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NAME AND LOCATION, ALAN STRAHLER, BOSTON UNIVERSITY

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ABSTRACT -- KEY POINTS

BRDF/ALBEDO

During the reporting period, we completed coding of the operational version of MOD43B in preparation for the launch of Terra on December 18, 1999. The code was compiled and placed in the production system at MODAPS. We participated extensively in testing of the MODAPS QA tools and testing of ordering products through the ESDIS Data Gateway (EDG). We also completed our prototyping operation using AVHRR data. In publications, four papers were published, while three still await publication. A further four papers have been accepted and revisions of these are completed or underway.

LAND COVER/LAND-COVER CHANGE

During the reporting period, we concentrated on two main activities. First, we continued algorithm testing using our North America site database. Second, we continued our database development activities to extend and improve our training and testing site database to support global scale mapping.

As part of this effort, we continued our work with advanced technology (AT) neural network and decision tree classification algorithms. The map of North America that was produced during the first half of the year using a decision tree classification algorithm was distributed to the EOS community, and input was solicited regarding the relative strengths and weaknesses of this map. All of the data (both training site and AVHRR imagery) used in producing the map were made available through our web site, and a CDROM with these data is currently being compiled. On the coding front, the Land Cover Monthly Code (MOD12M) that accumulates data for use by the quarterly classifier code was modified to ingest data in EOS HDF format, and to produce map products in the same format.

TASK PROGRESS

BRDF/ALBEDO PRODUCT

Personnel

Dr. Trevor Tsang is completing his postdoc at Boston University and will be

returning to Britain in the new year.

Algorithm Development

The BRDF/Albedo Code (MOD43B) QA flags were thoroughly tested and some minor bugs identified and resolved. The code was finally run operationally in MODAPS in December.

The BU SCF participated vigorously in the various MODAPS N-day and MOSS tests this fall. Although MOD43B was never run as part of these tests, we ordered large amounts of MOD09 data and MODAGG data (the inputs to MOD43B) to stress the system.

Scientific Advances

Testing on the North American and New England AVHRR 1-km datasets from 1995 was completed. Reduction of observations due to cloud cover will obviously be a major challenge, although the technique of coupling the archetypal BRDF database with the available observations in a magnitude inversion is working well.

Work on testing and refining the LiTransit kernel continues. The RossThickLiTransit model combination appears to extrapolate directional reflectances at high view angles somewhat better than the operational RossThickLiSparseR model (especially under high solar zenith angles).

Work is also underway in the appropriate use of a priori knowledge with the semiempirical kernel models. Use of land-cover deduced archetypal BRDFs in conjunction with limited observations to perform magnitude inversions is the simplest form of this. Although the archetypal BRDFs are based on field data, they compare similarly with BRDFs based on extensive POLDER data of appropriate land covers.

Outreach to the climate user community continues with collaborations with Robert Dickinson's research group. A meeting at BU was held in July and subsequently global BRDF and albedo information was supplied (which was based on global archetypal BRDFs coupled through magnitude inversion with limited monthly global AVHRR observations from February and July of 1995).

Further outreach to the climate community was achieved during this period by also presenting these global albedos to the ISLSCP-2 planning meeting in October; the International Workshop on Satellite Remote Sensing and Climate Simulations, Synergies and Limitations in Les Diablerets, Switzerland in September; and the International Workshop on Multiangular Measurements and Models(IWMMM-2) in Ispra, Italy in September.

We participated in the activities and celebrations associated with the launch of Terra!

Validation activities

We participated in the KONVEX validation exercise in mid-July in the Konza Prairie, Kansas. BU personnel acquired spatial measurements of albedo across the field site and particularly acquired

information during overflights by AVIRIS, AirMISR and MQUALS on the golden day of 13 July, 1999. KONVEX was led by Dr. Dave Meyer from EDC and is a MODLAND prelaunch validation effort. GPS located albedometer and site description will be registered with the MERCURY data system. We have received AirMISR and Parabola data from JPL for use in correlating airborne-derived albedos with the ground measurements. Also we participated in a MODLAND Validation Workshop at Goddard in November which summarized KONVEX and looked ahead to the Bigfoot and Safari campaigns of 2000.

LAND COVER/LAND-COVER CHANGE

During this reporting period testing of the land cover algorithm was performed using our North America site database. As part of this effort we conducted comparisons between map products generated using advanced technology (AT) neural networks and decision tree classifiers. A key area of activity was the development of methods that merge decision trees and neural networks. The analysis conducted through this effort used the North American database consisting of over 1100 training, testing and validation sites developed from Landsat TM data. As part of this effort, a web database of the IGBP Global Confidence Sites was established.

Algorithm Development and Testing

We continued research on decision tree and neural net classifiers focusing on operational processing scenarios. We continued processing of AVHRR, TM and ancillary data for a regional Central America test case, and began similar exercises in South America and Africa.

We finalized the development and testing of a land surface parameter database derived from Landsat TM and ancillary sources, concentrating on North America. We completed the development and documentation of our validation and test site database. Supervised classification was tested using neural networks, decision trees, and a hybrid algorithm that merges neural networks and decision trees.

