UMBC Intercomparisons
Ground-based Lidar, BAM and Nephelometer vs. Aircraft HSRL, in-situ SO$_4^{2-}$ and f(RH)

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**General Lidar Equation**

\[ P(\lambda_0, z) = \frac{K_0(\lambda_0, z)}{z^2} \beta(\lambda_0, z) \exp[-2\int_0^z \alpha(\lambda_0, z') dz'] \]

**LARC HSRL**

\[ P(\lambda_0, z) = \frac{K_0(\lambda_0, z)}{z^2} \beta(\lambda_0, z) \exp[-2\int_0^z \alpha(\lambda_0, z') dz'] \]

\[ \alpha_{\text{aw}}(\lambda_0, z) = \frac{d}{dx} \left[ \frac{N_{\lambda_0}(z)}{P(\lambda_0, z)^2} \right] - \alpha_{\text{aw}}(\lambda_0, z) \]

\[ S(\lambda_0, z) \equiv S(\lambda_0) = \frac{\alpha_{\text{aw}}(\lambda_0, z)}{\beta_{\text{aw}}(\lambda_0, z)} \]

**UMBC ELF**

\[ P(\lambda_0, z) = \frac{K_0(\lambda_0, z)}{z^2} \beta(\lambda_0, z) \exp[-2\int_0^z \alpha(\lambda_0, z') dz'] \]

Overall, extinction retrievals from ELF agree very well with HSRL measurements. Cases in which good agreement occurs indicate very well mixed aerosols within the PBL, when S does not vary with height.

**Assumptions:**
- BAM and NEPH measure dry aerosols;
- ELF measures aerosols at ambient conditions;

**Specific Scattering Coefficient (SSC):**

\[ SSC = \frac{\text{Scattering Mass Conc.}}{\text{PM2.5 Concentration}^2} = 4.8 \pm 0.4 [\text{m}^2 \text{g}^{-1}] \]

Extinction was dominated by scattering:

\[ \text{Neph} = 1.23(12) \times \text{ELF} + 41(13), R^2 = 0.63 \]

**Fraction of SO$_4^{2-}$ in total PM2.5 mass is ~ 25%**

\[ f(RH)_{\text{BAM}} = 6.5 \pm 4.8 \]

\[ f(RH)_{\text{UMBC}} = 1.7 \pm 0.2 = f(RH)_{\text{UMBC}} - 1.7 \sigma_{f(RH)} \]

**P3B UMBC Overpasses at 372m ± 31m**

**Acknowledgements:**
NASA cooperative agreements:
NNX10AR38G (DISCOVER-AO) and NNX10AT36A (J CET Task 336)