Transference Ratios to Predict Total Oxidized Sulfur and Nitrogen Deposition

Joseph E. Sickles, II[a] and Douglas S. Shadwick[b]

Use of model-predicted "transference ratios" is currently under consideration by the US EPA in the formulation of a Secondary National Ambient Air Quality Standard for oxidized nitrogen and oxidized sulfur. This term is an empirical parameter defined for oxidized sulfur (TS) as the ratio of the total oxidized sulfur deposition (from dry plus wet deposition) to the airborne concentration of oxidized sulfur. A multi-year record of weekly measured and data-derived quantities at selected monitoring sites in the eastern US was examined to determine the variability of TS that might be expected from field measurements. Weekly TS displayed considerable variability that depended on site, season, and year, but according to ANOVA, most heavily on site and season. Using weekly data, the variability of deposition-related quantities and error propagation analysis of TS both suggest that variation in parameters related to wet deposition processes are generally more important than variation in parameters related to dry deposition processes in determining variation in TS. Correlations between airborne seasonal concentration of oxidized sulfur and the various components of seasonal deposition (i.e., dry, wet, and total) also underscore the strong influence that the variability in wet deposition processes can have on estimates of total deposition. Analysis of monitoring results suggests that 95% CI for TS using weekly results over several years for a specific site and season could be as large as ±235%, but only as large as ±33% using annual aggregates for a specific site. At the annual scale, a regression model of the form that incorporates a site-specific transference ratio, yielded estimates of total oxidized sulfur deposition to within ±25% of the monitored values ≥ 95% of the time. Since all of the major oxidized nitrogen species are not monitored regularly, a parallel analysis was limited to only the monitored oxidized nitrogen species. Nevertheless, findings for monitored oxidized nitrogen are consistent with those described above for oxidized sulfur. These results suggest that at specific sites in the eastern US, annual estimates of total deposition to within ±25 to ±35 % may be expected using species- and site-specific transference ratios along with annual average monitored airborne concentrations.

[a] US EPA, ORD, NERL, Research Triangle Park, NC 27711, U.S.A
sickles.joseph@epa.gov 919.541.2446;
[b]Computer Sciences Corporation, Durham, NC 27713, U.S.A
dshadwic@csc.com 919.767.7526