

# **MODIS Science Team Semi-Annual Report**

**January 1 – June 30, 2002**

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with contributions from E. Vermote, J. Morisette, J. Descloitres

Contract #: NAS5-31365

## **a) Task Objectives**

This reporting period covers the period of Aqua launch and preliminary evaluation. The MODIS Terra products are in the process of being validated and disseminated by the EDC DAAC. This period includes the initial Rapid Response System development and its growth in collaboration with various users, through national collaborations and internationally through GOFD/GOLD, a project of the Global Terrestrial Observing System (GTOS). Emphasis has been on continuing evaluation of the Terra fire products, a preliminary evaluation of the Aqua fire products, determining product accuracy and outreach to users, answering questions and providing information on the product. The period also included a user outreach workshop on the MODIS Fire Products. This was held in conjunction with the GOFD/GOLD annual workshop at the University of Maryland. Considerable attention has been given to coordinating the land product validation activities and outreach to the user community.

We continued to build the collaborations required to conduct the work of developing community consensus algorithms on Fire, Surface Reflectance and Vegetation Indices. The project developed a number of collaborative activities that are intended to expand the scope of the team members' activities and involve a larger community in MODIS research and product validation.

Chris Justice participated in the Science Team Meetings, the Discipline Leaders meetings and whenever possible, the Land Science Data

Development Team Meetings and the Technical Team (TT) Meetings. In addition, the goals of the MODIS project, the status of the instrument and the results of this MODIS supported research were presented at scientific meetings. Results of the studies undertaken as part of the project are in the process of being written up and submitted for publication. This reporting period covered the completion of the MODIS Land Special Edition of Remote Sensing of the Environment (RSE) on Early Product Validation.

In agreement with the MODIS Project Scientist, resources from this project continue to support the MODIS Surface Reflectance product and the Fire Rapid Response System. This includes providing shared support for personnel and computer resources with Dr. E. Vermote, Dr Jacques Descloitres and the Land Science Data Team at GSFC. During this reporting period, refinements to the current fire algorithm were investigated by Dr. Vermote.

## **b) Tasks Accomplished**

### **1) Code Development, Delivery and Product Quality Assessment (Giglio)**

Giglio attended nine MODIS Land SDDT meetings concerning code status, testing plans and development of quality assurance (QA) tools for the MODIS surface reflectance and fire products. He also wrote code to compare ASTER scene locations with MODIS L2 fire product files to identify ASTER scenes to be ordered for fire validation. Software was also developed to extract MODIS and ASTER fire pixels, degrade ASTER data and generate statistical output to support validation of the MODIS fire product. Giglio assisted C. Elvidge (NOAA-NESDIS National Geophysical Data Center) to determine availability and quality of MODIS data for various dates as part of a GOFD fire-product validation activity in Southeast Asia.

Based on initial QA and validation results Giglio continued development of a refined MODIS active-fire detection algorithm to provide increased sensitivity to small fires and a much lower false alarm rate. The improved algorithm was inserted into the Rapid Response System in mid-April for operational testing.

On April 3 Giglio met with representatives from the Mexican Forest Service to discuss the version 4 MODIS active fire detection algorithm.

In May, Giglio prepared a global, gridded MODIS active fire data set spanning six months for inclusion on the Multidisciplinary CD-ROM being prepared at V. Solomonson's (MODIS Team Leader) request.

Giglio worked with Dr. E. Vermote (UMD) to conduct preliminary analyses of an alternative thermal anomaly (ANO) detection algorithm developed and promoted by Dr Vermote. Analysis revealed that while ANO detects roughly twice as many fires as the version 4.0.0 MODIS algorithm, it suffers from a large number of false detections. Evaluation of the ANO approach is on-going.

Version 4.0.0 of the MODIS L2 fire code to be included in MODAPS was completed. This version initially tested on the Rapid Response System, includes a revised detection algorithm that offers many fewer false alarms in areas in which the original algorithm had persistent problems (Ethiopia, Pakistan, and India for example) and a greatly improved ability to detect smaller fires. The Delivered code to MODIS Land Integration and Test Team on 1 May and will be included as part of the Collection 4 processing. Attention is now needed to improving the MODIS Land/Water mask.

Preliminary evaluation of the Aqua fire product revealed no major problems. The Rapid Response System and the Global Fire Browse were used for initial Aqua fire QA.

