TYPE OF REPORT: Semiannual

TIME PERIOD: Jul - Dec, 2002

NAME AND LOCATION: Alan Strahler, Boston University

CONTRACT NUMBER: NAS5-31369

ABSTRACT -- KEY POINTS

BRDF/ALBEDO

1) Collection 4 (V004) Terra MODIS reprocessing began and includes a
change to a sinusoidal projection, improved narrow- to broadband
coefficients for observations of pure snow, an improved MODIS-derived
BRDF database to serve as the first guess for the backup BRDF retrieval
algorithm, and 0.05 degree CMG (Climate Modelers' Grid) products.

2) We hosted the MODIS Workshop on Land Surface Radiation Budget
Variables and Snow and Ice Products in October, 2002.

3) We hosted the CEOS/WGCV Land Product Validation Workshop on Albedo
in October, 2002.

4) Personnel contributed to 4 journal articles which were published
during the period, while 3 articles were submitted for review. Two
journal papers were accepted and are awaiting publication.

LAND COVER/LAND COVER DYNAMICS

1) We delivered a new component of the land cover map product, a seven-
class layer of so-called "plant functional types," in support of the
Community Land Model in the NCAR Community Climate Model.

2) We performed extensive quality assessment of our training site
database, which is resulting in substantial improvements to the most
recent versions of the land cover map being produced in house.

3) We modified our algorithm to ingest 32-day composites, instead of 16-day composites, using Q/A flags as a basis for the compositing procedure.

4) We performed continued analysis of the global geographic and ecological sampling included in our site database, and strategically added new sites in land cover types and regions that were undersampled.

5) We completed development of a prototype land cover change product using change vector analysis.

6) We continued refinement and development of the global vegetation phenology parameter for the Land Dynamics Product, and have initiated analysis based on these data.

7) At the request of users, we compiled datasets for all MODIS land products in support of the Soil Moisture Experiment 2002, a large field experiment conducted in Iowa in the summer of 2002 under joint funding from the USDA and NASA.

8) We performed extensive analyses and algorithm development for the production of a new MODIS land-water mask. We are hoping to produce a new mask this spring.

9) We published three new journal articles, with two more in press. We made six presentations accompanied by short papers or abstracts at professional meetings.

TASK PROGRESS

BRDF/ALBEDO PRODUCT

Personnel

Dr Yufang Jin joined the MODIS group as a researcher in September.

Algorithm Development

A new BRDF archetypal database was implemented for the Collection 4 (V004) reprocessing. The database was derived from high quality V003 MODIS BRDF retrievals from specific land cover types.

While the original narrow-to-broadband albedo conversion coefficients are accurate over mixed snow and vegetation, Dr. Shunlin Liang (UMD) supplied new narrow-to-broadband conversion coefficients for pure snow cases based on arctic field data collected by Drs. Julienne Stroeve and Anne Nolan (CIRES/University of Colorado). Dr. Feng Gao implemented a scheme whereby only pixels exceeding a certain NDSI threshold (after a scheme by Dr. Andrew Klein, University of Texas) will be designated as "pure snow" and use the new coefficients. Dr. Stroeve evaluated the new coefficients in the total shortwave broadband and found them appropriate for most snow situations. While the coefficients may still be slightly low when compared with field measurements of pure dry unshadowed snow, they appear appropriate when used for 1-km pixels of even, dry snow.

Test runs of the Collection 4 reprocessed data indicate an improvement in the overall quality of the BRDF/Albedo products, primarily due to improvements in the atmospheric correction algorithms of the surface reflectance product and the snow detection algorithms in the cloud cover product.

Scientific Advances

Outreach efforts to the scientific community including hosting the MODIS Workshop on Land Surface Radiation Budget Variables and Snow and Ice Products in October, 2002. Presentations on the data products and on the tools to access them were given by MODIS Science Team, EDC DAAC and NSIDC DAAC personnel to the international attendees.

A number of collaborative efforts are underway with US climate researchers using NCAR's Common Land Model (CLM) in the Community Climate Systems Model (CCSM), as well as Europeans using the ECHAM4 climate model and the LPJ biogeochemical model. Two journal articles comparing the MODIS albedos with CLM results were submitted.

