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TITLE: Combined Lidar and Passive Sensing Techniques for Characterization of Aerosol Radiative Effects

Activities of note during the second year of this project are summarized as follows:

- Continued analysis of ACE-2 Micro-Pulse Lidar (MPL) and solar radiometer data to extract further information about aerosol extinction and backscatter properties and use of same in better defining aerosol properties needed to improve modeling of climate forcing by aerosols. Some results have been reported in the Tellus special ACE-2 issue (listed in GACP Bibliography section). Additional results have been obtained pertaining to marine aerosol extinction-to-backscatter ratio characteristics.

- Participated in a lidar, solar radiometer and scattering nephelometer experiment at Bondville, IL during late August and September of 1999 to validate lidar extinction retrievals and better characterize aerosol extinction-to-backscatter ratios for a variety of atmospheric conditions. This was a cooperative effort with another GACP funded project ("Validation of the Lidar Retrieval of Aerosol Extinction" - D.S. Covert & T.L. Anderson, PI's). MPL's used in the experiment were loaned by NASA Langley Research Center. A slant-path sensing mirror system fitted to one of the MPL's was loaned by Dr. Jim Spinhirne, NASA Goddard Space Flight Center. Preliminary lidar results were reported in a paper presented at IGARSS'2000, July, 2000 (listed in GACP Bibliography section). Work continues with the analysis of data collected during this experiment with the goal of submitting a paper to JAS by December, 2000.

- Continued cooperative interactions with NASA AERONET program. Through the assistance of A. Smirnov, obtained AERONET data base information from which aerosol extinction-to-backscatter ratios were extracted for representative aerosol types. This is an important contribution towards the goal of defining an aerosol extinction-to-backscatter ratio climatology. Establishing such a climatology is key to combining lidar and passive sensing techniques for characterizing aerosol radiative effects.

- Continued cooperative interactions with ongoing MPL ground-based sensing programs and future spaceborne lidar programs. The MPL interactions include the

DOE ARM and NASA MPL field programs coordinated by Dr. Jim Spinhirne, NASA Goddard Space Flight Center (GSFC). The spaceborne lidar interactions include the Geoscience Laser Altimeter System (GLAS) satellite atmospheric lidar program component, working with Dr. Jim Spinhirne, NASA/GSFC, and the new PICASSO-CENA ESSP satellite lidar program led by NASA Langley Research Center (P.I. John Reagan is a member of the PICASSO-CENA Science Team). Made presentations at GLAS and PICASSO-CENA Science Team meetings on preliminary efforts towards defining an aerosol extinction-to-backscatter ratio climatology.

- Began development of a database of aerosol properties based on the work of the Multi-Angle Imaging Spectroradiometer (MISR) group at JPL. This database will be used as part of the effort to improve the aerosol retrieval from the passive remote sensing systems and as a constraint on the lidar retrievals for comparison purposes.

- Continued field collections of sun photometer data related to validation campaigns for Landsat-7 Enhanced Thematic Mapper Plus and several sensors on the Terra platform. Related to this work were studies of the effects of aerosols on calibration of sensors such as MODIS and MISR when viewing a calibration test site at large view angles. This sensitivity study showed that large view angles of current test sites being used for calibration purposes are not significantly more sensitive to uncertainties in aerosol characterization than the near-nadir-viewing case. However, when solar zenith angles exceed 60 degrees, or the aerosols contain soot, uncertainties at large satellite view angles are significantly larger than the near-nadir case.

- Related to field collections of sun photometer data, measurements in the Tucson area were continued for development of a multi-year study of aerosols. The measurements began in March 1999 with collections being made on every day it was possible to track the sun with our automated radiometer and personnel were available to set up the equipment. This resulted in more than 100 data sets ending December 1999 when personnel to operate the equipment became unavailable. A side benefit to this work has also been the ability to study how these automated radiometers degrade with time.

GACP THIRD YEAR STATEMENT OF WORK

Name: John A. Reagan and Kurtis Thome

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Planned activities for year three of GACP are summarized as follows:

- Using improved estimates of aerosol extinction-to-backscatter ratios, continue analysis of LITE spaceborne lidar data and ACE-2 Micro-Pulse Lidar (MPL) data, and associated solar radiometer data, to extract further information about global aerosol optical/physical properties. Also, continue to test/validate how best to link these active and passive measurements in combined aerosol retrievals.

- Continue analysis of lidar, solar radiometer and scattering nephelometer data obtained in the Bondville, IL experiment, conducted during late August and September of 1999, to validate lidar extinction retrievals and better characterize aerosol extinction-to-backscatter ratios for a variety of atmospheric conditions. This is a cooperative effort with another GACP funded project ("Validation of the Lidar Retrieval of Aerosol Extinction" - D.S. Covert & T.L. Anderson, PI's).

- Continue evaluation of multiple instrument observations to understand the differences between measurements of solar transmittance, sky radiance and downwelling irradiance, and the impact of these differences on retrieved aerosol properties. Emphasis will be on further evaluations of diffuse-to-global observations and comparisons with results from the AERONET radiometer observations.

- Evaluate the ability of aerosol radiative models to predict the results of ground-based passive and active measurements. This work will begin by using the aerosol climatology developed for the MISR atmospheric correction plus further investigations of Micro-Pulse Lidar and solar radiometer data sets obtained from ACE-2 and the Bondville, IL LINC experiment.

- Continue cooperative interactions with ongoing MPL ground-based sensing programs and future spaceborne lidar programs. The MPL interactions include the DOE ARM and NASA MPL field programs coordinated by Dr. Jim Spinhirne, NASA Goddard Space Flight Center (GSFC). The spaceborne lidar interactions include the Geoscience Laser Altimeter System (GLAS) satellite atmospheric lidar program component, working with Dr. Jim Spinhirne, NASA/GSFC, and the new PICASSO-CENA ESSP satellite lidar program led by NASA Langley Research Center (P.I. John Reagan is a member of the PICASSO-CENA Science Team).

- Complete processing of lidar, solar radiometer data from the Bondville, IL experiment for comparison with scattering nephelometer data and validation of lidar extinction and backscatter retrievals. Results of this work are planned for submission to JAS by December, 2000.

- Use AERONET inferred extinction-to-backscatter ratios for establishing a link between lidar and passive sensing techniques for characterizing aerosol radiative effects. This work will also incorporate the aerosol databases used in establishing the MISR aerosol climatology.

- Conduct a sensitivity analysis of the ground-reference calibrations of Terra sensors to uncertainties in aerosol assumptions. The study will focus on the use of diffuse/direct irradiance measurements in defining the aerosol type and will include results of measurements from campaigns during the year 2000.

- Continue measurements of sun photometer in the Tucson area for development of a multi-year study of aerosols. Data were not collected from December 1999 until August 2000 due to personnel limitations and a demanding field schedule. These measurements will be restarted in September 2000. Preliminary results will be submitted to JAS in December, 2000.

GACP BIBLIOGRAPHY

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