## **2) NPP VIIRS (Giglio/Justice)**

The MODIS fire group continued to support the NPP Fire algorithm activities. Giglio reviewed the NPP VIIRS Version 5 Active Fire ATBD at the request of J. Privette (NASA) and R. Murphy (NASA). Justice communicated with Elaine Prins and Paul Menzell (NOAA) on the requirements for VIIRS Fire Detection and the lessons learned from MODIS. The MODIS Fire Team continues to be concerned about the continuity of fire data monitoring from MODIS to VIIRS.

## **3) MODIS Active Fire Product Validation and Analysis (Csiszar) with contributions from Giglio, Justice and Dr. Jeff Morisette (NASA/GSFC).**

Dr. Ivan Csiszar participated in a collaborative effort to validate the MODIS active fire product with coincident ASTER observations. He developed a

semi-automated procedure to identify in the EDC DAAC inventory of ASTER scenes that contain active fires. The procedure utilizes fire locations from the MODIS Land Rapid Response System stored in ASCII text files. A database of coincident ASTER level-1b and MODIS (MOD021km level-1b, MOD03 geometry and MOD14 fire product) has been compiled for various areas over the globe, with an emphasis on Southern Africa, Northern Eurasia, Mexico and South America. An evaluation of the MODIS fire product has been carried out over Southern Africa, including the creation of imagery simultaneously displaying ASTER fires and overlaying MODIS fire detection results, and a quantitative statistical analysis of MODIS detection probability based on summary statistics characterizing sub-MODIS-pixel scale fire properties. Results of this analysis have been reported in the paper "Validation of the MODIS Active fire product over Southern Africa with ASTER data" by J. Morisette, L. Giglio, I. Csiszar and C. Justice, submitted to Remote Sensing of Environment.

Csiszar also worked on extending the ASTER-based validation effort to other areas in the context of establishing or strengthening GOFC/GOLD regional fire networks. Progress has been made in Mexico, Russia and South America towards a collaborative effort and towards integrating airborne and ground-based fire observations into the validation and product development efforts. As part of network building in Russia, proposals are being developed to support regional participation in MODIS Validation.

#### Global Analysis of active fire distributions from MODIS

Csiszar has taken over and is continuing work started by B. Quinlan (UMd Graduate Student) on the distribution of MODIS active fires over the Conterminous United States and globally. GIS-based procedures and SAS statistical analysis has been carried out to study fire occurrence as a function of land cover type and tree cover. Time series of fire counts, as well as mid-IR channel brightness temperatures have been created. This latter exercise revealed the signature of algorithm change over time and pointed out the need for the creation of a homogeneous data record for a more rigorous scientific analysis. Results of this activity are also recommendations about the information saved in the Rapid Response ASCII text files, which are currently under consideration.

#### **4) SAFARI 2000 campaign and MODIS regional emissions (Korontzi) with contributions from D. Roy (UMd)**

Stefania Korontzi continued her research work on the development of a seasonal fire emissions model for southern Africa relying on MODIS information for the burned area. Emissions results were incorporated in a manuscript on the MODIS fire products by Justice et al. that will appear on the MODIS special issue of the Remote Sensing of Environment. Furthermore, she evaluated newly developed burned area products, such as the GBA-2000 by the European Space Agency and conducted inter-comparisons with the MODIS burned area product within the context of emissions modeling. The results from this study were presented at the GOFD/GOLD Fire and IGBP-IGAC/BIBEX Workshop and they will be included in a manuscript that is currently under preparation. Another manuscript that reports on seasonal emission factors from African savanna ecosystems is also under preparation. She also contributed to two manuscripts that describe a fuel load model and sensitivity analyses results, developed at the University of Virginia. Ms. Korontzi is currently evaluating different Net Primary Productivity models for use in the fire emissions modeling work.

## **5) MODIS Rapid Response and Fire Web Mapping**

During this reporting period the MODIS Rapid Response System was further developed. Jack Descloitres (SSAI) is the Rapid Fire project manager. John Owens is responsible for the Fire Rapid Response System and developing the Web Site ([www.rapidfire.sci.gsfc.nasa.gov](http://www.rapidfire.sci.gsfc.nasa.gov)) and has provided systems support for the RR processing and distribution system, and developed and implemented the system architecture. Louis Giglio is responsible for developing the RR Fire algorithms and Descloitres and Seaton are responsible for the production system and monitoring the quality of the output products. Presentations on the RR system were made at a number of meetings, including the Spring AGU in Washington DC and the GOFD/GOLD Workshop at UMD.