In a closely related effort, Dr. Crystal Schaaf visited with Dr. Wolfgang Lucht at the Potsdam Institute fur Klimafolgenforschung (PIK) in November to discuss both the LPJ (Lund-Potsdam-Jena) efforts and the use of MODIS BRDF data in the construction of MERIS derived albedos.

Validation Activities

The group hosted the CEOS/WGCV Land Product Validation Workshop on Albedo at BU in October, immediately following the outreach workshop. International field experts in validation field exercises, CarboFlux Europe, and the Baseline Surface Radiation Network (BSRN) joined satellite-derived albedo data providers from MODIS and METEOSAT to discuss the best way forward to validate albedo. Drs. Jeff Privette and Jeff Morisette of GSFC prepared an article for the Earth Observer on this workshop.

As a direct result of the workshop, the Oak Ridge National Lab (ORNL) DAAC offered to expand a database of MODIS products collected for global Fluxnet sites and also include BSRN sites that collect albedo as well as some additional field and calibration sites. This database now provides 7-km by 7-km cutouts of the MODIS albedo and vegetation products (and in some cases, atmospheric optical thickness) for over 250 field sites.

Dr. Jeff Privette (GSFC) has completed processing the albedo data from the Mongu tower site and reports excellent agreement with the MODIS values. Work has begun on the Skukuza Tower site in collaboration with Dr Xiaowen Li and a graduate student at Beijing Normal University.

LAND COVER/LAND COVER DYNAMICS

Personnel

Amanda Cooper left the group to work with Dr. Greg Asner at the Carnegie Institution of Washington in Palo Alto, California.

Products/Deliveries

There were no product deliveries during this period. However, we did produce a plant functional type layer, which is currently being evaluated by Gordan Bonan and his group at NCAR.

Algorithm Development

The main thrust with respect to algorithm development for this period was continued refinement of classification scripts. In particular, the main development on this front was the modification of the classification codes to ingest 32-day (rather than 16-day inputs), based on compositing of the two 16-day values using quality flags. This approach reduces the number of missing values, reducing classification time and enhancing classification accuracy. Preliminary results suggest that this change leads to significant improvements in map quality.

In addition, algorithm development work continued, focusing on the six-biome scheme used by Steve Running's group at Montana for his NPP product. The problem here was to make the six-biome layer as consistent as possible with the more-detailed IGBP layer. Unfortunately, several of the Montana classes are incompatible with IGBP classes. The focus of effort for this layer therefore emphasized the development of an approach that minimizes inconsistencies between these two layers.

In land cover dynamics, Dr. Zhang continued his development of a global phenology product, in which logistic curves are fitted to an annual sequence of EVI values calculated from NBARs, and derivatives are used to identify onset dates of greenness, green-up, maturity, senescence, and dormancy. We are now producing global maps of these parameters, and analysis of map quality is now ongoing.

Training Sites

Over the past six months we once again performed extensive quality assurance of the site database. This was performed using statistical and visualization methods to identify outlier data points and

problematic sites. These cases were then inspected manually for problems. The result from this effort was that roughly 10% of our training data was removed from the site database because it did not meet Q/A standards.

Validation Activities

Validation of our land cover product involves two types of information--classification of unseen training sites, and aggregation of classification confidence data. We had expected to publish accuracy statistics and an accompanying discussion on our web site by November 1. However, a variety of technical problems have delayed this effort. We are now targeting February 15 for posting these results. All indications are that we will award the consistent year product the status of "Validated, Level 1" at that time. In parallel with this effort, we also continued our cross-comparison effort, comparing our land cover product to other global datasets and to a database of California land cover types prepared from TM data for US Forest Service use.

Outreach

We compiled data sets for all MODIS land products in support of the Soil Moisture Experiment 2002, a large field experiment conducted in Iowa in the summer of 2002 under joint funding from the USDA and NASA.

PUBLICATION/PRESENTATION ACTIVITY

New Publications
----

* A paper describing the early results from the MODIS BRDF/Albedo algorithm was published in RSE in a special issue on MODIS early science.

Schaaf, C. B., F. Gao, A. H. Strahler, W. Lucht, X. Li, T. Tsang, N. C. Strugnell, X. Zhang, Y. Jin, J.-P. Muller, P. Lewis, M. Barnsley, P.

