MODIS Science Team Member
Quarterly Report *
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in conjunction
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This MODIS science team activity on V.I. and Fire was undertaken in close conjunction with the activities of Eric Vermote and other cooperating MODIS land team members. The surface reflectance code (Vermote) is combined with the code from the V.I. (Huete) and Fire (Kaufman). In addition resources were provided to support MODLAND community activities with the MODIS Land Cooperative activity managed by Robert Wolfe.

a) Task Objectives

During this phase of the project, emphasis was put on completing and testing the V1 code for the Fire Product and developing the Level 3 Vegetation Index code. Work has also been done on refining the QA plan. The group is helping David Roy with the developments of the MODIS Land Data Operational Product Evaluation (LDOPE) Facility. A validation prototyping campaign is being developed for a significant part of the land product chain. Significant attention has been given to instrument testing results. A response was written to the comments from the SWAMP Land ATBD review. The ATBD's have been revised ready for a further formal review in December. Justice and Vermote represented the land group at the weekly TT meetings and discipline group meetings.

b) Tasks Accomplished (Data analysis and interpretation)

Version 1 software

After delivery of the Version 1 surface reflectance, level 2G and vegetation indices codes, emphasis has been put on testing the thread using the synthetic dataset. Several anomalies were sucessfully detected and solutions are being worked out in coordination with the SCF's. Specific software improvements include:

- Modified MODIS MD09/13/14 (surface reflectance, VI, and fire product) code to properly handle day and night satellite operation modes. This involved bypassing the surface reflectance and VI calculations (which cannot be done at night) while continuing to invoke the fire detection algorithm. Earlier versions of the code aborted all processing rather than handling night mode gracefully. (Giglio)

- Required ECS metadata were incorporated into MODIS L2 fire product. (Giglio)

- Implemented improved fire-detection and energy algorithms developed by Yoram Kaufman for MOD14 Version 1. This involved rewriting nearly all of the Beta 3 fire code. Delivered Version 1 MOD14 code in mid-September. (Giglio)

- Development of a working version of the V1 MODIS L3 Vegetation Index code for delivery to MODIS SDST. This involved taking existing, but non-compilable, pieces of code and coding/debugging until recieving results consistant with the MODIS VI product specification. Upon completing, the code properly aligns the MODIS 250m pixels within the proper MODIS 500m footprints. (Fisher)

- Currently, we are implementing the MODIS L3 Fire and the MODIS Vegetation Index Climate Modeling Grid products. (Fisher)

Vegetation Index Compositing (w. Huete and Flynn)

The L1 code was delivered from University of Arizona, and successfully adapted to conform to the existing L2G software. Initial testing of the product with the MODIS synthetic data was conducted, and possible issues of concern were communicated to Huete. Privette assisted Huete's group in the collection of field validation data from pasture and forest areas in Chile (fAPAR of overstory while spectral reflectance of canopies was collected from aircraft). The sites are included as part of the Global Land Cover Test Sites project, and were studied for possible development (in collaboration with investigators from University of Chile) into MODIS Validation sites. Privette completed a study which identified simple bidirectional reflectance models suitable for use in the MODIS VI operational algorithm. This study considered 9 land cover data sets from PARABOLA and 11 BRDF models. Results were included in the VI ATBD (due Nov. 1). Plans were also discussed for developing a solar and view angle-corrected L3' VI product for use mainly in climate modeling. The current L3 VI products correct for view angle only.

MODIS Fire Detection (w. Kaufman and Flynn)

The two objectives of this three month effort were to complete tests of the empirical relationship between fire and emitted energy, and to determine the effects of the MODIS triangular response on fire pixels. Yoram Kaufman (GSFC) has derived an empirical relationship to calculate total emitted fire energy from the 3.95 µm MODIS data. Jackie Kendall (SSAI) incorporated this relationship into a working version of the MODIS code. Using the hypothetical MODIS fire scene of Yellowstone, we found 3145 fire pixels out of a total of 37800 pixels in the scene. Emitted energy characteristics of those pixels were found to be in agreement with a range of possible smoldering and flaming fire values. Other empirical formulas were tested that had limited success with either strong or weak fires, but not the entire range of fire intensities.

