

TIME PERIOD: Jul - Dec, 2001

NAME AND LOCATION: Alan Strahler, Boston University

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ABSTRACT -- KEY POINTS

BRDF/ALBEDO

1) Reprocessing (V003) of the first complete year of MODIS data (Nov00 - Oct 01) was nearing completion by the end of the reporting period.

2) Code was delivered for coarse resolution Climate Modeling Grid (CMG) versions of the albedo product and the BRDF parameters product (MOD43C1 and MOD43C2). Reprocessed data from July 2001 onward will be provided in the CMG format (global mosaics in a geographic projection at a 0.25 degree resolution -- note that a 0.05 degree spatial resolution will be used with V004 reprocessing).

3) Preliminary comparisons between the reprocessed MOD43B products and field data from the BARC site carried out by our Validation Scientist, Dr. Shunlin Liang, indicates differences of far less than 10 percent. Collaborations continue with our other validators (Drs. Privette, Li, and Barnsley).

4) Personnel contributed to one journal article which was published during the period, while five additional papers were accepted and one article was submitted for review. Seven refereed presentations were made as papers or posters, some with abstracts.

LAND COVER/DYNAMICS

1) Code was delivered for the coarse resolution CMG version of land cover as per specifications above. ISLSCP II products, which are similar to CMG, were made and delivered to ISLSCP II from the provisional product.

2) The MOD12Q1 algorithm was modified to provide four consistent sets of labels: IGBP; University of Maryland; LAI/FPAR biomes for Ranga Myneni's group; and Biome-BGC biomes for Steve Running's NPP products.

3) Classification codes and scripts were modified and streamlined for faster operation. Scripts to automate intercomparisons with other products and accumulation of training site statistics were improved.

4) Research continued on operational algorithms and codes for the Land Dynamics product, focusing on phenology using EVI as calculated from MOD43B4.

5) Personnel contributed to one journal article which was published during the period, and one additional paper was accepted. Five refereed presentations were made as papers or posters, some with abstracts.

TASK PROGRESS

BRDF/ALBEDO PRODUCT

Personnel

Dr. Elena Tsvetsinskaya joined the research group and is actively collaborating on MODIS IDS efforts.

Algorithm development

BRDF/Albedo Products (MOD43B) (PGE23) from the first reprocessing (Version 003) are available and indicate an increase in quality due primarily to improvements in the cloud mask and the atmospheric correction procedure (more high quality looks results in more high quality full BRDF inversions). The backup magnitude inversion scheme continues to operate well in those areas still afflicted by limited observations over a 16 day period. A change in the weight given pixels flagged as possible cloud shadows results in more coastline observations being retained and converted into NBARS (via magnitude inversions).

In addition to the operational CMG products at 0.25 degree, CMG products from 2001 (in binary) at 0.5 degree and 1 degree resolutions were made available for the ISLSCP-2 initiative.

Scientific advances

The algorithm continues to operate consistently and reliably. The global coverage of the reprocessed data is significantly increased and a number of preliminary evaluations indicate the results are of high quality. Temporal tracking of those pixels that represent snow albedo values indicate a great deal of stability over the winter of 2000/2001 (Jin et al., 2002) as do desert values from North Africa and the Arabian Peninsula (Tsvetsinskaya et al., 2002). Annual cycles of NBAR values for various vegetation covers display stable and characteristic phenological cycles. In addition to Dr. Liang's work at BARC, Ms. Jin undertook comparisons with field data from the SURFRAD network and also found a close agreement with the MODIS broadband albedos.

Dr. Gao completed testing of an inversion method that couples NDVI information with the angular observations to retrieve atmospherically resistant BRDFs (Gao et al., 2002).

Ms. Jin also completed some initial case studies melding data from MISR and MODIS. In cases where MODIS data are acquired in the cross principal plane, a priori information based on MISR data (which is therefore in the principal plane) can improve the quality of the BRDF inversion for that location (Jin et al., 2002).

Validation activities

Close collaboration continues with Dr. Shunlin Liang (UMD) over the BARC validation site.

Data for the Mongu (SAFARI) site continues to be accumulated for Dr. Jeff Privette (GSFC) as do data for several sites in China for Dr. Xiaowen Li (BU and Beijing Normal University). Extensive field campaigns were held in China in the late summer 2001 and results are being analyzed.

