**Abstract**

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program reconstructs light extinction from filter measurements and humidification growth factors. Under many atmospheric conditions reconstructions compare favorably with measurements; however, there are several possible sources of discrepancy. First, the IMPROVE reconstructions are based on 24 h averaged filter measurements taken once every four days; thus, important transient events may not be well resolved. Second, at high relative humidities (RH) extinction is sensitive to RH perturbations; thus, under such conditions humidification growth factors are highly uncertain.

During the majority of the campaign ambient extinction measured with an Open-Path Cavity Ringdown Spectrometer (OPCRDS) agreed closely with the GSM nephelometer and the reconstructed extinction. However, coarse-mode particles, and several high RH events were not resolved by the reconstructed extinction. Extinction calculated with the revised reconstruction algorithm (IMPROVE-2) was about 12% lower than the values calculated from the original algorithm and provided a slightly better fit to the OPCRDS data.

**Reconstructed aerosol extinction: IMPROVE**

Initially, the IMPROVE program estimated extinction from measurements of several species and growth factors (f(RH)).

**IMPROVE-1:**

\[ \text{extinction} = 3\times f(RH) [\text{Sulfate}] + 3\times f(RH) [\text{Nitrate}] + 4\times [\text{OM}] + 10\times [\text{EC}] + [\text{Fine Soil}] + 0.6\times [\text{Coarse Mass}] \]

Recently, the IMPROVE equation was modified to incorporate additional species, two particle size modes and other changes.

**IMPROVE-2:** similar but more complicated

**Measured aerosol extinction: Open-path Cavity Ringdown Spectrometer (OPCRDS)**

The extinction coefficient \( \alpha_{\text{extinction}} \) is a function of the decay rate of light with and without particles \( \tau \) and \( \tau_{\text{opcrds}} \) respectively in the cavity.

\[ \alpha_{\text{extinction}} = \frac{\alpha}{\tau} \times \frac{\tau - \tau_{\text{opcrds}}}{\tau} \]

**Results and Conclusions**

- Both IMPROVE extinction reconstructions agree well with measured ambient extinction (OPCRDS).
- IMPROVE-2 reconstruction is ~12% lower than IMPROVE-1 during this time period at GSM.
- Ambient extinction agrees closely with ambient scattering after wavelength correction.
- Coarse particle effects and/or high RH events may not be resolved by filters/IMPROVE.
- High RH (>~98%) transients lead to 20x increase in extinction; these events are resolved by the OPCRDS but not by filter measurements.

**Future Prospects**

- Find collaborators (you?) with complimentary instrumentation (e.g., closed-path optical, chemical composition, etc.) and deploy the OPCRDS in environments that have previously been difficult to characterize
  - coarse particle/dust dominated
  - high RH
  - marine
- Deploy the OPCRDS at long term monitoring sites

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