Owens and Justice strengthened collaborations with GOFD/GOLD partners in SE Asia, Southern Africa, Australia, and Brazil, to provide a feed of near real-time fire detections produced by the MODIS RR System for fire management and science. Justice presented the MODIS Fire Product at a Conference on Savanna Fires in Darwin, Australia, a paper is in preparation. In collaboration with IBAMA (the Brazilian Forest Service) in Brazil, Justice, Owens, Morisette and Csiszar developed plans for collaborative validation activities for the MODIS Fire and Thermal Anomalies product. Justice met with the USFS International Forestry group in Washington to try

and secure funding for Brazilian participation in this MODIS Validation activity. Fire direct broadcast code was provided to Pat Coronado at GSFC for broad distribution. In collaboration with the USFS, Owens provided a near real-time feed of MODIS RR fire detections, enabling the production of the USFS' MODIS Fire Maps western region cumulative fire mapping products. Csiszar has been working with Russian partners at the International Forest and Space Institutes in Moscow on the use Rapid Response products in support of fire management over Russia.

Demonstration activities have been set up a work plan has been developed towards a fully operational processing and use of MODIS fire products in the region. This activity is also part of the emerging Northern Eurasian Earth Science Partnership Initiative led by NASA and the Russian Academy of Sciences.

Owens and Crisologo undertook further development of the MODIS Web Fire Maps site (<http://firemaps.geog.umd.edu>), which makes available to the public an easy to use tool for analyzing MODIS active fire detections in a Web GIS framework for several regions of the world. Preparations were made to demonstrate the Rapidfire System at the NASA Booth at the WSSD Conference in Johannesburg, September 2002.

### Transitioning MODIS Land Rapid Response System to Operational Status in NOAA

Based on discussions at NASA HQ, the Rapid Response Team were encouraged to work towards transitioning the operational aspects of the RR System to NOAA NESDIS. Ivan Csiszar has worked with NOAA officials towards the implementation of the MODIS Land Rapid Response System by the NESDIS OSDPD Interactive Processing Branch. The system was installed by Owens, Descloitres and Csiszar at the NOAA World Weather Building and operational demonstration has been carried out. Fully operational processing is expected to start in Fall 2002 pending the installation of high capacity communication lines at WWB. Csiszar participated in the preparation of a proposal to NOAA Office of Systems Development for a joint NOAA/NASA/UMd collaboration to further operationalize and enhance the system.

## **6) Papers**

Justice C. O., Giglio L., Korontzi S., Owens J., Morisette, J. T., Roy D., Descloitres J., Alleaume S., Petitcolin F., Kaufman Y., 2002, The MODIS Fire Products, Remote Sensing of Environment, in press.

Morisette, J., Giglio, L., Csiszar, I., and Justice, C. O., Validation of the MODIS Active fire product over Southern Africa with ASTER data, submitted. Remote Sensing of Environment, in press

A Framework for the Validation of MODIS Land Products – Jeffrey T. Morisette, Jeffrey L. Privette and Christopher O. Justice, Remote Sensing of Environment, in press

Atmospheric Correction of MODIS Data in the Visible to Middle Infrared: First Results – Eric F. Vermote, Nazmi El Saleous, Christopher O. Justice, Remote Sensing of Environment, in press

Burned Area Mapping Using Multi-Temporal Moderate Spatial Resolution Data – a Bi-Directional Reflectance Model-Based Expectation Approach – D. P. Roy, P. E. Lewis, C. O. Justice, Remote Sensing of Environment, in press

An overview of MODIS Land data processing and product status  
Christopher O. Justice, John R.G. Townshend, Eric Vermote, Ed Masuoka, Robert Wolfe, Nazmi Saleous, David Roy, Jeff Morisette, Remote Sensing of Environment, in press

Towards operational monitoring of terrestrial systems by moderate-resolution remote sensing - John R. G. Townshend, Christopher O. Justice

Satellite-based Fire Monitoring: current capabilities and future directions  
Christopher O Justice, Richard Smith, Malcolm Gill, Ivan Csiszar – International Journal of Wildland Fire – in press

## **Posters Presented**

MODIS Fire Validation (I. Csiszar – GOFC/GOLD-Fire Annual Conference)

Southern Africa Fire Emissions using MODIS (S. Korontzi – GOFC/GOLD-Fire Annual Conference)

## **8) New Staff**

None