Hobson, M. Disney, G. Roberts, M. Dunderdale, C. Doll, R. d'Entremont, B. Hu, S. Liang, and J. L. Privette, 2002, First Operational BRDF, Albedo and Nadir Reflectance Products from MODIS, in press, Remote Sens. Environ., vol. 83, pp. 135-148.

* A paper describing the MODIS Land Cover product was published in RSE in a special issue on MODIS early science

Friedl, M. A., D. K. McIver, J. C. F. Hodges, X. Y. Zhang, D. Muchoney, A. H. Strahler, C. E. Woodcock, S. Gopal, A. Schneider, A. Cooper, A. Baccini, F. Gao, C. Schaaf, 2002, Global land cover mapping from MODIS: Algorithms and early results, Remote Sens. Environ., vol. 83, pp. 287-302.

* A paper describing the early MODIS BRDF/Albedo validation results was published in RSE in a special issue on MODIS early science.

Liang, S., H. Fang, M. Chen, C. J. Shuey, C. Walthall, C. Daughtry, J. Morisette, C. Schaaf and A. Strahler, 2002, Validating MODIS land surface reflectance and albedo products: Methods and preliminary results, Remote Sens. Environ., vol. 83, pp. 149-162.

* A paper documenting the use of the Land Cover product for LAI/FPAR retrievals was published in RSE in a special issue on MODIS early science.

Myneni, R. B., S. Hoffman, Y. Knyazikhin, J. L. Privette, J. Glassy, Y. Tian, Y. Wang, X. Song, Y. Zhang, G. R. Smith, A. Lotsch, M. Friedl, J. T. Morisette, P. Votava, R. R. Nemani, and S. W. Running, 2002, Global products of vegetation leaf area and fraction absorbed PAR from year one of MODIS data, Remote Sens. Environ., vol. 83, pp. 214-231.

* A paper describing a method to combine MISR information with MODIS data to produce an improved BRDF and Albedo retrieval was published in TGARS in a special issue on MISR early science.

Jin, Y., C. Schaaf, F. Gao, X. Li, A. Strahler, C. Bruegge, and J. Martonchik, 2002, Improving MODIS surface BRDF/albedo retrieval with

MISR multi-angle observations, IEEE Trans. Geosci. Remote Sens., vol. 40, pp. 1593-1604.

Proceedings Papers and Abstracts Published
----

* An abstract documenting a presentation at the Fall 2002 AGU meeting was published.

Friedl, M. A., A. H. Strahler, X. Zhang and J. C. F. Hodges, 2002, Mapping global land cover properties and dynamics using MODIS data, EOS Trans. Amer. Geophys. Union, vol. 83, no. 47, Fall Meeting Suppl., Abstract B61B-0715, Dec 6-10, 2002, San Francisco, CA.

* A paper describing global mapping of vegetation phenology from MODIS was published in the proceedings of a conference focusing on phenology.

Zhang, X., M. A. Friedl, C. B. Schaaf, A. H. Strahler, J. Hodges, and F. Gao, 2002, Mapping global vegetation phenology using 1 km MODIS data, Proc. 15th Conf. on Biometeorol. and Aerobiol., joint with 16th Int. Cong. on Biometeorol., 28-October-1 November, 2002, Kansas City, Missouri, pp. 343-347.

Papers in Press
----

* Two papers describing the evaluation and validation of the MODIS BRDF/Albedo product were accepted by JGR and now are in final form awaiting publication.

Jin, Y., C. B. Schaaf, C. E. Woodcock, F. Gao, X. Li, A. H. Strahler, W. Lucht, S. Liang, 2003, Consistency of MODIS surface BRDF/Albedo retrievals: 1. Algorithm performance, in press, J. Geophys. Res.

Jin, Y., C. B. Schaaf, C. E. Woodcock, F. Gao, X. Li, A. H. Strahler, W. Lucht, S. Liang, 2003, Consistency of MODIS surface BRDF/Albedo retrievals: 2. Validation, in press, J. Geophys. Res.

* A paper describing the use of the land cover product in retrieval of LAI/FPAR was accepted by IJRS.

Lotsch, A., Y. Tian, M. A. Friedl, and R. B. Myneni, 2002, Land cover mapping in support of LAI/FPAR retrievals from EOS-MODIS and MISR: Classification methods and sensitivities to errors, in press, Int. J. Remote Sens.