Dr. Mike Barnsley will begin comparing MODIS retrievals over the Barton Bendish site with SPOT retrievals.

Members of the MODIS BRDF/Albedo Team participated in the MODLAND field campaign held in Harvard Forest in August. Aircraft data and directional PARABOLA data (from a crane above the canopy) were acquired.

LAND COVER/DYNAMICS PRODUCT

Personnel

Amanda Cooper changed status from MA student to assistant researcher, following the receipt of her Masters' degree in May, 2001.

Algorithm and product development

Considerable effort was expended to code and prepare 5 km browse and coarser-resolution CMG products. The CMG products made from the provisional product were repackaged and delivered to the ISLSCP II database in November. The datasets were fully documented for the ISLSCP II effort.

Training sites were reviewed, edited, and revised in preparation for production of a new land cover product with a full year of reprocessed data, scheduled to be available shortly after January 1, 2002.

Classification codes and scripts were reviewed and streamlined for faster future processing.

Work continued on methods for providing the full suite of internally consistent land cover label sets, including IGBP and University of Maryland labels, LAI/FPAR biomes for Dr. Myneni's product, and Biome-BGC biome labels for Dr. Running's Photosynthesis/NPP product. Work is also underway, in collaboration with IDS PI Robert Dickinson, to also incorporate the Plant Functional Types (PFT) that are used by the Community Land Model.

Scientific advances

Dr. Xiaoyang Zhang continued development of his methodology to identify temporal metrics in vegetation activity as monitored by the MODIS EVI. These will be incorporated in the land cover dynamics product algorithm. Collaboration with Brad Reed at EDC on phenology continued with a visit to EDC by Dr. Zhang. The new methodology fits the yearly time-trajectory of EVI values for each pixel with a series of logistic

functions, then uses the slope derivatives of the fitted functions to identify onsets of greenup, maturity, senescence, and dormancy.,

Validation activities

Members of the BU land cover team participated in a field campaign at Harvard Forest, in coordination with Ranga Myneni's LAI/FPAR group. Three days were spent in the field inspecting local land covers and helping Dr. Myneni's group acquire validation data.

We continued the development of cross-validation procedures to be used in validation of the next land cover map, expected in April, 2002. This effort included coding scripts to make rapid automated accumulation of training site accuracy statistics as well as comparisons with existing global products, such as the at-launch database.

Other activities

We continued to support users of the land cover provisional product by e-mail and web site maintenance.

Publication/presentation activity

* A paper comparing BRDFs and albedos derived from AVHRR magnitude inversions with albedo values used in BATS and LSM schemes was published in JGR.

Wei, X., A. Hahmann, R. E. Dickinson, Z.-L. Liang, X. Zeng, K. Schaudt, C. Schaaf, and N. Strugnell, 2001, Comparison of albedos computed by land surface models and evaluation against remotely sensed data, *J. Geophys. Res.*, vol. D-106, pp. 20,687-20702.

* A paper on our land cover classification methodology was published in TGARS.

McIver, D. K. and M. A. Friedl, 2001, Estimating pixel-scale land cover classification confidence using nonparametric machine learning methods, *IEEE Transactions on Geoscience and Remote Sensing*, vol. 39, pp. 1959-1968.

* A paper making use of nadir BRDF-adjusted NDVIs to compensate for atmospheric effects that affect BRDF retrievals has been accepted by IEEE TGARS.

Gao, F., Y. Jin, X. Li, C. Schaaf, and A. H. Strahler, 2002, Bidirectional NDVI and atmospherically resistant brdf inversion for vegetation canopy, *IEEE Trans. Geosci. Remote Sens.*, in press.

* A paper describing the early results from the MODIS BRDF/Albedo algorithm has been accepted by RSE for 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, Remote Sens. Environ., in press

* A paper describing the MODIS Land Cover product has been accepted by RSE for a special issue on MODIS early science

Friedl, M. A., D. K. McIver, J. C. F. Hodges, X. Zhang, D. Muchoney, A. H. Strahler, C. E. Woodcock, S. Gopal, A. Schnieder, A. Cooper, A. Baccini, F. Gao, and C. Schaaf, 2002, Global land cover from MODIS: Algorithms and early results, Remote Sens. Environ., in press.

