and sun angle effects if biophysical and land cover differences in this semi-arid biome are to be detected. We found light aircraft radiometry to be very useful in land validation studies due to its rapidity, flexibility, consistency, and ability to measure at scales from meters to kilometers.

## 13. Meetings/ Conferences:

- Wim van Leeuwen, Faiz Rahman and several students attended the Regional Remote Sensing Network Meeting (Tucson, April 15, 1998) to discuss remote sensing data requirements for the application user community. The main topic discussed in that meeting was how to disseminate the remote sensing data more effectively among the user groups.

- Two papers were submitted for IGARSS'98 proceedings:

    - W.J.D. van Leeuwen, Alfredo Huete, Trevor Laing, “Evaluation of the MODIS vegetation index compositing algorithm using SeaWiFS data” and,

    - A.R. Huete, Dana Kerola, Kamel Didan, Wim J.D. van Leeuwen, Laerte Ferreira, “Terrestrial Biosphere Analysis of SeaWiFS data over the Amazon Region with MODIS and GLI Prototype Vegetation Indices”.

- Wim van Leeuwen attended a course "IDL PROGRAMMING FOUNDATIONS" in Tucson AZ, May 5-8, 1998.

- Alfredo Huete and Wim van Leeuwen attended the MODIS science team meeting (June 24-26, 1998).

## 14. Upcoming Tasks:

The tasks for the coming half year will include further development of the vegetation index compositing algorithms, error and uncertainty analysis, validation actvities, and related science issues. I will be participating in the southeast Asia regional land cover meeting, SEASTART, in August, delivering Vegetation Index presentations for moderate resolution monitoring of land cover. In addition, we will make further progress on MODIS-GLI co-validation activities and future plans. There will also be a GLI Science Team meeting in September in which I will work on furthering MODIS-GLI interactions.

Specific research plans include:

- Prototype and analyze MODIS vegetation index composite results with SeaWifs data using alternative composite scenarios (e.g. minimum blue channnel) and more temporal data (3 months),

- Continue to set up  QA analysis procedures and tool development for automated QA and in depth analysis of MODIS algorithms and their products,

- The use of a historical BRDF data base in combination with vegetation index composite scenario; to be tested on 8 km and 1 km AVHRR (test alternative compositing algorithms),

- Sun and view angle correction with BRDF models at climate modeling grid (CMG) level (incorporation of the Ross-thick_Li-sparse BRDF model in the compositing algorithm will allow for this, but needs further evaluation).

- Deliver PGE 26, 27, 28 (CMG's) in fall as well as optimized aggregation code .

- Try to complete an end-to-end error and uncertainty analysis of the temporally composited VI's,

- Conduct and end-to-end validation campaign at Maricopa Agriculture Center to prototype MODIS validation.  At Maricopa w will most likely attempt a field-airplane (MQUALS) - SeaWiFS coupling as our prototype experiment.

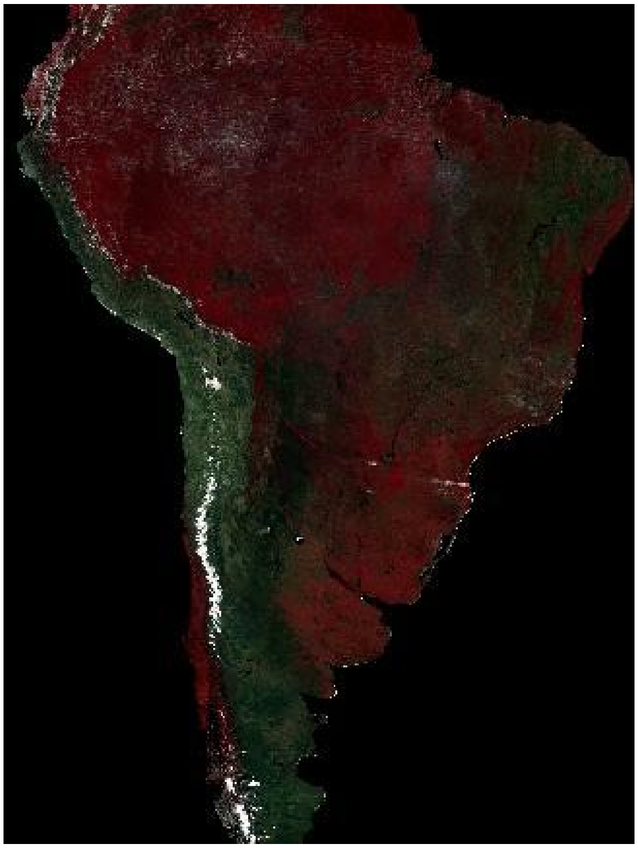

**Figure 1. 16-day Composite SeaWiFS GAC image of South America (green, red, and NIR reflectances; bands 4, 5, and 8, respectively).**

**Figure 2. LBA Tower Sites and Cerrado Test Site Development.**