MODELED AEROSOL OPTICAL PROPERTIES FROM MEASUREMENT-BASED MIXTURES OF CHEMICAL SPECIES: ASSESSING THE IMPACTS OF PARTICLE MORPHOLOGY AND ABSORPTION

SUMMARY OF RESEARCH
11/01/1998 – 12/31/2001

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This report serves as the final report for the Colorado State University portion of this grant. The original grant was awarded to CSU under the direction of co-Principal Investigators Kirk Fuller and Sonia Kreidenweis. Upon Dr. Fuller's relocation to the University of Alabama – Huntsville, the major portion of the award was also relocated. The following summarizes only that work completed by Prof. Kreidenweis under her remaining award.

SUMMARIES OF SIGNIFICANT ACCOMPLISHMENTS:

1. Calculation of aerosol hygroscopic and optical properties from data obtained in the Southeastern Aerosol and Visibility Study (SEAVS).

In accordance with the tasks outlined in the original proposal, chemical and physical aerosol measurements made at the surface in Great Smoky Mountains National Park during SEAVS were compiled into tables of aerosol properties as a function of relative humidity. These tables were provided to Dr. Fuller for further radiative transfer calculations and also posted to the GACP web site. Examples of relevant data are shown in the two accompanying figures. The first shows the ratio of scattering at the relative humidity, RH, indicated on the x axis, to the scattering at the baseline "dry" RH (here, taken as 30%). Variations in the scattering ratio can be traced to different air mass types that had correspondingly different chemical compositions and aerosol size distributions. The second figure summarized particle hygroscopic characteristics in a timeline for the study that again shows the influence of changes in air mass source region and aerosol chemistry. The significant variations seen during these several weeks in summer 1999 should be observable as changes in TOA radiative forcing.

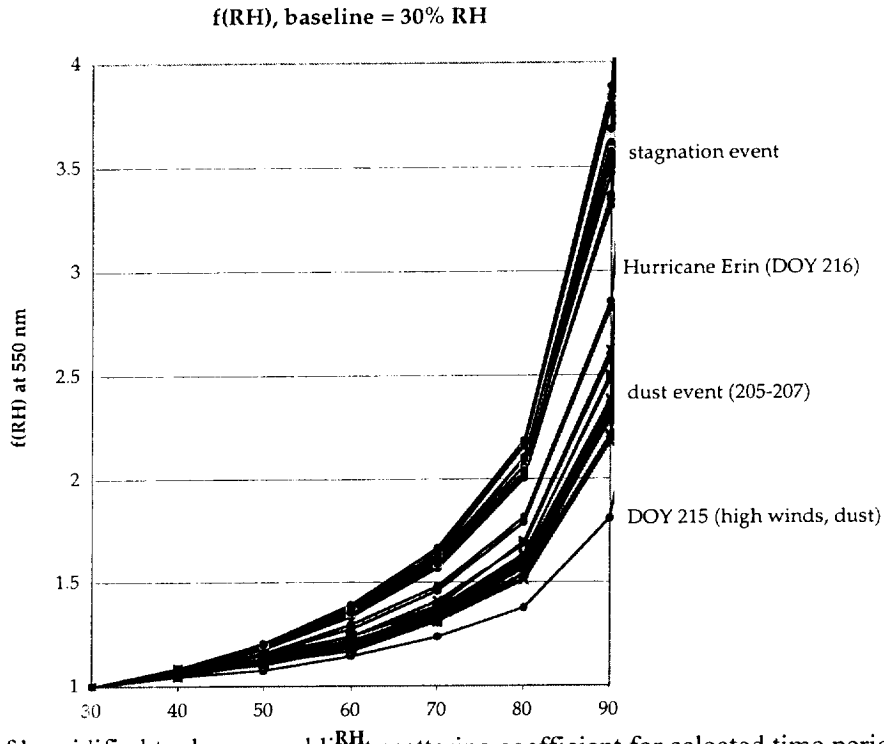

Figure 1. Ratio of humidified to dry aerosol light scattering coefficient for selected time periods during SEAVS.