* A paper discussing validation of the BRDF/Albedo product has been accepted by RSE for 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., in press.

* A paper exploring the temporal and spatial variation in the MODIS-detected albedos of various snow covered land types was accepted by GRL.

Jin, Y., C. Schaaf, F. Gao, X. Li, A. Strahler, X. Zeng, R. Dickinson, 2002, How does snow impact the albedo of vegetated land surfaces as analyzed with MODIS data? Geophys. Res. Let., in press.

* A paper exploring the variation in the MODIS detected desert albedos of North Africa and the Arabian Peninsula was accepted by GRL.

Tsvetsinskaya, E., C. Schaaf, F. Gao, A. Strahler, R. Dickinson, X. Zeng, W. Lucht, 2002, Relating MODIS derived surface albedo to soils and landforms over Northern Africa and the Arabian Peninsula, Geophys. Res. Let., in press.

* A paper describing a method to combine MISR information with MODIS data to produce an improved BRDF and Albedo retrieval was submitted to TGARS for 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, submitted to Trans. Geosci. Remote Sens., 2001.

* Four presentations were given at IGARSS'01 in Sydney, Australia, 9-13 July, 2001.

Strahler, A. H., C. Justice et al., Land science and applications results overview from the first 16 months of EOS Terra MODIS operations, (abstract), Proceedings of the International Geoscience and Remote Sensing Symposium (IGARSS'01), Sydney, Australia, 9-13 July, IEEE, 2001.

Schaaf, C. B., A. H. Strahler, F. Gao, W. Lucht, X. Li, X. Zhang, Y. Jin, E. Tsvetsinskaya, J.-P. Muller, P. Lewis, M. Barnsley, G. Roberts, C. Doll, S. Liang, and J. L. Privette, MODIS operational bidirectional reflectance and albedo products, Proceedings of the International

Geoscience and Remote Sensing Symposium (IGARSS'01), Sydney, Australia, 9-13 July, IEEE, 2001.

Doll, C., J.-P. Muller, C. Schaaf, A. Strahler, F. Gao, Mapping urban landcover using the BRDF/Albedo product from the EOS-MODIS instrument. Proceedings of the International Geoscience and Remote Sensing Symposium (IGARSS'01), Sydney, Australia, 9-13 July, IEEE, 2001.

Zhang, X., J. C. F. Hodges, C. B. Schaaf, M. A. Friedl, A. H. Strahler, and F. Gao, Global vegetation phenology from AVHRR and MODIS data. Proceedings of the International Geoscience and Remote Sensing Symposium (IGARSS'01), Sydney, Australia, 9-13 July, IEEE, 2001.

* Two posters were presented at the IGBP Global Change Open Science Conference in Amsterdam, Netherlands, 10-13 July, 2001.

Schaaf, C. B., A. H. Strahler, F. Gao, W. Lucht, X. Li, X. Zhang, Y. Jin, E. Tsvetsinskaya, J.-P. Muller, P. Lewis, M. Barnsley, G. Roberts, C. Doll, S. Liang, and J. L. Privette, Operational bidirectional reflectance and albedo products from the MODERate Resolution Imaging Spectroradiometer (MODIS) (abstract), IGBP Global Change Open Science Conference in Amsterdam, Netherlands, 10-13 July, 2001.

Hodges, J. C. F., M. A. Friedl, and A. H. Strahler, The MODIS Global Land Cover Product: New Data Sets for Global Land Surface Parameterization (abstract), IGBP Global Change Open Science Conference in Amsterdam, Netherlands, 10-13 July, 2001.

* Two posters were presented at the AMS Satellite Meteorology Conference in Madison, Wisconsin, 15-18 Oct, 2001.

Schaaf, C. B., F. Gao, A. H. Strahler, W. Lucht, X. Li, X. Zhang, Y. Jin, E. Tsvetsinskaya, J.-P. Muller, P. Lewis, M. Barnsley, G. Roberts, C. Doll, S. Liang, D. Roy, and Jeff Privette, Land surface albedo, Nadir BRDF-Adjusted Reflectance, and BRDF product from the MODERate Resolution Imaging Spectroradiometer (MODIS), Proceedings of the 11th Conference on Satellite Meteorology and Oceanography, Madison, WI, 15-18 Oct., AMS, pp. 592-595, 2001.

