

Title:

Data set associated with “A low-cost monitor for simultaneous measurement of fine particulate matter and aerosol optical depth – Part 1: Specifications and testing”

Abstract:

Globally, fine particulate matter (PM_{2.5}) air pollution is a leading contributor to death, disease, and environmental degradation. Satellite-based measurements of aerosol optical depth (AOD) are used to estimate PM_{2.5} concentrations across the world, but the relationship between satellite-estimated AOD and ground-level PM_{2.5} is uncertain. Sun photometers measure AOD from the Earth’s surface and are often used to improve satellite data; however, reference-grade photometers and PM_{2.5} monitors are expensive and rarely co-located. This work presents the development and validation of the Aerosol Mass and Optical Depth (AMOD) sampler, an inexpensive and compact device that simultaneously measures PM_{2.5} mass and AOD. The AMOD utilizes a low-cost light-scattering sensor in combination with a gravimetric filter measurement to quantify ground-level PM_{2.5}. Aerosol optical depth is measured using optically filtered photodiodes at four discrete wavelengths. Field validation studies revealed agreement within 10% for AOD values measured between co-located AMOD and AEROSOL ROBOTICS NETWORK (AERONET) monitors and for PM_{2.5} mass measured between co-located AMOD and EPA Federal Equivalent Method (FEM) monitors. These results demonstrate that the AMOD can quantify AOD and PM_{2.5} accurately at a fraction of the cost of existing reference monitors.

Associated publication:

Wendt, E. A., Quinn, C. W., Miller-Lionberg, D. D., Tryner, J., L'Orange, C., Ford, B., Yalin, A. P., Pierce, J. R., Jathar, S., and Volckens, J.: A low-cost monitor for measurement of fine particulate matter and aerosol optical depth. Part 1: Specifications and testing, *Atmos. Meas. Tech. Discuss.*, <https://doi.org/10.5194/amt-2019-110>, in review, 2019.

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Wendt, E. A., Quinn, C. W., Miller-Lionberg, D. D., Tryner, J., L'Orange, C., Ford, B., Yalin, A. P., Pierce, J. R., Jathar, S., and Volckens, J. (2019). Data set associated with “A low-cost monitor for simultaneous measurement of fine particulate matter and aerosol optical depth – Part 1: Specifications and testing.” Colorado State University. Libraries. <https://hdl.handle.net/10217/198162>

Format of data files:

.xlsx

Excel Archival Tool output for each .xlsx file (created for preservation purposes using <https://github.com/mcgrory/ExcelArchivalTool> and stored in .zip files):

.csv

.png (for charts and figures)

.txt (for formulas)

.html (for visual representation of Excel formatting)

Location where data were collected:

AMOD_AOD_co-locations.xlsx:

Location 1: NEON-CVALLA (N 40°09'39", W 105°10'01")

Location 2: Digital Globe (N 40°08'20", W 105°08'13")

AMOD_FEM_gravimetric_co-locations.xlsx:

Downtown Fort Collins, the Colorado State University main campus, and at several personal residences across the city.

AMOD_GRIMM_collocations.xlsx:

Colorado State University main campus (EPA monitoring site 08-069-0009)

File information:

AMOD_AOD_co-locations.xlsx: This file includes all raw data from the AOD co-location experiments as well as calculated summary statistics and draft plots. Note that the data taken from the Sterling site on sheet one were not used due to modifications to the instrument made after the experiment rendering those data unrepresentative of the device performance.

AMOD_FEM_gravimetric_co-locations.xlsx: This file includes all raw data from the gravimetric co-location experiments as well as calculated summary statistics and draft plots.

AMOD_GRIMM_collocations.xlsx: This file includes all raw data from the gravimetric co-location experiments as well as calculated summary statistics and draft plots.

Variable definitions:

From AOD validation file:

AMOD 440: AOD from 440nm channel on AMOD.

AMOD 520: AOD from 520nm channel on AMOD.

AMOD 680: AOD from 680nm channel on AMOD.

AMOD 870: AOD from 870nm channel on AMOD.

From gravimetric validation file:

AMOD (ug/m-3): PM2.5 concentration measured by AMOD

FEM (ug/m-3) : PM2.5 concentration measured by FEM

From light-scattering validation file:

AMOD: PM2.5 concentration measured by AMOD light scattering sensor

GRIMM FEM: PM2.5 concentration measured by GRIMM FEM