

MODIS Quarterly Report, Sept 1997

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This reports covers the **aerosol ocean and aerosol land algorithm**, the **NIR water vapor algorithm** and our involvement in the **fire algorithm**.

Main topics addressed in this period:

1. Version 2 algorithms for all products. (*Chu, Mattoo, Li, Remer*)
2. Presented MODIS atmosphere QA plan in EOS QA workshop in July 9-10 (*Chu*).
3. Analysis of field experiment data (*Kaufman, Kleidman, Ji*)
4. Analysis of data from laboratory experiment, in the Forest Service Fire Lab. with an CIA/John Hopkins Univ. instrument. (*Kaufman, Wald*),
5. Development of a new technique for remote sensing of dust over land using IR channels, to supplement present algorithm for remote sensing of aerosol from MODIS (*Wald, Tanre, Kaufman*)
6. Surface properties in the mid-IR and the visible: (*Wald, Karnieli, Kaufman, Remer, Mekler*)
7. Archiving of Images (*Li*)
8. Analyzed smoke effects on column stability (*Remer, Joseph*)
9. Study of vegetation indices. (*Kaufman, Li*)
10. CZCS algorithm comparison (*Fraser*)
11. Attended meetings: New Hampshire (*Kaufman*), MTPE and SIMBIOS review (*Fraser*) AAAR in Denver (*Kaufman*) EOS-validation in NASA Langley (*Kaufman*)
12. Aerosol research group web page organized. (*Ramaprasad*)
13. Six papers submitted to SCAR-B special issue of JGR (*Kaufman, Ji, Wald, Remer, Chu, Kleidman, Yamasoe*)
14. Publication of JGR special issue on remote sensing of aerosol and atmospheric correction (*Kaufman, Tanré, Fraser, Remer, Mattoo, Chu*)
15. Publication of papers in Science and in IEEE Trans Geosci. (*Kaufman, Fraser, Wald, Remer, Gao, Li*)

Topics postponed (or continued) to next quarter

1. New smoke-cloud interaction analysis
2. Dust aerosol model (*Tanré, Fraser*)
3. Comparison of IR dust retrieval with AVHRR retrieval for selected images near African coast.

Plans for the next quarter:

1. Version 2 delivery

2. In depth analysis of Israel spectra data: algorithm assumptions testing and vegetation indices analysis.
3. Implementation of Aerosol Group's web page.

1. Version 2 Algorithms

Ocean and land algorithms completed and integrated. All Version 2 toolkits and EOS HDF formats implemented. The combined program was tested using synthetic data. It runs successfully. The independent ocean algorithm was further tested using TARFOX MAS imagery with UKMO C130 aerosol size information. The land algorithm was tested against AERONET data. Good results with both algorithms. Total precipitable water algorithm completed. Integration still in progress. Stand alone precipitable water vapor tested with SCAR-B MAS measurements showed large discrepancy between 0.91 and 0.94 micron channel. Continued investigation necessary.

2. QA plan presented

Atmospheres QA plan presented at EOS-QA workshop July 9-10.

3. Field Experiment Data Analysis

1) Fire analysis from MAS imagery. Analysis and figures finished for paper. 2) Analysis of TARFOX DMPS data, concentrating on calculations of humidification factor. Investigated the similarity in TARFOX and SCAR-B CCN characteristics despite different hygroscopicity 3) Began analysis integrating Cuiaba cascade impactor data with DMPS data.

4. Laboratory experiment at USFS Fire Lab

Analysis of fire laboratory data show possibility of routine satellite monitoring of fires and fire products is possible. Products include total mass loss, total carbon burnt and total emitted energy. Preliminary analysis of smoke products as function of fire temperature written into paper submitted to SCAR-B special issue. Plans underway for follow-up experiment covering full spectral and dynamic range of fire radiance.

5. Remote sensing of dust using IR techniques

The development of a new technique for remote sensing of dust over land using IR channels is progressing well. Retrieval of optical thickness is confirmed using ground-based sunphotometry for optical thickness. Column water vapor variability presents a limitation on technique's robustness. Other IR channels that will reduce water vapor effects are currently being explored. Simulations have begun in order to test the observations against theory. Preliminary results written into a "concept paper" to be submitted to Geophysical Research Letters.

6. Surface Properties in the Mid-IR and visible channels

We collected spectrometer data over Charles County in July. This will add to our growing collection of surface spectra and almost round out our monitoring of the seasonal changes of surface spectral signature over a growing season. Data analysis on the spectra collected in Israel in May was begun. A hardware error concerning the time stamp on each file was discovered and fixed.

7. Archiving of Images and Validation

MAS and AVIRIS images from SCAR-B and TARFOX, and TM images of Africa were processed, resampled and archived for various purposes: vegetation index study, illustrations for papers, fire analysis, testing Version 2 algorithm etc.

8. Effect of smoke on column stability

In conjunction with J. Joseph of Tel Aviv University the previous analyses of the radiosonde data in Brazil were re-examined. The problem was better defined and a plan was drawn up. Collaboration with Ming-Dah Chou, Wei-Kuo Tao and Pinhas Alpert was initiated. P. Alpert did some preliminary analysis looking for a biomass burning signature in the IAU data from the Goddard Data Assimilation Office. No defining evidence was found and that method of analysis was discarded. The radiation code of M.-D. Chou was used to investigate the heating rates of an atmospheric column similar to the one used in the Ross and Hobbs (RH) investigative study. The results show a similar heating by the smoke aerosol as RH in the solar spectrum, but the IR spectrum that RH ignore dominates the heating profile and is in turn dominated by the strength of the inversion. A series of sensitivity studies using the Chou code are planned. The ultimate goal will be to run the Tao mesoscale model with an interactive surface and clouds to further understand the factors influencing dynamic stability in Brazil during the dry season.