We developed methods based on decision trees and neural networks to derive pixel-scale estimates of classification uncertainty. These methods will provide useful information for map QA/QC and were tested using the North American training and test site database derived from Landsat TM data.

Coding/Processing

The North American Land Cover map of IGBP classes was reprojected into Integerized Sinusoidal Projection and tiled in the MODIS grid with realistic metadata to serve as a simulated MODIS LC product.

Changes to metadata were implemented and final format changes were made to guarantee harmonization of the operational MODIS MOD12Q1 Land Cover product and the at-launch product prepared by the University of Maryland.

In-house testing of the complete processing stream from MOD43B4 NBARs output, through

MOD12M monthly code, to MOD12Q1 LC output was completed. This was accomplished with 4 months worth of daily AVHRR data of New England which was projected, tiled, and formatted to serve as prototype MODIS data.

Land Cover Change

In Land-Cover Change, we suspended work on the interannual variability of land-cover indicators at coarse spatial resolution using change vector analysis in order to focus more directly on launch-critical issues. We expect to return to change vector studies in the 2000 calendar year.

Deliveries

The Prototype MODIS Land Cover Map of North America was printed at a scale of 1,8,000,000 and about 150 copies were distributed by mail to EOS investigators and other researchers interested in land cover. Another 50 copies were distributed at research meetings, including the ISLSCP 2 meeting and the MODIS Team Meeting.

PARTICIPATION IN MODIS ACTIVITIES

Crystal Schaaf and Feng Gao attended the MODIS team meeting in November; PI Alan Strahler was unable to attend. The Terra launch was attended by Strahler, Schaaf, and John Hodges.

PROBLEMS/CORRECTIVE ACTIONS

During this reporting period, we did not encounter any significant problems requiring corrective actions.

ANTICIPATED ACTIVITIES DURING THE NEXT 6 MONTHS (JANUARY - JUNE, 2000)

BRDF/ALBEDO

* Obtain and quality assure MODIS data and produce operational MOD43B MODIS BRDF/Albedo Products

* Complete validation study using the KONVEX field data.

* Prepare for the special Terra session of the International Geosciences and Remote Sensing (IGARSS00) in Hawaii in July. (Four abstracts have been submitted).

* Complete and submit two journal articles describing MODIS prototyping efforts with AVHRR to Geophysical Research Letters and Transactions on Geoscience and Remote Sensing. Complete two articles for special IWMMM-2 issues in Journal of Geophysical Research and Remote Sensing

Reviews. Complete and submit an article on multikernel modeling strategies to Remote Sensing of Environment. Complete and submit an article on archetypal BRDFs to Geophysical Research Letters.

LAND COVER/LAND-COVER CHANGE

* Continued test site development, operational testing of algorithm and code on global data, and generation of Early Science Products.

* Expand algorithm testing from continental scale products to global products. This will exploit our expanded test site database using the 400 IGBP Core sites, the 30 MODLAND Core test sites, and the MODIS geolocation sites.

* Continued testing of the MODIS LC processing chain by using AVHRR data that has been converted to nadir reflectances through the BRDF/Albedo Product code, and which has been formatted with the Monthly Land cover code. A subset of this code interacts with the classification train and test scripts to produce a fully trained classification that is applied to the entire data set with the Quarterly Land Cover Product code.

* Continued development of robust algorithms to perform feature selection and refinement of methods to identify and remove outliers or errors in our database that cause problems in the estimation phase of the neural net and decision trees classifiers.

* Testing of the processing chain using merged MODIS and AVHRR data that has been converted to nadir reflectances through the BRDF/Albedo Product code, and which has been formatted with the Monthly Land cover code.

* Continued testing of our change vector and neural network change detection techniques. These activities will be conducted at specific sites to complement the multitemporal nature of the land cover activities. We will complete the land-cover change case studies and the interannual variability work, and write up the results of both activities.

PUBLICATIONS

BRDF/ALBEDO

Published Papers

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Proceedings Papers

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Papers in Press

Hu, B., W. Lucht, A. Strahler, C. Schaaf, and M. Smith, 2000, Surface albedos and angle-corrected NDVI from AVHRR observations over South America, Remote Sens. Environ., in press.

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Strugnell, N., and W. Lucht, Continental-scale albedo inferred from AVHRR data, land cover class and field observations of typical BRDFs, J. Climate, 2000, in press.

Presentations

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Gao, F., X. Li, A. Strahler, and C. Schaaf, Comparison and validation of the new Li-Transit Kernel, International Workshop on Multiangular Measurements and Models (IWMMM-2), Ispra, Italy, 15-17 Sept, 1999.

Li, X., F. Gao, J. Wang, A. Strahler, A Priori knowledge accumulation and its application to constrain inversion of kernel-driven linear BRDF models, International Workshop on Multiangular Measurements and Models (IWMMM-2),Ispra, Italy, 15-17 Sept, 1999.

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LAND COVER/LAND-COVER CHANGE

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Muchoney, D. M., A. Strahler, J. Hodges and J. LoCastro, 1999, The IGBP DISCover confidence Sites and the System for Terrestrial Ecosystem Parameterization, Tools for validating global land cover data, Photogrammetric Engineering and Remote Sensing, 65(9), pp. 1061-1067.

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