# MODIS Science Team Semi-Annual Report

## July 1 – December 31, 2001

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## a) Task Objectives

This reporting period covers the period post-launch as the MODIS products are starting to be validated and disseminated by the EDC DAAC and the Rapid Response System. The period also covered the MODIS Products Review at GSFC and the EOS Products Review at NASA HQ. Emphasis has been on evaluation of the fire products, determining product quality and accuracy and outreach to users, answering questions and providing information. Considerable attention has been given to coordinating the land product validation activities and outreach to the user community. The slow development of an operational data flow led the team to put considerable effort into developing a rapid response fire monitoring system, in time for the northern hemisphere fire season.

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. This was done through the international program Global Observation of Forest Cover /Global Observation of Landcover Dynamics (GOFC/GOLD), which is part of the Global Terrestrial Observing System (GTOS).

Chris Justice participated in the Discipline Leaders meetings and whenever possible the weekly PI Processing Meetings, 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.

In agreement with the MODIS Project Scientist, resources from this project continue to support the MODIS Surface Reflectance product, the 250m Production System developed in partnership with the NASA Earth System Information Partnerships (ESIPS) 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. A fuller account of this supporting activity is outlined in the companion report of Dr. Vermote.

**b) Tasks Accomplished**

**1) Code Delivery and Product Quality Assessment (Giglio)**

During this reporting period Louis Giglio, completed three revised versions of the MOD14 Code as a result of bugs identified in the production code.
Version 3.0.9 of L2 fire code. This version includes the new coarse resolution active fire product and additional debugging data layers. The code was delivered on July 17.
Version 3.1.4 of the MODIS L2 fire code. This version includes the ECS version of the new coarse resolution active fire product plus some minor bug fixes. The code was delivered to MODIS Land Integration and Test Team on August 27.
Version 3.1.6 of MODIS active fire code. This version contained several minor bug fixes. The code was delivered to SDDT on 12/20.

Giglio attended ten 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 designed a new coarse resolution MODIS fire product with J. Descloitres (SSAI). This product is an improvement over the previous coarse resolution product that was generated by the hybrid MODIS surface reflectance and active fire code. The product was implemented in the version 3.0.9 L2 fire code delivered on 17 July 2001. Giglio met with B. Ridgway (SSAI) on 25 October to discuss problems with the current MODIS processing and distribution scheme as part of MODIS processing Tiger Team Evaluation.
As part of the MODIS Fire Product evaluation, Giglio performed a preliminary TRMM VIRS/MODIS fire product comparison for one month of data over Central Africa. Differences were substantial, and additional work

will have to be performed to explain these large differences. Giglio interacted regularly with D. Roy (UMD/LDOPE) to ensure fire-related topics on the LDOPE "Known Issues" web site were kept up-to-date.

A number of problems were encountered with obtaining MODIS data files from the unstable EOS Data Gateway (EDG) ordering system was not able to find even though they did in fact exist. Giglio documented these problems and submitted them to the EDC DAAC for investigation. Giglio similarly documented several system problems with the MODIS Land development workstation ("modland"), including tampering from off-site intruders, and submitted these to MODIS Land system administration staff. System problems were frequent during the month of August and resulted in many delays delivering version 3.1.4 of the MODIS L2 fire code.

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

The MODIS fire group continued to support the NPP Fire algorithm activities. Justice sent letters to NOAA and the IPO requesting that the NPP instrument include fire monitoring capabilities. The MODIS Fire group was asked to provide supporting material for the NPP fire algorithm discussions. Giglio performed an investigation of Raytheon's multi-band fire characterization proposal at the request of R. Murphy MODIS Project Scientist (GSFC) and concluded that major discontinuities would result in the NPOESS VIIRS Active Fire EDR and that the proposed retrieval technique is problematic. Giglio attended VIIRS Operational Algorithm Team (VOAT) meeting on 23 August to present these results. This work was written up as a short letter and submitted to the International Journal of Remote Sensing.

Giglio repeated earlier work characterizing the distribution of instantaneous active fire temperatures and areas for the NPP VIIRS OAT meeting held in late December. This trial utilized a much larger data set and a slightly improved retrieval algorithm.

Giglio attended NPP VIIRS algorithm TIM (Technical Interchange Meeting) in November to review current Raytheon Active Fire proposal at the request of R. Murphy (GSFC) and the NPP VIIRS active fire algorithm meeting at the request of J. Privette, to discuss VIIRS 11 micron channel saturation with Raytheon representatives on 3 December 2001.

