Appendix B

Explanation of Method for Creating Summary Data from Raw IMPROVE Data

The summary data used in this report were provided by the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University. Raw data samples (measurements of particulate matter mass and its constituents) were collected on Wednesdays and Saturdays, and CIRA constructed the annual and seasonal summary data using the following timeframes:

1. Annual data for Year X cover the period from March in year X through February in year X+1.
2. Spring data cover the period from March through May.
3. Summer data cover the period from June through August.
4. Autumn data cover the period from September through November.
5. Winter data for Year X cover the period from December in year X through February in year X+1.

To calculate the seasonal (annual) summary data, the steps below were followed:

1. The daily species concentrations (sulfate, nitrate, organic carbon, elemental carbon, soil, and coarse mass) were first each averaged for the entire season (year) and reported in units of $\mu g/m^3$. This process yielded average seasonal (annual) concentrations for the species.[1]
2. The average seasonal (annual) concentrations for each species were multiplied by the seasonal (annual) f(RH) factor for that site and the species-specific light extinction factor (see Appendix C) to calculate the reported seasonal (annual) light extinction coefficients for each species.
3. The reported seasonal (annual) light extinction coefficients for the species were summed to give the total seasonal (annual) aerosol light extinction coefficient (b_{Aer}).
4. The seasonal (annual) light extinction coefficient for each species was divided by the total seasonal (annual) aerosol light extinction coefficient to calculate the seasonal (annual) contribution of the species to the total aerosol light extinction coefficient (expressed as percentages in Chapter 2's pie charts). These percentages often did not match the number calculated by averaging the percent contributions to light extinction coefficients of the species on the individual days. [2]
5. The deciview index (in deciviews) was calculated from the total seasonal (annual) aerosol light extinction coefficient b_{Aer} (in Mm^{-1}) by the following formula:

$$\text{deciview index} = 10\ ln[(b_{Aer}+b_{Ray})/10]$$

where b_{Ray} represented the Rayleigh light extinction coefficient (10 Mm^{-1} at 1.8 km elevation).

Each year's data was sorted into three groups based on the cumulative frequency of occurrence of $PM_{2.5}$: lowest fine mass days, 0 to 20 percent; median fine mass days, 40 to 60 percent; and highest fine mass days, 80 to 100 percent. Each group was then labeled by its midpoint (e.g., 10th, 50th, 90th percentiles). After sorting each group's average concentrations of $PM_{2.5}$ and selecting the associated principal aerosol species, scattering and/or absorption of each species, reconstructed light extinction and deciview are calculated.

Note that the sorting is based on fine mass concentrations and ignores coarse mass concentrations. Also, the result is not necessarily the same as the rankings for visibility impairment. Due to lack of other data, the 10th, 50th, and 90th percentiles were assigned as the least-impaired, mid-range, and most-impaired days in this report.

Footnote:

[1] On June 1, 1996, the sampling technique at all IMPROVE particulate samplers was altered. Glycerine was added to the denuders and resulted in nitrate measurements approximately 40 percent lower than earlier values. In order to assess visibility trends, a fixed nitrate concentration was chosen for all of the years of data at each site. The fixed measurement was based on the average nitrate value measured between 1997 and 1999, while the glycerine was added to the denuders. Therefore, this report does not discuss temporal trends in nitrate concentrations.

[2] At sites where visibility impairment is much greater in one season, this averaging method sometimes results in the annual species contributions being skewed toward the season with greater impairment.