The MODIS triangular response is a result of the sensor viewing geometry. Essentially, the radiance detected by the sensor for a 1 km pixel has a 50% overlap with the two neighboring pixels in the cross-track direction. Thus, a 1-km pixel is actually sampling 2 km of ground at the nadir position beneath the MODIS instrument. The area sampled for off-nadir pixels will be affected by the viewing angle of the MODIS sensor. An algorithm is being developed where a TM scene having 30 m pixels is resampled to the 1 km MODIS spatial resolution using the MODIS triangular response. The algorithm will keep track of fire statistics such as the number of fires (at 30 m resolution) in a particular quadrant. Thus, we will be able to determine the relationship between flagged fire pixels and the fire position relative to the center of the pixel. We will also determine whether or not a single fire will be reported multiple times in neighboring pixels. If the number of fires occurring cross-track is 2 to 3 times higher than that occurring along-track, then we know that the MODIS triangular response will have a significant effect on results. To confirm this, we will then run the same data set through the MODIS triangular pixel algorithm but rotated 90° with respect to the first run. Essentially, the cross-track direction then becomes the along-track direction. The effects of the MODIS triangular response will be apparent if the results are greater for the cross-track direction in both cases. The next step will be to try to remove the effects of cross-track multiple reports of single fires, if it is a significant problem.

A meeting of Chris Justice, Paul Fisher, Luke Flynn, and Robert Wolfe was held to discuss what would be included in the Level 3 MODIS gridded fire product. This was an effort to improve the quality and utility of this product, and make it more useful for both climate-modeling and biomass-burning studies. Refinements were made to the products planned for launch.

A first draft of the MODIS Version 1, Level 3, 1 km, daily and eight-day Gridded Fire Product Specifications was written. This document contains a detailed description of the file formats of the Level 3 fire products that will be produced by the MODIS land product code.

EOS Validation (w.Privette) :

Increasingly specific plans for tower and aircraft validation have been developed and presented to the MODLAND team for approval. These were outlined in 20 charts delivered to the Validation Office and currently available on-line. These currently are under review by SWAMP reviewers. We have presented these plans to the newly-formed AMERIFLUX group (continuous long term gas/energy flux tower sites) in St. Louis and received enthusiastic response in a request for participation. We have also contacted/questioned all U.S. LTER sites for information on existing tower facilities that would be required for validation sites. We are keeping both groups aware of evolving validation plans and the status of the Validation Office NRA.

We have tentatively planned two prototype campaigns for 1997 to assess the tower site instruments and sampling strategies over a short canopy (SALSA or Jornada LTER in southwest U.S.) and a tall canopy (NOAA deciduous forest site in Oak Ridge, TN). We plan to hold a meeting in January/February to bring participants together and discuss specific details. During the protocampaigns, we expect to have simultaneous measurements from tower instruments, field teams over the MODIS footprint area, and aircraft and satellite remote sensing data. We are in frequent communication with the Validation Office on our plans.

Justice presented the EOS Land Validation approach at the International Global Observing Systems In-Situ Meeting in Geneva.

Meetings Attended

- EDC DAAC visit and discussions on MODIS QA - Aug 12-13

-MODLAND/SDST meeting - (GSFC), July 11-12 1996.

- MCST Science Advisory Panel (GSFC) July 19, 1996

-SDST Science Advisory Panel (GSFC) , September 4-5 1996.

-The International Global Observing Systems In-Situ Meeting (Geneva), Sept 10-12 1996.

Publications

Asner, G. P, C. A. Wessman and J. L. Privette (1996), Estimating directional reflectance of AVHRR sub-pixel landcovers using spectral mixture analysis and geometric-spatial modeling, IEEE Geosci. and Remote Sens., submitted.

Kaufman, Y.J., C.O. Justice, L.P. Flynn, J. Kendall, E. Prins, D.E. Ward, A. Setzer, Monitoring Global Fires from EOS-MODIS, in preparation.

Privette, J. L., D. W. Deering and T. F. Eck (1996), Estimating albedo and nadir reflectance through inversion of simple BRDF models with AVHRR/MODIS-like data, *J. Geophys. Res.*, submitted.

Walter-Shea, E. A., J. L. Privette, D. Cornell, M. A. Mesarch, and C. J. Hays (1996), Sensitivity of relations between spectral vegetation indices and absorbed radiation and leaf area index in alfalfa, *Remote Sensing Environ.*, submitted.