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ABSTRACT -- KEY POINTS

BRDF/Albedo

The reporting period was dominated by the delivery of the version 1 software in early August, a major milestone. A quality assurance strategy was developed for the product. We attended the MISR science team meeting to forge a closer collaboration in validation and data exchange, leading to plans of participating in AirMISR campaigns. In September, a major international BRDF workshop was held in Beijing, China, with most of the researchers in the field in attendance to discuss the state of the art. The MODIS plans were presented and met with approval. In conjunction with this workshop, we conducted BRDF measurements in the Changchun Solar Simulation Laboratory of the Chinese Academy of Science. A key study of the sensitivity of atmospheric correction of reflectances to the surface BRDF was carried out.

Land Cover/Land Cover Change

Algorithm development for the land cover and land cover change products continued with pre-processing and analysis of TM for Glacier National Park and AVHRR data for Central America and the Caribbean. Testing and modification of the neural net and decision tree classifiers continued on the 1-degree global NDVI dataset. Status and progress was reported to the SWAMP/EOS-AM1 Land Review Panel in May.

TASK PROGRESS

BRDF/Albedo Product

Algorithm development/delivery

Version 1 coding progressed in July and early August. The code was delivered to SDST earlier than most other codes. It runs considerably faster than the beta-3 code, is more complete scientifically, produces an improved format, and adheres to the version 1 ECS- and MODIS-mandated metadata concepts. Full quality assessment is being

carried out on the pixel level. Contacts with SDST continued after delivery as the code was passed through the code acceptance process, which was completed successfully. The programmer hired for MODIS programming, Jim Tallent, left the project in mid-August.

A draft quality assurance plan was developed in conjunction with a MODLAND-SDST meeting July 11-12 and adapted to the specific needs of the BRDF/albedo product.

Scientific advances

Scientific advances related to the BRDF/albedo product were made in two areas during this 3-month reporting period.

First, a study was carried out on the sensitivity of atmospheric correction of reflectances to the surface BRDF, on errors made in BRDF/albedo retrieval if a Lambertian assumption is used in atmospheric correction, on the improvement in these errors if the retrievals are iteratively coupled, and on the influence of diffuse skylight on the BRDF/albedo retrieval accuracies. This study is key in resolving the interdependence of the MODIS atmospheric correction and BRDF/albedo algorithms. The results confirm that BRDF effects should be taken into account in atmospheric correction (planned for MODIS, but not usual otherwise), but that there is some leeway in the exact shape of the BRDF used, allowing a loose iterative coupling to succeed. Plots are now available allowing to assess the RMSE in retrieved directional reflectances as a function of error in the assumed albedos in atmospheric correction for MODIS and MISR angular sampling distributions, several different land cover types, and different values of the optical depth.

Second, one week in September was spent in the Solar Simulation Laboratory at Changchun, China, operated by the Chinese Academy of Science. This unique facility allows the rapid measurement of the BRDF of vegetation under laboratory conditions. The BRDFs of three different broadleaf plants were acquired, one interesting result being that details of plant canopy structure could be correlated with local effects in the observed BRDFs. The data acquired will be used for BRDF model validation.

Cooperation with the MISR team

Wolfgang Wanner attended the MISR science team meeting in Pasadena, August 12-14, on behalf of the BRDF/albedo team and MODLAND. There are many areas with possible synergy between MODIS and MISR. Besides establishing the contacts required for working on the data flow from

MISR into the MODIS production chain, the main benefit of this trip was to have proposed MODIS BRDF/albedo participation in the several AirMISR campaigns in 1997 and a coordination of flight locations and times. Validation needs between MODLAND and MISR-land are very similar, making joint field experiments most productive. AirMISR has properties that will make it an instrument we'd prefer to use rather than ASAS, most notably it will cover a larger area on the ground (8 by 10 km) and have a somewhat lower pixel resolution (10 m).

International BRDF workshop

From September 16-18 the first international workshop on multiangular remote sensing was held in Beijing, China. Most of the BRDF scientific community worldwide attended, allowing for very interesting discussions on the current state of the art. The MODIS BRDF/albedo plans and sensitivity studies were presented in two separate talks and met with the approval of the workshop. A spirited discussion of the future direction of BRDF research concluded the proceedings. Papers given at the work shop will be published in a special issue of a Chinese remote sensing journal.

