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ABSTRACT -- KEY POINTS

Coding and product specifications continued to be major foci of effort during this reporting period. Another major effort was field data collection at the Jornada PROVE campaign, where we acquired data on the spatial variability of albedo measurements and on land cover types and parameters in the broad 2 degree by 6 degree region including Jornada.

In BRDF/Albedo, we completed processing of the New England AVHRR data, providing the first-ever 1-km scale albedo map. Efforts to duplicate this process in the southern Amazon region continued. We completed a first cut at a global BRDF database, trained by land cover, that will be used in the BRDF/Albedo algorithm.

In land cover/land-cover change, we stepped up site activities with the analysis of the representativeness of the global site network based on bioclimatic and physical criteria, and the further development of a remote sensing-based land surface parameter database. Prototyping in the Central America Regional Test Site continued. Testing and valuation neural net and decision tree classifiers continued at the site level.

TASK PROGRESS

BRDF/Albedo Product

Algorithm development

- * MOD43 BRDF/albedo product-specific metadata was defined
- * The MOD43 product was divided into 4 separate products to allow smaller user file sizes. It now consists of (1) semiempirical BRDF/albedo parameters, (2) empirical BRDF/albedo product, (3) minimal albedo product ("ready to use reduced albedo"), and (4) BRDF-corrected nadir reflectance.
- * For all 4 MOD43 products version 2 file specs and quality flag fields were defined
- * MODLAND-SDST meeting in February set timetable for version 2 algorithm deliveries, resolved gridding and format issues and defined common approaches to metadata and quality control
- * The multiangular database building code was transitioned into Robert Wolfe's MODLAND responsibility, but BU remains involved
- * New ECS toolkits were installed (with problems due to ECS errors)
- * A format for the required ancillary BRDF database was developed

* New SGI-O2 workstations (joint with MOD12 landcover) moved the SCF closer to be able to handle at-launch data volumes

* The MODIS BRDF/albedo algorithm continues to be used by other investigators. In this reporting period requests for the code were received from the University of Nottingham, UK, the ETH in Zurich, Switzerland, and the University of Hamburg, Germany.

* Start of version 2 algorithm coding in June. Complete revision started of the version 1 code, removing cumbersome heritage functionality, which made changes and increased efficiency difficult.

Scientific advances

* Completed: BRDF inversions of 160,800 pixels of combined NOAA-AVHRR and GOES-8 Imager data over New England from September 1995. First-ever derivation of albedo on 1 km scale from the BRDF. This prototyping of the MOD43 algorithm has provided valuable insights into strengths and weaknesses of the MOD43 approach. Overall, the results are very satisfying. Surface reflectances, albedos and BRDF model parameters clearly correspond to surface features.

* Completed: A study of AVHRR/GOES-8 inversions for selected snow-covered regions in New England, demonstrating the capability of our models to handle trees on snow with consistency.

* Started: preparation of 4km AVHRR data taken over South America for BRDF inversions of tropical surfaces. Errors in the view and illumination geometries led to extensive reprocessing of the data with an independent determination of view/sun angles.

* Continued: investigation of the relationship between biophysical parameters and Ambrals BRDF model parameters through numerical simulation. A clear dependence of model parameters with simulated scene parameters was found.

* Completed: in a 3-month effort, BRDFs were assigned to the land classes used in the MODIS synthetic data set using field-observed BRDFs. These data will be used to enhance the synthetic data set for code testing.

* Started: processing of field-observed Parabola BRDF data for creating the MOD43 at-launch BRDF database, definition of projection and land cover data bases to be used

* Marc Leroy (France), David Jupp (Australia) and Jan-Peter Muller (UK) visited Boston University, gave talks and discussed the progress of the algorithm with us.

* Completed: a spatial scaling study using the MODIS BRDF model and ASAS data

* Completed: a study of the temporal trajectories of MODIS BRDF model parameters over the Sahel from AVHRR data; these clearly reveal that these semiempirical parameters carry some physical meaning.

* A visiting scholar, Gao Feng, worked on robust inversions of our

BRDF models based on minimal noise sensitivity instead on minimal RMSE.