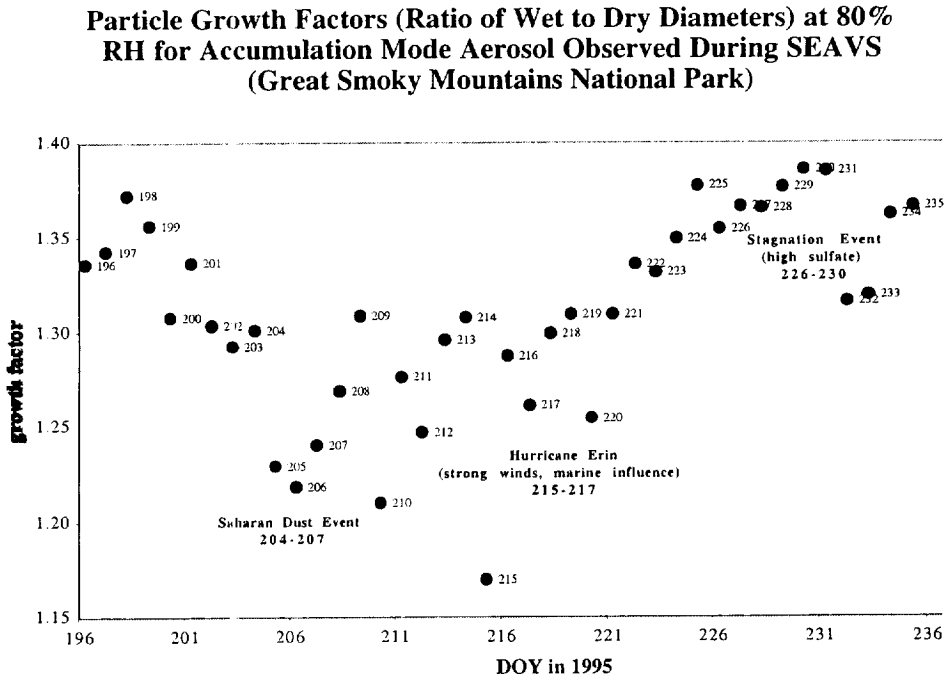

Figure 2. Timeline of particle hygroscopicity estimates during SEAVS.

2. Investigation of smoke optical properties from the May 1998 Mexico fires.

The grant partially supported S. Kreidenweis' sabbatical visit to Goddard Space Flight Center in the second half of 1999. During this time, she began a study of the optical properties of the smoke from the 1998 Mexican fires that was transported to the U.S. This work combined chemical data from the IMPROVE aerosol monitoring network with in-situ data from the smoke plumes. It was found that the smoke appeared to be significantly more hygroscopic, and to have a higher albedo, than smoke from prior biomass burning projects in South America and Africa. The work culminated in the following publication (a copy is enclosed) that cites the support of this grant.

S.M. Kreidenweis, L. A. Remer, R. Bruintjes, and O. Dubovik, Smoke aerosol from biomass burning in Mexico: Hygroscopic smoke optical model. *J. Geophys. Res.*, 106, 4831-4844, 2001.

The work also led to the discovery that seasonal biomass burning appeared to affect air quality in Big Bend National Park, on the Texas-Mexico border, annually. These ideas were of great interest to the National Park Service and led to further study that confirmed these impacts.

3. Comparison of ground-based aerosol data with aerosol properties derived from sun photometry.

In a separately-funded study, four months of ground-based aerosol physical and chemical measurements were made at Big Bend National Park, Texas, in 1999 as part of the Big Bend Aerosol and Visibility Observational (BRAVO) Study. This NASA project supported an offshoot analysis that compared the boundary-layer aerosol observations with aerosol optical depth and Angstrom exponent from a USDA visible MFRSR sun photometer. Although the measurements were not co-located, excellent agreement was found between them (Figure 3), indicating that the boundary layer was well-mixed and that most of the aerosol was confined to the boundary layer. The results are in a manuscript that is currently being prepared for submission and that will acknowledge support from this grant:

J. L. Hand, S. M. Kreidenweis, J. Slusser and G. Scott, Comparisons of aerosol optical properties derived from sun photometry to estimates inferred from surface measurements in Big Bend National Park, Texas. *J. Atmos. Sci.*, in preparation.

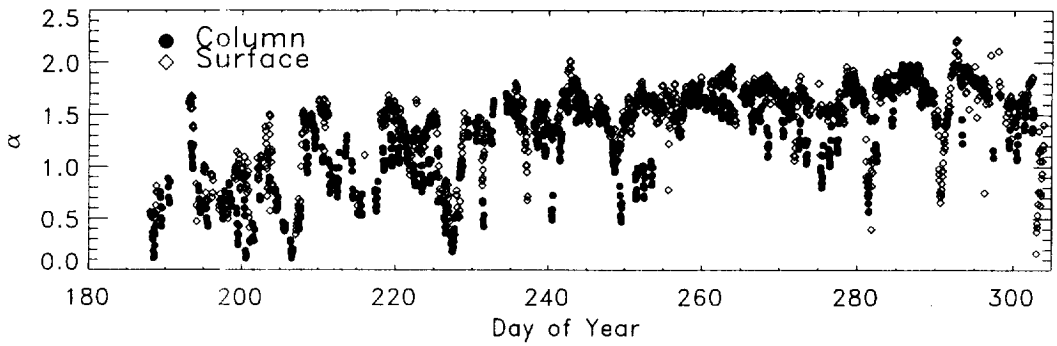

Figure 3. Comparison of Angstrom exponent computed from in-situ aerosol data and derived from sun photometer data for July-October 1999 in Big Bend National Park.