



Project Summary

SO₂ Concentration Estimates for New York City, 1880-1980

R. B. Husar and D. E. Patterson

The purpose of this investigation was to estimate the yearly ambient concentration of SO₂ and SO₄ wet deposition from 1880 to 1980 for the greater New York City area. This information was used to reconstruct ambient concentrations at two New York Veterans Administration cemeteries, Cypress Hills and Long Island, for studying marble deterioration. This study, which involved a determination of marble loss rate as a function of SO₂ concentrations, is the subject of another report. The methodology for developing the retrospective model to estimate yearly ambient concentrations since the turn of the century for the greater New York City area is presented in this report. The retrospective estimation of sulfur concentration and deposition required estimation of both local and regional emission trends since the turn of the century, along with suitable choice of a local and a regional dispersion model to relate emissions to ambient concentrations and deposition. The retrospective estimates are compared to observed SO₂ concentrations. It needs no elaboration that the estimation of local and regional emissions pertinent to a given receptor, the quantification of the local and regional contributions to SO₂ and to the wet deposition, and reconciliation with existing observations are formidable tasks. Lacking data for the historical trends, many of the assumptions are based on "best available science," and they should be revised with the availability of new knowledge.

This Project Summary was developed by EPA's Atmospheric Sciences

Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Weathering rates of marble tombstones in Veterans Administration (VA) cemeteries have been determined by New York University through a program with Task Group G, Effects on Materials and Cultural Resources, within the National Acid Precipitation Assessment Program. The cause of the marble loss nor the apportionment of the loss rate between natural and man-induced causes was not revealed in that study. In order to investigate this cause, estimates of the environmental history of the exposed marble are necessary. Standard meteorological parameters, but more importantly, for the estimation of the man-induced damage, the concentration history of air pollutants, particularly SO₂, that span this century are required.

The purpose of this investigation was to estimate the yearly ambient concentration of SO₂ and SO₄ wet deposition from 1880 to 1980 for the greater New York City area. The study to determine the effects of SO₂ concentration on marble deterioration at two Veterans Administration cemeteries located in New York is the subject of another report. The methodology for developing the retrospective model to reconstruct ambient concentrations since the turn of the century for the greater New York City area is presented in this report.

Discussion

The reconstruction of sulfur oxide concentrations over the past century for the

New York City area involved five distinct steps:

(1) Gathering of data on pollutant concentration. Although pollutant concentration data are generally sparse in time and space, a 15-year trend for SO₂ concentration between 1958 and 1972 was assembled from report measurements for New York City Central Park. These data provided significant anchor points for reconstruction.

(2) Reconstruction of emission trends. The reconstruction of the sulfur emission trends for the New York City metropolitan area were based on the fuel consumption data and on the estimate of the sulfur content of anthracite, bituminous coal, and residual fuel oil. In order to estimate the contribution of regional sources to the New York City area, consideration was given to the emission trends over eastern North America.

(3) Regional background concentration and deposition. The contribution of sources to the regional background was determined by using a long range transport model. A Monte Carlo or direct simulation scheme for the dispersion, transformation, and deposition of individual puffs of pollutants was used to estimate the regional background.

(4) Local concentrations. The sulfur dioxide concentration in New York City was strongly influenced by sources on the local scale (100 km), which required a local emission inventory and a local scale dispersion model. The maximum concentrations were estimated from the local model to be three times higher than the surface concentration given by the regional model.

(5) Reconciliation of monitoring data with model estimates. The 15-year trend data for SO₂ concentration was higher

than that predicted from the regional model but lower than the upper estimate because of local sources. In order to incorporate this observation, a "short stack" factor, which takes into account changing stack height over the last century, was applied to the regional model predictions to produce the "best estimate" of yearly SO₂ concentration for the New York City area over the last century.

The regional model was also used to estimate the wet deposition trend for New York City. Comparison of the wet deposition and SO₂ concentration trends show a similar pattern until the mid 1960's. At that time the wet deposition was evidently rising and leveled off in the 1970's, while

the SO₂ concentration has sharply declined because of the "tall stack" effects.

Conclusion

The estimation of local and regional emissions pertinent to the New York area and the quantification of the local and regional contributions to SO₂ and to SO₄ wet deposition are formidable tasks. Many of the assumptions that were made in reconstruction of the yearly SO₂ concentration of the New York City area are based on "best available science" and are to be revised with the availability of new knowledge. Uncertainties associated with retrospective concentration estimates are identified and discussed in the report.

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The complete report, entitled "SO₂ Concentration Estimates for New York City, 1880-1890," (Order No. PB 85-181 840/AS; Cost: \$8.50, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
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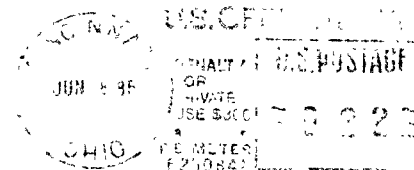
*The EPA Project Officer can be contacted at:
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