Validation activities

- * In January, a MODLAND field campaign at Jornada, NM, was agreed upon.
- * Field work was planned for this campaign in May, focusing on studying the spatial variation of albedo at the site and issues of scaling to MODIS 1 km footprints.
- * The market was investigating for buying pyranometers/albedometers, a data logger and a GPS. We decided to buy CM-21 albedometers from Kipp+Zonen, one for total SW broadband, one for the NIR broadband. These were readied electronically at BU and at GSFC.
- * In May, we were in the field for the MODLAND-PROVE1 campaign for 10 days (May 20-30). Our team consisted at various times of Mike Barnsley and Paul Hobson (University of Wales), Andrew Hyman and Wolfgang Lucht (Boston University) and Jan-Peter Muller (University College London). Data acquired: several hundred albedo measurements along short and long transects mainly at the tower site, but also at a grassland site; PS-II multiangular radiometer data of scene components; hemispherical photography of the albedo sites; GPS data. The campaign was very successful, evaluation will follow.
- * Coordination of validation activities with interested colleagues applying to the validation NRA.

Publication/talks activity

- * A paper on retrieval accuracies of BRDF and albedo from MODIS, was submitted to JGR.
- * A paper on the validation of the MODIS BRDF model was accepted at Remote Sensing of Environment.
- * A paper on the sensitivity of atmospheric correction to BRDF effects was submitted to IEEE TGARS.
- * Two conference talks concerning MODIS BRDF/albedo were accepted, one at IGARSS'97 and one at the IAMAS conference in Australia in July. The first talk will address the scientific community, the second the user community.
- * In January, a workshop was held by NASA at the University of Maryland to investigate the current status of BRDF research and to plot a way into the future for this field. Alan Strahler gave a report on the status of geometric-optical modeling, and Wolfgang Wanner gave a talk on retrieval accuracies as studied for the cases of MODIS and MISR.
- * In May we attended the MODIS Science Team Meeting, in June W. Lucht represented MODLAND at the MISR Science Team Meeting.

Land Cover/Land-Cover Change

TASK PROGRESS

We continued to concentrate on V2, site, training and validation and related issues. We continued our work with advanced technology (AT) classifiers: neural nets, decision trees and adaptive classifiers.

Test Sites

* Database Issues: During this reporting period, we continued the development and testing of a land surface parameter database derived from Landsat TM and ancillary sources, especially for two of our regional test sites, Central America and the Southwest US (including Jornada and Walnut Gulch). We also looked at the distribution of test sites globally using bioclimatic and physical data to assess the overall representativeness of the test site network.

* Test site activity continued in the Southwest US, in a regional site that includes Walnut Gulch Arizona, and Jornada and Sevilleta, New Mexico. We continued the extraction of land surface parameters for the Central America Regional Site. Analysis was initiated at Glacier National Park and Central America and the Caribbean.

Algorithm Development and Testing

* 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.

* Decision Tree Classifiers: We have continued development and testing of multivariate decision trees for feature selection and classification.

Algorithm Coding and SDST Issues

* V2 specs were delivered at the end of March; V@ code development continued in coordination with BRDF/Albedo effort.

Participation in MODIS Activities

* MODIS Science Data Support Team (SDST) meeting; 17-20 February 1997; GSFC

* Modis Science Team Meeting; 13-16 May 1997; GSFC

* MODIS Algorithm Developer's Workshop; 13 May 1997; GSFC

* Jornada Field Campaign; 17-28 May 1997

* PROARCA-CAPAS/The Nature Conservancy Central America Vegetation Working Group Workshop; 16-18 June; Guatemala City, Guatemala

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

BRDF/Albedo

- * Massive version 2 algorithm coding
- * Evaluation of the field campaign at Jornada
- * Continued work on the South America AVHRR data inversions

Land Cover/Land-Cover Change

- * Development of the the V2 code for late July delivery.
- * Continued development of the surface parameter extraction process for training, testing and validation of our classifiers using MODIS-like processing scenarios.
- * Algorithm testing in Glacier National Park with the Snow/Ice Team, and test site activities in Central America and the Southwest US. In addition to the 1-degree (FASIR) and 1km testing, we will begin testing using the AVHRR Pathfinder 8km data. We will continue site activities using the 1-km NDVI dataset for the western hemisphere and especially Central America.
- * Classification algorithm development and testing will focus on operational processing using neural net and decision tree classifiers, in more closely MODIS-like scenarios.
- * In land cover change activities, we will continue testing of change vector and neural network change detection techniques at specific sites to complement the multitemporal nature of the land cover activities. This includes expansion of our long-term change studies in Africa in cooperation with Eric Lambin.

PROBLEMS/CORRECTIVE ACTIONS

- * None required.