

Final report for NASA grant NAGW-3740 titled "The impact of aerosols generated from biomass burning, dust storms, and volcanoes upon the earth's radiative energy budget".

submitted by

Dr. Sundar A. Christopher
Department of Atmospheric Sciences
University of Alabama in Huntsville
Global Hydrology and Climate Center
977 Explorer Boulevard
Huntsville, AL 35899

submitted to:

Dr. Robert J. Curran
NASA Headquarters
Washington DC, 20546

Final
70-45012

4CIT
898444

Objective:

The two main objectives of this research effort was to

1. Using satellite imagery to detect aerosols generated from biomass burning, dust storms, and volcanic events, and
2. Estimate the radiative forcing of aerosols using the Earth Radiation Budget scanner data.

Significant accomplishments.

1. A new technique for detecting aerosols from biomass burning and dust storms has been developed.
2. The instantaneous net radiative forcing of biomass burning aerosols is -36W/m^2 . This estimate was derived from a new approach using collocated AVHRR and ERBE data.
3. The radiative forcing of aerosols has been estimated over four major ecosystems in South America. The net radiative forcing values are also negative.
4. A new smoke and fire detection scheme has been developed for biomass burning aerosols over South America.
5. Surface shortwave irradiance calculations has been developed in the presence of biomass burning aerosols during the SCAR-B experiment. This new approach utilizes ground based, aircraft, and satellite measurements.
6. The URL http://cloud.atmos.uah.edu/~sundar/res_list.html has been designed to highlight ongoing work in this area.

Publications.

Several journal and conference papers were published as part of this research effort.

1. Christopher, S.A., D. Kliche, V.S. Connors, and R.M. Welch, 1997: Satellite investigations of fires, smoke and Carbon Monoxide during the April 1994 MAPS missions: Case studies over tropical Asia, in press, *J. Geophys. Res.* (paper attached)

In this paper, biomass burning fires and smoke aerosols over Asia are detected using a combination of spectral measures. Then using empirical relationships, the carbon monoxide concentrations are computed from AVHRR data. These data are then compared with the space shuttle measurements made by MAPS. Results show that the spatial distribution of fires compare well with the CO concentrations as measured by the MAPS.

2. Christopher, S.A., and J. Chou, 1997: The potential of the AGLP and ERBE data sets for fire, smoke, and earth radiation. *Int. J. Rem. Sensing*, 18, 2657-2676. (paper attached)

Using coarse resolution AVHRR Land Pathfinder data set, the spatial and temporal patterns of fires are evaluated, The radiative forcing of smoke is also estimated from ERBE data.

3. Christopher, S.A., M. Wang, S.K. Yang, and R.M. Welch, 1996: The 1985 biomass burning season in South America: Satellite remote sensing of fires, smoke and regional radiative energy budgets. *J.Appl. Meteor.* (accepted) (paper attached)

Using collocated AVHRR and ERBE data, the instantaneous net radiative forcing of smoke aerosols over South America are evaluated.

4. Christopher, S. A., D. V. Kliche, J. Chou, and R.M. Welch, 1996: First Estimates of the Radiative Forcing of Aerosols Generated from Biomass burning Using Satellite Data. *J. Geophys. Res.*, 101,D16, 21265-21273. (paper attached)

This is one of the first studies to obtain radiative forcing of aerosols from satellite data alone.

Conference papers:

- Christopher, S.A, D.V. Kliche, and R.M. Welch, 1997: AVHRR and ERBE investigations of biomass burning in the tropics, *In Global Biomass Burning*, Ed, J.S. Levine, MIT Press.
- Christopher. S. A., 1997: Satellite Remote Sensing of Fire, Smoke and regional radiative energy budgets over South America. IGARSS 1997
- Christopher, S. A., 1997: Satellite Remote Sensing of Global Fire patterns during April 1994. IGARSS, Singapore.
- Christopher, S. A., Min Wang, D. V. Kliche, S. K. Yang, and R. M. Welch, 1997: Satellite estimates of the direct radiative forcing of biomass burning aerosols over South America and Africa. Radiation Conference Long Beach California.
- Christopher, S. A., and R. M. Welch, 1996: Radiative forcing of biomass burning aerosols. SCAR-B Symposium , Fortaleza, Brazil, 23-27
- Christopher, S.A., D.V. Vulcan and R.M. Welch, 1995: Regional Radiative Effects of Biomass burning , Dust Storms and Forest Fires, 8th conference on Satellite Meteorology and Oceanography in Atlanta, Georgia

In preparation

1. Christopher, S.A., M. Wang, S.K. Yang, and R.M. Welch, 1997: Satellite Remote Sensing of Fires and Smoke from NOAA-14 AVHRR. special issue on SCAR-B. *J. Geophys. Res.*

This paper maps the spatial and temporal distribution of fires during the SCAR-B campaign. A new smoke detection scheme has been developed.

2. Christopher, S.A. X. Li, J. Chou, R.M. Welch, T. Eck, B. Holben, J. Reid, and P.V. Hobbs, 1997: Validation of downward shortwave irradiances during SCAR-B. special issue on SCAR-B. *J. Geophys. Res.*

Using a coupled satellite, insitu, ground-based observation method, his paper outlines the methodology to validate the downward shortwave irradiances in the presence of biomass burning aerosols.