**3) MODIS Active Fire Product Validation (Alleuame, Giglio, Justice) with contributions from Morisette (SSAI) , Roy and Petitcolin (UMD).**

Research was conducted on the validation of the MODIS active fire product (MOD14) by comparison with data from the higher resolution

ASTER instrument. This activity was undertaken in the context of the international collaborative fire product validation activity being developed jointly by the Global Observation of Forest Cover (GOFC/GOLD) and Committee on Earth Observing Satellites Working Group on Calibration and Validation (CEOS WGCV), sub group on Land Product Validation. The approach adopted was to obtain a global sample of high resolution fire detections from different fire regimes, to project the coincident MODIS pixels onto these ASTER scenes, and undertake statistical analysis of the ASTER fire pixels occurring within the larger MODIS fire and non-fire pixels.

ASTER Level-1B Data were ordered through NASA Distributed Active Archive Center (DAAC). More than 115 ASTER scenes have been collected. For now the ASTER scenes are selected manually: MODIS daily scenes were checked through the Rapid Response System. If there was a potential fire detected in the MOD14 product, the corresponding scenes were ordered from the DAAC. After downloading, ASTER scenes are evaluated to identify the presence of fires in ASTER band 9 (2.43_m). Since this procedure is time consuming, an automated process was designed for identifying coincident MODIS-ASTER scenes using the Rapid Response output file and the ASCII version of the ASTER inventory search at EDC-DAAC.

An automatic ASTER/MODIS comparison procedure was developed in collaboration with Francois Petitcolin (UMd). Two models of MODIS pixels were considered: Perfectly square 1 km _ 1 km pixels, and 2 km _ 1 km rectangular pixels having an along-scan triangular line spread function (LSF). This second case was tested to account for the MODIS triangular response. Using cluster analysis, ASTER fire pixels within 150 m of each other were grouped together as a single fire. ASTER fire clusters and MODIS pixels were then associated using nearest neighbor resampling. The projection of MODIS fire pixels on ASTER fire pixels allowed extraction of several variables useful to assess the detection capability of the MODIS fire product. In particular, we concentrated on: (1) the number of ASTER clusters within the MODIS pixel, (2) the average size of those clusters, and (3) the maximum size of the ASTER fire clusters.

Stepwise logistical regression on the three variables ((1) (2) (3)) was produced in order to assess the relationship between MOD14 and ASTER-derived variables. The first results are being submitted for publication.

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

In the context of the international SAFARI 2000 project, a field validation campaign was undertaken by Samuel Alleaume in Zambia from August 10 to Sept 24 and in Namibia from September 16 to September 23, 2001. This was undertaken in collaboration with the Shugart EOS IDS Project. The field measurements consisted essentially of characterization of the vegetation in terms of structure and fuel load. These results contributed to a better understanding of fire ecology and emissions in African ecosystems. The data from this field campaign augmented the database created from the SAFARI-92 and SAFARI-2000 projects and will contribute to improve the existing fire behavior models, fuel loads, and biomass burning emissions estimation for the Southern Africa region.

Stefania Korontzi worked on science applications using MODIS experimental burned area information. The feasibility of using MODIS burned area information to estimate pyrogenic emissions was demonstrated for the 2000 Western U.S fires in Montana and Idaho. Suitable MODIS scenes were mapped for their burned areas. The results were incorporated in a manuscript by Kaufman et al.,(International Journal of Remote Sensing). Furthermore, a prototype spatio-temporal emissions model was developed for the southern Africa region, as part of the SAFARI 2000 international campaign. The model relied, among other datasets, on the MODIS burned area experimental product, developed by Dr. David Roy at GSFC. Results from this study were analyzed and presented at the American Geophysical Union Fall Meeting, in San Francisco. The presentation was received with great interest from the SAFARI 2000 scientific community, as it clearly illustrated the unique capability of the MODIS sensor to provide fire information that was previously unavailable. Currently, a manuscript is in preparation that describes the developed algorithm and discusses the findings from this study.

**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 setting up the Fire Rapid Response System and developing the Web Site (www.rapdfire.sci.gsfc.nasa,gov) and has provided systems administration for the RR processing and distribution system, and developed and implemented future architectures for the systems. Jack Descloitres, John Seaton (SSAI) and Louis Giglio were responsible for developing the algorithms and the production system and monitoring the

quality of the output products. Presentations on the RR system were made to Tim Gubbels (NASA HQ Data), Al Diaz and congressional staffers (NASA/GSFC).

