BNL - 64294
ABSTR.

SEASONAL VARIABILITY OF SULFATE BURDENS OVER THE NORTH ATLANTIC OCEAN

Carmen M. Benkovitz and Stephen E. Schwartz
Environmental Chemistry Division
Department of Applied Science
Brookhaven National Laboratory
Upton, NY 11973-5000

April 1997

Submitted for presentation at
the AGU/AWMA Specialty Conference
Visual Air Quality, Aerosols, and Global Radiation Balance
Burlington, VT
September 9-12, 1997

This research was performed under the auspices of the U.S. Department of Energy under Contract No. DE-AC02-76CH00016, with support from the Atmospheric Chemistry Program (ACP) under the Office of Health and Environmental Research.

ABSTRACT

Anthropogenic sulfate aerosol influences the global energy budget through the enhancement of clear-sky and cloud albedo [*Twomey et al.*, 1984; *Charlson et al.*, 1992]. Here we report on a study of the seasonal variability of sulfate burdens (volume integral of the concentration) over the North Atlantic Ocean using a sub-hemispheric scale Eulerian transport and transformation model that calculates sulfate burdens from precursor emissions. The meteorological driver is the output from the 6-hr forecast model of the European Centre for Medium-Range Weather Forecasts; the model includes transport, sulfur chemistry with parameterized oxidant concentrations, time-and-location dependent dry deposition, and wet deposition [*Benkovitz et al.*, 1994].

Simulations have been performed for an area from 141°W to 62°E and from 12°N to 81°N for four seasonal periods: Jun 28 to July 31, 1986 (JJ86); Oct 14 to Nov 15, 1986 (ON86); Jan 28 to Feb 28, 1987 (JF87); and Mar 28 to Apr 30, 1987 (MA87) [*Benkovitz and Schwartz*, 1997]. Residence times for sulfate are approximately 5 days, lowest for ON86 and highest in JJ86 and MA87. Residence times for MSA are also approximately 5 days, lowest for ON86 and highest for JF87. Residence times for SO_2 are approximately 2 days except for JJ87 when due to much lower deposition velocities and oxidation rates it is 6 days. Residence times for DMS are similar, with a high of 4 days for JF87. For all simulations the major sink of sulfate is wet deposition, which removes approximately 85% of the sulfate. Due to the greater availability of oxidants and the faster conversion rates, aqueous phase oxidation is the major sink for SO_2 for JJ86 (removing 45%), for the other three simulations dry deposition was the major sink for SO_2, removing from 65% (JJ87) to 45% (ON86 and MA87).

In the central North Atlantic (40°W to 20°W) anthropogenic sources in North America (west of 30°W) were generally the major contributors to the sulfate burden, except for certain weather patterns such as a cut-off low pressure system west of the Iberian peninsula (April 4 to 7, 1987), when anthropogenic sources in Europe (east of 30°W) become the major contributors.

References

Benkovitz, C.M., C.M. Berkowitz, R.C. Easter, S. Nemesure, R. Wagener, and S.E. Schwartz, Sulfate Over the North Atlantic and Adjacent Continental Regions: Evaluation for October and November, 1986 Using a Three-Dimensional Model Driven by Observation-Derived Meteorology, *J. Geophys. Res.*, *99* (D10), 20725-20756, 1994.

Benkovitz, C.M., and S.E. Schwartz, Evaluation of Modeled Sulfate and SO_2 over North America and Europe for Four Seasonal Months in 1986-87, *J. Geophys. Res. (submitted)*, 1997.

Charlson, R., S.E. Schwartz, J.M. Hales, R.D. Cess, J. J.A. Coakley, J.E. Hansen, and D.J. Hoffman, Climate Forcing by Anthropogenic Aerosols, *Science*, *255*, 423-430, 1992.

Twomey, S.A., M. Piepgrass, and T.L. Wolfe, An Assessment of the Impact of Pollution on Global Cloud Albedo, *Tellus*, *36B*, 356-366, 1984.