AirPhoton Nephelometer Characterization and Other Awesome Updates

SPARTAN Meeting
May 18, 2023

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About AirPhoton

• About me, John Hall
• AirPhoton and GRASP
• GAPMAP-0 has launched
• Instrumentation
  • Sampling Stations
  • Nephelometers
  • Accessories
AirPhoton Product Synopsis

Sampling Stations

- Physical sample collection
- Programmable automation
- Eight sampling filters
- Dual flow / PM size cut
- Outdoor, global operations
- Remote controllable
AirPhoton Product Synopsis
IN100 Integrating Nephelometer (and CR100)

- Multi-wavelength light scattering measurements
- Scanning PM size cut
- Outdoor, global operations
- Remote controllable
- Works with CR100 for periodic clean air references
AirPhoton Product Synopsis
Inverse Multi-Angular Polarimetric Nephelometer

• Light scattering measurement
• Multi-wavelength with discrete angular measurements and polarization
  • Scattering measurement at 5-degree
  • Up to 16 discrete angles (8 typical)
  • Up to four polarization (2 typical)
• Scanning PM size cut
• Outdoor, global operations
• Built-in clean air reference
• GRASP data processing available onboard
GAPMAP-0

- Multi-angular Polarimeter
- Three passive polarizations (0, 45, 90)
- April 15 - still in commissioning
AirPhoton Product Synopsis
Satellite Payloads and Accessories

• Satellite payloads
• Specialty setups
• Remote communication modules
• Common accessories
IN102 Series Nephelometer Size Distribution

- Size scanning operation
  - IN102: PM2.5 to PM10
  - IN102X: PM1 to PM10
- Aerodynamic size selection
- Figure shows optical measurements with two aerodynamic size cuts
IN102 Series Nephelometer Size Distribution

- Forward/Backward Scatter
- Three wavelengths
- Four aerodynamic sizes
- Sufficient information for a size distribution inversion
Nephelometer Quality System

• First, yes, it applies to all instruments
• IN100 series quality certificate example
• Continuous quality improvement
  • Additional quality verifications
  • Quality check for calibrations
  • When requested, results are shared.
Nephelometer Quality System - Improvements

- Implementing wavelength calibration per instrument
- Specified vs calibrated wavelength
- Average observations
  - 464 +/- 4 nm
  - 530 +/- 5 nm
  - 630 +/- 3 nm
- 1% error per nm (measured) input into Rayleigh calibration
- Effects every LED based nephelometer
Nephelometer Quality System - Improvements

• Studying temperature dependent wavelength shifts
• Calibrated vs operating wavelength
• Testing from -10°C to 50°C
• Shifts ranging from 4 to 8 nm
• Significantly less error suspected.
• **Negligible for aerosol measurement**
Updates of Interest
Sampling Stations

• KSA Station Order
  • Eight sets of Sampling Stations and accessories
  • Largest user of simultaneous flow configuration
  • New external extended temperature pump design
• Ammonia denuder modified sampling station
• Nitric acid denuder experiment
• Off-grid, solar testing
For all questions of a technical nature please write to support@airphoton.com

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Updates of Interest
Polarized Integrating Nephelometer (PIN100)

- Customizable Wavelengths
- 170 discrete angles
  - 5 to 175 degrees
- Active polarization control between 0, 45, 90
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