Land Cover/Land Cover Change

During this reporting period, we focused primarily on the validation plan, test site issues and algorithm development for land cover classification. We continued our work with advanced technology (AT) classifiers: neural nets, decision trees and adaptive classifiers.

Test Sites

The lack of an adequate test site network and IMS is a significant problem which greatly impedes algorithm testing and product validation for land cover (and other MODLAND products). These data are needed for training, validation and accuracy assessment. In this quarter, we began developing a multi-level database for test site data.

Test Site Activities

Test site activity continued in Arizona, Walnut Gulch and BOREAS, and analysis was initiated at Glacier National Park and Central America and the Caribbean.

Central America and the Caribbean

We began compiling and pre-processing AVHRR and ancillary data for this regional megasite test site.

Glacier National Park

We continued algorithm testing for TM data for Glacier National Park with the Snow/Ice Team (Dorothy Hall).

SNOW/ICE-Landcover New England Winter 97 Field Campaign

We continued development of a joint SNOW/ICE-Landcover New England Winter 97 Field Campaign at a megasite which includes Sleepers River, Vermont and the Hubbard Brook LTER in New Hampshire.

Global 1-degree data

We continued testing and modification of the neural net and decision tree classifiers for use with the 1-degree global NDVI dataset.

Walnut Gulch/Arizona

Efforts continued in the analysis of neural nets, decision tree classifiers and feature selection techniques using the simulated MODIS data.

Neural Nets

We continued research on neural net classifiers especially their application to the global 1-degree NDVI land cover data and snow/ice/land cover discrimination using the Glacier National Park TM and SNOPMAP dataset. Pertinent issues include the use of limited training and validation (accuracy assessment) data, and geographical organization of the multitemporal data ie. stratification into latitude or hemispheric regions.

Algorithm Coding

Completed the land cover 32-day and quarterly V1 code.

Participation in MODIS Activities

15-17 July 1996 Participated in in IGBP-DIS Landcover Working Group Workshop at JRC, Ispra, Italy (Strahler, Muchoney)

Deliveries

Delivered the land cover 32-day and quarterly V1 code deliveries (mid-July).

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER (October - December 1996)

BRDF/Albedo Product

A new version of the ATBD will have to be submitted. A new programmer will have to be hired. The retrieval accuracy studies conducted early in the year will be expanded in scope to cover all MODIS angular data acquisition scenarios. A paper on BRDF model validation will be submitted.

Land Cover/Land-cover Change Product

Participation in MODIS Activities

- o Programmer's Meeting; 9 October; GSFC
- o Modis Science Team Meeting; 9-11 October; GSFC
- o ATBD Review; 11-12 December; location TBD

Deliveries

- o Version 4.0 ATBD; 1 November 1996

Work will continue on Modelers Grid coding. This work had been set back because of unanticipated change in our programming staff.

During the next quarter, we will expand algorithm testing in Glacier National Park with the Snow/Ice Team, and test site activities in BOREAS and Central America. We will continue to develop the joint SNOW/ICE-Landcover New England Winter 97 Field Campaign.

In land cover change activities, we will begin testing of change vector and neural network change detection techniques at specific sites to complement the multitemporal nature of the land cover activities. We will continue site activities using the 1-km NDVI dataset for the western hemisphere and especially Central America. Classification algorithm development and testing includes several neural nets, as well as decision trees.

Work on Version 1 of the land cover code will continue. Early in the third quarter of 1996 we will deliver the monthly compositing

algorithm, the quarterly classification algorithm and the climate modeling grid product (spatially-degraded product at 0.5 degree).

We will respond to the SWAMP EOS-AM1 Land Workshop review and incorporate changes into a revised ATBD for delivery in August 1996. The MODIS Science Team meeting is scheduled for 9-11 October at GSFC.

Boston University will host a Land Cover Workshop in October or November. The purpose of the workshop will be to continue progress on test site, validation and classification issues, and to expand outreach to user communities in landscape ecology and global modeling.

PROBLEMS/CORRECTIVE ACTIONS

Our programmer left unexpectedly for another job. We expect to fill this position in the very near future with another competent person. Otherwise, we did not encounter any significant problems requiring corrective actions.