9. Vegetation Indices

Continued testing of various published vegetation indices (NDVI, ARVI, GARI, NDWI etc) and a new suggested index based on the 1.2 and 2.1 shows the strengths of the new index in hazy situations - AFRI the Atmospherically FRee vegetation Index .

10. CZCS algorithm comparison

Studied the pigment concentrations derived from 4 CZCS images by the operational algorithm and one we constructed. Although the water leaving radiances differed for the two algorithms, the pigment concentrations were essentially the same.

11. Meetings and review panels attended

Y. Kaufman attended the aerosol and visibility meeting in New Hampshire in September and the AAAR aerosol meeting in Denver in Oct. R. Fraser attended the review for MTPE and SIMBIOS in July. Kaufman attended the EOS atmospheric validation meeting in NASA Langley in Oct.

12. Web Page

A web page is in development to showcase the work and achievements of the Aerosol Research Group. It is expected that eventually not only will current and past research be summarized, but papers and data sets will be made available to web users.

13. Papers submitted

The following papers have been submitted to the SCAR-B special issue of JGR.

Chu, D.A., Y.J. Kaufman, L.A. Remer and B.N. Holben, Remote sensing of smoke from MODIS airborne simulator during the SCAR-B experiment., *J. Geophys. Res.*, submitted to the SCAR-B special issue.

Ji, Q., S.-C. Tsay, Y.J. Kaufman, G. Shaw and W. Cantrell, Ground-based measurements of aerosol characteristics in biomass burning and industrial pollution episodes *J. Geophys. Res.*, submitted to the SCAR-B special issue.

Kaufman, Y.J., P.V. Hobbs, V.W.J.H. Kirchoff, P. Artaxo, L.A. Remer, B.N. Holben, M.D. King, D.E. Ward, E.M. Prins, K.M. Longo, L.F. Mattos, C.A. Nobre, A.M. Thompson, J.F. Gleason and S.A. Christopher, The Smoke Cloud and Radiation Experiment in Brazil *J. Geophys. Res.*, submitted to the SCAR-B special issue .

Kaufman, Y.J., R.K. Kleidman and M.D. King, SCAR-B Fires in the Tropics: Properties and their Remote Sensing from EOS-MODIS, *J. Geophys. Res.*, submitted to the SCAR-B special issue.

Remer, L.A., Y.J. Kaufman, B.N. Holben, A.M. Thompson and D. McNamara, A model of tropical biomass burning smoke aerosol size distribution., *J. Geophys. Res.*, submitted to SCAR-B special issue.

Wald, A., Y. Kaufman, R. Susott, R. Babbitt, D. Ward, A. Abtahi, A. Korb, Laboratory studies of biomass fires. ., *J. Geophys. Res.*, submitted to SCAR-B special issue.

Yamasoe, M.A., Y.J. Kaufman, O. Dubovik, L.A. Remer, B.N. Holben and P. Artaxo, Retrieval of the real part of the refractive index of aerosols from sun/sky radiometers *J. Geophys. Res.*, submitted to the SCAR-B special issue.

14. Papers Published in special issue

JGR special issue on Passive Remote Sensing of Tropospheric Aerosol and Atmospheric Correction for the Aerosol Effect by Y.J. Kaufman, D. Tanré, H.R. Gordon and T. Nakajima appeared in the July 27, 1997 issue of JGR. Papers appearing in the special issue include:

Fraser, R.S., S. Mattoo, E.-N. Yeh and C.R. McClain, Algorithm for atmospheric and glint corrections of satellite measurements of ocean pigment., *J. Geophys. Res.*, 102, 17107-17118, 1997.

Kaufman, Y.J., D. Tanré, H.R. Gordon, T. Nakajima, J. Lenoble, R. Frouin, H. Grassl, B.M. Herman, M.D. King and P.M. Teillet, Passive remote sensing of tropospheric aerosol and atmospheric correction for the aerosol effect., *J. Geophys. Res.*, 102, 16815-16830, 1997.

Kaufman, Y.J., D. Tanré, L.A. Remer, E. Vermote, A. Chu and B.N. Holben, Operational remote sensing of tropospheric aerosol over land from EOS moderate resolution imaging spectroradiometer., *J. Geophys. Res.*, 102, 17051-17067, 1997.

Remer, L.A., S. Gassó, D.A. Hegg, Y.J. Kaufman and B.N. Holben, Urban/industrial aerosol: Ground-based sun/sky radiometer and airborne in situ measurements., *J. Geophys. Res.*, 102, 16849-16859, 1997.

Tanré, D., Y.J. Kaufman, M. Herman and S. Mattoo, Remote sensing of aerosol properties over oceans using the MODIS/EOS spectral radiances., *J. Geophys. Res.*, 102, 16971-16988, 1997.

Vermote, E.F., N.E. Saleous, C.O. Justice, Y.J. Kaufman, J.L. Privette, L.A. Remer, J.C. Roger and D. Tanré, Atmospheric correction of visible to middle-infrared EOS-MODIS data over land surfaces: Background, operational algorithm and validation., *J. Geophys. Res.*, 102, 17131-17141, 1997.

15. Other Papers Published during the quarter

Kaufman, Y.J. and R.S. Fraser, The effect of smoke particles on clouds and climate forcing., *Science*, 277, 1636-1639, 1997.

Kaufman, Y.J., A.E. Wald, L.A. Remer, B.-C. Gao, R.-R. Li and L. Flynn, The MODIS 2.1 μm Channel - Correlation with visible reflectance for use in remote sensing of aerosol., *IEEE Trans. Geo*, 35, 1286-1298, 1997.