* A paper on monitoring of vegetation phenology using MODIS was accepted by RSE.

Zhang, X., M. A. Friedl, C. B. Schaaf, A. H. Strahler, J. C. F. Hodges, and F. Gao, 2002, Monitoring vegetation phenology using MODIS, in press, Remote Sens. Environ.

Papers Submitted
----

* A paper describing the use of BRDF model information to derive vegetation structural information was submitted to RSE.

Gao, F., C. B. Schaaf, A. H. Strahler, Y. Jin, and X. Li, 2003, Detecting vegetation structure using a kernel-based BRDF model, submitted to Remote Sens. Environ.

* A paper comparing the MODIS albedos with the albedos generated by the Common Land Model was submitted to JGR.

Zhou, L., R.E. Dickinson, Y. Tian, X. Zeng, Y. Dai, Z. Yang, C.B. Schaaf, F. Gao, Y. Jin, A. Strahler, R.B. Myneni, H. Yu, W. Wu, and M. Shaikh, 2003, Comparison of seasonal and spatial variations of albedos from MODIS and common land model, submitted to J. Geophys. Res., 2003.

* A paper that compared the albedo results from the Community Land Model (CLM2) with MODIS albedos was submitted to GRL.

Oleson, K. W., G. B. Bonan, C. Schaaf, F. Gao, Y. Jin, and A. Strahler, 2003, Assessment of global climate model land surface albedo using MODIS data, submitted to Geophys. Res. Let.

Papers Accepted for Presentation
----

* A paper was accepted for the AMS Global Change Conference in Long
Beach, California, 9-13 February, 2003.

Tsvetsinskaya, E., C. Schaaf, F. Gao, A. H. Strahler, R. Dickinson, X.
Zeng and W. Lucht, 2003, Spatial variability in MODIS-derived surface
albedo over global arid and semiarid regions, 14th AMS Conf. on Global
Change and Climate Variations, 9-13 February, Long Beach, California.

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

BRDF/ALBEDO

Evaluation of the Collection 4 (V004) reprocessed data will proceed
with a complete three-year data set expected by the end of the period.
Evaluation will also proceed on the parallel production of the joint
Aqua and Terra products which will begin during this period.

We will continue our close collaboration with climate modeling efforts
within the IDS community and will present papers at the joint
EGS/AGU/EUG conference in Nice, France, in April.

We will continue our validation efforts with the data from the BSRN
stations and other field sites collecting albedo data as well as
comparing our product with products from other satellite platforms.

LAND COVER/LAND COVER DYNAMICS

Activities will center around (1) continued refinement of our training
site database, including the addition of new sites and quality control
of existing sites; (2) continued exploration of 32-day, instead of 16-
day inputs; (3) processing and analysis of validation statistics; (4)
continued development of alternate classification schemes, including
the Montana classification scheme; (5) continued development of
phenological metrics; (6) production and analysis of change vector

indicators of land cover change from multiyear input data; (7) land cover validation planning for CEOS; and (8) continued support of users of land cover classification data.

PROBLEMS/CORRECTIONS

As the reporting period progressed, we received funding plans from the project for the remainder of the contract period and a projected extension to November 30, 2003. However, we were not able to keep projected spending within the guidelines provided. This was due (1) to requests in the prior year to stretch out spending for an additional two months, which effectively reduced funding; and (2) an 8-percent projected cut in dollar costs for FY03. Actions taken and planned to close the gap included non-replacement of full-time researcher who departed on 1 November; lay-off of our 80-percent time programmer/web manager, effective 1 March; reduction of PI AY support and summer salary to zero, effective 1 February; reduction of salary for a research professor from 50 percent to 10 percent, effective 1 January; shifting of a postdoctoral researcher from full-time to half-time effective March 1; termination of the services of another postdoctoral researcher at 10 percent, effective March 1; termination of a graduate student on May 31, 2003; reductions in planned domestic travel; and transfer of all planned foreign travel costs to overhead accounts. Even with these actions, we are projected to overspend about $35K. Obviously, the reduction in funding will impact our ability to continue with algorithm development, validation, and various other mandated tasks for our MODIS products.