Jin, Y., F. Gao, C. Schaaf, A. Strahler, C. Bruegge, J. Martonchik, D. Diner, A synergistic surface BRDF/Albedo retrieval with MODIS and MISR observations: 1. Intercomparison, Proceedings of the 11th Conference on Satellite Meteorology and Oceanography, Madison, WI, 15-18 Oct., AMS, pp. 87-90, 2001.

* A poster was presented at the American Geophysical Union Fall Meeting, San Francisco, CA, 10-14 Dec, 2001.

Schaaf, C., F. Gao, W. Lucht, X. Li, Y. Jin, X. Zhang, E. Tsvetsinskaya, J.-P. Muller, P. Lewis, M. Barnsley, G. Roberts, C. Doll, S. Liang, J. Privette, D. Roy, Annual Cycle of MODIS Albedo, Nadir BRDF-Adjusted Reflectance and BRDF Products, (abstract), American Geophysical Union Fall Meeting, San Francisco, CA, 10-14 Dec, 2001.

* A paper was accepted for the AMS Global Change Conference in Orlando, Florida 13-17 January 2002.

Tsvetsinskaya E., C. Schaaf, F. Gao, A. H. Strahler, R. Dickinson, and X. Zeng: Improving the representation of arid regions of northern Africa and the Arabian peninsula in climate models by incorporating MODIS derived surface albedo, Proceeding of the 13th Symposium on Global Change and Climate Variations, 13-17 January, Orlando, Florida, J278-J280, 2002.

* A paper was accepted for the 29th International Symposium on Remote Sensing of Environment (ISRSE) which will be held in Buenos Aires, Argentina, April 8-12, 2002.

Moody, E. G., S. Platnick, M. D. King, C. B. Schaaf, A global white-sky surface albedo data set derived from Terra MODIS data, Proceedings 29th International Symposium on Remote Sensing of the Environment, 8-12 April, Buenos Aires, Argentina, 2002.

* A paper with abstract was presented at the Fall AGU meetings.

Friedl, M. A. and A. H. Strahler, 2001, Mapping global vegetation and land cover properties from MODIS, Eos, Transactions of the American Geophysical Union, vol. 82, Fall meeting supplement, Abstract B31A-0076, pp. F190.

ANTICIPATED ACTIVITIES DURING THE NEXT SEMI-ANNUAL PERIOD

BRDF/ALBEDO

Code deliveries will be completed for the V004 reprocessing. These updates will incorporate the LiTransit model as the second BRDF model (replacing the Walthall model), improved handling of snow albedo, an updated BRDF a priori database, and an increased resolution CMG product. We will continue to aid our colleagues in the field validation of the products. We anticipate upgrading the V003 products to a validated status by summer 2002.

Presentations, posters and papers will be prepared for the Base Surface Radiation Network meeting in May, International Workshop on Multiangular Measurements and Modals (IWMMM-3) in June, and International Geoscience and Remote Sensing Symposium (IGARSS'02) also in June.

We will continue our close collaborations with climate modeling efforts within the IDS community. Sample albedo and BRDF data sets prepared are being prepared for IDS researchers working on the CCM as well as collaborators at Potsdam and Jena, Germany, the DAO, and fellow MODIS Team members. Datasets to support an initiative to provide IDS coarse resolution MODIS products are also under preparation.

The group will be supporting a number of MODIS User Outreach workshops this summer and fall, including the Land Cover and Land Cover Change Workshop in June, the Vegetation Biophysical Parameters Workshop in July and the Radiation Products Workshop in October.

LAND COVER/DYNAMICS

A new version of the land cover map will be produced in the next semi-annual period, using V003 2001 data. This should be a

"validated" product. CMG versions of the new product will be repackaged for ISLSCP II and redelivered.

Presentations will be prepared for the Global Land Cover 2000 workshop, at the JRC in Ispra, Italy, in March, and for the International Geoscience and Remote Sensing Symposium (IGARSS'02) in June.

The Principal Investigator will support the efforts of the CEOS Cal-Val working group to develop community standards for land product validation.