Project Title: **Global Distribution of Tropospheric Aerosols: A 3-D Model Analysis of Satellite Data**

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A. Second Year Progress Report (August 1, 1999 - July 30, 2000)

In the second year of this investigation, the following tasks have been accomplished:

(1) The wet scavenging in sulfate simulation in the GOCART model has been improved by using the global precipitation data product, which is a merged product from the rain gauge measurements, satellite (SSM/I) observations, and data assimilation results (Houser et al., NASA Goddard Space Flight Center, manuscript in preparation).

(2) Dust emission has been modified by using an updated global vegetation map from the AVHRR. The major improvement is in the emission in southern hemisphere, which was too high in the old version.

(3) Detailed analysis of relationships between the TOMS absorbing aerosol index and meteorological variables over the dust source regions has been conducted. The meteorological variables include the surface wind speed, surface wetness, boundary layer depth, and surface level pressure.

(4) Simulations of organic carbon and black carbon have been implemented in the GOCART model. The updated BC emission inventory (Cooke et al., 1999) is used, and both hydrophilic and hydrophobic carbonaceous aerosols are considered.

(5) Total aerosol optical depth have been calculated. With all the major tropospheric aerosols (sulfate, dust, OC, BC, seasalt) simulated in the GOCART model and assuming an external mixture, we have used a mie code to calculate the optical properties (optical thickness, single scattering albedo, and asymmetry factor) of individual aerosols. The calculated total aerosol optical thickness is compared with the measured data from the AERONET sunphotometer network at many stations around the globe.

(6) We have contributed to the IPCC Third Assessment Report (TAR) by supplying the global dust emission and simulating the loading and optical thickness of major aerosol types using the IPCC projected present and future emission scenarios.

(7) With the total or partial support from this grant, two manuscripts have been accepted for publication in JGR (Chin et al., 2000a,b), two manuscripts are in preparation to be submitted to JGR (Ginoux et al., 2000a,b), and five papers were presented at the AGU Spring 2000 and the Western Pacific Geophysics Meeting.

B. Third Year Statement of Work

In the final year of the first phase of this investigation, we plan to do the following:

(1) Calculate the direct radiative forcing by individual aerosol types. We are going to use the radiative transfer model by Ming-Dah Chou at GSFC to calculate the direct radiative forcing using the aerosol fields in the GOCART model. This radiative transfer model has been used in the Goddard Data Assimilation Office in generating the assimilated meteorological data that we use in the GOCART model.

(2) Investigate the state of mixing of different types of aerosols. Our initial calculations for aerosol optical properties and radiative forcing will be based on the assumption that all the aerosols are externally mixed. However, this assumption is highly simplified, and the optical properties and radiative forcing are sensitive to how the aerosols are externally and internally mixed. While it is probably difficult to determine the mixing state in the real world, we will conduct a series of sensitivity studies to examine the response of the optical properties to the assumption of mixing state.

(3) Study the interactions between aerosols and tropospheric chemistry. We have done some preliminary test on the change of NO_2 and O_3 photolysis rates in the presence of dust aerosol. We plan to continue to investigate the issue of aerosol-chemistry interactions with a 1-D photochemical model.

(4) Submit 2-4 manuscripts.

C. Publications and Presentations:

Journal publications:

Chin, M., R. B. Rood, S.-J. Lin, J.-F. Muller, A. M. Thompson, Atmospheric sulfur cycle simulated in the global model GOCART: Model description and global properties, *J. Geophys. Res.,* in press, 2000a.

Chin, M., D. L. Savoie, B. J. Huebert, A. R. Bandy, D. C. Thornton, T. S. Bates, P. K. Quinn, E. S. Saltzman, W. J. De Bruyn, Atmospheric sulfur cycle simulated in the global model GOCART: Comparison with field observations and regional budgets, *J. Geophys. Res.,* in press, 2000b.

Ginoux, P., M. Chin, I. Tegen, D. Savoie, J. Prospero, B. Holben, S.-J. Lin, Global simulation of dust in the troposphere: Model description and evaluation, to be submitted to *J. Geophys. Res.*, 2000a.

Ginoux, P., J. Prospero, O. Torres, Global dust sources: Meteorological characterization, to be submitted to *J. Geophys. Res.*, 2000b.

Conference presentations:

Chin, M., P. Ginoux, The GOCART model study of aerosol composition and optical thicknesses: Present and future, Western Pacific Geophysics Meeting, Tokyo, Japan, 2000.

Chin, M., D. Thornton, A. Bandy, and B. Huebert, A 3-D model analysis of the impact of Asian anthropogenic emissions on the sulfur cycle over the Pacific Ocean, Western Pacific Geophysics Meeting, Tokyo, Japan, 2000.

Chin, M., P. Ginoux, O. Torres, X. Zhao, A 3-D model study of aerosol composition and optical thickness in the Asian-Pacific Region, Western Pacific Geophysics Meeting, Tokyo, Japan, 2000.

Ginoux, P., J. Prospero, O. Torres, Meteorological characterization of global dust sources, American Geophysical Union Spring meeting, Washington D.C., 2000.

Ginoux, P., S. Madronich, Global analysis of the effects of dust on the photodissociation rates, American Geophysical Union Spring meeting, Washington D.C., 2000.