Owens and Justice strengthened collaborations with GOFC/GOLD partners in SE Asia, Southern Africa, Russia, Australia, and Brazil, to provide a feed of near real-time fire detections produced by the MODIS RR System for fire management and science. In collaboration with IBAMA in Brazil, Owens developed plans for future validation activities for the MODIS Fire and Thermal Anomalies product. An active collaboration was established with Rob Sohlberg of UMD (John Townshend, MODIS PI) and the USFS (RSAC) to deliver active fire data and fire direct broadcast code in support of fire management. 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. Owens visited the USFS Remote Sensing Applications Center in Salt Lake City to assist with the installation of the Rapid Response processing package and integration of this with the FS MODIS Direct Broadcast capabilities. Giglio and Owens participated in 8 teleconferences with the USFS.

Owens led 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. This system was included in a presentation on Remote Sensing and GIS Technologies in Africa to Colin Powell (State Department). Alleaume assisted in integrating multi-source data in the web mapping system e.g. by compiling and mosaicking the MOD09 products.

## 6) Papers

Hély C., S., Alleaume, R.J. Swap, C. Justice, and H.H. Shugart, 2001. SAFARI-2000 characterization of fuels, fire behavior, combustion completeness, and emissions from experimental burns in infertile grass savannas in western Zambia, *Journal of Arid Environments*. (Accepted)

Alleaume S., C. Hély, J., Le Roux, S. Korontzi, D. Roy, R.J. Swap, H.H. Shugart, and C.O. Justice. Using MODIS to evaluate heterogeneity of biomass burning in Southern African savannas: Etosha region case study. *International Journal of Remote Sensing* (In preparation)

Giglio, L., and Kendall, J. D., 2001, Application of the Dozier retrieval to wildfire characterization: A sensitivity analysis. *Remote Sensing of Environment*, 77:34-49.

Giglio, L., and Justice, C. O., 2001, Effect of wavelength selection on characterization of fire size and temperature. Submitted.
During this period Justice edited the MODIS Special Edition of the International Journal of Remote Sensing including the MODIS Fire paper:

C. O. Justice, L. Giglio, S. Korontzi, J. Owens, S. Alleaume, J. T. Morisette, D. Roy, F. Petitcolin, J. Descloitres, and Y. Kaufman. Global Fire Products from MODIS. Submitted to *Remote Sensing of Environment (*In preparation*)*

**7) Posters Presented**

S. Korontzi, C. O. Justice, H.H. Shugart, D. Roy , P. Dowty, C. Hély, S. Alleaume, P. Desanker, D. Ward : SAPYRO: A Regional Spatio-temporal Model for Estimating Pyrogenic Emissions From Vegetation Fires in Southern Africa. American Geophysical Union, 2000 Fall Meeting, December 15-19, 2000, San Francisco, California

C. Hély, P. R. Dowty, S. Alleaume, K. K. Caylor, H. H. Shugart, 2001. *Regional Fuel Load Modeled for Two Contrasting Years in Central and Southern Africa*. American Geophysical Union, 2000 Fall Meeting, December 15-19, 2000, San Francisco, California

C. Hély, S. Alleaume,J. Le Roux, S. Korontzi, R.J. Swap, C. Justice, and H.H. Shugart, 2001. *Using MODIS to evaluate heterogeneity of biomass burning and emissions in Southern African savannas: Etosha National Park Case Study*. IGBP Workshop on Challenges of a changing Earth, Juillet, Amsterdam, Pays-Bas.

D. P. Roy, C.O. Justice, L. Giglio, F. Petitcolin, E. Vermote, J. Morisette, 2001. *The Moderate Resolution Imaging Spectroradiometer (MODIS) fire products and SAFARI 2000: mapping and validation of regional biomass burning*. 2001 Fall Meeting, 10-14 December 2001, San Francisco, California.

C. O. Justice, L. Giglio, J. Descloitres, D. Roy, S. Korontzi, S. Alleaume, Y. Kaufman, 2000. *Monitoring Fires with the Moderate resolution Imaging*

*Spectroradiometer*, 2000 Fall Meeting, December 15-19, San Francisco, California.

C. O. Justice and L. Giglio, *MODIS Fire Products*. MODIS Science Team Meetings. December17-19, Maryland.

**8) New Staff**

Ivan Csiszar (Research Associate, UMd)